ENVIRONMENTAL IMPACT STATEMENT REPORT FOR PANAY-GUIMARAS-NEGROS ISLAND BRIDGES PROJECT IN THE REPUBLIC OF THE PHILIPPINES

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KRC Environmental Services

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Basic Project Information

Project Name: Panay-Guimaras-Negros (PGN) Island Bridges Project

Project Location: Municipality of Leganes, Iloilo, Municipalities of Buenavista and San Lorenzo, Guimaras, Municipality of Pulupandan, Negros Occidental

Project Components:

Section A

Project Components	Location/Area Jurisdiction	Length/ Area
Major Components		
Segment3.1 *(Interchange)*	**Panay** *K0+000~K0+555*	0.555 km
Segment 3.2 *(Sea Cross Bridge)*	**Panay-Guimaras** *K0+555~k5+525*	4.970 km
Segment 3.3 *(link road)*	**Guimaras** *K5+525~K11+435*	5.910 km
Segment 3.4 *Interchange*	**Guimaras** *K11+435~K13+005*	1.57 km

Section B

Project Component	Location/Area Jurisdiction	Length/ Area
Major Components		
Segment3.5 *(Interchange)*	**Guimaras** *K0+000~K1+902*	1.902 km
Segment 3.6 *(Sea Cross Bridge)*	**Guimaras –Negros** *K1+902~k15+012*	13.110 km
Segment 3.7 *(link road)*	**Negros** *k15+012~K18+260*	3.248 km
Segment 3.8 *（Interchange）*	**Negros** *K18+260~K18+557*	0.297 km

List of Interchange Alignments

Name of interchange	**Crossing pile No.**	**Footprint area (m^2)**	**Form of interchange**	**Crossing mode**	**Name and grade of crossed road**
Interchange at the starting point of Line B	K0+009	78498	Rhomboid	Overcrossing of mainline	COASTAL ROAD (Roundabout Road on Panay Island)
Interchange at the ending point of Line B	K11+420	80208	Rhomboid	Overcrossing of mainline	Roundabout Road on Guimaras Island
Interchange at the starting point of Line D	K1+068	211018	Partial clover leaf	Overcrossing of mainline	Circumferential Road (Roundabout Road on Guimaras Island)
Interchange at the ending point of Line D	K18+680	90262	Type B single horn	Overcrossing of mainline	National Highway (National Expressway on Negro Island)

According to preliminary estimation, about 89.16 hectares of land are permanently occupied by the project, including about 8.10 hectares in Leganes, Iloilo Province, about 34.97 hectares in Buenavista, Guimaras Province, about 24.25 hectares in San Lorenzo, Guimaras Province and about 21.84 hectares in city of Pulupandan, Negros Occidental Province. Prefabricated yard on Panay Island, Guimaras Island and Negros Island respectively, and three temporary terminals such as material terminal, abutment shipping terminal and segmental beam shipping terminal are proposed to be set.

Proponent Profile:

Proponent	**DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS - Unified Project Management Office (DPWH-UPMO)**
Represented by **Address** **Tel. Nos.** **Webmail**	**VIRGILIO C. CASTILLO** Project Director, RMCI (B) - UPMO Bonifacio Drive, Port Area, Manila +632-304-3555
In Partnership with:	CCC Highway Consultants Co., Ltd.

In Charge of ECC Application:

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DESCRIPTION OF THE PROJECT'S EIA PROCESS

Initial screening using Annex A of the Revised Procedural Manual (RPM) Circular No 05 showed that the proposed project is Category A 3.4.3 Bridges and viaducts, new construction projects. The project is considered as new single projects that requires ECC application and to submit Environmental Impact Statement (EIS) report at EMB – Central Office. The format in Annex 1-A of MC 2014 for New Single Projects was used in this report.

The EIA was prepared in accordance with the RPM DAO 2003-30 guidelines. Site visits were made, verify project location, establish sampling stations for terrestrial flora and fauna, water quality, marine ecology, air, noise and soil quality, social survey; secondary data on geology, hydrology, oceanography. Additional secondary data were taken from government agencies, i.e., DOST-PAGASA. NSO, NWRB, LGUs, etc. and from related literature.

Terms of Reference of the EIA study

This document is prepared in accordance with the provision stipulated in the Revised Procedural Manual (RPM) for DENR Administrative Order No. 30 Series of 2003. Table below shows the issues raised by the stakeholders during the Technical and Public Scoping and how these were addressed in the EIS.

Main Issues Raised and Addressed in the EIA

Public Scoping/consultation meetings were conducted with stakeholders at the four (4) affected Municipalities: Municipality of Pulupandan in Negros Occidental, Municipality of Buenavista and San Lorenzo in Guimaras and Municipality of Leganes in Iloilo. The stakeholders are composed of LGU Officials, barangay councils, community leaders and representative from People's Organization and Government Agencies.

Based on the results of the interviews to the people in the community, the construction of bridges has mixed observation about the development of current scenario where it has benefits as well as drawbacks. The project is an indication of development because with proper transport bridge infrastructure, economic development is possible. There is possibility of attracting tourists and investors since they will be fascinated by the proper bridge system. Another benefit is that this project is creating employment opportunities to the people in the communities. According to the results of interview the people wants to involve or hire as a laborer. So, when the people are employed rather doing nothing, it contributes to the economic development. Considerations on the implementation of the project from the respondents are also acquired during the survey. The respondents mentioned that the project proponent should consider the needs of the people that will be affected. Just compensation on the affected houses should also be settled as well as consider the livelihood of those income that will be affected. Appropriate implementation of the project should consider so that the positive effects of the project will be realized.

EIA Team

The EIA team is composed of several members, each have their own expertise. The team is composed of the following.

Xinglong Chen	Team Leader from China
Maria Carmela Q. Capule	Team Leader from Philippines
Yucai Bai	Marine Ecologist
Baojun Cui	Terrestrial Specialist
Yun Meng	Water Specialist
Li Hang	Noise Specialist
Xianzhe Li	Air Specialist
Ricardo A. Capule	Water, Air and Noise Specialist
Carolyn P. Barrias	Environmental Specialist
Abelardo H. Angadol Jr	Terrestrial Specialist
Robert Pabiling	Marine water Ecologist
Milagrosa P. Asuncion	Sociologist

EIA Study Schedule

The EIA team undertook the following schedules from March to October 2019 as part of the preparation and conduct of the EIA process:

March 2019	Discussion of the project with DPWH- UPMO Office
	Review environmental regulations and standards implemented in the Philippines that cover the project
March – July 2019	Conduct survey, field investigation and site inspection of the project including the outlying areas to determine its biophysical conditions, i.e., land, air and water quality, noise environment, marine water ecology, socio-economic (perception survey etc.) land such as terrestrial flora and fauna, geological, etc.

	Conduct researches and gather data or information on the impact study area, i.e., geological, climatology, socio-economic aspects, past environmental conditions of the project.
June-July 2019	Preparation and submission of IEC to DENR-EMB Central Office
June – August 2019	Additional survey on terrestrial flora and fauna, groundwater quality, air and noise Report preparation
August 2019	Schedule of Public Scoping in affected Municipalities of Iloilo, Guimaras & Negros Occidental
September 2019	Submission of Public Scoping Report at DENR-EMB Central Office
	Schedule of Technical Scoping at DENR-EMB Central Office
October 2019	Presentation of draft EIS Report to DENR-EMB Schedule of 2nd Public Consultation/Presentation of Results
November 2019	Schedule of Public Hearing
November 2019	Submission of final EIS to DENR
November 2019	ECC Issuance

EIA Study Area

The EIA study area is at Municipality of Leganes, Iloilo, Municipalities of Buenavista and San Lorenzo, Guimaras and Municipality of Pulupandan, Negros Occidental in Region VI.

The study areas in general are the primary and secondary impact areas. The primary impacts areas of the project are the adjacent communities as shown below.

List of Municipalities affected by the PGN Project
Leganes, Iloilo
Municipality of Leganes
Barangay Gua-an
Buenavista, Guimaras
Municipality of Buenavista
Barangay Cansilayan
Barangay Banban
Barangay Navalas
Barangay San Miguel
Barangay Getulio
Barangay Dagsa-an
Barangay Salvacion
San Lorenzo, Guimaras
Municipality of San Lorenzo
Barangay M. Chavez
Pulupandan, Negros Island
Municipality of Pulupandan
Barangay Tapong
Barangay Canjusan
Barangay Pag Ayon
Barangay Zone 4A
Barangay Ubay

EIA Methodology

Different methods were used in collecting primary data from the field but utilized similar technique for secondary data collection. Tables below show the methods used for each field of study and the general methods for the EIA study.

Module	Coverage
Geology	Secondary data, Geological Mapping using GPS, Geologic Compass, and Topographic Map, secondary data
Hydrology	Delineation of streams and water shed boundaries using geological maps, Geographic location using GPS, water sampling and analysis
Meteorology	Secondary Data, maps, air quality measurement and analysis
Pedology (Soil quality)	Primary data
Terrestrial Biology	Primary data
Water Quality and Marine Ecology	Primary data
Air and Noise	Primary data
People	Primary data

Methods

General Methods for the EIA Study

Component	Methodology
Project Description	Meeting with DPWH and review of previous studies
Secondary Data and Relevant Environmental Laws	Research work: LGUs,NSO,PAGASA,EMB, DENR, NAMRIA, MGB Compilation of geohazard maps
Delineation of the Impact Areas	Annex 2-2 of RPM DAO 2003-30
Identification of the stakeholders	Annex 2-3 0f RPM DAO 2003-30
Description of the Existing Environment	EIS Scoping Checklist (Annex 2-7a of RPM DAO 2003-30) Secondary data collection Ocular inspection Terrestrial Flora and Fauna
Impact Identification	Modified impact identification checklist by Canter (1996)
Impact Assessment	Qualitative assessment Expert opinion
Environmental Management and Monitoring Plan	Impact Management Plan Template (Annex 2-17 of RPM DAO 2003-30) Template for Social Development Plan (Annex 2-18 of RPM DAO 2003-30) Template for IEC Plan (Annex 2-19 of RPM DAO 2003-30) Template for EMoP (Annex 2-20 of RPM DAO 2003-30)
Environmental Risk Assessment	Procedural Scoping Guidelines for ERA (Annex 2-7e of RPM DAO 2003-30)

Public Participation

Coordination meeting with different stakeholders like, DPWH, IPs, LGUs, and affected communities where conducted to discuss the project. Series of Public consultation were conducted on different date to inform the affected communities and plan of action, perceive impact and recommended mitigation and compensation for affected communities.

Summary of Baseline Characterization, Key Environmental Impacts and Management and Monitoring Plan and EMF and EGF Commitments

Key Baseline Findings

COMPONENTS/ SUBCOMPONENTS	KEY BASELINE FINDINGS
LAND	
Land Use	The region has a total land area of 2,022,311 hectares or approximately 35.7 percent of the total land area of the Visayas and 6.7 percent of the Philippines. The Province of Negros Occidental is the biggest in terms of land area with 792,607 hectares which is almost 40% of the total area of the region. Iloilo comes second with 471,940 hectares or 23%: Capiz with 263,317 hectares or 13%: Antique with 252,201 hectares or 12%: Aklan with 181,789 hectares or 9% and Guimaras with 60,457 hectares or 3%. In Guimaras, Forest and Forestlands (FFL) cover 5,459.40 hectares and Alienable and Disposable lands cover 54,593 hectares, more or less.
Pedology	Grab sampling was used for soil quality measurement. Samples were collected on March 20 and 22, 2019 & July 6, 2019 at sunny weather. As of this time, Philippines does not have regulations on soils. Results of analyses are compared with Dutch Intervention Values for Environmental Assessment. Results are within the intervention values for arsenic, cadmium, copper, chromium, lead, mercury and zinc.
Topography	The islands of Guimaras and the surrounding islands are considered by the geologists to be land connected to Panay Island. Most of them are hilly terrain with an altitude of less than 200 meters, and the east coast is a strip-shaped lowland beach. The topography of Guimaras island varies from level to steeply sloping, with land elevation ranging from 0 to nearly 300 masl. Mt. Dinalman, located in Milan, Sibunag, has the highest elevation of 267 masl. Guimaras' topography shows quite steep slopes on the western side of island with plateaus and peaks above 200 m in the central portion. A large part or 69% of the total land area is within the 0-18% slope, 19.73% is above 18-30% slope, 9.42% is above 30-50% slope and 1.74 percent is above 50% slope. Based on the preliminary Karst subsidence susceptibility mapping of Mines and Geosciences Bureau (MGB), in the Municipality of Buenavista there are 89 sinkholes (all types) and 85 cave openings while there are 457 sinkholes (all types) and 282 cave openings in the Municipality of Jordan. The south bank of Iloilo Island in the northwestern end of the bridge area is relatively flat. It belongs to the landform of the Chonghai Plain. The elevation of the ground is less than 2.0m. The southeastern side of the island of Guimaras has an ups and downs, belonging to the hilly landform, the rushing sea plain and the piedmont plain. The elevation of the ground is generally between 0 and 90 m. The terrain of the middle cross-sea bridge is slightly lower. It belongs to the sea stall, the underwater shallow stall and the shallow sea accumulation plain. The ground elevation is at least -37m.
Regional Geology	The geotectonic structure of the study area belongs to the Philippine plate (II), with the Eurasian plate (I) on the southwest and the Philippine sea plate on the northeast (III). The Eurasian plate and the Philippine Sea plate subducted into the lower part of the Philippine plate, forming the Negros subduction zone in the west and the Philippine subduction zone in the east. The Philippine break across the Philippine plate divides the Philippine plate into two sub-structural units: the western plate of the Philippines (II1) and the

COMPONENTS/ SUBCOMPONENTS	KEY BASELINE FINDINGS
	eastern plate of the Philippines (II2). The area is one of the most active tectonic zones with frequent seismic activity. The epicentral distribution map of the earthquake clearly shows that the area is covered by shallow and deep earthquakes, and the subduction seismic zone controls the seismic distribution of the area. Most of the shallow earthquakes in the offshore are related to the shallow brittle subduction zone called the thrust fault (depth 0-60km). Most of the deep-seismic earthquakes occur in the deeper toughness of the subduction zone, known as the Benioff belt. According to the regional data and in combination with the geological survey of the project, it is shown that the poor geological phenomena found in the site of recommended scheme for bridge location on Section A of Panay-Guimaras Island mainly cover the karst, collapse and sandy soil liquefaction. The construction of project may be affected, and may have a certain impact on geology and geomorphology. The bank slope at landing point on both sides of the proposed bridge is gentle and stable, and there is little possibility of bank collapse in natural state. However, the rock and soil layer on the surface layer of is relatively loose, and the change of hydrological environment may lead to the stability of the bank slope under the long-term water flow, especially after the construction of the bridge. It is suggested that the revetment works should be increased at the bridge location during design and construction period.
Terrestrial	
Flora	A total of 122 species belonging to 111 Genus in 46 Families were recorded from the 21 flora survey sites. There were 87 species (80 Genus, 40 Family) identified from the eastern side of Guimaras island while 44 species (43 Genus, 25 Family) was recorded from the western side of the island. Negros Island has 33 species (33 Genus, 17 Family) while 17 species belonging to 16 Genus and 13 Families was recorded in the Panay island (Ilo-ilo). This result is not surprising, since more sampling plots was established along the Eastern Guimaras Island, while only two plots was established in the Panay Island. This unequal sampling distribution among islands was strategically chosen based from the length the proposed PGN project ROW for each island upon bridge landing. On additional survey of ten sites, a total of 82 species were identified across the study belonging to 32 families. Of these, the most speciose family was legumes (Fabaceae) with 10 species, followed by Euphorbiaceae and Moraceae both with 8 representative species, and then five species each for Lamiaceae, Malvaceae and Rubiaceae. Of the 32 families, 16 (50%) were represented by only one species (known as singletons), and six families were represented by only 2 species (known as doubletons). A total of 82 species were identified across the study belonging to 32 families. Of these, the most speciose family was legumes (Fabaceae) with 10 species, followed by Euphorbiaceae and Moraceae both with 8 representative species, and then five species each for Lamiaceae, Malvaceae and Rubiaceae. Of the 32 families, 16 (50%) were represented by only one species (known as singletons), and six families were represented by only 2 species (known as doubletons). There are also 40 exotic species recorded across the study, with most are unsurprisingly recorded in Plantations, Agricultural and Residential Landscape – which reflects that human active grounds are venue of more exotic species. Exotics species have the potential to be invasive such

COMPONENTS/ SUBCOMPONENTS	KEY BASELINE FINDINGS
	as hagonoi (*Chromolaena odorata*), aroma (*Acacia farnesiana*) and koronitas (*Lantana camara*). Other exotics recorded in this study are planted such as big leaf mahogany and yemane (Gmelina). On additional survey of 10 sites, majority of species were identified as indigenous species listing 58 out of 82 species (71%) recorded in the study area, while 10 species (12%) are known Philippine endemic and 14 species are (17%) are exotic or not native to the Philippines. A critical habitat that may be affected upon implementation of the PGN project construction are Mangrove forest. Mangroves constitute less than 1% of all forest areas worldwide, but they play an extremely important role in providing environmental services. As such, mangroves serve as an essential nursery for coastal and offshore fisheries, provide an array of timber and non-timber forest products to local communities, sequesters and store a large amount of carbon, which helps to mitigate the impacts of global climate change. More importantly, mangroves enhance sediment deposition and protect the coast from the destructive power of waves and storm surges. The world has seen a 50% decline in the total area of mangroves since the mid-twentieth century, making them one of the most threatened ecosystem.
Fauna	Survey of fauna composition of the project area was undertaken in three (3) consecutive days on March 16-18, 2019 and on June 2019. Weather condition during the survey is sunny. Survey on fauna composition of the project area covers the avi-fauna, mammals, and herpeto-fauna. Prior to the conduct of sampling, general habitat assessment was undertaken to consider different ecosystems and topography within the project area for the selection of areas for observation. A total of 22 observation sites was identified based on its significance and influence relative to the perceived presence of faunal species within the project area. Selected sampling sites represent different ecosystems in the area. Recorded fauna species during the entire duration of survey are dominated by birds. A total of 42 species of birds are recorded from the 22 observation sites with a total abundance of 568 birds. Recorded bird species belongs to the 26 avi-fauna families, which is dominated by Columbidae composed of 6 species. In terms of abundance, the Eurasian Tree Sparrow (*Passer montanus)* is the dominant species followed by the Asian Glossy Starlings (*Aplonis panayensis*) and Black-Winged Stilt (*Himantopus himantopus)* with a total abundance of 96, 65, and 48, respectively. Observation sites with the highest species diversity composition is site no. 22 comprised of 14 species out of the 42 observed. It is then followed by site nos. 5 and 20 with the species diversity of 13. Conversely, site 12, 14, 18 has the least species diversity with only 3 species observed. A total of 8 herpeto-fauna species are recorded in the area. There were 4 observed reptiles, namely, Gecko-gecko *(Gecko gecko),* Water Monitor Lizard (*Varanus salvator),* Bubuli/ Skink (*Eutropis multi-fasciata*), and Emerald Tree Skink (*Lamprolepis smaragdina)*. There was one (1) Emerald Tree Skink, and four (4) Brown Skink observed in different survey sites. Meanwhile, Gecko-gecko was heard during the sampling. Lastly, the Water Monitor Lizard is discerned from an ethnobiological interview with key informant. Only 2 species of mammals observed during the survey. There was the Polynesian Rat (*Rattus exulans)* and the Common Rousette Bat (*Rousettus amplexicaudatus).* Only 1 mammal was observed during the survey in

COMPONENTS/ SUBCOMPONENTS	KEY BASELINE FINDINGS
	additional 10 sites, which is believed to be the Common Dawn Bat (*Eonycteris spelae)* which are wandering along the mangrove area. Among the eight (8) herpeto-faunal species, the seven (7) species are under least concern in the IUCN category. Meanwhile, the Water Monitor Lizard (*Varanus salvator*) is under the least concern in the IUCN category, however, it is categorized as Vulnerable. On additional survey, distribution status of the six (6) recorded herpeto-fauna species showed that 5 are native, or non-endemic to the Philippines, and 1 is Philippine endemic (see Table 7 and Table 8). Among the six (6) herpeto-faunal species, five (5) species are under least concern in the IUCN. Continuous loss of faunal habitats due to degradation of forest cover brought by land clearing, conversion of remaining sites into settlements and other land uses. Though, faunal species are mobile in nature this situation will force them to migrate in other areas to search for new habitat. Migration of other wildlife to new territory/ies or ecosystem will pose threat to their existence. They can be further exposed to hunting, persecution and trading. Continuous destruction of faunal habitats and disturbance will threaten the remaining species population and survival in the near future if not prevented. Thence, decrease of population to some species in this area will be expected to happen while others may not significantly affect. Wildlife offer a variety of commercial values and open several livelihood sources, utilization is not regulated as to case of illegal poaching and hunting and over collection. Though conservation actions are currently being made, illegal activities still continuously happen. The scenario puts wildlife population at risk of being threatened and has the probability of getting extinct if left unresolved.
WATER	
Oceanography	During dry season, the discriminant number of tidal current type on each level of C7 station is more than 0.5 and less than 2, which is irregular semidiurnal tidal current, and the discriminant number of tidal current type on each level of other stations is less than 0.5, which is the regular semidiurnal tidal current. During wet period, the discriminant number of tidal current type at the partial level of C6, C7, C8 and C9 stations is more than 0.5 and less than 2, which is irregular semidiurnal tidal current, accounting for 27% of statistical discriminant number of tidal current type; the discriminant number of tidal current type at each level of other stations is all less than 0.5, which is the regular semidiurnal tidal current. To sum up, the engineering sea area is the sea area dominated by the regular semidiurnal tidal current. The ocean current of the whole strait along the strait channel (or bank line) is mainly dominated by reciprocating flow, which is roughly northeast-southwest direction. Specific features are as follows: Observation Stations on northern section (C1): During dry season, the flow velocity of ocean current for high and medium tide is all higher, and the main direction of ocean current is NE-SW, which shows obvious characteristics of the reciprocating flow. The velocity of low tide is very low, and the ocean current mainly changes in the SW-dominated fan-shaped range, which shows the characteristics of rotating flow. During wet season, the flow velocity of ocean current during three tidal periods is all not high, and the main direction is dominated by reciprocating current, and the main direction is NNE-SSW. In the observation of high, medium and low tide periods during wet season and dry season, the maximum of flow velocity for ocean current in most stations appears on the surface layer or the 0.2H layer, and the flow velocity

COMPONENTS/ SUBCOMPONENTS	KEY BASELINE FINDINGS
	gradually decreases from the surface to the bottom, but the variation is less, and the distribution of flow direction on the vertical line is relatively consistent. During dry season, the duration of rising tide current for each station is 4.00~7.50 hours, and the duration of rising tide current for each station is 4.50 ~ 7.25 hours, the duration of rising tide current for C7, C8 and C9 stations is more than that of falling tide current, and the duration of rising tide current for other stations is less than that of falling tide current. During the medium tide period, the duration of rising tide current is 4.25 ~ 7.75 hours, the duration of falling tide current is 4.50 ~ 7.75 hours, the duration of rising tide current for C8 station is more than that of failing tide current, and the duration of rising tide current for other stations is less than that of falling tide current; During the low tide period, the duration of rising tide current is between 3.25-5.50 hours, the duration of falling tide current is between 6.25-8.50 hours, the duration of falling tide current for all stations is more than that of rising tide current. During high tide period, the duration of rising tide currenton each level of each station is between 5.00～6.00 hours, while the duration of falling tide current is between 6.00～7.50 hours. During the medium tide period, the duration of rising tide current on each level of each station is between 3.25～6.00 hours, while the duration of falling tide current is between 6.00～7.50 hours. During low tide period, the duration of rising tide current on each level of each station is between 5.00～7.50 hours, while the duration of falling tide current is between 7.00～8.00 hours. During high, medium and low tide periods, the duration of rising tide current for all stations is all less than that of falling tide current.
Fresh water	The main rivers on A section for PGN project are the Iloilo River, Tigum River and Jalaur River on Panay Island. The Iloilo River originates from the Batino River in Oton, flows through the Lapuz, Lapaz, Manduriao, Molo, Arevalo and Iloilo urban area and infuses into the Iloilo Strait. The water level fluctuates with the tides due to closing the estuary. Section A of PGN Project mainly refers to small seasonal rivers on Guimaras Island, while Section B of Project PGN refers to main river such as San Lorenzo River on Guimaras Island.The main river of PGN Project on Section B is the Bago River on Negros Island. Sulu Sea is located to the southwest of PGN Bridge, and Visayas Sea is located to the northeast. The islands and reefs distribute horizontally and vertically around Visaya Sea and Sulu Sea, the topography fluctuates sharply, the local wave conditions are complex, and the waves are complicated in the whole engineering area due to influence by topography.
Fresh Water Quality	Grab sampling was used for marine water quality measurement. Samples were collected on March 20 and 22, 2019 with fair to sunny weather. Total of 8 stations were sampled at low and high tide. Based on the results, pH, color, Dissolved Oxygen (DO), TSS, oil and grease, nitrate, phosphate, metals and fecal coliform bacteria meet the criteria guidelines of the DENR Administrative Order (DAO) No. 2016-08, Water Quality Guidelines and General Effluent Standards of 2016 for Class SC limits. It should be noted that DENR does not have regulatory standard for BOD, COD, chloride under class SC. Increased turbidity and suspended solids in marine water is one of the adverse impacts anticipated during the bridge pier foundation construction. These impacts will be short term and limited to the vicinity of the project site. The magnitude of suspended matter increase and impact scope is directly

COMPONENTS/ SUBCOMPONENTS	KEY BASELINE FINDINGS
	related to construction method. In the comparison and selection scheme of bridge pier foundation for this project, the caisson foundation scheme having great disturbance to seabed was abandoned, and the pile group foundation scheme was selected. More specifically, integral steel casing scheme was adopted for construction of main bridge foundation, and the steel trestle and steel casing scheme was adopted for construction of approach bridge foundation. Therefore, the significant disturbance on seabed during bridge pier construction will be felt mainly during the steel trestle construction stage and during installation of steel casing. The impact of bridge foundation construction on marine water quality is short term and is expected to be limited to the project site.
Groundwater Quality	Grab sampling was used for marine water quality measurement. Samples were collected on March 20 and 22, 2019 with sunny weather. All parameters measured are within the Philippine National Standards for Drinking Water (PNSDW) Administrative Order No. 10, Series of 2017 (DAO 2017-010) except for chloride in station 1 and station 6, color in stations 1,4 & 6. Fecal coliform bacteria in all groundwater stations failed to meet the drinking water standard. There should have no presence of fecal coliform bacteria in a water sample. Possible high concentration of chloride is salt water intrusion in the shallow wells. Total coliform is a measure of potential water contamination from bacteria that can be found in soil, vegetation and feces of warm-blooded animals. Most coliform bacteria are generally harmless but they may also pose some health risk if there is presence of fecal coliform. Fecal coliforms are associated with human or animal wastes. Factors of bacteria contamination are pre-mature to conclude unless successive monitoring will be done to say that water supply is contaminated with bacteria. There are no present drinking water guidelines for BOD, COD, dissolved oxygen, Surfactants, TSS, oil and grease, phosphate and hexavalent chromium. Though potential impacts from drilling are confined to marine environment, there is the possibility for ground water contamination due to mishandling and mismanagement of equipment, particularly in the work sites. During the constructional phase oil, paint or other chemicals will need to be handled properly. Mishandling of fuel has led to serious pollution of soil and groundwater. There have also been reports of spilled oil near temporary generator sets and around fuel transport lines in other similar projects. This sort of pollution may sometimes have long-term irreversible effects, extending through the operations stage, since such contamination does not degrade itself and is expensive to clean up. The clean-up itself may require extensive ground water extraction, which will impacts such as salt-water intrusion.
Marine Ecology	To establish baseline data on coastal resources, an assessment was carried out last 15 to 18 March 2019 to determine the current ecological conditions of submerged coastal habitats that may be impacted by the proposed construction of bridge project across the three main islands. A total of 22 sites were assessed during the conduct of seagrass assessment on the same period with that of coral reefs. Out of these sites, seven (7) were from barangays Nabitasan and Gua-an in the municipality of Leganes, province of Iloilo (Panay island); six (6) were in Getulio, Buenavista and four (4) in Cabano, San Lorenzo, both are located in Guimaras island; and five (5) in Poblacion, Pulupandan in Negros Occidental. Detailed coral reef assessment was conducted using the Photo-transect method (Vergara and Licuanan, 2007). Aside from facilitating the conduct of the survey and providing a

COMPONENTS/ SUBCOMPONENTS	KEY BASELINE FINDINGS
	permanent record of benthic cover, the photo-transect method is also accurate in detecting changes on the reef through time (Leujak and Ormond, 2007). Fish Visual Census (FVC) technique (English, *et al.*, 1997) was used to determine the species diversity, abundance and biomass in the different sites surveyed. This procedure was done on the same transect laid for the coral survey. After the line had been laid, observers waited for about 5-10 minutes before the actual census to allow for the disturbed fish community to return to their normal behavior. Starting at one end of the line, all fishes within a 5m x 10m imaginary quadrat were identified up to species level (if possible) and their numbers and estimated sizes recorded. Observer swam to and briefly stop at every 5-m mark along the line until the transect line was completed. The faster moving fishes were counted first before the slower ones. Each transect covers an area of 500m^2 (50m long x 10m width). A total of eight (8) sampling stations were conducted to assess the plankton abundance, diversity and richness last March 15-16, 2019. Vertical samples were taken at each station by hauling 25-cm mouth diameter conical plankton with 20 microns mesh size for phytoplankton. For zooplankton samples, a 60 microns mesh size was used. No seagrass and live coral were recorded across the seven (7) stations surveyed along barangays Nabitasan and Gua-an in the municipality of Leganes, province of Iloilo. The bottom substrate was generally muddy in Leganes, Iloilo. This geomorphological setting of the area contributed to the low visibility and high turbidity. Moreover, siltation and possibly eutrophication may promote plankton bloom, which in the process may cover the seagrasses and reef bottom to hinder further recruitment and settlement. The same pattern (no seagrass and corals) was observed in coastal areas across the various sampling sites in barangay Getulio, Buenavista in Guimaras Island. Aquaculture practices such as fish ponds also contributed to water turbidity aside from the area as a major route of fast craft along Iloilo Strait going back and forth to Iloilo and Guimaras. Silt was the limiting factor for coral recruitment aside from less hard substrate availability. Meanwhile, light and availability of suitable substrate may limit seagrass recruitment and establishment considering that the area was quite turbid and had hard substratum, which can be influenced by the presence of coralline cliff area at the coast. Among the four sites sampled in barangay Cabano, San Lorenzo in Guimaras Island, the northernmost site was confirmed to harbour seagrass *Cymodocea serrulata.* These seagrasses can be found about 150-200 m from the concrete municipal wharf and about 100 m from the shore facing a windmill. On top of *C. serrulata*, there were seaweeds present under the genus *Padina* and *Halimeda.* None of hard coral was observed across the five (5) sites surveyed in San Lorenzo, Guimaras. Based on the anecdotal account, locals observed live coral in shoal reef. However, the boat captain could not pin point the exact location of the shoals during the surveys. Hence, we did aspot dive along the coast considering that San Lorenzo reef was clearer compared to other sites. And yet, the area still had low visibility due to strong waves. All stations were sandy-muddy bottom where coral recruits are impossible to grow. Hard substrates were not observed during the dive except rocks near the coast. Those rocks were not sampled due to strong waves. No reefs and seagrasses were encountered from six (6) sampling areas in Pulupandan, Negros Occidental. Deep soft mud was observed in all spot dives in relatively deep areas. In addition, loose grayish sediment or volcanic

COMPONENTS/ SUBCOMPONENTS	KEY BASELINE FINDINGS
	origin along the coasts, which indicate unsuitability of sediment substrate for establishment. There were also a river system, Bago River, and major coastal development in the area that may seem to contribute to siltation and water visibility, hence deteriorating water quality for photosynthetic organisms like seagrasses and corals. Furthermore, silt and plankton bloom, if they settle at bottom, may cover the reef substratum for colonization, hence impossible for coral recruits to settle. None of the reef fish species were seen during the survey across the four sites. With the present reef condition, it is uncertain if there are still sites across the islands that harboured reef fish species. Some soft bottom fish species that can thrive in silted environment like in these areas are probably *bisugo* (thread brims) and *bagaong* (Teraponidae), mullet/gisaw (Mugilidae), (Siganidae) rabbitfish/danggit and barramundi/salungsong (Latidae), crab/alimasag (Portunidae), ponyfish/sap-sap (Leiognathidae). The *Acetes* or hipon are among the marine species along the Iloilo-Guimaras Channel were observed in seasonal pattern from September to October (Panay Power 2018). As part of the marine ecology study for the Panay-Guimaras-Bridge (PGN) Project, a water sampling covering eight stations was conducted to assess the plankton abundance, diversity and richness was conducted last March 15-16, 2019. A total of 30 phytoplankton species were identified across in all sampling stations. These identified taxa belonged to three major groups, *i.e.* diatoms, dinoflagellates and cyanobacteria. Overall, diatoms dominated the phytoplankton community accounting for almost 88.12%, followed by cyanobacteria with 11.09% and dinoflagellates with less than 1%.The top five most abundant phytoplankton taxa. Analysis of samples taken from the eight stations revealed a total of 17 zooplankton groups (adult and larval forms). Zooplankton observed during this sampling was typical groups/type found in marine environment. The top 5 dominant zooplankton were copepod nauplius (53%), adult copepods (29%), bivalve veligers (19%), copepod eggs (14%), larvacean (1%) and the remaining 2% was attributed to gastropod veliger, polychaete trocophore, cladoceran, decapod zoea, echinoderm larvae, crab zoea, fish larvae, mysids, and radiolarian (**Figure 90**). Zooplankton communities' analyzed were mostly represented by larval forms constituting for 70%while adult forms accounted for 30% of the total zooplankton community. The bulk of the larval forms were composed of copepod nauplius accounting for 53% and total density of 1.3 x 10^6individuals/m^3. Since coral reefs were hardly seen in all site surveyed while seagrasses were only reported in Cabano, San Lorenzo, Guimaras, the impact of the project on marine ecology along the project sites may be minimal in the sense that corals and seagrasses did not exist virtually in all sampling sites, with an exception in San Lorenzo sampling sites. The construction of bridge foundations could be on hard substrates and literally concrete material in nature, these foundations may hinder water circulation and longshore current, hence minimizing sediment and water mass exchanges. Therefore, it is recommended the engineering design of bridge (e.g., stockpiles) may consider these hydrodynamic processes in such a way not to dampen incoming and outgoing tides and currents. Sediment resuspension will negatively affect habitat quality. The presence of temporary structures will likely change water movement and fish migration in the area. Vibrations associated with operating large machinery might lead to

COMPONENTS/ SUBCOMPONENTS	KEY BASELINE FINDINGS
	mortality among certain fish especially the juveniles. Hence, mitigation measures should be implemented as soon as the work begins. The free circulation of water must be ensured to maintain fish habitat functions (feeding, nursery, spawning) downstream from the work area. Any debris or concrete waste must be properly disposed of. All debris accidentally introduced into the aquatic environment must be removed as quickly as possible.
AIR	
Climate	The climate map of the country is based on the Modified Coronas classification. The project area under study belongs to Type I category. This is characterized by two pronounced seasons; dry from December to April and wet during the rest of the year. The climate is tropical in Iloilo City. Most months of the year are marked by significant rainfall. The short dry season has little impact.
Rainfall	The southwest monsoon is the main rainfall-causing weather system of the area. Tropical cyclones seldom, if not rarely, cross the project area. The rainy season in the area occurs from May to November while the rest of the year is relatively dry. The month of July is the wettest, with a monthly average rainfall of 329.6 mm. The month of February, on the other hand is the driest, with a mean monthly rainfall of 16.0 mm. The average annual rainfall recorded based on 30 years of data is 1767mm. Rainfall in Guimaras during the northeast monsoon would most probably be due to conventional thunderstorms, a result of intense heating causing rapid evaporation, or to a lesser extent, typhoons which can occur in the region during October-November. The probability of a typhoon hitting Guimaras is fortunately low. The island has a rare frequency passage of 0% - 10% of the annual average of 19.8 typhoons. Precipitation in Iloilo averages 2083 mm.The driest month is February. There is 27 mm of precipitation in February. The greatest amount of precipitation occurs in August, with an average of 346 mm. The precipitation varies 319 mm between the driest month and the wettest month.
Temperature	With an average of 28.5 °C, May is the warmest month. The lowest average temperatures in the year occur in January, when it is around 25.8 °C. The variation in temperatures throughout the year is 2.7 °C. In Iloilo City, the average annual temperature is 27.1 °C.
PAGASA 2020-2050 projection	Hot days and dry days are likely to be more frequent over the Philippines with more heavy rainfall days especially over Luzon and Visayas by 2020 and 2050. Reduction in rainfall in most parts of the Philippines is predicted during the summer (MAM) season. However rainfall increase is a trend during the southwest monsoon (JJA) until the transition (SON) season in most areas of Luzon and Visayas in 2020 and 2050. Heavy daily rainfall will continue to become more frequent, and extreme rainfall is projected to increase in Luzon and Visayas only. But number of dry days is expected to increase in all parts of the country in 2020 and 2050.
Ambient Air Quality	Air Samples were collected on April 2-4 & July 8-9 in Buenavista, April 6-8, 2019 in San Lorenzo, Guimaras. In Iloilo, samples were collected on April 12-13 in Leganes and July 6-7, 2019 in Jaro. In Pulupandan, Negros Occidental, air samples were collected on April 9-11, 2019. Total of 9 stations were sampled. Weather conditions at the time of sampling were sunny, fair to cloudy with slight rains. Twenty-four (24) hours measurement were sampled for Total Suspended Particulates, PM10, Nitrogen Dioxide, Sulfur Dioxide and Carbon Monoxide.

COMPONENTS/ SUBCOMPONENTS	KEY BASELINE FINDINGS
	Results of air quality for all parameters measured at two (2) sites are compared with National Ambient Air Quality Guideline Values (NAAQGV) of Republic Act 8749 or known as Philippine Clean Air Act. All parameters tested in all sites are within the allowable limits. Pollution from the project are mainly air-borne dusts, generated from activities such as road construction, pipeline construction, and vehicle operations. The effect of pollution will be high on buildings close to the project site. Use of commercial asphalt is recommended in the construction, because its exhaust gas will have less impact. In the demolition and relocation on earlier stage, the air-borne dust from demolition and relocation may occur in the process of pushing, knocking and clearing transportation. The demolition of the project on earlier stage mainly involves the houses along the line. Therefore, in the process of demolition, it is necessary to strengthen the management, standardize the construction and adopt necessary ambient protection measures such as sprinkling water in order to reduce the air-borne dust impact on the periphery. Bridge construction mainly includes the construction of the foundation, bridge superstructure, lifting and splicing stage. In comparison to the air born dust resulting from the pavement construction, the impact of air-borne dust caused by bridge construction is relatively small. This is because, it neither involves the construction of a new pavement nor produces secondary air borne dust from driving on unfinished pavements.
Ambient Noise	Noise measurements were collected on April 2 to 11, 2019 & July 6-9, 2019 at Municipalities of Leganes, Iloilo, Buenavista, San Lorenzo, Guimaras and Pulupandan, Negros Occidental. Weather condition at the time of sampling was sunny to cloudy with slight rains. Twenty-four (24) hours measurement were sampled for Noise level. on the results of noise measurement, some areas failed to meet the standard limit set fort. However most of the said exceedances are not critical since high noise level created during sampling are mostly intermittent only specifically those coming from animals like barking of dogs, rooster crowing, etc. Noise sources of the planned project in the construction stage mainly come from construction machinery, supplemented by radiation noise of transport vehicles. Specific construction machinery used in the project and their distribution are drilling machine: this project adopts bored pile construction. Lifting machine, concrete mixer and concrete vibrator, asphalt paver, electric drill, electric saw, and cutting machine and so on are manly applied in pavement construction and traffic engineering construction, with comparatively less impact. Other sources are rollers, bulldozers, excavators, and pneumatic picks and so on which are mainly used in the construction of roads and dump trucks are mainly employed in the construction sites, to transport building material to construction site and convey construction wastes and project dredge to the designated locations. Significant noise and vibration impacts are anticipated during the construction of ground roads and bridge engineering.
PEOPLE	
Population	The located is located in one (1) Municipality in Iloilo, two (2) Municipalities in Guimaras and one (1) Municipality in Negros Occidental covering a total of 12 barangays. The total population of the 12 barangays are 19,097. Among the barangays cover, M. Chavez in the municipality of San Lorenzo, Guimaras

COMPONENTS/ SUBCOMPONENTS	KEY BASELINE FINDINGS
	and Getulio in the municipality of Buenavista, Guimaras have the highest population with 2,803 and 2,619, respectively. On the other hand, the least population within the project area is Barangay Pag-ayon with 981 populations. Based on 2015 Census of Population and Housing of Philippine Statistics Office, the four (4) municipalities have a total population of 136,764 and an average population density of 717.5 persons/km2. The highest average population density among the municipalities covered is Pulupandan in Negros Occidental with 1,200 persons/km^2.
Religious Affiliation	Majority of the population in Iloilo belongs to Roman Catholic comprising about 44% of the total population followed by Aglipay with only 2%(PSA 2015), while the remaining are composed of different religious sector with less than 1% in population. In Guimaras Island, 37% are Roman Catholic, 7% are Aglipay and 1% are Baptist. Likewise, religious sector in Negros Occidental are dominated by Roman Catholic with population comprised of 88% while the remaining percentage belongs to different religious sectors such as Aglipay, Born Again, Buddhist, Baptist, among others.
Ethnicity	The Ati, a Negrito ethnic group, are mostly found in Western and Central Visayas. Large concentrations are found in Aklan, Capiz, Antique, and Iloilo on Panay Island, and the biggest group is in Iloilo. There are also Ati populations on the islands of Guimaras and Negros (comprising Negros Occidental and Negros Oriental). Few Atis still speak their traditional language, as it has been replaced by Kinary-a, which is spoken in Antique and some parts of Iloilo. Moreover, there is no IP Groups nor CADT/CADC within the proposed bridge alignment that may be affected nor displaced
Education	In terms of literacy, age group from 10-14 and 15-19 has the highest population recorded in all municipalities affected while the least in terms of population are those age group of 60-64. Highest literacy in the data of PSA (2015) is in the municipality of Buenavista, Guimaras with 41,122 populations.
Water Supply	Leganes' sources of Level III potable water are the deep wells in the barangays of Guihaman and Cagamutan Sur. The municipality has adequate underground water supply, which can be tapped for domestic and commercial uses. The surface water in Calaboa Creek, Carismo-an Creek and Janipaan River are utilized for irrigation purposes. Water supply of Municipality of Buenavista come from their Municipal water district and served to 4,397 households. Some people in the community their water supplied by wells/spring in the brgy., Water supplied through water faucets in individual households. Municipality of Pulupandan get their water supply in Water System of Pulupandan. Water system was previously managed by the Municipality of Pulupandan. The water system consists of a 100 CU.M. Concrete Reservoir, Kilometers of pipelines consisting of combination of Galvanized iron and PBC pipes of varying sizes.
Power Supply	Electric supply of Municipality of Buenavista and San Lorenzo come from Guimaras Electric Cooperative (Guimelco). While municipality of Leganes and Pulupandan get their power supply in Negros Occidental Electric Cooperative (Noceco), catering to consumers in the southern portion of the province, from Pulupandan to Hinoba-an.
Transportation and	Leganes is only about eleven kilometers from Iloilo City and few kilometers

COMPONENTS/ SUBCOMPONENTS	KEY BASELINE FINDINGS
Road Network	from the Iloilo Airport of International Standards. It can be reached from Iloilo City through the National Highway to the north or the Coastal Highway to the Municipality of Dumangas. The Coastal Road serves as the shorter link of the town to the International Port in Barrio Obrero, Lapuz, Iloilo City and to some of the municipalities in the north. There are also barangay roads that connect the municipality to the adjacent towns like Sta. Barbara and Pavia. Buenavista and Guimaras can be reach by boat if you are coming outside the province. Jeepney, tricycle and motor are the main transportation in the area while in Pulupandan, Negross Occidental can be reach by bus when coming from other municipalities and provinces. Nearest airport to the area is in Bacolod City.
Peace and Order	In terms of peace and order in the four (4) municipalities affected by the project, through the joint effort of the police, fire department and the community, is considered as one of the most peaceful municipalities of the Province of based on the low crime rate recorded. No heinous or sensational cases have ever been recorded and there are no existing criminal groups in the area for several years. The police, fire department and the community are doing its part in keeping with the said status purposely to attract more investors to do business in the area and maintain a peaceful and ideal place to live, work and conduct business.
Gender and Children Rights	There is a gender and development in the four (4) municipalities affected by the project. They implemented the equal protection or treatment to women. Part of their gender and development initiatives is the implementation of GAD-ECCD Program which consider gender welfare as well as early childhood care and development.
LGU Income	In terms of IRA dependency, there are increase and decrease in dependency among all the municipalities within the project area. In San Lorenzo, Guimaras, from 97% IRA dependency in 2009, it decreased to 82% in 2016. On the other hand, there is an increasing trend of IRA dependency in Pulupandan, Negros Occidental while Buenavista, Guimara is consistent with 88% to 90% between 2009-2016. Leganes, Iloilo has the lowest record of IRA Dependency in 2010 with 69% while the highest was in 2013 with 81%.(Data source: Bureau of Local Government Finance, Department of Finance, 2017).
Public Participation	Public Scoping meetings were conducted with stakeholders last August 27-29, 2019 at the four (4) affected Municipalities: Municipality of Pulupandan in Negros Occidental, Municipality of Buenavista and San Lorenzo in Guimaras and Municipality of Leganes in Iloilo. The stakeholders are composed of LGU Officials, barangay councils, community leaders and representative from People's Organization and Government Agencies. On people, most of the issues and concerns raised were the road right of way (RROW) which include the families, properties, structures, land (agriculture, trees) that will be affected by the alignment and just compensation. Impact on livelihood to fishermen, prioritization of job opportunities to local communities

Impact Management Plan

Project Phase	Environmental Component Likely to be Affected	Potential Impact	Options for Prevention or Mitigation or Enhancement	Responsible Entity	Cost	Guarantee/ Financial Arrangements
I. Pre-Construction Phase	This will be addressed during implementation of RAP as resettlement is expected to be done prior to project implementation or prior to construction.					
Securing of Permits and Clearances from National and Local Agencies	People	Increase in government revenues	Submission of documents required by the national and local agencies	DPWH	Part of initial project cost	Incorporated in the work and financial plan of DPWH
Hiring of staff for preparatory works prior to construction	People	Economic/ job opportunity	Priority will be given to qualified residents in the project areas	DPWH	Part of initial project cost	Incorporated in the work and financial plan of DPWH
II. Construction Phase						
Civil works and site clearing	The Land	Change in land use Soil erosion Increase run off Destabilization of slope	• Set-up temporary fence around the construction area • Conduct slope stability analysis and construct silt trap and spoils disposal area • Limit the area of grading to the facility and access roads. • Spoil materials will be used as fill and as construction materials for site preparation. • The negative impact is insignificant and short term but irreversible	Proponent/ Contractors	Included in the Construction cost	ECC MMT

Project Phase	Environmental Component Likely to be Affected	Potential Impact	Options for Prevention or Mitigation or Enhancement	Responsible Entity	Cost	Guarantee/ Financial Arrangements
		Removal of vegetation and habitat disturbance	• Cutting Permit will be secured if there are trees that will be affected during construction • Limit land clearing in designated sites only. • Establishment of a small nursery as source of planting materials using the endemic species and fruit-bearing trees found onsite for the replacement of trees to be cut or removed • Gradual clearing and removal of vegetation to provide sufficient time for wildlife species to transfer to the nearby habitat. Planting of naturally-grown species in the designated areas might encourage the wildlife species to return in the future.			
		Solid wastes	• Ensure solid waste management plan prior to mobilization of project; proper segregation and disposal shall be included in the program; Strictly require contractors and their workers to observe proper waste disposal and sanitation			

Project Phase	Environmental Component Likely to be Affected	Potential Impact	Options for Prevention or Mitigation or Enhancement	Responsible Entity	Cost	Guarantee/ Financial Arrangements
Civil works and site clearing	The Water	• Increase in run-off -Generation of domestic wastewater -Generation of wastewater from comfort rooms, cleaning of construction equipment, vehicles and regular watering activities • Contamination of surface and marine water with oil and grease • Terrestrial and marine habitat disturbance	• Provision of portable portalets during construction and management of domestic wastewater to meet and comply with DENR effluent guidelines. • Site clearing will be limited to areas needed and restricted to acceptable weather conditions • No clearance or establishment works will be undertaken during high rainfall conditions to reduce the risk of sediment loss to the environment • Set up adequate toilet facilities; ensure sufficient washrooms for workers • Construction of settling ponds to contain inflow of muddy waters • Installation of oil traps and proper storage of used oil • Implement efficient construction methodology to shorten disturbance resulting from possible siltation	Proponent/ Contractors	Included in the operating cost	ECC, MMT
Civil works and site clearing	The Air	• Dust generation during clearing of the site and stockpiling of soil • Dust generation	• Roads will be watered especially during hot and dry weather. Regular water spraying by water sprinklers (road tank watering) during construction. • Regulate speed of delivery/ hauling	Proponent/ Contractors	Included in the operating cost	ECC,MMT

Project Phase	Environmental Component Likely to be Affected	Potential Impact	Options for Prevention or Mitigation or Enhancement	Responsible Entity	Cost	Guarantee/ Financial Arrangements
		during opening up of pits, associated with movement of vehicles and machinery and excavation, transportation and emplacement of rock and soil • Dust generation during construction of the processing plant, power plant and storage facility, associated with movement of vehicles and machinery and excavation, transportation and emplacement of rock and soil • Exhaust fumes and noise from vehicles	trucks • Provide equipment with ear plugs, mufflers and proper scheduling of noise-generating activities			
Civil works and site clearing	The People	• Increase in livelihood and business opportunities	• Alleviate economy and generation of income to hosts and nearby barangays • Increased LGU revenues resulting from	Proponent	Included in the operating cost	ECC

Project Phase	Environmental Component Likely to be Affected	Potential Impact	Options for Prevention or Mitigation or Enhancement	Responsible Entity	Cost	Guarantee/ Financial Arrangements
		• Increase in revenues	the purchase of locally available materials and equipment for construction, translating to additional taxes. Business establishments should be properly registered and payment of the required taxes shall be monitored.			
		• Provide job opportunities for construction workers	• The construction of the project will generate employment opportunities for local residents as well as migrant workers. It will bring increased income to those who will be employed. Local manpower may have to compete with migrant labor for employment. Employment of local residents during the construction stage shall be given priority, particularly those from families in the Direct Impact Area.			
		• Health and Safety Risk	• Use of appropriate PPEs and proper training of workers; strict implementation of health and safety plans and programs including road safety; comply with DOLE requirements			

Project Phase	Environmental Component Likely to be Affected	Potential Impact	Options for Prevention or Mitigation or Enhancement	Responsible Entity	Cost	Guarantee/ Financial Arrangements
Civil works and site clearing	Solid and Hazardous Wastes	Used oil, paint wastes, scrap metals, busted lamps, and spent fuels	• Ensure a Solid Waste Management Plan to cover proper segregation, waste handling, waste storage and a waste disposal system. • Employ waste management strategies on reduce, re-use and recycle programs - Reduce – Reduction of waste through less packaging by promoting bulk purchasing without packaging; less single-use devices - Reuse – Choose water supply, office supplies that are re-usable, e.g. use printer inks that are refillable - Recycle – Composting the water supply and kitchen waste is a very useful form of recycling -Waste receptacles/bins shall be provided in strategic locations within the work areas. There shall be an identified designated area for the temporary disposal of domestic and construction wastes -Proper handling, transport and storage of chemicals such as used oil, used batteries, busted lamps etc. must comply with local regulations -Selling of scrap metals and used oil will adhere to local regulations	Proponent/ Operator / Contractors	Included in the Operating cost	ECC

Project Phase	Environmental Component Likely to be Affected	Potential Impact	Options for Prevention or Mitigation or Enhancement	Responsible Entity	Cost	Guarantee/ Financial Arrangements
			• Safety Data Sheet will be in place • Climate Change Adaptation: - Reduction of greenhouse emissions from energy used in offices by using green energy power or use of lighting that is environment friendly such as LED lights. - Implementation of rain water harvesting - Recycle office paper, newspapers, beverage containers, electronic equipment and batteries. Reducing, reusing and recycling in the office helps conserve energy, and reduce pollution and greenhouse gases from resource extraction, manufacturing, and disposal. Reduce, reuse, and recycle in the office can be done by using two-sided printing and copying, buying supplies made with recycled content, and recycling used printer cartridges. For old electronics, donate used equipment to other organizations or sold to accredited scrap buyers. -			

Project Phase	Environmental Component Likely to be Affected	Potential Impact	Options for Prevention or Mitigation or Enhancement	Responsible Entity	Cost	Guarantee/ Financial Arrangements
III. Operation Phase A positive impact on island bridge development network is foreseen which will boost tourism, increase business opportunities and increase local revenues. With the anticipation of tourist influx, local economic activities will be improved. Expect more productive land use and utilization of local resources.						
IV. Abandonment Phase						

Project Phase	Environmental Component Likely to be Affected	Potential Impact	Options for Prevention or Mitigation or Enhancement	Responsible Entity	Cost	Guarantee/ Financial Arrangements
Demolition Activities	The Land	• Land degradation • Damage to access and hauling roads • Loss of livelihood	• Preparation and implementation of comprehensive abandonment management plan • Proper clean-up and decontamination of affected site • Proper dismantling of equipment • Disposal of hazardous waste • Maintenance and rehabilitation of roads with drainage system in place • Retrenchment packages for displaced employees • Provision of alternative livelihood	Proponent	Included in operating cost	ECC

Social Development Plan (SDP) /Framework for PGN Project

Concern	Responsible /Community Member/Beneficiary	Government Agency/NGO/and Services	Proponent	Indicative Timeline	Source of Fund
1. Relocation Land Purchase/ Resettlement	1. Barangay Chairman 2. Project's affected tenants 3. Land Owner	*LGU Municipal Assessor based on cadastral surveys *City Planning and Development Office *DSWD *DPWH (facilitating demolition of structures and transfer of affected families)	DPWH through Property Owner Community Relations Officer; Resettlement Specialist	Pre-construction	DPWH/LGU
a] High-value crops for farmers b] Employment - Job priority skills training for qualified workers c) organization of business establishment/ transport group/fisher folk etc.	1. Association Chairperson 2. Qualified Project affected men, women, youth and elderly 3. Association Chairperson	1. LGU City Planning Office 2. LGU City Social Welfare & Dev. Office TESDA/TLRC - Various skills training courses DA/BFAR ▪ Technical training farming methods	DPWH LGU PAMB	Operation	DPWH LGU / PAMB From revenues and fees
3. Health and Safety a] Improvement/ Renovation of Brgy. Health Center b] Health services	1. Barangay Kagawad for Health 2. Project's affected community	1. City Health Officer 2. Barangay Disaster Management Committee	Community Relations Officer (CRO)	Operation	LGU/ DPWH (according to the budget in table 5.2)

Concern	Responsible /Community Member/Beneficiary	Government Agency/NGO/and Services	Proponent	Indicative Timeline	Source of Fund
c] Potable water (bio-sand filter project) d] Supplemental feeding program for malnourished children e] Assistance to senior citizens and persons with disability					
4. Education & Recreation	1. Barangay Kagawad for Education/SK; Barangay PTA 2. Project affected families	Department of Education ▪ Scholarship program for qualified students ▪ Literacy programs & non- formal education programs City Engineer's Office ▪ Identification of appropriate project site, design, provide funding support, organize & implement related educational and recreation activities	LGU/PAMB	Construction Operation	LGU/ DPWH/ NGAs NGOs/ POs (according to the budget in table 5.2)
5. Environment & Sanitation ▪ Brgy. Solid Waste Management Plan ▪ Bio-sand water filters	1. Barangay Kagawad for Environment 2. Project's affected community	CENRO ENRO /MHO 1. Formulate training in SWM 2. Reforestation (tree planting) 3. Establishment of forest nurseries 4. Environmental monitoring 5. Health programs 6. Provide bio-sand water filters	LGU/PAMB	Pre-construction Construction Operation	LGU/ DPWH /NGAs/ NGOs/ POs (according to the budget in table 5.2)

Concern	Responsible /Community Member/Beneficiary	Government Agency/NGO/and Services	Proponent	Indicative Timeline	Source of Fund
		CHO and/or DOH			
6. Peace & Order	1. Barangay Kagawad for Peace & Order 2. Project's affected community	LGU PNP - Capacity-building & strengthening of barangay tanods in peacekeeping - Maintenance of peace and order and respond to security concerns	Chief Security Officer	Pre-construction Construction Operation	LGU/ DPWH/ (according to the budget in table 5.2)
7. Spiritual	Barangay Assigned Catholic priest, or pastor of different denomination	Parish Priest for Catholics or Pastor for Non-Catholics and Non-Muslims	Community Relations Officer (CRO)	Construction Operation	LGU/ DPWH/ (according to the budget in table 5.2)
8. Infrastructure	*LGU: City and Barangays * Barangay Kagawad for Infrastructure * CPDO	* DPWH/ City Engineer's Office * CPDO * LGU: City and Barangays * Repair/Improvement /Expansion of Barangay Road	Community Relations Officer (CRO)	Pre-construction Construction Operation	LGU/ DPWH/ (according to the budget in table 5.2)

IEC Plan/Framework of DPWH

1. Directly and indirectly affected population: LGUs with focus on Barangays affected	-The EIA process -The construction of the project The renumeration for identified land areas to be used by the project -The consequential impacts on the residents of the community The benefits of the project on their socio-cultural/ economic and bio-physical environment of the affected residents as they address the major issues of air and water pollution using IEC Proposed Corporate Social Responsibility Programs and Projects such as farming, skills and other livelihood trainings.	-Barangay Assemblies -FGD -Public consultations; -Information desk -Community meetings	1 Illustrative Primer/ Brochure (pictograms) about the Project - The EIA's process illustrated and simplified in the language of the affected community This includes ▪ The project description ▪ A graphic illustration about the construction and operation and the mitigating measures ▪ Major process activities, the structural, supporting and non-structural measures for the successful implementation of the project; ▪ Location map indicating the exact location of the major activities ▪ Frequently Asked Questions (FAQs) about the project; the identified impacts and mitigations; health and safety measures related to construction and operation of the project and correct behavior in relation to the Project ▪ The residents who will be affected by the Project's activities showing their right to complain for violations of ECC conditions	-Prior to start of project construction -Continuing Regularly or as needed; at least on an annual basis	The cost includes meals, venue, IEC materials, transport, design, layout, printing cost salaries, honoraria etc. Project cost is estimated at **PhP __________ per annum**
			a] Group discussions for the		

			identified tenants regarding their rights and responsibilities in relation to land purchase c/o the land owner and prior to land acquisition b] Group discussions with sectorial groups which will be affected with the activities, the legal processes with the application of priority job placement, and other benefits 2. Workshops to cover the preparation of IEC materials and campaigns		
			3. Posters and pictograms on EIA in local language		

Environmental Monitoring Plan (EMoP) with Environmental Quality Performance Levels (EQPLs)

Key Environmental Aspects per Project Phase	Potential Impacts per Environmental Sector	Parameters to be Monitored	Sampling & Measurement Plan			Lead Person	Annual Estimated Cost (Php)	EQPL MANAGEMENT SCHEME					
								EQPL Range			Mgt. Measures		
			METHOD	FREQUENCY	LOCATION			Alert	Action	Limit	Alert	Action	Limit
CONSTRUCTION PHASE													
Environmental Aspect	Coastal Water Quality Stations: Iloilo Guimaras Pulupandan	Coastal Water Total Suspended Solids (TSS), pH, BOD, DO, Oil & Grease, Color, fecal coliform bactiera	Grab Sampling RA 9275	Quarterly	sampling point to be monitored should be within the project site	Pollution Control Officer (PCO)	500,000	Siltation Surface Water: TSS- 60 mg/L increase pH: 6.4-8.4 BOD: 4 mg/L DO: 4.9 mg/L Oil & Grease: 0.5 mg/L Color: 45 CU	Siltation Surface Water: TSS- 65 mg/L increase pH:6.5-8.5 BOD: 5 mg/L DO: ≥5.0 mg/L O/G: 1.0 mg/L Color: 50 CU	DAO 2016-08, Class B TSS: 65mg/L increase pH: 6.5-8.5 BOD: 5 mg/L DO: ≥5.0 mg/L O/G: 1.0 mg/L Color: 50 CU			RA 9275/ DAO 2016-08
	Air Quality Proposed site locations -Brgy. Gua-an, Iloilo -Buenavista, San Lorenzo,	Total Suspended Particulates (TSP), PM10 & SO_2, NO_2	1-hr Sampling per RA 8749	Quarterly	Construction area; downwind; NSEW direction	PCO	2,000,000.	Fugitive dust		RA 8749		Regular sprinkling activities	RA 8749

	Guimaras -Pulupandan, Negros												
	Noise Proposed site locations --Brgy. Gua-an, Iloilo -Buenavista, San Lorenzo, Guimaras -Pulupandan, Negros	Ambient Noise and Vibration (especially during drilling activities)	Grab sampling	Monthly during construction, and when required	Pre-determined specially in areas near immediate receptors, construction site ; NSEW direction	PCO	600,000	Intermittent noise		NPCC 1978		Ear plugs/ ear muffs as necessary	NPCC 1978
	Solid Wastes	Construction debris, papers, plastics, biodegradable waste	Grab/ landfill	Daily	Construction site / SW storage area	PCO	500,000			RA 9003		Imposition of fines due to improper disposal	RA 9003
	Wastewater (domestic)	TSS, BOD, pH, Oil & Grease (canteen)	Grab Sampling RA 9275	As necessary	Common septic tanks for toilets & canteens	PCO	50,000	Wastewater from toilets, washings		RA 9275		Ensure portalets & septic tanks are in placed	RA 9275
	Chemicals & Hazardous Wastes	Used oil, busted lamps Used paints, spent solvents	Individual segregation & collection	As necessary	Storage Area/ Motorpool	PCO	100,000-200,000/annum	Oil spills		RA 6969		Instigate measures per regulatory requirements	RA 6969
	Socio-economic	Displacement of informal settlers;			Project location	Community	Included in the					Relocation	

		relocation Recruitment/hiring for manual labor & other skills available within the Host Barangay & nearby communities				Relations Officer (CRO)	operating costs					Job opportuni -ties	
	Terrestrial Flora & fauna Impacts	Flora- species dominance within quadrants in terms of total cover, relative ground cover, absolute density, absolute frequency, relative density and relative frequency of individual species Fauna – species diversity index, dominance index, and evenness index (Mangrove rehabilitation is not included in the cost)	Line transect/ quadrat / trap	Annual	Within project vicinity and its affected barangays	PCO	500,000						Other applicable local & internatio nal standards
	Social Impacts	Income comparison for relocated households before & after relocation Number of	Interviews	Annual	Brgys. affected	PCO	Included in the operating costs						

		immigrants attracted by the project Proportion of direct employment to residents of impact barangays to total direct employment provided by the Project and distribution of employed residents per impact barangay Number of alternative means of livelihood created and number of people actually benefited Income comparison for brgys. and municipality before and during the project Ratio of income gained and income lost											
	Health Impacts	Health impacts Morbidity, mortality Health profile of receptor communities Vital health indices Malnutrition Environmental	Interviews	Annual		Health & Safety Officer (HSO)	Included in the operating costs						DOH/ WHO

		Quality and Health Environmental Sanitation OHS records of employees Interviews and medical examination of high-risk groups Inspection of facilities, control devices, PPEs, and working conditions Health data-basing for most vulnerable public groups											
ABANDONMENT PHASE (IMMEDIATE AFTER CONSTRUCTION)													
Environmental Aspect	Land (Disposal Site) Clearing of construction debris; removal of construction equipment	-Heavy metals (As, Ba, Cd, Cr, Cu, Pb, Hg,Se,F) Corrosivity, NPK	Systematic sampling: Several Grab and composite Sampling	As prescribed	Designated disposal sites	PCO	2,000,000	TCLP Metals: As, 0.8 ppm Ba, 65 ppm Cd, 0.2 ppm Cr, 4 ppm Pb, 0.8 ppm Hg, 0.08 ppm Se, 0.08 ppm F, 95 ppm	TCLP Metals: As, 1 ppm Ba, 70ppm Cd, 0.3 ppm Cr, 5 ppm Pb, 1 ppm Hg, 1 ppm Se, 1 ppm F, 100 ppm	TCLP Metals: As, >1 ppm Ba,>70ppm Cd,>0.3ppm Cr, >5 ppm Pb, >1 ppm Hg,>0.1 ppm Se, >1 ppm F,>100ppm		Reme-diate/ clean up the contami-nated area	RA 6969

Environmental Guarantee and Monitoring Fund Commitments

DPWH shall see to it that EMF and EGF will be allocated. The EMF shall be used for the operationalization of the Multi-Partite Monitoring Team (MMT) and all costs related to environmental monitoring which include air, noise and water sampling, meetings, honorarium, transportation, etc. The amount of EMF to be located shall be based on the number of members, meetings conducted, sampling which will be computed annually. At least 1,000,000.00 shall be initially allocated to start up operation of the MMT and shall be replenish annually. On the other hand, the EGF shall be put up to be available in case of worst case scenarios such as immediate rehabilitation of areas affected by the damages to the environment caused by the construction of the roads and bridges and to compensate affected parties, etc. A Memorandum of Agreement shall be established to this effect.

Chapter 1

PROJECT DESCRIPTION

1.0 PROJECT DESCRIPTION

1.1 Project Location and Area

1.1.1 Project Location

Based on the previous meetings conducted by the DPWH with the other concerned parties (LGUs and Chinese representatives), the 5.7-km Panay-Guimaras bridge will be constructed between barangays in Nabitasan and Gua-an in Leganes, Iloilo and Getulio in Buenavista, Guimaras **(Table 1)**. Moreover, the longer 12.3-km Guimaras-Negros Bridge will initiate in barangays Cabano in San Lorenzo, Guimaras and Poblacion in Pulupandan, Negros Occidental (Figure 1). These areas were determined based on direct-shortest distance between islands. Benthic ecosystem surveys were conducted using photo-transect for corals, transect-quadrat method for seagrasses, and fish visual census (FVC) technique for reef fishes.

Below is the general overview of the four municipalities that may affect by the island bridge construction of the PGN project (according to various online sources, e.g. Phil Atlas, PSA, and others; Figure 1):

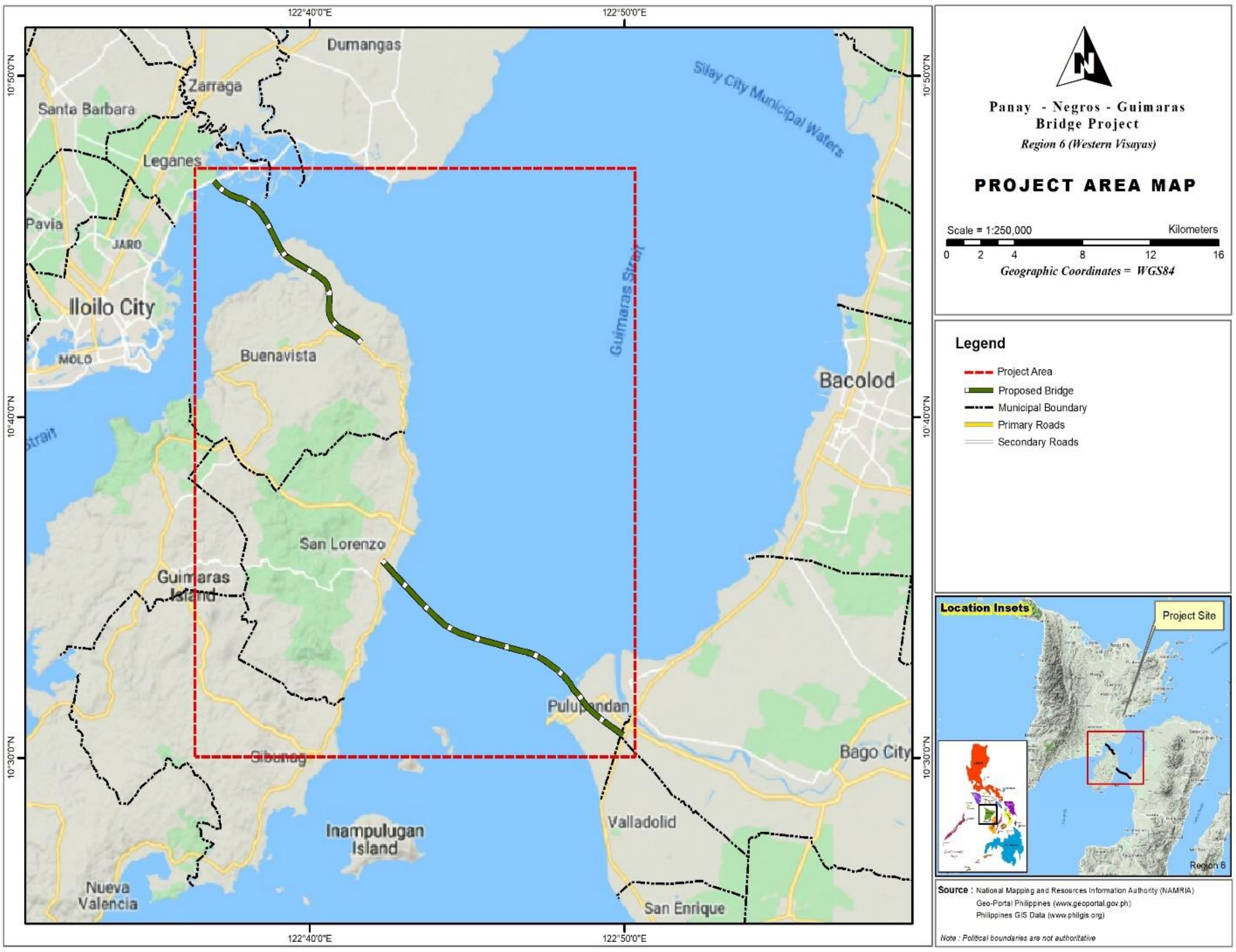


Figure 1. Location of the proposed PGN island bridge project in the Western Visayan region.

Leganes is a 4th class municipality in the province of Iloilo, located in Panay Island and 11 km away from Iloilo City. It has a total land area of more than 32 km^2, mostly agricultural and is politically subdivided into 18 barangays (including Nabitasan and Gua-an). According to the 2015 census, it has a population of 32,480 people, with a density of 1,000 inhabitants per km^2. In particular, adjacent barangays Nabitasanand Gua-an are situated at approximately 10.7867°N, 122.6307°E and 10.7822°N, 122.6172°E and at these coordinates, the elevations are estimated at 1.8 m and 5.9 m above mean sea level, respectively. The former barangay contributed about 9.4% of the total municipal population (3044 individuals based on 2015 census), with a positive population growth rate of 1.28% from the previous census while the later, it represented 3.8% or 1231 individuals and recorded a growth rate of 2.17%.

Guimaras lies southeast of Panay Island and northwest of Negros Island and it lies between 10°25'00" and 10°46'09" north latitude, and 122°28'20.99" and 122°28'40.53" east longitude. The island is separated from Panay by the 1.5 nautical mile long Iloilo Strait and acts a natural breakwater for Iloilo. The six nautical miles Guimaras Strait likewise separates the province from Negros. Buenavista is a 2nd class municipality and the largest settlement in the province of Guimaras (Island), Philippines. It has a total land area of about 128 km^2, which is politically subdivided into 36 barangays. According to the 2015 census, it has a population of 50,437 people, with a density of 390 inhabitants per km^2.Moreover, barangay Getulio has a land area of 467.3 has, majority of it has been classified into lowland and coastal. It has a total population of 2619 individuals, with 715 families and 544 households.

San Lorenzo is a 5th class municipality in the province of Guimaras (Island), Philippines that was created by virtue of Republic Act No. 7897 on February 20, 1995. It has a total land area of about 93 km^2, which is politically subdivided into 12 barangays. According to the 2015 census, it has a population of 26,112 people, with a density of 280 inhabitants per km^2.A fish sanctuary was established in Tumalintinan. Furthermore, barangay Cabano, the seat of LGU, is situated at approximately 10.5757°N, 122.6856°E and at these coordinates, the elevation is estimated at 35.8 meters above mean sea level. It has a land area of approximately 1864.6 has. Its total population is about 4247 individuals, composed of 918 families and 855 households.

Lastly, Pulupandan is a 3rd class municipality in the province of Negros Occidental, (Negros Island) Philippines. With a total land area of 23 km^2, it is the smallest town in terms of area in the province and further divided politically into 20 barangays. According to the 2015 census, it has a population of 27,735 people, with density of 1,200 individuals per km^2. The municipality of Pulupandan currently has a sea port with RORO vessels traveling straight to the island province of Guimaras.

Table 1. Affected Barangays Traversing the Project

List of Municipalities affected by the PGN Project
Leganes, Iloilo
Municipality of Leganes
Barangay Gua-an
Buenavista, Guimaras
Municipality of Buenavista

Barangay Cansilayan
Barangay Banban
Barangay Navalas
Barangay San Miguel
Barangay Getulio
Barangay Dagsa-an
Barangay Salvacion
San Lorenzo, Guimaras
Municipality of San Lorenzo
Barangay M. Chavez
Pulupandan, Negros Island
Municipality of Pulupandan
Barangay Tapong
Barangay Canjusan
Barangay Pag Ayon
Barangay Zone 4A
Barangay Ubay

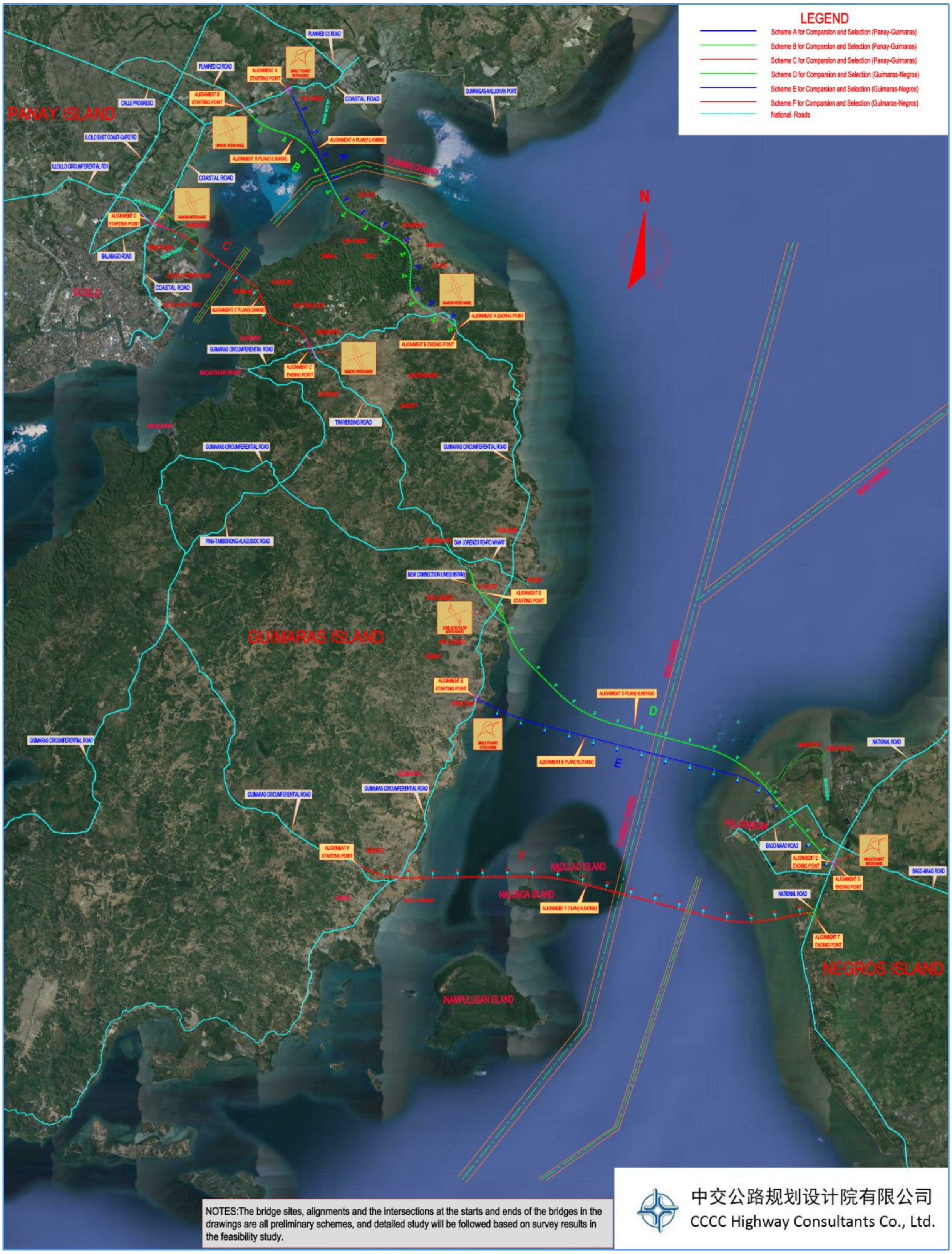
Table 2 and **Table 3** present the geographical coordinates of the project Alignment B and Alignment D respectively.

Table 2. Geographical Coordinates of the Project Alignment (Alignment B)

Stake number	Coordinate		Stake number	Coordinate	
	N (X)	E (Y)		N (X)	E (Y)
BK0+000	1192386.662	457870.489	BK12+500	1183902.323	466042.4138
BK0+500	1192017.03	458204.966	BK13+000	1183551.086	466365.9579
BK1+000	1191763.992	458633.8746	BK13+004.493	1183546.703	466366.9431
BK1+500	1191589.64	459102.4807			
BK2+000	1191414.114	459570.6279			
BK2+500	1191152.124	459994.108			
BK3+000	1190773.666	460318.0989			
BK3+500	1190355.79	460592.6522			
BK4+000	1189937.884	460867.1603			
BK4+500	1189519.978	461141.6685			
BK5+000	1189102.073	461416.1767			
BK5+500	1188684.167	461690.6849			
BK6+000	1188309.401	462016.8398			
BK6+500	1188051.04	462444.6593			
BK7+000	1187799.465	462876.7588			
BK7+500	1187547.89	463308.8583			
BK8+000	1187296.315	463740.9579			
BK8+500	1187022.216	464157.8048			
BK9+000	1186619.856	464448.5118			
BK9+500	1186134.268	464551.5059			
BK10+000	1185635.155	464522.6768			
BK10+500	1185138.572	464547.9683			
BK11+000	1184699.895	464778.8087			
BK11+500	1184399.809	465174.9421			
BK12+000	1184151.066	465608.6779			

Table 3. Geographical Coordinates of the Project Alignment (Alignment D)

Stake number	Coordinate		Stake number	Coordinate	
	N (X)	E (Y)		N (X)	E (Y)
DK0+000	1173128.232	467223.7076	DK12+500	1166531.39	477125.2729
DK0+500	1172797.993	467599.1306	DK13+000	1166297.183	477566.7913
DK1+000	1172441.856	467949.1828	DK13+500	1166020.067	477982.7222
DK1+500	1172029.476	468230.7479	DK14+000	1165702.812	478368.9097
DK2+000	1171573.64	468434.5871	DK14+500	1165348.587	478721.4952
DK2+500	1171104.812	468607.0962	DK15+000	1164968.607	479046.4529
DK3+000	1170672.242	468856.5357	DK15+500	1164587.144	479369.6963
DK3+500	1170290.806	469178.7916	DK16+000	1164205.682	479692.9398
DK4+000	1169936.651	469531.742	DK16+500	1163824.219	480016.1832
DK4+500	1169582.495	469884.6924	DK17+000	1163442.804	480339.4827
DK5+000	1169228.34	470237.6428	DK17+500	1163084.616	480687.873
DK5+500	1168881.213	470597.3583	DK18+000	1162772.658	481078.2021
DK6+000	1168569.039	470987.6643	DK18+500	1162505.871	481500.9399
DK6+500	1168297.389	471407.1859	DK18+603.094	1162452.399	481589.0827
DK7+000	1168068.979	471851.7313			
DK7+500	1167886.091	472316.8588			
DK8+000	1167748.21	472797.3345			
DK8+500	1167621.745	473281.0769			
DK9+000	1167495.28	473764.8193			
DK9+500	1167368.816	474248.5616			
DK10+000	1167242.351	474732.304			
DK10+500	1167115.886	475216.0464			
DK11+000	1166989.421	475699.7887			
DK11+500	1166862.957	476183.5311			
DK12+000	1166720.35	476662.5785			



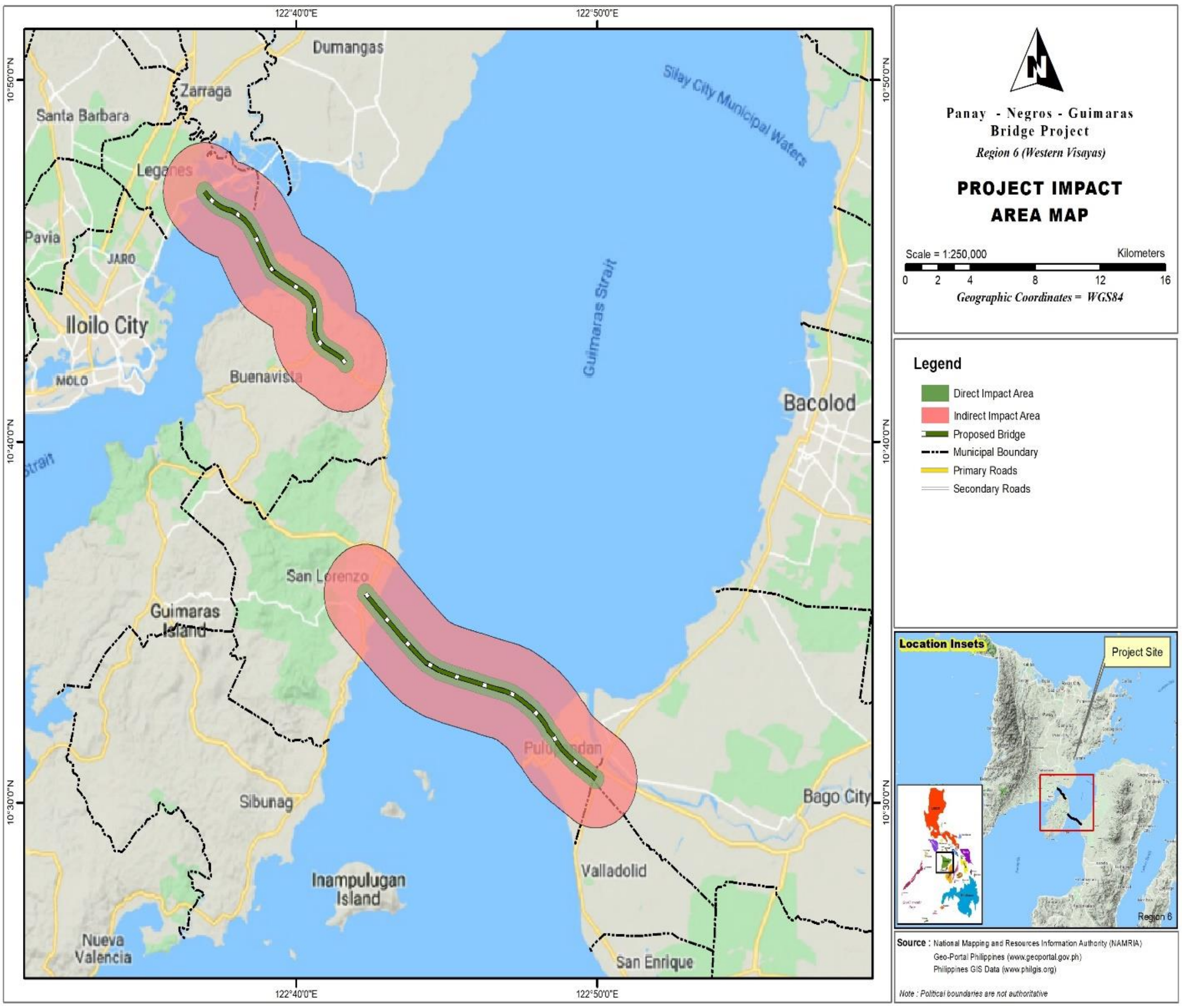
Source: Google Earth

Figure 2. Bridge Location and Route Scheme of PGN Bridge Project

1.1.2 Direct and Indirect Impact Area

As per DENR Administrative Order 2003-30 the direct impact of the project will be the areas of the whole alignment of the road and bridge, areas where road will be opened and developed, area where their structure will be constructed and the area where trees and structures will be cut and demolished. With the implementation of the proposed project, some aggregates of residential area, Informal settler's area, agricultural and industrial lands will be will be affected by the project. **Figure 3** presents the direct and indirect impact map of barangays that will be affected by the project.

All areas adjacent to the primary impacts will be the secondary impacts. These are the areas affected by the traffic jams during construction including delivery of equipment and materials; those who will be affected by noise, vibration, odor and dust brought about by the project implementation. This will also include the road network that will be used to transport material from and to the site.



Source: NAMRIA

Figure 3. Direct and Indirect Impact Map of the PGN Project

1.2 Project Rationale

The main goal of the project is to connect Panay Island, Guimaras Island and Negros Island to achieve an overland transport connection of the three islands, ensuring that pedestrians and vehicles can all-weather access the three islands, making the passage between the islands safer, faster and more convenient. Further promote the economic development of West Visayas (VI area). Also, to improve the construction of highway backbone network between among three islands to ensure effective movement of people, goods and services. Lastly, to promote the rapid development of local society and economy and achieve the goals of rapid development of this region and even Philippine government.

In view of current local socio-economic level and traffic conditions, and the project is required to be open and connected with local roads, therefore, the technology standards for first-class highway is more practical for this project.

1.2.1 Implementing the Project as Need of The Philippine National Strategy

The development of highway network within the Philippine system began in the late 1960s. The initial development focus was placed on expanding the transport network to provide basic transport access to main regions. Since the mid-1980s, the government's policy focus has been put on promoting infrastructure beyond Manila's urban areas.

In recent years, the Philippine Department of Transportation has identified a number of challenges, such as achieving a safe, reliable and economic access to and from the transport infrastructure of island regions and provinces; establishing backbone roads and bridges in the eastern region to achieve efficient transport; increasing the participation of private sectors in financially viable transport; improving infrastructure maintenance and monitoring, especially infrastructure standards for roads and bridges. To achieve the following objectives, the government will:

1) provide more convenient and effective traffic and easier accesses to domestic and foreign markets to alleviate poverty in rural areas, isolated islands and island areas;
2) establish more transport infrastructure to promote the growth of major regional economies and encourage public and private participation;
3) promote population reduction in Manila's urban areas, ensure effective economic linkages, and promote job opportunity, especially in island areas, provinces and their urban centers through transport and logistics systems;
4) strengthen peace and order in conflict-affected areas through effective transport and trade;
5) enhance national unity, family ties and tourism by achieving faster, safer and cheaper mobility of people, products and services.

The National Economic Development Agency of the Philippines (NEDA) published the *Draft of the Philippine Development Plan 2017-2022*, echoing the Philippines government's initiative to take large-scale actions in infrastructure construction. With regard to infrastructure construction, the report further points out that "infrastructure is a key driver of inclusive and sustainable socio-economic development. With the growth of the Philippine economy, the demand for infrastructure investment has become more important in view of the country's growing population and urbanization, as well as the huge gap in the supply of infrastructure services." To support this view, the Secretary of Finance, Carlos Dominguez, said, "Building infrastructure has the highest multiplier effect on the economy." It is also essential to transform the nature of economic growth so that economic growth is driven by investment rather than consumption."

In order to achieve the development goals of the country, the Philippine government proposed a National Islands-Link Projects Planning to connect Luzon Island, Visayas Island and Mindanao Island through bridges. DPWH of the Philippines has proposed seven islands-link projects to connect Panay Island, Guimaras Island, Negros Island, Cebu Island, Bohol Island, Leyte Island, Surigao Island, and Samal Island.

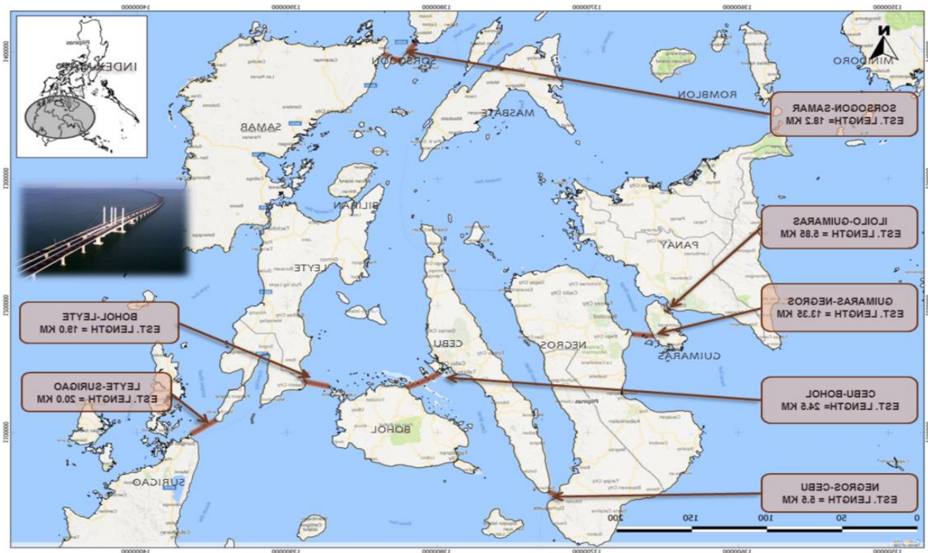


Figure 4. National Islands-Link Projects of the Philippines

Panay Island-Guimaras Island-Negros Island Bridges are part of the Islands-Link Projects in the Philippine National Development Plan. It is also the key project of the "Build, Build, Build Program" put forward by the Philippine government.

1.2.2 Implementing the Project as Need of Promoting The Integrated Development Strategy of The Three Islands

The economy of three islands to be connected by the Project has its own unique characteristics and mutual advantages. The tourism on Panay Island is limited to not only white sand beaches, primitive diving spots, waterfalls, summer resorts and cave structures, but also attractions and buildings that represent the history and culture of the region, such as centuries-old churches, watchtowers, commercial buildings, residential buildings and defensive fortifications and so on, which all attract visitors. In addition, Panay Island has relatively rich educational resources in various urban areas. There are many state universities and famous universities. Industrial companies and factories are also widely distributed. Therefore, many students and staff from other places are studying and working over here. As the main producer of sugar and pineapple, it has three sugar centers. With good market facilities, it can be used as an integration center for agricultural products, not only for household consumption, but also for bulk products traded to nearby urban, provincial or institutional customers.

Guimaras Island has relatively weak economic conditions and poor industrial, educational and medical levels. However, the mango planting and processing industry on island possess unique advantages. It is a national key protected and supported agricultural product in the Philippines. Its mango tastes delicious, and is widely welcomed. Related deep-processing products are sold at home and abroad in the Philippines, which is one of the symbols of geographical agricultural products in the Philippines. In addition, the island also has a lot of tourism resources for tourists to choose, and it is a good choice especially for those who like the beach or hiking, cycling and other related activities.

Negros Island is economically dominated by fisheries, aquaculture and small-scale mining. Bacolod City, known as the "Sugar Bowl" of the country as well the City of Smiles, is the most urbanized central city in Negros Occidental Province. On the annual Masskara Festival, art lovers will wear masks and gather to enjoy the city's unique cuisine and entertainment. San Carlos City Economic Zone, located in Negros Occidental Province, is currently considered as the renewable energy capital in the region, and its export processing zones and industrial parks are attracting new industries.

Because of the lack of necessary transport interconnection facilities, the development of each island is constrained at varying degrees. How to promote the integrated development of the three islands is a problem that Philippines has been constantly considering and studying from the central government to local authorities. After the completion of the PGN Island Bridges, the three islands will be integrated into one for coordinated development, which will give full play to their respective advantages, and form complementarities, and the imbalance of development among the three islands will be greatly improved. Driving from Panay Island to Negros Island will be shortened from the current 3-4 hour-shipping to about 1 hour. The Project will save time cost among the three islands, make it more conducive to more and more people to carry out business, tourism and other activities, and brings faster and more convenient personnel exchanges and material exchanges, making the three islands become the most dynamic economic zones in the central Philippines.

1.2.3 Implementing the Project as Need of Promoting the Rapid Development of Tourism and Agriculture.

The Philippines has Luzon Island in the north and Mindanao Island in the south. Manila, the capital of the Philippines, is located in Luzon Island. Its economy has been developing rapidly. The large influx of population into the capital has caused a large number of problems. The Philippine government has always hoped to accelerate the development of other areas, and rationally relieve the population of the capital. The Mindanao Island in the South has also developed rapidly in recent years. Especially since President Duterte took office, Davao City has been strongly supported by central policies and funds, and the economy has entered a fast lane. The development of Central Visayas is a top priority for the Philippine government, and a powerful measure for the Philippine government to enhance economic growth.

Western Visayas, known as the super region of the central Philippines because of its unique natural wonders, is one of areas in the Philippines with the largest tourism growth. Western Visayas has white beaches, rich coastal and marine biodiversity, and vast forests, diverse ecosystems, diverse cultures and historical landmarks. Panay Island, Guimaras Island, Negros Island, Cebu Island and Bohol Island constitute a golden triangle of tourism in the central Philippines as shown in **Figure 5**, which has accounted for more than 50% of the national tourism revenue for many years.

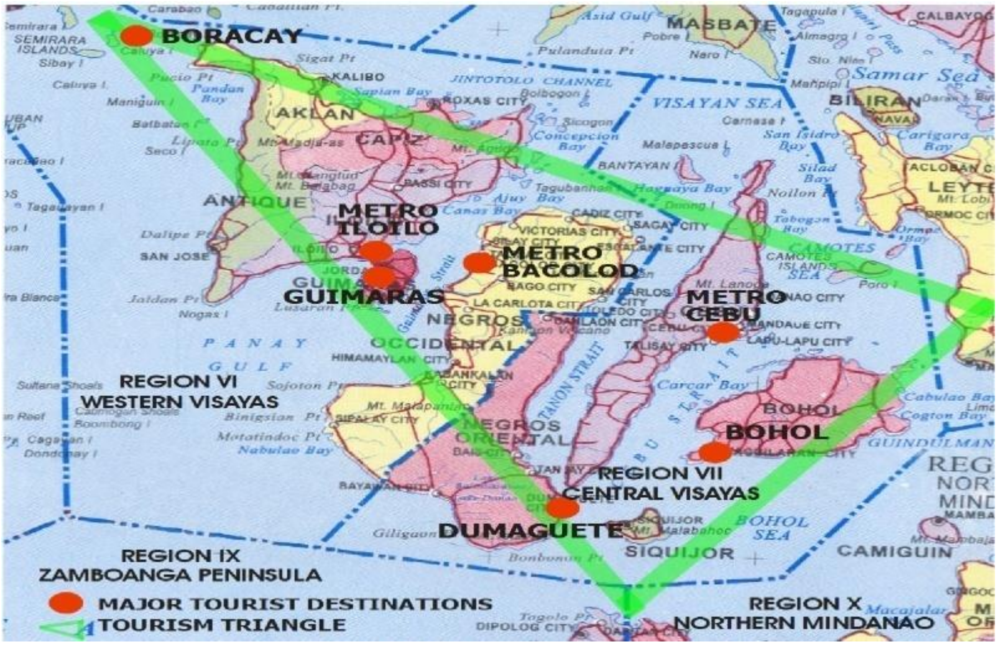


Figure 5. Golden Triangle of Tourism in the Central Philippines

A combination of natural, historical and man-made scenic spots stimulates people's interest, and makes Western Visayas the most popular tourist destination. Boracay, located in Aklan Province, is known for its beautiful white sand beaches, crystal blue waters, world-class accommodations and vibrant nightlife. Boracay is synonymous with Philippine tourism in the minds of tourists among more than 7,000 islands in the Philippines. Poetic and picturesque Cebu Island has become the most popular tourist attraction. The tourism industry here is quite mature. It has the whitest beach in the world, perfect entertainment facilities and first-class hotels. With an increasing number of tourists and strong demand every year, it is urgent to improve the infrastructure.

In 2018, the Gross regional domestic product (GRDP) of Western Visayas was about 13.967 billion US dollars, ranking seventh in all regions of the country, with a growth rate of 6.1%. The GDP per capita was about 1,740 US dollars, only accounting for 56% of the national GDP per capita. The GDP per capita of the project-affected areas falls far below the average level of the Philippines, and there is much room for economic development. In 2018, the tertiary production structure of Western Visayas was 20.2:24.5:55.3, and the growth rate of agriculture, forestry and fishery declined significantly from the previous year, only -1.4%. In 2017, the total tourism revenue of Western Visayas was about 2.428 billion US dollars, and the contribution rate of tourism to GNP was 17.4%. The total number of tourists reached 7.015 million, of which Asian tourists accounted for more than 70%. The implementation of this Project will greatly improve the tourism quality for tourists, attract more tourists to come for leisure and vacation, and promote the economic growth of the region.

The implementation of the Project will serve not only Western Visayas (Region VI), but also Negros Island and Central Visayas (Region VII), and create favorable conditions for connecting Cebu Island in the future, which will accelerate the attraction of investment in industry, manufacturing, agriculture, aquatic products and tourism within and outside the region, promote the rapid development of region and industry, and improve people's living standards in the region. Therefore, the implementation of the Project will further enhance the economic development of the region, and create economic growth points for Visayas in the central Philippines, thus promoting the rapid economic development of the Philippines. It is of great significance.

1.2.4 Implementing the Project as Need of Improving The Regional Highway Backbone Network and Ensuring All-weather Traffic

In recent years, the urbanization of the project-affected area has developed rapidly, and the traffic volume has surged. However, the existing road infrastructure in the region is relatively backward. At the same time, the rich tourism resources in the region have attracted more and more tourists, and the traffic demand is also increasing. As tourism resources spread across the islands in the region, tourists need to transfer to a car first, then to a ferry, and to the car in the last, to reach a destination. Especially due to the fact that ferries operate in a low efficient manner, travel time often needs to increase by 2-3 hours for just crossing the sea. In case of bad weather, the safety on the sea cannot be guaranteed, and ferries often stop operating. Even if the ferry is operating normally, passengers have to wait for the next day's shift due to a fixed number of shifts once shifts are full on the day. As a result, passengers have to wait for longer time, which seriously affects the trip plan of passengers.

Comprehensive factors have caused an urgent need for the interconnection and communication among the islands in the region, for guiding traffic and meeting the growing transport demand. Therefore, the implementation of the Project will improve the transportation infrastructure in the region, elevate the highway backbone network, and meet the need for efficient transportation of personnel, goods and services. Meanwhile, as a livelihood project and a moral project, the implementation of the Project will also realize the dream of several generations of Region VI.

1.2.5 Implementing the Project as Need of Ensuring Traffic Safety among the Islands

Philippine is an island country with transportation and communication among the islands relying on aviation and shipping. Due to high aviation transportation costs, shipping of lower cost has become the main transportation for goods and people among the islands. While obviously, ship navigating through the straits is vulnerable to weather and sea state so that it is hard to ensure traffic safety. Philippine is located where typhoon passes over frequently. Typhoon from the Pacific Ocean often brings great negative effects on the production, living and traffic of local people. Severe weather and sea state will impose safety risks on shipping through various straits.

On August 3, 2019, a major safety accident of two ferries colliding and sinking happened in Iloilo strait where the Project located, causing 31 death. One officer of the Philippine Coast Guard in charge of local rescue said that the gale or the wind blast worsened the weather which then caused the major accident that ferries lost control and collided. Meanwhile, the local coastguard explained that during the typhoon season every year, wrecking of ferries and other ships would occur frequently in Iloilo Strait and Guimaras Strait which caused relatively serious safety risks to local people's traffic. See **Figure 6**.

Figure 6. Ferry Wrecking in Iloilo Strait on August 2019

In order to ensure the traffic safety of local people and minimize the loss of people's life and property, it is in urgent need of building a bridge across over Iloilo Strait and Guimaras Strait to guarantee the safety of people and goods transportation among the islands. Therefore, the Project is of great need of ensuring traffic safety among the islands.

1.3 Project Alternatives

1.3.1 Procedure of Bridge Sites and Alignments Study

Through socio-economic investigation and traffic study, based on local road network conditions and planning as well as monographic study on the geology, marine hydrology, navigation and other construction conditions, extensive and in-depth studies are carried out on the engineering schemes including alignment, bridge site, navigational spans crossing waterways, non-navigational spans and access roads, etc. The preferred bridge sites and alignment corridor are proposed after optimizing and comparing different schemes of bridge sites and alignments.

1.3.2 Development Strategy of the PGN Island Bridges

The development strategy and orientation of the PGN island bridges project are as follows:

1) to create an all-weather, fast transport corridor connecting Panay Island, Guimaras Island and Negros Island to ensure the rapid flow of people, goods and services.
2) The Project shall provide necessary infrastructure for long-term planning of Iloilo City, Pulupandan City and Bacolod City, greatly improving the overall service level of tourism in Region VI and helping sustainable and healthy development of economy in Region VI.
3) The PGN island bridges shall be connected to important road networks in the region, and interchanges shall be set at the start point and end point to facilitate the smooth flow of main traffic.
4) The mileage from Panay Island to Negros Island shall be the shortest.
5) Entrance and exit shall be set up in important intersections where the bridges are connected with important roads to facilitate rapid entry and exit of vehicles and to alleviate traffic in the region.

1.3.3 Basic Principle of Bridge Sites and Alignments Study

1) The bridge site and alignment proposal shall comply with the overall development of the Philippines and the development planning of Region VI, and shall be fully coordinated with urban development and coastline development and utilization.
2) The alignment shall conform to the overall road network planning of Regional VI, and be organically connected with the local road network to meet the local government's demands for project construction.
3) Full consideration shall be given to the characteristics of navigation channels and waterways, and coastal sections with good natural conditions shall be selected.
4) The bridge site shall be located in an area where the sea is as narrow as possible to reduce total cost.
5) The feasibility and economic rationality of implementing engineering technical proposals shall be reasonable.
6) The alignment shall mainly consider reducing the quantities of demolition and relocation, and minimizing demolition of buildings on both sides of roads.
7) Coordination with adjacent environment.

1.3.4 Terrain Characteristics

The southern coast of Iloilo Island for the bridge site of Section A is relatively flat with the terrain of alluvial plain. The ground elevation is less than 2.0m, and there are many private fishing farms on the seashore. Guimaras Island on the southeast side is undulating with the terrain of hills, alluvial plains and piedmont plains. The ground elevation generally ranges between 0 and 90m. The bridge site is located where the strait has deep water, up to -39m.

Between the start point of Section B on Guimaras Island and the end point on Negros Island, the terrain is low as it is beach and shallow-sea accumulation plains. The bridge site is located where the strait has deep water, up to 26m in maximum. Generally, the terrain is gently inclined from the two coasts to the center of the strait, and in some parts, there are deep grooves formed by scouring.

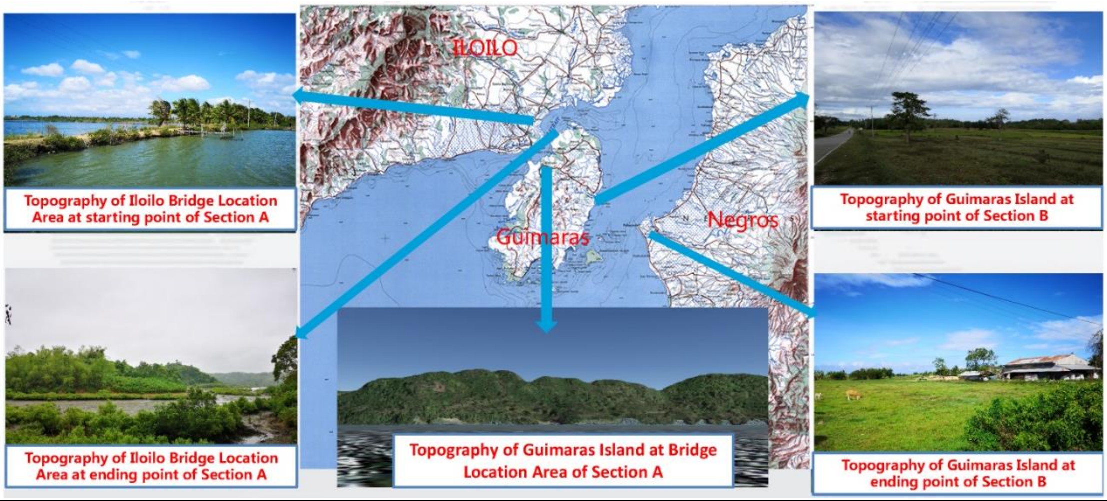


Figure 7. Topographic Feature at the Bridge Site

1.3.5 Possible Spaces (Corridors) for the Bridges

1.3.5.1 Preliminary Planning by the Philippine Side

During the interregional seminar held in Cebu in 1991, three Regional Development Committees (RDCs) and NEDA Regional Offices of Western, Central and Eastern Visayas Regions proposed a joint development program across the Visayas, including the Panay -Guimaras -Negros Islands

Bridge across the Iloilo Strait and the Guimaras Strait.

In 1999, JICA-DPWH joint study proposed a project to link Panay Island, Guimaras Island, Negros Island, Cebu Island and Bohol Island. The study emphasized strong economic link and regional commerce in history along the Visayas traffic axis, which shows effective transportation links would integrate island economies, facilitating faster and cheaper cargo and personnel movements. The study proposed two island-linking projects: the Panay -Guimaras-Negros Islands Bridges, and the

Central Visayas-Cebu-Bohol Bridges.

Based on the above ideas, DPWH Feasibility Study Project Management Office (PMO-FS) compiled a concept document for the PGN Bridges in August 2005 and conducted project evaluation. The document proposed detailed feasibility study from 2007 to 2011 including a preliminary timetable. In August 2006, the Western Visayas Regional Development Committee (RDC Region VI) passed a resolution approving the feasibility study on the PGN Bridges. Subsequently, DPWH prepared a preliminary feasibility study report from 2007 to 2008, and updated the project implementation plan in 2010.

According to data in the Updated Implementation Program of the Panay (Metro Iloilo)-Guimaras-Negros (Metro Bacolod) Island Bridges (PGN) Project (DPWH, April 2010), after study and evaluation on 16 bridge sites, DPWH focused on the proposal of two bridge sites for the Panay-Guimaras bridge and the Guimaras-Negros bridge respectively, and also studied a proposal for a sea-crossing bridge directly connecting Panay Island and Negros Island on the north side of the strait, as shown in **Figure 8**.

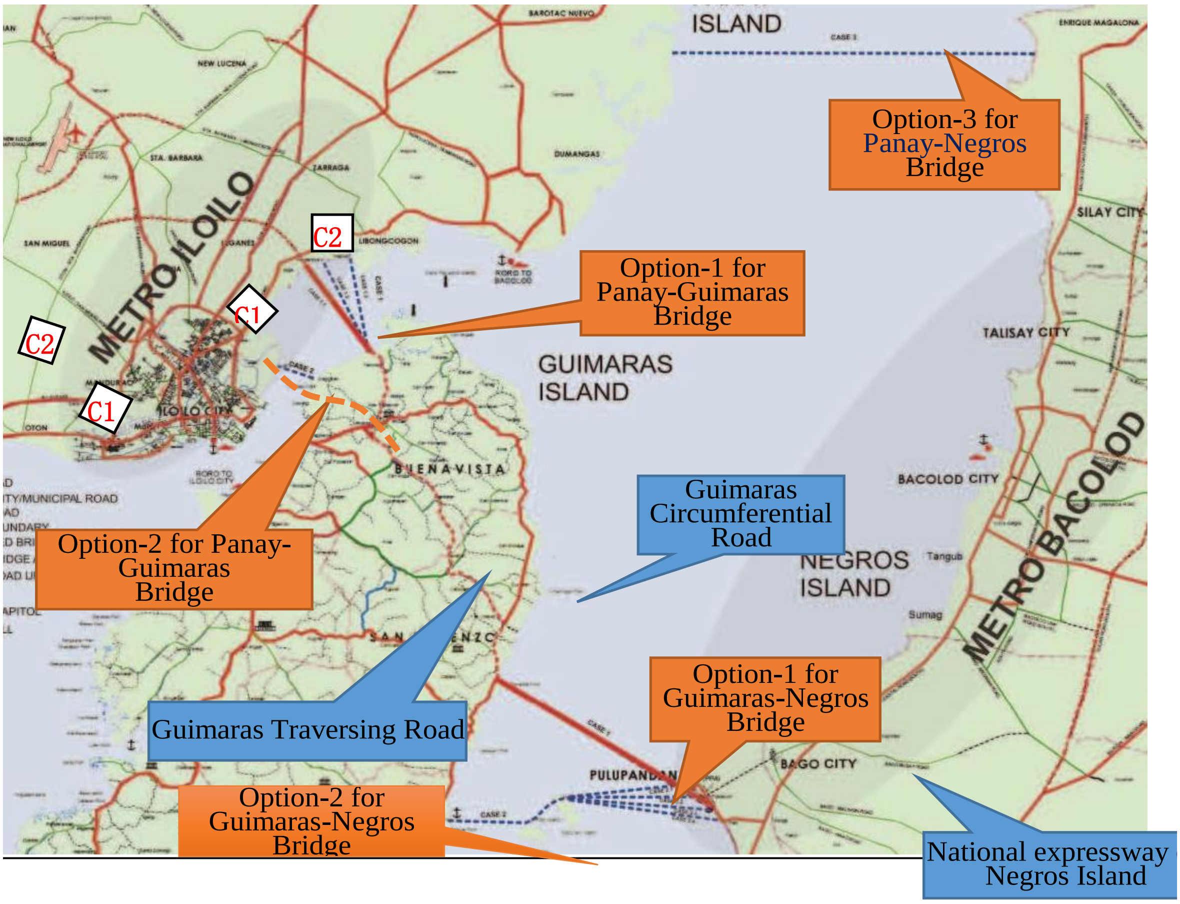


Figure 8. Proposals for Bridge Sites Planned and Studies in the Early Stage

Option 1 for the bridge site of the Panay-Guimaras Bridge: the bridge site is connected to Iloilo Urban Circumferential Line C2 on the side of Panay Island, across the Iloilo Strait, connected to the Guimaras Circumferential Road near Buenavista Town in Guimaras Province via a linking line.

Option 2 for the bridge site of the Panay-Guimaras Bridge: The bridge site is connected to Iloilo Urban Circumferential Line C1 on the north side of the Iloilo International Port on the side of Panay Island, across the Iloilo Strait, and connected to the Guimaras Circumferential Road near Buenavista Town in Guimaras Province via a linking line.

Option 1 for the bridge site of Guimaras-Negros Bridge: The bridge site is connected to the Guimaras Circumferential Road on the eastern side of Cabano Tone in San Lorenzo City on the side of Guimaras Island, across over the Guimaras Strait. The bridge lands near the north side of the port in the west of Pulupandan Town in Negros Province, connected to the Negros Circumferential Road at the end point.

Option 2 for the bridge site of Guimaras-Negros Bridge: The bridge site is connected to the Guimaras Circumferential Road near Sibunag on the side of Guimaras Island, across the Guimaras Strait. The bridge lands near the south side of the port in the west of Pulupandan Town in Negros Province, connected to the Negros Circumferential Road at the end point.

Option 3 for the bridge site of Panay-Negros Bridge: The bridge directly connects Panay Island and Negros Island across the sea on the north side of the Straits without connecting Guimaras Island. After a series of comparisons and selections on various alternatives including project scales, design options, implementation schemes, and cost estimations, in the report Option-1 for the bridge location of Panay-Guimaras Bridge and Option-1 for the bridge site of the Guimaras-Negros Bridge are recommended as preferred proposals.

1.3.5.2 Corridors for PGN Islands Bridge Proposed at This Stage

Based on the previous studies by the Philippine government, in this report the current situation, planning and detailed basic data in the project area are further studied. At the same time, combined with demands and suggestions from various departments of the Philippine, after site investigation and survey and considering various controlling factors, the corridors for Panay-Guimaras Bridge (Section A) and Panay-Negros Bridge (Section B) are proposed.

1.3.5.2.1 Corridor belt for bridge sites in Section A

The corridor belt for bridge in section A has three options, which are, from north to south, the North Corridor, the Central Corridor and the South Corridor, as shown in **Figure 9** below.

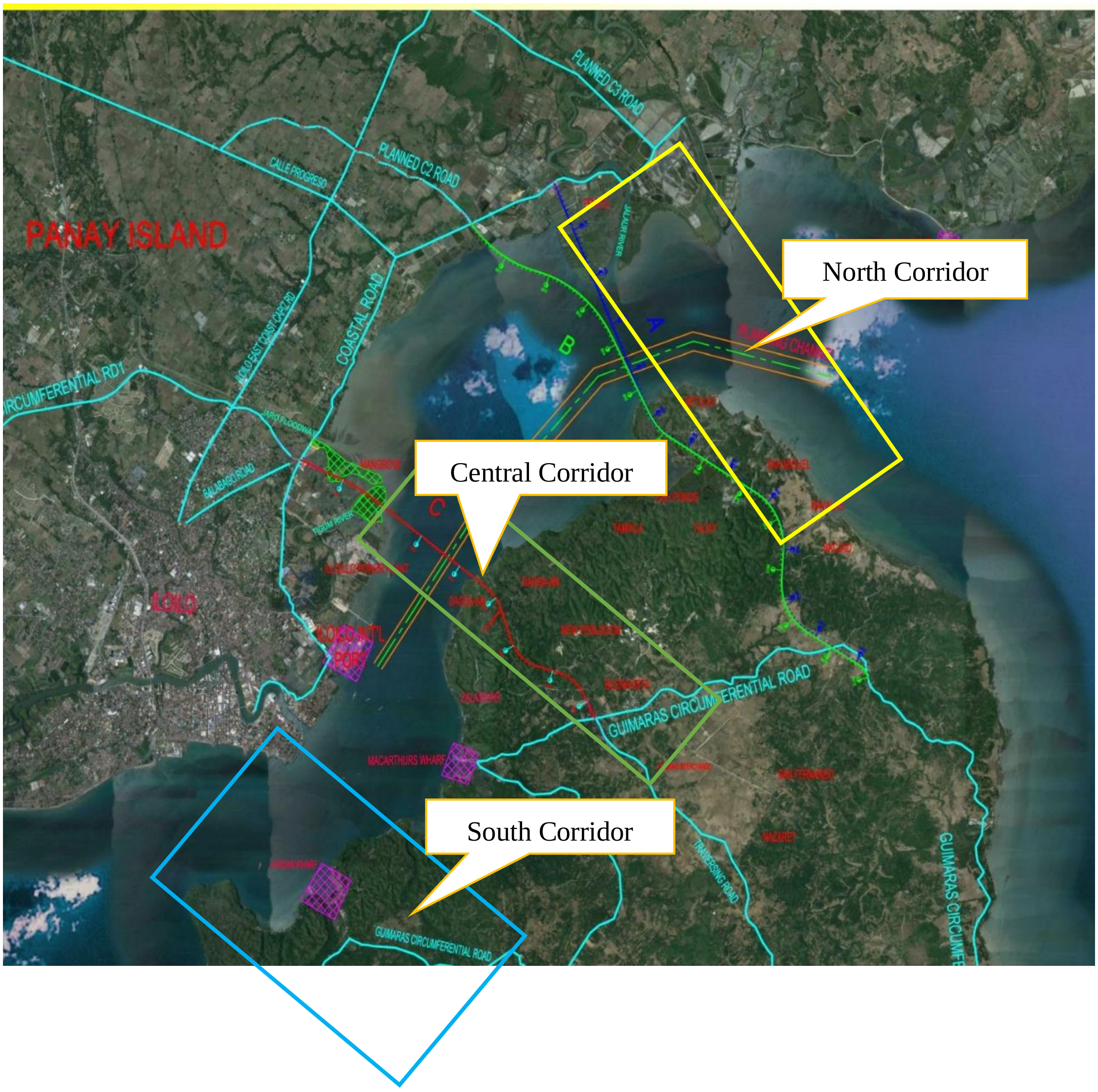


Figure 9. Corridors for bridge sites in section A

The start point of the north corridor is to connect the planed C2 ring road in Iloilo city, or the coastal road between C2 and C3 ring road. After crossing the Iloilo strait, the bridge lands in the north of Guimaras and is connected to the circumferential road in the northern part of the island. The strait of this corridor is relatively shallow, with relatively narrow surface. The terrain on the side of the Guimaras Island is less rolling, making the scale of the project relatively small; and the traffic flow is smooth as the bridge can have good connection with arterial roads of the road network on both sides. At the same time, the navigation channel is stable, and the corridor is far away from ports and terminals with less impact on existing port terminals and navigation channels. And therefore this corridor is desirous.

The central corridor is to connect C1 Ring Road in Iloilo City. After crossing the strait, the bridge lands in the northwest of Guimaras Island, connecting to the ring road and traversing road in this island. The strait of this corridor has relatively narrow surface, but the sea is relatively deep, and the terrain of Guimaras Island is undulating, making the scale of the project relatively larger. The bridge is connected with the arterial roads on both islands and the traffic flow is smooth. However, as the starting point is located in the urban area of Iloilo, this alignment converts the traffic to downtown Iloilo, causing traffic jam due to big traffic pressure in the city. With Iloilo power plant and international port in this central corridor, this alignment could affect future development of the international port. This corridor for the bridge site is feasible.

The starting point of the south corridor is to connect downtown area of Iloilo. After crossing the strait, the bridge lands in the west of Guimaras Island and connects the ring road in the island. The strait of this corridor has relatively narrow surface, but the sea is very deep with the maximum depth of 70m, making the project very difficult and project cost high. In this corridor there are many ports and ferry terminals, complicated ship and ferry routes, and anchorage of Iloilo international port, all making this corridor unsuitable for bridge construction (See **Figure 10**). Therefore, this corridor will not be studied in the future.

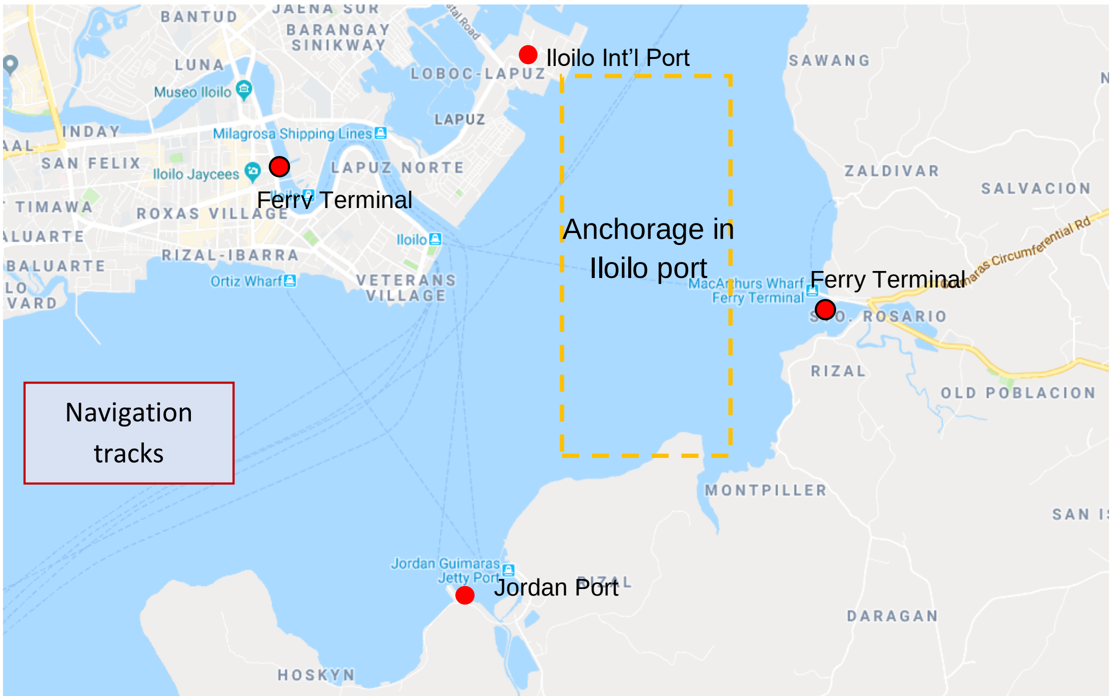


Figure 10. Ports, terminals and anchorage in south corridor

In summary, the follow-up studies will focus on the comparison and analysis for the north corridor and central corridor for bridge sites in section A.

1.3.5.2.2 Corridor for bridge sites in section B

The bridge sites in section B has two main corridor options: the North Corridor and the South Corridor, as shown in Figure 9.5-4 below.

The North Corridor starts near the town of Cabano, San Lorenzo in Guimaras Island and connects the ring road or the traversing road in Guimaras island. After crossing the Guimaras Strait, the bridge lands near the northern side of the Pulupandan port in Negros Island, and connects Negros National Highway in the end point. The strait of this corridor has relatively narrow surface, and is relatively shallow with average depth of about 10~20m. The terrain on both sides is relatively gentle with good geological conditions, making the scale of the project relatively small. The bridge is well connected with arterial roads on both islands and therefore the traffic flow is smooth. At the same time, the navigation channel is stable. The bridge corridor is far away from ports and terminals with less impact on existing ports, terminals and navigation channels. The north corridor is an ideal one.

The south corridor starts near Sibunag town in GUIMARAS Island and is connected with ring road in the island. After crossing Nalunga Island and Nadulao Island in the strait, the bridge lands to the south of the Pulupandan port in Negros Island and connects Negros National Highway in the end point. The strait of south corridor is relatively shallow with average depth of 10~20m. The terrain on both sides is relatively gentle, but the surface of the strait is relatively wide, making the scale of the project relatively large. The bridge is well connected with arterial roads on both islands and therefore the traffic flow is smooth. But this alignment is the longest one, with the longest detour when traversing the islands. In this corridor the navigation channel is stable, and the bridge is far away from ports and terminals with less impact on existing terminals and navigation channels. But as there are two navigation channels in this strait, the bridge needs to have two navigation spans, making this option less economical.

In summary, in follow-up stage focus will be on the comparison and study of the North Corridor and the South Corridor for bridge sites in section B.

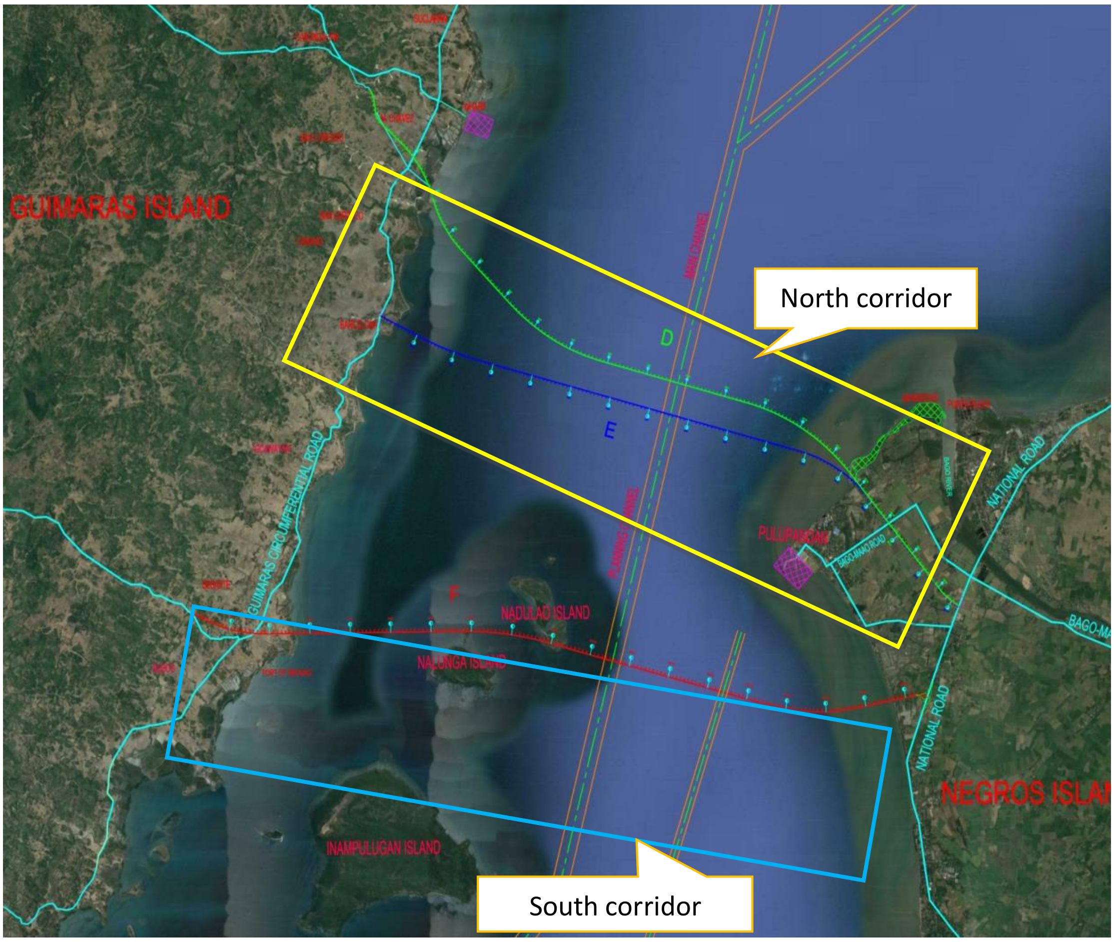


Figure 11. Corridor for bridge site in section B

1.3.5.3 Main Control Factors

For the above-mentioned North Corridor and Middle Corridor of the bridge in section A, and the North Corridor and South Corridor of the bridge in section B, the main control factors are as follows.

1.3.5.3.1 Influence of navigation channels on bridge sites

Currently, there are navigation channels in Iloilo Strait and Guimaras Strait for the passing of vessels. Therefore, the bridge direction shall be as perpendicular as possible to the channel to ensure navigation safety. At the same time, the channels on the north side of the Iloilo Strait are slightly curved as shown in **Figure 12**. Therefore, the bridge shall be kept as far as possible away from the corner of the channel to provide vessels with good sight distance to ensure safety.

Figure 12. Relationship between the Bridge Site and Navigation Channels in the Iloilo Strait

The bridge site of Section B in Guimaras Strait shall also be as perpendicular to navigation channel as possible. At the same time, the bridge sites are near Pulupandan Port and vessels need to enter and exit. Because the north side of the Pulupandan Port is relatively shallow sea, large vessels need to reverse to the middle navigation channel to pass through the strait after arriving at the Pulupandan Port. As a consequence, if the bridge sites are on the north of the Pulupandan Port, one navigation span shall be set up. If the bridge sites are on the south of the Pulupandan Port, two navigation spans shall be set up. Therefore, in order to save project costs and ensure the safety of vessels and bridges, the bridge sites shall be located as far as possible to the north of the Pulupandan Port. It is better to set up one navigation span for the PGN island bridges.

Figure 13. Relationship between the Bridge Site and Navigation Channel in the Guimaras Strait

1.3.5.3.2 Unfavorable geology

According to collected data on unfavorable geology and site survey, Section A of the Project in Guimaras Island has unfavorable geological conditions, primarily including soft soil, collapse, crag and karst. Especially on the western coast of the northern part of Guimaras Island, there is the possibility of high-risk landslides. Therefore, the landing position of Section A of the Project on Guimaras Island shall avoid areas with high-risk unfavorable geological condition.

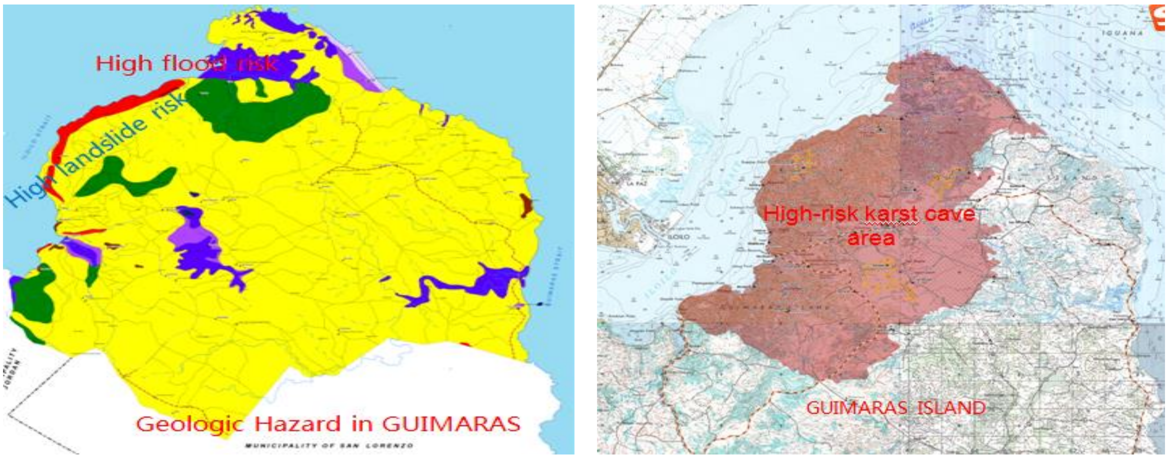


Figure 14. Distribution of Unfavorable Geology

1.3.5.3.3 Port, terminal and power plant

The Philippines is an archipelago and shipping plays a very important role in logistics and transportation between islands. In Panay Island, Guimaras Island and Negros Island, there are many ports, some of which have long-term development plans.

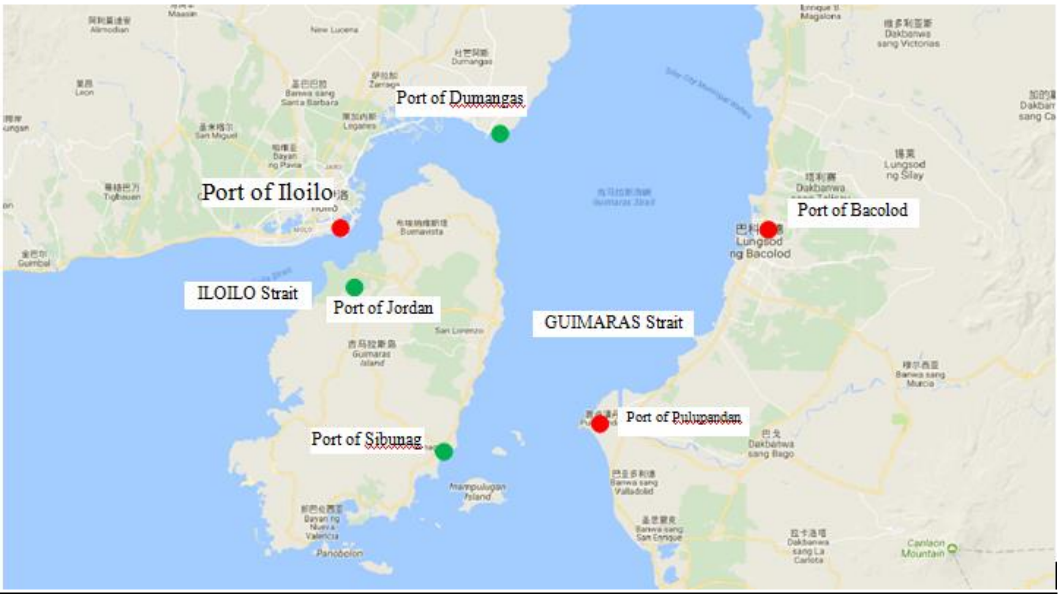


Figure 15. Distribution of Ports in Project Area

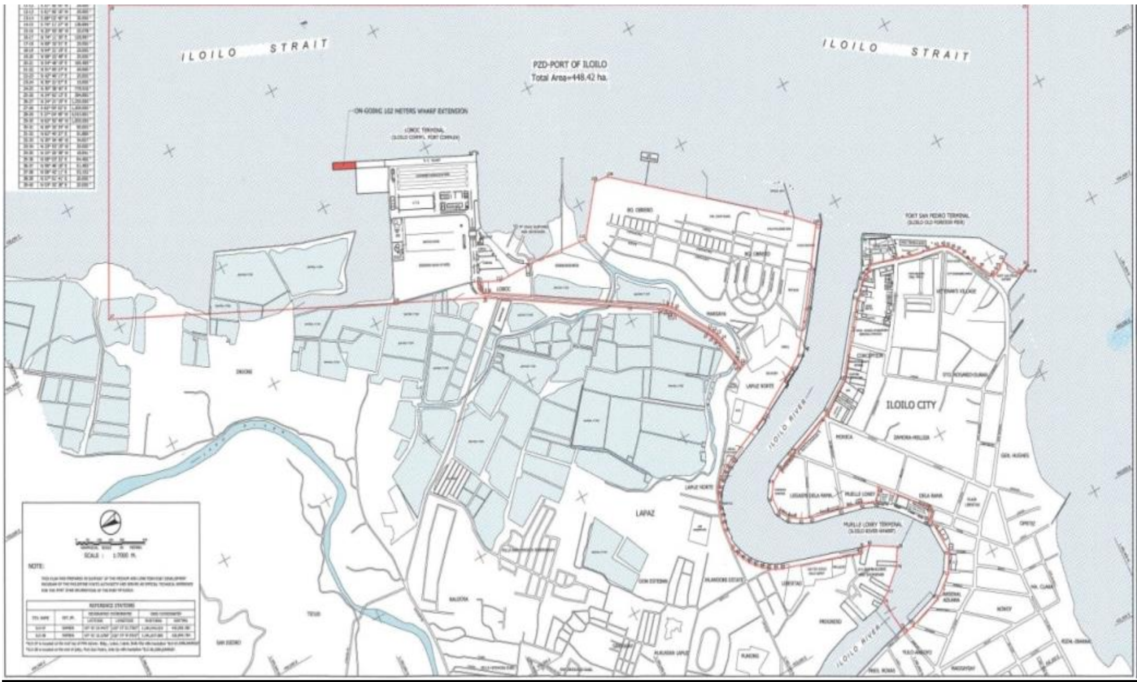


Figure 16. Planning of Iloilo Port

In addition, there is a power plant and power plant terminal in Ingore District on the eastern coast of Iloilo in Panay Island.

Figure 17. Power Plant (2km away from the north of Iloilo Port Terminal)

According to Article 6.1.3 in *Navigation Standard of Waterways for Seagoing Vessel of Chin*a (JTS 180-3-2018), the safety distance between buildings and structures across a channel and the operation area of a coastal port shall be no less than twice the total length of representative vessels. Therefore, the distance between the bridge site and the planning area of Iloilo International Port (the distance in alignment C is about 1,200m), and distance from the existing terminal of the power plant (the distance in alignment C is about 930m) must meet the requirements of Chinese specifications on a safety distance between bridge structures and the operation area of a port.

1.3.5.3.4 Mangroves

Mangroves are important plants for coastline protection. It is good for wind protection, wave elimination, siltation, beach protection, bank consolidation, dyke protection, and the purification of seawater and air. Therefore, the alignment of the bridge site shall be kept away as much as possible from mangroves.

Figure 18. Status of Mangroves (The left shows mangroves near Alignment B of Section A, and the right shows mangroves near Alignment C of Section A.)

(1) The landing point of Alignment B in Section A in Panay Island has avoided mangroves nearby.

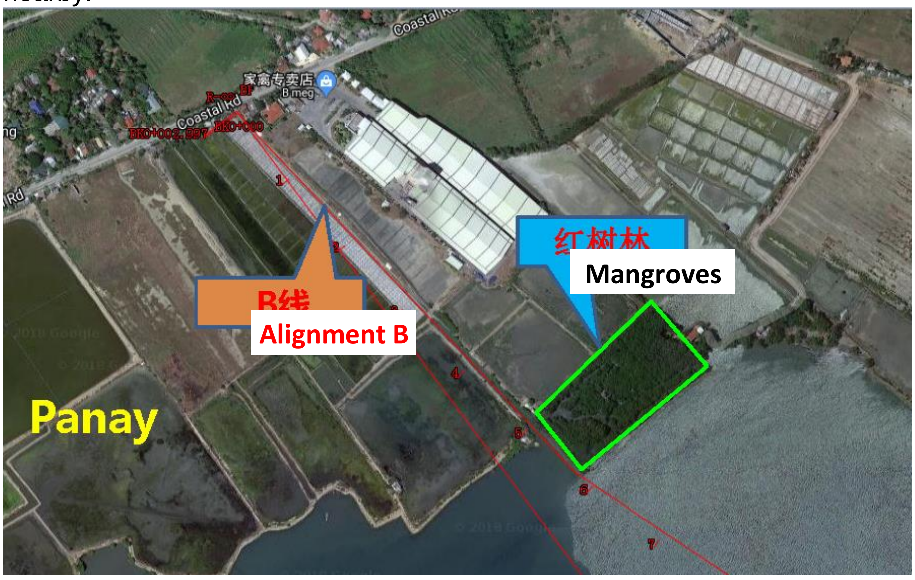


Figure 19. Alignment B in Section A and Location of Mangroves

(2) Alignment C in Section A traverses near the entrance of Tigum River on the junction between Iloilo ring road C1 and the Coastal Road. There are mangroves with an area of approximately 0.7 km^2 across the alignment, which is unavoidable due to limited conditions.

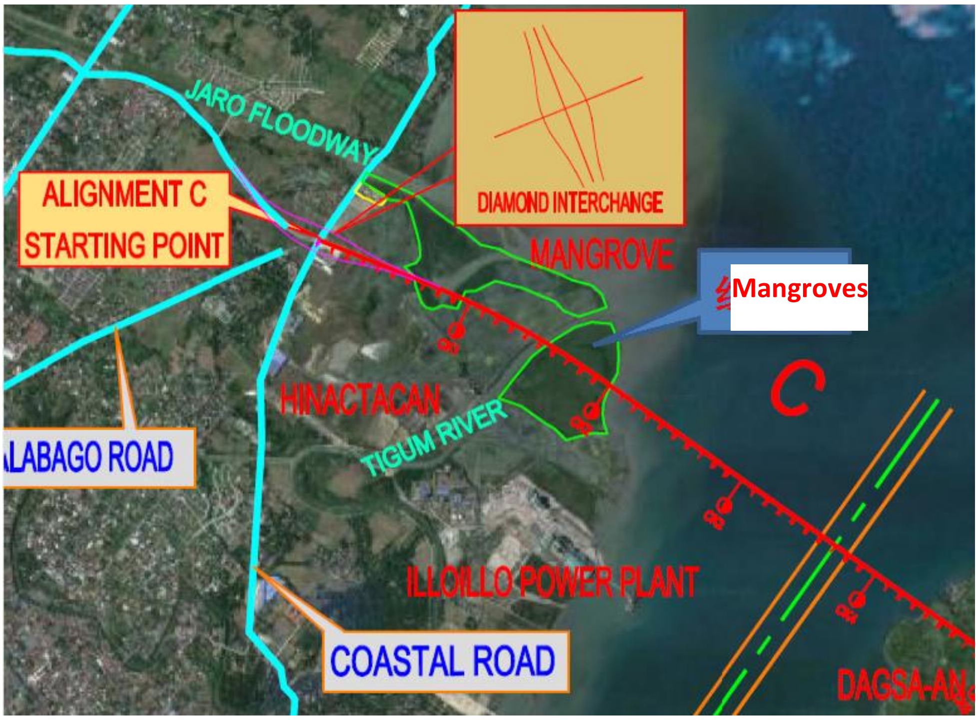


Figure 20. Alignment C of Section A and Location of Mangroves

(3) Alignment D (Alignment E) in Section B passes by a long and narrow area of mangroves at the entrance of the Bago River in the northern part of Pulupandan City. In this case, the mangroves covering an area of about 0.5 km^2 should be avoided by the alignment.

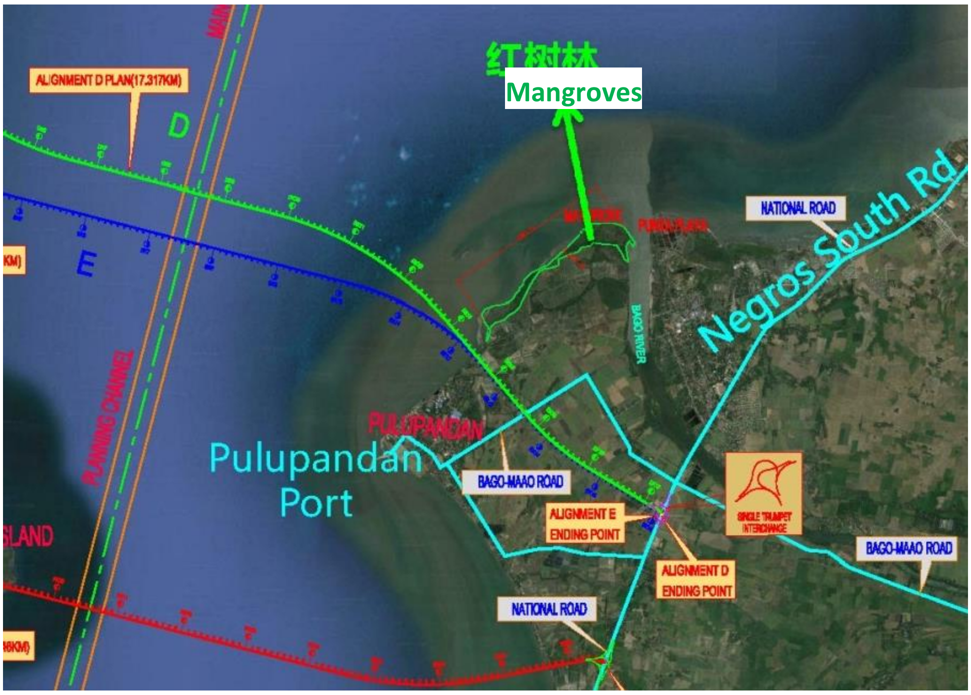


Figure 21. Alignment D/ Alignment E and Location of Mangroves

1.3.5.3.5 Wind power facilities

In the coastal area of San Lorenzo in the east of Guimaras Island, wind farms exist and are close to the alignment of the Project. Therefore, its impact should be considered when deciding the direction of the alignments. According to on-site conditions and communications with the wind farm, the start point in Alignment D shall avoid the location of wind towers as much as possible to reduce the impact on the wind farm.

Figure 22. Wind Farms in the Eastern Coastal Areas of Guimaras Island

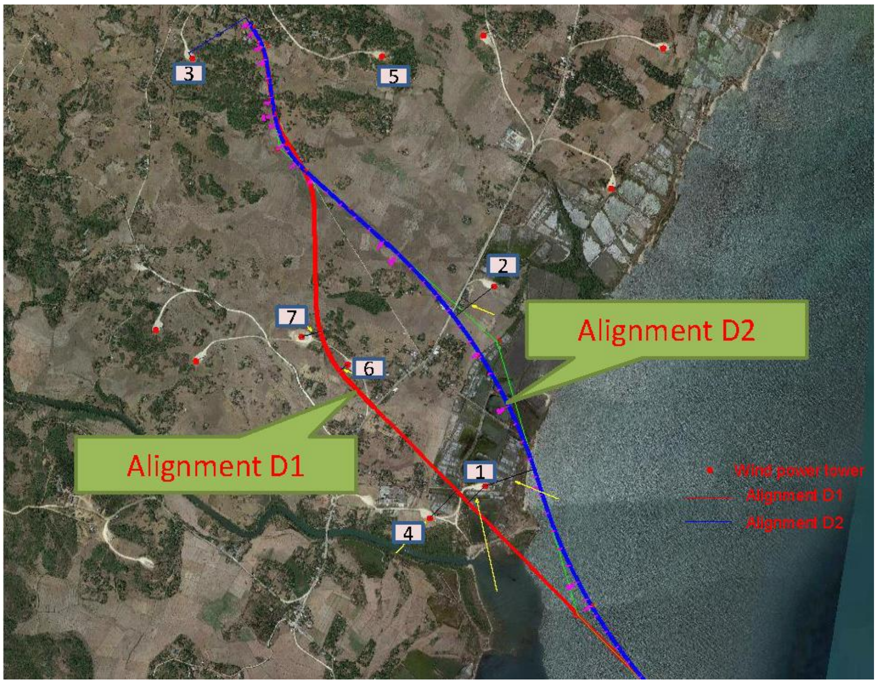


Figure 23. Wind Towers to be Avoided by the Alignment at the Start Point in Alignment D (The alignment is changed from D1 to D2, and the numbers in boxes are wind towers.)

1.3.5.3.6 General topography and culture

Within the corridor belt of the Project, buildings or annexes that have impact on the alignment fall into the following categories:

(1) High voltage towers and transformers in two areas within the alignment corridor:

a. At the intersection of Iloilo Circumferential Line C1 and the Circumferential Road, high-voltage cables are mainly set along the Circumferential Road with a voltage power of 138,000 volts. The removal and relocation of high-voltage lines are difficult, which makes the implementation of Alignment C more difficult.

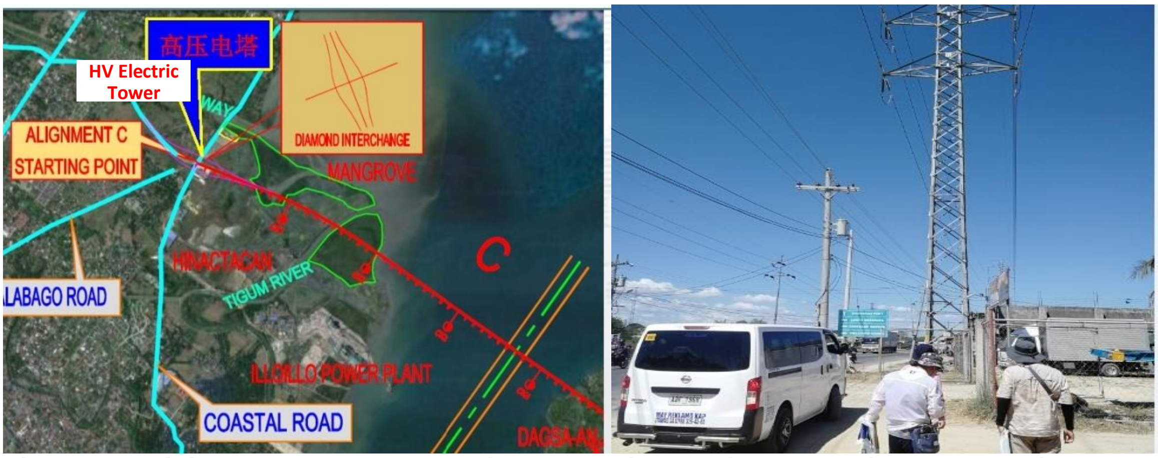


Figure 24. High-voltage Towers near the Start Point of Alignment C (138,000 volts)

b. Transformers are on the roadside of the Circumferential Road at Barcelona Town in the east of Guimaras Island.

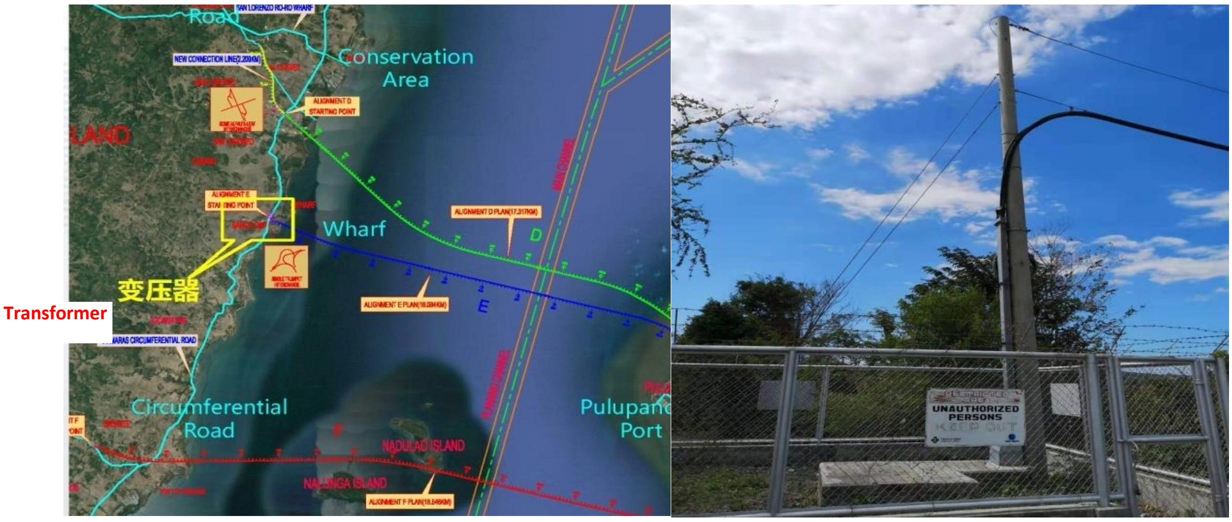


Figure 25. Transformer at the Start Point of Alignment E

c. Near the end point of Alignment C in Guimaras Island lies residential areas, churches and gas stations. And residents basically live along the two sides of the Circumferential Road. If the Project adopts Alignment C, there will be considerable difficulties in demolition.

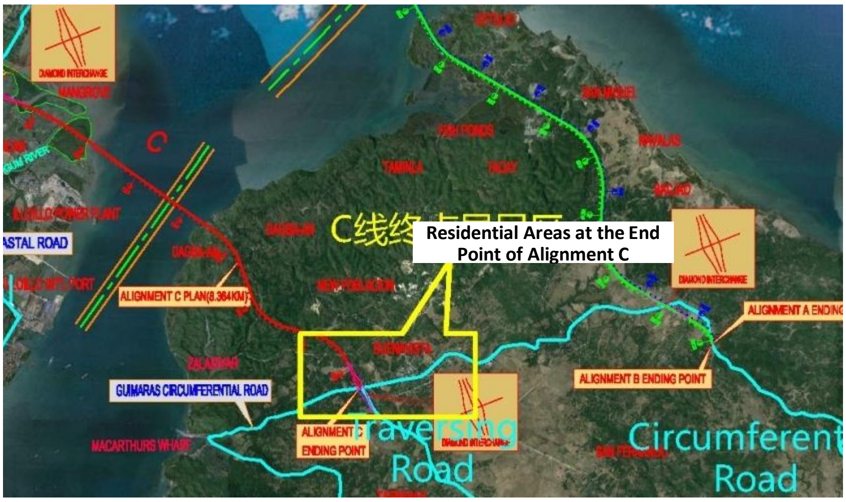


Figure 26. Residential Areas at the End Point of Alignment C

Figure 27. Church and Gas Station at the End Point of Alignment C

Figure 28. Residential Area and Warning Sign for Karst Caves near Alignment C

d. There are also salt fields near the starting point of Section A and Section B. These salt fields produce sea salt through solar distillation of extracted seawater. They are local small-scale economic industry. See **Figures 29** and **Figure 30**.

Figure 29. Salt Fields near the Alignment

Figure 30. Local Residents Making Salt

1.3.5.4 Proposals for Bridge Site

1.3.5.4.1 Demonstration of start point and end point

(1) Function analysis

At present, the three islands (Panay, Guimaras and Negros) are not interconnected by roads or bridges, which restrains freight trade between ports in the region and the shipment and export of industrial and agricultural products in the region, but also urban development in the project-affected area. There is an urgent need to build a new transport corridor to meet the growing demand for passenger and cargo transportation so as to achieve regional economic development goals.

According to Philippine Development Strategy for Island-linking Projects, the initial demand is to achieve the objective of all-weather traffic by linking Panay Island, Guimaras Island and Negros Island, and to further promote the economic development of Western Visayas (Region VI).

In accordance with this development strategy, after site inspection and study, the main function of the Project is to link the three islands for the connection of road networks on the three islands, to ensure all-weather passing of pedestrians and vehicles, making the traffic between the islands safer, more fast and more convenient, and promoting better development of local economy and society. Based on the principle of "connecting", the start and end points of alignments in the Project will connect the arterial roads on the islands for traffic distribution and island connection.

(2) Determination of start point and end point

According to the analysis in Chapter 4 about the regional road network in the project area, main roads on Panay Island include Urban Circumferential Lines C1, C2, C3, C4 and coastal roads. Circumferential Lines C3 and C4 are far away from the urban area, which is not conducive to urban development and direct connectivity between islands. Therefore, the main start points for linking lines on the side of Panay Island are Iloilo Circumferential Lines C1, C2 and coastal roads.
Main roads on Guimaras Island include Guimaras Circumferential Road and Guimaras Traversing Road. Both currently being upgraded; the two roads may be used as linking roads of the end point of Section A (Panay-Guimaras bridge) and the start point of Section B (Guimaras-Negros bridge) in the Project.

Main roads on Negros Island related to the Project consist of a national road, i.e., a Coast Circumferential Road and the main trunk road on Negros Island, which is an appropriate linking-up road on the side of Negros Island for the end point of the Project.
Based on above analysis and preliminary planning of bridge site by the Philippine side, considering important factors such as the bridge site, bridge size, terrain and ground objects, the start and end points of the Project are decided as follows:

Panay-Guimaras sea-crossing bridge (Section A)

Alignment A: the start point of the alignment is connected to Iloilo Coastal Road, lying between Circumferential Lines C2 and C3, about 2km away from the Circumferential Line C2; the end point is connected to the turning point of Guimaras Circumferential Road in the north of Buenavista Town.

Alignment B: the start point of the alignment is connected to the intersection of the planned Circumferential Line C2 and the Coastal Road; the end point (the same as that for Alignment A) is connected to the turning point of Guimaras Circumferential Road in the north of Buenavista Town.

Alignment C: the start point of the alignment lies at Iloilo International Port, Alagan, Iloilo City and on the northern side of the power plant, connecting with Iloilo Urban Circumferential Line C1; the end point is connected to the intersection of the Guimaras Traversing Road and the Circumferential Road.

Guimaras-Negros sea-crossing bridge (Section B)

Alignment D: the start point of the alignment lies on the eastern side of Cabano Town, San Lorenzo City, Guimaras province (an area of wind farm), connected to the Circumferential Road, and linking the Traversing Road via a connecting road; the end is connected to Negeros Circumferential National Road on the northern side of Pulupandan Port.

Alignment E: about 5km away from the Traversing Road, the start point of the alignment lies on the southern side of the Traversing Road, and connected to the Circumferential Road; the end point (the same as that for Alignment D) is connected to Negeros Circumferential National Expressway on the northern side of Pulupandan Port.

Alignment F: the start point of the alignment lies on the northeastern side of Sibunag Town, Guimaras Province; the end point is connected to Negros Circumferential Road on the southern side of Pulupandan Port, Negros Province.

1.3.5.4.2 Proposed bridge site and linking line schemes

Based on demands and suggestions from the Philippine side in the early stage, status and planning of local road network, demonstration of start points and end points of the alignment, and the results of monographic studies, fully considering controlling construction conditions in the project area, the proposed bridge site and linking lines are shown in **Figure 31**.

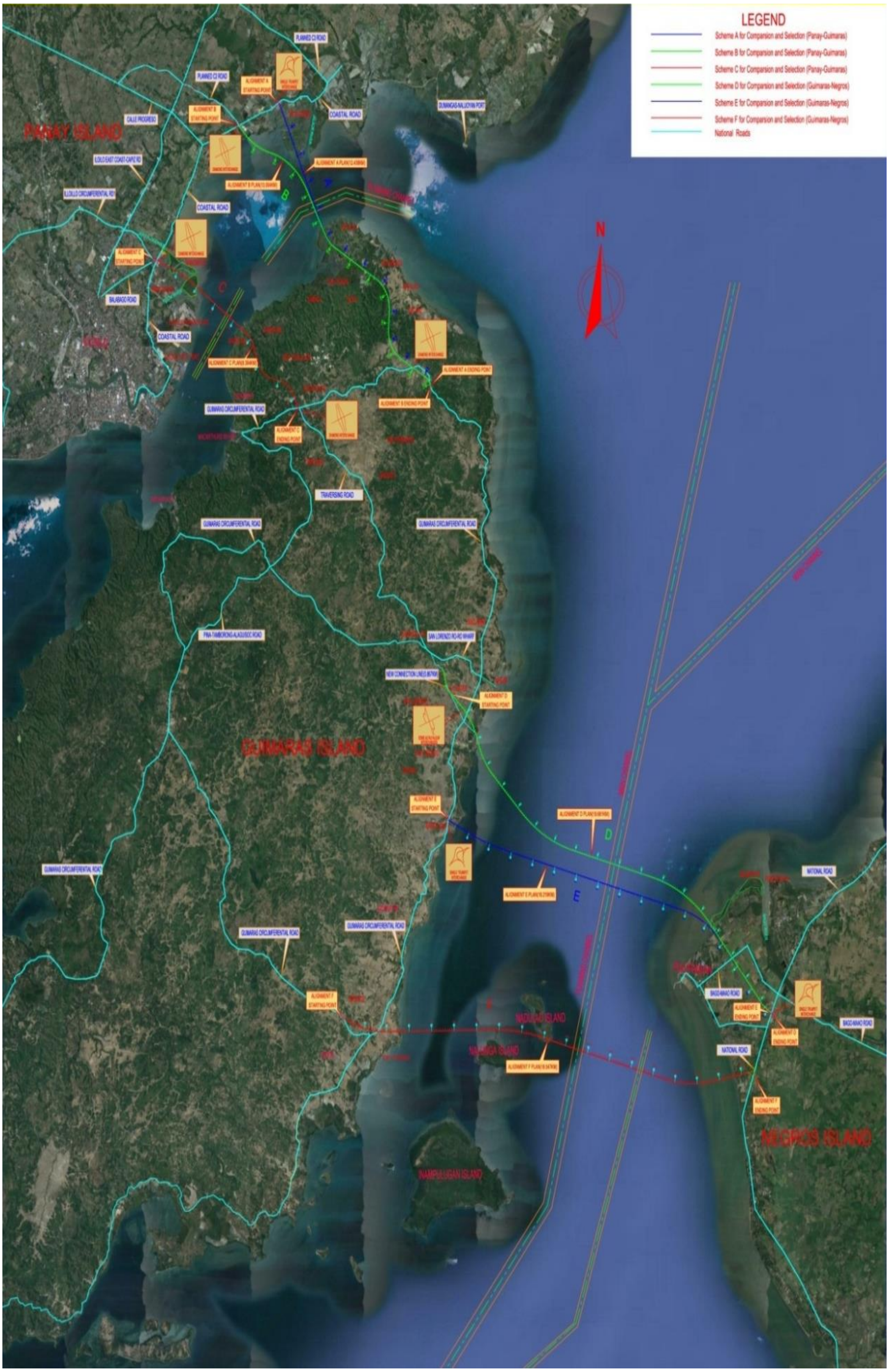


Figure 31. Bridge Sites and Alignment Proposals of the PGN Bridge Project

Panay-Guimaras sea-crossing bridge (Section A)

After comprehensively considering current status and planning of road network in the project area, and controlling factors such as power plants and port terminals, mangroves, waterways, topography, land acquisition and demolition, three possible bridge sites and alignments are proposed which are Alignment A, B and C-- for Panay-Guimaras section.

Alignment A: the start point of the alignment is connected to Iloilo coastal road, lying between Circumferential Lines C2 and C3, about 2km away from Circumferential Line C2. The start point will have a single-trumpet interchange to achieve traffic transfer. The alignment then passes through a large area of fish ponds, crossing over the Iloilo Strait. After landing in the north of Buenavista Town, Guimaras Province, the alignment then runs along the side of the mountain, connected to a turning point of the Guimaras Island Circumferential Road. A simple diamond interchange is planned at the Circumferential Road for traffic conversion. The total length of the alignment is approximately 12.438 km.

Alignment B: the start point of the alignment is connected to the intersection of the planned Circumferential Line C2 and the Coastal Road, where a diamond interchange is arranged for traffic conversion. Alignment B extends to the northeast and shares the same bridge site and alignment with Alignment A. The alignment after landing on Guimaras Island is basically the same as Alignment A. A diamond interchange is provided at the Circumferential Road for traffic conversion. The total length of the alignment is approximately 13.004km.

Alignment C: the start point of the alignment lies at Iloilo International Port, Alagan, Iloilo City and on the northern side of a power plant, connected to Iloilo Urban Circumferential Line C1, with a simple diamond interchange for traffic conversion. The alignment then crosses over the Iloilo Strait via a bridge in the southeast, landing near Dagsa-An in the western part of Buenavista Town, Guimaras Province. The end point is connected to the intersection of Guimaras Traversing Road and the Circumferential Road, where a simple diamond interchange is planned for traffic conversion. The total length of the alignment is approximately 8.364 km.

Each proposal for the PGN island bridge (Section A) is shown in **Figure 32**.

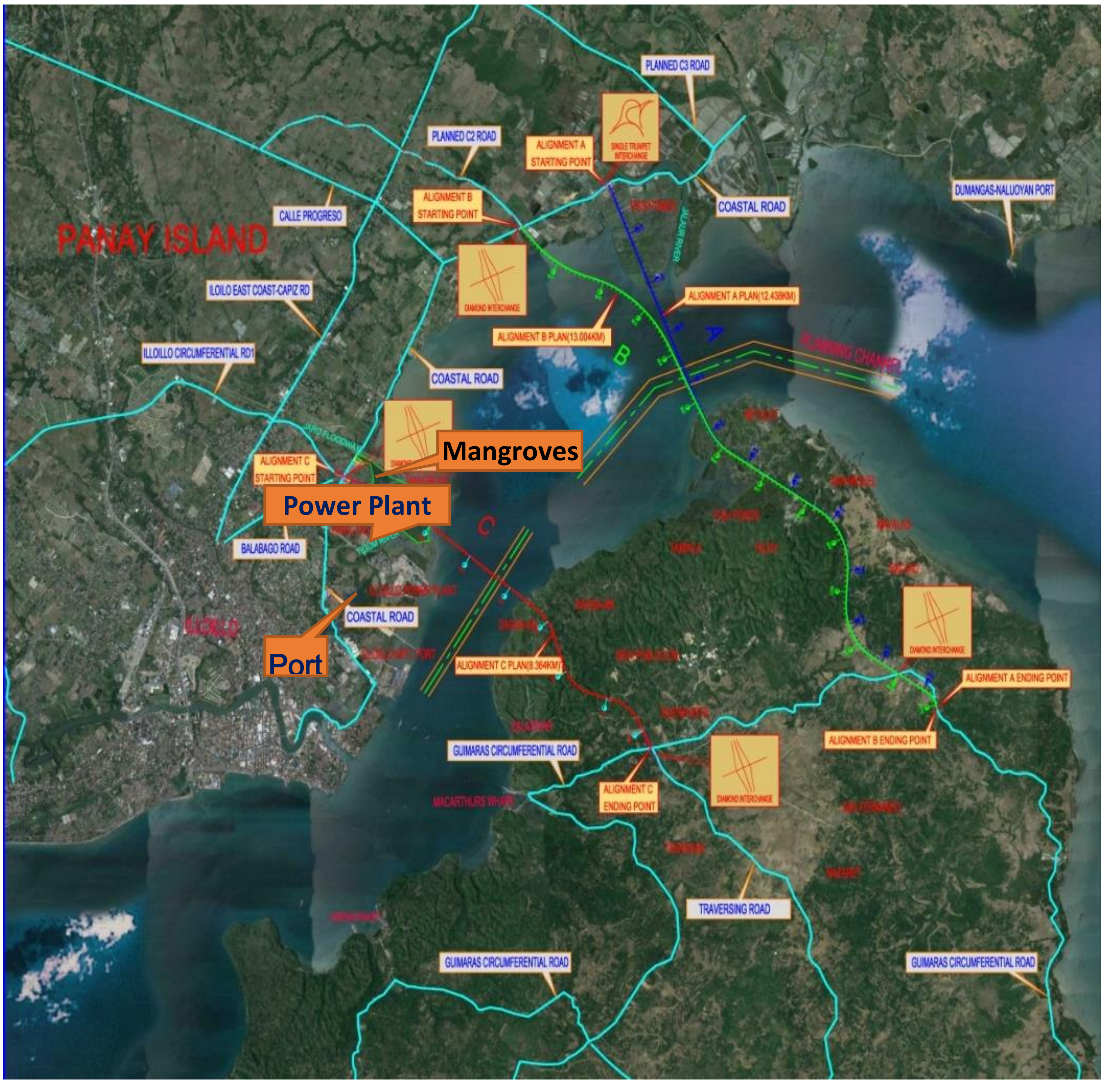


Figure 32. Bridge Sites and Alignments for Section A

Guimaras-Negros sea-crossing bridge (Section B)

After comprehensively considering current status and planning of road network in the project area, and controlling factors such as port terminals, mangroves, waterways, terrains, land acquisition and demolition, we would like to propose three possible bridge sites and alignments--Alignment D, E and F for the Guimaras-Negros section.

Alignment D: the start point of the alignment lies on the eastern side of Cabano Town (an area of wind farms), San Lorenzo City, Guimaras Province, connected to the Circumferential Road and the Traversing Road via a connecting road. A simple interchange is set up for traffic conversion at the intersection with the Circumferential Road. The alignment then extends southeastwards, crosses over the strait in a direction perpendicular to the main channel, lands on the northern side of Pulupandan Port, and eventually connected to Negeros Circumferential National Expressway. An interchange is planned for traffic conversion at the end point. The total length of the alignment is approximately 19.547 km (including linking lines).

Alignment E: about 5km away from the Traversing Road, the start point of the alignment is connected to the Circumferential Road on the southern side of the Traversing Road, where a single-trumpet interchange is provided for traffic conversion The alignment crosses over the strait in a direction perpendicular to the main channel, lands on the northern side of Pulupandan Port. After landing, the alignment is basically the same as Alignment D, finally connected to Negeros Circumferential Road. The total length of the alignment is approximately 16.219 km.

Alignment F: the start point of the alignment is connected to the Circumferential Road on the northeastern side of Sibunag Town, Guimaras Province, where an interchange will be built for traffic conversion. The alignment then crosses over a strait on the west side of Guimaras via a bridge in the east, running across the edge of Nalunga Island and Nadulao Island in the strait, crossing over a strait on the eastern side of Guimaras, and landing on the southern side of Pulupandan Port, Negros Province. The end point is connected to Negros Circumferential Road with an interchange for traffic conversion. The total length of the alignment is approximately 18.547 km.

The bridge sites and alignment proposals for the PGN island bridges (Section B) are shown in **Figure 33**.

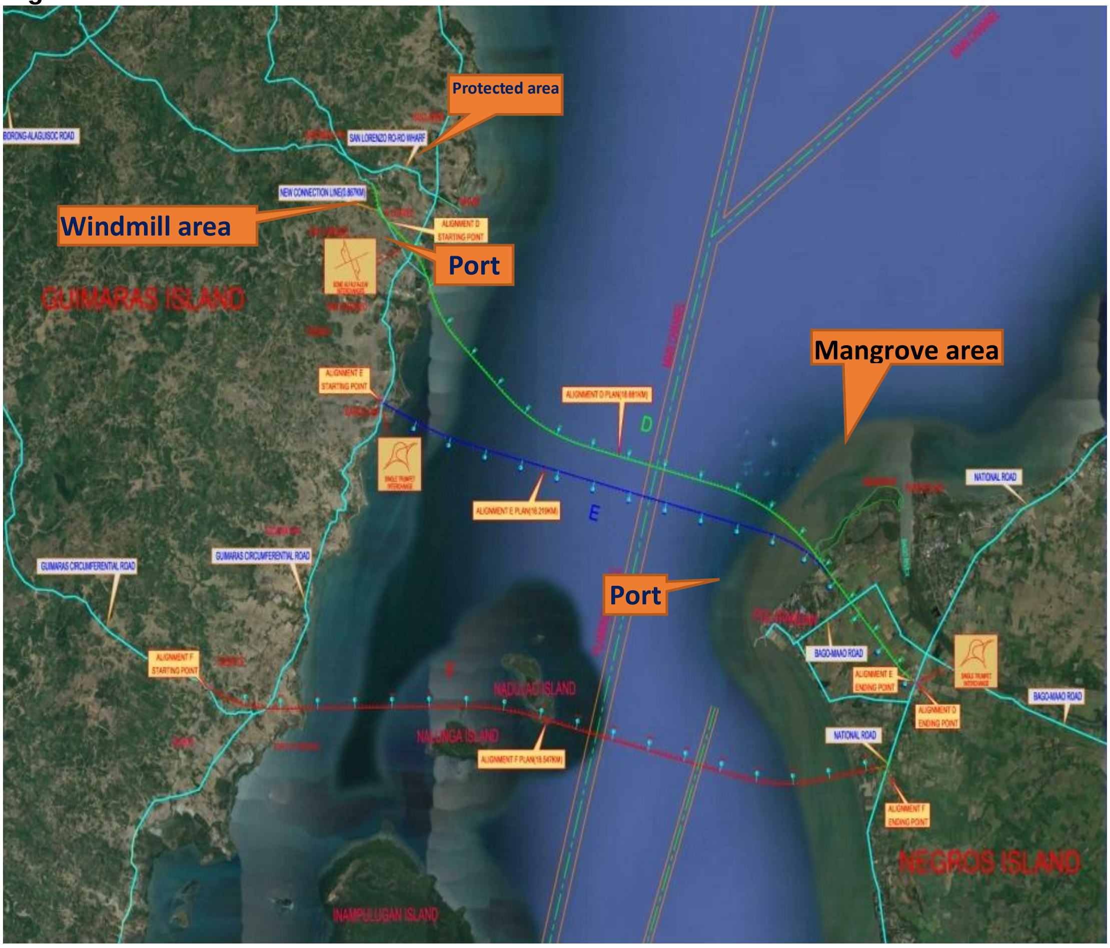


Figure 33. Bridge Sites and Alignments for Section B

1.3.6 Selection of Bridge Sites and Alignments

According to site inspection and the proposal for bridge sites, a comprehensive comparison of various proposals is made on the length of alignment and sea-crossing bridge, the connection between the bridge and the road network, the status of mangroves, main configurations of the sea-crossing bridge, and the difficulty of project implementation. The specific comparison result is shown in the table below.

1.3.6.1 Comparison of Bridge Site and Alignment Proposals of Section A

The comparison of Section-A bridge site and alignment proposals is shown in **Table 4**. Comparative Study of Alignment

(Requirements from DPWH, Including but not limited to these following contents)

Table 4. Comparison of the Panay-Guimaras Bridge of Section A

Comparison Items	Alignment A	Alignment B	Alignment C
Total Length	12.438km	13.004km	8.364km
Sea-Crossing Bridge Length	2.890km	4.970km	3.290km
Main Configuration of the sea-Crossing Bridge	11×30m+8×100m+(360+680+360) m+12×30m; Main bridge: double-tower cable-stayed bridge with composite beams; Approach span: box girders with a span of 100m in the deep-water area; prefabricated I beams with a span of 30m in the shallow water area.	58×30m+15×100m+(360+680+360) m+11×30m; Main bridge: double-tower cable-stayed bridge with composite beams; Approach span: box girders with a span of 100m in the deep-water area; prefabricated I beams with a span of 30m in the shallow water area.	39×30m+(530+1060+530) m; Main Bridge: double-tower cable-stayed bridge with steel box girders Approach span: prefabricated I beams with a span of 30m in the shallow water area.
Connection with the road network	Not directly connected to the planned Circumferential Road C2 or C3	Connected to the planned Circumferential Road C2	Connected to the Circumferential Road C1
Social Impact	Few houses and public buildings are affected. How many houses? 36 How many families? 36 How many buildings? 0 Area of Aquafarm?500,625m^2	Few houses and public building are affected. How many houses? 56 How many families? 55 How many buildings? 2 Area of Aquafarm? 64,670m^2	Few houses and public building are affected. Large area of Aquafarm is affected How many houses? 21 How many families? 22 How many buildings? 3 Area of Aquafarm? 559,732m^2
Environmental Impact	Few Mangroves are affected. How many Mangroves? 54,725 trees	Few Mangroves are affected. How many Mangroves? 38,361 trees	Amounts of Mangroves are affected. How many Mangroves? 404,036 trees
Advantages of Scheme	1) The shortest sea-crossing bridge length and relatively small project scale; 2) Less resettlement work; 3) Less difficulty in project implementation.	1) Direct connection with C2 Road in ILOILO, enabling smooth traffic flow. 2) Will not cause direct traffic pressure on the urban area.	1) Direct connection with C1 Road in ILOILO; 2) Close to the urban area, which can promote development

		3) Be good for future development of the city. 4) Less resettlement work; 5) Less difficulty in project implementation.	of IOLILO City in the near future and make easy for the citizens to take trips. 3) The route is relatively short.
Disadvantages of Scheme	1) No direct connection with planned C2 Road3, and no smooth traffic flow. 2) Far from Iloilo City. 3) A soft foundation area (fish pond) at the starting point on the side of Iloilo City.	1) Relatively larger project scale. 2) A litter far away from Iloilo City.	1) Large construction cost for sea-crossing bridge. 2) Bring traffic directly to Iloilo City and may easily cause congestion. 3) Passing through the mangrove conservation area. 4) A large amount of demolition. 5) PPA explicitly opposes the bridge site proposal; 6) Great difficulty in the subsequent implementation.
Indicative direct cost of construction	0.88	1.00	1.43
Comments	Alternative proposal	Recommended	Alternative proposal

1.3.6.2 Comparison of Bridge Site and Alignment Proposals of Section B

The comparison of Section-B bridge site and alignment proposals is shown in **Table 5**.

Table 5. Comparison of the Panay-Guimaras Bridge of Section B

Comparison Items	Alignment D	Alignment E	Alignment F
Total length of alignment	19.47km (including connecting lines)	16.219km	18.547km
Sea-Crossing Bridge Length	13.110km	12.270km	15.1km
Main Configuration of the sea-Crossing Bridge	20×30m+66×100m+(360+680+360) m+34×100m+37×30m Main bridge: double-tower cable-stayed bridge with composite beams; Approach span: box girders with a span of 100m in the deep-water area; prefabricated I beams with a span of 30m employed in the shallow water area.	9×30m+62×100m+(360+680+360) m+32×100m+40×30m Main bridge: double-tower cable-stayed bridge with composite beams; Approach span: box girders with a span of 100m in the deep-water area; prefabricated I beams with a span of 30m in the shallow water area.	——

Connection with the road network	The alignment is connected to Guimaras Traversing Road and the Circumferential Road with a smooth traffic flow and the shortest mileage across islands.	The alignment is not directly connected to Guimaras Traversing Road with a longer island-linking mileage	The alignment is connected to the Circumferential Road at the southeastern end of Guimaras Island with the farthest distance from the Traversing Road and the longest islands-linking mileage
Social Impact	Few houses and buildings affected How many houses? 200 How many families? 176 How many buildings? 38	Few houses and buildings affected How many houses?149 How many families? 149 How many buildings? 14	Few houses and buildings affected.
Environmental Impact	Few Mangroves are affected. How many Mangroves? Few	Few Mangroves are affected. How many Mangroves? Few	Few Mangroves are affected.
Advantages of Scheme	1) Connects directly to Guimaras traversing road and Circumferential Road with a smooth traffic flow. 2) Island-link mileage is the shortest from Panay Island to Negros Island. 3) Less difficulty in implementation.	1) A litter Lower construction cost for sea-crossing bridge. 2) Less difficulty in implementation.	It utilizes shallow water area near small islands in the strait.
Disadvantages of Scheme	Longer route and larger project scale compared to Scheme E	1) Not connected Guimaras Traversing Road directly, Alignment is about 5km away from Traversing Road. 2) Island-link mileage is longer from Panay Island to Negros Island.	1) Not connected to Guimaras Traversing Road, about 14km away from the Traversing Road; 2) Islands-link mileage is the longest from Panay island to Negros island. 3)The longest of bridge and the largest project scale and the highest cost; 4) More difficult in implementation.
Indicative direct cost of construction	_1.00_	_0.93_	
Comments	Recommended	Alternative proposal	No further study to be conducted

1.3.7 Recommended Bridge Sites and Alignments of the Project

After comprehensive comparison, adequate communications and discussions with DPWH and relevant local governments, environmental authorities, port authorities and other stakeholders in the project area, it is finally decided that Alignment B for the Panay Island-Guimaras Island Bridge, and Alignment D for the Guimaras Island-Negros Island Bridge are recommended.

1.3.8 Consequences of not proceeding with the project or no project option

The “No Project” option takes the following into account.
- “The PGN island bridge project” will not be built under this project.

A comparative summary of the advantages and disadvantages of the proposed alternative is given below.

Table 6. Comparative Summary of "No Project" alternative

Advantages	Disadvantages
• The money earmarked for bridge development could perhaps be diverted to more immediate social needs such as waste management, upgrading hospital or social housing. • Adverse environmental impacts related to bridge development can be avoided • Traffic diversion problems around the project area can be avoided during the construction phase • Public dissatisfaction among concerned stakeholders that currently own the structures, houses, land and trees along the proposed bridge areas can be avoided • Potential accidents associated with the bridge can be avoided. • Avoid further national debt for the project.	• Loss of opportunity to boost economic activities in Panay Island, Guimaras Island, and Negros Island through a physical link. • Loss of opportunity to provide a more reliable and convenient mode of transport for people living in Guimaras. • Increase the transit time and cost of passengers and motor vehicles between the three islands. • Loss of new direct employment opportunities related to the bridge project and subsequent indirect employment opportunities associated with the mobility provided from the bridge. • Loss of direct and indirect economic benefits associated with the bridge development project

In summary, the presence of a bridge will be a welcome boost to the economic activities and mobility among Panay Island, Guimaras Island, and Negros Island. Its economic and social benefits are expected to be extremely positive in the long run. However, the bridge between Guimaras Island and Negros Island may not be considered an immediate necessity at this stage of development in the Philippines, given the numerous more urgent investments required in the social and economic sector. Thus, on economic and social grounds, the no project option of the bridge between Guimaras Island and Negros Island is viable in the short-term.

1.4 Project Components

Table 7. List of Main Quantities for Project

Project Name	Unit	Recommended Route Scheme for Section A (Line B)	Recommended Route Scheme for Section B (Line D)	Remarks
Design speed	km/h	80	80	

Project Name		Unit	Recommended Route Scheme for Section A (Line B)	Recommended Route Scheme for Section B (Line D)	Remarks
Route mileage		km	13.004	Mainline 18.680, connecting line 0.867	
Number of lanes		Pcs.	Two-way four-lane	Two-way four-lane	
Subgrade fill		1000 m^3	98.679	27.141	
Subgrade excavation		1000 m^3	431.215	1.735	
Pavement (asphalt concrete)		1000 m^2	101.2	43.5	
Quantities of subgrade drainage and protective masonry		1000 m^3	16.287	5.852	
Bridge	Super major bridge	m/Pc.	4970/1 seat	13110/1 seat	Containing interchange mainline bridge
	Major bridge	m/Pc.	Block 1672.5/5	1340/2 Seat	
	Medium bridge	m/Pc.	97.5/1 seat	-	
	Small bridge	m/Pc.	-	-	
Culvert		Pc.	20	10	
Interchange		Pc.	2	2	
Grade crossing		Pc.	17	11	
Passageway		Pc.	6	1	
Overpass		Pc.	1	0	

Manpower

During its peak of construction, the proposed project will utilize about 1100 workers at a given time of construction. About 400 of them are skilled workers and about 700 are unskilled workers. The DPWH will include in the agreement with the contractors a provision of priority in hiring qualified local resident from host and neighboring LGUs. The contractors will coordinate with the concerned LGU offices in the dissemination of job openings for the PGN Bridge project. The information will be allowed for general circulation when no qualified local residents are hired within an agreed period of time between the contractors and the LGUs.

Support Facilities

Drainage Systems

The proposed project will be provided with efficient drainage system for surface and subsurface water including slope groundwater and seepage. It will provide an all-weather road drainage system of adequate cross-drain, drain collection system, sufficient countermeasures for flooding of road and major drainage structures, surface water infiltration and drainage outfalls. The drainage system comprises of a network of pipe culverts, roadside ditches, and internal drainage systems for the road pavement structures. The design of PGN Bridge Project

Project Name	Unit	Recommended Route Scheme for Section A (Line B)	Recommended Route Scheme for Section B (Line D)	Remarks
considerably prepares for the extreme conditions on rainfall and other meteorological/weather (PAGASA) criteria.				
Traffic Safety Device According to the specific requirements of traffic safety facilities, and taking into account the road characteristics and local geographical conditions, climate and environment, as well as rational use of highway construction funds and other factors, the design for safety facilities in this section includes traffic signs, traffic markings, guard fence, etc.				
Surveillance system With the whole section of the Project taken as the surveillance focus of the road, a complete surveillance system shall be provided to achieve video surveillance, traffic parameter collection, meteorological monitoring, accident alarm collection, traffic information release and speed control in some sections for timely traffic dispersion to ensure smooth traffic flow along the entire route.				
Lighting Systems The proposed project will be provided with highway safety and bridge lightings. Road lighting not only constitutes an essential part of road illumination and beautification, but also serves the road. Therefore, road lighting shall be first considered to ensure the safety of road operation, providing drivers with safe driving conditions. Street lamps for road lighting in the Project shall be provided by considering both the short-term and long-term road lighting requirements. Bridge lighting includes internal lighting for the box girder and internal lighting for the main body.				
Communication Conduit 12-hole Φ40/33 silicon core tubes shall be installed in the communication conduits in the Project and in the road under the interchange as well. Communication conduits in the approach span section in the shallow water area shall be installed in the steel tube box outside the bridge. The box shall be installed on the steel brackets fixed to the concrete guard fence of the bridge with expansion bolts. Communication conduits in the approach span section in the deep-water area shall be installed in the steel bridge frame in the box girder while the latter shall be installed on the section steel brackets fixed to the concrete box girder with expansion bolts. Communication conduits in the navigable span shall be installed in the steel bridge frame while the latter in the steel box girder shall be fixed to the tube hole in the diaphragm.				
Sources of Construction Materials, Storage/Staging, Power and Water All construction materials will be sourced from legitimate existing rock crushers, hot mix, and concrete batching plants located within the immediate vicinity that have valid environmental clearances and permits from DENR. Stockyard or material staging areas will be strategically located near the locations of interchanges due to its proximity to access road and relatively wide area. Power and water sources will come from the grid of local power supplier and local water utilities, respectively.				

The project is divided into Section A and Section B. The recommended scheme route for Section A (Panay-Guimaras cross-sea bridge) is 13.004 km in total length, therein, the length of bridge is about 4.97 km, and the length of connecting line on two sides is 8.034 km. The main line of recommended scheme route for Section B (Guimaras-Negros cross-sea bridge) is about 18.557 km in length, of which the bridge is about 13.10 km in length, the length of connecting line on two sides is 5.457 km, and the e length of connecting line is 0.845 km.

According to preliminary estimation, about 93.22 hectares of land are permanently occupied by the project, including about 8.10 hectares in Leganes, Iloilo Province, about 34.97 hectares in Buenavista, Guimaras Province, about 25.90 hectares in San Lorenzo, Guimaras Province and about 24.25 hectares in city of Pulupandan, Negros Occidental Province. Pprefabricated yard on Panay Island, Guimaras Island and Negros Island respectively, and three temporary terminals such as material terminal, abutment shipping terminal and segmental beam shipping terminal are proposed to be set. **Figure 34** shows the construction site and living camp which is about 30,000 square meters.

Figure 34. Construction site and living camp in Area 1 – Panay Island

Figure 35 shows construction site and living camp which is about 20,000 square meters.

Figure 35. Construction site and living camp in Area 2 – Guimaras Island

In area 3, **Figure 36** shows the construction site and Living camp in Guimaras Island (Alignment D). The area is about 40,000 square meters.

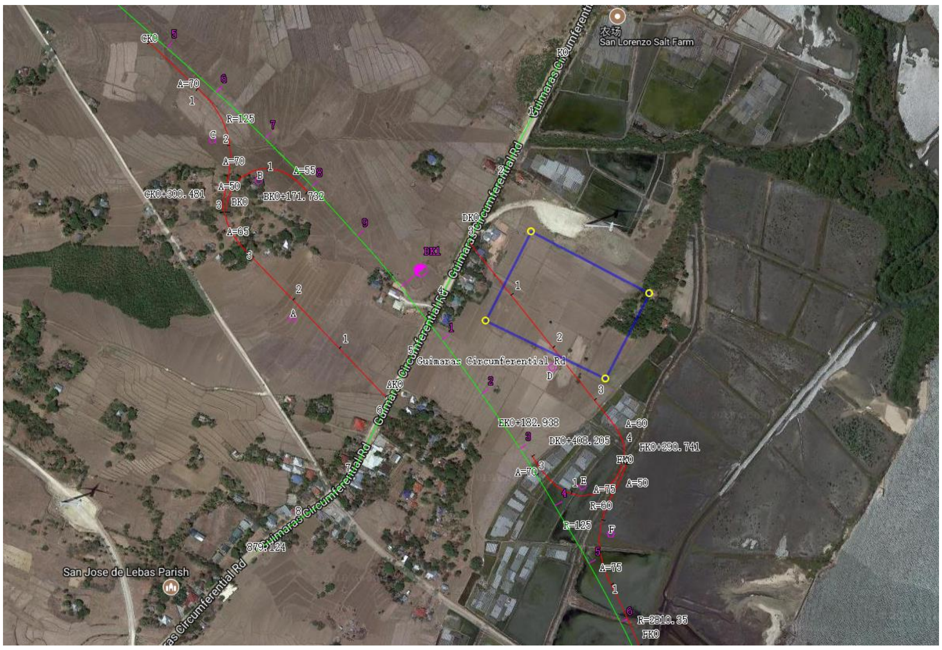


Figure 36. Construction site and living camp in Area 3 – Guimaras Island

In area 4, **Figure 10** shows the construction site and Living camp in Negros Island (Alignment D) which is about 30,000 square meters.

Figure 37. Construction site and living camp in Area 4 – Negros Island

1.4.1 Project Scheme Design

1.4.1.1 Elements of Major Bridge Design

1.4.1.1.1 Traffic volume forecast

The results of traffic volume forecast for this project are shown in **Table 5**.

Table 8. Results of Traffic Volume Forecast for Project (pcu/ d)

Bridge location	2028	2030	2035	2040	2047
Section P-G	8047	10401	13530	16020	19266
Section G-N	6589	7645	9172	10540	12503

1.4.2 Main technical Parameters

The main technical parameters of the Project are as follows.

(1) Road classification: Rural expressway (refer to China's Class I highway);

(2) Design service life: 100 years;

(3) Design running speed: 80km/h;

(4) Standard width of the bridge: Section A adopts a four-lanes layout, with a standard width of 20.2m for the bridge; Section B adopts a two-lane layout, with a standard width of 14.3m for the bridge;

(5) Design load of the bridge: DGCS (2015) HL-93 design lanes and vehicle loads;

(6) Deck cross fall: 2.0%;

(7) Design basic wind speed: 32.41m/s;

(8) Design frequency of high tide level for the sea-crossing bridge: the design high water level adopts the tidal level of 1% of diachronic cumulative frequency; the design low water level adopts the tidal level of 98% of diachronic cumulative frequency; the design flood frequency for major bridges, medium-sized bridges, minor bridges and culverts, as well as subgrade: 1/100.

Table 9. Table of Designed Tide Level

Bridge Location	Designed High Tide Level (m)	Designed Low Tide Level (m)
Section A	1.17	-1.13
Section B	0.97	-1.35

(9) Designed navigable water level: refer to **Table 10**.

Table 10. Designed Navigable Water Level

Bridge Location	Mean High Tide Level (m)
Section A	0.98
Section B	0.83

(10) Navigable clearance: The navigable clearance scale is shown in **Table 11**.

Table 11. List of Navigational Clearance Scale

Bridge Location	Items	Standard
Section A	Representative vessel types	2,000 DWT general cargo vessel /50,000-ton bulk carrier
	Navigational clearance height	50.3m
	Navigational clearance width	480m (single span with two-way)
Section B	Representative vessel types	50,000-ton bulk carrier/ with 100,000-ton class covered
	Navigational clearance height	57.5m
	Navigational clearance width	440m (single span with two-way)

(11) Seismic fortification standard: Level 1 Earthquake Ground Motion with a 100-year return periods or a probability of exceedance corresponding to 53% in 75 years and Level 2 Earthquake Ground Motion with a 1,000 year return periods or a probability of exceedance corresponding to 7% in 75 years.

1.4.3 Routed Design

Alignment B: The starting point is connected to the planned intersection of the Circumferential Road C2 and the coastal road, and a simple diamond interchange is set up for traffic conversion. After extending to the northeast, Alignment B shares a bridge site and alignment with Alignment A. After landing at Guimaras Island, the alignment is basically the same as Alignment A. A simple diamond interchange is set up at the cross-regional circumferential road for traffic conversion.

The alignment stretches 13.004km in length. There are seven horizontal curves on the whole alignment, with an average of 0.402 horizontal curve per kilometer. The minimum radius of horizontal curve is 350m/1 point, and the length of the horizontal curve accounts for 56.681% of the total length.

There are 23 vertical curves on the whole alignment, with an average of 1.769 times of non-uniform gradient per kilometer and a maximum longitudinal gradient of 5.0%/5 points. The vertical curve has a minimum convex radius of 4,000m and a minimum concave radius of 3,000m. The length of the vertical curve accounts for 42.552% of the total length.

Alignment D: The alignment starts at the east side of Cabano Town, San Lorenzo City, Guimaras Province (the wind farm area), is linked to the circumferential road and the traversing road via a linking line. A simple interchange is set up at the intersection with the circumferential road for traffic conversion. The alignment then extends southeast, crosses the main channel perpendicularly across the strait, lands on the north side of Pulupandan Port, and is ultimately connected to the circumferential road on Negros Island. The end point set ups an interchange to achieve traffic conversion.

The alignment stretches 19.47km in length, and the length of linking line is 0.87km. There are six horizontal curves on the whole alignment, with an average of 0.323 horizontal curve per kilometer. The minimum radius of horizontal curve is 2,800m/3 points, and the length of the horizontal curve accounts for 61.939% of the total length.

There are 14 vertical curves on the whole alignment, with an average of 0.754 time of non-uniform gradient per kilometer and a maximum longitudinal gradient of 2.1%/1 point. The vertical curve has a minimum convex radius of 7,000m and a minimum concave radius of 8,000m. The length of the vertical curve accounts for 22.012% of the total length.

1.4.4 Bridge Design Scheme of Section A

1.4.4.1 Design scheme of main bridge

The design scheme of main bridge on Section A is (100 + 260 + 680 + 260 + 100) m double-pylon RC cable-stayed bridge with composite beams.

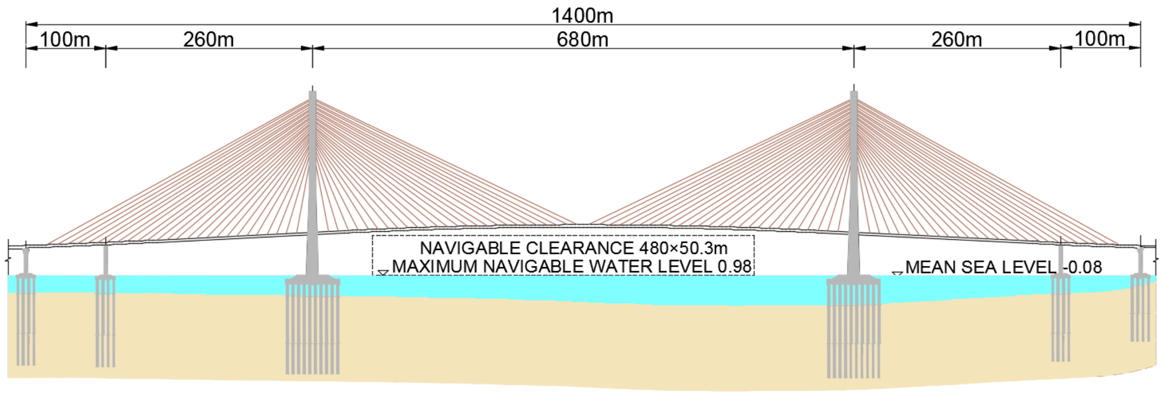


Figure 38. Layout of Main Bridge Span on Section A

The bridge adopts a four-lane standard with a standard section width of 20.2m. The section of the main bridge of the cable-stayed bridge is as shown in the figure, and the full width of the main beam section is 24.2m. The main beam is recommended to adopt the full width section, and a RC double-shelf composite beam is adopted, referring to **Figure 39**.

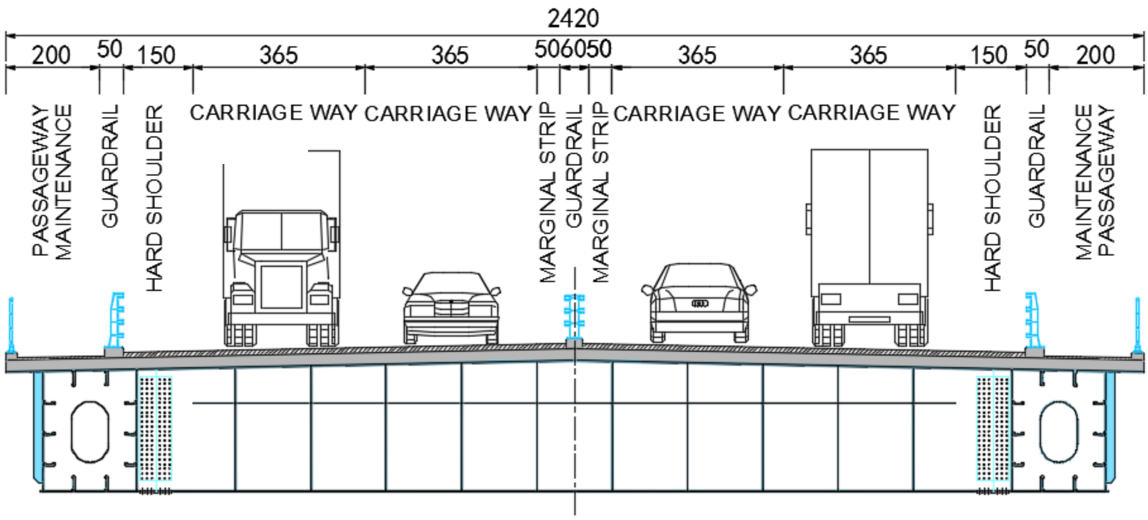


Figure 39. Standard Cross Section of Main Bridge on Section A (Unit: CM)

In consideration of the landscape, structural force and main beam section form, the diamond type is recommended for the bridge tower. The tower body consists of the upper tower column, the lower tower column and the cross beam. The tower is 212.75m high and has a hollow thin-walled section. The sectional dimension of a single column is linearly varied from 8m (transverse) x 14m (longitudinal) at the tower bottom to 7m (transverse) x 8m (longitudinal) at the tower top. The tower body is provided with a transverse beam along the height.

The foundation of the bridge tower adopts a monolithic chamfered rectangular pile cap. The pile cap is 67.5×95.5m in plan dimension. There are 134 pieces of steel pipe composite piles with a diameter of 2.8m and non-uniform cross section, as shown in **Figure 40**.

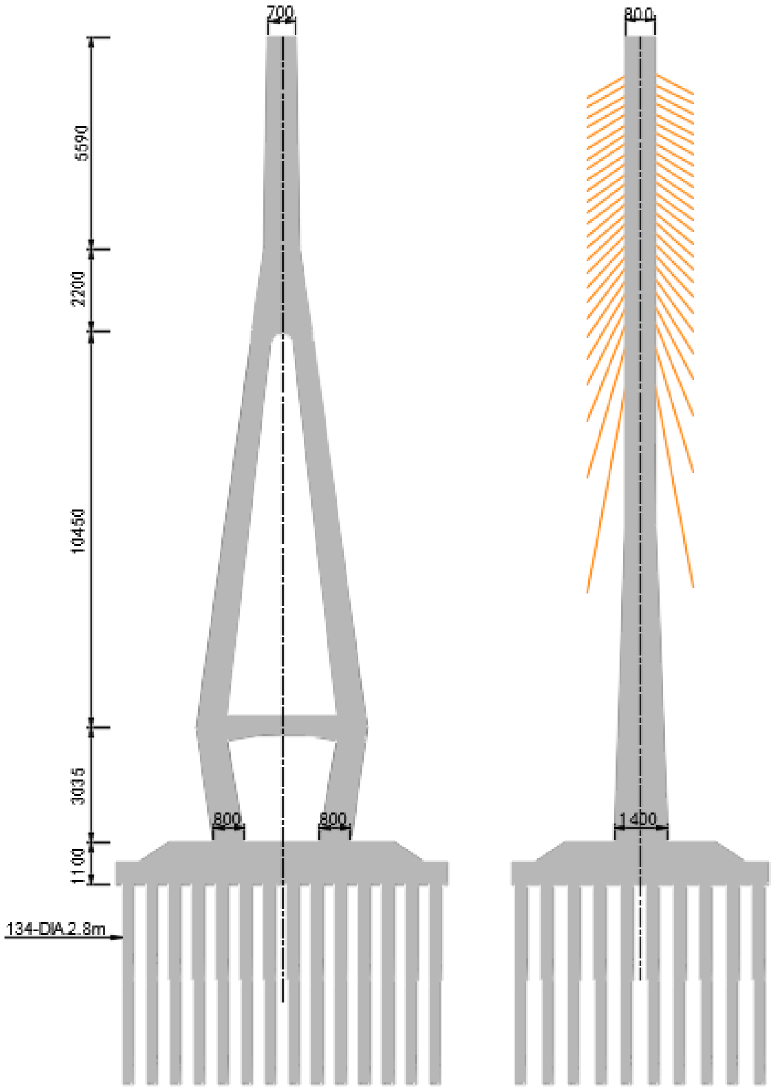


Figure 40. Bridge Tower and Foundation (Unit: CM)

Column vase-shaped piers, with top unfolding transversely, are employed for auxiliary piers. An octagonal hollow thin wall section is used. The sectional dimension of the pier bottom is 8m (transverse) × 4m (longitudinal), and that of the pier top is 24m (transverse) × 4m (longitudinal).

The auxiliary pier foundation adopts a monolithic chamfered rectangular bearing platform. The bearing platform is 25m×24.4m in plan view size, and there are 16 composite steel pipe columns with non-uniform diameter of 2.5m, as shown in **Figure 41**.

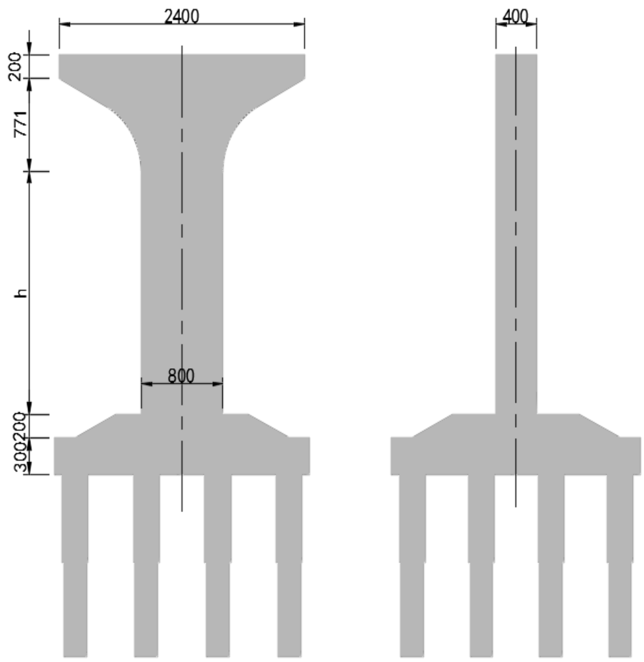


Figure 41. Auxiliary Pier and Foundation (Unit: CM)

Column vase-shaped piers, with top unfolding bi-directionally, are employed for transitional piers. An octagonal hollow thin wall section is used. The sectional dimension of the pier bottom is 8m (transverse) × 4m (longitudinal), and that of the pier top is 24m (transverse) × 7m (longitudinal).

The transitional pier foundation adopts a monolithic chamfered rectangular bearing platform. The bearing platform is 26×24.4m in plane dimension, and there are 16 non-uniform section composite steel pipe columns with diameter of 2.5m, as shown in **Figure 42**.

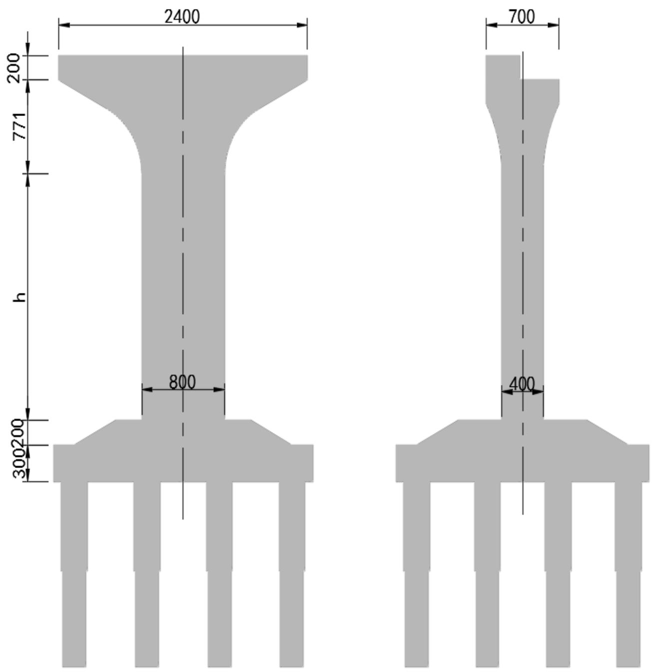


Figure 42. Transition Pier and Foundation (Unit: CM)

1.4.4.2 Design Scheme of Approach Bridge

A 14×100m precast concrete box girder with a non-uniform section is recommended for approach bridges in deep water area on Section A. The Section A bridge adopts the dual 2-lanes standard with a section width of 20.2m. According to the experience, it is recommended to use a full-width section of single box girder with double cells for the approach span section. Piers adopt column vase-shaped piers, with top unfolding transversely and anti-seismic blocks laterally arranged. Group pile foundation that comprising of steel-pipe composite piles and integrally-chamfered rectangular pile caps are adopted.

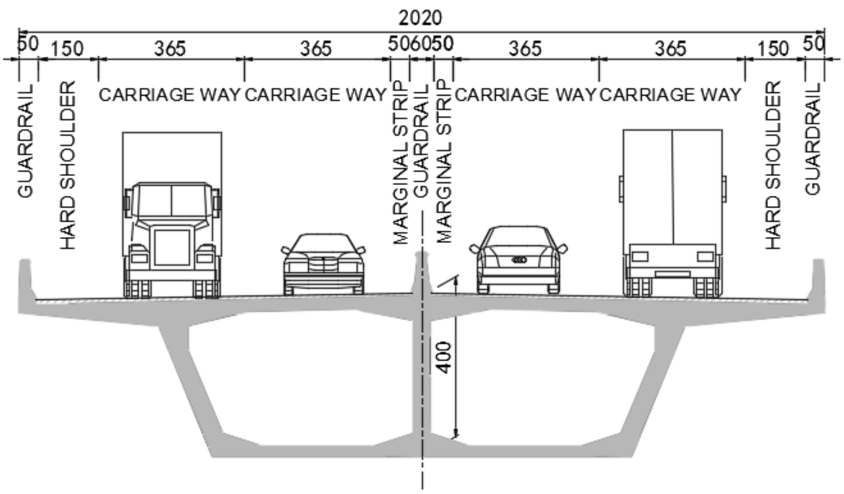


Figure 43. Cross Section Form of Approach Bridge in Deep Water Area (Unit: CM)

The approach bridge in shallow water area is adopted with 30 m prefabricated I-beam, the width of the bridge deck is 20.2 m, with full-width design, 10 I-type beams are arranged horizontally with a spacing of 2.0 m. The bridge girder erection machine is adopted for monolithic erection. T-shaped piers are selected with cantilevered bent caps. The group pile foundation comprising of steel-pipe composite piles and integrally-chamfered rectangular pile caps are employed.

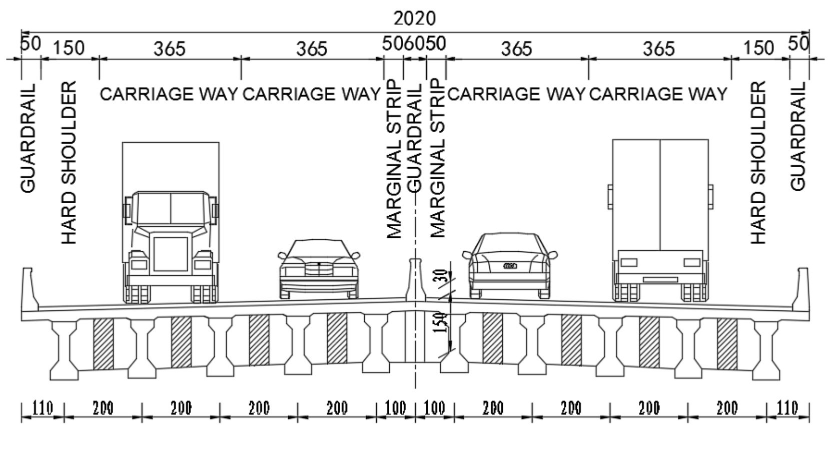


Figure 44. Cross Section Form of Approach Bridge in Shallow Water Area (Unit: CM)

1.4.4.3 Overall scheme design of whole bridge

The overall scheme design of major bridge on Section A is as shown in **Figure 45**.

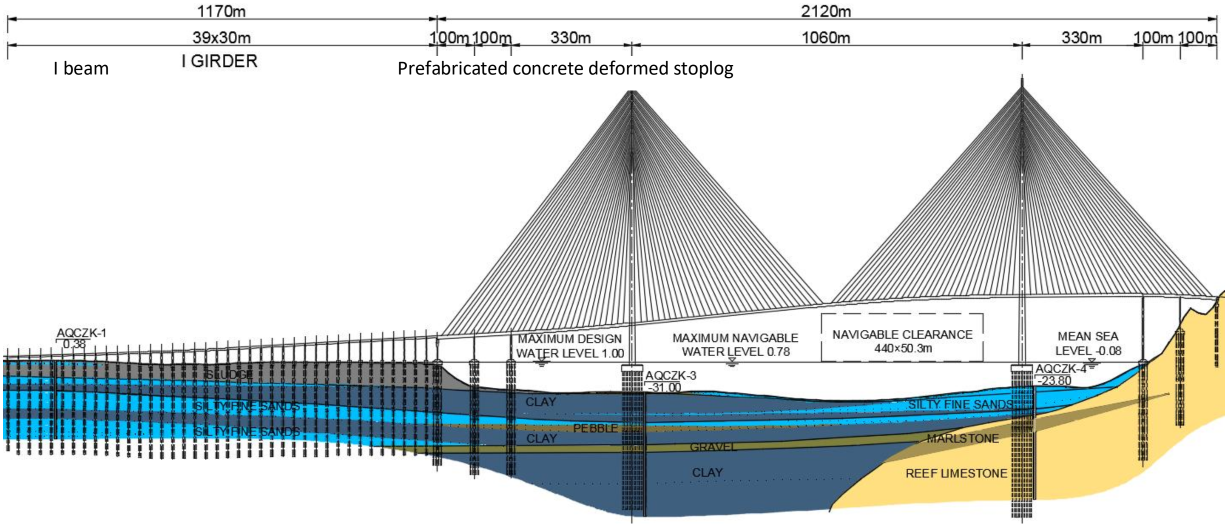


Figure 45. Skeleton Layout for Overall Scheme of Major Bridge on Section A

1.4.5 Bridge Design Scheme of Section B

1.4.5.1 Design scheme of main bridge

The design scheme of main bridge on Section B is a (100 + 260 + 680 + 260 + 100) m double-tower cable-stayed bridge.

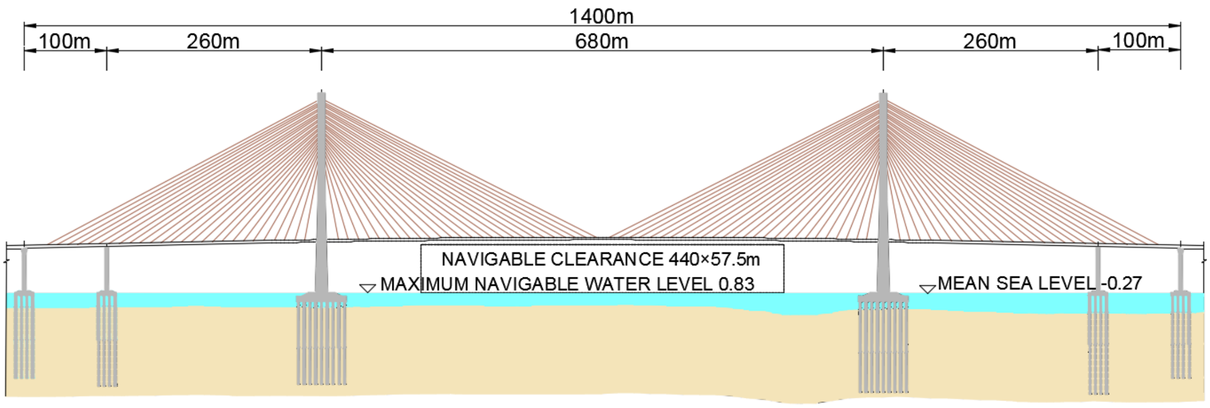


Figure 46. Layout of Main Bridge Span on Section B

Section B is adopted with two-way and two-lane standard, and the standard section width is 14.3m. For main bridge of cable-stayed bridge, the proposed cross section is as shown in the figure, and the main girder is 18.3 m for full width. Since the width is less, the main girder is recommended to be adopted with the form of entire cross-section, referring to **Figure 47**.

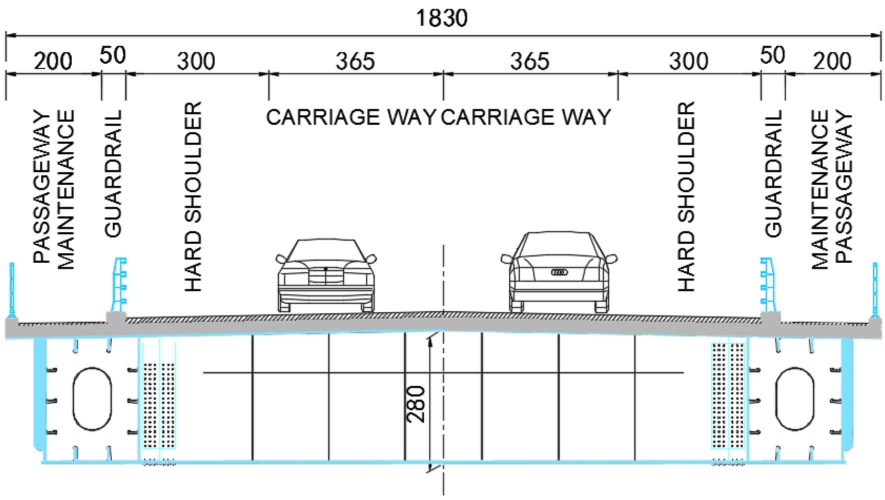


Figure 47. Standard Cross Section Diagram of Main Bridge on Section B

Diamond type is recommended for bridge tower. The tower body consists of upper tower column, lower tower column, cross beam and so on. The tower is 172 m in height and is adopted with hollow thin-wall cross-section. The cross-section size of a single tower column varies linearly from 8 m (transverse) × 13 m (longitudinal) at the tower bottom to 7 m (transverse) × 8 m (longitudinal) at the tower top. The integral chamfered rectangular pile cap is adopted, a plane dimension of pile cap is 74.5 × 60.5 m, and 93 variable section steel-tube composite piles with a diameter of 2.8 m in diameter are arranged under the foundation.as shown in **Figure 48**.

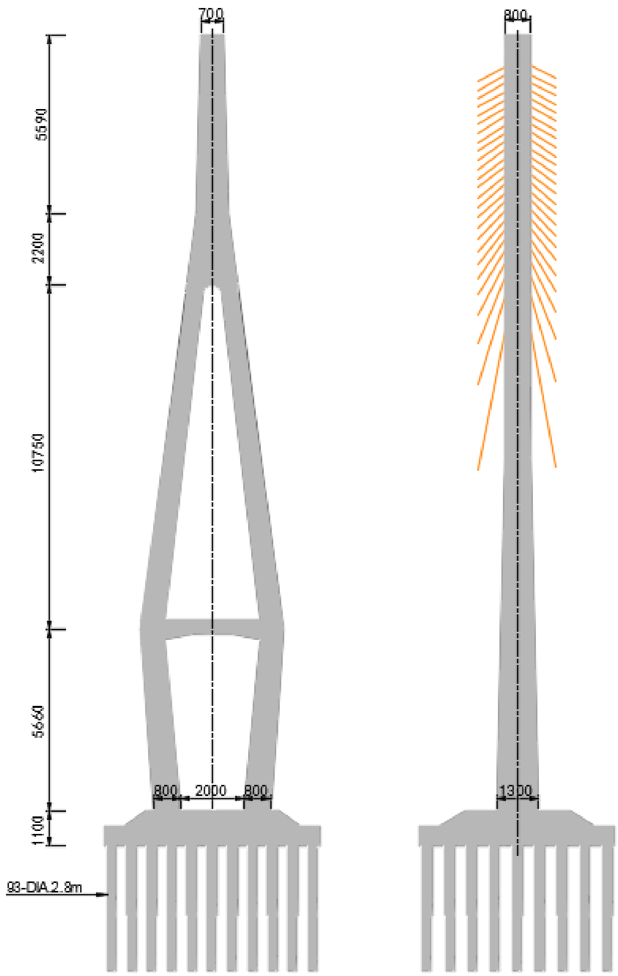


Figure 48. Bridge Tower and Foundation

The auxiliary pier body is modeled as a column-type vase pier adopting the pier top to expand in crossbridge direction. The octagonal hollow thin wall section is adopted. The cross section of pier bottom is 8 m (transverse) × 4 m (longitudinal) and the cross section of pier top is 18.2 m (transverse) × 4 m (longitudinal). The auxiliary pier foundation is provided with an integral chamfered rectangular pile cap is adopted, a plane dimension of pile cap is 25×17.6 m and 12 variable-section steel pipe composite piles with a diameter of 2.5 m are arranged under the foundation, as shown in **Figure 49**.

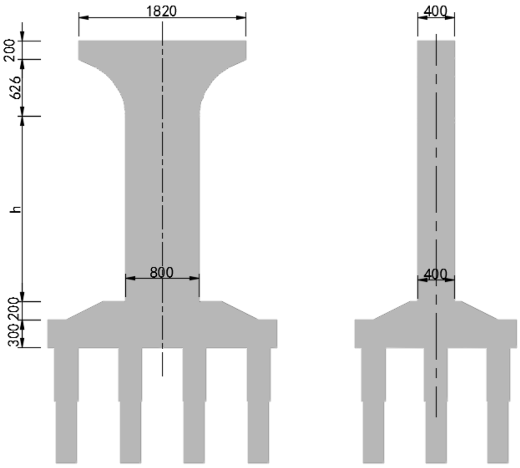


Figure 49. Auxiliary Pier and Foundation

The auxiliary pier body is modeled as a column-type vase pier adopting the pier top to expand in crossbridge direction. The octagonal hollow thin-wall section is adopted. The section size of pier bottom is 8 m (transverse) × 4m (longitudinal) and the section size of pier top is 18.2 m (transverse) × 7 m (longitudinal). The foundation of the transitional pier is adopted with integral chamfered rectangular pile cap is adopted, a plane dimension of pile cap is 25×17.6 m, and 12 variable section steel-tube composite piles with a diameter of 2.5 m are arranged under the foundation, as shown in **Figure 50**.

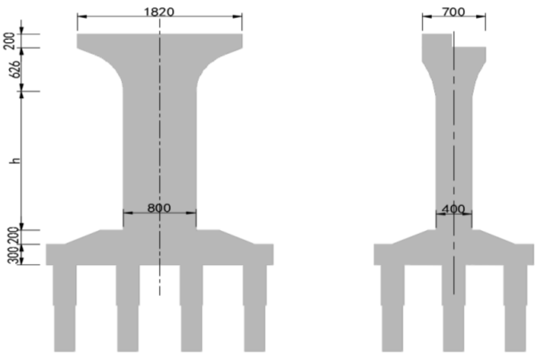
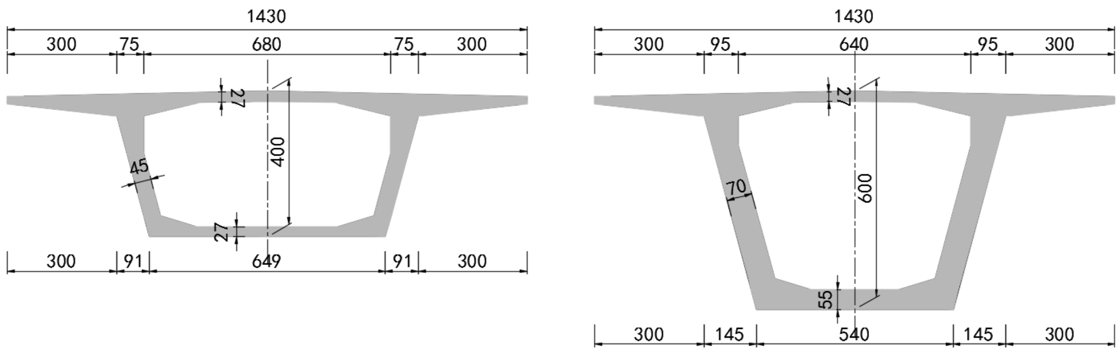


Figure 50. Transition Piers and Foundations

1.4.5.2 Design Scheme of Approach Bridge

The approach bridge in deep water area on Section B is recommended to be adopted with following schemes: Iloilo Bank: 66 × 100 m variable cross-section sectional precast concrete box girder; Guimaras Bank: 34 × 100 m variable cross-section sectional precast concrete box girder. Two-way four-lane bridge is adopted, and the cross section width of approach bridge is 14.3 m. According to the experience, the cross section of main girder is recommended to be adopted with single-box and single-chamber full-width cross section. The pier is adopted with a column-shaped vase pier, the transverse bridge at the top spreads out in the direction of bridge, and the anti-seismic block is set in the transverse direction. The foundation is adopted with group pile foundation with steel pipe composite pile and integral chamfered rectangular pile cap.



A. Midspan Section B. Section near Pier Top

Figure 51. Concrete Beam Cross Section of 100 m Approach Bridge

The approach bridge in shallow water area is adopted with 30 m prefabricated I-beam, the width of the bridge deck is 14.3 m, with full-width design, 7 I-type beams are arranged in the transverse direction, with spacing of 2.0 m. The bridge girder erection machine is adopted for monolithic erection. The T-shaped pier with cantilever bent cap is used for the bridge pier. The foundation is adopted with group pile foundation with steel pipe composite pile and integral chamfered rectangular pile cap.

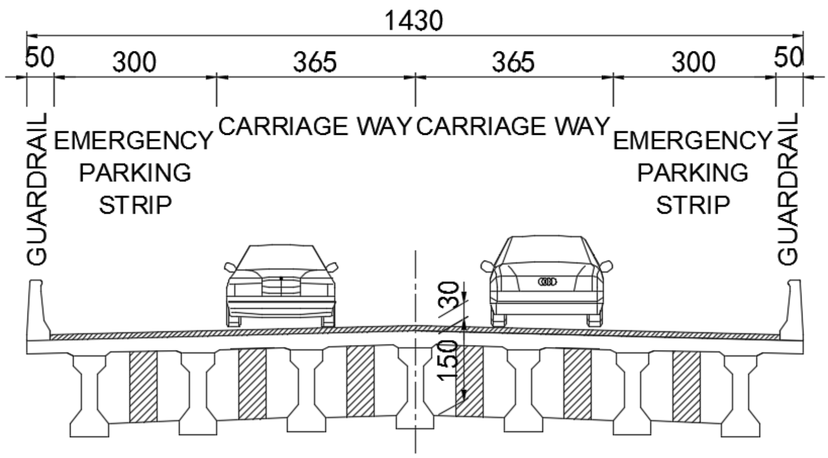


Figure 52. Section of 30 m Approach Bridge

1.4.5.3 Overall scheme design of whole bridge

The overall scheme design of whole bridge on Section B is shown in **Figure 26**.

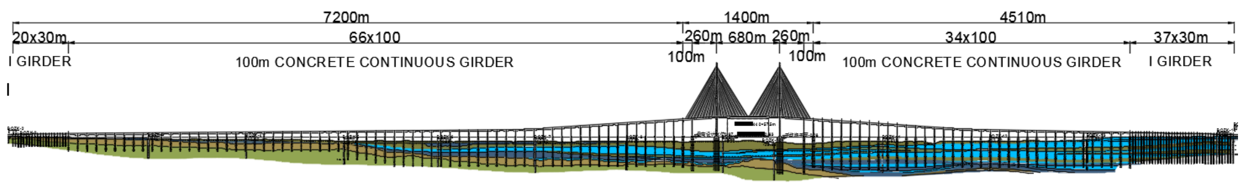


Figure 53. Skeleton Layout for Overall Scheme of Major Bridge on Section B

1.4.6 Wiring design scheme

1.4.6.1 Standard section form of connection

The Panay-Guimaras cross-sea bridge on Section A in this project is constructed and implemented in accordance with the two-way four-lane standard. The width of integrated subgrade for wiring road is 20.7 m, its cross section consists of: 0.75 m (earth shoulder) + 1.5 m (hard shoulder) + 2 × 3.65 m (carriageway) +1.6 m (middle strip) + 2 × 3.65 m (carriageway) + 1.5 m (hard shoulder) + 0.75 m (earth shoulder).

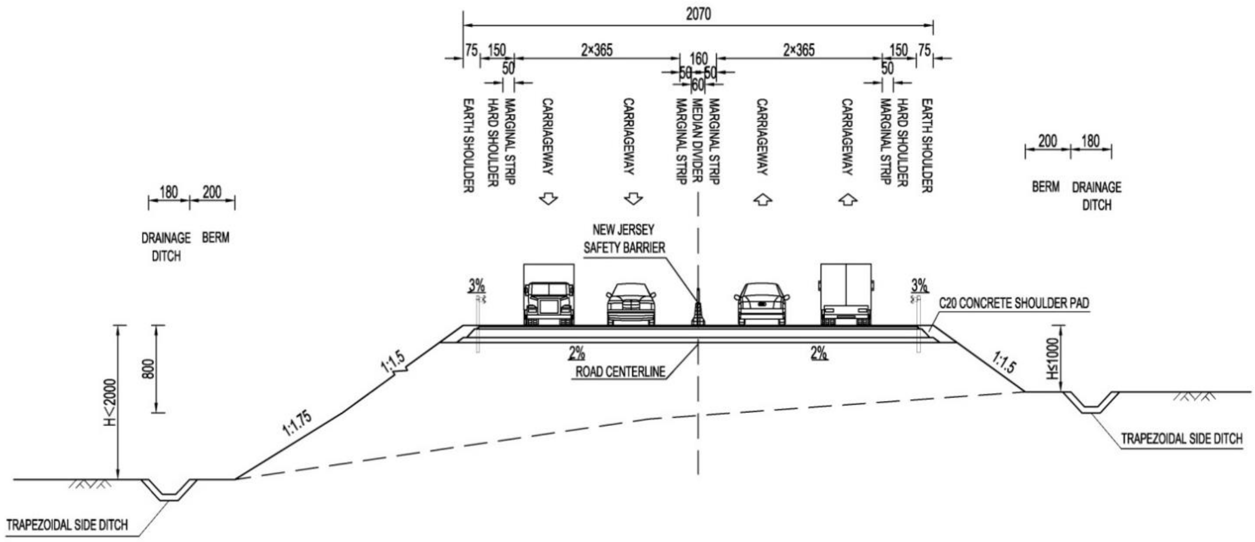


Figure 54. Standard Cross-Section Diagram of Subgrade on Section A (4 lanes)

The Guimaras-Negros cross-sea bridge on Section B in this project is constructed and implemented in accordance with the two-way two-lane standard. The width of integrated subgrade for wiring road is14.8 m, and the cross section consists of: 0.75 m (earth shoulder) + 3 m (emergency stopway) + 2 × 3.65 m (carriageway) + 3 m (emergency stopway) + 0.75 m (earth shoulder).

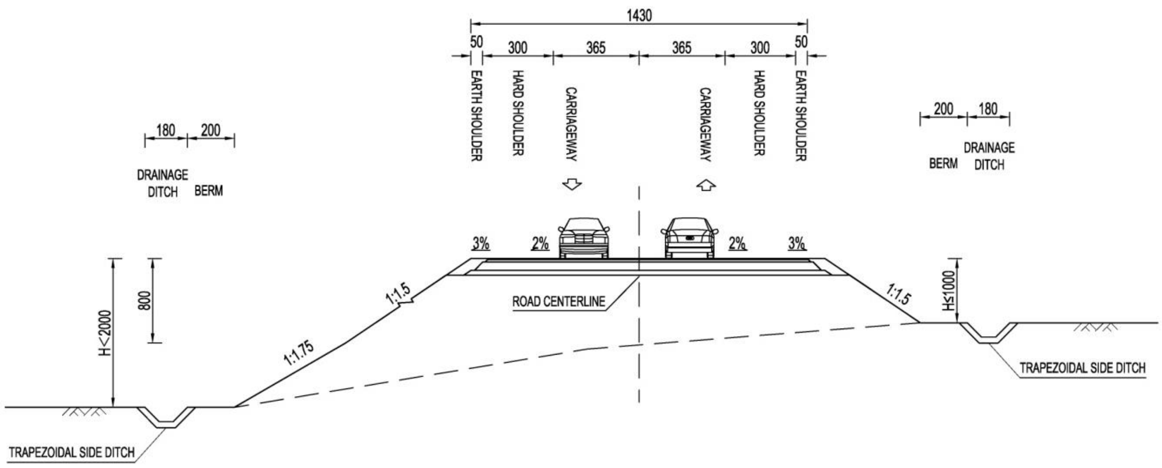


Figure 55. Standard Cross-Section Diagram of Subgrade on Section B (2 lanes)

According to Philippine standard, if high-grade highway is adopted with asphalt pavement structure, it is recommended that the transverse slope of road camber should be between 1% and 2%, and the maximum should not be more than 2%, therefore, it is considered from drainage factor, 2% is taken for transverse slope of road camber in this project, and 3% is adopted for transverse slope of earth shoulder.

1.4.6.2 Bridge culverts for connection

The wiring length of Line B on Section A in recommended scheme is shorter (500 m) on Panay Island. The main route passes through the salt field, being free of bridge structures and, at BK0 + 350 position, a Φ1.5 m pipe culvert is arranged to facilitate the seawater extraction operation required for operation in salt field.

After Line B on Section A in recommended scheme lands in Getulio area in the north of Guimaras Island, the route runs along mountainous areas with chicken-paw geomorphology mostly, there are local fish ponds and farmland, etc. in the mainline of route, therefore, the bridges are set up as far as possible to pass through when crossing fish ponds. 5 mainline bridges are set at the connection of Guimaras Island for Line B , the span arrangement is No.1 bridge 4 × 30 m, No.2 bridge 5 × 30 m, No.3 bridge 3 × 30 m, and three bridges all cross the fish pond; No.4 bridge is 6 × 30 m, crossing the deep ditches, and No.5 bridge is 5 × 30 m, crossing the crossed roads. In addition, at BK10 + 533 of Line B, there is original former road, and a 1 × 30 m cross-line bridge is considered to be set to be convenient for local residents' travel. The culverts and channels on Line B are arranged in suitable position according to the conditions of field investigation. The aperture of culvert is 3 × 2 m or 3 × 2.5 m, etc. and the number of hole is 1-3 unequally. The circular pipe culvert is Φ 1.5 m. A Φ 1.5 m circular pipe culvert is set at DK0 + 500 position of Guimaras Island for Line D on Section B.

Line D on Section B passes through Pulupandan Creek on Negro Island. According to the results of field survey, circular pipe culvert is planned to be selected during the feasible construction stage.

1.4.6.3 Pavement structure for connection

After calculating the indexes of permanent deformation and fatigue cracking index of asphalt mixture and the indexe of fatigue cracking for inorganic binder, the composite of pavement structure is recommended as: 5 cm asphalt mixture AC-16 surface layer + 10 cm asphalt stabilized macadam ATB-25 upper base + lower sub-base of 38 cm cement stabilized crushed stone + 20 cm graded crushed stone subbase.

1.4.6.4 Interchange and grade crossing for connection

1.4.6.4.1 Design of interchange

The type selection of interchange is mainly based on the planning of urban comprehensive road network, the size and direction of traffic volume and is combined with geology, topography, features and so on. 2 interchanges are set at Panay-Guimaras section and 2 interchanges are set at Guimaras-Negros section. The arrangement of interchange is shown in **Table 12**, **Figure 56 to Figure 59**.

Table 12. List of Interchange Arrangement

Name of interchange	Crossing pile No.	Footprint area (m^2)	Form of interchange	Crossing mode	Name and grade of crossed road
Interchange at the starting point of Line B	K0+009	78498	Rhomboid	Overcrossing of mainline	COASTAL ROAD (Roundabout Road on Panay Island)
Interchange at the ending point of Line B	K11+420	80208	Rhomboid	Overcrossing of mainline	Roundabout Road on Guimaras Island
Interchange at the starting point of Line D	K1+068	211018	Partial clover leaf	Overcrossing of mainline	Circumferential Road (Roundabout Road on Guimaras Island)
Interchange at the ending point of Line D	K18+680	90262	Type B single horn	Overcrossing of mainline	National Highway (National Expressway on Negro Island)

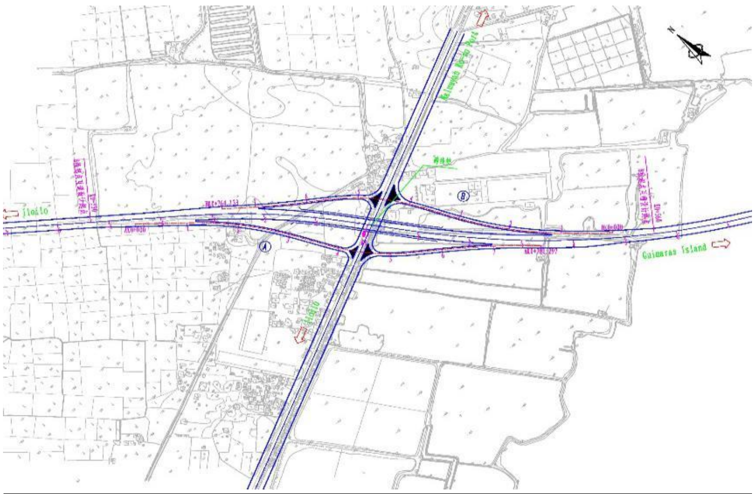


Figure 56. Interchange Scheme at Starting Point of Line B

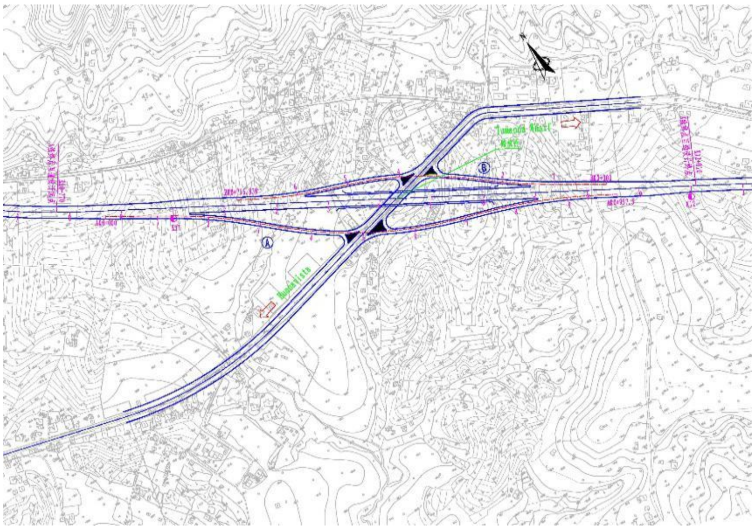


Figure 57. Interchange Scheme at Ending Point of Line B

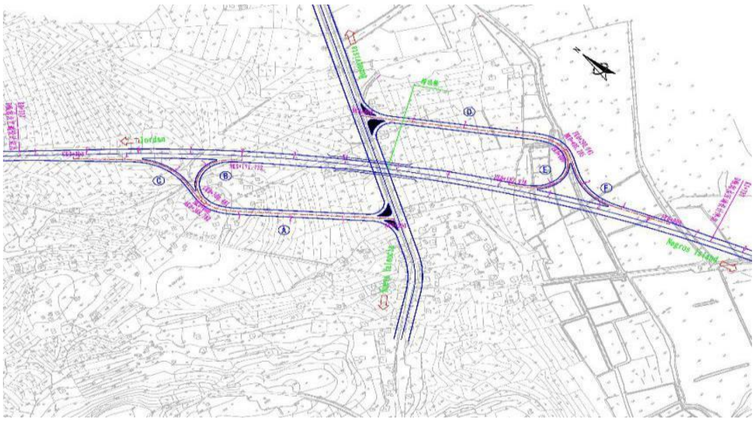


Figure 58. Interchange Scheme at Starting Point of Line D

Figure 59. Interchange Scheme at Ending Point of Line D

1.4.6.4.2 Design of grade crossing

Except that the interchange is set at the starting and ending point of the project, the grade crossing is all set at the intersections with local roads.

The grade crossing is designed to be adopted with the principle of maintaining the original road conditions as far as possible, no demolishing and ensuring residents' original travel habits, the circular corner is paved to be connected with the crossed roads, and the pavement structure of crossed roads is identical to pavement structure on the mainline.

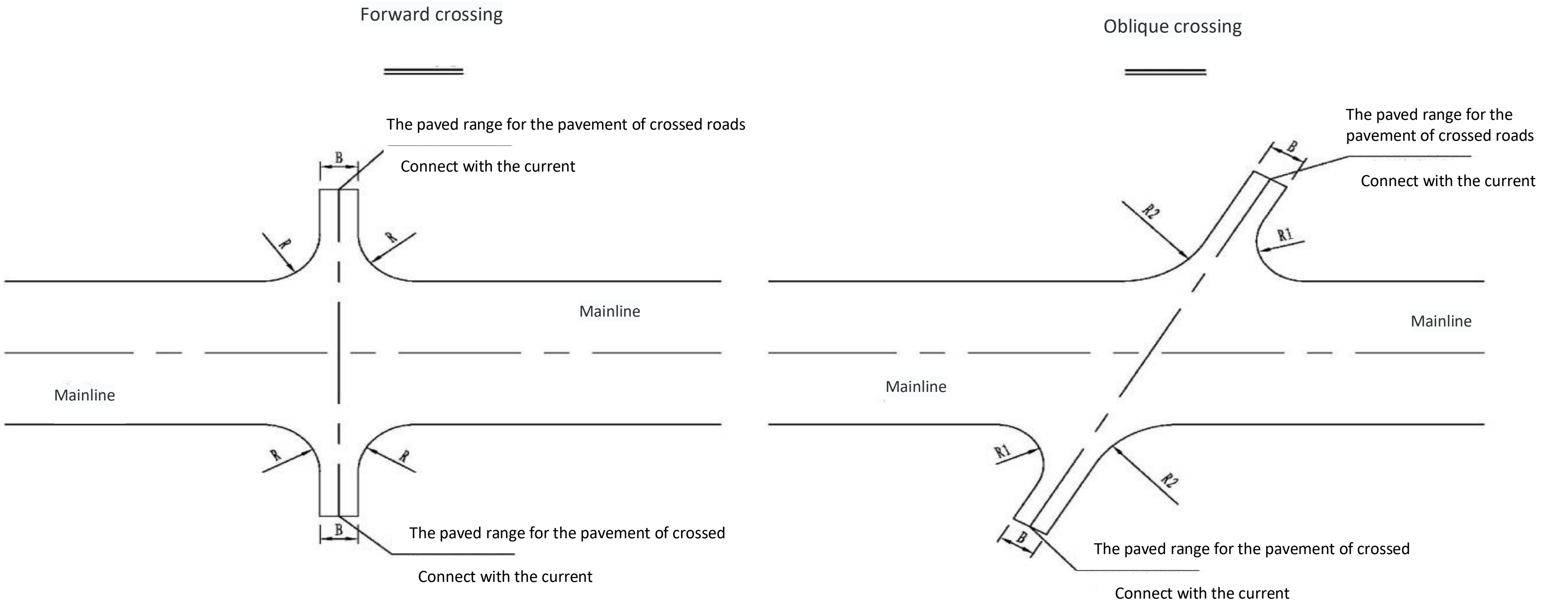


Figure 60. Layout of Grade Crossing Scheme

1.4.7 Support Facilities

Drainage Systems

The proposed project will be provided with efficient drainage system for surface and subsurface water including slope groundwater and seepage. It will provide an all-weather road drainage system of adequate cross-drain, drain collection system, sufficient countermeasures for flooding of road and major drainage structures, surface water infiltration and drainage outfalls. The drainage system comprises of a network of pipe culverts, roadside ditches, and internal drainage systems for the road pavement structures. The design of PGN Bridge Project considerably prepares for the extreme conditions on rainfall and other meteorological/weather (PAGASA) criteria.

Traffic Safety Device

According to the specific requirements of traffic safety facilities, and taking into account the road characteristics and local geographical conditions, climate and environment, as well as rational use of highway construction funds and other factors, the design for safety facilities in this section includes traffic signs, traffic markings, guard fence, etc.

surveillance system

With the whole section of the Project taken as the surveillance focus of the road, a complete surveillance system shall be provided to achieve video surveillance, traffic parameter collection, meteorological monitoring, accident alarm collection, traffic information release and speed control in some sections for timely traffic dispersion to ensure smooth traffic flow along the entire route.

Lighting Systems

The proposed project will be provided with highway safety and bridge lightings. Road lighting not only constitutes an essential part of road illumination and beautification, but also serves the road. Therefore, road lighting shall be first considered to ensure the safety of road operation, providing drivers with safe driving conditions. Street lamps for road lighting in the Project shall be provided by considering both the short-term and long-term road lighting requirements. Bridge lighting includes internal lighting for the box girder and internal lighting for the main body.

Communication Conduit

12-hole Φ40/33 silicon core tubes shall be installed in the communication conduits in the Project and in the road under the interchange as well. Communication conduits in the approach span section in the shallow water area shall be installed in the steel tube box outside the bridge. The box shall be installed on the steel brackets fixed to the concrete guard fence of the bridge with expansion bolts. Communication conduits in the approach span section in the deep-water area shall be installed in the steel bridge frame in the box girder while the latter shall be installed on the section steel brackets fixed to the concrete box girder with expansion bolts. Communication conduits in the navigable span shall be installed in the steel bridge frame while the latter in the steel box girder shall be fixed to the tube hole in the diaphragm.

1.5 Process/Technology

1.5.1 Description of Project Phases (Activities/Environmental Aspects, Associated Wastes and Built-in Pollution Control Measures)

1.5.1.1 Environmental Aspects/waste generation and built-in measures

During this phase generation of waste is expected. **Table 13** shows the type of waste and built-in measures.

Table 13. Type of Waste and Built-in measures

Type of waste	Source	Management measures
Water/Wastewater (during construction phase)	Domestic Wastewater	Provision for Portalet (portable toilet) Refer to Figure 61.
	Disturbed river water	Provide temporary rechanneling of river system
Solid wastes	Domestic and demolition residuals -construction debris, scraps	Practice 3R (Reduce Reuse and recycle); Residues for disposal to landfill Carton, wood, steel, bottle sent to recyclers
Hazardous waste	Used oil and batteries	Sent to Treatment Storage and Disposal facility
Air emission	Source equipment	Periodic maintenance of equipment and vehicle Source emission requirements for generator sets must comply with the DENR standards as per RA 8749.
	Dust	During the construction phase of the project, access roads and the operation of construction equipment and vehicles will be the main sources of pollution. Fugitive dust and combustion emissions will be

Type of waste	Source	Management measures
		generated. The primary sources of fugitive dust emissions will include construction activities such as land clearing, grading, excavation, and the transport and movement of construction material particularly the increased vehicle traffic on unpaved roads. The amount of dust generated will be a function of construction activities, soil type, moisture content, wind speed, frequency of precipitation, vehicle traffic, vehicle type, and roadway characteristics. Fugitive emissions will be highest during drier periods in areas of fine-textured soils. During the dry season, dust suppression will be applied as needed (such as watering of disturbed or exposed areas). A dust control plan will be implemented and regular maintenance of vehicles and equipment will be carried out. Regular sprinkling activities will be done
Noise	Heavy Equipment Construction activities such as drilling	During construction, increased noise and traffic levels will be significant due to heavy construction vehicles moving to and from the site. Increased traffic will be a result of trucks to and from the site for construction material deliveries and site clearing. Noise that will be generated will be through site clearing activities using soil scrappers and construction workers on site including construction equipment's operation. Since there are residential areas in the immediate vicinity of the site, the impact is considered significant. However, the impact will be managed through the implementation of the mitigation measures below. Noise generating activities will be restricted to normal working hours, thus limiting noise levels at nighttime to minimize the effect on the residents in the affected areas. Use of PPEs such as ear plugs, ear muffs are required as necessary. Contractors shall be required to ensure that construction equipment and vehicles are in a good state of maintenance.

Figure 61 shows the schematic diagram of wastewater generated during construction phase.

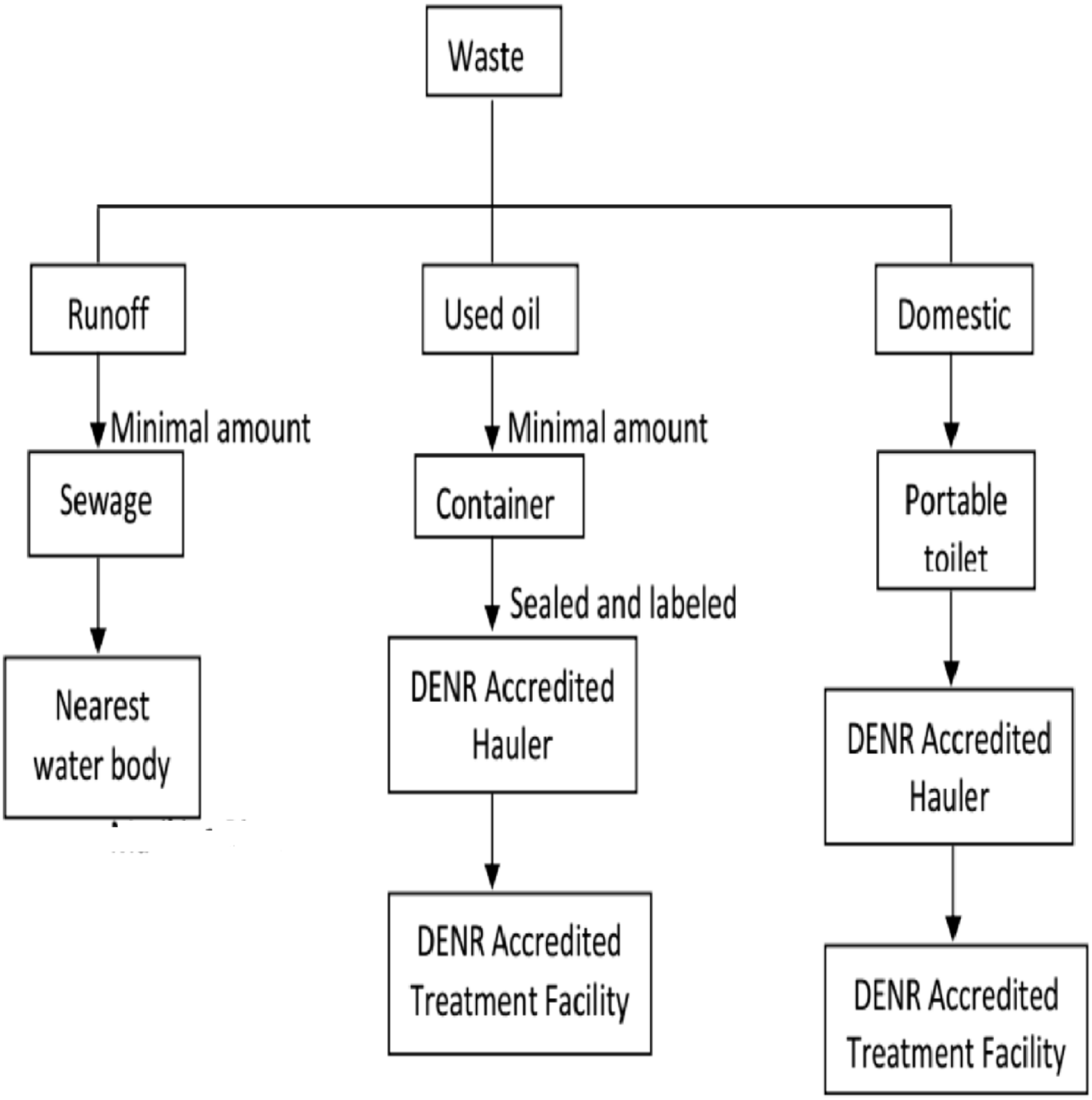


Figure 61. Schematic Diagram of Wastewater Generated During Construction Phase

1.6 Project Size

Table 14. Major Components and Size of Alignment B

Project Component	Location/Area Jurisdiction		Length/ Area
Major Components			
Segment3.1 *(Interchange)*	**<u>Panay</u>**	*K0+000~K0+555*	0.555 km

Segment 3.2 *(Sea Cross Bridge)*	**Panay-Guimaras** *K0+555~k5+525*	4.970 km
Segment 3.3 *(link road)*	**Guimaras** *K5+525~K11+435*	5.910 km
Segment 3.4 *Interchange*	**Guimaras** *K11+435~K13+005*	1.57 km

Table 15. Major Components and Size of Alignment D

Project Component	Location/Area Jurisdiction	Length/ Area
Major Components		
Segment3.5 *(Interchange)*	**Guimaras** *K0+000~K1+902*	1.902 km
Segment 3.6 *(Sea Cross Bridge)*	**Guimaras –Negros** *K1+902~k15+012*	13.110 km
Segment 3.7 *(link road)*	**Negros** *k15+012~K18+260*	3.248 km
Segment 3.8 *（Interchange）*	**Negros** *K18+260~K18+557*	0.297 km

1.7 Development Plan, Description of Project Phases and Corresponding Timeframes

1.7.1 Pre-Construction/Pre-operational phase

This will involve the acquisition of Environmental Compliance Certificate and other permits and clearances such as PAMB, LGU clearances, tree cutting permits etc.

DPWH to iron out details of the projects, finalized the detailed engineering design

Preparation and implementation of Relocation Action Plan for the affected communities

Acquisition of right of way and right to use land

1.7.2 Construction/Development Phase

1.7.2.1 Preparation Works

- Clearing and earthworks for the preparation of construction works,
- Construction of the temporary yard,

- Provision of power, water and sanitary facilities
- Mobilization of major construction equipment and tools
- Established main site logistics and transport requirements
- Delivery of construction materials

1.7.2.2 Construction Works

- Pile Foundation
- Excavation
- Installation of steel cage
- Concrete pouring by tremie pipe
- Extraction of casing and tremie pipe
- Completion of bored pile
- Construction of substructures
    1. Construction of cofferdam
    2. Drying inside of cofferdam
    3. Conduct of substructure
- Superstructures
- Compliance to Health and Safety; Implementation of Health and Safety Plans, Programs

1.7.2.3 Construction Proposal of Main Bridges

The main bridge is a cable-stayed bridge with composite beams. Main piers adopt group pile foundations, and main towers are of a concrete diamond-type tower, which is made up of upper, middle and lower tower columns, as well as lower floor beams and upper floor beams.

Transition piers and ancillary piers adopt group pile foundations, and a hollow thin-wall pier.

(1) Foundation construction

Full trestles or marine equipment may be employed for construction. It is recommended to use marine equipment for the construction of foundations due to deep sea water in the Project and a relatively narrow construction water area.

Based on the characteristics of the Project being located at sea with a large water depth, the following process will be adopted for substructures: driving of steel casing → erection of drilling platform → construction of pile foundation → assembly of steel suspension box → lowering of steel suspension box → welding of draw bar and pressure bar → pouring of bottoming concrete → pumping for the construction of bearing platform → construction of tower pedestal and cable tower.

Construction of pile foundation: a floating pile driver is used to insert steel pipe piles to set up a working platform. A floating crane and a vibrating pile driver are employed to insert steel pipes down to a design depth, then clear-water boring and pore-forming technology is adopted to drill down to a design pile bottom elevation. Reinforcement cages are lowered, and tremie concrete is poured with a waterborne mixing plant.

Construction of bearing platform: a double-wall steel cofferdam is used to surround water, and bottoming concrete is poured. Concrete for the bearing platform is poured after pumping. The concrete is supplied by a waterborne mixing plant.

A. Construction of steel tabular composite piles B. Construction pile-cap

Figure 62. Foundation Construction

(2) Construction of cable tower and pier body

The cable tower employs a construction technology based on hydraulic climbing formwork, in which tower cranes (located on both sides of the cable tower) provide coordination. Each segment of tower column is equipped with four independent climbing frames by section. The hydraulic climbing formwork is mainly composed of a climbing frame system and a formwork system, and the standard construction segment is 6m high. Floor beams are cast in place with steel pipes plus support for steel trussed girder. The base of support relies on the bearing platform for main piers, and the insufficient part is covered by steel pipe pile foundations driven into water. The prestressing on floor beams is applied by post-tensioning method. The concrete required is pumped by a waterborne mixing plant.

Fixed attached tower cranes are employed for the construction of tower column as lifting equipment, and elevators and ladders are provided as an access of personnel.

A steel anchor box will be used for the bridge as an anchoring structure for stay cables. The steel anchor box is processed in a professional steel structure factory, and installed with an 800-type tower crane.

The construction process for pier body is the same as that for the cable tower body as shown in **Figure 63**.

Figure 63. Construction of Tower Columns

3) Construction of main beams

The main beam is a type of steel-concrete composite beam, with the lower part being a box-shaped steel beam. Bridge decks are prefabricated first in a factory. After its storage for a certain period, large-scale lifting equipment is employed to transport box girders to assembly jigs, to hoist the bridge deck and to pour concrete for lamination in the factory. After the age is met, the composite beam is shipped to the bridge site for erection as shown in **Figure 64**.

The main beam is lifted in four parts: beam segments for tower zones, beam segments for side spans, standard beam segments, and closure segments. The beam segments for tower zones, and beam segments for side spans are hoisted and erected with 800 T large-scale floating cranes. The standard beam segments, and closure segments are symmetrically hoisted and erected with bridge deck cranes.

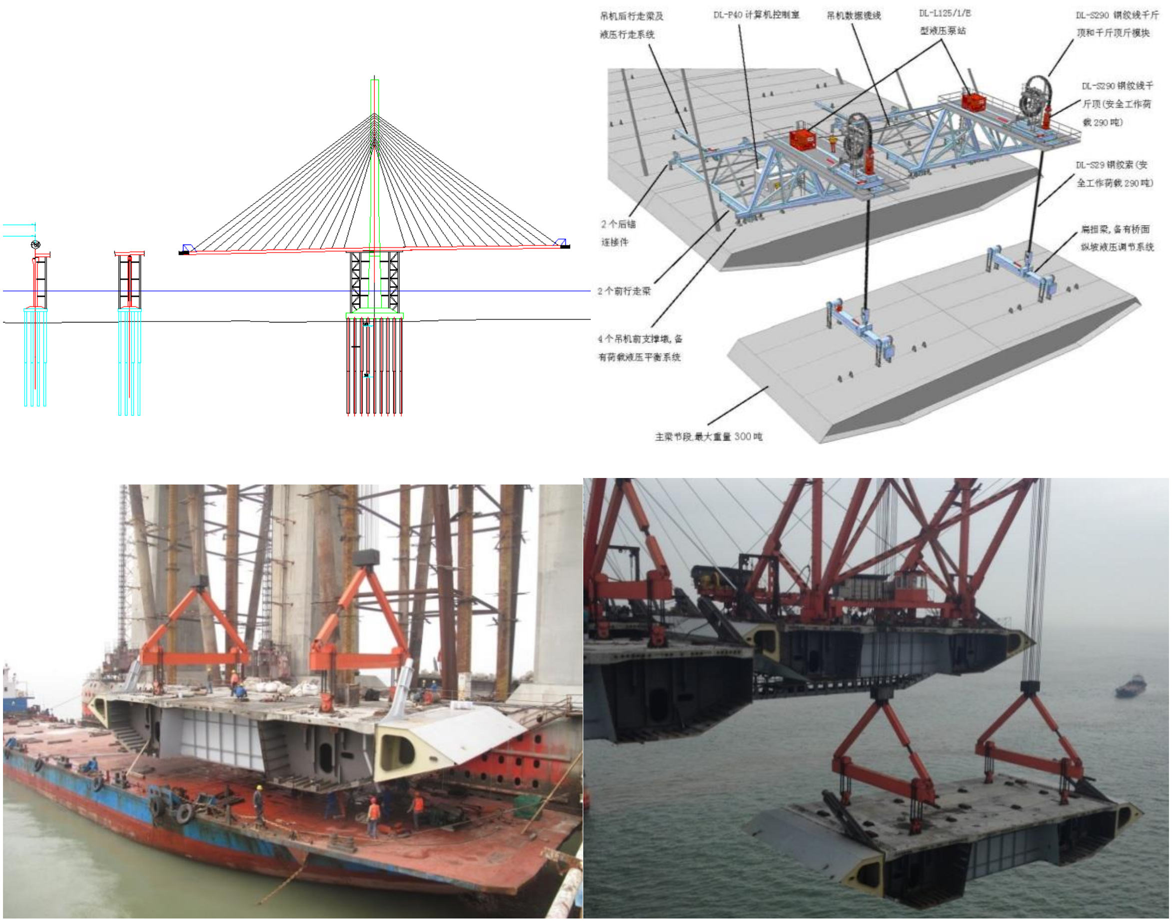


Figure 64. Symmetrical Erection of Composite Beams with Bridge Deck Cranes

(4) Construction of stay cables

Ready-made high-strength parallel steel wires are used as stay cables, coiled and transported to the site where they are put in place for lifting. Then a jack is employed for tensioning of the stay cable.

1.7.2.4 Construction Proposal for Approach Spans

(1) Construction of pile foundation

① Prefabrication of I beams in shoal areas

Full trestles construction is adopted. After a steel platform for boring is erected next to the trestle, the construction of bored piles is carried out.

② Approach span in deep-water areas

Due to the large depth in the deep-water area and inferior geological conditions, it is recommended to use marine equipment for constructing foundations. The construction process is as follows: a floating pile driver is used to insert steel pipe piles to set up a working platform. A floating crane and a vibrating pile driver are employed to insert steel pipes down to a design depth, then clear-water boring and pore-forming technology is adopted to drill down to a design pile bottom elevation. Reinforcement cages are lowered, and underwater concrete is poured with a waterborne mixing plant.

(2) Construction of bearing platform and pier body

① Prefabrication of I beams in shoal areas

A steel case is used to surround water in the construction of bearing platform, and then bottoming concrete is poured. Concrete for the bearing platform is poured after pumping. The pier body employs a construction technology based on hydraulic climbing formwork, in which tower cranes (located on both sides of the bearing platform) provide coordination. The concrete required is pumped by a waterborne mixing plant. Fixed attached tower cranes are employed for the construction, and elevators and ladders are also provided as an access of personnel.

② Approach span in deep-water areas

A steel case is used to surround water in the construction of bearing platform, and then bottoming concrete is poured. Concrete for the bearing platform is poured after pumping. Prefabricated pier bodies are hoisted and erected section by section with a floating crane. The prefabricated pier body is shipped from the fabrication field to the bridge site by a barge, and anchored over there. Then, the prefabricated pier body is taken from the barge to the bridge site by a floating crane, and anchored and positioned before being moved forward and erected at corresponding location of pier. Dry construction is adopted between pier body and pier segment.

A. Prefabrication of Pier B. Erection of Prefabricated Pier with a Floating Crane

Figure 65. Schematic Diagram for Construction of Prefabricated Pier

3) Construction of main beams

① 100m precast concrete continuous box girder with variable cross-section

The superstructure of a box girder is prefabricated by segments, and assembled with bridge deck crane cantilevers. The standard length of a prefabricated beam segment is 4m, 3.5m, and the segment lifting weight is about 250t. Prefabricated beam segments are spliced by a dense-tooth shear key, with the splicing surface painted with epoxy resin.

Large-scale floating cranes may also be used for large-segment hoisting in the light of contractor equipment.

A. Prefabrication of Beam Segments B. Assembly with Bridge Deck Crane Cantilevers

Figure 66. Schematic Diagram for Construction of Beams for 100 m Approach Spans

② Prefabrication of I beams

I beams are prefabricated in a fabrication filed, and are erected piece by piece with bridge erection equipment. The cast-in-situ top slab is integrated into one layer, and the erection of main beams is completed.

Figure 67. Schematic Diagram for Construction of I Beams for a 30 m Approach Spans

1.7.2.5 Construction Proposal of Land Connection

Constructing the landing areas will involve the following activities:

-Site clearing: All existing vegetation within the project foot print will be removed or relocated; the existing pavement and road surface will be demolished or disassembled; a temporary drain ditch and settling pond will be established on the road side; and the road area will be backfilled and levelled to the required level.
-Base treatment: Including levelling, compacting and sub grading.
-Surfacing and pavement construction

1.7.2.6 Demobilization/Decommissioning Phase

Demobilization/Decommissioning phase pertains to activities that will be undertaken immediately after the completion of road and bridge constructions. The Contractor/DPWH must ensure that the following decommissioning/demobilization activities are complied with.

- Complete closure and restoration of all temporary construction facilities and structures such as bunkhouses, field offices, facilities yard etc.
- Complete dismantling of portable sanitation facilities such as portalets provided in the construction sites;
- All construction sites are cleared of residual solid and domestic wastes generated from temporary sanitation facilities;
- All disconnected / disrupted basic social service facilities such as water and power supplies, and communication lines are fully restored to normal functions;
- Affected public structures are reconstructed/restored; and

All construction sites are cleared of residual construction spoils and debris

1.7.3 Operational Phase

The DPWH District Engineering Office (DPWH-DEO) who has jurisdiction over the newly construction island bridge and road shall perform periodic inspection and maintenance of the road section, including all appurtenant structures based on DPWH Standard Inspection and Maintenance Manual for Roads and Bridges.

Regular inspection and maintenance of the bridges (crossing river/waterway/and crossing roads) shall be undertaken by the DPWH-DEO concerned to ensure structural integrity of the facilities. Regular de-clogging and de-silting of the culverts shall be maintained to prevent flooding, particularly at low-lying and identified flood-prone areas.

1.7.4 Abandonment Phase

Abandonment for infrastructure project would mean that after end life of the road/bridge:

- Abandonment plan includes Land/soil restoration, decontamination or remediation activities and procedures and projected schedule which shall be prepared and submitted to DENR before implementation.
- Demolished temporary facilities/ construction yard
- Clearing and cleaning vacated construction yard
- Pull out equipment and other construction materials
- Disposal of all construction debris and other waste
- Rehabilitate vacated construction areas if needed

1.8 Manpower Requirements

During its peak of construction, the proposed project will utilize about 1100 workers at a given time of construction. About 400 of them are skilled workers and about 700 are unskilled workers. The DPWH will include in the agreement with the contractors a provision of priority in hiring qualified local resident from host and neighboring LGUs. The contractors will coordinate with the concerned LGU offices in the dissemination of job openings for the PGN Bridge project. The information will be allowed for general circulation when no qualified local residents are hired within an agreed period of time between the contractors and the LGUs.

Table 16 shows the indicative number of skilled and unskilled workers during construction and operation phases. During the construction, most of the skilled workers to be required are engineers, welders, heavy equipment operators, administration and accounting; and security personnel. The unskilled workers for the construction are mostly for excavation road foundation, concrete infusion, vibrating operation, steel bar processing, lashing operation and aides etc. During operation, most of the skilled workers to be required are for road maintenance; for road patrols and emergency assistance, for administration and accounting. The unskilled workers for the operation are mostly for janitorial works and maintenance of the buffer zones.

Table 16. Estimated Number of Workers

Phase	Skilled	Unskilled
Construction period	400 70% male 30% female	700 90% male 10% female
Operation period	100 50% male 50% female	50 70% male 30% female

1.9 Project Cost

The total estimated amount of Line B on Section A (four-lane) + Line D on Section B (two-lane) line in recommended scheme is ¥27,362,707,000 or ₱211, 862.12 million Philippine pesos. The total estimated amount of above-said project does not include the cost of land requisition and demolishing.

1.10 Project Duration and Schedule

The progress schedule is tentatively arranged as follows:
(1) Related government agencies and interested financial lending institutions make assessment of the project, which is expected to take 12 months;
(2) The Philippine side negotiate and sign loan agreements with interested financial institutions, which is expected to take 6 months;
(3) After the loan agreement is signed, selection of consultants will start, which is expected to take 3 months.
(4) After the consultant is selected, the engineering design will commence, which is expected to take 15 months;
(5) With the start of engineering design, expropriation concerning Right of Way can start at the same time, which is be expected to take 15 months;
(6) Selection of contractors, which is expected to take 6 months;
(7) The contractor enters the site and the construction starts. Till completion and handover, the duration is expected to be 72 months.

The construction organization progress chart is as follows:

Table 17. Construction Progress Chart

DESCRIPTION		Period	Year 1		Year 2		Year 3		Year 4		Year 5		Year 6		Year 7		Year 8		Year 9		Year 10
		(Month)	1-6	11-12	1-6	7-12	1-6	7-12	1-6	7-12	1-6	7-12	1-6	7-12	1-6	7-12	1-6	7-12	1-6	7-12	1-6
I RELATED GOVERNMENT AGENCIES AND INTERESTED FINANCIAL LENDING INSTITUTIONS MAKE ASSESSMENT OF THE PROJECT	1. Project assessment	12																			
	2.Signing loan agreement	6																			
II ENGINEERING DESIGN	1. Selection of design consultant	3																			
	2. Detailed engineering design	15																			
	3. Collection of Right of Way fee	15																			
III. BIDDING FOR PROJECT CONTRACTOR	Tender and bidding	6																			
IV. ENGINEERING CONSTRUCTION	1. Construction preparation	8																			
	2. Construction of trestles and wharfs	6																			
	3. Construction of main bridge	56																			
	3.1 Construction of pile foundations	14																			
	3.2 Construction of bearing platforms	12																			
	3.3 Construction of tower columns	16																			
	3.4 Construction of main beams	14																			
	4. Construction of 30m I beams for approach span	36																			
	4.1 Construction of pile foundations	18																			
	4.2 Construction of bearing platforms	18																			
	4.3 Construction of piers	18																			
	4.4 Prefabrication and erection of I beams	28																			
	5. Construction of 100m concrete beams for approach span	36																			
	5.1 Construction of pile foundations	15																			
	5.2 Construction of bearing platforms	18																			
	5.3 Construction of pier bodies	9																			
	5.4 Prefabrication and erection of main beams	24																			
	6. Construction of linking line works	30																			
	7. Construction of ancillary works	8																			

Chapter 2

BASELINE ENVIRONMENTAL CONDITIONS, IMPACT ASSESSMENT AND MITIGATION

2.0 BASELINE ENVIRONMENTAL CONDITIONS

The following discussion on the environmental impact of the project was based on the outline provided under DAO 2003-30 under the Environmental Management Bureau of the Department of Environment and Natural Resources (EMB - DENR).

Determinations of baseline environmental conditions were undertaken through research and secondary data. Furthermore, ocular inspections of the project site as well as its immediate vicinity and contiguous area/community were undertaken to determine any possible impact. Weather conditions were based on the Coronas classification of the Philippine climate. Also, provincial map, vicinity map and local map were secured to identify any possible social impact.

2.1 Land

2.1.1 Land Use and Classification

2.1.1.1 Land Area and Land Use

The region has a total land area of 2,022,311 hectares or approximately 35.7 percent of the total land area of the Visayas and 6.7 percent of the Philippines. The Province of Negros Occidental is the biggest in terms of land area with 792,607 hectares which is almost 40% of the total area of the region. Iloilo comes second with 471,940 hectares or 23%: Capiz with 263,317 hectares or 13%: Antique with 252,201 hectares or 12%: Aklan with 181,789 hectares or 9% and Guimaras with 60,457 hectares or 3%. In Guimaras, Forest and Forestlands (FFL) cover 5,459.40 hectares and Alienable and Disposable lands cover 54,593 hectares, more or less. (Source, DENR).

Based on the GIS computed data, the proposed PGN bridge alignment will pass through different land uses as shown in **Figures 1a, 1b, 1c and 1d**. Among the land uses include annual crop, perennial crop, brush/shrub land, fishpond and sea. In Leganes, Iloilo on **Figure 1a**, dominant land use within the project alignment are fishponds and mangrove forest. In terms of land use in Buenavista as shown in **Figure 1b**, majority of the project area are annual crops. Alignment of road also falls under fishponds, perennial crops and built-up areas. On **Figure 1c** in San Lorenzo, it is also dominated by annual crops in terms of land use. There are also portiond of fishponds, mangrove forest and inland water. Dominant land use in Pulupandan on **Figure 1d** is annual crop due to farming activities of the majority. Alignment also covers small portion of fishponds and perennial crops.

Table 1 shows the distribution of the land uses of the proposed PGN bridge project.

Table 1. Land use distribution of the PGN Project

Description	Area (ha)	Length (km)
Panay to Guimaras		
Annual Crop	5.65	5.24
Perennial Crop	1.21	1.23
Brush/Shrubs	8.36	7.80
Fishpond	2.81	3.03
Sea	10.51	9.61
Total	28.54	26.91
Guimaras to Panay		
Annual Crop	8.29	7.64
Perennial Crop	0.16	0.19
Fishpond	1.91	1.83
Sea	27.9167	25.5437
Total	38.2729	35.2051

Note: Values are based on GIS computation, 2015 NAMRIA data
Source: EIA Team

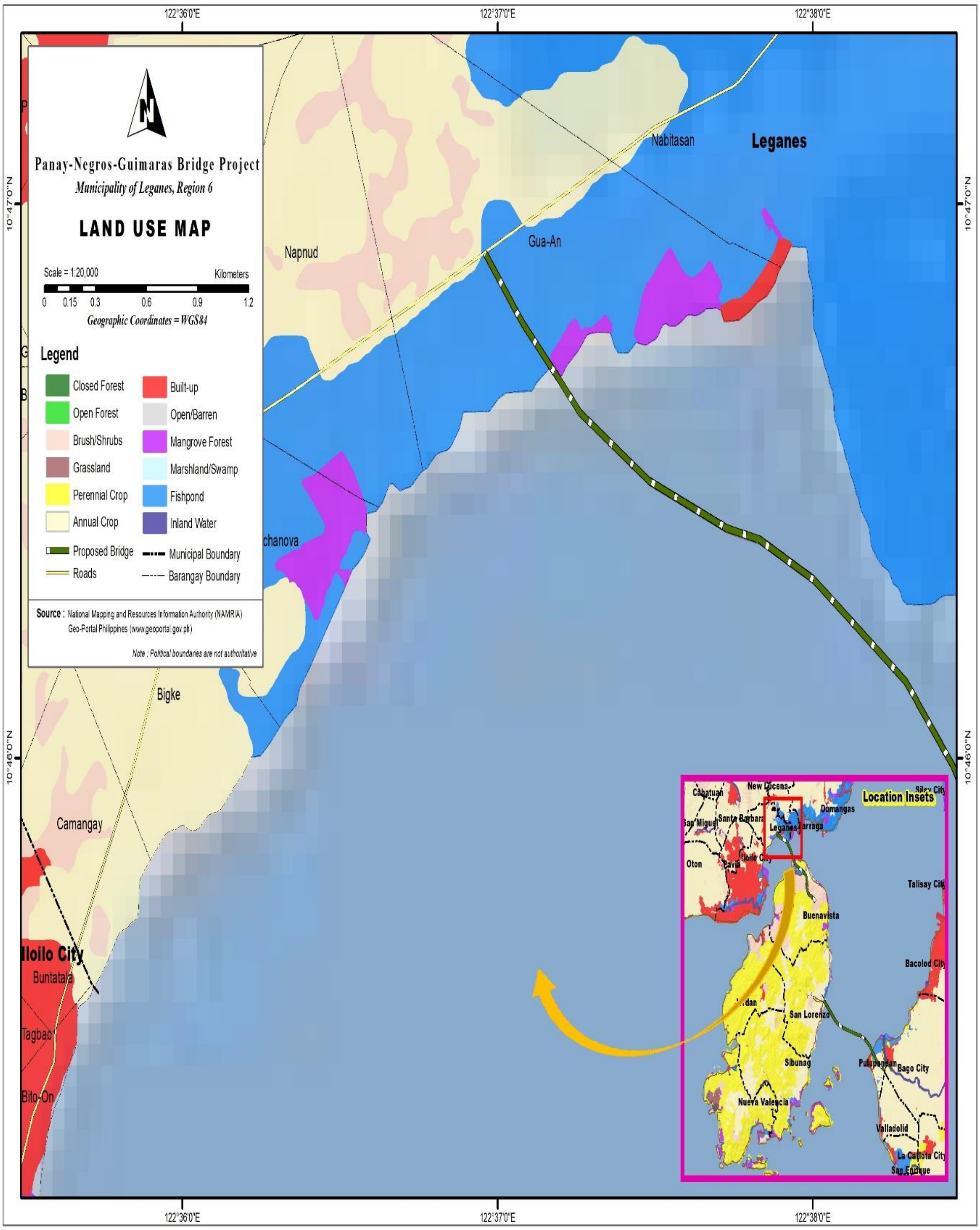


Figure 1a. Land Use Map of Leganes, Iloilo
Source: EIA Team

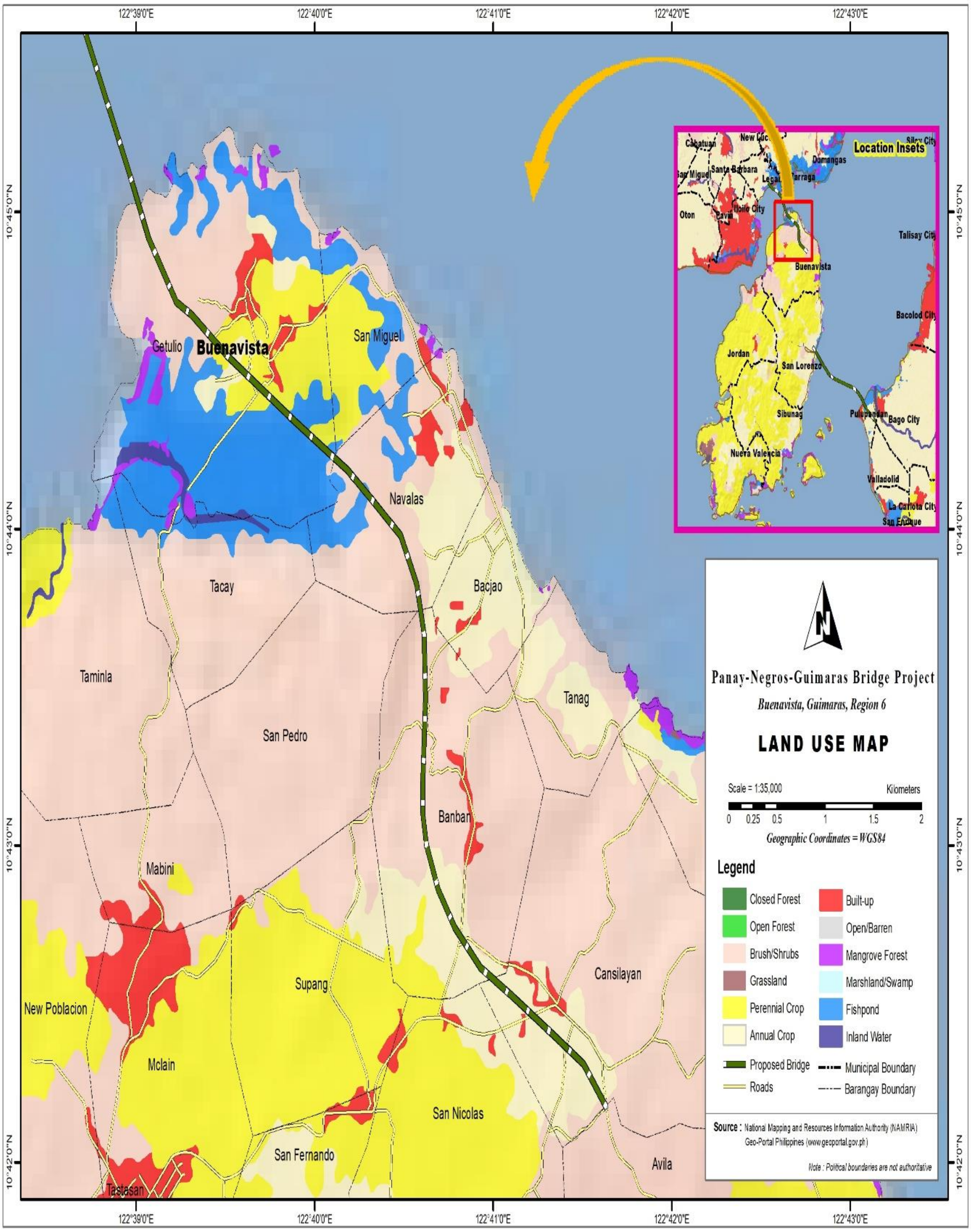


Figure 1b. Land Use Map of Buenavista, Guimaras
Source: EIA Team

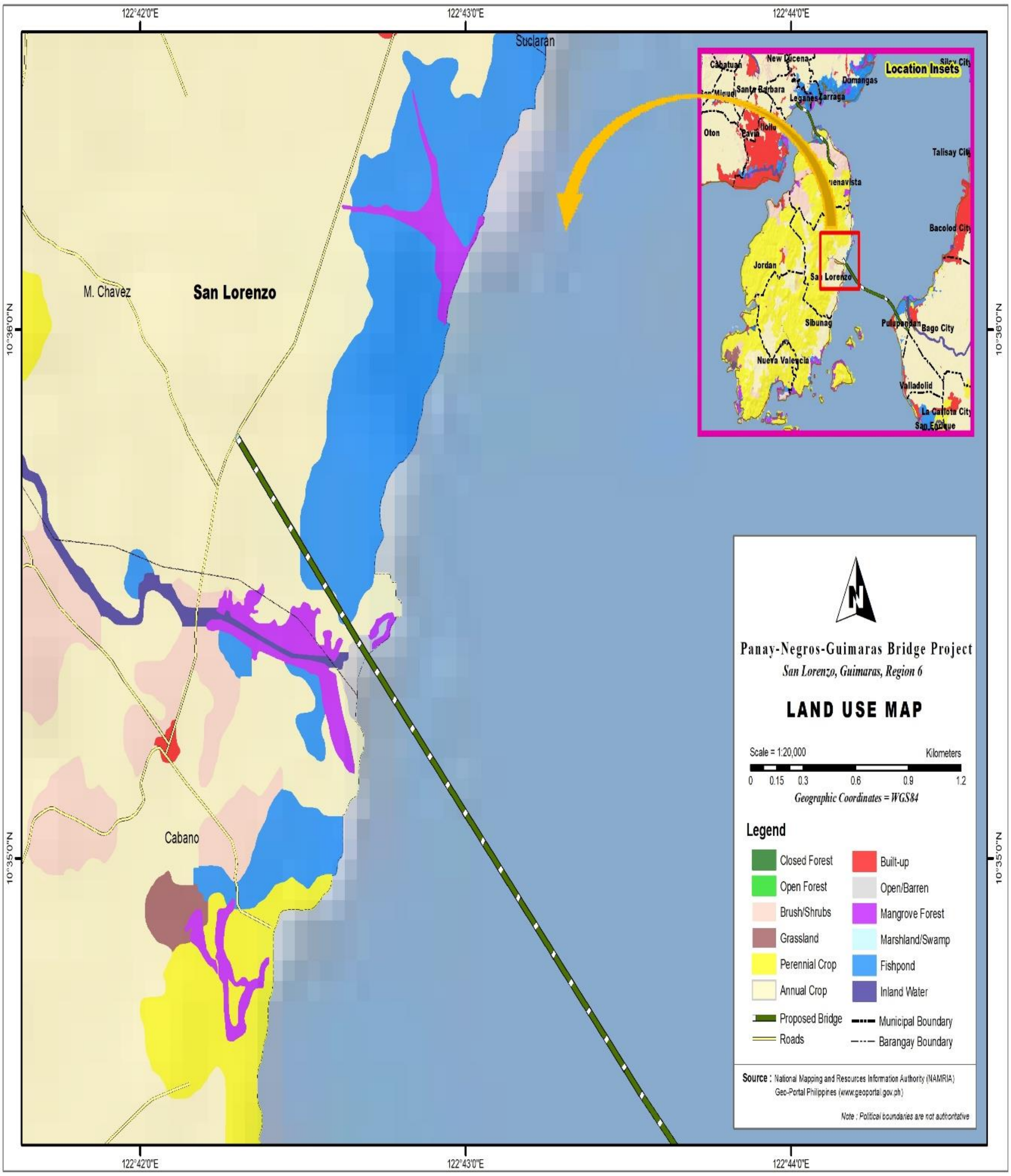


Figure 1c. Land Use Map of San Lorenzo, Guimaras
Source: EIA Team

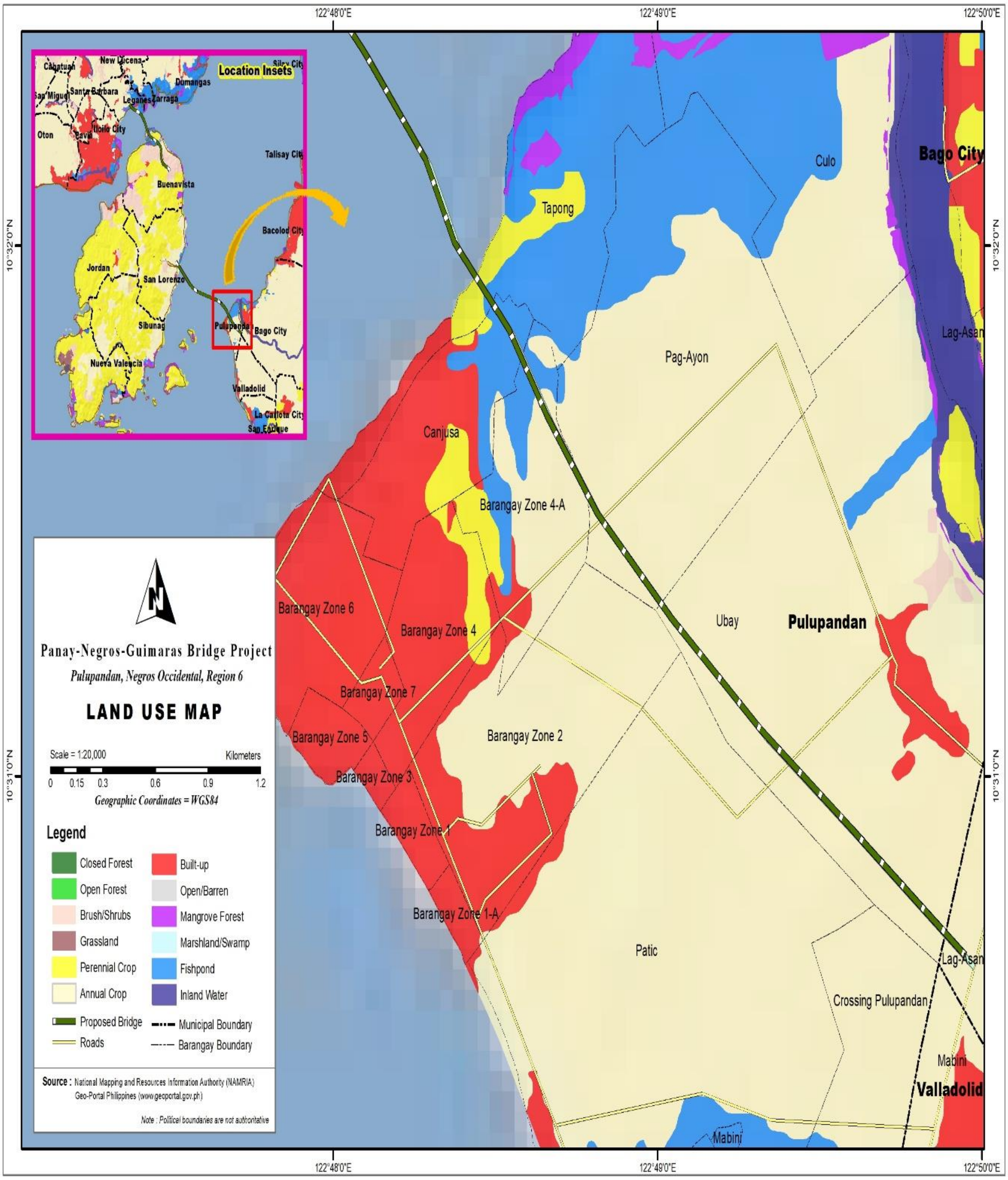


Figure 1d. Land Use Map of Pulupandan, Negros Occidental
Source: EIA Team

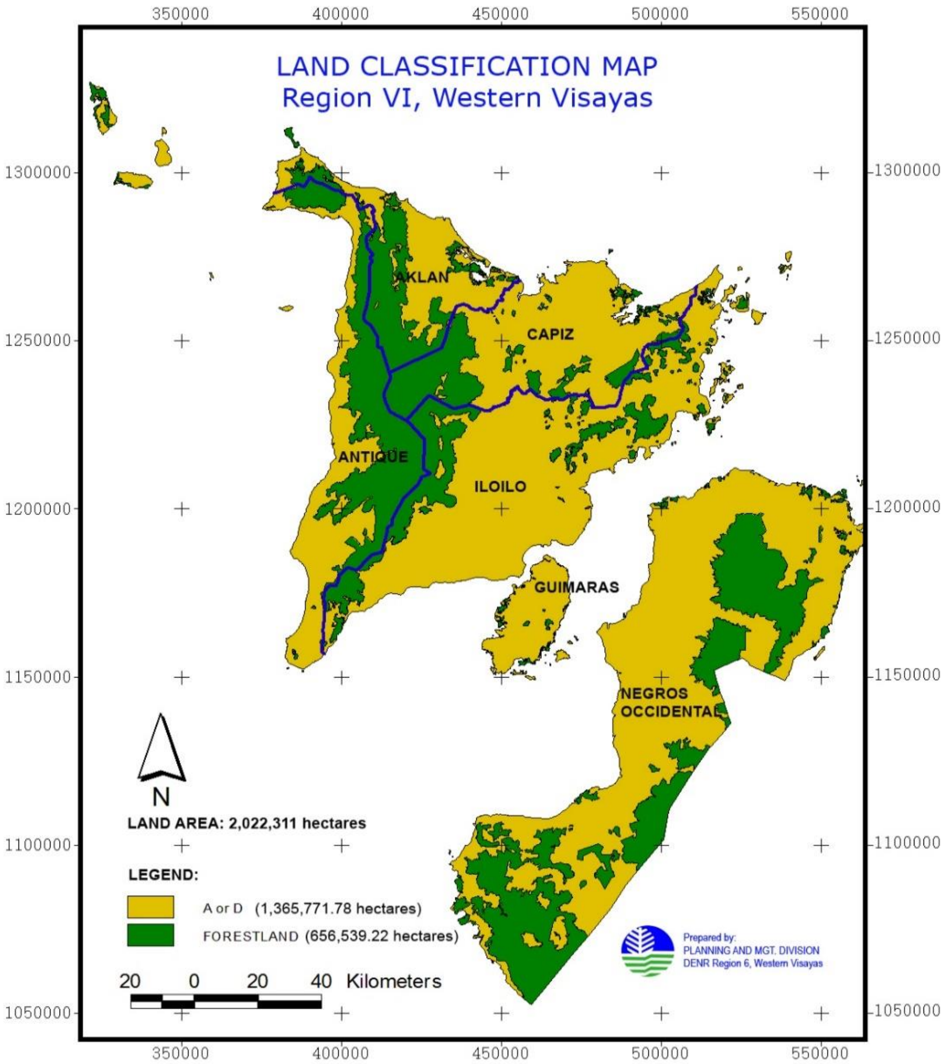
2.1.1.2 Land Classification

Region 6 has a total land area of 2,022,311 hectares. It is classified into Forestland covering an area of 656,539.22 hectares equivalent to 32% and Alienable and Disposable lands covering 1,365,771.78 hectares or around 68%. **Figure 2** shows the land classification map of Region 6.

The Province of Aklan has a total area of 181,789 hectares of which 59% or 106,795 hectares are classified as A & D while 41% or 74,994 hectares are classified as Forestland.

The Province of Iloilo has a total land area of 471,940 hectares. Of this, 76% or 357,857 hectares are classified as A & D while 24% or 57,620.89 hectares are classified as Forestland.

The Province of Negros Occidental has a total land area of 792,607 hectares of which 68% or 540,385.62 hectares are classified as A & D, while 32% or 252,221.38 hectares are classified as Forestland. (Source, DENR)



Source: DENR

Figure 2. Land Classification Map of Region VI

The proposed PGN bridge alignment will pass through Key Biodiversity Area (KBA) equivalent to 2.47 hectares based on the GIS computed data. **Figure 3 & Figure 4** show the ECA map of PGN.

Table 2. ECA of the proposed PGN Bridge Project

Description	Area (ha)	Length (km)
Panay to Guimaras		
KBA	2.64	2.47
Land	15.60	14.38
Sea	8.31	7.67
Flood Prone Area	2.00	1.91
Total	28.54	26.44

Guimaras to Panay		
Land	10.33	9.42
Sea	26.73	24.40
SeaWeeds/Seagrass	1.21	1.15
Total	38.27	34.97

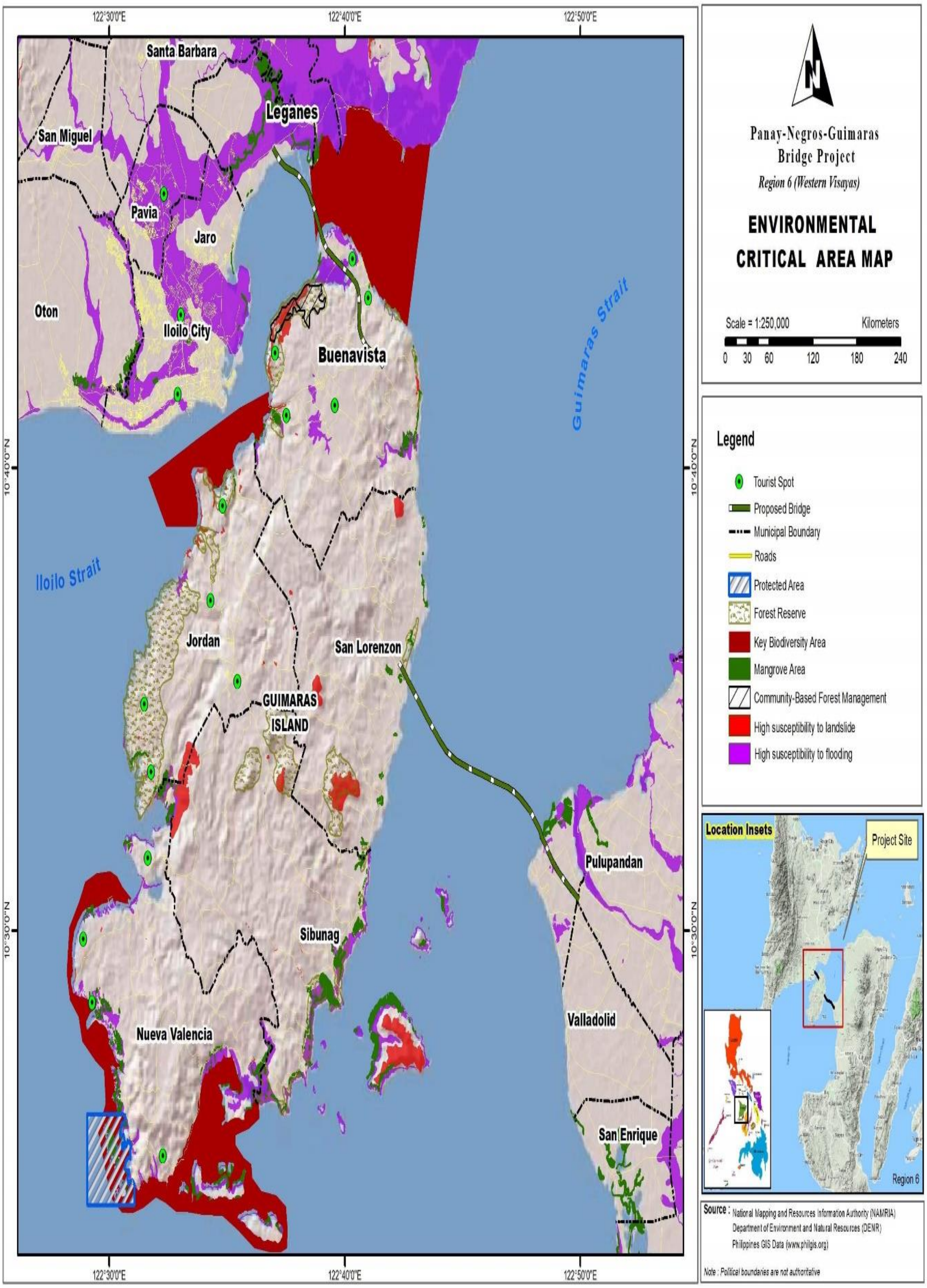


Figure 3. Environmental Critical Area Map of PGN Project
Source: EIA Team

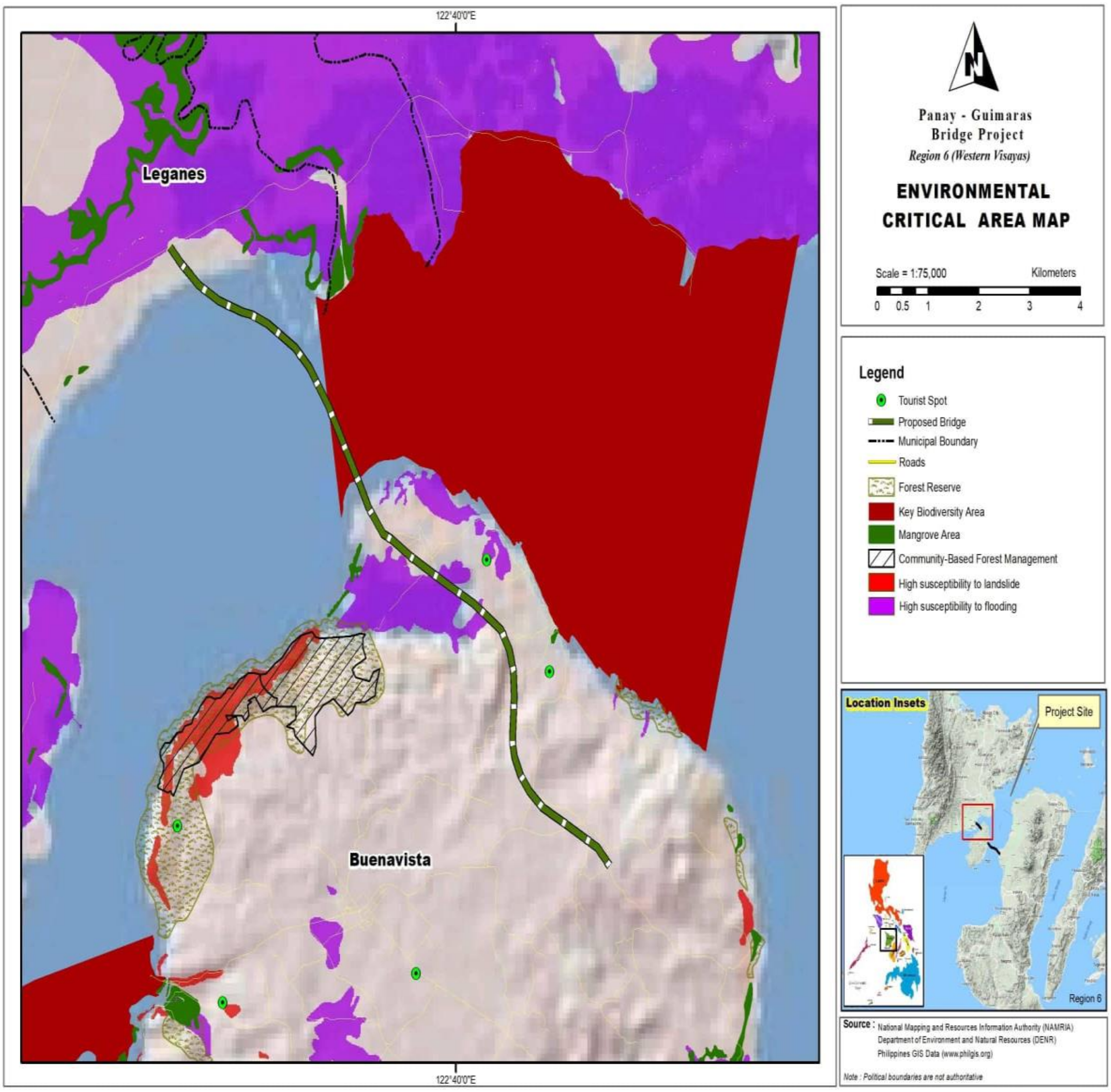


Figure 4. ECA the proposed PGN Bridge project (Panay-Guimaras alignment)
Source: EIA Team

Table 3 presents the area of Forest and Forest Land in Guimaras. It shows that Jordan has the largest upland forest and Nueva Valencia has the largest mangrove cover.

Table 3. Area of Forest and Forest Land (FFL) per Municipality in Guimaras

Municipality	FFL Classification (has)				Total
	FL (Upland)	FL (Fishpond)	FL (Mangrove)	Unclassified	
Buenavista	432.39	57.43	10.96	13.09	513.87
Jordan	1,090.46	15.29	36.22	12.73	1,154.70
Nueva Valencia	0.65	455.04	143.47	599.86	1,199.01
San Lorenzo	460.14	110.91	3.49	68.77	643.31
Sibunag	232.13	495.21	66.88	1,154.30	1,948.51
Total	2,215.77	1,133.88	261.02	1,848.75	5,459.40

a. Forest Cover

Based on 2005 data of Land Evaluation Party (LEP) – DENR 6, the forest cover is measured at 260,642.74 hectares or equivalent to 12.89 percent of the total land area of the region. 5.27% of the forest cover is classified as closed forest; 5.11% as open forest; 0.28% as plantation forest and 2.23% as mangrove forest.

Among the 6 provinces, Antique has the highest percent forest cover at 28.58% of its total land area or 72,022.25 hectares, followed by Aklan with 26.54% or 48,254.00 hectares. Capiz comes next with 11.47% or 30,208.27 hectares, Iloilo with 8.73% or 41,190.35 hectares, and Negros Occidental with 8.69% or 68,857.87 hectares. Guimaras has the lowest percent forest cover at 0.18% of its total land area or 110 hectares. (Source, DENR)

b Production and Protection Forests

Of the total forestland area of 656,539.22 hectares of the region, 376,380.38 hectares or 57% accounts for production forest and 280,158.84 hectares or 43% are for protection forest. Province of Negros Occidental has the largest area for both protection and production forest at 104,877.06 and 147,344.00 hectares, respectively. Province of Aklan has 46,650 hectares of protection forest and 8,344 hectares of production forest.

Antique has 69,008.79 and 49,626.21, Capiz has 22,267 and 71,502, and Iloilo has an area of 37,355.99 and 76,727.01 hectares of protection and production forest respectively. The province of Guimaras has 2,836.11 hectares only for production forest.

In Guimaras, The Forest and Forestland of Guimaras covers a total area of 5,459.40 hectares located in fifty-three (53) barangays comprising of 1,414 households. This plan primarily focuses on FFL categorized as: protection and production areas. The protection area covers 3,611 hectares associated with high biodiversity of forest and mangrove vegetation species, areas with aesthetic and natural landscape to develop as model site for community based-tourism, and unclassified forest lands (islands and islets) and riverbanks for eco-tourism due to its natural and scenic beauty that could provide recreational benefit and enjoyment for Guimarasnons and tourists. The production area covers 1,848.40 hectares mainly for production of fuel wood, agroforestry using high valued crops and fishpond development.

c. Watershed Areas

At present, there are nine (9) proclaimed Watershed Forest Reserves (WFRs) in the region, covering an aggregate area of 131,777 hectares. The Aklan River Watershed Forest Reserve in Aklan has an area of 23,185 hectares located in the municipalities of Madalag and Libacao. Two proclaimed watersheds are in the Province of Iloilo namely: Maasin Watershed Forest Reserve and the Jalaur River Watershed Forest Reserve with a total area of 15,378 hectares and located in the Municipalities of Maasin and Calinog. The Province of Negros Occidental has three (3) watersheds namely: Bago River Watershed Forest Reserve, Ilog-Hilabangan Watershed Forest Reserve, and Kabankalan Watershed Forest Reserve covering a total area of 72,569 hectares and located in the Cities of Bago and San Carlos, Kabankalan and Himamaylan.

d. Protected Areas

With the implementation of RA 7586 or the NIPAS Law of 1992, the region identified twelve (12) areas as initial components that may be legislated into NIPAS. These areas are being assessed and/or will be assessed to determine the current biodiversity status as to their suitability into the new system and reclassified into different categories provided by the law or will be disestablished and placed under the different management regime.

Among the twelve (12) sites identified as initial components, three (3) were proclaimed following the procedures provided in the law, covering an approximate area of 62,059.07 hectares. Two (2) of these were enacted in CY 2001 namely: the Sagay Marine Reserve (Republic Act No. 9106 dated April 14, 2001) in the City of Sagay, Province of Negros Occidental covering an area of 32,000.00 hectares and the Mt. Kanla-on Natural Park (Republic Act No. 9154 dated August 11, 2001) located in the Cities of Bago, La Carlota, and San Carlos and in the Municipalities of La Castellana and Murcia, Province of Negros Occidental, and in the City of Canlaon and Municipality of Vallehermoso, Province of Negros Oriental and covers an area of 24,557.60 hectares. Additional NIPAS sites proclaimed were Northwest Panay Peninsula found in Buruanga, Malay, Aklan and Pandan, Libertad, Antique covering an area of 12,009.29 and North Negros Natural Park located in the cities of Talisay, Victorias and Cadiz and in the municipalities of Murcia, Don Salvador Benedicto and Calatrava with an area of 80,454.50 while the designated buffer zone covers 169.00 hectares.

A mixed brushland-beach forest is along the project right-of-way. Beach forest and mangrove forest share some species (i.e. Lumnitzera, Excoecaria), where people might confuse the ecosystem is a mangrove. Strict Mangrove Forest, I say, are species with stilt roots and pneumatophores like Rhizophora, Avicennia, Brugierra etc. While the entire coast of the Municipality of Pulupundan is part of the Negros Occidental Coastal Wetlands Conservation Area (NOCWCA), the bridge project will cover only a small width (bridge, bridge landing and access road) of this coast, which will not impede the navigation of marine and coastal wildlife (turtles, birds). For plants, the concern is if there is a strict mangrove forest that may be affected, but there is none. The NOCWCA is part of the Ramsar Convention on Wetlands, which aims for the conservation and wise use of all wetlands through local and national actions and international cooperation. Yes, somehow, there may be an impact, but this can be address if the project proponent ensures to rehabilitate the surrounding area of the project right-of-way, in close observance of the scope of NOCWCA.

2.1.1.3 Tenurial Instruments

Figure 5 shows the tenurial map of the proposed PGN bridge project and **Figure 6** shows the tenurial map of the proposed bridge alignment in Leganes, Iloilo and Buenavista, Guimaras side. Based on the map, there are no tenurial instruments that will be affected by the proposed project.

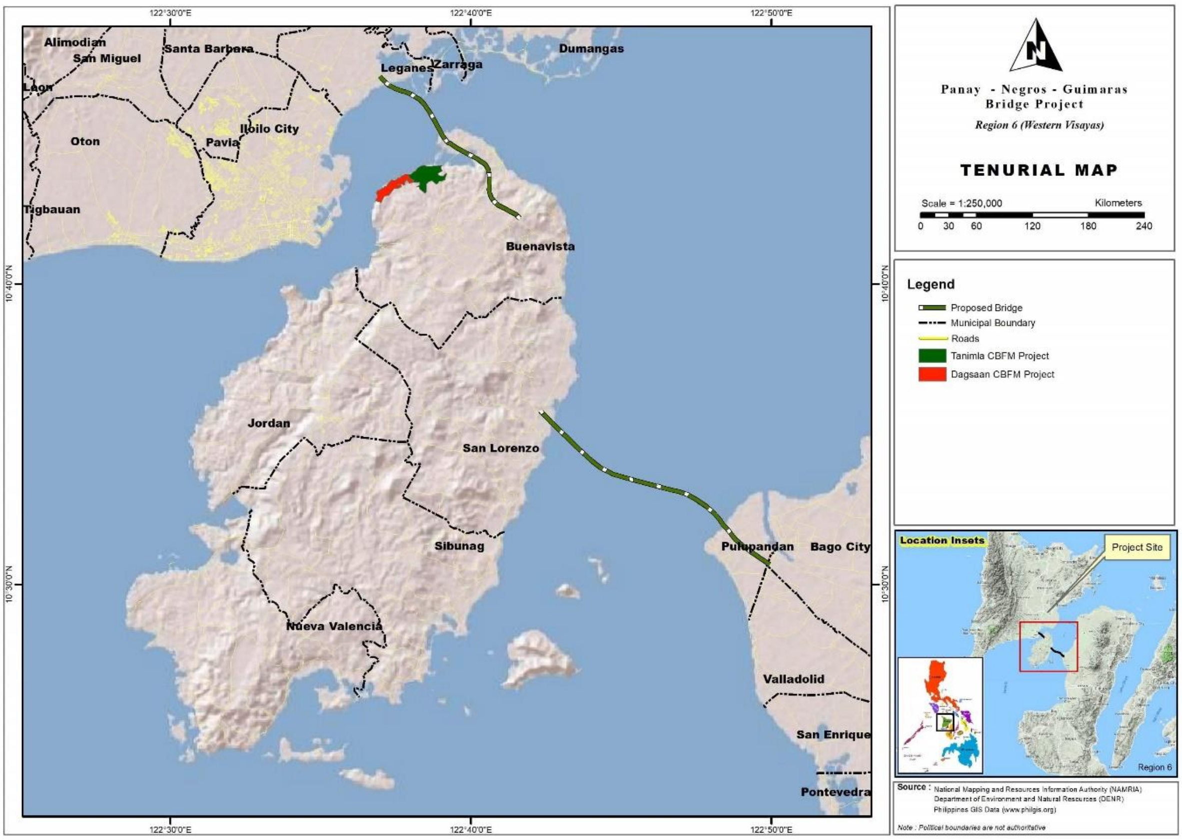


Figure 5. Tenurial Map of PGN Project
Source: EIA Team

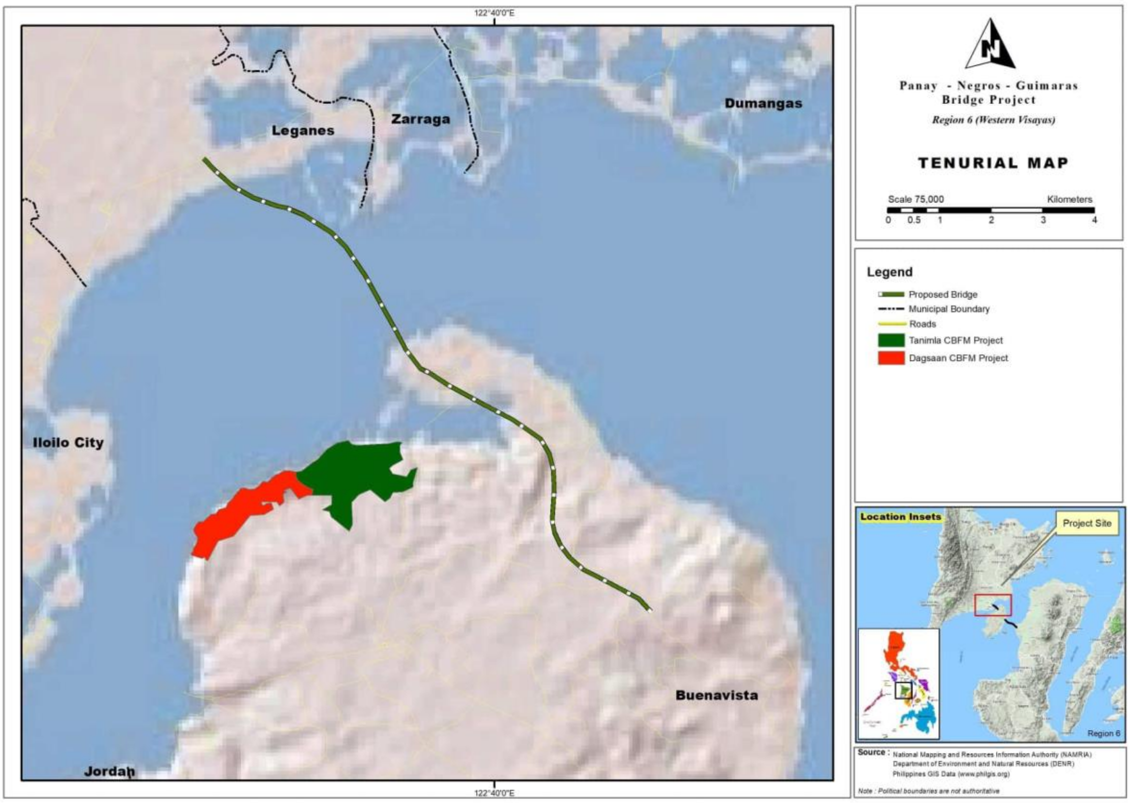


Figure 6. Tenurial Map of the proposed PGN Bridge Project (Panay-Guimaras alignment)
Source: EIA Team

2.1.1.3.1 Impacts on Land Tenure

Section A

Section A- Alignment B (Table 42) takes off from Barangay Gua-an in Leganes and touches down in Barangay Getulio. Gua-an is characterized by areas of aquafarms and salt beds. The alignment also touches on mangrove area at the shoreline.

The rest of the land is occupied by residential houses and farmlands. Alignment B has 33 land areas that are considered to be severely affected. **Tables 4a and 4b** present the list of barangays affected by the alignment on Section A and Section B respectively.

Table 4a. Impacts of Land Tenure on Barangays Affected by the alignment at Section A

LOCATION	TOTAL			SEVERITY OF EFFECT			
	SQ.M	MARKET VALUE	ASSESSED VALUE	SEVERE		MARGINAL	
				SQ.M	NO.	SQ.M	NO.
CANSILAYAN	93,770	636,381.77	240,551	-		13,648	13
BANBAN	354,627	1,907,292.23	749,360	40,965	9	18,314	17
NAVALAS	807,902	5,657,956.52	2,263,189	-		121,185	22
GETULIO	2,126,146	14,299,436.49	5,716,504	231,277	6	292,262	16
SAN NICOLAS	224,315	1,570,205.00	628,082	100,778	8	40,377	3
GUA-AN-LAND	1,254,527	219,364,363.40	87,745,745	103,217	6	12,392	7
GUA-AN SALT BED	6,800	3,468,000.00	1,387,200	6,800	1		
GUA-AN- AQUAFARM	64,670	4,202,256.60	1,680,903	64,670	3		
TOTAL	**4,932,757**	**251,105,892**	**100,411,533**	**547,707**	**33**	**498,178**	**78**

Section B

Section B (Alignment D) connects the Guimaras Island with Negros Island, starting from Barangay M. Chavez in San Lorenzo to land in Barangay Tapong in Pulupandan. It stretches further inland through Barangay Pag-ayon until the endpoint at Barangay Ubay, along the National Road. Due to the extent of coverage under this alignment, about 3,948,247 square meters of land will be affected while 839,109, square meters will be severely affected. Most of the severely affected lands (80 individual lands) are in Barangay M. Chavez. Total market value of the affected lands is PhP3,600,851,304.00. Lands in Pululandan are bigger in cut, thus the impact of the alignment is estimated to be marginal in effect compared to M. Chavez.

Table 4b. Impacts of Land Tenure on Barangays Affected by the alignment at Section B

LOCATION	T O T A L			SEVERITY OF EFFECT			
	SQ.M	MARKET VALUE	ASSESSED VALUE	SEVERE		MARGINAL	
				SQ.M	NO.	SQ.M	NO.
TAPONG	457,388	7,394,738	2,957,900			27,842	3
PAG-AYON	1,251,214	50,753,659	17,150,680			68,617	11
UBAY	1,215,000	41,056,250	16,322,490	43,142	1	73,409	18
M.CHAVEZ	1,024,645	10,097,643	2,903,875	795,967	79	4,322	4
TOTAL	**3,948,247**	**109,302,289**	**39,334,945**	**839,109**	**80**	**174,190**	**36**

2.1.1.3.2 Impairment of visual aesthetics

There are no significant landforms, landscapes and structures in the project alignments.

2.1.1.3.3 Devaluation of land value as a results of improper solid waste management and other related impacts

Impacts on solid waste management will be temporary. Construction debris will be used for back-filling. Proper solid waste management and disposal plan will be in placed to ensure discharges and contamination in the environment will be avoided.

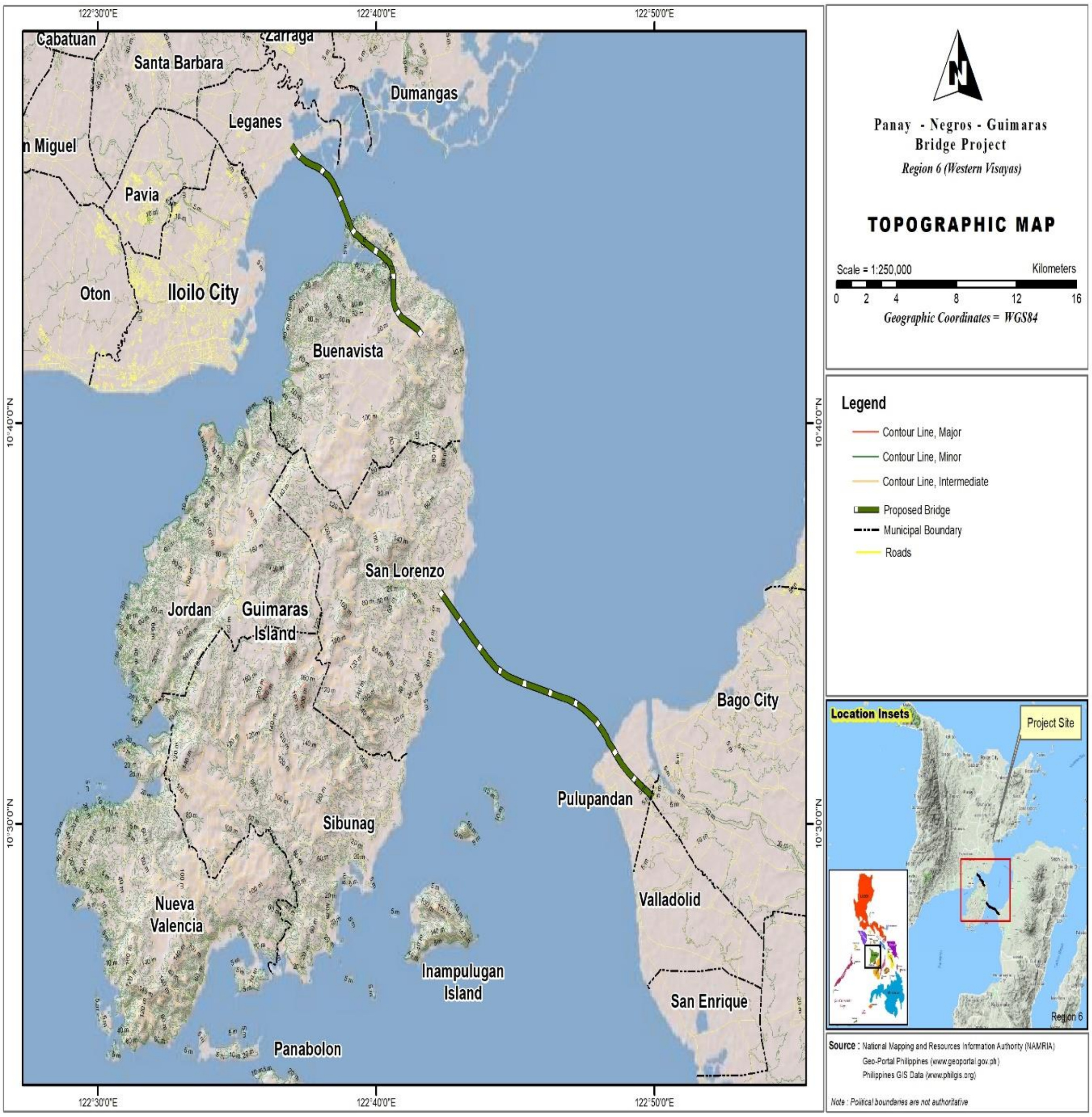
2.1.2 Geology and Geomorphology

2.1.2.1 Topography

The province of Iloilo is geographically divided into two districts, the western part of the Panay Mountains and the lowlands in the east. The northernmost Visayas Sea is dotted with small islands, mainly Pan de Azucar and Sicogon. Located on the junction of Iloilo, Capiz and Antik, Baloy is the highest mountain in Iloilo, at an altitude of 1908 meters. **Figure 7** shows the topography of PGN project.

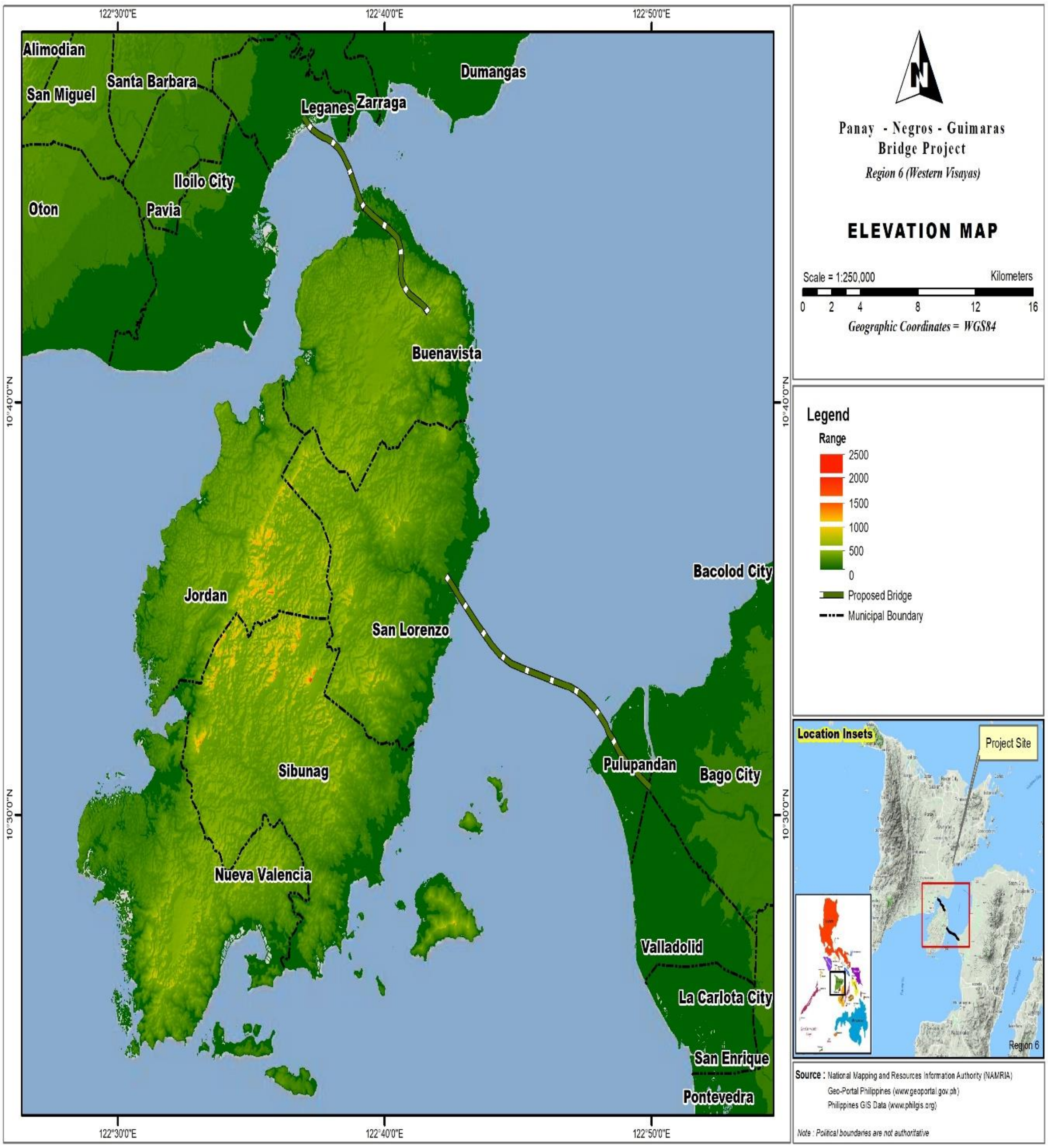
The islands of Guimaras and the surrounding islands are considered by the geologists to be land connected to Panay Island. Most of them are hilly terrain with an altitude of less than 200 meters, and the east coast is a strip-shaped lowland beach. The topography of Guimaras island varies from level to steeply sloping, with land elevation ranging from 0 to nearly 300 masl. Mt. Dinalman, located in Milan, Sibunag, has the highest elevation of 267 masl. Guimaras' topography shows quite steep slopes on the western side of island with plateaus and peaks above 200 m in the central portion. A large part or 69% of the total land area is within the 0-18% slope, 19.73% is above 18-30% slope, 9.42% is above 30-50% slope and 1.74 percent is above 50% slope. Based on the preliminary Karst subsidence susceptibility mapping of Mines and Geosciences Bureau (MGB), in the Municipality of Buenavista there are 89 sinkholes (all types) and 85 cave openings while there are 457 sinkholes (all types) and 282 cave openings in the Municipality of Jordan.

The south bank of Iloilo Island in the northwestern end of the bridge area is relatively flat. It belongs to the landform of the Chonghai Plain. The elevation of the ground is less than 2.0m. The southeastern side of the island of Guimaras has an ups and downs, belonging to the hilly landform, the rushing sea plain and the piedmont plain. The elevation of the ground is generally between 0 and 90 m. The terrain of the middle cross-sea bridge is slightly lower. It belongs to the sea stall, the underwater shallow stall and the shallow sea accumulation plain. The ground elevation is at least -37m. **Figure 8** shows the elevation map of PGN project.



Source: EIA Team

Figure 7. Topographic Map of the Project Site



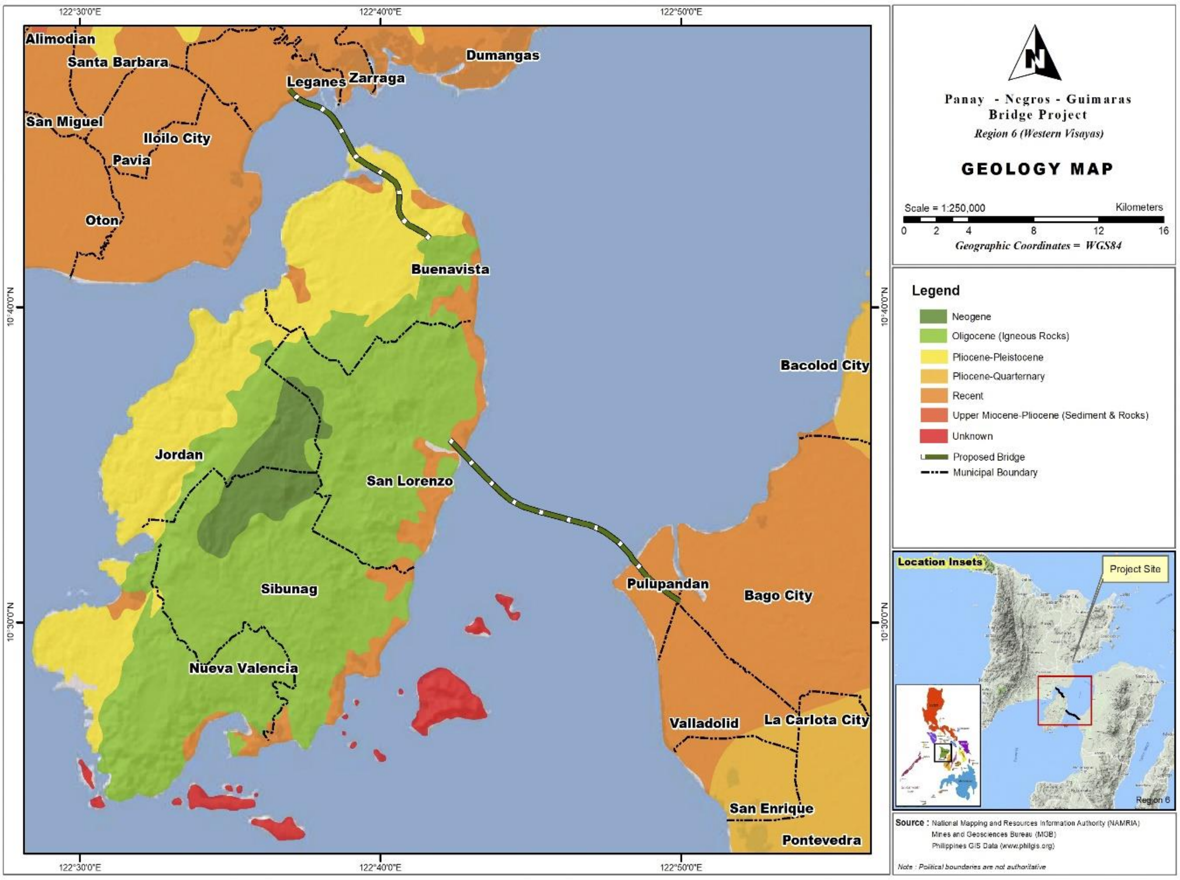
Source: EIA Team

Figure 8. Elevation Map of the Project Site

2.1.2.2 Geological structure

2.1.2.2.1 Regional structure

Figure 9 shows the geologica map of PGN project. The geotectonic structure of the study area (**Figure 10**) belongs to the Philippine plate (II), with the Eurasian plate (I) on the southwest and the Philippine sea plate on the northeast (III). The Eurasian plate and the Philippine Sea plate subducted into the lower part of the Philippine plate, forming the Negros subduction zone in the west and the Philippine subduction zone in the east. The Philippine break across the Philippine plate divides the Philippine plate into two sub-structural units: the western plate of the Philippines (II1) and the eastern plate of the Philippines (II2).



Source: EIA Team

Figure 9. General Geologic Map of PGN

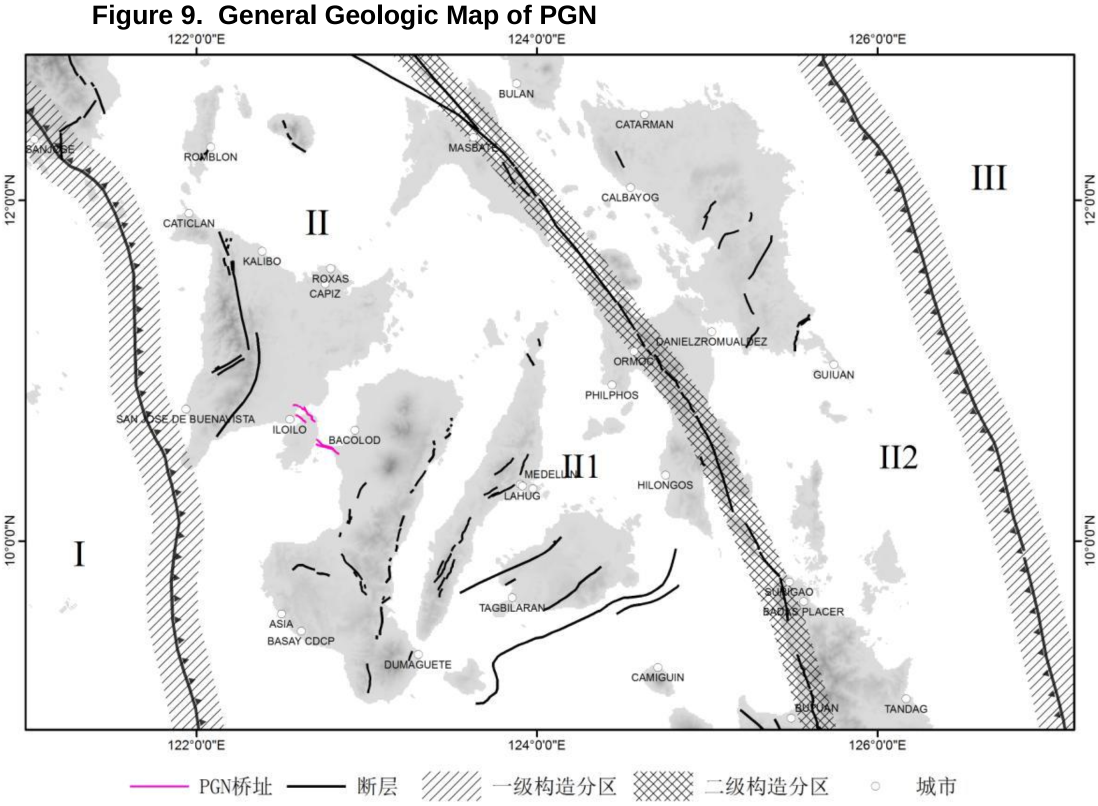


Figure 10. Geodetic division map

First-class geotectonic division: I-Eurasia plate; II-Philippine plate; III-Philippine sea plate

Secondary structural unit: II1-Philippine West Plate; II2-Philippine East Plate

Source: Seismic Safety Evaluation Report For Panay-Guimaras-Negros Island Bridges Project In The Republic Of The Philippines (October 2019)

In the project area (400km), the southwestern part is the Eurasian plate and the northeast is the Philippine sea plate. As the Eurasian plate and the Philippine Sea plate subducted, the Negros subduction zone in the west and the Philippine subduction zone in the east were formed. According to GPS observations, the subduction rate of the Eurasian plate is ~6mm/a, and the subduction rate of the Philippine sea plate is ~7-9mm/a. The intense crustal movement produced a large number of earthquakes.

The area is one of the most active tectonic zones with frequent seismic activity. The epicentral distribution map of the earthquake clearly shows that the area is covered by shallow and deep earthquakes, and the subduction seismic zone controls the seismic distribution of the area. Most of the shallow earthquakes in the offshore are related to the shallow brittle subduction zone called the thrust fault (depth 0-60km). Most of the deep-seismic earthquakes occur in the deeper toughness of the subduction zone, known as the Benioff belt.

2.1.2.2.2 Regional main activity fault

The fault structure of the Philippines is relatively developed, mainly including thrust faults and transverse faults. The larger ones are produced along the edge of the Philippine arc and the Su-Green arc. The longest is the Philippine trench near the SN in the eastern sea, followed by the Su-green trench in the southern NE and the Palawan trench in the western NE. And the south China Sea near the SN direction of the South China Sea trench, while in the Philippines, the thrust fault is relatively developed and distributed widely, but the scale is relatively limited, such as the thrust fault of the Central Central Mountain Range of Mianlan, Zamboangan thrust fault , Sama Island South thrust fault, Mindu Luodao East thrust fault, Kobeer thrust fault, etc., the length of up to tens of kilometers. Studies from these thrust faults show that most of the thrust fracture tends to face the trench, and the two tend to be opposite.

The transverse fault is relatively developed, with the largest scale in the Philippines. It originates in Lingayen Bay in the west of Luzon, along the southern Central Luzon Mountains to the Baltic Strait, through the Bonao Peninsula, Masbate Island and Leyte Island, to the Davao Straits in the eastern part of Mindanao. With a total length of 1200km. It is a transversely-sloping left-handed fracture with a horizontal component displacement greater than the vertical component. Studies have shown that the fault has been active since the Paleocene, and the Neogene on the Leyte Island has been displaced by 8 km; in 1977, a magnitude 7.3 earthquake occurred in Wright Bay, which displaced the existing ground fissure by 1.1 m to 3.4 m. Other large-scale transverse faults include the NW-transverse fault of Mindanao, which is 400km long. The Palawan near SN transverse fault is 300km long. It is near the SN transverse fault of Tablas in the northwest of Panay Island. It is 350km long. The north central mountain range of Luzon Island is NE-trending, with a length of 300km. Most of these transverse faults are left-handed shearing, which plays an important role in volcanic activity in this area.

According to the earthquake safety assessment report, the Philippine fault in the region is a Holocene active fault, but the distance from the PGN bridge site is more than 200km, which has limited impact on bridge construction. The West Panay rupture, the San Carlos rupture, the Calatrava-Toboso rupture and the Bindoy-Guihulngan rupture are closer to the bridge site, within 60 km. Other active break distance sites are around 100km or more.

2.1.2.2.3 Near field structure

Controlled by the subduction zone of the Pacific plate and the Philippine plate, the neotectonic features of the near-field area are obvious, and the controlling structures are mainly NE oriented.

The Panay west fault zone, which is nearly parallel to the subduction zone, is mainly distributed in the near-field area. There are two major faults, which are named the western branch of Panay west fault (f1-1) and the eastern branch of Panay west fault (f1-2).

The west branch of Panay west fault (f1-1) is located in the west of Panay island. The fault starts from Siya village in the shanxi section of Tanganhin in the north, and ends near

Bagumbayan village in the south via Cabatangan, Canawillian, Dao, Bagonanay, Pinaopawan, La Consolacion and Igpandan. The total length of the fault is about 70km, and the nearest distance to this project is about 35km. According to this investigation, it is a pre-quaternary fault, which has little impact on the project.

The eastern branch of Panay west fault (f1-2) is located in the east of Panay island. The fault is a transformation between the Pacific plate and Philippine plate subduction zone structure control, and coordinate the Panay island northwest tower blas (Tablas) NE to cross fracture strain distribution and form of important thrust faults, this fault is the latest active faults, located in the boundary zone of piedmont hills and alluvial plain, resulted in a 7.8 magnitude in Lady Caycay area in 1948. The fault starts from Agcarope village in the north, located in the east area of Tanganhin mountain, via Quiput, Dagami, Banagan, Marirong, Nangan, Buga, Dday, Bolbogan, ended in Bucaya near the village in the south, the total length of about 65 km. and the nearest distance to this project is about 30km. According to this investigation, it is a holocene activity fault, which has little impact on the project.

The getulio-valencia fault (F2) in the figure is an interpretation fault (according to geological map (Dumangas map) with the scale of 1:50000, edited by Philippine department of minerals and earth sciences, 2004). However, according to this survey, no obvious fault geomorphology was found, and it was preliminarily proved that it did not exist after verification of geophysical seismic image.

Because of landform and geological conditions, Iloilo strait also have the possibility of fault development, during the survey, single-channel seismic exploration was used in in the geophysical prospecting, no trace of fault was found in the test dates and results, combined with geological data, the formation information of horizontal line(line B and line C) is consistent with the vertical line, and no fault, fracture zone or other adverse geological phenomena were found.

In summary, no faults, fracture zones and other geological structures were found within the scope of the site. The nearest fault structures near the site were about 30km away from the site, which had little impact on the project, the structural stability of the field area is fair.

The seismic structure of the site is shown in **Figure 11**.

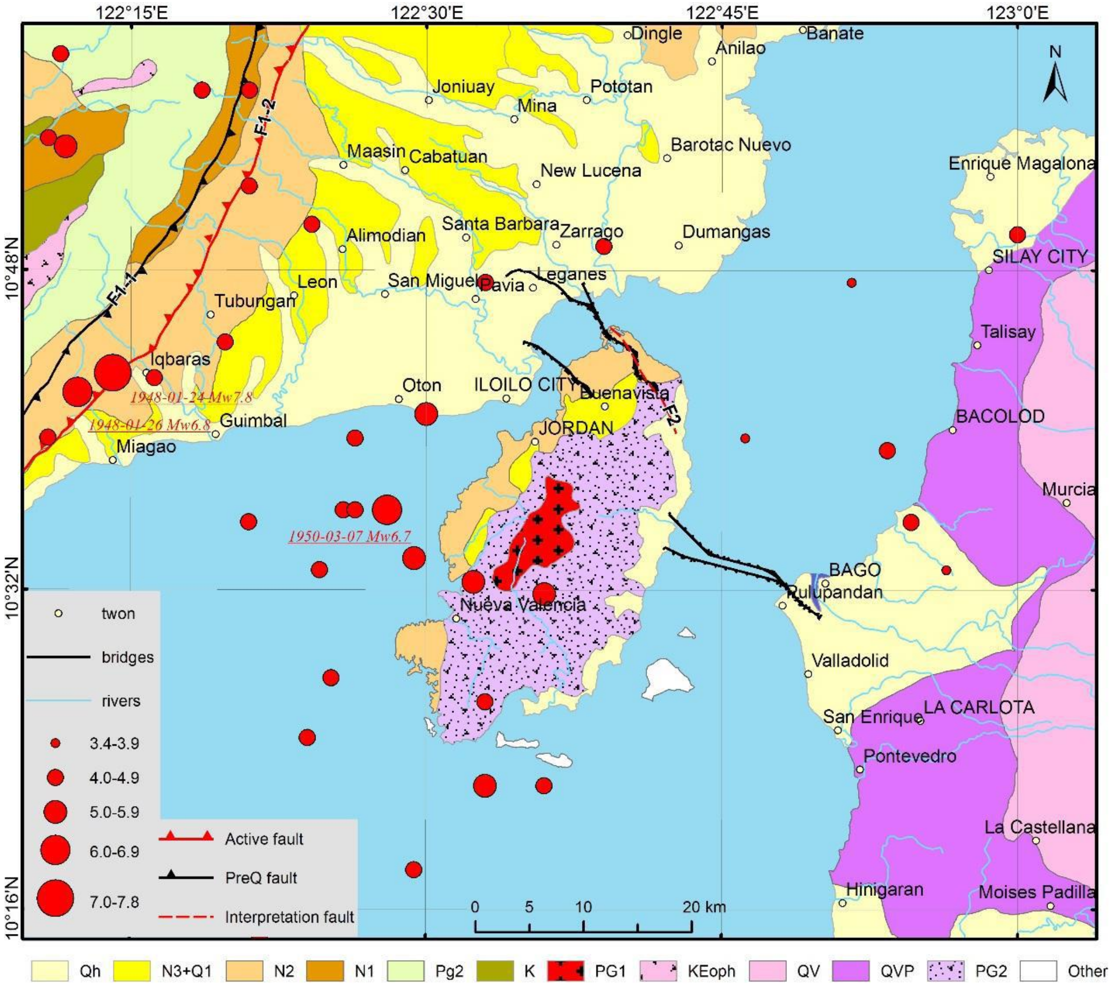


Figure 11. Near-field seismic structure map
Source: Seismic Safety Evaluation Report For Panay-Guimaras-Negros Island Bridges Project In The Republic Of The Philippines (October 2019)

2.1.2.3 Earthquake

The Philippines, where the bridge area is located, is located in the Pacific Rim earthquake zone. The crust is active, and volcanoes and earthquakes occur frequently. According to historical records, 39 earthquakes of M≥4.7 magnitude were recorded in the near-field area, the largest of which was M7.8 in 1948. Earthquake, the closest distance to the site is about 30km (**Figure 12**).

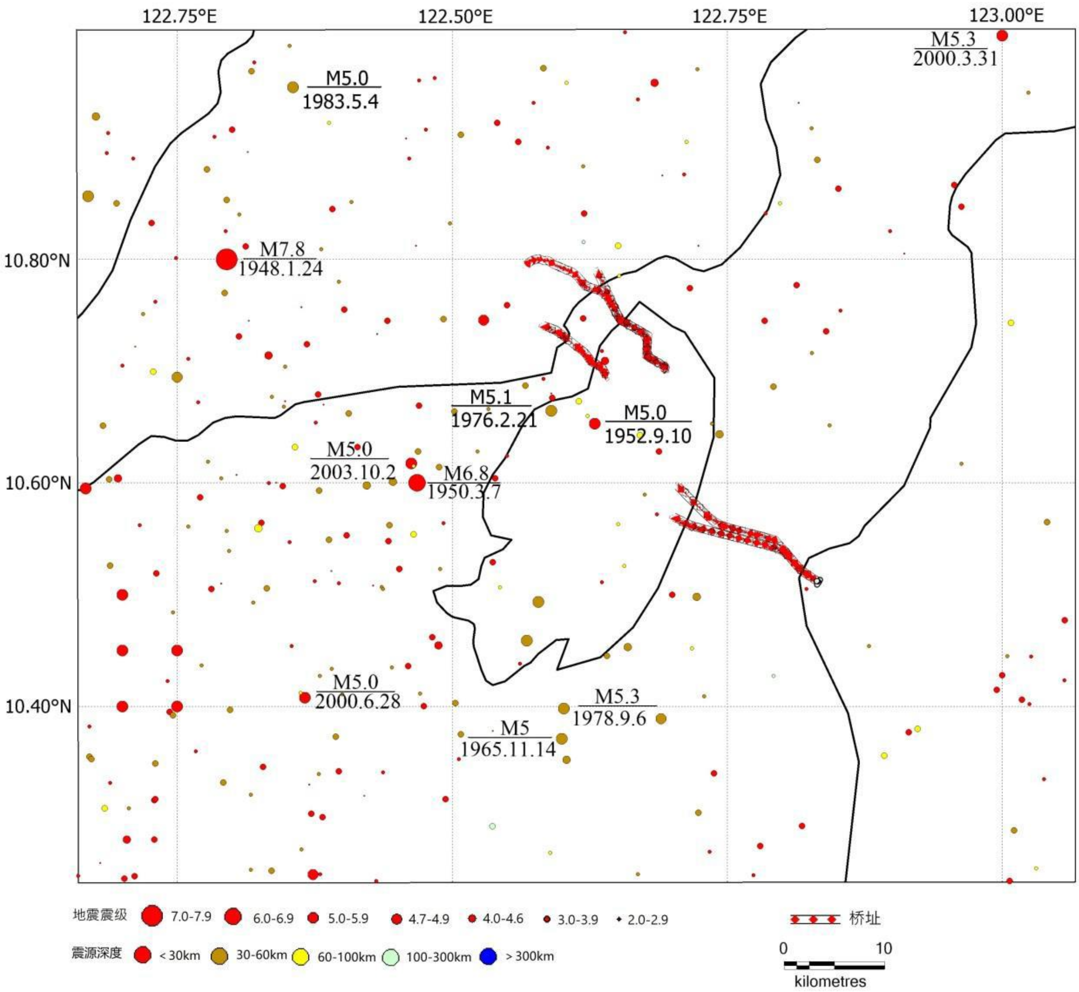


Figure 12. Near-field seismic activity(M≥4.7,AD 1600-now)
Source: Seismic Safety Evaluation Report For Panay-Guimaras-Negros Island Bridges Project In The Republic Of The Philippines (October 2019)

Table 5. Near-field earthquake catalog (M≥4.7, AD 1600-present)

NO.	Date	Latitude	Longitude	Depth	Scale	Magnitude
1	1868/06/05	10.45	122.20		Ms	4.8
2	1868/06/29	10.45	122.25		Ms	5.5
3	1886/04/10	10.50	122.20		Ms	5.4
4	1886/11/26	10.45	122.20		Ms	5.1
5	1887/01/24	10.40	122.20		Ms	5.1
6	1888/12/03	10.40	122.25		Ms	5.1
7	1891/06/21	10.40	122.20		Ms	5.1
8	1948/01/24	10.7997	122.2951	15	MS	7.8
9	1950/03/07	10.5996	122.4675	25	MS	6.8
10	1952/09/10	10.6529	122.6295	30	M	5.0
11	1964/03/26	10.3891	122.6899	32	mb	4.9
12	1964/04/04	10.5948	122.1667	16	mb	5.2
13	1965/11/04	10.3710	122.5997	32	mb	5.0
14	1965/11/04	10.4982	122.7224	32	mb	4.7
15	1969/06/26	10.4530	122.6597	32	mb	4.8

16	1976/02/20	10.6435	122.743	60	mb	4.8
17	1976/02/21	10.6645	122.5901	32	mb	5.1
18	1977/08/03	10.7456	122.5286	9.6	mb	4.9
19	1978/09/06	10.3980	122.6015	32	mb	5.3
20	1978/11/17	10.4934	122.5782	32	mb	5.1
21	1979/04/12	10.4590	122.5678	46.4	mb	5.3
22	1983/05/04	10.9538	122.3553	34.4	mb	5.0
23	1984/03/22	10.5976	122.4223	57.9	mb	4.7
24	1993/02/08	10.4546	122.4875	15.3	mb	4.7
25	1994/11/23	10.2495	122.3735	26.9	mb	4.9
26	1995/05/24	10.3524	122.6039	57.2	mb	4.8
27	2000/03/31	11.0	123.0		Mb	5.3
28	2000/06/28	10.408	122.366	29	mb	5.0
29	2002/09/21	10.281	122.204	11	mb	4.7
30	2003/05/18	10.5593	122.3238	83.8	mb	4.7
31	2003/10/02	10.6175	122.4626	8	mb	5.0
32	2004/11/19	10.958	122.684	12	mb	4.7
33	2005/07/14	10.6010	122.4462	33	mb	4.8
34	2007/01/15	10.604	122.196	8	mb	4.7
35	2010/02/01	10.709	122.639	24	mb	4.8
36	2011/06/16	10.714	122.333	1	mb	4.7
37	2011/08/25	10.9277	122.1761	51.7	mb	4.7
38	2016/08/15	10.8565	122.1689	36.3	mb	5.4
39	2018/11/05	10.6947	122.2499	55.9	mb	4.9

Source: CCCC Highway Consultants Co. Ltd.

Table 6. Statistics on seismic activity in the near-field area (AD 1600-present)

Magnitude file	M8.0-8.9	M7.0-7.9	M6.0-6.9	M5.0-5.9	M4.7-4.9
Times	0	1	1	18	19

Source: CCCC Highway Consultants Co. Ltd.

The seismic activity of the near-field area is obvious, and the strong earthquakes are mainly distributed in the west of the site and close to the area of the Negros trench. Two large earthquakes higher than M6 occurred in the near-field area, all of which were shallow earthquakes. The closest distance of the M7.8 earthquake in 1948 was about 30km from the site, and the M6.8 earthquake in 1950 was the closest to the site. The distance is approximately 20km.

2.1.2.4 Stratum

Section A of the Philippine Sea Bridge connects Panay Island and the western and central parts of Guimaras Island.

In general, the Philippine Islands can be divided into two geological entities: the Philippine Activity Belt (Gervasio, 1966) and the Palawan-Mindoro microcontinent. Palawan Island - Minduluoguan is a geological block that split from the Asian continent during the Late

Cretaceous-Late Eocene and drifted to its current position as the South China Sea Basin formed. The Philippine activity zone is a group of land masses that apparently originated in the Asian-Equatorial region and is currently located in the rotation and expansion of the Philippine Sea Plate during the Eocene to Miocene. Each of these two geological entities consists of four types of lithologic units of different types, namely: 1) metamorphic rocks, 2) ophiolite and ophiolite sets, 3) magmatic rocks and active volcanic arcs, 4) Sedimentary basins.

According to the regional geological data and the actual site survey, the area of Gimaras and the western part of the Guimaras is the Oligocene and Miocene magmatic rocks; the eastern part of the Guimaras and the west bank of Negros Island are mainly located in Quaternary volcanic group and volcanic belt. The distribution area is shown in **Figure 13** and **Figure 14**.

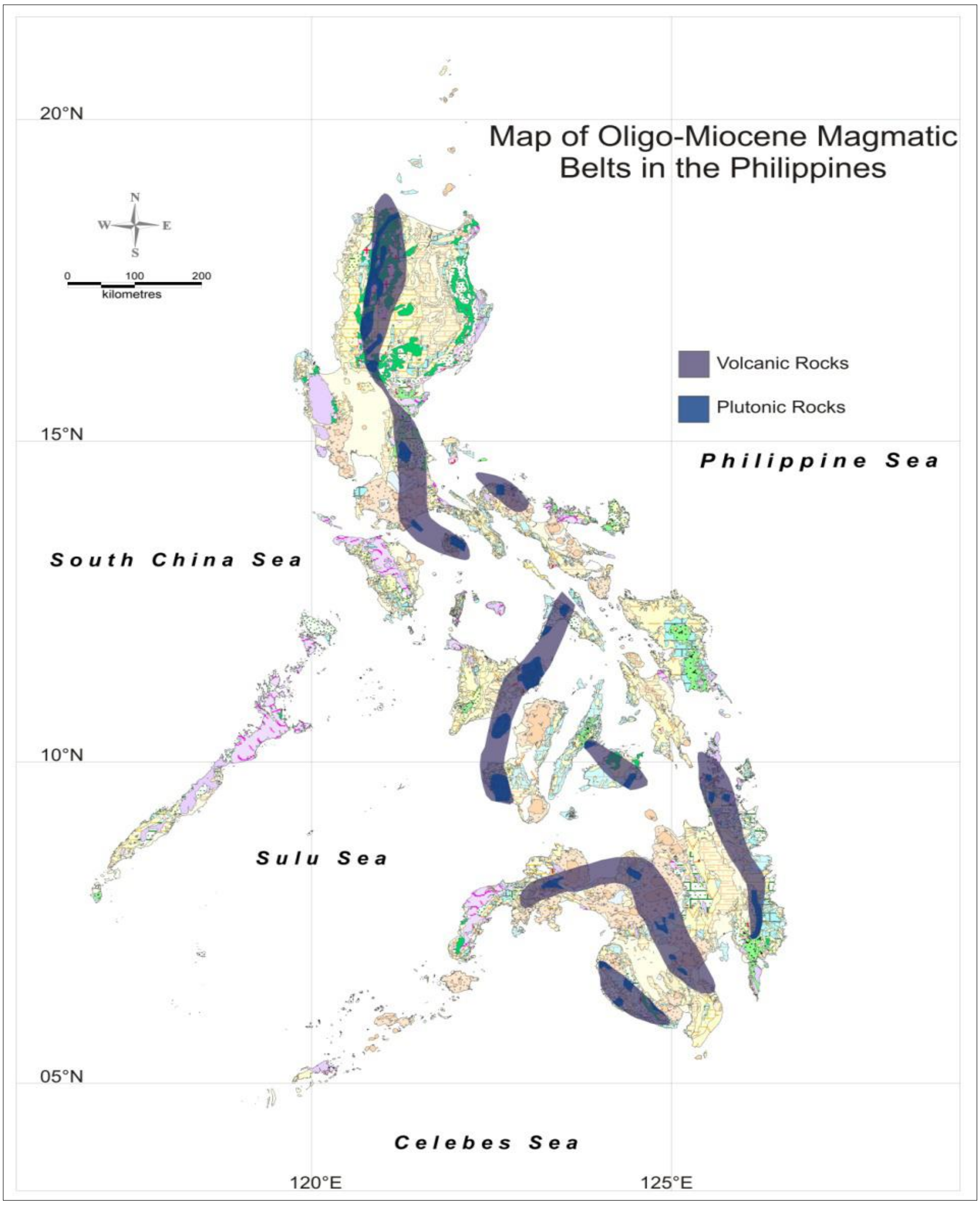


Figure 13. Map of Oligo-Micocene Magmatic Belts in the Philippines
Source: Seismic Safety Evaluation Report For Panay-Guimaras-Negros Island Bridges Project In The Republic Of The Philippines (October 2019)

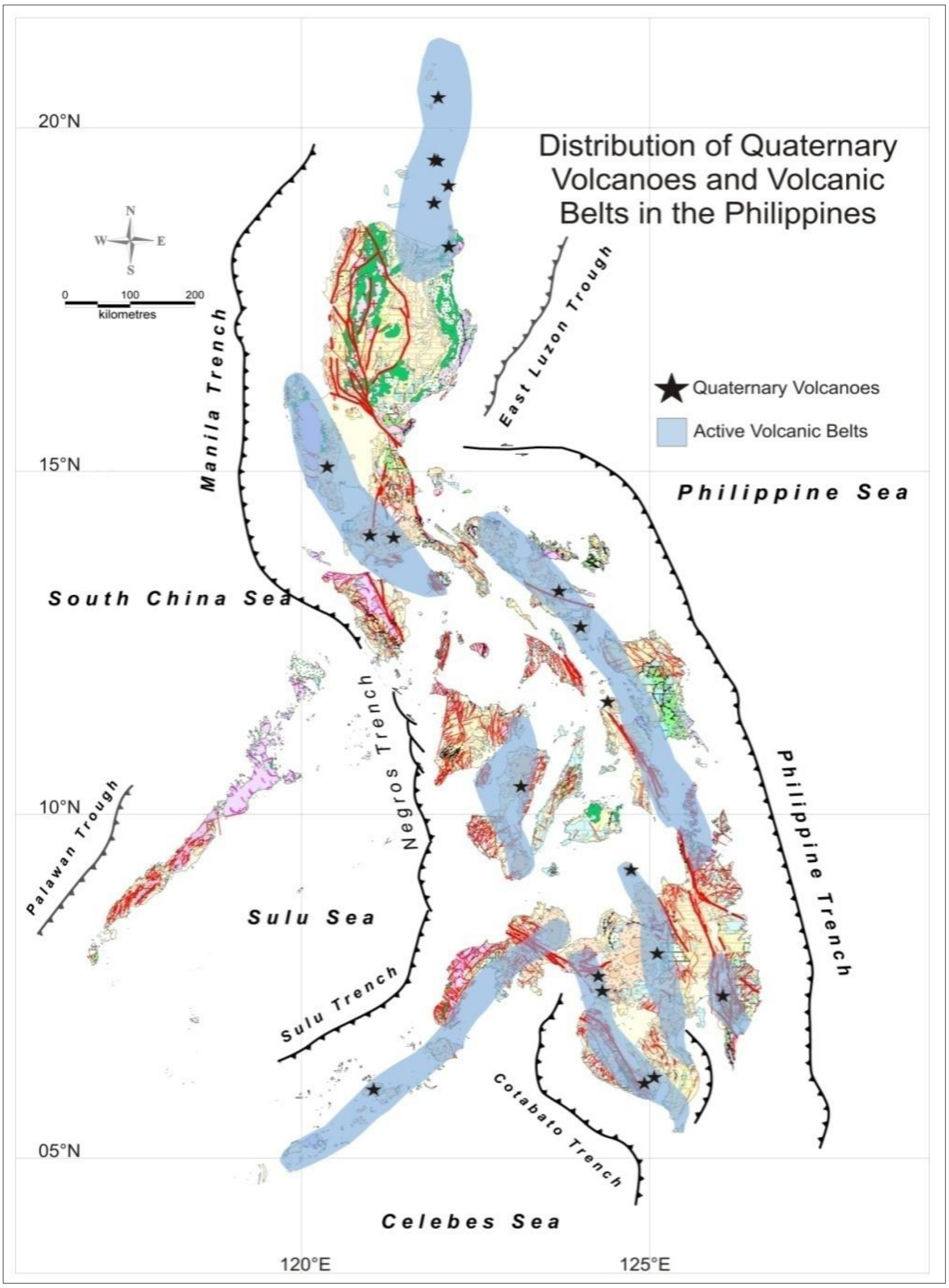


Figure 14. Distribution of Quatemary Volcanoes and Volcanic Belts in the Philippines
Source: Seismic Safety Evaluation Report For Panay-Guimaras-Negros Island Bridges Project In The Republic Of The Philippines (October 2019)

The starting point of the bridge is located in the coastal alluvial plain of Iloilo City, showing a sticky soil layer. According to the collected data and the drilling data, in the Iloilo shore and the Iloilo Strait, the stratum are alluvial marine sedimentation, alluvial pluvial, alluvium. And the lithology is dominated by soft clay, hard clay and sand. In which the sand layer is mainly distributed in the range of -30m ~ -60m, and the shallow sand layer is only scattered in the lens at -30m, and the sand layer is only partially exposed in the depth of -60m. The deepest drilling depth of this survey is 140m, which is up to - 168.27m, and the bedrock is not revealed.

The western part of the island of Guimaras is exposed in the Early Pliocene Buenavista limestone, the central part of the Early Eocene Pandan volcanic rock, and the Paleocene Gimaras group diorite, and the eastern coastal lowland is the alluvial sand layer. The exposed sediments in the southeast are mainly magmatic rocks including the Paleocene Gymaras diorite group (GDI) and the Cretaceous (K) Sibala group. The contact relationship is that GDI invades Sibala.

The Guimaras diorite group is named after Culp and Madrid and represents the diorite in the 9X4km range of Guimaras Island. It invades the sandstone of the Sibala group. The main minerals are light-medium colour, fine-medium particle feldspar, quartz, hornblende and pyroxene. It was previously thought to be contemporaneous with the Sara Diorite group, but according to the K-Ar radioactive measurement era should be 59 ± 2 Ma, which is about Paleocene (Wolfe, 1981).

2.1.2.5 Unfavorable geological phenomena

The unfavorable geological phenomena found in section A are mainly karst, collapse, dangerous rock and sand liquefaction.

2.1.2.5.1 Karst

In the reef limestone area of the bridge area, the mileage is BK5+200～BK9+100, CK3+500～CK8+364.128, mainly the hilly landform, the engineering geological section is AII area. The karst phenomenon is very developed, and the cave is found in many places, generally less than 5m in diameter. the small amount is more than 5m and the deepest is more than 20m. These caves are extremely harmful to the proposed bridge. The next stage of investigation should pay attention to it, fully grasp its distribution and development law, and avoid its adverse effects.The main development areas along the karst are BK5+755~BK6+050, BK8+400～BK9+000, CK5+100～CK6+000, CK6+700～CK7+100.

2.1.2.5.2 Collapse

In the reef limestone area of the bridge area, the mileage is BK5+200～BK9+100, CK3+500～CK8+364.128, mainly the hilly landform, and the engineering geological section is AII area. This survey has found many collapses through geological mapping, but generally the scale of development is relatively small. The collapse body is mainly reef limestone and marl. The position is generally more than 50m from the initial line, and has little effect on the proposed bridge. If the distance is close, the grading or slope protection measures can be taken.

2.1.2.5.3 Dangerous rock

Line C CK4+435.5 right 17.2m, CK4+638.8 right 141.8m, CK7+136.8 left 677.3m, etc., the landform is hilly and the engineering geological section is AII area. There are found boulder and rolling stones, which collapse and fall under certain conditions. The sinister danger should be removed during construction.

2.1.2.5.4 Sand liquefaction

According to the judgment in Section 4.3.2, under the earthquake magnitude of 7 grades, the layer ③$_{1}$ loose silty sand, the layer ③$_{2}$ medium loose silty sand, and the layer ④$_{3}$ loose-slight silty sand which lenticular distributed in the marine accumulation plains and the superficial sea area of the bridge area has the potential to liquefy. According to the designer, the latest longitudinal section is provided. The bridge section adopts the pile foundation. The foundation floor will be placed in the non-liquefied foundation, which is relatively less affected by the liquefied soil layer. The subgrade section needs to consider the uneven settlement of the subgrade caused by the liquefiable sand and other problems.

The unfavorable geological phenomena found in the area are shown in **Table 6**.

Table 7. List of unfavorable geological phenomena along the line

No.	Line	Point number and mileage	Unfavorable geology	Unfavorable geological features
1	B	B60 BK5+215.4 right 61.7m	Collapse	The collapse mass is 2.5 meters long and 8 meters high. The gap is developed and the surface gravel is distributed. The movement of the collapse mass is predicted to be completely covered by vegetation.
2	B	B30 BK5+274.0 left 143.9m	Collapse	The collapse mass is 2-5 meters in diameter, and the longest is about 8 meters. The surface gravel is distributed in a large amount. The bedrock is exposed locally, the south side is close to the vertical rock wall, the lithology is limestone, and the dissolution cave is about 2-20 cm, no layer has been found.
3	B	B29 BK5+367.8 left 203.8m	Collapse	The diameter of the collapse mass is generally 2-2.5 meters, the longest is about 20 meters. On the coastal slope, the surface of the bank slope 0.15 meters of vegetation development, the thickness of the residual slope is about 1.5 meters, containing gravel, under 1.5 meters is the middle of the weathered limestone with well developed pore .
4	B	B21 BK5+755.5 right 246.2m	Karst	Sea erosion cave, dissolution phenomenon, diameter 4 meters, cave depth 1-2 meters. Cave wall is moderately weathered limestone, pore well developed, 1-15 cm range. Small-scale stalactite, column length 15 cm, diameter 5-8 cm.
5	B	B22 BK5+772.8 right 291.9m	Karst	Marine erosion caves, 6-7 meters in diameter, 5-6 meters in depth, can be seen in the cave stalactites 30-80 cm long, 20-35 cm in diameter, stalagmites 1 meter in diameter, about 0.85 meters high, mangrove development. Along the way, more rolling stones, about 3 meters in diameter, the surface contains shells, limestone, pore development, 1-5 cm.
6	B	B58 BK5+893.5 right 302.2m	Karst	The diameter of the entrance to the cave is 10-15m, the height is 10-12m, and the thickness of the roof is 1-2m. Now it has collapsed. The diameter of the collapsed mass is 4-5m. The roof is locally developed with stalactites, 20-50cm in diameter, 30-100cm in height, and the cracks are well developed. The diameter of the cracks is 2-10cm.
7	B	B56 BK6+022.9 right 277.2m	Karst	The karst cave is 6-8 m in diameter, 3-4 m in height and 3 m in depth. It can be seen that there is a group of obvious layer with thickness of 30 cm-1 m and occurrence of 333_8. The roof is small-scale stalactites with diameter of 10 cm and length of 30-50 cm. The vegetation is developed and shrubs are dominant.
8	B	B55 BK6+050.6 right 255.3m	Karst	The karst cave has a diameter of 2 m and a height of 6-10 M. There are a few stalactites on the roof with a diameter of 10-20 cm and a length of less than 1 m. Vegetation is abundant and shrubs are dominant.
9	B	B79 BK7+975.6 right 249.6m	Collapse	At the site, there are many collapse bodies with a diameter of 1-3 meters, and the lithology is moderately weathered limestone. The dissolution is well developed and the porous space is relatively porous. It is assumed that the path has been completely covered by vegetation, and the collapse age is estimated to be longer.
10	B	B81 BK8+002.4 right 310.9m	Collapse	The lithology of the collapse body is moderately weathered limestone with diameters ranging from 3 to 10 meters. The bottom of the slope is dissolved by sea water and the pore is well developed.
11	B	B77 BK8+010.1 right 103.9m	Collapse	The collapsed mass is a moderately weathering limestone with a diameter of 3-4 meters. It is estimated that the collapse path has been completely covered by vegetation. It is estimated that the age of occurrence is longer. According to local investigations, there have been no landslides or collapses recently.
12	B	B131 BK8+243.6 right 447.3m	Collapse	The reef limestone collapsed in a moderately weathering state with a gap of 1-3 m. It is presumed that the collapse route has been completely covered by vegetation and has been in the collapse for a long time. The exposed reef limestone can be seen along the way, tending to 235 degrees. , the inclination is 4 degrees.

No.	Line	Point number and mileage	Unfavorable geology	Unfavorable geological features
13	B	B316 BK8+435.2 right 560.2m	Karst	The cave hole is about 1.5 meters long, about 0.9 meters wide and about 10 meters deep. It is waterless and the lithology of the cave wall is moderately weathering limestone.
14	B	B312 BK9+242.3 right 494.1m	Karst	The cave is about 5 meters long, 0.3-1.0 meters high and 1.0 meters deep. It has a reef limestone, yellowish white, and the gap is developed. It has no cover. Along the way, Many moderately weathered reef limestones exposed.
15	B	B299 BK9+866.9 right 566.7m	Karst	The cave hole is about 50 meters long, 2-4 meters high and 0.5-4 meters deep. The gap is developed, and there are many stone stalactites. The diameter of the cone bottom is about 1 meter and the length is 0.5-0.7 meters. The karst of the cave is the moderately weathered limestone.
16	C	B262 CK4+291.3 right 177.2m	Collapse	The collapse moderately weathered limestone in yellow-white ,7-10 meters long and the gap is developed. The hammering sound is dull and the collapse mass is not easy to break.
17	C	B260 CK4+435.5 right 17.2m	Karst	It is about 20 meters long, about 3 meters high and 4 meters wide, moderately weathered limestone. The gap is developed, the hammering sound is dull, it is not easy to break, and the vegetation is developed.
18	C	B258 CK4+457.5 left 101.4m	Karst	The cave is very large, 5-7 meters high, 20 meters wide and about 10 meters deep. There are many stone stalactites. The cave is now installed with three steel pipe barrels, which are used for collecting water. The water layer is reef limestone and the water seepage is fast about 2L/S.
19	C	B255 CK4+536.7 left 348.0m	Karst、 Collapse	There are many collapsed bodies on the beach, with a diameter of 3-5 meters.The cave is about 20 meters long and 1.5-2.5 meters high. It is unknown in death. There are bats flying around. The fishermen put the fishing boats and nets into the cave. Many stone stalactites can be seen. The lithology is the moderately weathered limestone, and the gap is seriously developed.
20	C	B254 CK4+599.6 left 355.3m	Karst	At the bottom of the hillside, the cave is about 3 meters long, about 1.5 meters wide, and about 2.5 meters deep. The stalactites can be seen (which has been artificially cut off, damaged, and the cave is now occupied by residents). The lithology is the moderately weathered limestone.
21	C	B247 CK4+638.8 right 141.8m	Dangerous rock	On the side of the inter-mountain road, see the bare rocky mountain, 2 blocks, 8-10 meters high, 5-8 meters wide, the gap is developed, the top of the vegetation is developed, the bottom of the bottom of the boulder is basically all caves.
22	C	B246 CK4+735.4 left 28.2m	Collapse	On the side of the hillside gravel road, see the height of 3-5 meters, the width of 2-3 meters, the length of 5-6 meters collapse body, has been covered by vegetation, the core of the gravel is the moderately weathered limestone, the gap is developed. The trajectory of the collapse body can not be judged.
23	C	B244 CK4+970.1 left 406.9m	Karst	The cave is about 30 meters long, 0.5-1.7 meters high and 0.8-2 meters deep. See many stone stalactites. The cone bottom diameter is 0.2-0.8 meters, ranging from 1-1.5 meters to 0.1-0.5 meters. Some have been cut off by residents.
24	C	B243 CK4+985.5 left 262.2m	Collapse	Located on the side of stone Road,there are three collapsed bodies, 1.5-8 meters in diameter and 1-2.5 meters in height. There is the upright slope above the collapsed body with less vegetation.
25	C	B242 CK4+993.6 left 176.2m	Karst	The cave is located on the side of the inter-hill stone road, about 10 meters long, 0.5-1.7 meters high and 0.5-2 meters deep. See more stalactites. The diameter of the bottom of the cone is 0.3-0.8 meters and the length is 0.2-0.5 meters. The rock mass is moderately weathered limestone, gap development.
26	C	B248 CK5+408.1 left 566.8m	Karst	On the side of the inter-hill road, there are many caves. The length of the cave is 2-5 meters, the height is 1-2 meters, the depth is 1-4 meters, There are many stone stalactites, the diameter of the cone bottom is 0.2-0.7 cm, and the length is 0.3-0.5 meters. The lithology is the moderately weathered limestone.

No.	Line	Point number and mileage	Unfavorable geology	Unfavorable geological features
27	C	B276 CK5+853.7 left 257.7m	Karst	The cave is about 50 meters long, 4-5 meters high and 1-3 meters deep. The moderately weathered limestone is yellow-white, and the gap is developed. See many stone stalactites, which are 10-50 cm long.
28	C	B281 CK6+760.3 left 246.0m	Karst	There are two caves, height 0.8* length 20* width 0.5, height 0.5* length 2* width 0.5 (unit: meter, approximate value), see stone stalactite, about 0.3 meters long.
29	C	B225 CK7+18.3 left 457.0m	Karst	Located in the larger quarry area, the cave is 5-6 meters long, and the height and depth are unknown (mostly backfilled). The core is strongly-moderately weathered reef limestone, yellowish white, mostly gravel, hammering can be broken.
30	C	B224 CK7+136.8 left 677.3m	Dangerous rock	The slope is vegetation development, slope 20-30 degrees. See the rolling stone, about 4 meters high, 8-10 meters long, about 2 meters wide, the predicted landslide path has been completely covered by vegetation.
31	B	BK5+755～BK6+050、BK8+400～BK9+000	Karst	BK5+755～BK6+050, BK8+400～BK9+000 sections are hilly landform, large terrain fluctuations, surface rocks are mostly exposed, lithology is reef limestone, rock dissolution phenomenon is observed along the outcrop, and dissolution pores are generally 5-10cm, a small amount of more than 30cm, locally seeing the dissolution trench.This survey also found many large caves in this section, but the distance from the line is far away, it is speculated that there may be hidden caves in the underground, the later investigation and construction should be focus on attention.
31	C	CK5+100～CK6+000、CK6+700～CK7+100	Karst	CK5+100～CK6+000、CK6+700～CK7+100sections are hilly landform, large terrain fluctuations, surface rocks are mostly exposed, lithology is reef limestone, rock dissolution phenomenon is observed along the outcrop, and dissolution pores are generally 5-10cm, a small amount of more than 30cm, locally seeing the dissolution trench.This survey also found many large caves in this section, but the distance from the line is far away, it is speculated that there may be hidden caves in the underground, the later investigation and construction should be focus on attention.

Source: CCCC Highway Consultants Co. Ltd.

Figure 15 presents the hazard map of PGN project specific on landslide and flooding. **Figure 16** shows the subsidence map in Buenavista, Guimaras.

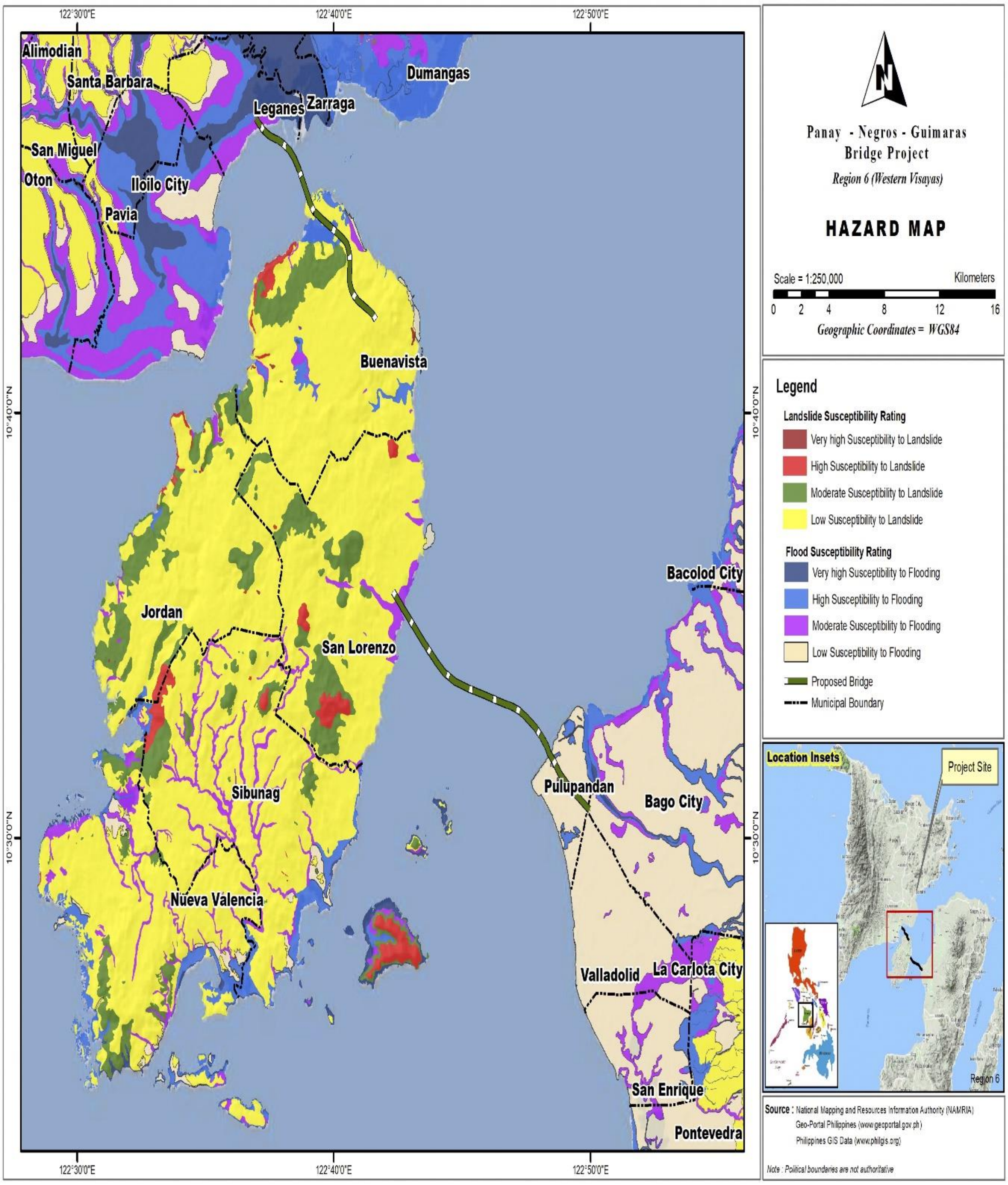


Figure 15. Hazard Map of PGN Project
Source: NAMRIA

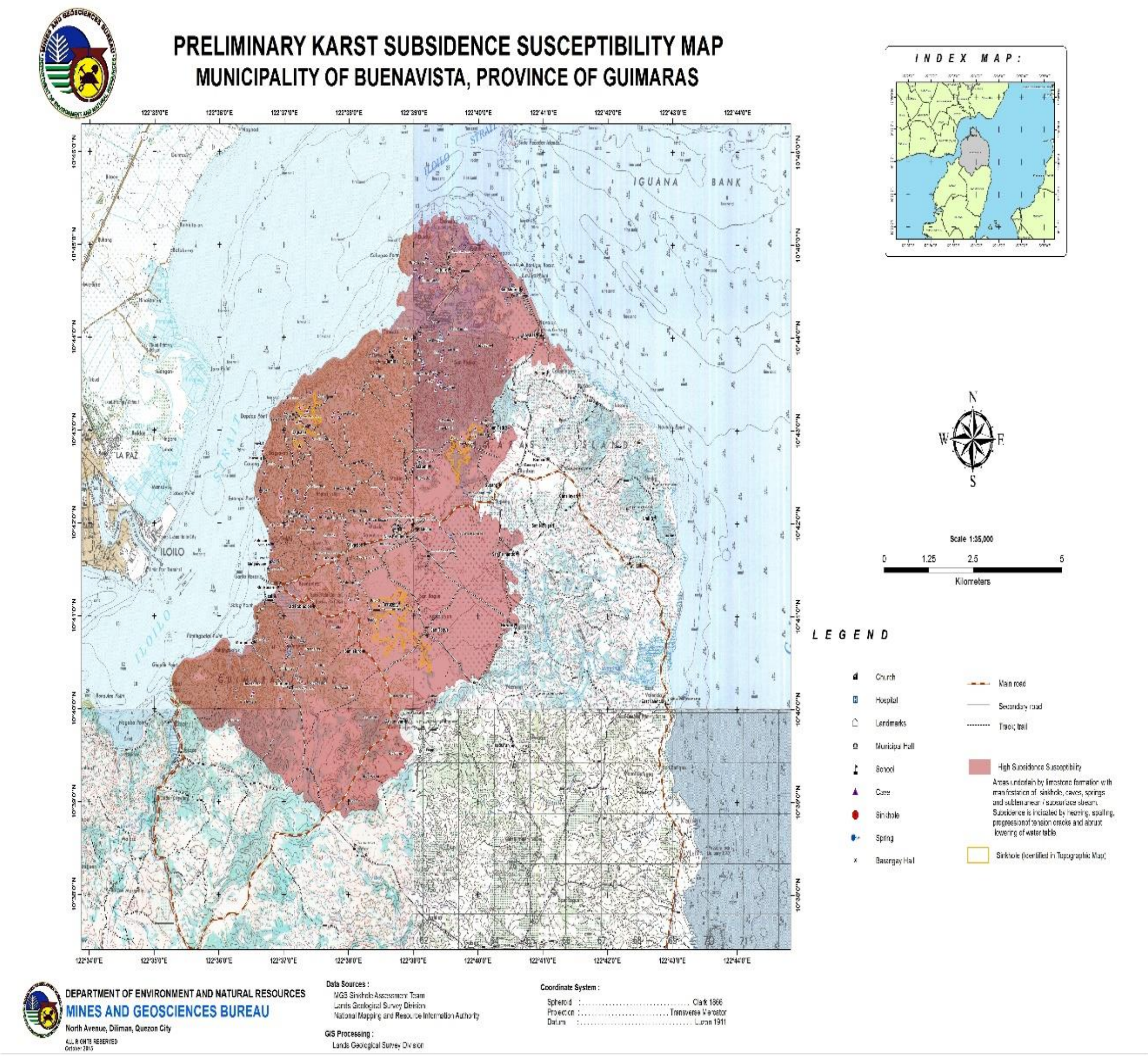


Figure 16. Subsidence Susceptibility Map of Buenavista, Guimaras

2.1.2.6 Engineering geology impact and measures

2.1.2.6.1 Engineering geology impact and measures for bridge location on Section A

According to the regional data and in combination with the geological survey of the project, it is shown that the poor geological phenomena found in the site of recommended scheme for bridge location on Section A of Panay-Guimaras Island mainly cover the karst, collapse and sandy soil liquefaction. The construction of project may be affected, and may have a certain impact on geology and geomorphology.

(1) Karst

BK5 + 200 ~ BK9 + 100 section in bridge location area belongs to reef limestone area mainly is hilly landform. The karst phenomenon is very well developed in the A Ⅱ subarea for engineering geology. There are many karst caves less than 5 m in diameter usually and more than 5 m in diameter a little, and the deepest depth is more than 20 m. These karst caves have great harm to the proposed bridge. Attention should be paid to the following stages when surveying, fully grasping their distribution and development rules to avoid adverse influence. Main developing sections along karst line cover BK5 + 755 ~ BK6 + 050 and BK8 + 400 ~ BK9 + 0.

In view of possible karst development conditions, the following treatment scheme is put forward.

River diversion: For karst springs or water overflowing holes above the subgrade, a drainage ditch is arranged to cut off the water outside of the subgrade, and a culvert is arranged to remove the water from the karst spring or water overflowing hole located at the subgrade base.

Spanning: For underground rivers, waterfall holes, waterflow pits and karst springs with greater flow at subgrade bottom or near the subgrade, a bridge is set for spanning; for above ones with smaller scale, the culverts are set for spanning or the retaining walls and guard shoulders are set outside of subgrade to avoid closure. It is necessary to calculate the roof of karst cave and the safe distance from the subgrade when the karst cave is located at subgrade bottom or near the subgrade.

Reinforcement treatment:

① When deep and small karst caves are not reinforced inside the caves, the stone coverplates or reinforced concrete coverplates are adopted for reinforcement, and the water leakage of side ditch should be prevented if the karst caves close the side ditch.

② For karst caves with small diameter and thin roof or broken rock strata, the roof is detonated and the rubble is used for backfilling and reinforcing. The arch culvert or slab culvert shall be adopted for spanning if the karst caves are required to be drained.

③ For ground surface collapse (soil cave) within the scope of subgrade, if the bedrock is not exposed, the clay is adopted for backfilling and tamping; If the bedrock is exposed and the hole opening of cavity is visible, first, a large rock block is used to block the hole opening, and the soil cave is backfilled by using the clay.

④ For isolated and undeveloped fissured karst caves with deep burying depth and sections with thin cavern roof, the borehole grouting is adopted for reinforcing: the grouting is adopted with low-pressure intermittent quantifying or circular pouring (grouting pressure 0.3 ~ 0.4 MPa) so that the loss of the slurry is reduced and the intermittent time can be controlled to 7 ~ 8 hours.

⑤ When the soil in the karst cave is not extruded from the adjacent places and is plastic or semi-hard, the driven pile may be used for reinforcement to improve the bearing capacity of foundation.

Filling treatment:

① For the karst caves on the cutting slope, if the stability of side slope is affected, the hole is filled with rubbles, the cave opening is constructed by using dry masonry, pointed by using mortar or sealed with mortar rubbles.

② For dry karst caves at the subgrade base or retaining wall base, when the cave opening is small and the depth is shallower, the backfilling and tamping shall be implemented; When the cave opening is wider and the depth is deeper, the bridge culvert spanning can be adopted. When the roof of the dry karst cave is too thin or the rock stratum is broken, the backfilling after blasting can be adopted or the bridge culvert spanning can be adopted.

③ For the unfilled corroded funnel on the base of the subgrade filling, the rubbles and macadam can be directly used for backfilling, if the cave belongs to water fall cave, the blind ditch is needed to introduce the ground water into the funnel; For corroded funnel with clay filling, the rubbles and macadam with suitable thickness can be replaced and filled according to the requirements of the foundation bearing capacity at the fill bottom and the uneven degree of the foundation.

(2) Collapse

The BK5 + 200 ~ BK9 + 100 section in bridge location area belongs to reef limestone area, which mainly is hilly landform, and the engineering geology subarea is AⅡ area. In this survey, several collapse phenomena are found through geological mapping, but the general development is small, the collapse body mainly covers the reef limestone and mud limestone, and the distance between the position and the initially-proposed line location is generally more than 50 m, which has little influence on the construction of the proposed bridge. If the position is closer to the line location, the sloping or slope protection measures can be taken for treatment.

(3) Liquefaction of sandy soil

.According to the judgement of Section 4.3.2, under Grade 7 earthquake magnitude, the alluvial plain and the shallow surface of sea area in the bridge location area show lenticular distribution. The loose silty sand on ③$_1$ layer, loose-dense silty sand, ③$_2$ layer of loose medium sand, ④$_3$ layer and loose-slightly dense silty sand have the possibility of liquefaction. According to the latest longitudinal section provided by the designer party, the bridge section is adopted with pile foundation, the baseplate of foundation will be placed in the non-liquefiable foundation, and the influence by liquefied soil layer is relatively less.

2.1.2.6.2 Engineering geology influence and measures by bridge location on Section B

There are not adverse geological functions affecting the safety of the project in the Gimaras Strait and its coastal areas where the proposed site is located, such as karst, debris flow, collapse, underground cavern, ground collapse and ground fissure

The bank slope at landing point on both sides of the proposed bridge is gentle and stable, and there is little possibility of bank collapse in natural state. However, the rock and soil layer on the surface layer of is relatively loose, and the change of hydrological environment may lead to the stability of the bank slope under the long-term water flow, especially after the construction of the bridge. It is suggested that the revetment works should be increased at the bridge location during design and construction period.

2.1.3 Pedology

2.1.3.1 Special geology

The special geotechnical soil found in section A is soft soil, weathered rock and a small amount of landfill scattered.

1、Soft soil
The very soft fat clay is widely distributed in the Iloilo shore, the alluvial plain and the B-line in the northwest of Guimaras Island. The main distributed mileage is AK0～AK4+700, BK0～BK5+200, BK7+025～BK7+480, CK0～. CK3+500.The main physical and mechanical properties of the soft soil layer of this bridge section are shown in **Table 7**.

This soft soil has the characteristics of wide distribution range, large thickness, high water content, large void ratio, high compressibility, medium sensitivity and poor stability. According to site seismic effect, the layer③ fat clay in the site needs to be considered the possibility of soft soil subsidence. According to the calculation result of over-consolidation ratio OCR of soft soil in bridge area, this soft soil is super-consolidated soil.

Table 8. Summary Table of Main Physical and Mechanical Properties of Soft soil of the Bridge Section

Layer No. & Name	Nature water content	Liquid limit	Plastic limit	Plasticity index	Liquidity index	Void ratio	Saturability	Overconsolidation ratio	Basic allowable value of bearing capacity	Compression coefficient	Compression modulus
	W	ω_L	ω_P	I_P	I_L	e	S_t	OCR	$[f_{a0}]$	$a_{0.1\sim0.2}$	$E_{s0.1\text{-}0.2}$
	%	%	%	-	-	-	-	-	kPa	MPa^{-1}	MPa
③ fat clay	58.3	52.7	25.5	26.3	1.36	1.675	5.30	5.52	40~50	1.44	2.0

Source: CCCC Highway Consultants Co. Ltd.

Seismic subsidence of the soft soil for the sea area bridge project with large pile foundation, the shallow surface subsidence caused by the earthquake subsidence is not so important, but it should be noted that when the earthquake subsidence occurs, the soft soil will cause downward friction on the pile foundation surface. The force acts to form the instantaneous loading of the pile foundation. Therefore, when the pile foundation load is unfavorable combination calculation, the negative friction force generated by the soft soil subsidence on the pile foundation should be considered.

In the Iloilo shore BK0～BK0+610, AK0～AK2+120, CK0～CK2+000 sections, the thickness is 4.4～14.4m, and the thickness varies greatly. It can be treated by preloading, gravel pile or cement soil mixing pile.

The marine section line C does not reveal the layer, line B BK0+610～BK5+200 and line A AK2+120～AK4+700, thickness 5.6～14.3m. For bridges, the influence of soft soil is mainly attention to its inevitable earthquake negative frictional resistance, no other treatment measures are required;

The thickness of the BK7+025-BK7+480 section of Guimaras coastal alluvial plain varies greatly. The thickness is generally 0-5m near the hills and 5-8m to the coast. It can be treated by filling cushion and preloading.

2. Weathered rock

The reef limestone and marl are widely distributed in the western and central parts of the Guimaras Island survey area. The reef limestone is characterized by its biochemical genesis, and it often has multiple growth and development characteristics. The marl is caused by uneven weathering. There are soft and hard alternate sedimentary, and a large number of developed karst phenomena are extremely harmful to bridge construction. In the next stage of investigation, these factors should be fully considered, the survey methods and workload should be reasonably arranged, to further judge the distribution of the stratum and the development of the cave.

3、Fill soil

The fill soil is mainly distributed in the original road or building area of the bridge area. Its composition is mainly roadbed filling or building foundation, and the distribution range is small and the thickness is not large.

The fill soil which can be directly removed during construction in BK0～BK0+600, BK11+115～BK11+130, BK11+975～BK11+995 is mainly the original roadbed. The fill soil which can be treated together with soft soil treatment schemes during construction is in the fish pond area on both sides of Iloilo and Guimaras Island.

2.1.3.2 Soil and stone excavation level

The hilly area of Guimaras Island has a large terrain, and some local roads need to be excavated. According to the existing data, there are 5 sections of excavation in line A and B, and 4 excavation sections in line C. The remaining subgrades are mainly filled roadbeds. For specific excavation sections, see **Table 8**.

Table 9. List of excavation sections along the line

Line position	Chainage	Filling / digging depth	Coordinates x	Coordinates y	Coordinates x	Coordinates y	Remarks
Line A	AK5+360	-14.25	461952.96	1188350.44			ordinary slope
	AK5+760	-8.985	462292.65	1188138.37			ordinary slope
	AK6+280	-10.417	462739.93	1187884.60			ordinary slope
	AK7+640	-19.311	463912.51	1187178.08	463927.84	1187203.66	high slope
	AK8+300	-11.97	464354.18	1186698.15			ordinary slope
Line C	CK4+620	-16.98	457999.69	1185481.53	457960.08	1185476.99	high slope
	CK5+920	-16.075	458738.27	1184271.38			ordinary slope
	CK6+620	-16.356	459252.61	1183791.07	459261.65	1183815.47	high slope
	CK7+500	-10.483	460065.97	1183523.87			ordinary slope

In addition to drilling the AK7+640 high slope, the other sections mainly carry out excavation and investigation. The AK7+640 engineering geological section is shown in Figure 4-8. According to this survey, all excavation slopes are mainly reef limestone weathering layer. Generally, the bedrock directly exposes the surface, or covers layer ②$_2$ of plastic-hard plastic clay with a thickness of not more than 0.5 m. Only layer ②$_2$ of AK6+280 cover layer have a thickness of 4.2 m. The underlying bedrocks are all reef limestones, and the superficial is strongly weathered. According to the borehole data, the fully weathered reef limestone which is turned into sand is partially embedded in the underlying strongly weathered reef limestone, and there may be a marl weathering layer. Acroading to Appendix J of the “Code for Geological Survey of Highway Engineering” (JTG C20-2011), the digability level of each layer of the slope is shown in **Table 9**.

Table 10. Soil and stone excavation classification

Soil layer number	Name	Soil &stone category	Soil &stone degree
②$_1$	Clay	Loose soil	Ⅰ
②$_2$	Clay	Common soil	Ⅱ
⑧$_1$	Fully weathered limestone	Hard soil	Ⅲ
⑧$_2$	Strongly weathered limestone	Soft stone	Ⅳ
⑨$_1$	Fully weathered limestone	Hard soil	Ⅲ
⑨$_2$	Strongly weathered limestone	Soft stone	Ⅳ
⑨$_3$	Moderately weathered limestone	Secondary hard stone	Ⅴ

2.1.3.3 Soil Quality

Grab sampling was used for soil quality measurement. Samples were collected on March 20 and 22, 2019 & July 6, 2019 at sunny weather. Use of stainless shovel was employed to collect surface soil samples. Samples were put in glass and plastic containers, properly sealed, labeled and preserved with ice at lower temperature inside coolers and transported to the laboratory. Samples were submitted for laboratory testing to CRL Environmental Corporation, an accredited ISO/IEC 17025:2005 laboratory. **Table 10** presents the sampling sites, date and time of collection conducted in Iloilo, Guimaras and Negros Occidental. **Figure 17** presents the sampling map of the sites. **Table 11** presents the parameters analyzed and their corresponding analytical methodologies.

Table 11. Summary of Surface Soil Sampling Sites, Coordinates, Weather condition, Date and Time of Samplings

Station No.	Sampling Stations	Coordinates	Weather Condition	Soil Classification	Date and Time of Samplings
S1	Leganes, Iloilo	10⁰46'55.5.0"N 122⁰36'57.5"E	Sunny	Clay	3/20/2019, 1140H
S2	Brgy. Getulio, Buenavista, Guimaras	10⁰44'39.9"N 122⁰39'17.5"E	Sunny	Clay	3/22/2019, 1430H
S3	Brgy. Pag-ayon, Pulupandan, Negros Occidental	10⁰31'45.2"N 122⁰48'45.4"E	Sunny	Sand	3/22/2019, 0745H
S4	Brgy. M. Chavez, San Lorenzo, Guimaras	10⁰35'47.0"N 122⁰42'18.0"E	Sunny	Clay loam	7/06/2019, 1538H

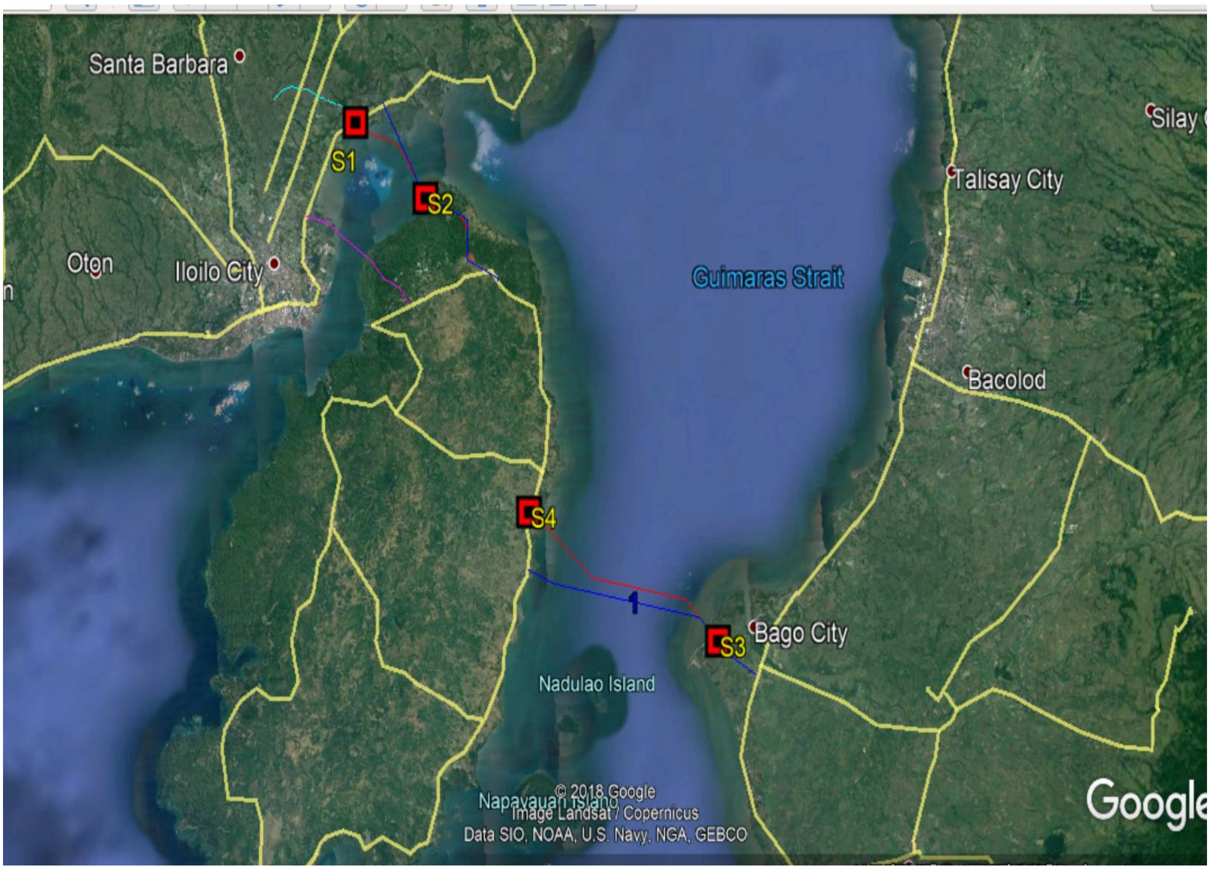


Figure 17. Soil Sampling Map
Source: Google Earth

Table 12. Parameters and Analytical Methodology

Parameter	Analytical Method
Total Organic Matter	Titrimetry
Total Phosphate-P	Vanadomolybdophosphoric Acid
Arsenic	Inductively Coupled Plasma (ICP) – OES
Cadmium, Chromium, Copper, Iron, Lead, Manganese, Zinc	Flame Atomic Absorption Spectroscopy (AAS)
Mercury	Cold Vapor AAS

As of this time, Philippines does not have regulations on soils. Results of analyses on **Table 12** are compared with Dutch Intervention Values for Environmental Assessment. Results are within the intervention values for arsenic, cadmium, copper, chromium, lead, mercury and zinc.

Table 13. Results of Soil Quality

Parameters, units	S1	S2	S3	S4	Dutch Intervention Values
Total Organic Matter, %w/w	0.49	2.53	0.53	1.16	---
Total Phosphorus-P, mg/kg	450	1,700	312	263	---
Arsenic, mg/kg	1.7	1.7	1.1	3.3	55
Cadmium, mg/kg	0.4	1.2	0.3	1.0	12
Copper, mg/kg	30	28	8.0	30	190
Chromium, mg/kg	8.3	18	0.8	17	380
Iron, mg/kg	8.3	21,100	7,110	47,100	---
Lead, mg/kg	8.5	20	4.8	20	530
Potassium, mg/kg	955	144	463	128	---
Manganese, mg/kg	194	1,610	208	2,380	---
Mercury, mg/kg	<0.1	0.6	<0.1	<0.1	10
Zinc, mg/kg	35	53	14	23	720

2.1.4 Terrestrial Biology

Flora and fauna biodiversity from islands of Panay, Guimaras and Negros has been assessed and presented in this report, where a bridge construction project has been proposed to connect these islands. Biodiversity assessment is conducted to evaluate the significant impacts of the project to the environment, especially the ecosystem covered by the project development. This report provides a thorough study focusing on the flora and fauna biodiversity of the project area with the intention of identifying potentially significant environmental impacts and determining appropriate mitigating measures. Assessing areas of high biodiversity value, especially along the project development area plays a vital role in determining key areas for conservation and establishing conservation priorities.

The objective of this assessment is to identify existing vegetation cover and prevailing wildlife species in the alignment and road access of the proposed bridge project. This is undertaken to assess the biodiversity composition of the area and link the possible impacts to the environment. In addition, the study will provide recommendation on the possible mitigating measures to minimize impact of the project to the remaining flora and fauna species. In this terrestrial biodiversity assessment, plots were established along the bridge and road access construction sites to examine the tree species and other vascular plants for floral analysis. For the faunal dimension, the study is limited on the observed species during the field survey, generated through ethnobiological interview to locals and collected species through application of traps (mist netting, pale traps, adhesive traps and cage traps).

Additional surveys on flora (plants) and fauna (wildlife) biodiversity along the proposed Panay-Guimaras-Negros (PGN) Bridge project were undertaken on June 29 to 30, 2019. This additional survey traverses an alternative route via Panay-Guimaras islands where a total of ten study sites was identified based on its significance and influence relative to the perceived presence of floristic and faunal species within the project area. This alternative alignment comes after an earlier study where 21 sampling sites were established connecting Panay-Guimaras-Negros Islands last March 2019.

2.1.4.1 Flora Biodiversity Assessment

Objective of flora assessment

Terrestrial floristic biodiversity assessment was conducted starting from the orientation in the sampling stations, coordination with the authorities, preparation of instruments, and the field work proper. The study on flora assessment focuses on the different areas of the proposed project site to represent different ecosystem type. The assessment aims to:

Determine current flora composition and diversity;

Compare species diversity, evenness and abundance of these areas in consideration with the location, ecosystem type and other ecological factors

2.1.4.1.1 Methodology

Plot establishment and vegetation survey

To assess and characterize the structure and species composition of the different plant communities, several survey plot were established along the right of way (ROW) of the proposed Panay-Guimaras-Negros (PGN) bridge. Plot establishment follows the nested quadrat sampling technique (see **Figure 18 and Figure 19**), which is one of the most applicable method for areas where almost all of the major plant groups are present. The sampling quadrats were established by laying a 20 x 20 meter quadrat to form a 400 m^2 quadrat, where all vegetation were recorded. The boundaries of the 20 x 20 meter quadrat was used sample all large trees with a diameter at breast height (DBH, in cm) greater than 10 (>10 cm DBH), and subsequently identified and measured. Inside the 20 x 20 meter quadrat, a nested 5 x 5 meter (25 m^2) quadrat is then established to identify and measure smaller trees having 5 to 10 cm DBH. Another nested quadrat measuring 1 x 1 meter (1 m^2) is established to measure all trees (> 5 cm DBH), herbs, grasses and creepers.

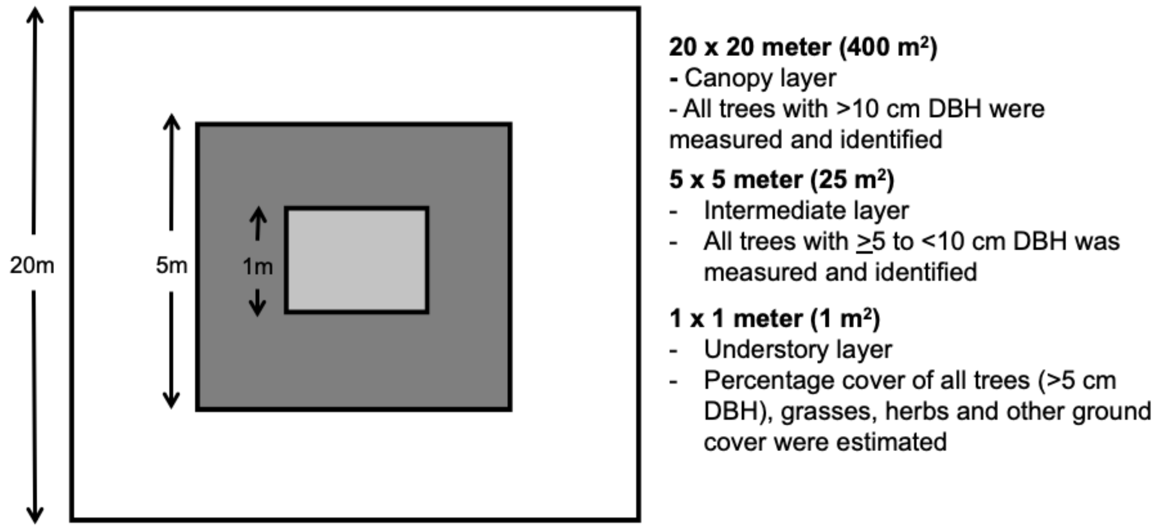


Figure 18. Nested Quadrat Sampling Design for Vegetation Survey


GETULIO
BARANGAY HALL

Figure 19. Coodination, plot establishment and vegetation survey.

Flora Biodiversity Measure

Data after the flora field survey were consolidated to form a species checklist indicating the common name, scientific name, and family name of the identified plants.

Floristic Diversity Measure

Species Richness, Shannon diversity H', Pielou's evenness J and importance value (%IV) were used to assess floristic biodiversity along the PGN flora survey sites.

Species Richness (Alpha diversity). Represent the number of species found in the study area. A site is more diverse when more species are found.

Diversity Indices. The Shannon-Wiener (H') assumes that individuals are randomly sampled from a large population and that all species are represented in the sample. It gives an estimate of species richness and distribution. The Pielou's Evenness (J') measures inequality of species distribution between sampling sites in the community. The Shannon-Wiener (H') and Pielou's evenness (J') index was used with the following formula:

Shannon-Wiener Diversity	$H' = -\sum p_i \ln (p_i)$, where, "H'"- represents the symbol for the amount of diversity in ecosystem (species diversity) "p_i"- represents the proportion or relative abundance of each individual species to the total (measured from 0 to 1) "ln p_i" - represents the natural logarithm of p_i
Pielou's Evenness	$J' = H'/H\max = H=H'/\ln S$, where, "J" – represents the symbol for the species richness "H'" – species diversity "Hmax" – species maximum diversity "S" – number of species in the community

Importance Value (%IV). Importance value (%IV) is the sum of relative density, relative frequency and relative dominance. A high importance value (ranges between 0 and 300) indicates that species is well represented in the stand because of some combination of a) a large number of individuals of species compared with other species in the stand, or b) a smaller number of individuals of species, but the trees are larger compared with others in the stand. Species with the highest %IV is considered species with the highest contribution/impact in the study area. The following formulas were used:

Basal Area (m^2) = $0.7854\ (DBH/100)^2$

Relative Dominance (%) = $\underline{\Sigma \text{ basal area of species } (m^2)}$ x 100

Plot area (m^2)

Abundance = $\frac{\text{Number of individuals of any species}}{\text{Area sample}}$

Relative Abundance (%RA) = $\frac{\text{Density of a species}}{\text{Total density of all species}} \times 100$

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

Relative Frequency (%RF) = $\frac{\text{Frequency of a species}}{\text{Total frequency of all species}} \times 100$

Importance Value (%) = %RD + %RA + %RF

2.1.4.1.2 Diversity assessment

Diversity was assessed following the Fernando Biodiversity Scale (refer to **Table 13**). The scale was based from the Shannon-Wiener H' index and Pielous Evenness J' of each site. Diversity is higher when H' value is higher. Evenness (J) is the distribution of species in the community. The higher the value of J, the more even the species will be in their distribution within the quadrat. An evenness that is equal to 1 means all species are equally represented in the community. The Shannon diversity index (H) is commonly used to characterize species diversity in a community, where it accounts for both abundance and evenness of the species present.

Table 14. The Fernando Biodiversity Scale (1998)

Relative Values	Shannon diversity (H') Index	Pielou's (J') Evenness Index
Very High	3.5 and above	0.75-1.00
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	1.9 and below	0.05-0.14

2.1.4.1.3 Conservation Assessment: Conservation Status and Endemism

Conservation status and endemism of flora species is determined with reference to the International Union for Conservation of Nature (IUCN) Red List of Threatened Species 2019 and the local Red List adaptation known as the DENR-AO 2017-11 "Updated National List of Threatened Philippine Plants and their Categories" were employed. Conservation Categories and description are defined below:

Critically Endangered (CR) - A taxon is Critically Endangered when it is facing an extremely high risk of extinction in the wild in the immediate future.
Endangered (EN) - A taxon is Endangered when it is not Critically Endangered but is facing a very high risk of extinction in the wild in the near future.
Vulnerable (VU) - A taxon is Vulnerable when it is not Critically Endangered or Endangered but is facing a high risk of extinction in the wild in the near future.
Near threatened (NT) - Taxa which do not qualify for Conservation Dependent, but which are close to qualifying for Vulnerable.
Least Concern (LC) - Taxa which do not qualify for Conservation Dependent or Near Threatened.

Other Threatened Species (OTS) - refers to a species or subspecies that is not critically endangered, endangered nor vulnerable but is under threat from adverse factors, such as over collection, throughout its range and is likely to move to the vulnerable category in the near future.
Not Evaluated (NE) - A taxon is Not Evaluated when it has not yet been assessed against the criteria.

2.1.4.1.4 Results and Discussion

2.1.4.1.4.1 The Flora Survey Sites

A total of 21 flora survey sites were established along the proposed PGN bridge ROW (refer to **Table 14**, see **Figure 20-21**), covering nine barangays, four municipalities, and three provinces. Of the 21 sites, 4 sites were established in the Negros island (Negros Occidental), 15 sites in the Guimaras island (5 sites on the western side and 10 sites on the eastern side of the island), and then 2 sites in the Panay island. Generally, the study sites are along coastal areas, in farmlands and plantations interspersed with or close to human settlements. Five major Land-use types were identified, namely: Residential, Agricultural, Plantation, Beach forest and Mangrove forest (see **Figure 22**).

Table 15. Habitat description, geographic coordinates and location of the 21 flora survey sites

Sites	Land-use	Geographic Coordinates		Island
		Northing	Easting	
S01	Residential	10°30’37.84”N	122°49’58.00”E	Negros
S02	Agricultural	10°31’0.95”N	122°49’23.76”E	Negros
S03	Beach forest	10°31’38.62”N	122°48’42.62”E	Negros
S04	Beach forest	10°31’58.19”N	122°48’26.11”E	Negros
S05	Mangrove	10°35’25.59”N	122°42’39.92”E	Guimaras
S06	Plantation	10°35’31.30”N	122°42’34.43”E	Guimaras
S07	Residential	10°35’39.06”N	122°42’26.98”E	Guimaras
S08	Plantation	10°35’59.80”N	122°42’11.54”E	Guimaras
S09	Agricultural	10°36’25.67”N	122°42’8.16”E	Guimaras
S10	Plantation	10°42’11.97”N	122°41’37.33”E	Guimaras
S11	Agricultural	10°42’26.89”N	122°41’11.20”E	Guimaras
S12	Agricultural	10°42’41.42”N	122°40’50.85”E	Guimaras
S13	Plantation	10°43’0.90”N	122°40’41.54”E	Guimaras
S14	Plantation	10°44’4.13”N	122°40’19.60”E	Guimaras
S15	Mangrove	10°44’11.17”N	122°40’6.83”E	Guimaras
S16	Plantation	10°44’26.42”N	122°39’38.67”E	Guimaras
S17	Plantation	10°44’35.24”N	122°39’24.83”E	Guimaras
S18	Plantation	10°44’47.02”N	122°39’11.92”E	Guimaras
S19	Beach forest	10°45’1.62”N	122°39’3.37”E	Guimaras
S20	Mangrove	10°46’43.05”N	122°37’9.30”E	Panay
S21	Residential	10°46’54.72”N	122°36’57.86”E	Panay

On additional survey, Terrestrial flora and fauna were sampled from ten study sites within the alternative bridge alignment – seven sites were in Buenavista, Guimaras (Guimaras Island) and three sites were in Jaro, Ilo-Ilo (Panay Island) (see geographic coordinates and description of the surveyed sites in **Table 15** and **Figure 20-21**). Ecosystem types within the survey sites are representative of four forests habitats appearing as shrubland ecosystem with a mixture of agricultural ecosystem; three plantations of mostly mahogany species (*Swietenia macrophylla*); two mangroves in wetland ecosystem, and; one residential site (see **Figures 23 to 27**).

Table 16. Description and geographic location of flora and fauna survey sites (June 2019)

Site no.	Ecosystem Type	Geographic Coordinates (WGS 84)		Remarks
		Northing	Easting	
1	**Forest:** shrubland ecosystem	10°42'0.52"	122°38'18.44"	Brgy. Salvacion Buenavista, Guimaras
2	**Forest:** mixture of shrub land and agricultural ecosystems	10°42'12.18"	122°38'5.91"	Brgy. Salvacion Buenavista, Guimaras
3	**Forest:** shrubland Ecosystem	10°42'31.16"	122°37'38.14"	Brgy. Zaldivar Buenavista, Guimaras
4	**Forest:** shrubland Ecosystem	10°42'42.08"	122°37'29.18"	Brgy. Dagsaan Buenavitsa, Guimaras
5	**Plantation:** combination of mahogany and gmelina plantation	10°42'52.17"	122°37'21.65"	Brgy. Dagsaan Buenavitsa, Guimaras
6	**Plantation:** mahogany plantation	10°43'4.73"	122°37'8.71"	Brgy. Dagsaan Buenavitsa, Guimaras
7	**Plantation:** mixtures of Shrub land and mahogany plantation	10°43'10.64"	122°37'0.90"	Brgy. Dagsaan Buenavitsa, Guimaras
8	**Mangrove:** mangrove and wetland ecosystem	10°44'3.72"	122°35'47.12"	Brgy. Hinactacan Ilo-Ilo City
9	**Mangrove:** mangrove and wetland ecosystem	10°44'13.49"	122°35'25.72"	Brgy. Hinactacan Ilo-Ilo City
10	**Residential:** mixture of grass land and wet land ecosystem	10°44'19.93"	122°35'8.16"	Brgy. Hinactacan Ilo-Ilo City

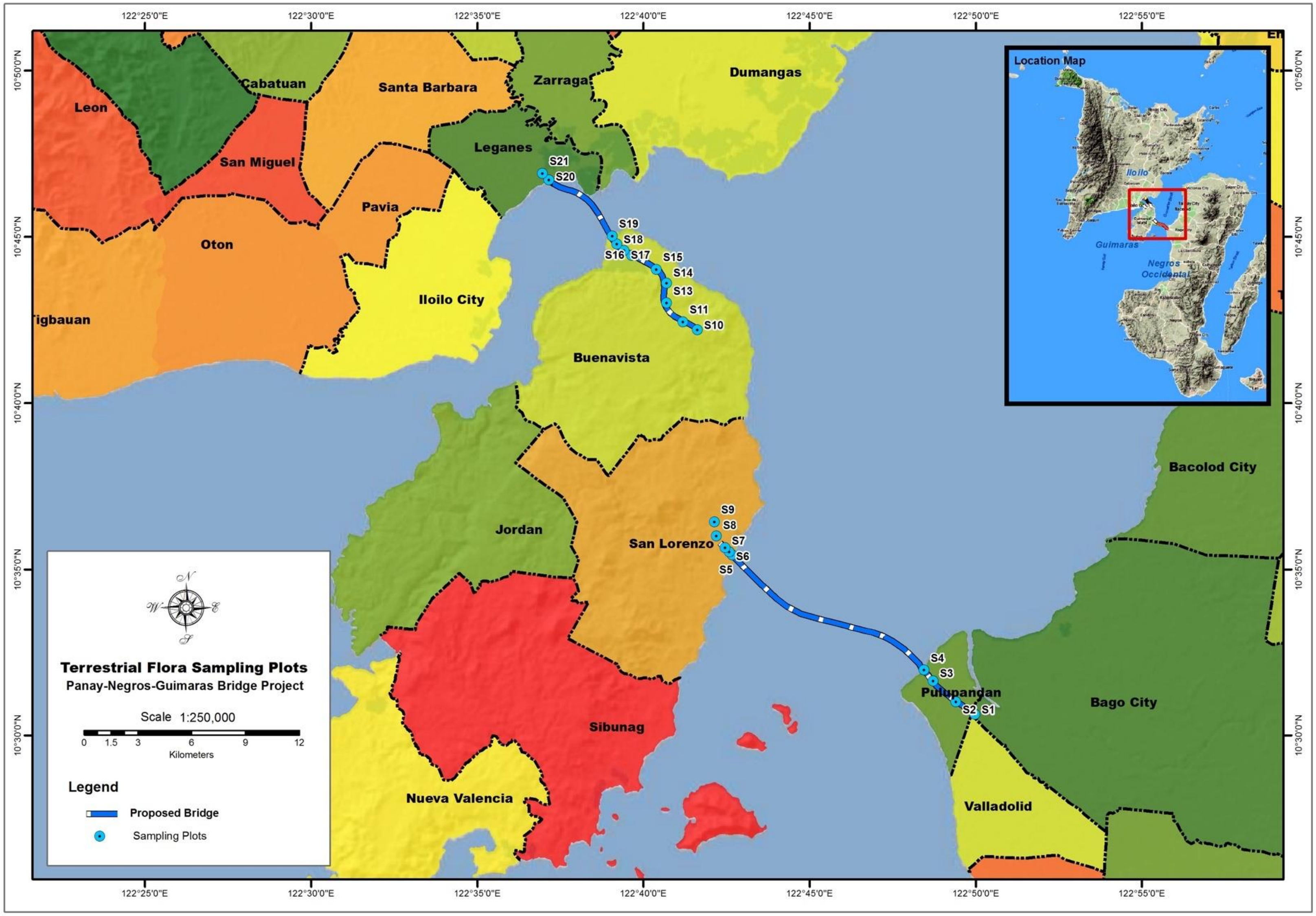


Figure 20. Flora sampling sites along Panay-Guimaras-Negros islands

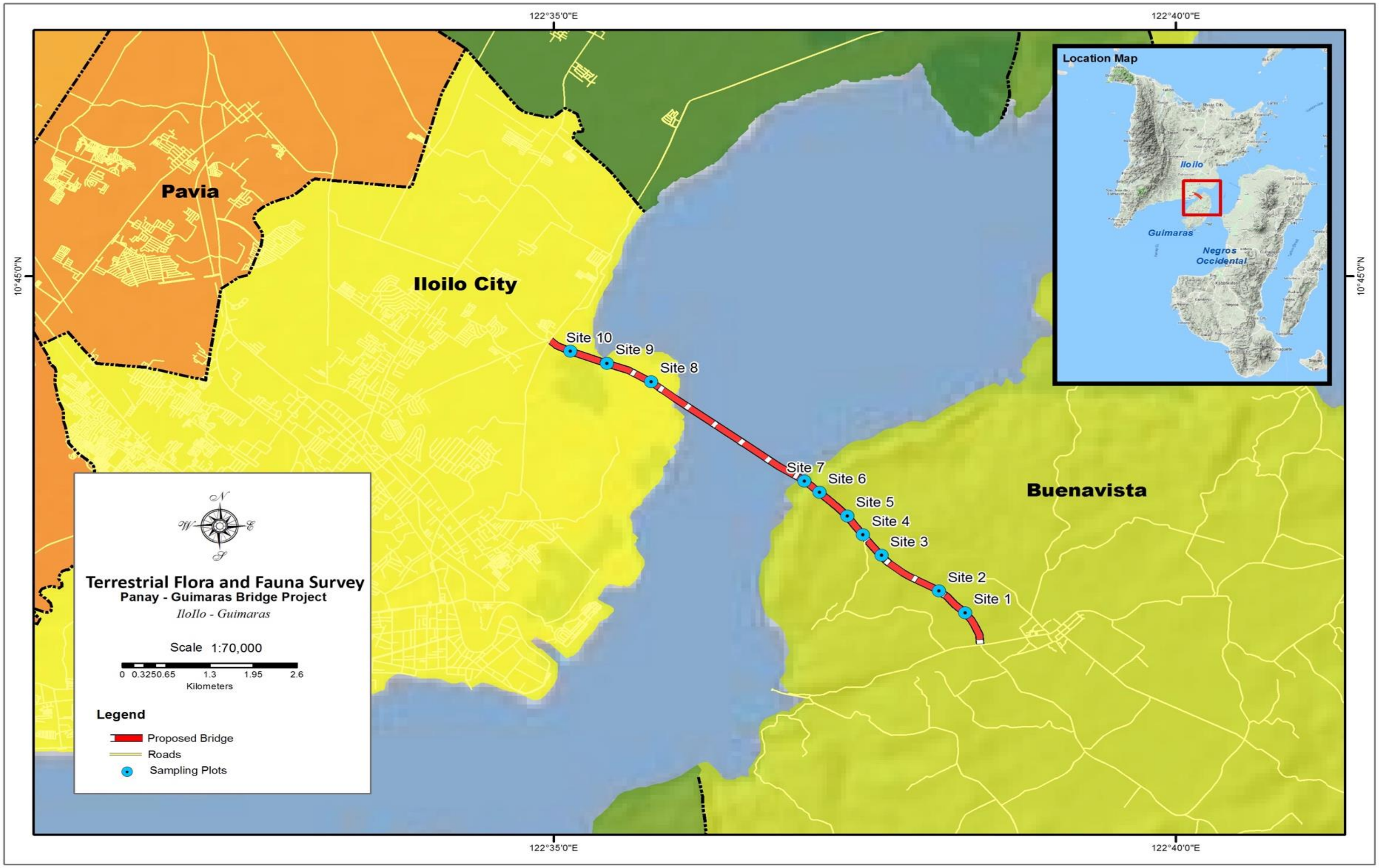


Figure 21. Additional sampling Sites within the alternative bridge alignment via Guimaras-Panay Islands (June 2019)

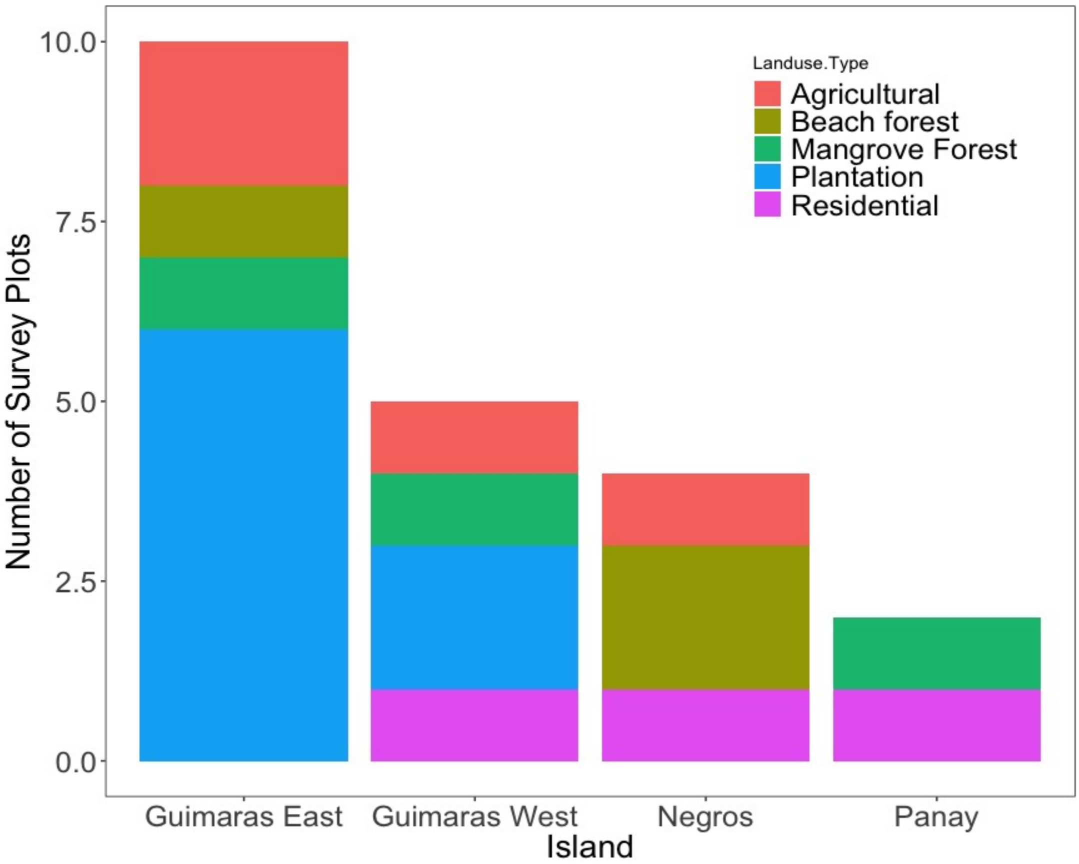


Figure 22. Distribution of the sampling site according to habitat type

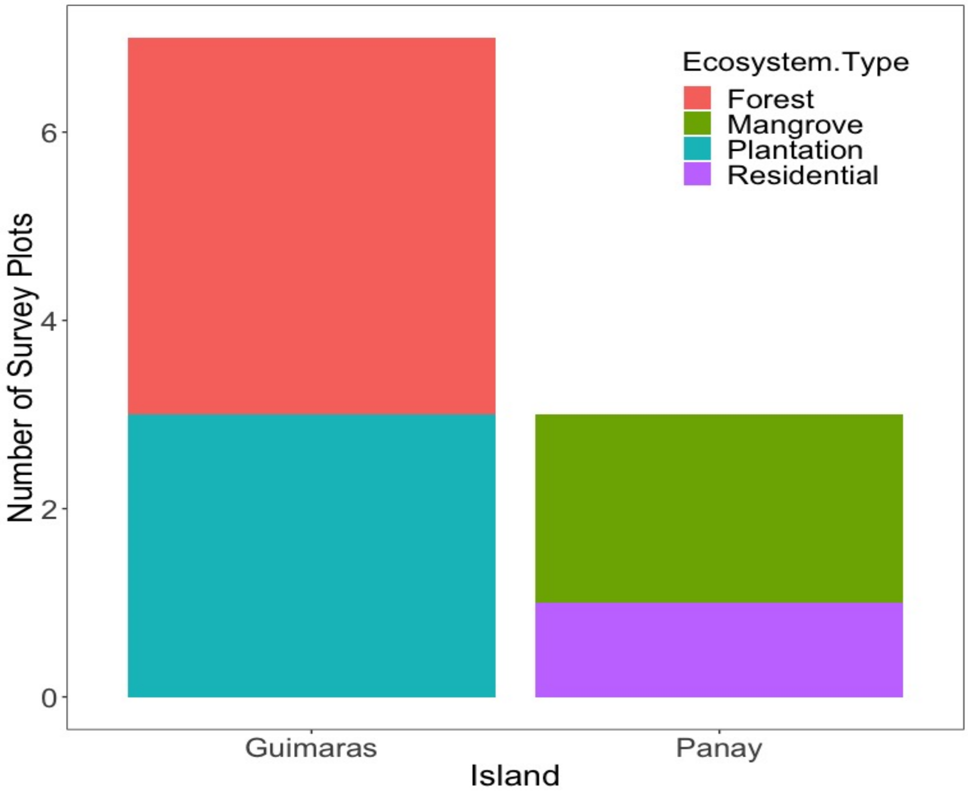


Figure 23. Distribution of the type of ecosystem of flora and fauna in the study area


Figure 24. Forest ecosystem (site 1 and site 3) located in barangay Salvacion Buenavista, province of Guimaras. The sites is covered with sapang (*Caesalpinia sappan*) planted along limestone-karst substrate.


Figure 25. Plantation forest (sites 6 and 7), planted with big leaf mahogany (*Swietenia macrophylla*) located in barangay Dagsaan Buenavista, province of Guimaras.

Figure 26. Mangrove forest (site 8) located in barangay Hinactacan, City of Ilo-ilo (Panay Island).

Figure 27. Residential site (site 10) located in barangay Hinactacan, City of Ilo-ilo (Panay Island).

2.1.4.1.4.2 Floristic Biodiversity

Floristic biodiversity reported here are findings from flora survey indicating dominant species composition determined by calculating importance value index (IVI), species richness, the biodiversity status assessed using Fernando Biodiversity Scale (1998) for Shannon-Weiner

Index (H) and Pielou's Evenness (J), and then the endemicity and conservation status of species identified from the study area.

2.1.4.1.4.3 Species composition

Different species were observed from the study area, with some species observed particular to each of the land-use type.

Residential Landscape

Three residential (human settlement) plots were surveyed across the study, which is one of the most affected land-use type as human settlements are also found entrenched within other land-use types (see **Figure 28**). Some physical features observed within and surrounding the residential landscapes are salt farms, roads and garden orchards. Calculated Importance Value Index (IVI) revealed that big leaf mahogany (*Swietenia macrophylla*) with IVI = 34.43, followed by ipil-ipil (*Leucaena leucocephala*), and and niog (*Cocos nucifera*) with IVI = 29.87 and 24.01, respectively. Manga (*Mangifera indica*) and yemane (*Gmelina arborea*) were also common with IVI = 23.92 and 21.33, respectively (refer to **Table 16**). These are common backyard species found in residential landscapes since these provides as fruit trees, shade trees and fodders of livestock.

Table 17. Ten species with the highest importance value index in Residential landscape.

Species	F	A	D	%RF	%RA	%RD	IVI
Swietenia macrophylla	0.33	11	133	2.70	18.97	12.76	34.43
Leucaena leucocephala	1.00	8	83	8.11	13.79	7.97	29.87
Cocos nucifera	0.67	4	122	5.41	6.90	11.71	24.01
Mangifera indica	0.67	3	139	5.41	5.17	13.34	23.92
Gmelina arborea	0.67	3	112	5.41	5.17	10.75	21.33
Sandoricum koetjape	0.67	2	65	5.41	3.45	6.24	15.09
Psidium guajava	0.67	4	24	5.41	6.90	2.30	14.61
Terminalia catappa	0.67	2	45	5.41	3.45	4.32	13.17
Annona muricata	0.67	2	24	5.41	3.45	2.30	11.16
Artocarpus heterophyllus	0.67	2	16	5.41	3.45	1.54	10.39

Figure 28. Residential landscape along the project ROW. Photos are mixtures of residentials along roads, orchards, salt farms and in agricultural landscape.

Agricultural Landscape

Agriculture is an integral land use type observed in the study area which provides a diverse array of commodities for both domestic and international markets. Agricultural lands also provide important areas of open space and wildlife habitat. Biophysical characteristics of the Agricultural plots are mixtures of agri-crops alongside human settlements (see **Figure 29**). As expected, farms in Negros island are planted with tubo/sugarcane (*Saccharum officinarum*), a primary agricultural crop known from the island introduced during the Spanish occupancy in the country between 1600 – 1900s. Other agricultural sites were observed in Guimaras, where palay/rice (*Oryza sativa*) crops are planted in shallow terraces with pakwan/watermelon (*Citrullus lanatus*) and corn (*Zea mays*) as rotational crops.

The species with the highest importance value in the agricultural plots is amor-seco (*Chyrsopogon aciculatus*) with IVI = 36.74, a common grass species in tropical Asia including in the Philippines, which grows well in open areas, as such in matrix of agricultural and road side environment. Hagonoi (*Chromolaena odorata*) comes next with IVI = 32.50, an invasive species throughout the tropics can be seen widespread in the agricultural area (refer to **Table 17**). This is followed by cogon (*Imperata cylindrica*) and talahib (*Saccharum spontaneum*), which are known species that proliferates in open areas with a combined IVI of 61.88.

Table 18. Ten species with the highest importance value index in Agricultural landscape.

Species	F	A	D	%RF	%RA	%RD	IVI
Chrysopogon aciculatus	0.50	2	45	10.00	10.00	14.06	34.06
Chromolaena odorata	0.50	2	40	10.00	10.00	12.50	32.50
Imperata cylindrica	0.50	2	40	10.00	10.00	12.50	32.50
Saccharum spontaneum	0.50	2	30	10.00	10.00	9.38	29.38
Saccharum officinarum	0.25	1	50	5.00	5.00	15.63	25.63
Citrullus lanatus	0.25	1	30	5.00	5.00	9.38	19.38
Dichanthium annulatum	0.25	1	15	5.00	5.00	4.69	14.69
Macroptilium atropurpureum	0.25	1	15	5.00	5.00	4.69	14.69
Cyrtococcum patens	0.25	1	10	5.00	5.00	3.13	13.13
Mimosa pudica	0.25	1	10	5.00	5.00	3.13	13.13

Figure 29. Agricultural landscape along the PGN bridge project ROW. Photos are sugarcane plantation in Negros (Panay Island) and rice farms in low terraces.

Tree Plantation

There are eight plantation plots across the study, all of which are in the Guimaras island. Plantations are also interspersed within residentials and shrubland. The most important species in the Tree Plantation sites were big leaf mahogany (*Swietenia macrophylla*), niyog (*Cocos nucifera*), manga (*Mangifera indica*) and yemane (*Gmelina arborea*), with IVI values of 39.42, 20.17, 17.94 and 13.57, respectively. These species were similar to dominant species observed in Residential landscape, since species in both land-use were tree crops that can be of use for human consumption. Hagonoi (*Chromolaena odorata*) was a common species (IVI = 12.50) found in understory layer in tree Plantations (refer to **Table 18** and **Figure 30**).

Table 19. Ten species with the highest importance value index in the tree Plantation sites.

Species	F	A	D	%RF	%RA	%RD	IVI
Swietenia macrophylla	0.88	31	555	5.47	15.58	18.38	39.42
Cocos nucifera	0.38	13	341	2.34	6.53	11.29	20.17
Mangifera indica	0.25	9	358	1.56	4.52	11.85	17.94
Gmelina arborea	0.50	8	206	3.13	4.02	6.82	13.97
Chromolaena odorata	0.75	6	145	4.69	3.02	4.80	12.50
Artocarpus altilis	0.50	7	93	3.13	3.52	3.08	9.72
Leucaena leucocephala	0.63	8	54	3.91	4.02	1.79	9.71

Artocarpus blancoi	0.50	6	69	3.13	3.02	2.28	8.42
Cratoxylum sumatranum	0.50	6	44	3.13	3.02	1.46	7.60
Canarium asperum	0.38	3	83	2.34	1.51	2.75	6.60

Figure 30. Plantations along the PGN bridge project ROW. Phots are coconut, mango and outgrowth from a shrubland.

Beach Forest

Similar to other islands in the Philippines, the coastal areas across Panay-Guimaras-Negros islands are beach forest type (see **Figure 31**). These coastal forest ecosystems are adapted to growing conditions that are often difficult as a result of edaphic or climatic extremes (strong winds, salinity, lack or excess of humidity). Only three plots were established because some of the beach forest along the project ROW have been converted to other land-uses, and the landscape have sandy soils and karst limestones.

Vegetations are mostly scrub-like with a high presence of stunted tree growths with species such as kulasi (*Lumnitzera racemosa*), niog (*Cocos nucifera*), buta-buta (*Excoecaria agallocha*), talisai (*Terminalia catappa*), and aroma (*Acacia farnesiana*) with a total calculated IVI = 110.59 (37%) (refer to **Table 19**). Understory species such as lagolo (*Acrostichum aureum*, IVI = 12.11) and ambayong (*Ipomea pes-caprae*, IVI = 10.35) are common the study landscape.

Table 20. Ten species with the highest importance value index in the Beach forest.

Species	F	A	D	%RF	%RA	%RD	IVI
Lumnitzera racemosa	0.33	9	104	2.70	14.29	12.25	29.24
Cocos nucifera	0.67	4	109	5.41	6.35	12.84	24.59
Excoecaria agallocha	0.33	6	64	2.70	9.52	7.54	19.76
Terminalia catappa	0.67	3	75	5.41	4.76	8.83	19.00
Acacia farnesiana	0.67	2	80	5.41	3.17	9.42	18.00
Azadirachta indica	0.33	4	39	2.70	6.35	4.59	13.65
Acrostichum aureum	0.67	2	30	5.41	3.17	3.53	12.11
Erythrina variegata	0.33	3	31	2.70	4.76	3.65	11.12
Ipomea pes-caprae	0.67	2	15	5.41	3.17	1.77	10.35
Tabernaemontana pandacaqui	0.67	2	13	5.41	3.17	1.53	10.11

Figure 31. Beach forest along the PGN bridge project ROW. Photos are landscape and the scrub-like species, aroma (*Acacia farnesiana*), as one of the dominant species observed in the study

Mangrove Forest

The mangrove forests have unique ecosystem generally found along sheltered coasts where they grow abundantly in saline soil and brackish water subject to periodic fresh- and salt-water inundation. The habitat is soft, silty and shallow, coupled with the endless flow of water providing very little support for most mangrove plants which have aerial (stilt roots) or prop roots (known as *pneumatrophores*, or respiratory roots). Three mangrove sites were surveyed in this study, one next to a mangrove reclamation (Panay island), and the others each in western and eastern Guimaras island (refer to **Figure 32**). Observed vegetations are pedada (*Sonneratia caseolaris*, IVI = 46.89), bungalon (*Avicennia marina*, IVI = 46.36), and plag-ao (*Xylocarpus moluccensis*, IVI = 28.48) (refer to **Table 1**)20.

Table 21. Ten species with the highest importance value index in Mangrove forest.

Species	F	A	D	%RF	%RA	%RD	IVI
Sonneratia caseolaris	1.00	11	152	9.38	17.46	20.05	46.89
Avicennia marina	1.00	12	136	9.38	19.05	17.94	46.36
Xylocarpus moluccensis	0.33	7	108	3.13	11.11	14.25	28.48
Lumnitzera racemosa	1.00	6	62	9.38	9.52	8.18	27.08
Acacia farnesiana	0.33	3	57	3.13	4.76	7.52	15.41
Ceriops tagal	0.67	4	21	6.25	6.35	2.77	15.37
Excoecaria agallocha	0.67	3	26	6.25	4.76	3.43	14.44
Sesuvium portulacastrum	0.67	2	35	6.25	3.17	4.62	14.04
Pongamia pinnata	0.67	2	28	6.25	3.17	3.69	13.12
Terminalia catappa	0.67	2	21	6.25	3.17	2.77	12.20


Figure 32. Mangrove forest along the PGN bridge project ROW. Above photos are stilt root of bakauan babae (*Rhizophora mucronata*) and pneumatophores of bungalon (*Avicennia marina*).

2.1.4.1.4.4 Species Richness

A total of 122 species belonging to 111 Genus in 46 Families were recorded from the 21 flora survey sites (see **Figure 33**). There were 87 species (80 Genus, 40 Family) identified from the eastern side of Guimaras island while 44 species (43 Genus, 25 Family) was recorded from the western side of the island. Negros Island has 33 species (33 Genus, 17 Family) while 17 species belonging to 16 Genus and 13 Families was recorded in the Panay island (Ilo-ilo). This result is not surprising, since more sampling plots was established along the Eastern Guimaras Island, while only two plots was established in the Panay Island. This unequal sampling distribution among islands was strategically chosen based from the length the proposed PGN project ROW for each island upon bridge landing.

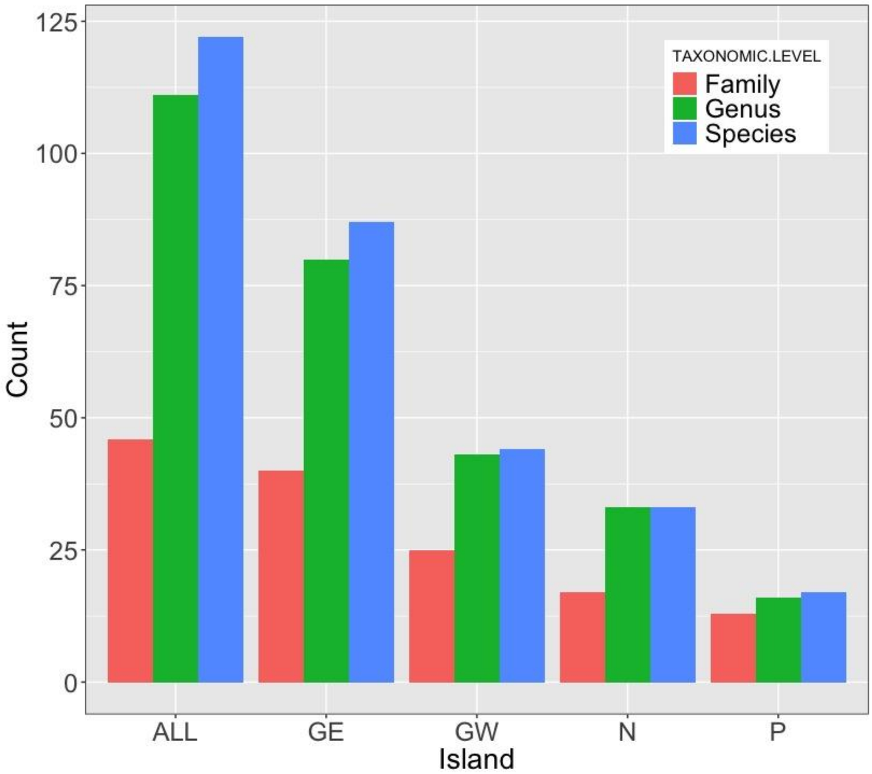


Figure 33. Number of Species, Genera and Family from different islands (A) and from different land use types (B) across the project ROW.

Among the 46 Families, the legumes (Fabaceae) was the most species rich family with 16 species (13%), followed by grasses (Poaceae) with 9 species (see **Figure 34**). The figs and bread fruit family (Moraceae) follows on third spot with 8 species. Twenty-four families have singletons (1 representative species) while 7 species are registered doubletons (2 representative species). This result indicates that most species occurring within these families are light sensitive species, as such, grasses, legumes, figs, and Euphorbiaceae, which appears as the dominant families in the study.

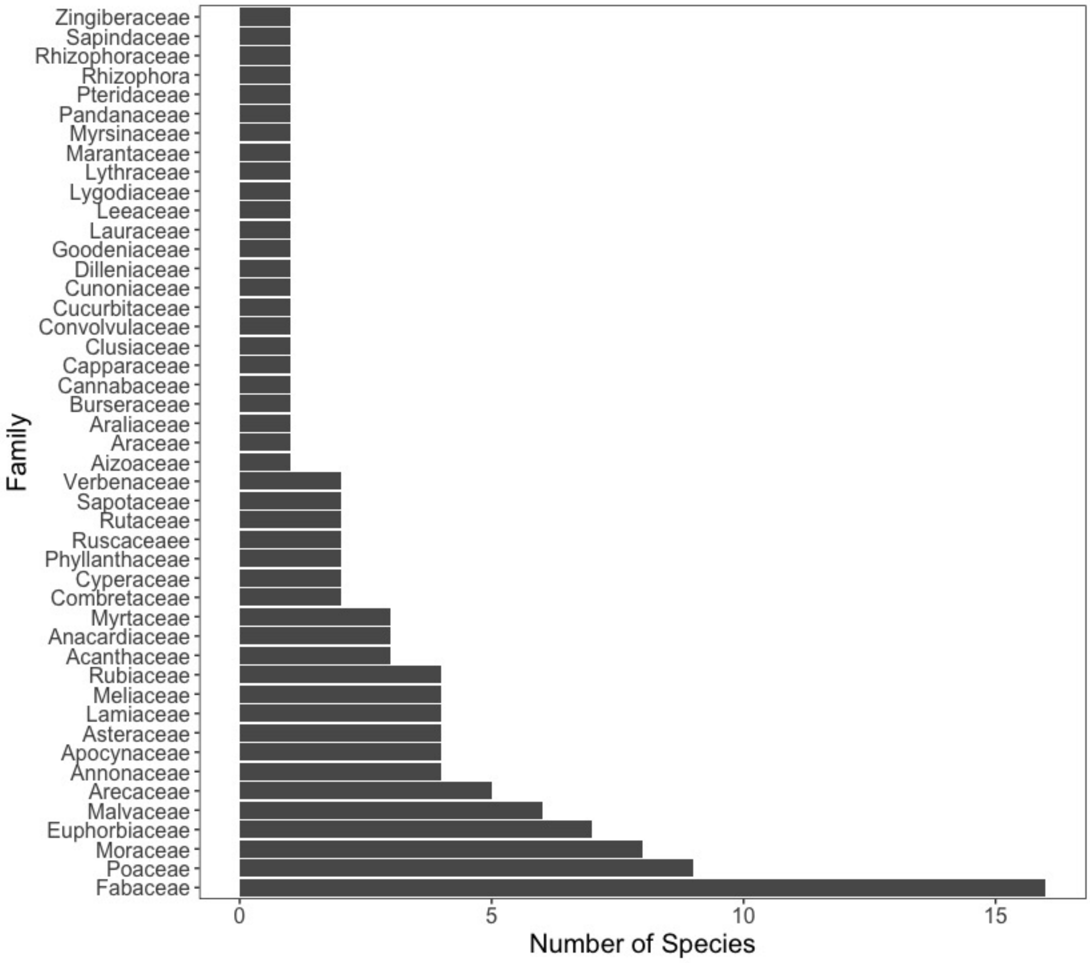


Figure 34. Number of species distributed across 46 floristic Family.

The most species rich among the studied sites was in site S10 with 19 species, followed by sites S17 and S18 with 18 species each), and sites S08 and S14 with 17 species. All these five sites are in Plantations, making Plantations as the most species rich among the land use types as also reflected in **Figure 35**, where 72 species (69 Genus, 34 Family) were identified. This can be attributed to some plantations imbedded in secondary forest as well as the combination naturally growing species and planted species in mixed plantations. The four surveyed sites in the agricultural landscape has the lowest number of species among the land use types, all of which have lower than 10 species, with one site having three species only. The Agricultural landscape has a total of 16 species only (14 Genus, 6 Family). This is expected due to the absence and lack of trees (canopy and intermediate layers) since the habitat is intended for farming purposes. While its low diversity, it is necessary to include agricultural sites in the study since areas along the PGN project ROW will affect several agricultural habitats.

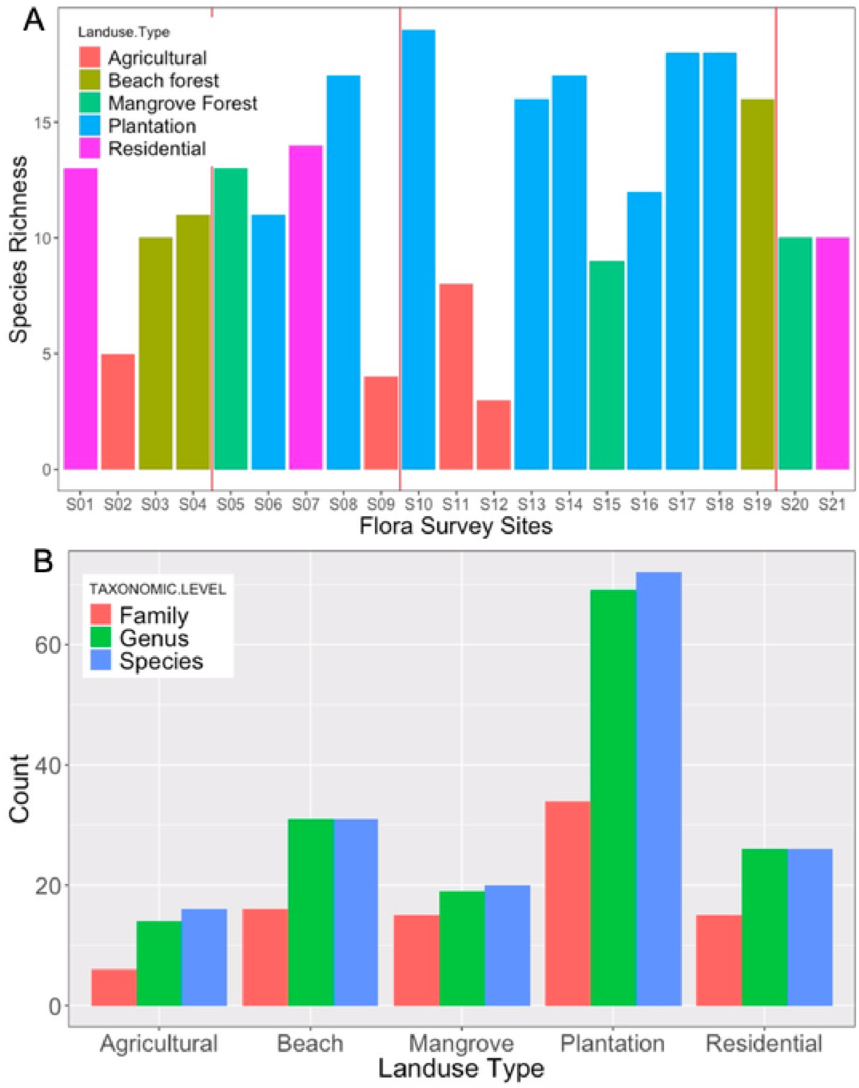


Figure 35. Number of species in each flora survey sites (A) and number of each taxonomic levels. Residential habitat

2.1.4.1.4.5.1 Additional survey on species richness and abundance

A total of 82 species were identified across the study belonging to 32 families (Figure 5 left panel). Of these, the most speciose family was legumes (Fabaceae) with 10 species, followed by Euphorbiaceae and Moraceae both with 8 representative species, and then five species each for Lamiaceae, Malvaceae and Rubiaceae. Of the 32 families, 16 (50%) were represented by only one species (known as singletons), and six families were represented by only 2 species (known as doubletons).

Family-abundance distribution (**Figure 36 right panel**) was not consistent with family-species distribution (**Figure 36 left panel**), as the number of species do not corresponds with the number individuals in the study area. Although with only three representative species, the family Meliaceae was the most abundant among the 32 plant families with 35 individuals (12.54%). This number were represented mostly by big leaf mahogany (*Swietenia macrophylla*) with 31 individuals. Euphorbiaceae, with 8 representative species is the second most abundant Family with 31 individuals (11.11%) mostly from 11 individuals of binunga (*Macaranga tanarius*) and 10 individuals of banato (*Mallotus philippinensis*). Fabaceae ranked third with 23 individuals followed by Moraceae and Sapindaceae both with 22 individuals and then Acanthaceae with 21 individuals.

Of all individuals counted, mahogany were the most abundance (31 individuals) followed by a mangrove associate “bungalon” (*Avicennia marina,* Family Acanthaceae) with 21 individuals and a common beach habitat palm species "niog" (*Cocos nucifera*, family Arecaceae) with 13 individuals (see **Figure 37**).

Plot level species richness showed Site 04 (A04) and Site 05 (A05) with the highest number of species (23 and 20 species, respectively). Sites within forest ecosystem are mostly species rich than other ecosystem, followed by plantation forest. Plot level abundance, on the other hand, recorded Sites 08 and 06 (A08 and A06) as the most abundant among the study sites (36 and 35 individuals respectively), with more evenly distributed number of individuals in most sites. Plot level species richness and abundance is presented in **Figure 38**.

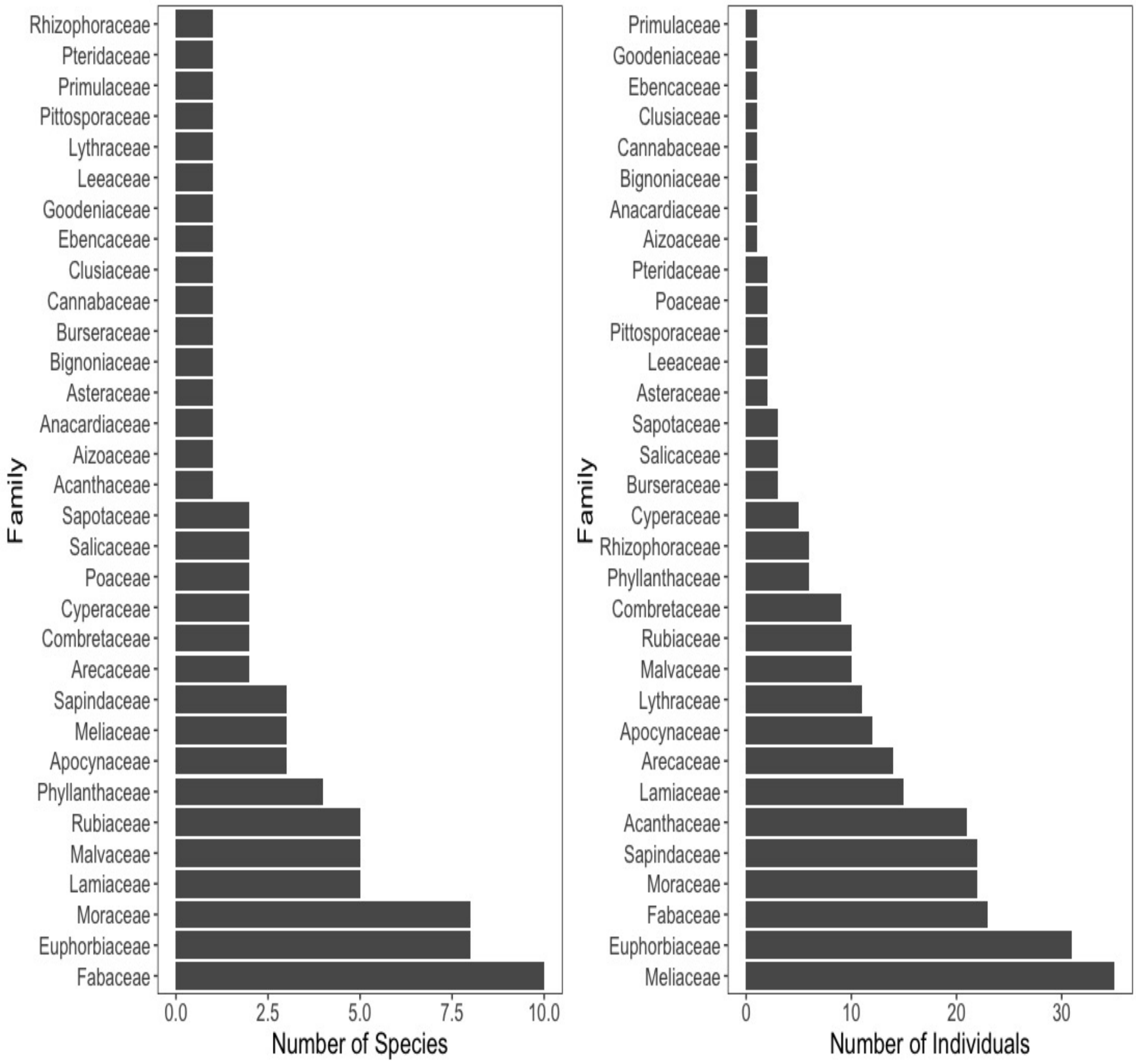


Figure 36. Family-level species (left panel) and individual (right panel) distribution of plants across the study area

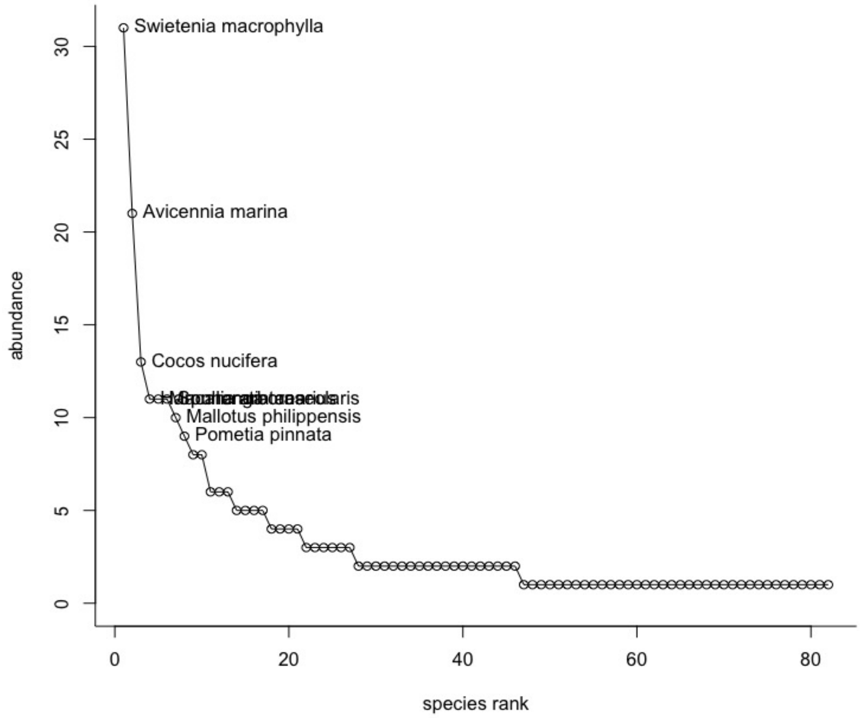


Figure 37. Plant species rank-abundance distribution across the study area

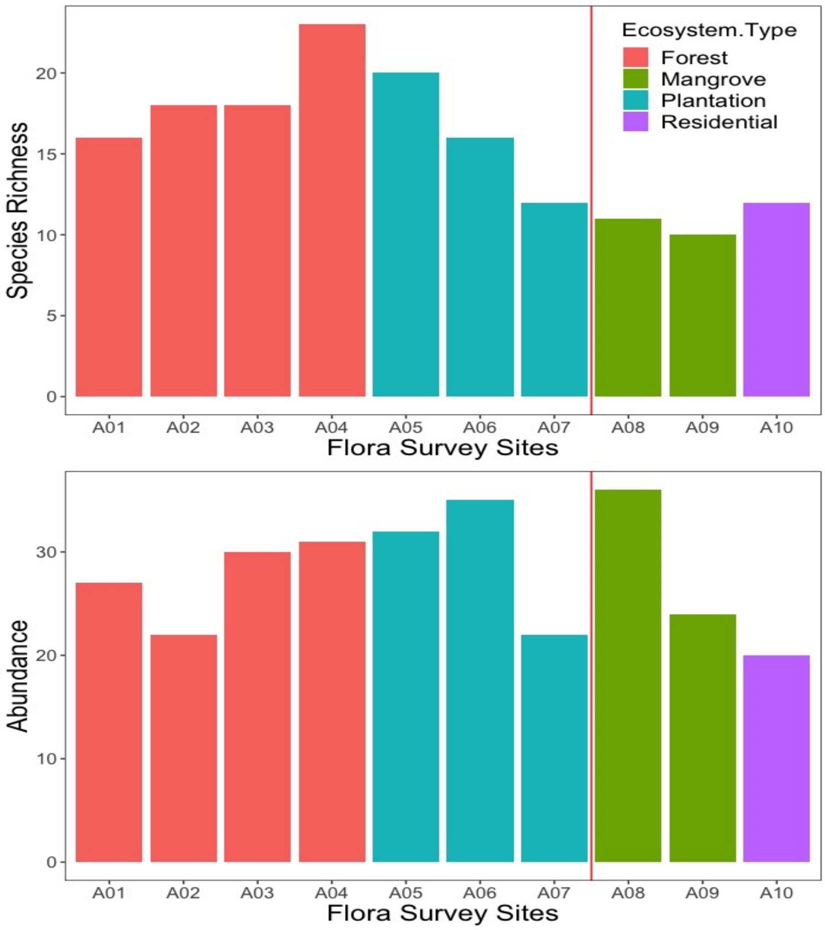


Figure 38. Site-level species richness (above panel) and abundance (bottom panel) distribution across the study. Vertical red line separates survey sites in Guimaras island (left side, 7 sites) and Panay island (right side, 3 sites). Color indicate ecosystem type

2.1.4.1.4.5 Flora Biodiversity Status

Figure 39 showed biodiversity status of each of the 21 surveyed plots across the PGN project ROW. The status of biodiversity was assessed based from Fernando Biodiversity Scale (1998). Floristic diversity based calculated diversity (Shannon-Weiner H) revealed moderate, low, and very low diversity for the surveyed sites. Seven sites have at least a moderate diversity (H = 2.50 – 3.00), one residential plot (S01), one beach forest plot (S19) and five plantation plots. Mangrove forest plots have low diversity (H = 2.00 – 2.50), while three out of four agricultural plots have very low diversity (H < 2.00). Assessment based from Pielou's evenness J showed that density of species are equally distributed within each sampling sites where J > 0.75 or very high evenness value. The low diversity observed in the study sites can be due to most sampling sites are within human settlements area, not necessarily houses but areas that are being utilize for human activities (farms, plantations). The beach and mangrove forest are heavily disturbed. This result suggest that the project ROW will not greatly affect the plant biodiversity since the more diverse ecosystem are avoided during the project design.

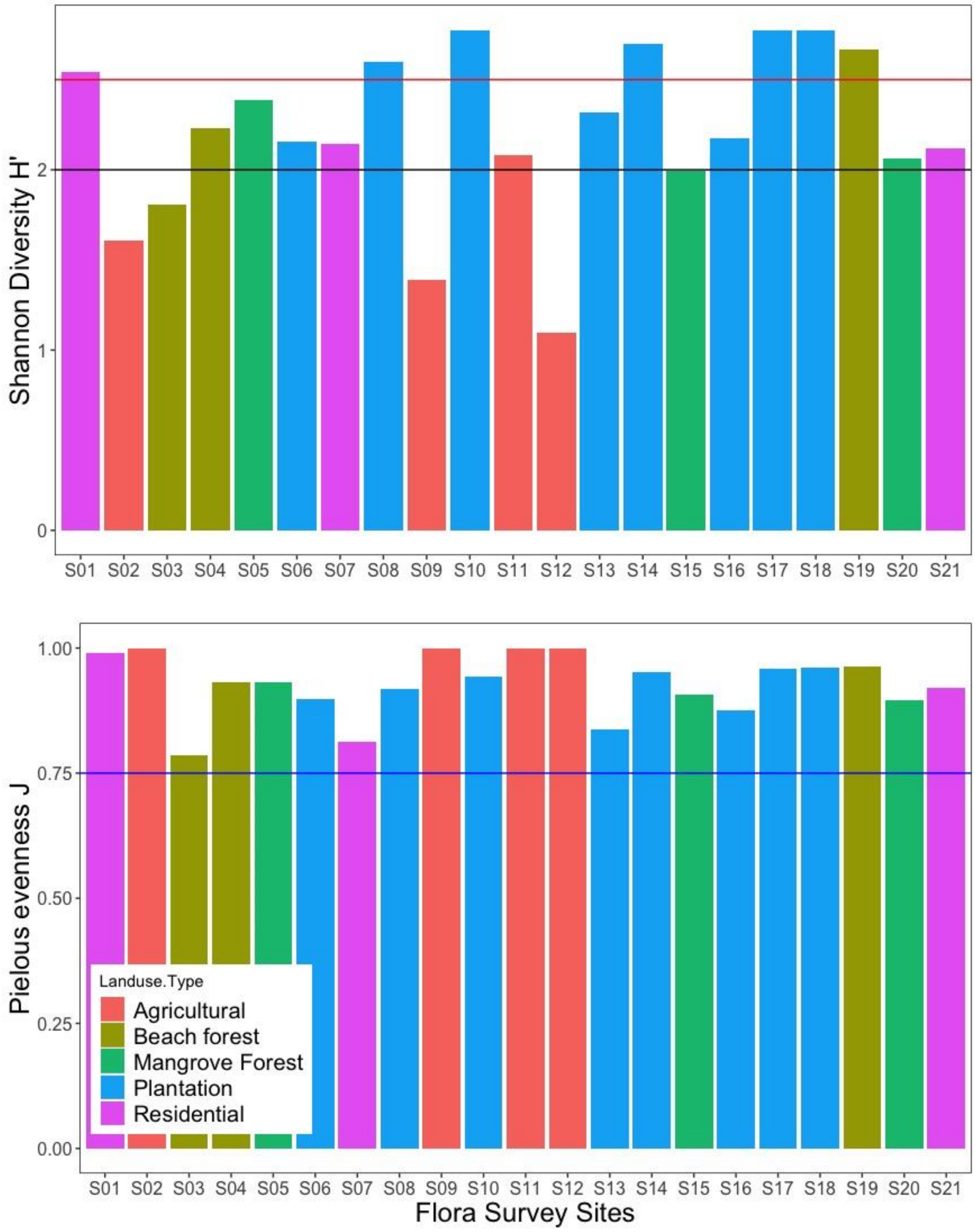


Figure 39. Shannon Diversity H' (above) and Pielou's Evenness J (bottom) across the study sites. Bar colours indicate land use type. Vertical lines indicate biodiversity scale based from Fernando Biodiversity Scale (1998) where above red line = moderate diversity (H = 2.50-2.99), in between black and red line = low diversity (H = 2.00 – 2.50), below black line = very low diversity (H < 2.00), and above blue line have very high evenness value (J > 0.75).

Figure 40 presented the calculated biodiversity indices of the 10 surveyed sites for Shannon-Wiener diversity H' (top panel) and Pielou's Evenness J' (bottom panel) and were assessed based from Fernando Biodiversity Scale (1998). The scale assumes highest diversity at H' > 3 (high and very high diversity), however, there was no site with H' > 3, indicating low diversity recorded in the studied sites. This can be due to relatively limestone-karst substrate in most survey sites, where fewer adapted species can grow compared to a more diverse rainforest. Instead, five sites were assessed with "moderate diversity" or H' = 2.50 – 2.99, including all of the four forest sites and one of the two mangrove sites. Three sites were assessed with low diversity (H = 2.00 – 2.49), and 2 of the plantation sites were assessed with low diversity (H < 1.99) due to clearance of original vegetation within the studied sites. The calculated evenness J' index of all the surveyed sites have J' > 0.75 (very high), which means an evenly distributed number of individuals for each species in the studied plot. This can be due to the number of singleton species (appeared only once) observed in each site.

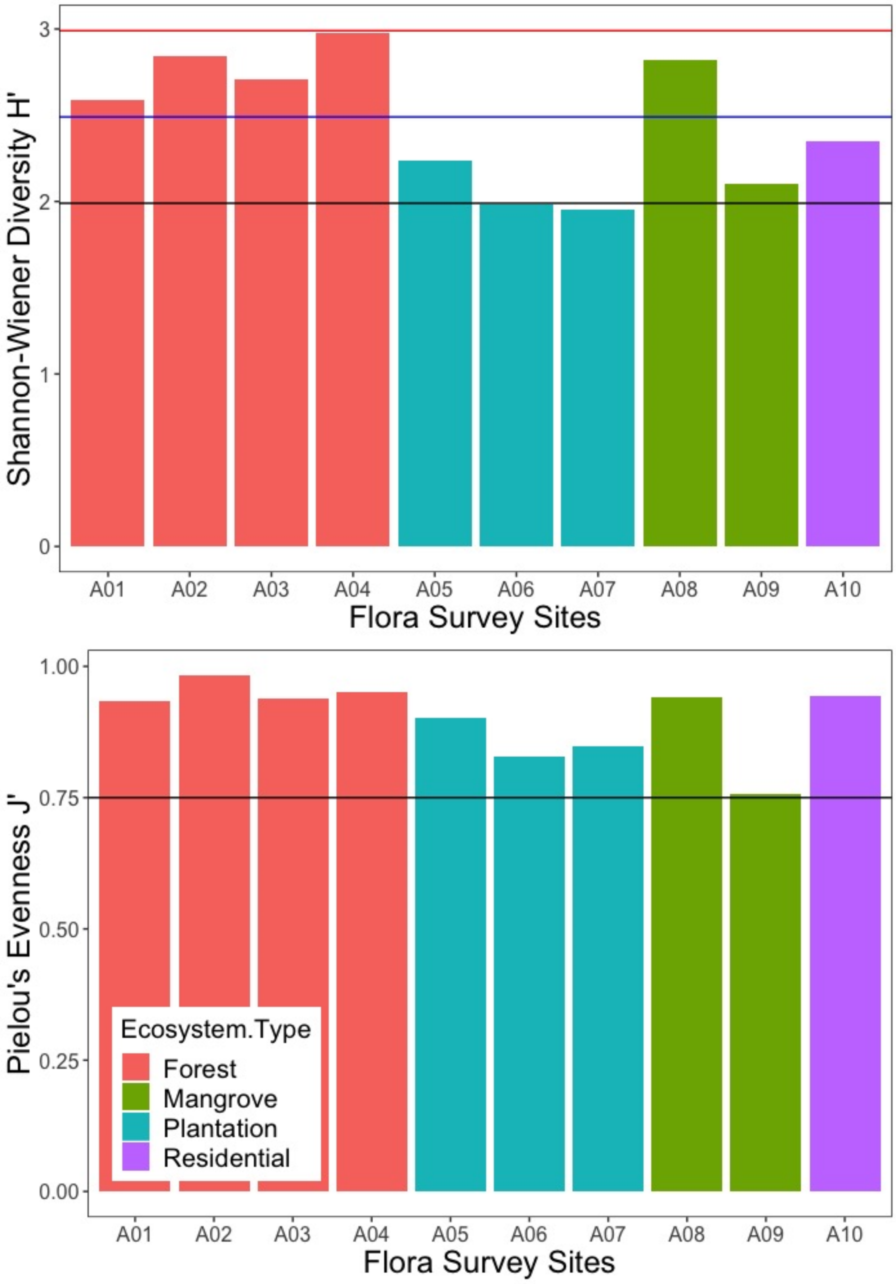


Figure 40. Site-level biodiversity status based from calculated Shannon-Wiener diversity H' (top panel) and Pielou's evenness J' (bottom panel) following criteria set in Fernando Biodiversity Scale (1998). Horizontal lines indicate biodiversity scale. Color indicate ecosystem type

2.1.4.1.4.6 Endemicity and Conservation Status

Endemicity

The geographical distribution of plant species has been very useful for assessing biodiversity values of regions, countries, and islands. Species confined to a particular site should be given particular conservation management strategies, as they are more vulnerable to disturbance due to their narrow range. However, categorizing species as endemic is very much dependent on availability of recent revisions, nomenclatural changes, and new evidences from various disciplines used in systematics, among others.

Of the 122 species identified across the study area, only 9 species are so called Philippine endemics or species that can only be found in the Philippines, which was recorded only in the Beach forest (1 endemic) and in the Plantation sites (8 endemics) (see **Figure 41**). Recorded endemic species are malubago (*Hibiscus tiliaceus*) found in Beach forest, and some in tree Plantations such as tagbak (*Alpinia elegans*), is-is (*Ficus ulmifolia*), and takipan (*Caryota cumingii*). These nine endemics are widely growing in the country. The number of endemics species recorded in this study is significantly lower compared to the country endemism reported to be 60% based on Merrill's Enumeration of Philippine Flowering Plants. In any case, the reported endemism for this study is far below the reported plant endemism in the country. This is understandable since the study areas are mostly marginal areas characterized by open canopy forest and agroforest ecosystems.

Most of the species identified in this study are indigenous to country or species that are naturally growing but are not limited in the Philippines, with 73 (60%) of the record. Plantation has 39 indigenous species, followed by beach forest with 25 indigenous species. The mangrove forest also registered 17 indigenous species. Some of the common indigenous species observed in the study were pedada (*Avicennia marina*), bungalon (*Sonneratia caseolaris*), and kulasi (*Lumnitzera raxemosa*) found in mangrove and beach forests. In the Plantations, some naturally growing endemics are pandakaki (*Tabernaemontana pandacaqui*) and binunga (*Macaranga tanarius*). Cogon, a common weed in tropical countries is also indigenous in the Philippines.

There are also 40 exotic species recorded across the study, with most are unsurprisingly recorded in Plantations, Agricultural and Residential Landscape – which reflects that human active grounds are venue of more exotic species. Exotics species have the potential to be invasive such as hagonoi (*Chromolaena odorata*), aroma (*Acacia farnesiana*) and koronitas (*Lantana camara*). Other exotics recorded in this study are planted such as big leaf mahogany and yemane (Gmelina).

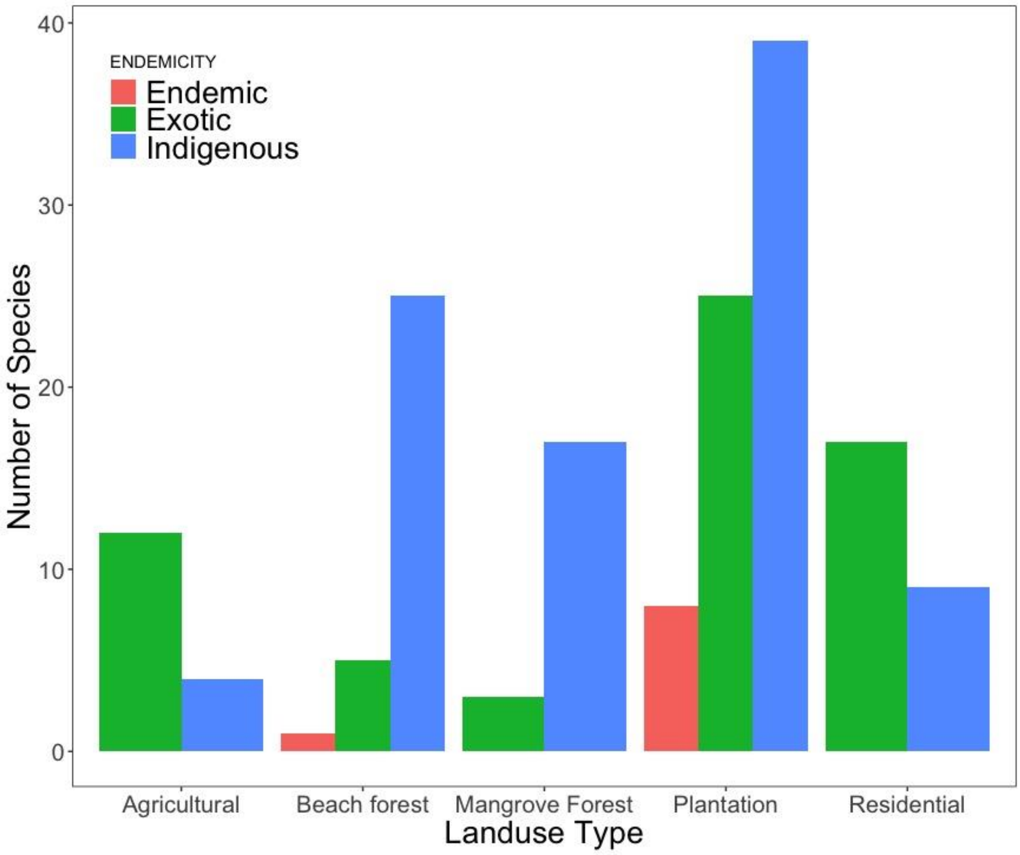


Figure 41. Bar plots showing endemicity of species to either native (endemic, indigenous) and non-native (exotic) species.

Figure 42. Representative species for endemic (*Sonneratia caseolaris*), indigenous (*Tabernaemontana pandacaqui*) and exotic (*Acacia farnesiana*).

On additional survey of 10 sites, majority of species were identified as indigenous species listing 58 out of 82 species (71%) recorded in the study area, while 10 species (12%) are known Philippine endemic and 14 species are (17%) are exotic or not native to the Philippines (see **Figure 43** and refer complete list in Annex). This result showed that native species (indigenous and endemic) are still common in the area although the landscape has been converted to plantations, residentials and mixed-agricultural land uses. Noteworthy species were the 10 endemic species or species that can only be found in the Philippines, such as takip asin (*Macaranga grandifolia*) and bayag-usa (*Voacanga* globasa) which are important pioneer species in the country along with several pioneer and indigenous species such as alim (*Melanolepis multiglandulosa*), hauili (*Ficus septica*), malabagang (*Glochidion album*) and uas (*Harpullia arborea*), among others. Moreover, many of native species provides economic importance such nipa (*Nypa fruticans*), noni (*Morinda citrifolia*), and himbabao (*Broussonetia luzonica*), being used in construction, medicinal and food source. Exotic species are the planted big leaf mahogany (*Swietenia macrophylla*), yemane (*Gmelina arborea*), and kape (*Coffea arabica*) along with some potentially invasive species such as hagonoi (*Chromolaena odorata*) and aroma (*Acacia farnesiana*).

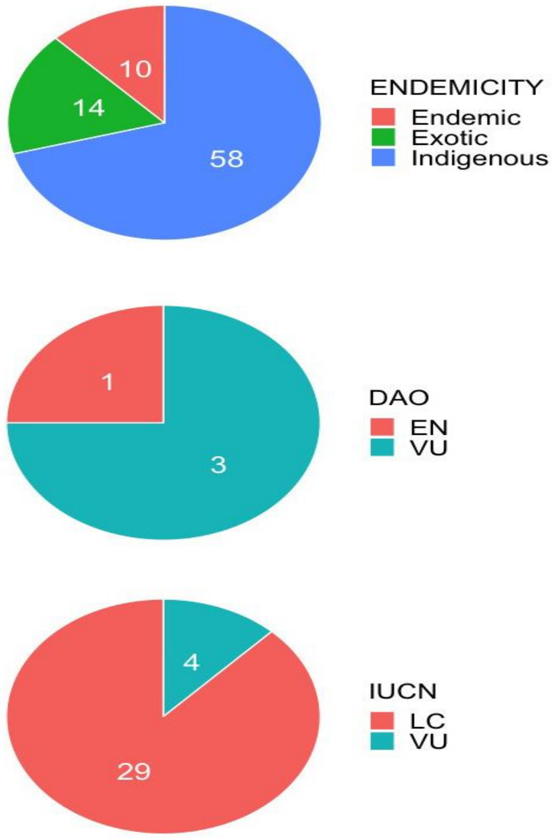


Figure 43. Flora endemicity (top panel), and conservation status based from DAO 2017-11 red list (middle panel) and IUCN red list (bottom panel) across the study

Conservation Status

The conservation status of species is based on the most recent recommendations of the Philippine Plant Conservation Committee (PPCC) of the Protected Areas and Wildlife Bureau (PAWB), DENR officially issued as DENR Administrative Order No. 2017-11 better known as ''Updated National List of Threatened Philippine Plants and their Categories'. The listing of protected species of CITES and threatened species of the IUCN red list were also used as reference. Based from the Philippine Red List (DENR Administrative Order 2017-1), only four species are considered threatened, of which three are endangered (*Camptostemon philippenense, Adonidia merrillii,* and *Vitex parviflora*) and one that is vulnerable (*Alpinia elegans*) (refer to **Table 21**). Although, 39 of the 122 species from the study are listed in the Global Red List (IUCN 2019), most of these are least concern (32 species) and two are near threatened (*Adonidia merrillii* and *Aegeceras floridum*), while only five species are considered threatened which include one endangered species (*Camptostemon philippenense*) and four vulnerable species (*Vitex parviflora, Swietenia macrophylla, Artocarpus blancoi,* and *Ficus ulmifolia*).

In the list, the manila palm (*Adonidia merrillii*) are commonly planted in residential areas as landscape ornamental. The big leaf mahogany (*Swietenia macrophylla*) is an exotic plantation species that is suspected to have an allelophytic effect (invasive) in tropical Asia, but its local origin in South America are becomingly endangered. Molave/tugas (*Vitex parviflora*) has been listed due to excessive collection for its good wood quality for woodworks.

Figure 43 and **Table 22** showed the red list species under the Philippine Red List (DENR Administrative Order No. 2017-11) and under Global Red List (IUCN list) for additional survey sites. Only four species were listed under the Philippine Red List – one is the endangered molave (*Vitex parviflora*) and the three others were vulnerable: tagpo (*Ardisia squamolosa*), bolong eta (*Diospyros pilosanthera*), and nato (*Palaquium luzoniense*). Molave had been used in the construction industry, due to its hard and dense wood, causing the decline in its population, while the three other species had been lost due habitat conversion. Under the Global Red List, 33 were listed but 29 of these were of Least Concern and only four were Vulnerable including one exotic species – the big leaf mahogany (*Swietenia macrophylla*). Big Leaf Mahogany were introduced in the country in the early 1900s for its good wood quality for construction.

Table 22. Conservation status of plant species between differn land use type base from DAO 2017-11 and IUCN category.

Species	DAO	IUCN	Land use type				
			Agricultural	Beach	Mangrove	Plantation	Residential
Avicennia marina		LC			x		
Avicennia officinalis		LC			x		
Annona muricata		LC			x	x	x
Alstonia macrophylla		LC				x	
Wrightia pubescens		LC		x			
Polyscias nodosa		LC				x	
Corypha utan		LC				x	
Nypa fruticans		LC		x			
Canarium asperum		LC				x	
Trema orientalis		LC				x	
Cratoxylum sumatranum		LC				x	
Lumnitzera racemosa		LC		x	x		
Excoecaria agallocha		LC		x	x		
Acacia auriculiformis		LC	x				
Cassia fistula		LC				x	
Erythrina variegata		LC		x			
Mimosa pudica		LC	x			x	x
Pongamia pinnata		LC		x	x	x	
Tamarindus indica		LC				x	
Sonneratia caseolaris		LC			x		
Ceiba pentandra		LC				x	
Heritiera littoralis		LC		x			
Azadirachta indica		LC		x	x	x	
Sandoricum koetjape		LC					x
Xylocarpus moluccensis		LC		x	x		
Osbornia octodonta		LC			x		
Psidium guajava		LC	x			x	x
Ischaemum muticum		LC		x			
Saccharum spontaneum		LC	x				x
Acrostichum aureum		LC			x		
Ceriops tagal		LC			x		
Scyphiphora hydrophyllacea		LC		x			
Camptostemon philippinense	EN	EN		x			
Adonidia merrillii	EN	NT					x
Aegiceras floridum		NT			x		
Vitex parviflora	EN	VU		x		x	
Swietenia macrophylla		VU				x	x
Artocarpus blancoi		VU				x	
Ficus ulmifolia		VU				x	
Alpinia elegans	VU					x	

Legend: EN-Endangered, VU-Vulnerable, NT-Near Threatened, LC-Least Concern

Table 23. Flora conservation status base from DAO 2017-11 and IUCN Red List category

Species	DAO 2017-02 Red List										IUCN Red List									
	A01	A02	A03	A04	A05	A06	A07	A08	A09	A10	A01	A02	A03	A04	A05	A06	A07	A08	A09	A10
Acacia auriculiformis												LC								
Ardisia squamolosa			VU																	
Avicennia marina																		LC	LC	
Caesalpinia sappan											LC		LC				LC			
Canarium asperum											LC			LC	LC					
Cassia fistula													LC							
Celtis philippensis														LC						
Cerbera manghas																LC	LC			
Cyperus rotundus												LC								
Diospyros pilosanthera			VU																	
Excoecaria agallocha																		LC		
Ficus variegata												LC								
Flueggea virosa											LC	LC								
Gmelina arborea											LC		LC		LC	LC				
Harpullia arborea											LC		LC	LC	LC					
Heritiera sylvatica																			LC	
Lumnitzera racemosa																		LC		
Macaranga grandifolia																VU				
Macaranga tanarius											LC				LC	LC	LC			LC
Mallotus floribundus												LC								
Mallotus philippensis											LC	LC		LC	LC	LC				
Melanolepis multiglandulosa																				LC
Melia dubia															LC					
Nypa fruticans																		LC		
Palaquium luzoniense			VU										VU							
Pithecelubium dulce																			LC	LC
Rhizophora mucronata																		LC	LC	
Saccharum spontaneum																				LC
Sonneratia caseolaris																		LC	LC	
Swietenia macrophylla												VU		VU	VU	VU	VU			
Thespesia populnea																		LC	LC	
Vitex negundo												LC								

Vitex parviflora	EN	VU						
Wrightia pubescens			LC	LC		LC		
Xylocarpus moluccensis							LC	LC

2.1.4.2 Fauna Biodiversity Assessment

Objective of Fauna Assessment

The conduct of fauna survey within the immediate vicinity of the proposed PGN project ROW is to be able to evaluate wildlife species composition of the area and determine if there are any significant impact of the project to faunal community in different project phases.

Specifically:

To determine fauna diversity of the area covering the direct impact area, and compare species diversity, evenness and abundance of these areas in consideration with the location, ecosystem type and other ecological factors relative to faunal composition

2.1.4.2.1 Methodology

The study area

Survey for fauna species was undertaken following the proposed approach of bridge projects and its extension road network connecting the islands of Panay, Negros, and Guimaras. Point centered count with a radius of 100 meter was made following the same sampling points for the flora survey. Surveyed sites cover the direct and indirect impact areas of the project. Ecosystem types within the survey sites are representatives of shrub land ecosystem, agro-ecosystem, settlement, mangrove ecosystem, and beach forest. A total of 22 sampling points was undertaken which were distributed in the 4 municipalities covering the proposed project namely; Pulupandan in Negros Occidental, San Lorenzo and Buenavista in Guimaras, and Leganes in Panay Island.

Geographic coordinates and description of the surveyed sites is presented in **Table 23**. Location map of the sampling sites is shown in **Figure 44**.

Table 24. Description and geographic location of fauna survey sites

Site no.	Description/Habitat	Geographic Coordinates (WGS 84)		Remarks
		Northing	Easting	
1	Mixture of settlement and agricultural ecosystem	10°30’37.84”N	122°49’58.00”E	Ubay Pulupandan Negros Occidental
2	Agricultural ecosystem (sugar cane plantation)	10°31’0.95”N	122°49’23.76”E	Ubay Pulupandan Negros Occidental
3	Mangrove ecosystem	10°31’38.62”N	122°48’42.62”E	Zone 4 -A Pulupandan, Negros Occidental
4	Beach Forest ecosystem	10°31’58.19”N	122°48’26.11”E	Tapong Pulupandan, Negros Occidental

5	Mixture of beach forest and mangrove ecosystem	10°35’25.59”N	122°42’39.92”E	M. Chavez San Lorenzo, Guimaras
6	Agricultural ecosystem (coconut plantation and Salt farm)	10°35’31.30”N	122°42’34.43”E	M. Chavez San Lorenzo, Guimaras
7	Mixture of agricultural ecosystem (rain fed paddy area) settlement ecosystem	10°35’39.06”N	122°42’26.98”E	M. Chavez San Lorenzo, Guimaras
8	Shrub land ecosystem	10°35’59.80”N	122°42’11.54”E	M. Chavez San Lorenzo, Guimaras
9	Agricultural ecosystem (Rain Fed paddy area)	10°36’25.67”N	122°42’8.16”E	M. Chavez San Lorenzo, Guimaras
10	Agricultural ecosystem (mixture of rain fed paddy area and coconut plantation)	10°42’11.97”N	122°41’37.33”E	Cansilayan Buenavista, Guimaras
11	Agricultural ecosystem (Rain fed paddy area)	10°42’26.89”N	122°41’11.20”E	Ban-ban Buenavista, Guimaras
12	Agricultural ecosystem (Rain fed paddy area)	10°42’41.42”N	122°40’50.85”E	Ban-ban Buenavista, Guimaras
13	Mahogany Plantation ecosystem	10°43’0.90”N	122°40’41.54”E	Ban-ban Buenavista, Guimaras
14	Shrubland ecosystem	10°44’4.13”N	122°40’19.60”E	Navalas Buenavista, Guimaras
15	mixture of Mangrove and fish pond ecosystem	10°44’11.17”N	122°40’6.83”E	Navalas Buenavista, Guimaras
16	Agricultural ecosystem (mango plantation)	10°44’26.42”N	122°39’38.67”E	Getulio Buenavista, Guimaras
17	Shrub land ecosystem	10°44’35.24”N	122°39’24.83”E	Getulio Buenavista, Guimaras
18	Shrub land ecosystem	10°44’47.02”N	122°39’11.92”E	Getulio Buenavista, Guimaras
19	Shrub land ecosystem	10°45’1.62”N	122°39’3.37”E	Getulio Buenavista, Guimaras
20	Mixture of mangrove and fish pond ecosystem	10°46’43.05”N	122°37’9.30”E	Gua-an Leganes, Ilo-ilo
21	mixture of salt farm and settlement ecosystem	10°46’54.72”N	122°36’57.86”E	Gua-an Leganes, Ilo-ilo
22	Municipal Plaza	10°41’49.39”N	122°38’50.94”E	Indirect impact area. Buenavista Guimaras

Figure 44. Fauna sampling sites

The study area

Figure 45. Beach ecosystem (brgy. Tapong Pulupandan, Negros Occidental)

Figure 46. Shrub land ecosystem (Brgy. Ban-ban

Figure 47. Agricultural ecosystem (Brgy. Cansilayan Buenavista Guimaras)

Figure 48. Wetland ecosystem (Brgy. Gua-an Leganes, Ilo-ilo)

Figure 49. Mangrove ecosystem (Brgy. Navalas Buenavista Guimaras)

Figure 50. Mixture of settlement and Orchard ecosystem (Brgy. Getulio Buenavista Guimaras)

Process and method

Survey of fauna composition of the project area was undertaken in three (3) consecutive days on March 16-18, 2019. Weather condition during the survey is sunny. Survey on fauna composition of the project area covers the avi-fauna, mammals, and herpeto-fauna. Prior to the conduct of sampling, general habitat assessment was undertaken to consider different ecosystems and topography within the project area for the selection of areas for observation. A total of 22 observation sites was identified based on its significance and influence relative to the perceived presence of faunal species within the project area. Selected sampling sites represent different ecosystems in the area.

Rapid survey was employed in the conduct of faunal assessment within the project area. Species not encountered during the period of field assessment is generated through ethnobiological interview with local informants to obtain other important information on the presence of other fauna species not encountered throughout the survey especially the medium to large mammals. Photo documentation of observed fauna was also undertaken for further verification of species when necessary.

Birds

Center point count method with a radius of about 100 meters long in each observation site is employed during the survey. All species observed within a radius of about 100 meters from the center line was recorded. Techniques employed during the survey includes ocular and aural observation, identification through wildlife calls, foot prints and droppings, if any. All the bird species seen and heard by the observer along the transect route were recorded. As much as possible, no double counting was made.

Reptiles and Amphibians

Active search for reptiles and amphibians was done systematically within the selected areas along the transect route especially in areas with the presence of suitable habitats like underneath of decaying logs, uprooted trees and bamboos. For each species observed and heard, the name of the species, number of individuals and the type of habitat where it was found were recorded. Double counting of the individuals of the same species was avoided.

Mammals

For non-volant mammals such as rodents, cage trapping was employed baited with grilled coconut meat added with peanut butter. Fifteen cage traps are laid on strategic sites within the selected sites. Interview with local informants was also undertaken to generate significant information relative to the presence/absence of large mammal species in the area. Observation during the dusk hour in some selected sites was also undertaken to observe some volant (flying) mammals primarily bats in a selected site. Mist nets was employed on selected areas using 3 units of mist nets with a dimension of 3 meters by 10 meters, to catch volant mammals including birds.

2.1.4.2.2 Fauna Biodiversity Measurement

Biodiversity measurements were computed and analyzed using the Shannon-Wiener Diversity and Pielou's Evenness Indexes, with formulas illustrated below:

Shannon-Wiener Diversity	=	$H' = -\sum p_i \ln (p_i)$, where, "H'"- represents the symbol for the amount of diversity in ecosystem (species diversity) "p_i"- represents the proportion or relative abundance of each individual species to the total (measured from 0 to 1) "ln p_i" - represents the natural logarithm of p_i
Pielou's Evenness	=	$J = H'/Hmax = H=H'/\ln S$, where, "J" – represents the symbol for the species richness "H'" – species diversity "Hmax" – species maximum diversity

"S" – number of species in the community

The interpretation of the values obtained using the above formulas will be based on the Fernando Biodiversity Scale (1998) shown in the Table 1.

2.1.4.2.3 Fauna species conservation status and endemism

Conservation status and endemism of fauna species is determined with reference to the International Union for Conservation of Nature (IUCN) Red List of Threatened Species 2016 and DENR-AO 2007-01 "Establishing the National List of Threatened Philippine Plant and Their Categories were employed. This is to provide scientifically based information on the status of the species and sub-species at a global level; draw attention to the magnitude and importance of threatened biodiversity; influence national and international policy and decision-making; and provide information to guide actions to conserve biological diversity (*Source: Convention on International Trade of Wild Flora and Fauna, Joint Meeting of the Animals and Plants Committee, Shepherds town, USA., December 2000, retrieved November 2012*). The IUCN Red list is set upon precise criteria to evaluate the extinction of thousands of species and sub-species. The aim of the Red List is to convey the urgency of conservation issues to the public and policy-makers, as well as to help the international community to try to reduce species extinction. In addition, the DENR AO 2007-01 was also used pursuant to Section 22 of Republic Act 9147, otherwise known as the Wildlife Conservation and Protection Act of 2001.

Conservation categories and description

Critically Endangered (CR) - A taxon is Critically Endangered when it is facing an extremely high risk of extinction in the wild in the immediate future.
Endangered (EN) - A taxon is Endangered when it is not Critically Endangered but is facing a very high risk of extinction in the wild in the near future.
Vulnerable (VU) - A taxon is Vulnerable when it is not Critically Endangered or Endangered but is facing a high risk of extinction in the wild in the medium-term future.
Near threatened (NT) - Taxa which do not qualify for Conservation Dependent, but which are close to qualifying for Vulnerable.
Least Concern (LC) - Taxa which do not qualify for Conservation Dependent or Near Threatened.
Other Threatened Species (OTS)- refers to a species or subspecies that is not critically endangered, endangered nor vulnerable but is under threat from adverse factors, such as over collection, throughout its range and is likely to move to the vulnerable category in the near future.
Not Evaluated (NE) - A taxon is Not Evaluated when it has not yet been assessed against the criteria.

2.1.4.2.4 Results and Discussions

2.1.4.2.4.1 Fauna composition and richness

Birds

Recorded fauna species during the entire duration of survey are dominated by birds. A total of 42 species of birds are recorded from the 22 observation sites with a total abundance of 568 birds. Recorded bird species belongs to the 26 avi-fauna families, which is dominated by Columbidae composed of 6 species, See **Table 24** and **Figure 51~53.**

Table 25. Top Three (3) families with the highest number of species

Family Name	Number of Species	Percentage (Species)
Columbidae	6	14.28%
Ardeidae	4	9.52%
Alcedinidae, Apodidae, Hirundinidae, Laniidae, Muscicapidae, Nectariniidae, Pycnonotidae, Scolopacidae	2	4.76%

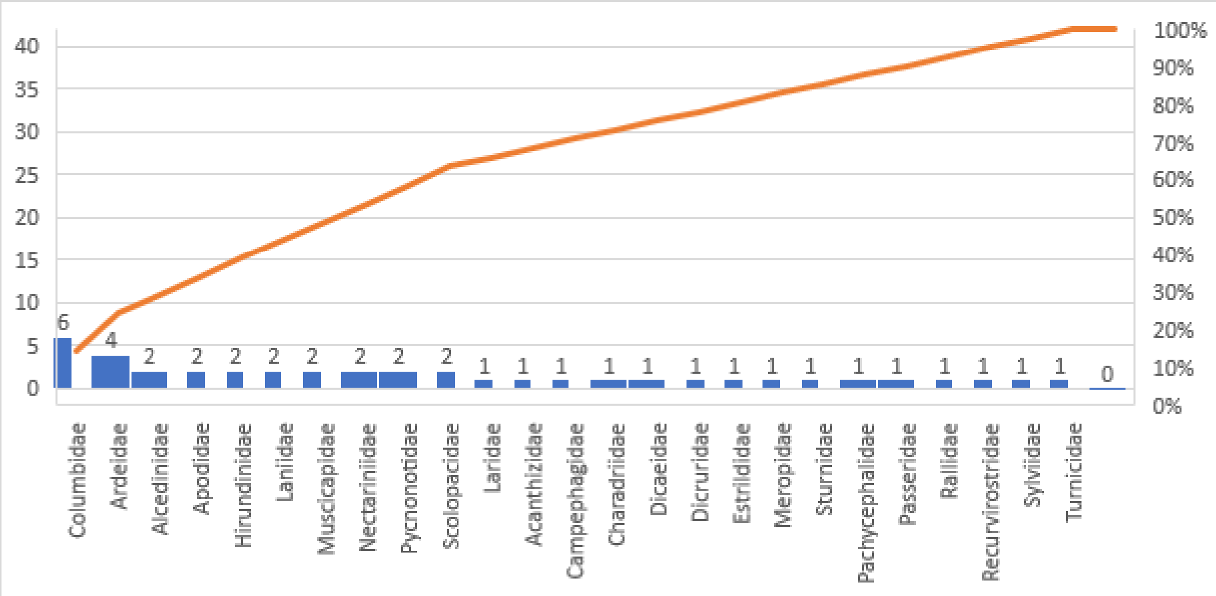


Figure 51. Family composition

In terms of abundance, the Eurasian Tree Sparrow (*Passer montanus)* is the dominant species followed by the Asian Glossy Starlings (*Aplonis panayensis*) and Black-Winged Stilt (*Himantopus himantopus)* with a total abundance of 96, 65, and 48, respectively. Observation sites with the highest species diversity composition is site no. 22 comprised of 14 species out of the 42 observed. It is then followed by site nos. 5 and 20 with the species diversity of 13. Conversely, site 12, 14, 18 has the least species diversity with only 3 species observed.

Local abundance of birds in each observation sites showed that site no. 22 has the utmost abundance of 96 followed by site no. 6 with a total of 55. Conversely, site no. 18 has the least abundance, with only 4 birds.

Most of the observed species are noted to be common in a wide range of habitats including agricultural areas, shrub lands, grass lands and in settlement areas. Many of these species thrive even in highly disturbed environment including settlement areas.

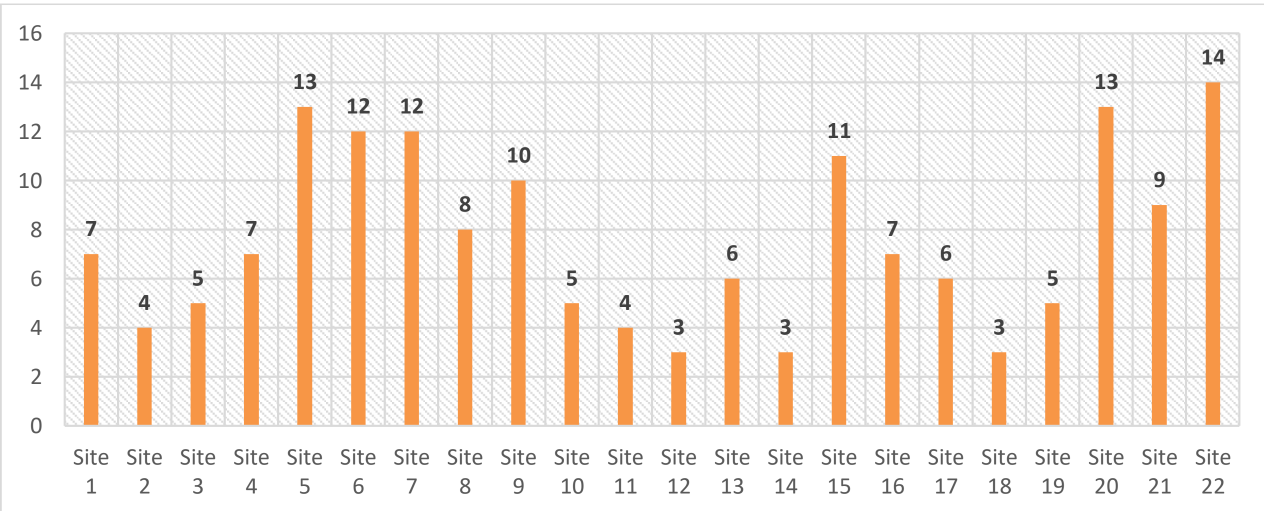


Figure 52. Number of species in each observation site

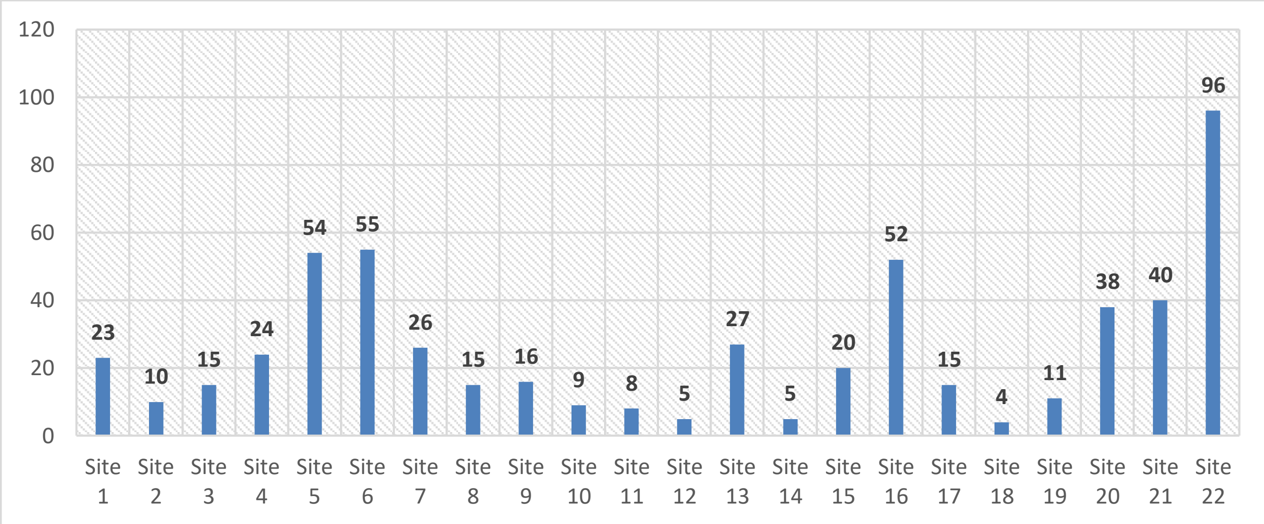


Figure 53. Abundance of birds in each observation site

Avi-fauna (Birds) on additional survey on June 2019

Recorded fauna species during the entire duration of survey are dominated by birds. A total of 37 species of birds are recorded from the 10 observation sites with a total abundance of 185 birds. Recorded bird species belongs to the 25 avi-fauna families, which is dominated by Columbidae and Ardeidae both composed of 4 species present, See **Table 25** and **Figure 54**.

In terms of abundance, the Asian Glossy Starlings (*Aplonis panayensis*) is the dominant species followed by the Eurasian Tree Sparrow (*Passer montanus)* and Yellow Vented Bulbul (*Pycnonotus goiavier)*, with total number of 26, 19, and 17, respectively. Observation sites with the highest species diversity composition is site no. 1 comprised of 11 species out of the 37 observed. It is then followed by site nos. 2 and 3 with the species diversity of 10. Conversely, site 5, 7, 10 has the least species diversity with only 4 species observed (see **Figure 55**).

Local abundance of birds in each observation sites exhibited that site nos. 1, 2 and 8 has the utmost abundance of 27 followed by site no. 9 with a total of 24. Conversely, site no. 5 has the least abundance, with only 7 birds.

Most of the observed species are noted to be common in a wide range of habitats including agricultural areas, shrub lands, wetlands, mangrove and wetland ecosystems. Many of these species thrive even in highly disturbed environment including settlement areas.

Table 26. Top Three (3) avi-fauna families with the highest number of species

FAMILY NAME	NUMBER OF SPECIES	PERCENTAGE (SPECIES)
Columbidae, Ardeidae	4	16%
Cuculidae	3	12%
Campephagidae, Dicaeidae, Pycnonotidae	2	8%

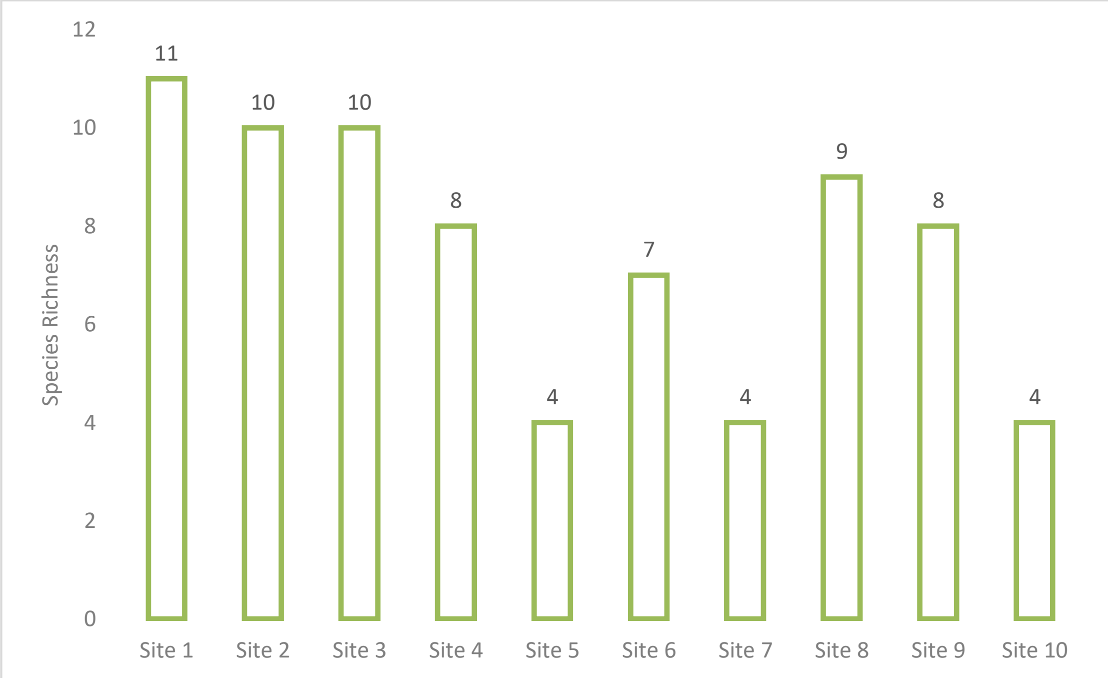


Figure 54. Avi-fauna species richness

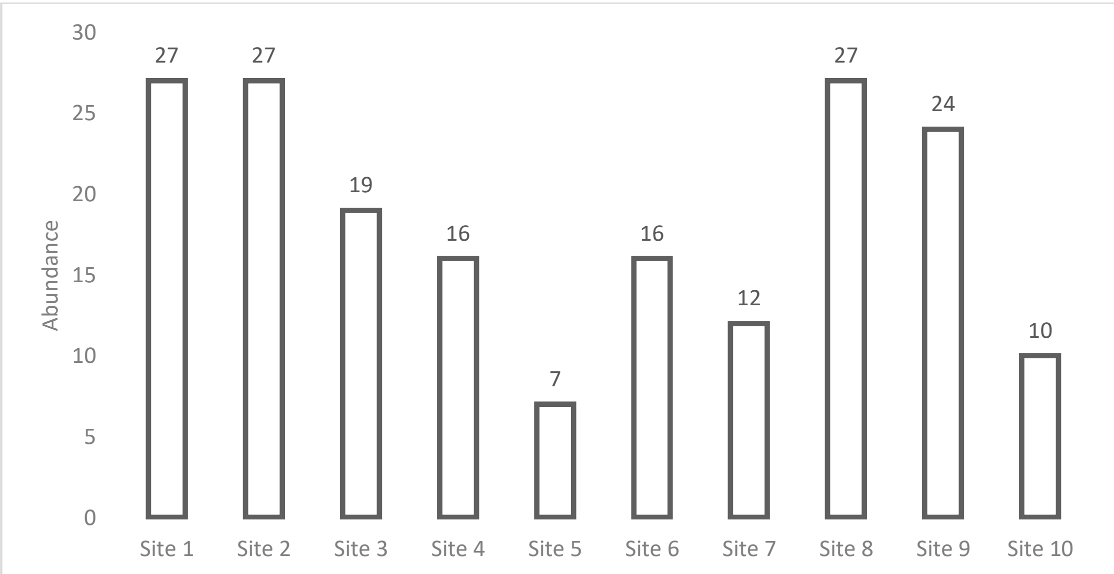


Figure 55. Avi-fauna abundance

Herpeto-fauna species

A total of 8 herpeto-fauna species are recorded in the area. There were 4 observed reptiles, namely, Gecko-gecko *(Gecko gecko),* Water Monitor Lizard (*Varanus salvator),* Bubuli/ Skink (*Eutropis multi-fasciata*), and Emerald Tree Skink (*Lamprolepis smaragdina)*. There was one (1) Emerald Tree Skink, and four (4) Brown Skink observed in different survey sites. Meanwhile, Gecko-gecko was heard during the sampling. Lastly, the Water Monitor Lizard is discerned from an ethnobiological interview with key informant.

On the other hand, 2 species of amphibians are also observed namely; Giant Marine Toad (*Bufo marinus),* and Banded Bullfrog (*Kaloulo pulchra).*

A total of 6 herpeto-fauna species are recorded in the area in the additional survey sites. Reptile species are Gecko *(Gecko gecko),* Water Monitor Lizard (*Varanus salvator),* Luzon Giant Forest Skink (*Otausur cumingi)*, and Spotted Green Tree Skink *(Lamprolepis smaragdina*). Water Monitor Lizard is claimed to be common in the area as per ethnobiological interview with residents living near the surveyed sites. Presence of two (2) amphibian species are also recorded in the survey sites- Painted Narrow-mouth Toad (*Kaloula picta)* and Cane Toad (*Rhenilla marina).*

Mammals

Only 2 species of mammals observed during the survey. There was the Polynesian Rat (*Rattus exulans)* and the Common Rousette Bat (*Rousettus amplexicaudatus).*

Only 1 mammal was observed during the survey in additional 10 sites, which is believed to be the Common Dawn Bat (*Eonycteris spelae)* which are wandering along the mangrove area.

2.1.4.2.4.2 Endemism and conservation status

With regard to conservation status with reference to IUCN, only 3 of the fauna species are near threatened in the category, 2 are vulnerable, 40 are least concern and only 1 is not evaluated, see **Table 26**. Relative to endemicity, 6 avifauna out of the 50 fauna species or 12% are Philippine endemic and the remaining 44 species or 88% are native to the country, see **Table 27**.

Table 27. Summary list of fauna species and their conservation status (IUCN, 2016)

CONSERVATION STATUS	AVES	MAMMAL/S	REPTILES	AMPHIBIANS	TOTAL
Near Threatened	3	0	0	0	**3**
Vulnerable	1	0	1	0	**2**
Least Concern	37	2	3	2	**40**
Not evaluated	1	0	0	0	**1**
TOTAL	**42**	**2**	**4**	**2**	**50**

Table 28. Summary list of fauna species and distribution status

Distribution Status	Conservation Status	Aves	Mammal/s	Reptiles	Amphibians	Total
Philippine endemic	NT	2	0	0	0	**2**
	VU	0	0	0	0	**0**
	LC	4	0	0	0	**4**
	NE	0	0	0	0	**0**
Native	NT	1	0	0	0	**1**
	VU	1	0	0	0	**1**
	LC	33	2	4	2	**33**
	NE	1	0	0	0	**1**
TOTAL		**42**	**2**	**4**	**2**	**50**

Regarding the conservation status with reference to IUCN, 1 is categorized under vulnerable, 42 are least concern and only 1 is not evaluated in additional survey sites conducted on June 2019 (see **Table 28** and **Figure 56)**.

Table 29. Summary list of fauna species and their conservation status (IUCN, 2016)

CONSERVATION STATUS	AVES	MAMMAL	REPTILES	AMPHIBIANS	TOTAL
Vulnerable	1	0	0	0	1
Least Concern	36	1	3	2	42
Not evaluated	0	0	1	0	1
TOTAL	37	1	4	2	44

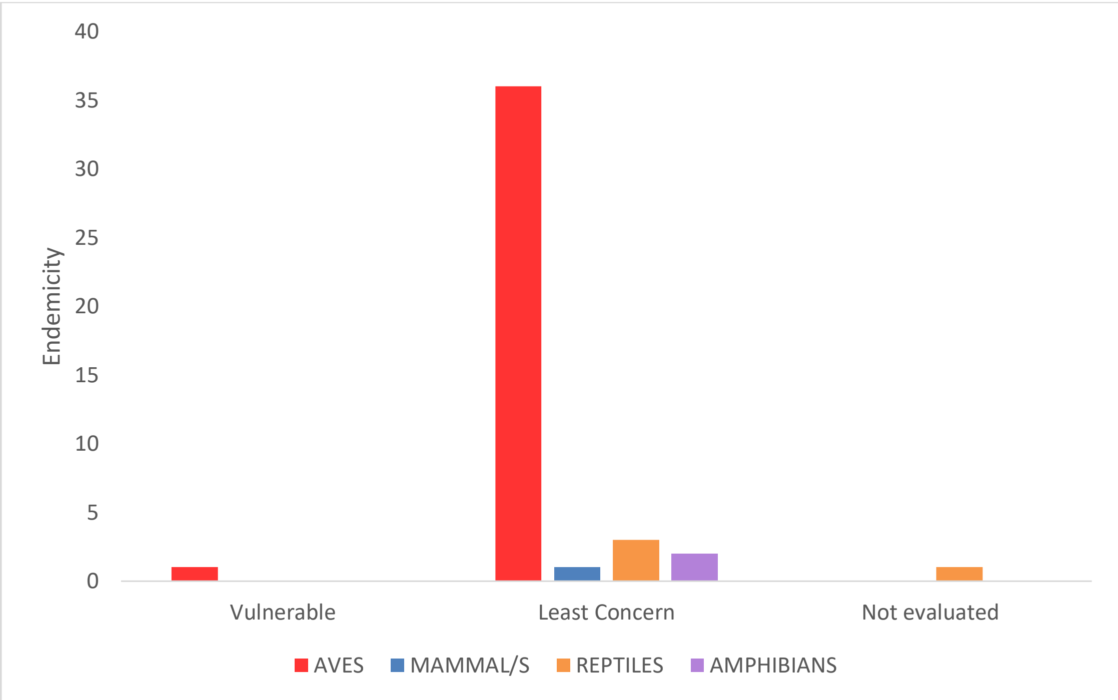


Figure 56. Conservation Status

Relative to endemicity, only 6 (13.63%) out of the 44 fauna species are Philippine endemic and the remaining 38 species (86.36%) are native to the country, see **Table 29** and **Figure 57**.

Table 30. Summary list of fauna species and distribution status

DISTRIBUTION STATUS	CONSERVATION STATUS	AVES	MAMMAL	REPTILES	AMPHIBIANS	TOTAL
Philippine Endemic	VU	1	0	0	0	**1**
	LC	4	0	1	0	**5**
Native	LC	32	1	2	2	**37**
	NE	0	0	1	0	**1**
TOTAL		**37**	**1**	**4**	**2**	**44**

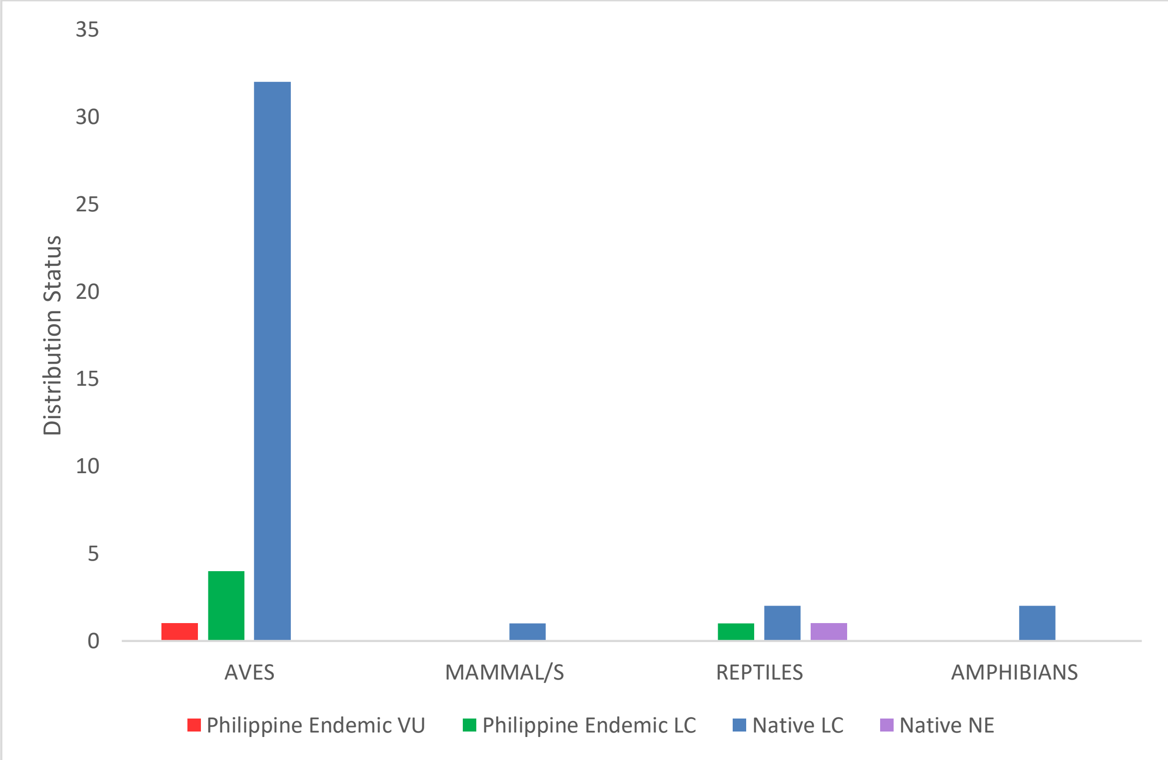


Figure 57. Faunal Endemicity

Birds

The distribution status of the recorded bird species showed that 6 species or 14.29% of the total species present are endemic in the country (see **Table 30**) and the remaining 36 or 85.71% are non-endemic species.

Table 31. List of endemic species

Species	Scientific Name	Family Name
Barred Rail	*Gallirallus torquatus*	Rallidae
Grey Hooded Sunbird	*Aethopyga primigenia*	Nectariniidae
Philippine Bulbul	*Hypsipetes philippinus*	Pycnonotidae
Mindanao Pygmy Babbler	*Dasycrotapha plateni*	Zosteropidae
White Eared Brown Dove	*Phapitreron leucotis*	Columbidae
Yellow-Bellied Whistler	*Pachycephala philippinensis*	Pachycephalidae

Conservation status of recorded species based on the International Union for Conservation of Nature (IUCN) (2016), are dominated by least concern in the category. Out of the 42 bird species, 37 are under Least Concern category, 1 species falls under Vulnerable, 3 is Nearly Threatened, and 1 is Not evaluated, though, this species is classified as Other threatened species by CITES.

Species under the vulnerable in category is the Java Sparrow (*Lonchura oryzivora*), while, Near Threatened species are the Grey Hooded Sunbird (*Aethopyga primigenia*), Mindanao Pygmy Babbler (*Dasycrotapha plateni*), and Grey -Tailed Tattler (*Heterocelus brevipes*). Species Not Evaluated is the Reddish Cuckoo-Dove (*Macrophygia phasianella),* however under the CITES is categorized as Other Threatened Species*.* The rest of the species are under the least concern in the category.

On additional survey sites, the distribution status of the recorded bird species exhibited that 5 species or 10.81% of the total avifauna species present are endemic in the country (see **Table 31**) and the remaining 33 or 86.84% are native species.

Conservation status of recorded species based on the International Union for Conservation of Nature (IUCN) (2016), are dominated by least concern in the category. Out of the 37 bird species, 32 are under Least Concern category, and 1 species falls under Vulnerable (see **Table 30**), though, this species is classified as Other Threatened Species (OTS) by CITES specified in Annex 8.5). Species under the vulnerable in category is the White-winged Cuckoo Shrike (Coracina ostenta). The rest of the species are under the least concern in the category. See **Table 30** and list of species in Annex 8.5.

Table 32. List of endemic avi-fauna species

SPECIES	SCIENTIFIC NAME	FAMILY NAME
Philippine Bulbul	*Hypsipetes philippinus*	Pycnonotidae
Philippine Coucal	*Chalcophaps indica*	Cuculidae
Red-Keeled Flower Pecker	*Dicaeum austral*	Dicaedidae
White-Breasted Waterhen	*Amaurornis phoenicurus*	Rallidae
White-winged Cuckoo Shrike	*Coracina ostenta*	Campephagidae

Mammalian and herpeto-faunal species

Meanwhile, the distribution status of the eight (8) recorded herpeto-fauna species are all native, or non-endemic to the Philippines .

Among the eight (8) herpeto-faunal species, the seven (7) species are under least concern in the IUCN category. Meanwhile, the Water Monitor Lizard (*Varanus salvator*) is under the least concern in the IUCN category, however, it is categorized as Vulnerable under the Appendix II of the Convention on International Trade in Endangered Species of Fauna and Flora which is not Critically Endangered or Endangered but is facing a high risk of extinction in the wild in the medium-term future. **Table 32** shows the conservation status of listed other fauna species.

Table 33. List of other fauna species and conservation status (IUCN)

SPECIES	SCIENTIFIC NAME	FAMILY NAME	IUCN
Gecko-gecko	*Gecko gecko*	Gekkonidae	LC
Water Monitor Lizard	*Varanus salvator*	Varanidae	LC (IUCN), VU (CITES app.2)
Emerald Tree Skink	*Lamprolepis smaragdina*	Scincinidae	LC
Brown Skink	*Eutropis multifasciata*	Scincinidae	LC
Giant marine toad	*Bufo marinus*	Bufonidae	LC
Banded bullfrog	*Kaloulo pulchra*	Microhylidae	LC
Common Rousette Bat	*Rousettus amplexicaudatus*	Pteropodidae	LC
Polynesian Rat	*Rattus exulans*	Muridae	LC

Legend: LC- Least Concern, VU- Vulnerable

On additional survey, distribution status of the six (6) recorded herpeto-fauna species showed that 5 are native, or non-endemic to the Philippines, and 1 is Philippine endemic (see Table 7 and Table 8). Among the six (6) herpeto-faunal species, five (5) species are under least concern in the IUCN category (see Annex C). Meanwhile, the Water Monitor Lizard (*Varanus salvator*) is also under the least concern in the IUCN category, however, it is categorized as Vulnerable under the Appendix II of the Convention on International Trade in Endangered Species of Fauna and Flora which is not Critically Endangered or Endangered but is facing a high risk of extinction in the wild in the medium-term future. **Table 33** shows the conservation status of listed fauna species.

Additionally, the only mammalian species observed in the site, which is the Common Dawn Bat (*Eonycteris spelae)* is native, or non-endemic to the Philippines and under the least concern category.

Table 34. List of other fauna species and their conservation status (IUCN)

SPECIES	SCIENTIFIC NAME	FAMILY NAME	IUCN
Gecko	*Gecko gecko*	Gekkonidae	LC
Water Monitor Lizard	*Varanus salvator*	Varanidae	LC (IUCN), VU (CITES app.2)
Luzon Giant Forest Skink	*Otosaurus cumingi*	Scincidae	LC
spotted green tree skink	*Lamprolepis smaragdina*	Scincidae	NE
Painted Narrow-mouth Toad	*Kaloula picta*	Microhylidae	LC
Cane Toad	*Rhenilla marina*	Bufonidae	LC
Common Dawn Bat	*Eonycteris spelae*	Pteropodidae	LC

Legend: LC- Least Concern, VU- Vulnerable, NE-Not Evaluated

Computed Biodiversity index

Biodiversity indices particularly Shannon-Wiener Diversity Index (H') and Pielou's Evenness Index (J') were computed for this survey using the bird sampling data. The overall computed biodiversity index of the project site by getting the average biodiversity index of the 22 sampling sites (refer to **Table 34**) has a computed value of 1.62 with species evenness value of 0.86. Interpretation of these values using the Fernando's Biodiversity Scale (1998) showed that the area has **very low biodiversity with very high species evenness**.

Computed diversity richness of the 22 sampling sites reveals that site nos. 20, 15 and 22 have the highest level of diversity scale of 2.36, 2.25 and 2.22, which is described to have a moderate diversity richness with a very high species evenness of 0.92, 0.94., and 0.84, respectively.

Sites 15 and 22 are situated within wetland ecosystems, whereas, site 22 is a highly urbanized area located within the secondary impact area. Notably, the location of site 22 still has a high level of diversity scale despite its location, that is, in front of the municipal hall of Buenavista in Guimaras.

Table 35. Computed Biodiversity index of each sampled sites

Site No.	Shannon-Wiener Index (H')	Pielou's Index (J) Species Evenness	Fernando's Biodiversity Scale (1998)
1	1.80	0.92	Very low diversity with very high species evenness
2	1.17	0.84	Very low diversity with very high species evenness
3	1.49	0.93	Very low diversity with very high species evenness
4	1.85	0.95	Very low diversity with very high species evenness
5	1.87	0.73	Very low diversity with high species evenness
6	2.05	0.82	Low diversity with very high species evenness
7	1.95	0.79	Very low diversity with very high species evenness
8	1.86	0.89	Very low diversity with very high species evenness
9	2.17	0.94	Low diversity with very high species evenness
10	1.52	0.95	Very low diversity with very high species evenness
11	1.21	0.88	Very low diversity with very high species evenness
12	0.50	0.72	Very low diversity with high species evenness
13	1.46	0.82	Very low diversity with very high species evenness
14	1.06	0.96	Very low diversity with very high species evenness
15	2.25	0.94	Low diversity with very high species evenness
16	1.04	0.54	Very low diversity with high species evenness
17	1.75	0.98	Very low diversity with very high species evenness
18	1.04	0.95	Very low diversity with very high species evenness
19	1.47	0.91	Very low diversity with very high species evenness
20	2.36	0.92	Low diversity with very high species evenness
21	1.59	0.72	Very low diversity with high species evenness
22	2.22	0.84	Low diversity with very high species evenness
Average	1.62	0.86	Very low diversity with very high species evenness

Species Relative Frequency

The proposed project area covering the study area delineated on map is abode to 42 bird species (based on this survey). In terms of species distribution, the Yellow-Vented Bulbul *(Pycnonotus goiavier)* has the highest frequency of occurrence in the study area with a computed Relative Frequency of 10.18%. It is then followed by the Eurasian Tree Sparrow (*Passer montanus*) with 8.38%, then the Zebra Dove (*Geopelia striata)* and Glossy Swiftlet (*Collocalia affinis*) with the same Relative Frequency of 5.99 %, (see **Table 35**).

Table 36. Relative Frequency of each sampled sites

Species Name	Scientific Name	Frequency of Occurrence Within the Survey Sites	Relative Frequency
Asian Glossy Starlings	*Aplonis panayensis*	6	3.59
Barred Rail	*Gallirallus torquatus*	2	1.20
Barn Swallow	*Hirundo rustica*	3	1.80
Black Crown Night Heron	*Nycticorax nycticorax*	1	0.60
Black-Winged Stilt	*Himantopus himantopus*	4	2.40
Blue tailed Bee eater	*Merops philippinus*	2	1.20
Brown Shrike	*Lanius cristatus*	5	2.99
Cattle Egret	*bubulcus ibis*	4	2.40
Common Emerald Dove	*Chalcopaps indica*	1	0.60
Common Kingfisher	*Alcedo atthis*	1	0.60
Eurasian Tree Sparrow	*Passer montanus*	14	8.38
Glossy Swiftlet	*Collocalia affinis*	10	5.99
Golden-Bellied Flyeater	*Gerygone sulphurea*	2	1.20
Great Crested Tern	*Sterna bergii*	3	1.80
Great Egret	*Egetta alba*	5	2.99
Grey Hooded Sunbird	*Aethopyga primigenia*	1	0.60
Grey -Tailed Tatler	*Heterocelus brevipes*	1	0.60
Island Swiftlet	*Collocalia vanikorensis*	2	1.20
Java Sparrow	*Lonchura oryzivora*	1	0.60
Lesser Sand-Plover	*Charadrius leschenaultii*	1	0.60
Little Egret	*Egretta garzetta*	1	0.60
Long Tailed Shrike	*Lanius schach*	5	2.99
Olive-Backed Sunbird	*Nectarinia jugularis*	6	3.59
Pacific Swallow	*Hirundo tahita*	2	1.20
Pied Bush cat	*Saxicola caprata*	1	0.60
Pied Fantail	*Rhipidura javanica*	8	4.79
Pied Thriller	*Lalage nigra*	1	0.60
Philippine Bulbul	*Hypsipetes philippinus*	1	0.60
Mindanao Pygmy Babbler	*Dasycrotapha plateni*	3	1.80
Pygmy Flower Pecker	*Dicaeum pygmaeum*	9	5.39
Red Turtle- Dove	*Streptopelia tranquebarica*	9	5.39
Reddish Cuckoo-Dove	*Macrophygia phasianella*	2	1.20
Small Botton Quail	*Turnix sylvatica*	1	0.60
Spangled Drongo	*Dicrurus bracteatus*	1	0.60
Spotted Dove	*Spilopelia chinensis*	4	2.40
Tawny Grass Bird	*Megalurus timoriensis*	3	1.80
White Collared King Fisher	*Halchyon chloris*	5	2.99
White Eared Brown Dove	*Phapitreron leucotis*	6	3.59
Wood Sandpiper	*Tringa glareola*	1	0.60
Yellow Vented Bulbul	*Pycnonotus goiavier*	17	10.18
Yellow-Bellied Whistler	*Pachycephala philippinensis*	2	1.20
Zebra Dove	*Geopelia striata*	10	5.99
TOTAL		167	100

The proposed project covering the study area delineated on map is abode/feeding area to 37 bird species based on this additional survey in June. In terms of species distribution, the White-Eared Brown Dove has the highest frequency of occurrence in the study area with a computed Relative Frequency of 9.33%. It is then followed by the Yellow-Vented Bulbul (Pycnonotus goiavier) with 8% (refer to **Table 36**).

Table 37. Species relative frequency (using the avi-fauna data)

SPECIES NAME	SCIENTIFIC NAME	FREQUENCY	RELATIVE FREQUENCY
Asian Glossy Starling	*Aplonis payanensis*	5	6.67
Barn Swallow	*Hirundo rustica*	2	2.67
Black Crown Night Heron	*Nycticorax nycticorax*	2	2.67
Black Naped-Oriole	*Oriolus chinensis*	1	1.33
Blue Throated Bee-eater	*Merops viridis*	1	1.33
Brown Shrike	*Lanius cristatus*	1	1.33
Cattle Egret	*Bubulcus ibis*	1	1.33
Common Emerald Dove	*Chalcopaps indica*	2	2.67
Eurasian Tree Sparrow	*Passer montanus*	2	2.67
Glossy Swiftlet	*Collocalia affinis*	1	1.33
Great Egret	*Egretta alba*	1	1.33
Greater Coucal	*Centripus sinensis*	2	2.67
Hooded Pitta	*Pitta sordida*	1	1.33
Large-Billed-Crow	*Corvus macrorhynchos*	1	1.33
Lesser Coucal	*Centropus bengalensis*	1	1.33
Little Heron	*Butorides striata*	1	1.33
Mangrove Whistler	*Pachycephala cinerea*	1	1.33
Olived-Back Sunbird	*Nectarinia jugularis*	5	6.67
Oriental Magpie-Robin	*Copsychus saularis*	1	1.33
Philippine Bulbul	*Hypsipetes philippinus*	3	4.00
Philippine Coucal	Chalcophaps indica	3	4.00
Pied Fantail	*Rhipidura javanica*	5	6.67
Pied Thriller	*Lalage nigra*	1	1.33
Pygmy Flower Pecker	*Dicaeum pygmaeum*	2	2.67
Red-Keeled Flower Pecker	*Dicaeum australe*	1	1.33
Red Jungle Fowl	*Gallus gallus*	0	0.00
Red-Turtle Dove	*Streptopelia tranquebarica*	2	2.67
Whiskered tern	*Chlidonias hybrida*	1	1.33
White Breasted Waterhen	*Amaurornis phoenicurus*	1	1.33
White Collared King Fisher	*Halchyon chloris*	3	4.00
White-Breasted Wood Swallow	*Artamus leucocrynchus*	1	1.33
White-Eared Brown-Dove	*Phapitreron leucotis*	7	9.33
White-Throated King Fisher	*Halcyon smyrnensis*	1	1.33
White-Winged Cuckoo Shrike	*Coracina ostenta*	3	4.00
Wood Sandpiper	*Actitis hypoleucos*	1	1.33
Yellow Vented Bulbul	*Pycnonotus goiavier*	6	8.00
Zebra Dove	*Geopelia striata*	2	2.67
		75	100

2.1.4.3 Ecological and Economic Importance

Faunal species are good indicator of the existing environment of certain ecosystem or area. They play a significant role in many aspects that includes enhancement of the ecological balance and food chain cycle and other natural environmental processes. Most of fauna species are also known as natural agents in seed dispersal and pollination which aid in the transport of varieties of seeds in the environment. They also act as natural predators to some pest in our agricultural crops.

Aside from the wildlife’s significance in an ecosystem, they also provide economic importance in various aspects. They are even valuable as source of food and medicines. Commercially, some wildlife species are being utilized as trade pets as source of income. They are also considered among of the aesthetic value of the ecosystem which they are economically important for the tourism industry. Faunal species are also significant in the field of science and research. Existence of varieties of fauna species are part of country’s cultural asset.

Threats

Continuous loss of faunal habitats due to degradation of forest cover brought by land clearing, conversion of remaining sites into settlements and other land uses. Though, faunal species are mobile in nature this situation will force them to migrate in other areas to search for new habitat. Migration of other wildlife to new territory/ies or ecosystem will pose threat to their existence. They can be further exposed to hunting, persecution and trading. Continuous destruction of faunal habitats and disturbance will threaten the remaining species population and survival in the near future if not prevented. Thence, decrease of population to some species in this area will be expected to happen while others may not significantly affect. Wildlife offer a variety of commercial values and open several livelihood sources, utilization is not regulated as to case of illegal poaching and hunting and over collection. Though conservation actions are currently being made, illegal activities still continuously happen. The scenario puts wildlife population at risk of being threatened and has the probability of getting extinct if left unresolved.

2.1.4.4 Key Environmental Impacts and Mitigating Measures

The proposed project will require land clearing for the right of way for PGN project right of way (ROW). These entails disturbance of plants and wildlife of the area, which requires key mitigating measures to reduce the project impact on biodiversity. A permanent and major modification in the study area is the construction of bridge and access roads.

Land disturbance and clearing

During construction, earthmoving activities will be carried out in the sites designated for bridge and road construction, species along coastal areas where bridge landing will be constructed. The excavated materials if not properly managed could be exposed to erosion especially during rains and will contribute to the siltation of the coastal and marine habitat. Stockpiles of sand and gravel brought in from sources outside the project area could also be susceptible to erosion. Aside from erosion, earthmoving or excavation at the proposed structure sites, whether mechanically undertaken or aided by blasting, could initiate down slope movement.

Erosion will be mitigated by requiring the construction contractor to submit and implement an appropriate material handling program that will be monitored regularly by the project proponent. As much as practicable, earthmoving activities will be scheduled during the drier months of the year. Concrete walls and vegetative support along slopes should be constructed in primary impacted area and on access roads. An experienced team of an engineering geologist and geotechnical engineer should monitor all earthmoving activities at these structure sites. Slope failure will be addressed through the conduct of geological and geotechnical investigations during the design stage. Moreover, strict adherence to the development plan of the project site especially during land clearing should be observed. Land clearing will be confined on designated sites only based on the approved development plan. Likewise, gradual land clearing and removal of vegetation is encouraged to provide sufficient time for non-volant fauna species to transfer in the nearby habitat.

Damage to existing vegetation

Vegetation will be permanently removed along the main construction (bridge and road) ROW. Vegetation in adjacent areas or access roads may either be damaged or removed. Affected species may include some ecologically important species (indigenous, endemics and threatened) identified in the studied sites.

To mitigate this, ecologically important species must be identified and marked to minimize damage especially in sites adjacent to proposed engineering development. Seeds and propagules of ecologically important species during the inventor must be collected for use in propagation in damaged areas that will not be occupied by the dam and other structures. Further mitigating measure is the replacement of trees that will be submerged or will be subject of tree cutting during the construction. Prior to project implementation the proponent will coordinate to the DENR to seek clearance for the identification of required documents for the issuance of needed tree cutting permit (PD 705). Moreover, to compensate loss of habitats, the proponent will replace the number of trees removed/cut and plant them to nearby areas with the advice from DENR. As per DENR Memorandum Order No. 02 of 2012 mandated that "*Uniform replacement ratio for cut or relocated trees"* item 2.2 *"For planted trees in private land and forest lands... tree replacement shall be 1:50 while naturally growing trees on the same area, including those affected by the project shall be 1:100 ratio in support of the National Greening Program (NGP) and Climate Change Initiatives of the Government*". Species that will be used for the reforestation must be indigenous trees and/or fruit bearing trees endemic in the place that can attract wildlife species.

Alteration of wildlife natural habitats

Although the studied sites are somehow biologically disturbed, the road and bridge construction may further damage the existing habitats for wildlife, which reduces the total area of habitat available for wildlife and may lead to crowding and increased competition among individuals and species. Further loss of vegetation cover as a result of land clearing will enhance movement/migration of wildlife species in the area aggravated by the loss of habitat and remaining sources of food for survival. Likewise, wildlife disturbance due to noise generated during construction brought about by the operation of heavy equipment's will force some faunal species to migrate in other or nearby areas/habitat where disturbance is less.

Significant portions of forests at higher elevations will serve as wildlife refuge. Restoration/ rehabilitation of terrestrial areas next to the bridge landing and access roads should be carried out to ensure that alternative wildlife refuge will be available. Semi-annual monitoring schemes for wildlife should also be implemented to determine possible effects of the project most specially to identified noteworthy species. The proponent should also ensure that its employees must be prohibited/warned/informed not to engage in any mode of wildlife collection and/or hunting for the conservation and protection of remaining wildlife species. Promote wildlife protection using innovative means such as putting up of warning signage's on strategic areas for public information and warning. To consider during planning the establishment of natural buffer or boundary land mark along the project boundary using fruit bearing trees. This method could also help provide a natural abode to some wildlife as well as source of food.

Mangrove rehabilitation plan

A critical habitat that may be affected upon implementation of the PGN project construction are Mangrove forest. Mangroves constitute less than 1% of all forest areas worldwide, but they play an extremely important role in providing environmental services. As such, mangroves serve as an essential nursery for coastal and offshore fisheries, provide an array of timber and non-timber forest products to local communities, sequesters and store a large amount of carbon, which helps to mitigate the impacts of global climate change. More importantly, mangroves enhance sediment deposition and protect the coast from the destructive power of waves and storm surges. The world has seen a 50% decline in the total area of mangroves since the mid-twentieth century, making them one of the most threatened ecosystem.

Three mangrove site were identified in this study, two of which will be affected due to bridge landing construction (Panay Island and the western side of Guimaras), and one inner streams of Eastern Guimaras which will be affected due road access construction. Considerations to off-set the impact of construction to these mangrove habitat is suggested.

First is to recognize the ecology of the naturally occurring mangrove species at the site, in particular the patterns of reproduction, distribution, successful seedling establishment, and their environment. It is helpful to gather information to which species are growing across the mangrove habitat in the area. This can be done by conducting extensive biodiversity studies across mangrove areas, including those unaffected areas including studies.

Second, select appropriate rehabilitation areas that are likely to succeed in the rehabilitation of mangrove ecosystem. Often there are a number of different sites available for possible restoration, so it’s important to start by selecting one that has a fairly good chance of achieving rehabilitation objectives. For example it should be a site that contained mangroves in the recent past or presently contains degraded mangroves. Also, it is necessary to study the tidal activities and consequently the frequency of inundation as well as dryness that influence the mangrove forest as each mangrove species thrives at a different substrate level which in some part dictates the amount of exposure the mangrove will have to tidal waters. It is also important to include resolving land ownership/use issue if there is any, which is necessary for ensuring long-term access to and conservation of the site and associated wildlife.

Third, after mangrove re-planting, regular monitoring of growth and survival, and identifying causes of seedling mortality. When necessary, it is essential to conduct silvicultural activities. Beating up or replanting of propagules and/or seedlings in patches may be necessary where planting has failed.

Fourth, it is important to always consider the involvement of local communities. This can be effective since residential areas are near the coastal sites in the studied area, where possible mangrove rehabilitation site can be established. The project creates incentives for local communities to collect and supply planting materials, which they will be paid by the amount supplied and thereby generating some income. Through this arrangement, contractors do not need to employ full-time workers for gathering mangrove propagules and seedlings. With community participation in the project activities, there is greater awareness that mangroves are important ecosystems that need to be restored.

2.1.4.5 Conclusion and Recommendation

Result of the flora and fauna study revealed that overall, the studied area within Panay-Guimaras-Negros Islands for the bridge and access road construction have relatively low diversity but still considerable flora and fauna biodiversity. The low diversity can also be due to open ecosystems mostly covered in all land-use types. Despite this, there are number of key important species recorded and a critical mangrove habitat that might be affected. Relative to the presented result of terrestrial flora and fauna survey, it is necessary to consider during the detailed planning design of the project the inclusion of the recommended mitigating measures to minimize project impacts to flora and fauna and in the surrounding environment. Further, this information could also assist in the conduct of further studies on how we could effectively and sustainably manage and/or improve the ecosystems in the project area.

2.2 The Water

2.2.1 Hydrology and Hydrogeology

2.2.1.1 Surface Water

The main rivers on A section for PGN project are the Iloilo River, Tigum River and Jalaur River (**Figure 58**) on Panay Island. The Iloilo River originates from the Batino River in Oton, flows through the Lapuz, Lapaz, Manduriao, Molo, Arevalo and Iloilo urban area and infuses into the Iloilo Strait. The water level fluctuates with the tides due to closing the estuary. Section A of PGN Project mainly refers to small seasonal rivers on Guimaras Island, while Section B of Project PGN refers to main river such as San Lorenzo River on Guimaras Island (**Figure 59**).The main river of PGN Project on Section B is the Bago River on Negros Island.

According to satellite imagery and field surveys, the bridge spans the Iloilo Strait, and the land connections at both ends do not cross rivers. However, almost all of the coastal plains on both sides of the strait are fish ponds, and the surface water is connected to the seawater. fluctuating with the tide, but controlled by artificial water network such as small gates and dams, the water depth is generally 0-0.8m, and the local water depth exceeds 2m during the tide. According to satellite imagery and field survey, surface water in the survey area is mainly sea water in the sea area and rivers developed at landing sites on both sides. There is also a small amount of surface water in the salt field and its adjacent ditches crossed by land routes. The water volume is greatly affected by the salt field production, and the general water depth is about 0.2~0.3m.

Figure 58. Main surface water system of Section A (thick green line)
Source: Google Earth

Figure 59. Main Surface Water Systems of Section B (Green Line)

2.2.1.2 Groundwater

The groundwater of the site can be divided into two major categories: land area groundwater and marine area groundwater according to the location of the aquifer.

2.2.1.2.1 Land area groundwater

According to the lithology and groundwater occurrence conditions of the aquifer, the land area groundwater can be divided into Quaternary loose layer pore water, weathered zone pore water and bedrock fissure water.

The groundwater exposed in the Iloilo bridge area is mainly the Quaternary loose layer pore water, and the Quaternary loose layer lithology is mainly composed of fat clay, with trace amounts of clayey sand layer and poorly graded gravel. Clayey sand layer and poorly graded gravel layer structure are loose and the pores are relatively developed, which becomes a place for pore water movement and storage, forming an aquifer with different water abundance layers. Silt and silty clay form a relatively aquifer, mainly receiving atmospheric precipitation, rivers, seawater and lateral runoff recharge. In addition to evaporation, manual extraction, multi-discharge to the pond and into the sea; according to the occurrence conditions of groundwater, hydrodynamic characteristics, the groundwater in the bridge area is divided into loose rock pore diving water and loose rock pore micro-pressure water. The loose rock pore diving water aquifer is mainly composed of muddy soil and cohesive soil layer. The water-bearing and water-permeable of these layers are poor. It can be considered that the loose rock pores water in the bridge area are not developed.The loose rock pore pressure water are mainly found in the sand layer and the gravel layer. Because the sand layer and the round gravel layer in the bridge area are mainly distributed by the lens body, the distribution range and thickness are not large, and they are discontinuous. The water-bearing and water-permeable conditions are general. The groundwater level measured during the survey is 0.00~1.70m, and the elevation is 2.64~2.83m.

The surface of Guimaras Island is mainly Quaternary loose pore water, weathered zone pore water, bedrock fissure water. Quaternary loose layer pore water occurs in Quaternary artificial fill layer and alluvial pluvial layer. The water-bearing and water-permeable are good. These groundwaters are obviously affected by climate and topography, mainly receive direct infiltration replenishment and lateral runoff recharge of atmospheric precipitation, and the coastal part also accepts supply from the Guimaras Strait. Except for evaporation and manual extraction, most of them are discharged into the gully pond and into the sea, and a small part of the infiltration is replenished to the lower weathering group. The weathered zone pore water is present in the Quaternary residual layer and the fully-strongly weathered rock. It is weakly water abundance and has poor permeability. It is a weak or micro-aquifer. This type of groundwater mainly receives the infiltration of pore water in the upper Quaternary loose layer, and the runoff discharge is mainly based on the lateral recharge of the bedrock fractured water-bearing rock group. The bedrock fissure water occurs in the weathering fissures and tectonic fissures of the medium-micro weathered bedrock. It mainly accepts the infiltration replenishment of the upper pore water, and receives the vertical infiltration replenishment of the atmospheric precipitation. The runoff is controlled by the fracture morphology and is layered or banded shape, and rule out the possibility of partial crushing with a large amount of groundwater. The depth of the groundwater level of Section A measured in this survey is 0.00～1.60m, and the elevation is 2.47～14.85m. According to the actual borehole survey during the survey period, the groundwater depth in the Guimaras interchange of Section B is 3.6m, and that in the roadbed of salt field is 0-0.2m, which is greatly affected by the salt field production.

The surface layer of Negros Island is mainly pore water of Quaternary loose layer. Groundwater is shallowly buried. The burial depth near salt fields is generally 0-0.2m. Other areas, such as sugarcane fields, are buried about 2m. It mainly receives the direct infiltration and lateral runoff recharge of precipitation, and the coastal part also receives the recharge of the Guimaras Strait. Besides evaporation and artificial extraction, it also drains into ditches and into the sea.

2.2.1.2 Marine area groundwater

The groundwater in the marine area can be divided into two types: Quaternary loose layer pore water and weathered zone pore water according to the lithology of the aquifer and the groundwater storage conditions. The quaternary loose layer pore water occurs in quaternary holocene marine sedimentation sand soil layer, the weathered zone pore water occurs in the tertiary pliocene fully to strongly weathered rock. In addition to the marine sedimentation sand layer and the possible water abundance bedrock fracture zone, the overall water abundance is weak, the permeability is poor, and it is weak or micro-aquifer. The two types of groundwater are mainly replenished by the vertical infiltration of seawater, and the water-bearing rock group concealed in the lower part receives the infiltration replenishment or over-flow recharge of the upper aquifer group.

2.2.1.3 Impact assessment and mitigation measures for hydrology and hydrogeology

The connecting length of Line B on Panay Island is shorter (500m). The main route passes through the salt pan, a pipe culvert is proposed to be set at the position of BK0 + 350 to be convenient for operation in salt pan. When Line B spans the gullies and fish ponds on Guimaras Island, the bridge is proposed to be set as far as possible for passing. The terrain of Line D is relatively flat at the connection location on Guimaras Island and connecting line, three culverts are proposed to be set. Line D mainly passes through the local fish ponds and farmland on Negros Island, the terrain is basically flat, being free of bridge structures, and nine culverts shall be set for agricultural irrigation. According to the grade of highway, topography, geology, hydrology, meteorology and the setting of bridge and culvert in this project, the drainage design of subgrade and pavement should be considered comprehensively, and the attention on connection between various drainage facilities and drainage structures should be paid so that a perfect drainage system can be formed on the whole line. Comprehensive planning, rational distribution, less occupation of cultivated land should be implemented, and the coordination with local drainage and irrigation system shall be implemented to prevent the destruction of farmland and water conservancy facilities, paying attention to environmental protection and preventing the soil erosion and water pollution. This project fails to cross the water body of rivers and lakes, and the project construction will not affect the water depth of rivers and lakes, river discharge and lake capacity; After completion of the project, the drainage pattern of the river system and natural ditches around the project will not be changed, and the project construction will not increase the flood risk.

In the period of subgrade construction, if there is heavy rain and the pavement seepage is reduced due to compaction, the pavement runoff will flow down along the slope. If the soil on the slope is loose and the soil holding force is weak, the soil erosion will be combined as small-scale water flow for scouring under heavy rain, and the surface runoff will develop into shallow ditches and dissected ditches so as to result in liner erosion. In addition, landslides may occur in the areas where the slope is not compacted in the event of heavy rain. These scoured sediments may affect the drainage of natural ditches downstream. Therefore, a temporary drainage system should be constructed during construction. Before the construction of the subgrade, temporary drain ditch should be excavated on both sides of the subgrade. Th60 e drain ditch is 30cm×50cm for trapezoidal cross section, 1:1 for internal slope ratio, with tamped ditch wall. In combination with the topography, a sedimentation basin should be set in the drain ditch. The sedimentation basin is designed to be 3m× 2m × 1.2m, with 1:1 in slope ratio. After passing through the sedimentation basin, the water flow drains into the natural channel nearby and drains into the sedimentation basin. At the same time, the sedimentation basin shall be deposited on a regular basis. After that, the dredged sediments will be filled into the local depression area for tree planting and greening restoration in future.

The JALAUR River and the ILOILO River are developed near Item of Section A in this project as well as the BAGO River is developed near Item of Section B, which can basically meet the demands of engineering water. In addition, the project passes through the land area with abundant groundwater and good quality of water, and the water can also be used as engineering water directly. As water for concrete pouring, it needs to be further tested and qualified before it can be used. The engineering water will result in competitive use of water resources, but this impact is negligible given that the capacity of water used for engineering only covers a very small proportion in the flow of rivers and groundwater.

2.2.2 Oceanography

Figure 60 and Figure 61 show the bathymetric map of Iloilo and Guimaras Straight respectively.

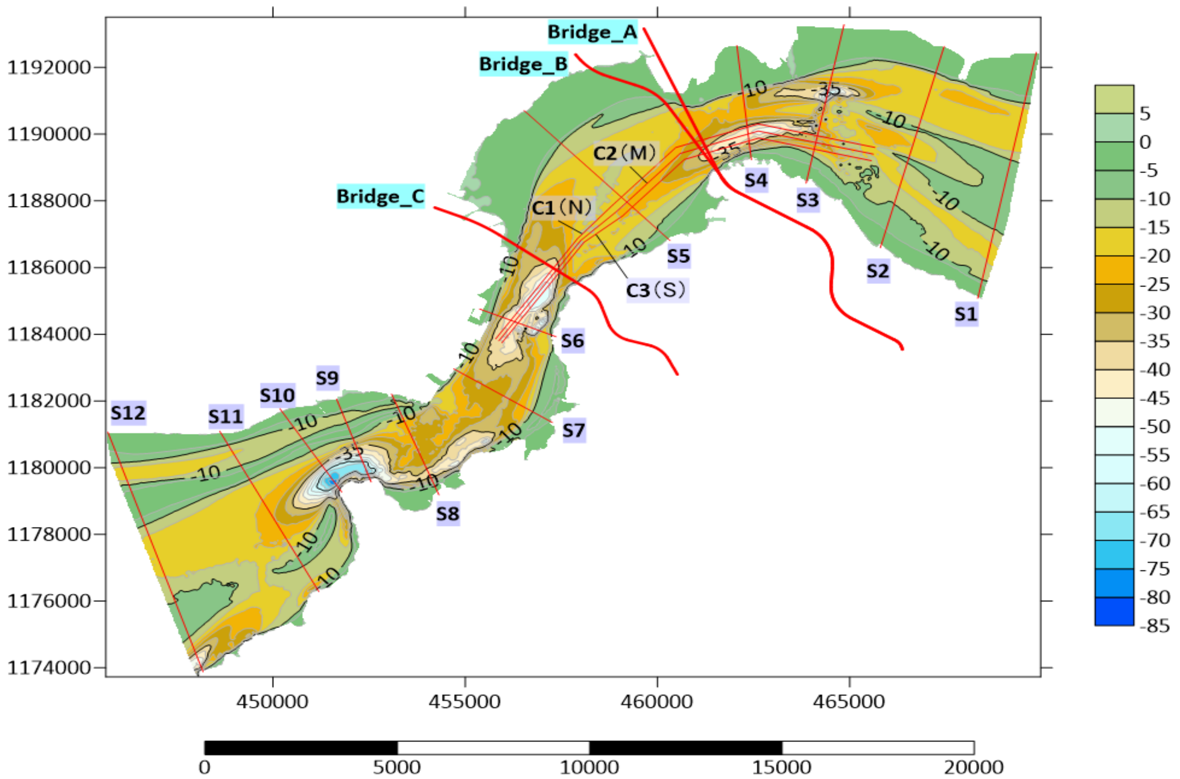


Figure 60. Bathymetric Map of Iloilo Straight
Source: Marine Hydrologic Study Report for Panay-Guimaras-Negros Island Bridges Project in Republic of the Philippines (October 2019)

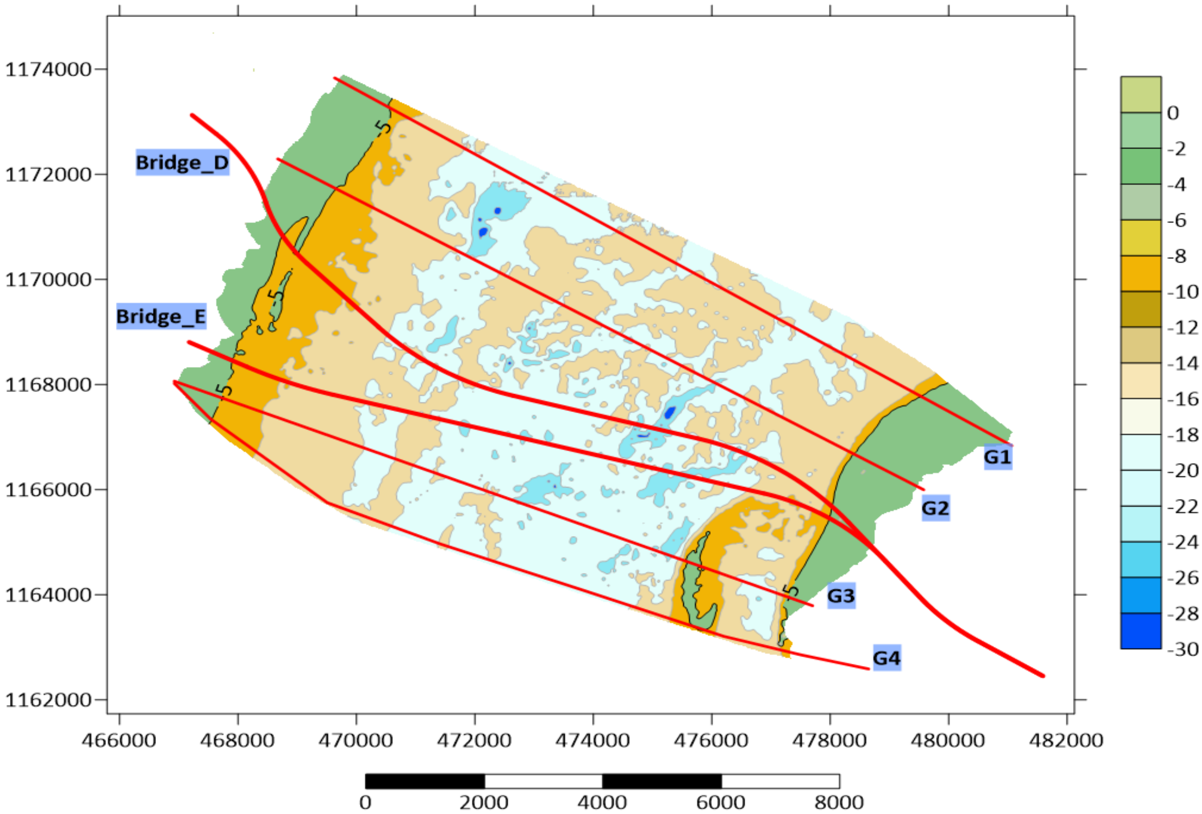


Figure 61. Bathymetric Map of Guimaras Straight
Source: Marine Hydrologic Study Report for Panay-Guimaras-Negros Island Bridges Project in Republic of the Philippines (October 2019)

2.2.2.1 Current situation of marine hydrodynamics

The offshore tidal waves in Philippines are mainly caused by the introduction of tidal waves in the Pacific. The Iloilo Strait and the Gimaras Strait where PGN Bridge is located communicate the Sulu Sea in the west and the Visayan Sea in the east. The Sulu Sea is larger in area and can reach a depth of 2000 m, which is connected with the Pacific and the South China Sea through multiple straits The Visayan Sea is a smaller in area, It is an inland sea surrounded by the Philippine Islands, with a depth of only 200 m. Most of tidal waves are introduced from the south to the north through the Bay of Panay in the Sulu Sea.

2.2.2.1.1 Tide

The Ministry of Natural Resources' First Marine Research Institute shall set up a long-term Tidal Level Observation Stations (T1 Stations) in the engineering sea area to carry out long-term tidal level observation, and two short-term Tidal Level Observation Stations (T2, T3 Stations) to carry out one-month tidal level observation during wet season and dry season. The position of Tidal Level Observation Stations is as shown in **Figure 62**, its coordinates and observation time refer to **Table 37** for details.

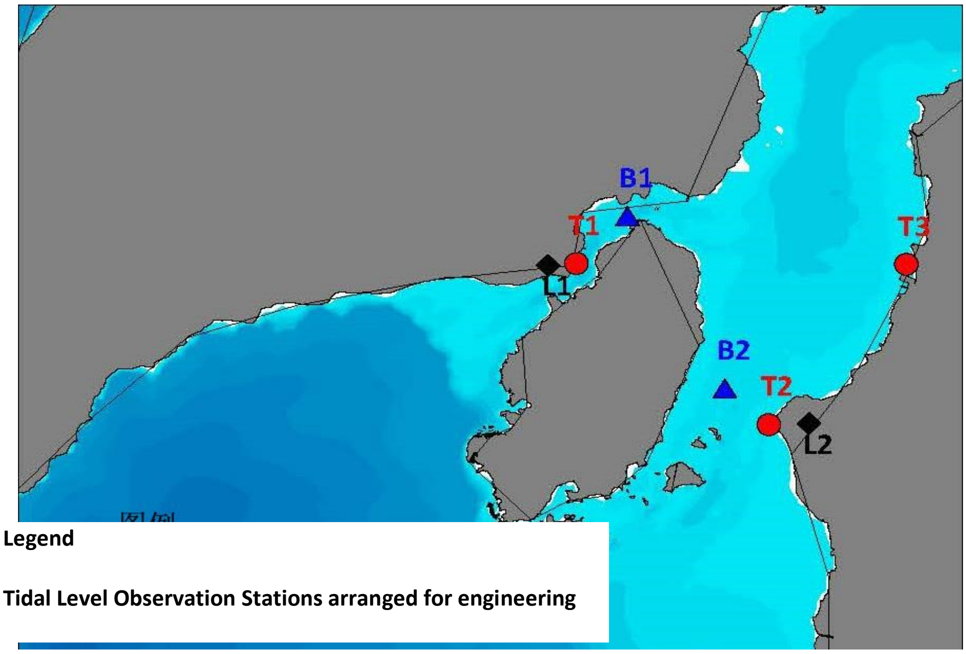


Figure 62. Position of Tidal Level Observation Stations for PGN Project

Table 38. Information Summary of Tidal Level Observation Station

Stations	**Longitude**	**Latitude**	**Starting time of observation**	**Ending time of observation**
T1	122°35.46'E	10°42.22'N	2018-12-21	---
T2	122°47.69'E	10°31.14'N	2019-02-18 (dry season) 2019-05-18 (wet season)	2019-03-22 (dry season) 2019-06-19 (wet season)
T3	122°56.43'E	10°42.17'N	2019-03-22 (dry season) 2019-06-19 (wet season)	2019-05-17 (dry season) 2019-06-19 (wet season)

(1) Tide natures

K value of T1 ~ T3 Stations (the sum of K_1 and O_1 partial tide amplitude and the ratio of M2 partial tide amplitude) is all more than 0.5 and less than 2 during the wet and dry period (referring to **Table 38**). According to the standard of tidal type classification in China, the tides in the sea area where the project is located are irregular semi-diurnal tides.

Table 39. Ratio of Main Partial Tide Amplitude in Each Observation Stations

Stations	**K (Dry Period)**	**K (Wet Period)**
T1	1.50	—
T2	1.23	1.27
T3	0.96	1.60

(2) Characteristic values of tides

Table 39 shows the statistical characteristic values for actually-measured tidal level of various stations in the engineering sea area during dry and wet period.

Table 40. Statistical Characteristic Values for Actually-Measured Tidal Level During Dry Period and Wet Period

Items	**Voyage during wet season**		**Voyage during dry season**		
	T2 stations	**T3 stations**	**T1 stations**	**T2 stations**	**T3 stations**
Maximum tidal range	255cm	295cm	242cm	263cm	313cm

Items	Voyage during wet season		Voyage during dry season		
	T2 stations	T3 stations	T1 stations	T2 stations	T3 stations
Minimum tidal range	13cm	22cm	13cm	24cm	24cm
Mean tidal range	118cm	146cm	124cm	140cm	177cm
Highest tidal level	104cm	145cm	127cm	120cm	151cm
Lowest tidal level	-151cm	-150cm	-115cm	-145cm	-172cm
Mean high tidal level	37cm	72cm	54cm	49cm	72cm
Mean low tidal level	-81cm	-74cm	-70cm	-91cm	-104cm
Mean duration of rising tide	6h8 min	6h6 min	6h6 min	6h6min	6h5min
Mean duration of falling tide	6h20 min	6h20 min	6h19 min	6h24min	6h25min
Mean sea level	-25 cm	-2cm	-8 cm	-27 cm	-16cm

Note: The normal zero is mean sea level in Philippines; Statistical time of wet season: May 18, 2019-Lune 19, 2019, Statistical time of dry season: Feb 18, 2019-March 22, 2019.

(3) Tide level of recurrence period

After simulated calculation (FVCOM model verification refers to Section 2.2.2.2), the high tidal level and low tidal level at each calculation point during the recurrence period are obtained, as shown in **Table 40** for details. The high tidal level with 300-year return period is 2.17 m at bridge site on Section A, and the low tidal level with 300-year return period is -1.79 m; the high tidal level with 300-year return period is 2.14 m at bridge site on Section B, and the low tidal level with 300-year return period is -2.54m.

Table 41. High Tidal Level and Low Tidal Level at Each Calculation Point during Recurrence Period

Calculation Point	Tidal Level	2 years	50 years	100 years	300 years
T1	High tidal level (m)	1.06	1.46	1.55	1.69
	Low tidal level (m)	-1.08	-1.32	-1.36	-1.42
T2	High tidal level (m)	0.96	1.43	1.53	1.69
	Low tidal level (m)	-1.36	-2.32	-2.53	-2.86
T3	High tidal level (m)	1.45	2.62	2.87	3.27
	Low tidal level (m)	-1.45	-1.87	-1.95	-2.06
B1 (Bridge Site on Section A)	High tide level (m)	1.24	1.84	1.97	2.17
	Low tidal level (m)	-1.24	-1.61	-1.68	-1.79
B2 (Bridge Site on Section B)	High tidal level (m)	1.06	1.92	2.11	2.41
	Low tidal level (m)	-1.48	-2.16	-2.31	-2.54

2.2.2.1.2 Ocean current

The Ministry of Natural Resources' First Marine Research Institute has carried out the simultaneous and continuous observation on ocean current, suspended sediment, water level, seawater temperature and salinity by multiple ship fixed points for high, medium and low tides during wet period and dry period for multiple ships at fixed point for 9 stations in the engineering sea area. The observation time is not less than 25 hours, and the observation level is 6 vertical layers. The position of Observation Stations is as shown in **Figure 63**, its coordinates, observation date and timeand so on are shown in **Table 41** for details.

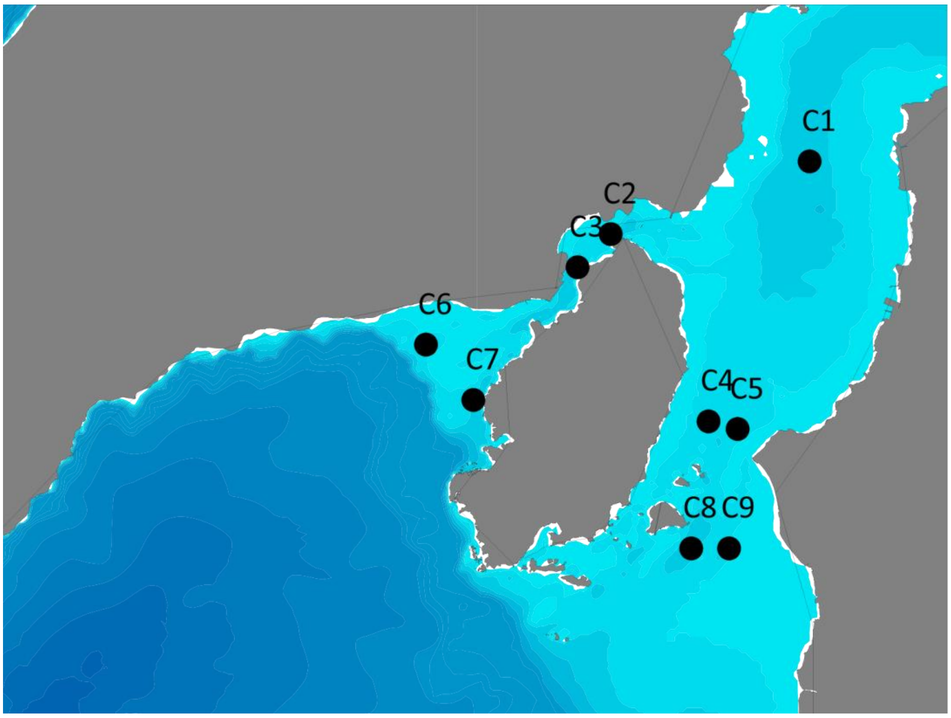


Figure 63. Location of Ocean Current Observation Stations for PGN Project

Table 42. Information Summary of Total Tide Observation Station

Stations	Longitude	Latitude	Water depth of nautical chart (m)	Observation time
C1	122°51.30′E	10°50.10′N	29.6	Dry Period High tide: 12:00 on February 19,2019 to 14:00 on February 20,2019 Medium tide: 14:00 on February 23,2019 to 15:00 on February 24,2019 Low tide: 16:00 on February 26,2019 to 17:00 on February 27,2019 Wet Period High tide: 12:00 on May 21,2019 to 13:00 on February 22,2019 Medium tide: 13:00 on May 24,2019 to 14:00 on February 25,2019 Low tide: 11:00 on February 27,2019 to 12:00 on February 28,2019
C2	122°38.80′E	10°45.12′N	37.4	
C3	122°36.70′E	10°43.40′N	39.0	
C4	122°44.90′E	10°33.64′N	13.7	
C5	122°46.74′E	10°33.16′N	13.5	
C6	122°27.00′E	10°38.50′N	14.5	
C7	122°30.00′E	10°35.00′N	21.2	
C8	122°43.80′E	10°25.60′N	30.6	
C9	122°46.20′E	10°25.60′N	17.5	

(1) Tide natures

During dry season, the discriminant number of tidal current type on each level of C7 station is more than 0.5 and less than 2, which is irregular semidiurnal tidal current, and the discriminant number of tidal current type on each level of other stations is less than 0.5, which is the regular semidiurnal tidal current. During wet period, the discriminant number of tidal current type at the partial level of C6, C7, C8 and C9 stations is more than 0.5 and less than 2, which is irregular semidiurnal tidal current, accounting for 27% of statistical discriminant number of tidal current type; the discriminant number of tidal current type at each level of other stations is all less than 0.5, which is the regular semidiurnal tidal current. To sum up, the engineering sea area is the sea area dominated by the regular semidiurnal tidal current.

Table 43. Discriminant Number of Tidal current Type at Each Level of Each Stations during Dry Season (WO1 + WK1)/WM2

Station level	C1	C2	C3	C4	C5	C6	C7	C8
Surface layer	0.15	0.16	0.20	0.22	0.21	0.28	0.62	0.26
0.2 H	0.15	0.16	0.20	0.22	0.21	0.28	0.65	0.26
0.4 H	0.16	0.17	0.23	0.23	0.20	0.28	0.73	0.26
0.6 H	0.17	0.16	0.22	0.23	0.21	0.31	0.77	0.29
0.8 H	0.18	0.17	0.22	0.22	0.19	0.35	0.82	0.30
Bottom layer	0.23	0.17	0.26	0.20	0.21	0.36	0.77	0.26
Mean of vertical line	0.17	0.17	0.22	0.22	0.20	0.31	0.73	0.27

Table 44. Discriminant Number of Tide Type at Each Level of Each Station during Wet Season (WO1 + WK1)/ WM2

Station level	C1	C2	C3	C4	C5	C6	C7	C8
Surface layer	0.09	0.30	0.42	0.40	0.36	0.34	0.48	0.58
0.2H	0.13	0.28	0.42	0.39	0.36	0.36	0.49	0.63
0.4H	0.13	0.29	0.43	0.37	0.34	0.41	0.51	0.58
0.6H	0.09	0.31	0.41	0.39	0.32	0.50	0.52	0.59
0.8H	0.14	0.32	0.40	0.34	0.34	0.55	0.53	0.62
Bottom layer	0.12	0.33	0.41	0.35	0.30	0.61	0.52	0.62
Mean of vertical line	0.12	0.30	0.42	0.37	0.34	0.46	0.51	0.60

(2) Horizontal distribution of ocean current

The maximum and mean flow velocity (cm/s) and the corresponding flow direction (°) of average rising tide and falling tide for actually-measured vertical lines in each station during dry season are shown in **Table 44**. The maximum and mean flow velocity (cm/s) and the corresponding flow direction (°) of average rising tide and falling tide for actually-measured vertical lines in each station during wet season are shown in **Table 45**. The vector diagram for horizontal distribution of ocean current for vertical line in each station during dry season is shown in **Figure 64 to Figure 66**, and the vector diagram for horizontal distribution of ocean current for vertical line in each station during wet season is shown in **Figure 67 to Figure 69**.

The ocean current of the whole strait along the strait channel (or bank line) is mainly dominated by reciprocating flow, which is roughly northeast-southwest direction. Specific features are as follows:
Observation Stations on northern section (C1): During dry season, the flow velocity of ocean current for high and medium tide is all higher, and the main direction of ocean current is NE-SW, which shows obvious characteristics of the reciprocating flow. The velocity of low tide is very low, and the ocean current mainly changes in the SW-dominated fan-shaped range, which shows the characteristics of rotating flow. During wet season, the flow velocity of ocean current during three tidal periods is all not high, and the main direction is dominated by reciprocating current, and the main direction is NNE-SSW.

Observation Stations on bridge site section (C2, C3, C4, C5): C2 and C3 stations are located in the north of Guimaras Island, and C4, C5 stations are located in the east of Guimaras Island. The four stations are located in the narrow location of strait, and the flow velocity of ocean current during the dry and wet season is all higher, showing very obvious reciprocating flow along the terrain. The main direction of ocean current for C2 stations is all ENE-WSW, and the main direction of ocean current for C3, C4 and C5 station is all NE-SW.

Observation stations on southern section (C6, C7, C8, C9): C6 and C7 stations are located in the west of Guimaras Island,, and C8 and C9 stations are located in the southeast of Guimaras Island, During dry season, because the four stations are located in the open location of strait, the flow velocity of the ocean current is lower than that of the other stations, showing some characteristics of the rotating flow. C6 and C7 stations have the characteristics of reciprocating flow during high and medium tides, but the direction of ocean current changes within two sectors with the axis of main flow direction: the main direction of ocean current for C6 stations is E-W direction, and the main direction of ocean current for C7 stations is NE-SW direction. The C6 and C7 stations are completely rotating flow during low tide, being free of main flow direction. The current velocity of ocean current for C8 and C9 stations decreases gradually from high tide and medium tide to low tide, and the main direction of ocean current is NE-SW. During wet season, because C6 and C7 stations are located in the open area of strait, compared with the other stations, the ocean current is lower. The main direction of ocean current for C6 station is NE-SW direction during high and low tide period and ENE-WSW direction during the medium tide period; The main direction of ocean current for C7 station is ENE-WSW direction during high and low tide period and NE-SW direction during the medium tide period. The main direction of ocean current for C8 and C9 stations is all NE-SW.

① Mean flow velocity and flow direction of mean tide rising and tide falling for vertical line

During dry season, the average flow velocity of mean rising tide current for vertical line during high tide period is between 28 ~ 64 cm/s, and the average flow velocity of mean falling tide current is between 34～67 cm/s; the average flow velocity of mean rising tide current for vertical line during medium tide period is between 25～69 cm/s, and the average flow velocity of mean falling tide current is between 25～70 cm/s; during low tide period: the average flow velocity of mean rising tide current for vertical line is between 9～34 cm/s, and the average flow velocity of mean falling tide current is between 15～48 cm/s.

During wet season, the average flow velocity of mean rising tide for vertical line during high tide period is between 17～60 cm/s, and the average flow velocity of mean falling tide is between 19～64 cm/s; the average flow velocity of mean rising tide for vertical line during medium tide period is between 12～45 cm/s, and the average flow velocity of mean falling tide current is between 15～50 cm/s; during low tide period: the average flow velocity of mean rising tide current for vertical line is between10～24 cm/s, and the average flow velocity of mean falling tide current is between 9～25 cm/s.

② Maximal flow velocity and flow direction of mean tide rising and tide falling for vertical line

During dry season, the maximum flow velocity of mean tide rising for vertical line during high tide period is between 57~103 cm/s, the maximum flow velocity of mean tide rising for vertical line is 103 cm/s, the flow direction is 23 °, which appears in C3 stations; the maximum flow velocity of the falling tide is between 52~128 cm/s, the maximum flow velocity of mean falling tide for vertical line is 128 cm/s, the flow direction is 195 °, which appears in C3 stations; the maximum flow velocity of mean tide rising tide for vertical line during medium tide period is between 38～110 cm/s, the maximum flow velocity of mean rising tide for vertical line is 110 cm/s, the flow direction is 26 °, which appears in C3 stations; the maximum flow velocity of mean falling tide for vertical line is between 43～117 cm/s, the flow direction is 194°, which appears in C3 stations; the maximum flow velocity of mean tide rising for vertical line during low tide period is between 13 ~ 51 cm/s, the maximum flow velocity of mean rising tide for vertical line is 51 cm/s, the direction of flow is 68 °, which appears in C2 stations; the maximum flow velocity of mean falling tide for vertical line is between 24 ~ 82 cm/s, the maximum flow velocity of mean falling tide for vertical line is 82 cm/s, the direction of flow is 192 °, which appears in C3 stations.

During wet season, the maximum flow velocity of mean tide rising for vertical line during high tide period is between 29～105 cm/s, the maximum flow velocity of mean tide rising for vertical line is 105 cm/s, the flow direction is 32°, which appears in C5 stations; the maximum flow velocity of falling tide is between 39～107 cm/s, the maximum flow velocity of mean falling tide for vertical line is 107 cm/s, the flow direction is 198°, which appears in C3 stations; the maximum flow velocity of mean rising tide for vertical line during medium tide period is between 20～66 cm/s, the maximum flow velocity of mean tide for vertical line is 66 cm/s, the direction of flow is 37°, which appears in C5 station; the maximum flow velocity of mean falling tide for vertical line is between 27～95 cm/s, the maximum flow velocity of mean falling tide for vertical line is 95 cm/s, the direction of flow is 243°, which appears in C2 station; .During the low tide period, the maximum flow velocity of mean rising tide for vertical line is between 15～44 cm/s, the maximum flow velocity of mean rising tide for vertical line is 44 cm/s, the direction of flow is 11°, which appears in C3 stations; the maximum flow velocity of mean falling tide for vertical line is between 20～51 cm/s, the maximum flow velocity of mean falling tide for vertical line is 51 cm/s, the direction of flow is199°, which appears in C3 stations.

(3) Vertical distribution of ocean current

In the observation of high, medium and low tide periods during wet season and dry season, the maximum of flow velocity for ocean current in most stations appears on the surface layer or the 0.2H layer, and the flow velocity gradually decreases from the surface to the bottom, but the variation is less, and the distribution of flow direction on the vertical line is relatively consistent.

(4) Duration of rising tide and falling tide current

During dry season, the duration of rising tide current for each station is 4.00~7.50 hours, and the duration of rising tide current for each station is 4.50 ~ 7.25 hours, the duration of rising tide current for C7, C8 and C9 stations is more than that of falling tide current, and the duration of rising tide current for other stations is less than that of falling tide current. During the medium tide period, the duration of rising tide current is 4.25 ~ 7.75 hours, the duration of falling tide current is 4.50 ~ 7.75 hours, the duration of rising tide current for C8 station is more than that of failing tide current, and the duration of rising tide current for other stations is less than that of falling tide current; During the low tide period, the duration of rising tide current is between 3.25-5.50 hours, the duration of falling tide current is between 6.25-8.50 hours, the duration of falling tide current for all stations is more than that of rising tide current.

During high tide period, the duration of rising tide currenton each level of each station is between 5.00～6.00 hours, while the duration of falling tide current is between 6.00～7.50 hours. During the medium tide period, the duration of rising tide current on each level of each station is between 3.25～6.00 hours, while the duration of falling tide current is between 6.00～7.50 hours. During low tide period, the duration of rising tide current on each level of each station is between 5.00～7.50 hours, while the duration of falling tide current is between 7.00～8.00 hours. During high, medium and low tide periods, the duration of rising tide current for all stations is all less than that of falling tide current .

Table 45. Maximum and Mean Flow Velocity (cm/s) and Flow Direction (°) of Mean Rising and Falling Tide for Actually-Measured Vertical Line in Each Station during Dry Period

Station No.	High tide period								Medium tide period								Low tide period							
	Maximum flow velocity, corresponding flow direction				Average flow velocity and corresponding flow direction				Maximum flow velocity and corresponding flow direction				Average flow velocity and corresponding flow direction				Maximum flow velocity and corresponding flow direction				Average flow velocity and corresponding flow direction			
	Rising tide		Falling tide		Rising tide		Falling tide		Rising tide		Falling tide		Rising tide		Falling tide		Rising tide		Falling tide		Rising tide		Falling tide	
	Flow velocity	Flow direction	Flow velocity	Flow direction	Flow velocity	Flow direction	Flow velocity	Flow direction	Flow velocity	Flow direction	Flow velocity	Flow direction	Flow velocity	Flow direction	Flow velocity	Flow direction	Flow velocity	Flow direction	Flow velocity	Flow direction	Flow velocity	Flow direction	Flow velocity	Flow direction
C1	68	24	86	208	49	32	42	203	49	22	70	200	40	36	44	200	13	71	40	209	9	70	25	211
C2	97	71	123	247	61	71	67	246	95	69	108	249	65	69	65	244	51	68	78	246	34	72	48	246
C3	103	23	128	195	64	23	66	193	110	26	117	194	69	24	70	187	45	23	82	192	27	26	47	194
C4	78	27	95	200	44	27	44	199	84	32	87	203	57	30	48	199	42	27	58	200	27	30	37	200
C5	74	31	101	212	41	31	45	212	92	25	93	210	58	26	51	201	38	23	68	206	27	26	39	213
C6	58	66	77	259	36	75	40	266	38	70	43	66	25	66	25	249	24	40	24	253	16	76	15	249
C7	57	33	79	205	28	28	34	204	38	19	70	218	30	36	37	216	20	21	47	243	17	34	23	237
C8	71	43	68	231	42	47	35	227	39	29	46	35	27	32	26	232	36	42	39	223	25	24	26	228
C9	59	20	52	214	28	25	35	210	46	24	48	214	28	24	27	215	32	25	44	213	21	25	23	213

Table 46. Maximum and Mean Flow Velocity (cm/s) and Flow Direction (°) of Mean Rising and Falling Tide for Actually-Measured Vertical Line in Each Station during Wet Period

Station No.	High tide period								Medium tide period								Low tide period							
	Maximum flow velocity, corresponding flow direction				Average flow velocity and corresponding flow direction				Maximum flow velocity and corresponding flow direction								Maximum flow velocity, corresponding flow direction				Average flow velocity and corresponding flow direction			
	Rising tide		Falling tide		Rising tide		Falling tide		Rising tide		Falling tide		Rising tide		Falling tide		Rising tide		Falling tide		Rising tide		Falling tide	
	Flow velocity	Flow direction	Flow velocity	Flow direction	Flow velocity	Flow direction	Flow velocity	Flow direction	Flow velocity	Flow direction	Flow velocity	Flow direction	Flow velocity	Flow direction	Flow velocity	Flow direction	Flow velocity	Flow direction	Flow velocity	Flow direction	Flow velocity	Flow direction	Flow velocity	Flow direction
C1	29	13	39	190	17	14	19	193	20	19	27	199	12	24	15	206	15	27	22	197	10	26	9	206
C2	95	77	101	251	53	73	64	247	66	70	95	243	40	74	50	243	38	68	45	247	22	68	21	245
C3	94	24	107	198	54	22	57	199	65	22	90	196	45	20	41	196	44	11	51	199	24	18	25	197
C4	56	21	69	200	32	21	28	202	47	24	58	211	25	22	25	207	29	20	30	208	16	27	15	200
C5	105	32	71	209	60	31	41	215	66	37	77	202	42	36	35	208	38	31	35	214	19	34	18	207
C6	38	42	65	218	23	40	31	206	41	65	51	240	25	69	23	253	22	11	25	200	10	25	12	213
C7	41	63	47	265	26	68	20	273	26	32	41	217	17	27	20	211	19	120	20	219	11	104	11	230
C8	78	42	101	218	49	39	54	219	56	39	74	225	30	44	39	219	28	28	35	234	16	35	18	227
C9	80	12	86	193	37	19	47	196	47	24	71	173	23	27	34	179	29	34	37	193	17	32	17	203

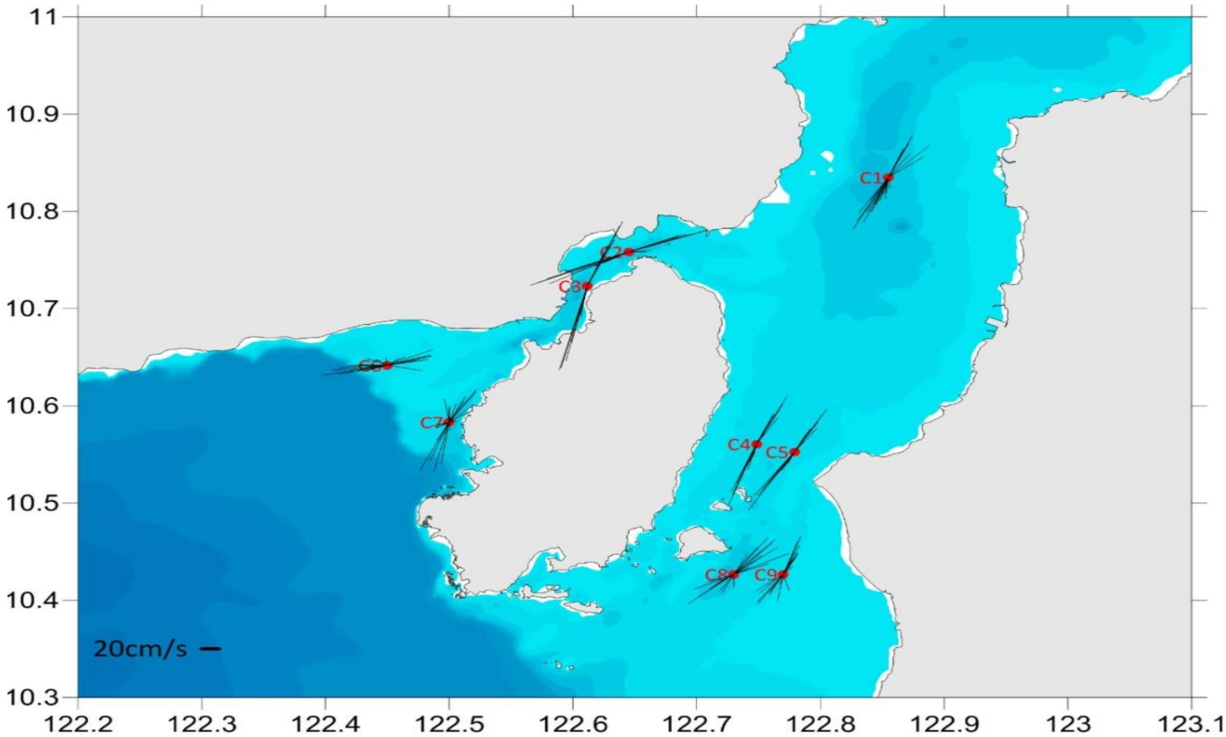


Figure 64. Vector Diagram for Horizontal Distribution of Mean Ocean Current for Vertical Line in Each Station during High Tide Period in Dry Season

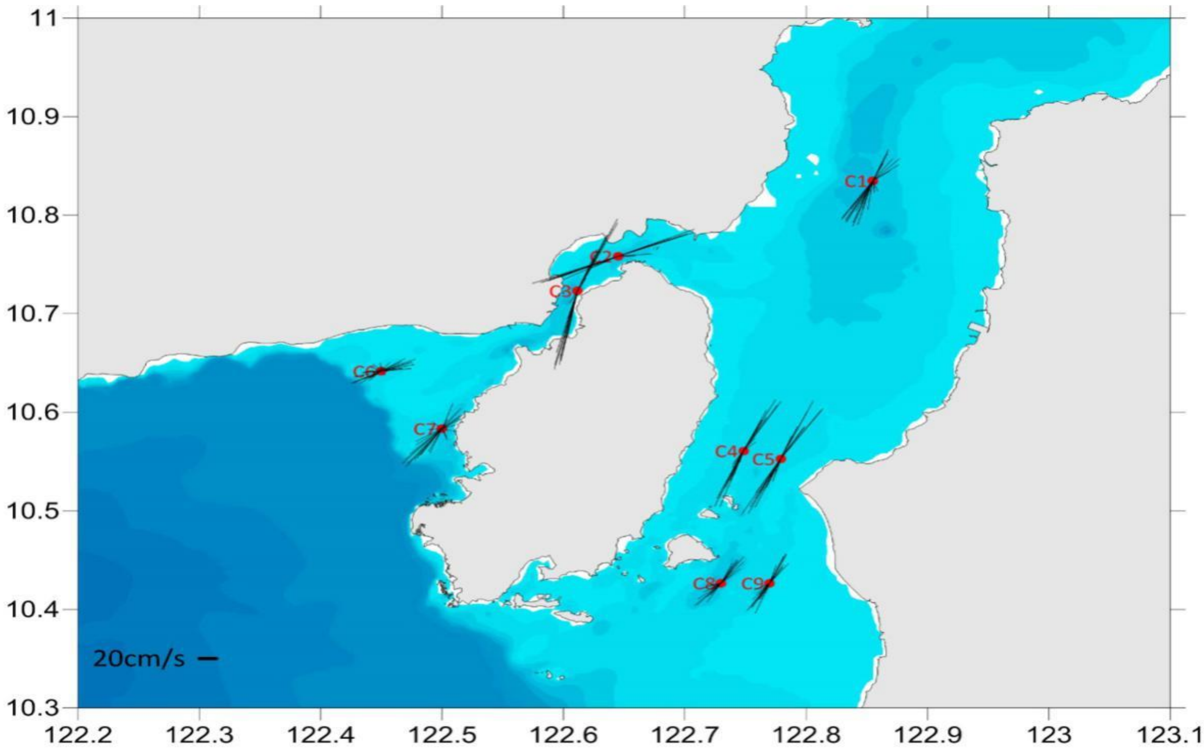


Figure 65. Vector Diagram for Horizontal Distribution of Mean Ocean Current for Vertical Line in Each Station during Medium Tide Period in Dry Season

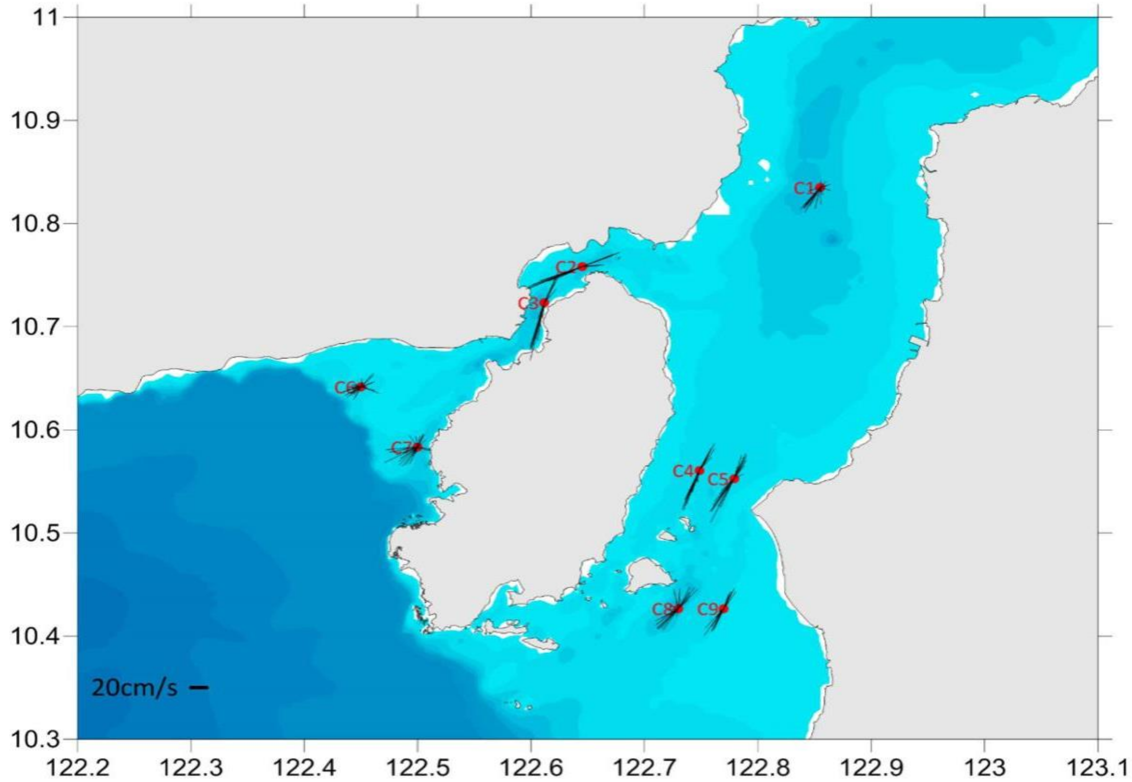


Figure 66. Vector Diagram for Horizontal Distribution of Mean Ocean Current for Vertical Line in Each Station during Low Tide Period in Dry Season

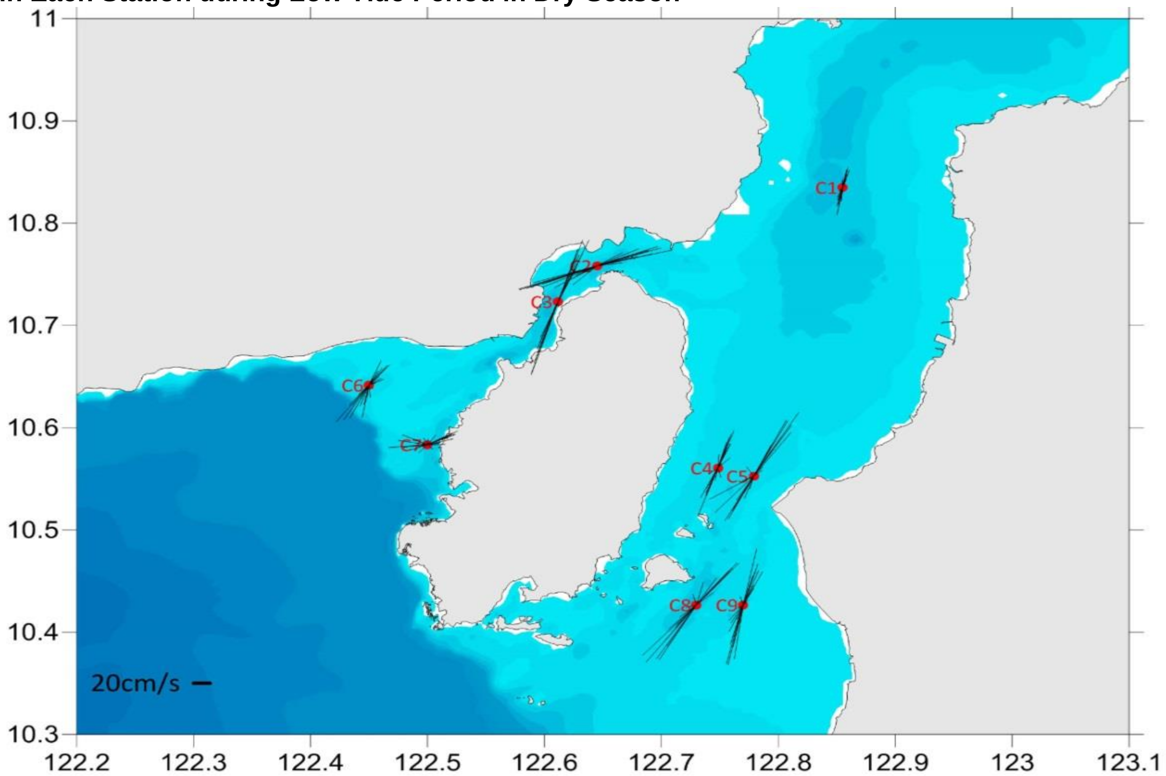


Figure 67. Vector Diagram for Horizontal Distribution of Mean Ocean Current for Vertical Line in Each Station during High Tide Period in Wet Season

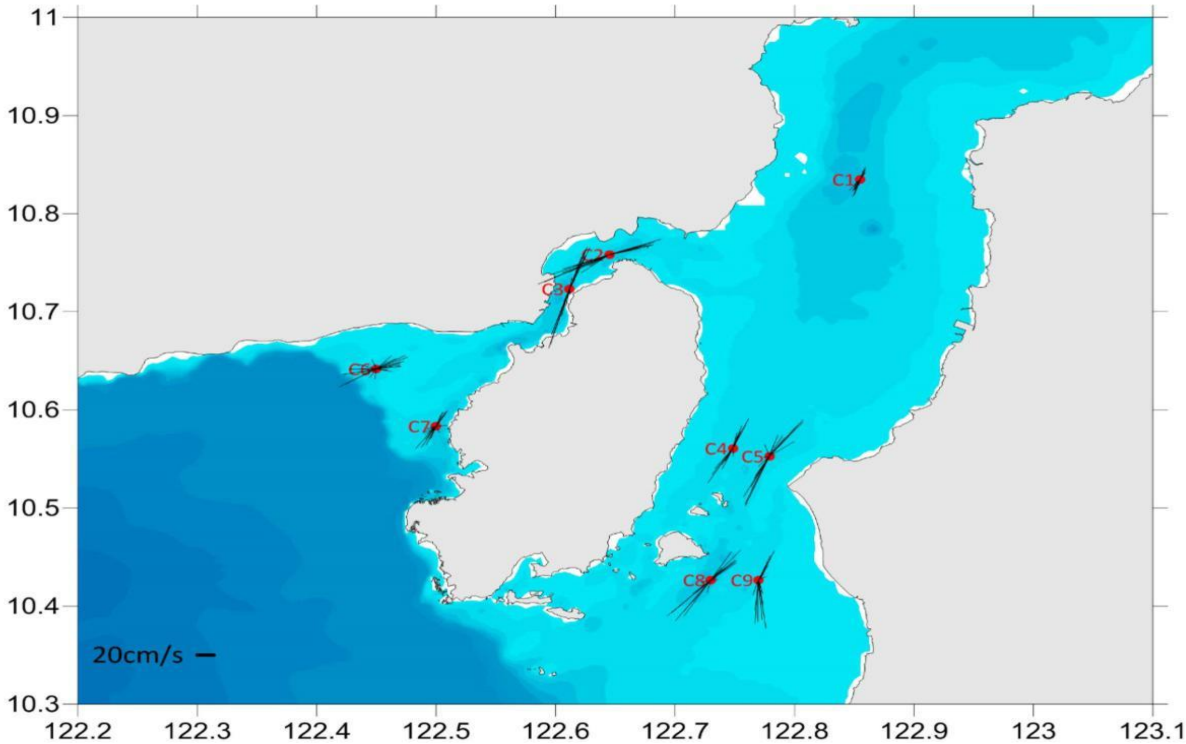


Figure 68. Vector Diagram for Horizontal Distribution of Mean Ocean Current for Vertical Line in Each Station during Medium Tide Period in Wet Season

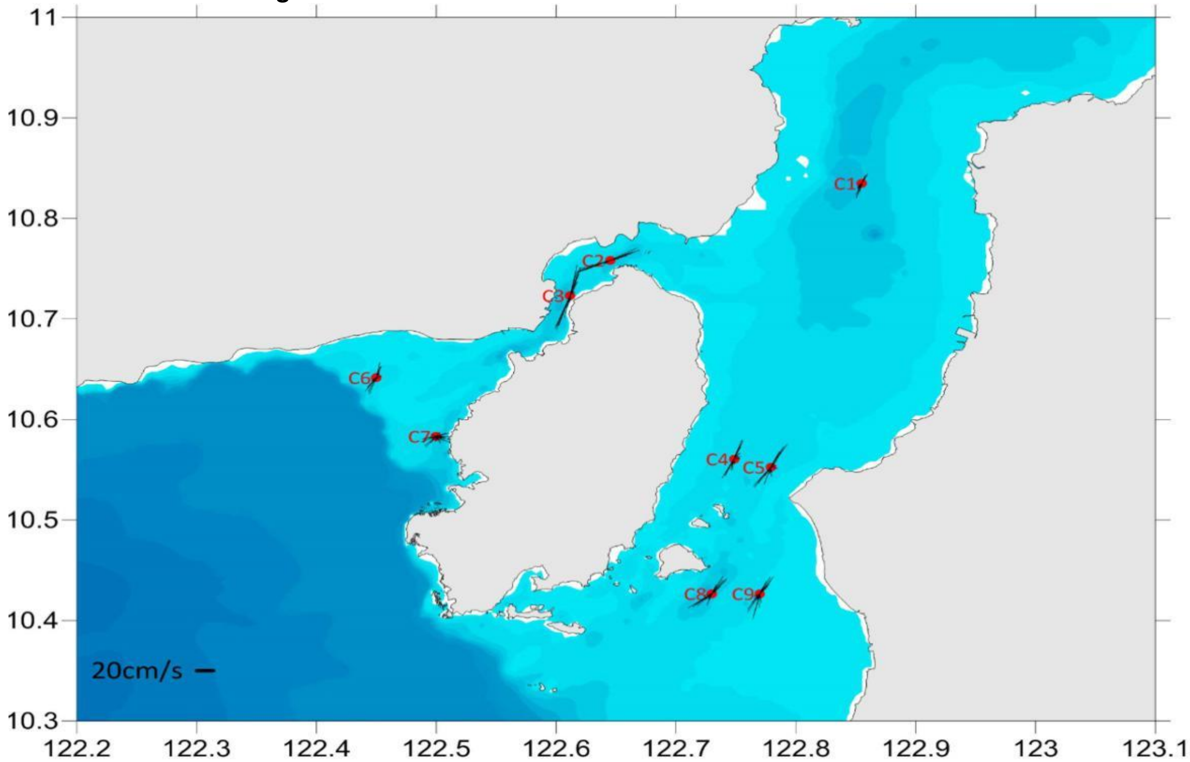


Figure 69. Vector Diagram for Horizontal Distribution of Mean Ocean Current for Vertical Line in Each Station during Low Tide Period in Wet Season

(5) Velocity during recurrence period

Numerical simulation results of tidal conditions at different recurrence periods show that the longer the recurrence period of tidal conditions, the greater the flow velocity of rapid fluctuation moments at each location in the computed domain. Under the tide type of 300-year return period, the flow velocity of tide at the bridge axis in each scheme is not more than 1.8 m/s, and the flow velocity of tide in the whole computed domain does not exceed 3.4 m/s.

Table 47. Maximum Flow Velocity inside Computed Domain under Tidal Conditions during Various Recurrence Periods

Recurrence period/ year	**50**	**100**	**300**
Iloilo Strait (m/s)	2.90	3.19	--3.40
Guimaras Strait (m/s)	1.97	2.16	2.26

Table 48. Maximum Flow Velocity on Bridge Axis under Tidal Conditions during Various Recurrence Periods

Recurrence period/ year	**50**	**100**	**300**
Line B on Section A（m/s）	1.42	1.52	1.60
Line D on Section B（m/s）	1.32	1.40	1.48

2.2.2.1.3 Suspended sediment

The First Marine Research Institutes of Ministry of Natural Resources has established 9 observation stations in the engineering sea area to synchronously observe the contents of suspended sediment, and the location of observation station is the same as that of continuous ocean current observation station, referring to **Figure 67** for details.

During wet season, the variation of sediment concentration is less in the sea area through observation, the variation range of sediment concentration is between 5.7×10^{-3} kg/m^3～64.6×10^3 kg/m^3, and the average sediment concentration is 13.5×10^{-3} kg/m^3～31.8×10^{-3} kg/m^3.During low tide period, the average sediment concentration is between 13.5×10^{-3} kg/m^3～27.9×10^{-3} kg/m^3; during medium tide period, the average sediment concentration is between 4.1×10^{-3} kg/m^3～29.1×10^{-3} kg/m^3; During high tide period, the average sediment concentration is between 13.9-$\times10^{-3}$ kg/m^3～31.8×10^{-3} kg/m^3.

During dry season, the variation of sediment concentration is less in the sea area through voyage observation, the variation range of sediment concentration is between 3.1×10^{-3} kg/m^3～153.7×10^{-3} kg/m^3, and the average sediment concentration is 16.1×10^{-3} kg/m^3～65.5×10^{-3} kg/m^3. During high tide period, the average sediment concentration is between25.9×10^{-3} kg/m^3～65.5×10^{-3} kg/m^3; during medium tide period, the average sediment concentration is between 22.5×10^{-3} kg/m^3～52.3×10^{-3} kg/m^3; During low tide period, the average sediment concentration is between 16.1×10^{-3} kg/m^3～33.6×10^{-3} kg/m^3.

As a whole, except that the average sediment concentration of C1, C2, C3 and C7 stations in the Iloilo Strait during the mid-tide observation period in dry season is slightly higher than that of high tide in wet and dry season for two voyages, the average sediment concentration in the rest stations is the highest in the high tide, second in the medium tide and least in the low tide. The sediment concentration for two voyages increases gradually from surface to bottom vertically, and the sediment concentration for offshore shallow water station is higher and the sediment concentration for offshore deep water station is less. The sediment concentration of voyages in dry season is higher than that in wet season; it is caused by influence by the monsoon for dry season, frequent gale weather, it is more intense agitation function for water body.

2.2.2.1.4 Salinity of seawater

The station of seawater salinity observation stations is the same as the continuous ocean current observation stations, with 9 stations totally. The results of observational statistics show that:

The daily average salinity is 34.28 ~ 34.55 on the surface layer during the high-water season in the engineering sea area, The average daily salinity in the middle layer is between 34.36 and 34.49, and the average daily salinity in the bottom layer is between 34.34 and 34.48.. In dry season, the daily average salinity is between 34.29 and 34.36 in the surface layer, 34.30～34.36 in the middle layer, and 34.30～34.35 in the bottom layer. IThe salinity of most stations varies little from the surface to the bottom.in the wet and dry season, the salinity of bottom layer is slightly higher than that of surface layer. In dry season, the sea water mixes more evenly and the vertical difference of salinity is smaller.

2.2.2.1.5 Seawater temperature

The station of seawater temperature observation station is the same as the continuous ocean current observation station, with 9 stations totally. The results of observational statistics show that:

During wet season, the average daily water temperature on surface layer in engineering sea area is between 30.79℃~31.43℃, the average daily temperature of the middle layer is between 29.23 ℃~ 31.25 ℃, and the average daily temperature of the bottom layer is between 28.55 ℃~ 31.18 ℃. During dry season, the average daily water temperature of surface layer is between 27.02 ℃~ 27.35 ℃, the average daily water temperature of middle layer is between 26.71 ℃ ~ 27.36 ℃, and the average daily water temperature of bottom layer is between 26.83 ℃~ 27.34 ℃. The daily average water temperature in dry season is lower than that in wet season, and the daily water temperature difference is less than that in wet season. Overall, the vertical variation of water temperature is all not significant in wet and dry season.

2.2.2.1.6 Sediments

The First Marine Research Institutes of Ministry of Natural Resources has set up 98 surface sediment observation stations in the engineering sea area, and the location of observation station is shown in **Figure 70**.

The statistical results of observation data show that there are five types of sediments in the engineering sea area: gravel sand GS (containing sandy gravel SG), medium coarse sand MCS (containing coarse medium sand CMS and sand S), fine sand FS (containing medium fine sand MFS), silty sand(TS) and sandy silt (ST). The distribution of sediment types on the surface layer is shown in **Figure 71**.

In terms of the quantitative composition, the gravel sand GS (containing sandy gravel SG) in the sediments on the surface layer of sea area accounts for 9.18% of sample quantity; the medium coarse sand MCS (containing coarse medium sand CMS and sand S) accounts for 29.59%; the fine sand (containing medium fine sand MFS and fine medium sand FMS) accounts for 22.45%; the silty sand (TS) and sandy silt (ST) account for 29.59% and 9.18% respectively. In terms of grain size composition, in the sediments on the surface layer in the sea area, the sandy sediments are most, accounting for more than 50% in proportion totally; the quantity of sediments composed of sand and silty sand is second, accounting for nearly 40% in proportion;. the quantity of sediments composed of gravel and sand is least, accounting for less than 10%.

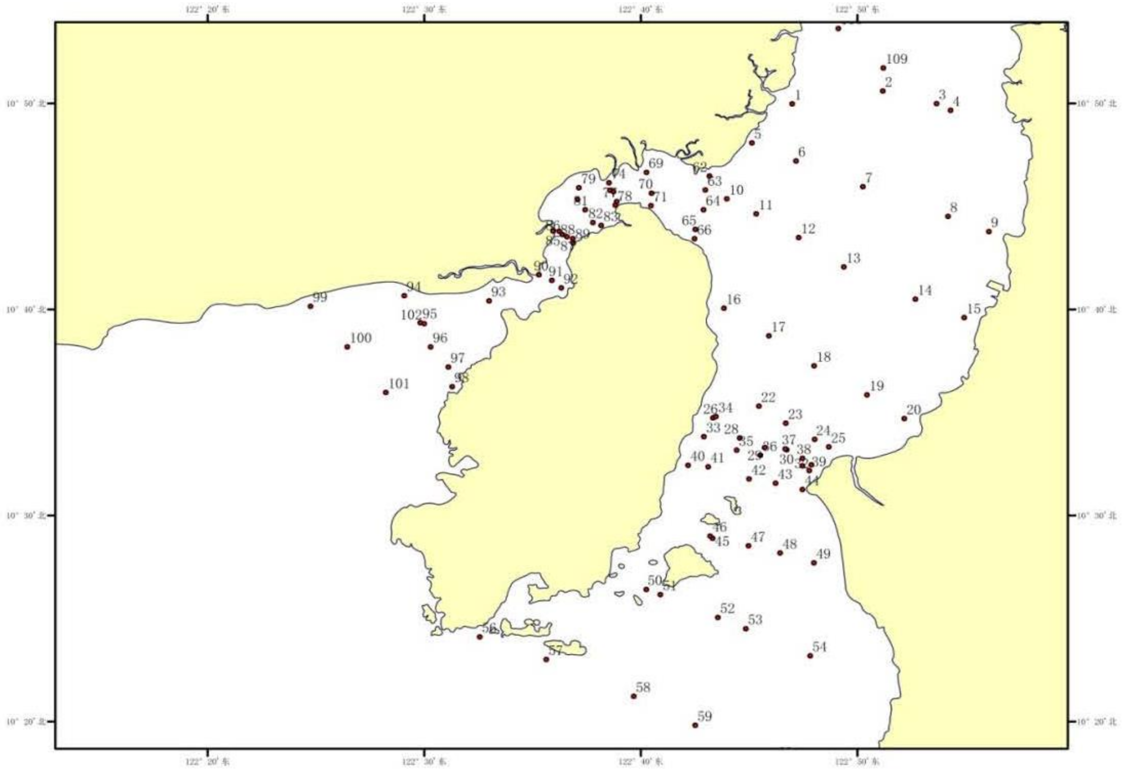


Figure 70. Stations Map for Surface Sediments Sampling

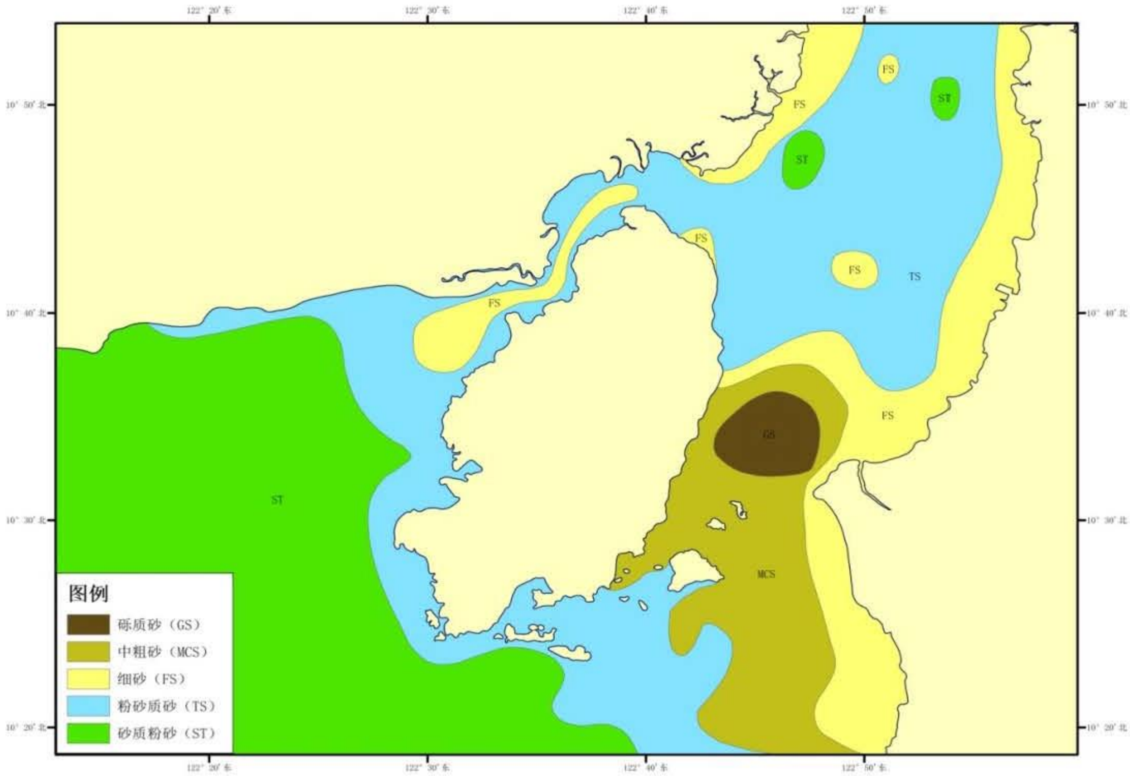


Figure 71. Distribution Map of Surface Sediments Type

2.2.2.1.7 Wave

Sulu Sea is located to the southwest of PGN Bridge, and Visayas Sea is located to the northeast. The islands and reefs distribute horizontally and vertically around Visaya Sea and Sulu Sea, the topography fluctuates sharply, the local wave conditions are complex, and the waves are complicated in the whole engineering area due to influence by topography.

In the special topic study on marine hydrology in feasible engineering stage, 12 calculation points of wave recurrence period (**Figure 72**) are simulated and calculated for different recurrence periods, and the calculation results are compared and verified with actually measured results, having good coincidence. **Table 48** shows the extreme value on each computed point during recurrence period.

Table 49. Extreme Value on Each Computed Point for Wave during Recurrence Period

Calculation point	Wave element	2 years	50 years	100 years	300 years	Main wave direction
C1	Hs (effective wave height, m)	1.3	3	3.4	3.9	198.7°/22.5°
	Tz (zero-crossing period, s)	3.4	4.9	5.1	5.4	
C2	Hs (effective wave height, m)	0.6	1.5	1.7	2	227.6°/55.8°
	Tz (zero-crossing period, s)	2.1	3.3	3.5	3.9	
C3	Hs (effective wave height, m)	0.6	1.4	1.6	1.9	223.1°/32.9°
	Tz (zero-crossing period, s)	2	3	3.3	3.6	
C4	Hs (effective wave height, m)	1	3.1	3.7	4.6	27.6°/199.3°
	Tz (zero-crossing period, s)	3.1	5	5.4	5.9	
C5	Hs (effective wave height, m)	1.1	3.1	3.6	4.5	17.5°/211.9°
	Tz (zero-crossing period, s)	3.2	5	5.4	5.9	
C6	Hs (effective wave height, m)	1.8	4.2	4.6	5.3	221.2°
	Tz (zero-crossing period, s)	4.6	6.8	7.1	7.5	
C7	Hs (effective wave height, m)	2	4.5	5	5.6	220.6°
	Tz (zero-crossing period, s)	4.9	7.2	7.5	7.9	
C8	Hs (effective wave height, m)	1.5	3	3.2	3.6	225.0°
	Tz (zero-crossing period, s)	3.8	5.2	5.5	5.7	
C9	Hs (effective wave height, m)	1.3	2.6	2.8	3.1	242.4°
	Tz (zero-crossing period, s)	3.5	5	5.2	5.5	
P1	Hs (effective wave height, m)	1.9	5	5.6	6.5	238.8°
	Tz (zero-crossing period, s)	4.7	7.6	8	8.6	
P2	Hs (effective wave height, m)	2.4	6.8	7.7	9.1	240.0°
	Tz (zero-crossing period, s)	5.1	8.3	8.7	9.4	
P3	Hs (effective wave height, m)	2.3	6.5	7.3	8.6	223.7°
	Tz (zero-crossing period, s)	1.3	3	3.4	3.9	

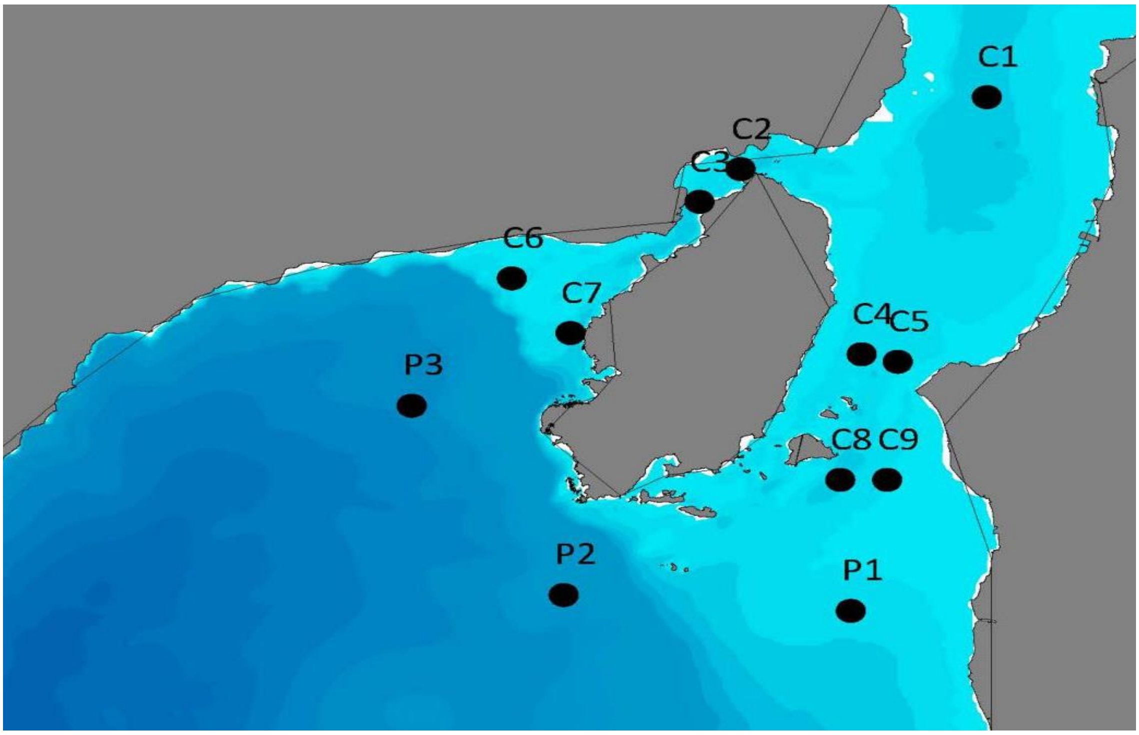


Figure 72. Schematic Diagram for Computed Point Position of Sea Wave During Recurrence Period

2.2.2.1.8 Tsunami

The Philippines is located at the junction of the Asia-Europe plate, the Indian Ocean and the Pacific, with complex tectonic movement and frequent seismic activity. The project is located on Panay Island, Guimaras Island and Negros Island in central Philippines, directly facing the tsunami risk from the Sulu Sea.

Figure 73 shows the distribution of historical earthquakes in Philippines and around (from Historical Seismological Catalogue of GCMT Project). **Figure 74** shows the historical tsunami distribution in Philippines and around (from National Geophysical Data Center and Tsunami Database of World Data Service (NGDC/WDS), in which NULL represents that, although there is historical record of tsunami in certain location, a record on tsunami intensity or parameters that can be used to calculate tsunami intensity lacks.

As can be known from **Figure 73 to Figure 74**, the Philippines and its surrounding areas are earthquake and tsunami-prone areas .Seismological and tsunami sources are mainly located in fault zones, including major faults such as Manila Trench, the Philippine Trench, the Java Trench, and some smaller faults such as the Negros Trench and the Cotabato Trench. The quantity of earthquake in the Sulu Sea area is relatively less since 1976, mainly referring to earthquakes below Magnitude 7. The earthquakes mainly distribute in the vicinity of Negros Trench in the east of the Sulu Sea and Sulu Sea Trench in the south. There are few historical tsunamis record for Sulu Sea, but there are two historical tsunamis records for the strait where the cross-sea bridge is located.

According to the *Study Report on Tsunami Numerical Simulation of Marine Hydrologic Special Topic Study for Feasibility Study Project of Aid to Philippine Cross-sea Bridg*e, the extreme tsunamis from the Negros Trench may pose a greater threat to the targeted area, while extreme tsunamis from Sulu Sea Trench are less affected. The wave height of tsunami from Sulu Sea Trench in the engineering area is less than 1.0m, and the arrival time is more than 40min. The extreme tsunami generated by the northern section of Negros Trench will reach the targeted area within 20min, and the wave height is more than 3m.Moreover, the tsunami risk faced by Iloilo Strait in the north is much higher than the Guimaras Strait in the south.

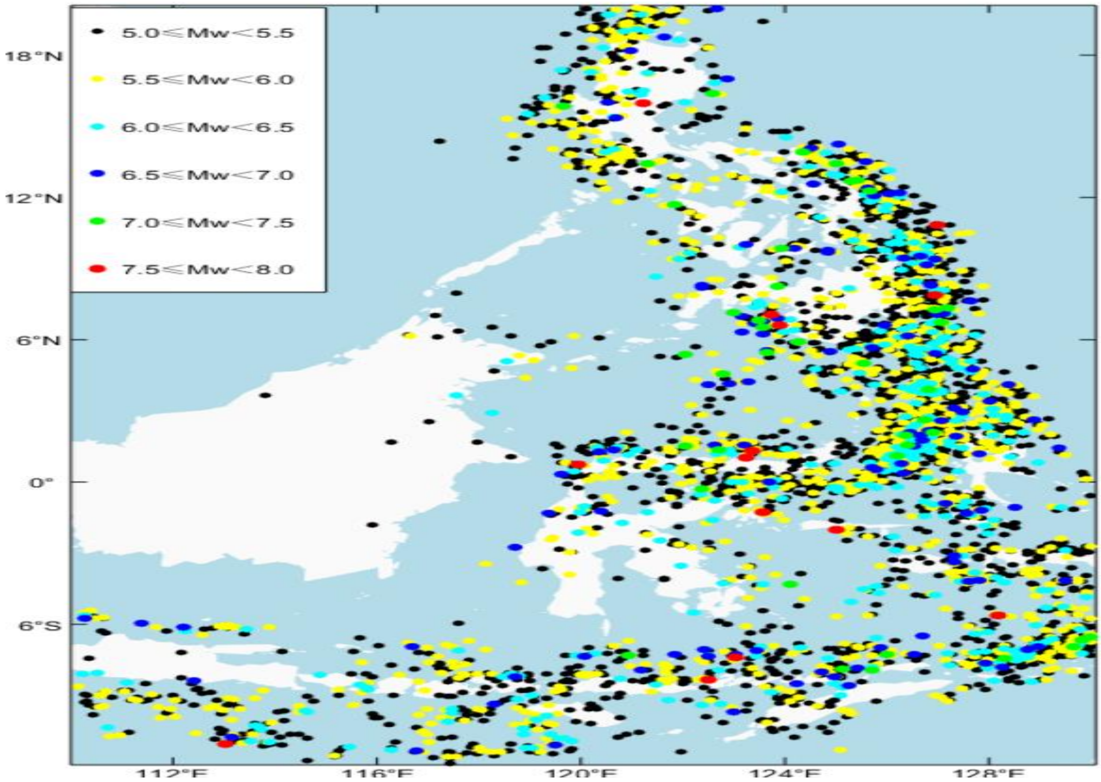


Figure 73. Historical Earthquake Distribution Map in Philippines and Surrounding Areas

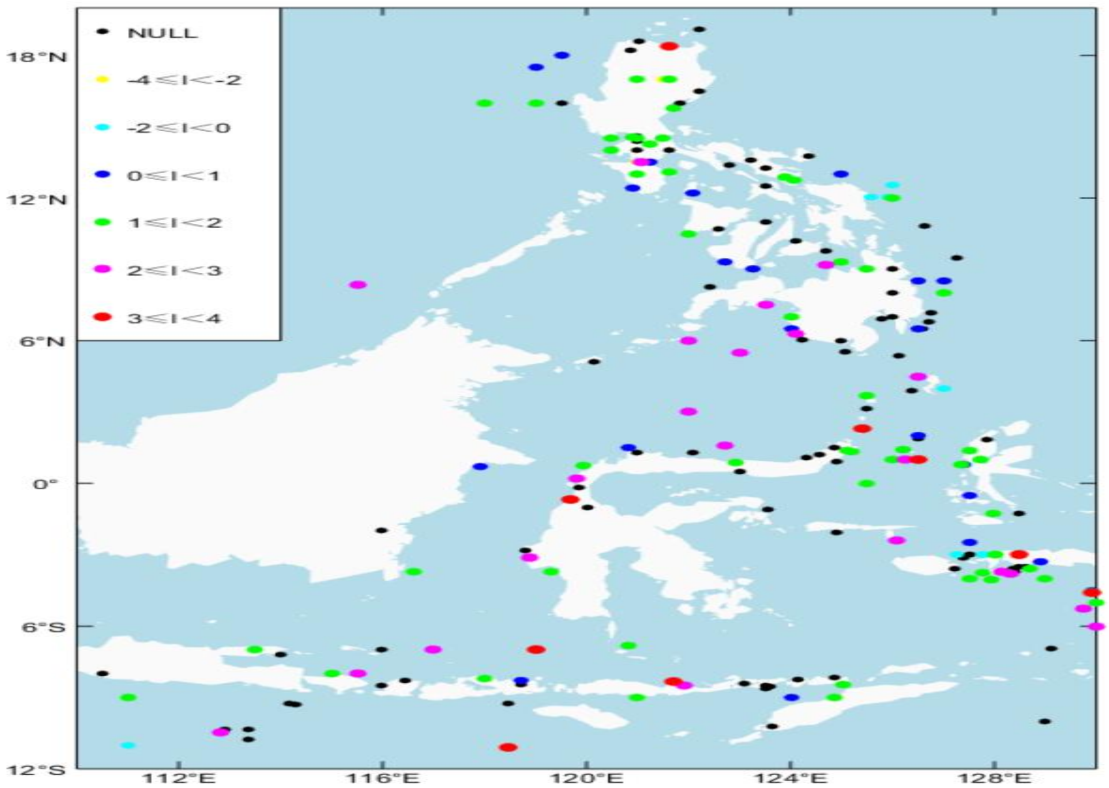


Figure 74. Historical Tsunamis Distribution Map in Philippines and Surrounding Areas

2.2.2.2 Hydrodynamic Environmental Impact Assessment

In order to get a complete understanding of distribution characteristics of ocean current in the vicinity of the project and the influence of PGN project on the flow field in the vicinity of the project, a plane two-dimensional mathematical model is established by using the vertical mean motion equation, and the flow field in the calculation area before and after the project is simulated by using Mike21 software to predict the impact of project construction on flow field in the vicinity.

The area of numerical calculation model in this project is shown in **Figure 75**. The north boundary of the model is taken from the cross-section of passage where the total tide hydrology observation station C1 is located; the southwest boundary is taken from the cross-section of passage where the total tide hydrology observation station C6 and C7 are located; the southeast boundary is taken from the cross-section of passage where the total tide hydrology observation station C8 and C9 are located. In this project, a six-node triangular grid cell is used to discretize the computational domain, and the area with larger variation of seabed topography and convoluted coastline shall be densified for treatment.

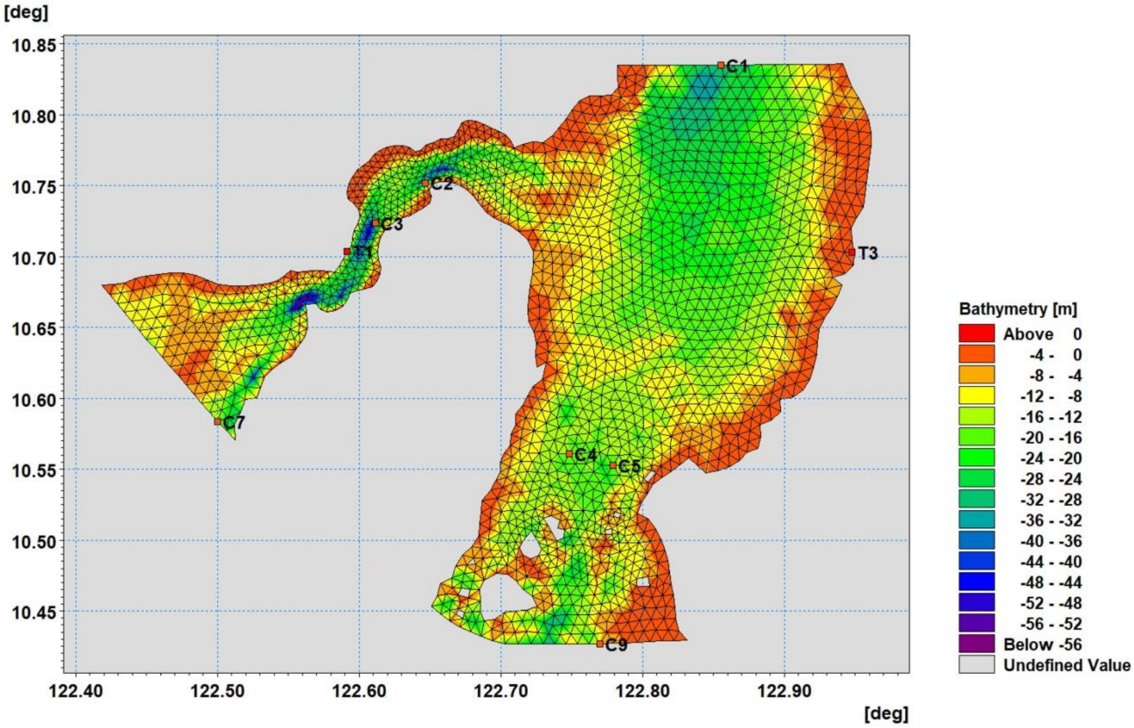


Figure 75. Computational Domain and Grid Division

(4) Model verification

The accuracy of model is verified by using two actually-measured points of tide level (T1, T3) and four actually-measured points of ocean current (C2-C5). The position of verification point for tide level and tide is shown in **Figure 76** and **Figure 77**.

a. Tide level verification

Figure 76 and **Figure 77** show the comparison between the calculated value and actually-measured values for flow velocity calculated at medium tide T1 and T3 stations, and it can be known that the calculated tide level process line at the T1 and T3 stations are basically coincided with the actually measured tide level process, the moment at which the high and low tide points appear is consistent, and the calculated tidal level value is basically consistent with the actually measured value, therefore, the simulation to tide level by model conforms to the reality.

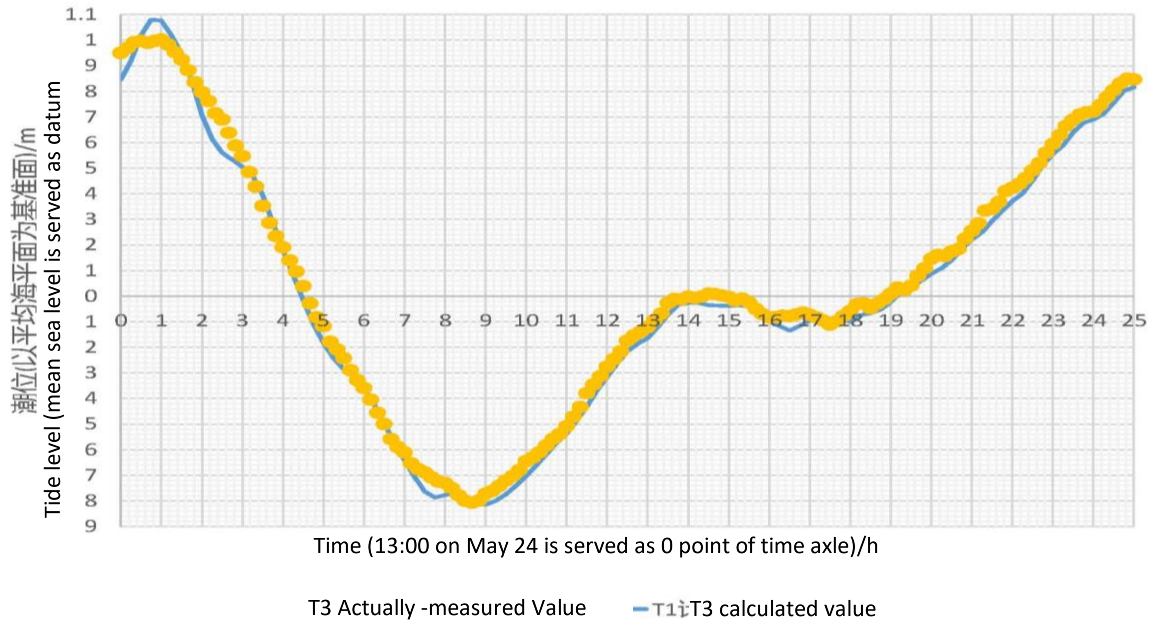


Figure 76. Comparison between Calculated Value and Actually-Measured Value at T1 Tide Level (Medium Tide)

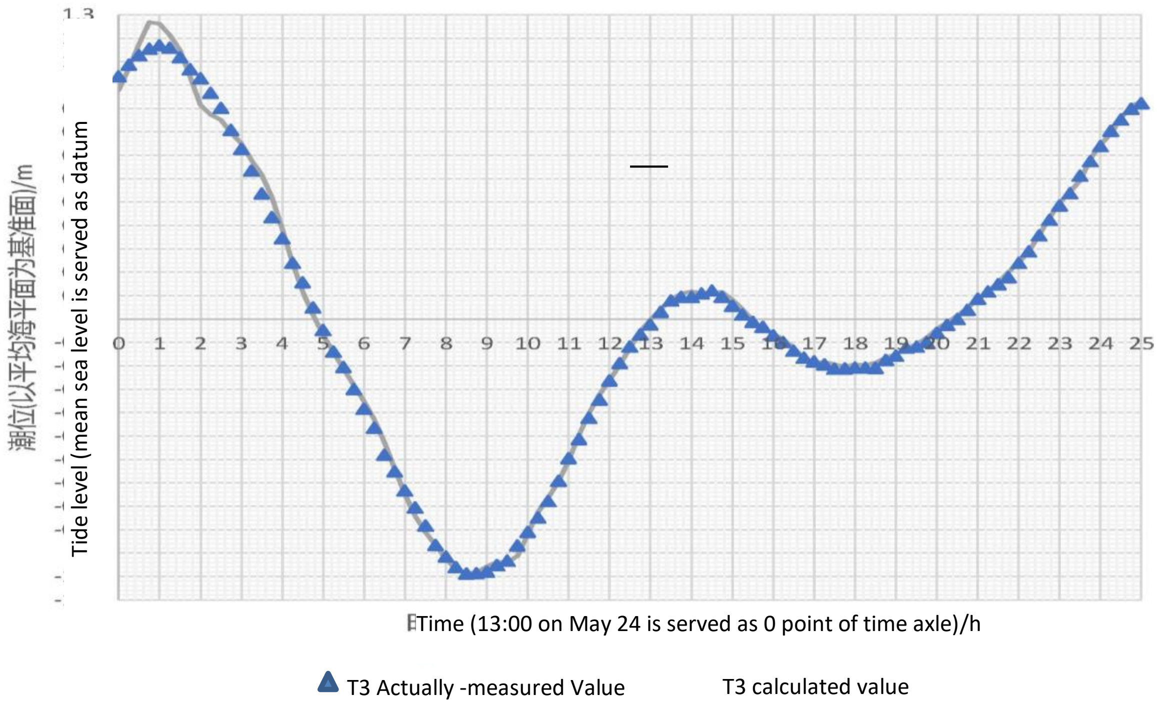
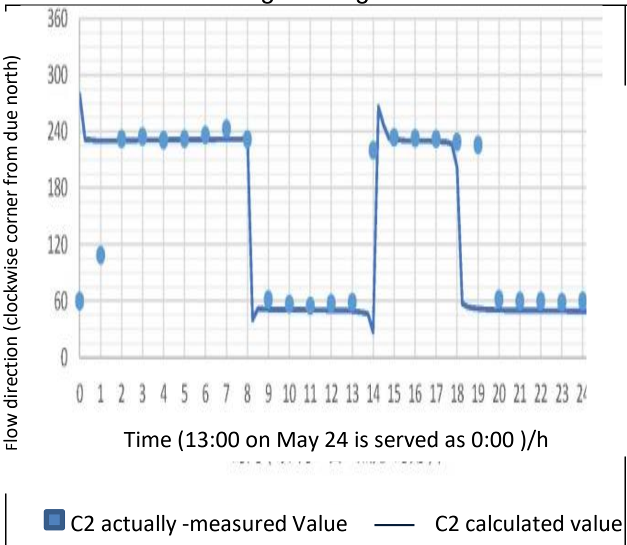


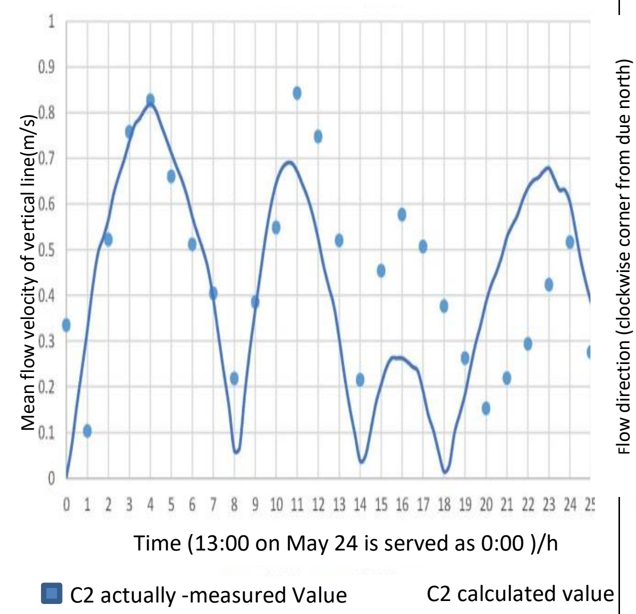
Figure 77. Comparison between Calculated Value and Actually-Measured Value at T3 Tide Level (Medium Tide)

b. Ocean current verification

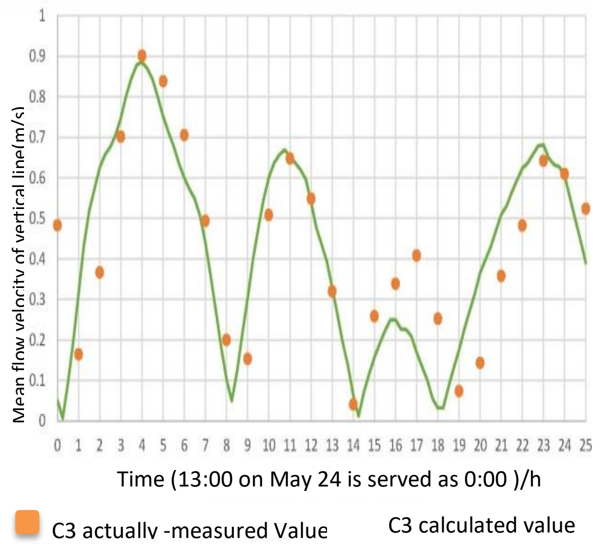
Figure 78 shows the comparison between the calculated mean vertical flow velocity, flow direction and actually-measured value under the medium-tide working condition at C2-C5 stations. It can be known that the calculated mean flow velocity and flow direction for vertical line at C2-C5 stations are properly coincided with the actually-measured value, and the calculated flow velocity process line and the actually-measured flow velocity change process trend are almost same. Therefore, the simulation for flow velocity and flow direction by model is close to reality.

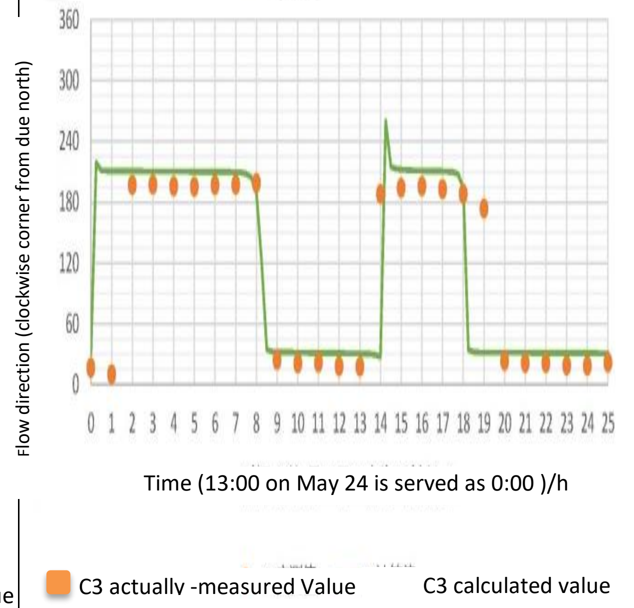
To sum up, the calculated tidal level value coincides with the actually-measured value very well, and the calculated values for flow velocity and flow direction are generally close to the actually-measured values. The numerical model of ocean current built in this project meets the requirements of simulation accuracy and can be used to reproduce the characteristics of flow field in the engineering area



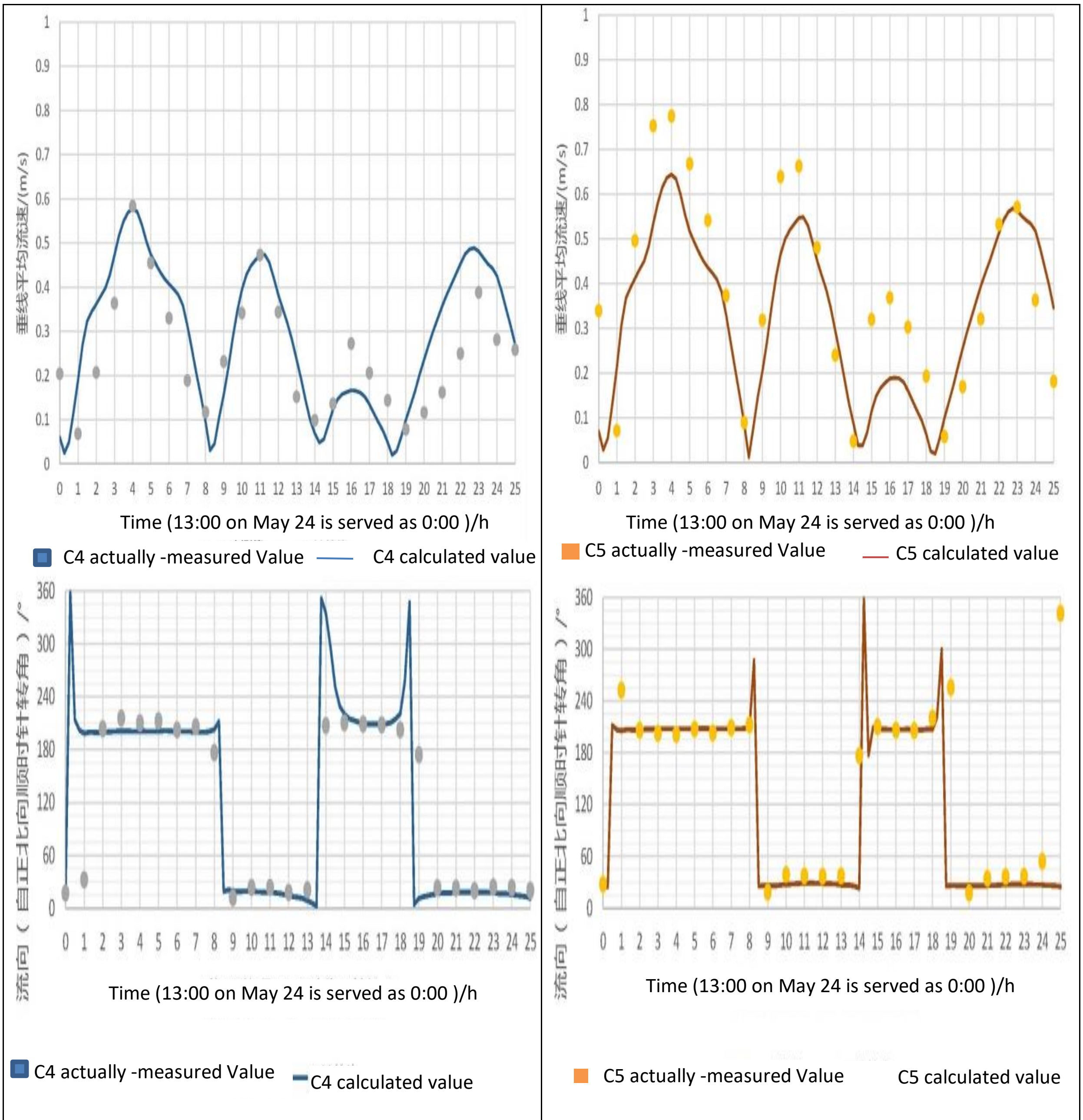


Verification of Flow Velocity and Flow Direction for Ocean Current in C2 Station





Verification of Flow Velocity and Flow Direction for Ocean Current in C3 Station



Verification of Flow Velocity and Flow Direction for Ocean Current in C4 Station	Verification of Flow Velocity and Flow Direction for Ocean Current in C5 Station

Figure 78. Verification of Flow Velocity and Flow Direction for Ocean Current (Medium Tide)

c. Influence on flow field by engineering construction

Hydrodynamics is the extreme condition (300-year-old tide type, basically belongs to flood), there is no engineering influence on normal condition field in hydrology. **Figure 79** and **Figure 80** show the flow field diagram of tidal sharp rising and falling at 300-year return period before engineering construction. When the tide rises sharply, the ocean current rushes into Vesarya Sea from the Gulf of Panay in the Sulu Sea via the Iloilo Strait and the Guimaras Strait. The flow direction of ocean current in the Iloilo Strait and Guimaras Strait is roughly northeast, and the ocean current velocity is higher, and the mainstream is basically consistent with the harbor trench. The flow velocity near the concave bank in the strait is lower, the flow velocity near the convex bank is greater, the convex bank on the side of south bank on Line B of Section A is more rugged for seabed topography, and the tidal current more than 2 m/s can be formed at about 500 m away from the bridge location. At about 4km to the south of Line D on Section B, because the collected water flow on island reef may form the tide more than 2.3 m/s, the flow velocity at the open strait is relatively lower. While falling shaprly, the general flow direction of water flow is contrary to the one while tide rising. The ocean current rushes into Gulf of Panay in the Sulu Sea from Vesarya Sea via the Iloilo Strait and the Guimaras Strait, and the flow direction of ocean current in the Iloilo Strait and Guimaras Strait are roughly southwest.

Figure 81 and **Figure 82** show the flow field map of sharp tide rising and falling at 300-year return period after construction. Through comparison, it can be known that the characteristics of ocean current in the engineering sea area before and after construction are basically same, and the characteristics of ocean current may not change due to engineering construction. In order to compare the characteristics of flow field in engineering area before and after the engineering construction, **Figure 83** and **Figure 84** show the distribution of flow field map of sharp tide rising and falling at 300-year return period before and after the engineering construction. After the bridge is built, the flow velocity in the middle section of bridge location on Line B of Section A decreases at the time of the sharp rise, the flow velocity in the Iloilo Strait increases 0.037 m/s maximally and decreases 0.026 m/s maximally. The variation range of 0.02 m/s flow velocity will influence the area from 2 km upstream to 2km downstream at bridge location of the Iloilo Strait; the flow velocity in the Guimaras Strait increases about 2.8 m/s maximally and decreases 0.047 m/s minimally, and the variation range of 0.02 m/s flow velocity will influence the area from 2 km upstream to 2km downstream. In the event of sharp tide falling, the flow velocity in the Iloilo Strait increases about 0.073 m/s maximally and decreases 0.048 m/s maximally, and the variation range of 0.02 m/s flow velocity will influence the area from 2 km upstream to 10km downstream at bridge location on Line B of Section A in the Iloilo Strait. The flow velocity in the middle section and south in the vicinity of bridge location on Line B of Section A-channel decreases, and the flow velocity in the northern section increases. The maximum flow velocity in the Guimaras Strait increases about 0.026 m/s maximally and decreases 0.035 m/s minimally, and the variation range of 0.02 m/s flow velocity will influence the area from 2 km upstream to 3 km downstream.

To sum up, the flow velocity variation before and after the bridge construction does not exceed 0.073m/s, and in general, the bridge construction may not cause the change of flow field characteristics in the engineering sea area.

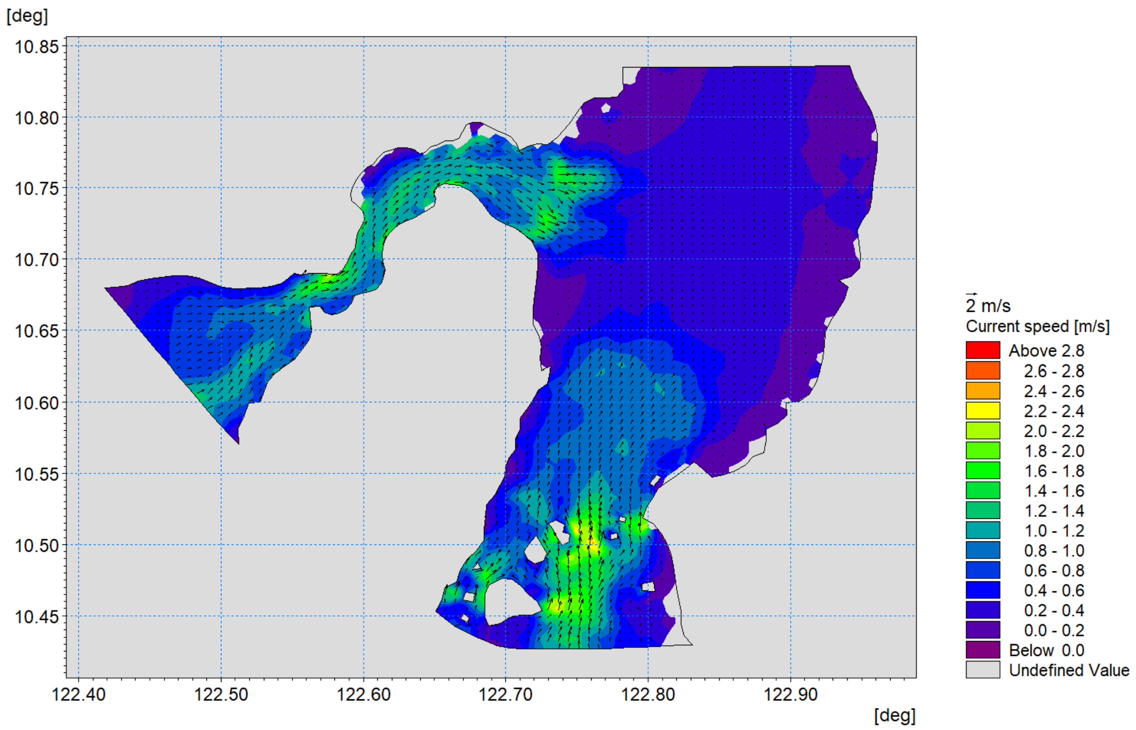


Figure 79. Flow Field at the Moment of Rapid Rise before Bridge Construction (Tidal Type at 300-Year Return Period)

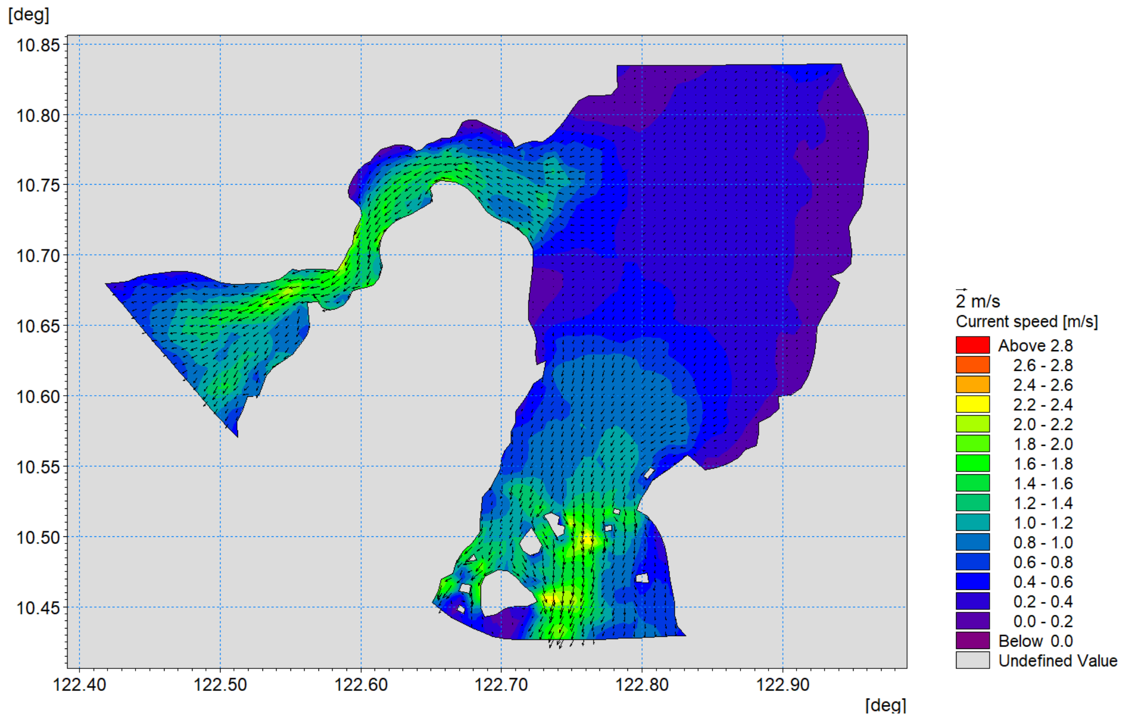


Figure 80. Flow Field at the Moment of Rapid Fall before Bridge Construction (Tidal Type at 300-Year Return Period)

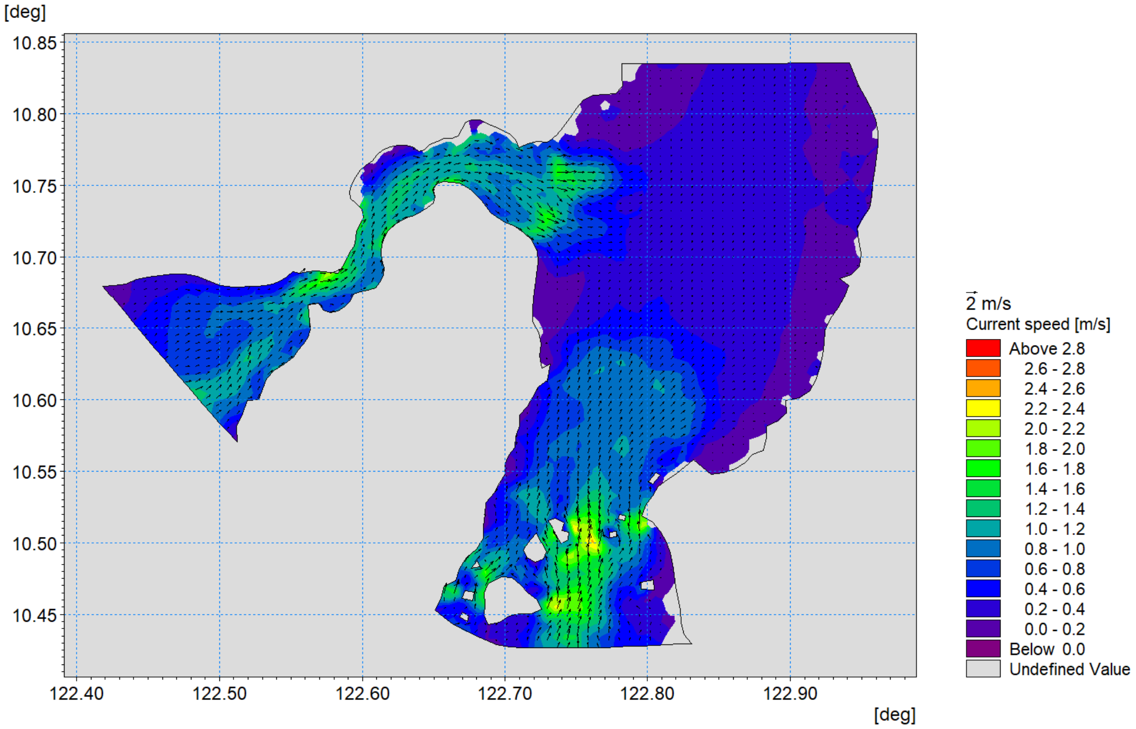


Figure 81. Flow Field at the Moment of Rapid Rise after Bridge Construction (Tidal Type at 300-Year Return Period)

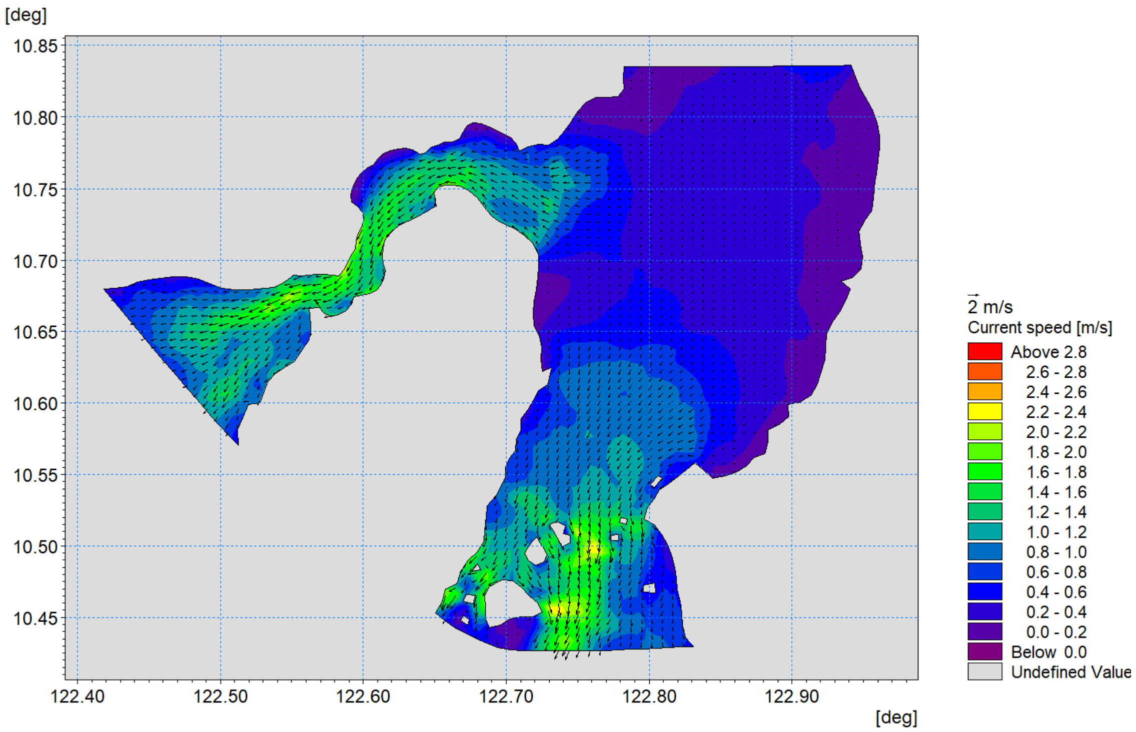


Figure 82. Flow Field at the Moment of Rapid Fall after Bridge Construction (Tidal Type at 300-Year Return Period)

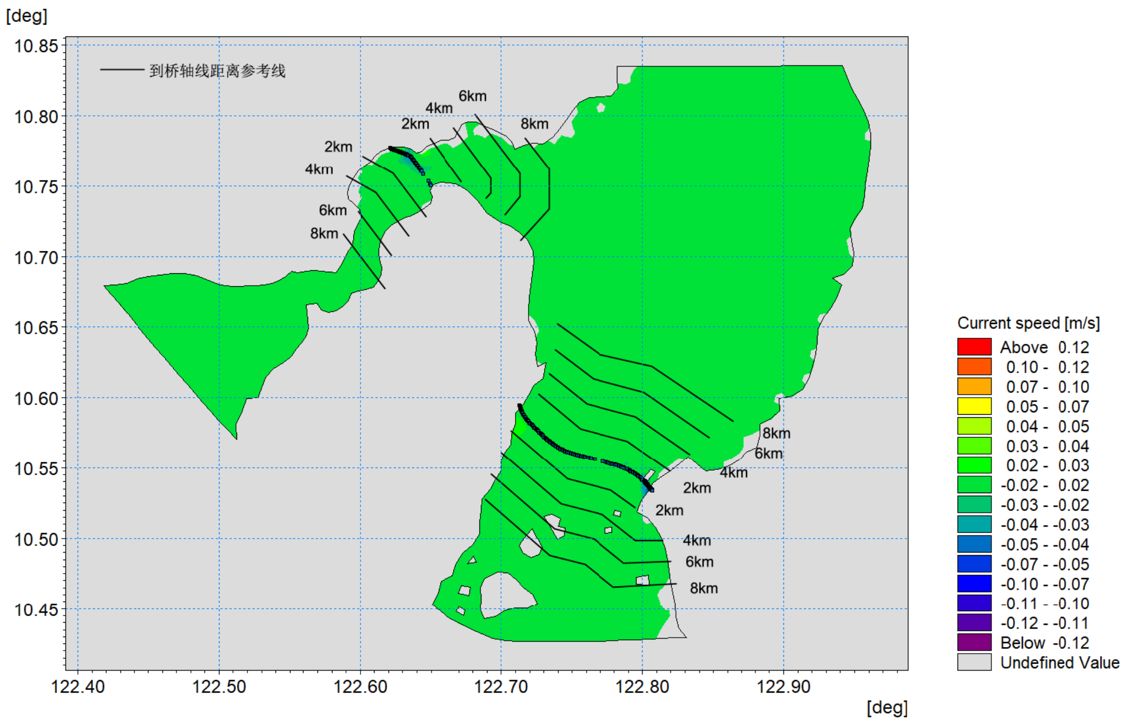


Figure 83. Flow Velocity Variation at the Moment of Rapid Rise after Completion of Bridge Construction for Tidal Type at 300-Year Return Period

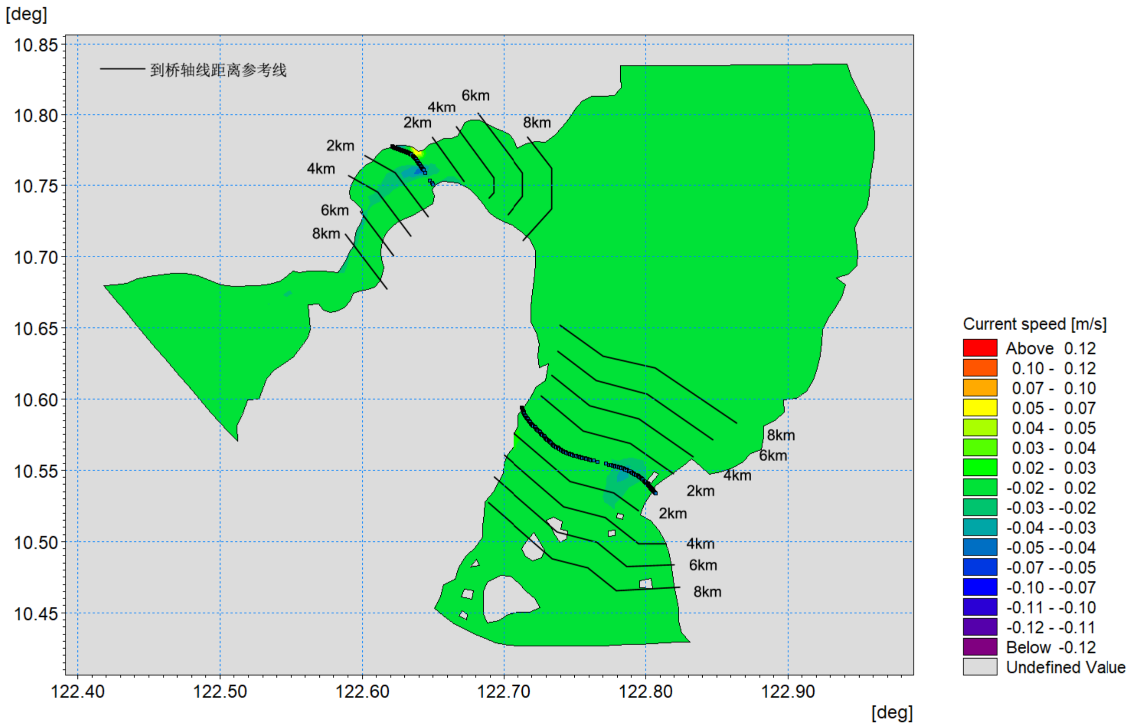


Figure 84. Flow Velocity Variation at the Moment of Rapid Fall after Completion of Bridge Construction for Tidal Type at 300-Year Return Period

2.2.2.2.1 Assessment of the Environmental Impact of Scouring and Silting

In this section, the mathematical model of tidal current and sediment as well as the mathematical model of seabed deformation in the engineering area are coupled and the Sand Transport of MIKE21 Flow Model is applied to simulate and calculate the sediment transporting and seabed scouring and siltation in the engineering sea area so as to further analyze the seabed evolution of the Iloilo Strait and Guimaras Strait where the bridge project is located before and after the construction.

Figure 85 shows the seabed deformation situation before and after bridge construction on Line B in project area after five years (seabed elevation after bridge construction subtracts the seabed elevation before bridge construction), the blockage in the figure represents the bridge pier. It can be known from the diagram that the influence on deformation of seabed in most areas around bridge location by construction of Line B is within 0.6 m, and more than 1.2 m scouring may occur in local area. It is required to be noticed that the more than 7.2 m sedimentation may occur in the area close the bank to south side of main bridge. It is predicted that the scouring area of seabed in five years accounts for about 70% of the total calculated seabed area in Iloilo Strait, with an average scouring depth of 0.15 m in five years and an average annual scouring depth of 0.03 m. It is predicted that the depositing area of seabed in five years accounts for about 30% of the total calculated seabed area in Iloilo Strait, with an average shallow depositing depth of 0.18 m in five years and an average annual shallow depositing of 0.036 m.

Figure 86 shows the seabed deformation situation before and after bridge construction on Line D in project area after five years (the seabed elevation after bridge construction subtracts the seabed elevation before bridge construction), the blue blockage in the figure represents the bridge pier. It can be known from the diagram that the influence on deformation of seabed in most areas around bridge location by construction of Line D is within 0.2 m, and more than 3 m scouring may occur on the island to the south of bridge location, and the scouring area in five years accounts for about 80% of the total calculated seabed area in Guimaras Strait, with an average scouring depth of 0.05 m in five years and an average annual scouring depth of 0.01 m; the depositing area of seabed in five years accounts for about 20% of the total calculated seabed area in Guimaras Strait, with an average shallow depositing depth of 0.02 m in five years and an average annual shallow depositing of 0.004 m. The evolution of the seabed is very slow in the area from 4km to the north of bridge location to 2km to the south of bridge location before and after bridge construction, the seabed is very stable, the evolution trend before bridge construction is mainly dominated by scouring, and the influence on seabed evolution by bridge construction is to generally enable that the seabed produces the scouring slightly larger than the one before bridge construction.

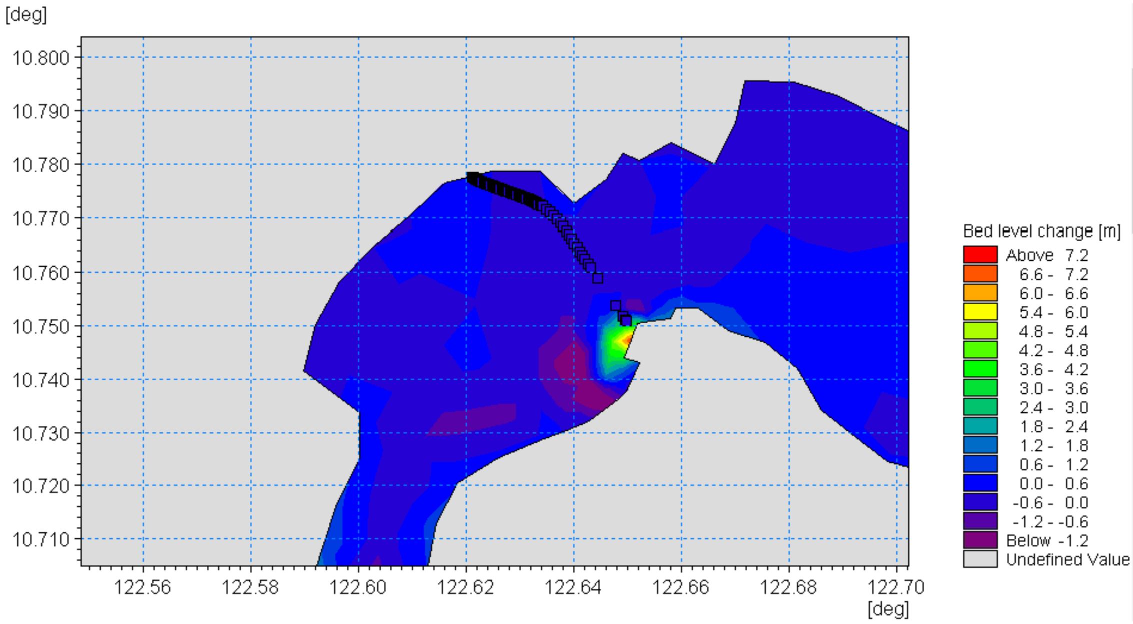


Figure 85. Seabed Deformation Conditions in Engineering Area before and after Bridge Construction on Line B after 5 Years

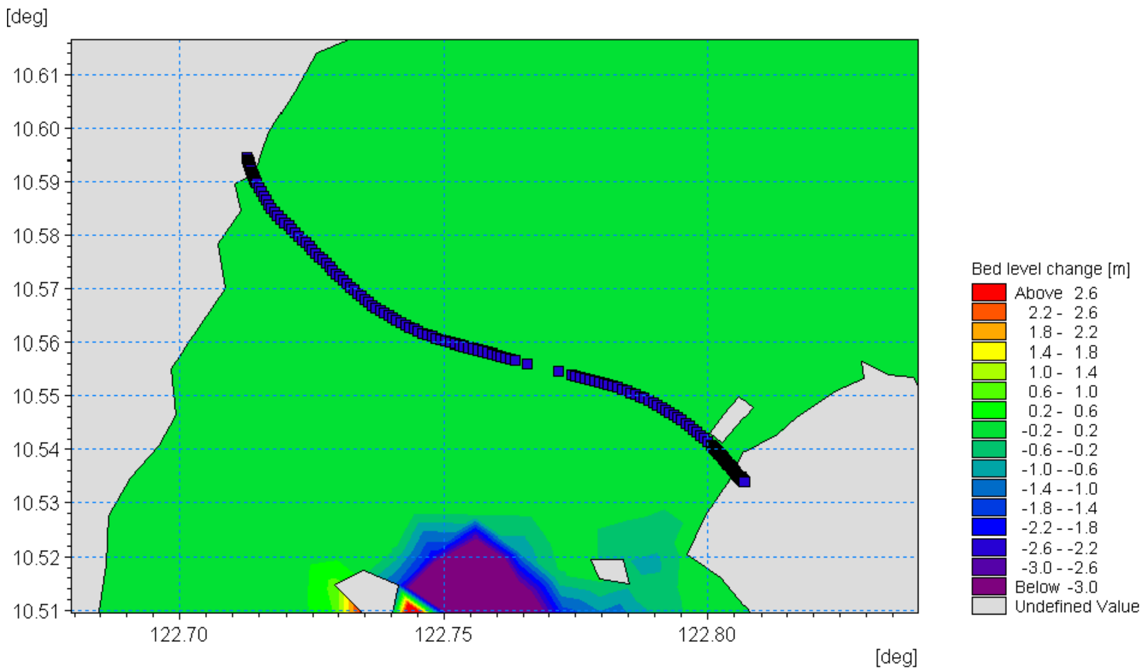


Figure 86. Seabed Deformation Conditions in Engineering Area Before and After Bridge Construction on Line D After 5 Years

To sum up, the construction of cross-sea bridge on Line B in Iloilo Strait and cross-sea bridge on Line D in Guimaras may produce less influence on scouring and siltation characteristics and the evolution of seabed in project area, and the influence on the Guimaras Strait by construction of this project is less than that on the Iloilo Strait.

2.2.3 Water Quality

2.2.3.1 Marine Water Quality

Grab sampling was used for marine water quality measurement. Samples were collected on March 20 and 22, 2019 with fair to sunny weather. Vandorn Water Sampler was used to collect water samples. Samples were put in glass and plastic containers, properly sealed, labeled and preserved with ice at lower temperature inside coolers and transported to the laboratory. On-site measurement was done for pH, temperature and dissolved oxygen. Samples were submitted for laboratory testing to CRL Environmental Corporation (CRL), a recognized Department of Environment and Natural Resources (DENR) third party laboratory. **Table 49** presents the sampling sites, date and time of collection conducted in Iloilo, Guimaras and Negros Occidental. **Figure 87** presents the sampling map of the sites.

Table 50. Summary of Marine Water Sampling Sites, Coordinates, Weather condition, Date and Time of Samplings

Station No.	Sampling Stations	Coordinates	Weather Condition	Date and Time of Samplings
MW1	High Tide	10°46'29.48"N 122°37'29.26"E	Sunny	3/20/2019, 1050H
	Low Tide		Sunny	3/20/2019, 1600H
MW2	High Tide	10°45'55.20"N 122°38'30.20"E	Sunny	3/20/2019, 1030H
	Low Tide		Sunny	3/20/2019, 1615H
MW3	High Tide	10°45'7.80"N 122°38'55.33"E	Sunny	3/20/2019, 1015H
	Low Tide		Sunny	3/20/2019, 1630H
MW4	High Tide	10°34'28.38"N 122°43'30.77"E	Sunny	3/22/2019, 1109H
	Low Tide		Fair	3/22/2019, 0430H
MW5	High Tide	10°33'45.64"N 122°44'17.42"E	Sunny	3/22/2019, 1050H
	Low Tide		Fair	3/22/2019, 0455H
MW6	High Tide	10°33'19.98"N 122°45'35.14"E	Sunny	3/22/2019, 1025H
	Low Tide		Fair	3/22/2019, 0515H
MW7	High Tide	10°33'4.10"N 122°46'49.86"E	Sunny	3/22/2019, 1010H
	Low Tide		Fair	3/22/2019, 0535H
MW8	High Tide	10°32'29.60"N 122°47'56.90"E	Sunny	3/22/2019, 0945H
	Low Tide		Fair	3/22/2019, 0555H

Source: Google Earth

Figure 87. Marine Water Sampling Map of PGN Project

2.2.3.1.1 Methodology

The approved test methods use by CRL are in accordance to DENR Administrative Order No. 93, Series of 1998 and DENR-EMB Memorandum Circular 2016-012. These methods are based on Standard Methods for Examination of Water and Wastewater, 22nd Edition, American Public Health Association/American Waterworks Association (APHA/AWWA). Field and Laboratory testing methods used are presented in **Table 50**.

Table 51. Parameters and Analytical Methodology

Parameter	Analytical Method
pH	Glass Electrode; pH Meter
Temperature	pH/Temperature meter
Color	Visual Comparison Method
Biochemical Oxygen Demand (BOD)	Winkler (Dilution Technique) Titrimetry
Chemical Oxygen Demand (COD)	Open Reflux Titrimetry
Total Suspended Solids (TSS)	Gravimetric Method
Dissolved Oxygen (DO)	Azide Modification (Winkler Method)
Surfactants (MBAS as LAS)	Chloroform Extraction Colorimetry
Oil and Grease	Gravimetry (Hexane Extraction)
Chloride	Argentometric Method
Hexavalent Chromium	Diphenylcarbazide Colorimetric Method
Nitrate-N	Brucine-Colorimetry
Phosphate-P	Stannous Chloride Method
Antimony, Arsenic, Cadmium, Copper, Lead, Nickel, Zinc	Inductively Coupled Plasma (ICP) – OES
Mercury	Cold Vapor AAS
Fecal Coliform	Multiple Tube Fermentation Technique

2.2.3.1.2 Results and Discussions

Table 51a, Table 51b and Table 51c show the results of physical and chemical analyses for marine water collected in Iloilo, Guimaras and Negros Occidental. Based on the results, pH, color, Dissolved Oxygen (DO), TSS, oil and grease, nitrate, phosphate, metals and fecal coliform bacteria meet the criteria guidelines of the DENR Administrative Order (DAO) No. 2016-08, Water Quality Guidelines and General Effluent Standards of 2016 for Class SC limits. It should be noted that DENR does not have regulatory standard for BOD, COD, chloride under class SC.

Hereto attached on Annex 8.5 are the results of Water Quality Stations.

Table 52a. Results of Physico-chemical Analyses of Marine Water

Parameters, units	MW 1 (Low Tide)	MW 1 (High Tide)	MW 2 (Low Tide)	MW 2 (High Tide)	MW 3 (Low Tide)	MW 3 (High Tide)	DAO No. 2016-08, Class SC Limits
pH	8.0	8.0	8.1	8.0	8.1	8.0	6.5 – 8.5
Temperature, °C	29.5	28.3	28.3	28.3	28.2	28.3	25-31
Color	3	3	3	3	3	3	75
BOD, mg/L	1	1	1	1	1	1	n/a
COD, mg/L	204	196	416	297	121	297	n/a
DO, mg/L	5	6	6	7	6	7	5.0 mg/L minimum
Surfactants, mg/L	0.4	1.2	0.3	0.6	0.2	0.6	1.5
TSS, mg/L	26	24	27	10	18	10	80
Oil and Grease, mg/L	0.53	0.53	0.43	0.50	0.56	0.50	3.0
Chloride, mg/L	20,200	19,900	20,100	661	20,100	661	n/a
Nitrate-N, mg/L	0.3	0.1	0.3	0.01	0.3	0.01	10
Phosphate-P, mg/L	0.01	0.1	0.02	0.4	0.02	0.4	0.5
Antimony, mg/L	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	---
Arsenic, mg/L	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	0.02
Cadmium, mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.005
Copper, mg/L	<0.003	0.006	<0.003	<0.003	<0.003	0.009	0.02 as dissolved Cu
Hexavalent Chromium, mg/L	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.05
Lead, mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.05
Nickel, mg/L	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	0.06
Mercury, mg/L	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.002
Zinc, mg/L	<0.005	<0.005	<0.005	0.008	<0.005	<0.005	0.8
Fecal Coliform, MPN/100 ml	<1.8	4.5	<1.8	79	<1.8	79	200

Table 51b. Results of Physico-chemical Analyses of Marine Water

Parameters, units	MW 4 (Low Tide)	MW 4 (High Tide)	MW 5 (Low Tide)	MW 5 (High Tide)	MW 6 (Low Tide)	MW 6 (High Tide)	DAO No. 2016-08, Class SC Limits
pH	8.0	8.3	8.3	8.3	8.3	8.3	6.5 – 8.5
Temperature, °C	27.5	28.5	27.9	28.4	27.2	28.5	25-31
Color	3	3	3	3	3	3	75
BOD, mg/L	<1	<1	<1	<1	<1	<1	n/a
COD, mg/L	205	81	246	60	185	89	n/a

Parameters, units	MW 4 (Low Tide)	MW 4 (High Tide)	MW 5 (Low Tide)	MW 5 (High Tide)	MW 6 (Low Tide)	MW 6 (High Tide)	DAO No. 2016-08, Class SC Limits
DO, mg/L	7	7	6	7	7	7	5.0 mg/L minimum
Surfactants, mg/L	0.8	0.4	1.1	0.1	0.4	0.2	1.5
TSS, mg/L	29	27	22	28	28	25	80
Oil and Grease, mg/L	0.56	0.56	0.53	0.60	0.42	0.53	3.0
Chloride, mg/L	18,200	18,800	18,600	18,700	18,400	19,200	n/a
Nitrate-N, mg/L	0.1	0.06	0.02	0.1	<0.02	0.07	10
Phosphate-P, mg/L	0.02	0.01	0.01	<0.01	0.01	<0.01	0.5
Antimony, mg/L	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	---
Arsenic, mg/L	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	0.02
Cadmium, mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.005
Copper, mg/L	0.01	<0.003	0.003	<0.003	<0.003	<0.003	0.02 as dissolved Cu
Hexavalent Chromium, mg/L	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.05
Lead, mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.05
Nickel, mg/L	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	0.06
Mercury, mg/L	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.002
Zinc, mg/L	<0.005	<0.005	<0.005	0.005	0.006	<0.005	0.8
Fecal Coliform, MPN/100 ml	2.0	<1.8	<1.8	<1.8	<1.8	<1.8	200

Table 51c. Results of Physico-chemical Analyses of Marine Water

Parameters, units	MW 7 (Low Tide)	MW 7 (High Tide)	MW 8 (Low Tide)	MW 8 (High Tide)	DAO No. 2016-08, Class SC Limits
pH	8.3	8.2	8.3	8.2	6.5 – 8.5
Temperature, °C	27.5	28.3	27.5	28.4	25-31
Color	3	3	5	5	75
BOD, mg/L	<1	<1	<1	7	n/a
COD, mg/L	57	45	165	131	n/a
DO, mg/L	7	7	6	7	5.0 mg/L minimum
Surfactants, mg/L	0.3	0.3	0.7	0.2	1.5
TSS, mg/L	29	26	27	68	80
Oil and Grease, mg/L	0.43	0.53	0.55	1.3	3.0
Chloride, mg/L	17,800	18,700	18,000	19,700	n/a
Nitrate-N, mg/L	0.03	0.08	0.05	2.1	10
Phosphate-P, mg/L	0.03	0.01	0.02	0.08	0.5
Antimony, mg/L	<0.008	<0.008	<0.008	<0.008	---
Arsenic, mg/L	<0.008	<0.008	<0.008	<0.008	0.02
Cadmium, mg/L	<0.001	<0.001	<0.001	<0.001	0.005
Copper, mg/L	0.003	<0.003	0.004	0.004	0.02 as dissolved Cu
Hexavalent Chromium, mg/L	<0.002	<0.002	<0.002	<0.002	0.05
Lead, mg/L	<0.005	<0.005	<0.005	<0.005	0.05
Nickel, mg/L	<0.003	<0.003	<0.003	<0.003	0.06
Mercury, mg/L	<0.0002	<0.0002	<0.0002	<0.0002	0.002
Zinc, mg/L	<0.005	<0.005	0.007	<0.005	0.8
Fecal Coliform, MPN/100 ml	<1.8	<1.8	2.0	5.5	200

2.2.3.1.3 Impact Analysis and Mitigation Measures during construction period

2.2.3.1.3.1 Impacts and Mitigations on Marine Water Quality during construction period

Increased turbidity and suspended solids in marine water is one of the adverse impacts anticipated during the bridge pier foundation construction. These impacts will be short term and limited to the vicinity of the project site. The magnitude of suspended matter increase and impact scope is directly related to construction method. In the comparison and selection scheme of bridge pier foundation for this project, the caisson foundation scheme having great disturbance to seabed was abandoned, and the pile group foundation scheme was selected. More specifically, integral steel casing scheme was adopted for construction of main bridge foundation, and the steel trestle and steel casing scheme was adopted for construction of approach bridge foundation. Therefore, the significant disturbance on seabed during bridge pier construction will be felt mainly during the steel trestle construction stage and during installation of steel casing. The impact of bridge foundation construction on marine water quality is short term and is expected to be limited to the project site.

The construction of cast in-situ bored pile will produce dregs or dredge waste, mainly from the bore holes. Dredges disposal into the sea will pollute the sea. All drilling dredges shall be transferred to the waste management area.

Accidental oil leakage from the machinery, equipment and vessels may pollute the marine water. Hence special attention will be given to prevent oil leakages to the sea during the construction of the bridge.

The project is proposed to set up a prefabricated yard on Panay Island, Guimaras Island and Negros Island respectively, and three temporary terminals such as material terminal, abutment shipping terminal and segmental beam shipping terminal are proposed to be set. If the materials (such as asphalt, sand, chemicals, etc.) which are stored in the precast yard and the wharf are not properly kept or scoured by the rainstorm, the pollution of the water body will be caused due to enter into water body.

Mitigation Measures

Due to the high number of bridge piers in this project and the dreg quantity is high and must be disposed properly. Based on communication with Ministry of Housing and Infrastructure in Maldives, all drilling dregs shall be transported to the designated waste management centre, which may be used for backfilling or reclamation.

Domestic sewage generated in the bridge construction site must be disposed via septic tanks and shall not be directly discharged into nearby ditches. Sewage treated in septic tanks must be cleared and disposed at the designated waste management centre. Domestic waste generated by workers shall be collected in a designated location, and disposed at waste management centre. The flushing wastewater for sandstone materials must be recycled after sedimentation treatment in the sedimentation tank.

Chemicals and hazardous materials on the vessel will be safely stored and secured for offsite treatment. The sandstone, cement and other powdery materials stockpiled on construction trestle, temporarily-constructed dock and concrete mixing vessel must be covered for safekeeping.

The machinery and vessels used in construction of the bridge must be inspected strictly in the process of bridge construction so as to prevent the oil leaking. It is strictly forbidden to dispose sewage, garbage and waste oil into sea, these wastes should be gathered and disposed together with pollutants on the bridge construction site for offsite treatment and disposal by accredited hauler and treater of the DENR.

2.2.3.1.3.2 Impact of Bridge Deck runoff on marine water quality during operation period

After the bridge is constructed and commissioned, the pollutants discharged out by various vehicles, particles from wearing of automobile tyre, particles adhered on the vehicle frame, oil leaked by vehicles in poor operating condition and other pollutants that are deposited on the road, may all enter into the drainage system of road along with bridge deck runoff due to rain. These pollutants may enter into marine water. The study shows that, within 30 mins from preliminary stage of rainfall to runoff, the concentration of suspended matters in the rainwater and oily substances are higher. After half an hour, the concentration may decline rapidly along with receding rainfall. After 40～60 mins of rainfall, the pavement will be rinsed thoroughly; the concentration of pollutants produced by pavement runoff is lower level.

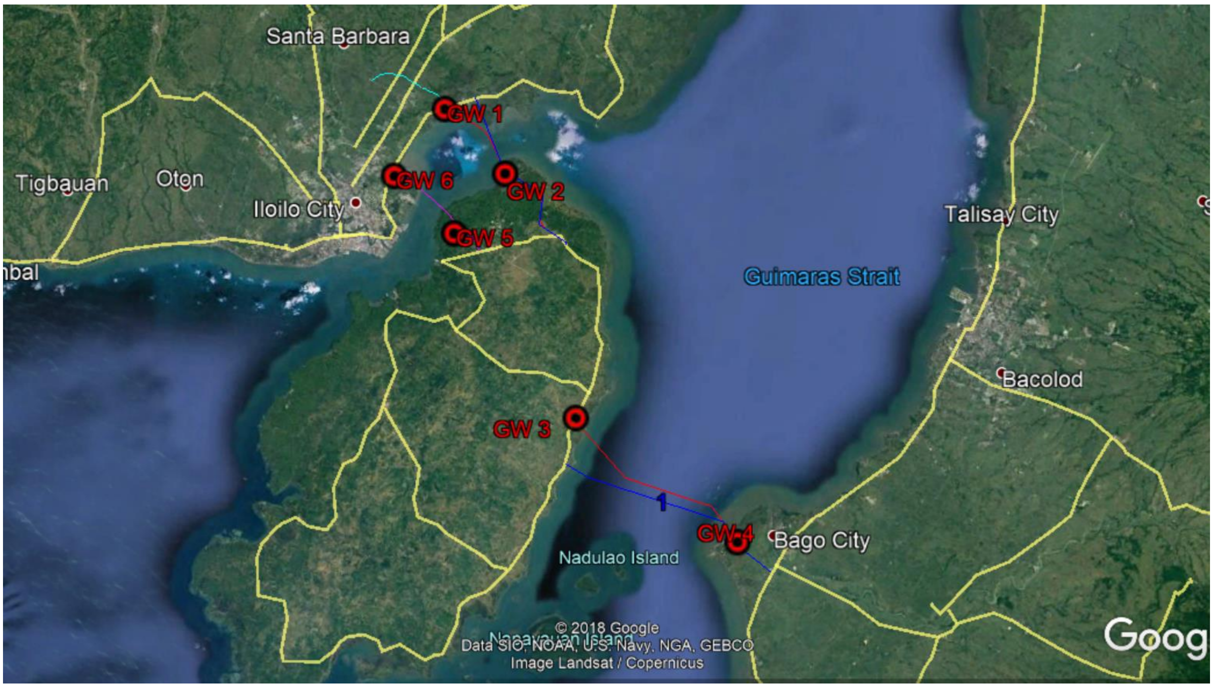
Based on design document of the project, the bridge deck runoff is directly discharged from drainpipe set on both sides of bridge through intervals. After the bridge deck runoff is discharged into water body, the instantaneous concentration of pollutants within the small range adjacent to runoff water dropping point will be high. However, due the strong tidal current flow in the area, mixing within the water column and dispersal will occur rapidly. Thus, impacts from runoff are not expected to be significant.

2.2.3.2 Ground Water Quality

Grab sampling was used for marine water quality measurement. Samples were collected on March 20 and 22, 2019 with sunny weather. Direct filling method was used to collect water samples. Purging/flushing of water for at least five minutes was done prior to collection. Shallow water well and hand pumps were available in the area. Samples were put in glass and plastic containers, properly sealed, labeled and preserved with ice at lower temperature inside coolers and transported to the laboratory. On-site measurement was done for pH, temperature and dissolved oxygen. Samples were submitted for laboratory testing to CRL Environmental Corporation, an accredited Department of Health (DOH) laboratory. **Table 52** presents the sampling sites, date and time of collection conducted in Iloilo, Guimaras and Negros Occidental. **Figure 88** presents the sampling map of the sites. **Table 53** presents the parameters analyzed and their corresponding analytical methodologies based on approved methods of analysis of the Philippine National Standards for Drinking Water (PNSDW) Administrative Order No. 10, Series of 2017 (DAO 2017-010).

Table 53. Summary of Ground Water Sampling Sites, Coordinates, Weather condition, Date and Time of Samplings

Station No.	Sampling Stations	Coordinates	Weather Condition	Date and Time of Samplings
GW1	Brgy. Gua-an, Leganes, Iloilo	$10^0$46’53.3.0”N $122^0$36’52.6”E	Sunny	3/20/2019, 1155H
GW2	Brgy. Getulio, Buenavista, Guimaras	$10^0$44’40.0”N $122^0$39’16.0”E	Sunny	3/22/2019, 1420H
GW3	Brgy. M. Chavez, San Lorenzo, Guimaras	$10^0$35’54.7”N $122^0$42’27.0”E	Sunny	3/22/2019, 1330H
GW4	Brgy. Pag-ayon, Pulupandan, Negros Occidental	$10^0$31’44.6”N $122^0$48’44.3”E	Sunny	3/22/2019, 0740H
GW5	Java Residence, Sition Tinabuan, Brgy. Zaldivar, Buenavista, Guimaras	$10^0$42’22.0”N $122^0$37’31.0”E	Sunny	7/7/2019, 0845H
GW6	Brgy. Balabago, Jaro, Iloilo	$10^0$44’20.0”N $122^0$35’9.0”E	Sunny	7/7/2019, 1145H



Source: Google Earth

Figure 88. Ground Water Sampling Map of PGN Project

Table 54. Parameters and Analytical Methodology

Parameter	Analytical Method
pH	Glass Electrode; pH Meter
Temperature	pH/Temperature meter
Color	Visual Comparison Method
Biochemical Oxygen Demand (BOD)	Winkler (Dilution Technique) Titrimetry
Chemical Oxygen Demand (COD)	Open Reflux Titrimetry
Total Suspended Solids (TSS)	Gravimetric Method
Dissolved Oxygen (DO)	Azide Modification (Winkler Method)
Surfactants (MBAS as LAS)	Chloroform Extraction Colorimetry
Oil and Grease	Gravimetry (Hexane Extraction)
Chloride	Argentometric Method
Hexavalent Chromium	Diphenylcarbazide Colorimetric Method
Nitrate-N	Cadmium Reduction Colorimetry Method
Phosphate-P	Stannous Chloride Method
Antimony, Arsenic, Cadmium, Copper, Lead, Nickel, Zinc	Inductively Coupled Plasma (ICP) – OES
Mercury	Cold Vapor AAS
Fecal Coliform	Multiple Tube Fermentation Technique

2.2.3.2.1 Results and Discussions

Table 54 presents the results of physical and chemical analyses of groundwater taken in different sites from shallow well and hand pumps. All parameters measured are within the Philippine National Standards for Drinking Water (PNSDW) Administrative Order No. 10, Series of 2017 (DAO 2017-010) except for chloride in station 1 and station 6, color in stations 1,4 & 6. Fecal coliform bacteria in all groundwater stations failed to meet the drinking water standard.

There should have no presence of fecal coliform bacteria in a water sample. Possible high concentration of chloride is salt water intrusion in the shallow wells.

Total coliform is a measure of potential water contamination from bacteria that can be found in soil, vegetation and feces of warm-blooded animals. Most coliform bacteria are generally harmless but they may also pose some health risk if there is presence of fecal coliform. Fecal coliforms are associated with human or animal wastes. Factors of bacteria contamination are pre-mature to conclude unless successive monitoring will be done to say that water supply is contaminated with bacteria.

There are no present drinking water guidelines for BOD, COD, dissolved oxygen, Surfactants, TSS, oil and grease, phosphate and hexavalent chromium.

Table 55. Results of Physico-chemical Analyses of Ground Water

Parameters, units	GW1	GW2	GW3	GW4	GW5	GW6	DOH AO 2017-10
pH	7.32	7.3	7.3	7.3	6.6	8.1	6.5 – 8.5
Temperature, °C	28.2	27.1	29.1	27.3	25.0	25.0	---
Color	**15**	3	3	**60**	3	**250**	10
BOD, mg/L	1	1	1	<1	1	13	---
COD, mg/L	37	6.9	21	7.9	23	71	---
Dissolved Oxygen, mg/L	3.5	2	3	3	3	1	---
Surfactants, mg/L	0.2	<0.02	<0.02	<0.02	<0.02	<0.02	---
TSS	10	3.0	<2.5	4.0	<2.5	8.0	---
Oil and Grease, mg/L	0.50	1.3	0.65	0.53	0.63	0.80	---
Chloride, mg/L	**661**	59	160	183	12	**894**	250
Nitrate, mg/L	0.01	4.7	1.7	0.02	0.6	0.2	50
Phosphate, mg/L	0.4	0.06	0.04	0.1	0.01	1.2	---
Antimony, mg/L	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	0.02
Arsenic, mg/L	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	0.01
Cadmium, mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.003
Copper, mg/L	0.006	0.006	0.03	<0.003	<0.003	<0.003	1.0
Hexavalent Chromium, mg/L	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	---
Lead, mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.01
Nickel, mg/L	0.008	<0.003	<0.003	<0.003	<0.003	0.004	0.07
Mercury, mg/L	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.001
Zinc, mg/L	0.02	0.02	0.02	0.02	0.02	0.3	5.0
Fecal Coliform, MPN/100 ml	**>8.0**	**>8.0**	**>8.0**	**>8.0**	**>8.0**	**2.6**	<1.1

Hereto attached on Annex 8.5 are the photos taken during sampling.

2.2.3.2.2 Impact Assessment on Groundwater during construction period

Though potential impacts from drilling are confined to marine environment, there is the possibility for ground water contamination due to mishandling and mismanagement of equipment, particularly in the work sites.

During the constructional phase oil, paint or other chemicals will need to be handled properly. Mishandling of fuel has led to serious pollution of soil and groundwater. There have also been reports of spilled oil near temporary generator sets and around fuel transport lines in other similar projects. This sort of pollution may sometimes have long-term irreversible effects, extending through the operations stage, since such contamination does not degrade itself and is expensive to clean up. The clean-up itself may require extensive ground water extraction, which will impacts such as salt-water intrusion.

Excavation can also expose groundwater and the deeper sections of the soil to more harmful contaminants such as oils and hydrocarbons from vehicles and other machineries used during the construction.

Solid waste and wastewater generation during the construction stage can also affect the groundwater, if they are mishandled and mismanaged during the construction stage. The risk is moderate as construction will be well supervised and managed by project staff to ensure that waste is handled and disposed properly.

Groundwater pollution can also occur as a result of leaking sewerage connections and may pollute the soil. This in turn will lead to the formation and accumulation in the aquifer of hazardous gases such as hydrogen sulphide. Eventually, the immediate vicinity of the ground water aquifer may become polluted and cause hazards to human health in medium to long-term.

2.2.3.2.3 Mitigation Measures to reduce risks on ground water

- Use of high quality fluids during the drilling process to minimise any chance of pollution of ground water.
- Where possible, above ground sumps or mud handling systems will be used.
- Additives to drilling water may be used in small quantities, which prevent the contamination of aquifers during drilling operations. BTEX drilling fluids will not be used.
- Oil, solid waste & hazardous waste handled carefully & transported in sealed containers.
- All paints, lubricants, and other chemicals used on site stored in a secure and bunded location
- General refuse stockpiled in one central area
- Keep spill clean-up materials readily available
- Train workers in spill prevention and clean-up, and designate responsible individuals
- Properly tune and maintain all machinery
- Carry out construction activities user the supervision of a suitably experienced person
- Only undertake dewatering when absolutely required

2.2.4 Marinewater Ecology

To establish baseline data on coastal resources, an assessment was carried out last 15 to 18 March 2019 to determine the current ecological conditions of submerged coastal habitats that may be impacted by the proposed construction of bridge project across the three main islands. The main goal of the study is to characterize and evaluate the present status of plankton, macro invertebrates (benthos), corals, seagrasses as well as its fishes thriving within the reefs. The specific objectives of the study are:

- o conduct a detailed assessment of plankton, macro invertebrates (benthos), seagrass and coral reefs in pre-identified areas,
- o determine the density of plankton, macro invertebrates (benthos), seagrasses and cover of corals,
- o determine species composition, abundance and biomass of associated reef fishes, plankton, macro invertebrates (benthos),
- o identify existing threats to the overall health of the coastal marine environment, and
- o based on the results will recommend action plan/s and/or enhancement to reduce the impact of the proposed project.

2.2.4.1 Sampling Sites

2.2.4.1.1 Seagrass Meadows

A total of 22 sites were assessed during the conduct of seagrass assessment on the same period with that of coral reefs. Out of these sites, seven (7) were from barangays Nabitasan and Gua-an in the municipality of Leganes, province of Iloilo (Panay island); six (6) were in Getulio, Buenavista and four (4) in Cabano, San Lorenzo, both are located in Guimaras island; and five (5) in Poblacion, Pulupandan in Negros Occidental (Negros island; **Table 55**). The location of sampling sites waspre-identified from the proposed construction sites in the islands and information from local people based on activities of Chinese consultants/experts on the ground.

The standard method for seagrass assessment, which is transect-quadrat method by English et al. (1997) and modified by Duarte & Kirkman (2001) and Short et al. (2006) was used. A motorized banca was used to spot check the bottom area to determine the presence or absence of seagrasses and to cover relatively wider coasts. To determine the exact location of the sampling sites and possible extent and area covered by the seagrass meadows, if present, a GPS was used and the coordinate readings were plotted in Google Earth Pro and other GIS-related free software.

In Cabano, San Lorenzo, Guimaras, a 100-m transect was initially employed, laid perpendicular to the shore starting at the first seagrass incidence (**Table 55**). However, since the water conditions was very turbid due to strong wind, sediment resuspension, and riverine input, it was really hard to estimate seagrass abundance using the said method, even using a SCUBA diving gear. Hence, we determined seagrass density by randomly throwing a 50-cm x 50-cm (0.25 m^2) quadrat tied with a floater at least 10 times. All seagrass shoots were individually and manually counted within each quadrat. After sampling, the shoreline were checked for litters of seagrass leaves as indication of possible presence of seagrasses in nearby areas. Photos of the seagrass sites were also taken and appended in this report.

2.2.4.1.2 Benthic Coral Community

Detailed coral reef assessment was conducted using the Photo-transect method (Vergara and Licuanan, 2007). Aside from facilitating the conduct of the survey and providing a permanent record of benthic cover, the photo-transect method is also accurate in detecting changes on the reef through time (Leujak and Ormond, 2007). These features make the method ideal for long term monitoring program of coral reefs. The advantages of using the photo-transect method in coral reef assessment have been extensively discussed in the works of Vergara and Licuanan (2007) and Leujak and Ormond (2007). In the survey, transects were deployed depending on the reef morphology and depth of the reef. Usually, transects were laid at the reef slope or reef edge. For each transect, digital photographs were taken at 1-meter interval and at a camera to substrate distance of about 1-meter. The consistency of the camera distance to the substrate was ensured using a stainless distance bar with a camera mounting provision. The camera is set at full wide angle to capture the largest possible area of the substrate. Photographs were refined using the ADOBE Photoshop software. Ten points were superimposed in the image using the same program. In each of these points, life forms and hard coral genus intercepted were recorded and scored. For the life form identification, the standard 28 benthic lifeform categories of English *et al*. 1997 were used.

Percent cover was computed using the following equation:

$$\textit{Percent cover (\%)} = \frac{\text{Total number of points per life form}}{\text{Total number of points per transect}} \times 100\%$$

Reef health had been assessed using the quartile index established by Gomez and Alcala 1979, Gomez *et al.*, 1981 wherein the proportion of living corals (Hard +Soft coral) were compared relative to other benthic components (e.g., dead coral, soft coral, algae, rubble, etc.). Coral reefs were classified as poor having 0-24.9% live hard coral cover, fair (25-49.9% cover), good (50-74.9% cover) and excellent (75-100% cover).

Table 56. Geo-references of sampling sites, with indicator of possible presence or absence of seagrass in the area during the March 2019.

ISLAND	PROVINCE	MUNICIPALITY	LOCATION	Site Code No.	GPS Coordinates N	GPS Coordinates E	Presence of seagrass/es
PANAY (P)	Iloilo	Leganes	Panos-od, Nabitasan	LI1	10.771120°	122.640840°	No
				LI2	10.771220°	122.639200°	No
				LI3	10.771860°	122.637290°	No
				LI4	10.777550°	122.624380°	No
			Sitio 30, Gua-an	LI5	10.777130°	122.622580°	No
				LI6	10.777080°	122.622440°	No
				LI7	10.777140°	122.619190°	No
GUIMARAS (G)	Guimaras	Buenavista	Getulio	BV1	10.753084°	122.654966°	No
				BV2	10.753085°	122.653579°	No
				BV3	10.752410°	122.652030°	No
				BV4	10.751750°	122.652590°	No
				BV5	10.751153°	122.651054°	No
				BV6	10.750929°	122.649067°	No
		San Lorenzo	Sitio Paos, Cabano	SL1	10.592960°	122.712790°	**Yes**
				SL2	10.577191°	122.705913°	**Leaf litter**
				SL3	10.574036°	122.706168°	No
				SL4	10.570376°	122.708256°	No
NEGROS (N)	Negros Occidental	Pulupandan	Zone A, Poblacion	PP1	10.512030°	122.805240°	No
				PP2	10.516060°	122.793420°	No
				PP3	10.515320°	122.798590°	No
				PP4	10.515420°	122.800620°	No
				PP5	10.514460°	122.802120°	No

2.2.4.1.3 Reef Fish Community

Fish Visual Census (FVC) technique (English, *et al.*, 1997) was used to determine the species diversity, abundance and biomass in the different sites surveyed. This procedure was done on the same transect laid for the coral survey. After the line had been laid, observers waited for about 5-10 minutes before the actual census to allow for the disturbed fish community to return to their normal behavior. Starting at one end of the line, all fishes within a 5m x 10m imaginary quadrat were identified up to species level (if possible) and their numbers and estimated sizes recorded. Observer swam to and briefly stop at every 5-m mark along the line until the transect line was completed. The faster moving fishes were counted first before the slower ones. Each transect covers an area of 500m^2 (50m long x 10m width). All fish sizes were estimated to the nearest centimeter using the total length (TL). All fishes observed were group into three (3) groups i.e., Target, coral indicator and major species. *Target* species is the commercially-important species, coral indicator species is coral-associated, and major species those that belong to non-commercially important species. Fish density and biomass were then computed using ReefSum(Uychiaoco, 2000). Fish biomass is based from the relationship,

$W=aL^b$,

where W is the weight in grams; and *b* are the growth coefficient values taken from published length-weight data; and L is the length of the fish in cm (English, *et al.*, 1997).

Fish abundance will be expressed in terms of individuals per 500m^2 while biomass is extrapolated to metric tons per km^2, which is also equivalent to grams per m^2.

Table 57. Species richness categories adapted from Hilomen et al. (2000).

Category	No. of species per 1,000m^2
VERY POOR	0 – 26
POOR	27 – 47
MODERATE	48 – 74
HIGH	75 – 100
VERY HIGH	>100

Table 58. Fish abundance categories as adapted from Hilomen et al. (2000).

Category	No. of individuals per 1,000m^2
VERY POOR	0 – 201
POOR	202 – 676
MODERATE	667 – 2267
HIGH	2268 – 7582
VERY HIGH	>7592

Table 59. Fish biomass categories adapted from Nañola et al. (2006).

Category	Biomass (MT per km^2)
VERY LOW	<5
LOW	6-10
MEDIUM	11-20
HIGH	21-40
VERY HIGH	>41

2.2.4.1.4 Plankton Community

The sampling program is based on the areas covered by the map presented as **Figure 89**. The geographic coordinates of each of the stations were taken using Garmin Venture HC etrex with the position format of hours-minutes-seconds (hdddomm’ss.s). **Table 59** shows the coordinates and descriptions of Marine Ecology Stations (Plankton and Macroinvertebrates).

A total of eight (8) sampling stations were conducted to assess the plankton abundance, diversity and richness last March 15-16, 2019. Vertical samples were taken at each station by hauling 25-cm mouth diameter conical plankton with 20 microns mesh size for phytoplankton. For zooplankton samples, a 60 microns mesh size was used. Hauling was made from approximately near the bottom to the surface to minimize the effect of variations brought about by diurnal migration of plankton (Jillett, 1971; Estudillo, 1979). In this manner, all levels of the water column were sampled. The sampling depth per station was recorded to be used to estimate the volume of water filtered by the net during each haul. For phytoplankton samples, Lugol's solution was used as preservative and is allowed to settle in the laboratory. After settling, phytoplankton samples were decanted and placed in a Sedgewick-Rafter counting chamber. Samples were identified and enumerated using the inverted microscope. Organisms are identified down to the lowest taxonomic level. Species counts are expressed as cells per cubic meter (cells/L).

Zooplankton samples were preserved with 10 % neutral formalin. Dye was added to facilitate sorting and identification. The preserved samples were identified, enumerated, and counted in the laboratory using a stereomicroscope. Identification was done down to the lowest practical taxonomic level. Results were expressed in number per cubic meter (nos./m^3).

Diversity, species richness and evenness were computed using a Primer E software. Photomicrographs of the most dominant organisms were also done for documentation purposes.

Source: Google Earth

Figure 89. Sampling Stations for Marine Ecology located in Leganes, Iloilo; Buenavista, Guimaras and Pulupandan, Negros Occidental.

Figure 90 shows the conventional plankton net used in the study/sampling.

Table 60. List of Sampling Stations for Marine Ecology (Plankton and Macro invertebrates) with their Corresponding Location and Date of sampling.

Station	Location	Date of Sampling	GPS Coordinates
MW1	Iloilo Strait, Brgy. Gu-an, Leganes, Iloilo	March 15, 2019	10° 46'39.02"N 122°37'8.79"E
MW2	Iloilo Strait, Brgy. Nabitasan, Leganes, Iloilo	March 15, 2019	10° 46'7.84"N 122°38'21.08"E
MW3	Iloilo Strait, Brgy. Tullo, Buenavista, Guimaras	March 15, 2019	10° 45'2.09"N 122°38'51.96"E
MW4	Guimaras Strait, Brgy. Echavez, San Lorenzo, Guimaras	March 16, 2019	10°35'23.60"N 122°42'53.90"E
MW5	Guimaras Strait, Near Tangban fishpens, Guimaras	March 16, 2019	10° 34'41.2"N 122°43'27.0"E
MW6	Middle part of Guimaras Strait (Guimaras side)	March 16, 2019	10°33'30.05"N 122°45'3.23"E
MW7	Middle part of Guimaras Strait (Negros side)	March 16, 2019	10°33'12.12"N 122°46'49.38"E
MW8	Guimaras Strait, Pulupandan, Negros Occidental	March 17, 2019	10°32'36.14"N 122°48'15.21"E

Figure 90. Conventional plankton net used in the collection of plankton samples.

2.2.4.1.5 Benthic Macroinvertebrates (Soft Bottom Community) Sampling and Analysis

The survey was intended to evaluate the benthic community in the area with respect to its composition, density and relative abundance.

Replicate samples were obtained from locations consistent with the stations of plankton survey stations using a portable grab sampler covering an area of 0.0225 m^2 aboard a motorized boat. The benthic samples were taken with a portable gravity grab sampler deployed over the side of the boat. The grab sampler was lowered through the water column with the jaws open and locked. The motorized boat was anchored at each sample location, and sample positions were recorded using a Global Positioning System (GPS) unit.

Benthic samples were then placed in a pre-labeled plastic bag. The grab samples for faunal analysis were fixed immediately with 10% formalin and stained with Rose Bengal and brought to the laboratory for processing. In the laboratory, the samples were wet sieved using different openings. The collected samples were further sorted and identified in the laboratory using a dissecting microscope and readily available taxonomic keys.

Benthic macroinvertebrates in each sample were identified down to the lowest practicable taxonomic level and enumerated as much as possible.

Quantities are expressed as numbers of individuals per square meter (individuals/m^2).

Figure 91 shows the portable ponar grab sampler used in the collection of benthic macroinvertebrates samples.

Figure 91. A Portable ponar grab sampler used in the collection of benthic macroinvertebrates samples.

Data Processing and analyses for Plankton and Macroinvertebrates

Ecological condition indicators were computed for each sampling station using the formulas below.

Dominance

The dominant species for each site were determined based on the importance value (IV). The IV is the sum of the relative density, relative frequency, and relative dominance. These were computed using the following formula:

Density = $\frac{\text{Total number of individuals counted for a given species}}{\text{Total area sampled}}$

Relative density = $\frac{\text{Total number of individuals of a given species}}{\text{Total number of individuals of all species}} \times 100$

Dominance = $\frac{\text{Total area covered by a given species}}{\text{Total area sampled}}$

Relative dominance = $\frac{\text{Total coverage of a species}}{\text{Total coverage of all species}} \times 100$

Frequency = $\frac{\text{Number of plots where a given species occurs}}{\text{Total number of plots in the site}} \times 100$

Relative frequency = $\frac{\text{Frequency of a given species}}{\text{Total frequency of all species}} \times 100$

Importance Value = Relative density + Relative dominance + Relative frequency

Species Diversity and Abundance

On the other hand, species diversity indices were computed using the following formula:
Shannon-Weiner diversity index (H')

$$H' = -\Sigma p_i \ln p_i$$

where p_i, the proportional abundance of the *i*th species = (n_i/N)

Evenness (J) of the species was calculated using the formula:

$$J = H'/\ln S$$

where S, number of species in a stand

Pielou's Evenness = $J = H/H\max = -[\sum(p_i)(\ln p_i)]/\ln S$, where,

"J" – represents the symbol for the species richness
"H'" – species diversity

"Hmax" – species maximum diversity

"S" – number of species in the community

The interpretation of the values obtained using the above formulas were based on the Fernando Biodiversity Scale, 1998 shown in the table below.

Table 61. The Fernando Biodiversity Scale, 1998

Relative Values	Shannon Biodiversity (H') Index	Pielou (J') Evenness Index
Very High	3.5 and above	0.75-1.00
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	1.9 and below	0.05-0.14

2.2.4.1.6 Results and Discussion

2.2.4.1.6.1 Benthic Community Assessment: Seagrasses and Corals

Leganes, Iloilo

No seagrass and live coral were recorded across the seven (7) stations surveyed along barangays Nabitasan and Gua-an in the municipality of Leganes, province of Iloilo (**Table 61**, **Figure 92**). The bottom substrate was generally muddy (**Figure 93**). This type of substrate is expected because of large main rivers draining into the area (Iloilo Strait) such as Batiano snakes and Jalaur River. In addition to major river system, there are also small streams and aquaculture ponds that emptied into the strait. This geomorphological setting of the area contributed to the low visibility and high turbidity. Moreover, siltation and possibly eutrophication may promote plankton bloom, which in the process may cover the seagrasses and reef bottom to hinder further recruitment and settlement.

Table 62. Dive location for corals and reef fishes along coastal municipality of Leganes, Iloilo.

Site	Latitude	Longitude	Depth (m)	Remarks
Nabitasan, Leganes,	10.77122	122.64085	2	Turbid/silted, muddy
Iloilo	10.77126	122.63921	2	Turbid/silted, muddy
	10.77180	122.63734	3	Turbid/silted, muddy
Guwaan, Leganes,	10.77761	122.62445	3	Turbid/silted, muddy
Iloilo	10.77725	122.62299	3	Turbid/silted, muddy
	10.77698	122.62105	3	Turbid/silted, muddy
	10.77718	122.61938	3	Turbid/silted, muddy

Buenavista, Guimaras

The same pattern (no seagrass and corals) was observed in coastal areas across the various sampling sites in barangay Getulio, Buenavista in Guimaras Island (**Table 62**, **Figure 94**). Aquaculture practices such as fish ponds also contributed to water turbidity aside from the area as a major route of fast craft along Iloilo Strait going back and forth to Iloilo and Guimaras. Silt was the limiting factor for coral recruitment aside from less hard substrate availability. Meanwhile, light and availability of suitable substrate may limit seagrass recruitment and establishment considering that the area was quite turbid and had hard substratum, which can be influenced by the presence of coralline cliff area at the coast.

In 2010, the entire municipality of Buenavista harboured around 22 hectares of seagrass area (Provincial Government of Guimaras & PEMSEA, 2012). Fortunately enough, it seems that these seagrasses thrived in other barangays and not in Getulio. This was also the case for coral reefs based on previous study conducted. Coral reef was present in barangay Montpiller along the western side of island province (Hayuma 2000). According to their report, most of life form coral were massive and sub-massive from 14 coral genera. During that time, the reef area was dominated by *Goniastrea*, *Porites*, *Goniopora*, *Pocillopora*, *Montipora*, *Favites*, *Favia*, *Galaxea*, *Lobophyllia*, *Tubepora*, *Symphyllia*, *Merulina*, *Diploastrea* and *Caulastrea*.

Table 63. Dive location of corals and reef fish along coastal municipality of Buenavista, Guimaras.

Site	Latitude	Longitude	Depth (m)	Remarks
Getulio, Buenavista	10.75261	122.65250	3	Turbid/silted, muddy
Guimaras	10.75334	122.65324	3	Turbid/silted, muddy
	10.75417	122.65446	3	Turbid/silted, muddy
	10.75513	122.65848	3	Turbid/silted, muddy

Figure 92. Location of (A) seagrass assessment and (B) dive sites for corals and reef fishes along coastal barangays of Nabitasan and Gua-an in the municipality of Leganes, Iloilo.

Site coordinates of seagrass sites are stipulated in **Table 47**.


Diver prepare to dive


Diver about to descend


Muddy substrate

Panoramic shot along Brgy. Nabitasan, Leganes, Iloilo

Panoramic shot along Brgy. Gua-an, Leganes, Iloilo

Figure 93. Photo-documentation during the survey in Leganes, Iloilo.

San Lorenzo, Guimaras

Among the four sites sampled in barangay Cabano, San Lorenzo in Guimaras Island, the northernmost site was confirmed to harbour seagrass *Cymodocea serrulata* (**Table 63**; **Figure 96**). Its mean density was estimated to be 244 ± 45 shoots m^{-2}. These seagrasses can be found about 150-200 m from the concrete municipal wharf and about 100 m from the shore facing a windmill. On top of *C. serrulata*, there were seaweeds present under the genus *Padina* and *Halimeda* (**Figure 97**). It was quite surprising to observed seagrasses in such very turbid area with strong wind and waves. The low water clarity was possibly due to sediment resuspension from strong water movement and wind blows, and inputs from a nearby river system (**Figure 98**). Likewise, it was noteworthy to observe leaf litters of seagrasses along the coast in site SL2, which suggests that seagrasses exist possibly within the adjacent surroundings. Species of seagrass leaves collected from the shore were *Enhalus acoroides*, *Thalassia hemprichii*, *Cymodocea rotundata*, and *Syringodium isoetifolium*. Based on 2010 data, there was relatively smaller seagrass area, ~9 hectares, along the coastal municipality of San Lorenzo compared to three other municipalities in Guimaras, namely Buenavista, Jordan and Nueva Valencia (Provincial Government of Guimaras & PEMSEA, 2012).

None of hard coral was observed across the five (5) sites surveyed in San Lorenzo, Guimaras (**Table 63**, **Figure 98**). Although there are some benthic attributes observed during the dive. These included soft coral, sea whip coral and sponges with other fauna such as tubeworm and sea urchin **(Figure 98**). Based on the anecdotal account, locals observed live coral in shoal reef. However, the boat captain could not pin point the exact location of the shoals during the surveys. Hence, we did aspot dive along the coast considering that San Lorenzo reef was clearer compared to other sites. And yet, the area still had low visibility due to strong waves. All stations were sandy-muddy bottom where coral recruits are impossible to grow. Hard substrates were not observed during the dive except rocks near the coast. Those rocks were not sampled due to strong waves.

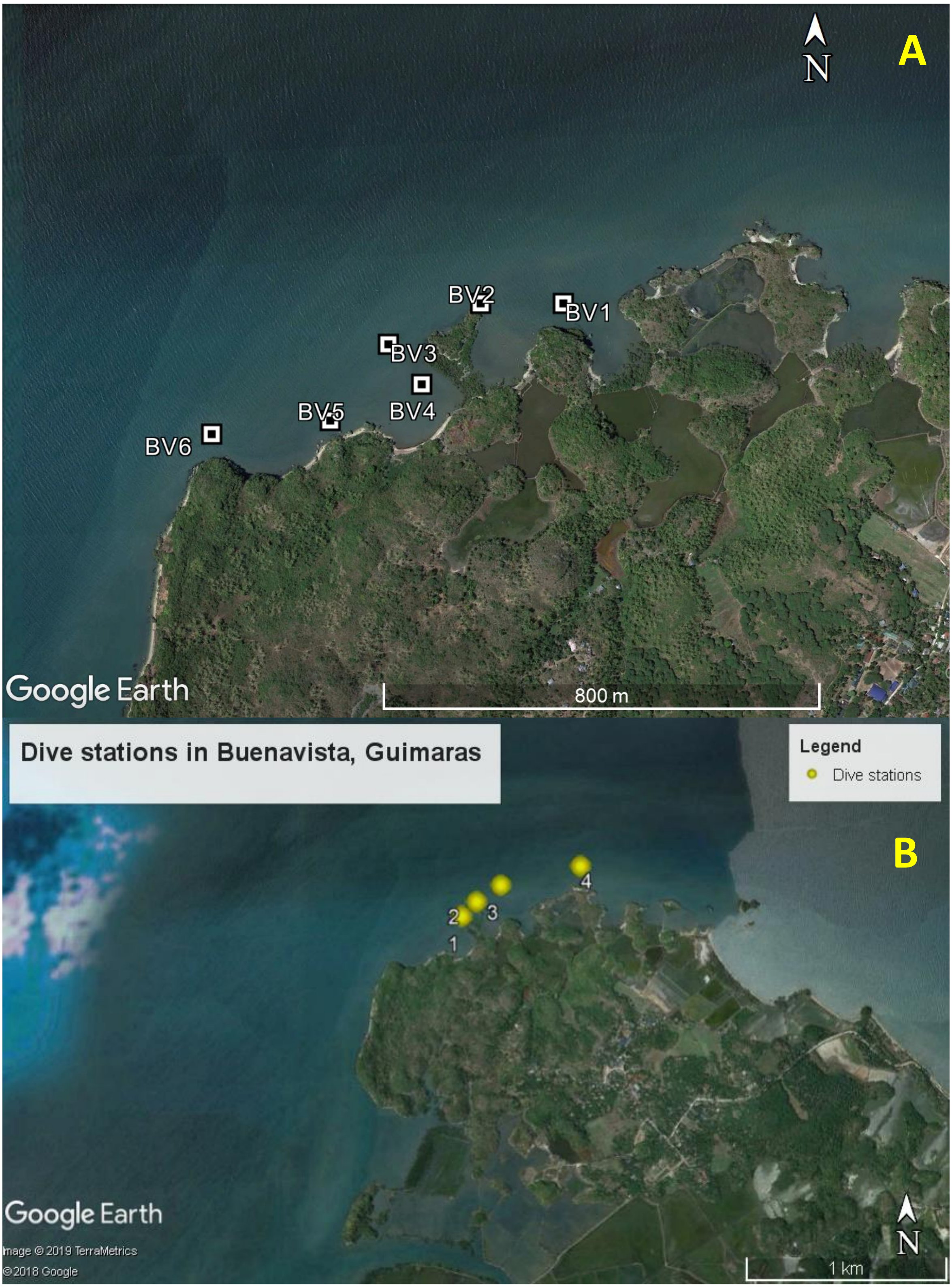


Figure 94. Map of (A) seagrass assessment and (B) corals and reef fish sites along the coastal barangay of Getulio, Buenavista in Guimaras Island.

Panoramic shot during the travel across Iloilo-GuimarasStrait

Diver check the bottom substrate

Panoramic shot in dive spot in Getulio, Buenavista

Panoramic shot in dive spot along Brgy. Getulio, Buenavista

Panoramic shot in dive spot along Brgy. Getulio, Buenavista

Figure 95. Photo-documentation during the survey in Brgy.Getulio, Buenavista, Guimaras.

Table 64. Dive location along coastal municipality of San Lorenzo, Guimaras.

Site	Latitude	Longitude	Depth (m)	Remarks
San Lorenzo, Guimaras	10.58284	122.72246	6	Turbid/silted, sandy-muddy
	10.58161	122.72107	5	Turbid/silted, sandy-muddy
	10.58027	122.72023	5	Turbid/silted, sandy-muddy
	10.57674	122.71897	5	Turbid/silted, sandy-muddy
	10.57371	122.71744	5	Turbid/silted, sandy-muddy

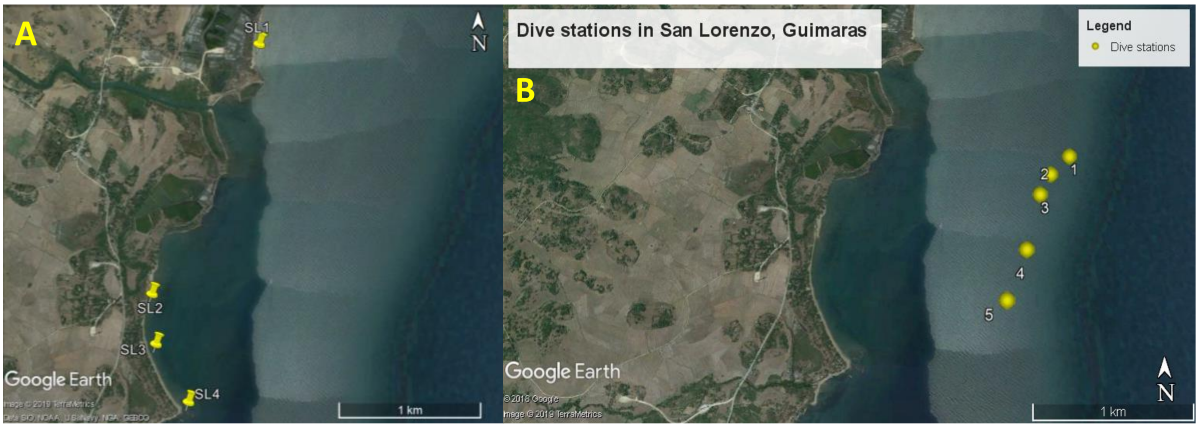
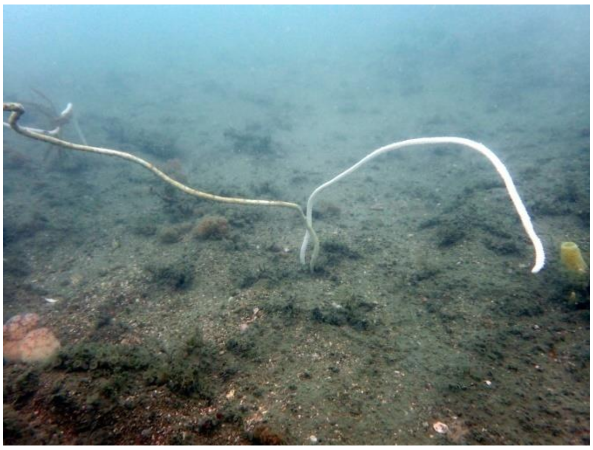


Figure 96. Map of (A) seagrass assessment and (B) coral and reef fish sites along coastal municipality of San Lorenzo, Guimaras.

Figure 97. Photo-documentation during the seagrass survey in Cabano, San Lorenzo, Guimaras. (A-B) shoots of Cymodocea serrulata and (C) seaweed Halimeda species

Panoramic shot along San Lorenzo highway


Barrel sponge


Sea whip coral


Tube worm


Soft coral

Figure 98. Photo-documentation during the survey in San Lorenzo, Guimaras

Pulupandan, Negros Occidental

No reefs and seagrasses were encountered from six (6) sampling areas (**Table 64**, **Figure 99** & **Figure 100**). Deep soft mud was observed in all spot dives in relatively deep areas. In addition, loose grayish sediment or volcanic origin along the coasts, which indicate unsuitability of sediment substrate for establishment. There were also a river system, Bago River, and major coastal development in the area that may seem to contribute to siltation and water visibility, hence deteriorating water quality for photosynthetic organisms like seagrasses and corals. Furthermore, silt and plankton bloom, if they settle at bottom, may cover the reef substratum for colonization, hence impossible for coral recruits to settle.

Table 65. Dive location along coastal municipality of Pulupandan, Negros Occidental.

Site	Latitude	Longitude	Depth (m)	Remarks
Zone 1, Pulupandan,	10.50675	122.79727	7	Turbid/silted, muddy
Negros Occidental	10.50726	122.79642	7	Turbid/silted, muddy
	10.50904	122.79591	8	Turbid/silted, muddy
	10.51134	122.79479	6	Turbid/silted, muddy
	10.51399	122.79347	6	Turbid/silted, muddy
	10.51686	122.79342	6	Turbid/silted, muddy

The basic environment requirements of seagrasses are as follows: (1) protection from strong waves and winds, hence they are usually found in areas that are protected from such harsh conditions; (2) suitable substrate consists of sand and muddy, which the seagrasses can use to anchor using roots and rhizome system area; (3) light considering that seagrasses are photoautotroph, they utilize light to drive one of the important biological process called photosynthesis; and (4) nutrients such as nitrogen , carbon, and phosphorus to drive photosynthesis, metabolism and growth. Except in Cabano, San Lorenzo, Guimaras, most sites that were surveyed failed to comply with these very basic requirements, hence, seagrasses were rarely seen. The seagrass species found in the area is capable of vertical rhizome elongation to counter the adverse effect of low water visibility. It is recommended therefore, that seagrasses in Cabano should be protected from the impact of the bridge construction. These seagrasses might be the source of materials to colonise nearby areas through water and surface dispersal.

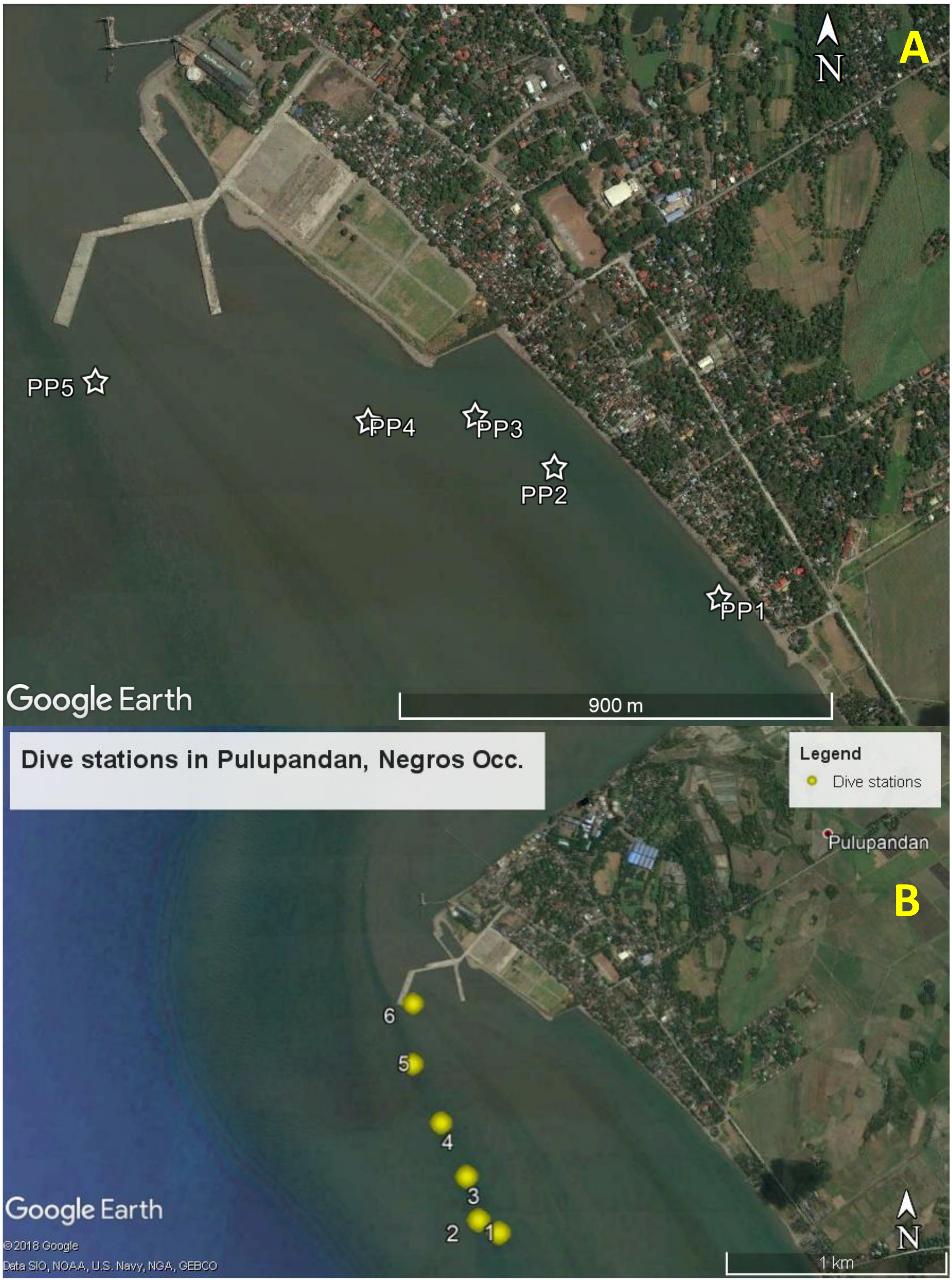


Figure 99. Map showing (A) seagrass assessment and (B) dive location for corals and fishes along coastal municipality of Pulupandan, Negros Occidental.

Panoramic shot along Brgy. Zone 1, Pulupandan

Diver prepare to dive

Diver about to descend

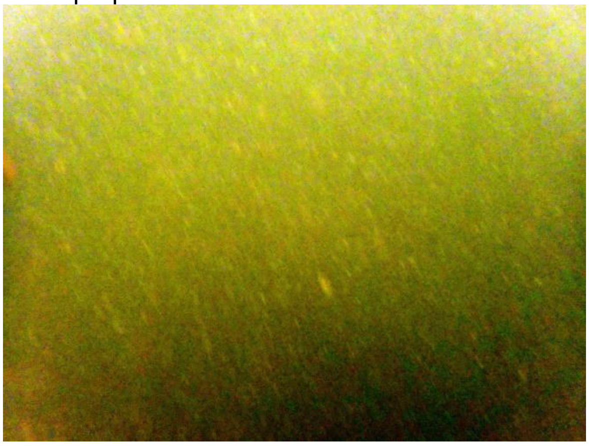


Image in zero visibility

Dive spot near pier

Figure 100. Photo-documentation during the survey in Pulupandan, Negros Occidental.

Coastal Resources

Based on the computed GIS data, the bridge alignment will pass through a total of 1.21 hectares of seaweeds/seagrass area within Palupandan side as shown in **Figure 101**.

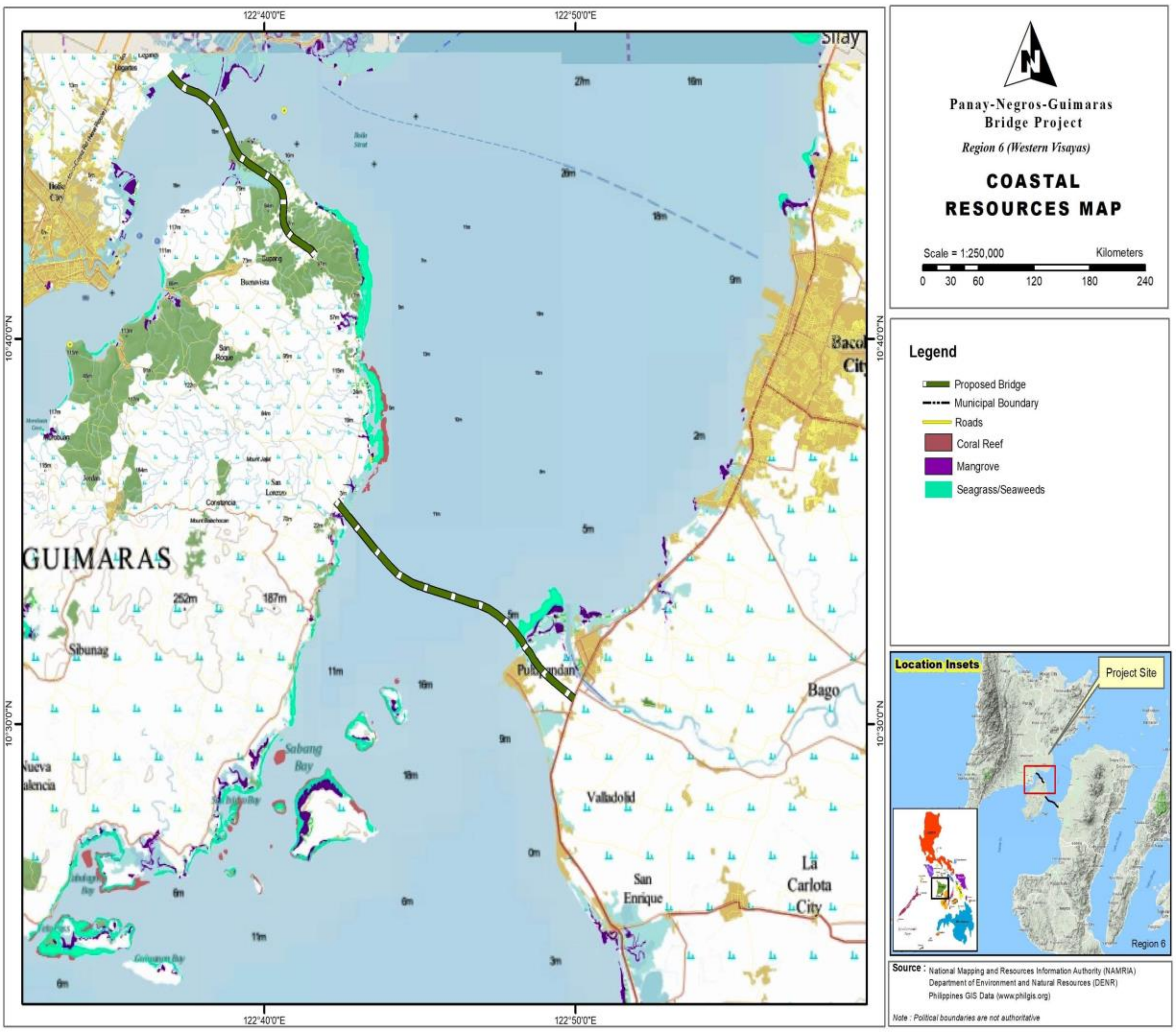


Figure 101. Coastal Resoureces of PGN Project

2.2.4.1.6.2 Assessment of reef fish communities

None of the reef fish species were seen during the survey across the four sites. With the present reef condition, it is uncertain if there are still sites across the islands that harboured reef fish species. Some soft bottom fish species that can thrive in silted environment like in these areas are probably *bisugo* (thread brims) and *bagaong* (Teraponidae), mullet/gisaw (Mugilidae), (Siganidae) rabbitfish/danggit and barramundi/salungsong (Latidae), crab/alimasag (Portunidae), ponyfish/sap-sap (Leiognathidae). The *Acetes* or hipon are among the marine species along the Iloilo-Guimaras Channel were observed in seasonal pattern from September to October (Panay Power 2018).

2.2.4.1.6.3 Phytoplankton communities

As part of the marine ecology study for the Panay-Guimaras-Bridge (PGN) Project, a water sampling covering eight stations was conducted to assess the plankton abundance, diversity and richness was conducted last March 15-16, 2019. A total of 30 phytoplankton species were identified across in all sampling stations. These identified taxa belonged to three major groups, *i.e.* diatoms, dinoflagellates and cyanobacteria. Overall, diatoms dominated the phytoplankton community accounting for almost 88.12%, followed by cyanobacteria with 11.09% and dinoflagellates with less than 1%.The top five most abundant phytoplankton taxa are shown in **Figure 102**. Of the five taxa, the chain forming pennate diatom, *Bacteriastrum* spp. was the most abundant constituting for 61% of the total phytoplankton count. The high density of this taxa is generally indicative of productive waters since they serve as food to higher trophic levels. The cyanobacterium *Trichodesmium* also recorded high relative abundance with 11%. It is a common marine phytoplankter found in all tropical and subtropical ocean which likely play key roles in the ecosystem because of their ability to fix atmospheric nitrogen thereby contributing to new nitrogen inputs in oligotrophic waters (Blondeau-Patissier et al 2018). The potentially harmful species detected during the sampling was *Dinophysis miles* which has been reported to produce toxins associated with Diarrhetic Shellfish Poisoning (DSP). However cell densities detected in station Ph5 and Ph6 were very low (20-90 cells/) so toxicity can be ruled out but continued monitoring is highly recommended.

Table 65 shows the Phytoplankton composition, distribution, diversity and abundance (cells/L) in eight sampling stations for the Panay-Guimaras-Bridge (PGN) Project in March 2019 sampling.

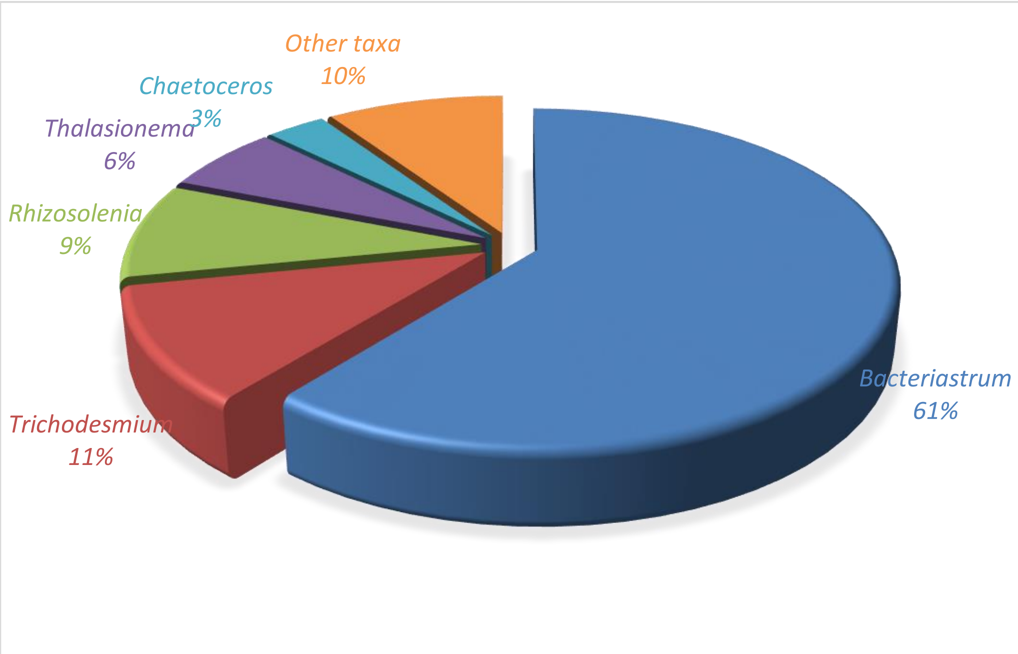


Figure 102. Percentage composition of top 5 major phytoplankton genera in eight sampling stations for the Panay-Guimaras-Bridge (PGN) Project in March 2019.

Table 66. Phytoplankton composition, distribution, diversity and abundance (cells/L) in eight sampling stations for the Panay-Guimaras-Bridge (PGN) Project in March 2019.

TAXA	STATIONS								Grand	Rel.
	Ph1	Ph2	Ph3	Ph4	Ph5	Ph6	Ph7	Ph8	Total	Abund.
Cyanobacteria	**22,765**	**18,600**	**13,050**	**7**	**19,080**	**7,410**	**5,335**		**86,247**	**11.095**
Trichodesmium	22,765	18,600	13,050	7	19,080	7,410	5,335		86,247	11.095
Diatoms	**306,999**	**155,805**	**52,432**	**962**	**74,418**	**29,029**	**26,037**	**39,906**	**685,588**	**88.196**
Bacillaria				33	24				57	0.007
Bacteriastrum	277,917	120,000	34,075	98	29,640	2,561	3,383	8,773	476,445	61.291
Bellorochea	3,649	368			11,160	2,873	1,375		19,425	2.499
Chaetoceros	500	7,425	3,661	46	3,690	2,184	1,210	6,090	24,806	3.191
Climacosphenia				46	48				94	0.012
Coconeis				13					13	0.002
Coscinodiscus	65	8	7	20					100	0.013
Cylindrotheca				65					65	0.008
Diploneis	22		22	7					50	0.006
Dytilum	29						6	15	49	0.006
Gomphonema	239	15		7					261	0.034
Guidaria	392	698			4,020	3,510	2,024	4,169	14,812	1.905
Hemialus	529	413	1,595		7,200	1,859	3,108	575	15,278	1.965
Melosira					408		319	116	843	0.108
Navicula	51	233	65	13	66	26			454	0.058
Nitzschia	580	285	566	182		189	176		1,977	0.254
Odontella	138	38		72	90			65	402	0.052
Planktoniella					6				6	0.001
Pleurosigma	522	450	261	85	36	20	138	703	2,214	0.285
Rhabdonema				143		13			156	0.020
Rhizosolenia	17,110	19,050	8,120	72	10,800	5,070	7,260	4,060	71,542	9.203
Skeletonema sp.								1,892	1,892	0.243

Synedra				39	30				69	0.009
Thalasionema	5,256	6,825	4,060	26	7,200	10,725	7,040	8,555	49,687	6.392
Thalasiothrix								4,894	4,894	0.630
Dinoflagellates	**754**	**1,688**	**399**	**59**	**768**	**774**	**88**	**986**	**5,514**	**0.709**
Ceratium	638	1,133	399	20	222	748	66	979	4,203	0.541
Dinophysis miles					90	20			110	0.014
Diplopsalis						7	6	7	19	0.002
Peridinium	116	555		39	456		17		1,183	0.152
Grand Total	**330,518**	**176,093**	**65,881**	**1,027**	**94,266**	**37,213**	**31,460**	**40,892**	**777,349**	**100**
Richness	**19**	**17**	**12**	**21**	**20**	**16**	**16**	**14**		
Evenness	**0.23**	**0.41**	**0.58**	**0.88**	**0.66**	**0.74**	**0.74**	**0.78**		
Diversity	**0.68**	**1.14**	**1.45**	**2.64**	**1.94**	**1.99**	**2.00**	**2.05**		

The mean phytoplankton abundance during this sampling was 40,892cells/L. In terms of spatial distribution, the water sample collected from station Ph1 located in Iloilo Strait, Brgy. Gu-an, Leganes, Iloilo recorded the highest phytoplankton abundance with 176,093cells/L while station Ph4 located in Iloilo Strait, Brgy. Nabitasan, Leganes, Iloilo had the most number of phytoplankton genera observed with 21 (**Figure 103**). The lowest phytoplankton abundance was quantified in station Ph4 with total density 1,027 cells/L while the most depauperate station was observed in the water sample collected from station Ph3 Iloilo Strait, Brgy. Tullo, Buenavista, Guimaras with 12 taxa. Diversity index based on Shannon Weiner was quite variable with the highest value observed in station Ph4 with 2.64. The lowest diversity and evenness indices were computed in station Ph1 with 0.23 and 0.68. The low diversity and evenness in this station was due to the bloom of the diatom *Bacteriastrum* spp.

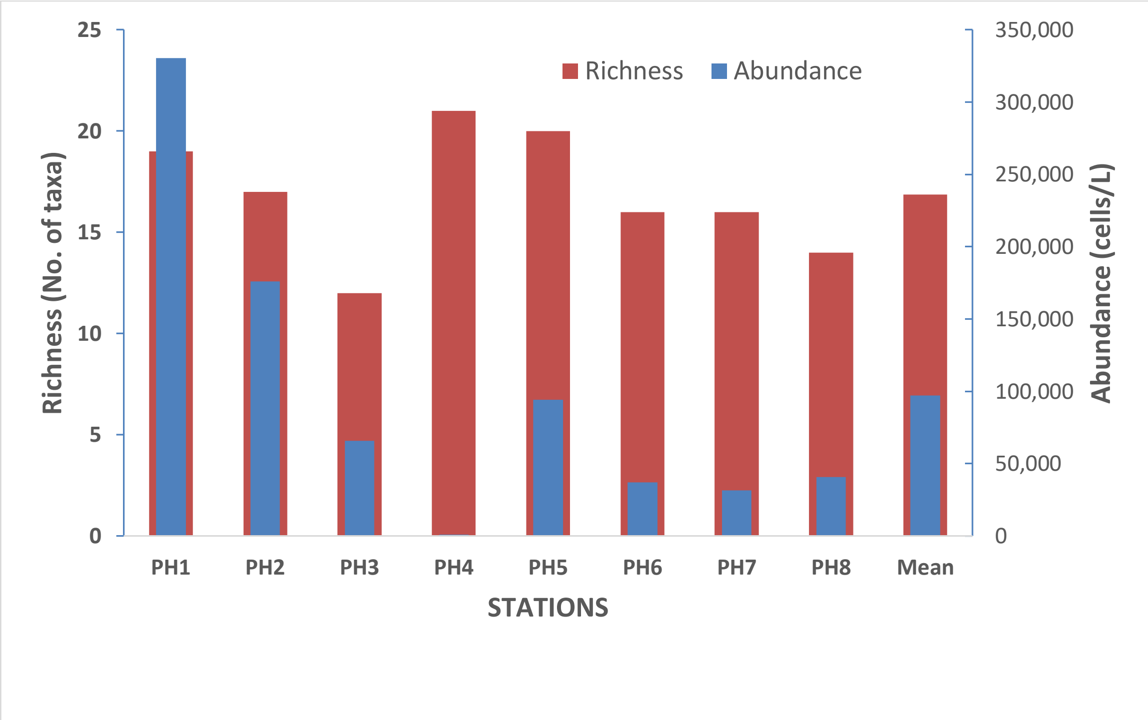


Figure 103. Total phytoplankton density and richness in eight sampling stations for PGN Project in March 2019.

2.2.4.1.6.4 Zooplankton Community

Analysis of samples taken from the eight stations revealed a total of 17 zooplankton groups (adult and larval forms). Zooplankton observed during this sampling was typical groups/type found in marine environment. The top 5 dominant zooplankton were copepod nauplius (53%), adult copepods (29%), bivalve veligers (19%), copepod eggs (14%), larvacean (1%) and the remaining 2% was attributed to gastropod veliger, polychaete trocophore, cladoceran, decapod zoea, echinoderm larvae, crab zoea, fish larvae, mysids, and radiolarian (**Figure 104**). Zooplankton communities' analyzed were mostly represented by larval forms constituting for 70%while adult forms accounted for 30% of the total zooplankton community. The bulk of the larval forms were composed of copepod nauplius accounting for 53% and total density of 1.3 x 10^6individuals/m^3.

Bivalve veliger also contributed high relative abundance with 14%. For adult forms, calanoid copepods were the most abundant constituting for 25%.Larval forms of important zooplankton taxa like crab zoeae, mysiids and fish larvae were also observed indicating a productive fisheries area.

The mean zooplankton abundance was 320,004individuals/m^3. The water sample collected from station ZP7 located in Guimaras Strait (Negros side) had the highest total zooplankton density with613,983individuals/m^3 while the most taxa rich sample was observed in station ZP8 located in Guimaras Strait, Pulupandan, Negros Occidental with 14 zooplankton groups. The most depauperate station was observed in station ZP1 located in Iloilo Strait, Brgy. Gu-an, Leganes, Iloilo with 5 zooplankton groups. The highest calculated diversity index based on Shannon Weiner was observed station ZP8 with 1.45. The lowest diversity and evenness indices were computed in station Ph1with 0.39 (**Table 66**). In this survey, most of the zooplankton are common types with no endemic or rare groups encountered. Total zooplankton density and taxa richness of the eight sampling stations for the Panay-Guimaras-Bridge (PGN) Project in March 2019 is shown in **Figure 105**.

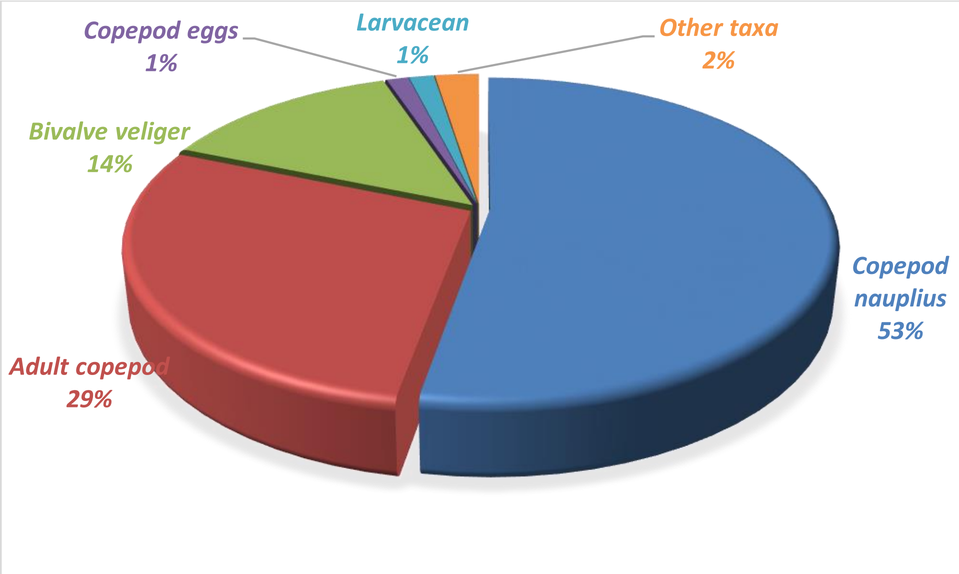


Figure 104. Percentage composition of top 5 zooplankton taxa in eight sampling stations for PGN Project in March 2019

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Table 67. Zooplankton composition, distribution, diversity and abundance (individuals/m^3) in eight sampling stations for the Panay-Guimaras-Bridge (PGN) Project in March 2019.

TAXA	STATIONS								Grand	Rel.
	ZP1	ZP2	ZP3	ZP4	ZP5	ZP6	ZP7	ZP8	Total	Abund.
Adult forms	**7,781**	**31,528**	**92,461**	**88,655**	**84,074**	**84,074**	**268,794**	**118,684**	**776,051**	**30.31**
Cladoceran		2,425	1,516		876	657		2,930	8,404	0.33
Copepod calanoid	5,558	24,252	69,725	76,394	68,310	76,849	237,671	73,262	632,020	24.69
Copepod cyclopoid		2,425	9,095	6,602	876	5,255	14,147	14,652	53,052	2.07
Copepod harpacticoid	1,112		3,032	5,659	7,882	657	14,147	11,722	44,210	1.73
Larvacean	1,112	2,425	9,095		5,255	657	2,829	14,652	36,025	1.41
Lucifer sp.								1,465	1,465	0.06
Radiolarian					876				876	0.03
Larval forms	**23,343**	**103,476**	**321,341**	**226,353**	**143,626**	**138,591**	**345,189**	**482,062**	**1,783,980**	**69.69**
Bivalve veliger	2,223	20,210	13,642	5,659	15,764	13,137	53,759	222,715	347,109	13.56
Copepod eggs			25,768	2,829				2,930	31,528	1.23
Copepod nauplius	21,120	71,948	274,352	210,320	125,235	123,484	285,771	240,298	1,352,528	52.83
Crab zoeae								2,930	2,930	0.11
Decapod zoaea			3,032	943		657			4,631	0.18
Echinoderm larvae			1,516					1,465	2,981	0.12
Fish larvae		1,617			876				2,493	0.10
Polychaete trophocore		1,617		1,886		657	2,829	4,396	11,385	0.44
Shrimp larvae								1,465	1,465	0.06
Snail veliger		8,084	3,032	4,716	1,752	657	2,829	5,861	26,930	1.05
Grand Total	**31,124**	**135,003**	**413,802**	**315,008**	**227,701**	**222,665**	**613,983**	**600,745**	**2,560,031**	**100**
Richness	**5**	**9**	**11**	**9**	**10**	**10**	**8**	**14**		
Evenness	**0.39**	**0.68**	**0.77**	**0.63**	**0.73**	**0.73**	**0.53**	**0.98**		
Diversity	**1.00**	**1.42**	**1.17**	**0.99**	**1.20**	**1.05**	**1.18**	**1.45**		

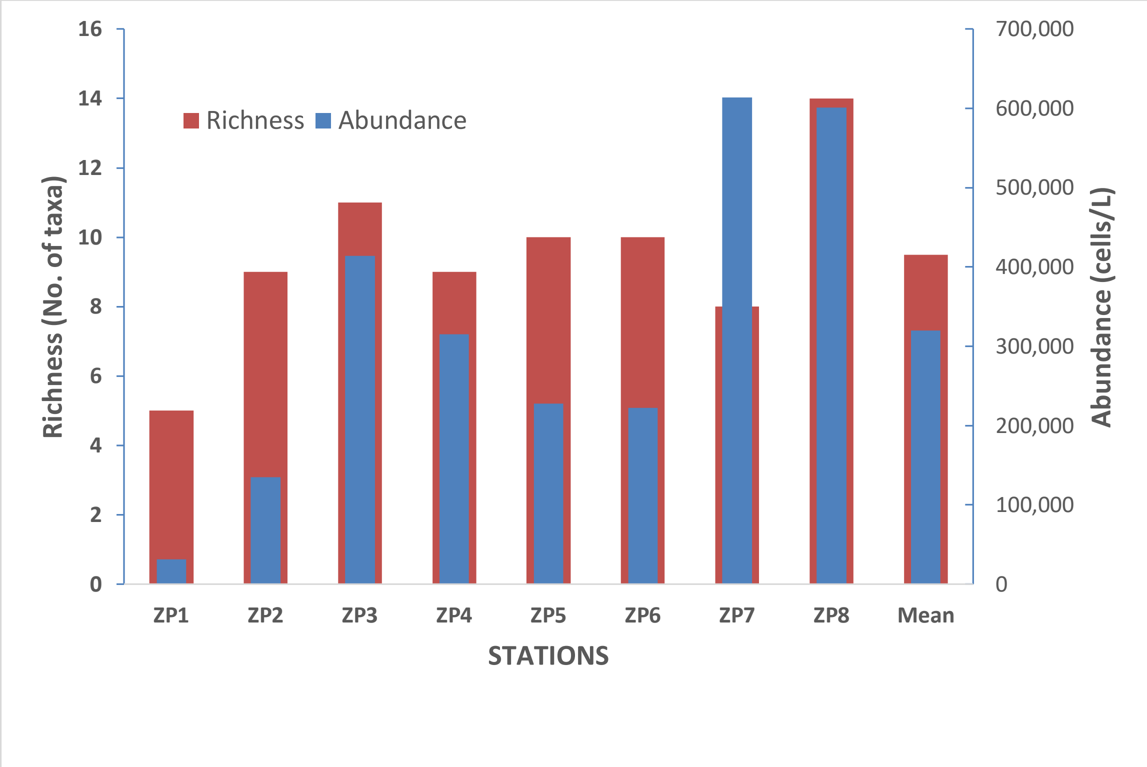


Figure 105. Total zooplankton density and taxa richness of the eight sampling stations for PGN Project in March 2019.

2.2.4.1.6.5 Marine Macroinvertebrates (Benthic fauna) Assessment

The taxonomic listing, abundance, distribution and diversity of benthic macroinvertebrates observed in eight sampling stations for the Panay-Guimaras-Bridge (PGN) Project is presented **Table 66**. Images of the major macrobenthos identified in this sampling are shown in **Figure 106**.

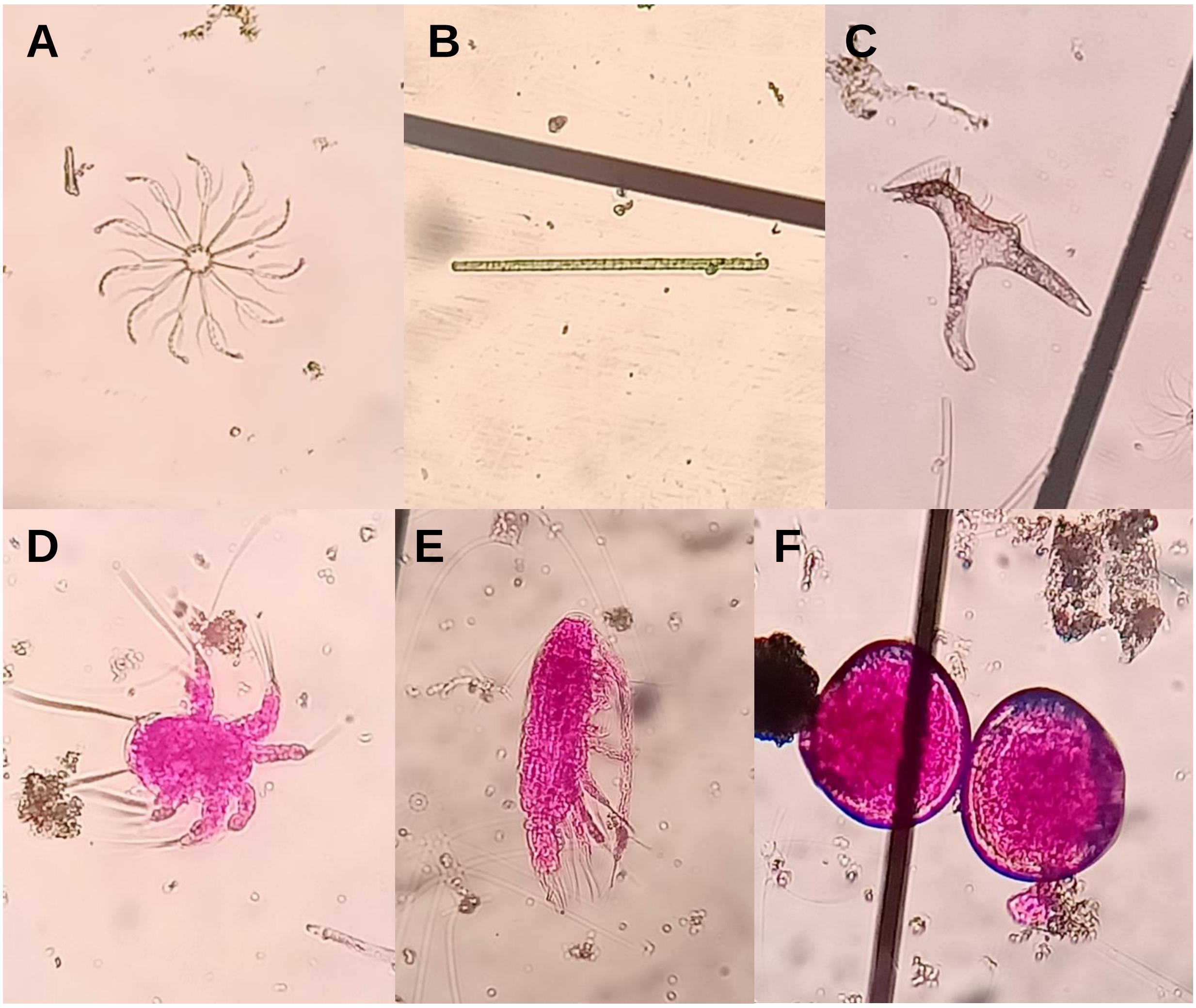


Figure 106. **Dominant plankton taxa during the March 2019 sampling. (A)*Bacteriastrum*. (B) *Trichodesmium*. (C) *Dinophysis miles* (D) Copepod nauplius (E) Calanoid copepod (F) Bivalve veliger**

2.2.4.1.6.6 Assessment of Marine Ecological Impact and Mitigation Measures

Since coral reefs were hardly seen in all site surveyed while seagrasses were only reported in Cabano, San Lorenzo, Guimaras, the impact of the project on marine ecology along the project sites may be minimal in the sense that corals and seagrasses did not exist virtually in all sampling sites, with an exception in San Lorenzo sampling sites. The construction of bridge foundations could be on hard substrates and literally concrete material in nature, these foundations may hinder water circulation and longshore current, hence minimizing sediment and water mass exchanges. Therefore, it is recommended the engineering design of bridge (e.g., stockpiles) may consider these hydrodynamic processes in such a way not to dampen incoming and outgoing tides and currents.

During operational phase, appropriate control measures have also to be put in place to prevent spillage of construction materials that may have an adverse impact on coastal habitats and fishes such as oil and gas. This in mind, oil and gas spill should be handled carefully to avoid this catastrophic incident. Remember that province of Guimaras experienced oil spill on 11 August 2006 when an oil tanker M/T Solar 1 sank off the coast of the island province, causing the worst oil spill in the Philippines. The said incident caused harmed not only to coastal habitats but coastal communities through socio-economic means. In line with the construction, monitoring and evaluation of benthic habitats, particularly the seagrasses in Cabano, San Lorenzo, should be conducted at least bi-annually to capture the possible changes brought about by the project and/or by other natural and anthropogenic activities. Since there are no coral reefs in the project sites, other marine components such plankton communities, soft bottom communities and fisheries should be done.

Regarding dugong, a vulnerable marine mammal species that rarely seen throughout the archipelago except for some areas like Palawan and Davao, this species has been documented in Guimaras Island together with other species (other organisms include Irrawaddy and spinner dolphins, and whale sharks) by a study conducted by Parreño et al. (2013) as cited by PEMSEA and Provincial Government of Guimaras (2018). Furthermore, they found out that dugongs and others* are frequently seen during the months of April – June and September – November based on their historical data. It seems, however, that their identification was based on photographs and they have not really mentioned the exact location where all the photos of sea cows were taken. Given these information, it is not surprising, therefore, to anecdotally report the occurrence of such marine mammal species in San Lorenzo, Guimaras. The potential presence of dugongs in the area may boost ecotourism in the municipality. But before, implementing ecotourism plan and the PGN project, it is suggested to conduct aerial survey to determine the population of dugongs that may be affected.

Considering sea cows are mobile due to their feeding habits which is strict herbivory and dependent on the presence of more digestible seagrass species like Halophila and Halodule species, they are less likely to be affected by the construction with an exception where their feeding areas are being destroyed. The impact of the project is wholly dependent on how big the sea cow population and the location of construction site (by avoiding seagrass meadows). Moreover, the PGN project may enhance the socio-economic activity of the island-province by promoting the mobility of people, services and goods, which in turn good for and promote local ecotourism sector.

2.2.4.1.6.6.1 Analysis of the impact on phytoplankton

The spatial and temporal distribution and quantity variation of plankton are closely related to the transparency of water body. If suspended substances produced by bridge pier construction form a certain range of high-concentration suspended substances, the decrease of transparency of local water body will be caused so that the growth of plankton will be affected.

Phytoplankton and Zooplankton would be generally subjected to short-term impacts during the construction. Threat to plankton community would come from the increase load of suspended solids during the construction of the project resulting to reduction of depth of photosynthetic activity of the phytoplankton. Similarly, highly turbid water would affect the grazing success of zooplankton. This would temporarily result to lower rates of photosynthesis and primary production. However, plankton population recovery after construction would be generally rapid due to quick reproduction periods including recruitment and advection from adjacent unaffected areas. With increase of suspended substances in the sea water, the suspended particles will adhere to the surface of zooplankton and interfere with its normal physiological functions, especially the filter-feeding zooplankton will swallow the suspended particles with appropriate particle sizes to cause internal digestive system disordered. The decrease of water transparency and dissolved oxygen is not conducive to the photosynthesis of phytoplankton so as to affect the cell division and growth of phytoplankton and decrease the quantity of phytoplankton in the unit water body so as to lead to the decrease of primary productivity in this water area. The results of two-week laboratory experiment for different zooplankton show that the mortality rate was very high when the content of total suspended solids (TSS) exceeds10,000 mg/ L, but the existing study fails to show a significant relationship between dredging and related construction activities (Clarke and Wilbur, 2000).In addition, many larval stages only exist for a short period of time in the plankton, while other populations also have a shorter life cycle, meaning that their recovery rate is relatively faster (less than a year) (James et al.,2015). Considering the temporary impact and limitation of impact on the adjacent water body by high turbidity water, it is concluded that the influence on the plankton community by the project is less, and the impact will disappear after construction ending, and the plankton can recover quickly.

During the construction of the bridge section in this project, the construction process that the bottom sediment is disturbed is the foundation construction process. According to the hydrological and geological conditions of the project, the main bridge in the proposed project and the foundation of the approach bridge in deep water area shall be constructed by the marine equipment, and the approach bridge in shallow water shall be constructed by the total station bridge. The construction process is carried out in the casing pipe uniformly. The mud is pumped into the sedimentation tank by vacuum in the cavity of drill pipe for recycling after sedimentation, and the deposited waste slag is discharged into the mud carrier and transported to the tideland reclamation area for hydraulic reclamation. Pile-driving and borehole construction can cause some disturbance to the water body so as to form a certain quantity of suspended sediment, and the area near the pier is affected by the construction disturbance, the concentration of suspended material increases obviously in the range of 3-5m depth under the seabed, so the impact on plankton by foundation construction in this project is slight.

In addition, during the construction of the bridge, if the mechanical equipment on the construction platform leaks the oil, residual oil leaking and oil leakage from constructional ship machinery equipment in the machinery maintenance process may cause serious oil pollution to the sea water quality so as to influence the plankton, therefore, it is necessary to take strict construction management measures.

2.2.4.1.6.6.2 Analysis of the impact on benthic organisms

Benthic organism is one of the most important biotypes in marine ecosystem. Because of low activity capability of benthic organisms, its survival is obviously influenced by environmental change. The most direct impact is that the pier foundation takes up partial seabed to lead to the decrease of e activity area for benthic organisms so as to completely destroy the habitat environment of benthic organisms in the sea area and cause irreversible and destructive damage to benthic organisms occupying the sea area. After completion of construction, the affected benthic organism communities will be gradually recovered or be replaced by the new communities except that pier permanently occupies the area outside the sea area; secondly, local scouring is caused by the change of hydrological conditions near the pier to reduce benthic organisms' activity area. In addition, the construction disturbs the bottom sediments to produce certain suspended sediments, the suspended sediments will eventually settle onto the seabed to cover the original substrates so as to produce certain mechanical compression and suffocation harm to the organisms t living on the surface layer of substrates and having poor swimming ability; the influence for the benthic animals living on the surface layer of substrates and having powerful activity ability is little. However, because the suspended substances disappear gradually after the completion of construction, and the influence range is generally within 3-5 m range around the pile foundation, the influence on benthic organisms by suspended substances caused by the construction disturbance is slight.

The loss of benthic organisms in the sea area caused by the construction of this project mainly refers to the biomass loss caused by the destruction of benthic habitat in the sea area. Referring to the "*Technical Code on Impact Assessment for Marine Biological Resources by Construction Project*, the loss for this part of biomass is the product between the biological resource density (ind./ m^2) and the area of sea area.

This project consists of two sections: Section A (Panay-Guimaras Cross-Sea Bridge), the setting of piers and the occupation conditions of sea area are presented in **Table 67**.

Table 68. Sea Area Occupied By Project

Section A (Panay-Guimaras Cross-Sea Bridge)	Platform pile No. range or No.	Quantity of platform	Quantity of pile foundation on each platform	Radius of pile foundation m	Sea area m2
	Starting point	2	4	0.75	14.14
	0 + 590-1 + 900	44	4	0.9	447.87

	1 + 900-2 + 300	13	6	0.9	198.49
	2 + 300-2 + 800	6	9	1.05	187.03
	2 + 900-3 + 300	5	12	1.05	207.82
	3 + 400-3 + 700	4	15	1.05	207.82
	3 + 800-3 + 900	2	16	1.25	157.08
	4 + 000-5 + 000	2	134	1.4	1650.22
	5 + 100-5 + 200	2	16	1.25	157.08
	5 + 200-5 + 540	9	6	1.05	187.03
	5 + 200-5 + 540	1	4	0.9	10.18
	Ending point	1	4	0.75	7.07
	Total				3431.81
Section B (Guimaras-Negros Cross-Sea Bridge)	A0	2	4	0.75	14.14
	P1-P19	19	6	0.9	290.09
	P20-P85	66	6	1.05	1371.59
	P86	1	20	1.25	98.17
	P87	1	16	1.25	78.54
	P88-P89	2	102	1.4	1256.13
	P90	1	16	1.25	78.54
	P91	1	20	1.25	98.17
	P92-P100	9	15	1.05	467.59
	P101-P117	18	12	1.05	748.14
	P118-P125	8	9	1.05	249.38
	P126-P161	36	6	0.9	549.65
	A1	2	4	0.75	14.14
	Total				5314.28

According to the statistical results of above Table, the area of permanently occupied sea area for construction on Section A (Panay-Guimaras Cross-Sea Bridge) is 3431.81 m^2 and the area of permanently occupied sea area is 5314.28 m^2 for the construction on Section B (Guimaras-Negros Cross-Sea Bridge), with total area of 8746.09 m^2.

Both coral reef and seaweed habitats permanently occupied in the sea area will be squeezed, however, according to the previous survey, because the coral reefs are rarely seen at all survey sites, while seaweeds are only reported in Cabano, San Lorenzo and Guimaras, therefore, the impact on reef fish along the project and these habitats and may be minimal. In addition, the benthic organisms in the permanently-occupied sea area will be permanently lost. According to the results of the previous survey, the average habitat density of benthic organisms in the adjacent project areas is 966.88 ind./m^2. Thus, it can be calculated that the construction of the project will result in the permanent loss of approximately 8.45 × 104 ind. benthic organisms and will have a certain impact on the benthic organisms in the sea area of project within the short term, and the corresponding losses of benthic organisms will gradually recover along with completion of construction.

Monitoring and evaluation of benthic habitats (e.g., seagrass bed, coral reefs, associated fishes and other fauna) will be conducted quarterly or bi-annual to capture the changes brought about by the project and/or by other natural and anthropogenic activities in the area.

2.2.4.1.6.6.3 Impact Analysis on fishery resources

Fish habitats will be affected during the constructions, post-construction and operation phases by the following activities:

- Land clearing and soil stripping;
- Excavation and earthwork;
- Work in aquatic environments;
- Machinery transportation, operation and maintenance;
- Infrastructure maintenance and repair;
- Presence and use of infrastructure.

Sediment resuspension will negatively affect habitat quality. The presence of temporary structures will likely change water movement and fish migration in the area. Vibrations associated with operating large machinery might lead to mortality among certain fish especially the juveniles.

Hence, mitigation measures should be implemented as soon as the work begins. The free circulation of water must be ensured to maintain fish habitat functions (feeding, nursery, spawning) downstream from the work area. Any debris or concrete waste must be properly disposed of. All debris accidentally introduced into the aquatic environment must be removed as quickly as possible.

During the construction of project, a certain quantity of suspended sediment will be produced, and the toxicological hazard to organisms by excessive suspended sediment will be shown as blocking or destroying aquatic organisms' water filtration and respiratory organs to result in suffocation death. The tolerance range for content of suspended substances by different fish species is different. Large-particle suspended substances will also directly cover the benthic organisms, such as shellfish and crustaceans especially their young larvas during sedimentation. The cumulative impact for long period of time will result in the decline or death of benthic organisms. Suspension particles adhere onto the surface of organisms and also interfere with its normal physiological function, and the filter-feeding swimming animals and fish will swallow the suspension particles with appropriate particle size to result in internal digestive disorder.

Aquatic organisms such as fish fully adapt the slow change of water environment but are sensitive to sudden change of environment. The change of SS content is caused by construction operation, and the change of turbidity for water body is caused, presenting jumping and pulsing type for process, which will inevitably cause the change of other swimming creatures such as fish so that the fish will avoid this source turbidity area to produce "dispersing effect". Too high and tiny suspended particles in the water body can adhere onto the surface to impede roe's respiration so as to be inconducive to roe's survival and hatching, thus affecting the reproduction of fish. The increase of suspended particles in the water body impedes the light transmission, weaken the thickness of true light layer, affect the photosynthesis, decrease the quantity of phytoplankton in the water area, decrease the primary productivity and decrease the biomass of zooplankton that the phytoplankton is served as bait as well as decrease the abundance of fish feeding on zooplankton due to bait reduction, and Large-sized fish preying the fish are also unable to find food due to decline for the resources of previous producers.

However, because the water depth in this project construction area is deeper and the drilling and pore-forming technology in clear water is adopted for pile foundation construction, therefore, the generated suspended sediment is less, and this technology is in 3-5m area on the left of construction generally, the influence scope is less, therefore, the influence on fishery resources is slight, and this influence will disappear gradually along with construction ending.

2.2.4.1.6.6.4 Mitigation Measures for Marine Ecology Impact

- The mitigation measures for influence on sea water quality by bridge construction that are proposed in the preceding chapter are strictly implemented.

- Reasonable arrangement of construction link shall be implemented, and the pile driving and pile foundation construction should avoid the spawning period of local fishery resources as far as possible;
- Construction of bridge foundations can be carried out on hard basement and concrete materials, these foundations may impede the water circulation and coastal current so as to reduce the mass exchange of sediment and water. Therefore, it is suggested that these hydrodynamic processes should be considered at the design stage of bridge so as not to affect the incoming and outgoing tide and current.
- Prior to the commencement of construction, a detailed survey for seabed in the construction area of pier shall be carried out to transplant the live corals and seaweed within 10m range of the pier and surrounding areas.
- The suitable areas shall be selected for artificial reef to compensate for the loss of coral reef area due to bridge pier construction.
- During construction, the tracking monitoring and assessment of benthic organisms and seaweed should be carried out at least once every six months, with emphasis on areas such as Cabano and San Lorenzo. In addition, the marine ecology including plankton, benthic organisms and fishery resources should also be monitored accordingly.

2.3 Air Quality

2.3.1 Meteorology

2.3.1.1 Climate

The climate map of the country is based on the Modified Coronas classification. The project area under study belongs to Type I category. This is characterized by two pronounced seasons; dry from December to April and wet during the rest of the year. **Figure 107** shows the geographical extent of Type I category. The climate is tropical in Iloilo City. Most months of the year are marked by significant rainfall. The short dry season has little impact. This location is classified as Am by Köppen and Geiger.

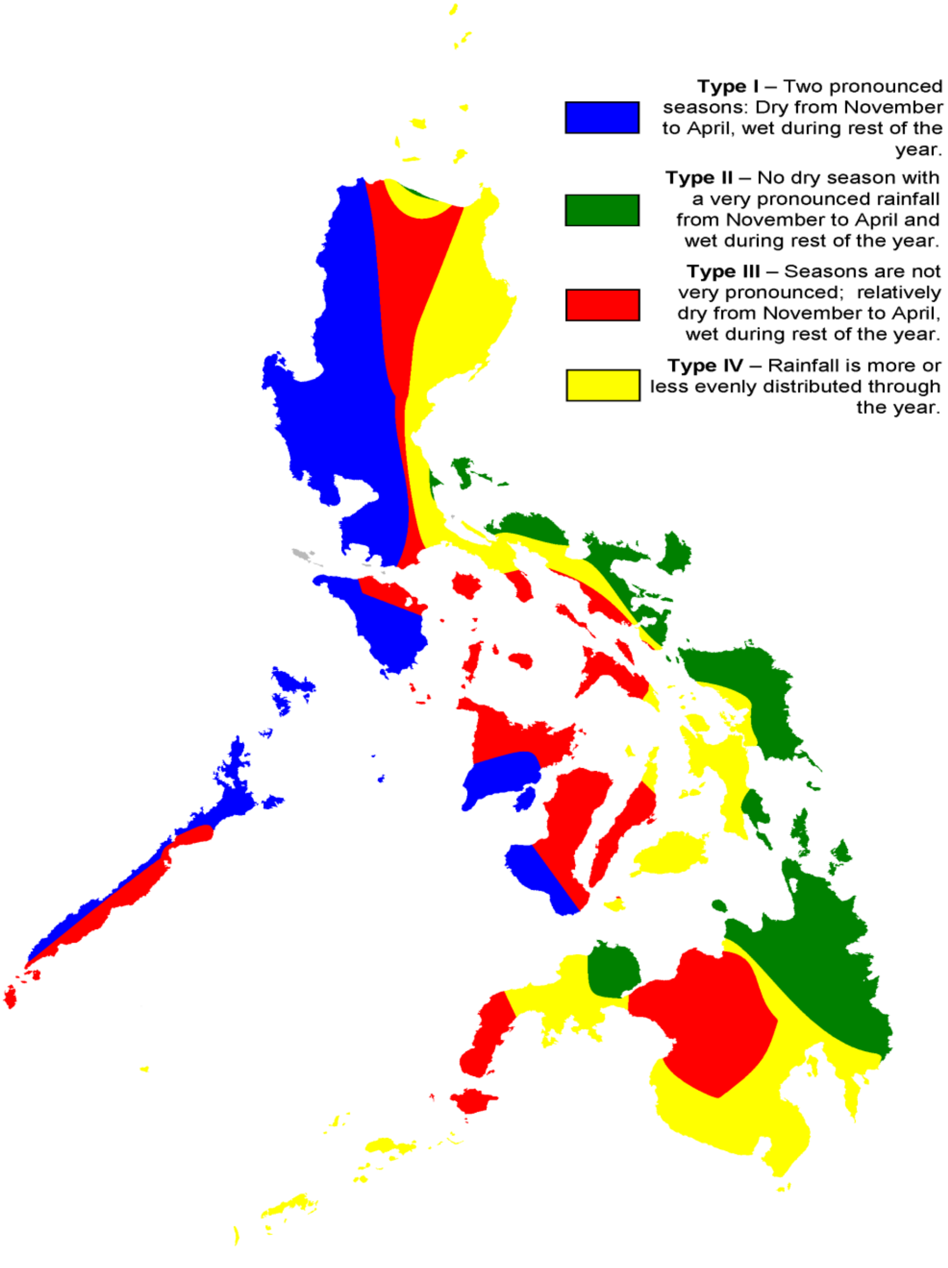


Figure 107. **Modified Coronas Classification**
Source: PAGASA

Table 69. Climatological Normals in Iloilo City, Iloilo (1980-2009)

MONTH	RAINFALL		TEMPERATURE						VAPOR PRESS. (mbs)	RH (%)	MSLP (mbs)	WIND		CLOUD AMT. (okta)	NO. OF DAYS W/	
	AMOUNT (mm)	NO. OF RD	MAX (°C)	MIN (°C)	MEAN (°C)	DRY BULB (°C)	WET BULB (°C)	DEW POINT (°C)				DIR (16pt)	SPD (mps)		TSTM	LTNG
JAN	38.4	9	30.4	22.9	26.65	26.4	23.9	23	28.2	81	1011.5	NNE	4	5	1	1
FEB	33.7	6	31.2	23.1	27.15	26.9	24	23	28.2	78	1011.6	NNE	4	5	0	0
MAR	50	6	32.5	23.7	28.1	28	24.6	23.4	28.8	76	1011.2	NE	4	4	2	1
APR	68.9	6	33.9	24.6	29.25	29.2	25.5	24.3	30.2	74	1010	NE	3	4	4	4
MAY	140	11	33.5	24.9	29.2	29.2	25.8	24.7	31.1	76	1009.2	SW	3	5	12	13
JUN	318.8	18	31.9	24.6	28.25	28.3	25.6	24.7	31.1	80	1009.1	SW	2	6	13	14
JUL	340.5	20	31	24.3	27.65	27.7	25.3	24.5	30.7	82	1009	SW	3	7	11	11
AUG	381.2	20	30.9	24.3	27.6	27.7	25.3	24.5	30.8	82	1008.8	SW	3	7	10	8
SEP	292.5	18	31.2	24.2	27.7	27.6	25.3	24.6	30.8	83	1009.4	SW	3	6	10	10
OCT	246.5	19	31.5	24.2	27.85	27.7	25.3	24.5	30.7	82	1009.4	NNE	2	6	13	12
NOV	161.7	14	31.4	24	27.7	27.6	25.1	24.3	30.3	82	1009.6	NNE	3	5	6	9
DEC	100.2	11	30.7	23.2	26.95	26.7	24.3	23.5	29	82	1010.7	NNE	3	5	2	3
ANNUAL	**2172.4**	**158**	**31.68**	**24**	**27.84**	**27.75**	**25**	**24.08**	**30**	**80**	**1010**	**NNE**	**3.0833**	**5.41667**	**84**	**86**

Source: PAGASA

Table 70. Climatological Extremes in Iloilo City, Iloilo as of July 2010

MONTH	TEMPERATURE (°C)				GREATEST DAILY RAINFALL (mm)		STRONGEST WINDS (mps)			SEA LEVEL PRESSURES (mbs)			
	HIGH	DATE	LOW	DATE	AMOUNT	DATE	SPD	DIR	DATE	HIGH	DATE	LOW	DATE
JAN	34.7	01-28-1990	16.5	01-23-1976	118.6	01-03-1931	21	NE	01-05-1952	1020.0	01-21-2005	1000.4	01-24-1975
FEB	35.5	02-25-2005	16.7	02-04-1976	79.5	02-16-1925	24	NNE	02-17-1962	1018.8	02-24-1985	1002.5	02-09-2001
MAR	39.0	03-04-1973	18.6	03-03-1968	214.6	03-01-1996	22	NE	03-20-1965	1017.8	03-02-1987	1001.2	03-04-1999
APR	37.5	04-25-1998	20.0	04-08-1976	104.6	04-28-1994	25	SE	04-25-1971	1017.3	04-14-1968	991.3	04-25-1971
MAY	37.8	05-26-1987	20.2	05-19-1977	242.5	05-12-2006	30	SW	05-27-2003	1016.2	05-10-1957	1000.1	05-05-1951
JUNE	37.5	06-05-1991	21.0	06-28-1997	188.4	06-20-2008	26	SW	06-25-1992	1015.3	06-30-1983	999.1	06-10-1974
JULY	35.4	07-05-2010	19.5	07-31-1975	319.8	07-29-1994	25	SSW	07-28-1982	1015.9	07-31-1987	996.0	07-02-1952
AUG	34.8	08-11-1939	20.0	08-01-1975	222.3	08-08-1929	25	SW	08-01-1986	1015.3	08-30-1983	1000.4	08-06-1964
SEP	37.8	09-16-1975	19.8	09-05-1975	154.7	09-04-1962	20	WSW	09-03-1991	1017.0	09-27-1982	993.6	09-02-1984
OCT	35.4	10-03-1976	19.2	10-18-1975	225.0	10-28-1995	36	SW	10-28-1995	1017.6	10-05-1987	990.8	10-28-1995
NOV	34.8	11-01-1930	19.4	11-22-1975	255.6	11-05-1984	45	N	11-24-1968	1017.2	11-30-1978	977.2	11-13-1990
DEC	34.5	12-19-1998	18.3	12-03-1904	172.2	12-21-1933	34	NE	12-10-1951	1017.9	12-12-2002	993.0	12-10-1951
ANNUAL	**39.0**	**03-04-1973**	**16.5**	**01-23-1976**	**319.8**	**07-29-1994**	**45**	**N**	**11-24-1968**	**1020.0**	**01-21-2005**	**977.2**	**11-13-1990**
Period of Record	**1903 - July 2010**				**1903 - July 2010**		**1949 - July 2010**			**1949 - July 2010**			

Source: PAGASA

Table 71. List of Tropical Cyclones which crossed Guimaras Province with 100KM Buffer from 1948 to 2018

YEAR	MONTH	TYPE	TC NAME	PAR BEG	PAR END	MSW
1948	11	TD	TD4816	11/28/1948	11/30/1948	
1949	7	TS	ELAINE	7/4/1949	7/9/1949	
1949	10	TY	TY4917	10/30/1949	11/3/1949	
1949	11	TS	TS4918	11/4/1949	11/8/1949	
1949	11	TS	RENA	11/10/1949	11/13/1949	
1949	12	TS	BETTY	12/2/1949	12/7/1949	
1950	11	TS	DELILAH	11/18/1950	11/22/1950	
1951	12	TY	AMY	12/6/1951	12/16/1951	
1952	6	TY	EMMA	6/30/1952	7/4/1952	
1954	5	TY	ELSIE	5/4/1954	5/9/1954	
1954	11	TY	TILDA	11/28/1954	11/30/1954	
1954	12	TS	TS5418	12/23/1954	12/29/1954	
1958	11	TD	TD5817	11/24/1958	11/25/1958	
1960	4	TY	KAREN	4/19/1960	4/26/1960	139
1962	11	TY	LUCY	11/25/1962	11/28/1962	139
1964	11	TS	MONING	11/27/1964	11/29/1964	
1965	3	TS	DALING	3/6/1965	3/7/1965	65
1967	3	TY	BEBENG	3/1/1967	3/5/1967	185
1967	11	TS	YAYANG	11/6/1967	11/8/1967	140
1968	11	TY	SENIANG	11/21/1968	11/26/1968	220
1970	10	TY	TITANG	10/16/1970	10/22/1970	251
1970	11	TD	ANING	11/24/1970	11/24/1970	45
1971	4	TS	DIDING	4/23/1971	4/28/1971	154
1971	10	TY	GOYING	10/19/1971	10/22/1971	130
1972	1	TY	ASIANG	1/5/1972	1/8/1972	230
1972	12	TY	UNDANG	12/1/1972	12/8/1972	110
1973	11	TS	OPENG	11/18/1973	11/24/1973	89
1975	1	TY	AURING	1/22/1975	1/25/1975	130
1978	12	TD	GARDING	12/14/1978	12/16/1978	55
1979	5	TS	KARING	5/10/1979	5/16/1979	65
1980	6	TS	HUANING	6/22/1980	6/25/1980	85
1980	11	TD	BASIANG	11/12/1980	11/13/1980	35
1981	10	TS	UNSING	10/11/1981	10/13/1981	63
1982	3	TY	BISING	3/22/1982	3/29/1982	
1982	12	TY	ANING	12/3/1982	12/8/1982	
1984	8	TY	NITANG	8/31/1984	9/4/1984	222
1984	11	TY	UNDANG	11/3/1984	11/6/1984	222
1986	12	TY	ANING	12/20/1986	12/24/1986	165
1986	12	TY	BIDANG	12/30/1986	1/1/1987	110
1988	11	TS	WELPRING	11/1/1988	11/5/1988	85
1990	11	TY	RUPING	11/10/1990	11/14/1990	240

1991	4	TS	BEBENG	4/23/1991	4/26/1991	55
1991	11	TS	URING	11/1/1991	11/6/1991	75
1993	11	TS	LURING	11/18/1993	11/22/1993	85
1993	12	TD	ONING	12/14/1993	12/17/1993	55
1993	12	TY	PURING	12/24/1993	12/29/1993	120
1994	3	TS	BISING	3/31/1994	4/9/1994	100
1995	10	TS	PEPANG	10/26/1995	10/30/1995	105
1996	2	TS	ASIANG	2/28/1996	3/1/1996	75
1998	11	TS	MIDING	11/22/1998	11/24/1998	75
2001	2	TD	AURING	2/17/2001	2/19/2001	55
2001	11	TY	NANANG	11/6/2001	11/10/2001	120
2001	12	TS	QUEDAN	12/4/2001	12/7/2001	85
2002	3	TD	CALOY	3/20/2002	3/23/2002	55
2003	10	TD	URSULA	10/23/2003	10/24/2003	55
2004	6	TS	GENER	6/7/2004	6/11/2004	65
2004	9	TD	PABLO	9/15/2004	9/17/2004	55
2005	3	TS	AURING	3/15/2005	3/17/2005	105
2005	12	TD	QUEDAN	12/16/2005	12/18/2005	55
2007	11	TS	LANDO	11/19/2007	11/27/2007	130
2008	4	TS	AMBO	4/13/2008	4/15/2008	65
2008	11	TS	QUINTA	11/6/2008	11/11/2008	85
2008	11	TD	ROLLY	11/7/2008	11/9/2008	55
2012	12	TY	PABLO	12/2/2012	12/9/2012	185
2012	12	TS	QUINTA	12/24/2012	12/26/2012	75
2013	11	TY	YOLANDA	11/6/2013	11/9/2013	235
2014	1	TS	BASYANG	1/30/2014	2/1/2014	65
2014	11	TD	QUEENIE	11/25/2014	11/28/2014	65
2014	12	TS	SENIANG	12/27/2014	12/31/2014	65
2016	11	TS	MARCE	11/23/2016	11/28/2016	85
2018	1	TS	AGATON	1/1/2018	1/3/2018	65
2018	11	TD	SAMUEL	11/18/2018	11/22/2018	55

Source: PAGASA

PAR BEG means date when the tropical cyclone entered the PAR
PAR END means date when the tropical cyclone exited the PAR
MSW means estimated Maximum Sustained Winds in km/h
****** means Tropical Cyclones with multiple entry in PAR

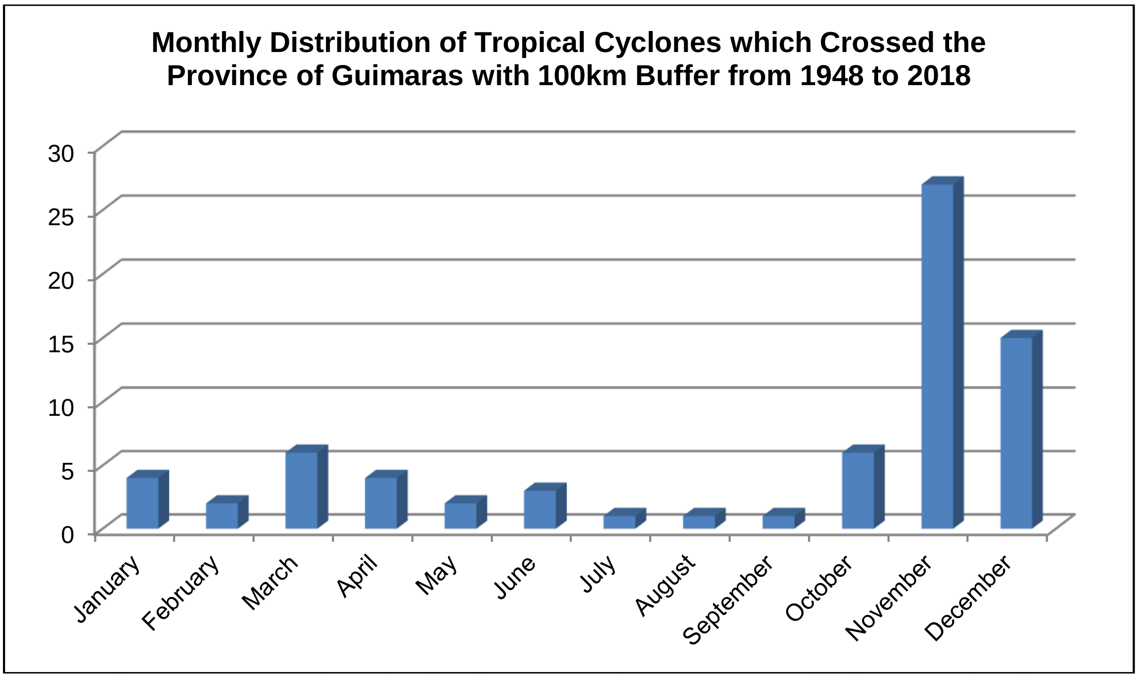


Figure 108. Monthly Distribution of Tropical Cyclones which crossed Guimaras Province from 1948 to 2018
Source: PAGASA

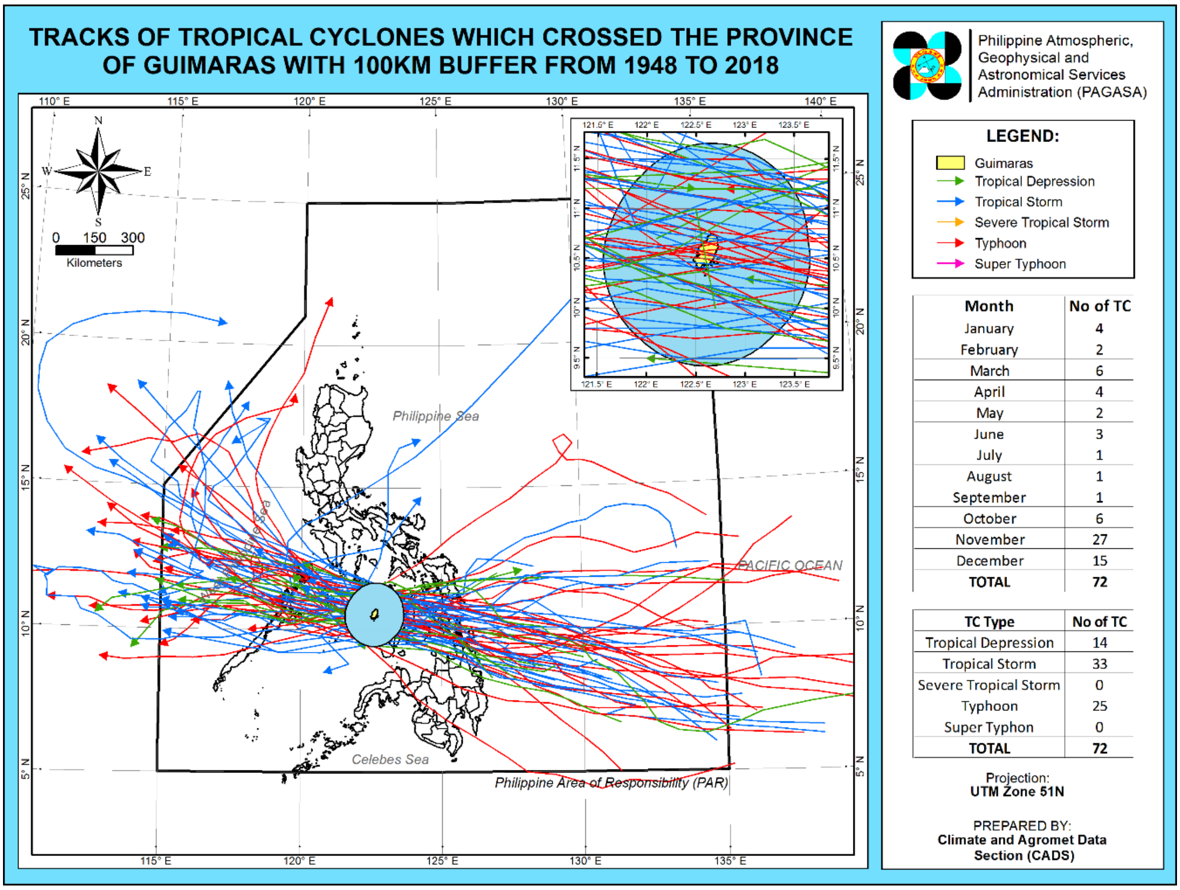


Figure 109. Tracks of Tropical Cyclones which crossed Guimaras Province within 100 km Buffer from 1948 to 2018
Source: PAGASA

2.3.1.1.1 Future Climate Trends in Region 6

Based on the PAGASA study, the seasonal climate projections in 2020 and 2050 in Cavite Province for temperature increase, rainfall change and frequency of extreme events are shown in **Tables 71** to **Table 73**, respectively. The abbreviations used in the tables are as follows:

DJF - the northeast monsoon season from December to February;
MAM - the summer season from March to May;
JJA - the southwest monsoon season from June to August; and
SON - the transition season from September to November.

PAGASA has also forecasted the climate trend in the future such as:

- The Philippines ranks high among the countries that are at risk to climate change.
- Climate projections indicate increases in annual mean temperatures by 0.9-1.1 °C in the 2020s and 1.8-2.2 °C in the 2050s.
- Hot days and dry days are likely to be more frequent over the Philippines with more heavy rainfall days especially over Luzon and Visayas by 2020 and 2050.
- Reduction in rainfall in most parts of the Philippines is predicted during the summer (MAM) season. However rainfall increase is a trend during the southwest monsoon (JJA) until the transition (SON) season in most areas of Luzon and Visayas in 2020 and 2050.
- Heavy daily rainfall will continue to become more frequent, and extreme rainfall is projected to increase in Luzon and Visayas only. But number of dry days is expected to increase in all parts of the country in 2020 and 2050.

Table 72. Seasonal Temperature Increases in 2020 and 2050 in Region 6

	OBSERVED BASELINE (1971-2000)				CHANGE IN 2020 (2006-2035)				CHANGE IN 2050 (2036-2065)			
Region 6	DJF	MAM	JJA	SON	DJF	MAM	JJA	SON	DJF	MAM	JJA	SON
Ioilo	26.4	28.2	27.9	27.6	1	1.3	1.1	1.0	1.9	2.4	2.1	1.9
Negros Occidental	36.7	28.4	27.8	27.6	0.9	1.2	1.0	1.0	1.9	2.3	2.0	1.9

Note: Under medium-range emission scenario

Table 73. Seasonal Rainfall Change in 2020 and 2050 in Region 6

	OBSERVED BASELINE (1971-2000)				CHANGE IN 2020 (2006-2035)				CHANGE IN 2050 (2036-2065)			
Region 6	DJF	MAM	JJA	SON	DJF	MAM	JJA	SON	DJF	MAM	JJA	SON
Ioilo	324.8	290.6	932.8	828.3	1.2	-8.6	-0.6	11.5	20.4	-13.3	3.8	3.9
Negros Occidental	234.9	283	899.6	784	7.1	-3.7	6	5.7	7.3	-9.3	11.8	14.3

Note: Under medium-range emission scenario

Table 74. Frequency of Extreme Events in 2020 and 2050 in Region 6

Provinces	Stations	No. Of Days w/ Tmax > 35 °C			No. Of Dry Days			No. Of Days w/ Rainfall > 200mm		
		OBS (1971-2000)	2020	2050	OBS	2020	2050	OBS	2020	2050
Iloilo	Iloilo	460	1431	3076	7839	5227	5226	4	5	4
Negros Occidental	Iloilo	460	1431	3076	7839	5227	5226	4	5	4

Note: Under medium-range emission scenario

To use the tables and arrive at values of seasonal mean temperature and seasonal rainfall in 2020 and 2050, the projections are added to the observed values (presented in each of the tables). For example, the projected values in 2020 are:

DJF mean temperature = (26.4 + 1.0) °C = 27.4 °C;
DFJ rainfall = (324.8 + (324.8+ 1.2%)) mm = (324.8 +3.9) mm = 325.7mm;
No. of days with Tmax > 35 °C in Iloilo during the 2006-2035 period (centered in 2020) = 1,431;
No. of dry days in Iloilo City during the 2006-2035 period (centered in 2020) = 5,227; and
No. of days with rainfall > 300mm in Iloilo during the 2006-2035 period (centered in 2020) = 3.
Obs - Observed Baseline (1971-2000)

2.3.1.2 Rainfall

The southwest monsoon is the main rainfall-causing weather system of the area. Tropical cyclones seldom, if not rarely, cross the project area. The rainy season in the area occurs from May to November while the rest of the year is relatively dry. The month of July is the wettest, with a monthly average rainfall of 329.6 mm. The month of February, on the other hand is the driest, with a mean monthly rainfall of 16.0 mm. The average annual rainfall recorded based on 30 years of data is 1767mm.

Rainfall in Guimaras during the northeast monsoon would most probably be due to conventional thunderstorms, a result of intense heating causing rapid evaporation, or to a lesser extent, typhoons which can occur in the region during October-November. The probability of a typhoon hitting Guimaras is fortunately low. The island has a rare frequency passage of 0% - 10% of the annual average of 19.8 typhoons.

Precipitation in Iloilo averages 2083 mm.The driest month is February. There is 27 mm of precipitation in February. The greatest amount of precipitation occurs in August, with an average of 346 mm. The precipitation varies 319 mm between the driest month and the wettest month. **Table 74** presents the monthly total and annual rainfall data in Iloilo City.

Table 75. Monthly Total and Annual Climatic Data, Rainfall Amount (mm) in Iloilo City, Iloilo

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
1951	25.0	29.1	10.4	48.4	182.3	410.5	214.9	304.3	198.2	272.7	157.4	301.0	2154.2
1952	22.7	11.6	38.8	3.9	120.2	238.3	291.3	519.1	126.6	396.8	126.0	186.2	2081.5
1953	24.3	32.5	101.7	40.5	50.7	190.2	320.3	381.0	92.0	218.5	116.6	83.0	1651.3
1954	42.2	28.2	70.1	14.2	155.4	174.4	213.1	249.9	392.0	32.1	191.4	190.2	1753.2
1955	77.9	30.8	37.8	122.7	108.3	371.6	102.2	241.9	114.4	282.2	373.5	50.3	1913.6
1956	45.4	20.8	72.5	134.3	356.8	178.0	182.3	360.0	503.4	254.9	154.5	235.5	2498.4
1957	131.8	27.8	6.4	68.7	6.1	244.7	320.9	588.0	395.6	137.4	51.8	22.7	2001.9
1958	30.5	5.1	21.7	25.1	26.3	196.1	307.1	309.4	251.2	184.5	288.4	35.8	1681.2
1959	11.4	20.4	62.9	16.8	62.6	274.7	304.0	286.7	137.9	251.2	210.8	151.0	1790.4
1960	22.6	18.8	15.0	112.5	113.6	283.3	251.1	274.5	269.0	209.2	184.7	50.9	1805.2
1961	0.5	9.8	15.1	28.1	252.3	466.2	349.2	511.9	158.6	370.8	130.3	70.5	2363.3
1962	16.0	30.7	9.3	28.4	123.4	87.1	638.9	335.7	518.8	137.8	131.6	25.7	2083.4
1963	3.3	0.6	12.3	4.8	17.3	274.5	178.7	372.5	322.8	240.2	63.9	91.3	1582.2
1964	19.1	38.7	14.2	37.6	250.2	308.8	81.6	324.3	256.3	195.7	460.8	52.5	2039.8
1965	57.8	12.7	81.8	33.3	70.6	243.3	360.7	267.5	219.0	166.4	251.8	121.2	1886.1
1966	81.1	21.1	10.5	11.0	514.4	255.5	364.7	115.4	234.5	200.5	255.6	70.7	2135.0
1967	184.8	48.8	39.9	12.4	78.1	246.4	326.2	425.0	102.0	322.5	185.7	29.7	2001.5
1968	11.5	7.1	10.7	15.1	75.7	158.4	173.6	409.7	141.2	50.8	190.4	9.9	1254.1
1969	6.4	T	8.9	10.0	39.3	152.6	426.1	125.0	183.6	109.6	53.2	71.2	1185.9
1970	25.9	7.2	35.1	5.3	151.0	414.4	195.8	256.1	234.9	225.0	101.8	60.7	1713.2
1971	9.2	4.1	5.6	84.0	94.2	174.4	353.3	182.4	42.6	301.3	77.4	110.5	1439.0

1972	143.4	23.4	26.0	31.0	118.7	236.6	767.8	221.9	377.6	187.9	188.1	150.0	2472.4
1973	-2.0	20.5	2.0	12.5	T	120.2	392.6	533.9	480.9	272.3	483.5	161.7	2480.1**
1974	48.8	22.0	33.1	27.5	36.8	265.2	302.4	326.9	92.9	669.0	147.0	139.0	2110.6
1975	130.5	90.0	11.1	144.9	147.1	378.5	100.5	253.4	297.7	328.2	55.0	119.5	2056.4
1976	45.5	37.9	26.0	20.6	315.3	217.3	509.1	386.7	331.2	174.3	131.8	99.5	2295.2
1977	38.7	60.4	21.0	T	8.1	247.5	224.4	281.0	545.8	73.6	77.0	21.7	1599.2
1978	26.2	9.1	3.8	131.4	66.8	150.3	131.9	503.6	320.8	252.7	119.6	162.6	1878.8
1979	12.5	17.7	T	125.3	97.5	139.5	501.5	667.4	207.6	706.6	84.5	62.7	2622.8
1980	21.5	74.3	72.4	7.3	22.1	648.0	220.8	206.1	348.4	363.2	193.0	94.3	2271.4
1981	40.3	5.8	7.6	80.4	30.6	423.2	203.0	345.9	283.8	117.3	134.3	85.3	1757.5
1982	15.3	2.0	151.8	60.8	158.0	396.6	285.2	668.3	381.0	215.6	53.4	9.9	2397.9
1983	73.4	5.0	31.2	2.4	9.4	181.7	247.5	278.5	346.3	264.6	284.9	102.1	1827.0
1984	32.3	64.6	97.0	66.8	109.5	508.6	391.6	505.8	411.5	515.8	365.9	72.3	3141.7
1985	36.9	54.1	35.4	267.6	59.2	460.1	271.4	161.7	341.7	470.2	182.0	90.4	2430.7
1986	40.2	15.3	51.5	49.2	70.4	254.2	300.8	892.4	257.8	182.4	248.9	97.4	2460.5
1987	30.1	12.0	1.0	5.7	41.9	162.4	452.7	224.5	517.0	152.0	212.3	21.8	1833.4
1988	13.7	13.3	13.1	85.2	197.6	483.0	323.5	264.9	272.7	561.6	312.7	39.4	2580.7
1989	94.1	33.0	58.8	68.7	253.5	323.5	308.5	672.6	160.6	138.2	37.4	9.0	2157.9
1990	15.1	0.6	8.0	9.1	262.1	602.2	326.6	466.1	182.0	124.6	319.5	22.5	2338.4
1991	3.1	20.0	48.4	26.4	8.2	357.9	371.5	709.3	76.7	94.1	123.4	37.8	1876.8
1992	1.6	5.9	0.0	3.0	48.8	337.6	226.6	451.2	190.1	224.4	188.2	74.4	1751.8
1993	17.6	5.5	49.9	47.4	26.0	175.5	287.3	540.1	120.7	319.6	133.1	320.1	2042.8
1994	40.8	56.1	34.8	226.4	348.2	465.1	972.9	232.1	293.1	218.8	40.0	131.8	3060.1
1995	36.6	10.4	5.3	12.2	36.2	320.4	345.6	314.3	743.4	441.3	150.4	119.6	2535.7
1996	75.1	65.1	250.5	279.5	137.3	274.8	224.8	180.8	376.8	243.9	350.3	85.7	2544.6
1997	6.1	53.3	16.3	25.2	199.9	286.9	481.0	265.9	90.2	113.3	34.1	22.1	1594.3
1998	2.3	4.0	4.5	2.0	227.9	179.3	211.6	131.6	295.1	274.3	131.2	240.2	1704.0
1999	117.3	60.5	85.2	124.0	121.5	289.2	367.7	407.2	275.7	213.9	142.0	132.0	2336.2
2000	11.9	67.5	83.3	75.0	153.0	183.6	324.4	387.4	226.1	280.3	157.6	281.2	2231.3
2001	46.4	122.3	111.7	113.8	168.8	219.1	205.3	489.5	110.0	265.5	319.0	185.3	2356.7
2002	13.2	2.6	39.6	4.8	60.0	179.4	597.1	452.3	222.5	127.2	55.7	15.4	1769.8
2003	49.1	11.8	T	55.6	302.5	109.9	383.1	319.2	170.2	178.7	90.2	47.9	1718.2
2004	3.7	23.4	38.3	9.2	296.0	338.8	225.0	450.9	150.3	149.4	76.9	102.4	1864.3
2005	3.8	0.8	16.8	23.7	112.2	217.3	488.3	392.8	151.7	243.6	52.4	165.7	1869.1
2006	41.2	27.3	42.2	5.1	385.9	276.0	403.8	390.4	282.1	266.6	28.2	167.2	2316.0
2007	91.9	0.2	2.6	12.0	91.9	132.8	185.7	193.0	872.0	107.8	262.6	89.2	2041.7
2008	139.9	65.8	67.0	182.9	-2.0	420.9	225.2	161.2	277.2	249.2	105.0	140.5	2034.8**
2009	37.9	127.4	26.9	136.6	121.9	354.8	355.8	280.4	349.5	277.1	65.3	3.6	2137.2
2010	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0**

Source: PAGASA

Note: -2, means no data

T, means trace

**, means annual values with missing months

2.3.1.3 Temperature

With an average of 28.5 °C, May is the warmest month. The lowest average temperatures in the year occur in January, when it is around 25.8 °C. The variation in temperatures throughout the year is 2.7 °C. In Iloilo City, the average annual temperature is 27.1 °C.

2.3.1.4 Windrose Diagram

A windrose diagram shows how much of time (expressed in percent) that the wind speed is within a certain range, for each compass direction, using the 16 points of the compass. The windrose displays the frequency distribution data as spokes radiating from the central hub, and there is a spoke of the 16 direction points.

Table below shows the ranges of values of the mean wind speed, and their description, as used in the plot. The number of observations is used to calculate the frequency distribution.

Table 76. Wind Speed Range and their Description

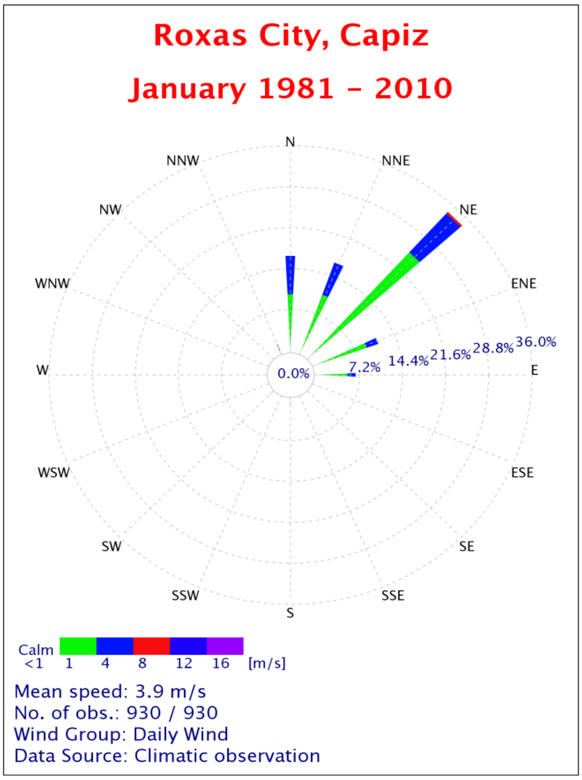
Wind speed range (mps)	Description
1-4	Light
5-8	Moderate
9-12	Moderate to Strong
13-16	Strong
17-24	Very Strong
Above 24	Violent

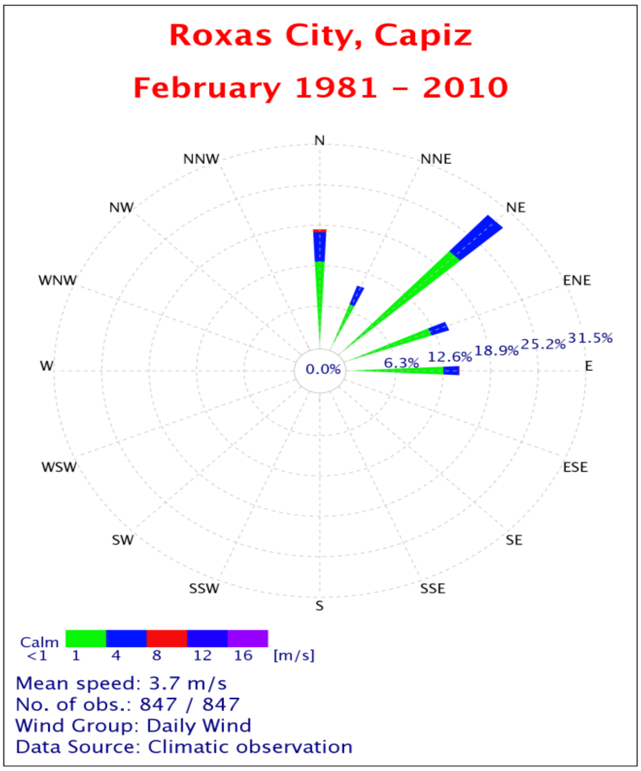
The nearest wind rose analysis is in Roxas City, Capiz where data were taken from daily data for the period 1981-2010. For example, the windrose diagram for the month of January on **Table 76** shows that 38.5 of the time the wind direction comes from the North East with 27.8 percent ranging from 1-4 meters per second (mps), 10.2 percent ranging from 5-8 m/s and 0.4 percent ranging above 8 m/s. Therefore, the prevailing wind direction for the month of January is North Easterly (from the NE), with an average wind speed (mean) 3.9 m/s. Calm conditions were observed at 0 percent of the time. **Figure 110** shows the monthly windrose diagram in Roxas.

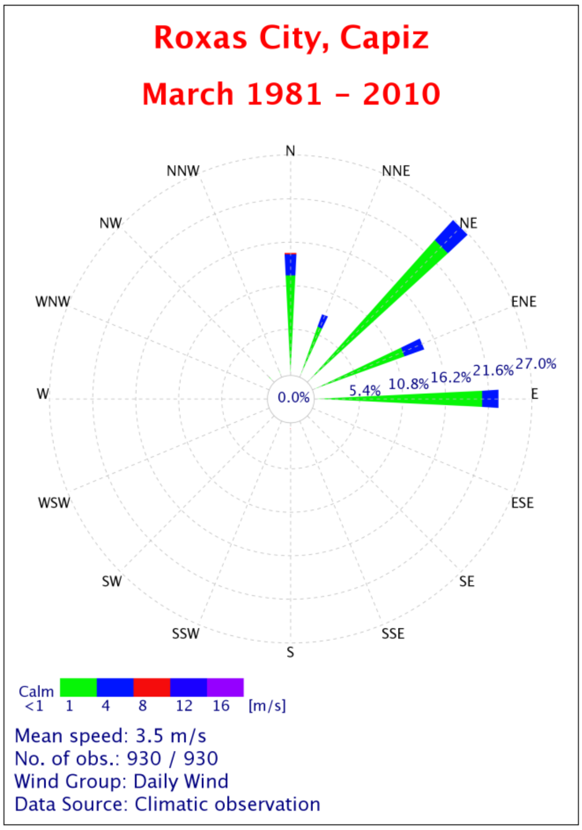
Table 77. % Frequencies of Occurrence for concurrent wind direction in Roxas City from 1981-2010

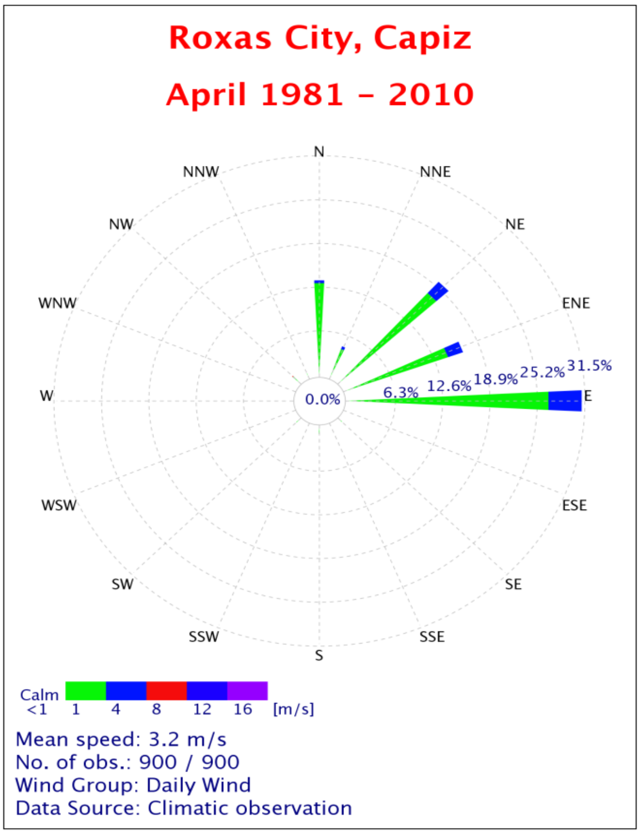
	Wind speed range						
Direction	**1-4**	**5-8**	**9-12**	**13-16**	**>16**	**% Frequency**	**Mean Speed**
Calm						0	
Variable	0	0	0	0	0	0	
N	11.1	7.4	0	0	0	18.5	4.2
NNE	12	6.7	0	0	0	18.7	4.1
NE	27.8	10.2	0.4	0	0	38.5	3.9
ENE	10.3	2.4	0	0	0	12.7	3.6
E	5.8	1.5	0	0	0	7.3	3.4
ESE	0	0	0	0	0	0	0
SE	0.1	0	0	0	0	0.1	3
SSE	0	0	0	0	0	0	0
S	1.1	0.1	0	0	0	1.2	3.5
SSW	0	0	0	0	0	0	0
SW	0.5	0	0	0	0	0.5	3
WSW	0	0	0	0	0	0	0
W	0.1	0.1	0	0	0	0.2	3.5
WNW	0	0	0	0	0	0	0
NW	0.6	0	0	0	0	0.6	3.3

NNW	0.4	0.6	0.5	0	0	1.6	6.5



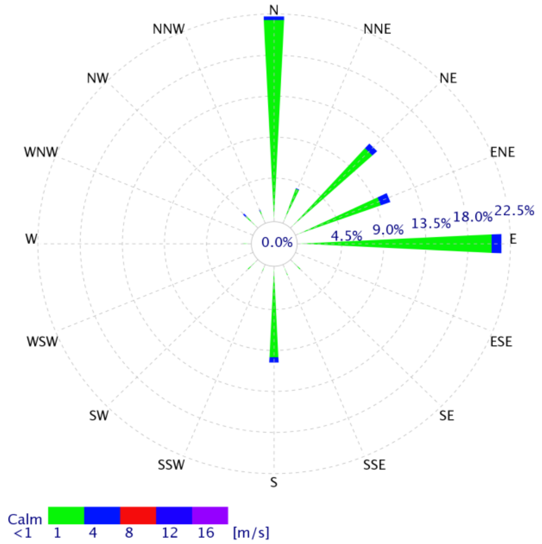






Roxas City, Capiz

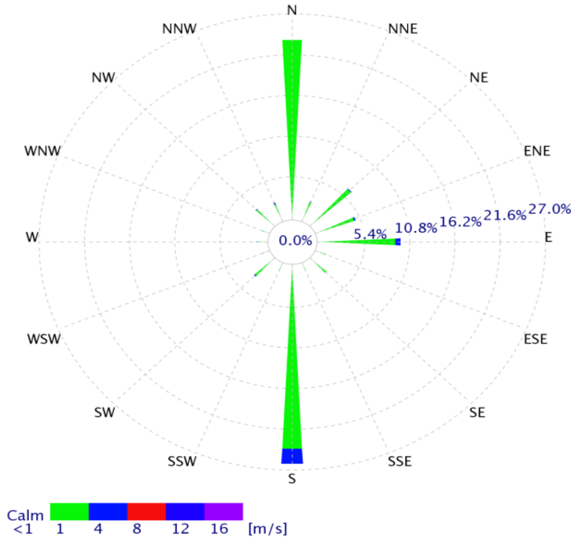
May 1981 – 2010



Mean speed: 2.6 m/s
No. of obs.: 929 / 930
Wind Group: Daily Wind
Data Source: Climatic observation

Roxas City, Capiz

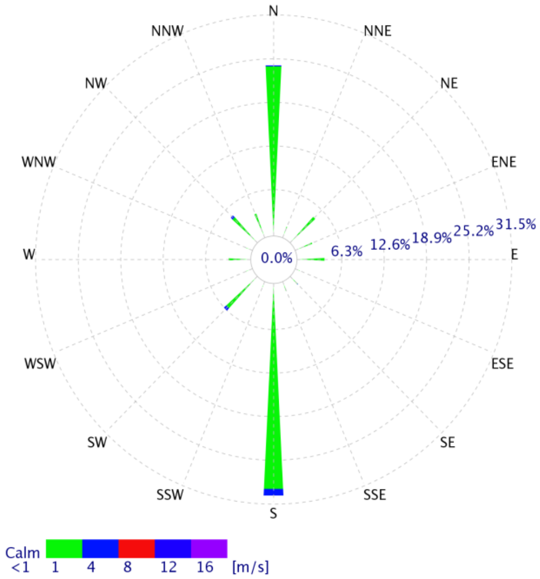
June 1981 – 2010



Mean speed: 2.3 m/s
No. of obs.: 900 / 900
Wind Group: Daily Wind
Data Source: Climatic observation

Roxas City, Capiz

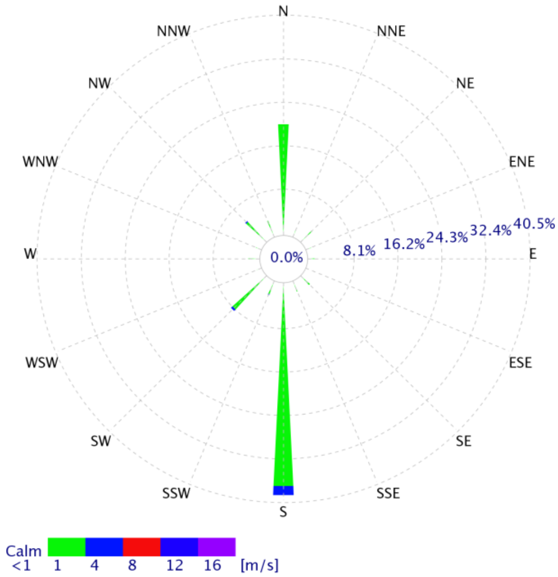
July 1981 – 2010



Mean speed: 2.2 m/s
No. of obs.: 928 / 930
Wind Group: Daily Wind
Data Source: Climatic observation

Roxas City, Capiz

August 1981 – 2010



Mean speed: 2.3 m/s
No. of obs.: 930 / 930
Wind Group: Daily Wind
Data Source: Climatic observation

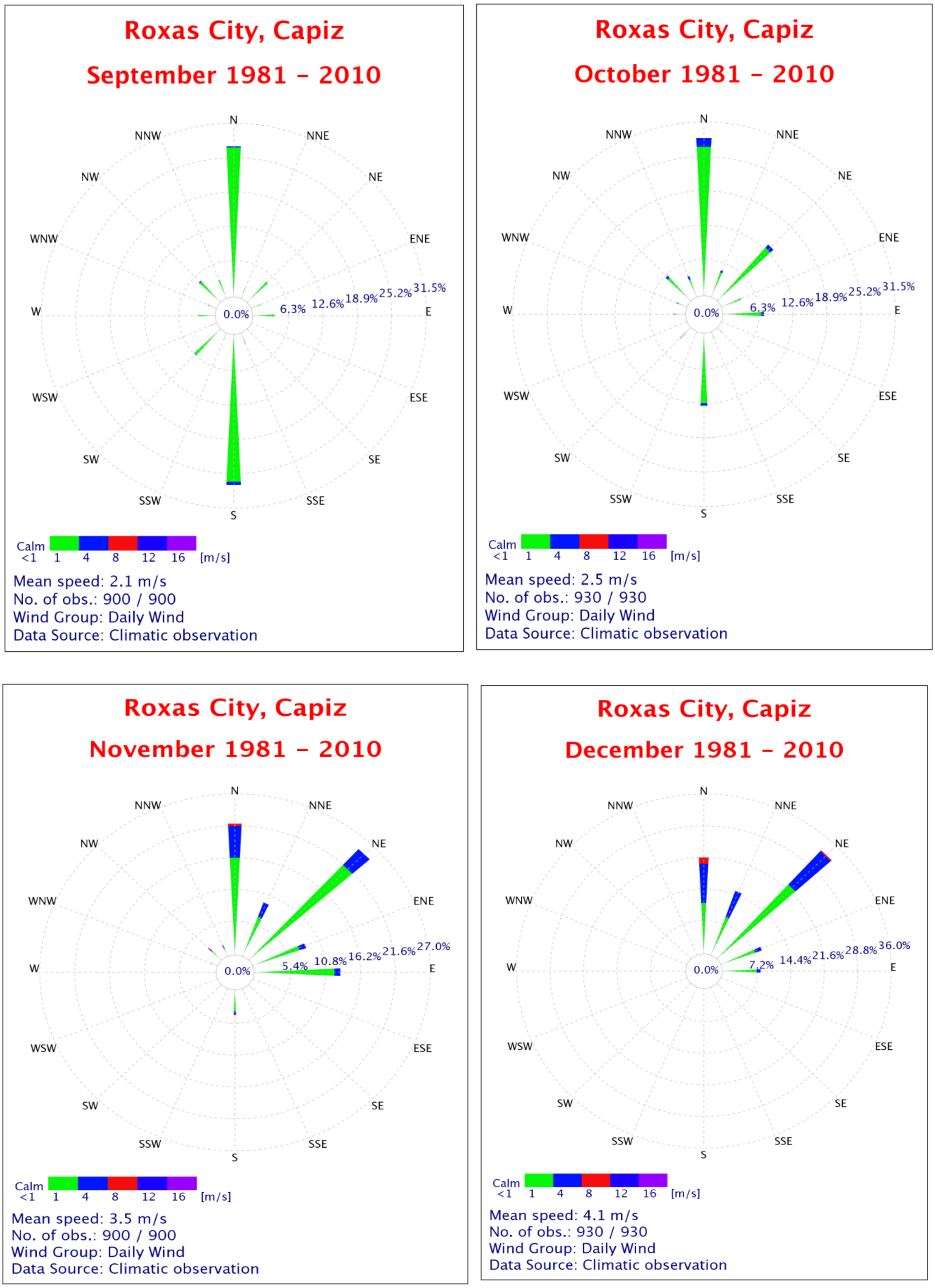


Figure 110. Monthly Windrose Diagram in Roxas City from 1981 to 2010
Source: PAGASA

2.3.2 Ambient Air Quality

Air Samples were collected on April 2-4 & July 8-9 in Buenavista, April 6-8, 2019 in San Lorenzo, Guimaras. In Iloilo, samples were collected on April 12-13 in Leganes and July 6-7, 2019 in Jaro. In Pulupandan, Negros Occidental, air samples were collected on April 9-11, 2019. **Figure 111** shows the sampling locations for PGN project. Weather conditions at the time of sampling were sunny, fair to cloudy with slight rains. Twenty-four (24) hours measurement were sampled for Total Suspended Particulates, PM10, Nitrogen Dioxide, Sulfur Dioxide and Carbon Monoxide. **Table 77** presents the sampling sites, date and time of collection conducted in Iloilo, Guimaras and Negros Occidental.

Source: Google Earth

Figure 111. Air Sampling locations at PGN Project

Table 78. Summary of Air Sampling Stations, Coordinates, Weather condition, Date and Time of Samplings

Station No.	Sampling Stations	Coordinates	Weather Condition	Date and Time of Samplings
A1	Brgy. Gu-an, Leganes, Iloilo	10°46'50.93"N 122°36'54.22"E	Cloudy, fair to sunny	April 12-13, 2019
A2	Brgy. Getulio, Buenavista, Guimaras	10°44'38.86"N 122°39'35.71"E	Fair to sunny, slight rains	April 2-3, 2019
A3	Brgy. Cansilayan, Buenavista, Guimaras	10°42'27.36"N 122°41'19.82"E	Fair to sunny	April 3-4, 2019
A4	Brgy. M. Chavez, San Lorenzo, Guimaras	10°35'49.47"N 122°42'21.79"E	Cloudy, fair to sunny	April 6-7, 2019

A5	Brgy. Cabano, San Lorenzo, Guimaras	10°34'10.79"N 122°42'8.96"E	Cloudy, fair to sunny	April 7-8, 2019
A6	Brgy. Pag-ayon, Pulupandan, Negros Occidental	10°31'45.65"N 122°48'45.01"E	Cloudy, fair to sunny, slight rains	April 9-10, 2019
A7	Brgy. Ubay near Lagasan Boundary, Pulupandan, Negros Occidental	10°30'39.90"N 122°49'56.13"E	Cloudy, fair to sunny	April 10-11, 2019
A8	Brgy. Hinactacan, Jaro, Iloilo City	10°44'23.00"N 122°35'6.00"E	Cloudy, fair to sunny	July 6-7, 2019
A9	Stio Cabanbanan, Brgy. Salvacion, Buenavista, Guimaras	10°42'11.59"N 122°38'9.26"E	Cloudy, fair to sunny	July 8-9, 2019

2.3.2.1 Sampling Equipment

There were three (3) major types of ambient air equipment used as described in **Table 78**.

Table 79. Ambient Air Monitoring Equipment Specifications

Equipment Name/Description	Brand/Model	Testing Capabilities
High Volume Sampler	Tisch Environmental /5170	TSP
Dual Channel Dust Sampler	Instrumex	PM_{10}
Personal Sampler	SKC	NO_2, SO_2
Anemometer	Testo	Wind speed

*TSP – Total Suspended Particulate Matter; PM_{10} – Particulate Matter at 10µ; NO_2 – Nitrogen Dioxide; SO2 – Sulfur Dioxide

The high volume sampler is equipped with all weather shelter timer and flowchart meter and is powered by electricity through external power sources. The Personal Sampler is equipped with flow meter powered by external/internal power sources and a low flow controller. It is attached to parallel tubing with two (2) pieces of midget impingers. For SO_2, the bubbler has a straight orifice nozzle while for NO_2 the bubbler has a fritted nozzle. While for the anemometer and it has a range of 0.4m/s - 20m/s (2.8km/hr - 108km/hr) with 0.1m/s resolution and is calibrated against standards that are traceable to National Institute of Standards and Technology (NIST).

2.3.2.2 Sampling Methodologies

The ambient air quality measurement conducted by CRL Calabarquez Corporation was performed at an elevation of at least two (2) meters above the ground level and sampling was strategically stationed within the project site. After sampling was conducted for each station, the gas samples were carefully recovered in the sampling bottles and preserved at low temperature and were immediately submitted to the laboratory for analysis.

2.3.2.2.1 FILTRATION METHOD BY HIGH-VOLUME SAMPLER

2.3.2.2.1.1 Total Suspended Particulates (TSP) SAMPLING

Principle of Sampling - Ambient air was drawn through a glass fiber filter over a period of time. The filter paper containing the sample was weighed hence the final weight of the sample over that of the standard volume of air sampled gave the concentration of TSP.

2.3.2.2.1.2 PM_{10} SAMPLING (Reference Method Appendix J to Part 50)

Principle of Sampling - Ambient air was drawn at a constant flow rate into a specially shaped inlet where the suspended particulate matter is inertially separated into one or more size fractions within PM_{10} size range. The particles were collected in a glass fiber filter and determined by measuring gravimetrically. The filter paper containing the sample was weighed hence the final weight of the sample over that of the standard volume of air sampled gave the concentration of PM10.

2.3.2.2.2 ABSORPTION IN LIQUIDS FOR GASEOUS POLLUTANTS

2.3.2.2.2.1 Nitrogen Dioxide (NO_2), Sulfur Dioxide (SO_2) SAMPLING

Principle of Sampling - A known volume of air (0.4L/min for NO_2, 0.5L/min for SO_2) was sampled with a wet-chemical system where a constant air sample passes through a suitable reagent (absorbing reagent) that was reactive to the specific pollutant desired. As the air sample passes through the bubbler rack, the air diffuses forming air bubbles and slowly reacts to the chemical reagent forming a complex ion. The personal sampler was calibrated with NIST traceable digital calibrator to assure its accuracy. The samples were then analyzed using prescribed and approved methods.

2.3.2.3 Results and Discussions

Results of air quality for all parameters measured at two (2) sites are compared with National Ambient Air Quality Guideline Values (NAAQGV) of Republic Act 8749 or known as Philippine Clean Air Act. All parameters tested in all sites are within the allowable limits. **Table 79 and Table 80** present the results of air quality in selected sites of the project area.

Table 81 to **Table 89** present the meteorological data of the air samples collected.

Table 80. Ambient Air Test results taken in Buenavista and San Lorenzo, Guimaras

Station I.D.	Location	TSP (µg/Ncm)	PM_{10} (µg/Ncm)	NO_2 (µg/Ncm)	SO_2 (µg/Ncm)	CO (ppm)
Date of Sampling: April 2 to 4, 6 to 8 and July 8-9, 2019						
A2	Brgy. Getulio, Buenavista, Guimaras	55.5	14.4	6.4	ND	1.0
A3	Brgy. Cansilayan, Buenavista, Guimaras	78.7	17.0	7.3	1.6	ND
A4	Brgy. M. Chavez, San Lorenzo, Guimaras	42.5	16.5	4.6	0.9	ND
A5	Brgy. Cabano, San Lorenzo, Guimaras	43.1	18.3	3.0	ND	1.0
A9	Stio Cabanbanan, Brgy. Salvacion, Buenavista, Guimaras	14.1	11	0.7	ND	ND
National Ambient Air Quality Guideline Values (NAAQGV)^		**230**	**150**	**150**	**180**	**30**
Remarks		**Passed**	**Passed**	**Passed**	**Passed**	**Passed**

TSP, PM_{10}, NO_2, SO_2 – corrected at 25°C, 760mm Hg; *RA 8749 (Philippine Clean Air Act of 1999); ND – Not Detected

Table 81. Ambient Air Test results taken in Brgy. Pag-ayon, Pulupandan, Negros Occidental and Brgy. Gua-an, Leganes, Brgy. Hinactacan, Jaro, Iloilo

Station I.D.	Location	TSP (µg/Ncm)	PM_{10} (µg/Ncm)	NO_2 (µg/Ncm)	SO_2 (µg/Ncm)	CO (ppm)
Date of Sampling: April 9 to 13 and July 6-7, 2019						
A6	Brgy. Pag-ayon, Pulupandan, Negros Occidental	52.2	13.6	8.8	ND	ND
A7	Brgy. Ubay near Lagasan Boundary	57.9	10.5	8.5	1.0	ND
A1	Brgy. Gua-an, Leganes, Iloilo	74.2	13.2	5.7	2.6	ND
A8	Brgy. Hinactacan, Jaro, Iloilo City	22.7	19.5	2.1	2.8	ND
National Ambient Air Quality Guideline Values (NAAQGV)^		**230**	**150**	**150**	**180**	**30**
Remarks		**Passed**	**Passed**	**Passed**	**Passed**	**Passed**

TSP, PM_{10}, NO_2, SO_2 – corrected at 25°C, 760mm Hg; *RA 8749 (Philippine Clean Air Act of 1999); ND – Not Detected

Table 82. Meteorological Data at Brgy. Getulio, Buenavista, Guimaras

Division of 24 - Hours Sampling	Prevailing Wind	Temperature (deg. C)	Barometric Pressure (mmHg)	Remarks
April 2 to 3, 2019 1340H - 1540H	SE-NW	33.4	756.2	Sunny
1540H - 1740H	SE-NW	33.4	755.9	Sunny
1740H - 1940H	SE-NW	29.6	756.4	Fair
1940H - 2140H	Calm	29.0	757.5	Fair
2140H - 2340H	Calm	29.3	758.3	Fair
2340H - 0140H	Calm	27.3	758.3	Fair
0140H - 0340H	Calm	26.8	758.0	Rains Lightly
0340H - 0540H	Calm	26.7	758.5	Fair
0540H - 0740H	Calm	26.2	758.3	Fair
0740H - 0940H	SE-NW	27.2	758.5	Sunny
0940H - 1140H	SE-NW	31.6	758.3	Sunny
1140H - 1340H	SE-NW	33.6	758.5	Sunny

Table 83. Meteorological Data at Brgy. Cansilayan, Buenavista, Guimaras

Division of 24 - Hours Sampling	Prevailing Wind	Temperature (deg. C)	Barometric Pressure (mmHg)	Remarks
April 3 to 4, 2019 1600H - 1800H	NW-SE	31.5	749.2	Sunny
1800H - 2000H	Calm	27.2	749.9	Fair
2000H - 2200H	Calm	26.9	751.1	Fair
2200H - 0000H	Calm	22.2	752.0	Fair
0000H - 0200H	Calm	25.5	751.6	Fair
0200H - 0400H	Calm	25.5	750.8	Fair
0400H - 0600H	Calm	26.3	751.6	Fair
0600H - 0800H	NW-SE	26.6	751.2	Fair
0800H - 1000H	NW-SE	30.1	752.2	Sunny
1000H - 1200H	NW-SE	32.3	751.6	Sunny
1200H - 1400H	NW-SE	32.6	751.9	Sunny
1400H - 1600H	NW-SE	33.5	749.3	Sunny

Table 84. Meteorological Data at Sitio Cabanbanan, Brgy. Salvacion, Buenavista, Guimaras

Division of 24 - Hours Sampling	Prevailing Wind	Temperature (deg. C)	Barometric Pressure (mmHg)	Remarks
July 8 to 9, 2019 0940H - 1140H	NE-SW	33.6	752.3	Sunny
1140H - 1340H	SW-NE	30.0	750.8	Sunny
1340H - 1540H	NE-SW	30.8	751.8	Cloudy
1540H - 1740H	NE-SW	32.2	752.2	Sunny
1740H - 1940H	NE-SW	31.0	751.6	Cloudy
1940H - 2140H	SW-NE	27.3	751.1	Fair
2140H - 2340H	Calm	26.1	751.7	Fair
2340H - 0140H	Calm	25.5	751.3	Fair
0140H - 0340H	Calm	25.4	752.0	Fair
0340H - 0540H	SW-NE	25.6	751.6	Fair
0540H - 0740H	Calm	24.9	751.2	Fair
0740H - 0940H	NE-SW	28.2	751.4	Sunny

Table 85. Meteorological Data at Brgy. M. Chavez, San Lorenzo, Guimaras

Division of 24 - Hours Sampling	Prevailing Wind	Temperature (deg. C)	Barometric Pressure (mmHg)	Remarks
April 6 to 7, 2019 1100H - 1300H	NE-SW	33.1	757.4	Cloudy
1300H - 1500H	NE-SW	33.0	756.6	Sunny
1500H - 1700H	NE-SW	32.9	755.5	Sunny
1700H - 1900H	NE-SW	29.7	755.6	Cloudy
1900H - 2100H	NE-SW	29.1	757.3	Fair
2100H - 2300H	NE-SW	29.0	758.1	Fair
2300H - 0100H	Calm	28.3	758.4	Fair
0100H - 0300H	Calm	28.0	758.2	Fair
0300H - 0500H	NE-SW	28.2	755.8	Fair
0500H - 0700H	NE-SW	29.0	757.2	Fair
0700H - 0900H	NE-SW	28.9	758.3	Cloudy
0900H - 1100H	NE-SW	29.2	758.4	Cloudy

Table 86. Meteorological Data at Brgy. Cabano, San Lorenzo, Guimaras

Division of 24 - Hours Sampling	Prevailing Wind	Temperature (deg. C)	Barometric Pressure (mmHg)	Remarks
April 7 to 8, 2019 1200H - 1400H	NE-SW	34.3	757	Sunny
1400H - 1600H	NE-SW	33.1	755.1	Sunny
1600H - 1800H	NE-SW	32.6	755.5	Sunny
1800H - 2000H	NE-SW	30.1	757.1	Cloudy
2000H - 2200H	NE-SW	29.6	757.4	Fair
2200H - 0000H	NE-SW	28.8	757.9	Fair
0000H - 0200H	NE-SW	27.7	757.7	Fair
0200H - 0400H	Calm	27.5	757.6	Fair
0400H - 0600H	NE-SW	27.1	756.2	Fair
0600H - 0800H	NE-SW	27.7	757.0	Cloudy
0800H - 1000H	NE-SW	31.0	758.0	Sunny
1000H - 1200H	NE-SW	33.6	757.6	Cloudy

Table 87. Meteorological Data at Brgy. Pag-ayon, Pulupandan, Negros Occidental

Division of 24 - Hours Sampling	Prevailing Wind	Temperature (deg. C)	Barometric Pressure (mmHg)	Remarks
April 9 to 10, 2019 1000H - 1200H	NE-SW	33.6	757.3	Sunny
1200H - 1400H	NE-SW	33.7	757.6	Sunny
1400H - 1600H	NE-SW	30.7	755.7	Rains Lightly
1600H - 1800H	NE-SW	29.8	755.5	Cloudy
1800H - 2000H	Calm	28.2	756.0	Rains Lightly
2000H - 2200H	Calm	28.8	757.1	Fair
2200H - 0000H	Calm	28.3	757.5	Fair
0000H - 0200H	Calm	27.9	757.2	Fair
0200H - 0400H	Calm	27.6	757.0	Fair
0400H - 0600H	Calm	27.5	756.8	Fair
0600H - 0800H	Calm	27.4	757.5	Fair
0800H - 1000H	NE-SW	29.7	758.6	Cloudy

Table 88. Meteorological Data at Brgy. Ubay, Near Lagasan Boundary, Negros Occidental

Division of 24 - Hours Sampling	Prevailing Wind	Temperature (deg. C)	Barometric Pressure (mmHg)	Remarks
April 10 to 11, 2019 1230H - 1430H	NW-SE	34.5	755.2	Sunny, Partly Cloudy
1430H - 1630H	NE-SW	33.7	754.7	Cloudy
1630H - 1830H	NE-SW	30.2	755.2	Cloudy
1830H - 2030H	Calm	28.3	757.7	Rains Lightly
2030H - 2230H	NE-SW	26.8	757.5	Rains Lightly
2230H - 0030H	NE-SW	26.7	757.3	Rains Lightly
0030H - 0230H	Calm	25.1	757.1	Fair
0230H - 0430H	Calm	25.3	756.8	Fair
0430H - 0630H	Calm	25.4	756.1	Fair
0630H - 0830H	Calm	25.5	756.2	Cloudy
0830H - 1030H	NW-SE	31.4	757.3	Sunny
1030H - 1230H	NW-SE	31.9	756.6	Sunny

Table 89. Meteorological Data at Brgy. Gua-an, Leganes, Iloilo

Division of 24 - Hours Sampling	Prevailing Wind	Temperature (deg. C)	Barometric Pressure (mmHg)	Remarks
April 12 to 13, 2019 1000H - 1200H	SE-NW	33.1	757.9	Sunny, Partly Cloudy
1200H - 1400H	SE-NW	33.6	756.8	Sunny
1400H - 1600H	SE-NW	33.9	755.5	Sunny
1600H - 1800H	SE-NW	32.5	755.3	Sunny
1800H - 2000H	Calm	31.6	756.4	Fair
2000H - 2200H	Calm	30.0	757.4	Fair
2200H - 0000H	SE-NW	29.4	757.7	Fair
0000H - 0200H	Calm	28.6	757.9	Fair
0200H - 0400H	Calm	28.5	757.7	Fair
0400H - 0600H	SE-NW	27..6	757.6	Fair
0600H - 0800H	SE-NW	28.9	757.5	Cloudy
0800H - 1000H	SE-NW	31.6	759.0	Sunny

Table 90. Meteorological Data at Brgy. Hinactacan, Jaro, Iloilo City

Division of 24 - Hours Sampling	Prevailing Wind	Temperature (deg. C)	Barometric Pressure (mmHg)	Remarks
July 6 to 7, 2019 1130H - 1330H	NW-SE	33.6	753.2	Cloudy
1330H - 1530H	NW-SE	33.8	753.1	Cloudy
1530H - 1730H	NW-SE	32.5	752.6	Sunny
1730H - 1930H	SW-NE	29.7	753.3	Cloudy
1930H - 2130H	SW-NE	27.9	754.7	Fair
2130H - 2330H	SW-NE	28.7	755.3	Fair
2330H - 0130H	Calm	27.8	755.2	Fair
0130H - 0330H	SE-NW	27.5	754.8	Fair
0330H - 0530H	SE-NW	27.6	755.1	Fair
0530H - 0730H	SE-NW	26.1	755.2	Fair
0730H - 0930H	NW-SE	30.2	755.2	Sunny
0930H - 1130H	NW-SE	33.6	755.1	Sunny

2.3.2.4 Meteorological Environment and Design Wind Parameters Study for PGN Project

The scope of the study is to investigate the wind parameters of the bridge structures and necessary meteorological parameters around the bridge sites. In order to obtain the wind effect on the structure of PGN project, the Research Center for Wind Engineering Southwest Jiaotong University carried out the detailed research by field investigation, data analysis and numerical simulations. The corresponding conclusion can support the feasibility study, as well as be used as a reference for preliminary design. A detailed of the study is presented in separate report. Below is the summary.

2.3.2.4.1 Statistical analysis of basic wind speed at bridge site

2.3.2.4.1.1 Maximum gust wind speed and direction

The annual maximum gust wind speed (for 3 seconds) and direction during 1980 to 2009 obtained by Iloilo Weather Station (IWS) are listed in **Table 90**, where the data has been conducted with correspondence to 10 meters standard height. As the bridge site is very near to IWS, the data of IWS can be directly applied for calculation of bridge design wind speed.

Table 91. Annual maximum gust wind speed (for 3 seconds) and direction of IWS near to the bridge site

YEAR	WIND SPEED	WIND DIR	YEAR	WIND SPEED	WIND DIR
1980	21	WSW	1995	36	SW
1981	18	SW	1996	24	SW
1982	25	WSW	1997	36	SW
1983	17	SW	1998	20	NE
1984	25	SSW	1999	19	SW
1985	15	SW	2000	18	S
1986	25	SW	2001	28	WSW
1987	30	NE	2002	20	W
1988	19	SW	2003	30	SW
1989	14	SW	2004	18	W
1990	44	S	2005	15	NE
1991	20	WSW	2006	20	W
1992	26	SW	2007	18	W
1993	22	SW	2008	22	SSE
1994	20	N	2009	16	SW

2.3.2.4.2 Statistical analysis method

According to the hypothesis test in statistics, the probability distribution of annual (or monthly) maximum wind speed in Philippines can be generally considered as the Extreme Value Type I (Gumbel Type), which can be expressed as following:

$$F_I(x) = \exp\{-\exp[-\alpha(x-\mu)]\}$$

The above undetermined parameter □, □ can be obtained according to the calculation of mathematical expectation and standard deviation of wind speed records.

The calculation steps are as follows:

Obtained as many years of maximum wind speed as possible;

(1) Arrangethe annual maximum wind speed from big value to small value(1,2,…m,…N;N represent the year)；

(2) For each wind speed, calculation the probability P that is less than it., P □ m/(N + 1);

(3) For each probability P, computing equivalent variable y = - Ln (LnP);

(4) Series of equation is obtained of wind speed U or x and y, and then determine the best α and □ values by the least square method.

2.3.2.4.3 Determination of basic wind speed

Based on the annual maximum gust wind speed records, it can be obtained by the above method that the gust wind speeds within a return period of 50 years and 100 years as shown in **Table 91**, respectively.

Table 92. Gust wind speed of bridge site in different return periods based on the annual maximum gust wind speed records

Return period /Year	***P***	**Gust wind speed**（m/s）
50	0.98	42.17
100	0.99	46.19

ASCE7-05 presents the conversion relations of maximum wind speed of different average interval and maximum average wind speed of 1 hour, as shown in **Figure 112**. From the figure, the ratio of gust wind speed within 3 seconds to the 10-minute averaged wind speed is 1.425. According to the relationship, the 10 minutes maximum average wind speed of every 50 years and 100 years is 29.59 m/s and 32.41 m/s, as shown in **Table 92**.

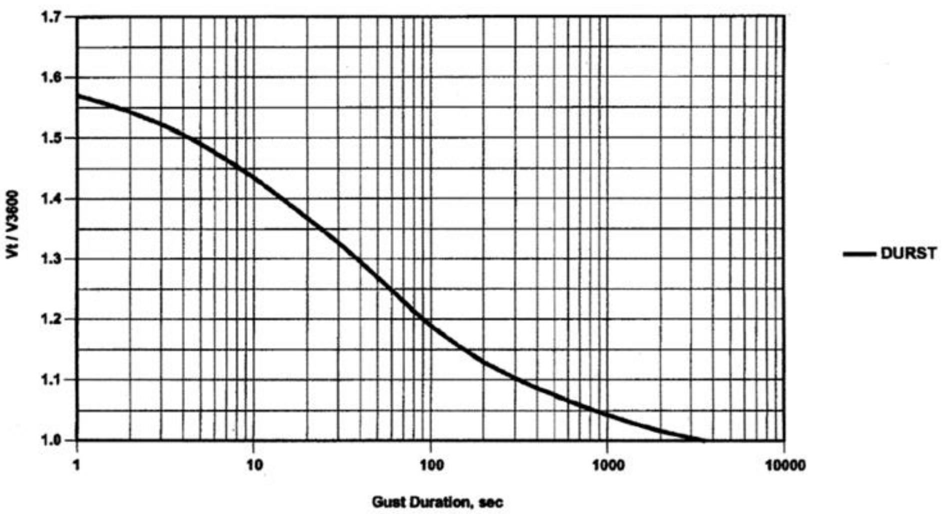


Figure 112.Conversion relation of wind speed with different time distance

Table 93. The basic wind speed at bridge site in different return periods

Return period /Year	***P***	**Gust wind speed**（m/s）	**10-minute averaged wind speed**（m/s）
50	0.98	42.17	29.59
100	0.99	46.19	32.41

2.3.2.4.2 Numerical simulation of wind field at the bridge site

The CFD software OpenFOAM (Open Field Operation and Manipulation) was applied to investigate the wind field of bridge site, which includes the wind velocity contours, wind attack angle and distributions of wind direction.

2.3.2.4.2.1 Governing equations and turbulence model

Here in order to obtain the results accurately, SST k-ω model, which is a two-equation turbulence model, is applied in this numerical simulation.

SST k-ω model have been a mature turbulence model in the aspect of theory and practical application, combining with the continuity equation and momentum equation of fluid mechanics. FLUENT is a mature commercial software to solve the whole flow field area. This research adopts CFD software Fluent 15.0 for numerical solution of the above equations.

When using FLUENT software to calculate, the first step is to establish the geometry model in fluid field, mesh the computational domain and set the boundary conditions with the software ICEM. It's worth noting that the degree of meshing grid has a direct impact on the calculation results. Then choose the appropriate model and parameters in FLUENT software solver to do the calculation. At last, export the results and graphics.

2.3.2.4.2.2 Numerical setup

As to the topography characteristics of the Bridge Site, OpenFoam software was used for wind field numerical simulation using DELL T5500 calculation workstation. The physical memory of calculation workstation was up to 48 G, the kernel for the workstation is Intel(R) Xeon(R) CPU (double processor), which can better competent the calculation hardware requirements.

2.3.2.4.2.2.1 Terrain information

Based on the SRTM (shuttle radar topography mission) file, the three-dimensional terrain coordinates were extracted by the professional terrain software of Global Mapper. Then these coordinate points were imported into the grid software and transformed into the associated surface. **Figure 113** shows the contour map of the terrain at bridge site which can be applied to establish the grid system.

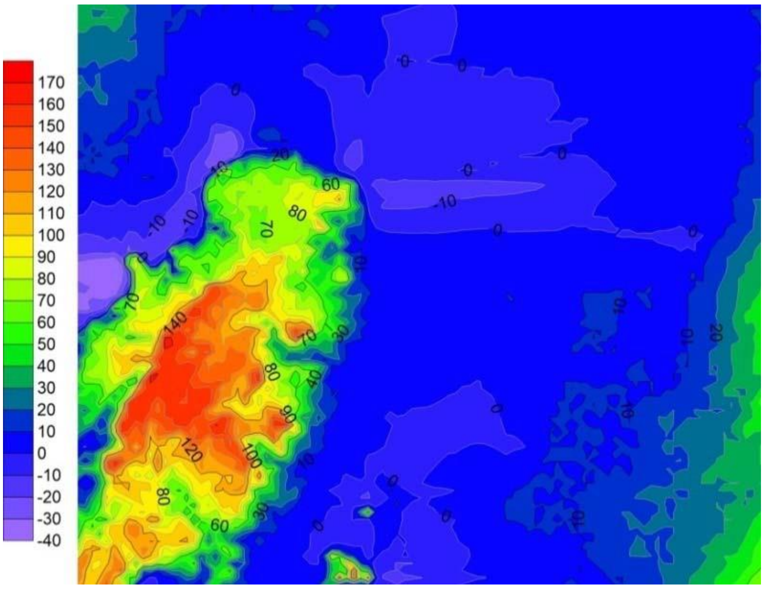


Figure 113. Contour map of the terrain

2.3.2.4.2.2.2 Computational domain and mesh system

The calculation area is generated based on the astigmatism cloud map with an interval of 30 m, taking into account the calculation accuracy and calculation efficiency. The terrain model map is shown in **Figure 114**. The blue line in the figure represents the bridge, with the A segment on the upper left and the B segment on the lower right. The total number of grid cells in the A section of the bridge is 8,857,434. The B section is divided into two sections for calculation. The total number of grid cells in the B1 segment is 9643854, and the total number of B2 grid cells is 12114738. The local surface meshing is shown in **Figure 115**, and the overall grid is shown in **Figure 116**.

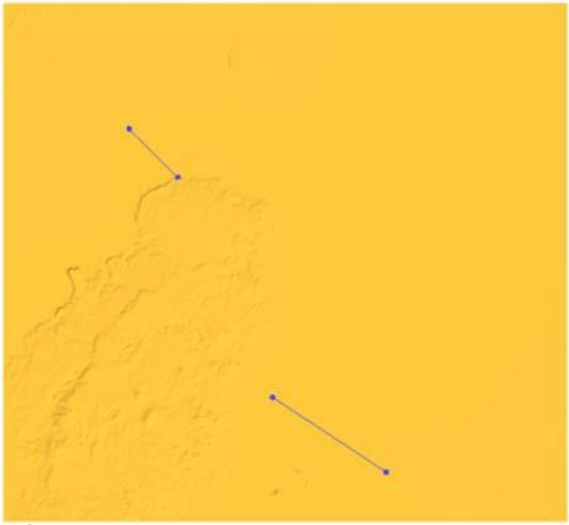


Figure 114.Topographic map of calculated area

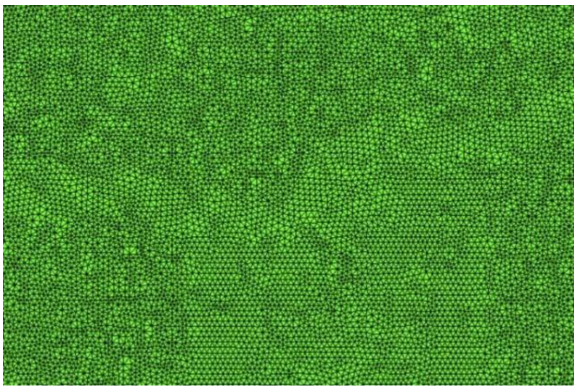


Figure 115. Local grid meshing

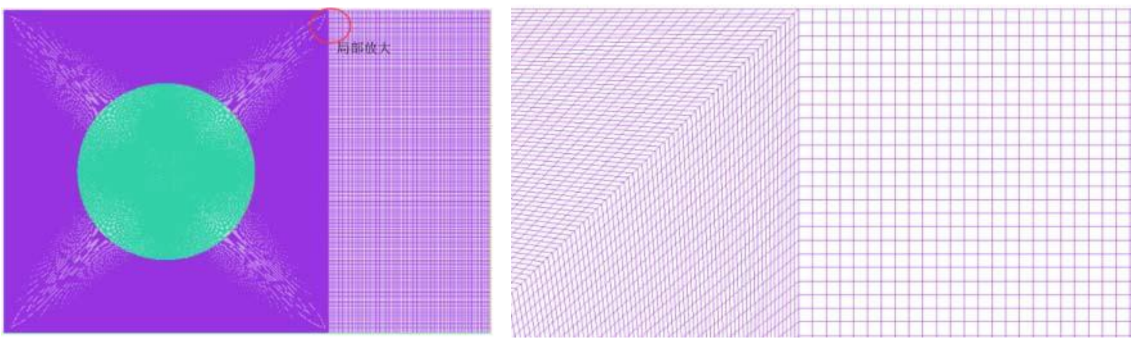


Figure 116. Overall grid and partial detail

2.3.2.4.2.2.3 Case setup

In order to investigate the effect of wind direction on the wind field at the bridge site, twelve cases were taken into consideration with the step size of 30° (total wind direction of 360°) in present study as shown in **Figure 117**, where the number in the circle represents the wind direction. The solid line in the middle represents the direction of the flow and the direction of the bridge axis. Thus the wind direction of Case 1 is vertical to bridge site.

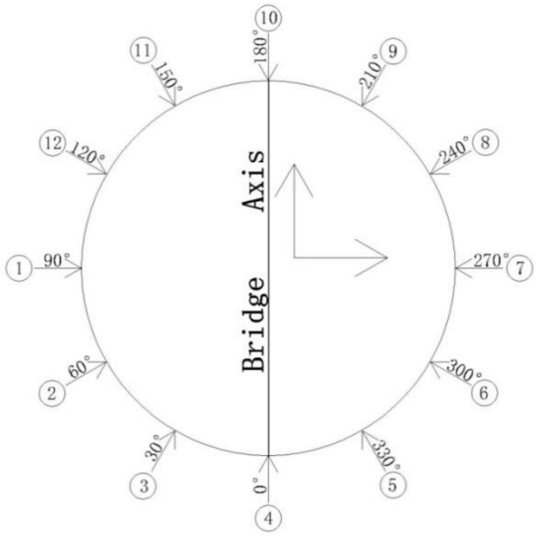


Figure 117. **Case setup**

2.3.2.4.2.2.4 Set of wind profile

In wind field numerical simulation, wind profile at the entrance is set with class A topography type according to the "Standard of Wind-resistant Design of Highway Bridges in China D60-01-2004”. Boundary layer height is set with 300 m (see **Figure 118**), with the wind speed *U* of 20 m/s at the height of 10 m.

Wind profile function at the inlet:

$$U = 20 \bullet (\frac{H}{10})^{0.12}, \quad 0 < H \leq 300m$$

$$U = 20 \bullet (\frac{300}{10})^{0.12} = 30.1, \quad H > 300m$$

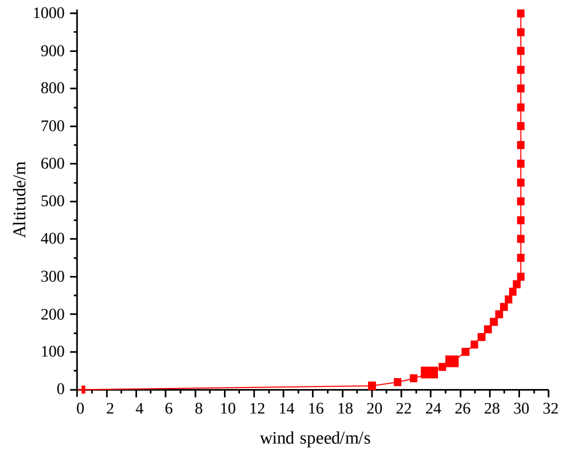


Figure 118. Wind profile at the entrance of the calculation domain

2.3.2.4.3 Numerical results

In order to study the influence of flow in different directions on the bridge wind field, a series of observation points are set on the bridge axis.

In order to visually describe the relationship between the wind speed at the observation point and the wind speed at the boundary entrance, the wind speed-up factor Cu, a dimensionless parameter, is defined, which is the ratio between the wind speed of the observation point to that on the inlet. V_b is the wind speed at the observation point, and V_{10} is the wind speed at a height of 10m on the inlet. C_U reflects the amplification or attenuation of the wind speed at the observation point. The wind angle of attack α and the wind direction angle β are important parameters describing the wind field of the bridge. The angle of attack α has an important influence on the wind resistance of the main beam. The positive angle of attack represents the updraft and the negative angle of attack represents the downdraft.

$$C_U = \frac{V_b}{V_1}$$

2.3.2.4.3.1 Result of wind speed influence coefficient at lane

The PGN Bridge project is an important traffic project in the Philippines so that the safety assessment of the impact caused by the wind is required. In order to ensure driving comfort and safety, present research calculates the wind speed influence coefficient λ_S within 4m height of the bridge lane center.

The layout of the lane of the bridge is shown in **Figure 119** and the first lane is at the windward position.。

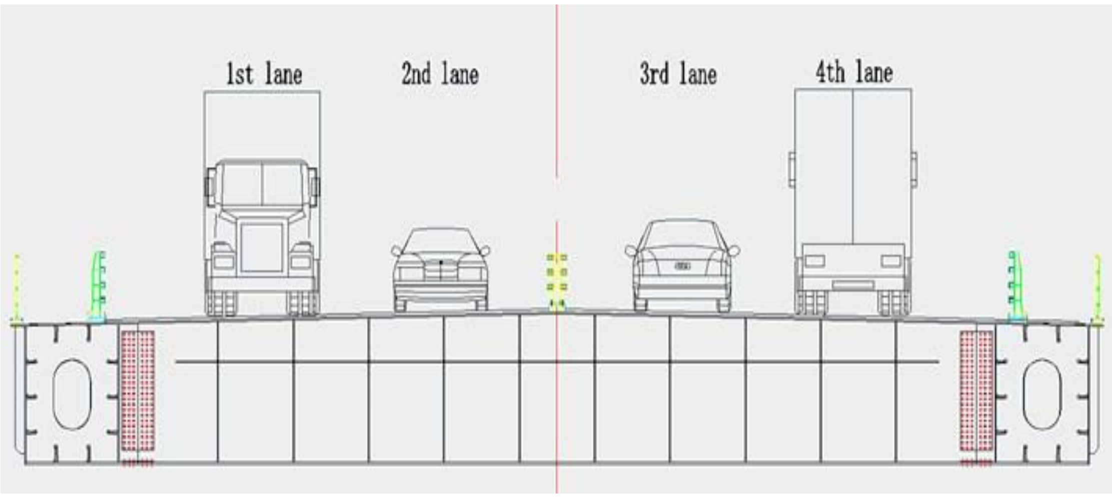


Figure 119. The Layout of the Lane

2.3.2.4.4 Conclusions

(1) The basic wind speed of the PGN Bridge, which is referred to the 10min mean wind speed at the standard height of 10m and 100-year return period, is 32.41m/s. The category of the bridge site can be classified as Class D as defined in the NSCP-2001 (Philippines Code).

(2) The designed wind speed at the height of bridge deck of the main bridge is 45.6 m/s, and the associated wind angle of attack can be limited into the range of -3°~+3°.

(3) The necessary meteorological parameters for the construction including temperature, humidity, rainfall and rainfall days at bridge sites were presented in this research.

(4) As the wind effects on the traffic lanes of two main bridges are so obvious, the corresponding wind barrier measures is essential to maintain the safety of vehicles.

(5) The aerodynamic coefficients of main girders for different design options were presented in this research.

2.3.2.5 Impact Assessment of Ambient Air during Construction Period

Pollution from the project are mainly air-borne dusts, generated from activities such as road construction, pipeline construction, and vehicle operations. The effect of pollution will be high on buildings close to the project site. Use of commercial asphalt is recommended in the construction, because its exhaust gas will have less impact.

(1) Air-borne dust from demolition and relocation

In the demolition and relocation on earlier stage, the air-borne dust from demolition and relocation may occur in the process of pushing, knocking and clearing transportation. The demolition of the project on earlier stage mainly involves the houses along the line. Therefore, in the process of demolition, it is necessary to strengthen the management, standardize the construction and adopt necessary ambient protection measures such as sprinkling water in order to reduce the air-borne dust impact on the periphery.

Air-borne dust from road and pipeline construction

The subsequent waste following the establishment of the pipeline and construction of the road will need to be cleared at the earliest in order to avoid dust emission by wind and air. The construction activities such as loading and unloading on the construction site will also increase air-borne dust.

Bridge construction

Bridge construction mainly includes the construction of the foundation, bridge superstructure, lifting and splicing stage. In comparison to the air born dust resulting from the pavement construction, the impact of air-borne dust caused by bridge construction is relatively small. This is because, it neither involves the construction of a new pavement nor produces secondary air borne dust from driving on unfinished pavements.

Secondary air-borne dust from driving vehicles

The scattering dust from the vehicles used to transport concrete and muck along the way, which will increase the amount of air-borne dust on the driving routes, especially at the construction road, the entrance and exit points of the work sites.

Air-borne dust in storage yard

Storage yards are required to store construction materials such as lime, sand and stones for road construction. The air-borne dust blown by wind and generated in the loading and unloading process at storage yards will lead to air pollution. The volume of dust emission in the storage yard is closely related to the type and nature of materials and wind speed. For example, the materials with smaller gravity are more prone to dusting when they are disturbed and materials with large proportion of small particles, the corresponding degree of dusting will be high. The contractor will take the effective measures to alleviate the air-borne dust pollution, and watering is a comparatively effective way to control such dust.

Air-borne dust from material mixing

The concrete mixing stations is set up in three construction sites for the project. If the mixing station in the construction site is near residential areas, the impact on these residences will be high unless mitigation measures are taken. Thus, all mixing stations will adopt concentrated mixing mode and will operate in a fully enclosed space, to minimise the impact of air-borne dust in mixing process and to control the air-borne dust pollution from mixing materials.

In conclusion, the air-borne dust pollution during the construction period of the project is mainly from the road construction dust, the pipeline construction dust, construction air-borne dust in storage yards and from mixing materials. Strict pollution control plans and precautionary measures in accordance with the relevant laws and regulations will need to be executed to effectively control and alleviate air-borne dust pollution.

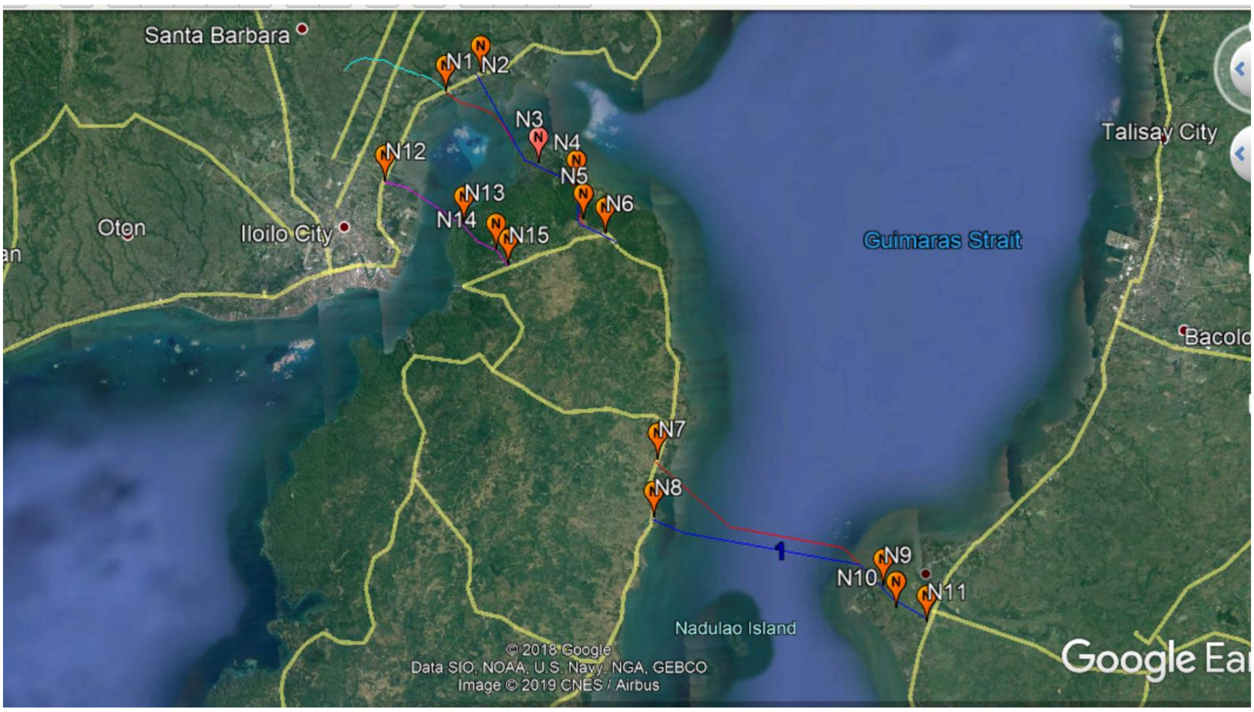
2.3.2.6 Mitigation Measures during Construction Period

Specific measures about prevention and control of dust pollution are as follows:

- Fixed hard enclosure walls not lower than 2 m high will be set up around the construction area of the proposed project to prevent the impact of air-borne dust in the construction site; the contractor will assure that trained staff will be responsible for the maintenance and repair of facilities and for regular inspections.
- Optimize the layout plan of construction site in Male: the concrete mixing area where the air-borne dust is produced will be arranged on the eastern side, away from residential area.
- When the construction machineries are at work in the construction process of roadbed, pipelines, etc., the surface should be regularly watered to prevent air-borne dust pollution.
- Facilities to wash vehicles, matched drainage facilities and mud sedimentation facilities will be set up at the construction site. The carrier vehicles will be washed, covered and cleaned thoroughly daily. This will prevent the construction materials, rubble and muck from scattering.
- The road used to transport materials and the road in and out of the storage yard will be watered timely. The contractor will provide watering carts for watering twice a day and watering number should be appropriately increased in humid weather or strongly windy weather to prevent air-borne dust on the pavements.
- Wind proofing and covering will be required for the materials such as concretes, sand and lime that can be easy to be scattered during loading and unloading, transporting, transferring and temporarily storing.
- Mortar and concrete will be mixed openly in the construction site similar to other open type processing operations that are prone to air-borne dust.
- The demolition and dismantlement of construction structures shall be carried out in calm weather conditions with lower levels of wind speed in order to reduce the amount of air-borne pollutants. Any unfinished work of the day should be covered along with watering measures as well.

2.3.3 Noise Quality

Noise measurements were collected on April 2 to 11, 2019 & July 6-9, 2019 at Municipalities of Leganes, Iloilo, Buenavista, San Lorenzo, Guimaras and Pulupandan, Negros Occidental. **Figure 120** shows the noise sampling locations for PGN project. Weather condition at the time of sampling was sunny to cloudy with slight rains. Twenty-four (24) hours measurement were sampled for Noise level. **Table 93** presents the sampling sites, date and time of collection conducted in Iloilo, Guimaras and Negros Occidental.



Source: Google Earth

Figure 120. Noise Sampling locations at PGN Project

Table 94. Summary of Noise Sampling Stations, Coordinates, Date and Time of Samplings

Station No.	Sampling Stations	Coordinates	Date and Time of Samplings
N1	Brgy. Gua-An, Leganes, Iloilo	10°46'54.20"N 122°36'59.08"E	July 9 ~ 10, 2019 12:20:20 PM to 12:20:20 PM
N2	Brgy. Nabitasan, Leganes, Iloilo	10°47'23.49"N 122°38'3.19"E	July 8 ~ 9, 2019 11:50:30 AM to 11:50:30 AM
N3	Brgy. Getulio, Buenavista, Guimaras	10°44'38.84"N 122°39'32.91"E	April 5-6, 2019 10:30:26 AM to 10:30:26 AM
N4	Brgy. Navalas, Buenavista, Guimaras	10°43'54.14"N 122°40'36.53"E	April 2-3, 2019 4:17:25 PM to 4:17:25 PM

N5	Brgy. Banban, Buenavista, Guimaras	10°42'55.51"N 122°40'44.40"E	April 5-6, 2019 1:51:19 PM to 1:51:19 PM
N6	Brgy. Cansilayan, Buenavista, Guimaras	10°42'28.72"N 122°41'21.09"E	April 3-4, 2019 4:46:41 PM to 4:46:41 PM
N7	Brgy. M. Chavez, San Lorenzo, Guimaras	10°35'53.07"N 122°42'23.90"E	April 6-7, 2019 3:10:08 PM to 3:10:08 PM
N8	Brgy. Cabano, San Lorenzo, Guimaras	10°34'13.17"N 122°42'9.44"E	April 6-7, 2019 11:59:33 AM to 11:59:33 AM
N9	Brgy. Pag-ayon, Pulupandan, Negros Occidental	10°31'46.80"N 122°48'43.83"E	April 9-10, 2019 10:55:16 AM to 10:49:15 AM
N10	Brgy. Ubay, Pulupandan, Negros Occidental	10°31'6.20"N 122°49'3.46"E	April 10-11, 2019 1:56:42 PM to 1:56:42 PM
N11	Brgy. Ubay near Lagasan Boundary, Pulupandan, Negros Occidental	10°30'37.90"N 122°49'55.57"E	April 10-11, 2019 11:59:33 AM to 11:59:33 AM
N12	Brgy. Hinactacan, Jaro, Iloilo	10°44'25.81"N 122°35'1.37"E	July 6-7, 2019 11:27:40 AM to 11:27:40 AM
N13	Brgy, Dagsa-An, Buenavista, Guimaras	10°43'5.57"N 122°37'14.02"E	July 7-8, 2019 3:18:40 PM to 3:18:40 PM
N14	Purok Sinamay, Sitio Cabanbanan Brgy, Salvacion, Buenavista, Guimaras	10°42'11.59"N 122°38'9.26"E	July 6-7, 2019 2:15:20 PM to 2:15:20 PM
N15	Brgy, Salvacion, Buenavista, Guimaras	10°41'46.86"N 122°38'26.41"E	July 8-9, 2019 8:58:46 AM to 8:58:46 AM

2.3.3.1 Sampling Equipment

A digital sound level meter was used in the noise measurement activity conducted by CRL Calabarquez Corporation. The sound level meter used was Lutron that meets the IEC 61672 standard, class 1. The equipment have A frequency weighting and fast time weighting with a measurement range of 30 dB to 130 dB and resolution of 0.1 dB.

2.3.3.2 Sampling Methodologies

The noise measurements were conducted within selected sites of PGN Island Bridges Project. The lowest and highest noise levels monitored were recorded thru data logger. The multiple sounds reading each station was recorded and summarized by getting its logarithmic average. The result of this gave the equivalent noise level (Leq).

2.3.3.3 Results and Discussions

Table 94a to Table 94o present the results of noise level monitoring conducted from the two (2) stations. The results of each station are summarized by getting the lowest (Min) and highest (Max) readings and by computing the equivalent continuous noise level in its logarithmic form (L_{Aeq}) for each time period. The results are compared with the DENR Ambient Noise Quality Standards Sec. 78 Chapter IV, Article 1 of National Pollution Control Commission (NPCC) Rules and Regulations, 1978 standard limits for Class "AA" School Area Category; Class "A" Residential Category and using correction factor of "+5 dBA" if sampling area is facing four (4) lanes road and Class "B" Industrial Category.

Based on the results of noise measurement, some areas failed to meet the standard limit set fort. However most of the said exceedances are not critical since high noise level created during sampling are mostly intermittent only specifically those coming from animals like barking of dogs, rooster crowing, etc.

Attached are the recorded noise measurements in 24-hour period.

Table 95a. (N1) Noise Data at Brgy. Gua-An, Leganes, Iloilo

Sampling Time	Logarithmic Average dB (A)	Remarks	Noise Sources
Morning (0500H - 0900H)	57.45	Passed	Noise came from passing-by of vehicles, from operation of nearby feed mill factory, residents activity, from dogs barking, from insects.
Daytime (0900H - 1800H)	60.60	Passed	
Evening (1800H - 2200H)	57.72	Passed	
Nighttime (2200H - 0500H)	53.78	Passed	

***Category	"B":	A section or contiguous area which zoned or used as heavy industrial area
0900H – 1800 H	65	dB (Daytime)[Maximum allowable limit based on division of 24-hour sampling]
1800H – 2200 H	60	dB (Evening)[Maximum allowable limit based on division of 24-hour sampling]
2200H – 0500 H	55	dB (Night time)[Maximum allowable limit based on division of 24-hour sampling]
0500H – 0900 H	60	dB (Morning)[Maximum allowable limit based on division of 24-hour sampling]

Note: Monitoring was conducted on a 2-hour interval. In practice, the start of sampling time is used as the basis for noise divisions.

Table 94b. (N2) Noise Data at Brgy. Nabitasan, Leganes, Iloilo

Sampling Time	Logarithmic Average dB (A)	Remarks	Noise Sources
Morning (0500H - 0900H)	59.82	Failed	Noise came from passing-by of vehicles, from dogs barking and from insects.
Daytime (0900H - 1800H)	66.94	Failed	
Evening (1800H - 2200H)	58.97	Failed	
Nighttime (2200H - 0500H)	53.74	Failed	

***Category "A": A section or contiguous area which is primarily used for residential purposes.
" I " Areas directly fronting or facing a four-lane road ……….+ 5 dBA
0900H – 1800 H 55 + 5 dB (Daytime)[Maximum allowable limit based on division of 24-hour sampling]
1800H – 2200 H 50 + 5 dB (Evening)[Maximum allowable limit based on division of 24-hour sampling]
2200H – 0500 H 45 + 5 dB (Night time)[Maximum allowable limit based on division of 24-hour sampling]
0500H – 0900 H 50 + 5 dB (Morning)[Maximum allowable limit based on division of 24-hour sampling]

Table 94c. (N3) Noise Data at Brgy. Getulio, Buenavista, Guimaras

Sampling Time	Logarithmic Average dB (A)	Remarks	Noise Sources
Morning (0500H - 0900H)	63.38	Failed	Noise came from residents activity, kids playing, loud music, dogs barking, birds chirping, roosters crowing, insects like crickets and others.
Daytime (0900H - 1800H)	63.25	Failed	
Evening (1800H - 2200H)	42.99	Passed	
Nighttime (2200H - 0500H)	64.93	Failed	

***Category "A": A section or contiguous area which is primarily used for residential purposes.
0900H – 1800 H 55 dB (Daytime)[Maximum allowable limit based on division of 24-hour sampling]
1800H – 2200 H 50 dB (Evening)[Maximum allowable limit based on division of 24-hour sampling]
2200H – 0500 H 45 dB (Night time)[Maximum allowable limit based on division of 24-hour sampling]
0500H – 0900 H 50 dB (Morning)[Maximum allowable limit based on division of 24-hour sampling]

Table 94d. (N4) Noise Data at Brgy. Navalas, Buenavista, Guimaras

Sampling Time	Logarithmic Average dB (A)	Remarks	Noise Sources
Morning (0500H - 0900H)	44.64	Passed	Noise came from residents activity, kids playing, cow mooing, dogs barking, birds chirping, roosters crowing, insects like crickets and others.
Daytime (0900H - 1800H)	59.22	Failed	
Evening (1800H - 2200H)	65.23	Failed	
Nighttime (2200H - 0500H)	44.64	Passed	

***Category "A": A section or contiguous area which is primarily used for residential purposes.
0900H – 1800 H 55 dB (Daytime)[Maximum allowable limit based on division of 24-hour sampling]
1800H – 2200 H 50 dB (Evening)[Maximum allowable limit based on division of 24-hour sampling]
2200H – 0500 H 45 dB (Night time)[Maximum allowable limit based on division of 24-hour sampling]
0500H – 0900 H 50 dB (Morning)[Maximum allowable limit based on division of 24-hour sampling]
Note: Monitoring was conducted on a 2-hour interval. In practice, the start of sampling time is used as the basis for noise divisions.

Table 94e. (N5) Noise Data at Brgy. Banban, Buenavista, Guimaras

Sampling Time	Logarithmic Average dB (A)	Remarks	Noise Sources
Morning (0500H - 0900H)	54.26	Failed	Noise came from residents activity, vehicles passing-by, kids playing cow mooing, dogs barking, birds chirping, roosters crowing, insects like crickets and others.
Daytime (0900H - 1800H)	59.53	Failed	
Evening (1800H - 2200H)	45.84	Passed	
Nighttime (2200H - 0500H)	53.07	Failed	

***Category "A": A section or contiguous area which is primarily used for residential purposes.
0900H – 1800 H 55 dB (Daytime)[Maximum allowable limit based on division of 24-hour sampling]
1800H – 2200 H 50 dB (Evening)[Maximum allowable limit based on division of 24-hour sampling]
2200H – 0500 H 45 dB (Night time)[Maximum allowable limit based on division of 24-hour sampling]
0500H – 0900 H 50 dB (Morning)[Maximum allowable limit based on division of 24-hour sampling]

Table 94f. (N6) Noise Data at Brgy. Cansilayan, Buenavista, Guimaras

Sampling Time	Logarithmic Average dB (A)	Remarks	Noise Sources
Morning (0500H - 0900H)	55.00	Passed	Noise came from passing by of vehicles, residents activity, dogs barking, birds chirping, roosters crowing, insects like crickets and others.
Daytime (0900H - 1800H)	60.20	Failed	
Evening (1800H - 2200H)	57.65	Failed	
Nighttime (2200H - 0500H)	55.85	Failed	

***Category "A": A section or contiguous area which is primarily used for residential purposes.
" I " Areas directly fronting or facing a four-lane road ……….+ 5 dBA
0900H – 1800 H 55 + 5 dB (Daytime)[Maximum allowable limit based on division of 24-hour sampling]
1800H – 2200 H 50 + 5 dB (Evening)[Maximum allowable limit based on division of 24-hour sampling]
2200H – 0500 H 45 + 5 dB (Night time)[Maximum allowable limit based on division of 24-hour sampling]
0500H – 0900 H 50 + 5 dB (Morning)[Maximum allowable limit based on division of 24-hour sampling]

Table 94g. (N7) Noise Data at Brgy. M. Chavez, San Lorenzo, Guimaras

Sampling Time	Logarithmic Average dB (A)	Remarks	Noise Sources
Morning (0500H - 0900H)	57.05	Failed	Noise came from passing by of vehicles, wind turbine operation, residents activity, cow mooing, dogs barking, birds chirping, roosters crowing, insects like crickets and others.
Daytime (0900H - 1800H)	56.28	Passed	
Evening (1800H - 2200H)	50.31	Passed	
Nighttime (2200H - 0500H)	50.66	Failed	

***Category "A": A section or contiguous area which is primarily used for residential purposes.
" I " Areas directly fronting or facing a four-lane road ……….+ 5 dBA
0900H – 1800 H 55 + 5 dB (Daytime)[Maximum allowable limit based on division of 24-hour sampling]
1800H – 2200 H 50 + 5 dB (Evening)[Maximum allowable limit based on division of 24-hour sampling]
2200H – 0500 H 45 + 5 dB (Night time)[Maximum allowable limit based on division of 24-hour sampling]
0500H – 0900 H 50 + 5 dB (Morning)[Maximum allowable limit based on division of 24-hour sampling]
Monitoring was conducted on a 2-hour interval. In practice, the start of sampling time is used as the basis for noise divisions.

Table 94h. (N8) Noise Data at Brgy. Cabano, San Lorenzo, Guimaras

Sampling Time	Logarithmic Average dB (A)	Remarks	Noise Sources
Morning (0500H - 0900H)	54.45	Passed	Noise came from passing by of vehicles, wind turbine operation, residents activity, cow mooing, dogs barking, birds chirping, roosters crowing, insects like crickets and others.
Daytime (0900H - 1800H)	62.56	Failed	
Evening (1800H - 2200H)	49.89	Passed	
Nighttime (2200H - 0500H)	62.04	Failed	

***Category "A": A section or contiguous area which is primarily used for residential purposes.
" I " Areas directly fronting or facing a four-lane road ……….+ 5 dBA
0900H – 1800 H 55 + 5 dB (Daytime)[Maximum allowable limit based on division of 24-hour sampling]
1800H – 2200 H 50 + 5 dB (Evening)[Maximum allowable limit based on division of 24-hour sampling]
2200H – 0500 H 45 + 5 dB (Night time)[Maximum allowable limit based on division of 24-hour sampling]
0500H – 0900 H 50 + 5 dB (Morning)[Maximum allowable limit based on division of 24-hour sampling]

Table 94i. (N9) Noise Data at Brgy. Pag-ayon, Pulupandan, Negros Occidental

Sampling Time	Logarithmic Average dB (A)	Remarks	Noise Sources
Morning (0500H - 0900H)	52.22	Failed	Noise came from nearby construction activity, loud music from residential area, residents and school activity, dogs barking, roosters crowing and insects.
Daytime (0900H - 1800H)	55.05	Failed	
Evening (1800H - 2200H)	41.43	Passed	
Nighttime (2200H - 0500H)	43.30	Failed	

***Category "AA": A section or contiguous from area which required quietness, such as areas within 100 meters from school sites, nursery schools, hospitals, and special homes for the aged.
0900H – 1800 H 50 dB (Daytime)[Maximum allowable limit based on division of 24-hour sampling]
1800H – 2200 H 45 dB (Evening)[Maximum allowable limit based on division of 24-hour sampling]
2200H – 0500 H 40 dB (Night time)[Maximum allowable limit based on division of 24-hour sampling]
0500H – 0900 H 45 dB (Morning)[Maximum allowable limit based on division of 24-hour sampling]

Table 94j. (N10) Noise Data at Brgy. Ubay near Pag-Ayon Boundary, Pulupandan, Negros Occidental

Sampling Time	Logarithmic Average dB (A)	Remarks	Noise Sources
Morning (0500H - 0900H)	67.26	Failed	Noise came from residents activity, loud music, dogs barking, cow mooing, birds chirping, roosters crowing, insects like crickets and others.
Daytime (0900H - 1800H)	65.94	Failed	
Evening (1800H - 2200H)	69.95	Failed	
Nighttime (2200H - 0500H)	50.44	Failed	

***Category "A": A section or contiguous area which is primarily used for residential purposes.
0900H – 1800 H 55 dB (Daytime)[Maximum allowable limit based on division of 24-hour sampling]
1800H – 2200 H 50 dB (Evening)[Maximum allowable limit based on division of 24-hour sampling]
2200H – 0500 H 45 dB (Night time)[Maximum allowable limit based on division of 24-hour sampling]
0500H – 0900 H 50 dB (Morning)[Maximum allowable limit based on division of 24-hour sampling]
Note: Monitoring was conducted on a 2-hour interval. In practice, the start of sampling time is used as the basis for noise divisions.

Table 94k. (N11) Noise Data at Brgy. Ubay near Lagasan Boundary, Pulupandan, Negros Occidental

Sampling Time	Logarithmic Average dB (A)	Remarks	Noise Sources
Morning (0500H - 0900H)	63.98	Failed	Noise came from vehicle passing-by, residents activity, loud music, dogs barking, cow mooing, birds chirping, roosters crowing, insects like crickets and others.
Daytime (0900H - 1800H)	65.98	Failed	
Evening (1800H - 2200H)	74.88	Failed	
Nighttime (2200H - 0500H)	60.25	Failed	

***Category "A": A section or contiguous area which is primarily used for residential purposes.
0900H – 1800 H 55 dB (Daytime)[Maximum allowable limit based on division of 24-hour sampling]
1800H – 2200 H 50 dB (Evening)[Maximum allowable limit based on division of 24-hour sampling]
2200H – 0500 H 45 dB (Night time)[Maximum allowable limit based on division of 24-hour sampling]
0500H – 0900 H 50 dB (Morning)[Maximum allowable limit based on division of 24-hour sampling]

Table 94l. (N12) Noise Data at Brgy. Hinactacan, Jaro, Iloilo

Sampling Time	Logarithmic Average dB (A)	Remarks	Noise Sources
Morning (0500H - 0900H)	46.70	Passed	Noise came from vehicle passing-by, residents activity and insects.
Daytime (0900H - 1800H)	47.40	Passed	
Evening (1800H - 2200H)	46.10	Passed	
Nighttime (2200H - 0500H)	44.90	Passed	

***Category "A": A section or contiguous area which is primarily used for residential purposes.
0900H – 1800 H 55 dB (Daytime)[Maximum allowable limit based on division of 24-hour sampling]
1800H – 2200 H 50 dB (Evening)[Maximum allowable limit based on division of 24-hour sampling]
2200H – 0500 H 45 dB (Night time)[Maximum allowable limit based on division of 24-hour sampling]
0500H – 0900 H 50 dB (Morning)[Maximum allowable limit based on division of 24-hour sampling]

Table 94m. (N13) Noise Data at Brgy. Dagsa-An, Buenavista, Guimaras

Sampling Time	Logarithmic Average dB (A)	Remarks	Noise Sources
Morning (0500H - 0900H)	49.18	Failed	Noise came from vehicle passing-by, residents activity, kids playing, dogs barking, roosters crowing, birds chirping, crickets and other insects.
Daytime (0900H - 1800H)	58,59	Failed	
Evening (1800H - 2200H)	51.05	Failed	
Nighttime (2200H - 0500H)	50.47	Failed	

***Category "A": A section or contiguous area which is primarily used for residential purposes.
0900H – 1800 H 55 dB (Daytime)[Maximum allowable limit based on division of 24-hour sampling]
1800H – 2200 H 50 dB (Evening)[Maximum allowable limit based on division of 24-hour sampling]
2200H – 0500 H 45 dB (Night time)[Maximum allowable limit based on division of 24-hour sampling]
0500H – 0900 H 50 dB (Morning)[Maximum allowable limit based on division of 24-hour sampling]
Note: Monitoring was conducted on a 2-hour interval. In practice, the start of sampling time is used as the basis for noise divisions.

Table 94n. (N14) Noise Data at Purok Sinamay, Sitio Cabanbanan, Brgy. Salvacion, Buenavista, Guimaras

Sampling Time	Logarithmic Average dB (A)	Remarks	Noise Sources
Morning (0500H - 0900H)	49.81	Passed	Noise came from vehicle passing-by, residents activity, dogs barking and insects.
Daytime (0900H - 1800H)	54.80	Passed	
Evening (1800H - 2200H)	49.23	Passed	
Nighttime (2200H - 0500H)	43.32	Passed	

***Category "A": A section or contiguous area which is primarily used for residential purposes.
0900H – 1800 H 55 dB (Daytime)[Maximum allowable limit based on division of 24-hour sampling]
1800H – 2200 H 50 dB (Evening)[Maximum allowable limit based on division of 24-hour sampling]
2200H – 0500 H 45 dB (Night time)[Maximum allowable limit based on division of 24-hour sampling]
0500H – 0900 H 50 dB (Morning)[Maximum allowable limit based on division of 24-hour sampling]
Note: Monitoring was conducted on a 2-hour interval. In practice, the start of sampling time is used as the basis for noise divisions.

Table 94o. (N15) Noise Data at Sitio Cabanbanan, Brgy. Salvacion, Buenavista, Guimaras

Sampling Time	Logarithmic Average dB (A)	Remarks	Noise Sources
Morning (0500H - 0900H)	47.60	Passed	Noise came from residents activity, dogs barking and insects.
Daytime (0900H - 1800H)	45.90	Passed	
Evening (1800H - 2200H)	46.50	Passed	
Nighttime (2200H - 0500H)	42.70	Passed	

***Category "A": A section or contiguous area which is primarily used for residential purposes.
0900H – 1800 H 55 dB (Daytime)[Maximum allowable limit based on division of 24-hour sampling]
1800H – 2200 H 50 dB (Evening)[Maximum allowable limit based on division of 24-hour sampling]
2200H – 0500 H 45 dB (Night time)[Maximum allowable limit based on division of 24-hour sampling]
0500H – 0900 H 50 dB (Morning)[Maximum allowable limit based on division of 24-hour sampling]
Note: Monitoring was conducted on a 2-hour interval. In practice, the start of sampling time is used as the basis for noise divisions.

2.3.3.4 Impact Assessment on Ambient Noise during Construction Period

2.3.3.4.1 Construction Machinery and Distribution

Noise sources of the planned project in the construction stage mainly come from construction machinery, supplemented by radiation noise of transport vehicles. Specific construction machinery used in the project and their distribution are:

- Drilling machine: this project adopts bored pile construction.
- Lifting machine: it is mainly used in hoisting and splicing of bridge precast box girder;

- Concrete mixer and concrete vibrator are mainly used in the bridge foundation construction, casting and compacting of concrete works. They will be used in all work sites.
- Asphalt paver, electric drill, electric saw, and cutting machine and so on are manly applied in pavement construction and traffic engineering construction, with comparatively less impact.
- Rollers, bulldozers, excavators, and pneumatic picks and so on are mainly used in the construction of roads.
- Dump trucks are mainly employed in the construction sites, to transport building material to construction site and convey construction wastes and project dregs to the designated locations.

2.3.3.4.2 Noise vibration impact during the construction period

(1) Analysis of construction noise impact
Significant noise and vibration impacts are anticipated during the construction of ground roads and bridge engineering.

Ground road construction is mainly involved in the bridge landing areas. During ground road construction, rain pipes, sewage pipes, electricity channel and communication conduits, and various municipal pipelines shall be installed by excavating the both sides of the road. The construction machinery used primarily includes a pneumatic pick, drilling machine, bulldozer, excavator, air compressor, loader, land leveler, vibratory roller, and concrete mixer truck and transport vehicles. The noise intensity of these machineries is high, and part of them will generate vibration impact, having greater effect on the surrounding sensitive spots.

The major noises in the bridge construction are generated by: the perfusion of drilling machinery adopted in the foundation construction; casting and compacting of concrete in the pier sites; lifting machine or erecting machines and related activities and so on. During the bridge construction, vibration mainly comes from the construction process of bridge pile foundation. According to the approved designing scheme, the bored pile construction adopted in this project has less vibration impact than the pile drivers. The nearest distance between piers and residential buildings is about 100 m. In addition to the pile casting, all other construction activities related to the foundation works have comparatively less impact on the residential building.

The nearest residential building is approximately 20 m from this site. Hence, noise and vibration generated at this site is likely to be a nuisance to the residents in this area.
In order to mitigate construction noises impact, strict management measures shall be taken in the
construction process, as well as strengthened noise reduction measure of the works.

(2) Analysis on acoustic environment impact of the transportation vehicles

In the process of construction, a great deal of transportation marine vessels and land vehicles are required. Large transport vehicles emit loud noises, which usually cause greater impacts on the acoustic environment along transport roads. Furthermore, horns, overloads, over-speeding, and construction at midnight, etc. all may worsen such noises impacts.

2.3.3.4.3 Mitigation Measures

- Delineate the construction sites and in the worksites, erect a boundary wall that is no less than 2 m high around the construction area.
- While implementing the general layout of construction site, the equipment producing loud noises shall be set away from residential area close to the construction site. The office and living area that will not produce loud noises shall be arranged in the side of work site near

the residential area. And at the same time, distribute the construction site rationally to minimize the effects on surrounding residential areas.

- According to impact analysis during the construction period, construction at night with strong noise has a higher impact, especially the sensitive buildings at the start section. So, the construction plan needs to be arranged reasonably during planning. The project should avoid all construction work during nighttime which involves high noise pollution. These may exclude continuous pouring of concrete and repair work. If it requires construction between 22:00 and 06:00 the next day, contractor should ask for the opinions and approvals from the local municipal administrative authority. After acquiring permission of nighttime construction, the requirements for noise mitigation shall be strictly followed. In cased of bored pile construction at night-time, casting and compacting of concrete as well as horns of all the vehicles in and out of the construction site shall be forbidden.

- Strengthen the maintenance of construction equipment. Keep it lubricated and fasten all parts to reduce vibration noises while operating. Construction mechanical equipment should be placed firmly and steadily on the ground and if possible, vibration attenuation base should be used.

- Reasonably arrange the driving routes and schedules for construction vehicles in and out of the site and strengthen the management of those construction vehicles. No horns watch out the speed limit and drive courteously to reduce the traffic noises. Construction vehicles should try to avoid the driving in residential areas. For those that have to pass through the residential areas, a reasonable driving plan shall be made and negotiation and communication with neighboring residents shall be strengthened, to prevent the noise disturbance to the residents.

2.4 Baseline in Socio-Economic Condition

2.4.1 Demographic Data

2.4.1.1 Household and Household Size

In terms of household number, the highest in the PSA 2015 records is the municipality of Buenavista, Guimaras with 12,115 household population. Household size of the four (4) municipalities are in 4 while the highest household head are male.

Table 96. Household and Household Size in the Municipalities Affected by the Project

Province	Municipality	Household Number			Household Size
		Male Headed Households	Female Headed Households	Total	
Iloilo	Leganes	5,601	1,432	7,033	4.6
Guimaras	Buenavista	9,977	2,138	12,115	4.2
	San Lorenzo	4,954	1,041	5,995	4.4
Negros Occidental	Pulupandan	4,990	1,426	6,416	4.3

Source: Philippine Statistics Authority, 2015

2.4.1.2 Population and Growth Rate

The located is located in one (1) Municipality in Iloilo, two (2) Municipalities in Guimaras and one (1) Municipality in Negros Occidental covering a total of 12 barangays. The total population of the 12 barangays are 19,097. Among the barangays cover, M. Chavez in the municipality of San Lorenzo, Guimaras and Getulio in the municipality of Buenavista, Guimaras have the highest population with 2,803 and 2,619, respectively. On the other hand, the least population within the project area is Barangay Pag-ayon with 981 populations.

Table 97. Population per Barangay Covered by the Project (2015, 2018)

Province	Municipality		Barangay	Population
Iloilo	Leganes	1	Guan	1,231
Guimaras	Buenavista	2	Cansilayan	1,369*
		3	Banban	1,205*
		4	Navalas	1,595*
		5	San Miguel	703*
		6	Getulio	2,619*
	San Lorenzo	7	M. Chavez	2,803
Negros Occidental	Pulupandan	8	Tapong	1,168
		9	Canjusa	1,991
		10	Zone 4A	1,516
		11	Pag-ayon	981
		12	Ubay	1,916
			Total	19,097

Source: Philippine Statistics Authority (2015)
Municipal Profile, Buenvista, Guimaras Island (2018)

Historically, there are significant changes in terms of population growth in the project area. Based on PSA data (2015), there is an increasing trend of population from 1960 to 2015 among the 4 municipalities covered except in 1995 in Buenavista, Guimaras and 1990 in Pulupandan, Negros Occidental. San Lorenzo in Guimaras records of population started only in 1995 since its creation by virtue of Republic Act No. 7897 on February 20, 1995.

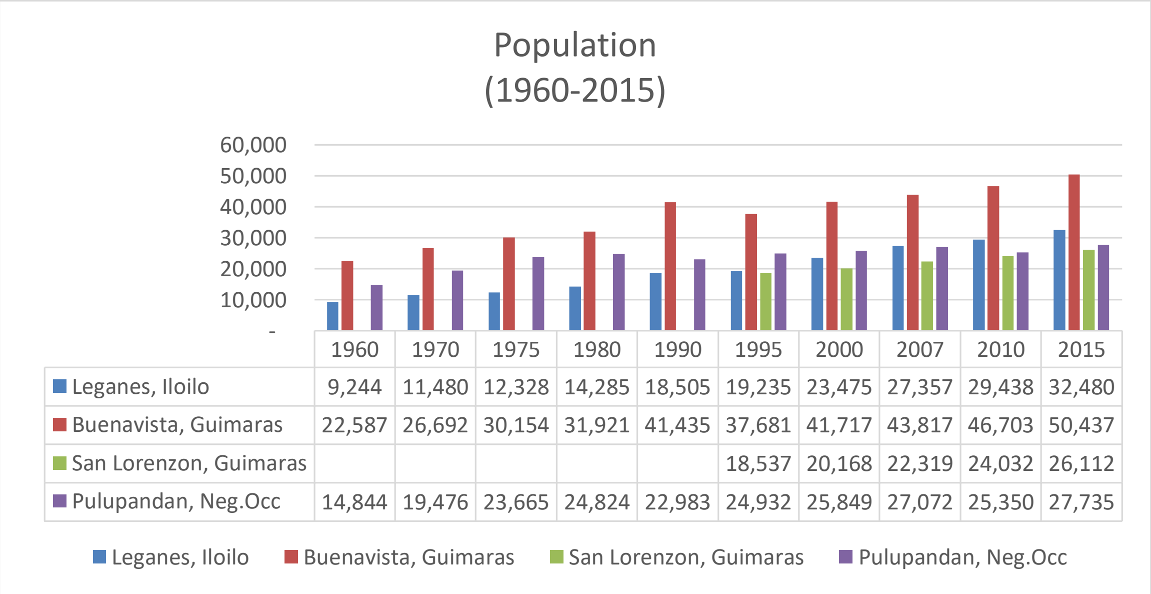


Figure 121. Population per Census Year in the Municipalities Affected by the Project

With regards to population growth (by province), Negros Occidental has the lowest annual average growth rate between the periods of 2000-2010 and 2010-2015, with 1.15 and 0.79, respectively. Iloilo and Guimaras, on the other hand have average growth rates of 1.48 and 1.42 between the periods of 2000-2010 and 1.34 and 1.33 between the periods of 2010-2015, which have only small gaps.

Table 98. Population Growth in the Municipalities Affected by the Project

Province	Annual Average Growth Rate (in percent)	
	2000-2010	2010-2015
Iloilo	1.48	1.34
Guimaras	1.42	1.33
Negros Occidental	1.15	0.79

Source: Philippine Statistics Authority, 2015

2.4.1.3 Population Density

Based on 2015 Census of Population and Housing of Philippine Statistics Office, the four (4) municipalities have a total population of 136,764 and an average population density of 717.5 persons/km2. The highest average population density among the municipalities covered is Pulupandan in Negros Occidental with 1,200 persons/km^2.

Table 99. Population Density in the Municipalities Affected by the Project

Province	Municipality	Population (2015)	Land area (km2)	Population density (persons/km^2)
Iloilo	Leganes	32,480	32.20	1,000
Guimaras	Buenavista	50,437	128.26	390
	San Lorenzo	26,112	93.04	280
Negros Occidental	Pulupandan	27,735	23.00	1,200

Source: Philippine Statistics Authority, 2015

2.4.1.4 Gender and age profile

As per census 2015 in the four (4) municipalities, male slightly dominates the female with a total population of 69,464 and 67,300 and with percentages of 50.79% and 49.21% respectively.

In terms of broad-age grouping, majority of the population belongs to the 5-9 years old bracket with 13,338, closely followed by the 10-14 brackets at 12,641. The group with the least population was the 80 years old and over with only 1,638.

Table 100. Population by Group Age in the Municipalities Affected by the Project

All Ages	Buenavista		San Lorenzo		Leganes		Pulupandan	
	Male	Female	Male	Female	Male	Female	Male	Female
Under 1	425	373	248	237	311	305	219	222
1 - 4	1,898	1,819	1,176	1,129	1,324	1,244	983	848
5 - 9	2,438	2,317	1,393	1,376	1,653	1,572	1,322	1,267
10 - 14	2,295	2,170	1,341	1,217	1,564	1,514	1,269	1,271

15 - 19	2,333	2,171	1,323	1,214	1,553	1,475	1,324	1,157
20 - 24	2,310	2,163	1,265	1,108	1,519	1,533	1,298	1,234
25 - 29	2,236	2,194	1,167	1,005	1,402	1,275	1,188	1,083
30 - 34	2,065	1,928	1,026	878	1,243	1,140	1,033	1,017
35 - 39	1,870	1,576	953	757	1,160	1,127	1,052	940
40 - 44	1,630	1,460	834	720	998	979	959	905
45 - 49	1,392	1,335	678	638	885	871	840	853
50 - 54	1,247	1,259	574	555	781	796	760	734
55 - 59	1,146	1,073	511	497	636	642	615	612
60 - 64	901	876	391	392	467	543	452	539
65 - 69	579	684	246	300	330	398	313	389
70 - 74	365	480	193	216	216	304	169	266
75 - 79	269	417	118	168	134	213	123	225
80 years and over	236	507	113	155	105	268	79	175
Total	**25,635**	**24,802**	**13,550**	**12,562**	**16,281**	**16,199**	**13,998**	**13,737**

Source: Philippine Statistics Authority, 2015

There is a gender and development in the four (4) municipalities affected by the project. They implemented the equal protection or treatment to women. Part of their gender and development initiatives is the implementation of GAD-ECCD Program which consider gender welfare as well as early childhood care and development.

2.4.1.5 Literacy Rate

In terms of literacy, age group from 10-14 and 15-19 has the highest population recorded in all municipalities affected while the least in terms of population are those age group of 60-64. Highest literacy in the data of PSA (2015) is in the municipality of Buenavista, Guimaras with 41,122 populations.

Table 101. Literacy by Age Group

Age Group	Leganes, Iloilo	Buenavista, Guimaras	San Lorenzo, Guimaras	Pulupandan, Neg Occ
10 – 14	3,078	4,465	2,558	2,540
15 – 19	3,015	4,500	2,536	2,481
20 – 24	2,971	4,468	2,373	2,532
25 – 29	2,673	4,423	2,170	2,265
30 – 34	2,381	3,993	1,903	2,045
35 – 39	2,287	3,436	1,709	1,991
40 – 44	1,976	3,081	1,553	1,861
45 – 49	1,756	2,724	1,316	1,692

Age Group	Leganes, Iloilo	Buenavista, Guimaras	San Lorenzo, Guimaras	Pulupandan, Neg Occ
50 – 54	1,577	2,506	1,127	1,493
55 – 59	1,278	2,215	1,008	1,227
60 – 64	1,009	1,777	783	991
65 years old and over	1,967	3,534	1,509	1,739
Total	25,968	41,122	20,545	22,857

Source: Philippine Statistics Authority, 2015

2.4.1.6 Education

In terms of access to educational services in the four (4) municipalities affected by the project, availability of school facilities is accessible. In terms of population of highest grade level completed, Philippine Statistics Authority (2015), the highest grade completed of most of the population in the affected municipalities are high school while post baccalaureate has the least number. Special education is available in all municipalities. Table below presents the grade level completed with corresponding numbers of population.

Table 102. Highest Grade/Year Completed in the Municipalities Affected by the Project

Highest Grade/Year Completed	Leganes, Iloilo	Buenavista, Guimaras	San Lorenzo, Guimaras	Pulupandan, Neg Occ
No Grade Completed	572	851	386	454
Pre-School	841	1,176	735	612
Special Education	14	4	5	7
Elementary	7,658	13,103	9,215	7,394
1st - 4th Grade	3,828	6,324	4,561	3,461
5th - 6th Grade	1,229	2,469	1,743	1,287
Graduate	2,601	4,310	2,911	2,646
High School	9,909	16,737	8,537	10,870
Undergraduate	4,040	6,575	3,553	3,265
Graduate	5,869	10,162	4,984	7,605
Post-Secondary	1,750	2,116	696	992
Undergraduate	12	23	33	33
Graduate	1,738	2,093	663	959

Highest Grade/Year Completed	Leganes, Iloilo	Buenavista, Guimaras	San Lorenzo, Guimaras	Pulupandan, Neg Occ
College Undergraduate	3,422	4,957	1,978	2,258
Academic Degree Holder	5,066	6,927	1,750	2,854
Post Baccalaureate	50	43	16	19
Not Stated	14	8	4	3
Total	**29,296**	**45,922**	**23,322**	**25,463**

Source: Philippine Statistics Authority, 2015

2.4.1.7 Settlement in the Project Alignment

Figure 122 presents initial settlement locations within and proximity of the bridge and road alignment generated from the Geographic Information System and google earth. These settlements will be affected on the implementation of the project. It will be further detailed during the implementation of Resettlement Action Plan (RAP).

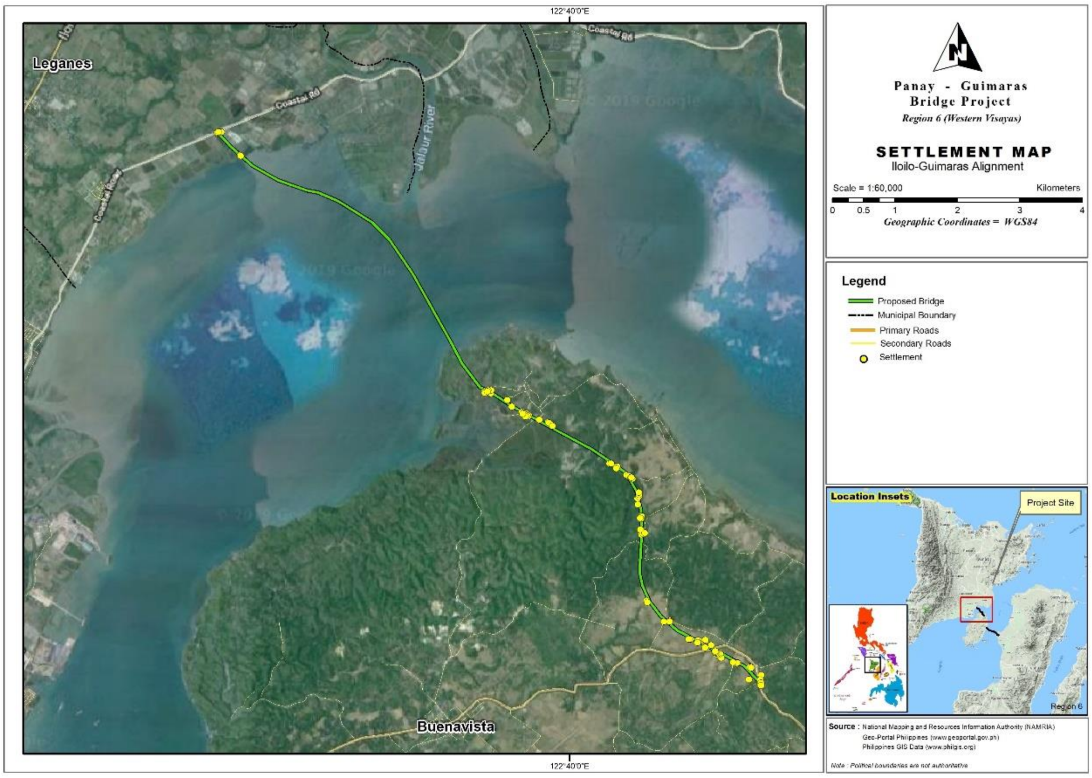


Figure 122a. Settlement Map in the Project Alignment (Panay-Guimaras segment)

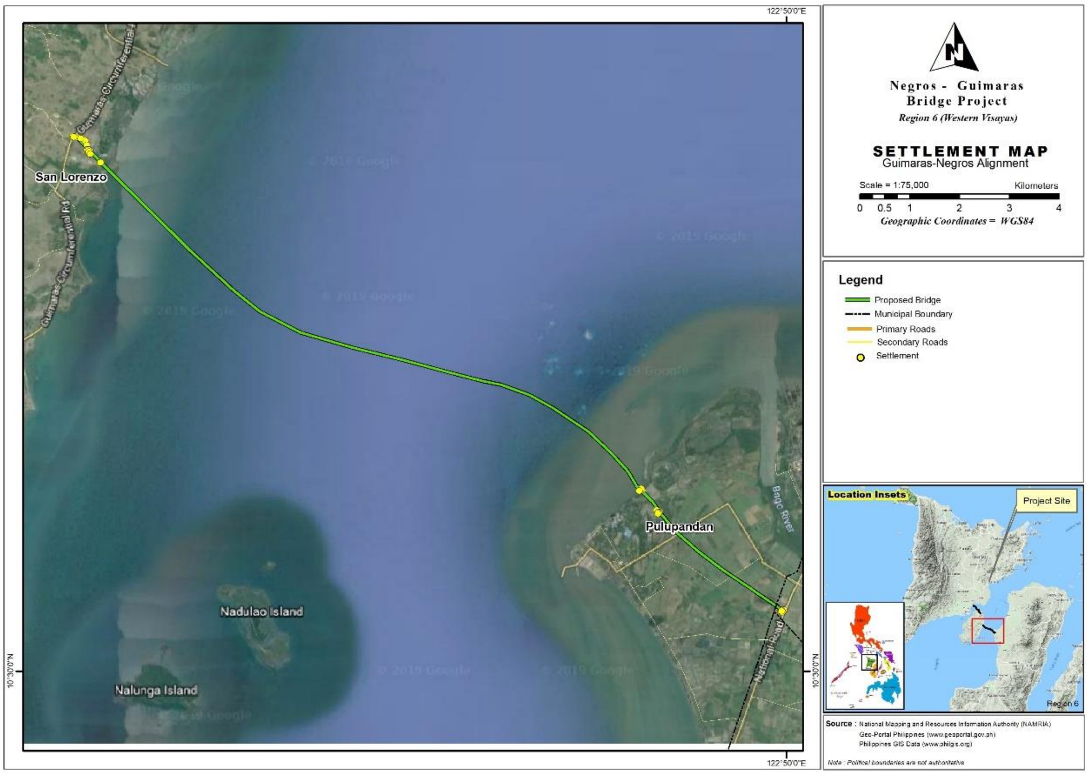


Figure 122b. Settlement Map in the Project Alignment (Guimaras-Negros segment)

2.4.2 In-Migration

2.4.2.1 Housing ownership profile

Most housing units found in the municipalities are made of both permanent and semi-permanent materials. On the other hand, housing units that are made of lights materials like cogon, nipa and bamboo are commonly seen in the rural areas.

The most common type of materials used for roofing and walling purposes are made up of strong materials like galvanized iron, wood, and concrete. About 24,343 households are made up of strong materials, 10,429 of which are made up of light materials like nipa, sawali, cogon and bamboo.

Table 103. Construction materials of roof and wall in the Municipalities Affected by the Project

Construction Materials of the Outer Walls and City/Municipality	Total Occupied Housing Units	Construction Materials of the Roof							
		Galvanized iron/aluminum	Tile/concrete/clay tile	Half galvanized iron and half concrete	Bamboo/ cogon/ nipa/anahaw	Asbestos	Make shift/ salvaged/ improvised materials	Trapal	Others
BUENAVISTA									
Total	12,077	10,642	22	187	1,219	-	3	3	1
Concrete/brick/stone	3,911	3,876	10	16	9	-	-	-	-

Construction Materials of the Outer Walls and City/Municipality	Total Occupied Housing Units	Construction Materials of the Roof							
		Galvanized iron/aluminum	Tile/concrete/clay tile	Half galvanized iron and half concrete	Bamboo/cogon/nipa/anahaw	Asbestos	Makeshift/salvaged/improvised materials	Trapal	Others
Wood	1,475	1,365	7	18	84	-	-	1	-
Half concrete/brick/stone and half wood	2,947	2,802	5	117	23	-	-	-	-
Galvanized iron/aluminum	49	41	-	1	7	-	-	-	-
Bamboo/sawali/cogon/nipa	3,647	2,522	-	34	1,089	-	1	-	1
Asbestos	4	3	-	1	-	-	-	-	-
Glass	-	-	-	-	-	-	-	-	-
Makeshift/salvaged/improvised materials	18	11	-	-	5	-	2	-	-
Trapal	8	4	-	-	2	-	-	2	-
Others	1	1	-	-	-	-	-	-	-
No walls	4	4	-	-	-	-	-	-	-
Not Reported	13	13	-	-	-	-	-	-	-
SAN LORENZO									
Total	5,991	5,031	16	148	795	-	-	1	-
Concrete/brick/stone	1,230	1,212	7	5	6	-	-	-	-
Wood	477	435	-	10	32	-	-	-	-
Half concrete/brick/stone and half wood	1,272	1,161	3	91	17	-	-	-	-
Galvanized iron/aluminum	38	29	6	2	1	-	-	-	-
Bamboo/sawali/cogon/nipa	2,933	2,156	-	40	736	-	-	1	-
Asbestos	2	2	-	-	-	-	-	-	-
Glass	2	2	-	-	-	-	-	-	-
Makeshift/salvaged/improvised materials	3	1	-	-	2	-	-	-	-
Trapal	1	-	-	-	1	-	-	-	-
Others	2	2	-	-	-	-	-	-	-
No walls	-	-	-	-	-	-	-	-	-
Not Reported	31	31	-	-	-	-	-	-	-
PULUPANDAN									
Total	6,267	4,715	21	448	1,070	1	8	3	1
Concrete/brick/stone	2,192	2,131	8	34	17	1	1	-	-
Wood	664	531	1	16	116	-	-	-	-
Half concrete/brick/stone and half wood	1,944	1,504	11	306	122	-	-	1	-
Galvanized iron/aluminum	50	40	1	4	5	-	-	-	-
Bamboo/sawali/cogon/nipa	1,371	481	-	85	798	-	5	1	1

Construction Materials of the Outer Walls and City/Municipality	Total Occupied Housing Units	Construction Materials of the Roof							
		Galvanized iron/aluminum	Tile/concrete/clay tile	Half galvanized iron and half concrete	Bamboo/ cogon/ nipa/anahaw	Asbestos	Makeshift/ salvaged/ improvised materials	Trapal	Others
Asbestos	1	1	-	-	-	-	-	-	-
Glass	-	-	-	-	-	-	-	-	-
Makeshift/salvaged/improvised materials	24	9	-	1	11	-	2	1	-
Trapal	5	4	-	-	1	-	-	-	-
Others	1	1	-	-	-	-	-	-	-
No walls	-	-	-	-	-	-	-	-	-
Not Reported	15	13	-	2	-	-	-	-	-
LEGANES									
Total	7,018	5,513	81	215	1,194	1	3	2	9
Concrete/brick/stone	2,584	2,457	67	44	8	1	-	1	6
Wood	1,001	861	4	15	120	-	-	-	1
Half concrete/brick/stone and half wood	685	620	4	44	17	-	-	-	-
Galvanized iron/aluminum	177	32	6	91	48	-	-	-	-
Bamboo/sawali/cogon/nipa	2,478	1,456	-	21	998	-	1	-	2
Asbestos	25	25	-	-	-	-	-	-	-
Glass	-	-	-	-	-	-	-	-	-
Makeshift/salvaged/improvised materials	11	6	-	-	3	-	2	-	-
Trapal	7	6	-	-	-	-	-	1	-
Others	-	-	-	-	-	-	-	-	-
No walls	-	-	-	-	-	-	-	-	-
Not Reported	50	50	-	-	-	-	-	-	-

Source: PSA 2015

2.4.2.1 Census on Population and Property to be displaced

The project is expected to cause damage to properties including residential dwellings of Project Affected Persons (PAPs) in different Barangay. All alignment options were visited and CCCC Highway Consultants Co., Ltd. / The ALMANA Construction and Development Corporation (ACDC) structures located within the perimeter of the alignments were documented. The valuation of each structure is based on the replacement cost as defined in Section 6.6 of the IRR for R.A.10752. The structures surveyed are documented by photographs, with name of resident and location (Barangay and GPS coordinates) as well as the estimated floor area.

For the purpose of estimating the replacement cost of these structures, the latest Construction Material Price Date (CMPD) for the second quarter of CY 2019 (under DPWH Memo 097-7_070419) was used as guide. Included in the total cost of the structures is the demolition cost of the old one. However, certain reservations were observed in making the estimates as thorough investigation of the property, especially in the interior part of the house cannot always be done due to limited access. It is therefore expected that the final survey may vary from what is presented in the RAP Report. **Table 104** presents the total structures of affected barangay

Section A-Alignment B shows to impact on 82 structures with heavy concentration in Barangay Guan, Leganes. Of the total affected structures, 55 are residential dwelling. Total assessed value of these structures is PhP 4,821,146.00. The estimated cost is contributed mostly by large concrete dwellings in Gua-an.

Table 104. Total Number of Affected Structures by the Alignment

Barangay	Total Structures	Structure Usage		
		Residential Dwelling	Others	
Cansilayan & San Nicolas	8	4	Electric poles	4
Banban	11	6	Electric poles	5
Navalas	19	16	Electric poles	3
Getulio	15	10	Electric poles	5
Gua-an	29	19	Electric poles	8
			Sari-Sari Store	1
			Shed House	1
Total Structures	**82**	**55**		**27**
Total Assessed Value	**4,821,146**			

Section B-Alignment D has the largest number of structures and improvements affected bythe project since the inland coverage of the project is longer and wider in both the M.Chavez takeoff point and the endpoint in Ubay, Pulupandan. A total of 302 structures, 200 of which are residential dwellings will be affected. These structures are estimated to have a total value of P14,853,424. **Table 105** presents the total estimate of trees/plants affected by the project.

The 102 non-residential dwellings are varied in nature but significantly include a school, chapel and barangay hall in M. Chavez. There are two rice mills in this alignment and several sari-sari stores and furniture shops, particularly in Ubay, Pulupandan.

Table 105a. Inventory of Trees/Plants Affected by Option B

Barangay	Total Structures	Structure Usage		
		Residential Dwelling	Others	
Tapong	30	28	Electric poles	2
Pag-ayon	21	15	Electric poles	4
			Sari-Sari Store	1
			Pigpen	1
Ubay	154	94	Electric poles	51
			Furniture shops	5
			Fruit Stand	2
			Rice Mill	1
			Rice Mill Office	1
M. Chavez	97	63	Electric poles	24
			Basketball Court	1
			Concrete Wall	2
			School	1
			Barangay Hall	1
			Chapel	1
			Sari-sari Store	2
			Rice Mill	1
			Rice Drying Field	1
Total	**302**	**200**		**102**
Total Assessed Value	**14,853,424**			

Impacts on Trees and Plants

Section A (Option B) likewise show substantial number of mangrove trees affected. These mangroves are found in the forests of Getulio and shoreline of Gua-an. The inventory also registered eight Narra trees that require special permits to cut. Details on the inventory of trees are found in **Table 105b**.

Table 105b. Inventory of Trees/Plants Affected by Option B.

Type	Number	Total Bd.Ft	Estimated Value
Buenavista, Guimaras:			
Fruit Trees	76	7,293	259,229
Industrial Trees	434	44,389	2,014,998
Coconuts	132	14,331	316,576
Bamboos	76	na	152,000
Mangroves	35	na	10,200
Gua-an, Leganes:			
Fruit Trees	23	2,955	102,933
Industrial Trees	14	653	25,683
Coconuts	51	2,012	44,274
Mangroves	38,326	na	1,437,225
Total	**39,167**	**71,633**	**4,363,118**

Section B- Option D covers M.Chavez and Pulupandan. These areas have 271 trees, coconuts and bamboos that may be affected. Total cost of these trees is P781,884.

Table 105c. Inventory of Trees/Plants Affected by Option D.

Type	Number	Tota Bd.Ft	Estimated Value
Pulupandan:			
Fruit Trees	96	5,048	176,664
Industrial Trees	68	4,465	169,883
Coconuts	84	10,850	238,690
Bamboos	23	na	46,000
M.Chavez, Guimaras:			
Fruit Trees	7	500	17,489
Industrial Trees	65	2,661	107,881
Coconuts	8	967	21,277
Bamboos	2	na	4,000
Total	**353**	**24,490**	**781,884**

2.4.3 Cultural Lifestyle Change (Demographic Data on Indigenous People)

The Ati, a Negrito ethnic group, are mostly found in Western and Central Visayas. Large concentrations are found in Aklan, Capiz, Antique, and Iloilo on Panay Island, and the biggest group is in Iloilo. There are also Ati populations on the islands of Guimaras and Negros (comprising Negros Occidental and Negros Oriental). Few Atis still speak their traditional language, as it has been replaced by Kinary-a, which is spoken in Antique and some parts of Iloilo.

Moreover, there is no IP Groups nor CADT/CADC within the proposed bridge alignment that may be affected nor displaced.

On inventory of physical cultural resources, there are no cultural resources/historical sites within the alignment.

2.4.4 Availability of Public Services

2.4.4.1 Water Supply

Leganes was annexed to the service area of Metro Iloilo Water District (MIWD) by virtue of a Memorandum of Agreement signed by Mayor Enrique M. Rojas and former MIWD General Manager Moises G. Molen, Jr. way back in 2000. In 2005, the MIWD laid down 13,013.70 linear meters of various sizes of transmission and distribution lines, including appurtenances, installation of new service connections and rehabilitation of the town's existing well source but as to this date the MIWD pipeline is not functional. No household within the municipality has been supplied with water from the MIWD. The need for water is immediate. It is proposed that the municipality should operate its own water system independent of the MIWD to ensure the access of all households in the municipality to potable water.

Leganes' sources of Level III potable water are the deep wells in the barangays of Guihaman and Cagamutan Sur. The municipality has adequate underground water supply, which can be tapped for domestic and commercial uses. The surface water in Calaboa Creek, Carismo-an Creek and Janipaan River are utilized for irrigation purposes.

Water supply of Municipality of Buenavista come from their Municipal water district and served to 4,397 households. Some people in the community their water supplied by wells/spring in the brgy., Water supplied through water faucets in individual households

Municipality of Pulupandan get their water supply in Water System of Pulupandan. Water system was previously managed by the Municipality of Pulupandan. The water system consists of a 100 CU.M. Concrete Reservoir, Kilometers of pipelines consisting of combination of Galvanized iron and PBC pipes of varying sizes.

2.4.4.2 Electric Power Supply

Electric supply of Municipality of Buenavista and San Lorenzo come from Guimaras Electric Cooperative (Guimelco). While municipality of Leganes and Pulupandan get their power supply in Negros Occidental Electric Cooperative (Noceco), catering to consumers in the southern portion of the province, from Pulupandan to Hinoba-an.

2.4.4.3 Communication Networks

Communication Networks are available in the four (4) municipalities affected by the project. There are three (3) available cell sites in the areas such as Smart Communications, Globe and Sun Cellular. Also, there are landlines and wireless services. There are also a radio stations existing in the areas providing broadcast service. Moreover, there are television networks from Manila provide live telecast to the people in the community. These are the GMA, ABS-CBN, TV 5.

2.4.4.4 Peace and Order

In terms of peace and order in the four (4) municipalities affected by the project, through the joint effort of the police, fire department and the community, is considered as one of the most peaceful municipalities of the Province of based on the low crime rate recorded. No heinous or sensational cases have ever been recorded and there are no existing criminal groups in the area for several years. The police, fire department and the community are doing its part in keeping with the said status purposely to attract more investors to do business in the area and maintain a peaceful and ideal place to live, work and conduct business.

2.4.4.5 Health Resources

2.4.4.5.1 Health Service

The main rural health unit (RHU) of the municipality is an accredited Sentrong Sigla with available laboratory, maternal, child care, and referral services. The staff of the RHU composed of one (1) doctor, two (2) nurses, one (1) medical technologist, and four (4) midwives, who are on call twenty four hours a day to attend to the needs of the public.

Every barangay in the municipality has an organized barangay nutrition scholars (BNS), barangay health workers (BHW), daycare workers (DCW) and barangay tanods who monitors and administers first degree intervention for nutrition, health and sanitation, early childhood development, and maintenance of peace and order respectively. Programs, projects and services from the national, provincial or municipal level are channeled through these volunteer groups that implement such in their areas of coverage. They ensure the timely delivery of interventions to residents of their respective barangays.

Accessibility to far flung areas of the municipality has never been an issue. National, provincial, municipal, barangay and NIA access roads give mobility to people, products and services which means access to basic services such as health and welfare is only a few minutes away wherever in the municipality.

The Municipal Nutrition Office in coordination with the Municipal Health Office is tasked to provide a comprehensive implementation of nutrition programs and services to malnourished children residing within the community. This is to minimize the perennial problem of malnutrition. To maximize the utilization of limited resources, this project will carry out stopgap strategies that will include food production, food and micronutrients supplementation, information education campaign (IEC) in all day care center, schools and barangays. In addition to these efforts, a regular periodic laboratory examination of all water sources will ensure safe drinking water for all residents; the zero open defecation component of the project will ensure that all households have sanitary toilets; the installation of hand washing facilities in schools and fluoride tooth brushing will ensure proper hygiene; a mass drug administration of deworming drugs to all preschool and school children three times a year; and an information, education, communication drive to integrate the message of fighting intestinal worm infection to school curriculum will hopefully reduce the number of malnourished children in the municipality.

2.4.4.5.2 Morbidity and Mortality

General Health Indicators

In the latest record of the DOH Region VI year 2017 a total of 110,058 livebirths were recorded, while there are 43,371 total number of death. There were 1,130 numbers of infant death and 72 maternal death. The leading cause of Infant Mortality as per 2017 record of DOH Region VI were Prematurity, Septicemia, Pneumonia, Asphyxia, heart diseases, Respiratory distress syndrome, Congenital anomaly, Diarrheal diseases, Infection and Umbilical cord accident.

Table 106. Live births and deaths in Region VI

Health indicator	Number
Total Live Birth	110,058
Total Death	43,371
Infant Death	1,130
Maternal Death	72

Source: DOH Region VI Report, 2017

Leading Causes of Morbidity

ALRTI and pneumonia ranked first followed by the Hypertension, Acute Respiratory Infection, Bronchitis, Urinary Tract Infection, TB Respiratory, Influenza, Acute Watery Diarrhea, Chickenpox and Acute Hemorrhagic Fever. While record from the DOH-Center for Health Development-Western Visayas as of 2006 listed the following as the leading cause of morbidity Upper Respiratory Tract Infection, Pneumonia, Diarrhea, Bronchitis, hypertension, Injuries, Influenza, TB Respiratory/Pulmonary, Parasitism and Urinary Tract Infection.

Table 107. Leading Cause of Morbidity, Region VI

Causes	Number
Upper Respiratory Tract Infection	124,287
Pneumonia/ALRTI	40,182

Hypertension	38,260
Animal Bites	30,495
Injuries (All Types)	24,711
Urinary Tract Infection	18,379
Pulmonary Tuberculosis	12,259
Skin Diseases (All Types)	9,005
Diabetes Mellitus	8,586
Diarrhea	8,104

Source: DOH Region VI Report, 2017

Hypertensive Cardiovascular Diseases (HCVD) has become the leading cause of mortality in 2017 at the record 10,485 cases. Pneumonia became the number two as Malignant Neoplasm (Cancer) is the number three leading cause of mortality for adults. Other causes of death are Injuries/Accidents, Kidney diseases, Cerebro Vascular Accidents (CVA), Tuberculosis, Chronic Obstructive Pulmonary Disease (COPD), Diabetes and Septicemia.

Table 108. Deaths, Infant Deaths and Maternal Deaths by Sex, Region VI

Population	Live Births	Deaths				Infant Deaths				Maternal Deaths	
		Male	Female	Total	Rate	Male	Female	Total	Rate	No.	Rate
7,919.888	110,058	24,697	18,674	43,371	5.48	644	486	1,130	10.27	72	65.42

Source: DOH Region VI Report, 2017

2.4.4.5.3 Environmental and health sanitation

As per DOH Region VI report in 2017, 83.90% of the total households of 1,691,250 has access to sanitary toilets, satisfactory disposal of solid waste, and with complete basic sanitation facilities.

Table 109. Number and Percentage Distribution of Households with Sanitary Toilet, Satisfactory Disposal of Solid Waste and Complete Basic Sanitation Facilities in Region VI

Total Households (HH)	HHs with Sanitary Toilet		HHs with satisfactory disposal of solid waste		HHs with complete basic sanitation facilities	
	No.	%	No.	%	No.	%
1,691,250	1,418,901	83.90	1,264,935	74.79	1,124,263	66.48

Source: DOH Region VI Report, 2017

2.4.5 Generation of Local Benefits from the project

2.4.5.1 Employment and Workforce

The 2015 Census of Population by the Philippine Statistics Authority grouped major occupations into ten (10) classifications which include managers, professionals, technical and associate professionals, clerical support workers, service and sales workers, skilled agricultural forestry and fishery workers, craft and related trades workers, plant and machine operators and assemblers, elementary occupations and armed forces occupation. Other occupations elsewhere classified and not reported are also accounted. These workers included in the statistics are gainful workers 15 years old and above. Buenavista, Guimaras is recorded to have the highest number of workers with 22,045.

In terms of classification, out of the total of all the municipalities/cities covered by the project, the highest number of employment are those on Elementary Occupations with a total of 41,190 for the two municipalities.

Table 110. Employment/Workers in the Municipalities Affected by the Project

Major Occupation Group	Leganes, Iloilo	Buenavista, Guimaras	San Lorenzo, Guimaras	Pulupandan, Neg Occ
Managers	985	1,427	303	832
Professionals	1,021	1,294	385	647
Technicians and Associate Professionals	828	881	236	423
Clerical Support Workers	951	1,083	315	656
Service and Sales Workers	1,984	3,328	1,242	2,508
Skilled Agricultural Forestry and Fishery Workers	1,339	2,769	3,290	1,390
Craft and Related Trades Workers	1,179	2,482	808	1,068
Plant and Machine Operators and Assemblers	1,445	3,030	1,001	1,485
Elementary Occupations	3,580	5,689	3,277	2,943
Armed Forces Occupations	19	44	10	10
Other Occupation Not Elsewhere Classified	-	-	-	-
Not Reported	24	18	6	9
Total	13,355	22,045	10,873	11,971

Source: Philippine Statistics Authority, 2015

2.4.5.2 LGU Income

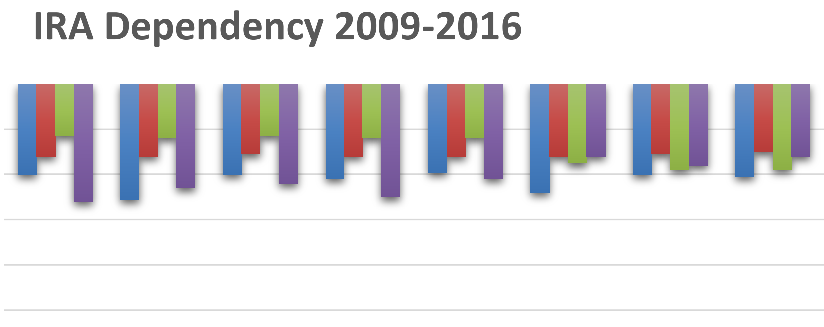
Based on the 2016 data from the municipal profiles, Buenavista, Guimaras has the highest income with 115,000,000 pesos followed by Leganes, Iloilo with an income of 87,000,000 pesos. Meanwhile, San Lorenzo has a total of 81,200,000 pesos while Pulupandan has an income of 70,700,000 pesos.

Table 111. Income in the Project Area (2016)

Province	Municipality	Income (Php, Million)
Iloilo	Leganes	87.1
Guimaras	Buenavista	115
	San Lorenzo	81.2
Negros Occidental	Pulupandan	70.7

Source: Bureau of Local Government Finance, Department of Finance CY 2014

In terms of IRA dependency, there are increase and decrease in dependency among all the municipalities within the project area. In San Lorenzo, Guimaras, from 97% IRA dependency in 2009, it decreased to 82% in 2016. On the other hand, there is an increasing trend of IRA dependency in Pulupandan, Negros Occidental while Buenavista, Guimara is consistent with 88% to 90% between 2009-2016. Leganes, Iloilo has the lowest record of IRA Dependency in 2010 with 69% while the highest was in 2013 with 81%.(Data source: Bureau of Local Government Finance, Department of Finance, 2017).



	2009	2010	2011	2012	2013	2014	2015	2016
Leganes, Iloilo	80%	69%	80%	78%	81%	72%	80%	79%
Buenavista, Guimaras	88%	88%	89%	88%	88%	88%	89%	90%
San Lorenzo, Guimaras	97%	96%	97%	96%	96%	85%	82%	82%
Pulupandan, Neg Occ	68%	74%	76%	70%	78%	88%	84%	88%

Figure 123. IRA Dependency in the Municipalities Affected by the Project

2.4.5.3 Poverty Incidence

Poverty reduction remains the overarching goal of the Philippine government. The main vision of the Philippine Development Plan (PDP) 2011-2016 is to achieve rapid, sustainable and inclusive growth that will generate employment opportunities and reduce poverty. Official poverty statistics in the country are generated by the former National Statistical Coordination Board (NSCB), now part of the Philippine Statistics Authority (PSA), in accordance with Executive Order (EO) No. 352. Poverty Incidence is the proportion of families/individuals with per capita income/expenditure less than the per capita poverty threshold to the total number of families/individuals. In the project area, data of the poverty incidence are recorded from 2006, 2009 and 2012. It is evident in the Table below that poverty incidence in year 2012 was significantly decreased in the municipalities within the project area.

Table 112. Poverty Percentage in the Municipalities Affected by the Project

Province	Municipality	Poverty Percentage		
		2006	2009	2012
Iloilo	Leganes	14.0	15.2	10.1
Guimaras	Buenavista	22.5	23.9	16.3
	San Lorenzo	45.4	44.0	28.7
Negros Occidental	Pulupandan	17.8	24.6	10.3

Source: Philippine Statistics Authority, 2015

2.4.6 Transportation and Road Network

Leganes is only about eleven kilometers from Iloilo City and few kilometers from the Iloilo Airport of International Standards. It can be reached from Iloilo City through the National Highway to the north or the Coastal Highway to the Municipality of Dumangas. The Coastal Road serves as the shorter link of the town to the International Port in Barrio Obrero, Lapuz, Iloilo City and to some of the municipalities in the north. There are also barangay roads that connect the municipality to the adjacent towns like Sta. Barbara and Pavia.

Buenavista and Guimaras can be reach by boat if you are coming outside the province. Jeepney, tricycle and motor are the main transportation in the area while in Pulupandan, Negross Occidental can be reach by bus when coming from other municipalities and provinces. Nearest airport to the area is in Bacolod City.

2.4.7 Resettlement Policy Framework

As provided by the DPWH's LAPRAP, it is important to ensure that no project affected persons will be worsened off during the project implementation. To achieve this, it is imperative that acquisition of the necessary Right-of-Way must be dealt with carefully. The best way to achieve this is through the preparation of a Resettlement Action Plan (RAP) that is based on international guidelines on involuntary resettlement such as World Bank's O.P. 4.12, Asian Development Bank's Involuntary Resettlement Policy, and the Chinese Environmental and Social Guidelines for Foreign Loans and Investments (2018).

As a government agency though, DPWH has to abide by Philippine laws. In order to fill the gap between international standards and national laws, some measures need to be implemented. Being in the forefront of the nation's infrastructure development, the DPWH had developed its own resettlement policy known as the Land Acquisition, Resettlement, Rehabilitation and Indigecous Peoples' Policy (LARRIPP) of 2007, which upholds project-affected peoples' rights to project benefits. Provided below are salient points of the principles that guide the preparation of this RAP. Details of the Social Impact Report are provided in separate report.

2.4.7.1 International Guidelines

The following policies are some basic principles of various international institutions which uphold the principles of involuntary resettlement and were utilized as basis in the preparation of the RAP of the proposed Project.

World Bank's Involuntary Resettlement Policy

Operational Procedure (O.P.) 4.12:

Involuntary resettlement should be avoided where feasible, or minimized, exploring all viable alternative project designs;

Where it is not feasible to avoid resettlement, resettlement activities should be conceived and executed as sustainable development programs, providing sufficient investment resources to enable the persons displaced by the project to share in project benefits;

Displaced persons should be meaningfully consulted and should have opportunities to participate in planning and implementing resettlement; and

Displaced persons should be assisted in their efforts to improve their livelihoods and standards of living or at least to restore them, in real terms, to pre-displacement levels or to levels prevailing prior to the beginning of project implementation, whichever is higher.

Asian Development Bank's (ADB) Involuntary Resettlement Policy

Carry out meaningful consultations with affected persons, host communities, and concerned nongovernment organizations. Inform all displaced persons of their entitlements and resettlement options. Ensure their participation in planning, implementation, and monitoring and evaluation of resettlement programs.

Pay particular attention to the needs of vulnerable groups, especially those below the poverty line, the landless, the elderly, women and children, and Indigenous Peoples, and those without legal title to land, and ensure their participation in consultations.

Ensure that displaced persons without titles to land or any recognizable legal rights to land are eligible for resettlement assistance and compensation for loss of nonland assets.

Establish a grievance redress mechanism to receive and facilitate resolution of the affected persons' concerns;

Improve, or at least restore, the livelihoods of all displaced persons through (1)land-based resettlement strategies when affected livelihoods are land based where possible or cash compensation at replacement value for land when the loss of land does not undermine livelihoods, (2) prompt replacement of assets with access to assets of equal or higher value, (3) prompt compensation at full replacement cost for assets that cannot be restored, and (4) additional revenues and services through benefit sharing schemes where possible;

Provide secured tenure to relocation land, better housing at resettlement sites with comparable access to employment and production opportunities, integration of resettled persons economically and socially into their host communities, and extension of project benefits to host communities;

Improve the standards of living of the displaced poor and other vulnerable groups, including women, to at least national minimum standards. In rural areas provide them with legal and affordable access to land and resources, and in urban areas provide them with appropriate income sources and legal and affordable access to adequate housing;

Conceive and execute involuntary resettlement as part of a development project or program. Include the full costs of resettlement in the presentation of project's costs and benefits. For a project with significant involuntary resettlement impacts, consider implementing the involuntary resettlement component of the project as a stand-alone operation;

Pay compensation and provide other resettlement entitlements before physical or economic displacement. Implement the resettlement plan under close supervision throughout project implementation; and

Monitor and assess resettlement outcomes, their impacts on the standards of living of displaced persons, and whether the objectives of the resettlement plan have been achieved by taking into account the baseline conditions and the results of resettlement monitoring.

***Chinese Environmental and Social Guidelines for Foreign Loans and Investments* (Third Edition, September 2018)**

The Chinese guidelines on environmental and social risk management are a set of principles, guidelines and criteria established by Chinese public entities with the aim of guiding banks and companies (mostly state-owned and in some cases private) operating overseas to avoid and minimize the negative impacts of the projects they execute (Garzon, 2018). These guidelines ensure the:

Giving of importance on ex-ante and ex-post environmental and social impact assessments, and preparation of due diligence assessments by independent evaluators; others refer to the obligation to respect the rights of workers, to make information available to the public and to establish opportunities for civil society participation. Chinese guidelines on environmental and social conditions recognize that enterprises have a role in avoiding and minimizing the negative impacts of their investments outside of China.

Quantitative analysis of environmental costs and benefits must be part of an investment decision-making process.

Establishment of a comprehensive control system for assessment and management of environmental and social risks, act in compliance with environmental regulations, learn from the Equator Principles.

Giving of special attention to environmental and social risks in the energy industry, agriculture, forestry, livestock, fisheries, large infrastructure, engineering contracts. If necessary, consult a third party.

Preservation of the rights of the local population including the rights of workers and respect for local culture.

Establishment of a grievance mechanism and strengthen information dissemination mechanisms.

Giving of provisions to prevent and mitigate damages from displacement as a result of Chinese funded infrastructure projects outside of China.

2.4.7.2 Philippine Legislation and Guidelines

The following discussions focus on Philippine laws, implementing rules and regulations, and guidelines pertaining to involuntary resettlement.

E.O. 1035 (1985)

This provides the procedures and guidelines for the expeditious acquisition by the government of private real properties or rights thereon for infrastructure and other government development projects: financial assistance to displaced tenants, cultural minorities and settlers; compensation for improvements on land acquired under Commonwealth Act 141; and the government has the power to expropriate lands in cases where no agreement has been reached. The tenants referred in this EO (1035) are the displaced tenants of agricultural lands and the financial compensation shall be equivalent to the value of the gross harvest for one year on the principal and secondary crops of the area acquired, based on the average annual gross harvest for the last three preceding crop years; Provided, that in no case shall the financial assistance be less than P15,000.00 per hectare.

Republic Act 6389 Section 7 (1971)

R.A. 6389 also known as the Code of Agrarian Reforms of the Philippines. It provides that agricultural lessees shall be entitled to disturbance compensation equivalent to five times the average of the gross harvests on his landholding during the last five preceding calendar years.

Republic Act 10752 and Its Implementing Rules and Regulations (IRR)

Republic Act 10752 supercedes R.A. 8974 and was passed into law in July 2016. The main objective of the enactment is to avoid delays in implementation of development projects due to ROW acquisition-related problems. Republic Act 10752, is otherwise known as "An Act Facilitating the Acquisition of Right-Of-Way Site or Location for National Government Infrastructure Projects".

This law prescribed new standards for assessment of the value of the land subject to negotiated sale or expropriation proceedings, namely:

The classification and use for which the property is suited; (Which shall be based on the approved land use plan and/or zoning ordinance, if any, of the city concerned);

The size, shape or location, tax declaration, and zonal valuation of the land;

The price of the land as manifested in the ocular findings, oral, as well as documentary evidence presented;

The reasonable disturbance compensation for the removal and/or demolition of certain improvement on the land and for the value of improvements thereon;

The developmental costs for improving the land. Based on the records and estimates of the City or Municipal Assessor concerned);

The value declared by the owners; (as shown in their latest Tax Declaration Certificates or Sworn Statements);

The current price of similar lands in the vicinity; which shall be based on the records on Deeds of Sale in the Office of the Register of Deeds concerned; and

Such facts and events as to enable the affected property owners to have sufficient funds to acquire similarly-situated lands of approximate areas as those required from them by the government, and thereby rehabilitate themselves as early as possible.

Another important feature of R.A. 10752's IRR that makes ROW acquisition more acceptable to property owners is Section 6 which prescribes valuation of affected improvements and/or structures to be computed based on replacement cost method. The replacement cost of improvements/structures is defined as "*the amount necessary to replace the cost of a structure or improvement affected by the ROW based on the current market prices of materials, equipment, labor, contractors profit and overhead, and all other attendant costs associated with the acquisition and installation of a similar asset in place of the affected asset".*

Compared to previous statutes, valuation of land and improvements using this legislation is by far the most equitable, and practical. Adherence to these provisions would also make the gap between Philippine legislation and international standards smaller.

Presented below are other important and applicable provisions of the IRR:

Section 4 of RA 10752 states that any Implementing Agency which requires acquisition of ROW for its projects may explore donation as a first option;

Sets the first offer for negotiated sale of land (just compensation) as the price indicated in the current zonal valuation issued by the BIR for the area where the property is located;

Provides for the engagement of government financing institutions or private appraisers as an option to undertake appraisal of the land and/or improvements/structures, to determine its fair market value;

Section 14 of RA 10752 appoints the National Housing Authority (NHA) in coordination with the LGUs and Implementing Agencies concerned, to establish and develop resettlement sites for informal settlers, including the provision of adequate basic services and community facilities, in anticipation of informal settlers that have to be removed from the ROW or site of future infrastructure projects, pursuant to the provisions of the RA No. 7279. Whenever applicable, the concerned LGUs shall provide and administer the resettlement sites.

Republic Act 7279 (Urban Development and Housing Act of 1992) and its IRR

Section 5 of the Act, and Sections 3.1, and 6.6 of its Annex (Guidelines for the Inventory and Identification of Lands and Sites for Socialized Housing) states that lands or portions thereof, set aside for government offices, facilities, and other installations, whether owned by the National Government, its agencies and instrumentalities, including government-owned or controlled corporations, or by the Local Government Units, but which have not been used for the purpose for which they have been reserved or set aside for the past 10 years from the effectivity of the Act (i.e., as of 2002) shall be covered by the Act. As such, these areas, when identified as suitable for socialized housing, shall immediately be transferred to the NHA, subject to the approval of the President of the Philippines, or by the LGU concerned, as the case may be, for proper disposition with the Act;

Section 8 of the Act and its Annex “A” mandated all local government units in coordination with the NHA, Housing and Land Use Regulatory Board (HLURB), National Mapping and Resource Information Authority (NAMRIA), and the DENR Land Management Bureau (LMB) to identify lands for socialized housing and resettlement areas for the immediate and future needs of the underprivileged and homeless in the urban areas;

Section 6.3 of the Act’s Annex sets the following criteria to be used for evaluating the suitability of sites for socialized housing:

To the extent feasible, socialized housing and resettlement projects shall be located in new areas where employment opportunities are available;

Priority shall be given to areas where basic services and facilities are already existing or where they can be introduced within a very short time;

Transportation costs to work places and other services should be affordable considering that the target beneficiaries are the homeless and under privileged;

The site shall not require excessive levelling, cutting, and filling. Sites requiring excessive engineering works shall be avoided. Likewise, sites on steep slopes and/or weak soil foundation shall not be considered;

Environmentally critical areas like those that are flood prone or earthquake zones or areas near rivers and canals shall be avoided;

Compatibility with existing zoning;

Financial feasibility and viability where land valuation offer is low; and

Tenurial status must be ascertained

Section 16 of the Act provides the eligibility criteria for program beneficiaries as follows:

Must be a Filipino citizen;

Must be an underprivileged and homeless citizen (i.e., as defined in Section 3 of the same Act, refers to beneficiaries of the Act and to individuals or families residing in urban and urbanizeable areas whose income or combined household income falls within the poverty threshold as defined by the National Economic Development Authority (NEDA) and who do not own housing facilities, including those who live in makeshift dwelling units and do not enjoy security of tenure);

Must not own any other real property whether in the urban or rural areas;

Must not be a professional squatter or a member of squatting syndicates

Section 28 of the Act stipulates that eviction or demolition as a practice shall be discouraged; however, it may be allowed under the following conditions:

When persons or entities occupy danger areas such as esteros, railroad tracks, garbage dumps, riverbanks, shorelines, waterways, and other public places such as sidewalks, roads, parks, and playgrounds;

When government infrastructure projects with available funding are about to be implemented; or

When there is a court order for eviction and demolition

In the execution of the above Section 28, the following shall be mandatory:

Notice upon the affected persons or entities at least (30) days prior to date of eviction and demolition;

Adequate consultations on the matter of resettlement with the duly designated representatives of the families to be resettled and the affected communities in the areas where they are to be relocated;

Presence of Local Government Officials or their representatives during eviction or demolitions;

Proper identification of all persons taking part in the demolition;

Execution of eviction or demolition only during regular office hours from Mondays to Fridays and during good weather, unless the affected families consent otherwise;

No use of heavy equipment for demolition except for structures that are permanent and other of concrete materials;

Proper uniforms for members of the Philippine National Police who shall occupy the first line of law enforcement and observe proper disturbance control procedures; and

Adequate relocation, whether temporary or permanent; provided however, that in cases of eviction and demolition pursuant to a court order involving under privileged and homeless citizens, relocation shall be undertaken by the LGU concerned and the NHA with assistance of other government agencies within (45) days from service of notice of final judgement by the court, after which period the said order shall be executed; provided further that should relocation not be possible within the said period, financial assistance in the amount equivalent to the prevailing minimum daily wage multiplied by (60) days shall be extended to the affected families by the LGU concerned.

Section 30 of the Act stipulates that after the effectivity of the Act in 1992, the barangay, municipal or city government units shall prevent the construction of any kind of illegal dwelling units of structures within their respective localities.

DPWH Department Order (D.O.) No. 65 (Series of 2017)

Promulgated in line with the Department of Public Works and Highways continuing efforts to streamline its operations, decentralize and rationalize right-of-way (ROW) operations for a more effective and expeditious implementation of infrastructure projects in the interest of efficient public service.

Implementing Office (IO) shall ensure that IROW costs are always included in project budgets;

The IO shall provide an estimated cost breakdown of each project to the IROW and Resettlement Project Management Office (RPMO) and the Central Financial Management System (CFMS) prior to any disbursement of funds. The first priority of the budget for a project shall be all costs prior to construction (Please note that this includes Right-of-Way acquisition);

If ROW costs differ from the approved ROW budget after detailed design has been finalized, a budget adjustment shall be approved;

A Land Acquisition Plan and Resettlement Action Plan (LAPRAP) shall be prepared for all projects, whether local or foreign funded, that will require Right-of-Way (ROW) acquisitions, using a standardized compensation package;

The determination of Project Affected Persons (PAPs) and improvements shall be based on the cut off date, which is the start of the census of APs and tagging for improvements; and

The IO shall prepare the final as-built ROW Plan upon completion of the project, for submission to the IROW and Resettlement PMO.

DPWH Department Order (D.O.) No. 152 (series of 2017) Updated "DPWH Acquisition Manual (DRAM) dated December 08, 2017 "

This updated DPWH Acquisition Manual was created to provide a clear, uniform, and user-friendly guide on the rules and procedures for the acquisition by the DPWH of right-of-way (ROW) for its infrastructure projects, in accordance with the provisions of Republic Act No. 10752 (ROW Act) and its Implementing Rules and Regulations, in order to achieve a more effective and expeditious implementation of DPWH projects.

DPWH Department Order (D.O.) No. 34 (series of 2007)

This provides a step-by-step methodology and guidance to DPWH resettlement staff on how to validate and evaluate infrastructure ROW claims, conduct title searches, and similar activities.

DPWH D.O. No. 327 (series of 2003) "Guidelines for Land Acquisition and Resettlement Action Plan (LAPRAP) for Infrastructure Projects"

LAPRAP document shall describe the project, expected impacts and mitigating measures, socio- economic profile of PAPs, compensation package, timetable of implementation, institutional arrangements, monitoring and evaluation arrangements, participation, consultation and grievance procedures;

LAPRAP shall be prepared using inputs from the IROW Action Plan, the census and socioeconomic survey conducted, the detailed engineering study, and the parcellary survey results.

LAPRAP shall be the basis for qualifying and compensating PAPs for lands, structures and/or improvements that are partially or fully affected by the Department's infrastructure projects in accordance with the qualification entitlement, and compensation guidelines.

Provision of resettlement sites shall be the responsibility of the Local Government Units (LGUs) concerned, with assistance from the concerned government agencies tasked with providing housing. The DPWH shall coordinate with these LGUs and appropriate government agencies for the resettlement and relocation of qualified PAPs. The acquisition, planning, and development of resettlement sites shall be part of the LAPRAPs, with the responsibility resting mainly with the concerned LGUs, Housing and Urban Development Coordinating Council (HUDCC), National Housing Authority (NHA), and other concerned agencies;

Where relocation is considered necessary, the receiving LGU (under whose political jurisdiction the relocation site will be located) may seek assistance from DPWH for the provision of basic facilities and services;

An Indigenous People's Action Plan (IPAP) shall be formulated for IPs if they are affected by the Department's infrastructure projects, in coordination with the National Commission of Indigenous People (NCIP) to ensure that the ancestral domain and culture of the IP are secured.

Philippine Constitution Article III, Section 9 and Article XII Section 5

Article III, Section 9 of the Philippine Constitution provides that private property shall not be taken for public use without just compensation, while Article XII Section 5 stipulates that, the State, subject to the provisions of this Constitution and national development policies and programs, shall protect the rights of indigenous cultural communities to their ancestral lands to ensure their economic, social, and cultural well-being. However, in all the project alignment sites, no indigenous cultural communities were covered, hence no Indigenous Peoples are affected by the project.

Moreover, Article XII Section 5 of the same Constitution stipulates that the State, subject to the provisions of the Constitution and national development policies and programs, shall protect the rights of indigenous cultural communities to their ancestral lands to ensure their economic, social, and cultural well-being. The Congress may provide for the applicability of customary laws governing property rights or relations in determining the ownership and extent of ancestral domain.

Land Acquisition, Resettlement, Rehabilitation, and Indigenous Peoples (LARRIP) Policy, 3rd Edition, 2007

All efforts must be exercised to ensure that:

Adverse social impacts are avoided, minimized, and/or mitigated;

Everybody, including Affected Persons (APs), will benefit from the projects;

APs are provided with sufficient compensation and assistance for lost assets which will assist them to improve or at least maintain their pre- project standard of living;

Project stakeholders (which include APs) are consulted regarding the projects' design, implantation, and operation.

Only those APs found to be residing in, doing business, or cultivating land or having rights over resources within, the project area as of the date of the census surveys (i.e., cut-off date) are eligible for compensation for lost assets;

The Land Acquisition Plan and Resettlement Action Plan (LAPRAP) document shall describe the project, expected impacts and mitigating measures, socio- economic profile of APs, compensation package, timetable of implementation, institutional arrangements, participation, consultation, and grievance procedures;

LAPRAP shall be the basis for qualifying and compensating APs for lands, structures and/or improvements, that are partially or fully affected by the Department's infrastructure projects;

Provision of resettlement sites shall be the responsibility of the Local Government Units (LGUs) concerned, with assistance from concerned government housing agencies.

R.A. 9710 and Implementing Rules and Regulations (series of 2010) known as the "Magna Carta of Women

This pertains to the rights of women: equal treatment before the law; protection from all forms of violence; participation and representation; equal access and elimination of discrimination against women in education, scholarships and training; equal rights in all matters related to marriage and family relations; comprehensive health services and health information/education; non-discrimination in employment; and other items.

Executive Order 273 Series of 1995

This approved and adopted the Philippine Plan for Gender-Responsive Development (PPGD), 1995-2025; a successor plan of the expired Philippine Development Plan for Women (PDPW) for 1989-1992.

The Updated Harmonized Gender and Development Guidelines (GAD) (2010)

The harmonized GAD guidelines seek to promote the twin goals of gender equality and women's empowerment. It provides among others all Philippine government agencies with a common set of analytical concepts and tools for integrating gender concerns into its development programs and projects. It also envisions to help achieve gender equality in, and empower women through development projects of the government and other development practitioners.

DPWH and World Bank publication, "A Toolkit on Making Road Infrastructures and Related Facilities Gender Responsive"

This presents the principles, approaches and procedures for making road infrastructures and related facilities sensitive to the differing travel needs and patterns of women and men, especially those from low income sectors who rely solely on public and intermediate modes of transport.

2.4.7.3 Cut-off Date for Entitlement

Cut-off date for entitlements is recognized by international institutions such as the World Bank (WB), and Asian Development Bank (ADB). Operational Procedure (O.P.) 4.12 of the WB defines it as "... the date the project area was delineated, prior to the census, provided that there has been an effective public dissemination of information on the area delineated, and systematic and continuous dissemination subsequent to the delineation to prevent further population influx".

These provisions were explained to the PAPs during initial public consultations and first round of meetings in the local barangays and during town hall assemblies attended by LGUs and other stakeholders. The landowners were requested, to the extent possible, not to introduce any development in the lots that were identified for R-O-W acquisition. In terms of informal settlements, the respective Barangay Chairpersons were reminded of Urban Development and Housing Act (UDHA) provision and were requested to control proliferation of informal settlements in said areas.

2.4.8 Socioeconomic Profile and Perception of the Affected People

A comprehensive understanding of the level of participation/acceptance of households in the influence areas is deemed essential for the baseline profiling. In this undertaking, a household is defined as a unit comprising of more than one person who usually living together in the same dwelling and making common provisions for living essentials.

Random (purposive) survey was conducted to gather pertinent data and perceptions of the community covered by the proposed project. Communities residing within or near the proposed bridge alignment were interviewed.

Statistical Computation of Sample Size

Equation for Sample Size (Unknown Population):

$$n = \frac{z^2 \times ṕ\,(1 - ṕ)}{\varepsilon^2}$$

wherein:

n = sample size
z = z score
ṕ = sample proportion
ε = margin of error

Given:
At 95% confidence level:
z= 1.96
ṕ= 50% (conservative estimate)
$\varepsilon = 5\%\ (selected\ margin\ for\ unknown\ population)$

Computation:

$$n = \frac{1.96^2 \times 0.50\,(1 - 0.50)}{.05^2}$$

$$n = \frac{3.84 \times 0.25}{0.0025}$$

$$\boldsymbol{Sample\ size = 384}$$

In the absence of existing household level data of the directly affected people, using sampling size equation for unknown population, at 95% confidence interval with 5% margin of error, a total of 384 respondents were interviewed for this survey distributed in the four (4) municipalities with twelve (12) barangays covered by the project.

Design and Contents of the Survey Questionnaire

The contents of the survey include the following elements:

- Respondents profile: religion, educational attainment, year of stay, and occupation;
- Household information: household size, estimated household income;
- Awareness and perception of the project: project to benefit the community and family, and mitigations for negative impacts.

Data Analysis

Data were analyzed using a standard statistical package for the social sciences (SPSS) program and Microsoft Excel. In order to control the differences in population size, the study employed weighted average in the calculation of results. The results are reported in percentages and are displayed in frequency tables and graphs.

People within the project area that includes:

- Household
- People engaged to business
- Employees (government/private) within the impact areas
- Barangay council
- Community Leaders

2.4.8.1 Respondent's Profile and Household Information

Of the 384 respondents surveyed, around 316 or 82.29% are female while the remaining 68 or 17.71% are male (**Figure 124**). More females were interviewed, since during the conduct of the survey, most of the male household heads were at work.

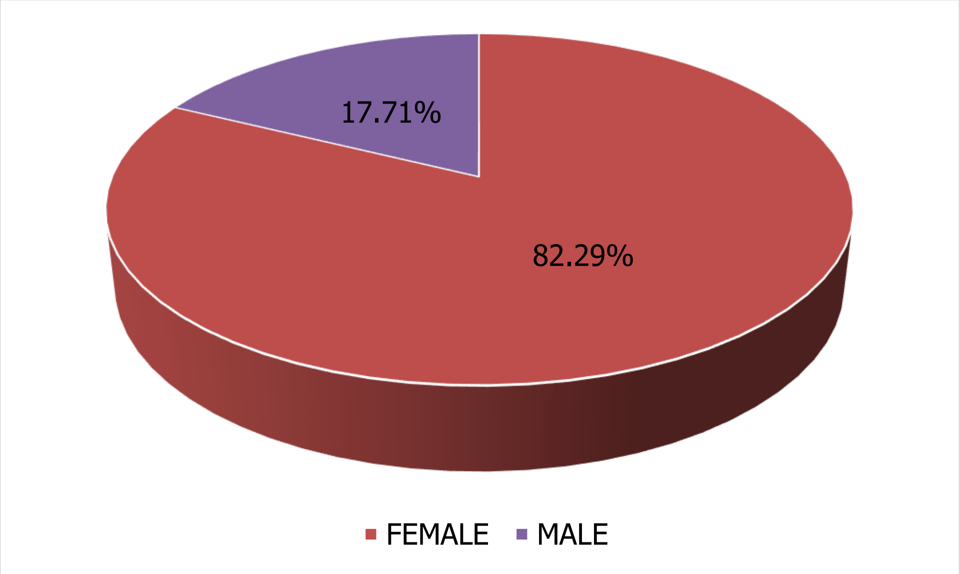


Figure 124. Gender of Respondents

In terms of age, 45 to 49 are the largest age group interviewed representing 18.75% of the respondents followed by aged 50 to 54. A summary of the age distribution of the respondents is shown in **Table 113**.

Table 113. Age Distribution of the Respondents

Age	Frequency	% Percentage
20-24	3	0.78%
25-29	8	2.08%
30-34	25	6.51%
35-39	48	12.50%
40-44	70	18.23%
45-49	72	18.75%
50-54	71	18.49%

55-59	46	11.98%
60-64	22	5.73%
65 and above	19	4.95%

Table 114 shows the civil status of the respondents. Majority 372 or 96.88% of the respondents are married with spouse present. Around 5 or 1.30% widow and 2 of the respondents are single.

Table 114. Civil Status of the Respondents

Civil Status	Frequency	% Percentage
Single	2	0.52%
Married	372	96.88%
Separated	1	0.26%
Widow/Widower	5	1.30%
Live-in	1	0.26%
Others	3	0.78%

Table 115 shows the highest educational attainment of the respondents. Around 177 or 46.09% of the respondents reported that they were finished up to high school level while 86 or 22.40% reported being able to finish elementary level. Around 17 or 4.43% of the respondents reported being able to finish vocational and only around 3.91% reported finishing college. Around 16.15% of the respondents reported they have not received any formal education.

Table 115. Attainment of the Respondents

Educational Attainment	Frequency	% Percentage
Elementary Level	12	3.13%
Elementary Graduate	86	22.40%
High School Level	5	1.30%
High School Graduate	177	46.09%
College Level	10	2.60%
College Graduate	15	3.91%
Vocational	17	4.43%
No formal Education	62	16.15%

Table 116 shows the religious affiliation of the respondents. Majority of the respondents 376 or 97.92% are Roman Catholics. Other religious denominations present in the project area include Born Again, Iglesia Ni Cristo and others.

Table 116. Religious Affiliation of the Respondents

Religion	Frequency	% Percentage
Roman Catholic	376	97.92%
Iglesia Ni Cristo	1	0.26%
Islam/Muslim	0	0.00%
Baptist	0	0.00%
Born Again	4	1.04%
Others	3	0.78%

Table 117 shows the number years that the respondents have lived in the barangay. The three highest frequency of stay in the barangay are 40 to 44, 45 to 49 and 50 to 54. The data notices that most of the respondents lived in the barangays or communities since their birth.

Table 117. Respondent's Years in the Barangay

Years in Barangay	Frequency	% Percentage
5 years and below	0	0.00%
5-10	1	0.26%
11-15	2	0.52%
16-20	11	2.86%
21-24	4	1.04%
25-29	12	3.13%
30-34	29	7.55%
35-39	47	12.24%
40-44	70	18.23%
45-49	69	17.97%
50-54	61	15.89%
55-59	39	10.16%
60-64	21	5.47%
65 and above	18	4.69%

Table 118 shows the employment profile of the respondents. Based from the occupation or source of income of the respondents, most of them depends on farming 39.32% and fishing 14.58%. Around 9.11% are engaged in business (like sari-sari stores), 7.55% are engaged as laborers while 4.69% are employed. Around 19.01% is not currently employed (without a permanent employment record or did not provide employment information).

Table 118. Employment Profile

Household Employment	Frequency	% Percentage
Farming	151	39.32%
Employed	18	4.69%
Business	35	9.11%
Fishing	56	14.58%
Laborers	29	7.55%
None	73	19.01%
Others	22	5.73%

The monthly income of the respondents reflects the status and capacity of providing the basic needs of the family. **Table 119** shows the monthly income reported by the respondents. As per interview, 69.53%% have a total monthly income of 5,000 to 10,000 pesos, 27.60% earned 5,000 pesos and below. Around 2.86% earned 10,001 to 15,000 pesos.

Table 119. Monthly Income (Estimated)

Monthly Income	Frequency	% Percentage
5,000 and below	106	27.60%
5,001-10,000	267	69.53%
10,001-15,000	11	2.86%
15,001-20,000	0	0.00%
20,001-25,000	0	0.00%
25,001-30,000	0	0.00%
30,001-35,000	0	0.00%
35,001-40,000	0	0.00%
40,001 and above	0	0.00%

In terms of housing structure, 75.26% of them have semi-concrete house structures, 21.61% are made of concrete materials and 3.13% of them made of light materials as shown in **Figure 125.**

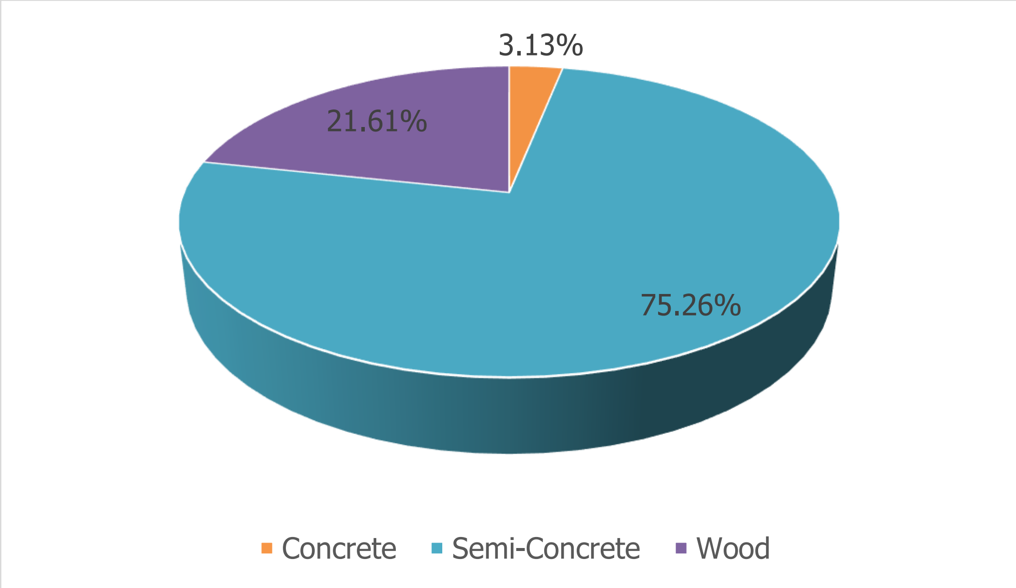


Figure 125. Type of House

Table 120 shows the resources of drinking water of the respondents. Majority (78.65%) of the respondents utilize water from mineral water and 14.58% from local water district. Other drinking water sources include water pumps while some are connected to neighbors. For domestic use (washing and cooking), they sourced it from water pumps and local water district.

Table 120. Source of Potable Water

Source of Potable Water	Frequency	% Percentage
Local Water District	56	14.58%
Neighbor's Connection	1	0.26%
Water Pump	25	6.51%
Others (Mineral Water)	302	78.65%

Figure 126 shows the access of electricity of the respondents. Majority (381 or 99.22%) of respondents' source of electricity are from local electric supply/cooperative and 3 or 0.78% mentioned that they are connected from neighbors. This result indicates that the people in the area are capable of acquiring and paying for power connection.

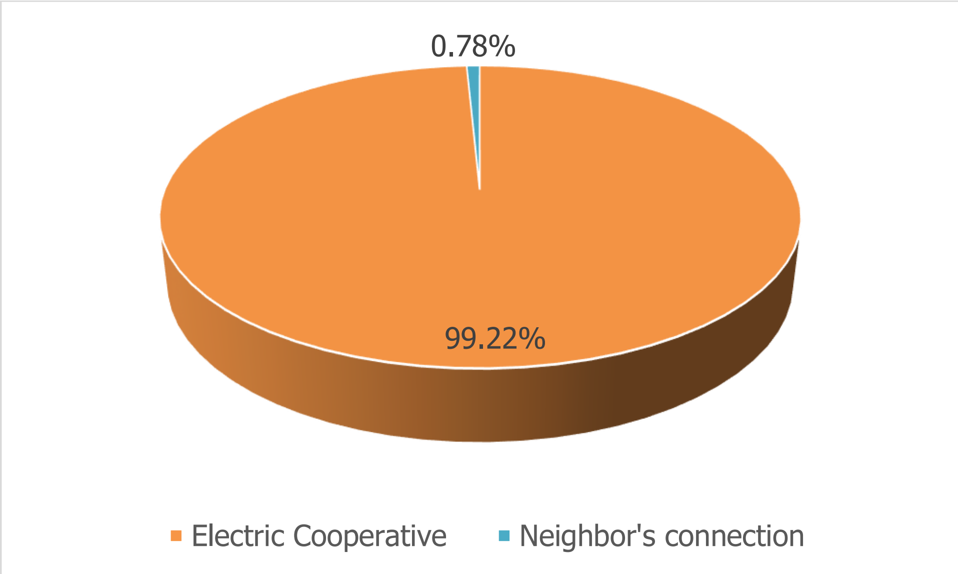


Figure 126. Source of Electricity

The domestic waste disposal practiced by the respondents' shows in **Figure 127.** Three hundred-forty-nine (349) or 90.89% of the respondents stated that they disposed their waste to an open pit. Also, 33 or 8.59% they stated that they practiced composting as a means of waste disposal and 3 or 0.52% respondents burn their domestic solid waste.

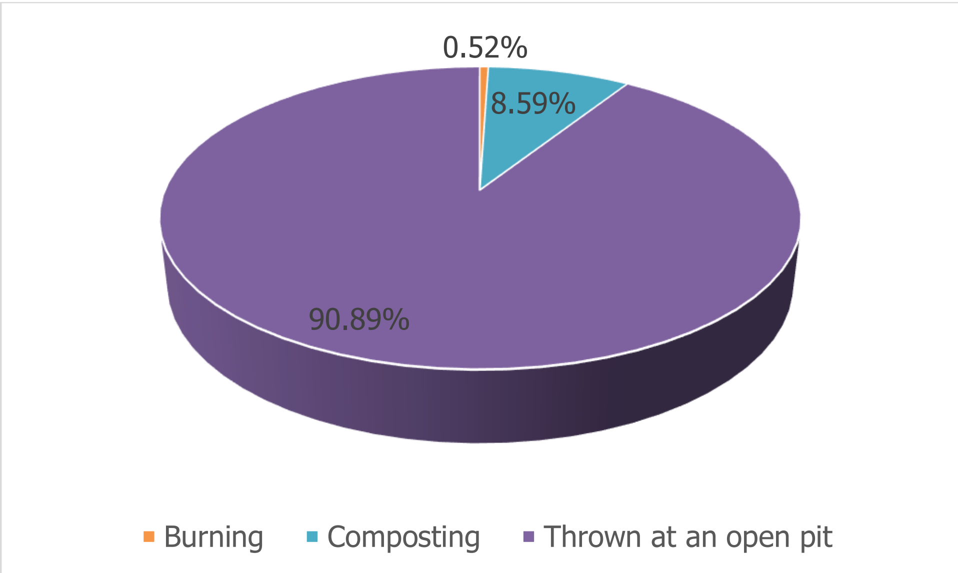


Figure 127. Type of Garbage Disposal

In terms of type of toilet system, survey result shows in **Table 121** that 380 or 98. 96% of the respondents have their own private toilet system. The other respondents mentioned that they shared by household (0.78%) and uses antipolo type (0.26%).

Table 121. Type of Toilet Facilities

Type of Toilet Facilities	Frequency	% Percentage
Antipolo type	1	0.26%

Shared with household	3	0.78%
Water-sealed type	380	98.96%

2.4.8.2 Perceived Impacts of the Project

2.4.8.2.1 Positive Effects

Most of the respondents mentioned that the project implementation may have positive effects on the economic aspect of the people/stakeholders especially those engaged on business. It will improve their accessibility in terms of transportation for people and trading of products. The bridges will connect people among the 3 provinces and nearby places, allowing them to have more opportunities in terms of work and business. They are all eager to pursue the implementation of the said project, it will boost the tourist and labor industry of the area which will benefit not only the LGUs but most especially the locals.

2.4.8.2.2 Perceived Negative Effects

When respondents were asked to identify possible problems in the implementation of the project in the area, they said that it may affect the livelihood and businesses of the bangkeros. With the implementation of the project, these livelihood activities might be displaced or removed. Other major concern of the respondents is the houses that may be affected by the proposed project as well as the increasing concern on accidents once the project implemented. Also, it may provide threat to the peace and order due to in and out of vehicles and possibility of the abuse of the environment due to bulk of the people or tourist entering in the community (particularly in Guimaras Island).

The respondents were also asked about their recommendations on the possible activities that can be undertaken to avoid the negative effects of the project and mentioned that careful identification and planning should be implemented. When further asked of their suggestion to improve the implementation of the project, the respondents answered the following:

- Minimize disturbance of residents
- Intensive consultation with the affected people
- Proper relocation/compensation for the affected families
- Close coordination between project proponent and the local government
- Enhanced security to avoid peace and order issues
- Bridge design should address the various elements that contribute to over-speeding through measures such as traffic signs, markings, etc.

2.4.8.2.3 Impacts to People

During pre-construction phase, significant impact identified is the apprehension of locals towards project development. This may attribute to the loss of their houses and livelihood that might possibly be affected by the implementation of the proposed project. Information dissemination in the community about the project through coordination with LGUs, PO's, NGOs, barangay officials and other concerned community groups should be conducted. This program will introduce the proposed project in the area and avert negative perception of people towards the project.

The proposed project will employ a substantial number of workers during the construction phase. The migrant workers will definitely add to the existing population size within the project area, especially so if they bring in members of their family. If these migrant workers take temporary residence in the project area, these will add to the general population size. Some may be transient workers who will opt to commute daily and will therefore impact only on the day-time population size. Whichever case, demand for resources especially food and water at the minimum, and services attendant to these, will increase.

To avoid influx of migration in the area where the Project is located, qualified residents of Barangays that the project will traversed and other neighboring barangays/municipalities near the project area must be given priority in the hiring of construction personnel. This must be coordinated with the LGU and barangay officials.

The construction work will create a multiple effect where various economic activities will either be created, or the existing ones will experience growth. This will lead to the creation of more jobs. In relation to this, disposable income will also increase. The potential for economic opportunity and growth will arise, leading to the generation of more jobs. In effect, a growing cycle of economic growth and employment generation will arise.

The Project’s purchases of supplies and materials from local establishments, together with expenditures by project workers typically result in increased business activity and employment in the local trade and service sectors.

During the interviews with the people in the community, they see the possibility that the project will possibly acquire lands and at the same time may affect settlements/properties located along the proposed project. They recommend for a just compensation for houses to be affected. In terms of land, large portion of land in Guimaras and Pulupandan are privately owned (haciendas). Majority of the people are tenants or given rights to live and build house in the area. During implementation, land owners should be consulted and closely coordinated. The involvement of the concerned LGUs in this matter is very essential.

The implementation of the project will post threat particularly in the incidence of accidents during construction phase and operation period due to the bulk of the vehicles entering in the area. People most likely children are vulnerable to accidents during construction and operations. The proponent should closely monitor compliance of the contractor to safety through provision of signages, speed limit and pedestrians especially areas like school zone, markets, church, among others.

2.4.8.2.4 Project’s Favorability

The results of the survey show that all or 100% of the respondents mentioned that they are in favor of the implementation of the project. They also, in favor for the implementation for better access to the people in the community during the typhoon especially in the island areas.

However, there are considerations on the implementation of the project from the respondents. The respondents mentioned that the project proponent should consider the needs of the people that will be affected. Some hope that their home will not be affected. Just compensation on the affected houses should also be settled as well as consider the livelihood of those income that will be affected. Appropriate implementation of the project should consider so that the positive effects of the project will be realized.

2.4.8.2.5 Summary of the Study

The positive effects of the proposed project are recognized by the concerned communities and socially acceptable at this stage. The developments will provide local businesses, create employment, improve accessibility and enhance the lives of the local government and community.

Based on the results of the interviews to the people in the community, the construction of bridges has mixed observation about the development of current scenario where it has benefits as well as drawbacks. The project is an indication of development because with proper transport bridge infrastructure, economic development is possible. There is possibility of attracting tourists and investors since they will be fascinated by the proper bridge system. Another benefit is that this project is creating employment opportunities to the people in the communities. According to the results of interview the people wants to involve or hire as a laborer. So, when the people are employed rather doing nothing, it contributes to the economic development.

The negative side of project implementation according to the respondents is the possible acquisition of properties. The bridge system is one of the basic infrastructures. The development of bridges is a basic requirement for the development in the community. Bridges connect people in different communities. This capacity is especially essential for areas where one town has an abundance of raw materials and another has a labor force in need of work. In this way, both people and communities can support one another.
In summary and conclusion, the positive effects of the proposed project are recognized by the concerned communities and socially acceptable at this stage. The developments will provide local businesses, create employment and enhance the lives of the local government and community.

2.4.9 Impacts to People

2.4.9.1 Displacement/Disturbance of Properties

The project will acquire lands and at the same time may affect settlements/properties located along the bridge alignment. This loss of land and properties to give way to project development will affect numbers of settlers/households in the area. Affected people are composed of private owners, tenants and informal settlers. In acquiring the land for project development, a just compensation package based on the fair market value should be implemented. In the case of the tenants, the final agreement should be done between the land owner and the tenants. Informal settlers on the other hand have a different approach in settling this issue. The involvement of the concerned LGUs in this matter is very essential.

Upon the implementation of the project, a detailed Resettlement Action Plan or RAP will be formulated undertaking 100% inventory of affected people and properties including the compensation scheme. In addition, livelihood programs and trainings should be implemented with those directly affected people.

Formulation of an equitable compensation and acquisition scheme will be designed to ensure that affected people will have a just compensation for the land, crops and other properties that will be affected by the project.

2.4.9.2 Proliferation of informal settlers

The proposed project will employ a substantial number of workers during the construction phase. The migrant workers will definitely add to the existing population size within the project area, especially so if they bring in members of their family. If these migrant workers take temporary residence in the project area, these will add to the general population size. Some may be transient workers who will opt to commute daily and will therefore impact only on the day-time population size. Whichever case, demand for resources especially food and water at the minimum, and services attendant to these, will increase.

To avoid influx of migration in the area where the Project is located, qualified residents of Barangays that the project will traversed and other neighboring barangays/municipalities/cities near the project area must be given priority in the hiring of construction personnel. This must be coordinated with the LGU and barangay officials.

2.4.9.3 Generation of Local Benefits from the Project

Increase in Business/Economic Activities and livelihood opportunities

The construction work will create a multiple effect where various economic activities will either be created, or the existing ones will experience growth. This will lead to the creation of more jobs. In relation to this, disposable income will also increase. The potential for economic opportunity and growth will arise, leading to the generation of more jobs. In effect, a growing cycle of economic growth and employment generation will arise.

The Project's purchases of supplies and materials from local establishments, together with expenditures by project workers typically result in increased business activity and employment in the local trade and service sectors.

Increase in revenue of LGUs

The increase of business activities in the project area will provide a ripple effects in the development of each municipalities covered by the project. This means there will be higher tax income generated from the existing business and new economic venture in the area due to easier accessibility going in and out from island to island.

2.4.9.4 Increase in accidents

The implementation of the bridge will post threat particularly in the incidence of road accidents. People most likely children are vulnerable to accidents during construction and operations. The proponent should closely monitor compliance of the contractor to road safety through provision of signages, speed limit and pedestrians especially areas like school zone, markets, church, among others.

2.4.9.5 Threat to Peace and Order

The construction of bridge will tend to provide unlimited access to the island particularly Guimaras Island. People perceived that the in and out of vehicles in the area will post threat to peace and order because of the different people coming in to the island. To mitigate this impact, the LGU and the PNP should work together to increase their efforts to watch and guard the people coming in and out to the area. Check points should be provided and strict compliance with the laws and regulations should be implemented. Barangay councils should be also vigilant and enhance their workforce and patrolling.

2.4.10 People‘s Participation and Social Acceptability

Public Scoping/consultation meetings were conducted with stakeholders at the four (4) affected Municipalities: Municipality of Pulupandan in Negros Occidental, Municipality of Buenavista and San Lorenzo in Guimaras and Municipality of Leganes in Iloilo. The stakeholders are composed of LGU Officials, barangay councils, community leaders and representative from People's Organization and Government Agencies.

Before the start of the consultation meeting, emcee/moderator of the meeting, Ms. Maria Carmela Capule, asked the attendees what is their preferred language/dialect to be used for the meeting. The attendees agreed that they preferred Bisaya, Tagalog and English.

The proponent and consultant presented the details of the project, the possible negative and positive impacts to their community and the next activities of the Proponent needed for the application of Environmental Compliance Certificate (ECC). After the presentation, there are questions and clarifications from the stakeholders about the project. Issues and concerns were also raised.

The schedules of activities are as follows:

Table 122. Schedules of Activities

Direct Impact Area	Date and Time	Venue	Invited Stakeholders	Stakeholders Group Attended	No. of Attendees by Sex
Municipality of Pulupandan, Negros Occidental: 1. Brgy. Pag-Ayon 2. Brgy. Zone 4A 3. Brgy. Canjusa 4. Brgy. Tapong 5. Brgy. Ubay	August 27, 2019, 9:00AM-12:00PM	Brgy. Pag-Ayon Evacuation Center, Brgy. Pag-Ayon, Pulupandan, Negros Occidental	• Local Government Officials of Pulupandan • Key Officials of Barangays affected of the project (Brgy. Pag-Ayon, Brgy. Zone 4A, Brgy. Canjusa,	• Local Government Officials of Pulupandan • Key Officials of Barangays affected of the project (Brgy. Pag-Ayon, Brgy. Zone 4A, Brgy. Canjusa, Brgy. Tapong, Brgy. Ubay)	59 (Total) 25 (Male) 34 (Female)

			Brgy. Tapong, Brgy. Ubay) • Women's Associations • Philippine Port Authority • DENR R7	• Women's Associations • Philippine Port Authority	
Municipality of Buenavista, Guimaras: 1. Brgy. Banban 2. Brgy. Cansilayan 3. Brgy. Navalas 4. Brgy. Getulio 5. Brgy. San Miguel 6. Brgy. Salvacion 7. Brgy. Dagsaan 8. Brgy. Zaldivar	August 28, 2019, 9:00AM-12:00PM	Business Development Cooperative Bldg., Buenavista, Guimaras	• Local Government Officials of Municipality of Buenavista • Key Officials of Barangays affected of the project (Brgy. Banban, Brgy. Cansilayan, Brgy. Navalas, Brgy. Getulio, Brgy. Salvacion, Brgy. Dagsaan, Brgy. Zaldivar) • Buenavista Womens Association • Philippine Coast Guard • Office of the Provincial Governor of Guimaras, • Municipal Agri-Fisheries Council • Getulio Farmers Association	• Local Government Officials of Municipality of Buenavista • Key Officials of Barangays affected of the project (Brgy. Banban, Brgy. Cansilayan, Brgy. Navalas, Brgy. Getulio, Brgy. Salvacion, Brgy. Dagsaan) • Integrated Women's Alliance Group • Philippine Coast Guard • Office of the Provincial Governor of Guimaras, • Municipal Agri-Fisheries Council	30 (Total) 20 (Male) 10 (Female)

			• Katilingban sang mga Mangunguma sa Banban • Navalas Farmers Association		
Municipality of San Lorenzo: 1. Brgy. M. Chavez	August 28, 2019, 2:00PM-5:00PM	Municipal Hall, San Lorenzo, Guimaras	• Local Government Officials of Municipality of San Lorenzo • Key Officials of Barangays Brgy. M. Chavez, Brgy. Cabanon • Philippine Coast Guard • Bureau of Fire and Protection • Kristianong Katilingban sang Kababaihan San Lorenzo • San Lorenzo Goat Raisers Association	• Local Government Officials of Municipality of San Lorenzo • Key Officials of Barangays Brgy. M. Chavez, Brgy. Cabanon • Philippine Coast Guard • Bureau of Fire and Protection	22 (Total) 13 (Male) 9 (Female)
Municipality of Leganes: 1. Brgy. Gua-an 2. Brgy. Navitasan	August 29, 2019, 2:00PM-5:00PM	Youth Development Center, Municipality of Leganes, Guimaras	• Local Government Officials of Municipality of Leganes • Key Officials of Barangays Brgy. Gua-an, Brgy. Navitasan • Philippine Coast Guard • Farmers Association	• Local Government Officials of Municipality of Leganes • Key Officials of Barangays Brgy. Gua-an, Brgy. Navitasan • Philippine Coast Guard • Farmers Association • Senior Citizen Association	41 (Total) 30 (Male) 11 (Female)

			• Senior Citizen Association • Civic Organization • Zoological Society of London-Philippines • Leganes Premier Land Consulting • Trans Asid Shipping Lines • Philippine Chamber of Commerce • Maritime Industry Authority (Marina) • FF Cruz Shipping Corp • Leganes Pantawid Association	• Civic Organization • Zoological Society of London-Philippines • Leganes Premier Land Consulting	

2.4.10.1 Issues and Concerns of the Stakeholder during the Public Scoping Meeting

The conduct of Public Scoping is a good avenue to present and inform the stakeholders about the details of the proposed project as well as express the people's perception towards the project. Majority of the stakeholders are concerned about affected structures, land, trees, mangrove, marine ecology, dust during delivery of construction materials, traffic congestion during construction, and inclusion of bike and motorcycle lane in the design.

The public scoping was very informative. The pressing issues and concerns were also raised by the stakeholders. The proponent, barangays and people in the community should closely coordinate among others to resolve issues and problems on the implementation of the project. According to the attendees, they don't oppose the project and recognized its importance to development but if possible, they are requesting for the doable solution or plan of action about their raised concerns.

Municipality of Pulupandan, Negros Occidental

Table 123. Summary of Issues and Response during Public Scoping

Environmental Component Likely to be Affected	EIA Module	Issues/Suggestions raised by the Stakeholders	Sector or Representative who raised the issues/suggestions	Proponents Responses
Land	Terrestrial Flora (Mangrove)	How about the mangroves that may possibly affected by the project?	Mr. Jimwell Canedo, Brgy. Pag-Ayon	**Ms. Carmela Capule, Consultant, KRC** The areas with mangroves affected by the projects were included in the study. We will assess the present condition of the mangroves. DENR have a guideline regarding the affected mangroves. We will check the present species of mangroves in the area. DENR will have the final say on the approval of the ECC.
Water	Water Resources	It is possibility that our source of water be affected during the construction?	Ms. Mila Lourdes Tandoy, Municipal Sanitary Inspector	**Ms. Carmela Capule, Consultant, KRC** If the source of water is coming from the shallow well, it will be affected. As well as the pipe lines. The contractor must be responsible in keeping the source of water safe and clean. We will recommend to the people in the community to closely monitor during the construction to mitigate the loss of

Environmental Component Likely to be Affected	EIA Module	Issues/Suggestions raised by the Stakeholders	Sector or Representative who raised the issues/suggestions	Proponents Responses
				the water. For the disposal, we will include in our recommendation that the contractor need to have a proper disposal of waste during and after the construction.
People	Institutional	What is the role of the LGU in the project?	Barangay Captain Marina Amacio of Brgy. Pag-Ayon	**Ms. Carmela Capule, Consultant, KRC** The role of the LGU in this project is very significant. The contractor shall have close coordination with the LGU and the affected people before and during the construction of the project. We will include in the study the social development project but it depends to the DPWH if this will included on their plan.
People	Delivery of Materials	How is the process during the construction with regards to the delivery of the construction materials? we see that it will affect some other areas with respect to air safety conditions? They consider the other route or alternative road for the delivery vehicle for the materials to create less traffic and	Ms. Josenel Joy Salinas, Municipal Social Welfare Officer	**Mr. Ricardo Capule, Consultant, KRC** As far as we know same road will be used during the delivery of the construction materials. The possible effect are the dust and noise pollution during construction. We have appropriate mitigating measures such as provision of water sprinkling to

Environmental Component Likely to be Affected	EIA Module	Issues/Suggestions raised by the Stakeholders	Sector or Representative who raised the issues/suggestions	Proponents Responses
		disturbance in the community? We hope that we will not be affected by the construction.		minimized dust, all heavy equipment, trucks etc. It must be properly maintained to prevent generation of air pollution. In terms of noise, all equipment must be provided with muffler to lower the noise level generated during operation. Proper timing of activity will be undertaken. We will include in our study that the people in the community will not disturb during the construction. **Ms. Josenel Joy Salinas, Municipal Social Welfare Officer** With regards to the route or alternative road, do you have a suggestion? We can provide suggestion on the alternative route of the road during the delivery of the construction materials at Singko Onse.
People	Project Affected	What will happen to the affected structures, houses, land and trees when it traversed by the alignment?	Ms. Virginia Cordeno, Brgy. Kgwd. Brgy. Zone 4A	**Ms. Carmela Capule, Consultant, KRC** The affected property or land will be compensated by DPWH with

Environmental Component Likely to be Affected	EIA Module	Issues/Suggestions raised by the Stakeholders	Sector or Representative who raised the issues/suggestions	Proponents Responses
				fair market value. DPWH and assessor's office will validate on the submitted report. The Resettlement Action Plan team will be responsible in making an inventory of all affected concerns such as crops and houses. Every property affected by the project shall be appropriately compensated. DPWH will pay the trees based on their guidelines. It depends on the size, and height of the trees.
People	Livelihood	We hope that during construction the livelihood of our fisherman will not affected. Fishing is the main livelihood in our area. That area is clearly affected by the project alignment. What will happen to the fishes once road construction takes place? Do you have any security measures with respect to this concern?	Ms. Mary Jane Odelmo, Brgy. Kgwd. Brgy. Tapong	**Mr. Ricardo Capule, Consultant, KRC** Before the construction the contractor will inform the community for their plan for the construction period. The contractor will put up the safety measure to mitigate accidents during the construction and the residents cannot enter to the project site to prevent accidents. The safety

Environmental Component Likely to be Affected	EIA Module	Issues/Suggestions raised by the Stakeholders	Sector or Representative who raised the issues/suggestions	Proponents Responses
				officers are responsible to ensure even the safety of the immediate residents and their crops. The DPWH, as the project proponent should coordinate with the contractors with regards to safety provisions. As residents, you have also to be vigilant about the activities during the road construction. We expect a disturbance to the fishermen's during the construction. On the other hand, this project is very helpful for the development in the community particularly accessibility.
		Is there a chance of having a job opportunity once project implementation takes place?	Barangay Captain Marina Amacio of Brgy. Pag-Ayon	**Ms. Carmela Capule, Consultant, KRC** Absolutely yes! Numerous incomes generating jobs will rise.

Environmental Component Likely to be Affected	EIA Module	Issues/Suggestions raised by the Stakeholders	Sector or Representative who raised the issues/suggestions	Proponents Responses
Others	Project Details	How many lanes is the bridge?	Mr. Eduardo Moreno, Brgy. Kgwd. Brgy. Pag-Ayon	**Mr. Ricardo Capule, Consultant, KRC** For now, there will be only 2 lanes with emergency bay. **Engr. Ligaya Maravilla, Municipal Engineer** This is the not final number of lanes. This is included in the study and subject for approval by the DPWH. As of now this is a proposed or under feasibility study. There are proposed alternatives and best alignment. We conducted this consultation meeting to discuss or confirm you if you are favor on the said project and what are your concerns on the environment

Environmental Component Likely to be Affected	EIA Module	Issues/Suggestions raised by the Stakeholders	Sector or Representative who raised the issues/suggestions	Proponents Responses
		Where is the alignment of the bridge project from Panay-Guimaras?	Mr. Eduardo Moreno, Brgy. Kgwd. Brgy. Pag-Ayon	**Mr. Ricardo Capule, Consultant, KRC** Presented the alignment to the attendees and he states that the alignment on the concerned area is located at the right side of elementary school of Pag-Ayon.
		When is the target or timeline of the project? Also, can we suggest to include the bike lane?	Barangay Captain Marina Amacio of Brgy. Pag-Ayon	**Ms. Carmela Capule, Consultant, KRC** Year 2022 is the proposed implementation of the construction of the project or after the approved detailed engineering design. Six years is the timeline for the construction of the project. 2028 is the target to operate the bridge. We will take note your suggestion for inclusion of bike lane in the design.
Others	ECC	Who will apply for the ECC?	Mr. Jimwell Canedo, Brgy. Pag-Ayon	**Ms. Carmela Capule, Consultant, KRC**

Environmental Component Likely to be Affected	EIA Module	Issues/Suggestions raised by the Stakeholders	Sector or Representative who raised the issues/suggestions	Proponents Responses
				DPWH or the proponent is one responsible for the applying the ECC to DENR-EMB. We as consultant are helping them for the process through this EIA study and we will provide them the results of the study.
Others	Expression of Support	We are thankful to government because they give as a chance to have this project here in our community. We say “Yes” and gave a “thumbs up” for this project. Because of this project, there are lots of possibility on the promotions of tourist spots here in Pulupandan. We are hoping that this project will be implemented. Let us support this project. LGU will always support on projects that will provide welfare to the people in Pulupandan.	Ms. Yryne Valenzuela, P.I.O/Executive Assistant	
		We don’t have any problem with the proposed project. I am full support and no objections to the proposed bridge project. We hope	Barangay Captain Marina Amacio of Brgy. Pag-Ayon	

Environmental Component Likely to be Affected	EIA Module	Issues/Suggestions raised by the Stakeholders	Sector or Representative who raised the issues/suggestions	Proponents Responses
		that the project will be fast track. The proposed alignment is less people and structures affected. In behalf of Brgy. Pag-ayon community, we are very full support!		

Municipality of Buenavista, Guimaras

Environmental Component Likely to be Affected	EIA Module	Issues/Suggestions raised by the Stakeholders	Sector or Representative who raised the issues/suggestions	Proponents Responses
Land	Terrestrial Flora and Fauna	Did you consider the trees in the study? Because in the affected areas they have a lot of trees, crops and kalamansi	Ms. Girlie Magilo, Municipal Agri-Fisheries Council	**Ms. Carmela Capule, Consultant, KRC** Yes, trees were included in the study. It will be included in the Resettlement Action Plan (RAP). RAP will conduct 100% assessment to all affected properties such as structures, trees and land after the final or approved alignment provided by the DPWH. It will be paid by DPWH with fair market value. We have a guidelines that before the cutting of the trees we need to request a permit to DENR. DPWH will compensate the trees based on their guidelines. It depends on the size, and

Environmental Component Likely to be Affected	EIA Module	Issues/Suggestions raised by the Stakeholders	Sector or Representative who raised the issues/suggestions	Proponents Responses
				height of the trees. This meeting is the avenue for us to know and disseminate regarding the project.
People	Project Affected	What will happen to the affected land properties to be traversed by the alignment?	Mr. Eliodoro Millama, Brgy. Kgwd. Brgy. Cansilayan	**Ms. Carmela Capule, Consultant, KRC** The affected property or land will be compensated by DPWH with fair market value. DPWH and assessor's office will validate on the submitted report. Resettlement Action Plan Team will assess all properties of the affected people. DPWH have guidelines for the compensation.
People	Livelihood (Fisherfolk)	As per experience the construction of the wind turbines greatly affected our crops. Have you also considered the displacement of our fisher folks and natural resources once construction takes place?	Ms. Girlie Magilo, Municipal Agri-Fisheries Council	**Mr. Ricardo Capule, Consultant, KR** We have a mitigating measure on the livelihood of the fishermen that may be affected. Prior to construction, the contractor will place barrier to prevent the sediments from scattering out to the protected area. In case the contractors fail to follow those measures, we can ask help from DENR and have thorough investigation. **Ms. Carmela Capule, Consultant, KRC**

Environmental Component Likely to be Affected	EIA Module	Issues/Suggestions raised by the Stakeholders	Sector or Representative who raised the issues/suggestions	Proponents Responses
				In our study we included the marine or the impact of biodiversity. It is included in our Environmental Impact Assessment study all the marine ecology: the flora and fauna and the present condition of marine life. We have already conducted the study and we will have it presented by next meeting. Those affected fisher folks will be taken into consideration by the contractors in making mitigating measures. We will emphasize to the project proponents to provide mitigating measures to be followed by the contractors and must be observed during implementation. EMB have continuous monitoring on environmental aspect. The contactor need to follow the protocol
People	Livelihood (Mango Plantation)	As per concern from Central Office, since Guimaras is known for its abundant production of mango fruits, how can you protect the mango industry of the area from outside mango traders once the road project is realized?	Mr. Ricardo Capule, Consultant, KRC	**Ms. Girlie Magilo, Municipal Agri-Fisheries Council** We have a quarantine area before to enter in our island. We have a check point. It is already a national law that mango fruits of outside traders are prohibited from entering the island. We will assure that we will take it into strict implementation when it comes to happen.

Environmental Component Likely to be Affected	EIA Module	Issues/Suggestions raised by the Stakeholders	Sector or Representative who raised the issues/suggestions	Proponents Responses
				Mayor Eugenio Reyes, Municipal Mayor of Buenavista We consider to put up an inspection in the project area to monitor the entering of goods to prevent outside traders from entering the island.
Others	Project Design	This concern is more on engineering and technical design of the proposed bridge, have you included in your design the lanes to which people could pass though by walking or using bicycles or motorcycles?	Mayor Eugenio Reyes, Municipal Mayor of Buenavista	**Mr. Ricardo Capule, Consultant, KRC** We will inform to the proponent the final design of the bridge and we will inform them your suggestions for possible inclusion of bike lane and motorcycle lane in their design.
Others	Expression of Support	We are very thankful for the government for the project in our municipality. It will give us economic development and it also attract tourists and investors in or community. This project is very helpful to us because most of the passengers stranded every time have a typhoon and we cannot cross the sea due to no other means of transportations. Also, if this project realizes, we hope that the next project is Airport in our municipality. We are requesting to the proponent for the close coordination to the LGU before and during the construction of the	Mayor Eugenio Reyes, Municipal Mayor of Buenavista	

Environmental Component Likely to be Affected	EIA Module	Issues/Suggestions raised by the Stakeholders	Sector or Representative who raised the issues/suggestions	Proponents Responses
		project for their information and mostly for the displacement of the affected people of the project. Right now the LGU still updating their CLUP.		

Municipality of San Lorenzo, Guimaras

Environmental Component Likely to be Affected	EIA Module	Issues/Suggestions raised by the Stakeholders	Sector or Representative who raised the issues/suggestions	Proponents Responses
Land	Mangroves	What about the mangroves and timberland?	Ms. Catherine Ann Gawara, Municipal Planning and Development Coordinator (MPDC)	**Ms. Carmela Capule, Consultant, KRC** The areas with mangroves affected by the projects were included in the study. We will assess the present condition of the mangroves. DENR have a guidelines regarding the affected mangroves of the project. We check the present species of mangroves in the area. DENR will be the final say for the approval of the ECC.
People	Project Affected	How about the affected houses by the project? Also, I think we should have a meeting to all affected people.	Ms. Chona Tabiano, Brgy. Kgwd. Brgy. M. Chavez	**Mr. Ricardo Capule, Consultant, KRC** Based on the DPWH guidelines. The affected property, structures and land will be paid by DPWH with fair market value. DPWH and assessor's office will validate on the submitted report.

Environmental Component Likely to be Affected	EIA Module	Issues/Suggestions raised by the Stakeholders	Sector or Representative who raised the issues/suggestions	Proponents Responses
				Ms. Carmela Capule, Consultant, KRC We have another study team for the assessment of all affected properties this is the team of RAP. Resettlement Action Plan (RAP) Team will assess all properties of the affected people after the final approval of the alignment. She mentioned that DPWH have a guidelines for the compensation. This public scoping meeting is the avenue for us to know and disseminate regarding the project. We have a separate meeting for the RAP team they will present the results of their assessment. DPWH will pay the acquisition of all affected structures after the conduct of RAP. All affected will be compensated as long as included in the inventory or during cut offs.
		I and Kgwd. Chona Tabiano are one of the affected by the project. I have a 2 house and 1 house for kgwd. Chona. We are requesting for the consideration to re-route the alignment of the propose alignment.	Mr. Rafael Tabiano, Brgy. Kgwd. Brgy. M. Chavez	**Ms. Carmela Capule, Consultant, KRC** DPWH have a guidelines for compensation for the affected people. 2021 is the propose schedule for the settlement to the affected residents in the project. The LGU or the affected barangay will provide or submit the certificate for no objection of the project. **Engr. Claudio Cabrias, DPWH-Region VI**

Environmental Component Likely to be Affected	EIA Module	Issues/Suggestions raised by the Stakeholders	Sector or Representative who raised the issues/suggestions	Proponents Responses
				The one consideration of the recommended alignment is based on the distance of the windmill and safety of the people.
		The recommended alignment traverses some buildings like barangay hall, day care and houses. Can we recommend another alignment in the avoidance of those affected buildings?	Mr. Rafael Tabiano, Brgy. Kgwd. Brgy. M. Chavez	**Mr. Ricardo Capule, Consultant, KRC** We will take that into considerations. **Engr. Claudio Cabrias, DPWH-Region VI** Prior to the selection of the most recommended road alignment, we have also considered those wind turbines constructed in certain areas.
		How about the relocation of the affected people? LGU have no fund or budget for their relocation or resettlement.	Ms. Catherine Ann Gawara, Municipal Planning and Development Coordinator (MPDC)	**Ms. Carmela Capule, Consultant, KRC** We will raise this issue to the proponent if they can provide.
People	Public Consultation	The recommended alignment will traverse a fishpond area. There should be a public hearing to be conducted in the affected barangay.	Ms. Catherine Ann Gawara, Municipal Planning and Development Coordinator (MPDC)	**Ms. Carmela Capule, Consultant, KRC** There will be another study once the alignment is final, that is the Land Acquisition and Resettlement Action Plan. This is actually a

Environmental Component Likely to be Affected	EIA Module	Issues/Suggestions raised by the Stakeholders	Sector or Representative who raised the issues/suggestions	Proponents Responses
				detailed study to evaluate and account all the properties affected by the road alignment. There will be public hearing. It is important for us to know all your concerns regarding the environmental impact of the project.
		May we suggest that on the next consultation meeting more attendees from other government agencies and specialist	Ms. Catherine Ann Gawara, Municipal Planning and Development Coordinator (MPDC)	**Ms. Carmela Capule, Consultant, KRC** We have sent an invitation to the target participants such as Regional DENR and other non-government organization for the consultation meeting but they cannot around for the possible reason of the bad weather earlier. For the next consultation we will ensure that they can attend or send their any representative to attend the said meeting.
People	Social Acceptability	What will happen if the involved barangay will go against the alignment?	Ms. Chona Tabiano, Brgy. Kgwd. Brgy. M. Chavez	**Ms. Carmela Capule, Consultant, KRC** It is advised that the barangay has to submit a letter of disagreement with road alignment. The final decision will lie to the Environmental Management Board (EMB) to grant the letter or not.

Environmental Component Likely to be Affected	EIA Module	Issues/Suggestions raised by the Stakeholders	Sector or Representative who raised the issues/suggestions	Proponents Responses
Others	Project Design	Where is the approach of the bridge in the M. Chavez?	SFOI Charlie Nieles, OIC-Bureau of Fire and Protection	**Engr. Claudio Cabrias, DPWH-Region VI** Showed the propose approach to the stakeholders the map of the bridge through the aid of Google earth.
		May we suggest that before and during construction the proponent can provide rerouting of the vehicle to prevent accidents in the area.	SFOI Charlie Nieles, OIC-Bureau of Fire and Protection	**Mr. Ricardo Capule, Consultant, KRC** Yes, we will raise your suggestion to the proponent for their consideration.
		We want to have the actual plan of the bridge	Mr. Ibany Bonilla, Municipal Administrator	**Ms. Carmela Capule, Consultant, KRC** Yes, we will include in our recommendation to the proponent to provide the final plan or design for your approval. Proper coordination to the affected people are very important.
		What is the length of the bridge?	SFOI Charlie Nieles, OIC-Bureau of Fire and Protection	**Mr. Ricardo Capule, Consultant, KRC** Based on the recommended length it is around 13.10 meters.
		Did you consider the earthquake in the design?	SFOI Charlie Nieles, OIC-Bureau of Fire and Protection	**Engr. Claudio Cabrias, DPWH-Region VI** Yes, we already included and considered in the design.

Environmental Component Likely to be Affected	EIA Module	Issues/Suggestions raised by the Stakeholders	Sector or Representative who raised the issues/suggestions	Proponents Responses
		Are we allowed to walk or jog in the bridge? We hope that they consider this in the design.	Ms. Susie Ferrer, Brgy. Cabano	**Lui Feng, CCCC Highway Consultant** People are not allowed to walk, take on the consideration that the bridge is very long and we prevent accidents for the people. **Engr. Claudio Cabrias, DPWH-Region VI** For now, the bridge is composed of 2 lanes with emergency lane. If the people can walk in the bridge it is their choice and personal risk.
Others	Project Details	How many million or billion cost of the project?	SFOI Charlie Nieles, OIC-Bureau of Fire and Protection	**Ms. Carmela Capule, Consultant, KRC** Based on the estimated cost of the bridge project it estimated around 27 Billion. But this is not a final cost. It depends on the agreement from Philippine Government and Government of China
		If the bridge already operationalized, they have a toll-fee?	Mr. Rafael Tabiano, Brgy. Kgwd. Brgy. M. Chavez	**Ms. Carmela Capule, Consultant, KRC** There is no toll fee because this is not an expressway.
Others	Project Benefits	How wide is the design of the bridge project?	SFOI Charlie Nieles, OIC-Bureau of Fire and Protection	**Mr. Ricardo Capule, Consultant, KRC** For now, there are only two lanes to be constructed along the proposed project. Most

Environmental Component Likely to be Affected	EIA Module	Issues/Suggestions raised by the Stakeholders	Sector or Representative who raised the issues/suggestions	Proponents Responses
				probably every lane has a wide of 3.5 or 4 meters.

Municipality of Leganes, Iloilo

Environmental Component Likely to be Affected	EIA Module	Issues/Suggestions raised by the Stakeholders	Sector or Representative who raised the issues/suggestions	Proponents Responses
Land	Terrestrial Flora and Fauna	Our concerns is about the habitat, terrestrial (flora and fauna) to be affected by the project.	Mr. Jofel Coching, Zooligical Society of London-Philippines	**Ms. Carmela Capule, Consultant, KRC** We have partially conducted survey including the terrestrial flora and fauna. The sampling methods were based on the alignment presented to us. The marine ecology, flora and fauna are of separate survey. Please attend on our next meeting consultation and we will be presenting the result of our surveys: land surveys, water surveys, air surveys, noise surveys, and socio-economic survey.
	Terrestrial Flora (Mangrove)	How about the species possibly be affected by the alignment? In the proposed alignment there are a lot of sea grass for the Dugong and mangrove plants.	Mr. Rodney Golbeque, Zooligical Society of London-Philippines	**Mr. Ricardo Capule, Consultant, KRC** We will consider those concerns in our study. By next presentation we will show you the results from our conducted surveys.
People	Traffic Congestion	We foresee that during construction it will give a traffic congestion in the area. Do you have a plan to mitigate this possible problem?	Atty. Jeorge Gregorio, Leganes Premier Land Consulting	**Mr. Ricardo Capule, Consultant, KRC** Yes, we have a mitigating measures on that issue. The DPWH will have a traffic management to mitigate the traffic congestion during construction. Also, the

Environmental Component Likely to be Affected	EIA Module	Issues/Suggestions raised by the Stakeholders	Sector or Representative who raised the issues/suggestions	Proponents Responses
				contractor will closely coordinate to the LGU and people in the community.
People	Project Affected	What is the cost of the private lands to be traversed by the road project?	Mayor JunJun Jaen, Municipal Mayor, Leganes	**Ms. Carmela Capule, Consultant, KRC** It will be based on the DPWH guidelines for compensation to the affected people. The DPWH has the guidelines about 2017 Right of Way Acquisition manual and in relation to the "per market value". Those guidelines will be the basis for the assessment even the overall computation.
Others	Project Details	As we are talking about environmental issues, can I ask when does this project start?	Engr. Samson Jaspe, Sangguniang Bayan Member, Leganes	**Ms. Carmela Capule, Consultant, KRC** So this is the process. At the end of this year, they're targeting to finalize the agreement including the budget and costing. Here's the schedule: • Year 2020: detailed engineering design (DED) • 2021- right of acquisition of all affected properties and structures or period for settlement for the Land Acquisition Plan (LAP) and Resettlement Action Plan (RAP). • 2022- starting of construction which will last until 2027

Environmental Component Likely to be Affected	EIA Module	Issues/Suggestions raised by the Stakeholders	Sector or Representative who raised the issues/suggestions	Proponents Responses
				Given the time frame, once the alignment is final there is still a need to conduct detailed engineering design in activity. This is to assess all the affected properties by the final alignment and compensation. The selection of contractors will be conducted between year 2020 and 2021. Since this is a government project, we have to follow official time frame.
		Where is the passageway of those big ships? If we have no international port. Can we request to put up a shipyard?	Mayor JunJun Jaen, Municipal Mayor, Leganes	**Mr. Ricardo Capule, Consultant, KRC** Presented the navigation through powerpoint with the aid of google earth. **Ms. Carmela Capule, Consultant, KRC** We will raise your concern to the proponent regarding your concern about shipyard for their consideration.
		Leganes has the most feasible and strategic location for international port than in Iloilo, that is my personal belief because we are located at the middle. Leganes is the only municipality having a land mass which is an important component for a port for industrial parks. In the province of	Mayor JunJun Jaen, Municipal Mayor, Leganes	**Ms. Carmela Capule, Consultant, KRC** We will raise your concern to the proponent for their consideration.

Environmental Component Likely to be Affected	EIA Module	Issues/Suggestions raised by the Stakeholders	Sector or Representative who raised the issues/suggestions	Proponents Responses
		Iloilo, the Leganes is eyeing for industrial park or economic zone since Leganes owns a property of 186 hectares. That's why I am asking if where is the passageway of those big ships in relevant to the height of the proposed bridge project." "My concern is the area of Leganes where the road alignment takes place already has a reclamation and proposal of making that area industrial zone. I don't know if this is the right forum for me to raise such concern. In my own point of view, if international port will not be put up in our area, we are asking at least for a shipyard specifically in our reclamation area. Also, consider my concern regarding our proposal on industrial economic zone. The bridge provides no employment to us, whereas the industrial economic zone will offer us income and employment."		

Environmental Component Likely to be Affected	EIA Module	Issues/Suggestions raised by the Stakeholders	Sector or Representative who raised the issues/suggestions	Proponents Responses
Others	Project Design	What is the height of the bridge project and how many lanes?	Mayor JunJun Jaen, Municipal Mayor, Leganes	**Engr. Claudio Cabrias, DPWH-Region VI** The proposed height is around 58 meters. In the proposed is 4 lanes. The initial bridge is designed for only 28meters, but then the Philippine Port Authority of Iloilo went against to this height of bridge all because the Dumangas in the future will become international port. With this, CCCC highway consultants revised the designed and made the measurement 58 meters high the same as the Guimaras-Pulupandan bridge height.
		After the construction, can we request to the proponent or contractor to give us the used materials or debris?	Atty. Jeorge Gregorio, Leganes Premier Land Consulting	**Ms. Carmela Capule, Consultant, KRC** It is possible. You can coordinate to the proponent.

Environmental Component Likely to be Affected	EIA Module	Issues/Suggestions raised by the Stakeholders	Sector or Representative who raised the issues/suggestions	Proponents Responses
		Can we request/suggest for the possible re alignment of the proposed project to Municipality of Saraga, because we see that the owner of the land there is only one the Ledesma Family.	Mayor JunJun Jaen, Municipal Mayor, Leganes	**Ms. Carmela Capule, Consultant, KRC** We will raise you suggestion to the proponent for their consideration. **Engr. Claudio Cabrias, DPWH-Region VI** Prior to the recommendation of the road alignment, the CCCC had considered the road connection to C2 line.

Results of Public Hearing

A separate report will be provided once the public hearing is done.

Chapter 3

ENVIRONMENTAL MANAGEMENT PLAN

3.0 ENVIRONMENTAL MANAGEMENT PLAN

3.1 Impact Management Plan

3.1.1 Construction Phase

The objective of this chapter is to describe and evaluate the expected anticipated impacts of the proposed development on the relevant environmental components, identify applicable mitigation measures and evaluate the significance of the impact once the proposed mitigation measures have been implemented.

The environmental impacts associated with the activities during the construction phase have taken into the account the existing environmental conditions. It is assumed that the proposed project site and services in the area meet the requirements of the project.

3.1.1.1 Impacts on Land

3.1.1.1.1Loss/Deterioration of Current Vegetation Cover

The project development will require removal of vegetation communities and associations. The removal of vegetation will also result to reduction in the population of the plant species growing within the disturbance area. Future vegetation will face a great threat during the clearing activity. This activity will hinder the opportunity of these regenerants to grow and replace the vegetation in the area.

Vegetation will be permanently removed from sites designated for the improvement of Pansipit River and construction of slope protection. Trees in adjacent areas may either be damaged or removed.

3.1.1.1.2 Loss of habitat

The project will require land clearing resulting to the removal of portions of remaining vegetation's to give way for the construction of island bridge and road network. This entails to further disturbance of wildlife, loss of habitats and reduction to biodiversity composition of the area.

3.1.1.1.3 Decrease/ migration of faunal species

Further loss of vegetation cover as a result of land clearing may encourage movement/migration of wildlife species in the area aggravated by the loss of habitat and remaining sources of food for survival. Likewise, wildlife disturbance due to noise generated during construction brought about by the operation of heavy equipment's will force faunal species to migrate in other or nearby areas/habitat where disturbance is less.

3.1.1.1.4 Erosion and Siltation

Soil erosion is a major agricultural problem. Abnormal rainfall causes the soaking of soil and increases the amount of water and its velocity, thus increasing its load capacity. Soil material that will be transported can cause blockage of water channel ways, which eventually results in flooding.

The removal of vegetation cover will lead to loss/removal of topsoils resulting from excavation activities. Erosion and siltation of the river may occur due to occasional rains and during movement of heavy equipment passing over unpaved roads and soil stockpile area. Similarly, alteration of land topography may result in heavy influx of surface run-off waters resulting to erosion in the uncovered surfaces and siltation downstream of the sloping condition of the project site.

3.1.1.1.5 Mitigation Measures

Replacement of trees cut due to land clearing

Prior to project implementation the proponent will coordinate to the DENR to seek clearance for the identification of required documents for the issuance of needed tree cutting permit (PD 705). Moreover, to compensate loss of habitats, the proponent will replace the number of trees removed/cut and plant them to nearby areas or in accordance with the advice of the DENR. Species that will be used for the reforestation must be indigenous trees and/or fruit bearing trees endemic in the place that can attract wildlife species.

As per **DENR Memorandum Order no. 05 of 2012** mandated that "Uniform replacement ratio for cut or relocated trees" item 2.2 "For planted trees in private land and forest lands... tree replacement shall be 1:50 while naturally growing trees on the same area, including those affected by the project shall be 1:100 ratio in support of the National Greening Program (NGP) and Climate Change Initiatives of the Government".

Under the **Joint Memorandum Circular No. 01 series of 2014** outline the "Guidelines for the implementation of the DPWH-DENR-DSWD Partnership on the Tree Replacement Project" states "The Tree Replacement Program ensures the planting of one hundred (100) seedlings/saplings/propagules as replacement for every tree cut within or along the RROW of all DPWH-administered infrastructure projects".

-Strict adherence to the development plan of the project site especially during land clearing

Land clearing will be confined on designated sites only based on the approved development only. Likewise, gradual land clearing and removal of vegetation is encouraged to provide sufficient time for non-volant fauna species to transfer in the nearby habitat.

Faunal monitoring is also recommended to be undertaken in different project phases-during construction and abandonment phase to determine if there are any adverse/positive changes in faunal species and population within the project area.

-Prohibition of wildlife poaching/collection

The proponent should also ensure that its employees must be prohibited/warned/informed not to engage in any mode of wildlife collection and/or hunting for the conservation and protection of remaining wildlife species. Promote wildlife protection using innovative means such as putting up of warning signage's on strategic areas for public information and warning.

-Establishment of natural noise buffer/natural perimeter along the alignment using landscape species or fruit bearing trees

To consider in the planning the establishment of natural buffer perimeter within the project alignment using landscape or fruit bearing trees. This method could also help provide a natural abode to some wildlife as well as source of food.

-Sedimentation/siltation control

Proper phasing and/or scheduling of earthmoving activities and proper stockpiling of scrapped soils in the proposed project development areas should be observed well, if any, away from the bodies of water/river. Installation of barrier nets, engineering technology, silt traps or sedimentation basin leading to water bodies is encourage to minimize siltation.

Soil erosion impacts can be minimized by clearing only small tracts of land at a time, and by minimizing the length of time that the cleared areas for industrial use are void of vegetation or for agriculture use not under active cultivation. Following these mitigation measures, the impact of the Project on soil erosion would be insignificant (low severity; low likelihood).

3.1.1.2 Increased Noise and Traffic during road widening

During construction of the bridge, road opening and road widening, increased noise and traffic levels will be significant due to heavy construction vehicles moving to and from the site. Increased traffic will be a result of trucks to and from the site for construction material deliveries and site clearing. Noise that will be generated will be through site clearing activities using soil scrappers and construction workers on site. However, as a pro-active measure, the project proponent in coordination with the local government units will devise a contingency traffic management scheme to assist the local government units in case of occurrence of traffic-related problem near and around the project area. Posting of traffic related advisory will be a component of the traffic management scheme.

It is anticipated that construction and operation will take approximately three (3) years. Due to the limited construction and operation period and the fact that there are residential areas in the immediate vicinity of the site, the impact is considered significant.

However, the impact will be managed through the implementation of the mitigation measures below.

6.1.2.1 Noise generating activities will be restricted to normal working hours, thus limiting noise levels at nighttime to minimize the effect on the residents in the affected areas.

6.1.2.2 Contractors shall be required to ensure that construction equipment and vehicles are in a good state of maintenance.

3.1.1.3 Increased Air Pollution

During the construction phase of the project, access roads and the operation of construction equipment and vehicles will be the main sources of pollution. Fugitive dust and combustion emissions will be generated. The primary sources of fugitive dust emissions will include construction activities such as land clearing and preparation of re-channeling and river widening in the area, grading of access roads, excavation, and increased vehicle traffic on unpaved roads. The amount of dust generated will be a function of construction activities, soil type, moisture content, wind speed, frequency of precipitation, vehicle traffic, vehicle type, and roadway characteristics.

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Fugitive emissions will be highest during drier periods in areas of fine-textured soils. During the dry season, dust suppression will be applied as needed (such as watering of disturbed or exposed areas). A dust control plan will be implemented and regular maintenance of vehicles and equipment will be carried out.

The primary sources of combustion emissions include the operation of diesel or gasoline-powered construction equipment such as graders, dozers, trucks, and other mobile sources. These sources produce sulfur dioxide (SO_2), nitrogen oxides (NOx), carbon monoxide (CO), and Carbon Dioxide (CO_2). Air emissions from construction and operation activities will occur over a period of three years and will affect populations around the project area so the impact to air quality will be minor (low severity to medium likelihood).

3.1.1.4 Increase in Solid Waste and Hazardous Waste Generation

The solid waste generated during construction will consist of (a) domestic waste and construction waste from work camps, and (b) hazardous waste from work sites. Improperly-managed wastes could accumulate into unsightly piles or small dumpsites. These dumpsites become breeding grounds for pests and other vectors and contribute to onsite sanitation problems. Leachate from these dumps could contaminate local groundwater and surface water bodies.

The project contractors shall be required to implement a waste management program. Waste receptacles/bins shall be provided in strategic locations within the work areas. There shall be an identified designated area for the temporary disposal of domestic and construction wastes.

Biodegradable waste materials can be composted while the non-biodegradable wastes shall be collected separately and temporarily stored at the waste area until collected for proper final disposal in a government-approved disposal site. Recyclable construction waste materials such as wood, steel, and other related materials may be reused by the contractors.

Hazardous wastes such as used oil, busted lamps, used batteries etc. shall be collected and stored onsite in approved facilities according to DENR standards. Hazardous wastes shall then be removed from the site to approved DENR accredited treatment and storage disposal (TSD) facilities.

3.1.1.5 Impact on Water

-Generation of Domestic and Industrial Wastewater

Workers, equipment and vehicles will be brought to the area and worker camps and stockyard will be constructed. This could generate domestic and industrial wastewater in the form of sewage, waste water from cleaning and maintenance of equipment and vehicles, water contaminated with oil and grease, etc.

Waste treatment facilities such as septic tanks or portable toilets must be installed on site during construction. The project should ensure that no untreated human waste should be allowed to enter any water course where this will affect rivers' water quality, aquatic environment, and human health. There shall be provision for oil and grease trap, or outside maintenance of equipment and vehicles.

-Discoloration of surface water and marine water

With the construction of slope protection and widening, road opening and widening, there will be temporary discoloration of the surface and marine water, increase run off and soil erosion.

There must be provisions for temporary rechanneling of river flow and construction of settling ponds to contain inflow of muddy waters in the road construction. No clearance or establishment works shall be undertaken during heavy rainfall conditions to reduce the risk of sediments loss to the environment.

3.1.1.5.1 Marine Ecology

3.1.1.5.1.1 Construction

On Plankton

Threat to plankton community would come from the increase load of suspended solids during the construction of the project resulting to reduction of depth of photosynthetic activity of the phytoplankton. Similarly, highly turbid water would affect the grazing success of zooplankton. Moreover, the mortality of plankton community in the impact area just be replenished through water currents and tidal influences from other areas unaffected by the construction as being passively drifting organisms. Given, the temporary and limited extend of the effect of highly turbid waters relative to the overall area of project, the impact on plankton community are predicted to be low.

These impacts, while significant, are localized and temporary. Turbidity of the water column is expected to decrease to normal levels immediately following the completion of the construction activities.

To mitigate the aesthetic impacts and the impact among fish larvae/juveniles including other planktonic organisms, use of silt curtains is recommended.

On Benthic Community

The benthic macroinvertebrates community in this survey was mostly comprised of arthropods, mollusks and annellids. These groups of organisms are dependent on the availability of food in the benthic zone and mainly part of the food chain as well. Some species are tolerant to pollution and can survive by feeding on the organic materials deposited in the bottom part of the aquatic habitat. Macro-benthos can migrate to other area once disturbed; hence, the project is not expected to pose significant impact on this aquatic community.

Clear cutting hardwood timber, heavy crop irrigation, and industrial/residential development which occur in the watershed can impact populations of biotic macroinvertebrate and fish communities in the study area. Cutting of bottomland hardwoods eliminates leaves and woody debris which are an important primary food source. Loss of canopy cover allows solar radiation to raise water temperature to high levels, especially in summer. Erosion and siltation resulting from logging operations can also have detrimental effects on water quality.

Activities such as earth moving and removal of vegetation within the development area will proportionately increase runoff. Most of the water will be directed to the downstream zones and outfall areas adjacent to the river mouth. Sediment runoff will have a potential impact to river organisms as well as flora and may be a potential source of threat to existence of locally important species.

Silt fence which will act as sieves and filter for sediment particles will be installed at specific areas to minimize potential impacts of the construction phase.

Minimal impact to loss of freshwater habitat since the expansion will focus on the upland areas. However, as part of the monitoring program, freshwater monitoring will be conducted congruently within the freshwater quality stations. This ensures correlation of results of the biotic cover with that of the abiotic and physico-chemical parameters.

On Fishes and Other Types of Marine Life

The impacts of construction on mobile organisms such as fish and other forms of marine life would be localized, temporary and minimal because of the inherent ability of these organisms to avoid disturbance. Increased suspended sediment levels and turbidity generated by construction activities would cause adult fish in the affected area to migrate to other suitable areas. However, smaller species that are unable to migrate would be chronically exposed to high turbidity may suffocate as their gills become clogged with sediments. Even low levels of resuspended fine sediment could also affect benthic larvae and juveniles of commercial clam, snail and shrimp populations. This impact is expected to occur within the vicinity of the construction site. However, as the construction activities are done, impact on the fish resources is expected to be minimal.

To mitigate the impact among smaller species, use of silt curtains is recommended.

3.1.1.6 Impact on People

3.1.1..6.1 Apprehension of Locals towards the Project

During pre-construction phase, significant impact identified is the apprehension of locals towards project development. This may attribute to the loss of their land, crops and other properties that might possibly be affected by the implementation of the proposed project. Information dissemination in the community about the project through coordination with LGU's, PO's, NGO's, barangay officials and other concerned community groups should be conducted. This program will introduce the proposed project in the area and avert negative perception of people towards the project.

3.1.1.6.2 In-Migration

The proposed project will employ a substantial number of workers during the construction phase. The migrant workers will definitely add to the existing population size within the project area, especially so if they bring in members of their family. If these migrant workers take temporary residence in the project area, these will add to the general population size. This might increase the population of the people near the lake.

Some may be transient workers who will opt to commute daily and will therefore impact only on the day-time population size. Whichever case, demand for resources especially food and water at the minimum, and services attendant to these, will increase.

To avoid influx of migration in the area where the Project is located, qualified residents of Barangays that the project will traversed and other neighboring barangays/municipalities near the project area must be given priority in the hiring of construction personnel. This must be closely coordinated with the LGU and barangay officials.

3.1.1.6.3 Increase in Business/Economic Activities

The construction work will create a multiple effect where various economic activities will either be created or the existing ones will experience growth. This will lead to the creation of more jobs. In relation to this, disposable income will also increase. The potential for economic opportunity and growth will arise, leading to the generation of more jobs. In effect, a growing cycle of economic growth and employment generation will arise.

The Project’s purchases of supplies and materials from local establishments, together with expenditures by project workers typically result in increased business activity and employment in the local trade and service sectors.

Upon project completion, tourism opportunity is also expected which will benefit the local government and the community. This in effect will create tourism related business and job opportunity.

3.1.1.6.4 Increased Generated Waste at the Project Site

Workers will be brought to the area and worker camps will be constructed. This could generate industrial and domestic waste such as engine parts, tires, garbage, sewage etc. Poor waste disposal could lead to the generation of foul odor, litter on the site and potential contamination of the lake from the leachates.

The project should implement proper waste management. Installation of Material Recovery Facility (MRF) for waste segregation and compost pits must be provided in the construction and workers campsite/bunkhouses.

Waste treatment facilities such as septic tanks or portable toilets must be installed on site during construction. The project should ensure that no untreated human waste should be allowed to enter any water course where this will affect the lakes’ water quality, aquatic environment, and human health. Likewise, proper clean up and abandonment of the site after completion of the project, such as removal of temporary bunkhouses, stock yard and other unnecessary structures should be undertaken.

3.1.1.6.5 Health and Safety of Construction Workers

Accidents and hazards may occur on sites thus there are risks facing both skilled and unskilled workers. Personal protective equipment (PPE) should be strictly implemented during construction activities. Personal protective equipment (PPE) refers to protective clothing, helmets, goggles, or other garments or equipment designed to protect the wearer's body from injury or infection. This is to reduce employee on the exposure to hazards when engineering and administrative controls are not feasible or effective to reduce these risks to acceptable levels. The construction contractors will be required to provide temporary housing for their workers, with provision for adequate water and toilet facilities. Construction workers will be oriented to strictly observe proper hygiene and sanitation practices at the construction site. Contractors will be required to provide basic medical services to ensure that the health and sanitation of workers are protected. The contractor must also provide a first aid kit and availability of health worker to attend to any immediate health needs of workers and in case of untoward incidents. Hiring of medical staff is also recommended to ensure that there will be professional staff that will cater those who are injured or ill.

With the influx of construction workers to the project area, there will be an increase in the volume of sewage and solid waste generation. If not properly managed, these wastes will create unsanitary conditions in the area, which can cause local outbreak of diseases. This will be aggravated if there are no provisions for temporary bunkhouses for workers and other sanitary facilities.

3.1.6.6 Safety and Public Health Hazards

Workers at the construction area will be exposed to construction-related hazards. Accidents can happen and cause minor and/or major injuries as well as disability if there are no adequate provisions for the safety of workers and visitors. A Safety Officer is required during the construction activities to ensure effective implementation of safety measures to avoid accidents and protect workers. Provision of appropriate Personnel Protective Equipment (PPE) shall be required within the construction premises to ensure safety of the staff and workers. In order to avoid accidents, proper signages/warnings shall be placed in construction work areas. Health precautions will be undertaken to minimize health risks to construction workers and nearby residents.

These hazards may also be experienced in adjoining communities and activities that will generate noise pollution and dusts, hence, development activities would have to adopt proper measures to ensure public health and safety. Also, migration of some workers on site and nearby community will increase possible spread of communicable diseases and accumulation of domestic wastes.

To protect health host communities against possible spread of communicable diseases, routine medical check-up to workers must be undertaken. Observe disinfection of water logged areas and provision of drainage facilities to avoid creation of disease vectors habitat.

3.1.1.6.7 Increase Traffic Congestion

Hauling of construction materials and movement would be significant since there is heavy traffic in the some section of the project area. However, as a pro-active measure, the project proponent in coordination with the local government units will devise a contingency traffic management scheme to assist the local government units in case of occurrence of traffic-related problem near and around the project area. Posting of traffic related advisory will be a component of the traffic management scheme.

3.1.1.6.8 Loss of Land and Properties

The project development will affect people physically and economically. There will be acquisition of land which will result in the displacement, loss of land and properties of a number of occupants.

The project will acquire lands and at the same time may affect settlements/properties located at the coastal area. This loss of land and properties to give way to project development will affect numbers of settlers/households in the area. Affected people are composed of private owners and informal settlers. The involvement of the concerned LGUs in this matter is very essential. To this end, DPWH will enter to negotiations with the concerned land/property owners based on the established final alignment of the project. Compensation and relocation concerns should be closely coordinated with the LGUs, barangay and affected community. A Resettlement Action Plan should be prepared to properly and completely document and inventory all the project affected people, lands, and other properties for possible compensation and relocation. Intensive consultation with the affected people during this period will be undertaken to avoid misunderstanding and opposition against the project. Formulation of an equitable compensation and acquisition scheme will be designed to ensure that affected people will have a just compensation for the land, crops and other properties that will be affected by the project.

3.1.1.6.9 Peace and Order Concerns

To maintain peace and order during the construction phase, coordination with the local governments and police should be undertaken. Cooperation of the community is necessary to keep peace and order in the project area, thus a good relationship between the DPWH and affected communities will be maintained. Regular monitoring of community complaints must be documented to address them properly.

Implementation of security management will likewise be undertaken. Also, as additional safety measure will be secured with a perimeter fence equipped with safety features and the appropriate number of security personnel.

3.1.2 Impact Management Plan During Operation

The main objective of the project is to boost tourism along the project areas. Bridge and road construction and widening along the lake will result to increase in local revenues due to tourist influx.

Local economic activities such as business opportunities will be developed. Expect more tourism related business, utilization of land and local resources and creation of more jobs.

However, as a result more waste and garbage both solid and liquid waste will be generated once business establishment increase within the area. The Local Government Unit shall have control over the businesses and activities over the area. Each establishment big or small must have proper waste management plan. A more strict compliance to environmental regulation should be enforced.

3.1.3 Impact Management Plan During Abandonment Phase

The abandonment activities involve the demolition and restoration of disturbed areas to a landform that approximates and blends in with the surrounding landform, minimal impacts to the soils are expected. The rehabilitation process will involve primarily the demolition and revegetation of disturbed areas to native species, controlling erosion, controlling invasive non-native plants, and monitoring results.

Table 1 presents the matrix of mitigation and enhancement measures for each type of activity.

Table 1. Impact Management Plan

Project Phase	Environmental Component Likely to be Affected	Potential Impact	Options for Prevention or Mitigation or Enhancement	Responsible Entity	Cost	Guarantee/ Financial Arrangements
I. Pre-Construction Phase	This will be addressed during implementation of RAP as resettlement is expected to be done prior to project implementation or prior to construction.					
Securing of Permits and Clearances from National and Local Agencies	People	Increase in government revenues	Submission of documents required by the national and local agencies	DPWH	Part of initial project cost	Incorporated in the work and financial plan of DPWH
Hiring of staff for preparatory works prior to construction	People	Economic/ job opportunity	Priority will be given to qualified residents in the project areas	DPWH	Part of initial project cost	Incorporated in the work and financial plan of DPWH
II. Construction Phase						
Civil works and site clearing	The Land	Change in land use Soil erosion Increase run off Destabilization of slope Removal of vegetation and habitat disturbance	• Set-up temporary fence around the construction area • Conduct slope stability analysis and construct silt trap and spoils disposal area • Limit the area of grading to the facility and access roads. • Spoil materials will be used as fill and as construction materials for site preparation. • The negative impact is insignificant and short term but irreversible • Cutting Permit will be secured if there are trees that will be affected during construction • Limit land clearing in designated sites only. • Establishment of a small nursery as source of planting materials using the endemic species and fruit-bearing trees found onsite for the replacement of	Proponent/ Contractors	Included in the Construction cost	ECC MMT

		Solid wastes	trees to be cut or removed • Gradual clearing and removal of vegetation to provide sufficient time for wildlife species to transfer to the nearby habitat. Planting of naturally-grown species in the designated areas might encourage the wildlife species to return in the future. • Ensure solid waste management plan prior to mobilization of project; proper segregation and disposal shall be included in the program; Strictly require contractors and their workers to observe proper waste disposal and sanitation			
Civil works and site clearing	The Water	• Increase in run-off -Generation of domestic wastewater -Generation of wastewater from comfort rooms, cleaning of construction equipment, vehicles and regular watering activities • Contamination of surface and marine water with oil and grease • Terrestrial and marine habitat disturbance	• Provision of portable portalets during construction and management of domestic wastewater to meet and comply with DENR effluent guidelines. • Site clearing will be limited to areas needed and restricted to acceptable weather conditions • No clearance or establishment works will be undertaken during high rainfall conditions to reduce the risk of sediment loss to the environment • Set up adequate toilet facilities; ensure sufficient washrooms for workers • Construction of settling ponds to contain inflow of muddy waters • Installation of oil traps and proper storage of used oil • Implement efficient construction methodology to shorten disturbance resulting from possible siltation	Proponent/ Contractors	Included in the operating cost	ECC, MMT
Civil works and site clearing	The Air	• Dust generation during clearing of the site and stockpiling of soil	• Roads will be watered especially during hot and dry weather. Regular water spraying by water sprinklers (road tank watering) during construction.	Proponent/ Contractors	Included in the operating cost	ECC,MMT

		• Dust generation during opening up of pits, associated with movement of vehicles and machinery and excavation, transportation and emplacement of rock and soil • Dust generation during construction of the processing plant, power plant and storage facility, associated with movement of vehicles and machinery and excavation, transportation and emplacement of rock and soil • Exhaust fumes and noise from vehicles	• Regulate speed of delivery/ hauling trucks • Provide equipment with ear plugs, mufflers and proper scheduling of noise-generating activities			
Civil works and site clearing	The People	• Increase in livelihood and business opportunities • Increase in revenues • Provide job opportunities for construction workers	• Alleviate economy and generation of income to hosts and nearby barangays • Increased LGU revenues resulting from the purchase of locally available materials and equipment for construction, translating to additional taxes. Business establishments should be properly registered and payment of the required taxes shall be monitored. • The construction of the project will generate employment opportunities for local residents as well as migrant workers. It will bring increased income to those who will be employed. Local manpower may have to compete with migrant labor for employment. Employment of local residents during	Proponent	Included in the operating cost	ECC

			the construction stage shall be given priority, particularly those from families in the Direct Impact Area.			
		• Health and Safety Risk	• Use of appropriate PPEs and proper training of workers; strict implementation of health and safety plans and programs including road safety; comply with DOLE requirements			

Civil works and site clearing	Solid and Hazardous Wastes	Used oil, paint wastes, scrap metals, busted lamps, and spent fuels	• Ensure a Solid Waste Management Plan to cover proper segregation, waste handling, waste storage and a waste disposal system. • Employ waste management strategies on reduce, re-use and recycle programs - Reduce – Reduction of waste through less packaging by promoting bulk purchasing without packaging; less single-use devices - Reuse – Choose water supply, office supplies that are re-usable, e.g. use printer inks that are refillable - Recycle – Composting the water supply and kitchen waste is a very useful form of recycling -Waste receptacles/bins shall be provided in strategic locations within the work areas. There shall be an identified designated area for the temporary disposal of domestic and construction wastes -Proper handling, transport and storage of chemicals such as used oil, used batteries, busted lamps etc. must comply with local regulations -Selling of scrap metals and used oil will adhere to local regulations • Safety Data Sheet will be in place • Climate Change Adaptation: - Reduction of greenhouse emissions from energy used in offices by using green energy power or use of lighting that is environment friendly such as LED lights. - Implementation of rain water harvesting - Recycle office paper, newspapers, beverage containers, electronic equipment and batteries. Reducing, reusing and recycling in the office	Proponent/ Operator / Contractors	Included in the Operating cost	ECC

			helps conserve energy, and reduce pollution and greenhouse gases from resource extraction, manufacturing, and disposal. Reduce, reuse, and recycle in the office can be done by using two-sided printing and copying, buying supplies made with recycled content, and recycling used printer cartridges. For old electronics, donate used equipment to other organizations or sold to accredited scrap buyers.			

III. Operation Phase A positive impact on island bridge development network is foreseen which will boost tourism, increase business opportunities and increase local revenues. With the anticipation of tourist influx, local economic activities will be improved. Expect more productive land use and utilization of local resources.						
IV. Abandonment Phase						
Demolition Activities	The Land	• Land degradation • Damage to access and hauling roads • Loss of livelihood	• Preparation and implementation of comprehensive abandonment management plan • Proper clean-up and decontamination of affected site • Proper dismantling of equipment • Disposal of hazardous waste • Maintenance and rehabilitation of roads with drainage system in place • Retrenchment packages for displaced employees • Provision of alternative livelihood	Proponent	Included in operating cost	ECC

Chapter 4

ENVIRONMENTAL RISK ASSESSMENT (ERA) & EMERGENCY RESPONSE POLICY AND GUIDELINES

4.0 Environmental Risk Assessment

4.1 Current Situation of Navigation

4.1.1 Channel

The Iloilo Strait is the only channel for ships access to the port of Iloilo. At present, the Iloilo Strait has been equipped with navigation marks in two water areas, one is the Iloilo Strait's southern navigation channel, and the other is the Iloilo Strait's northern navigation channel. Large-sized ships normally enter and exit from the southern channel in the south of Iloilo Strait; Restricted by the depth of channel, the northern channel can only meet the navigation requirements of small-scale ships.

(1) Iloilo Strait's southern navigation channel

Iloilo Strait's southern navigation channel starts from Sinapsapan Cape in the south and reaches Bondolan Cape, in the north, with full channel length of 10.40 km, and the water depth along the line is about 10 m above, which can meet the navigation requirements of large-sized ships.

(2) Iloilo Strait's northern navigation channel

Iloilo Strait's northern navigation channel starts from Cabugao Cape in the east and reaches Bantigui Cape in the west, with full channel length of 5.24 km, and the water depth along the line is about 6 m above, which can meet the navigation requirements of small-sized ships.

The traffic separation system is implemented for Iloilo Strait's northern navigation channel. The red floaters 2 #, 4 #,6 # and 8 # are the left side marks of channel; the green floaters 1 #,3 #,5 # are the right-side marks of channel; A, B and C are the intermediate dividing marks of channel. The ship sailing in the direction of Bacolod is driven by the channel on the one side of Guimaras island (green float), and the ships sailing in the direction of Iloilo Port travel on the other side of the channel (red float).

According to the marking width of channel, the width of northern channel of the Iloilo Strait is about 900 m, and the width of the sub-channel is about 450 m.

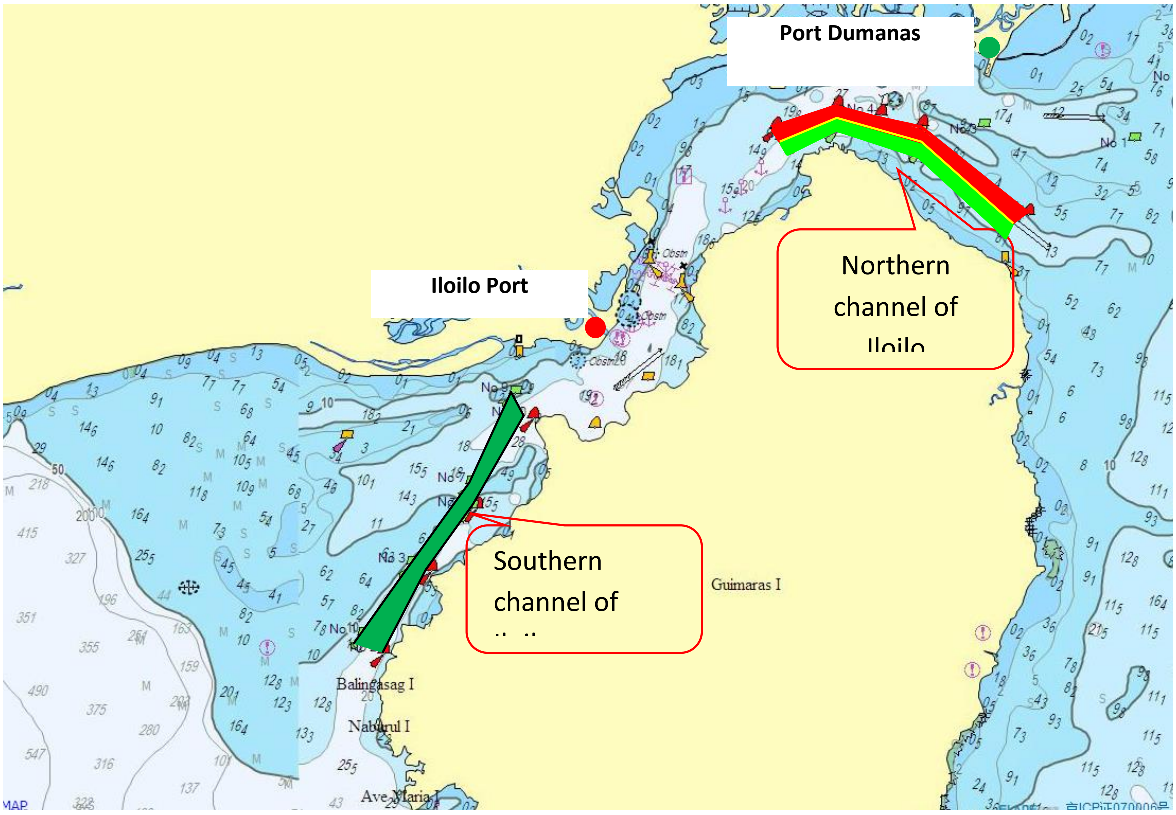

Figure 1. **Schematic Diagram of Channel in Illoilo Strait**

(3) Guimaras Strait's channel

The Guimaras Strait is a passageway for ships access to the Port of Plupandan and the Port of Bacolod. The overall water depth of the Guimaras Strait is in good condition. Except forr a few shallow points, the charted depth of Strait is above 10 m, having the navigable conditions of large-size ships.

There are two navigable waterways for ships in Guimaras Strait, one is the eastern channel, which is located on the east side of IGOIGO BANK (Shoal), with three buoys, for ships access to and from the Port of Plupandon; the other is the Guimaras Strait navigable waterway between IGOIGO BANK and Nalulao Island for ships access to and from the Port of Bacolod and transiting, as shown in Figure 3.1-2.

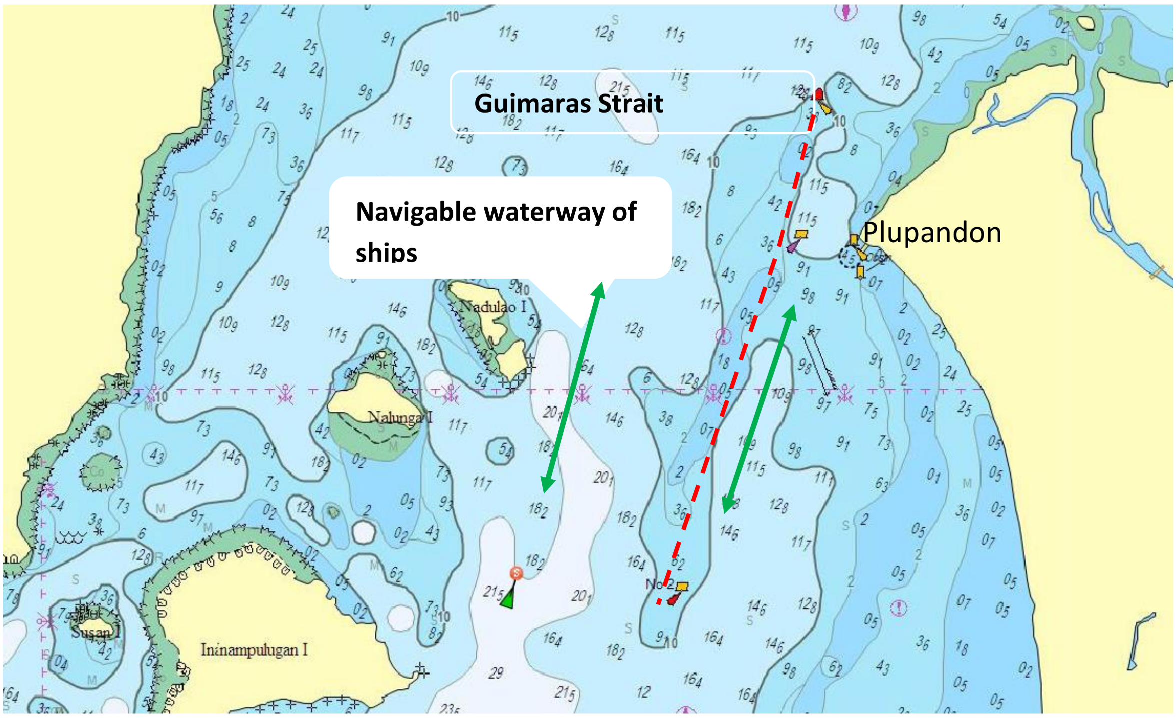

Figure 2. **Schematic Diagram of Channel in Gimmaras Strait**

4.1.2 Ship traffic flow

According to relevant information provided by the Philippine Coast Guard, the daily traffic volume across the bridge location of Iloilo Strait (Section A of bridge) is about 42 shiptimes (over 15,000 ships for ship traffic flow per year). The daily traffic volume of the bridge across the Guimaras Strait (Section B of bridge) is 28 shiptimes (more than 10,000 ships for ship traffic flow per year).

Figure 3 shows the ship flow direction diagram drawn based on AIS ship position. As can be observed from the diagram:

(1) After three traffic flows converge at the southern mouth of the Iloilo Strait, the traffic flow inflows into the Port of Iloilo. After the cargo loading/ unloading is implemented in the ships at the Port of Iloilo and the passengers go up and down the ships, large-sized ships outflow from the southern mouth of the Iloilo Strait, and some small-sized ships also outflow from the southern mouth of the Strait. A small number of ships pass through the northern channel of the Iloilo Strait and enter into the Port of Bacolod or enter into the Guimaras Strait for proceeding northward continuously.

(2) After two traffic flows converge at the southern mouth of the Guimaras Strait, the traffic flow crosses the bridge location of Guimaras Strait (Section B), a small number of ships enter into the Port of Plupandon, most of which enter into the Port of Bacolod, and another a small number of ships directly pass through Guimaras Strait.

(3) After passing through Tomonton Shoal, the traffic flow inflowing from the northern mouth of Guimaras Strait is mainly divided into three flows, most of which inflow into the Port of Bacolod, a small portion of which flows into the Iloilo Strait through the northern channel of Iloilo, and another a small number of ships directly flow out of the southern mouth of Guimaras Strait.

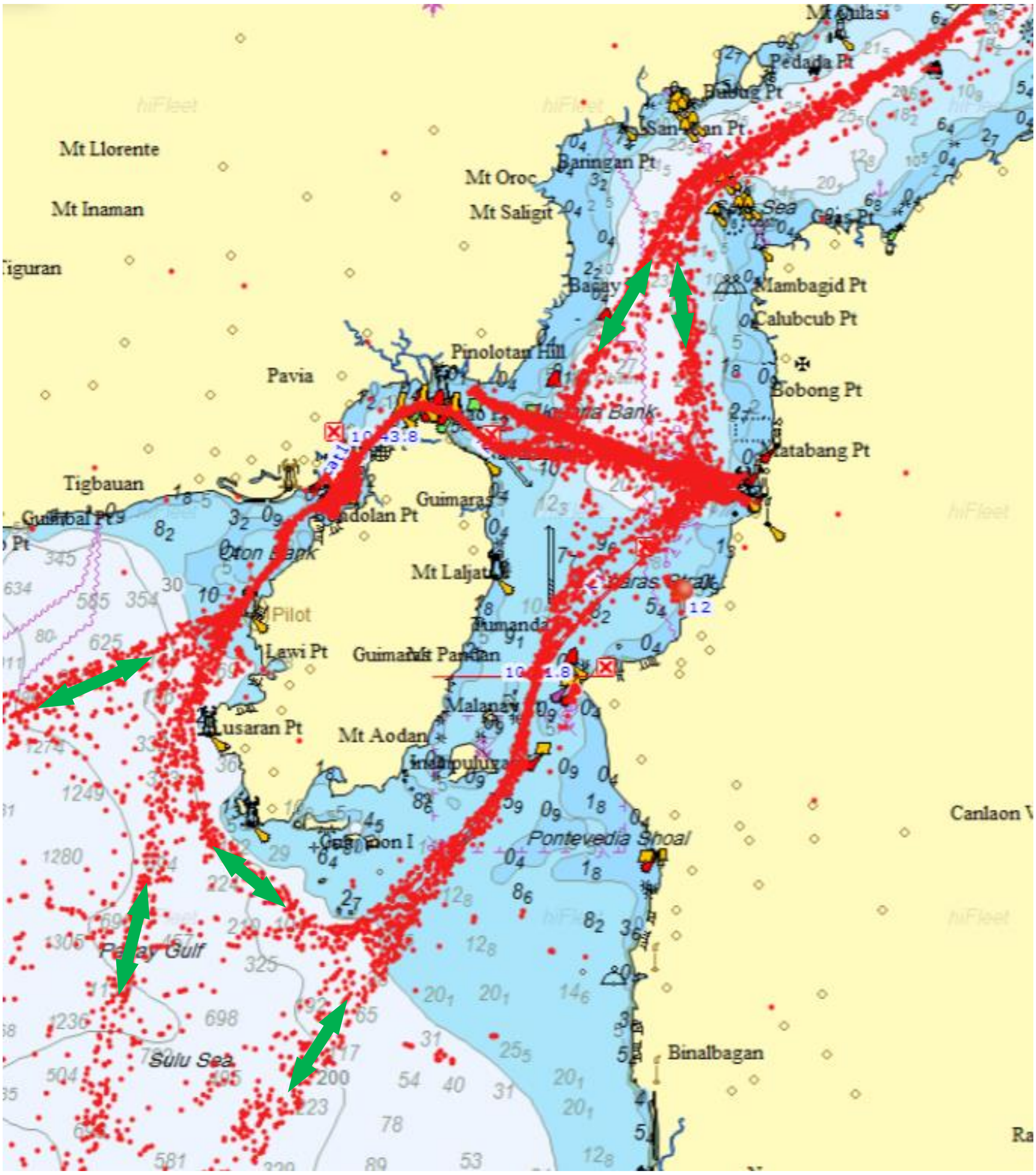

Figure 3. Ship Traffic Flow

4.1.3 Current Status of navigable ships

Ships passing through the proposed Iloilo-Guimaras bridge location (Section A) are mainly as follows:

- Passenger ships in the Port of Iloilo-Bacolod, navigable ships are FAST CAT, WEESAM, SUPER CAT and OCEAN JET, the total ship length is between 30-50 m.
- The passenger ships among Iloilo~Cebu~ Palumpont are FILIPINAS OZAMIS, FILIPINAS CEBU and FILIPINAS NASIPIT, the total ship length is about 80 m.
- Small-sized cargo ships and oil tankers, the ship length of is 50-80 m mostly, such as MV SF OMEGA, LCT DAICHI, NAGATA MARU and other cargo ships.

According to the data, the largest navigable ships crossing the Iloilo Strait Bridge (Section A) are 2000 GT passenger ships and the 2000 DWT general cargo ships.

Ships passing through the channel of the Guimaras Strait on section B of the proposed bridge area mainly are ships access to and from the Port of Bacolod, Bacolod-Cagayandeoro the Bacolod-Cagayande oro passenger ships. On average, 28 shiptimes (passenger/ cargo ships/ oil tankers) pass through the Guimaras Strait every day.

Most navigable ships are the ships less than 180 m (35,000 tonnages) and passenger and cargo ro-ro ships from Cebu, Manila, etc. The maximum navigable ro-ro ship is 20000 GT, and the cargo ship is of 50,000 tonnages bulk cargo ship.

4.1.4 Ship navigation safety status

The Philippine Coast Guard is responsible for the safety supervision and administration in the water area. The safety on water area of the PGN bridge area are under the responsibility of the Philippine Coast Guard's Western Visayan Headquarters, and the subordinated Iloilo Guard Station, Dumonas Sub-Station, Iloilo Sub-Station, Haldane Sub-Station, Buenavista Sub-Station, Nueva Sub-Station and Sibunag Sub-Station, which are equipped with patrol boats to carry out the on-site management.

(1) Pilotage

Boarding point upon pilotage on Port of Iloilo:

Northern entrance (Nabalas Point):10 ° 43.5 'N,122 ° 43.5' E;12 nautical miles away from Port of Iloilo.

Southern entrance（Sinapsapan Point）：10°35′N，122°30′E 8 nautical miles away from Port of Iloilo.

Pilotage service is required to be notified by agent ahead of 24 hours, the pilot is listening on VHF Channel 16 and working on Channel 13, and the pilot shall be contacted by using VHF Channel 16 to inform the pilotage at Sinapsapan or Nabalas.

(2) Ship navigation

Ship navigation in the water area of the bridge area should comply with the international rules of collision avoidance, and the northern channel of Iloilo shall be implemented with the navigation traffic separation system.

4.2 Safety analysis on bridge navigation

4.2.1 Influence on waterway setting by bridge construction

(1) The northern channel of the Iloilo Strait is a two-way route, the channel separation system shall be adopted, and the ship's navigation shall comply with the "*International Rules for Collision Avoidance at Sea in 1972*. The ship navigation holes of proposed bridge are set in the central area of the northern channel of the Iloilo Strait, with a net width of 480 m. After the bridge is completed, the navigable water area of the existing ships in the bridge area will be compressed, but the ships could still sail according to their original habits and pass through the bridge navigation holes according to their respective principles of keeping on the right.

(2) The Guimaras Strait is a two-way route and the ships navigate in compliance with the *International Rules for Collision Avoidance at Sea in 1972*. The ship navigation holes of proposed bridge are set on the existing habitable route for navigation ships, with a net width of 480 m. After the bridge is completed, the navigable water area of the existing ships in the

bridge area will be compressed, but the ships could still pass through the water area of bridge navigation holes according to their respective principles of keeping on the right.
Therefore, the bridge construction basically does not affect the existing ship route. But considering from the angle of ship navigation safety, once the ship is operated wrongly or is out of control, there is certain risk of ship collision, it is necessary to take anti-collision protection measures and set up navigation aids for waterways and bridges.

4.2.2 Influence on channel trafficability, traffic flow and traffic order by bridge construction

According to PPA data, the average daily flow for northern channel of the Iloilo Strait that the bridge span currently is about 42 shiptimes (one-way), mainly giving primary to high-speed ships; the daily average one-way flow of ships in Guimaras Strait is about 28 shiptimes. After the implementation of development plan for Port of Dumanasa, the navigable traffic flow will increase in the bridge area. It is reckoned according to the current shiptimes for ships arriving at the port in Iloilo International Port, the future daily average flow for northern channel of the Iloilo Strait is about 45 shiptimes, and the daily average flow Guimaras Strait will also increase.

(1) The existing northern channel of the Iloilo Strait is a two-way route. After the bridge is completed, the northern channel still is a two-way route. Ships can navigate on their own routes. Through the theoretical calculation and analysis of the ship area, the navigation capacity of the navigation channel in the bridge area is larger than that of the future navigation flow (45 shiptimes/ day) and is more abundant. Therefore, the bridge construction will not have great influence on the trafficability, ship traffic flow and traffic order.

(2) At present, the ships in the bridge location of the Guimaras Strait are sailing in accordance with the customary route, there is not navigation mark, and the daily average one-way flow is only 28. After the completion of the bridge, the ship still uses the existing customary route. From the current navigation situation and development plan of the Guimaras Strait, the traffic flow of ships will increase in the future, but the overall flow is low, and the trafficability of the channel in the area of the bridge is far greater than the existing passing capacity now. Therefore, the construction of the bridge will not affect the trafficability of ships and traffic order of ships in the Guimaras Strait.

4.2.3 Influence on ship's safe navigation by bridge construction

(1) As a result of the completion bridge of the Iloilo Strait and the Guimaras Strait, the navigable water area of the ships has been compressed and the degree of freedom for navigation of ships will be limited.

(2) After the bridge is completed, due to the installation of piers in the water course, the ship may collide the piers when the ship is out of control, improper operation or in bad weather such as heavy fog and high wind, which will have potential risks to the safety of ships and bridges.

4.2.4 Influence on navigation safety facilities by ships

The Iloilo-Guimaras Bridge spans the northern channel of the Iloilo Strait, this channel is equipped with 9 navigation marks totally. Now no navigation marks in the bridge area of Guimaras Bridge. There are no other navigational safety facilities near the bridge location.

After the completion of the bridge, the navigation marks for northern channel of the Iloilo Strait are required to be adjusted accordingly, and the channel at the bridge area of Guimaras Strait are required to be equipped with the corresponding navigation marks.

4.2.5 Influence on safety supervision by bridge construction

The West Visayan Headquarters of Philippine Coast Guard is responsible for the navigation management for water area in the bridge area, giving primary to supervision by on-site patrol boats. The ships are mainly equipped with VHF communication and AIS equipment. There are not VTS and other supervision facilities in the waters of bridge area.

At present, the ship-to-shore communication and ship-to-ship communication mainly give primary to VHF communication and AIS communication, and the bridge construction has no obvious effect on these communication systems.

Under the current conditions, the ship flow in Iloilo Strait and Guimaras Strait all is low, the change by proposed bridge will be less for existing channel and customary route, but the freedom of navigation in the waters of bridge area is limited, and the risk of safe navigation increases. In order to ensure the safety of the bridge area, the competent authority shall that, in accordance with the navigable environment in the waters of the bridge area during the construction period and operation period, formulate the corresponding regulations on navigable safety of ships in the bridge area and strengthen on-site supervision and management.

During the period of bridge construction and operation, the corresponding safety emergency plan should be worked out according to the navigable environment of the waters in the bridge area, the activity of the ship, the distribution of the dangerous sources and so on.

4.2.6 Analysis on anti-collision for bridges

Bridge on Section A and Bridge on Section B in this project span the northern channel of Iloilo Strait and Guimaras Strait respectively, and the hydrometeorological conditions of the channel in the bridge area are complex. The large-sized ships are planned for navigation in the bridge area, the ship collision risk exists for main piers of bridge, bridge piers of non-navigable holes and the main beam of bridge. especially the Line B position of bridge is located near the channel Curve area and is easy to cause the ship collision accidents. The main navigable holes of bridge on each line location are adopted with the bridge-type scheme with large span and the net navigation width is abundant, which are beneficial to reduce the risk of bridge collision. The risk of damage to the bridge by the ship collision should be minimized because of the large investment and long service life of the proposed cross-sea bridge project, and the bridge should be a critical bridge, referring to AASHTO (AASHTO LRFD - Clause 4.1.1) specification. The annual damaged collision frequency of the whole bridge is less than $\leq 10^{-4}$ (0.01 time within 100 years), the damaged collision risk level of bridge is acceptable. According to the calculation, the annual damaged collision frequency of bridge on Section A is 0.7673×10^{-4} and is less than 10^{-4} , the annual damaged collision frequency of bridge on Section B is 0.7315×10^{-4} and is less than 10^{-4}, and the damaged collision risk level of this bridge is acceptable.

4.3 Risk factor analysis for proposed projects

The original open waters in the project site will change to “discontinuous” waters as a result of the piers built as supporting structures for the bridge. In case a ship gets out of control, is badly operated or gets caught in bad weather conditions such as dense rainfall and strong wind, the ship may collide with the piers, resulting in potential risk to ship and to the bridge as well.

The navigable passages in the proposed Section A bridge and Section B bridge are located in the middle of the channel with a width of 480m and 440m, allowing some vessels to pass through while limiting the navigation freedom of other vessels. The changes in the navigation environment will be challenging to the pilots of the ships who are otherwise used to navigating in open waters. This could increase the risk of ship collisions.

The construction of the proposed bridge will change the navigation channel which some ships are used to navigate in. If the relevant local authorities fail to properly address these changes through the establishment and enforcement of new navigation safety standards that is appropriate for the proposed bridge design, there could be unfortunate accidents from ships colliding with the bridge.

The construction of the bridge increases the risk of marine accidents near the bridge site, especially the risk of ships colliding with the bridge piers. The impact of such accidents would be magnified if the local maritime search and rescue authority fails to prepare the corresponding safety emergency plan according to the changes in navigational environment around the bridge area, and to respond to accidents in a timely manner.

4.4 Risk Management of Proposed Projects

4.4.1 Risk prevention measures

4.4.1.1 Anti-collision design of bridge piers

In order to protect the pier body and cap pile foundation of the main navigable hole bridge, anti-collision facilities are installed around the main pier, auxiliary pier and transitional pier cap of the main navigable hole bridge. The anti-collision facilities mainly consist of steel structures and rubber parts. The steel structural outer plate, bottom plate, platform plate and main deck of anti-collision facilities are equipped with the wave-absorbing holes. The anti-collision facilities can be constructed, assembled in sections and outwardly hung around the pile cap.

4.4.1.2 Construction period

During the construction of bridge pile foundation, a safety operating area should be set up around the pile foundation and an over-water construction and navigation notice should be issued to prevent accidents from happening as a result of ships entering the construction zone. Contractor should not extend the range of safety operating area arbitrarily and should set up the relevant safety warning mark, be equipped with necessary safety facilities or guard ships and arrange the temporary navigation aids. The constructing ships or facilities should display the specified line lamps and shape in a visible area.

Strengthen the management of marine traffic and the administration of ships used for construction works. Provide effective communication devices for the ships or assign guard ships to oversee the sight during construction. Assign special personnel for warning and monitoring the marine traffic of the channel during the construction works or activities.

Pay attention to the weather and flow conditions to prevent unfavorable operation under bad weather conditions such as strong wind and wave activity, which may affect navigation safety. Improve the standard operations of the marine navigators and strictly comply with the ship navigation rules to prevent accidents resulting from nonstandard operations and fatigued working from personnel, etc. Meanwhile, constructors shall conduct training to enhance the safety consciousness and environmental protection consciousness of related personnel and ensure that the implementation of the emergency plan and reporting is done in a timely manner in the event an accident occurs.

4.4.1.3 Operating period

Once the bridge work is completed, the marine navigation environment around the bridge area would have changed to some extent and the traditional sea route of the ships will be altered. The relevant government authorities should set out the corresponding navigation safety standards and ensure that these safety standards are implemented.

Before crossing the bridge, the vessels should obey the unified schedule of the command department and strictly comply with the relevant safety navigation standards set for the bridge area. Vessels should not race with each other when crossing the bridge and when vessels come close, should keep strong alertness and be fully prepared to give way.

Set up two pairs of and 8 lateral marks on both sides of 2 planned one-way channels. Take the protective measures, including potential collision with the bridge pile foundation, by establishing the bridge aids mark for navigation. These include 2 one-way navigation span marks, 4 navigation span limit marks, 8 navigation prohibition marks for navigation spans and 4 pier warning marks.

The vessels crossing the bridge should accurately understand the real time bridge clearance dimension, water level, weather and other navigation information and reasonably select the timing to cross the bridge.

Provide effective training for the boat pilots and crews. Standardize the safety communication operation in the bridge area to prevent the occurrence of accidents caused by nonstandard operation. At the same time, encourage pilot and crew to study the emergency plan to ensure timely action in case of accident to minimize accidents.

4.4.2 Emergency plan

DPWH will have a comprehensive Emergency Response Plan which describes programs and actions in response to various major events such as terrorism, disasters and catastrophes like earthquakes, flash floods, fires, explosion regardless of cause and landslides.

For effective implementation of the emergency and contingency procedures, effective management structures shall be in place. The structures must clearly define the duties and responsibilities of all personnel involved in the emergency organization.

The emergency response plan describes policies, the members of the team, its roles and responsibilities, operating procedures, personnel safety, property protection and monitoring. Audit and inspection reports are included in the plan. Trainings on emergency response and safety are programmed annually.

Each type of emergency shall have a documented procedure which shall be strictly followed during emergency situations. Intensive training and drills on the procedures shall be undertaken regularly. Each procedure shall be reviewed and updated regularly.

According to the risk analysis of the proposed project, the risk of accidents happening is highest in and around the bridge construction sites. The probability of accidents can be greatly reduced through preventative measures; however, some level of risk will inevitably remain despite such measures. Any such accidents will have impacts on the environment and on public safety. A sound emergency plan needs to be established in order to timely respond to accidents and mitigate the consequences effectively.

The emergency plan should be planned based on the provisions of relevant laws and regulations, the risk assessment of the proposed project, and the physical conditions of the project area. This plan should be a scientific, realistic and reasonable plan. The emergency plan should include the following aspects:

Emergency plan should comprise of steps to respond to emergencies at the project site and environmental pollution resulting from accidents (such as oil spills).

The organization and personnel for emergency

Based on the features of the risk assessment of the proposed project, an emergency organizational setup consisting of all relevant authorities needs to be established. A command organization should also be set up with clearly identified roles and responsibilities during an emergency.

Guarantee for emergency rescue

A sufficient inventory of emergency response facilities (such as oil booms, oil machine and oil dispersant) needed to respond to the risks identified in the risk assessment of the proposed project needs to be provided in addition to those required by relevant national and international laws and regulations. Additionally, during an emergency, good coordination with authorities outside the emergency organization system could help respond to emergencies quickly and effectively and minimize environmental, ecological and social consequences such as loss of life and property.

Emergency communications

A good emergency communication system needs to be established to ensure timely and reliable transmission of information required for quick and effective response from all relevant authorities (including search and rescue authority) during an emergency such as a marine accident or oil spills.

Emergency monitoring

An emergency monitoring system needs to be set up in the identified risk areas of the proposed project to monitor accidents, accurately identify the location of the ships involved in the accident, to learn about the nature and scale of accidents, etc. The existing over-water safety supervision facilities (CCTV system, GMDSS system, patrol boat, etc.) can be combined to form this emergency monitoring system which will provide the basis for emergency response measures and scheme selection.

Emergency response and termination condition

All the risks identified in the risk assessment needs to be categorized based on the scale, nature, and controllability of the accident, the range of influence and the severity of the impacts, in order to determine the response procedure for different accidents. Such categorization will ensure that effective and precise measures are taken to contain the range of accident and mitigate the severity of consequences. In addition to this, the conditions for termination of emergency plan needs to be clearly defined.

Awareness, training and drills

Improve the awareness of knowledge related to sea and provide regular training for personnel responsible for the implementation of emergency plan. Training of personnel should be based on performance assessment of the personnel to improve the quality and professional skills of those personnel. Emergency drills also need to be conducted regularly to prepare and familiarize emergency personnel with the emergency control equipment and procedure.

4.4.3 Emergency measures

Accidents should be reported to relevant authorities immediately upon finding out about the accident. The emergency organization should initiate the emergency plan as soon as the accident is reported to them. The emergency procedures initiated should be based on the category of the accident as specified in the emergency plan.

Promptly report the accident once the accident occurs. The emergency organization should initiate the emergency preplan when receiving the accident report, starting the emergency procedures as per the accident levels specified in the preplan, developing the emergency actions based on the responsibilities and immediately taking the emergency measures. The report should include:

Time, place, name of ship and location of the accident
Weather and hydrology situation of the sea where the accident occurs
The measures taken and the level of control of the situation
The developing situation of the accident and the possibility of severe consequences
The required assistance (emergency facilities and materials, personnel, environmental monitoring, medical assistance, etc.);
Command organization, contact and telephone number, etc.

Depending on the nature of the accident, it is necessary to follow the principle of prioritizing the protection of personnel and the safety of the ship over the protection of the environment during an emergency response. It is important to quickly organize the evacuation of personnel from the area where the accident happened, guide other ships to safe areas and to provide rescue assistance as soon as it is safe and feasible to take emergency action. At the same time, if the ship or ships involved in the accident are believed to be a risk to other ships using the navigational channel or to the residents of the coastal dwellings close to the accident zone, guidance should be sought from the command centre and inform the traffic regulation authority to control or divert the traffic headed towards the accident zone.

The emergency personnel should wear the appropriate protective garment and respirator when attending the accident. The specific traffic control command should be uniformly issued by the command center to the relevant authorities and the traffic channel should clear for the passage of the rescue ships and materials.

4.4.3.1.1 Fire

Fire prevention, awareness and firefighting programs shall be established. All necessary fire prevention, warning, suppression, control equipment shall be provided and available in good condition. Fire extinguishers will be strategically located and everyone shall be trained to use them. Exit areas shall always be clear from clutter and with visible signages.

Handling and storage of flammable materials such as paints shall be covered by fire emergency procedures.

4.4.3.1.2 Chemical and oil Spills

Procedures in handling, storage, transport and use of oil and liquid materials shall incorporate steps in preventing spillages and leakages. Secondary containment for all liquid materials shall be in place.

There shall be enough available equipment and materials to control and clean-up any spillages or leakages when these arise. Any collected spills or leaks shall be stored and disposed of properly in accordance with Republic Act 6969.

Good housekeeping practices will be observed in the work place at all times. Safety Data Sheets (SDS) shall be strategically located where necessary.

4.4.3.1.3 Earthquakes, Landslides and Other Catastrophes

Each type of catastrophe should have its own emergency procedures. Open channels of communication to concerned government agencies in the formulation of the emergency procedures is necessary. Readiness to implement evacuation procedures when needed shall be ensured.

4.4.4 Occupational Health and Safety

The company shall subscribe to a pro-active program of pursuing a healthy, safe and environment-friendly operation. It shall push for the adoption of industrial hygiene programs to ensure a work environment that is consistent with internationally-accepted norms of industrial operations. It should comply with the requirements of the Republic Act 11058, an act Strengthening Compliance with Occupational Safety and Health Standards.

A Loss Control Program, allied to the pursuit of the safety program, shall also be implemented and overseen by the Safety Officer. The Safety Officer shall be designated and together with the Pollution Control Officer (PCO), shall undergo health, safety and environment training programs.

Company guidelines on health and safety programs will be made clear to contractors and all employees during construction and operation. Strict compliance with these guidelines will be part of the Employee's Code of Conduct; sanctions will be imposed upon violators. An annual program of safety evaluation within the plants will be conducted with the aim of continuously improving safety conditions.

Site Management will conduct annual health examination of employees by an external physician for health maintenance, in addition to the continuous availability of medical attention for sickness and medical emergencies as required by Philippine labor laws. Provision for first-aid shall be available at the site.

Chapter 5

SOCIAL DEVLEOPMENT PLAN/ FRAMEWORK (SDP) AND IEC FRAMEWORK

5.1 SOCIAL DEVELOPMENT FRAMEWORK

The indicative Social Development Framework (SDF) of the project is aligned with the Proponent's vision to support the affected barangays around the project and the local government units so as to help improve the economic status and quality of life of its constituents.

The construction and operation of the PGN Project shall comply with both local and International standards on safety and environmental regulations.

The indicative SDF of the company is anchored and aligned with the Host Barangays' framework for social development.

5.2.1 Objective

The purpose of the SDF is to identify the doable supports of the Project to the Host Barangays subject to the company's policy on community services and according to the priorities within the Project's vicinity. It shall cover the construction, operation and abandonment phase of the project.

Below is a summary of the company's community relations and development programs.

Table 1 details the SDMP Plan/Framework for PGN Project pursuant to DENR AO 2003-30.

5.2.2 Programs

a] Information Education Campaigns
b] Community Development Projects and Community Relations Programs
c] Health
d] Donations
e] Baseline study

Table 1. Cost Estimates for SDMP Framework

Item	*Amount (PhP)*
Municipality & Barangay Development Funds	3,000,000.00
Medical Mission, Health Programs, Clinic	1,000,000.00
Infrastructure (community projects)	2,000,000.00
Livelihood Programs (farming, fingerlings, fishing, etc.)	3,000,000.00
Socio-cultural, Clean & Green Activities	1,000,000.00
Donations	--
TOTAL	10,000,000.00

5.2.3 Program/Project/Activity Implementation

To ensure that it meets, and wherever possible, surpasses its legal, environmental and social obligations, DPWH will observe the following corporate policies:

a] Sustainability policy
b] Environment policy
c] Community relations policy

DPWH Management will actively work with the local community and the Local Government Units (LGUs/PAMB) to establish formal policies, systems and procedures for managing the SDMP programs, projects and activities. Projects are typically generated through a

Memorandum of Agreement (MOA), such as the Community MOA wherein programs to promote local social development shall include, among others

a] Human resource development and institution building

b] Enterprise development and networking.

Each project/program will be submitted for DPWH approval as part of detailed annual barangay development plan and implemented through a monthly program. DPWH will monitor the progress/projects on a daily and weekly basis. The community and the Local Government Units (LGUs) are responsible for implementing the programs/projects with DPWH support.

The MOA will stipulate that a minimum of 80% of the funds to be provided are used on the project/program and that only not more than 20% may be used for administration. No funds are to be used for honoraria to community members unless they hold a working position in implementing the program/project.

5.2.4 Monitoring of Programs / Projects / Activities

Key Performance Indicators

DPWH will require each program/project to agree or comply with a series of Key Performance Indicators (KPIs) prior to inception of each program. These indicators will be used to establish agreed points of success, goals or milestones throughout each program. This will ensure that each program/project has clearly identified goals and targets and that money spent will be well directed.

Table 2 presents the summary of DPWH SDF plans and framework.

Table 2. Social Development Plan (SDP) /Framework for Panay-Guimaras-Negros Island Bridge Project

Concern	Responsible /Community Member/Beneficiary	Government Agency/NGO/and Services	Proponent	Indicative Timeline	Source of Fund
1. Relocation Land Purchase/ Resettlement	1. Barangay Chairman 2. Project's affected tenants 3. Land Owner	*LGU Municipal Assessor based on cadastral surveys *City Planning and Development Office *DSWD *DPWH (facilitating demolition of structures and transfer of affected families)	DPWH through Property Owner Community Relations Officer; Resettlement Specialist	Pre-construction	DPWH/LGU
a] High-value crops for farmers b] Employment - Job priority skills training for qualified workers c) organization of business establishment/ transport group/fisher folk etc.	1. Association Chairperson 2. Qualified Project affected men, women, youth and elderly 3. Association Chairperson	1. LGU City Planning Office 2. LGU City Social Welfare & Dev. Office TESDA/TLRC - Various skills training courses DA/BFAR ▪ Technical training farming methods	DPWH LGU PAMB	Operation	DPWH LGU / PAMB From revenues and fees
3. Health and Safety a] Improvement/ Renovation of Brgy. Health Center b] Health services c] Potable water (bio-sand filter project) d] Supplemental feeding program for malnourished children e] Assistance to senior citizens and persons with disability	1. Barangay Kagawad for Health 2. Project's affected community	1. City Health Officer 2. Barangay Disaster Management Committee	Community Relations Officer (CRO)	Operation	LGU/ DPWH (according to the budget in table 5.2)
4. Education & Recreation	1. Barangay Kagawad for Education/SK; Barangay PTA	Department of Education ▪ Scholarship program for qualified students	LGU/PAMB	Construction Operation	LGU/ DPWH/ NGAs NGOs/ POs (according to the

	2. Project affected families	▪ Literacy programs & non- formal education programs City Engineer's Office ▪ Identification of appropriate project site, design, provide funding support, organize & implement related educational and recreation activities			budget in table 5.2)
5. Environment & Sanitation ▪ Brgy. Solid Waste Management Plan ▪ Bio-sand water filters	1. Barangay Kagawad for Environment 2. Project's affected community	CENRO ENRO /MHO 1. Formulate training in SWM 2. Reforestation (tree planting) 3. Establishment of forest nurseries 4. Environmental monitoring 5. Health programs 6. Provide bio-sand water filters CHO and/or DOH	LGU/PAMB	Pre-construction Construction Operation	LGU/ DPWH /NGAs/ NGOs/ POs (according to the budget in table 5.2)
6. Peace & Order	1. Barangay Kagawad for Peace & Order 2. Project's affected community	LGU PNP - Capacity-building & strengthening of barangay tanods in peacekeeping - Maintenance of peace and order and respond to security concerns	Chief Security Officer	Pre-construction Construction Operation	LGU/ DPWH/ (according to the budget in table 5.2)
7. Spiritual	Barangay Assigned Catholic priest, or pastor of different denomination	Parish Priest for Catholics or Pastor for Non-Catholics and Non-Muslims	Community Relations Officer (CRO)	Construction Operation	LGU/ DPWH/ (according to the budget in table 5.2)
8. Infrastructure	*LGU: City and Barangays * Barangay Kagawad for Infrastructure * CPDO	* DPWH/ City Engineer's Office * CPDO * LGU: City and Barangays * Repair/Improvement /Expansion of Barangay Road	Community Relations Officer (CRO)	Pre-construction Construction Operation	LGU/ DPWH/ (according to the budget in table 5.2)

5.2 INFORMATION, EDUCATION AND COMMUNICATION (IEC) PLAN FRAMEWORK

The Information, Education, and Communication Plan of DPWH shall focus on the Project's information dissemination, predicted impacts of activities to the environment particularly to the people and their inherent resources, the benefits that the community and the people may derive, and the cost and benefit analysis of the operations with regards to environmental protection, and the future of the community after the abandonment of the project.

The proposed IEC will include public consultations which will allow DPWH to report on its environmental performance and at the same time solicit feedback and suggestions from community members on how to improve and enhance its environmental protection and enhancement activities. **Table 3** describes the IEC Plan/Framework of the company.

Table 3. IEC Plan/Framework of DPWH

Target Sector Identified as Needing Project IEC	Major Topic/s of Concern in Relation to Project	IEC Scheme/ Strategy Method	Information Medium	Indicative Timelines and Frequency	Indicative Cost
1.Directly and indirectly affected population LGUs/POs/ NGOs 2. Directly affected population for land acquisition	Project information - Simplified version of the Project's technical operations and environmental aspects; - General and specific benefits of the Project - Compensation Plan - Options of the Families - Roles & Responsibilities of PAF and Proponent - Indicative Timelines of Implementation - Status/ Updates/ Final Decisions	Barangay assemblies - FGD - Public Consultations; Barangay Assemblies; Information Desk	- Handouts - Audio-Visual Presentations - Illustrative Primer about the Project in local dialect - Audio-visual presentations	Prior to start of project construction Prior to implementation	The cost includes meals, venue, IEC materials, transport, design, layout, printing cost salaries, honoraria etc.
3. Directly and indirectly affected population LGUs/POs/ NGOs	- Proper waste disposal - Project facility safety/protection - Lake protection and management	- Public Assembly - Community Meetings	- Flyers/posters on environmental protection and management	Continuing- starting pre-construction of the project (Quarterly)	Project cost is estimated at PhP 1,000,000 per annum

Chapter 6

ENVIRONMENTAL COMPLIANCE MONITORING

6.0 ENVIRONMENTAL COMPLIANCE MONITORING

The Environmental Compliance Monitoring Plan is prepared to ensure the company's compliance to environmental regulations, thereby minimizing adverse effects of the Project to its immediate surroundings and protecting the health of the affected public.

6.1 Environmental Monitoring Plan (EMoP)

The proposed Environmental Monitoring Plan with Environmental Quality Performance Levels (EQPLs) is shown in using the recommended format in Annex 2-20 of RPM DAO 2003-30. However this will be finalized once the ECC has been issued.

Objectives:

1. Ensure that all emissions, effluent and other wastes generated as a result of the Flood Mitigation Project are in accordance with DENR Rules and Regulations which include, but is not limited to, Presidential Decree 1586 (the *Philippine Environmental Impact Statement System*), Republic Act 8749 (*Clean Air Act*), RA 9275 (*Clean Water Act*), RA 9003 (*Ecological Solid Waste Management Act*), RA 6969 (*Philippine Chemical & Chemical Substances and Hazardous & Nuclear Waste Control Act*), PD 984 (*Pollution Control Act*)
2. Define monitoring mechanisms and identify monitoring parameters
3. Validate the changes in the various environmental media as discussed in the Impact Assessment Plan
4. Provide mitigation measures and performance levels
5. Provide early warning on any unacceptable environmental conditions.

6.2 ECC Compliance Reporting

After the issuance of the ECC, the company through its Pollution Control Officer will ensure that regular reporting of compliance to DENR standards and other regulatory industries will be undertaken. The Self-Monitoring Reports (SMR) detailing status of compliance with ECC and other environmental regulation shall be submitted quarterly to DENR-EMB Region 6.

6.3 Multi-Partite Monitoring Team (MMT)

An MMT for the project may opt to be formed during construction only, based on the requirements of DENR Administrative Order 2003-30, Annex 3-4.

6.3.1 MMT Formation

The following comprised the proposed MMT but not limited to.

a. Environmental Management Bureau Regional Office 6, CENRO/PENRO
b. DPWH /CCCC Highway Consultants Co., Ltd. (Consultant)
c. Provincial Government of Iloilo, Guimaras, Negros Occidental
d. LGU Representative (Municipal, Barangay)
e. NGO Representative

Executive Committees

The Executive Management Committee (MMT Execom) shall consist of the following members;

a. DENR – PENRO, CENRO
b. DPWH

6.3.2 MMT Functions

- Monitor project compliance with the conditions stipulated in the ECC and commitments made in the Environmental Management Plan (EMP) by:
- Reviewing and validating proponent's progressive report and other reports (e.g., third party audits) and submits compliance monitoring and validation report to DENR-EMB
- Preparing, integrating, and disseminating simplified monitoring reports and recommendations to the DENR
- Validating and implementation of IEC and other programs
- Interfacing with proponent, third party auditors and other parties, or engage the services of other expects as deemed necessary
- Initiating popularization of M&E results for community consumption

- Prepare the MMT Manual of Operations (MOO), Work and Financial Plan, and other plans/reports based on the proponent's EMP;

- Institutionalizes best practice for Environmental Management Fund (EMF) management and administration; and

- Receive complaints/requests from the public-at-large for transmittal to the proponent and the DENR-EMB and be able to recommend immediate measures against the complaint.

The MMT Execom shall organize and supervise the activities of the SMT, review and approved the monitoring work and financial plan of the MMT, administer and manage the EMF and resolve issues arising from its monitoring activities.

The Secretariat shall inform the MMT members of the schedule of meeting, monitoring activities of the MMT, provide documentation of the minutes of MMT meetings and monitoring results and action items generated from the discussions, and ensure the safekeeping of MMT documents, materials and properties;

The Sectoral Monitoring Team (SMT) organize and carry out the field monitoring activities of the MMT in their respective area of jurisdiction based on the guidelines that will be adopted by the MMT. Advice the entire MMT on the need for additional monitoring activities and/or requirements to employ assistance of other relevant government agencies and other sectors to provide necessary expertise and participate in the actual monitoring activity.

6.3.3 Roles, duties and responsibilities of MMT Members at the Institutional Level

EMB Regional Office - The EMB shall:

- Be responsible for policy formulation, evaluation of monitoring results, resolution of issues and the provision of needed support for the operationalization of the MMT.
- Act as lead agency in monitoring work and shall coordinate the MMTs activities to ensure an efficient monitoring of the entire PROJECT.
- Coordinate monitoring, evaluate monitoring results and make recommendations/appropriate action(s) to resolve issues/problems and concur with monitoring reports.
- Provide technical assistance and participate in activities of MMT.

Proponent thru DPWH/CCCC Highway Consultants Co. Ltd. shall:

- Provide necessary budget/funds for the operationalization of the monitoring activities;
- Make available to the MMT members all information relevant to the PROJECT to determine compliance with the ECC;
- Grant permission to MMT members to inspect and observe operation activities of the PROJECT including the testing, calibration and operation of pollution control and in-house monitoring equipment;
- Participate in actual monitoring activities;
- Concur with and sign the monitoring reports; and
- Provide documentation of the minutes of MMT meetings and monitoring results.

The LGU shall designate a representative who shall participate in actual sectoral monitoring works and concur with and sign the monitoring reports. It shall provide the necessary information about local policies, plans and programs affecting MMT monitoring results and standards, advise the MMT of any complaints, information or reports from LGUs concerning the PROJECT.

The NGO and vulnerable groups shall participate in actual monitoring work, and concur with and sign the monitoring reports.

Other Government Agencies and other sectors (academe, etc.) shall on an on-call basis, provide necessary expertise and participate in the actual monitoring activity and concur with and sign the monitoring reports.

6.4 Environmental Guarantee and Monitoring Fund Commitments

DPWH shall see to it that EMF and EGF will be allocated. The EMF shall be used for the operationalization of the Multi-Partite Monitoring Team (MMT) and all costs related to environmental monitoring which include air, noise and water sampling, meetings, honorarium, transportation, etc. The amount of EMF to be located shall be based on the number of members, meetings conducted, sampling which will be computed annually. At least 2,000,000.00 shall be initially allocated to start up operation of the MMT and shall be replenish annually. On the other hand, the EGF shall be put up to be available in case of worst case scenarios such as immediate rehabilitation of areas affected by the damages to the environment caused by the construction of the roads and bridges and to compensate affected parties, etc. A Memorandum of Agreement shall be established to this effect.

Table 1. Environmental Monitoring Plan (EMoP) with Environmental Quality Performance Levels (EQPLs)

Key Environmental Aspects per Project Phase	Potential Impacts per Environmental Sector	Parameters to be Monitored	Sampling & Measurement Plan			Lead Person	Annual Estimated Cost (Php)	EQPL MANAGEMENT SCHEME					
								EQPL Range			Mgt. Measures		
			METHOD	FREQUENCY	LOCATION			Alert	Action	Limit	Alert	Action	Limit
CONSTRUCTION PHASE													
Environmental Aspect	Coastal Water Quality Stations: Iloilo Guimaras Pulupandan	Coastal Water Total Suspended Solids (TSS), pH, BOD, DO, Oil & Grease, Color, fecal coliform bacteria	Grab Sampling RA 9275	Quarterly	sampling point to be monitored should be within the project site	Pollution Control Officer (PCO)	500,000	Siltation Coastal Water: TSS- 78 mg/L pH: 6.4-8.4 BOD: N/A DO: 4.9 mg/L Oil & Grease: 2.5 mg/L Color: 70 TCU Fecal Coli: 180 MPN/ 100 ml	Siltation Surface Water: TSS- 80 mg/L pH:6.5-8.5 BOD: N/A DO: ≥5.0 mg/L O/G: 3.0 mg/L Color: 75 TCU Fecal: 200 MPN/ 100 ml	DAO 2016-08, Class SC TSS: 80 mg/L pH: 6.5-8.5 BOD: N/A DO: ≥5.0 mg/L O/G: 3.0 mg/L Color: 75 TCU Fecal: 200 MPN/ 100 ml	Siltation Coastal Water: TSS- 78 mg/L pH: 6.4-8.4 BOD: N/A DO: 4.9 mg/L Oil & Grease: 2.5 mg/L Color: 70 TCU Fecal Coli: 180 MPN/ 100 ml	Siltation Surface Water: TSS- 80 mg/L pH:6.5-8.5 BOD: N/A DO: ≥5.0 mg/L O/G: 3.0 mg/L Color: 75 TCU Fecal: 200 MPN/ 100 ml	DAO 2016-08, Class SC TSS: 80 mg/L pH: 6.5-8.5 BOD: N/A DO: ≥5.0 mg/L O/G: 3.0 mg/L Color: 75 TCU Fecal: 200 MPN/ 100 ml
	Marine Ecology	Phytoplankton and Zooplankton Benthic macroinverte-	Grab	Annual	Pre-determined points in project site		1,500,000						

		brates Coral Assessment Reef Fish Marine Mammals											
	Air Quality Proposed site locations -Brgy. Gua-an, Iloilo -Buenavista, San Lorenzo, Guimaras -Pulupandan, Negros	Total Suspended Particulates (TSP), PM10 & SO_2, NO_2	1-hr Sampling per RA 8749	Quarterly	Construction area; downwind; NSEW direction	PCO	2,000,000.	Fugitive dust	TSP: 300 PM10: 200 SO2: 340 NO2: 260	RA 8749 @ 1hr. TSP: 300 PM10: 200 SO2: 340 NO2: 260	TSP: 300 PM10: 200 SO2: 340 NO2: 260	Regular sprinkling activities TSP: 300 PM10: 200 SO2: 340 NO2: 260	RA 8749; DAO 2000-81
	Noise Proposed site locations --Brgy. Gua-an, Iloilo -Buenavista, San Lorenzo, Guimaras -Pulupandan,	Ambient Noise and Vibration (especially during drilling activities)	Grab sampling	Monthly during construction, and when required	Pre-determined specially in areas near immediate receptors, construction site ; NSEW direction	PCO	600,000	Intermit-tent noise		NPCC 1978		Ear plugs/ ear muffs as necessary	NPCC 1978

	Negros												
	Solid Wastes	Construction debris, papers, plastics, biodegradable waste	Grab/ landfill	Daily	Construction site / SW storage area	PCO	500,000			RA 9003		Imposition of fines due to improper disposal	RA 9003
	Wastewater (domestic)	TSS, BOD, pH, Oil & Grease, Surfactants (canteen)	Grab Sampling RA 9275	As necessary	Common septic tanks for toilets & canteens	PCO	50,000	Wastewater from toilets, washings		RA 9275		Ensure portalets & septic tanks are in placed	RA 9275
	Chemicals & Hazardous Wastes	Used oil, busted lamps Used paints, spent solvents	Individual segre-gation & collection	As necessary	Storage Area/ Motorpool	PCO	100,000 - 200,000 /annum	Oil spills		RA 6969		Instigate measures per regulatory requirement	RA 6969
	Socio-economic	Displacement of informal settlers; relocation Recruitment/hiring for manual labor & other skills available within the Host Barangay & nearby communities			Project location	Commu-nity Relations Officer (CRO)	Included in the opera-ting costs					Relocation Job opportuni-ties	
	Terrestrial Flora & fauna	Flora- species dominance within	Line transect/	Annual	Within project	PCO	500,000						Other applicab

	Impacts	quadrants in terms of total cover, relative ground cover, absolute density, absolute frequency, relative density and relative frequency of individual species Fauna – species diversity index, dominance index, and evenness index (Mangrove rehabilitation is not included in the cost)	quadrat / trap		vicinity and its affected barangays								le local & internati onal standar ds
	Social Impacts	1. Income comparison for relocated households before & after relocation 2. Number of immigrants attracted by the project 3. Proportion of direct employment to residents of	Interviews	Annual	Brgys. affected	PCO	Included in the operatin g costs						

		impact barangays to total direct employment provided by the Project and distribution of employed residents per impact barangay 4. Number of alternative means of livelihood created and number of people actually benefited 5. Income comparison for brgys. and municipality before and during the project 6. Ratio of income gained and income lost											
	Health Impacts	1. Health impacts 2. Morbidity, mortality 3. Health profile of receptor communities 4. Vital health indices 5. Malnutrition Environmental	Interviews	Annual		Health & Safety Officer (HSO)	Included in the opera-ting costs						DOH/ WHO

		Quality and Health 6. Environmental Sanitation ▪ OHS records of employees ▪ Interviews and medical examination of high-risk groups ▪ Inspection of facilities, control devices, PPEs, and working conditions ▪ Health data-basing for most vulnerable public groups											
ABANDONMENT PHASE (IMMEDIATE AFTER CONSTRUCTION)													
Environmental Aspect	Land (Disposal Site) Clearing of	-Heavy metals (As, Ba, Cd, Cr, Cu, Pb, Hg,Se,F) Corrosivity, NPK	Systematic sampling: Several Grab and composite Sampling	As prescribed	Designated disposal sites	PCO	2,000,000	TCLP Metals: As, 0.8 ppm Ba, 65 ppm Cd, 0.2 ppm Cr, 4 ppm Pb, 0.8 ppm Hg, 0.08 ppm	TCLP Metals: As, 1 ppm Ba, 70ppm Cd, 0.3 ppm Cr, 5 ppm Pb, 1 ppm Hg, 1 ppm	TCLP Metals: As, >1 ppm Ba,>70ppm Cd,>0.3ppm Cr, >5 ppm Pb, >1 ppm Hg,>0.1 ppm		Reme-diate/ clean up the contami-nated area	RA 6969

	construction debris; removal of construction equipment							Se, 0.08 ppm F, 95 ppm	Se, 1 ppm F, 100 ppm	Se, >1 ppm F,>100ppm			

Chapter 7

DECOMMISSIONING/ABANDONMENT/ REHABILITATION POLICY

7.0 DECOMMISSIONING, ABANDONMENT AND REHABILITATION POLICY

The final Abandonment/Decommissioning and Rehabilitation plan will include:

1. Land and soil restoration, decontamination and remediation
2. Strategies and methods for final rehabilitation of the environment disturbed by the project Rehabilitation and Remediation plan should be in accordance with DENR-EMB guidelines. The proponent shall submit the plan and secure clearance and approval to EMB prior to its implementation.
3. Land use suitability of the various land disturbances.

The proposed activities and components of the Plan in the event of the Project Decommissioning are presented as follows:

- Procedures for decommissioning of the project components
- Personnel Decommissioning Program
- Retrenchment Packages, separation fees as per DOLE requirements
- On-site inspections
  a. Project site
  b. Construction camp
  c. Temporary field offices
  d. Equipment and support facilities
  e. Waste disposal and storage areas
  f. Potable Wastewater treatment facility
- Secure necessary permits and clearances
  a. DENR-EMB permits
  b. Safety permits
  c. LGU permits
  d. Others
- Disassembly and crating/packaging
- Disassembly and disposal of mechanical and electrical systems
- Dismantling of structures and facilities
- Dewatering and backfilling
- Disposal of construction materials
- Loading supervision of the shipment of the following:
  a. Unused fuels and consumables
  b. Scrap materials, spare parts and equipment
- Clearing and leveling
- Remediation of contaminated soil and water resources due to spill and leakages of oils and other materials used in the construction.
- Transport and disposal of equipment, waste and other materials used or generated in the project;
- Alternative for future use of abandoned area.

The following is a summary of the wastes to be expected as a result of abandonment.

Building and Road Demolition Wastes

- The waste building materials, packaging and rubble resulting from renovation, repair and demolition of pavements, buildings and structures.

Special Wastes

- Wastes that may have particular health, safety and environmental concerns. These include lightings, electrical and office equipment, appliances, waste lubricants, used oils, other fluids, used paints etc.

Chapter 8

INSTITUTIONAL PLAN FOR EMP IMPLEMENTATION

8.0 Institutional Plan for EMP Implementation

The Institutional Plan is the establishment of a body that will implement the proposed Environmental Management Plan (EMP) whose main thrust is to ensure that environmental, socio-economic, political and public health issues are properly address in a timely manner. It provides necessary mechanism that will strengthen the organizational relationship of the proponent with the host community, concern government agencies and other stakeholders.

8.1 DPWH's Environmental Unit

DPWH thru the Unified Project Management Office (UPMO), being the proponent shall coordinate with the Environmental Unit of DPWH. The project engineers of the UPMOs shall be responsible in the monitoring of the project in coordination with the DPWH - Environmental and Social Safeguards Division (ESSD), under the Planning Service. Enough resources/budget shall be appropriated to support the different environmental programs.

The UPMO shall designate an acting pollution control officer among the project engineers who shall have the following functions:

Plan and implement the environmental management plan;

- Monitor compliance of contractors implementation of the EMP;
- Identify sources of pollution;
- Monitor and evaluate the effectiveness of mitigating/enhancement measures;
- Plan, propose, and implement modifications, or additional environmental measures that are deemed necessary to more effectively protect the environment;
- Coordinate with relevant oversight agencies and other stakeholders including the local government and the community to ensure their effective participation in the implementation of the environmental management plan.

DPWH may designate a separate Health and Safety Officer or PCO may act concurrently as the Health & Safety Officer.

The PCO and Safety Officer shall report directly to the UPMO's head, while the head shall coordinate with the ESSD. The head shall be responsible for the overall environmental management program. The PCO should be given enough authority and competence on decision-making with reference to environmental management. The PCO shall be responsible for LAND, AIR, WATER, SOLID and HAZARDOUS WASTE components. The Safety Officer shall be responsible for the health and safety component, while the Security Officer shall be in-charge of Peace and order to include security risk management and emergency responses. The Community Relations Officer (Comrel) who will be designated from among the project engineers, shall handle the PEOPLE and shall be responsible for plans and implementation of social development programs, IEC activities and implementation and monitoring of RAP.

The Manager, PCO, Safety Officer, Comrel and Security Officer shall have appropriate educational background and/or experience and training on environmental, community organization and development, health and safety and security risk regulations and practices. **Figure 1** shows the organizational chart of environmental and social team.

8.2 Health and Safety

The company shall subscribe to an active program of pursuing a health, safe and environment-friendly operation. It shall push for the adoption of industrial hygiene programs to ensure a work environment that is consistent with internationally-accepted norms of industrial operations.

A Loss Control Program, allied to the pursuit of the safety program, shall also be implemented and overseen by the Safety Officer. A Safety Officer shall be designated and together with the Pollution Control Officer (PCO) as well as UPMO's Manager shall undergo health and safety training programs.

Company guidelines on health and safety programs will be made clear to contractors and all employees during construction. Strict compliance with these guidelines will be part of the Employee's Code of Conduct; sanctions will be imposed upon violators. Regular program of safety evaluation within the construction area will be conducted with the aim of continuously improving safety conditions. Provisions for first-aid shall be available at the site.

8.3 Contractor's Accountability

Since the construction of the project will rely on the contractors, DPWH shall ensures that the contractors be bound by rules of conduct, practice, and accountabilities, which carry the different Environmental and Safety program of the project.

The accountabilities of contractors must include:
- Full disclosure of product information relating to safety and environmental impact;
- Safe transport and delivery of materials;
- Minimum pollution and risks in the delivery of materials and services; and
- Immediate response to environmental incidents.

The DPWH shall ensure that the contractors shall be legally and financially liable to the Environmental Management Plan. The DPWH and the contractors shall be accountable for any damages that may occur to human beings, property, and or environment caused by their operations. The contract may be terminated and or the contractor will be included in the blacklist once taken the penalty for negligence, bad housekeeping, disregard the environmental policy of the company, and unsound practice.

The essential knowledge and awareness of the contractors regarding their responsibilities and accountabilities must be assured and incorporated in the contract signed by both the DPWH and contractor for every activity.

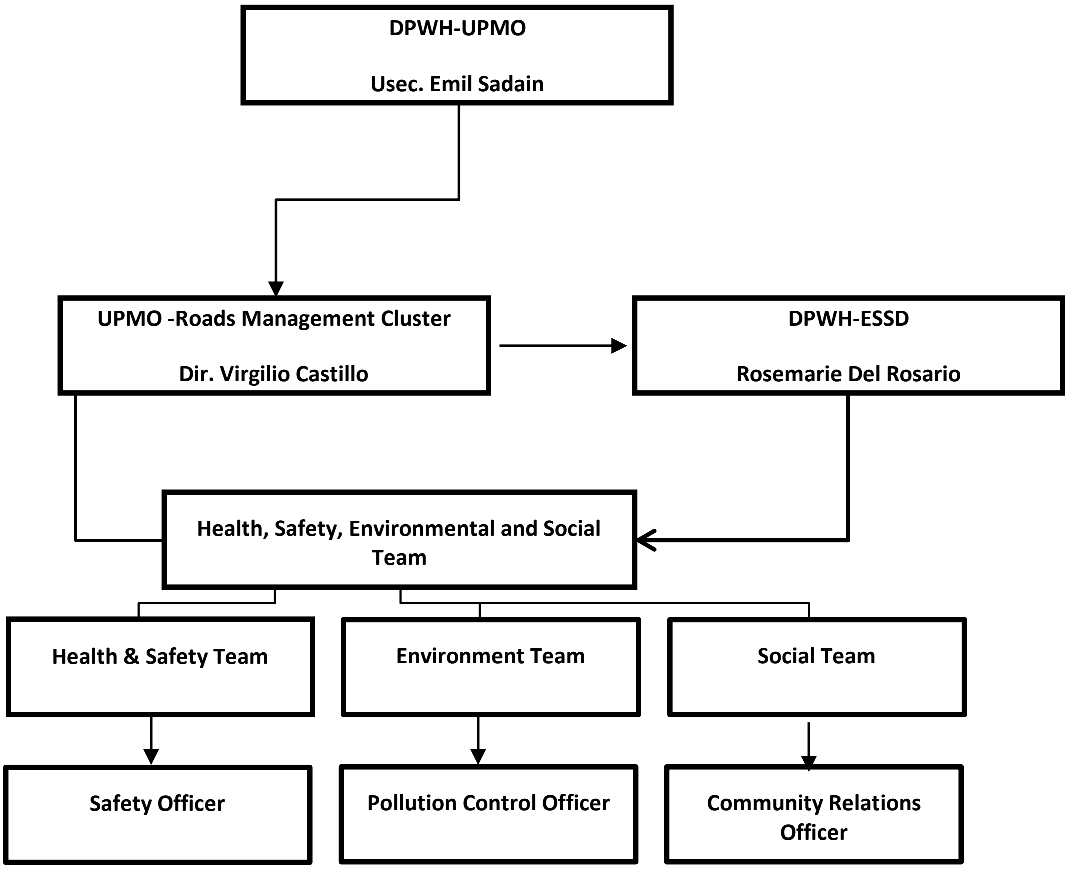

Figure 1. Organizational Chart of Environment & Social Team

ANNEX 8.5.1

SCOPING CHECKLIST

GENERIC EIS/EPRMPSCOPING AND SCREENING FORM

☑ 1st ☐2nd ☐3rd ___ th Screening

Date Submitted for Screening: 18 October 2019
Form of Submission: ___ Hard ___ Digital
Project Title: Panay-Guimaras-Negros Island Bridges Project
Project Location: Western Visayas Region
Project Proponent: Department of Public Works and Highways
Authorized Representative: Mr. Virgilio J. Bonsol, Project Manager I - UPMO
Address: 2nd Floor DPWH RMCI (B)-UPMO, NCR Compound, 2nd Street, Port Area, Manila
Contact No: (02) 304-3805; 304-3681 Fax No: ________ Contact Person: ________
EIS Consultant: KRC Environmental Services
Address: ________
Contact No: 0917 713 262 Fax No: ________ Contact Person: Mr. Ricardo Capule
Project Category & Type *(based on Annex A of MC 2014-005 Guildelines)*: Category A (ECP): Infrastructure Projects
Project Size *(use parameter in Annex A of MC 2014-005 Guildelines)*: ________

Project Status *(Please Check)*:
X New Project
__Existing   Year of Establishment: _____

With Previous ECC? *(Please check)* __Yes __No

If with Previous ECC, Date/s of Issuance and Reference Code/s: *(List in chronological order)*

Date/s of Issuance: Reference Code/s:

Date of Technical Scoping: 27 September 2019/ 2:00 PM
Venue of Technical Scoping: EIA Conference Room, EMB Building

Table 1. Checklist of Documentary Requirements
Boxes and blanks in the first column are to be filled-up during scoping and the rest, upon submission of EIS for screening

	Acceptable?		Screening Officers' Remarks
	Yes	No	
Check required EIA Report[1] ☑ Environmental Impact Statement (EIS) ☐ Environmental Performance Report and Management Plan (EPRMP) *(include photographs or plates of project site, impact/affected areas and communities and land-use plan showing compatibility of the proposed project)*		✓	-See comments on Table 2-4 -Indicate in the attached comments of Engr. Mendoza the pages where his concerns/requirements are addressed/located. -Attach as Annex copies of the Laboratory Results of the samples gathered in the baseline study, IEC documentation, PSR, and other pertinent EIA documents
Proof of Authority over the Project Site ☐ TCT ☐ Lease Agreement ☐ Others: ROW acquisition		✓	-Present status of ROW acquisition and parcellary survey
Accountability Statements of Preparers & Proponent (see Annexes 2-21 & 2-22 of Revised Procedural Manual for DAO 2003-30)		✓	-Have the accountability notarized -This should be attached in the Annexes
Duly Accomplished Project Environmental Monitoring & Audit Prioritization Scheme (PEMAPS) Questionnaire (see Annex 2-7d of Revised Procedural Manual for DAO 2003-30)		✓	-Attach as Annex the completed PEMAPS Questionnaire and notarized accountability statement
For EPRMP, Copy of previous ECC			N/A
For EPRMP, Proof of compliance in the submission of monitoring reports			N/A

Received by:
27 Sept 2019

Received by:
KRC

1 Please refer to attached checklist of EIS/EPRMP Contents

GENERIC EIS/EPRMPSCOPING AND SCREENING FORM

☑ 1st ☐2nd ☐3rd ___ th Screening

ACTION TAKEN: (Please check to indicate corresponding action taken)

☐ Document accepted; please submit __ copies
☑ Document not accepted

NOTED BY:

Engr. Carlo Vic J. Arida, EnP	Engr. Esperanza A. Sajul
Screening Officer Division	Section/Division Chief

EMB Office
Screening Office

Date: 10/21/2019

☑ 1st ☐2nd ☐3rd ___ th Screening

Table 2. EIS/EPRMP Annotated Outline

Sections / Subsections	Content	Page #	Acceptable?	REMARKS
Executive Summary (maximum of 10 pages)				
Project Fact Sheet	Summary of Project Description *(For EPRMP, Include comparative matrix of the existing project components vis-à-vis the proposed changes)*			Include also the components of the Guimaras-Negros link
Process Documentation	Documentation of the process undertaken in the conduct of EIA *(EIA Team, EIA Study Schedule & Area, description of key EIA Methodologies including sampling and measurement plan, Scoping and Public Participation)*			-Provide a summary of the public participation activities conducted. Present the issues and concerns gathered per EIA module. Attach as Annex the IEC documentation and Public Scoping Report. -Reivse matrix on p.xxiii -For EIA methodology, indicate samplingmethod and analysis. Cite the standard used.
EIA Summary	• Summary of alternatives considered in terms of siting, technology selection/operation processes and design • Concise integrated summary of the main impacts and residual effects after applying mitigation • Risks and uncertainties relating to the findings and implications for decision making			Provide the required information for the EIA Summary
1. Project Description Include as an introduction, basic information about the project and project proponent				
1.1 Project Location and Area *For EPRMP, discussions should be in the context of the proposed modification/changes*	a) Map showing sitio, barangay, municipality, province, region boundaries, vicinity, proposed buffers surrounding the area and Primary & secondary impact areas			-Present the project areas, i.e Panay-Guimaras and Guimaras-Negros links, in separate NAMRIA maps -NAMRIA maps should be used in presenting the **required** information for this section -Cite Table1 in the discussion -Print Figure 2 in A3
	b) Geographic coordinates (shape file data) of project area (use WGS 84 datum - GPS setting)			Provide the geogrphical coordinates of the project alignment and area using WGS 84 as the coordinate reference system
	c. Describe the vicinity and the accessibility of the project site/area			-Identify the Direct and Indirect Impact Areas based on DAO 2017-15 and DAO 2003-30
I.2. Project Rationale *For EPRMP, discussions should be in the context of the proposed modification/changes*	• Cite and focus on the need for the project based on national and regional/local economic development in terms of contribution to sustainable development agenda or current development thrusts. • Describe the justification for the Project with particular reference made to the economic and social benefits, including employment and associate economic development, which the project may provide. The status of the project should be discussed in a regional and national context.		Yes	
I.3. Project Alternatives *For EPRMP, discussions should be in the context of the proposed modification/ changes*	a) Cite criteria used in determining options for facility siting, development design, process/technology selection, resource utilization and discuss how the decisions on the preferred options were made. Siting: Alternative project locations including factors significant to the selection such as severity of impacts, perception of affected communities with regards to project, ancestral domain issues, land classification, etc. Discuss other options on the siting of major components of the project within the project area. Technology Selection/Operation Processes and design Selection for storage: Alternative technologies, operation processes, and measures to minimize wastes, prevent adverse impacts such as air and water pollution, groundwater and land contamination, and for the prevention/control of emergency events (eg. fire, explosion, leaks, spills) including factors significant to the selection. Resources: Alternative sources of power, water, raw materials and other resources needed including factors			Have Figure 31 be printed in A3 to make the map labels and legends legible

☑ 1st ☐2nd ☐3rd ___ th Screening

Sections / Subsections	Content	Page #	Acceptable?	REMARKS
	significant to the selection such as supply sustainability and climate change projections *Likewise contextualize the determination of preliminary options in terms of project site factors significant to the selection such as supply sustainability and susceptibility to:* • *Liquefaction, Ground Shaking, Ground Rupture, Earthquake induced Landslides Volcanic eruptions, tsunami (PHIVOLCS)* • *Rain-induced landslide and flooding (MGB)* • *Storm surge, and flooding as well as extreme climatologic conditions (PAGASA)*			
	b) Summarize and discuss comparison of environmental impacts of each alternative for facility siting, development design, process/technology selection, resource utilization		Yes	
	c) Discuss the consequences of not proceeding with the project or no project option	Provide discussion		
1.4 Project Components *For EPRMP, discussions should be in the context of the proposed modification/changes; boundaries of current project area should be delineated from the proposed expansion area, if any*	a) General layout of facilities;	-Idenfity the major components, support facilities and pollution control devices per segment/link, i.e Panay-Guimaras and Guimaras Negros		
	b) Maps showing in particular, the location and boundaries of project area, location and footprint of main facilities, storage and support facilities, and proposed buffers.	-Have the Figures in this section printed in legible maps showing barangay boundaries		
	c) Identification and general description of major components such as materials, capacity, number, safety features , etc.			
	d) Identification and description of support facilities and infrastructure requirements such as energy/power generating facility (if any) or energy source, water supply/storage, storm water drainage, sewerage, telecommunications, safety devices/emergency facilities, accommodation and similar facilities			
	e)Identification and description of pollution control devices and waste management system for the waste materials: wastewater, air emissions, domestic wastes, toxic and hazardous wastes, non toxic and non hazardous wastes, etc.			
I.5. Process/ Technology *For EPRMP, include discussion/comparison of existing and proposed modifications or expansion*	a) Description of the Processing/Manufacturing technology o process flow sheet showing material, and water (and energy, if applicable) balance including inputs and similar data on products, recycling and waste streams o materials/product handling and transport including storage protocols		Yes	
	b) Description of the pollution control devices and waste management system			
	c) Description of the operations and maintenance of facility			
I.6. Project Size *For EPRMP, include discussion/comparison of existing and proposed modifications or expansion*	a) Total capacity / stock population/dimension (whichever is applicable based on screening parameter in the Guidelines for Coverage Screening per MC 2014-005)	Indicate also the footprint area of the interchanges		
	b)Total Project Area in sq.m. or hectares			

☑ 1st ☐2nd ☐3rd ___ th Screening

Sections / Subsections	Content	Page #	Acceptable?	REMARKS
I.7. Development Plan, Description of Project Phases and Corresponding Timeframes For EPRMP, *discussions should be in the context of the proposed modification/changes*	Phases to be described in terms identifying specific activities (w/ special attention on those with significant environmental impacts as well as climate change adaptation options relevant to the project and project activities) and corresponding projected implementation timeframes: • ***Pre-construction*** (e.g. planning, acquisition of rights to use land, etc.) • ***Construction*** (e.g. land/site clearing, temporary housing, transport of materials, health and other services for the workforce, discussion of temporary facilities including the progress of works/milestones and the number workers required per milestones) • ***Operation*** (projected period of start-up/commissioning/full operation of various project components) include discussion on the operation of various components (as identified above) in terms of raw materials, fuel requirements, waste management and infrastructure requirements • ***Decommissioning/Abandonment/Rehabilitation*** - projected life of the project and alternatives for the future use of the project area which should be consistent with long term zoning and land use development plan of the municipality; - Abandonment Plan (general) to include management plan for the projected cumulative/long term project impacts such as remediation of contaminated soil and water resources, land restoration, proper dismantling/abandonment of facilities/ equipment and other necessary activities			-Expound discussion, particulary on the construction phase, per segment/link -Provide projected implementation time framesPresent
I.8. Manpower	Tabulate the following per project phase (pre-construction, construction, operation and maintenance): • manpower requirements; • expertise/skills needed; • nature & estimated number of jobs available for men, women, and indigenous peoples (if in IP ancestral land); • scheme for sourcing locally from host and neighboring LGUs			The discussion should be based on the requirements for this section.
I.9. Project Cost	Indicative Project Investment Cost (Philippine Peso)		Yes	
2. Assessment of Environmental Impacts See Table 3 for the list of key environmental impacts which shall be subjected to assessment. The assessment shall done using the prescribed approach/method and in relation to the corresponding baseline characterization in the primary and secondary impact areas (*as determined using the Guidelines in Annex 2-2 of the Revised Procedural Manual (RPM) for DAO 2003-30 or succeeding issuances*). The sampling and measurement plan used shall be discussed. Likewise, the assessment should be done for the various phases of development (i.e. pre-construction, construction and operation) and should consider climate change projections and disaster risks based on existing natural hazard information. For all maps, include overlays of project area footprint, show sensitive/critical receptors and sampling points for baseline data (indicate geographical coordinates). In conclusion, the residual and cumulative impacts shall be assessed. For EPRMP, the result of the proponent's monitoring shall be used as baseline. The assessment of environmental impacts of proposed modification shall be discussed in relation to the actual impacts of existing project operations which shall be presented from a summary of the results of compliance monitoring (in matrix and graphical form) as described in 6.1.				-See comments on Table 2 -Cite source and year of maps used in the discussion

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Sections / Subsections	Content	Page #	Acceptable?	REMARKS
3. Environmental Management Plan Appropriate mitigation/management measures should be specified for each of the identified key impacts (Table 3). Appropriate climate change adaptation and disaster risk reduction measures/options shall likewise be thoroughly discussed. The impact management plan should be summarized using at the minimum, the format in Annex 2-17 of RPM for DAO 2003-30 For EPRMP, the proposed impact management plan to be discussed shall consider review of performance of existing project based on the Environmental Quality Performance Levels (EQPLs) set. Also include change in adaptation measures / options and remediation of contaminated soil and water resources, land restoration proper dismantling, if any. ***Predicted impacts should be based on the baseline assessment results and should be quantified and not generic.***			Yes	
4. Environmental Risk Assessment (ERA) & Emergency Response Policy and Guidelines The level of coverage and type of document required shall first be determined based on Annex 2-7e of RPM for DAO 2003-30. For EPRMP, discuss status of implementation of the safety policies/guidelines and any proposed changes. Include last three (3) years of safety statistics. Also include incidence such as spills, near spills and similar incidents such as accidents and emergency. Discuss actions taken. See Table 4 for details		See Table 4 for comments		
5. Social Development Plan/Framework (SDP) and IEC Framework For EPRMP, discussion should focus on the status of implementation of SDP and IEC commitments. Discuss adjustments that should be undertaken.				
5.1 Social Development Program (SDP)	Community development or livelihood programs/activities, projected beneficiaries, partner institutions, timeframe of implementation as well as source and amount allotted per activity/component (See Annex 2-18 of RPM for DAO 2003-30)		Yes	
5.2.Information and Education Campaign (IEC)	Target sector, key messages, scheme/strategy/methods, Information medium, timelines and frequency, cost (See Annex 2-19 of RPM for DAO 2003-30)	Update and use the prescribed format. See Annex 2-19 of DAO 2003-30		
6. Environmental Compliance Monitoring				
6.1 Environmental Performance (for EPRMP only)	• Results of compliance monitoring in matrix and graphical form showing and explaining the trend in environmental conditions • Analyze performance based on the Environmental Quality Performance Levels (EQPLs) set • Discuss compliance to ECC conditions and performance against the originally approved Environmental Management and Monitoring Plan, MMT requirements/commitments, third party audits (if any) • Discuss implementation of appropriate and effective environmental impact remedial actions in case of exceedances • Discuss operationalization of complaints management system		N/A	

☑ 1st ☐2nd ☐3rd ___ th Screening

Sections / Subsections	Content	Page #	Acceptable?	REMARKS
6.2.Self-Monitoring Plan	The monitoring plan shall be summarized using Annex 2-20 of RPM for DAO 2003-30 or succeeding issuances as template. For EPRMP, the original and proposed additional/changes in sampling sites/stations shall be discussed and shown in map/s. Proposed reduction in or additional parameters especially for air and water shall likewise be identified. The proposed changes in parameters and/or sampling stations which shall be based on the results of the impact assessment reported in Chapter 2 shall be discussed in this section.			Complete the information of the EQPL matrix in page 6-4
6.3.Multi-Sectoral Monitoring Framework	Discussion on the necessity of creating a Multi-Partite Monitoring Team (MMT). If deemed necessary, describe the proposed scope of MMT responsibilities and activities and tabulate the list of proposed stakeholder-members of the MMT, basis of selection and proposed role. (See Annex 3-4 of the RPM for DAO 2003-30). Use DAO 2017-15 and DAO 2018-18 for reference.			Provide the required information. Use DAO 2003-30, DAO 2017-15 and DAO 2018-18 as reference.
6.4 Environmental Guarantee and Monitoring Fund Commitments	• Discussion on the necessity of putting up an EGF. If deemed necessary, present a proposed amount of EGF indicating the basis for the estimate (per guidelines in annex 3-6 of RPM for DAO 2003-30) • If MMT is deemed necessary, present a proposed amount of EMF (based on a draft AWFP in following the format in Annex 3-4 and consistent with guidelines in Annex 3-5 of RPM for DAO 2003-30);			Provide the required information. Use DAO 2003-30, DAO 2017-15 and DAO 2018-18 as reference.
7.Decommissioning / Abandonment /Rehabilitation Policy Statement on Proponent's policies to implement the abandonment plan described in Item 1.7 and to formulate and submit procedures for Rehabilitation/ Decommissioning/Abandonment within a timeframe specified in the ECC. For EPRMP, present approved plan/program, if any, and proposed changes.			Yes	
8. Institutional Plan for EMP Implementation Present the organizational scheme of the proponent including line of command and reporting procedures as well as manpower complement and relationships with other operating departments. For EPRMP, discuss status of implementation and any proposed changes in the plan to cover modification/expansion if any.			Yes	

Table 3. Key Environmental Impacts to be included in the Assessment and Formulation of Management and Monitoring Plan to be reflected in the EIS/EPRMP

During scoping: Unless otherwise specified as agreed during scoping, all items listed are required. Write specific instructions (if any) on the blanks/spaces provided			✓ *For completeness during procedural screening; page numbers should be provided upon submission of the EIS/EPRMP*								
List of Key Impacts	**Baseline Data Parameter Requirements**	**Required Assessment Methodology/Approach**	Baseline Conditions		Impact Analysis		Mgmt. Plan		Monitoring Plan		**Remarks**
			Page	✓	Page	✓	Page	✓	Page	✓	
I. Land											
1.1. Land Use and Classification											
1.1.1 Impact in terms of compatibility with existing land use	Description & Map showing the project area in relation to existing land use.	Assessment of the compatibility of the proposed project vis-a-vis actual land use and the approved comprehensive land use plan/zoning classification, ECA Classification and/or the coastal resource management plan of the LGU if any.	Hve the project area superimposed in CLUP of affected municipalities								
1.1.2 Impact on compatibility with classification as an Environmentally Critical Area (ECA)	Identify ECA where the project is located or near the project area. Identify areas vulnerable/susceptible to natural hazards where the project is located or near the project area (include map/s).										
1.1.3 Impact in existing land tenure issue/s	Determine if the project area is under CARP or with CADC / CADT / CALC/ CALT, with IFMA/CBFMA, within COC, within MPSA or other tenurial instruments and identify corresponding existing tenure issues including presence of informal settlers.	Identify and assess impact in terms of land tenure issues in relation to project implementation	Discuss here the properties/titled lands that will be affected by the project alignment and the ROW acquisition								
1.1.4 Impairment of visual aesthetics	Visually significant landforms/ landscape/structures	Identify and assess impact of the project on these visually significant landforms/landscape/structures	Provide discussion								
1.1.5 Devaluation of land value as a result of improper solid waste management and other related impacts	Existing solid waste management and related land management scheme in the area	Identify and assess impacts of the estimated generation of solid wastes in terms of: - amount and - characteristics (hazardous or domestic) and other related issues on the existing management scheme	Provide discussion								
1.2 Geology/Geomorphology											

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During scoping: Unless otherwise specified as agreed during scoping, all items listed are required. Write specific instructions (if any) on the blanks/spaces provided			✓ *For completeness during procedural screening; page numbers should be provided upon submission of the EIS/EPRMP*								
List of Key Impacts	**Baseline Data Parameter Requirements**	**Required Assessment Methodology/Approach**	Baseline Conditions		Impact Analysis		Mgmt. Plan		Monitoring Plan		**Remarks**
			Page	✓	Page	✓	Page	✓	Page	✓	
1.2.1 Change in surface landform/geomorphology/ topography/ terrain/slope	Slope and Elevation/Topographic Map;	Identify and assess project impact in terms of the changes in surface landform/topography/terrain/slope including existing hazard as maybe aggravated by climate change as projected by PAGASA	Cite the source and year of the maps used in this section. Replace all maps with legible labels and legends								
1.2.2 Change in sub-surface geology/underground conditions	Regional/General Geological Map Natural Hazard Map (sub surface)	Identify and assess project impact in terms of the changes in sub-surface geology and inducement of subsidence, liquefaction, landslides, mud/debris flow to the environment including the possibility of aggravating existing natural hazards Discuss and assess the impacts of geologic hazards and planned earthworks on the project facilities (e.g., landslides, mudflows, subsidence, ground shaking from earthquake, liquefaction, flooding, etc.). Note in the discussion how climate change can aggravate the hazards and impacts. The geologic hazards map must consider the hazards/exposure/vulnerability/ risk maps of Section 1.1.2.	Cite the source and year of the maps used in this section. Replace all maps with legible labels and legends								
1.2.3 Inducement of subsidence, liquefaction, landslides, mud / debris flow, etc.	Geological Map as needed.; hazard maps (NAMRIA, NDRRMC, MGB, PHIVOLCS, PAGASA)		Cite the source and year of the maps used in this section. Replace all maps with legible labels and legends								
1.3 Pedology											
1.3.1 Soil erosion / Loss of topsoil/overburden	• Summary of Soil Investigation Report on soil type and quality • Soil map showing soil types, sampling stations, topography, streams, built-up areas, and planned project features • Water and wind erodibility potential • Sediment sources, and	Describe capability of the land to accommodate the proposed development with minimal or without soil erosion/loss of topsoil/overburden Describe the physical properties and erodibility potential of the soil, ongoing erosion processes and assess the									Acceptable

☑ 1st ☐2nd ☐3rd ___ th Screening

)uring scoping: Unless otherwise specified as agreed during scoping, all items listed are required. Write specific instructions (if any) on ıe blanks/spaces provided			*✓ For completeness during procedural screening; page numbers should be provided upon submission of the EIS/EPRMP*								
.ist of Key Impacts	**Baseline Data Parameter Requirements**	**Required Assessment Methodology/Approach**	Baseline Conditions		Impact Analysis		Mgmt. Plan		Monitoring Plan		**Remarks**
			Page	✓	Page	✓	Page	✓	Page	✓	
	• Riverbank stability	erosional impacts of the project. The Universal Soil Loss Equation (USLE) and its variants may be used in the modeling.									
.3.2 Change in soil quality/fertility	Laboratory results on soil sample analysis for N, P, K, pH, organic matter, micronutrients and trace metals e. g. Pb, Hg, As, Cd, Cr hexavalent, etc.	Assess the impact of the project activities including the possibility of spills on soil quality and fertility									Acceptable
.4 Terrestrial Ecology											
.4.1 Vegetation removal and loss of habitat	• Map showing land cover; sampling sites; location of observed important, endangered, and keystone species; ecologically sensitive sites; planned land development works • Flora and fauna species inventory or survey report to cover species listing, abundance, richness, dominance, diversity, evenness, ecological status, and uses; • Historical occurrences of pest infestation, forest/grass fire and/or similar incidences • ***Map showing the project area and the sampling points for the assessment of flora and fauna. Sampling made should be adequate enough to represent the total population of species.***	To establish baseline, - Use quadrat sampling for flora to cover all land cover types - Use transect walk ~~,~~ mist nets, traps, for fauna - show survey locations in a map Identify and assess specific impacts of the project activities guided by the following: 1. Habitat loss or degradation – Land clearing, river damming, etc. will result in the loss of habitat. Some activities may lead to the alteration of habitat composition, structure or function. Some habitats, e.g., wetlands, are critical to ecological processes or endangered species. 2. Habitat fragmentation – This is the break-up of the natural landscape into small patches isolated from one another. It affects the number of species present, movement of									Acceptable
.4.2 Threat to existence and/or loss of important local species	Summary of endemicity / conservation status										Acceptable

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uring scoping: Unless otherwise specified as agreed during scoping, all items listed are required. Write specific instructions (if any) on e blanks/spaces provided			✓ *For completeness during procedural screening; page numbers should be provided upon submission of the EIS/EPRMP*								
ist of Key Impacts	**Baseline Data Parameter Requirements**	**Required Assessment Methodology/Approach**	Baseline Conditions		Impact Analysis		Mgmt. Plan		Monitoring Plan		**Remarks**
			Page	✓	Page	✓	Page	✓	Page	✓	
4.3Threat to abundance, frequency and distribution of important species	• Summary of abundance, frequency and distribution • Economic importance and uses of significant flora and fauna	species, and transfer of materials among habitats. 3. Loss of species – Of special interest are the keystone, endangered, and endemic species. 4. Pollution effects on species – The stressors include dust, noise,chemical/ petrochemical spills, eroded sediment, increased temperature, etc. Relate discussions to estimated GHG emissions and possible carbon sequestration program/s									Acceptable
4.4 Hindrance to wildlife access	Survey map in relation to the project site										Acceptable
. THE WATER											
.1 Hydrology/Hydrogeology											
.1.1 Change in drainage morphology / ducement of flooding/ Reduction in ream volumetric flow	Drainage map (also showing local drainage system/infrastructures); Historical flooding/drought occurrences, stream flow measurements/estimates; Delineation of watershed /sub-watersheds/ floodplain; and identification of aquifers if any	Identify and assess project impact on the change in drainage morphology/local drainage system and resulting effects of flooding pattern in the project area and surrounding. Include climate projections effects on flooding. Relate discussions to item 3.1.1									Acceptable
.1.2 Change in stream, lake water depth	Regional hydrogeological map	Identify and assess project impact in terms of change in stream, lake water depth									Acceptable
.1.3 Depletion of water resources / competition in water use	Current / projected water use (groundwater/surface water) in the area and adjacent areas	Identify and assess project impact on the existing water resources and the resulting competition in the water use using analysis/estimation of water availability. Include discussions taking									Acceptable

☑ 1st ☐2nd ☐3rd ___th Screening

uring scoping: Unless otherwise specified as agreed during scoping, all items listed are required. Write specific instructions (if any) on e blanks/spaces provided			✓ *For completeness during procedural screening; page numbers should be provided upon submission of the EIS/EPRMP*								
ist of Key Impacts	**Baseline Data Parameter Requirements**	**Required Assessment Methodology/Approach**	Baseline Conditions		Impact Analysis		Mgmt. Plan		Monitoring Plan		**Remarks**
			Page	✓	Page	✓	Page	✓	Page	✓	
	Inventory of water supply source including springs and wells(indicate depth of water table) and show location in a map of appropriate scale	into consideration the PAGASA medium to long term projections									
.2 Oceanography *(applicable to projects with jetty/port and/or subsea structures that will change the bathymetry in the area)*											
.2.1 Change/disruption in water circulation pattern, littoral current, and coastal erosion and deposition	• Bathymetric survey and map • Measurement of water currents • Analysis of available proximate tides data • Hydrodynamic modeling • Particle dispersion modeling and map • Storm surge hazard, exposure, vulnerability, risk maps	Identify and assess project impact on the degree of change/disruption of circulation pattern and the potential for coastal erosion Build a hydrodynamic model based on the measured bathymetry and currents and tidal analysis and then validate the model. A public domain software like the United States Environmental Protection Agency Environmental Fluid Dynamics Code (EFDC) may be used. Through the validated hydrodynamic model, assess the impacts of the project on water circulation, littoral current, and coastal erosion and deposition. Use the modeling results of Sec. 1.3.1 and 2.1.1. Discuss how the impacts may be affected by climate change especially sea level rise.									Provide bathymetric survey and map

☑ 1st ☐2nd ☐3rd ___th Screening

During scoping: Unless otherwise specified as agreed during scoping, all items listed are required. Write specific instructions (if any) on the blanks/spaces provided			✓ *For completeness during procedural screening; page numbers should be provided upon submission of the EIS/EPRMP*								
List of Key Impacts	**Baseline Data Parameter Requirements**	**Required Assessment Methodology/Approach**	Baseline Conditions		Impact Analysis		Mgmt. Plan		Monitoring Plan		**Remarks**
			Page	✓	Page	✓	Page	✓	Page	✓	
2.2.2 Change in bathymetry	Bathymetric map;	USLE / similar modeling when applicable Use the hydrodynamic model to assess the impacts of the bathymetric changes. Discuss how the impacts may be affected by climate change. Compare projected new bathymetry as a result of the project with the existing									
2.3 Water Quality											
2.3.1 degradation of groundwater quality	Physico-Chemical characterization of water: ☑ pH ☑ BOD5 ☑ COD ☑ DO ☑ Oil and grease ☑ TSS ☑ Heavy Metals ☑ fecal / total coliform ☑ sampling site map Use DAO 2016-08 for reference	Identify and assess project impact in terms of degradation of groundwater, coastal surface water and coastal/marine water quality. Use DENR standard methods and procedures for sampling and analysis. Assess impact on siltation of surface and coastal/marine waters. Circulation / plume modeling for regular discharges, leaks/spills, worst case scenario of failure of WTF and other emergency/ accident scenarios for facilities with structures in water bodies Link discussion of spills with Section 1.3 especially if spills affect soil and groundwater. Aquifer (Groundwater) vulnerability Assessment (i.e. discussions on groundwater contamination due to project operation).									Acceptable
2.3.2 degradation of surface water quality											Acceptable
2.3.3 degradation of coastal/marine water quality											Acceptable

☑ 1st ☐2nd ☐3rd ___ th Screening

During scoping: Unless otherwise specified as agreed during scoping, all items listed are required. Write specific instructions (if any) on the blanks/spaces provided			✓ *For completeness during procedural screening; page numbers should be provided upon submission of the EIS/EPRMP*								
List of Key Impacts	**Baseline Data Parameter Requirements**	**Required Assessment Methodology/Approach**	Baseline Conditions		Impact Analysis		Mgmt. Plan		Monitoring Plan		**Remarks**
			Page	✓	Page	✓	Page	✓	Page	✓	
		Show in a map, sampling sites for monitoring purposes based on the above assessment.									
2.4 Freshwater Ecology											
2.4.1 Threat to existence and/or loss species of important local and habitat	• Summary of endemicity / conservation status • Abundance of ecologically and economically important species (fishes, benthos, planktons); • Presence of pollution indicator species; • sampling site map	Identify and assess project impact in terms of threats to existence/and or loss of species, abundance frequency and distribution species and include discussions on overall impact to freshwater ecology. Relate discussions to air and water Show in a map, sampling sites for monitoring purposes based on the most significant threats identified.									
2.4.2 Threat to abundance, frequency and distribution of species											
2.5 Marine Ecology *(applicable if project involves activities, discharges and structure in marine waters)*											
2.5.1 Threat to existence and/or loss of important local species and habitat	• Abundance/densities/distribution of ecologically and economically important species (mangroves, fishes, benthos, planktons, coral reefs, algae, seaweeds, sea grasses); • Presence of pollution indicator species; • Historical occurrences of red-tide, fish kill or any related event • marine resource map • sampling site map • ***Map showing the project area overlayed in a map showing the proximity of the coastal resources (mangroves, seagrass beds, coral reefs), tributaries.***	Quadrat, transect, line intercept, spot dive, manta tow, marine resource characterization (e.g. municipal and commercial fisheries data) for baseline gathering. Identify and assess project impact in terms of threats to existence, loss of important local species, threat to abundance, frequency and distribution and include discussions on overall impact to marine ecology. Relate discussions to air, water and oceanography Show in a map, sampling sites for monitoring purposes based on the most significant threats identified.									Acceptable
2.5.2 Threat to abundance, frequency and distribution											Acceptable

☑ 1st ☐2nd ☐3rd ___ th Screening

During scoping: Unless otherwise specified as agreed during scoping, all items listed are required. Write specific instructions (if any) on the blanks/spaces provided			✓ *For completeness during procedural screening; page numbers should be provided upon submission of the EIS/EPRMP*								
List of Key Impacts	**Baseline Data Parameter Requirements**	**Required Assessment Methodology/Approach**	Baseline Conditions		Impact Analysis		Mgmt. Plan		Monitoring Plan		**Remarks**
			Page	✓	Page	✓	Page	✓	Page	✓	
	• *Map showing the project area and the sampling points for the assessment of flora and fauna. Sampling made should be adequate enough to represent the total population of species.*										
3.0 THE AIR											
3.1 Meteorology/Climatology											
3.1.1 Change in the local micro-climate e.g. local temperature	Monthly average rainfall and temperature of the area; Climatological normals/extremes; Wind rose diagrams; Frequency of Tropical cyclones	Identify and assess project impact in terms of change in the local micro-climate change. Also discuss effects of climate change using PAGASA medium to long term projections			Provide the required data and assessment						
3.1.2 Contribution in terms of greenhouse gas emissions (or GHG mitigation potential) Note: applicable only for projects with significant GHG emissions	Data on Greenhouse gasses (i.e. carbon dioxide, nitrous oxide);	Estimate projected greenhouse gases (GHG) (i.e. carbon dioxide, nitrous oxide) using IPCC guidelines; include mitigation and/or sequestration for both construction and operation phases.									
3.2 Air Quality (& Noise)											
3.2.1 Degradation of air quality	Characterization of ambient air quality: ☑ TSP ☑ PM10 ☑ SOx ☑ NOx (for sampling methods refer to Clean Air Act) ☑ sampling site map	Use DENR standard methods and procedures for sampling and analysis. Relate selection of sampling locations using data collected in 3.1.1 Identification and assessment of impact of the project to the identified parameters including VOCs and odor through air dispersion modeling (as may be applicable)									Acceptable

☑ 1st ☐2nd ☐3rd ___th Screening

During scoping: Unless otherwise specified as agreed during scoping, all items listed are required. Write specific instructions (if any) on the blanks/spaces provided			✓ *For completeness during procedural screening; page numbers should be provided upon submission of the EIS/EPRMP*								
List of Key Impacts	**Baseline Data Parameter Requirements**	**Required Assessment Methodology/Approach**	Baseline Conditions		Impact Analysis		Mgmt. Plan		Monitoring Plan		**Remarks**
			Page	✓	Page	✓	Page	✓	Page	✓	
		Show in a map, sampling sites for monitoring purposes based on the above assessment. *Compare changes in air quality over time using statistical tools e.g. across sampling sites over time, and test for significant changes*									
3.2.2 Increase in ambient noise level	Characterization of ambient noise level sampling site map	Use DENR standard methods and procedures for sampling and measurement. Identification and assessment of impact to ambient noise level using noise attenuation modeling and comparing it with relevant standards. (applicable if estimated total noise level will exceed noise standard).									Acceptable
4.0 THE PEOPLE To conduct perception survey of affected communities.											
4.1 Displacement of settler/s Displacement / disturbance of properties Change/conflict in land ownership Change/conflict Right of way Impact on Public Access	Demographic data of impact area: - Number of households and household size - Land area, - Population, - Population density /growth - gender and age profile, - literacy rate, profile of educational attainment - settlements map	Identify and assess project impacts on demography of affected communities. Use assessment in the formulation of SDP/IEC Assess availability of alternative public access and housing options for displaced settlers For project with displacement/ disturbance of properties/settlers, change/conflict in land ownership and change/conflict right of way, formulate resettlement framework plan or RAP		Revise the discussion in this module. Follow the topics outlined in this screening form							

☑ 1st ☐2nd ☐3rd ___th Screening

During scoping: Unless otherwise specified as agreed during scoping, all items listed are required. Write specific instructions (if any) on the blanks/spaces provided			✓ *For completeness during procedural screening; page numbers should be provided upon submission of the EIS/EPRMP*								
List of Key Impacts	**Baseline Data Parameter Requirements**	**Required Assessment Methodology/Approach**	Baseline Conditions		Impact Analysis		Mgmt. Plan		Monitoring Plan		**Remarks**
			Page	✓	Page	✓	Page	✓	Page	✓	
4.2 In-migration proliferation of informal settlers	Census of population / property that will be displaced / disturbed Housing ownership profile / availability of housing/ number of informal settlers	Identify and assess project impact due to in-migration patterns including proliferation of informal settlers									
4.3 Cultural/Lifestyle change (especially on Indigenous People, if any)	Demographic data on Indigenous People (if any) and existing Culture/Lifestyle that may be significantly affected	Identity and assess project impact in terms of Culture/Lifestyle that may be affected and/or introduced									
4.4 Impacts on physical cultural resources	Inventory and description of physical cultural resources and landscapes that have archaeologic, paleontologic, historical, religious, aesthetic, or cultural significance: Movable or immovable objects, below ground or under water, sites, structures, groups of structures, and natural features Classify cultural interest value/ importance into local, provincial, national, or international level *Sources of information: UNESCO, National Museum (NM), National Historical Commission of the Philippines (NHCP), National Commission for Culture and Arts (NCAA) and the Local Government Units (LGUs) in the project area and other UN or National Publications*	Identify all potential project impacts in an integrated manner considering the type, significance, and value/importance of the physical cultural resource/s Identify risks in terms of capacity and commitment in managing the impacts *(protocols in handling chance finds shall be implemented)*									
4.5 Threat to delivery of basic services /resource competition	Availability of public services in terms of: • Water supply • Power supply • Communications /transportation • peace and order / crime • education facilities	Identify and assess project impact in terms of threats to delivery of basic services including potential for resource competition in the area including effects of in-migration									

☑ 1st ☐2nd ☐3rd ___ th Screening

During scoping: Unless otherwise specified as agreed during scoping, all items listed are required. Write specific instructions (if any) on the blanks/spaces provided			✓ *For completeness during procedural screening; page numbers should be provided upon submission of the EIS/EPRMP*								
List of Key Impacts	**Baseline Data Parameter Requirements**	**Required Assessment Methodology/Approach**	Baseline Conditions		Impact Analysis		Mgmt. Plan		Monitoring Plan		**Remarks**
			Page	✓	Page	✓	Page	✓	Page	✓	
	• recreational facilities / sports facilities statistical data / information related to public services: • literacy rate, profile of educational attainment • Crime rate • Food security										
4.6 Threat to public health and safety	Availability of public services in terms of: health resources (Government and Private) Statistical data / information related to public services: • Morbidity and mortality rates (infants and adults - 5-year trend) • Common diseases in the area including endemic diseases; Environmental Health and Sanitation Profile	Identify and assess specific threats to public health and safety due to project impacts. Relate discussions to land, air and water (Item 1 to 3) Analysis of the impact of project implementation on existing disease profile including weather sensitive diseases and impact aggravation as a result of climate change as projected by PAGASA									
4.7 Generation of Local Benefits from the project Enhancement of employment and livelihood opportunities Increased business opportunities and associated economic activities Increased revenue of LGUs	Socioeconomic data: • Main sources of Income • Employment rate/ profile • Poverty incidence • sources of livelihood • commercial establishments and activities • banking and financial institutions	Identify and assess local benefits of the project in terms of enhancement of employment and livelihood opportunities, increased business opportunities and associated economic activities and increased revenue of LGU									
4.8 Traffic congestion	Road network/ systems Existing Transportation/traffic situation	Identify and assess project impact on the traffic situation in the area									

☑ 1st ☐2nd ☐3rd ___ th Screening

During scoping: Unless otherwise specified as agreed during scoping, all items listed are required. Write specific instructions (if any) on the blanks/spaces provided			*✓ For completeness during procedural screening; page numbers should be provided upon submission of the EIS/EPRMP*								
List of Key Impacts	**Baseline Data Parameter Requirements**	**Required Assessment Methodology/Approach**	Baseline Conditions		Impact Analysis		Mgmt. Plan		Monitoring Plan		**Remarks**
			Page	✓	Page	✓	Page	✓	Page	✓	
		including congestion based on existing capacity of road system									

Table 4. Environmental Risk Assessment to be included in EIS/EPRMP

During scoping: Check (✓) required/applicable items; items with ✓ are automatically required; write specific instructions (if any) on the blanks/spaces provided.			*✓ For completeness during procedural screening; page numbers should be provided upon submission of the EIS/EPRMP*						
Level of Coverage & Type of Risks	**CONTENTS OF ERA AS PART OF EIS/EPRMP For the identified safety risks in column 1**	Remarks/ Specific Scoping Instruction/s	ERA		ERP		Monitoring Plan		REMARKS
			Page	✓	Page	✓	Page	✓	
Level of Coverage: Refer to Annex 2-7e of the RPM for DAO 2003-30 ☐ Level 2 (QRA Required) ☐ Level1 (Emergency Plan based on hazard analysis) ☐ Risk Screening Level	For EPRMP, include HAZOP or QRA for existing facilities and compare with that for the expansion. Also include discussions on safety incidents/records/history (in relation to environmental risks) classified into first aid, medical attention cases, days away from work cases, fatalities (including contractors), record of drills (fire, spills, explosion, among others) and any experience in implementing the ERP For EIS, check type of report to be submitted prior to Operation: ☐ Quantitative Risk Assessment(QRA) ☐ HAZOP ☐ Others : ___________								Acceptable
Safety Risks Type: ☐ Fire ☐ Explosion ☐ Release of toxic substances	☑ Description of conditions, events and circumstances which could be significant in bringing about identified safety risks ☑ Description & assessment of the possible accident scenarios posing risk to the environment ☑ Description of the hazards, both immediate (acute effects) and delayed (chronic effects) for man and the environment posed by the release of toxic substance, as applicable ☑ The safety policy and emergency preparedness guidelines consistent with the regulatory requirements. Emergency								Acceptable

☑ 1st ☐2nd ☐3rd ___ th Screening

During scoping: Check (✓) required/applicable items; items with ✓ are automatically required; write specific instructions (if any) on the blanks/spaces provided.			✓ *For completeness during procedural screening; page numbers should be provided upon submission of the EIS/EPRMP*						
Level of Coverage & Type of Risks	**CONTENTS OF ERA AS PART OF EIS/EPRMP For the identified safety risks in column 1**	Remarks/ Specific Scoping Instruction/s	ERA		ERP		Monitoring Plan		REMARKS
			Page	✓	Page	✓	Page	✓	
	Preparedness should also consider natural hazards to the infrastructures and facilities. For EPRMP, present actual Emergency Response Policy,record of drills and recorded events.								
☐ Physical Risks (Failure of Structure w/c could endanger life, property and/or the environment)	☑ Description of conditions, events and "trigger" which could be significant in bringing about identified physical risks ☑ Description & assessment of the possible accident scenarios posing risk to the environment ☑ Description of the hazards both immediate (acute effects) and delayed (chronic effects) for man and the environment posed by the failure of structure, as applicable								Acceptable

Noted By:	Signature		Signature
Review Committee Members		**EMB Representatives**	
1. Engr. Ramon Aguilar, Jr.		1. Engr. Carlo Vic Arida, EnP	
2. Engr. Nicanor Mendoza		2. Engr. Joel Polintan	
3. Mr. Edmundo Vargas		**Project Proponent:**	
4. Dr. Chester Cabalza		Mr. Virgilio J. Bonsol	
5. Dr. Maria Lourdes Moreno		**Project Preparer/Consultant:**	
Resource Person		Mr. Ricardo Capule	
1. Ms.Caroline Brasileño			

☐ 1st ☐2nd ☐3rd ___ th Screening

Recommendations on the Proposed Panay – Guimaras – Negros Island Bridges Project for EIS/ Technical Scoping

1.Baseline on water quality data for the affected water bodies (surface and ground water) within the DIA & SIA in the major three (3) islands of the direct and secondary impacted areas of the proposed project;

1.1 WQ samplings stations should be properly identified & taken at areas where activities are causing / generating source of pollution and or impacts in any receiving water bodies;

2.Primary and secondary WQ parameters (DAO 2016-08) with assessment should be reflected in the EIS;

3.Discussion on the following:

a. Water Pollution Impact during construction & operation phase . Discuss the identified source of pollution in any activities or related interventions on various components of the proposed project.

b. Impact on Environmental Sanitation during construction & operation phase for directly impacted area (DIA) and secondary impacted area (SIA)

c. Discussion on the storm drainage system and run-off effects to the immediate receiving body of waters.

d. Proposed Water supply system and its sanitation facilities for the identified displaced families , households and structure or facilities.

4.In page 35 item IX under preliminary identified Environmental Aspects , please discuss comprehensively the listed predicted impacts stipulated in Water sector .These should be highlighted with engineering studies and or mathematical modeling tool to substantiate what you stated in the matrix of environmental impacts

5. Discuss the application of Green Infrastructure System in the Design , criteria and specifications for the whole components of the Project both for construction & operation phases.

Submitted by :
Engr. Nicanor E. Mendoza
EMB Internal Reviewer

September 27, 2019

MEMORANDUM

FOR: **ENGR. ESPERANZA A. SAJUL**
Chief EIAMD, EMB

Attention: **Engr. CARLO VIC J. ARIDA**
Case handler

SUBJECT: **REQUIREMENTS FOR THE PROPOSED PANAY-GUIMARAS-NEGROS ISLAND BRIDGES PROJECT**

FROM: **MARIA LOURDES Q. MORENO**
TERRESTRIAL, FRESHWATER AND MARINE Module Reviewer

Please include the following on top of what is in the proforma:

The project footprint

Map showing the project area overlayed in a map showing the proximity of the coastal resources (mangroves, seagrass beds, coral reefs), tributaries.

Map showing the project area and the sampling points for the assessment of flora and fauna. Sampling made should be adequate enough to represent the total population of species.

Predicted impacts and mitigation measures should be based on the baseline assessment results and should be quantified and not generic.

Make sure that mitigation measures are in place before construction to minimize impacts to coastal resources.

For your consideration please.

MARIA LOURDES Q. MORENO, PhD.
REVCOM

ANNEX 8.5.2

DULY NOTARIZED ORIGINAL SWORN STATEMENT OF THE PROPONENT

SWORN STATEMENT OF ACCOUNTABILITY OF THE PROPONENT

This is to certify that all the information and commitments in this Environmental Impact Statement Report (EIS) for the **FEASIBILITY STUDY OF PANAY-GUIMARAS-NEGROS ISLAND BRIDGES PROJECT** are accurate and complete to the best of our knowledge, and that an objective and thorough assessment of the project was undertaken in accordance with the dictates of professional and reasonable judgment. Should we learn of any information which would make the EIS report inaccurate, we shall immediately bring the said information to the attention of the EMB-DENR Central Office.

I hereby certify that no DENR-EMB personnel was directly involved in the preparation of this EIS report other than to provide procedural and technical advice consistent with the guidelines in the DAO 03-30 Revised Procedural Manual.

I hereby bind myself to answer any penalty that may be imposed arising from any misrepresentations or failure to state material information in the EIS report.

In witness whereof, I hereby set my hands this ____ day of DEC 02 2019 2019 at QUEZON CITY.

VIRGILIO C. CASTILLO
Project Director
RMCI (B) - UPMO
Department of Public Works and Highways

SUBSCRIBED AND SWORN to before me this DEC 02 2019 day of ______ 2019 at QUEZON CITY, Affiant having been identified through his ______ with Nos. ______ issued on ______ at ______, in his capacity as Proponent and acknowledged to me that this EIS Report is his free and voluntary act and deed of the entity he represents. This document, which consists of ___pages, including the page on which this acknowledgment is written, is an Environmental Impact Statement Report.

ATTY. ROGELIO J. BOLIVAR
NOTARY PUBLIC IN QUEZON CITY
AM Adm. Not. Com. No. NP-... 12-31-2020
Notary Public
IBP O.R. No. 055255 Jan. 2019 & IBP O.R. No. 055256 Jan.2020
PTR O.R No. 7376155 C 1-7-19/Roll No. 33 P32 / TIN# 129-871-009
MCLE No. V-0019296 valid from 04/15/2016 until 04/14/2019/PASIG CITY
Address: 31-F Harvard St. Cubao, Q.C.

Doc. No. 241
Page No. 50
Book No. IV-A
Series of 2019

ANNEX 8.5.3

DULY NOTARIZED ORIGINAL SWORN STATEMENT OF THE KEY EIS CONSULTANTS

SWORN STATEMENT OF ACCOUNTABILITY OF PREPARERS

This is to certify that all information in this Environmental Impact Statement Report (EIS) for the **FEASIBILITY STUDY OF PANAY-GUIMARAS-NEGROS ISLAND BRIDGES PROJECT** are accurate and complete to the best of our knowledge, and that an objective and thorough assessment of the project was undertaken in accordance with the dictates of professional and reasonable judgment. Should we learn of any information which would make the EIS inaccurate, we shall immediately bring the said information to the attention of the appropriate EMB DENR Central Office.

We hereby certify that no DENR-EMB personnel was directly involved in the preparation of this EIS other than to provide procedural and technical advice consistent with the guidelines in the DAO 03-30 Revised Procedural Manual.

We hereby bind ourselves jointly and solidarity to answer any penalty that may be imposed arising from any misrepresentations or failure to state material information in the EIS Report.

In witness whereof, we hereby set our hands this day of OCT 2 5 2019 2019 at QUEZON CITY.

Name	Field of Expertise/EIA Accreditation Number	Signature
1. Maria Carmela Q. Capule	Team Leader IPCO- 045	
2. Ricardo A. Capule	Environmental Specialist	
3. Xinglong Chen	Geologist	
4. Carolyn P. Barrias	Terrestrial Specialist	
5. Milagrosa P. Asuncion	Sociologist	
6. Yun Meng	Hydrologist	
7. Robert R. Pabiling	Marine Quality Specialist/ IPCO-107	

SUBSCRIBED AND SWORN to before me this OCT 2 5 2019 day of ______________ 2019 at QUEZON CITY, Affiants having been identified through their ID with No. ______________ issued on __________________ at ______________________, in their capacity as Preparer/Consultants of CCCC Highway Consultants Co. Ltd. and acknowledged to me that this EIS Report is their free and voluntary act and deed of the entity they represent. This document, which consists of ___pages, including the page on which this acknowledgment is written, is an Environmental Impact Statement Report.

Notary Public

ATTY. ROGELIO J. BOLIVAR
NOTARY PUBLIC IN QUEZON CITY
AM Adm. Not. Com. No. NP-124 1-12-19 until 12-31-2020
IBP O.R. No. 055255 Jan. 2019 & IBP O.R. No. 055256 Jan.2020
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MCLE No. V-0019296 valid from 04/15/2016 until 04/14/2019/PASIG CITY
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Doc. No. 97
Page No. 21
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ANNEX 8.5.4

PROOF OF PUBLIC PARTICIPATION

PUBLIC SCOPING REPORT
FOR THE
PANAY-GUIMARAS-NEGROS
ISLAND BRIDGES PROJECT

Table of Contents

I. Rationale of Public Scoping

In compliance with the DENR Administrative Order No. 15 series of 2017 under the Philippine EIS System, the public scoping is undertaken as part of promoting Public Participation. Its main rationale is to improve transparency and participation of the stakeholders to ensure efficient and effective assessment, management and monitoring of environmental impacts.

The public scoping was undertaken to:

1. Inform and generate awareness and understanding of the concerned public about the project;
2. Provide the stakeholders and avenue to ventilate salient issues and concerns regarding the project;
3. Give an opportunity to the stakeholders to have an open discussion with the EIA Preparers, Project Owner and the Proponents about the project;
4. Educate the stakeholders of their rights and privileges; and
5. Enable the stakeholders to effectively participate and make informed and guided decisions.

II. Description of the Project

The PGN Island Bridges Project is a part of the National Islands-Link Projects in the Philippines and it is one of the flagship projects of the Administration's Build, Build, Build program. A grant and technical assistance from the People's Republic of China Government through CCC Highways Consultants Co. Ltd.

2.1. Project Objectives and Rationale

The main goal of the project is to connect Panay Island, Guimaras Island and Negros Island to achieve the connection of the three islands, ensuring that pedestrians and vehicles can all-weather access the three islands, making the passage between the islands safer, faster and more convenient. Further promote the economic development of West Visayas (VI area).

In view of current local socio-economic level and traffic conditions, and the project is required to be open and connected with local roads, therefore, the technology standards for first-class highway is more practical for this project.

2.2 Project Alternatives

The feasibility study team has proposed the bridge sites and alignments based on the needs and suggestions raised by the Philippine government during the Pre-Feasibility Study and Feasibility Study Stage, taking into consideration of current conditions and planning of the local road networks as well as the results of all subject studies and controlling construction conditions in the project area. After comparative study, **Alignment B in Section-A and alignment D in Section-B are recommended. Figure 1** shows the layout of the bridge sites and alignments.

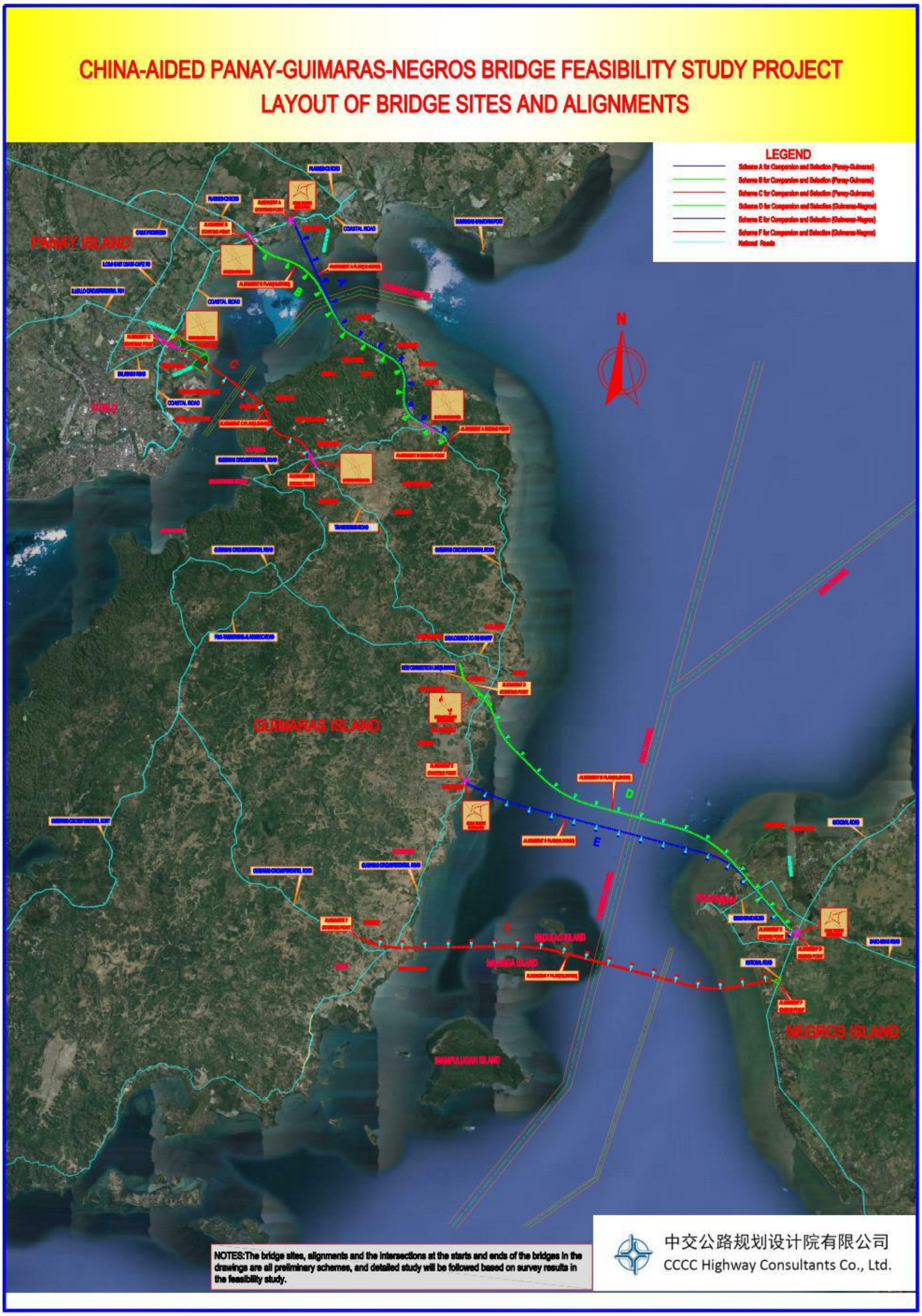


Figure 1. The layout of the bridge sites and alignments for section A and B

2.2.1 Section A (Panay-Guimaras Bridge)

Alignment B (Recommended Alignment): Alignment B connects to the intersection between the planned C2 Circumferential Road and coastal road at Iloilo City, and is designed with a rhombus type interchange to achieve traffic connection. Alignment B stretches northeastwards and crosses ILOILO Strait, and lands on the island at the north of Buenavista Town, GUIMARAS Province. After landing on the sland, the bridge alignment goes around the hill side, then, connects to the turning point of Guimaras Circumferential Rd, where a simple rhombus interchange is designed to meet the circumferential road for traffic connection. The length of the alignment is about 13.1 km in total.

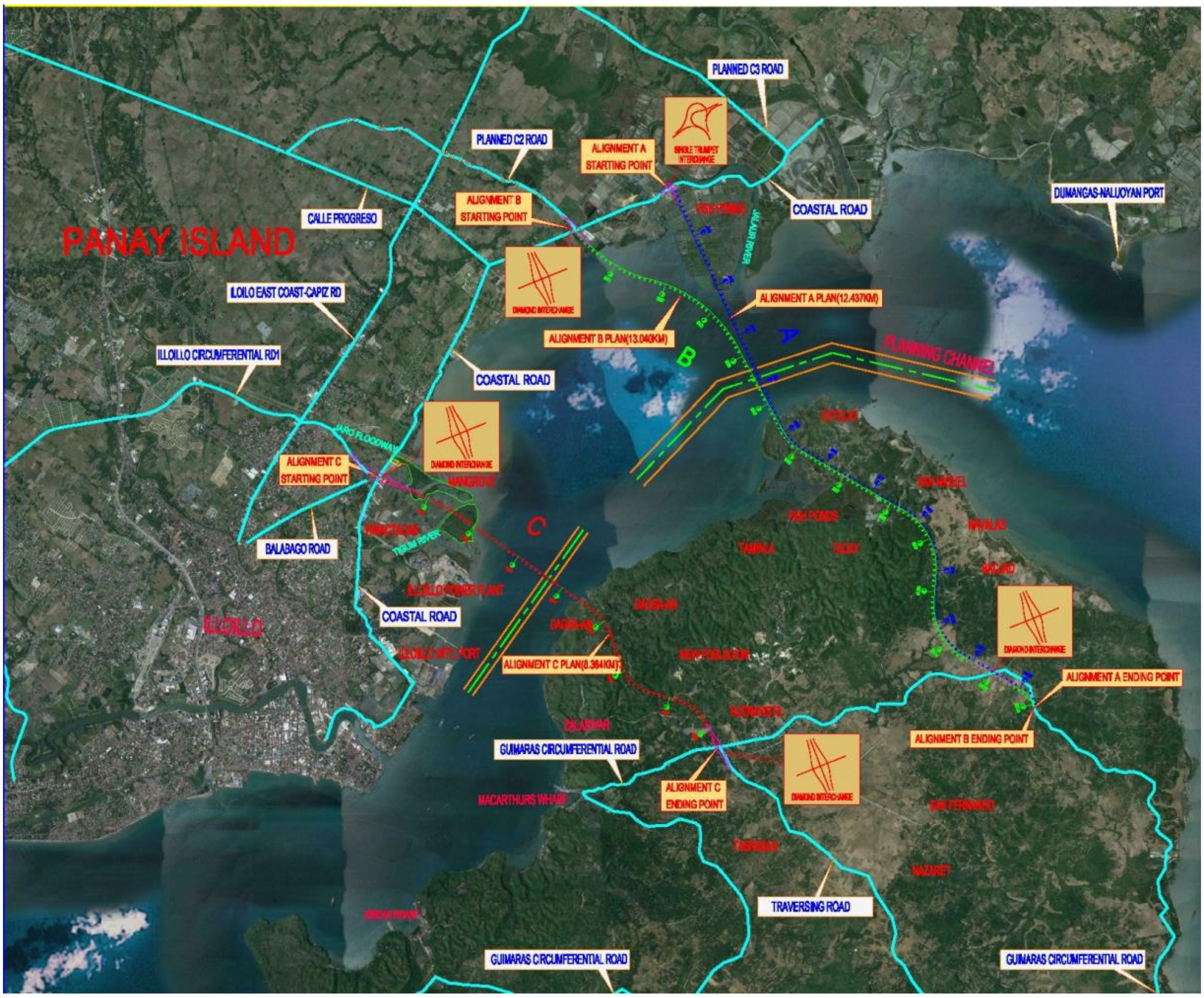


Figure 2: Layout of Alignment B (Section A)

2.2.2 Section B (Guimaras-Negros Bridge)

Alignment D (Recommended Alignment): This alignment starts from the east side of M. Chavez Town (the wind power generation farms), San Lorenzo City, Guimaras Province, and connects to the circumferential road, and also connects to the island-traversing road through a connecting road. At the intersection with the circumferential road, one simple interchange is designed to achieve traffic connection. Thereafter, it stretches southeastwards and crosses the strait perpendicular to the main fairway. It lands on the island at the north side of Pulupandan Port, and finally connects to NEGROS State Highway. One interchange is designed at its end point to achieve traffic connection. This alignment is about 19.5 km in total length (including the connecting road).

Figure 3: Layout of Alignment D (Section B)

Summary of Alternative Alignments, its advantages and disadvantages

Alignments	Total length	Bridge length	Connection with Road	Construction difficulty	Pros &cons	Recommendation
A	12.5km	2.7km	Not direct connection with under-planning C2 or C3 Road. Far from Iloilo city	Few household building to be demolished, No other public building. Few mangrove	Sea-crossing bridge is small-scaled. Few building to be demolished. No direct connection with under-planning C2 or C3 Road. Far from Iloilo city. Soft soil foundation at landing area.	
B	13.1km	4.8km	Direct connection with Iloilo C2 Road	Few household building to be demolished, No other public building Few mangrove	Direct connection with under-planning C2 road. No traffic pressure brought to Iloilo city. Facilitating city development. A litter far from city. Larger construction scale	Recommended

C	8.5km	2.7km	Direct connection with Iloilo C1 Road	Pylon to be removed. Affecting port expansion as it's close to power plant and international port. High risk with sink holes. Hard to demolish church, gas station and community. Large amount of mangrove	Direct connection with C1. Close to city; Facilitating city development; Shorter alignment; Smaller construction scale. Brings traffic to Iloilo city. Passing large area of mangrove; Close to power plant and international. High risk with sink holes; Hard to demolish church, gas station and community.	
D	Main: 17.4km Connection Road:3.1km	12.5 km	Connected to circumferential road and traversing road directly. Smooth traffic. Shorter sea-crossing islands distance	Few household building to be demolished, No other public building	Pros：Smooth connection with circumferential road. Smooth traffic flow.，Short sea-crossing distance. Cons：Longer alignment and large project scale than alignment E.	Recommended
E	16.1km	11.9km	Not connected to circumferential road directly	Few household building to be demolished, No other public building	Pros：Better alignment and smaller project scale. Cons：No direct connection with traversing road. 5km away from traversing road in the north. Long operating distance. Long detour distance crossing the island.	

2.3. Project Components and Project Size

Alignment B and alignment D consist of the following components.

Table 1: Major Components and Size of Alignment B

Project Component	Location/Area Jurisdiction	Length/Area
Major Components		
Segment3.1 *(Interchange)*	**Panay** *K0+000~K0+555*	0.555 km
Segment 3.2 *(Sea Cross Bridge)*	**Panay-Guimaras** *K0+555~k5+525*	4.970 km
Segment 3.3 *(link road)*	**Guimaras** *K5+525~K11+435*	5.910 km
Segment 3.4 *Interchange*	**Guimaras** *K11+435~K13+005*	1.57 km

Table 2: Major Components and Size of Alignment D

Project Component	Location/Area Jurisdiction	Length/Area
Major Components		
Segment3.5 *(Interchange)*	**Guimaras** *K0+000~K1+902*	1.902 km
Segment 3.6 *(Sea Cross Bridge)*	**Guimaras –Negros** *K1+902~k15+012*	13.110 km
Segment 3.7 *(link road)*	**Negros** *k15+012~K18+260*	3.248 km
Segment 3.8 *(Interchange)*	**Negros** *K18+260~K18+557*	0.297 km

2.3.1. Alignment B and Alignment D

The standard cross-section width of the bridge is 20.2 m. The cross section is composed of 0.5 m + 1.5 m (emergency parking lane) + 2 × 3.65 m (carriageway width) + 1.6 m (middle bandwidth) + 2 × 3.65 m (carriageway width) +1.5 m (emergency parking lane) + 0.5 m.

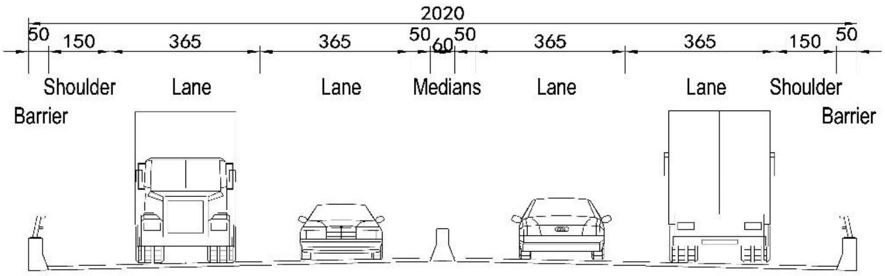


Figure 4: Typical Cross Section of the bridge

The bridge spans of the alignment B are as 58×30m + 15×100m + (360+680+360) m + 11×30m, which is shown in the following figure.

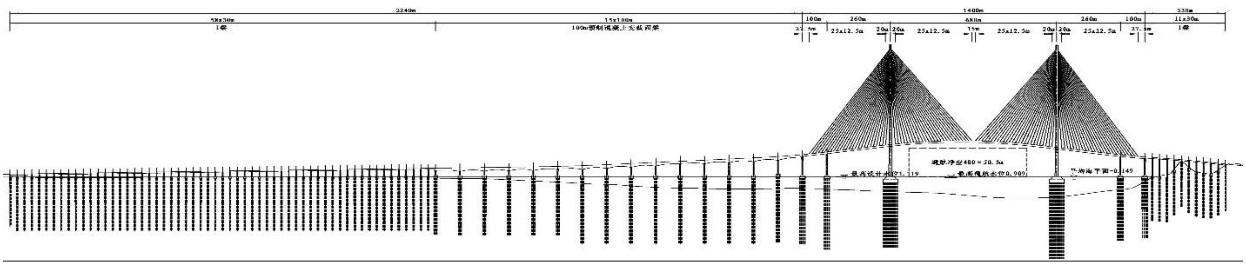


Figure 5: Sea Cross Bridge Profile (Alignment B)

Table 3: Major Components of Alignment B（*Sea Cross Bridge*）

Bridge scheme		**Iloilo side**		**The main bridge**	**Guimaras side**	
alignment		Shallow water	Deep Water		Deep Water	Shallow water
B	Superstructure	58×30m	15×100m	(360+680+360)m	-	11×30m
		Prefabricated grider	Concrete box girder	Twin-tower cable-stayed bridge		Prefabricated grider
	Foundation	Concrete pier	Concrete pier	Concrete pier	-	Concrete pier
		Pile foundation	Pile foundation	Pile foundation		Pile foundation

The bridge spans of the alignment D are as 20×30m + 66×100m + (360+680+360) m + 34×100m + 37×30m, which is shown in the following figure.

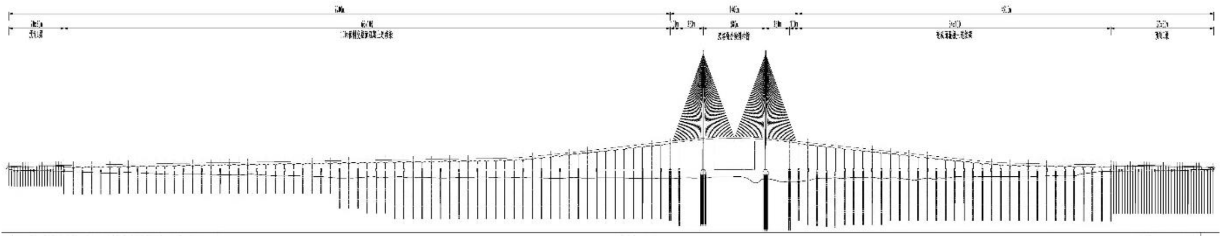


Figure 6: Sea Cross Bridge Profile (Alignment D)

Table 4: Major Components of Alignment D（*Sea Cross Bridge*）

Bridge scheme		**Iloilo side**		**The main bridge**	**Guimaras side**	
alignment		Shallow water	Deep Water		Deep Water	Shallow water
D	Superstructure	20×30m	66×100m	(360+680+360)m	34×100m	37×30m
		Prefabricated grider	Concrete box girder	Twin-tower cable-stayed bridge	Concrete box girder	Prefabricated grider
	Foundation	Concrete pier	Concrete pier	Concrete pier	Concrete pier	Concrete pier
		Pile foundation	Pile foundation	Pile foundation	Pile foundation	Pile foundation

2.3.2. Link Road

The typical cross-section of the link road of the project is as follows:

The width of the whole subgrade is 20.7 m, and the composition of cross section is 2×2×3.65 m, with middle bandwidth of 1.6 m (including 0.6 m width of the central median and 0.5 m width of the left curb belt), the width of hard shoulder is 2×1.5 m (including 0.5 m width of the right curb belt), and the width of the soil shoulder is 2×0.75 m.

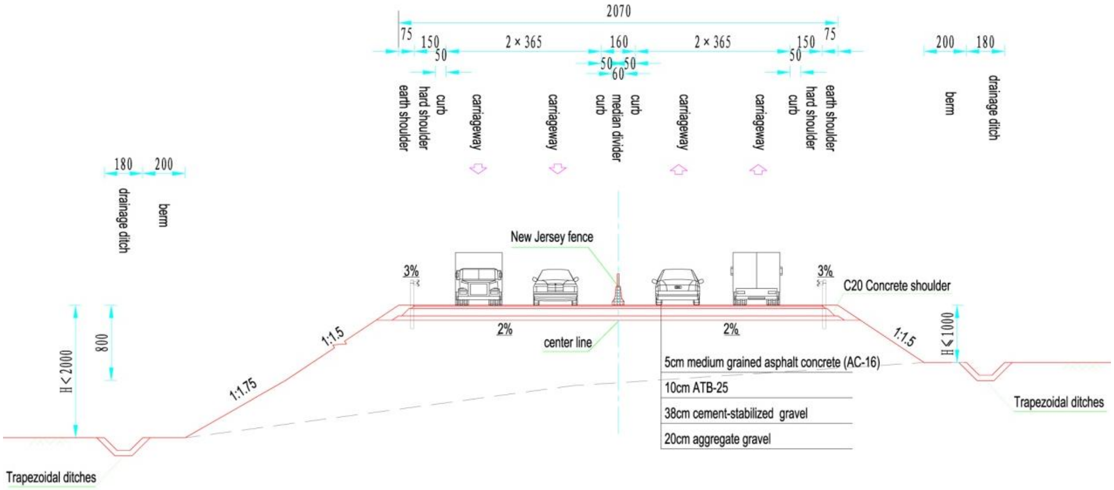


Figure 7: Typical Cross Section (link road)

2.3.3. Interchange

(1) Scheme of interchange of Alignment B starting point

In the interchange scheme of Alignment B starting point, the crossed road is COASTAL ROAD. Based on the main line and the longitudinal section of the crossed road as well as the forecast of turning traffic volume, diamond-shaped interchange is adopted, with an intersection between the ramp and the crossed road for channelization. The minimum radius of the ramp circle curve R = 400 m and the design speed is 40 km/h. According to the forecast of turning traffic volume, for one-way single-lane ramp and one-way two-lane ramp, the subgrade width are 9.0 m and 10.5 m respectively, the acceleration lane is in parallel and the deceleration lane is direct.

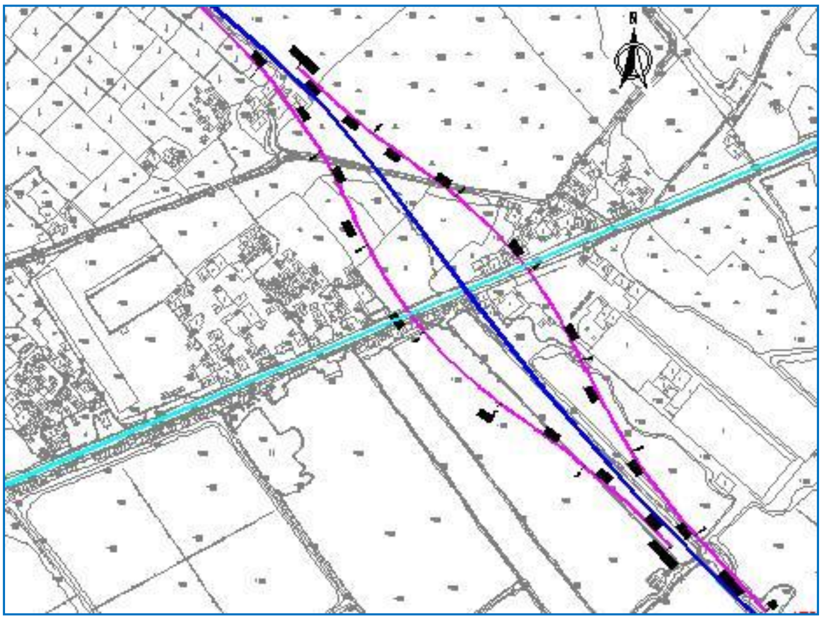


Figure 8: Alignment B Starting Point Interchange Scheme

(2) Interchange scheme of Alignment B end point

In the interchange scheme of Alignment B end point, the crossed road is GUIMARAS CIRCUMFERENTIAL ROAD. Based on the main line and the longitudinal section of the crossed road as well as the forecast of turning traffic volume, the rhombus interchange is adopted, with an intersection between the ramp and the crossed road for channelization. The minimum radius of the ramp circle curve R = 400 m and the design speed is 40 km/h. According to the forecasted turning traffic volume, one-way single-way ramp and one-way two-lane ramp are adopted with the subgrade width of 9.0 m and 10.5 m, the acceleration lane is in parallel and the deceleration lane is direct.

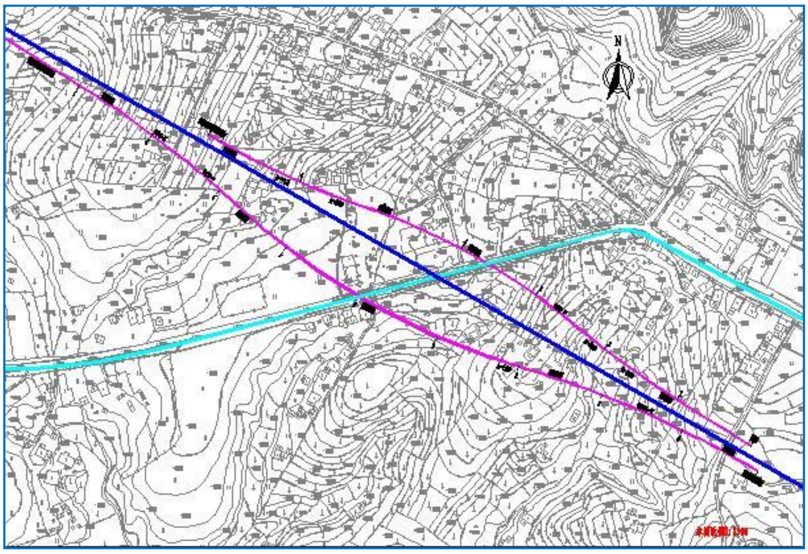


Figure 9: Alignment B End Point Interchange Scheme

(3) Interchange scheme at Alignment D starting point

In the interchange scheme for Alignment D starting point, the crossed road is GUIMARAS CIRCUMFERENTIAL ROAD. Based on the main line and the longitudinal section of the crossed roads as well as the forecast of turning traffic volume, partial clover leave interchange is adopted, with an intersection between the ramp and the crossed roads for channelization. The minimum radius of circle curve for the ramp is R = 60 m and the design speed is 40 km/ h. According to the forecasted turning traffic volume, one-way single-lane ramp is adopted, and the width of subgrade is 9.0 m. The subgrade width of two-way ramp is 16.5 m. the acceleration lane is in parallel and the deceleration lane is direct.

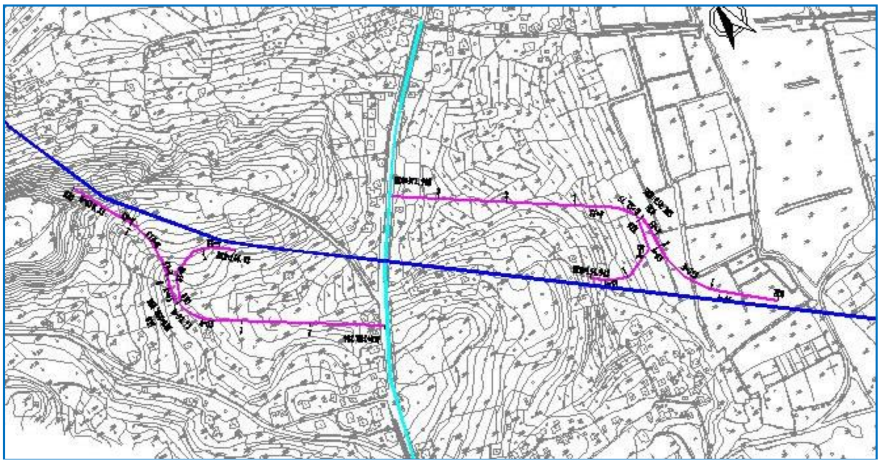


Figure 10: Interchange Scheme of Alignment D Starting Point

(4) Interchange scheme of Alignment D end point

In the interchange scheme of Alignment D end point, the crossed road is NATIONAL ROAD. Based on the mainline and the longitudinal section of crossed roads as well as the forecasted turning traffic volume, T-type interchange is adopted, the minimum radius R = 80 m of the ramp circle curve is designed at a speed of 40km/h. According to the prediction of turning traffic volume, one-way single-lane and one-way two-lane ramps are adopted with the subgrade width of 9.0 m and 10.5 m respectively. The acceleration lane is in parallel and the deceleration lane is direct.

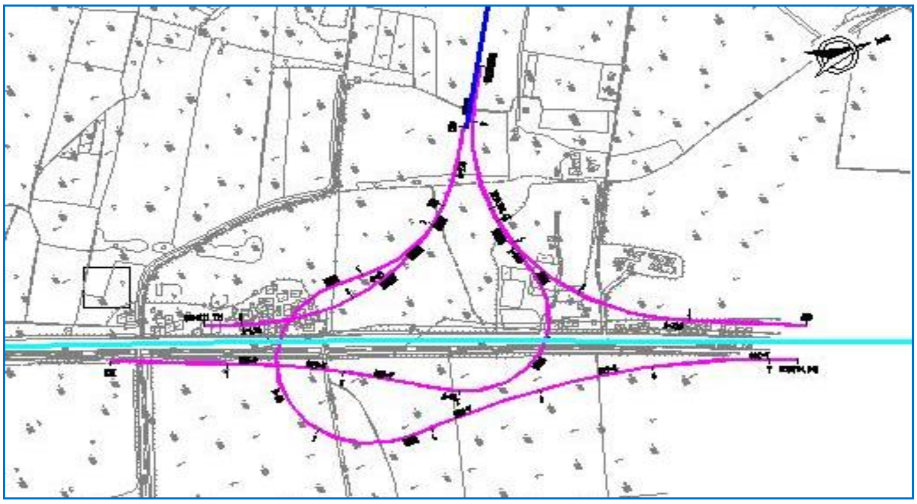


Figure 11: Interchange Scheme of Alignment D End Point

2.4. Project Process/technology (including toxic chemicals that will be used or produced and maybe released to the environment)

Pre-Construction

Determination at designed speed at present, for the highway connected with the two-sections cross-sea bridge in this project, the traffic conditions are general, and the highest driving speed on most sections is 60 km/h, being able to reach 80 km/h for several sections, therefore, the difference between the design speed of this project and the speed of connecting roads on two sides cannot be too great.

At the same time, there is hilly landform in the places where the route passes through Guimaras Island, and the terrain on some sections is more undulating, and the lands in the corridor belt of the bridge channel are private domains mostly, with more residential areas distributed. To minimize scale of removal is the main idea for route layout on this section. Too high plane indexes will result in greater quantities of removal, and increasing the implementation difficulty of this project on later stage.

Therefore, in combination with the existing topographic conditions, geological survey data and the traffic conditions and speed of the existing adjacent roads, it is suggested that the design speed of this project is adopted with 80 km/ h.

The main technical standards of this project are as follows.

(1) Road grade: first-class highway;

(2) Design service life:100 years;

(3) Design driving speed: 80 km/ h;

(4) Standard bridge width: 23.2 m, See Figure 3.5-2 for specific road width division;

(5) Bridge design load: highway- Class I.

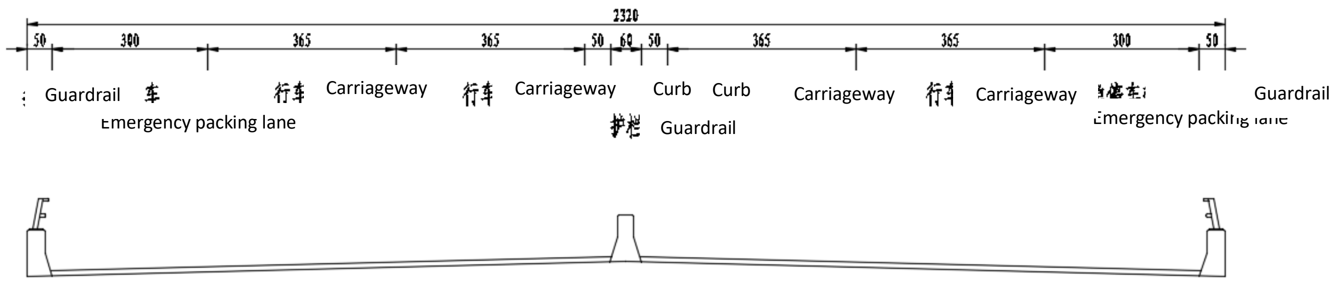


Figure 12. Standard Cross Section of Bridge

Project Resource Utilization

In the wiring section of the two sea-crossing bridges, a large amount of roadbed filling is required. At present, the filling and excavation parts of each island are required to utilize the local gravel soil for resource utilization.

Water and electricity for construction need to be connected to local municipal pipelines and contact with local production and life.

2.5. Project Location

The Panay (Metro Iloilo) - Guimaras – Negros Island Bridges (PGN) Project is located in Region Ⅵ in the Philippines. It will connect Panay Island, Guimaras Island and Negros Island with bridge A and bridge B. Bridge A connects Panay Island and Guimaras Island, and bridge B connects Guimaras Island and Negros Island. Refer to map. Table 1 presents the locations of the PGN project.

Table 5: Locations traversing the PGN Project

List of Municipalities affected by the PGN Project
Leganes, Iloilo
Municipality of Leganes
Barangay Gua-an
Buenavista, Guimaras
Municipality of Buenavista
Barangay Cansilayan
Barangay Banban
Barangay Navalas
Barangay San Miguel
Barangay Getulio
Barangay Dagsa-an
Barangay Salvacion

San Lorenzo, Guimaras
Municipality of San Lorenzo
Barangay M. Chavez
Pulupandan, Negros Island
Municipality of Pulupandan
Barangay Tapong
Barangay Canjusan
Barangay Pag Ayon
Barangay Zone 4A
Barangay Ubay

2.6. Proposed EIA Study Area

Figure 13(a) Monitor Sampling station along P-G Bridge

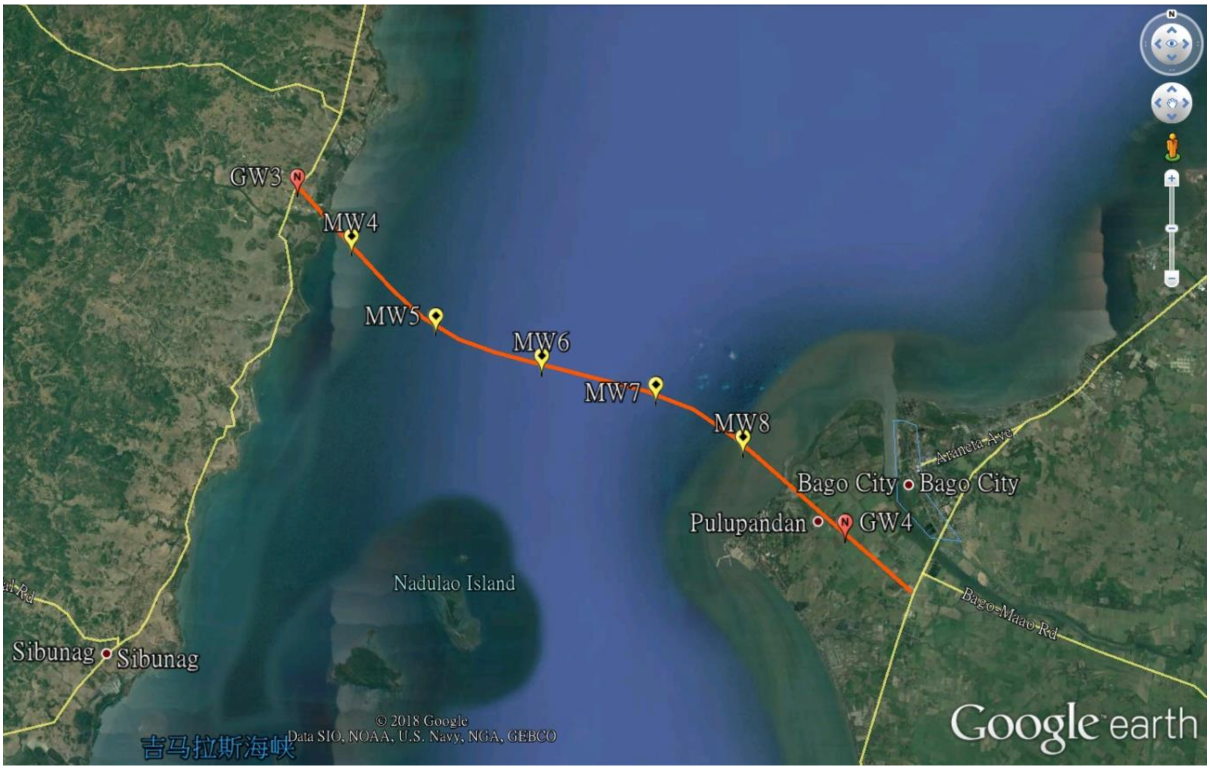


Figure 13 (b) Monitor Sampling station along G-N Bridge

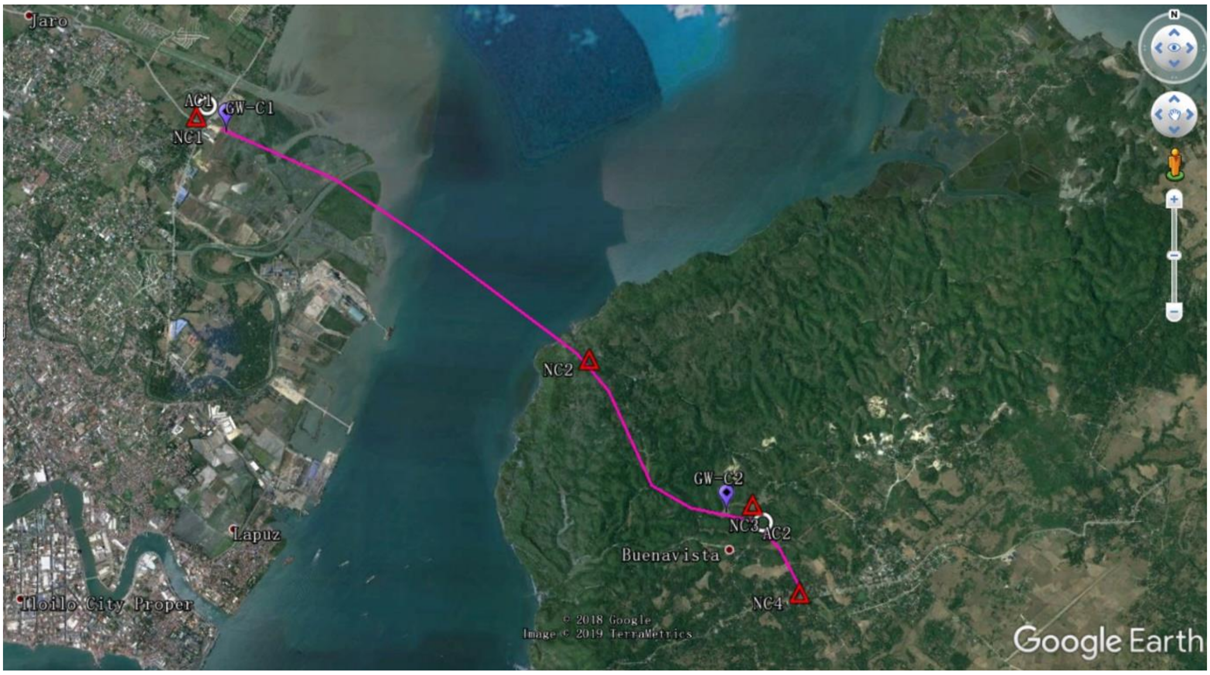


Figure 13 (c) Monitor Sampling station along P-G Bridge Line C

Figure 14 (d) Air and Noise Sampling station along P-G-N Bridge

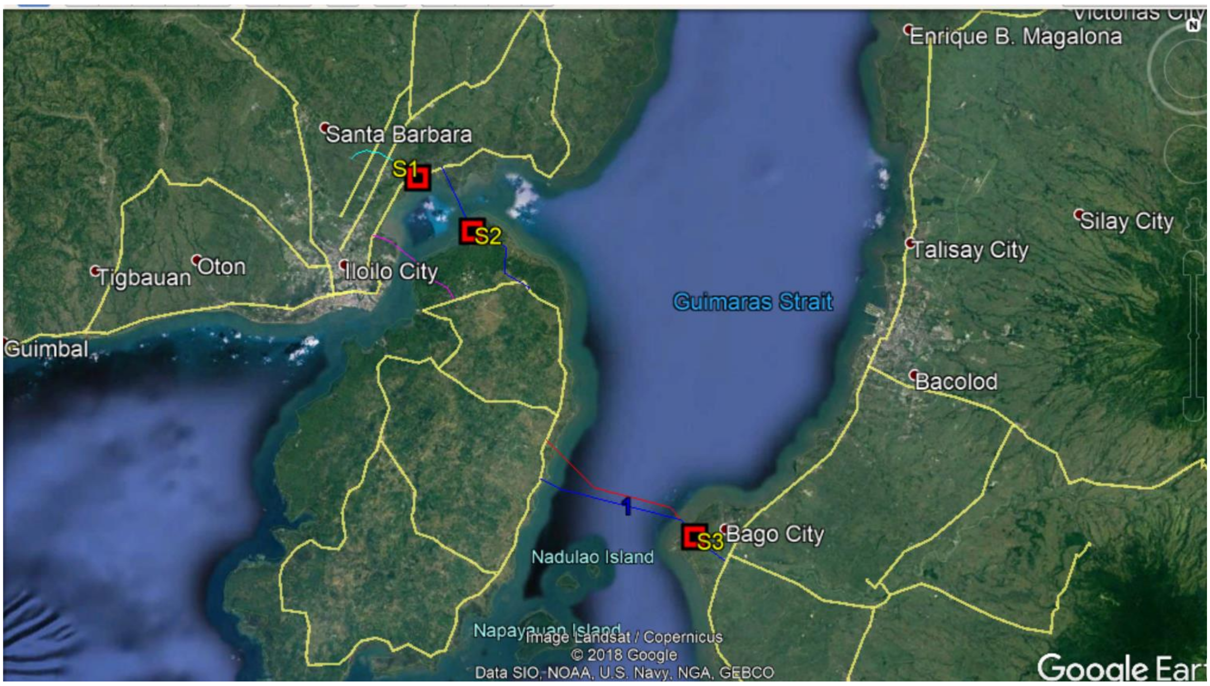


Figure 14 (e) Soil Sampling station along P-G-N Bridge

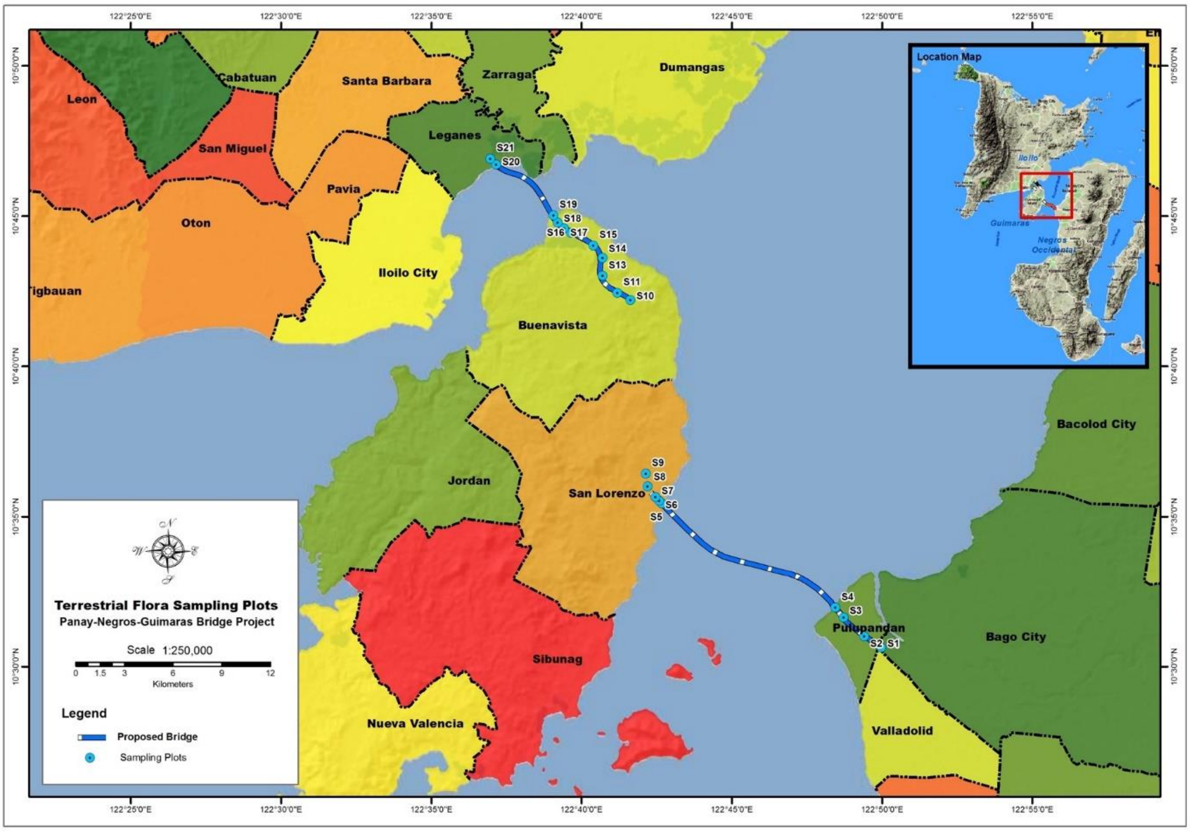


Figure 14 (f) Terrestrial Flora and Fauna Sampling station along P-G-N Bridge

Considering Alignment C is close Iloilo city, it will facilitate city development and transportation. However, once Alignment C brings traffic into Iloilo city, there'll be traffic congestion. In addition, Alignment C goes through mangroves near Iloilo. Then it's near to Iloilo international port and 900m from power plant, which will affect the port's future expansion. Also, it passes area with sink holes that can cause great risk in the project. At last, there are pylon, church, gas station and community at the end of Alignment C, which means resettlement work is difficult and huge.

Photographs:

Church at the end of Alignment C

Gas station at the end of alignment C

Alignment A is the yellow one. Its starting point connects somewhere in the middle of coastal road, C2 Road and C3 Road, with 2km distance from C2 road. After passing large area of fish ponds, alignment A crosses over the strait. Once landing on Guimaras Island, it goes along the northeast side of the island 'til it connects Guimaras Circumferential Road. Total length of Alignment A is 12.5km.

Large area of fish pond in Alignment A (mollisol)

4 -lanes road at starting point in Alignment A

Alignment B is the red one. Its starting point connects the intersection of coastal road and under-planning C2 Road. After extending into southeast, Alignment B shares the same bridge site with Alignment A. It also has the same alignment with alignment A after it lands on Guimaras Island. Total length of Alignment B is 13.1km. This alignment connects the under-planning C2 road. And it won't bring traffic pressure to Iloilo city, which means it will facilitate city's future development. However, it's far away from Iloilo city; compared to Alignment A, the total length is more and bridge scale is larger.

Salt Farm in Alignment B

2.7. Project Proponent

Proponent: Department of Public Works and Highways

Proponent Address: Bonifacio Drive, Port Area, Manila

Consultant: People's Republic of China Government through CCC Highways Consultants Co. Ltd

2.8. Projected Timeframe of the Project Phases

Expected:
Construction of the Bridge Foundation began in 2022
Construction of Superstructure and Road Pavement began in 2025
Construction of ancillary facilities began in 2027
Open in 2028

2.9. Preliminary Identified Environmental Aspects for each alternative

Predicted Impact	Degree of the significance	Duration, Extent and Magnitude of Impact
PRE-CONSTRUCTION PHASE		
Loss and Damage to property	NOT RELEVANT	NOT RELEVANT
Loss of trees and vegetative cover	MODERATE	IRREVERSIBLE SHORT TERM
Change in land use as a consequence of development	LOW	LOW
CONSTRUCTION PHASE		
LAND		

Predicted Impact	Degree of the significance	Duration, Extent and Magnitude of Impact
Soil contamination	MODERATE	IRREVERSIBLE, SHORT TERM
Generation of Spoils and Construction Waste Disposal	HIGH	SHORT TERM
Impair local aesthetic or scenic resources	LOW	REVERSIBLE SHORT TERM
GEOHAZARD		
Damage of structures due to liquefaction	LOW	SHORT TERM
Flooding	Low	SHORT TERM
Tsunami	Low	SHORT TERM
WATER		
Increase in siltation rates along surface and marine waters	LOW	SHORT TERM
Damage to Marine Flora	LOW	IRREVERSIBLE, SHORT TERM
Displacement of Marine Fauna	LOW	SHORT TERM
Contamination of ground water	LOW	SHORT TERM
Decrease ground water flow	LOW	SHORT TERM
Occurrence of flooding	MODERATE	SHORT TERM
Contamination on nearby bodies of water	LOW	SHORT TERM
AIR/NOISE		
Increase in particulate matter (dust) and levels of gaseous emission	HIGH	REVERSIBLE SHORT TERM
Increase in noise and vibration levels	HIGH	REVERSIBLE SHORT TERM
Global warming	LOW	SHORT TERM
PEOPLE		
Traffic Congestion	HIGH	SHORT TERM
Interruption of service utilities (water, power)	MODERATE	SHORT TERM

Predicted Impact	Degree of the significance	Duration, Extent and Magnitude of Impact
Incidence of construction-related accidents	HIGH	SHORT TERM
Loss of historical structure	NOT RELEVANT	NOT RELEVANT
Pose human health and safety hazards	MEDIUM	SHORT TERM
Generation of employment/ local hired labor	BENEFICIAL	LONG TERM
Enhanced economic activity	BENEFICIAL	LONG TERM

3. Results of Public Scoping

Public Scoping/consultation meetings were conducted with stakeholders at the four (4) affected Municipalities: Municipality of Pulupandan in Negros Occidental, Municipality of Buenavista and San Lorenzo in Guimaras and Municipality of Leganes in Iloilo. The stakeholders are composed of LGU Officials, barangay councils, community leaders and representative from People's Organization and Government Agencies.

Before the start of the consultation meeting, emcee/moderator of the meeting, Ms. Ma.Carmela Capule, asked the attendees what is their preferred language/dialect to be used for the meeting. The attendees agreed that they preferred Bisaya, Tagalog and English.

The proponent and consultant presented the details of the project, the possible negative and positive impacts to their community and the next activities of the Proponent needed for the application of Environmental Compliance Certificate (ECC). After the presentation, there are questions and clarifications from the stakeholders about the project. Issues and concerns were also raised.

The schedules of activities are as follows:

Table 4. Schedules of Activities

Direct Impact Area	Date and Time	Venue	Invited Stakeholders	Stakeholders Group Attended	No. of Attendees by Sex
Municipality of Pulupandan, Negros Occidental: 1. Brgy. Pag-Ayon 2. Brgy. Zone 4A 3. Brgy. Canjusa 4. Brgy. Tapong 5. Brgy. Ubay	August 27, 2019, 9:00AM-12:00PM	Brgy. Pag-Ayon Evacuation Center, Brgy. Pag-Ayon, Pulupandan, Negros Occidental	• Local Government Officials of Pulupandan • Key Officials of Barangays affected of the project (Brgy. Pag-Ayon, Brgy. Zone 4A, Brgy. Canjusa, Brgy. Tapong, Brgy. Ubay) • Women's Associations • Philippine Port Authority • DENR R7	• Local Government Officials of Pulupandan • Key Officials of Barangays affected of the project (Brgy. Pag-Ayon, Brgy. Zone 4A, Brgy. Canjusa, Brgy. Tapong, Brgy. Ubay) • Women's Associations • Philippine Port Authority	59 (Total) 25 (Male) 34 (Female)

Municipality of Buenavista, Guimaras: 1. Brgy. Banban 2. Brgy. Cansilayan 3. Brgy. Navalas 4. Brgy. Getulio 5. Brgy. San Miguel 6. Brgy. Salvacion 7. Brgy. Dagsaan 8. Brgy. Zaldivar	August 28, 2019, 9:00AM-12:00PM	Business Development Cooperative Bldg., Buenavista, Guimaras	• Local Government Officials of Municipality of Buenavista • Key Officials of Barangays affected of the project (Brgy. Banban, Brgy. Cansilayan, Brgy. Navalas, Brgy. Getulio, Brgy. Salvacion, Brgy. Dagsaan, Brgy. Zaldivar) • Buenavista Womens Association • Philippine Coast Guard • Office of the Provincial Governor of Guimaras, • Municipal Agri-Fisheries Council • Getulio Farmers Association • Katilingban sang mga Mangungum a sa Banban • Navalas Farmers Association	• Local Government Officials of Municipality of Buenavista • Key Officials of Barangays affected of the project (Brgy. Banban, Brgy. Cansilayan, Brgy. Navalas, Brgy. Getulio, Brgy. Salvacion, Brgy. Dagsaan) • Integrated Women's Alliance Group • Philippine Coast Guard • Office of the Provincial Governor of Guimaras, • Municipal Agri-Fisheries Council	30 (Total) 20 (Male) 10 (Female)
Municipality of San Lorenzo: 1. Brgy. M. Chavez	August 28, 2019,	Municipal Hall, San Lorenzo, Guimaras	• Local Government Officials of	• Local Government Officials of	22 (Total) 13 (Male)

	2:00PM-5:00PM		Municipality of San Lorenzo • Key Officials of Barangays Brgy. M. Chavez, Brgy. Cabanon • Philippine Coast Guard • Bureau of Fire and Protection • Kristianong Katilingban sang Kababaihan San Lorenzo • San Lorenzo Goat Raisers Association	Municipality of San Lorenzo • Key Officials of Barangays Brgy. M. Chavez, Brgy. Cabanon • Philippine Coast Guard • Bureau of Fire and Protection	9 (Female)
Municipality of Leganes: 1. Brgy. Gua-an 2. Brgy. Navitasan	August 29, 2019, 2:00PM-5:00PM	Youth Development Center, Municipality of Leganes, Guimaras	• Local Government Officials of Municipality of Leganes • Key Officials of Barangays Brgy. Gua-an, Brgy. Navitasan • Philippine Coast Guard • Farmers Association • Senior Citizen Association • Civic Organization • Zoological Society of London-Philippines • Leganes Premier Land Consulting	• Local Government Officials of Municipality of Leganes • Key Officials of Barangays Brgy. Gua-an, Brgy. Navitasan • Philippine Coast Guard • Farmers Association • Senior Citizen Association • Civic Organization • Zoological Society of London-Philippines • Leganes Premier Land Consulting	41 (Total) 30 (Male) 11 (Female)

			• Trans Asid Shipping Lines • Philippine Chamber of Commerce • Maritime Industry Authority (Marina) • FF Cruz Shipping Corp • Leganes Pantawid Association		

4. Issues and Concerns of the Stakeholder during the Public Scoping Meeting

The conduct of Public Scoping is a good avenue to present and inform the stakeholders about the details of the proposed project as well as express the people's perception towards the project. Majority of the stakeholders are concerned about affected structures, land, trees, mangrove, marine ecology, dust during delivery of construction materials, traffic congestion during construction, and inclusion of bike and motorcycle lane in the design.

The public scoping was very informative. The pressing issues and concerns were also raised by the stakeholders. The proponent, barangays and people in the community should closely coordinate among others to resolve issues and problems on the implementation of the project. According to the attendees, they don't oppose the project and recognized its importance to development but if possible, they are requesting for the doable solution or plan of action about their raised concerns.

Municipality of Pulupandan, Negros Occidental

Environmental Component Likely to be Affected	EIA Module	Issues/Suggestions raised by the Stakeholders	Sector or Representative who raised the issues/suggestions	Proponents Responses
Land	Terrestrial Flora (Mangrove)	How about the mangroves that may possibly affected by the project?	Mr. Jimwell Canedo, Brgy. Pag-Ayon	**Ms. Carmela Capule, Consultant, KRC** The areas with mangroves affected by the projects were included in the study. We will assess the present condition of the mangroves. DENR have a guideline regarding the affected mangroves. We will check the present species of mangroves in the area. DENR will have the final say on the approval of the ECC.
Water	Water Resources	It is possibility that our source of water be affected during the construction?	Ms. Mila Lourdes Tandoy, Municipal Sanitary Inspector	**Ms. Carmela Capule, Consultant, KRC** If the source of water is coming from the shallow well, it will be affected. As well as the pipe lines. The contractor must be responsible in keeping the source of water safe and clean. We will recommend to the people in the community to closely monitor during the construction to mitigate the loss of the water. For the disposal, we will include in our recommendation that the

Environmental Component Likely to be Affected	EIA Module	Issues/Suggestions raised by the Stakeholders	Sector or Representative who raised the issues/suggestions	Proponents Responses
				contractor need to have a proper disposal of waste during and after the construction.
People	Institutional	What is the role of the LGU in the project?	Barangay Captain Marina Amacio of Brgy. Pag-Ayon	**Ms. Carmela Capule, Consultant, KRC** The role of the LGU in this project is very significant. The contractor shall have close coordination with the LGU and the affected people before and during the construction of the project. We will include in the study the social development project but it depends to the DPWH if this will included on their plan.
People	Delivery of Materials	How is the process during the construction with regards to the delivery of the construction materials? we see that it will affect some other areas with respect to air safety conditions? They consider the other route or alternative road for the delivery vehicle for the materials to create less traffic and disturbance in the community? We hope that we will not be affected by the construction.	Ms. Josenel Joy Salinas, Municipal Social Welfare Officer	**Mr. Ricardo Capule, Consultant, KRC** As far as we know same road will be used during the delivery of the construction materials. The possible effect are the dust and noise pollution during construction. We have appropriate mitigating measures such as provision of water sprinkling to minimized dust, all heavy equipment, trucks etc. It must be properly maintained to prevent generation of air pollution.

Environmental Component Likely to be Affected	EIA Module	Issues/Suggestions raised by the Stakeholders	Sector or Representative who raised the issues/suggestions	Proponents Responses
				In terms of noise, all equipment must be provided with muffler to lower the noise level generated during operation. Proper timing of activity will be undertaken. We will include in our study that the people in the community will not disturb during the construction. **Ms. Josenel Joy Salinas, Municipal Social Welfare Officer** With regards to the route or alternative road, do you have a suggestion? We can provide suggestion on the alternative route of the road during the delivery of the construction materials at Singko Onse.
People	Project Affected	What will happen to the affected structures, houses, land and trees when it traversed by the alignment?	Ms. Virginia Cordeno, Brgy. Kgwd. Brgy. Zone 4A	**Ms. Carmela Capule, Consultant, KRC** The affected property or land will be compensated by DPWH with fair market value. DPWH and assessor's office will validate on

Environmental Component Likely to be Affected	EIA Module	Issues/Suggestions raised by the Stakeholders	Sector or Representative who raised the issues/suggestions	Proponents Responses
				the submitted report. The Resettlement Action Plan team will be responsible in making an inventory of all affected concerns such as crops and houses. Every property affected by the project shall be appropriately compensated. DPWH will pay the trees based on their guidelines. It depends on the size, and height of the trees.
People	Livelihood	We hope that during construction the livelihood of our fisherman will not affected. Fishing is the main livelihood in our area. That area is clearly affected by the project alignment. What will happen to the fishes once road construction takes place? Do you have any security measures with respect to this concern?	Ms. Mary Jane Odelmo, Brgy. Kgwd. Brgy. Tapong	**Mr. Ricardo Capule, Consultant, KRC** Before the construction the contractor will inform the community for their plan for the construction period. The contractor will put up the safety measure to mitigate accidents during the construction and the residents cannot enter to the project site to prevent accidents. The safety officers are responsible to ensure even the safety of the immediate residents and their crops. The DPWH, as the project proponent should coordinate with the contractors with regards to safety provisions. As residents, you have also to be vigilant about the

Environmental Component Likely to be Affected	EIA Module	Issues/Suggestions raised by the Stakeholders	Sector or Representative who raised the issues/suggestions	Proponents Responses
				activities during the road construction. We expect a disturbance to the fishermen's during the construction. On the other hand, this project is very helpful for the development in the community particularly accessibility.
		Is there a chance of having a job opportunity once project implementation takes place?	Barangay Captain Marina Amacio of Brgy. Pag-Ayon	**Ms. Carmela Capule, Consultant, KRC** Absolutely yes! Numerous incomes generating jobs will rise.
Others	Project Details	How many lanes is the bridge?	Mr. Eduardo Moreno, Brgy. Kgwd. Brgy. Pag-Ayon	**Mr. Ricardo Capule, Consultant, KRC** For now, there will be only 2 lanes with emergency bay. **Engr. Ligaya Maravilla, Municipal Engineer** This is the not final number of lanes. This is included in the study and subject for approval by the DPWH. As of now this is a proposed or under feasibility study. There are proposed alternatives and best alignment. We conducted this consultation meeting to

Environmental Component Likely to be Affected	EIA Module	Issues/Suggestions raised by the Stakeholders	Sector or Representative who raised the issues/suggestions	Proponents Responses
				discuss or confirm you if you are favor on the said project and what are your concerns on the environment
		Where is the alignment of the bridge project from Panay-Guimaras?	Mr. Eduardo Moreno, Brgy. Kgwd. Brgy. Pag-Ayon	**Mr. Ricardo Capule, Consultant, KRC** Presented the alignment to the attendees and he states that the alignment on the concerned area is located at the right side of elementary school of Pag-Ayon.
		When is the target or timeline of the project? Also, can we suggest to include the bike lane?	Barangay Captain Marina Amacio of Brgy. Pag-Ayon	**Ms. Carmela Capule, Consultant, KRC** Year 2022 is the proposed implementation of the construction of the project or after the approved detailed engineering design. Six years is the timeline for the construction of the project. 2028 is the target to operate the bridge. We will take note your suggestion for inclusion of bike lane in the design.
Others	ECC	Who will apply for the ECC?	Mr. Jimwell Canedo, Brgy. Pag-Ayon	**Ms. Carmela Capule, Consultant, KRC** DPWH or the proponent is one responsible for the applying the

Environmental Component Likely to be Affected	EIA Module	Issues/Suggestions raised by the Stakeholders	Sector or Representative who raised the issues/suggestions	Proponents Responses
				ECC to DENR-EMB. We as consultant are helping them for the process through this EIA study and we will provide them the results of the study.
Others	Expression of Support	We are thankful to government because they give as a chance to have this project here in our community. We say "Yes" and gave a "thumbs up" for this project. Because of this project, there are lots of possibility on the promotions of tourist spots here in Pulupandan. We are hoping that this project will be implemented. Let us support this project. LGU will always support on projects that will provide welfare to the people in Pulupandan.	Ms. Yryne Valenzuela, P.I.O/Executive Assistant	
		We don't have any problem with the proposed project. I am full support and no objections to the proposed bridge project. We hope that the project will be fast track. The proposed alignment is less people and structures affected. In behalf of Brgy. Pag-ayon community, we are very full support!	Barangay Captain Marina Amacio of Brgy. Pag-Ayon	

Municipality of Buenavista, Guimaras

Environmental Component Likely to be Affected	EIA Module	Issues/Suggestions raised by the Stakeholders	Sector or Representative who raised the issues/suggestions	Proponents Responses
Land	Terrestrial Flora and Fauna	Did you consider the trees in the study? Because in the affected areas they have a lot of trees, crops and kalamansi	Ms. Girlie Magilo, Municipal Agri-Fisheries Council	**Ms. Carmela Capule, Consultant, KRC** Yes, trees were included in the study. It will be included in the Resettlement Action Plan (RAP). RAP will conduct 100% assessment to all affected properties such as structures, trees and land after the final or approved alignment provided by the DPWH. It will be paid by DPWH with fair market value. We have a guidelines that before the cutting of the trees we need to request a permit to DENR. DPWH will compensate the trees based on their guidelines. It depends on the size, and height of the trees. This meeting is the avenue for us to know and disseminate regarding the project.

Environmental Component Likely to be Affected	EIA Module	Issues/Suggestions raised by the Stakeholders	Sector or Representative who raised the issues/suggestions	Proponents Responses
People	Project Affected	What will happen to the affected land properties to be traversed by the alignment?	Mr. Eliodoro Millama, Brgy. Kgwd. Brgy. Cansilayan	**Ms. Carmela Capule, Consultant, KRC** The affected property or land will be compensated by DPWH with fair market value. DPWH and assessor's office will validate on the submitted report. Resettlement Action Plan Team will assess all properties of the affected people. DPWH have guidelines for the compensation.
People	Livelihood (Fisherfolk)	As per experience the construction of the wind turbines greatly affected our crops. Have you also considered the displacement of our fisher folks and natural resources once construction takes place?	Ms. Girlie Magilo, Municipal Agri-Fisheries Council	**Mr. Ricardo Capule, Consultant, KRC** We have a mitigating measure on the livelihood of the fishermen that may be affected. Prior to construction, the contractor will place barrier to prevent the sediments from scattering out to the protected area. In case the contractors fail to follow those measures, we can ask help from DENR and have thorough investigation.

Environmental Component Likely to be Affected	EIA Module	Issues/Suggestions raised by the Stakeholders	Sector or Representative who raised the issues/suggestions	Proponents Responses
				Ms. Carmela Capule, Consultant, KRC In our study we included the marine or the impact of biodiversity. It is included in our Environmental Impact Assessment study all the marine ecology: the flora and fauna and the present condition of marine life. We have already conducted the study and we will have it presented by next meeting. Those affected fisher folks will be taken into consideration by the contractors in making mitigating measures. We will emphasize to the project proponents to provide mitigating measures to be followed by the contractors and must be observed during implementation. EMB have continuous monitoring on environmental aspect. The contactor need to follow the protocol

Environmental Component Likely to be Affected	EIA Module	Issues/Suggestions raised by the Stakeholders	Sector or Representative who raised the issues/suggestions	Proponents Responses
People	Livelihood (Mango Plantation)	As per concern from Central Office, since Guimaras is known for its abundant production of mango fruits, how can you protect the mango industry of the area from outside mango traders once the road project is realized?	Mr. Ricardo Capule, Consultant, KRC	**Ms. Girlie Magilo, Municipal Agri-Fisheries Council** We have a quarantine area before to enter in our island. We have a check point. It is already a national law that mango fruits of outside traders are prohibited from entering the island. We will assure that we will take it into strict implementation when it comes to happen. **Mayor Eugenio Reyes, Municipal Mayor of Buenavista** We consider to put up an inspection in the project area to monitor the entering of goods to prevent outside traders from entering the island.
Others	Project Design	This concern is more on engineering and technical design of the proposed bridge, have you included in your design the lanes to which people could pass though by	Mayor Eugenio Reyes, Municipal Mayor of Buenavista	**Mr. Ricardo Capule, Consultant, KRC** We will inform to the proponent the final design of the bridge and we will inform

Environmental Component Likely to be Affected	EIA Module	Issues/Suggestions raised by the Stakeholders	Sector or Representative who raised the issues/suggestions	Proponents Responses
		walking or using bicycles or motorcycles?		them your suggestions for possible inclusion of bike lane and motorcycle lane in their design.
Others	Expression of Support	We are very thankful for the government for the project in our municipality. It will give us economic development and it also attract tourists and investors in or community. This project is very helpful to us because most of the passengers stranded every time have a typhoon and we cannot cross the sea due to no other means of transportations. Also, if this project realizes, we hope that the next project is Airport in our municipality. We are requesting to the proponent for the close coordination to the LGU before and during the construction of the project for their information and mostly for the displacement of the affected people of the project. Right now the LGU still updating their CLUP.	Mayor Eugenio Reyes, Municipal Mayor of Buenavista	

Municipality of San Lorenzo, Guimaras

Environmental Component Likely to be Affected	EIA Module	Issues/Suggestions raised by the Stakeholders	Sector or Representative who raised the issues/suggestions	Proponents Responses
Land	Mangroves	What about the mangroves and timberland?	Ms. Catherine Ann Gawara, Municipal Planning and Development Coordinator (MPDC)	**Ms. Carmela Capule, Consultant, KRC** The areas with mangroves affected by the projects were included in the study. We will assess the present condition of the mangroves. DENR have a guidelines regarding the affected mangroves of the project. We check the present species of mangroves in the area. DENR will be the final say for the approval of the ECC.
People	Project Affected	How about the affected houses by the project? Also, I think we should have a meeting to all affected people.	Ms. Chona Tabiano, Brgy. Kgwd. Brgy. M. Chavez	**Mr. Ricardo Capule, Consultant, KRC** Based on the DPWH guidelines. The affected property, structures and land will be paid by DPWH with fair market value. DPWH and assessor's office will validate on the submitted report. **Ms. Carmela Capule, Consultant, KRC** We have another study team for the assessment of all affected properties this is the team of RAP. Resettlement Action Plan (RAP)

Environmental Component Likely to be Affected	EIA Module	Issues/Suggestions raised by the Stakeholders	Sector or Representative who raised the issues/suggestions	Proponents Responses
				Team will assess all properties of the affected people after the final approval of the alignment. She mentioned that DPWH have a guidelines for the compensation. This public scoping meeting is the avenue for us to know and disseminate regarding the project. We have a separate meeting for the RAP team they will present the results of their assessment. DPWH will pay the acquisition of all affected structures after the conduct of RAP. All affected will be compensated as long as included in the inventory or during cut offs.
		I and Kgwd. Chona Tabiano are one of the affected by the project. I have a 2 house and 1 house for kgwd. Chona. We are requesting for the consideration to re-route the alignment of the propose alignment.	Mr. Rafael Tabiano, Brgy. Kgwd. Brgy. M. Chavez	**Ms. Carmela Capule, Consultant, KRC** DPWH have a guidelines for compensation for the affected people. 2021 is the propose schedule for the settlement to the affected residents in the project. The LGU or the affected barangay will provide or submit the certificate for no objection of the project. **Engr. Claudio Cabrias, DPWH-Region VI**

Environmental Component Likely to be Affected	EIA Module	Issues/Suggestions raised by the Stakeholders	Sector or Representative who raised the issues/suggestions	Proponents Responses
				The one consideration of the recommended alignment is based on the distance of the windmill and safety of the people.
		The recommended alignment traverses some buildings like barangay hall, day care and houses. Can we recommend another alignment in the avoidance of those affected buildings?	Mr. Rafael Tabiano, Brgy. Kgwd. Brgy. M. Chavez	**Mr. Ricardo Capule, Consultant, KRC** We will take that into considerations. **Engr. Claudio Cabrias, DPWH-Region VI** Prior to the selection of the most recommended road alignment, we have also considered those wind turbines constructed in certain areas.
		How about the relocation of the affected people? LGU have no fund or budget for their relocation or resettlement.	Ms. Catherine Ann Gawara, Municipal Planning and Development Coordinator (MPDC)	**Ms. Carmela Capule, Consultant, KRC** We will raise this issue to the proponent if they can provide.
People	Public Consultation	The recommended alignment will traverse a fishpond area. There should be a public hearing to be conducted in the affected barangay.	Ms. Catherine Ann Gawara, Municipal Planning and Development Coordinator (MPDC)	**Ms. Carmela Capule, Consultant, KRC** There will be another study once the alignment is final, that is the Land Acquisition and Resettlement Action

Environmental Component Likely to be Affected	EIA Module	Issues/Suggestions raised by the Stakeholders	Sector or Representative who raised the issues/suggestions	Proponents Responses
				Plan. This is actually a detailed study to evaluate and account all the properties affected by the road alignment. There will be public hearing. It is important for us to know all your concerns regarding the environmental impact of the project.
		May we suggest that on the next consultation meeting more attendees from other government agencies and specialist	Ms. Catherine Ann Gawara, Municipal Planning and Development Coordinator (MPDC)	**Ms. Carmela Capule, Consultant, KRC** We have sent an invitation to the target participants such as Regional DENR and other non-government organization for the consultation meeting but they cannot around for the possible reason of the bad weather earlier. For the next consultation we will ensure that they can attend or send their any representative to attend the said meeting.
People	Social Acceptability	What will happen if the involved barangay will go against the alignment?	Ms. Chona Tabiano, Brgy. Kgwd. Brgy. M. Chavez	**Ms. Carmela Capule, Consultant, KRC** It is advised that the barangay has to submit a letter of disagreement with road alignment. The final decision will lie to the

Environmental Component Likely to be Affected	EIA Module	Issues/Suggestions raised by the Stakeholders	Sector or Representative who raised the issues/suggestions	Proponents Responses
				Environmental Management Board (EMB) to grant the letter or not.
Others	Project Design	Where is the approach of the bridge in the M. Chavez?	SFOI Charlie Nieles, OIC-Bureau of Fire and Protection	**Engr. Claudio Cabrias, DPWH-Region VI** Showed the propose approach to the stakeholders the map of the bridge through the aid of Google earth.
		May we suggest that before and during construction the proponent can provide rerouting of the vehicle to prevent accidents in the area.	SFOI Charlie Nieles, OIC-Bureau of Fire and Protection	**Mr. Ricardo Capule, Consultant, KRC** Yes, we will raise your suggestion to the proponent for their consideration.
		We want to have the actual plan of the bridge	Mr. Ibany Bonilla, Municipal Administrator	**Ms. Carmela Capule, Consultant, KRC** Yes, we will include in our recommendation to the proponent to provide the final plan or design for your approval. Proper coordination to the affected people are very important.
		What is the length of the bridge?	SFOI Charlie Nieles, OIC-Bureau of Fire and Protection	**Mr. Ricardo Capule, Consultant, KRC** Based on the recommended length it is around 13.10 meters.

Environmental Component Likely to be Affected	EIA Module	Issues/Suggestions raised by the Stakeholders	Sector or Representative who raised the issues/suggestions	Proponents Responses
		Did you consider the earthquake in the design?	SFOI Charlie Nieles, OIC-Bureau of Fire and Protection	**Engr. Claudio Cabrias, DPWH-Region VI** Yes, we already included and considered in the design.
		Are we allowed to walk or jog in the bridge? We hope that they consider this in the design.	Ms. Susie Ferrer, Brgy. Cabano	**Lui Feng, CCCC Highway Consultant** People are not allowed to walk, take on the consideration that the bridge is very long and we prevent accidents for the people. **Engr. Claudio Cabrias, DPWH-Region VI** For now, the bridge is composed of 2 lanes with emergency lane. If the people can walk in the bridge it is their choice and personal risk.
Others	Project Details	How many million or billion cost of the project?	SFOI Charlie Nieles, OIC-Bureau of Fire and Protection	**Ms. Carmela Capule, Consultant, KRC** Based on the estimated cost of the bridge project it estimated around 27 Billion. But this is not a final cost. It depends on the agreement from Philippine Government and Government of China

Environmental Component Likely to be Affected	EIA Module	Issues/Suggestions raised by the Stakeholders	Sector or Representative who raised the issues/suggestions	Proponents Responses
		If the bridge already operationalized, they have a toll-fee?	Mr. Rafael Tabiano, Brgy. Kgwd. Brgy. M. Chavez	**Ms. Carmela Capule, Consultant, KRC** There is no toll fee because this is not an expressway.
Others	Project Benefits	How wide is the design of the bridge project?	SFOI Charlie Nieles, OIC-Bureau of Fire and Protection	**Mr. Ricardo Capule, Consultant, KRC** For now, there are only two lanes to be constructed along the proposed project. Most probably every lane has a wide of 3.5 or 4 meters.

Municipality of Leganes, Iloilo

Environmental Component Likely to be Affected	EIA Module	Issues/Suggestions raised by the Stakeholders	Sector or Representative who raised the issues/suggestions	Proponents Responses
Land	Terrestrial Flora and Fauna	Our concerns is about the habitat, terrestrial (flora and fauna) to be affected by the project.	Mr. Jofel Coching, Zooligical Society of London-Philippines	**Ms. Carmela Capule, Consultant, KRC** We have partially conducted survey including the terrestrial flora and fauna. The sampling methods were based on the alignment presented to us. The marine ecology, flora and fauna are of separate survey. Please attend on our next meeting consultation and we will be presenting the result of our surveys: land surveys, water surveys, air surveys, noise surveys, and socio-economic survey.
	Terrestrial Flora (Mangrove)	How about the species possibly be affected by the alignment? In the proposed alignment there are a lot of sea grass for the Dugong and mangrove plants.	Mr. Rodney Golbeque, Zooligical Society of London-Philippines	**Mr. Ricardo Capule, Consultant, KRC** We will consider those concerns in our study. By next presentation we will show you the results from our conducted surveys.
People	Traffic Congestion	We foresee that during construction it will give a traffic congestion in the area. Do you have a plan to mitigate this possible problem?	Atty. Jeorge Gregorio, Leganes Premier Land Consulting	**Mr. Ricardo Capule, Consultant, KRC** Yes, we have a mitigating measures on that issue. The DPWH will have a traffic management to mitigate the traffic congestion during

Environmental Component Likely to be Affected	EIA Module	Issues/Suggestions raised by the Stakeholders	Sector or Representative who raised the issues/suggestions	Proponents Responses
				construction. Also, the contractor will closely coordinate to the LGU and people in the community.
People	Project Affected	What is the cost of the private lands to be traversed by the road project?	Mayor JunJun Jaen, Municipal Mayor, Leganes	**Ms. Carmela Capule, Consultant, KRC** It will be based on the DPWH guidelines for compensation to the affected people. The DPWH has the guidelines about 2017 Right of Way Acquisition manual and in relation to the "per market value"**.** Those guidelines will be the basis for the assessment even the overall computation.
Others	Project Details	As we are talking about environmental issues, can I ask when does this project start?	Engr. Samson Jaspe, Sangguniang Bayan Member, Leganes	**Ms. Carmela Capule, Consultant, KRC** So this is the process. At the end of this year, they're targeting to finalize the agreement including the budget and costing. Here's the schedule: • Year 2020: detailed engineering design (DED) • 2021- right of acquisition of all affected properties and structures or period for settlement for the Land Acquisition Plan (LAP) and

Environmental Component Likely to be Affected	EIA Module	Issues/Suggestions raised by the Stakeholders	Sector or Representative who raised the issues/suggestions	Proponents Responses
				Resettlement Action Plan (RAP). • 2022- starting of construction which will last until 2027 Given the time frame, once the alignment is final there is still a need to conduct detailed engineering design in activity. This is to assess all the affected properties by the final alignment and compensation. The selection of contractors will be conducted between year 2020 and 2021. Since this is a government project, we have to follow official time frame.
		Where is the passageway of those big ships? If we have no international port. Can we request to put up a shipyard?	Mayor JunJun Jaen, Municipal Mayor, Leganes	**Mr. Ricardo Capule, Consultant, KRC** Presented the navigation through powerpoint with the aid of google earth. **Ms. Carmela Capule, Consultant, KRC** We will raise your concern to the proponent regarding your concern about shipyard for their consideration.

Environmental Component Likely to be Affected	EIA Module	Issues/Suggestions raised by the Stakeholders	Sector or Representative who raised the issues/suggestions	Proponents Responses
		Leganes has the most feasible and strategic location for international port than in Iloilo, that is my personal belief because we are located at the middle. Leganes is the only municipality having a land mass which is an important component for a port for industrial parks. In the province of Iloilo, the Leganes is eyeing for industrial park or economic zone since Leganes owns a property of 186 hectares. That's why I am asking if where is the passageway of those big ships in relevant to the height of the proposed bridge project." "My concern is the area of Leganes where the road alignment takes place already has a reclamation and proposal of making that area industrial zone. I don't know if this is the right forum for me to raise such concern. In my own point of view, if international port will not be put up in our area, we are asking at least for a shipyard specifically in our reclamation area. Also, consider my concern regarding our proposal on industrial economic zone. The bridge provides no	Mayor JunJun Jaen, Municipal Mayor, Leganes	**Ms. Carmela Capule, Consultant, KRC** We will raise your concern to the proponent for their consideration.

Environmental Component Likely to be Affected	EIA Module	Issues/Suggestions raised by the Stakeholders	Sector or Representative who raised the issues/suggestions	Proponents Responses
		employment to us, whereas the industrial economic zone will offer us income and employment."		
Others	Project Design	What is the height of the bridge project and how many lanes?	Mayor JunJun Jaen, Municipal Mayor, Leganes	**Engr. Claudio Cabrias, DPWH-Region VI** The proposed height is around 58 meters. In the proposed is 4 lanes. The initial bridge is designed for only 28meters, but then the Philippine Port Authority of Iloilo went against to this height of bridge all because the Dumangas in the future will become international port. With this, CCCC highway consultants revised the designed and made the measurement 58 meters high the same as the Guimaras-Pulupandan bridge height.
		After the construction, can we request to the proponent or contractor to give us the used materials or debris?	Atty. Jeorge Gregorio, Leganes Premier Land Consulting	**Ms. Carmela Capule, Consultant, KRC** It is possible. You can coordinate to the proponent.

Environmental Component Likely to be Affected	EIA Module	Issues/Suggestions raised by the Stakeholders	Sector or Representative who raised the issues/suggestions	Proponents Responses
		Can we request/suggest for the possible re alignment of the proposed project to Municipality of Saraga, because we see that the owner of the land there is only one the Ledesma Family.	Mayor JunJun Jaen, Municipal Mayor, Leganes	**Ms. Carmela Capule, Consultant, KRC** We will raise you suggestion to the proponent for their consideration. **Engr. Claudio Cabrias, DPWH-Region VI** Prior to the recommendation of the road alignment, the CCCC had considered the road connection to C2 line.

5. Proposed Method of Analysis Raised by the Stakeholders

In consideration to relevant local and indigenous knowledge, stakeholder's involvement in the EIS process is deemed necessary. The involvement and support of local people in efforts to define problems and incorporate local initiatives and ideas in the design and implementation process are prerequisites for EIA. The success and sustainability of projects depends upon local understanding, approval, and participation in all aspects of the project cycle.

Participatory and rapid appraisals will be adopted using various tools and techniques as defined by the stakeholders. This includes the following:

- Individual Interview with the Affected Community
- Key Informant Interviews
- Community validations
- Small Group Meetings
- Community Consultations (conduct and review of the study)

The above tools and techniques will also support and validate the data gathered during sampling and secondary data gathering. The data will be an analyze using both quantitative and qualitative approaches. The quantitative data were subjected to frequency and percentage distribution analysis, while qualitative methods were utilized in recommendations, reactions and perceptions of the stakeholders.

Proposed analysis of stakeholder/public participation in the EIA Process.

EIA Process (DAO 2003-30)	**Stakeholder**	**Objective**	**Methods**
Scoping	• LGU of Pulupandan, Buenavista, San Lorenzo and Leganes • Bgy. Councils of the affected barangays • Community Leaders (Senior Citizen, Youth Leader, Purok, Leader) • Philippine Coast Guard • Religious Group • National Agency within the project area • Non-Government Agencies	• Identify possible scope of the EIA Study, predicted issues and problems, and possible affected community	• Individual Interview with the Affected Community • Key Informant Interviews • Small Group Meetings • Community Consultations • Perception Surveys • Public Hearing • Community validations
Baseline Study		Source of information on biophysical and socio-economic environment of the project	
Impact Assessment		• Provide environmental indicators for the assessment of changes/trends on their environment Identify project impacts and social acceptability	

Identification of Mitigation	• Civil Society Organization • Peoples Organization	Recommend measures for the identified impacts to be considered in the formulation of environmental management plan	
Review and Validation		Community validation and review on the results of the EIA Study	

During project implementation, stakeholder's participation in the monitoring of compliance of the project were also recognized. This is to ensure that environmental management measures were strictly followed.

6. Transcription of the Public Scoping

Proceeding of Consultation Meeting in Municipality of Pulupandan, Negros Occidental

The proponent and consultant together with the representatives from CCCC Highway Consultants Co., Ltd. conducted public scoping/consultation meeting in Municipality of Pulupandan, Negros Occidental last 27 August 2019 at Barangay Pag-Ayon Evacuation Center together with the Barangay Officials, member of women's association and other Stakeholders. The representative from DPWH and CCCC were in attendance to provide responses and clarifications to queries on the proposed project. The formal program started at 9:00 am after all participants have arrived and registered in the attendance form and ended at 12:00 PM.

Before the start of the program, the participants registered to the attendance sheet as proof that the public consultation conducted and as requirement for submission to the DENR-EMB for the issuance of ECC. After the registration, invocation and singing of National Anthem conducted and was led by Mr. Randy Hugo of KRC. Welcome remarks was headed by Hon. Marina Amacio, Barangay Captain of Barangay Pag-Ayon, Pulupandan delivered welcome remarks to the stakeholders. She welcomed everyone for coming into the meeting, the residents and officials from five involved barangays, municipal officers, agencies, NGO's, and visitors from KRC Environmental Services and CCCC Highways Consultants. She expressed her heartfelt gratitude of having their area being chosen as part of the proposed project which is likely to bring development both social and economic. She ended up her message with a high hope and spirit that may the said project will come into reality.

Ms. Maria Carmela Capule, Consultant-KRC, introduced the participants, presented the overview on the conduct of the public consultation and target objectives of the Environmental Impact Assessment (EIA). Mr. Ricardo Capule, discussed the project details of the project. After the presentation, there are questions and clarifications from the participants about the project.

Mr. Eduardo Moreno, Brgy. Kgwd. Brgy. Pag-Ayon, asked if where is the alignment or way of the bridge project from Panay-Guimaras? Mr. Ricardo Capule, Consultant, KRC, presented the alignment to the attendees and he states that the alignment at the right side of elementary school of Pag-Ayon.

Ms. Virginia Cordeno, Brgy. Kgwd. Brgy. Zone 4A, asked if what will happen to the affected structures, houses, land and trees when it traversed by the alignment? Ms. Carmela Capule, Consultant, KRC responded that the affected property or land will be paid by DPWH with fair market value. DPWH and assessor's office will validate on the submitted report. The Resettlement Action Plan team will be responsible in making an inventory of all affected concerns such as crops and houses. Every property affected by the road project shall be appropriately compensated. DPWH will pay the trees based on their guidelines. It depends on the size, and height of the trees.

Ms. Mary Jane Odelmo, Brgy. Kgwd. Brgy. Tapong, mentioned that they hoping that during construction the livelihood of our fisherman will not affected. Fishing is the main livelihood in our area. That area is clearly affected by the project alignment. What will happen to the fishes once road construction takes place? Do you have any security measures in respect to this concern? Mr. Ricardo Capule, Consultant, KRC, answered that before the construction the contractor will inform the community for their plan for the construction period. The contractor will put up the safety measure to mitigate accidents during the construction and the residents cannot enter to the project site to prevent accidents. The safety officers are responsible to ensure even the safety of the immediate residents and their crops. The DPWH, as the project proponent should coordinate with the contractors with regards to safety provisions. As residents, you have also to be vigilant about the activities during the road construction. We expect a disturbance to the fishermen's during the construction but this project is very helpful for the development in the community.

Mr. Eduardo Moreno, Brgy. Kgwd. Brgy. Pag-Ayon, asked if how many lanes of the bridge project? Mr. Ricardo Capule, replied that the proposed lanes is only 2 lanes with emergency bay. Also, Engr. Ligaya Maravilla, Municipal Engineer mentioned to the stakeholders that the number of lanes is not a final. She discussed that their issues and concerns will be included in the study and subject for approval by the DPWH. As of now this is a proposed or under feasibility study. There are proposed alternatives and best alignment. We conduct this consultation meeting to discuss or confirm you if you are favor on the said project and with environment concerns.

Mr. Jimwell Canedo, Brgy. Pag-Ayon asked regarding the mangroves possibly affected by the project. Ms. Carmela Capule, answered that the areas with mangroves affected by the projects were included in the study. We will assess the present condition of the mangroves. DENR have a guidelines regarding the affected mangroves of the project. We check the present species of mangroves in the area. DENR will be the final say for the approval of the ECC.

Mr. Jimwell Canedo asked if who will apply for the ECC. Ms. Carmela Capule answered that DPWH or the proponent is one of the responsible for the applying the ECC to DENR-EMB. We as consultant we are helping them for the process through this EIA study and we will provide them the results of the study.

Ms. Mila Lourdes Tandoy, Municipal Sanitary Inspector, asked if it is a possibility that their source of water be affected during the construction. Ms. Capule, answered that if the source of water are came from the shallow well, it were affected. Also, the pipe lines will affected. The contractor must be responsible in keeping the source of water safe and clean. We will recommend to the people in the community to closely monitor during the construction to mitigate the loss of the water in the community. For the disposal, we will include in our recommendation that the contractor to have a proper disposal of waste during and after the construction.

Barangay Captain Marina Amacio, asked if what the role of the LGU in the project is. Ms. Carmela Capule replied that the role of the LGU in this project is very significant. The contractor shall be close coordination to the LGU and the affected people before and during the construction of the project. We will include in the study the social development project but it depends to the DPWH if they will include in their plan.

Barangay Captain Marina Amacio, asked if when is the target or timeline of the project? Also can we suggest to include the bike lane? Ms. Carmela Capule, mentioned to the attendees that the the proposed implementation of the construction of the project is by 2022 or after the approved detailed engineering design. 6 years is the timeline for the construction of the project. 2028 is the target to operational of the bridge. We will take note your suggestion for inclusion of bike lane in the design. Also, Barangay Captain Marina Amacio, asked if there a chance of having a job opportunities once project implementation takes place. Ms. Capule replied that absolutely yes, there are numerous income generating jobs will rise.

Barangay Captain Marina Amacio, mentioned they don't have any problem with the proposed project. I am full support and no objections to the proposed bridge project. We hope that the project will be fast track. The proposed alignment is less people and structures affected. In behalf of Brgy. Pag-ayon community, they are very full support to the implementation of the project.

Ms. Josenel Joy Salinas, Municipal Social Welfare Officer, asked if how the process during the construction with regards to the delivery of the construction materials we see that it will affect some other areas in respect to air safety conditions. They consider the other route or alternative road for the delivery vehicle for the materials to create less traffic and disturbance in the community? We hope that we cannot affected during construction. Mr. Capule answered that the as far as we know it same road to be used during the delivery of the construction materials. The possible effect are the dust and noise pollution during construction. We have appropriate mitigating measures such as provision of water sprinkling to minimized dust, all heavy equipment, trucks etc. must be properly maintained to prevent generation of air pollution. In terms of noise, all equipment must be provided with muffler to lower the noise level generated during operation. Proper timing of activity will be undertaken. We will include in our study that the people in the community will not disturb during the construction. Also he asked Ms. Salinas if they have a suggestion with regards to the route or alternative road. Ms. Salinas mentioned that can suggests the alternative route at Singko Onse for the delivery of construction materials during construction.

Ms. Maria Carmela Capule, synthesized the issues and concerns and agreements on the consultation meeting. Ms. Yryne Valenzuela, Public Information Officer and Executive Assistant of Mayor Pena of Municipality of Pulupandan delivered her closing remarks and she stated that "Thank you so much for coming, especially our barangay captains for helping us welcome our visitors from KRC Environmental Services and CCCC Highways Consultant to conduct this EIA Public Scoping. So, I think everything was addressed. At the end of the day, if I may relay to everyone there is only one message that our mayor would like to convey to all of us here, that is **'Just say yes and thumbs-up'**. So, it is a yes for us and we are giving our all- out support to this project because this is for the people of Pulupandan, for the economic development of the town and for the people as well; to generate a job to improve everyone's lives; and improve transportation from Negros islands. We are very lucky enough that the bridge alignment on the Negros side comes stand here in Pulupandan. Thank you so much. And so with the CCCC engineers for appreciating somehow our geographical location. Let us support this project. In every step of the way, LGU is on our side to help. So don't worry about it. We are taking this not at our disadvantage and please be assure that our mayor and the LGU is at all times at your side. It is not all business or progress but of course, the welfare of people must be on top priority. That's why, we have our EIA team to get all your concerns and issues. But at the end of the day, it is a yes! Thank you everyone! Welcome to Pulupandan!"

Proceeding of Consultation Meeting in Municipality of Buenavista, Guimaras

The proponent and consultant together with the representatives from CCCC Highway Consultants Co., Ltd. conducted public scoping/consultation meeting in Municipality of Buenavista, Guimaras last 28 August 2019 at Business Development Cooperative Building, Buenavista, Guimaras together with the Barangay Officials, member of women's association and other Stakeholders. The formal program started at 9:00 AM after all participants have arrived and registered in the attendance form and ended at 12:00 PM.

Before the start of the program, the participants registered to the attendance sheet as proof that the public consultation conducted and as requirement for submission to the DENR-EMB for the issuance of ECC. After the registration, invocation and singing of National Anthem conducted and was led by Mr. Randy Hugo of KRC. Welcome remarks was headed Ms. Ma. Leah Joy Gabayeron, EMS I/GENRO, Province of Guimaras, by gave her opening remarks in behalf of the municipal and provincial government of Guimaras. She welcomed all the participants, the consultants, and national government agency present in the meeting. Also, she encouraged everyone to listen to the presentations especially the environmental impact assessment report so they could understand the scope of the project and its potential environmental impact. Furthermore, she told them to raise their issues and concerns in a hope that all of which shall be addressed.

Ms. Maria Carmela Capule, Consultant-KRC, introduced the participants, presented the overview on the conduct of the public consultation and target objectives of the Environmental Impact Assessment (EIA). Mr. Ricardo Capule, discussed the project details of the project. After the presentation, there are questions and clarifications from the participants about the project.

Mr. Eliodoro Millama, Brgy. Kgwd. Brgy. Cansilayan, asked what will happen to the affected land properties to be traversed by the alignment? Ms. Carmela Capule, Consultant, KRC, answered that the affected property or land will be paid by DPWH with fair market value. DPWH and assessor's office will validate on the submitted report. Resettlement Action Plan Team will assess all properties of the affected people. Ms. Capule mentioned to the stakeholders that DPWH have a guidelines for the compensation.

Ms. Girlie Magilo, Municipal Agri-Fisheries Council, raised that as per experienced the construction of the wind turbines in a certain area greatly affected our crops. Have you also considered the displacement of our fisher folks and natural resources once construction takes place? Mr. Ricardo Capule replied that we have a mitigating measures on that issue to do not affect the livelihood of the fishermen's. Prior to constructions, the contractor will place barrier to prevent the sediments from scattering out to the protected area. In case the contractors fail to follow those measures, we can ask help from DENR and thorough investigation shall be made. Also, Ms. Capule mentioned that in the study they included the marine or the impact of biodiversity. It is included in our Environmental Impact Assessment study all the marine ecology: the flora and fauna and the present condition of marine life. With the expertise of our divers and marine biologists, we have already conducted the study and we will have it presented by next meeting. Those affected fisher folks will be taken into consideration by the contractors in making mitigating measures. We will emphasize to the project proponents to provide mitigating measures to be followed by the contractors and must be observed during especially during implementation. EMB have continuous monitoring on environmental aspect. The contactor need to follow the protocol.

Ms. Girlie Magilo asked if they consider the trees in the study. Because in the affected areas they have a lot of trees, crops and kalamansi. Ms. Carmela Capule, informed to the stakeholders that trees were included in the study. It will be included in the Resettlement

Action Plan (RAP). RAP will conduct 100% assessment to all affected properties such as structures, trees and land after the final or approved alignment provided by the DPWH. It will be paid by DPWH with fair market value. We have a guidelines that before the cutting of the trees we need to request a permit to DENR. DPWH will pay the trees based on their guidelines. It depends on the size, and height of the trees. This meeting is the avenue for us to know and disseminate regarding the project.

Mr. Ricardo Capule, asked to the stakeholders or attendees during consultation meeting regarding the mango fruits, he stated that as per concern from Central Office, since Guimaras is known for its abundant production of mango fruits, how they protect the mango industry of the area from outside mango traders once the road project is realized. Ms. Girlie Magilo sees that they have a quarantine area before to enter in our island. We have a check point. It is already a national law that mango fruits of outside traders are prohibited from entering the island. We will assure that we will take it into strict implementation when it comes to happen. Also, Mayor Reyes mentioned that they consider to put up an inspection in the project area to monitor the entering of goods to prevent outside traders from entering the island.

Mayor Eugenio Reyes mentioned that his concern is more on engineering and technical design of the proposed bridge, have you included in your design the lanes to which people could pass though by walking or using bicycles or motorcycles. Mr. Ricardo Capule replied that his concerns will raise to the proponent the final design of the bridge and we will inform them your suggestions for possible inclusion of bike lane and motorcycle lane in their design.

Ms. Capule, synthesized the issues and concerns and agreements on the consultation meeting and the next steps. Hon. Eugenio G. Reyes, Municipal Mayor of Buenavista delivered his positive outlook towards the proposed project. For him, the realization of the project will surely bring opportunities to the area and is of great help for the uplifting of economic living as the project will address the timely and continuing problem of transportation. The LGU however is preparing for the project implementation as there are identified displacements of residents and their properties. He added, that economic growth and development of tourism industry are just few of the many opportunities offered by the bridge project to the ends of Guimaras.

Proceeding of Consultation Meeting in Municipality of San Lorenzo, Guimaras

The proponent and consultant together with the representatives from CCCC Highway Consultants Co., Ltd. conducted public scoping/consultation meeting in Municipality of San Lorenzo, Guimaras last 28 August 2019 at Municipal Hall of San Lorenzo together with the Barangay Officials and other Stakeholders. The representative from DPWH and CCCC were in attendance to provide responses and clarifications to queries on the proposed project. The formal program started at 2:00 PM after all participants have arrived and registered in the attendance form and ended at 5:00 PM.

Before the start of the program, the participants registered to the attendance sheet as proof that the public consultation conducted and as requirement for submission to the DENR-EMB for the issuance of ECC. After the registration, invocation and singing of National Anthem conducted and was led by Mr. Randy Hugo of KRC. Welcome remarks was headed by Mr. Ibany G. Bonilla, Municipal Administrator of Municipality of San Lorenzo, delivered welcome remarks to the stakeholders. He said that in behalf of the local officials, municipal officials and project stakeholders of San Lorenzo, welcomed everyone who attended the said meeting, representative from coast guard, residents and officials from barangay M. Chavez and barangay Cabano, OIC of BFP, MPDC officer, CCCC Highway consultants, DPWH Region 6, and KRC Environmental Services consultants. He ended up his remarks with a high hopes that the said project proposal shall be realized.

Ms. Maria Carmela Capule, Consultant-KRC, introduced the participants, presented the overview on the conduct of the public consultation and target objectives of the Environmental Impact Assessment (EIA). Mr. Ricardo Capule, discussed the project details of the project. After the presentation, there are questions and clarifications from the participants about the project.

SFOI Charlie Nieles, OIC-Bureau of Fire and Protection asked to the team where the approach of the bridge in the M. Chavez. Engr. Claudio Cabrias, DPWH-Region VI showed the propose approach to the stakeholders the map of the bridge through the aid of Google earth.

Ms. Chona Tabiano, Brgy. Kgwd. Brgy. M. Chavez asked How the affected houses of the project? Also, I think we have a meeting to all affected people. Mr. Ricardo Capule, Consultant, KRC replied to the query that based on the DPWH guidelines. The affected property, structures and land will be paid by DPWH with fair market value. DPWH and assessor's office will validate on the submitted report. Also, Ms. Carmela Capule mentioned to the stakeholders that they have another study team for the assessment of all affected properties this is the team of RAP. Resettlement Action Plan (RAP) Team will assess all properties of the affected people after the final approval of the alignment. She mentioned that DPWH have a guidelines for the compensation. This public scoping meeting is the avenue for us to know and disseminate regarding the project. We have a separate meeting for the RAP team they will present the results of their assessment. DPWH will pay the acquisition of all affected structures after the conduct of RAP. All affected will be compensated as long as included in the inventory or during cut offs.

SFOI Charlie Nieles asked regarding the wide of the design of the bridge project. Mr. Ricardo Capule answered that for now there are only two lanes to be constructed along the proposed project. Most probably every lane has a wide of 3.5 or 4 meters.

Mr. Rafael Tabiano, Brgy. Kgwd. Brgy. M. Chavez shared that he and Kgwd. Chona Tabiano are included in the affected structures of the project. I have a 2 house and 1 house for kgwd. Chona. We are requesting for the consideration to re-route the alignment of the propose alignment. Ms. Carmela Capule discussed to the stakeholders that DPWH have a guidelines for compensation for the affected people. 2021 is the propose schedule for the settlement to the affected residents in the project. The LGU or the affected barangay will provide or submit the certificate for no objection of the project. Also, Engr. Claudio Cabrias mentioned that the one consideration of the recommended alignment is based on the distance of the windmill and safety of the people.

Mr. Rafael Tabiano raised during meeting that the recommended alignment traverses some buildings like barangay hall, day care and houses. He recommend another alignment in the avoidance of those affected buildings. Mr. Ricardo Capule, said that it will take note and will raise to the proponent for their considerations. Engr. Cabrias mentioned that prior to the selection of the most recommended road alignment, we have also considered those wind turbines constructed in certain areas.

Ms. Catherine Ann Gawara, Municipal Planning and Development Coordinator (MPDC) raised that the recommended alignment will traverse a fishpond area. She mentioned that there should be a public hearing to be conducted in the affected barangay. Ms. Capule answered that there would be another study once the alignment is final, that is the Land Acquisition and Resettlement Action Plan. This is actually a detailed study to evaluate and account all the properties affected by the road alignment.

There will be another scoping to be conducted regarding the public hearing matter. It is important for us to know all your concerns regarding the environmental impact of the project.

Ms. Catherine Ann Gawara followed up question regarding the relocation of the affected people? LGU have no fund or budget for their relocation or resettlement. Ms. Capule replied that they will raise this concern to the proponent of the project for their considerations.

Ms. Chona Tabiano asked what will happen if the involved barangay will go against the alignment. Ms. Carmela Capule responded that the barangay has to submit a letter of disagreement with road alignment. The final decision will lie to the Environmental Management Board (EMB) to grant the letter or not.

SFOI Charlie Nieles suggested the team that before and during construction the proponent can provide rerouting of the vehicle to prevent accidents in the area. Mr. Ricardo Capule replied that they will raise their suggestion to the proponent for their consideration.

Mr. Ibany Bonilla, Municipal Administrator said that they will actualize the plan of the bridge and the road to minimize the effect to the people. Ms. Carmela Capule mentioned that they will include in our recommendation to the proponent to provide the final plan or design for your approval. Proper coordination to the affected people are very important.

SFOI Charlie Nieles asked the length of the proposed bridge. Mr. Capule, answered that based on the recommended length it is around 13.10 meters. Also, Mr. Nieles asked the team if they consider the earthquake in the design. Engr. Cabrias sees that they already included and considered in the design.

Ms. Catherine Ann Gawara asked about the mangroves and timberland in the areas affected. Ms. Carmela Capule answered that the areas with mangroves affected by the projects were included in the study. We will assess the present condition of the mangroves. DENR have a guidelines regarding the affected mangroves of the project. We check the present species of mangroves in the area. DENR will be the final say for the approval of the ECC.

SFOI Charlie Nieles asked about the cost of the project. Ms. Capule replied that based on the estimated cost of the bridge project it estimated around 27 Billion. But this is not a final cost. It depends on the agreement from Philippine Government and Government of China.

Mr. Rafael Tabiano asked if the bridge already operationalized they have a toll-fee. Ms. Carmela Capule response that they have no toll fee because this is not an expressway.

SFOI Charlie Nieles asked the benefits of the project to the people. Ms. Capule answered that there are more benefits to the residents or people in your community such as economic development of the barangay or municipality, attract tourists and you can go to other areas using the car through the bridge.

Ms. Catherine Ann Gawara suggested that on the next consultation meeting more attendees from other government agencies and specialist. Ms. Capule mentioned that they sent an invitation to the target participants such as Regional DENR and other non-government organization for the consultation meeting but they cannot around for the possible reason of the bad weather earlier. She also sees that may be on the next consultation meeting more stakeholders can attend.

Ms. Susie Ferrer, Brgy. Cabano asked they allow to walk or jogging in the bridge and they hoping that they can consider in the design. Mr. Lui Feng, CCCC Consultant answered that people are not allowed to walk, take on the consideration that the bridge is very long and we prevent accidents for the people. Also, Engr. Cabrias shared that the bridge is composed of 2 lanes with emergency lane. If the people can walk in the bridge it is their choice and personal risk.

Ms. Capule, synthesized the issues and concerns and agreements on the consultation meeting and the next steps. Mr. Ibany G. Bonilla, Municipal Administrator of Municipality of San Lorenzo delivered his closing remarks hoping that all their concerns and recommendations addressed and take into consideration.

Proceeding of Consultation Meeting in Municipality of Leganes, Iloilo

The proponent and consultant together with the representatives from CCCC Highway Consultants Co., Ltd. conducted public scoping/consultation meeting in Municipality of San Lorenzo, Guimaras last 29 August 2019 at Youth Development Building of Municipality of Leganes together with the Barangay Officials and other Stakeholders. The representative from DPWH and CCCC were in attendance to provide responses and clarifications to queries on the proposed project. The formal program started at 2:00 PM after all participants have arrived and registered in the attendance form and ended at 5:00 PM.

Before the start of the program, the participants registered to the attendance sheet as proof that the public consultation conducted and as requirement for submission to the DENR-EMB for the issuance of ECC. After the registration, invocation and singing of National Anthem conducted and was led by Mr. Randy Hugo of KRC. Welcome remarks was headed by Hon. Vicente Jaen II, Municipal Mayor of Municipality of Leganes, delivered his opening remarks during the meeting. He started his remarks with a warm greetings to all attendees: visitors from KRC Environmental Services and CCCC Highways Consultants, Municipal Officials, Barangay Officials, representatives from Coast Guard, Zoological Services of London-Philippines, stakeholders of the proposed project, and all other LGU officials. Mayor Jaen strongly believed that the proposed project is a big help to all the people of Leganes although the proposal is yet to be considered in relation to its advantages and disadvantages to the municipality of Leganes in general. He further encouraged the attendees to raise their concerns and willing He ended up his message hoping for a productive and fruitful afternoon.

Ms. Maria Carmela Capule, Consultant-KRC, introduced the participants, presented the overview on the conduct of the public consultation and target objectives of the Environmental Impact Assessment (EIA). Mr. Ricardo Capule, discussed the project details of the project. After the presentation, there are questions and clarifications from the participants about the project.

Engr. Samson Jaspe, Sangguniang Bayan Member, Leganes, asked if if when does this project start. Ms. Carmela Capule, Consultant, KRC replied that by the end of this year, they're targeting to finalize the agreement including the budget and costing. Here's the schedule:

- Year 2020: detailed engineering design (DED)
- 2021- right of acquisition of all affected properties and structures or period for settlement for the Land Acquisition Plan (LAP) and Resettlement Action Plan (RAP).
- 2022- starting of construction which will last until 2027

Given the time frame, once the alignment is final there is still a need to conduct detailed engineering design in activity. This is to assess all the affected properties by the final alignment and compensation. The selection of contractors will be conducted between year 2020 and 2021. Since this is a government project, we have to follow official time frame.

Mr. Rodito Jinon, Sangguniang Bayan Member, Leganes, asked if the project will be materialized, what will happen to those informal settlers traversed by the alignment. Is there a relocation site to be provided for those people possibly be displaced by the road alignment? Ms. Carmela Capule, Consultant, KRC responded that Based on the DPWH guidelines. The affected property, structures and land will be paid by DPWH with fair market value. DPWH and assessor's office will validate on the submitted report. She mentioned that they have another study team for the assessment of all affected properties this is the team of RAP. Resettlement Action Plan (RAP) Team will assess all properties of the affected people after the final approval of the alignment. She mentioned that DPWH have a guidelines for the compensation. This public scoping meeting is the avenue for us to know and disseminate regarding the project. We have a separate meeting for the RAP team they will present the results of their assessment. DPWH will pay the acquisition of all affected structures after the conduct of RAP. All affected will be compensated as long as included in the inventory or during cut offs. For the relocation, it depends on the DPWH. DPWH is responsible for this concern. We will raise your issues and concerns and discuss with the DPWH or proponent.

Mayor JunJun Jaen, Municipal Mayor, Leganes asked about the cost of the private lands to be traversed by the road project. Ms. Capule, answered that based on the DPWH guidelines for compensation to the affected people. The DPWH has the guidelines about 2017 Right of Way Acquisition manual and in relation to the "per market value". Those guidelines will be the basis for the assessment even the overall computation. Also, Mayor Jaen, asked if where is the passageway of those big ships? If we have no international port. He requested to put up a shipyard. Mr. Ricardo Capule, Consultant, KRC presented the navigation through powerpoint with the aid of google earth and Ms. Capule said that they will raise your concern to the proponent regarding your concern about shipyard for their consideration.

Mayor Jaen mentioned that Leganes has the most feasible and strategic location for international port than in Iloilo, that is my personal belief because we are located at the middle. Leganes is the only municipality having a land mass which is an important component for a port for industrial parks. In the province of Iloilo, the Leganes is eyeing for industrial park or economic zone since Leganes owns a property of 186 hectares. He asking if where the passageway of those big ships in relevant to the height of the proposed bridge project." His concern is the area of Leganes where the road alignment takes place already has a reclamation and proposal of making that area industrial zone. I don't know if this is the right forum for me to raise such concern. In my own point of view, if international port will not be put up in our area, we are asking at least for a shipyard specifically in our reclamation area. Also, consider my concern regarding our proposal on industrial economic zone. The bridge provides no employment to us, whereas the industrial economic zone will offer us income and employment.

Mayor Jaen asked regarding the height of the bridge project and how many lanes. Engr. Claudio Cabrias, answered that the proposed height is around 58 meters. In the proposed is 4 lanes. The initial bridge is designed for only 28meters, but then the Philippine Port Authority of Iloilo went against to this height of bridge all because the Dumangas in the future will become international port. With this, CCCC highway consultants revised the designed and made the measurement 58 meters high the same as the Guimaras-Pulupandan bridge height.

Atty. Jeorge Gregorio, Leganes Premier Land Consulting asked during construction it will give a traffic congestion in the area. He mentioned if the proponent have a plan to mitigate this possible problem. Mr. Capule answered that they have a mitigating measures on that issue. The DPWH will have a traffic management to mitigate the traffic congestion during construction. Also, the contractor will closely coordinate to the LGU and people in the community. Also, Atty. Gregorio asked if after the construction if they request to the proponent or contractor to give us the used materials or debris. Ms. Capule replied that it is possible. You can coordinate to the proponent.

Mayor Jaen suggested to the team for the possible realignment of the proposed project to Municipality of Saraga, because we see that the owner of the land there is only one the Ledesma Family. Engr. Claudio Cabrias, answered that prior to the recommendation of the road alignment, the CCCC had considered the road connection to C2 line. Also, Ms. Capule mentioned to Mayor Jaen that they will raise his suggestion to the proponent for their consideration.

Mr. Jofel Coching, Zooligical Society of London-Philippines, asked about the habitats, terrestrial (flora and fauna) to be affected by the project. Ms. Carmela Capule replied that they have partially conducted survey including the terrestrial flora and fauna. The sampling methods were based on the alignment presented to us. The marine ecology, flora and fauna are of separate survey. Please attend on our next meeting consultation and we will be presenting the result of our surveys: land surveys, water surveys, air surveys, noise surveys, and socio-economic survey.

Mr. Rodney Golbeque, Zooligical Society of London-Philippin es, asked about the species possibly be affected by the alignment? He shared that in the proposed alignment there are a lot of sea grass for the Dugong and mangrove plants. Mr. Capule, mentioned they already considered those concerns in the study. By next presentation they will show the results from the conducted surveys or study to the stakeholders.

Ms. Capule, synthesized the issues and concerns and agreements on the consultation meeting and the next steps. Mayor Jaen gave his closing remarks with a positive hope that along with the on-going consultations and surveys on the project is also the consideration of their reclamation and proposal of Leganes area about Industrial Economic Zone.

7. Attendance of Public Scoping and General Public

Municipality of Pulupandan, Negros Occidental

Feasibility Study of Panay-Guimaras-Negros Island Bridges Project

CHINA AID

PUBLIC SCOPING MEETING

8 am to 12 noon, 27 August 2019, Brgy. Pag-ayon Evacuation Center, Brgy. Pag-ayon, Pulupandan, Negros Occidental

ATTENDANCE

Name	Designation/ Office/ Agency	Email/ Cel/Tel Number	Signature	Gender
1) Lorna O. Maggrio	Brgy. Tapong	09070110293	[illegible]	F
2) Teresita S. Dorupez	Brgy. Canjusa P/B	09331816823	[illegible]	F
3) EVE A. FLORES	BRGY. CANJUSA / KAGAWAD	09264607367	[illegible]	F
4) Ana Marie A. Nuñez	Brgy. Tapong BNS	09386386741	[illegible]	F
5) Genrose S. Apelando	Brgy. Canjusa /Secretary	09459859287	[illegible]	F
6) Cecilia Q. Yuro	Brgy. Canjusa / Kagawad	09274916074	[illegible]	F
7) CLAUDIO C CABRAS	DPWH 6	09993627997	[illegible]	M
8) MA [illegible] A TAMBAY	SI-II | LGU Pulupandan	09452195811	[illegible]	F
9) Roy G. JARLATA	BRGY. TAPONG		[illegible]	M
10) Virginia M. Cordeno	Brgy Kagawad / Zone 4A	0920230641	[illegible]	F
11) Eliseo C. Yungue	Brgy Zone 4-A Brgy Kag	09079415844	[illegible]	F
12) Johna P. Ganal	Brgy Kagawad	09078865042	[illegible]	F

Feasibility Study of Panay-Guimaras-Negros Island Bridges Project

CHINA AID

PUBLIC SCOPING MEETING

8 am to 12 noon, 27 August 2019, Brgy. Pag-ayon Evacuation Center, Brgy. Pag-ayon, Pulupandan, Negros Occidental

ATTENDANCE

Name	Designation/ Office/ Agency	Email/ Cel/Tel Number	Signature	Gender
13) MARY JEAN ODELMO	BRGY TAPONG	09182650023	[illegible]	F
14) Anila P. Ebalca	BRGY. TAPONG / Treasurer	09334378446	[illegible]	F
15) Merlyn D. Jamili	BRGY. CANJUSA / Kgwd	09154005840	[illegible]	F
16) JOWEN O CARBOS	Brgy CANJUSA KGAWD		[illegible]	M
17) Jeoffrey P. Yungue	Brgy. ZONE 4A	09424967070	[illegible]	M
18) Marina C. Amacio	Brgy. Capt. Brgy. PAG-AYON	jrd92013@gmail.com 09093446488	[illegible]	F
19) Josenel Jay A. Salinas	SWO II / MSWDO Pulupandan	09428779795	[illegible]	F
20) FRANCISCO DOREPE	Brgy. CANJUSA	09438050324	[illegible]	M
21) Alma S CRUZ	Brgy. Pag ayon	09281698429	[illegible]	F
22) Tomas Molon	Brgy pag-ayon	09695403421	[illegible]	M
23) ARIEL APOSTOL	BRGY. PAG-AYON	09090209478	[illegible]	M.
24) Ryan Arnaez	Brgy Zone 4A	09097550272	[illegible]	M

Feasibility Study of Panay–Guimaras–Negros Island Bridges Project

CHINA AID

PUBLIC SCOPING MEETING

8 am to 12 noon, 27 August 2019, Brgy. Pag-ayon Evacuation Center, Brgy. Pag-ayon, Pulupandan, Negros Occidental

ATTENDANCE

Name	Designation/ Office/ Agency	Email/ Cel/Tel Number	Signature	Gender
25) EDUARDO E. MORENO	BRGY. KAGAWAD, PAG-AYON	09484178 0593		MALE
26) JHONNY CANDACO	TANOD " "	09213807437		MALE
27) REYMOND N. ILLORIN	BRGY. KAGAWAD PAG-AYON	09107007769		MALE
28) JIMWELL R. CAÑEDO	BRK - PAG-AYON	09300615389		MALE
29) Jonah N. Garbeta	BRGY. TAPONG	09234974416		FEMALE
30) Honely Cuchillon	Brgy. Pag-ayon	0918 3273060		Female
31) ARNOLD L. YANSON	Brgy. CANDIDA (Kagawad)			MALE
32) Li Shuang	CCCC	09668838273		M
33) Liu Feng	CCCC	09668838273	Liu feng.	M.
34) SHEVA M. MAGNILA	MAYOR'S OFFICE	09770894808		F
35) Meng Yun	China Shipping Environment (Shanghai)	+63945357 1449		F
36) RYAN A. PASION	KRC	0946-276-0612		M

Feasibility Study of Panay–Guimaras–Negros Island Bridges Project

CHINA AID

PUBLIC SCOPING MEETING

8 am to 12 noon, 27 August 2019, Brgy. Pag-ayon Evacuation Center, Brgy. Pag-ayon, Pulupandan, Negros Occidental

ATTENDANCE

Name	Designation/ Office/ Agency	Email/ Cel/Tel Number	Signature	Gender
37) JOVIN S. ABASOLO	BRGY PAG-AYON			Male
38) JOEL M. NUÑEZ	BRGY. TAPONG - Brgy. Capt.			M
39) Antonieta I. dela Rosa	BRGY. PAG-AYON			F
40) HAZEL CANDIASO	Brgy. Pag Ayon			F
41) Merle Odelmo	Brgy. Pag-Ayon			F
42) LIGAYA M. MANANILLA	LGU-PULUPANDAN - ENG'G			F
43) Diadema O. Vereza	PPA - Pulupandan			F
44) Jazel Rose V. Gumayan	Phil Ports Authority - Pulupandan			F
45) Lorena Cristal	ZONE 4A		L. Cristal	F
46) Virgilio N. Cartalaga JR.	ZONE 1-A			M
47) Ernesto Miravalles	Tapong			M
48) Rosal I. ORTEGA	Brgy. Pag-ayon			F

Feasibility Study of Panay-Guimaras-Negros Island Bridges Project

CHINA AID

PUBLIC SCOPING MEETING

8 am to 12 noon, 27 August 2019, Brgy. Pag-ayon Evacuation Center, Brgy. Pag-ayon, Pulupandan, Negros Occidental

ATTENDANCE

Name	Designation/ Office/ Agency	Email/ Cel/Tel Number	Signature	Gender
49) ELA T-AMECHACHURRA	CONSULTANT ARCHITECT / LGU	09178962298	[signature]	F
50) MARY GERALDIN BALOCOS	WOMENS / Pag-ayon	09075351840	[signature]	F
51) GRETCHEN CAÑEDO	WOMENS / " - "	09101056033	[signature]	F
52) Leo L. Agudo	Barangay Way / Brgy. Sec.	09500395139	[signature]	M
53) Nuñez, Johance A.	NGO / Tapong		[signature]	M
54) ROLAND NICOR	BRGY PAG AYON	09308267521	[signature]	F
55) Gryne A. Valenzuela	P.I.O / EA / LCR	09177138630	[signature]	F
56) RICHIE A. VILLASANTA	CHIEF SAFETY OFFICER / PPA	09209205863	[signature]	M
57) Maria Carmela R. Capule	Technical Director / KRC Environmental Services	09175276332	[signature]	F
58) Ricardo A. Capule	KRC	09177132629	[signature]	M
59) HUGO, RANDY	KRC	09274502314	[signature]	M
60)				

Municipality of Buenavista, Guimaras

Feasibility Study of Panay-Guimaras-Negros Island Bridges Project

CHINA AID

PUBLIC SCOPING MEETING

8 am to 12 noon, 28 August 2019, Business Development Cooperative Bldg., Buenavista, Guimaras

ATTENDANCE

Name	Designation/ Office/ Agency	Email/ Cel/Tel Number	Signature	Gender
1) Rommel J. Infante	Brgy Captain / Salvacion	09564728570		M
2) Victor S. Perez	P/B Getulio	09174225582		M
3) Eliodoro Millama	Brgy KGWD / Cansilayan	09558605924		M
4) TANGLORE Y GABITO	PB - BAMBAN	09173492141		F
5) WILLIAM FALSO	P/B DAGSAAN	09302833815		M
6) MC NORIEL MILLANA	BRGY SECRETARY / BANBAN	09173491169		M
7) Ma. Leah Joy T. Gabayeron	EMS I / GENRO / PGG	09275504566		F.
8) CPO JOSE JESSIE A GAYOBA	PCG DEPUTY STATION COMMANDER CGSGUIMARAS	09195796114		M
9) Babeth F Deana	P/B Navalas	09184949539		F
10) MARK ANTHONY FLORES	Brgy Tanod / Salvacion			M
11) ESMAEL GALLO	Brgy Tanod / Salvacion	09265314313		M
12) Joel A. Gabayeron Sr.	Brg Kagawad / Salvacion			M

Feasibility Study of Panay-Guimaras-Negros Island Bridges Project

CHINA AID

PUBLIC SCOPING MEETING

8 am to 12 noon, 28 August 2019, Business Development Cooperative Bldg., Buenavista, Guimaras

ATTENDANCE

Name	Designation/ Office/ Agency	Email/ Cel/Tel Number	Signature	Gender
13) Elen R. Flores	Ardurisin, Aldo.	09462734095		F
14) RHONA PILLORA	BAN[24], BTA., GUIM.	09389404402		F
15) CHRISTY GABAY	Navalas Bta. Guim.	09667333089		F
16) CAESAR VALENZUELA.	CAUNGAO	09125925846		M
17) DENNIS GENON	SAN ROQUE	09090905221		M'
18) EUGENIO G. REYES	MAYOR, MUN. OF BUENAVISTA			M
19) Gerlie U. Magno	Municipal Agri-Fisheries Council	09093223981		F
20) EDITHA C. GALLO	SALVACION	09084969892		F
21) Jessie Gavan	M.O.	09487696436		M
22) Jessica P. Gestada	Navalas / IWAG	09162448765		F
23) SAMUEL P. PARCON	BANBAN	09150057266		M
24) MARVIN MORANTE	LGU BUENAVISTA	0915 766 3398		M

Feasibility Study of Panay-Guimaras-Negros Island Bridges Project

CHINA AID

PUBLIC SCOPING MEETING

8 am to 12 noon, 28 August 2019, Business Development Cooperative Bldg., Buenavista, Guimaras

ATTENDANCE

Name	Designation/ Office/ Agency	Email/ Cel/Tel Number	Signature	Gender
25) HUGO, RANDY	KRC	09274502314		M
26) PASION, RYAN A.	KRC	0946-276-0612		M
27) Joemarie P. Aquino	Tanod Salvacion	09096380341		M
28) Joseph Anthony Escaran	LGU Buenavista	0977 011 6618		M
29) Maria Carmela Capule	KRC Environmental Services	09175276352		F
30) Ricardo A. Capule	KRC	09177132629		M
31)				
32)				
33)				
34)				
35)				
36)				

Municipality of San Lorenzo, Guimaras

Feasibility Study of Panay-Guimaras-Negros Island Bridges Project

PUBLIC SCOPING MEETING

1 pm to 5 pm, 28 August 2019, Municipal Hall, San Lorenzo, Guimaras

ATTENDANCE

Name	Designation/ Office/ Agency	Email/ Cel/Tel Number	Signature	Gender
1) CPO LEO OLMOS PCG	SUB STATION COMMANDER CGSS SIBUNAG PCG	cgsssibunag.guimaras@gmail.com		M
2) SN2 Lloyd Manz Racho PCG	CGSS SIBUNAG (MEMBER)	09178428369		M
3) TABIANO, RAFAEL	BRGY. KGWD M. CHAVEZ			M
4) DE LA TORRE, NOLI	PB M.CHAVEZ	09302631293		M
5) TABIANO CHONA	BRGY. KGWD - M-CHAVEZ			F
6) Susie C. [illegible]	Barangay Cabano			F
7) Olivia Tario	San Lorenzo Goat Raisers [illegible]			F
8) CHERRY D. GALVEZ	M. CHAVEZ			F
9) Catherine Ann L. Gavana	MPDC | San Lorenzo LGU	0950-837-7246		F
10) SFO1 Charlie Nieles	OIC - BFP San Lorenzo	09501846566		M
11) Luzielle G. Solez	Planning Staff			F
12) Ruben Pollente	KGD. / Cabano	09279367125		M

Feasibility Study of Panay-Guimaras-Negros Island Bridges Project

PUBLIC SCOPING MEETING

1 pm to 5 pm, 28 August 2019, Municipal Hall, San Lorenzo, Guimaras

ATTENDANCE

Name	Designation/ Office/ Agency	Email/ Cel/Tel Number	Signature	Gender
13) CLAUDIO C. CABRIAS JR.	DPWH-6	09993029970		M
14) Liu feng	CCCC	1921931@QQ.com		M.
15) Li Shuang	CCCC	09668838273		M
16) Meng Yun	China Shipping Environment Technology(Shanghai) .Co. LTD	1105664942@qq.com		F
17) Maria Carmela Q. Capule	KRC Environmental Service	0917527[illegible]		F
18) Nany G. Bonilla	Mun. Admin., San Lorenzo	09178712835		M
19) HUGO, RANDY	KRC	09274502314		M
20) PASION, RYAN A.	KRC	0946-276-0612		M
21) Ricardo A. Capule	KRC	09177132629		M
22) Arminda Galijaso	LGU SL			F
23)				
24)				

Municipality of Leganes, Iloilo

Feasibility Study of Panay-Guimaras-Negros Island Bridges Project

PUBLIC SCOPING MEETING

1 pm to 5 pm, 29 August 2019, Municipal Hall, Leganes, Iloilo

ATTENDANCE

Name	Designation/ Office/ Agency	Email/ Cel/Tel Number	Signature	Gender
1) ALBERTO H. CATAHAY Jr.	P.B. Brgy. Gua-an Leganes	09081930040	[signature]	M
2) Genevieve P. Gonzales	Brgy. Kagawad Gua-an Leganes	09103138768	[signature]	F
3) Wilson A. Batislaon	MENRO LGU Leganes	09091561704	[signature]	M
4) Radito C. Jimo	SB member "	09479405738	[signature]	M
5) ABELARDO T BELMONTE	LIGA PRES	09509151995	[signature]	M
6) Joy Lim	LGU Leganes	09482043951	[signature]	F
7) Allain John Eturaiga	LGU Leganes	09289455589	[signature]	M
8) F. Diaz	LGU Leganes		[signature]	M
9) DOMINADOR E. ARDALES	UNATODA PRES	09086387986	[signature]	M
10) Elizabeth A. Sal	Farmers MAFC Chairman	09216634818	[signature]	F
11) Florentino J. Sopio	Cag. Sen SCFAI Pres Senior	09999402166	[signature]	F
12) Evangeline P. Libres	Guinhom-an C.O (LESAA)	09098786021	[signature]	F

Feasibility Study of Panay-Guimaras-Negros Island Bridges Project

PUBLIC SCOPING MEETING

1 pm to 5 pm, 29 August 2019, Municipal Hall, Leganes, Iloilo

ATTENDANCE

Name	Designation/ Office/ Agency	Email/ Cel/Tel Number	Signature	Gender
13) CLAUDIO C. CABRIAS JR	DPWH-6	09993629970	[signature]	M
14) Li Shuang	CCCC	09688838273	[signature]	M
15) Liu Feng	CCCC	19211931@QQ.com	Liu Feng	M
16) Meng Yun	China Shipping Environment Technology (Shanghai) Co. LTD	110586494@qq.com	Meng Yun	F
17) NINFORO A. RAYMUNDO	ME. LGU. Leganes	09999271284	[signature]	F
18) NEMESIO D. GANON JR.	ASSESSOR - LEGANES	09053585690-	[signature]	M
19) SAMSON V. VASPE	SB MEMBER	09178110589	[signature]	M
20) EVENTO E. SINARRIO	PGENRO	09197164076	[signature]	M
21) VONS. GUILORETA	OSCA-Head Leganes	09286511498	[signature]	F
22) NORMAN PEREZ	ENGR. I / PENRO-LGU	09204621439	[signature]	M
23) LARRY H. LABUSON	SB MEMBER	09307826975	[signature]	M
24) ERNEST CARL J. BAPANA	MPDC	09177237454	[signature]	M

Feasibility Study of Panay-Guimaras-Negros Island Bridges Project

PUBLIC SCOPING MEETING

1 pm to 5 pm, 29 August 2019, Municipal Hall, Leganes, Iloilo

ATTENDANCE

Name	Designation/ Office/ Agency	Email/ Cel/Tel Number	Signature	Gender
25) Eymor Marcos	Mayor's Office			F
26) Harold Hopkos	MEO			M
27) Carantal MV.	MEO			M
28) Wilfredo P. Sempiagan	Kagawad/Gua-an			M
29) CDR PERLITA P CINCO PCG	CS, CGDWV	09975682792	Pcinco	F
30) CPO LEONELLO T ENCIO PCG	MEPU-WV/PCG	09292853370		M
31) RODNEY GOLBERVE	(ZSL) Zoological Society of London-Philippines	09771060456		M
32) JOFEL O. COCHING	ZSL-Philippines	09179971643		M
33) Jun Jun Jaen	Municipal Mayor of Leganes			M
34) Jeffrey Cordova	PCG			M
35) Atty. Jeffrey H. Gregorio	LPLC	09562553727		M
36) MARCEL LORIA	LPLC	09164727758		M

Feasibility Study of Panay-Guimaras-Negros Island Bridges Project

PUBLIC SCOPING MEETING

1 pm to 5 pm, 29 August 2019, Municipal Hall, Leganes, Iloilo

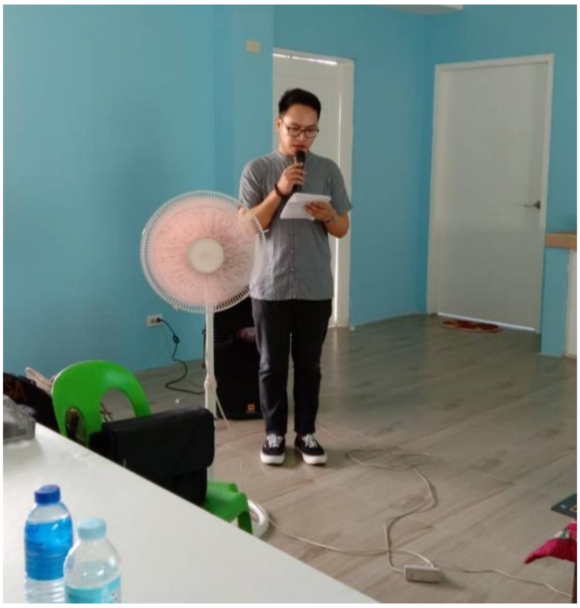
ATTENDANCE

Name	Designation/ Office/ Agency	Email/ Cel/Tel Number	Signature	Gender
37) Nemo Deromille	Mayor's Office	09289800960		Male
38) HAGO, RANDY	KRC	09274802314		M
39) PASION, RYAN A.	KRC	0946-276-0612		M
40) RICARDO CAPULE	KRC			M
41) MA. CARMELA CAPULE	KRC	09175276752		F
42)				
43)				
44)				
45)				
46)				
47)				
48)				

8. Photographs

Photo Documentation during Consultation Meeting in Municipality of Pulupandan

Registration period for Stakeholders



Opening Prayer

Hon. Marina Amacio delivering the welcome remarks to the stakeholders

Ms. Carmela Capule acknowledging the stakeholders

Ms. Carmela Capule, presentations on overview of the conduct of the public consultation and target objectives of the Environmental Impact Assessment (EIA)

Mr. Ricardo Capule, presentations on project outline and project details

Mr. Eduardo Moreno, Brgy. Kgwd. Brgy. Pag-Ayon

Ms. Virginia Cordeno, Brgy. Kgwd. Brgy. Zone 4A

Ms. Mila Lourdes Tandoy, Municipal Sanitary Inspector

Ms. Mary Jane Odelmo, Brgy. Kgwd. Brgy. Tapong

Barangay Captain Marina Amacio of Brgy. Pag-Ayon

Ms. Josenel Joy Salinas, Municipal Social Welfare Officer

Engr. Ligaya Maravilla, Municipal Engineer

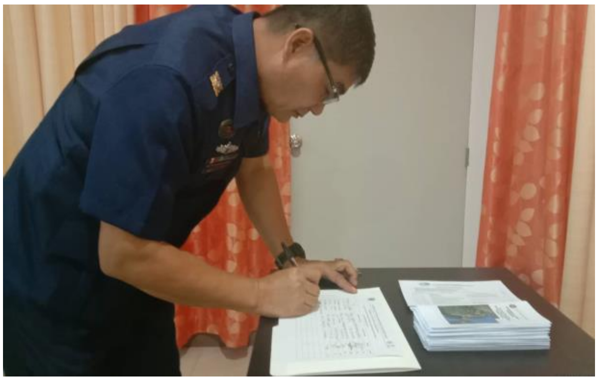
Mr. Jimwell Canedo, Brgy. Pag-Ayon

Mr. Ricardo Capule, Consultant, KRC

Ms. Yryne Valenzuela, P.I.O/Executive Assistant, delivering closing remarks and message to the stakeholders

Group photos of the Stakeholders and Consultants

Photo Documentation during Consultation Meeting in Buenavista, Guimaras




Registration period for Stakeholders

Ms. Ma. Leah Joy Gabayeron, EMS I/GENRO, Province of Guimaras delivering the welcome remarks to the stakeholders

Ms. Carmela Capule, presentations on overview of the conduct of the public consultation and target objectives of the Environmental Impact Assessment (EIA)

Mr. Ricardo Capule, presentations on project outline and project details

During presentation of Mr. Ricardo Capule with the Stakeholders

Hon. Eugenio G. Reyes, Municipal Mayor of Buenavista during question and answer

Mr. Eliodoro Millama, Brgy. Kgwd. Brgy. Cansilayan

Ms. Girlie Magilo, Municipal Agri-Fisheries Council

Hon. Rommel Infante, Brgy. Captain of Brgy. Salvacion and Ho. Victor Perez, Brgy. Captaion of Brgy. Getulio shared the affected areas of the alignment

Hon. Eugenio G. Reyes, Municipal Mayor of Buenavista delivering closing remarks and message to the stakeholders

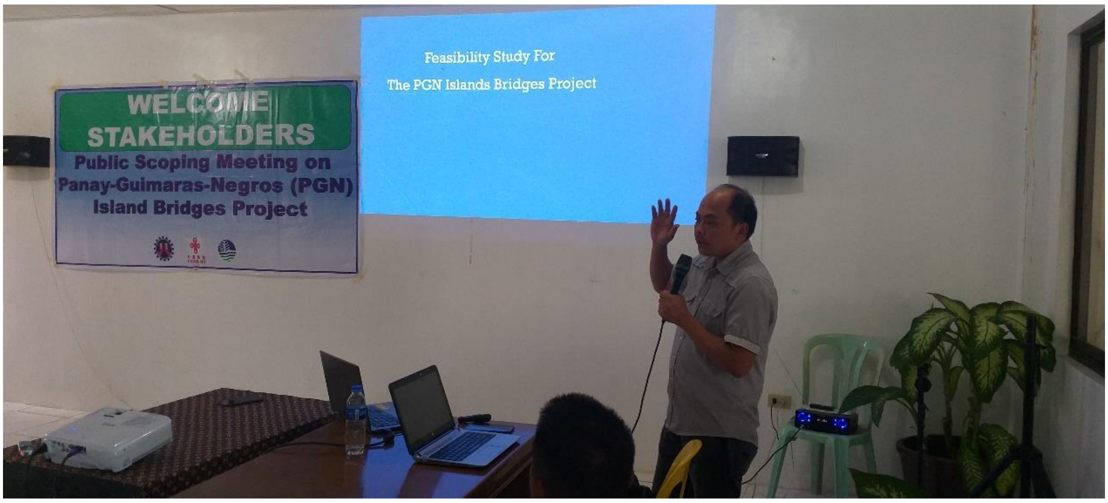
Group photos of the Stakeholders and Consultants

Photo Documentation during Consultation Meeting in Municipality of San Lorenzo, Guimaras


Registration period for the Stakeholders

Mr. Ibany Bonilla, Municipal Administrator delivering the welcome remarks to the stakeholders and consultants

Ms. Carmela Capule, presentations on overview of the conduct of the public consultation and target objectives of the Environmental Impact Assessment (EIA)



Mr. Ricardo Capule, presentations on project outline and project details

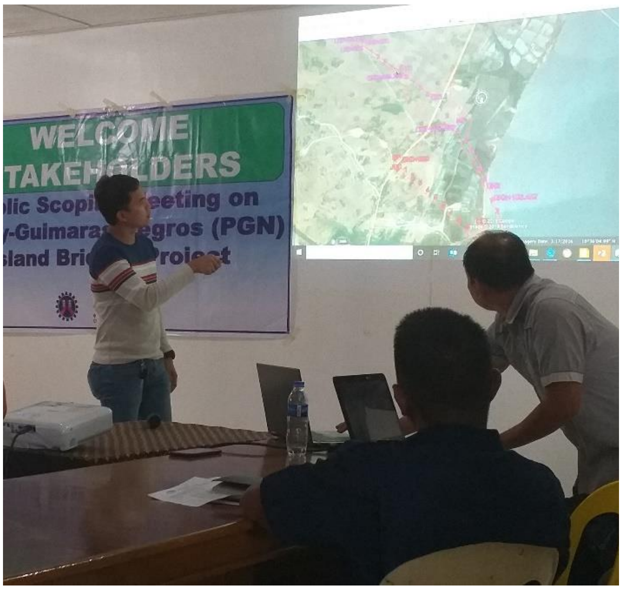
Engr. Claudio Cabrias, DPWH-Region VI, Showed the propose approach to the stakeholders the map of the bridge through the aid of Google earth

Ms. Chona Tabiano, Brgy. Kgwd. Brgy. M. Chavez

Mr. Rafael Tabiano, Brgy. Kgwd. Brgy. M. Chavez

During presetation of Ms. Carmela Capule with the stakeholders

Ms. Catherine Ann Gawara, Municipal Planning and Development Coordinator (MPDC)



Engr. Claudio Cabrias, DPWH-Region VI

Group photos of the Stakeholders and Consultants

Photo Documentation during Consultation Meeting in Municipality of Leganes, Iloilo

Registration period of the Stakeholders

Hon. Vicente “JunJun” Jaen II, Municipal Mayor of Municipality of Leganes, delivering the welcome remarks to the stakeholders and consultants

Ms. Carmela Capule, presentations on overview of the conduct of the public consultation and target objectives of the Environmental Impact Assessment (EIA)

Mr. Ricardo Capule, presentations on project outline and project details

Engr. Samson Jaspe, Sangguniang Bayan Member, Leganes

Representative from Philippine Coast Guard

Mayor JunJun Jaen, during question and answer

Engr. Claudio Cabrias, DPRW-Region VI, answering the question of Mayor Jaen

Mayor JunJun Jaen, suggesting the possible realignment

Mr. Jofel Coching, Zooligical Society of London-Philippines

Mr. Rodney Golbeque, Zooligical Society of London-Philippines

Mr. Rodito Jinon, Sangguniang Bayan Member, Leganes

Atty. Jeorge Gregorio, Leganes Premier Land Consulting

Group photos of the Stakeholders and Consultants

ANNEX 8.5.5

BASELINE STUDY INFORMATION

ANNEX 8.5.6

IMPACT ASSESSMENT AND EMP SUPPORT INFORMATION

ENVIRONMENTAL RISK CATHEGORIZATION
PROJECT ENVIRONMENTAL MONITORING AND AUDIT PRIORITIZATION SCHEME (PEMAPS)

Project Name	:	**Feasibility Study of Panay-Guimaras-Negros (PGN) Island Bridges Project**
Project Location	:	**Municipalities of Leganes, Iloilo, Buenavista and San Lorenzo, Guimaras, Pulupandan, Negros Occidental**
ECC Reference No.	:	**For application**
Proponent	:	**Department of Public Works and Highways-Unified Project Management Office (DPWH-UPMO)** **Virgilio C. Castillo** **Project Director, RMCI (B) - UPMO** **In Partnership with:** **CCCC Highway Consultants Co. Ltd.**
Address	:	**DPWH, Manila, Philippines**
Tel. No./Fax No./Email	:	
Project Type	:	**Road and bridge construction**
Project Status	:	**Feasibility study stage**

I. PROJECT CONSIDERATIONS

1.1. Size and Type

1.1.1. Size based on number of employees

Specify number of employees	**400 (skilled); 700 (unskilled)**

1.1.2. Type

ECP (in either ECA or Non-ECA)	✓
Non-ECP but in ECA	
Non-ECP and Non-ECA	

1.2. Waste Generation and Management

1.2.1. Enumerate Waste Type and Specify Quantity of Wastes generated in your facility.

Category	Waste	Type		Quantity
		Hazardous	Non-Hazardous	
Air	dust		✓	Minimal
	Emission			
Liquid	domestic		✓	To be determined
Solid	Domestic		✓	
	Construction debris		✓	
	Used oil, batteries	✓		**Minimal**

1.3. Pollution Control System (PCS)

1.3.1. Enumerate PCS or Waste Management Method Used in your facility.

Category	PCS/ Waste Management Method Used	Remarks
Air and Noise	Regular maintenance of vehicle and equipment	
	Regular water sprinkling; use of PPEs	
	Minimize night shift work during construction to avoid unwanted noise; use of PPEs	
	Good Sanitation Practice	
Liquid	Provision of septic tanks or Portalet; regular siphoning of domestic wastewater to accredited TSD facility	
Solid	Off-site treatment & disposal of used oil, busted lamps, contaminated oil rags, used electronic equipment and batteries	
	Segregation/Reuse and recycling	

II. Pathways

2.1. Prevailing wind towards barrio or city? Yes ✓ No ____

2.2. Rainfall (impacts surface & groundwater pathways)

2.2.1. Average annual net rainfall (specify amount in mm) **2,083** mm

2.2.2. Maximum 24-hour rainfall (specify amount in mm) ____ mm

2.3. Terrain (select one and mark) Flat ✓ Steep ____

2.4. Is the facility located in a flood-prone area? Yes ____ No ✓

2.5. Ground Water (Depth of groundwater table in meter) (select on and mark)

0 to less than 3 ____

3 to 10 ____

Greater than 10 ✓

II. RECEIVING MEDIA/RECEPTORS

3.1. Air (Distance to nearest community in km) (select on and mark)

0 to less than 0.5 ____

0.5 to 1 ____

Greater than 1 ✓

3.2. Receiving Surface Water Body

3.2.1. Distance to receiving surface water in km (select on and mark)

0 to less than 0.5 ____

0.5 to 1 ____

Greater than 1 ✓

3.2.2. Size of population using receiving surface water (specify number) n/a

3.2.3. Fresh Water

2.3.1. Classification of fresh water (select one and mark)

AA ______

A ______

B ______

C ✓ ______

D ______

2.3.2. Size of fresh water body (specify size) *Rivers* ______ km²

2.3.3. Economic value of water use ______

Drinking ______

Domestic ______

Recreational ______

Fishery ______

Industrial ______

Agricultural ✓ ______

3.2.4. Salt Water

3.2.4.1. Classification of salt water n/a

SA ______

SB ______

SC ✓ ______

SD ______

3.2.4.2. Economic Value of Water use ______

Fishery ✓ ______

Tourist zone or park ______

Recreational ______

Industrial

3.3. Ground Water

3.3.1. Distance to the nearest recharge area

0 to less than 0.5 ______

0.5 to 1 ✓ ______

Greater than 1 ______

3.3.2. Distance to the nearest well used

0 to less than 0.5 ______

0.5 to 1 ✓ ______

Greater than 1 ______

3.3.3. Groundwater use within the nearest well

Drinking ______

Industrial ______

Agricultural ✓ ______

3.4. Land

3.4.1. Indicate current/actual uses within 0.5 km radius

Residential ✓ ______

Commercial/Institutional ______

Industrial ______

Agricultural/Recreational ✓

Protected Area ______

3.4.2. Potential/proposed land uses within 0.5 km

Residential ______

Commercial/Institutional ______

Industrial ______

Agricultural/Recreational ✓

Protected Area ______

3.4.3. Number of affected Environmentally Critical Areas within 1 km:

Specify Number ______

3.4.4. Distance to nearest ECA (in km)

0 to less than 0.5 ______

0.5 to 1 ______

Greater than 1 ✓

IV. ENVIRONMENTAL PERFORMANCE (for existing projects for expansion)

4.1. Compliance

Law	Violation	Type (please specify number of times committed)				Type of Admin Violation	Additional Remarks/ Status of Compliance
		STANDARD					
		Emission/ Effluent/	Ambient	Human Impact	Admin/ ECC		
RA 8749	-	-	-	-	-	-	-
RA 9275	-	-	-	-	-	-	-
RA 6969	-	-	-	-	-	-	-
PD 1586	-	-	-	-	-	-	-
RA 9003	-	-	-	-	-	-	-

4.2. Number of Valid Complaints

4.2.1. Citizen and NGOs

Specify number n/a

4.2.2. Others (other Government Agencies, Private Institutions)

Specify number n/a

(To be filled up by EMB Personnel)

RECOMMENDATION/S:

____

____

____

Assessed by: Noted by:

____________________________ ____________________________