REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS

ROAD NETWORK DEVELOPMENT PROJECT IN CONFLICT – AFFECTED AREAS IN MINDANAO

(Parang-Balabagan Road)

ENVIRONMENTAL IMPACT STATEMENT (EIS) REPORT

CTI ENGINEERING INTERNATIONAL CO., LTD.

in association with

KRC Environmental Services

PROJECT FACT SHEETS

NAME OF PROJECT	**ROAD NETWORK DEVELOPMENT PROJECT IN CONFLICT – AFFECTED AREAS IN MINDANAO** **Parang-Balabagan Road**
PROJECT LOCATION	**Municipalities of Parang & Matanog, Maguindanao and Balabagan & Kapatagan, Lanao Del Sur**
ROAD WIDTH	**6.7 meters**
ROAD LENGTH (TOTAL)	**35.3 kilometers**
NAME OF PROPONENT	**Department of Public Works and Highways-Unified Project Management Office (DPWH-UPMO)** **Hon. Emil K. Sadain, CESO I** **Undersecretary for UPMO Operations and Technical Services** **In Partnership with:** **CTI Engineering International Co. Ltd.**
OFFICE ADDRESS	**DPWH, Manila, Philippines**
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Project Background

Within Mindanao, the ARMM remains the poorest region with poverty incidence of 55.8% in 2012. Likewise, the region's GRDP in 2015 accounts for only 0.7% of the Philippines' GDP with annual average growth in the last five years of merely 1.13% which is the smallest among the regions. Similarly, economic structure of the region reflects its position as less developed where agriculture accounts for more than half (59.1%) of the GRDP with industry accounts only for 2.7% and services accounts for 38.2%.

Recognizing the above, the GOP through DPWH has made a request to the Government of Japan to undertake feasibility study of 7 priority roads identified in the 2016 JICA assisted Bangsamoro Development Plan – II. Part of the tasks is to study the possibility of utilizing Yen loan as of the possible sources of fund to implement the identified projects. The Preparatory Survey started in August 2017 and is expected to complete in May 2018

The Road Network Development Project in Conflict Affected Areas in Mindanao is a Japan International Cooperation (JICA) assisted study in the Republic of the Philippines. The said study is awarded to CTI Engineering International Co. Ltd. in joint venture with Oriental Consultants Global Co., Ltd., and IC-Net Ltd. referred to as JICA Study Team.

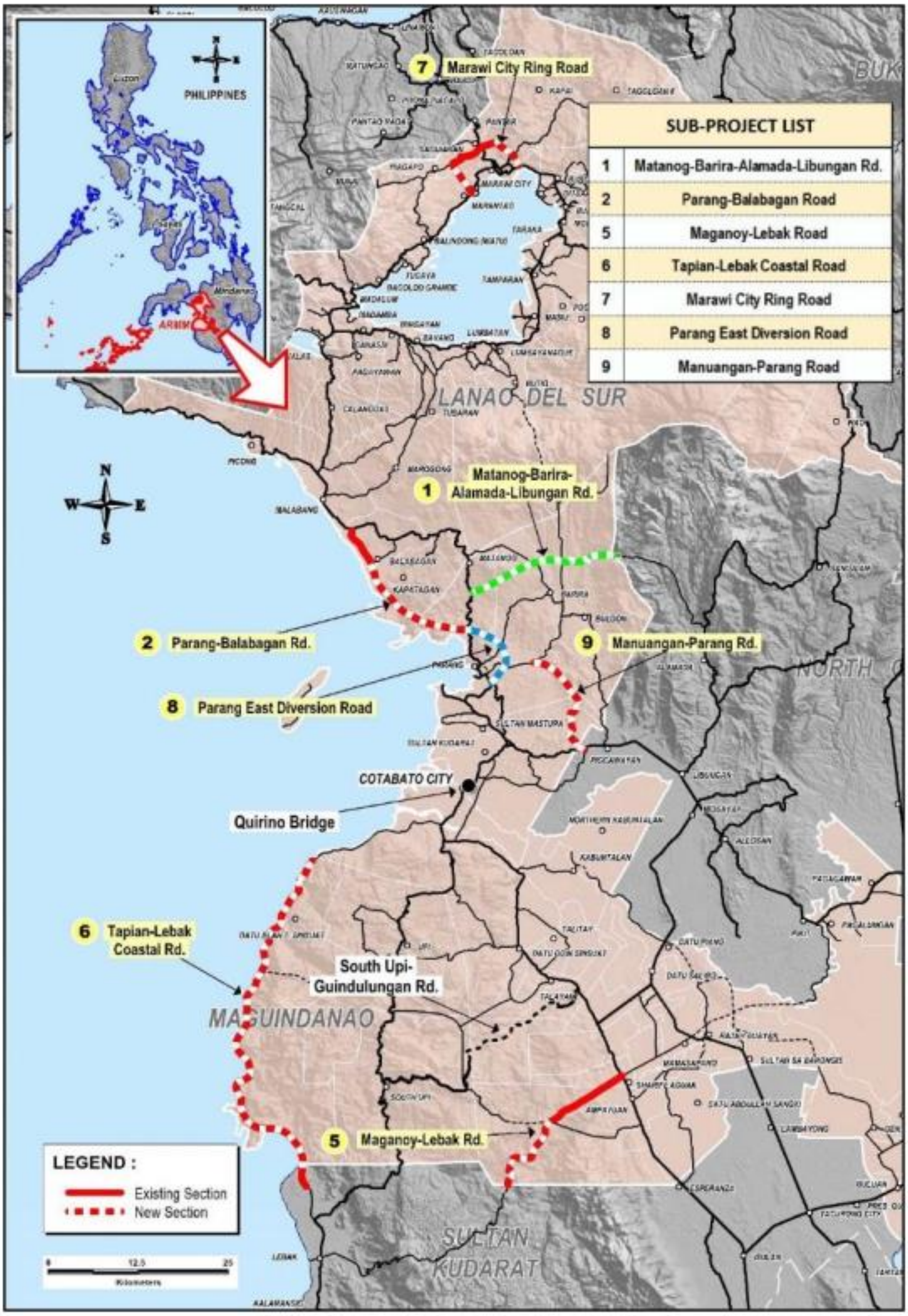
The project area has favorable natural conditions for agriculture –i.e. high temperature, plenty of rainfalls distributed throughout a year, dominant fertile soil and outside of the typhoon belt.

Infrastructure supply is also limited – ARMM for instance needs 800 km of new road to close the gap with other regions in Mindanao.

One of the reasons for delay of development is the presence of protracted armed conflict between the government and different armed groups (particularly MILF).

In recent years, efforts towards securing peace is gaining momentum, FAB (Framework on the Bangsamoro) was signed in 2014; BBL was submitted to Congress this August 2017.

For the region to recover, there's a need to complement the progress of the peace process by way of addressing the shortage of infrastructure supply in the region. Figure 1 presents the Road Network Development Projects in Mindanao.



Source: JICA Study Team

Figure 1 – Proposed Road Network Development Projects in Mindanao

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Acronyms and Abbreviations

AASHTO	:	American Association of State Highway and Transportation Officials
AFP	:	Armed Forces of the Philippines
AO	:	Administrative Order
APHA	:	American Public Health Association
ARMM	:	Autonomous Region in Muslim Mindanao
ASTI	:	Academy of Science and Technology Institute
AWWA	:	American Water Works Association
BBL	:	Bangsamoro Basic Law
BOD	:	Biochemical Oxygen Demand
BWC	:	Bureau of Working Conditions
CCC	:	Climate Change Commission
CENRO	:	Community Environment and Natural Resources Office
CLUP	:	Comprehensive Land Use Plan
CPDC	:	City Planning and Development Coordinator
CPDO	:	City Planning and Development Office
CRO	:	Community Relations Officer
CTII	:	CTI Engineering International Co., Ltd.
DA	:	Department of Agriculture
DBM	:	Department of Budget and Management
DENR	:	Department of Environment and Natural Resources
DED	:	Detailed Engineering Design
DEO	:	District Engineering Office
DGCS	:	Design Guidelines, Criteria and Standards
DILG	:	Department of the Interior and Local Government
DND	:	Department of National Defense
DO	:	Department Order
DO	:	Dissolved Oxygen
DOH	:	Department of Health
DOLE	:	Department of Labor and Employment
DOST	:	Department of Science and Technology
DOTR	:	Department of Transportation
DPWH	:	Department of Public Works and Highways
DRM	:	Disaster Risk Management
DRRMC	:	Disaster Risk Reduction and Management Council
ECC	:	Environmental Compliance Certificate
EIA	:	Environmental Impact Assessment
EIS	:	Environmental Impact Statement
EMB	:	Environmental Management Bureau
ESSD	:	Environmental and Social Safeguards Division
JICA	:	Japan International Cooperation Agency
JST	:	JICA Study Team
HSP	:	Health and Safety Plan
IEC	:	Information and Education Campaign
IEE	:	Initial Environmental Examination
IUCN	:	International Union for Conservation of Nature

Acronyms and Abbreviations

LGU	:	Local Government Unit
LWUA	:	Local Water Utilities Administration
MGB	:	Mines and Geosciences Bureau
MILF	:	Moro Islamic Liberation Front
MPDO	:	Municipal Planning and Development Office
NAAQGV	:	National Ambient Air Quality Guideline Values
NAMRIA	:	National Mapping and Resource Information Authority
NGO	:	Non-Government Organization
NGP	:	National Greening Program
NPCC	:	National Pollution Control Commission
NWRB	:	National Water Resources Board
OCD	:	Office of Civil Defense
OSHS	:	Occupational Safety and Health Standards
PAGASA	:	Philippines Atmospheric Geophysical and Astronomical Services Administration
PAPs	:	Project Affected Persons
PCA	:	Philippine Coconut Authority
PCO	:	Pollution Control Officer
PD	:	Presidential Decree
PHIVOLCS	:	Philippine Institute of Volcanology and Seismology
PENRO	:	Provincial Environment and Natural Resources Office
PM_{10}	:	Particulate Matter at 10 microns (µ)
PNRC	:	Philippine National Red Cross
PPE	:	Personal Protective Equipment
RA	:	Republic Act
RAP	:	Resettlement Action Plan
ROW	:	Right of Way
TSP	:	Total Suspended Particulate Matter
TSS	:	Total Suspended Solids
UPMO	:	Unified Project Management Office

EXECUTIVE SUMMARY

Project Fact Sheet

Project Type	**Road and Bridge Construction**
Project Name	**Road Network Development Project in Conflict Affected Areas in Mindanao** **Parang-Balabagan Road**
Project Location	**Municipalities of Parang & Matanog, Maguindanao and Balabagan & Kapatagan, Lanao Del Sur**
Project Size	**Width: 6.7 meters** **Length: 35.3 kilometers**
Project Components	Sub-Project 2 is divided into two (2) packages. Package 1: 20.6km (Road length: 19,860m, Bridge length: 740m) Package 2: 14.7km(Road length: 14,085m, Bridge length: 575m) 5 Bridges (Package 1), 5 Bridges (Package 2) Farm-to-market road Drainage & slope protection (Package 1): RCPC(910mmR 35places) 650m, RCPC(1,220mmR 2places) 37m, RCBC(1.25mx1.2m 14places) 211m, RCBC(1.5mx1.8m 1place) 51m, RCBC(3.0mx3.0m 5places) 132m, Grout Riprap 2,308m^3, Stone masonry 28,189m^3, Hand Laid Rock Embankment 10,911m^3, Concrete Slope Protection 7,761m^3 Drainage & slope protection (Package 2): RCPC(910mmR 27places) 617m, RCPC(1,220mR 8places)38m, RCBC(1.25mx1.0m 2places) 30m, RCBC(3.0mx4.0m 1place) 23m, Grout Riprap 2,720m^3, Stone masonry 48,198m^3, Hand Laid Rock Embankment 20,731m3 Miscellaneous work (Package 1) - Guardrail 9,860m, Chevron Signs 759ea, Road markings 11,330m^2, Coco-net 75,160m^2 Miscellaneous work (Package 2) - Guardrail 10,526m, Chevron Signs 767ea, Road markings 8,063m2, Coco-net 76,274m2 Package 1: North segment – Total 9.5km, Bridge No.1 – No.4 (L= 620m); Matanog branch office South segment - Total 11.1km, Bridge No.5 (L=120m); Lalabugan bay main office Package 2: Main Office - North side of Parang Branch Office - Lalabugan Bay Temporary Camp & facilities Batching Plant; farm to market road
Project Cost	**Mil PhP 3,897.00**
Man Power	**4,914 man-month (skilled)** **10,982 man-month (unskilled)**

Proponent Profile

Proponent	**Department of Public Works and Highways-Unified Project Management Office (DPWH-UPMO)** **Hon. Emil K. Sadain, CESO I** **Undersecretary for UPMO Operations and Technical Services**

In partnership with/ Represented by Email	**CTI Engineering International Co. Ltd.** Mr. Mitsuo Kiuchi Team Leader kiuchi.mitsuo67@gmail.com; kiuchi@ctii.co.jp

In Charge of ECC Application

Company Consultants with Contact Details	KRC ENVIRONMENTAL SERVICES Ricardo A. Capule (02) 5061409; (0917)713-2629 racapule@yahoo.com Marilou P. Avenido (0917)5109892 alot_avenido@yahoo.com Maria Carmela Q. Capule (917)527-6352 cqcapule@yahoo.com

DESCRIPTION OF THE PROJECT'S EIA PROCESS

The environmental impact assessment was undertaken based on the Procedural Manual for DENR Administrative Order No. 30 Series of 2003 (DAO 03-30) for the proposed project. The resulting study was documented in the form of an Environmental Impact Statement Report (EIS). Minimum required by DENR-EMB for the issuance of an Environmental Compliance Certificate (ECC) will be a detailed EIS.

The EIS as outlined in the revised procedural manual was used as basis in the conduct of this study.

The result of the EIS shall be used by the proponent as a tool in the formulation of appropriate environmental management plan for the proposed project.

EIS TEAM

KRC Environmental Services is composed of multi-disciplinary specialists with expertise in the conduct of Environmental Impact Assessment, EIS and other environmental studies. The following are the team composition.

Ricardo A. Capule	-	President / Air & Noise Quality Specialist
Marilou P. Avenido	-	Team Leader
Maria Carmela Q. Capule	-	Project Manager/Environmental Scientist
Milagrosa P. Asuncion	-	Sociologist
Abelardo H. Angadol Jr.	-	Terrestrial Specialist
Pablito C. Argamosa	-	Geologist
Virgilio M. Garcia	-	Hydrologist
Robert Pabiling	-	Aquatic/Marine Specialist

EIS STUDY SCHEDULE

The team was assigned to conduct the EIS study from November 2017 to March 2018. Public Consultations with Municipalities and Barangay Scopings were held on December 2017 and January 2018 respectively. 2nd Public consultations with Municipalities were held on February and March 2018.

Ocular inspection of the area to determine the exact location of the project site, to establish the primary and secondary impact areas, the existing land uses, the receiving body of water, ecological characteristics, geophysical feature, etc.

Both primary and secondary were collected and used in the environmental examination and assessment of impacts of the project. Different methods were used in gathering primary and secondary data:

- Meeting with the proponent and extensive discussion on the description of the project
- Gathering and review of secondary data from proponent, private and concern government offices.
- Actual site investigation, focus group discussion and consultative meetings
- Mapping using GPS, compass, topographic and google maps
- Actual water, air and noise survey
- Actual flora and fauna survey
- Actual investigation of socio economic profile and gathering and review of secondary data

EIS STUDY AREA

The scope of the study focuses on the probable adverse impact that may occur during the operation phase of the project on water, air, soil, health, people and the environment in general. The impact prediction is based on similar, past actual eventuality and perceptions based on the present physical condition of the environment

Based on the predicted impacts, the enhancement and mitigating measures were formulated to prevent the occurrence of such adverse impact. However, the limitation of the study is that it was only predictable based on the available primary and secondary physical and scientific data. The study area is within the direct impact which are Barangays Macasandag, Sapad, Kidama, Salaman, Matimos, Bakikis, Lusain, Banago, Narra, Lorenzo, Molimoc, Barorao, Batuan and Budas where the road alignment and right of way are situated while the indirect impacts are the surrounding barangays, the hosts and surrounding municipalities and provinces.

EIA METHODOLOGY

Scoping with DENR is usually done to define the range of actions, alternatives, and impacts that are to be examined. The project falls under **Item Major Roads and Bridges D.3.c (Roads, new construction, widening including RO-RO facilities)** with a total length of 65.7 kilometers having no critical scopes covered. The presented outline prepared by DENR in the Revised Procedural Manual for DAO 03-30 was used as basis to determine the actual scope of this study. **Table 1** presents the different components and methodologies of the project.

Table 1: Components and Methodologies of the Project

COMPONENT	METHODOLOGY
Project Description	Meetings with the proponent and actual site investigation
Baseline Environmental Condition	Secondary data gathered from the proponent, concern government offices and institution, actual gathering of flora and fauna, transect method in the identification of trees ,actual social-economic investigation.
Delineation of Impact areas	Annex 2-2 of Rev Procedural Manual DAO 2003-30
Impact Assessment	Qualitative assessment and expert opinion

Environmental Management and monitoring Plan	Template on Annex 2-17,2-18,2-19, 2-20 of the Rev. Procedural Manual of DAO2003-30
Secondary Data	Research, gathering and review of data from LGUs concern, PHIVOLCS, PAGASA, EMB, DPWH, CTI, LGUs

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

COMPONENTS/ SUBCOMPONENTS	KEY BASELINE FINDINGS
LAND	
Geology	The Project Area is dominated by volcanic plain or volcanic piedmont deposits, chiefly pyroclastics and/or volcanic debris usually found at the foot of volcanoes. Plateau basalt in Pagadian and Lanao regions, and non-active cones (generally pyroxene andesite) are also present.
Topography	Characterized by low elevations at the upper half that form the transition area between the coastal plain and hilly areas. The lower half of the road alignment is generally steep due to the presence of Mt. Abunabun.
Geomorphology	The mountainous areas in the region consist chiefly of basement and Tertiary volcanic rocks; while Tertiary sedimentary rocks predominate in lowland areas. A cluster of inactive volcanoes with associated volcanic lakes in Lanao del Norte and Lanao del Sur.is collectively called the Lanao Volcanic Complex. The volcanoes include Mt. Gadungan, Dos Hermanos Peaks, Mt. Cabugao, Mt. Iniaoan, Lake Nunungan, Mt. Catmon, Mt. Sagada, Mt. Puerai and Gurain Mountains. The Lanao Volcanic Complex is assigned an age range of Pliocene – Pleistocene on the basis of available information.
Terrestrial	
Flora	Survey on the terrestrial component of the proposed road project alignment was undertaken within the municipalities of Parang, Kapatagan, and Balabagan. The 9 observation sites for flora and faunal species are situated in 8 coastal barangays namely: barangay Makasandag in the municipality of Parang, Matimos, Salaman, and Bakikis in the municipality of Kapatagan, and Batuan, Narra, Lorenzo, and Barorao in the municipality of Balabagan. Land cover are sampled sites are aggregates of agricultural areas, shrub lands, and grassland and near settlement sites. Elevations of selected observation sites are in between 5 to 100 meters above sea level which topography is from nearly flat to moderately sloping. **Floristic** composition of the alignment with reference to the sampled sites divulges a total of 88 species belonging to 77 genera 35 plant families dominated by family Fabaceae. Relative to the plant category, the majority of the plant species are trees (54.55%); seconded by grass and herb (11.36%), followed by shrubs (9.09%); vines (6.82%); fern (4.55%), and palm trees (2.27%). Species dominating the canopy layer is the Niog (*Cocus nucifera)* interspersed with some forest tree species such as Gmelina or *Gmelina arborea,* Tan-ag (*Kleinhovia hospita*) and kakauate (*Gliricidia sepium*).

	Understory species is dominated by Banana (*Musa sapientum)* in aggregation with poles size Gmelina (*Gmelina arborea)* trees. On the other hand, in the ground layer are primarily dominated by grass and herb species such as the blue grass (*Poa* sp.), Mani-manian (*Arachis pintoi*), Dilang Butiki (*Centrosema pubescens),* and Kudzo (*Pueraria montana)*. The computed biodiversity index of the study area reveals a low diversity composition. The conservation status of species identified on site with reference on the Asia Life Science- The Asia International Journal of Life Sciences "Threatened Plant of the Philippines: Preliminary Assessment 2008"; International Union for Conservation of Nature (IUCN) Red List of Threaten Species (2006); and DAO 2007-01 entitled "The National List of Threaten Plants under Categories, only the Narra (*Pterocarpus indicus*) species is identified to be on the list, and categorize as critically endangered.
Fauna	The result of **fauna** survey registered a total of 30 species of Aves belonging to 21 families with a total abundance of 166 accounted within the 9 observation sites. Of the 21 bird families, Columbidae and Ardeidae are the dominant families represented by 4 species of Dove and 3 species of herons, respectively. With regard to species abundance, the Chestnut Munia (*Lonchura malacca*) and Pacific Swallow (*Hirundo tahita*) under family Estrildidae and Hirundinidae are the abundant species within the assessed area. The aforesaid species has an observed population of 35 and 17, respectively. In terms of species, relative frequency showed that the White-Collared King Fisher (*Halchyon chloris*), Zebra Dove (*Geopelia striata*), Eurasian Tree Sparrow (*Passer montanus*), and Pacific Swallow (*Hirundo tahita*) has the highest relative frequency of 7.018 %(each of the species). Other fauna species found within the study area also includes 3 species of mammals, 1 reptile, and 2 species of amphibian. Note that 2 of the recorded species (Civet Cat and Large Field Rat) are included based on the result of an interview with local informants which recurrent encounter with this wildlife had been told. In terms of avifaunal species endemicity, only 5 species are found to be endemic in the country and the rest of the recorded species are native/non-endemic species. Among the endemic species is the Grey Hooded Sun Bird *(Aethopyga primigenius),* Pygmy Flower Pecker *(Dicaeum pygmaeum),* Guaiabero *(Bolbopsittacus lunulatus*), Barred Rail (*Gallirallus torquatus*) and the White-Eared Brown Dove (*Phapitreron leucotis*). On the hand, only the Greater Musky Fruit Bat (*Ptenochirus jagori*) from herpeto-fauna is endemic in the country. Conversely, the Marine Toad (*Bufo marinus*) is introduced species in the country. Biodiversity indices particularly Shannon-Wiener Diversity Index (H') and Pielou's Evenness Index (J') were computed for this survey using the avifaunal data. The overall computed biodiversity index, interpreted using the Fernando's Biodiversity Scale (1998) showed a **very low biodiversity** with **very high species evenness**. With reference to the International Union for Conservation of Nature (IUCN) (2017), the conservation status of recorded species within the project area has no Critically endangered nor endangered species in the category. Of the 30-fauna species observed only the Grey-Hooded Sunbird (*Aethopyga primigenia*) is under Near Threatened in the category. The rest are under least concern in category and others are not evaluated.

WATER	
Hydrology/Hydrogeology	The river systems that affect the proposed road alignment are the Tigatan, Matimus, Salanga, Abunabun and Muda Rivers and Diarong Creek**.** During the conduct of field investigation, no ground water wells or springs were found that may be affected by the project but based on the data from the National Water Resources Board (NWRB), two springs are within the vicinity of the road alignment namely; Macasandag Spring and Libuan Spring. These springs are used for municipal and irrigation purposes respectively. In general, the proposed alignment has a low susceptibility to flooding.
Surface Water Quality	Surface water samples were sampled on November 16, 2017 with cloudy to slight rain showers experienced. Surface water samples were collected at Budas River and Matimos-Minoan River in Balabagan and Kapatagan, Lanao del Sur respectively. Based on the results, Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD), pH and TSS meet the criteria guidelines of the DENR Administrative Order No. 2016-08, Water Quality Guidelines and General Effluent Standards of 2016. It should be noted that DENR does not have regulatory standard for Turbidity.
Marine Ecology	A total of 22 phytoplankton species belonging to diatoms (9 genera) and dinoflagellates (13 genera) was recorded during the sampling conducted in the proposed road expansion project in Matanog, Maguindanao and Kapatagan, Lanao del Sur. *Coscinodiscus spp*. is most abundant species recorded. Dinoflagellates were observed all stations and were dominated by *Protoperidinium* spp. The potentially harmful phytoplankton species observed are *Pseudonizschia* spp. and *Dinophysis caudata*. The overall impression of the phytoplankton community during this survey is poor as indicated low phytoplankton abundance, richness and overall diversity. However, the presence of potentially harmful species should have a good monitoring system after the project has been successfully established. A total of 15 zooplankton groups (adult and larval forms) were identified in four stations in the vicinities of proposed road expansion project in Matanog, Maguindanao and Kapatagan, Lanao del Sur Copepod count was the most dominant zooplankton group. Larval zooplankton life forms had 9 groups recorded during this survey. The large portion of the larval zooplankton was represented by copepod nauplii. Calanoid copepod was the most abundant of the adult zooplankton. Other important group like gastropod veliger and bivalve veliger also contributed significant portion of the total zooplankton count. Fish larvae were not observed in any samples during this survey. There were no rare or endemic zooplankton species found in the area and majority of the groups are common and cosmopolitan in distribution. A total 2,818 individuals of benthic macroinvertebrates belonging to 27 groups/families were recorded. The families identified belonged to seven major phyla i.e Annelida, Nematoda, Arthropoda, Retaria, Echinodermata, Mollusca and Chordata, in decreasing level of abundance . Phylum Annelida accounted for 43% of the total macrobenthos abundance, followed by Arthropoda with 18%, Retaria with 16% and Nematoda with 16%. The polychaetes are the most family rich group with 13 and also among the most commonly occurring phylum. Among the polychaetes, the

	family Spionidae constituted 13% of the total macrobenthos making it most abundant annelid. Coral distribution of Sapad reef is patchy, interspersing with areas covered with sand and silt over a shallow gradually sloping reef (2-8m depth). Coral bommies provide topographical relief for the reef. Dominant corals are the sub-massive *Euphyllia, Fungiids* and some encrusting *Porites.* The reef is not well developed extending a short strip from the coastline (<100m) fringing along Brgy. Kidama shoreline. The rich coral reef lies in shallow clear water extending in depths of 2 -8 meters. The survey area is part of the reef system fringing along the coastline of Brgy. Lusain in Kapatagan. The coral reef lies in depths ranging from 3-12 meters, sloping 80° downwards with 5-10m water visibility. The survey area is part of the reef system fringing along the coastline of Brgy. Lusain in Kapatagan. The coral reef lies in depths ranging from 3-12 meters, sloping 80° downwards with 5-10m water visibility. The coral reefs in the coast of Bakikis are not developed. It is characterized with black sandy substratum gradually sloping to deep water. Generally, the coastline of Matanog-Kapatagan municipalities developed shallow fringing reefs that extend narrow strips along the shores. Most of the reefs sloped abruptly towards the deep water except the coral reef of Brgy. Sapad are gradually sloped down to silty bottom. The results showed that the coral reefs in these areas have a mean live hard coral cover of 41.5% and categorized to be in "fair" condition, which is high above the average live coral cover (32.3%) of the Philippines. The non-*Acropora* species dominated the reef areas, represented mostly of massive *Porites.* Some encrusting *Porites* and mushroom *Fungia* genera were also observed. On the average, dead coral with algae has 31.2% cover, while other fauna, abiotic component and algae have only 13.3%, 11.8% and 1.5%, respectively
AIR	
Climate	The area belongs to Type III climate according to the Modified Coronas Classification from which seasons are not very pronounced, relatively dry from November to April and wet during the rest of the year.
Rainfall	The nearest PAGASA synoptic station is in Cotabato City. Based on the data from this station the average annual rainfall from a 30-year record is 2487.8 millimeters. The rainiest months are from May to October.
Temperature and Humidity	The annual mean temperature is 27.8ºC with high temperature of 28.6ºC in April and low temperature of 27.3ºC in July. The lowest recorded temperature of 18.9ºC occurred on 26 January 2014 while the highest recorded temperature was 37.7ºC which occurred on 28 March 1997. The average wind speed is 2 meters per second distributed over the whole year at NNW direction. Relative humidity averages from 73% to 76% and vapor pressure averages from 28.4 millibars to 29 millibars. Mean sea level atmospheric pressure varies from 1012.6 millibars to 1011.2 millibars, with higher value in February then lower in October.
Ambient Air Quality	Air Samples were collected December 12-14, 2017 at Brgy. Salaman, Kapatagan and Brgy. Poblacion, Balabagan, Lanao del Sur. Total Suspended Particulates, Particulate Matter at 10 micron, Sulfur Dioxide and Nitrogen Dioxide were measured. 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 are within the allowable limits.
Noise	Ambient noise levels around the project sites have exceeded the National Pollution Control Commission (NPCC) allowable limits for residential areas. During morning and daytime, noise levels were within the allowable levels of the DENR. Noise levels during evening and nighttime are slightly higher where noise coming from animal such as barking from dogs, rooster's crow, sounds from insects such as crickets etc. may have impacted the increase in sound measurement. Most of the noise sources measured came from animal and insects during nighttime and wind propagation. Activities from residents near the sampling area also influenced the sound measurements during morning time.
PEOPLE	
Population	The Parang-Balabagan Road SP 2 is located in two (2) Municipalities of Maguindanao and two (2) municipalities of Lanao del Sur covering a total of 14 barangays. In terms of population of barangays in SP 2, the largest population is 6,041 in Sapad of Matanog, while the smallest is Matimos in Kapatagan. In Maguindanao province, three barangays have more than 40 percent of the total population.
Affected Families and Persons	Based on RAP report, the total number of households to be affected by alignment is 110 and total PAPs is 155.

SUMMARY OF PUBLIC PARTICIPATION

A total of 22 stakeholders' meetings were held for SP 2 from December 2017 to March 2018. The stakeholders' meetings/ public consultations conducted (1st Public Consultations, Barangay Scoping and 2nd Public Consultations) are the Information, Education and Communication (IEC) based on the Philippine EIA guidelines held in the municipal halls of Parang, Matanog, Kapatagan and Balabagan with the affected stakeholders, barangay and municipal officials, and concerned LGU offices such as Assessors, MPDC as shown in **Table 1**. Public consultations were attended by 596 participants (Male -441 and Female – 155) while barangay scoping were attended by 249 male and 67 female.

Summary of the salient issues and concerns raised, as well as comments and suggestions made are summarized in the table below. Responses to queries are also included in the Table.

Queries/Concerns/Suggestions/Comments	Response to Queries
Project affected without land title	Based on the discussion with JICA during our meeting in Manila last November 2017, DPWH will compensate the affected land owner. In absence of land/lot title and other supporting documents will not be compensated from DPWH. Land owners should secure proper documents. For affected without land titles, we will compensate the cost of the properties affected. The government thru DPWH will be fare for those affected with and without land titles. We will include this in our study and the estimated cost of the affected properties.
Land within military reservation	There are government policies that we follow if under public lands such as the military. The affected properties, trees and displacement of habitat will be included in the computations but not the payment of the land. The alignment of

	the project is not yet final. We will provide a copy of the results of the inventory per Barangay level for their information and confirmation.
To avoid muslim cemetery	We will always consider and respect the heritage area for the benefit of the culture of the affected community. We need your cooperation during the survey in your community. All affected will be listed and be reported to JICA for consideration in the finalization of the project design
Realignment of the proposed road in Matanog and Parang	Suggestion will be noted and included in the report. This should also raise during the Steering Committee so that JICA/DPWH will consider the concern in finalizing the project design
If the design of the road PWD friendly	The road will follow the design road guidelines of DPWH. It includes the signage and pedestrians especially for schools. We will consider the needs of PWD particularly in pedestrians
Alignment of the proposed project	(Presented the alignment of the Project) This however might be changed in the detailed engineering
If who will pay the compensation of affected land, house, trees and crops	DPWH will be the implementing agency and will pay the acquisition of all affected land, structures after the inventory of RAP team considering the rules and regulation adopted by DPWH
If all the affected people's land will be acquired	You will be compensated and provided assistance (i.e livelihood)
If trees are included for compensation	Yes, it will be compensated as long as included in the inventory conducted by RAP team. DPWH will pay based on their guidelines.
Needed documents to be compensated	Certificate of land title or tax declaration certified by LGU. For the cost that wanted by the owners, we will negotiate that to DPWH based on their guidelines and by what is present cost of the said land, structures for compensation. Also, we will coordinate to the municipal assessor.
Basis for compensation	RAP team will present the details on compensation based on the laws and policies of the Philippine Government on land acquisition.
Realignment to avoid air strip in Balabagan	Write a resolution and submit it during the steering committee. The resolution will be helpful and provide advance information to JICA and DPWH on the plan of the municipality especially the Air Strip area.
If the proposed project is a continuation of the ongoing road construction in our barangay that was implemented by Mayor (Kapatagan)	This ongoing road construction implemented by DPWH ARMM was discussed during the first steering meeting in Manila. This proposed national road project is different location and far from the ongoing road construction.
If one affected barangay will disapprove the proposed project	The project will be realigned or even will not continue. Based on the consultations

	conducted, all of the barangay and LGUs we have visited are very supportive on the project. The DPWH said mentioned during one of the public consultation that if the proposed national road will be constructed, the interior road going to the barangays are planned to be connected to this.
Area occupied by the road project in meters	Team responded that only 30 meters will be occupied
Submission of documents for compensation	RAP team will explain the process for compensation. They will conduct separate scoping
Get the trees that will be cut	This depends to DENR. They have processes regarding tree cutting.
Negative effects to the students on noise and air during construction	The team explained that there will be negative effect but will be mitigated through measures identified in the study. The constructor should follow the said measures to minimize impact on noise and air. Also, the residents can monitor if the contractor will not follow the environmental management plan.
Occurrence of floods	There are studies to avoid flooding in the area. This will be considered in the detailed engineering.
Compensation prior to construction	This will be noted. Private property owners are advised to prepare proof of ownership such as titles, certifications or declarations for them to be compensated
Prioritization of Local in hiring	This will be recommended to the proponent considering that they are qualified for the job.
Informing the PAPs during the inventory	The team will coordinate to RAP team for proper coordination and information dissemination to the affected families. The RAP team will present the detail and results of their assessment.
Closely coordinate with the PAPs	Yes, this will be noted
Provision of livelihood program or support especially for the affected households.	This will be recommended to the proponent for the possibility to provide livelihood program for the affected households/families.
Safety to pass the road (from terrorist)	Security will be tightened when project will be implemented. The government will not allow this terrorism to happen.
Requested a farm to market road	It is not part of the project but will be noted for considerations. The barangay officials can submit a resolution to Municipal Officials for endorsement to DPWH or other government agencies
Requested water system and electricity	It is not part of the project but will be noted for considerations. The barangay officials can submit a resolution to Municipal Officials for endorsement to DPWH or other government agencies

Photo 1: Mr. Hja Mardiah Panguntungan, Brgy. Bakikis raised her regarding the loss of their land due to road construction (Kapatagan)

Photo 2: Mr. Malik Bilalag, Brgy. Salaman asked what will happen to those land without titles (Kapatagan)

Photo 3: Ms. Modesta G. Aranego, Consultant of Municipal Population Office (MPO) on what will happen to barangay affected (Balabagan)

Photo 4: Ms. Merlita A. Dagandar, inquiry on those affected witout land title (Balabagan)

Photo 5: Abdul M. Ariman- quiry on land without titles (Parang)

Photo 6: Ramil Mama – Chairman, PDAO (PWD) stated if the road is accessible for all, with signage and PWD friendly (Parang)

Photo 7: Rudy A. Cabahug – Fisher folk, MFARMC Brgy. Macasandag quoted, "We need this project for our children and to the next generation. We need to support for the development in our community. We are thankful to JICA and DPWH for their continuous support" (Parang)

Photo 8: Ms. Baitan Ginta, Budget Officer, Mun. of Matanog regarding the documents needed to be compensated (Matanog)

Photo 9: Mr. Norodin Mang-kay requesting a farm to market road for easier access of their harvested products (Matanog)

Photo 10: Mr. Malik Cadal, Brgy. Sapad inquiring the road alignment of the proposed project (Matanog)

SUMMARY OF KEY IMPACTS and MITIGATING MEASURES

It has been determined that most of the negative impacts will be during construction phase In terms of environmental impacts, the main components that need to be managed are: compensation and relocation of displace residence and structures, dust and noise suppression, traffic management. Positive Impacts is expected during Operation Phase.

Environmental Component Likely to be Affected	Impacts	Duration and Types of Impacts	Intensity of Impacts	Mitigation/Enhancement Measures
Pre-Construction and Construction Phases				
The Land				
Geology	Ground Shaking: - The proximity of active faults to the proposed road alignment makes it susceptible to moderately strong to strong ground shaking.	Long-term, negative	High	• Conduct a site specific Probabilistic Seismic Hazard Assessment (PSHA) to quantify the rate (or probability) of exceeding various ground-motion levels. • Determine the Design Basis earthquake (DBE) and Maximum Credible Earthquake (MCE) to define the Peak Ground Acceleration (PGA) resulting from the movement of specific earthquake generator. • The ground acceleration within the study area is estimated to be 0.21g for bedrock and about 0.60g for soft soils, which should be considered in determining the seismic coefficient during the design of foundation of the proposed road project.
Slope	Destabilization of slope	Short-term, negative	High	• Set-up temporary fence around the construction area • Conduct slope stability analysis and construct silt trap and spoils disposal area
Terrestrial Ecology	Removal of vegetation and habitat disturbance	Long-term, negative	High	• 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.
	Loss of planted trees, agroindustry trees such as coconut, and high-value commercial crops/trees such as banana, mango,	Long-term, negative	High	

Marine Ecology	Threat to Plankton Community	Long-term, negative	High	• 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 marine habitat since the project will focus on the upland areas. However, as part of the monitoring program, marine ecology monitoring will be conducted congruently within the marine water quality stations. This ensures correlation of results of the biotic cover with that of the abiotic and physico-chemical parameters.
	Threat to benthic community	Long-term, negative	High	
Freshwater Ecology	Threat to Existence and Loss of Important Local Species	Long-term, negative	High	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.
	Loss of Habitat	Long-term, negative	High	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.
The Water				
Water Quality	Increase in coliform level due to improper management of domestic and solid wastes	Short-term, negative	Medium	• Provision of temporary sanitation facilities such as portalets and trash bins to properly manage solid and domestic wastes to be generated by the at construction workers, particularly near the waterways; • Strict implementation of proper waste segregation scheme; • Strict implementation of daily inspection of the areas provided with temporary sanitation facilities to ensure proper waste management • Site clearing will be limited to areas needed and restricted to acceptable weather conditions • No clearance or establishment works will be undertaken along the riverbanks during high rainfall conditions to reduce the risk of sediment loss to the environment • Set up adequate toilet facilities; ensure sufficient washrooms for workers
	Generation of wastewater from cleaning of construction equipment, vehicles and regular watering activities	Short-term, negative	Medium	
	Contamination of surface water with oil and grease	Short-term, negative	Medium	

				• Installation of silt traps to contain inflow of muddy waters • Installation of oil traps and proper storage of used oil
The Air				
Air Quality	Possible increase the TSP levels of due to resuspension of dust particulates	Short-term, negative	High	• Exposed and cleared construction areas will be regularly sprayed with water to minimize dust re-suspension; • Temporary stockpiles of excavated materials and construction spoils must be covered with tarpaulin or sack materials to prevent resuspension of particulate matters; • Construction spoils will be regularly hauled and disposed to areas duly-approved by the DENR/LGUs
	Possible increase in the ambient concentration levels of NO2 and SO2 due to operation of various construction vehicles, equipment, and machineries	Short-term, negative	High	• Periodic Maintenance Service (PMS) of construction vehicles, heavy equipment and machineries must be regularly conducted to ensure these are in good working condition; and • Daily routine check-up of construction vehicles, equipment, and machineries must be strictly complied with
Noise Level	Possible increase in the noise level in the area due to operation of various construction equipment and machineries	Short-term, negative	High	• Bored piles using a special boring equipment will be adopted during foundation works instead of pile driving; • Noise suppressors will be installed to maintain noise generated by various heavy equipment and construction machineries at permissible limit; • High noise generating activities will be done during the daytime to minimize noise disturbance to adjacent residential areas; and • Temporary noise barriers will be installed at noise sensitive areas such as residential, schools, and

				places of worships to maintain noise level at permissible limit
Communities along the Alignment	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.	Short term, negative	High	• 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. • Consultation with landowners, farmers, tenants with regards to the development of an acceptable land acquisition and compensation package.
Assets and Properties	Loss of private lands, settlements (110 Affected HHs, 155 PAPs, 8 residential Structures, 1 commercial, 3 cemetery)	Long term, negative	High	• Determine conditions of the affected people and tagging of existing structures as control measures. • Provide food, transport and livelihood assistance, and orderly dismantling of structures • Determine exact legal status of these displaced individuals and implement measures to compensate and restore/ improve their standard of living • Involve these affected individuals in the planning of their relocation to secure their commitment and sense of ownership of the program • Create a grievance committee that will arbitrate, address matters of claims and disputes with regards to compensation or benefits • Acquisition of private properties will be limited to the required 30 m RROW • Prompt payment of compensation at fair market values for land (DPWH R.A. 10752). Compensation and relocation concerns should be closely coordinated with the LGUs, barangay and affected community. A detailed Resettlement Action Plan will 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.
Employment	Generation of temporary employment	Short-term, positive	High	Qualified skilled workers and laborers in the Direct Impact Areas (DIA) duly endorsed by the Brgy. Captains will be given priority in hiring during implementation of the project. This will reduce numbers of migrant workers
Public health	Possible spread of communicable diseases due to solid and domestic wastes generated by the construction personnel	Short-term, negative	Medium	• Temporary sanitation facilities such as garbage bins and portable toilets must be provided by the Contractor at the construction area; • Regular disposal of the solid and domestic wastes to the designated disposal areas duly-approved by the host and affected LGUs must be strictly complied with • Weekly inspection of the work sites must be undertaken to ensure proper management of the solid and domestic wastes generated
Occupational health	Construction personnel, particularly operators of heavy equipment and machineries may experience upper respiratory ailments and may likewise experience temporary hearing problems	Short-term, negative	Medium	• Construction personnel will be provided with Personal Protective Equipment (PPE) such as protective masks, ear muffs, and hard hats, and related gears • First aid stations supervised by the Environment and Safety Health Officer (ESHO) of the Contractor will be located within the construction site
Temporary Employment and Small-scale Business Opportunities	Availability of temporary employment during construction period. Female members of the community, particularly wives of tenant farmers can	Short-term, Positive	High	• Qualified skilled workers and laborers in the DIA will be given first priority in hiring during construction period • Applicant workers will be required to secure certification from their respective barangays to confirm residency status in the area; • Strict screening of female members of the community to ensure that those who will be given priority in the business concessions to be created are the directly affected persons

	engage in small scale business enterprises such as eateries, and supply of other goods and services			
Traffic	Traffic congestion during transport of construction materials and in the construction area	Short-term, negative	Medium	• Approved Traffic management Plan (TMP) and re-routing schemes will be strictly implemented to minimize traffic congestion on said road junctions; • Parking time of idle construction vehicles and equipment along the major roads will be limited, especially during rush hours; • Transport of fabricated construction materials will be done during nighttime;
Operation Phase				
The People				
Basic Services	The new road will provide easier transport of products from Farm to Market	Long term, positive	High	Care and proper maintenance of the road to lengthen the benefits of the communities
Abandonment Phase				
Land	Land degradation	Long-term	High	• Preparation and implementation of comprehensive abandonment management plan • Proper clean-up and decontamination of affected site • Proper demolition of temporary construction yard and facilities • Disposal of hazardous waste

Summary of Compliance Monitoring

Key Environmental Aspects per Project Phase	Potential Impacts per Environmental Sector	Parameters to be Monitored	Sampling & Measurement Plan			Lead Person
			METHOD	FREQUENCY	LOCATION	
CONSTRUCTION PHASE						
Environmental Aspect	Fresh Surface Water Quality Stations: Major river tributaries River sediments	Surface Water Total Suspended Solids (TSS), pH, BOD, DO, Oil & Grease, Color, turbidity -Heavy metals (As, Ba, Cd, Cr, Cu, Pb, Hg,Se,F)	Grab Sampling RA 9275 RA 6969	Monthly Semi-annual	Upstream; midstream and downstream Sampling point to be monitored should be within the project site Same stations with fresh surface water quality	Pollution Control Officer (PCO)
	Air Quality Proposed site locations upwind and downwind	Total Suspended Particulates (TSP)	1-hr Sampling per RA 8749	Monthly	Upwind; downwind; NSEW direction	PCO
	Noise Quality Same as air station	Ambient Noise (especially during drilling activities)	Grab sampling	Monthly/ Weekly during drilling	Upwind; downwind; NSEW direction	PCO
	Solid Wastes	Construction debris, papers, plastics, biodegradable waste		Daily	Construction site / SW storage area	PCO
	Wastewater (domestic)	TSS, BOD, pH, Oil & Grease (canteen)	Grab Sampling RA 9275	As necessary	Common septic tanks for toilets & canteens	PCO
	Chemicals & Hazardous Wastes	Used oil, busted lamps Used paints, spent solvents	Individual segregation & collection		Storage Area/ Motorpool	PCO
	Socio-economic	Displacement of informal settlers; relocation Recruitment/ hiring for manual labor & other skills available within the Host Barangay & nearby communities			Project location	Community Relations Officer (CRO)

	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 Soil Nutrients, Plant Tissue Nutrients	Line transect/ quadrat / trap	Annual	Within project vicinity and its affected barangays	PCO
ABANDONMENT PHASE (IMMEDIATE AFTER CONSTRUCTION PHASE)						
Environmental Aspect Land	Clearing of construction debris; removal of construction equipment	Soil: -Heavy metals (As, Ba, Cd, Cr, Cu, Pb, Hg,Se,F)	Systematic sampling: Several Grab and composite Sampling	As prescribed	Contaminated sites	PCO

Environmental Monitoring Fund (EMF) and Environmental Guarantee Fund (EGF) 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 500,000.00 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.

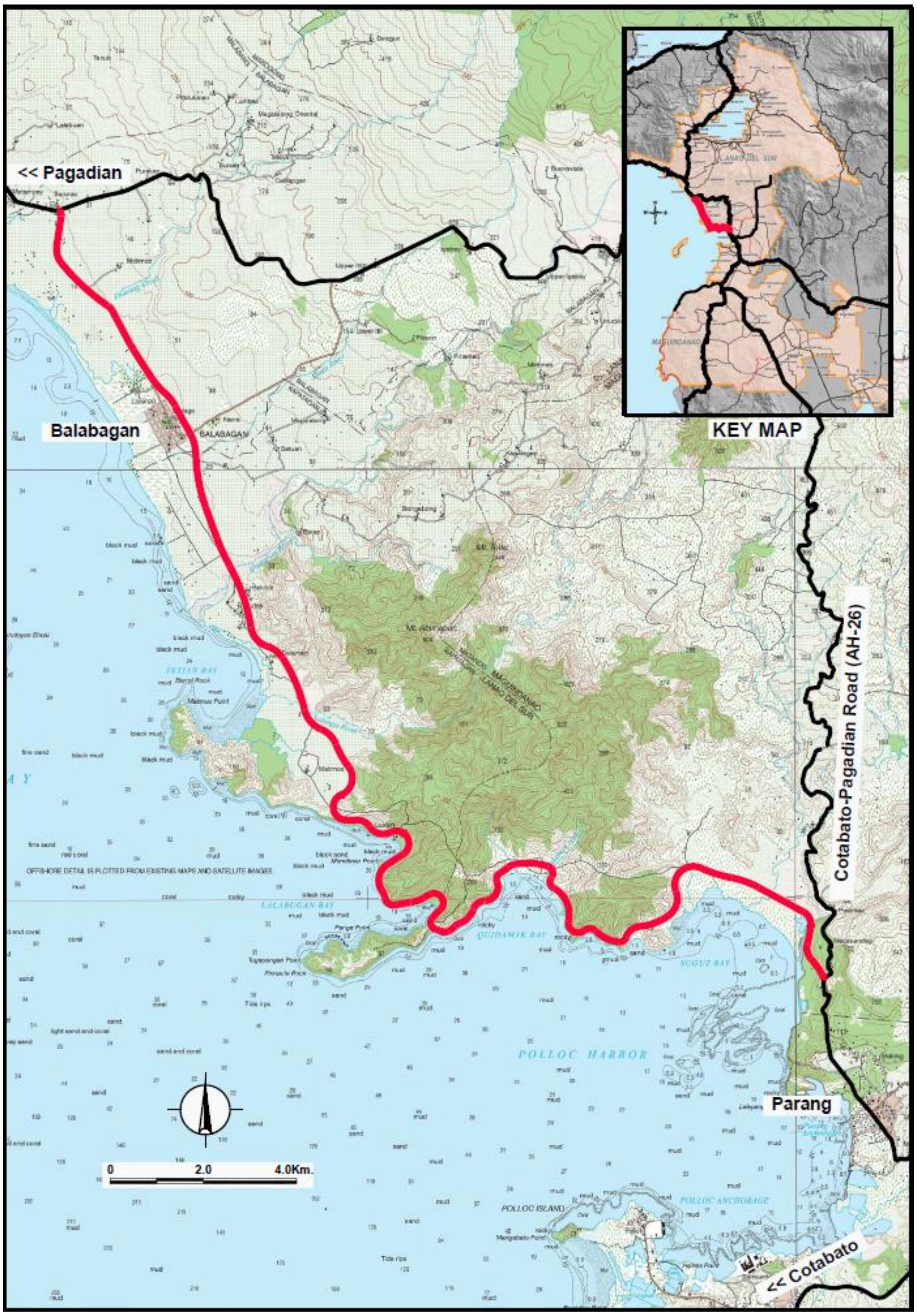
Section 1

PROJECT DESCRIPTION

1.1 PROJECT DESCRIPTION

1.1.1 PROJECT LOCATION AND AREA

The proposed road alignment will traverse the Municipalities of Parang and Matanog, Maguindanao and Balabagan and Kapatagan, Lanao del Sur. **Figure 1** shows the location map of the study area. **Table 1** shows the list of Municipalities and affected barangays.



Source: JICA Study Team
Figure 1. Location Map Showing the study area

Table 1. Parang-Balabagan Road

Municipality	Name of Barangay
Parang	Macasandag
Matanog	Sapad
	Kidama
Kapatagan	Salaman
	Matimos
	Bakikis
	Lusain
Balabagan	Banago
	Narra
	Lorenzo
	Molimoc
	Barorao
	Batuan
	Budas

Figure 2 shows the map of affected Barangays traversing the road alignment along the Municipalities of Parang and Matanog, Maguindanao and Balabagan and Kapatagan, Lanao del Sur.

Source: JICA Study Team

Figure 2. Map Showing the Affected Barangays at Sub-Project 2

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1.1.2 Primary and Secondary Impact Areas

As per DENR Administrative Order 2003-30 the direct or primary impact of the project will be the whole stretch of the 30-meter-wide and the whole length road alignment. These are all the trees that will be cut, the farm that will be abolished, the houses and settlers that will be resettled and removed, all the structures that will be removed and all the areas where structures will be constructed.

Indirect or secondary impact are those areas outside the alignment that will be affected as a result of the construction. Those that will be affected by dust, noise and traffic as a result of the construction. It also includes the access road that will be used to transport construction materials and equipment.

Figure 3 shows the map of direct and indirect impact of the study area at 1 km radius. Direct impact area- 250 meters from the center line in both sides (total of 500 meters) width. This covers the total width of the road intended for construction and immediate vicinity which will be impacted during construction activities.

Indirect impact- width is about 500 meter in both sides (total of 1km. width). This covers areas that will experience certain disturbance/enhancement of environment brought by the project activities. i.e. dust, noise, traffic adversity, peace and order issues due to possible temporary migration of workers in the project site etc. while, positive impact will be increased in goods/supply demand due to presence of workers which local economy will somehow be enhance during the construction phase.

During the pre-construction phase, there are certain populations, house structures, improvements, crops and private lands directly affected by the project due to the acquisition of Right of Way (RoW) for the construction and improvements of proposed road.

1.1.3 Accessibility

The project site is accessible via land through cars, motor vehicles, jeepneys, bus, etc.

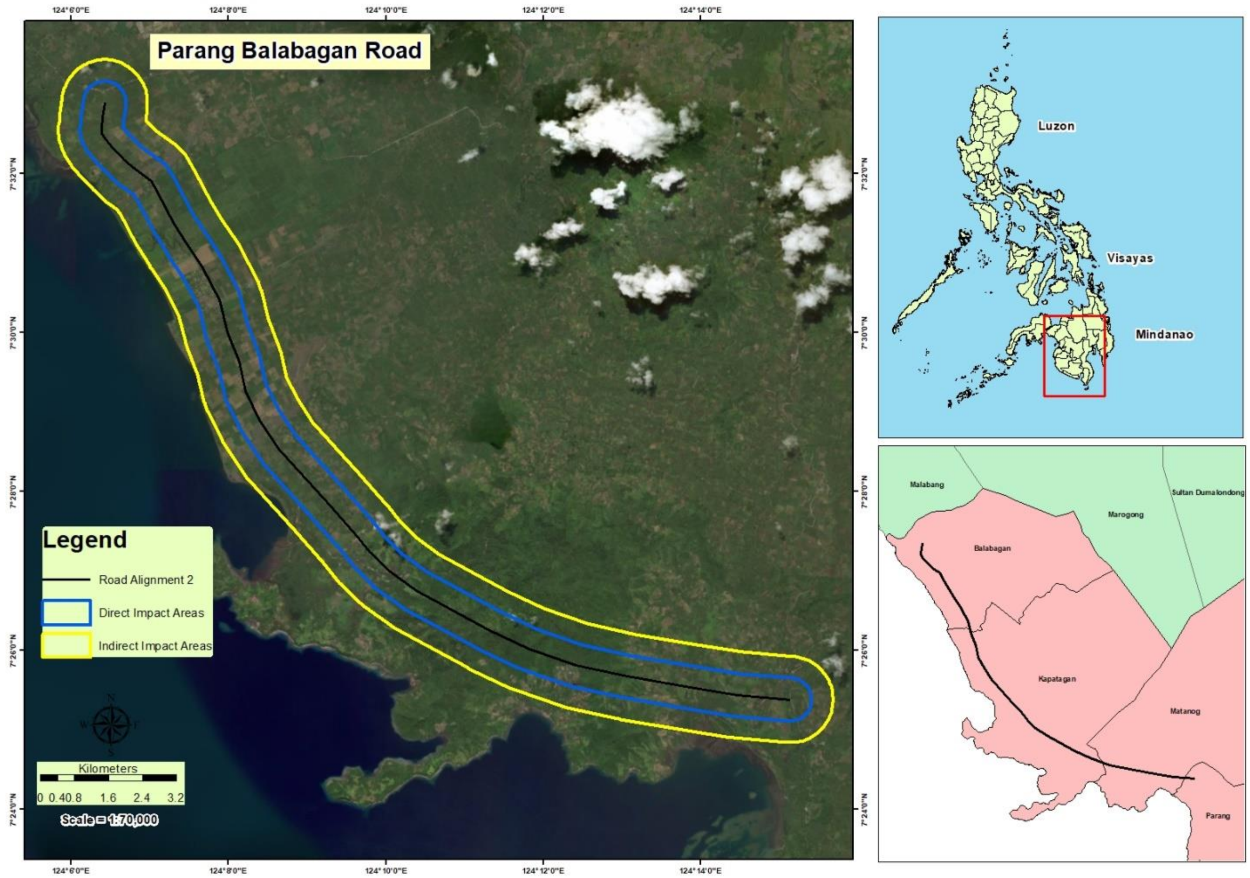


Figure 3. Impact Map of Parang-Balabagan Road

1.2 PROJECT RATIONALE

1.2.1 National

The project area has favorable natural conditions for agriculture –i.e. high temperature, plenty of rainfalls distributed throughout a year, dominant fertile soil and outside of the typhoon belt. Infrastructure supply is also limited – ARMM for instance needs 800 km of new road to close the gap with other regions in Mindanao.

One of the reasons for delay of development is the presence of protracted armed conflict between the government and different armed groups (particularly MILF).

In recent years, efforts towards securing peace is gaining momentum, FAB (Framework on the Bangsamoro) was signed in 2014; BBL was submitted to Congress this August 2017.

For the region to recover, there's a need to complement the progress of the peace process by way of addressing the shortage of infrastructure supply in the region.

Within Mindanao, the ARMM remains the poorest region with poverty incidence of 55.8% in 2012. Likewise, the region's GRDP in 2015 accounts for only 0.7% of the Philippines' GDP with annual average growth in the last five years of merely 1.13% which is the smallest among the regions. Similarly, economic structure of the region reflects its position as less developed where agriculture accounts for more than half (59.1%) of the GRDP with industry accounts only for 2.7% and services accounts for 38.2%.

The road infrastructure of ARMM is less developed as well compared to other regions. While the country and Mindanao has an average road density of 0.25 and 0.17 respectively, ARMM has only 0.10. This means that for the ARMM to close the gap and reach the Mindanao average, at least 800 km of new roads should be constructed. The signing of the Comprehensive Agreement on Bangsamoro (CAB) between the government and the Moro Islamic Liberation Front (MILF) in March 2014 however is expected to provide extra push for social and economic development of ARMM.

Recognizing the above, the Government of the Philippines through DPWH has made a request to the Government of Japan to undertake feasibility study of 7 priority roads identified in the 2016 JICA assisted Bangsamoro Development Plan – II. Part of the tasks is to study the possibility of utilizing Yen loan as of the possible sources of fund to implement the identified projects. The Preparatory Survey started in August 2017 and is expected to complete in May 2018.

The Road Network Development Project in Conflict Affected Areas in Mindanao is a Japan International Cooperation (JICA) assisted study in the Republic of the Philippines. The said study is awarded to CTI Engineering International Co. Ltd. in joint venture with Oriental Consultants Global Co., Ltd., and IC-Net Ltd. referred to as JICA Study Team.

National level

The project is in line with the trust of the government to encourage economic development, reduce poverty and contribute in the government effort to peace development in the conflict-affected area in Mindanao. As shown below its objectives.

- To contribute in economic development;
- To contribute in poverty reduction;
- To contribute in peace building in the conflict-affected areas through improvement and construction of roads and bridges which would facilitate smoother commodity flow, more active economic activities and improved accessibilities and linkages to other regions in Mindanao.

Regional level

The project will increase flexibility of network.

For Sub-Project 2, Parang-Balabagan Road, the following are the specific objectives:

- Increase flexibility of the network by linking two primary inter-city roads (Cotabato-Pagadian Road and Cotabato-Davao Road)
- Support small farmers by providing reliable access road that would result to reduced transport cost of their products.
- Promote development of agri-industry such as banana plantation by provision of high capacity road.
- Support peace building by improving access to MILF camps and other areas without stable road connection due to long-protracted armed conflicts.
- Provide access to the areas with high poverty incidence (56.53%) to help them access social services and sell their products to urban centers with minimal transportation cost.

1.3 Project Alternatives

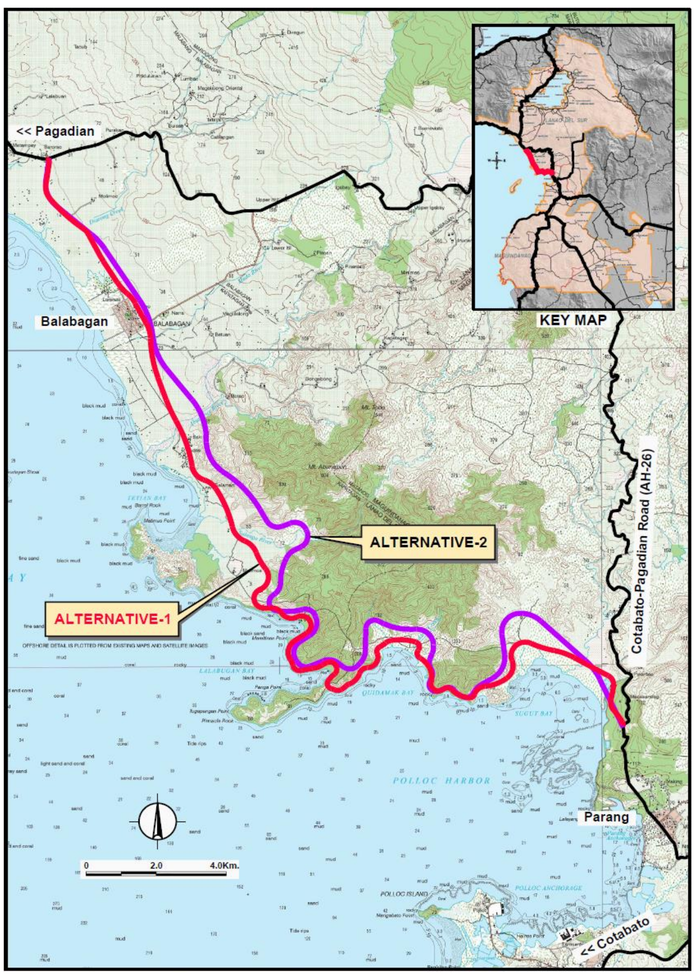
1.3.1 Design Criteria and Standards

No alternative for design criteria and standards as the constructions of road and bridges need to comply with design criteria and standards set forth by DPWH and JICA requirements.

1.3.2 Alignment Study

Project alternative in the case of road construction would mean the other alternative alignment that were considered, reviewed and studied to come up with the best alignment. The choice of the alignment was based on the most cost effective in terms of less length or lesser no of bridges to be constructed; in terms of economic impact base on the most number of people that will benefit and more agricultural area that will be saved; the environmental impact based on the lesser number of people that will be affected and based on the slope with lesser cutting and filling to be done and finally based on the most effective technical features.

At least two (2) alignment were studied. And based on the bases of studies shown below and the evaluation made as shown in **Table 2**, Alternative 1 was the choice.
Figure 4 shows the alternative alignments for Sub-Project No. 2.



Source: JICA Study Team

Figure 4. Alternative Alignments for Parang-Balabagan Road

The following were the bases on evaluating alternative alignments.

- Best Alternative:
  Evaluated to be "Good" ○
- Within 10% difference from the Best Alternative:
  Also evaluated to be "Good" ○
- Within the 10% to 20% Difference from the Best Alternative:
  Also evaluated to be "Medium" △
- More than 20% Difference from the Best Alternative:
  Evaluated as "Bad" X

Table 2 presents the evaluation on alternative alignments.

Table 2. Evaluation on Alternative Alignments

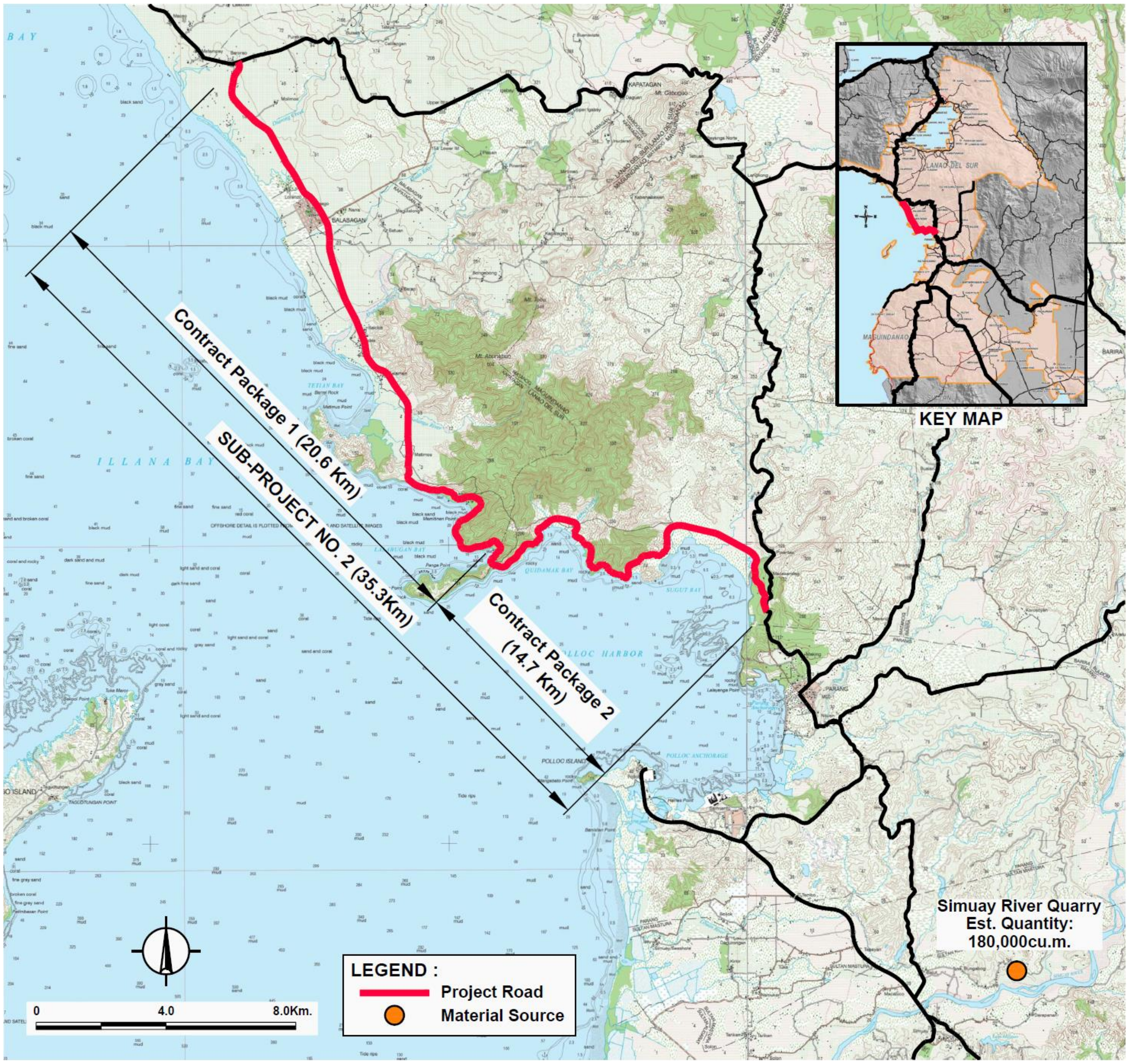
Indicators	Items		Unit	ALT-1		ALT-2	
Cost, Consruction Period	Total Road Length		km	33.9	○	35.7	○
	Utilization of Existing Road/Trail		km	2.5	○	2.5	○
	New construction road length		km	31.4	-	35.7	-
	No. of bridges		nos	7	-	20	-
	Total length of bridges		m	1,410	○	7,300	×
	No. of box culverts		nos	8	-	14	-
Economic Impact	No. of Direct Beneficiaries		persons	28,385	○	27,389	○
	Agricultural land areas to be served		km	13.86	○	11.47	△
Environmental Impact	High-filling section length (H= 10m or more)		m	1,581	○	9,375	×
	High-cutting section length (H= 10m or more)		m	5,175	×	3,781	○
	Number of houses/buildings affected		nos	19	○	39	×
Technical Features	Alignment	Total no. of curves	nos	33	-	37	-
		No. of curve radius < 300m	nos	9	×	5	○
		Length of vertical grade ≧ 5%	m	912	○	5,695	×
Evaluation				○ = 8 △ = 0 × = 2		○ = 5 △ = 1 × = 4	
Recommendation				Recommended		-	

Source: JICA Study Team

1.4 PROJECT COMPONENTS

Parang-Balabagan project road is diversion road connected from Parang to Balabagan finally access to Malabang which has the airport. The Sub project road starts from the National Highway (AH26) at northern part of Parang city area, goes to along the coastal side and finally connected to National Highway (AH26) in Balabagan. Sub-project No. 2 (SP-2) has a total road length of 35.3km, thus it was judged to divide SP-2 into two (2) contract packages as shown in Figure

During the series of public consultations at barangay level under this Study, the subject of farm-to-market roads (FMR) was always raised by the communities to extend the influence of sub-project road to their productive lands (farms). The road should be planned in a way that it supports the said industry comprehensively. This can be done by including FMRs in the sub-projects. Length of each farm-to-market road may extend from 2 km to 5 km depending on the productivity level of target productive land.



Source: JICA Study Team
Figure 5. Construction Site and Package

The western section of the subproject passes relatively through a flat terrain, whereas the eastern section passes through mountainous area. In order to shorten the construction period, the sub-project was divided into two packages. **Table 3** & **Table 4** present the proposed Contract Package I and Contract Package II project components respectively.

Table 3. Components of the Construction Plan (Package 1)

Item	Contents
Road length	20.6km (Road length: 19,860m, Bridge length: 740m)
Earth work	Clearing 49.7ha, Roadway Excavation 64,000m^3, Embankment from Roadway Excavation 257,000 m^3, Embankment 106,000m^3,
Pavement work	PCCP(280mm) 141,192m^2,
Road shoulder work	PCCP shoulder(150mm) 18,375m^2, Gravel surface shoulder 13,075m^3

Bridge	Bridge No.1 L=90m, St.0+575 - +665 Bridge No.2 L=280m, St.2+210 - +490 Bridge No.3 L=50m, St.6+000 - +050 Bridge No.4 L=200m, St.8+940 - +St.9+140 Bridge No.5 L=120m, St.12+640 - +760
Drainage & slope protection work	RCPC(910mmR 35places) 650m, RCPC(1,220mmR 2places) 37m, RCBC(1.25mx1.2m 14places) 211m, RCBC(1.5mx1.8m 1place) 51m, RCBC(3.0mx3.0m 5places) 132m, Grout Riprap 2,308m^3, Stone masonry 28,189m^3, Hand Laid Rock Embankment 10,911m^3, Concrete Slope Protection 7,761m^3,
Miscellaneous work	Guardrail 9,860m, Chevron Signs 759ea, Road markings 11,330m^2, Coco-net 75,160m^2
Segment Information North Segment	
North segment	St.0 – St.9+500, Total 9.5km, Bridge No.1 – No.4 (L= 620m)
Branch office	Beside of Abunabun River (St.6+200)
South Segment	
South segment	St.9+500 – St.20+600, Total 11.1km, Bridge No.5 (L=120m)
Main office	Lalabugan bay (St.20+500)
Loading port	Polloc port

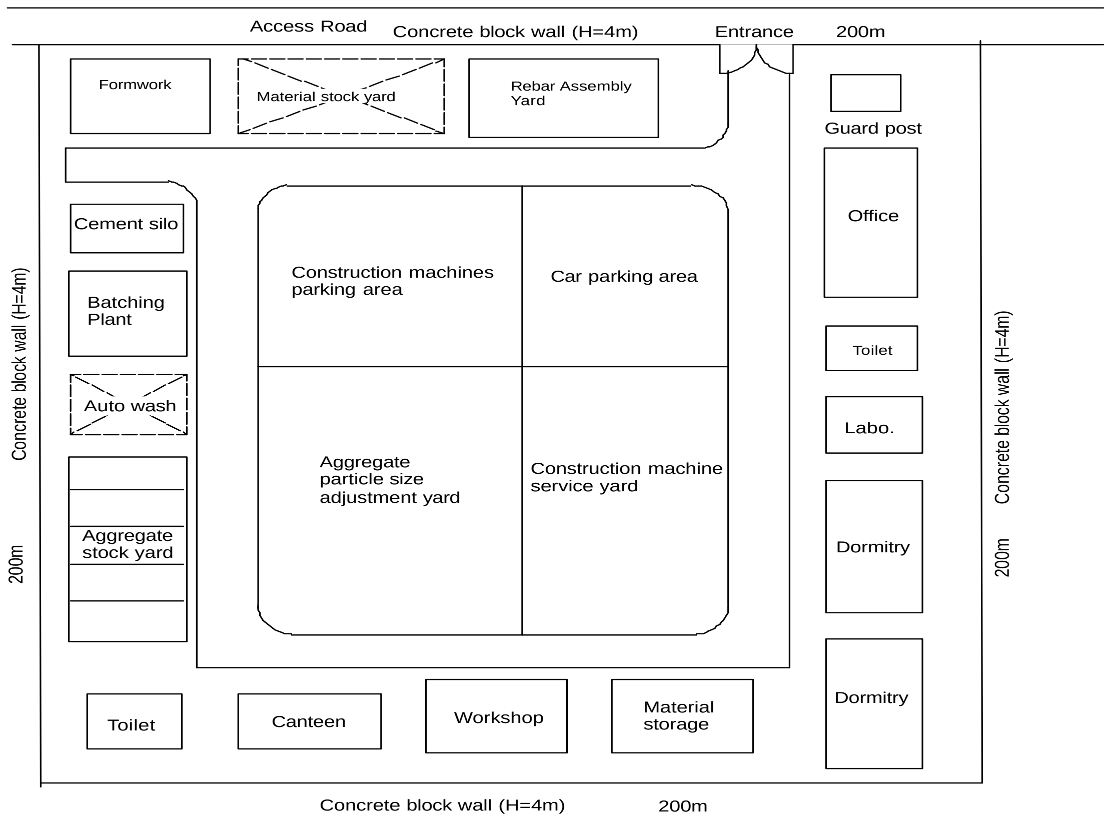
Source: JICA Study Team

Table 4. Components of the Construction Plan (Package 2)

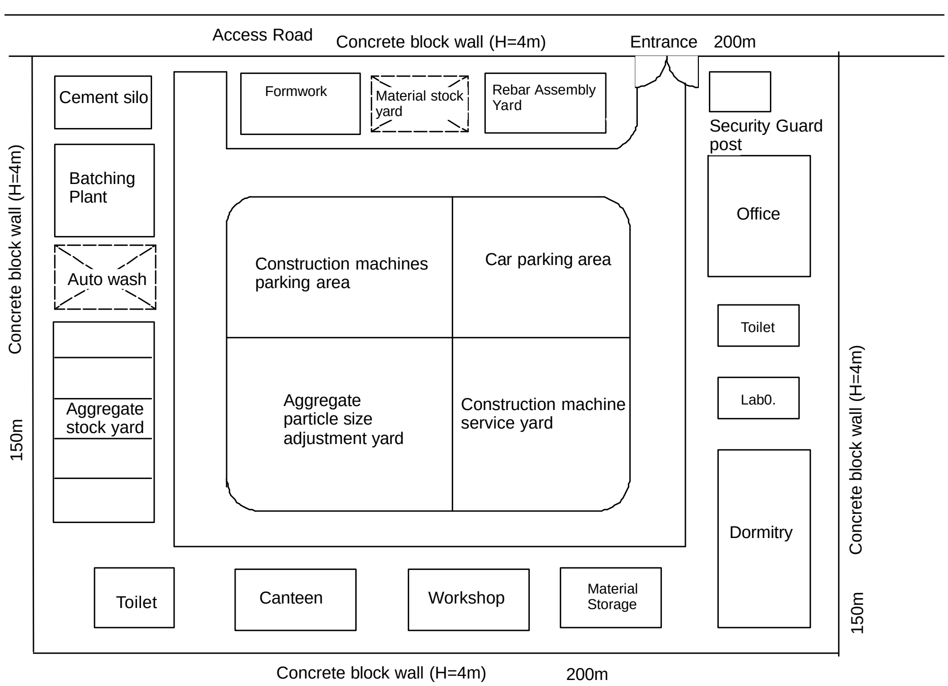
Item	Contents
Road length	14.7km(Road length: 14,085m, Bridge length: 575m)
Earth work	Clearing 47.4ha, Roadway Excavation 523,000m^3, Embankment from Roadway 386,000m^3
Pavement work	PCCP(280mm) 111,087m^2,
Road shoulder work	PCCP shoulder(150mm) 48,250m^2, Gravel surface shoulder 4,232m^3
Bridge	Bridge No.1 L=60m, St.23+925 - +985 Bridge No.2 L=100m, St.24+860 - +960 Bridge No.3 L=75m, St.30+650 - +725 Bridge No.4 L=280m, St.30+965 - St.31+245 Bridge No.5 L=60m, St.32+430 - +490
Drainage & slope protection work	RCPC(910mmR 27places) 617m, RCPC(1,220mR 8places)38m, RCBC(1.25mx1.0m 2places) 30m, RCBC(3.0mx4.0m 1place) 23m, Grout Riprap 2,720m^3, Stone masonry 48,198m^3, Hand Laid Rock Embankment 20,731m3
Miscellaneous work	Guardrail 10,526m, Chevron Signs 767ea, Road markings 8,063m2, Coco-net 76,274m2

Source: JICA Study Team

Main camp is proposed to be located at almost center of the north segment. **Figure 6** and **Figure 7** show the proposed main camp and branch camp respectively. Concrete batching plant within the project temporary camp yards for construction is required. Thus, in looking for appropriate construction yard for each project package, a sufficient space to accommodate concrete batching plant and stockpiles of construction materials and the required number of equipment should always be considered.



Source: JICA Study Team
Figure 6. Proposed Main Camp



Source: JICA Study Team
Figure 7. Proposed Branch Camp

1.4.1 Design Criteria and Standards

In order to achieve the objectives of the project, the roads, bridges and other structures shall be designed in consideration of providing a high grade road as national highway which would facilitate smoother commodity flow, more active economic activities and improve accessibilities and linkage to other regions.

The preliminary design of the road, bridges, and other structures will be executed mainly in accordance with “Design Guideline, Criteria and Standards published by the Department of Public Works and Highway (DPWH-DGCS)” and Japanese standard will be applied to the design as a supplement.

The proposed Subproject 2 is a 35.3-kilometer road with 6.7 meters long and a Road Right-of-Way at 30 meters. The number of lanes required is set at two-lanes initially. Projected increase in number of lanes from 2-lanes to 4-lanes will be after 2035 depending on traffic demand.

1.4.2 Road Design

1.4.2.1 Geometric Design Standards

a) National Road Classification for Subproject 2

The road classification for subproject – Parang-Balabagan Road is tertiary located in rural area.

b) Road Design Criteria for Subproject

i. Applied Design Criteria in relation with Road Classification

Highway design standard of DPWH in Philippines basically defines the standard in accordance with traffic volume. However, National Tertiary Road is not indicated in Highway Design Standard of DPWH. On the other hand, Expressway is treated as one of functional classification. In AASHTO, an expressway (a freeway) is not a functional class in itself but is normally classified as a principal arterial. In reference with the former highway design standard of DPWH, it is recommended to apply the road classification as follows:

	ADT Range
• National Primary Road	More than 2,000
• National Secondary Road	1,000 – 2,000
• National Tertiary Road	400 – 1,000

ii. Design Target Year for Number of Lanes

In a practical sense, the design volume should be a value than can be estimated with reasonable accuracy and it is believed the maximum design period is in the range of 15 to 24 years. Therefore, a period of 20 years is widely used as a basis for design year from planning stage. Traffic cannot usually be forecast accurately beyond this period on a specific facility. For the subprojects, design year for number of lanes is proposed year 2035.

iii. Geometric Design Criteria for Subprojects

The proposed design criteria is tabulated in **Table 5**.

iv. Maximum Superelevation

The subproject roads not only strengthen the highway network, but also contribute to the enhancement of agro-fishery business. The trucks for this business in ARMM are generally old and over-loaded. When such trucks stop on the curve with high superelevation, it may roll over. Also, for slow-moving vehicles such as agriculture vehicles, pedestrian and bicyclists, high superelevation is uncomfortable, dangerous and may causes accidents.

Table 5. Summary of Geometric Design Standards for Subprojects

Road Classification	National Tertiary	National Secondary	National Primary
Average Daily Traffic (ADT)	400-1,000	1,000-2,000	More than 2,000
	Design Speed (km/h)		
Flat Topography	70	80	95
Rolling Topography	60	60	80
Mountainous Topography	40	50	60
	Min. Horizontal Radius (m)		
Flat Topography	160	220	320
Rolling Topography	120	120	220
Mountainous Topography	50	80	120
	Max. Horizontal Radius for Use of a Spiral Curve Transition (m)		
Flat Topography	290	379	592
Rolling Topography	213	213	379
Mountainous Topography	95	148	213
	Max. Vertical Grade (%)		
Flat Topography	5.0	4.0	3.0
Rolling Topography	6.0	5.0	5.0
Mountainous Topography	8.0	7.0	6.0
	Min. Crest Vertical Curve Based on SSD (K-value)		
Flat Topography	17	26	52
Rolling Topography	11	11	26
Mountainous Topography	4	7	11
	Min. Vertical Curve on Sag (K-value)		
Flat Topography	23	30	45
Rolling Topography	18	18	30
Mountainous Topography	9	13	18
	Typical Cross Section (m)		
Cross-fall for Pavement (%)	1.5	1.5	1.5
Cross-fall for Shoulder (%)	3.0	3.0	3.0
Carriageway Width (m)	3.35	3.35	3.35
Shoulder Width (m)	1.50	2.50	3.00
Right of Way Width (m)	30	30	30
Superelevation (%)	6.0 (max.)	6.0 (max.)	6.0 (max.)
	Non Passing (Stopping) Sight Distance (m)		
Flat Topography	90	115	150
Rolling Topography	70	70	115
Mountainous Topography	40	60	70
	Passing Sight Distance (m)		
Flat Topography	490	560	645
Rolling Topography	420	420	560
Mountainous Topography	270	360	420
	Surface		
Surface Type	Portland Cement Concrete	Portland Cement Concrete	Portland Cement Concrete

Source: JICA Study Team

Where there is a tendency to drive slowly, it is common practice to utilize a lower maximum rate of superelevation, usually 4 to 6%. The terrain of subproject areas is mountainous. Therefore, the maximum superelevation is recommended to apply 6.0%.

v. Superelevation Rates

When the maximum value of superelevation is applied 6%, the superelevation rates are shown in **Table 6**.

Table 6. Minimum Radii for Design Superelevation Rates, Design Speeds and e_{max} = 6%

	Design Speed (kph)	20	30	40	50	60	70	80	90	100	110	120	130
e (%)	NC	194	421	738	1050	1440	1910	2360	2880	3510	4060	4770	5240
	RC	138	299	525	750	1030	1380	1710	2090	2560	2970	3510	3880
	2.2	122	265	465	668	919	1230	1530	1880	2300	2670	3160	3500
	2.4	109	236	415	599	825	1110	1380	1700	2080	2420	2870	3190
	2.6	97	212	372	540	746	1000	1260	1540	1890	2210	2630	2930
	2.8	87	190	334	488	676	910	1150	1410	1730	2020	2420	2700
	3.0	78	170	300	443	615	831	1050	1290	1590	1870	2240	2510
	3.2	70	152	269	402	561	761	959	1190	1470	1730	2080	2330
	3.4	61	133	239	364	511	697	882	1100	1360	1600	1940	2180
	3.6	51	113	206	329	465	640	813	1020	1260	1490	1810	2050
	3.8	42	96	177	294	422	586	749	939	1170	1390	1700	1930
	4.0	36	82	155	261	380	535	690	870	1090	1300	1590	1820
	4.2	31	72	136	234	343	488	635	806	1010	1220	1500	1720
	4.4	27	63	121	210	311	446	584	746	938	1140	1410	1630
	4.6	24	56	108	190	283	408	538	692	873	1070	1330	1540
	4.8	21	50	97	172	258	374	496	641	812	997	1260	1470
	5.0	19	45	88	156	235	343	457	594	755	933	1190	1400
	5.2	17	40	79	142	214	315	421	549	701	871	1120	1330
	5.4	15	36	71	128	195	287	386	506	648	810	1060	1260
	5.6	13	32	63	115	176	260	351	463	594	747	980	1190
	5.8	11	28	56	102	156	232	315	416	537	679	900	1110
	6.0	8	21	43	79	123	184	252	336	437	560	756	951

Source: JICA Study Team

vi. Traveled-Way Widening on Horizontal Curves

According to the equation in AASHTO, proposed traveled-way widening on horizontal curves are listed in **Table 7**.

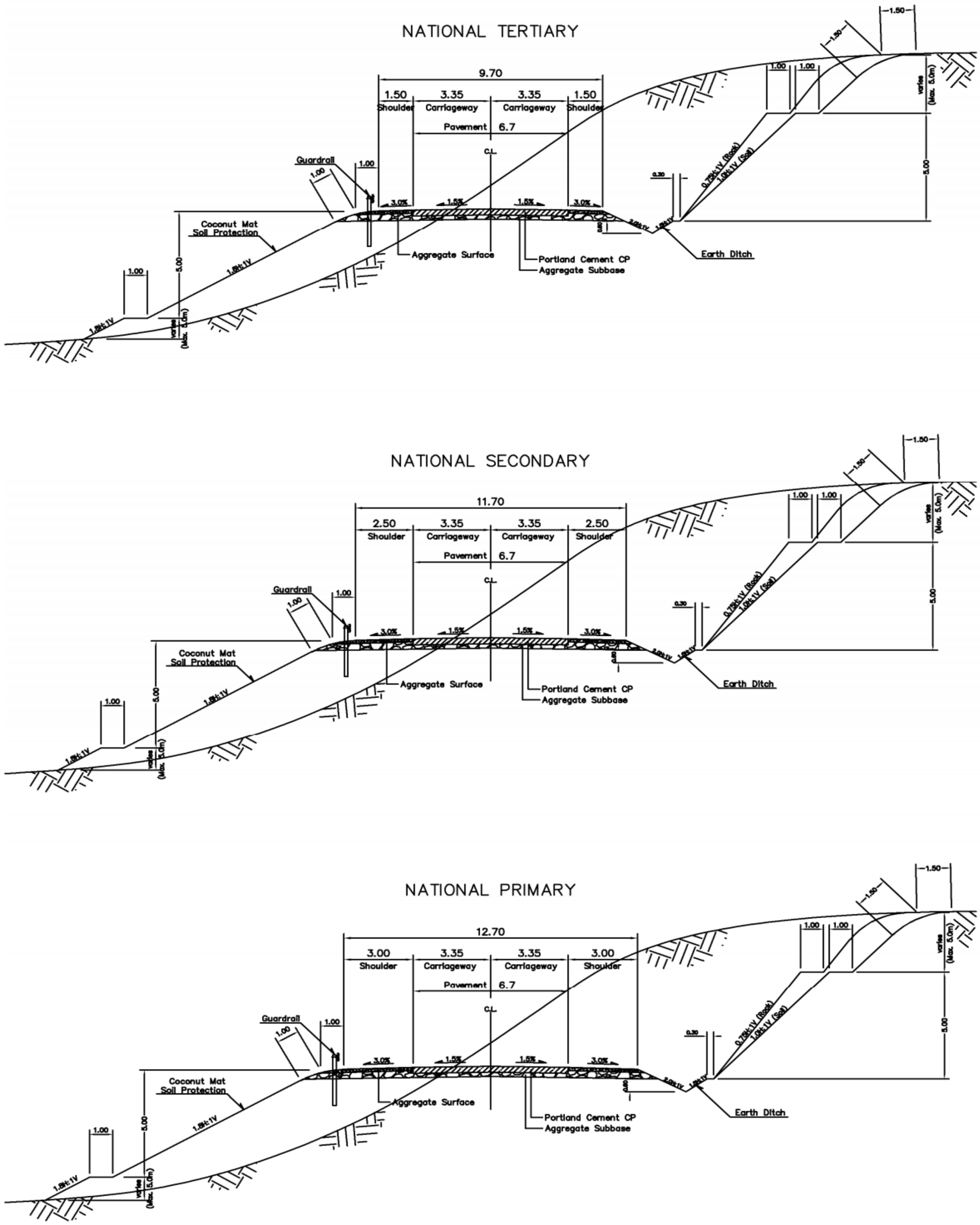
Table 7. Summary of Geometric Design Standards for Subprojects

No. of lanes		2			2			2		
Traveled-way width (m)		6.7			6.7			6.7		
Design Speed (kph)		40	60	70	50	60	80	60	80	95
Radius of curve (m)	1,000	0.3	0.4	0.4	0.3	0.4	0.4	0.4	0.4	0.5
	900	0.3	0.4	0.4	0.4	0.4	0.5	0.4	0.5	0.5
	800	0.4	0.4	0.5	0.4	0.4	0.5	0.4	0.5	0.6
	700	0.4	0.5	0.5	0.5	0.5	0.6	0.5	0.6	0.6
	600	0.5	0.6	0.6	0.5	0.6	0.6	0.6	0.6	0.7
	500	0.6	0.6	0.7	0.6	0.6	0.7	0.6	0.7	0.8
	400	0.7	0.8	0.8	0.7	0.8	0.9	0.8	0.9	1.0
	300	0.9	1.0	1.0	0.9	1.0	1.1	1.0	1.1	1.2
	250	1.0	1.2	1.2	1.1	1.2	1.3	1.2	1.3	
	200	1.3	1.4	1.5	1.3	1.4	1.5	1.4	1.5	
	150	1.6	1.8	1.9	1.7	1.8		1.8		
	140	1.7	1.9		1.8	1.9		1.9		
	130	1.9	2.0		2.0	2.0		2.0		
	120	2.0	2.2		2.1	2.2		2.2		
	110	2.2			2.3			2.4		
	100	2.4			2.5			2.6		
	90	2.6			2.7					
	80	2.9			3.0					
	70	3.3								
	60	3.9								
	50	4.6								

Source: JICA Study Team

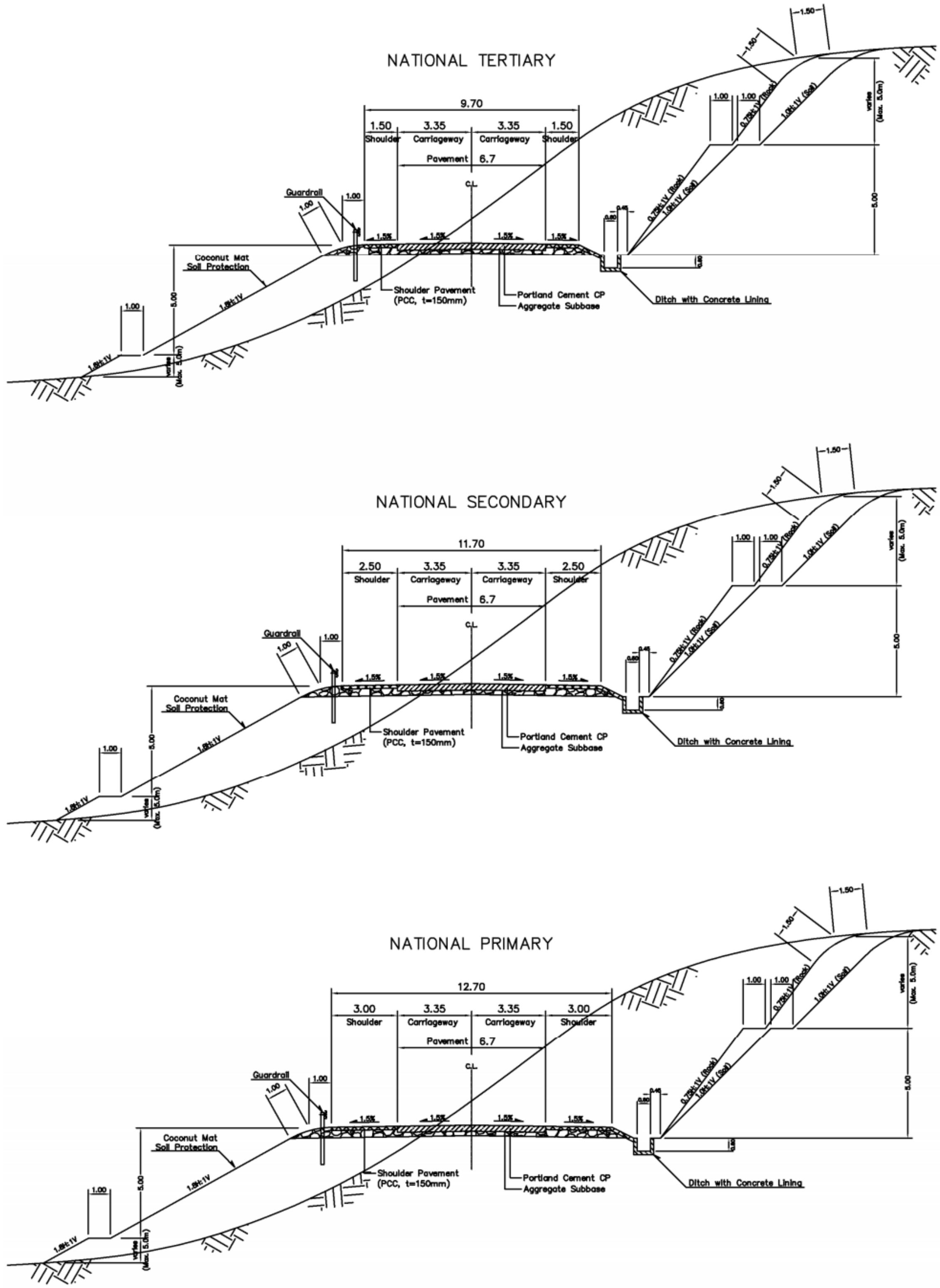
1.4.2.2 Typical Cross Sections

Typical cross sections by class of road are shown in **Figure 8 and Figure 9.**



Source: JICA Study Team

Figure 8. Typical Cross Sections for Subproject Roads (Vertical Grade Less Than 4%)



Source: JICA Study Team

Figure 9. Typical Cross Sections for Subproject Roads (Vertical Grade 4% and More)

1.4.3 Bridge and Structural Design

1.4.3.1 Specifications

Bridge design standards to be applied in this project shall be set in accordance with the following specifications

- Design Guidelines, Criteria & Standards Volume 5 Bridge Design 2015 (DGCS)
- DPWH Guide Specifications LRFD Bridge Seismic Design Specifications 1st Edition 2013

1.4.3.2 Load

1) General

The load types that shall be considered for the design bridge structure and other structures in this project are mainly as follow.

a) Dead load
b) Live load includes impact or dynamic effect of the live load and pedestrians load
c) Earth pressure
d) Seismic load

2) Dead load

Dead loads include all loads that are relatively constant over time, including the weight of the bridge itself and there are three primary types of dead load

- Down drag force (DD)
- Dead load of non-structural attachment (DC), and
- Dead load of wearing surfaces and utilities, designated as DW

The dead loads shall be the volumes of the member of the structural elements computed based on unit weights of materials. The following unit weights as shown in **Table 8** shall be used for dead load

Table 8. Unit Self-Weight of the Materials

Materials		Unit self-weight (kg/m3)
Aluminium Alloys		2,800
Bituminous waring Surface		2,250
Cast Iron		7,200
Compacted Sand, Silt or Clay		1,925
Concrete	Normal w/ f'c ≦35MPa	2,400
	Normal w/ 35< f'c≦105	2,250+2.29f'c
Loose Sand, Silt or Gravel and Soft Clay		1,600
Rolled Gravel, Macadam, or Ballast		2,250
Steels		7,850
Stone Masonry		2,725
Wood	Hard	960
	Soft	800

Source: JICA Study Team

3) Live Load

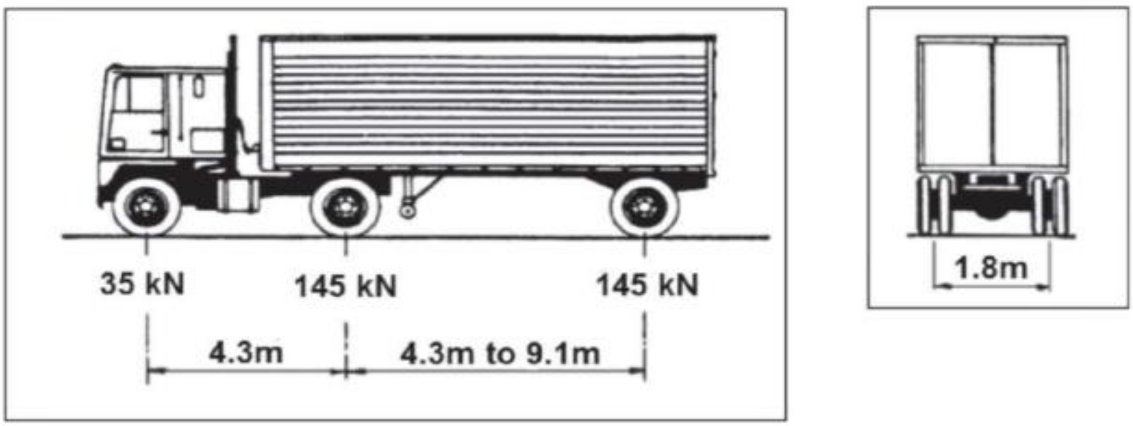
Design live loads of the bridges shall consist of:

a) The vehicle live load (LL)

Vehicular live loading on the road ways of bridges or incidental structures, designated HL-93 and shall consist of combination of the design truck and design lane load.

The weights and spacing of axials and wheels for the design truck shall be in accordance as shown in **Figure 10.**

The design lane load shall consist of a load of 9.34 kN/m, uniformly distributed in the longitudinal direction. Transversely, the design lane load shall be assumed to be uniformly distributed over 3.0m width. The force effects from the design lane load shall not be subject to a dynamic lane allowance.



Source: JICA Study Team
Figure 10. Characteristics of the Design Truck

b) Vehicular dynamic load allowance (IM)

The static effects of design truck, other than centrifugal and braking forces, shall be increased by the percentage specified in **Table 9** for dynamic load allowance in accordance with DPWH Design Guidelines, Criteria and Standards (DGCS).

Table 9. Dynamic Load Allowance (IM)

Component	Limit States	IM
Deck Joints	All Limit States	75%
All Other Components	Fatigue and Fracture	15%
	All Other Limit States	33%

Source: JICA Study Team

Dynamic load allowance need not be applied to:
- Retaining walls not subject to vertical reactions from the super structure
- Foundation components that are entirely below ground level

c) Dynamic Load Allowance (IM) for Culverts and Other Buried Structures

The factor to be applied to the static load shall be taken as:

IM = $33(1.0 - 0.125D_E) \geq 0\%$
Where:
D_E = the minimum depth of earth cover above the structure (mm)

d) Multiple Presence Factors

Multiple presence factors shall be based on **Table 10**.

Table 10. Multiple Presence Factors

Number of Loaded Lanes	Multiple Presence Factors
1	1.2
2	1.0
3	0.85
>3	0.65

Source: JICA Study Team

e) Pedestrians Load

A pedestrian load of 3.6kPa shall be applied to all sidewalks wider than 600mm and consider simultaneously with the vehicular design live load in the vehicle lane.

f) Live load for Box Culvert

Live load applied for Box Culvert design shall be estimated in accordance with Article 11.3.2.10 of DPWH Design Guidelines, Criteria and Standards Volume 5.

4) Earth Pressure

Earth Pressure shall be determined in accordance with Chapter 10.15 of DPWH Design Guidelines, Criteria & Standards Volume 5.

5) Seismic Load

Earthquake effects shall be determined in accordance with DPWH Guide Specifications LRFD Bridge Seismic Design Specifications 1st Edition 2013.

a) Condition of seismic design

- Earthquake Ground Motion: Level 1, Level 2
- Bridge Operation Classification: OC-III

b) Design Response Spectrum

1.4.3.3 Materials

1) Concrete Strength

The strength of the concrete use for the bridges and other structures design shall be in accordance with **Table 11.**

Table 11. Concrete Strength of Concrete Elements

Description		Fc'(min) (MPa)
Superstructure	PSC I -girder	38
	Deck Slabs, Cross beam	28
Substructure	Abutment walls, footings	28
	RC Pier coping, columns, footings	28
	PSC Pier coping, Rotating pier head	38
	Bored piles	28
Earth covered RC Box structure		28
Other concrete (normal use)		21
Lean concrete (for leveling)		17
Non Shrink grout		41

Source: JICA Study Team

2) Reinforcing Steel

Reinforcing steel used for the design of bridge and other structure shall follow

- ASTM GRADE 40, fy=278 Mpa
- ASTM GRADE 60, fy=415 Mpa

3) Prestressing

Ultimate stress of prestressing steel shall be: fs' = 1860 MPa

4) Structural Steel

Structural Steel shall follow in accordance with DPWH DGCS Volume 5.

- Steel plate and rolled shapes: ASTM A36
- Bolts: AASHTO M164 (ASTM A325)
- Welds: AWSD1.1 – 183, E70XX series

1.4.3.4 Concrete Cover for Reinforcing Steel

Concrete cover for reinforcing steel shall follow **Table 12.**

Table 12. Concrete Cover

Situation	Cover (mm)
Direct exposure to salt water	100
Cast against earth	75
Coastal	75
Exposure to deicing salts	60
Deck surfaces subject to tire stud or chain wear	60
Exterior other than above	50
Interior other than above • Up to No. 36 bar • No. 43 and No. 57 bars	 40 50
Bottom of cast-in-place slabs • Up to No. 36 bar • No. 43 and No. 57 bars	 25 50
Precast soffit form panels	20
Precast reinforced piles • Noncorrosive environments • Corrosive environments	 50 75
Precast prestressed piles	50
Cast-in-place piles • Noncorrosive environments • Corrosive environments - General - Protected • Shells • Auger-cast, tremie concrete, or slurry construction	 50 75 75 50 75

Source: JICA Study Team

1.4.3.5 Superstructure Arrangements

1) Vertical Clearance of Bridge Superstructure

The vertical clearance between the Design Flood Level (DFL) and the lowest member of the bridge superstructure shall not be less than 1.5m for reverse carrying debris in accordance with DPWH DGCS.

Since all roads of this project are National Road, applied flood frequency shall as in accordance to **Table 13.**

- 50 years flood frequency shall be applied for the estimation of flood level (DFL)
- 100 years flood shall be used for check vertical clearance of the bridge superstructure

Table 13. Design Flood Frequency for Bridges

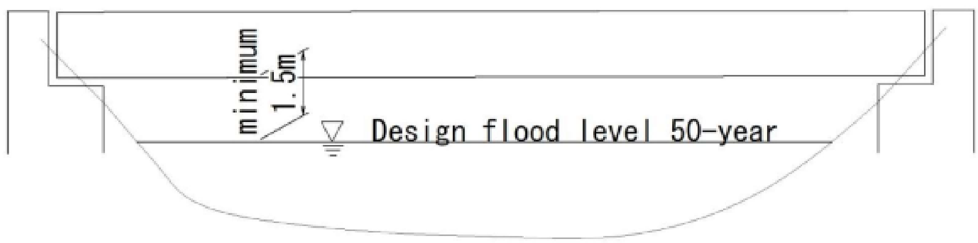
Road Classification	River				Bridge Drainage	
	Structure		Hydraulic Scour			
	Design Flood	Check Flood	Design Flood	Check Flood	Design Flood	Check Flood
Expressway	100 yr	200 yr	*100 yr	*500 yr	25 yr	50 yr
National Road	50 yr	100 yr	*100 yr	*500 yr	10 yr	25 yr
Other Roads	25 yr	50 yr	50 yr	100 yr	5 yr	10 yr

Source: JICA Study Team

From mentioned above, when 100 years flood level is more than 1.5m higher than 50 years flood level, the lowest level of the bridge superstructure shall be kept to be higher than the 100 years flood level as shown in **Figure 11.**

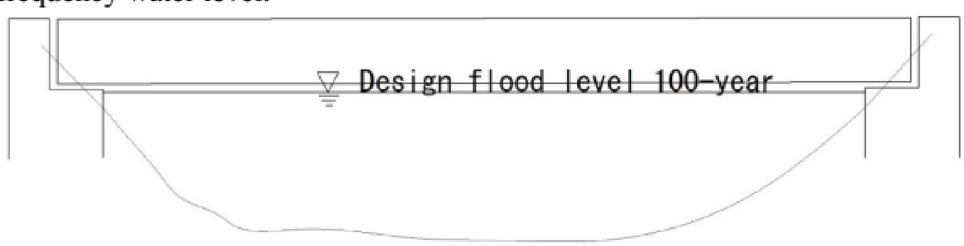
- 50-years Flood frequency

The vertical clearance between the design flood level and the lowest member of the bridge superstructure shall not be less than 1.5m



- Flood frequency by 100-year

The height of lowest member of girders shall be higher than the 100-yr flood frequency water level.



Source: JICA Study Team
Figure 11. Vertical Clearance of Bridge Superstructure

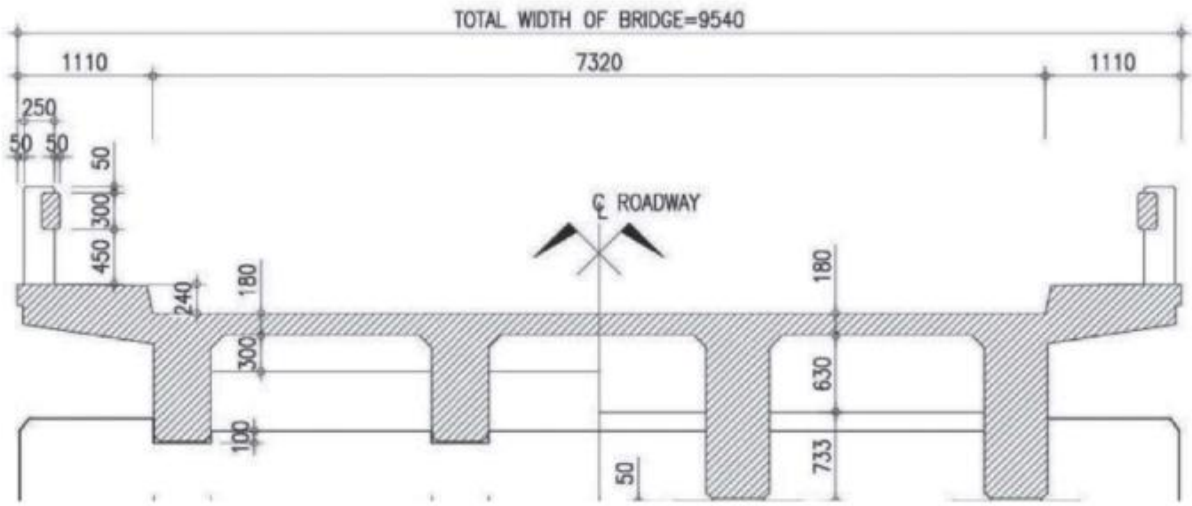
Discharge of river will be estimated in accordance with DPWH DGCS Volume 3 and 4. The Criteria for hydrological analysis are described in separate report of JICA Study Team.

2) Bridge Span Length

Minimum bridge span length shall be determined in accordance with Article 4.2 of DPWH DGCS Volume 5 using 50 years frequency flood discharge.

3) Width of Roadway

The minimum width of bridge for 2 lanes shall be 7.32m and the minimum width of the pedestrian sidewalk shall be 750mm, in accordance with DPWH DGCS Volume 5. Typical cross section of the bridge is shown in **Figure 12.**



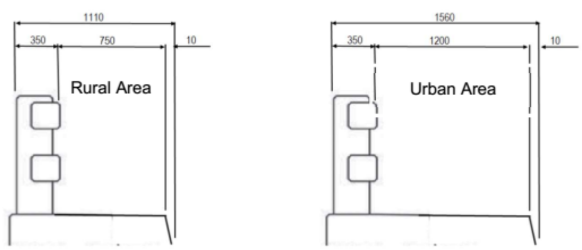
Source: JICA Study Team
Figure 12. Typical Cross Section of Bridge

4) Width of Sidewalk

According to DPWH DGCS Volume 5, the minimum width of pedestrian sidewalk is specified as follow:

- In rural area: minimum pedestrian width is 750mm
- In urban area: minimum pedestrian width is 1200mm

Width of sidewalk is shown in **Figure 13**.



Source: JICA Study Team
Figure 13. Width of Sidewalk

1.4.3.6 Substructure Arrangements

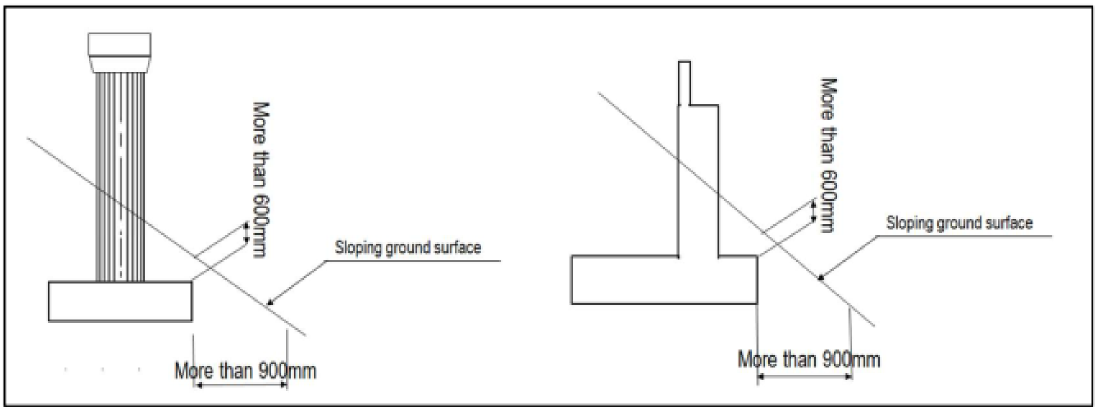
1) Seat Length

DPWH Guide Specifications LRFD Bridge Seismic Design Specifications 1st Edition 2013 will be followed.

2) Depth of Footing

a) Minimum embedment and bench depth (except in water way)

- Adequate bearing capacity shall be maintain
- 900 mm of the bottom of the footing
- 600 mm cover over the footing
- When the spread footing located on a slope, the minimum distance from the lower edge of the footing to the sloping ground surface should be 900 mm as shown in **Figure 14.**
- Maximum height of abutment is 15.0m.



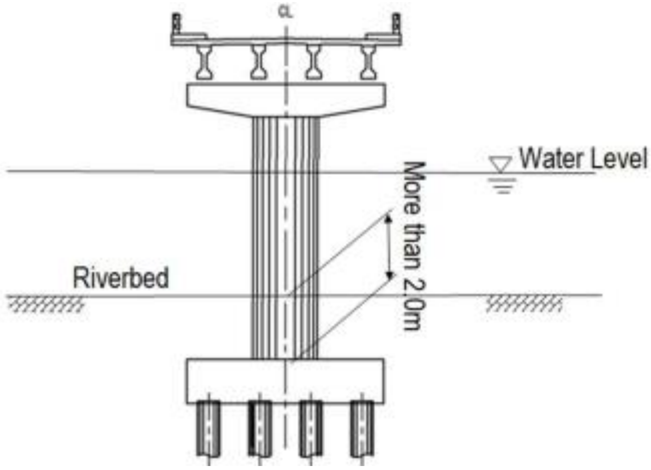
Source: JICA Study Team
Figure 14. Footing Position on Slope

b) In Water Way

According to DPWH DGCS Volume 5, the depth of pier footing in water way is specified as follow.

- On soil: top of footing must be located below the scour depth
- On rock: the bottom of footing must be embedded in non-erodible rock

Therefore, in this project, the cover of the top of the foundation from riverbed shall be kept greater than 2.0 m based on Japanese Standards as shown in **Figure 15**.

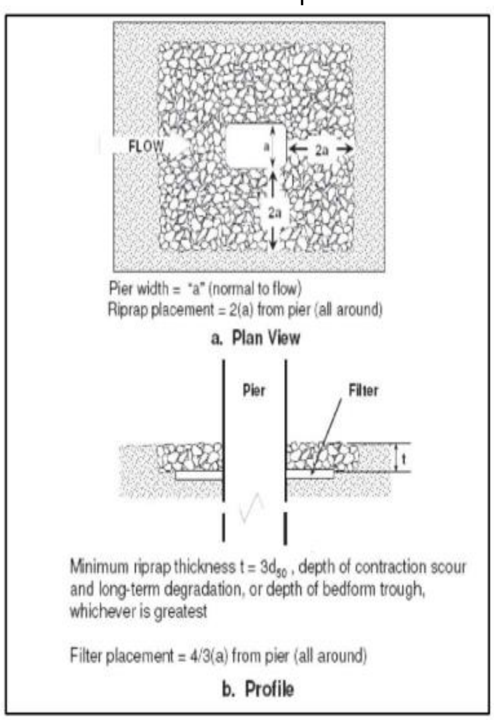


Source: JICA Study Team
Figure 15. Depth of Pier Footing in Water Way

1.4.3.7 River Protection

1) Pier Foundation

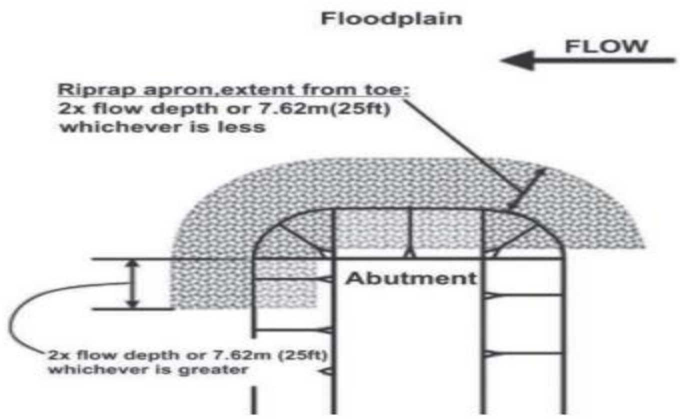
The pier footing shall be protected against a scouring of river bed by loose bolder apron, gabions, precast concrete blocks and grout-filled or sand/cement-filled bags. The example of the riverbed protection measure at the pier is shown in **Figure 16**.



Source: JICA Study Team
Figure 16. Example of Riverbed Protection (Typical Bolder Apron Layout)

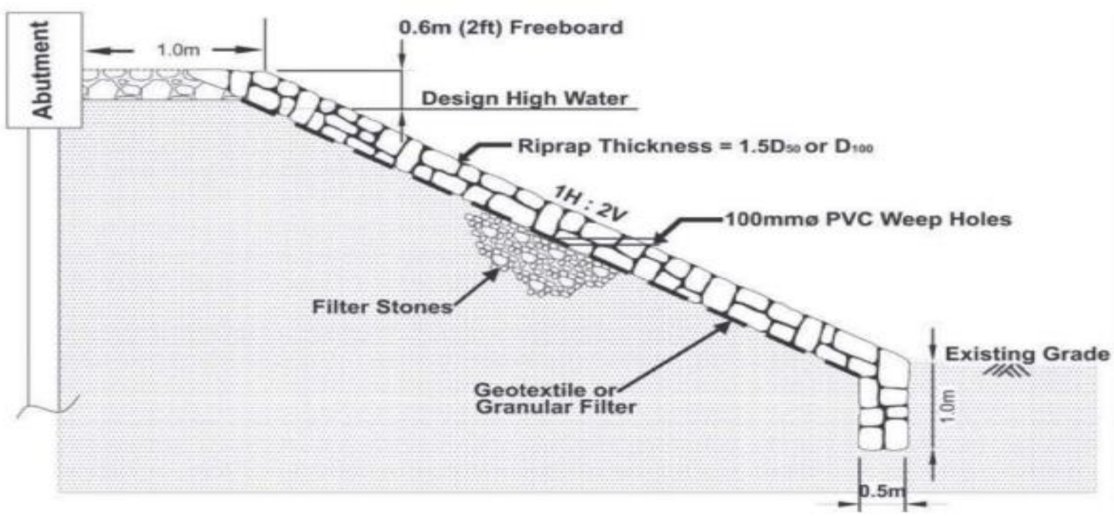
2) Abutment

The plan of abutment protection and typical cross section of the revetment front of abutment is shown in **Figure 17 and Figure 18.**



a) The plan of abutment protection

Source: JICA Study Team
Figure 17. Plan of Abutment Protection



b) Typical cross section of the revetment

Source: JICA Study Team
Figure 18. Example of Protection for Abutment

1.4.4 Pavement Design Standards

The following standard is basically applied for this project.
Chapter 6 Pavement Design, DGCS Volume 4 Highway Design 2015, BoD, DPWH

1) Design Life for Pavement

In estimating the design volume, the minimum life is commonly assumed to be 20 years for a rigid pavement. The pubic opening is assumed to be year 2022. Therefore, design life for pavement design is proposed between year 2022 and year 2042.

2) Type of Pavement

In Mindanao Island, the Portland Cement Concrete Pavement (PCCP) is widely used because the cement is plenty produced. In consideration with the road maintenance, the PCCP is applied for this project.

3) Minimum Thickness of PCCP Slab

In accordance with Department Order (DO), the minimum thickness of PCCP slab for new construction is adopted 280 mm, if the cumulative equivalent single axle load (CESAL) is more than 7.0×10^6.

4) Minimum Width of PCCP

In accordance with DO, the minimum width of PCCP on National Highways for new construction adopted is 6.70 meters.

1.4.5 Drainage Design Standards

1.4.5.1 Road Surface Drainage

The following standard is basically applied for this project.

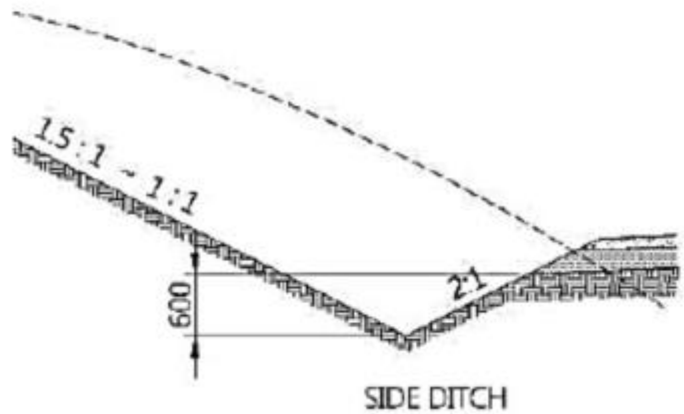
- Chapter 5 Highway Drainage DGCS Volume 4 Highway Design 2015, BoD, DPWH
- Guidelines for drainage work; Japan Road Association

1) Type of Roadside Channel

Between the roadway and cutting slope, the open earth gutters will be provided where the vertical grade is less than 4 percent. Where the vertical grade is 4 percent and more, the open concrete ditches will be installed. Also, shoulder shall be paved by PCCP with 150mm in thickness, and a part between edge of paved shoulder and ditch should be lined by concrete.

2) Minimum Depth of Roadside Channel

The minimum depth of roadside channel is applied 600mm from the bottom of pavement as shown in **Figure 19.**



Source: JICA Study Team
Figure 19. Minimum Depth of Ditch

1.4.5.2 Culverts

The following standard is basically applied for this project.

- DPWH DGCS Volume 3 Water Engineering Projects 2015
- Chapter 5 Highway Drainage Design of DPWH DGCS Volume 4 Highway Design 2015
- Standard Drawings for Roads and Bridges

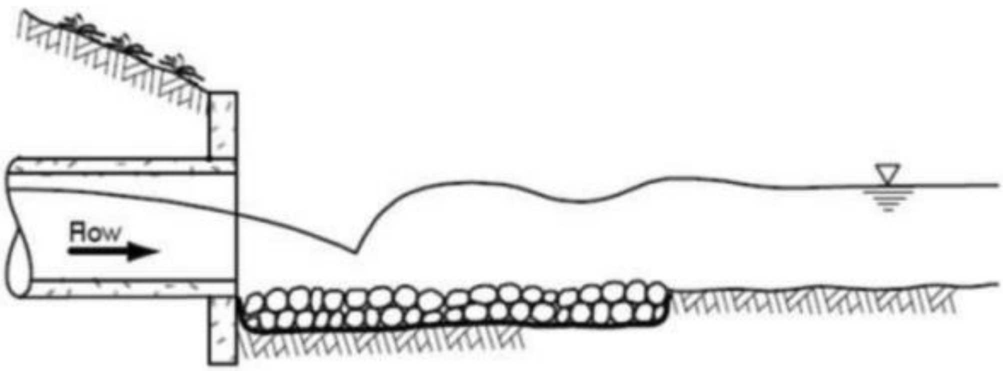
1) Discharge (Hydrologic Analysis)
2) Hydraulic and Structural Design of Culvert

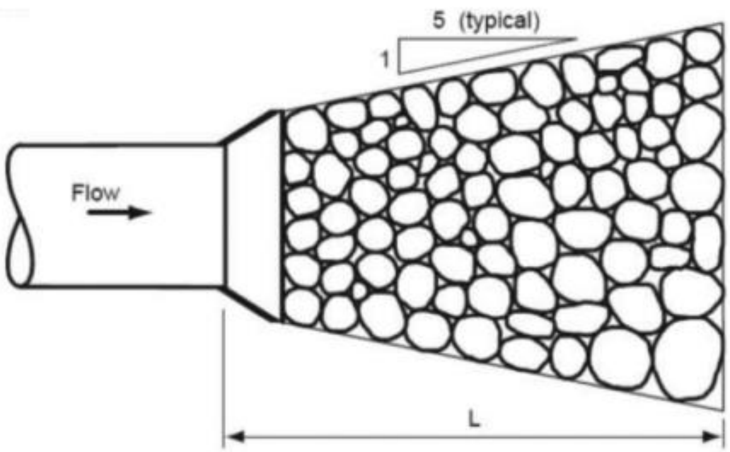
Hydraulic design of culverts will be done in accordance with Chapter 5.8 of DPWH DGCS Volume 4 Highway Design 2015

Criteria for structural design of culvert are discussed on separate report.

The culvert shall be designed in consideration of the items below.

- Minimum cover: 0.6 m
- Size of culvert (minimum internal width and clear depth): 0.910 m
- Minimum velocity: 0.8m/sec
- Maximum velocity: 5m/sec
- Outlet scour control – refer to **Figure 20**.





Source: JICA Study Team

Figure 20. Typical Layout of Outlet Scour Control

1.4.6 Slope Design Standards

The following standard is basically applied for this project.

- Chapter 7 Earthworks, DGCS Volume 4 Highway Design 2015, BoD, DPWH
- Guidelines for road earthwork; Japan Road Association
- Manual for Slope Protection, Highway Earthwork Series; Japan Road Association

1) Filling Slope

Based on **Table 14**, the height, berm and slope ration for filling slope are applied as follows:

- Max. Height (1 step): 5.0 m
- Width of Berm: 1.0 m
- Slope Ratio: 1.8H:1V

The slope protection is adopted the coconut mat soil protection because it is widely used in the Philippines and is economical.

Table 14. Stability of Cut and Fill Slopes for Different Material Types

Filling Material*	Nature of Material	Height of Cut/ Fill (m)	Slope Ratio (H:V)***	Remarks
Well graded sand (SW)	Soil	Less than 5	1.5:1 to 2.0:1	Applied to fills with sufficient bearing capacity at foundation ground, which are not affected by inundation (assumed drained and unsaturated).
Gravel with Silt (GM)				
Gravel with Clay (GC)				
Well Graded Gravel (GW) Poorly Graded Gravel (GP)		5 to 15	1.8:1 to 2.5:1	
Poorly Graded Sand (SP)		Less than 10	1.8:1 to 2.5:1	Consistency assumed to be medium dense (non-cohesive) or stiff (cohesive) or better.
Silty Sand (SM)		Less than 5	1.5:1 to 2.0:1	
Clayey Sand (SC)				
Hard clayey soils and clay of alluvium, loam (CL)		5 to 10	2.0:1 to 2.5:1	
Soft Clay of high plasticity (CH), Silts (ML, MH)		0 to 5	2.5:1 to 3.0:1	
Medium to High Strength Rock, Slightly Weathered to Fresh	Rock**	Less than 10	0.5:1 to 1:1	Assess all rock slopes in cut in accordance with Section 7.3.
		10 to 15	0.75:1 to 1.2:1	
Very Low to Medium Strength Rock, Extremely to Distinctly Weathered		Less than 5	0.75:1 to 1.2:1	
		5 to 10	1.0:1 to 1.5:1	
Residual Soil to Extremely Low Strength Rock, Extremely Weathered		Less than 5	1.0:1 to 1.5:1	
		5 to 10	1.5:1 to 2:1	

2) Cutting Slope

Based on **Table 14**, the height, berm and slope ration for filling slope are applied as follows:

- Max. Height (1 step): 5.0 m
- Width of Berm: 1.0 m
- Slope Ratio: 1.00H:1V
- Slope Ratio (Soft Rock): 0.75H:1V

1.4.6.1 Slope Protection for Bank of River / Drainage System

Slope and foot protection works for river/drainage system passing across road alignment shall be planned and designed in accordance with DGCS 2015. All considerations as design criteria are described in "(2) Slope and Foot Protection Works or Revetments".

1.5 TECHNOLOGY OPTIONS

1.5.1 Design Criteria and Standards

In order to achieve the objectives of the project, the roads, bridges and other structures shall be designed in consideration of providing a high grade road as national highway which would facilitate smoother commodity flow, more active economic activities and improve accessibilities and linkage to other regions.

The preliminary design of the road, bridges, and other structures will be executed mainly in accordance with "Design Guideline, Criteria and Standards published by the Department of Public Works and Highway (DPWH-DGCS)" and Japanese standard will be applied to the design as a supplement.

The following standard is basically applied for this project.

- o Design Guidelines, Criteria and Standards Volume 4 Highway Design 2015, BoD, DPWH

  Also, the following standards are referred to:

- o Policy on Geometric Design of Highways and Streets, AASHTO 2011, 6th Edition
- o Japan Road Association, Road Structure Ordinance, 2015

1.6 PROJECT SIZE

The total length of the project is 35.3 km with 5 bridges on Package 1 and 5 bridges on Package 2. Total bridge length for package 1 is 740m and for Package 2 is 575m. Refer to **Table 3** and **Table 4** for details.

1.7 DEVELOPMENT PLAN, DESCRIPTION OF PROJECT PHASES AND CORRESPONDING TIMEFRAMES

1.7.1 Pre Construction Phase

- This will involve the acquisition of Environmental Compliance Certificate and other permits and clearances
- Proponent to iron out details of the projects, finalized the detailed engineering design (DED)
- 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 Phase

1.7.2.1 Preparation Works

- Mobilization
- Clearing and earthworks for the preparation of construction works, stripping, grubbing
- Construction of the temporary yard and facilities (workers' camp, field offices,

facilities 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

- Dredging
- Pile Foundation
  1. Excavation
  2. Installation of steel cage
  3. Concrete pouring by tremie pipe
  4. Extraction of casing and tremie pipe
  5. Completion of bored pile

- Construction of substructures
  1. Construction of cofferdam
  2. Drying inside of cofferdam
  3. Conduct of substructure
- Superstructures

1.7.2.3 Health, Safety and other services for the workforce, refer to Section 9 – Emergency Response Policy and Generic guidelines for details

1.7.2.4 Environmental Aspects/waste generation and built in measures

During this phase generation of waste is expected. **Table 15** shows the type and built-in measures.

Table 15. Type of Waste and Built-in measures

Type of waste	Management measures
Domestic Wastewater	Provision for Portalet (portable toilet) Proper wastewater treatment of domestic wastewater either through an accredited Treatment, Storage and Disposal Facility (TSD) or an accredited septic tank hauler and treater Provision of oil and water separator should be included in the wastewater treatment for oil spills, vehicle and construction cleaning etc.
Solid waste	Practice 3R (Reduce Reuse and recycle Carton, wood, steel, bottle sent to recyclers Use of Materials Recovery Facility (MRF) and santirary landfill through respective LGUs involve
Used oil and batteries	Sent to Treatment Storage and Disposal facility
Air emission	-Periodic maintenance of construction equipment and vehicle -For batching plants, use of insulation board to prevent the spread of dust and to reduce the noise pollution at work, cement dust filter is also needed

Dust	Administrative control: Regular sprinklers Engineering control: For dust removal of cement silo, it is a general practice to install the dust collector on the top of the cement warehouse in order to reduce the dust pollution

1.7.3 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

1.7.4 Operation Phase

- Operation would mean the opening and utilization of the roads to the public.
- Inspection and monitoring of the whole alignment and maintenance and rehabilitation whenever necessary.

The DPWH District Engineering Office (DPWH-DEO) who has jurisdiction over the newly construction 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 roads and 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.

1.7.5 Abandonment Phase

Abandonment may not be applicable in this project since the utilization of roads will be used and maintained endlessly unless the government decides to restructure the project sites into different landuse. Refer to Section 10 – Abandonment, Decommisioning and Rehabilitation Policy for details.

1.8 MANPOWER REQUIREMENTS

Total manpower man-month is approximately 4,914 for skilled and 10,982 for non-skilled workers who shall be employed during construction. This may vary during actual works.

1.9 INDICATIVE PROJECT INVESTMENT COST

The total estimated project cost is **Mil PhP 3,897.00.** The summary of quantity and total project costs for the road and bridge project are shown in **Table 16**. Details of project cost are provided in **Table 17** and **Table 18**.

Table 16. Summary of Estimated Project Cost

Sub Project	Road length (km)	No. of Bridges	Total Brdiges length (m)	No. of contract package	Main road cost (million php)	Farm to Market Road cost (php)	Total cost (million php)	Cost per km of road section (million php)	Cost per m of bridge (million php)	Total cost per km (million php)
No.2	35.260	10	1,315	2	3,632.8	264.2	3,897.0	68.90	0.99	110.52
No.2-1	20.600	5	740		2,082.9	132.1	2,215.0	68.18	0.99	107.52
No.2-2	14.660	5	575		1,549.9	132.1	1,682.0	69.92	0.98	114.73

Source: JICA Study Team

Table 17. Detailed Estimated Project Cost (Package 1)

Item	Contents	Qty	Cost (mill. php)	Cost per km (mill. Php)	Bridge/m (mill. Php)	Portion (%)
A	Facilities for engineer	1.0	31.603	1.59		1.4%
B	Other general requirement	1.0	76.548	3.85		3.5%
C	Earth work	1.0	350.807	17.66		15.8%
D	Subbase and base course	1.0	220.315	11.09		9.9%
E	Surface course	1.0	450.227	22.67		20.3%
F	Bridge structure (Total)	740m	728.920		0.99	32.9%
	F1	90m	91.913		1.02	4.1%
	F2	280m	264.360		0.94	11.9%
	F3	50m	62.223		1.24	2.8%
	F4	200m	186.814		0.93	8.4%
	F5	120m	123.609		1.03	5.6%
G	Drainage and slope protection	1.0	136.040	6.85		6.1%
H	Miscellaneous item	1.0	88.458	4.45		4.0%
I	Farm to Market road	11km	132.074			6.0%
	Grand Total		2,214.992	68.18		100.0%

Source: JICA Study Team

Table 18. Detailed Estimated Project Cost (Package 2)

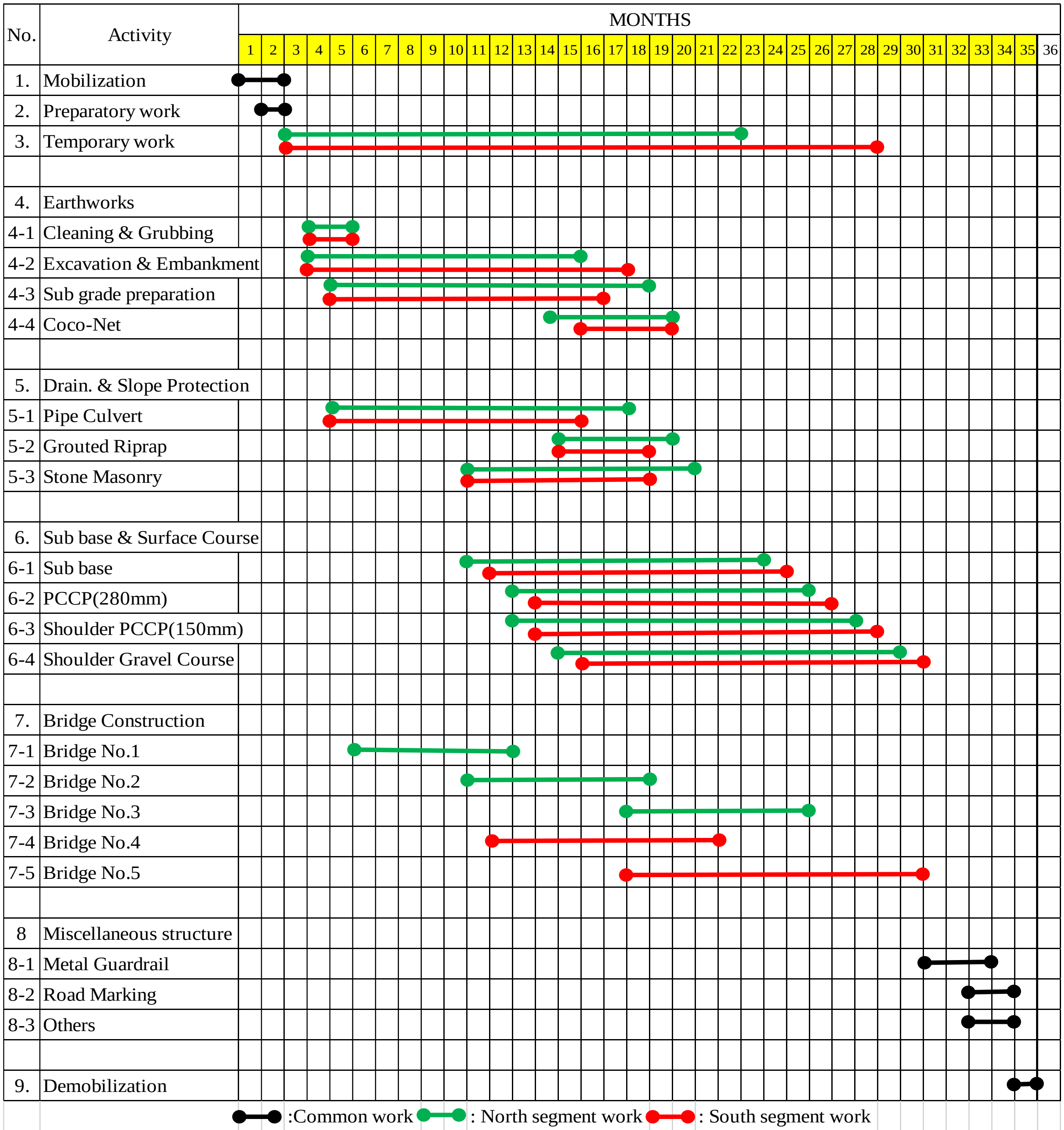
Item	Contents	Qty	Cost (million php)	Cost per km (mill. Php)	Bridge/m (mill. Php)	Portion (%)
A	Facilities for engineer	1.0	23.923	1.70		1.4%
B	Other general requirement	1.0	63.238	4.49		3.8%
C	Earth work	1.0	228.816	16.25		13.6%
D	Subbase and base course	1.0	154.815	10.99		9.2%
E	Surface course	1.0	312.091	22.16		18.6%
F	Bridge structure (Total)	575m	565.145		0.98	33.6%
	F1	60m	62.096		1.03	3.7%
	F2	100m	94.221		0.94	5.6%
	F3	75m	81.451		1.09	4.8%
	F4	280m	263.178		0.94	15.6%
	F5	60m	64.199		1.07	3.8%
G	Drainage and slope protection	1.0	114.312	8.12		6.8%
H	Miscellaneous item	1.0	87.629	6.22		5.2%
I	Farm to Market road	11km	132.074			7.9%
	Grand Total		1,682.043	69.92		100.0%

Source: JICA Study Team

1.10 Project Duration and Schedule

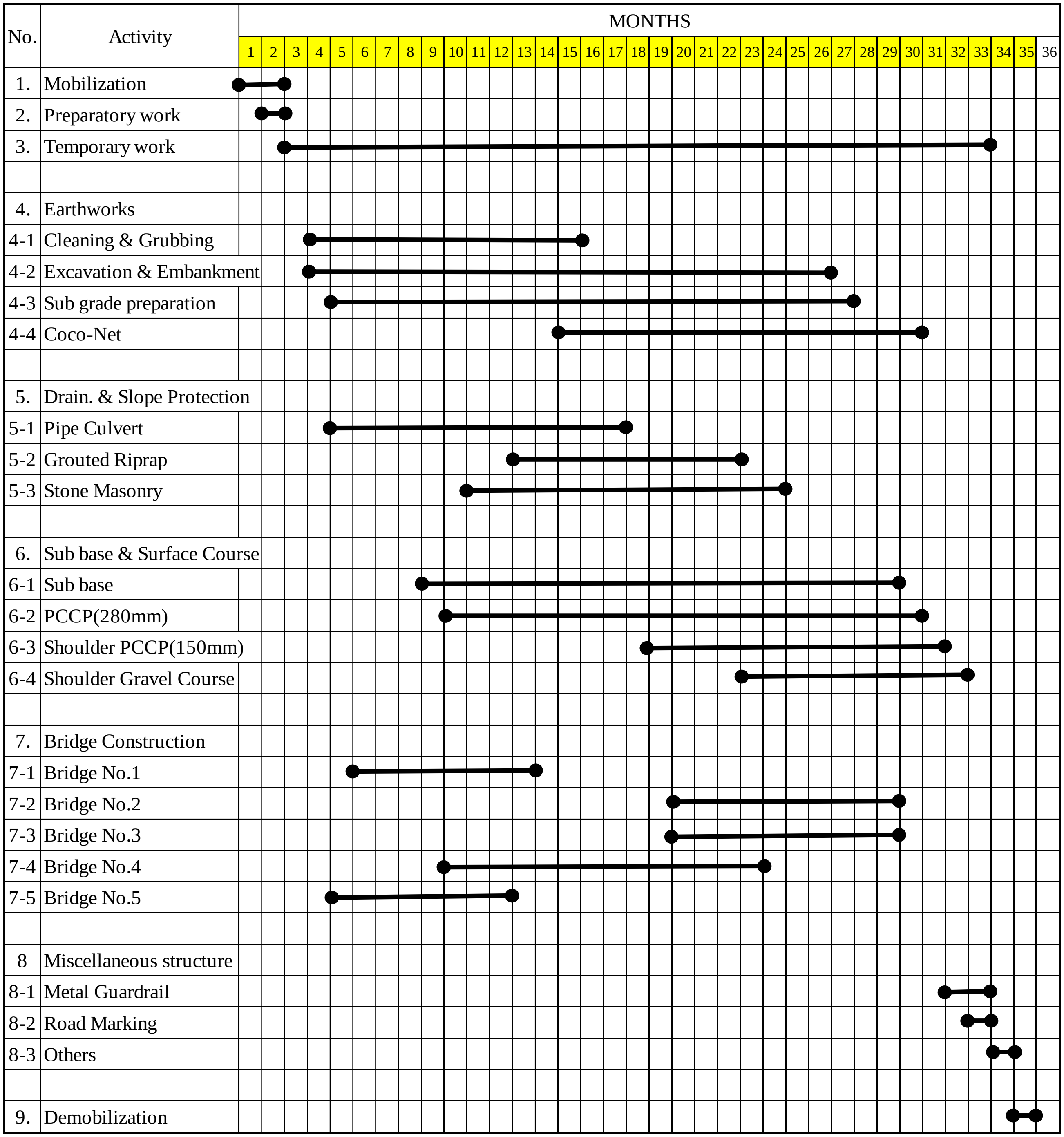
Estimated construction period is 35 months. **Table 19** and **Table 20** show the project duration and schedule.

Table 19. Project Duration and Schedule (Package 1)



Source: JICA Study Team

Table 20. Project Duration and Schedule (Package 2)



Source: JICA Study Team

Section 2

LEGAL AND ENVIRONMENTAL ASSESSMENT FRAMEWORK AND DESCRIPTION OF PROJECT EIA'S PROCESS

2.0 LEGAL AND ENVIRONMENTAL ASSESSMENT FRAMEWORK

The environmental impact assessment was undertaken based on the Procedural Manual for DENR Administrative Order No. 30 Series of 2003 (DAO 03-30) for the proposed project. The resulting study was documented in the form of Environmental Impact Statement (EIS) Report which is the minimum requirement by DENR-EMB for the issuance of an Environmental Compliance Certificate (ECC).

The EIS as outlined in the revised procedural manual was used as basis in the conduct of this study.

The result of the EIS shall be used by the proponent as a tool in the formulation of appropriate environmental management plan for the proposed project.

2.1 National and Local Environmental Assessment, Laws, Regulations and Standards

National and Local laws, regulations and standards are summarized in **Table 21**.

Table 21. Philippine Environmental Laws and Decree by Category

Category	Title	Outline
Natural Resources	Constitution Article 12/Clause 2.	Investigation of natural resources, development use
	Presidential Decree (PD)/No. 1198	Protection of Natural Environment
Protection of wildlife and biodiversity	Republic Decree No. 826	Preservation of Natural Parks and Establishment of Wildlife Protection Committee
	Statement No. 2141	Preservation of wilderness region
	Administrative Order	No. 243 (1970) Prohibition of slaughter for buffalo
Forest resources	Presidential Decree (PD) NO. 209	Encourage of common forest project
	Presidential Decree (PD) No. 277	Encourage of report on offender against forest law
	Presidential Decree (PD) No. 278	Procedural regulation on development application for forest resources and forest land development use
	Presidential Decree (PD) No. 331 (1973)	Sustainable forest development forest resources
	Presidential Decree (PD) No. 389	Regulation on forest recovery
	Presidential Decree (PD) No. 705 (1975)	Amendment of regulation on forest recovery
	Presidential Decree (PD) No. 865	Export of lumber (selective deforestation)
	Presidential Decree (PD) No. 953	Request of forestation
	Presidential Decree (PD) No. 1153	Decree of forestation
	DNR Decree No. 78 (1987)	Regulation on permission range for felling and collection of oak, other hard wood
	DNR Decree No. 79 (1987)	Establishment of foundation of forest regeneration
	DNR memorandum No. 8 (1986)	Full prohibition of log export
	Notification No. 818	Diminution of forest
	Forest Development Bureau Circular No. 13 (1986)	Full prohibition of land possession within mangrove area, river area,

		preservation area, wilderness area. National park, wildlife reserve, experimental forest etc.
Coastal marine	Presidential Decree (PD) No. 600 (1974)	Prevention of marine pollution
	Presidential Decree (PD) No. 602 (1974)	Establishment for oil pollution management center
	Presidential Decree (PD) No. 979	Prevention of ocean pollution
Ambient air	Republic law No. 3931	Establishment of National air, water pollution control committee, definition of pollution and penalty
	Presidential Decree (PD) No. 1181	Air pollution regulation on incidence origin of traveling
	Presidential Decree (PD) No. 1160	Barangay Captain Community Leader on implementation of law on prevention of public nuisance
	Circulation No. 247	Appointment of highway patrol guard
	Circulation No. 551	Equipment of prevention devices of motor vehicles
Water quality	Republic law No. 3931	Establishment of National Water and Air Pollution Control Commission
	Presidential Decree (PD) No. 600	Establishment of Philippine coastal guard, measure for marine pollution
	Presidential Decree (PD) No. 602	Establishment of National oil pollution management center
	DENR Decree No. 34	Classification of water and use
	DENR Decree No. 35	Regulation on discharge water for industrial and urban drainage
Land use and resettlement	Constitution Article 13	Establishment of human protective committee and their responsibility
	DPWH Department Order No. 65	Land use procedure for public project and expressway project
	DPWH Department Order No. 120 (1988)	Compensation of private land for DPWH project
	DPWH Department Order No. 234 (1990)	Amendment of compensation of private land for DPWH project
	Revised Administrative Code No. 64	Competence of house of justice on private land acquisition by the government
	DPWH Department Order No. 65 (1983)	Guideline for land use and right of way
	Presidential Decree (PD) No. 1517	Designation of reserve area at reorganization of urban land use
	Senate Article No. 328	Decree of temporally prohibition for removal of displaced persons
	Republic Act 7279 (Urban Development and Housing Act of 1992)	An Act to provide a comprehensive and continuing urban development and housing program, establish the mechanism for its implementation, and for other purpose; procedure for removal of habituated peoples.
Land acquisition	Republic Act 6389 (1971); The Agricultural Land Reform Code	The agricultural lessee 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
	Executive Order (1985)	Providing the procedures and guidelines for the expeditions acquisition by the government of private real properties or rights thereon for infrastructure and other government development projects

	Republic Act 8974 (2000)	An act to facilitate the acquisition of right-of-way, site or location for national government infrastructure project and for other purposes
	Department Order 34 (2007)	Simplified Guidelines for the validation and Evaluation of Infrastructure Right-of-Way Claims" and the DPWH Land Acquisition, Resettlement, Rehabilitation, and Indigenous Peoples' Policy (LARRIPP), Revised March 2007
	Republic Act 10752 (2016)	The Right-of-Way Act An Act facilitating the acquisition of Right-of-Way Site or Location for National Government Infrastructure Projects
Human Rights	Executive Order No. 153 (2002)	Instituting the national drive to suppress and eradicate professional squatting and squatting syndicates; Amending E.O. 178 (1999) and E.O. 128 (1993)
	Indigenous People's Rights Act (IPRA) of 1997	Sets the conditions, requirements, and safeguards for plans, programs and projects affecting Indigenous Peoples (IPs).
	NCIP Administrative Order No. 1, Series of 2006	The procedure for obtaining the "Free and Prior Informed Consent" (FPIC) for affected communities
	DOLE Department Order No. 13, series of 1998	Occupational Safety and Health and DOLE Department Order No. 56, series of 2015, also known as Guidelines Governing Occupational Safety and Health in the Construction Industry
Conservation of historical cultural assets	Republic Decree No. 4365	Responsibility of National historic committee on authorization, restoration and maintenance for historical assets
	Republic Decree No. 4346	Responsibility of protection and propulsion of maintenance for cultural assets within National museum
Environmental Assessment	Presidential Decree (PD) No. 1586	Environmental assessment system and administrative organization
	Presidential Decree (PD) No.2146	3 Industrial sectors with large environmental impacts and 12 environmental critical regions
National integrated protected area system	National Integrated Protected Area System Act (1992)	Review of National Integrated Protected Area

Source: JICA Study Team

2.2 JICA Environmental and Social Requirement

Major laws regarding environment is shown in **Table 22**. Environmental related laws in the Philippines are composed of under the Presidential Decree PD) No. 1151 as environmental policy and PD No. 1152 as environmental regulation in relation to the national policy and regulation.

Table 22. Philippine's Major Environmental Laws

Title	Contents
Presidential Decree (PD) NO. 1151	Environmental policy
Presidential Code (PD) No. 1152	Environmental regulation

Source: JICA Study Team

2.3 Philippine Environmental Impact Assessment System for Road and Bridges Project

The project falls under **item D.3.c (Roads, new construction, widening including RO-RO facilities)** with a total length of 65.7 kilometers with no critical scopes covered. The presented outline prepared by DENR in the Revised Procedural Manual for DAO 03-30 was used as basis to determine the actual scope of this study**. Table 23** shows the policies, laws, administrative orders and memorandum circulars that are applicable and discussed in the Environmental Impact Study.

Table 23*.* Laws, Regulations and Administrative Orders Applicable in EIS

Environmental Impact Assessment	Revised Procedural Manual for DENR Administrative Order No. 30 Series of 2003 (Implementing Rules and Regulations of Presidential Decree No. 1586, Establishing the Philippine Environmental Impact Statement System), August 2007.
	Memorandum Circular No. 005, Series of 2014, Revised Guidelines for Coverage Screening and Standardized Requirements Under the Philippine EIS System
	Memorandum Circular No. 005, Series of 2011, Incorporating Disaster Risk Reduction (DRR) and Climate Change Adaptation (CCA) concerns in the Philippine EIS System
	DENR Administrative Order (AO) No. 37, Series of 1996 – Revising DENR AO No. 21, Series of 1992, to further strengthen the implementation of the Environmental Impact Statement (EIS) System
	DENR Administrative Order No. 2017-15: Guidelines on Public Participation under the Philippine Environmental Impact Statement (EIS) System
Land (Terrestrial Flora and Fauna)	Republic Act 9147, otherwise known as the Wildlife Conservation and Protection Act of 2001
	DENR-AO 2007-01 "Establishing the National List of Threatened Philippine Plant and their Categories
	International Union for Conservation of Nature (IUCN) Red List of Threatened Species 2016
	Memorandum Circular No. 01, Series of 2014. Guidelines for the Implementation of the DPWH-DENR-DSWD Partnership on the Tree Replacement Project
Ambient Water Quality	Philippine Clean Water Act of 2004 or known as Republic Act 9275
	Administrative Order No. 10, Series of 2005, Implementing Rules and Regulations of the Philippine Clean Water Act of 2004
	DENR Administrative Order No. 08, Series of 2016, Water Quality Guidelines and General Effluent Standards of 2016
	DENR Administrative Order No. 34, Revised Water Usage and Classification/Water Quality Criteria Amending Section Nos. 68 and 69, Chapter III of the 197 NPCC Rules and Regulations
Ground Water Quality	Philippine National Standards for Drinking Water 2017
	Philippine National Standards for Drinking Water 2007
	Administrative Order No. 0012 Series of 2007
Ambient Air Quality	Republic Act 8749 or known as Philippine Clean Air Act,
	DENR Administrative Order No. 2000-81

Noise Quality	National Pollution Control Commission (NPCC) Rules and Regulations, Chapter IV, Article 1, Section 78
Solid Wastes	Republic Act 2003, Ecological and Solid Waste Management Act, Series of 2000
	Administrative Order No. 34, Series of 2001. Implementing Rules and Regulations of RA 9003
Hazardous Wastes	Republic Act 6969, Toxic Substances and Hazardous Wastes Act, 1990.
	DENR AO No. 22, Series of 2013 – Revised Procedures and Standards for the Management of Hazardous Wastes (Revising DAO 2004-36)

2.4 Gap Analysis between JICA and Related Regulations in the Philippines

Based on the principles for EIA Reports for Category A projects requested by JICA Guidelines, gaps between the Guideline and the legislation in Philippines reviewed in **Table 24**. Basically, the Philippines legislation deems to meet the policy of JICA's Guideline, this Philppine EIA process is applicable on this project.

Table 24. Gaps Between JICA Guideline and the Philippine Legislation on EIA

JICA Guidelines	Legislation of the Philippines (DENR Administrative Order No. 30 Series of 2003)	Gaps	Policy to fill up gaps in this study
1. When assessment procedures already exist in host countries, and projects are subject to such procedures, project proponents must officially finish those procedures and obtain the approval of the government of the host country	The project is required to prepare the EIA and obtain the environmental compliance certificates (ECCs) in accordance with Philippine laws	No difference	Not required
2. EIA reports (which may be referred to differently in different systems) must be written in the official language or in a language widely used in the country in which the project is to be implemented. When explaining projects to local residents, written materials must be provided in a language and form understandable to them	The order stipulates that EIA shall be written in the local dialect or mixed with the popularly known language of the host communities. In this case, English is recognized a s popularly known language in the project area.	-	Not required
3. EIA reports are required to be made available to the local residents of the country in which the project is to be implemented. The EIA reports are required to be available at all times for perusal by project stakeholders such as local residents and copying must be permitted	The proponent is required to give copies of the full EIA report to the EMB Regional office host municipalities; copies of executive summary to the host barangays	-	Not required
4. In preparing EIA reports, consultations with stakeholders, such as local residents, must take place after sufficient information has been disclosed. Records of such consultations must be prepared.	The prescript public consultation is held with project affected persons and other relevant agencies at scoping stage and draft EIA stage respectively after sufficient announcement of the meeting(s). Project	-	Not required

	outline is explained sufficiently prior to public consultation at scoping stage.		
5. Consultations with relevant stakeholders, such as local residents should take place if necessary throughout the preparation and implementation stages of a project. Holding consultations is highly desirable, especially when the items to be considered in the EIA are being selected, and when the draft report is being prepared.	The prescript public consultation is held with project affected persons and other relevant agencies at scoping stage and draft EIA stage respectively after sufficient announcement of the meeting (s).	-	Not required

Source: JICA Study Team

2.5 DESCRIPTION OF THE PROJECT'S EIA PROCESS

The environmental impact assessment was undertaken based on the Procedural Manual for DENR Administrative Order No. 30 Series of 2003 (DAO 03-30) for the proposed project. The resulting study was documented in the form of an Environmental Impact Statement Report (EIS). Minimum required by DENR-EMB for the issuance of an Environmental Compliance Certificate (ECC) will be a detailed EIS.

The EIS as outlined in the revised procedural manual was used as basis in the conduct of this study.

The result of the EIS shall be used by the proponent as a tool in the formulation of appropriate environmental management plan for the proposed project.

2.5.1 EIS TEAM

KRC Environmental Services is composed of multi-disciplinary specialists with expertise in the conduct of Environmental Impact Assessment, EIS and other environmental studies. The following are the team composition.

Ricardo A. Capule	-	President / Air & Noise Quality Specialist
Marilou P. Avenido	-	Team Leader
Maria Carmela Q. Capule	-	Project Manager/Environmental Scientist
Milagrosa P. Asuncion	-	Sociologist
Abelardo H. Angadol Jr.	-	Terrestrial Specialist
Pablito C. Argamosa	-	Geologist
Virgilio M. Garcia	-	Hydrologist
Robert Pabiling	-	Aquatic/Marine Specialist

2.5.2 EIS STUDY SCHEDULE

The team was assigned to conduct the EIS study from November 2017 to March 2018. Public Consultations with Municipalities and Barangay Scopings were held on December 2017 and January 2018 respectively. 2nd Public consultations with Municipalities were held on February and March 2018.

Ocular inspection of the area to determine the exact location of the project site, to establish the primary and secondary impact areas, the existing land uses, the receiving body of water, ecological characteristics, geophysical feature, etc.

Both primary and secondary were collected and used in the environmental examination and assessment of impacts of the project. Different methods were used in gathering primary and secondary data:

- Meeting with the proponent and extensive discussion on the description of the project
- Gathering and review of secondary data from proponent, private and concern government offices.
- Actual site investigation, focus group discussion and consultative meetings
- Mapping using GPS, compass, topographic and google maps
- Actual water, air and noise survey
- Actual flora and fauna survey
- Actual investigation of socio economic profile and gathering and review of secondary data

2.5.3 EIS STUDY AREA

The scope of the study focuses on the probable adverse impact that may occur during the operation phase of the project on water, air, soil, health, people and the environment in general. The impact prediction is based on similar, past actual eventuality and perceptions based on the present physical condition of the environment

Based on the predicted impacts, the enhancement and mitigating measures were formulated to prevent the occurrence of such adverse impact. However, the limitation of the study is that it was only predictable based on the available primary and secondary physical and scientific data. The study area is within the direct impact which are Barangays Macasandag, Sapad, Kidama, Salaman, Matimos, Bakikis, Lusain, Banago, Narra, Lorenzo, Molimoc, Barorao, Batuan and Budas where the road alignment and right of way are situated while the indirect impacts are the surrounding barangays, the hosts and surrounding municipalities and provinces.

2.5.4 EIA METHODOLOGY

Scoping with DENR is usually done to define the range of actions, alternatives, and impacts that are to be examined. The project falls under **Item Major Roads and Bridges D.3.c (Roads, new construction, widening including RO-RO facilities)** with a total length of 65.7 kilometers having no critical scopes covered. The presented outline prepared by DENR in the Revised Procedural Manual for DAO 03-30 was used as basis to determine the actual scope of this study. **Table 28** presents the different components and methodologies of the project.

Table 25. Components and Methodologies of the Project

COMPONENT	METHODOLOGY
Project Description	Meetings with the proponent and actual site investigation
Baseline Environmental Condition	Secondary data gathered from the proponent, concern government offices and institution, actual gathering of flora and fauna, transect method in the identification of trees ,actual social-economic investigation.
Delineation of Impact areas	Annex 2-2 of Rev Procedural Manual DAO 2003-30
Impact Assessment	Qualitative assessment and expert opinion
Environmental Management and monitoring Plan	Template on Annex 2-17,2-18,2-19, 2-20 of the Rev. Procedural Manual of DAO2003-30
Secondary Data	Research, gathering and review of data from LGUs concern, PHIVOLCS, PAGASA, EMB, DPWH, CTI, LGUs

Section 3

BASELINE ENVIRONMENTAL CONDITIONS AND ANALYSIS OF KEY ENVIRONMENTAL ASPECTS

This section describes and discusses the existing environmental conditions of the project site.

DESCRIPTION OF EXISTING CONDITIONS

Determinations of environmental conditions were undertaken through extensive research. Furthermore, ocular inspections of the project site as well as its immediate vicinity and contiguous area/community were undertaken to determine any possible impact.

3.1 The Land

3.1.1 Land Use and Classification

The land use along the proposed alignment is classified into agricultural and residential areas. Since no Comprehensive Land Use Plan (CLUP) provided by the Local Government Units (LGUs) from the Municipalities affected to properly identify the delineation of the residential land, the survey team did an estimated delineation using a GPS. **Table 26** shows the land use of affected barangays.

Table 26. Land Use (sq. m)

Municipalities	Barangays	Residential	Commercial	Agricultural	All Lands
Parang	Macasandag	0	1895	76,059	77954
	Sub-total	**0**	**1,895**	**76,059**	**77,954**
Matanog	Sapad	0	0	96,530	96530
	Kidama	0	0	212,093	212093
	Sub-total	**0**	**0**	**308,623**	**308,623**
Kapatagan	Salaman	0	0	58,337	58337
	Matimos	0	0	61,180	61180
	Bakikis	0	0	28,350	28350
	Lusain	0	0	187,174	187174
	Sub-total	**0**	**0**	**335,041**	**335,041**
*Balabagan	Banago	0	0	21,477	21477
	Narra	1669	0	17,791	19460
	Lorenzo	29403	0	6,690	36093
	Molimoc	73375	0	0	73375
	Barorao	31319	2116	0	33435
	Batuan	0	0	38,328	38328
	Budas	0	0	65,355	65355
	Sub-total	**135,766**	**2,116**	**149,641**	**287,523**
	TOTAL	**135,766**	**4,011**	**869,364**	**1,009,141**

Source: RAP Survey Team
Note: * Classification is based on the Municipal Assessors.

3.1.2 Geology and Geomorphology

The study was guided by the Department of Environment and Natural Resources (DENR) Administrative Order No. 2000-28, which requires all land development projects to undertake engineering geological and geohazard evaluation to safeguard such projects from the hazards caused by geological phenomena. The guidelines and checklist in carrying out the study and the preparation of the corresponding report follows Memorandum Circular No. 2000-33 issued by the Mines and Geosciences Bureau (MGB).

The geological and geohazard assessment is a vital component of the Environmental Impact Survey for the Project to enable the preparation of an Environmental Assessment (EIA) report of the Project. The general procedures in carrying out the activities are described as follows:

a) Bibliographic research and desk studies involving the review of available relevant data from national agencies, local government units, and private entities. These include the regional MGB office, National Mapping and Resource Information Authority (NAMRIA), Philippine Institute of Volcanology and Seismology-Department of Science and Technology (PHIVOLCS-DOST), and the provincial and municipal government of involved localities. Other pertinent information was obtained from several literatures, published materials, and online sources.

b) The field verification of existing secondary information was guided by the available geological maps from MGB, the quadrangle topographic maps published by NAMRIA, and the index/location maps, pertinent plans and drawings provided by JICA.

c) The extensive areal extent of the project necessitates the use of available aerial photographs, and imageries including available Google Earth maps.

d) The field mapping was done on a base with sufficient and satisfactory horizontal and vertical control, such as a detailed topographic map. The nature and source of the base map used are specifically indicated.
e) Careful attention was given to the lithology, structural elements, and three-dimensional distribution of the earth materials exposed or inferred within the area. A clear distinction was made between observed and inferred geologic features and relationships. Where three-dimensional relationships are significant but cannot be described satisfactorily in words alone, the report shall be accompanied by appropriately positioned geologic/structural cross sections.

f) The geomorphologic characteristics of the project area were verified including the evaluation of the presence of natural hazards such as erosion, active slope movement, flooding and seismic risk.

3.1.2.1 Regional Setting

3.1.2.1.1 General Geology

The Project Area is dominated by volcanic plain or volcanic piedmont deposits, chiefly pyroclastics and/or volcanic debris. The most recent deposits, Quaternary Alluvium, is composed of alluvium, fluviatile, lacustrine and beach deposits, raised coral reefs, and beachrock. Other lithological facies are composed mostly of submarine andesite and basaltic flows intercalated with pyroclastics and clastic sedimentary rocks; and reef limestone lenses largely confined within the axial zones Mindanao. Thick, extensive, transgressive mixed shelf marine deposits, largely wackes, shales and reef limestone are also present.

The MGB classified the island of Mindanao into western, central and eastern geologic provinces. Previous geologic studies have identified three (3) main physiographic-structural units in Mindanao as follows:

Pacific Cordillera, Mindanao Central Cordillera and Agusan-Davao Basin that trend N – NNW;

Tiruray-Daguma Range and Cotabato Basin that trend NW; and.

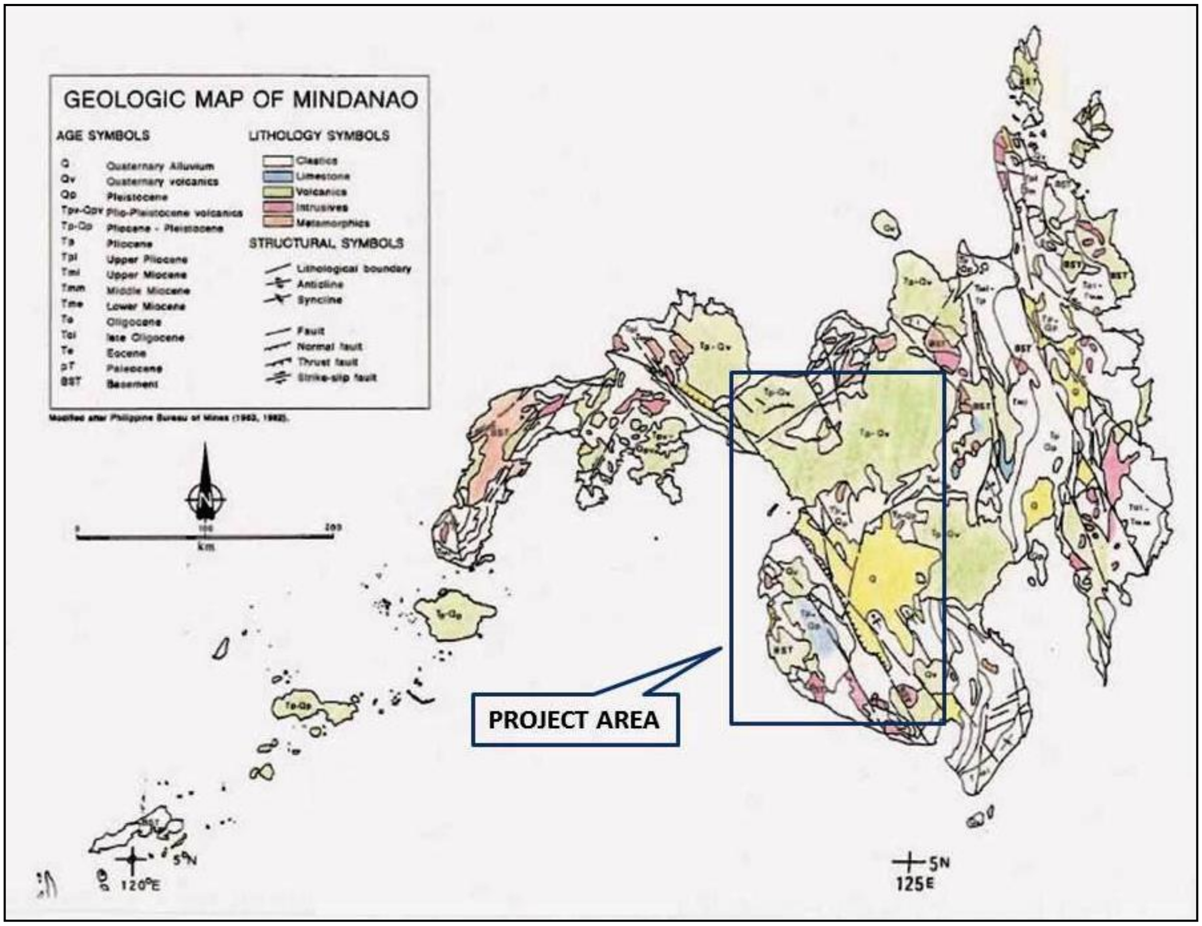
NE-trending Zamboanga Peninsula and Sulu Islands.

The province of Lanao del Sur belongs to the Mindanao Central Cordillera physiographic-structural unit. It consists of uplifted Cretaceous-Paleogene basement intruded by Neogene plutons with Quaternary volcanoes covering most of the range. The oldest rocks include mica and chlorite schists, slates and ultramafics (Pacis, 1966), which correlate with intensely folded and faulted basement schists and quartzites thrusted rocks in the central part of the range (Ranneft et al., 1960).

The magmatic and tectonic actions generated by subducting westward and northeast crustal dipping plates resulted in the uplift of the metamorphic, igneous and sedimentary rocks found in the province.

The province of Maguindanao forms part of the Tiruray-Daguma Range block which forms the southwest margin of the Cotabato Basin. The basement is composed of Cretaceous-Paleogene metamorphosed sediments and volcanics. The northern portion is covered by uplifted Pleistocene reefal limestone and andesite. The southeastern part consists of Pliocene to Pleistocene andesitic pyroclastics and lavas that form Mt Parker.

In Maguindanao, the oldest rocks are the partly metamorphosed Cretaceous to Paleogene tuffaceous mudstone and greywacke which are intercalated with lava flows. The geologic map of Mindanao is shown in **Figure 21**.



Source: MGB, as cited in Corpuz, 1992

Figure 21. General Geology of Mindanao

3.1.2.1.2 Tectonics

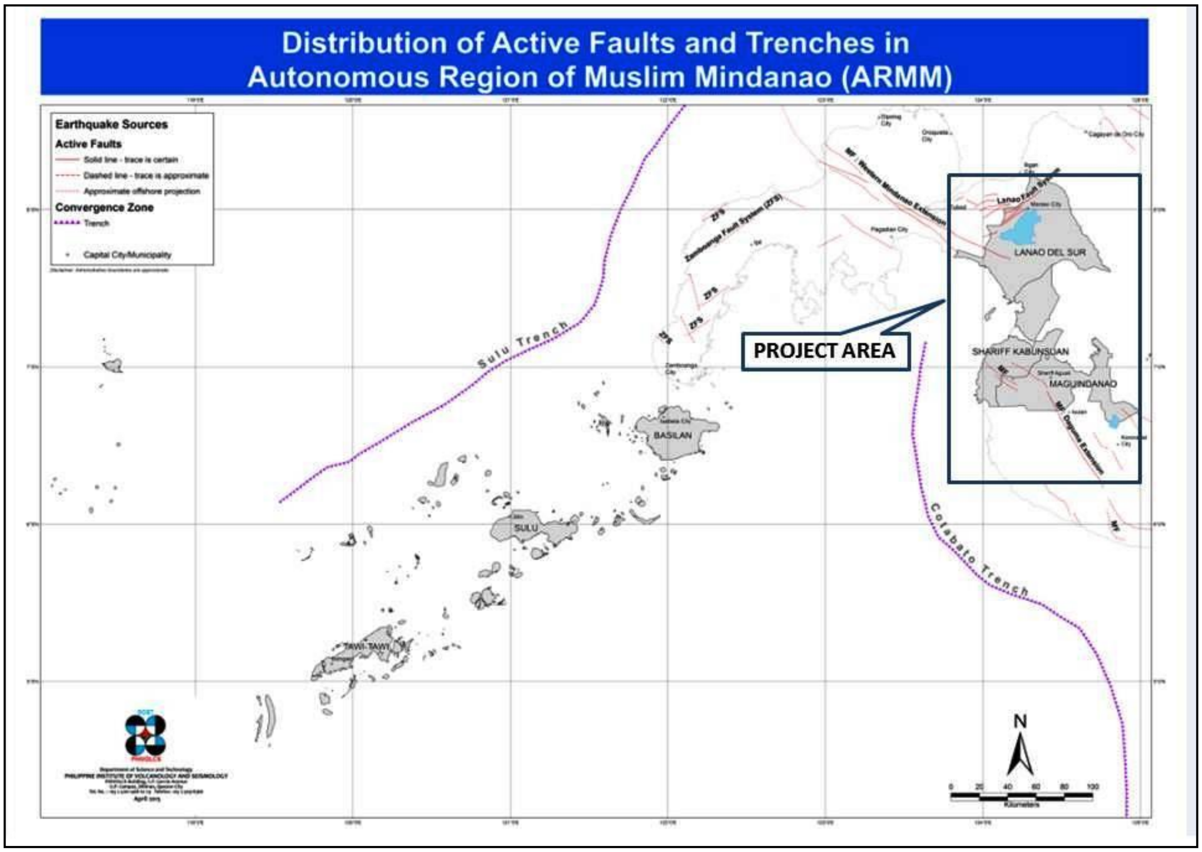
Mindanao Island is a composite of at least two terranes; one with Eurasian affinity (western Mindanao) and the other belonging to the Philippine Mobile Belt (eastern Mindanao) of Philippine Sea plate affinity. The island is surrounded by three subduction zones that have been installed only in the past 4 million years. Prior to this, the two terranes were separated by an ocean that disappeared continuously by subduction of its two edges beneath western and eastern Mindanao. The suturing of the two terranes occurred at ca. 5 Million years. Following this major structural reorganization, abrupt changes are recorded in the old magmatism of the island (Sajona et al., 1994).

3.1.2.1.3 Seismicity

Mindanao Island is prone to seismic events emanating from major earthquake generators in the Philippine Arc System. Active trenches mark out large areas of mainland Mindanao, as well as major fault systems, sub faults and lineaments (PHIVOLCS). In the ARMM, the active faults within a 100-km radius of the Project Area include the Cotabato Trench and Mindanao Fault. By definition, an active fault is one that has moved during the last 10,000 years.

The Philippine Fault located farther east of the Project Area is also included in the discussion due to its significant influence to the seismicity of Mindanao.

In the ARMM, the major earthquake generators include the Cotabato Trench and Mindanao Fault as shown in **Figure 22.**



Source: PHIVOLCS

Figure 22. **Distribution of Active Faults and Trenches in ARMM**

a) Cotabato Trench

The Cotabato Trench is a deep depression approximately 4 km deep at the northeastern edge of the Celebes Sea Basin. This geological structure is considered responsible for the Moro Gulf earthquake of August 17, 1976 that registered a computed magnitude of 7.9 in the Richter Scale. The Palimbang earthquake of 2002 with a registered a magnitude of 7.5 was also attributed by PHIVOLCS to subduction along the Cotabato Trench.

A left-lateral strike-slip feature known as the Cotabato Fault that cuts across the Zamboanga Peninsula appears to link the Cotabato Trench with the Negros Trench (Pubellier, et al., 1993).

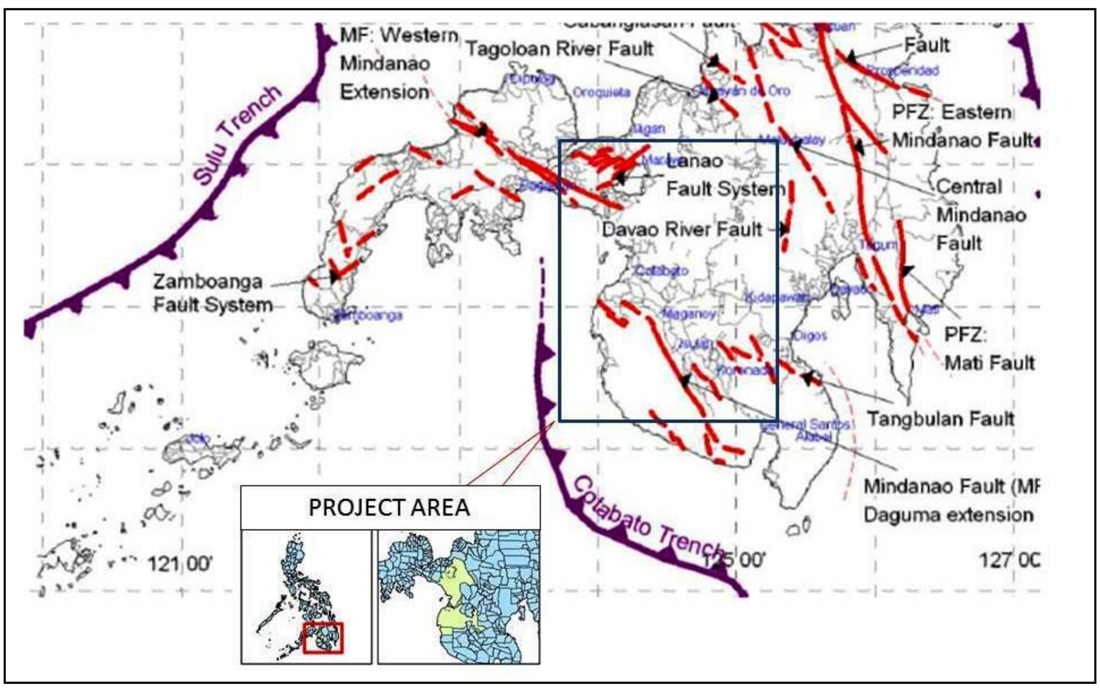
b) Mindanao Fault

The Mindanao Fault is a North West (NW) trending fault extending from northern Zamboanga Peninsula to eastern Cotabato. The fault is physically traceable to approximately 400 km long on the western third of Mindanao Island. It has two distinct segments including that which separates the Daguma Range from the Cotabato Basin corresponding to the Cotabato Fault segment (MGB, 2010). This segment is highly linear and has features suggestive of normal faulting although it may have been a sinistral fault during its early history. The Sindangan Fault segment, on the other hand, represents the northern continuation of the fault towards Zamboanga. Focal mechanism solutions of earthquakes offshore and narrow shear zones transection recent gravel deposits suggest active sinistral faulting (Pubellier & others, 1991).

c) Philippine Fault Zone

The Philippine Fault Zone (PFZ) is located farther east within a 300-km radius of the Project Area. The 1,200-km-long PFZ is a major tectonic feature that transects the whole Philippine archipelago from northwestern Luzon to southeastern Mindanao (PHIVOLCS). This arc-parallel, left-lateral strike slip fault is divided into several segments and has been the source of large-magnitude earthquakes in recent years, such as the 1973 Ragay Gulf earthquake (M 7.0), 1990 Luzon earthquake (Mw 7.7), and the 2003 Masbate earthquake (Ms 6.2).

Several subordinate faults are intimately linked to the evolution of the PFZ. In Mindanao, a left-lateral fault zone is comprised by the NW-trending Sindangan-Cotabato-Daguma Lineament (**Figure 23**). This accommodates some of the stress that is not being accommodated by the surrounding trenches in Mindanao (Yumul et al., 2008).



Source: PHIVOLCS

Figure 23. **Distribution of Active Faults and Trenches in Mindanao**

d) Other Potential Earthquake Generators

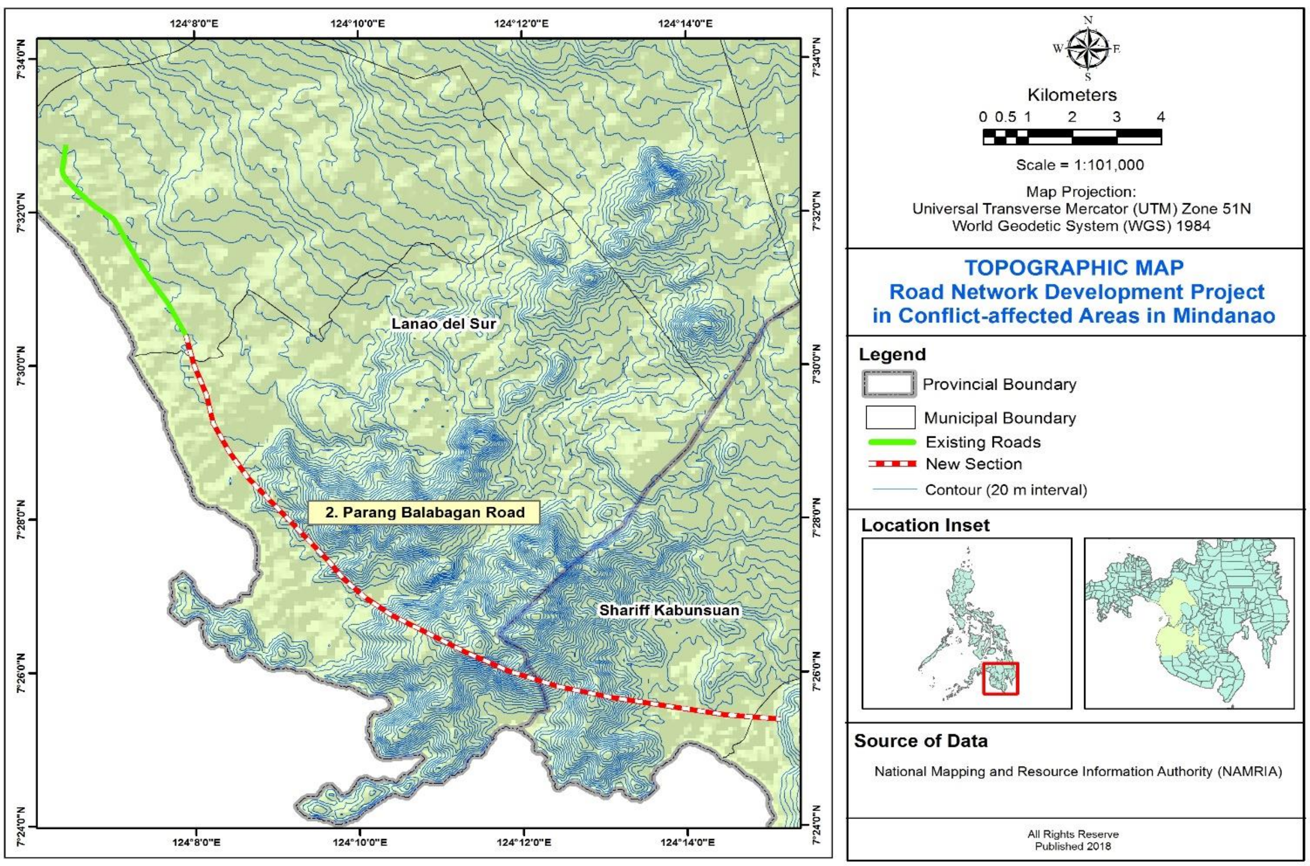
Small to moderate earthquakes could be generated by the Sulu Trench, the Zamboanga Fault System, and the Lanao Fault System. The Sulu Trench has been seismically inactive for the last 120 years but PHIVOLCS considers it potentially capable of triggering a major earthquake due to stress build up.

3.1.2.2 Project Site Geologic Setting

3.1.2.2.2.1 Topography

In general the province of Lanao del Sur has 40 percent plain and 60 percent sloping areas. Maguindanao for its part has 45 percent plain and 55 percent sloping areas. Its southwestern part consists of mountain cluster of the Binica and Blit Mountains. The biggest and longest river is the Rio Grande de Mindanao which flows through Liguasan Marsh before emptying into the Moro Gulf (REDPB-ARMM, 2005).

The mountainous areas in the Project Area consist chiefly of basement and Tertiary volcanic rocks; while Tertiary sedimentary rocks predominate in lowland areas. A cluster of inactive volcanoes with associated volcanic lakes in Lanao del Norte and Lanao del Sur.is collectively called the Lanao Volcanic Complex. The inactive volcanoes include Mt. Gadungan, Dos Hermanos Peaks, Mt. Cabugao, Mt. Iniaoan, Lake Nunungan, Mt. Catmon, Mt. Sagada, Mt. Puerai and Gurain Mountains.



Source: NAMRIA
Figure 24. Topographic Map of the Project Area

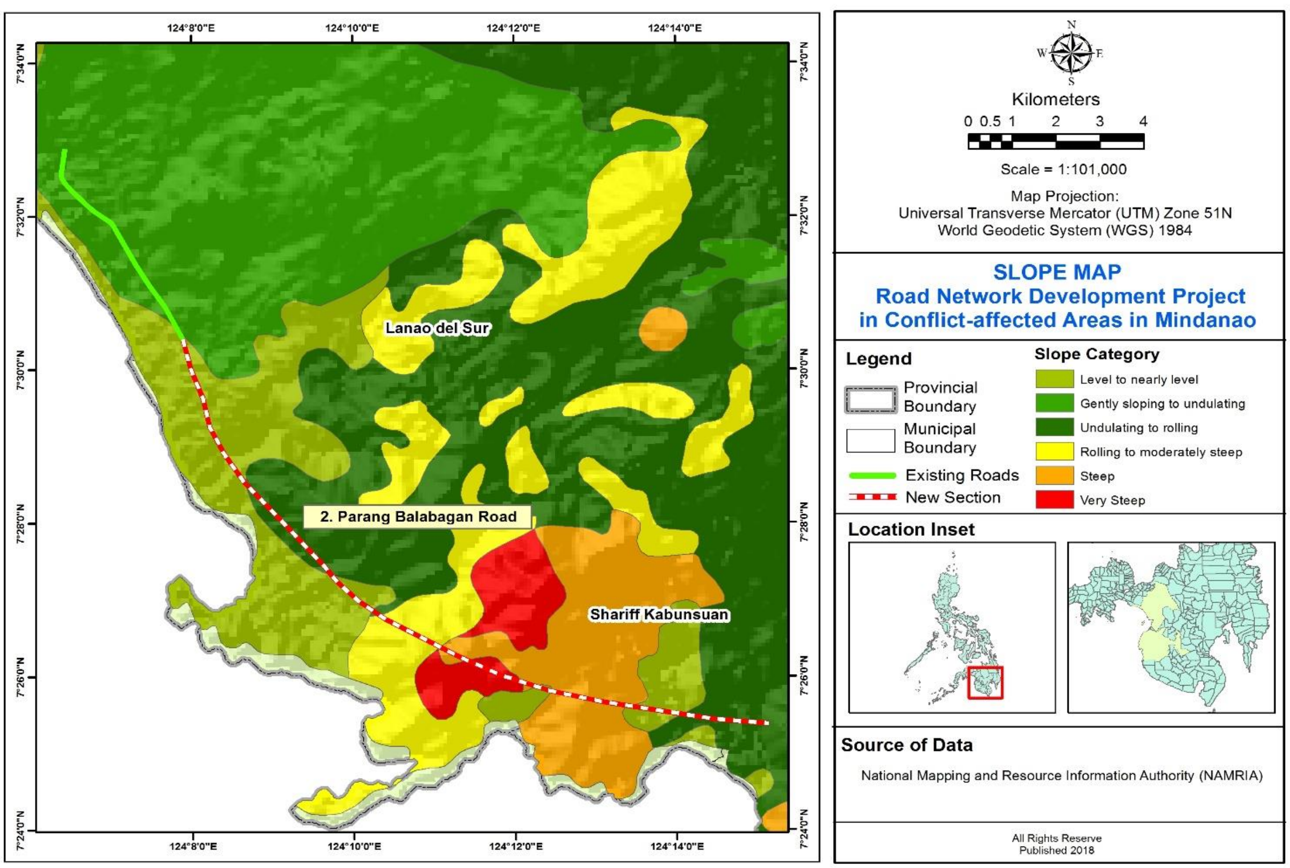
The gently sloping to undulating area consists of the coastal and alluvial plains. These areas have nearly flat ground slope of 0 to 8 degree. The topography is characterized by lower elevations that are commonly developed into agricultural lands. The terrain is generally flat to nearly flat and the groundwater table is expected at relatively shallow depth. The area forms the transition between the coastal plain and the undulating to rolling area.

The undulating to rolling area is underlain by volcanic and/or sedimentary rock formation that gave rise to undulating to rolling ground. The ground slope ranges from 8 to 18 degree. The groundwater table is expected to be fairly deep. Most areas are covered with assorted secondary growth trees, coconuts, and grasses.

The rolling to moderately steep terrain has a ground slope range from 18 to 30 degree. It is generally found on the mountain foot slope formed by volcanic and/or sedimentary rock formation. This topography includes rolling hills, ridges and elevated inland valley.
Table 27 shows the slope classification of the project area and **Figure 25** shows the slope map of the project site.

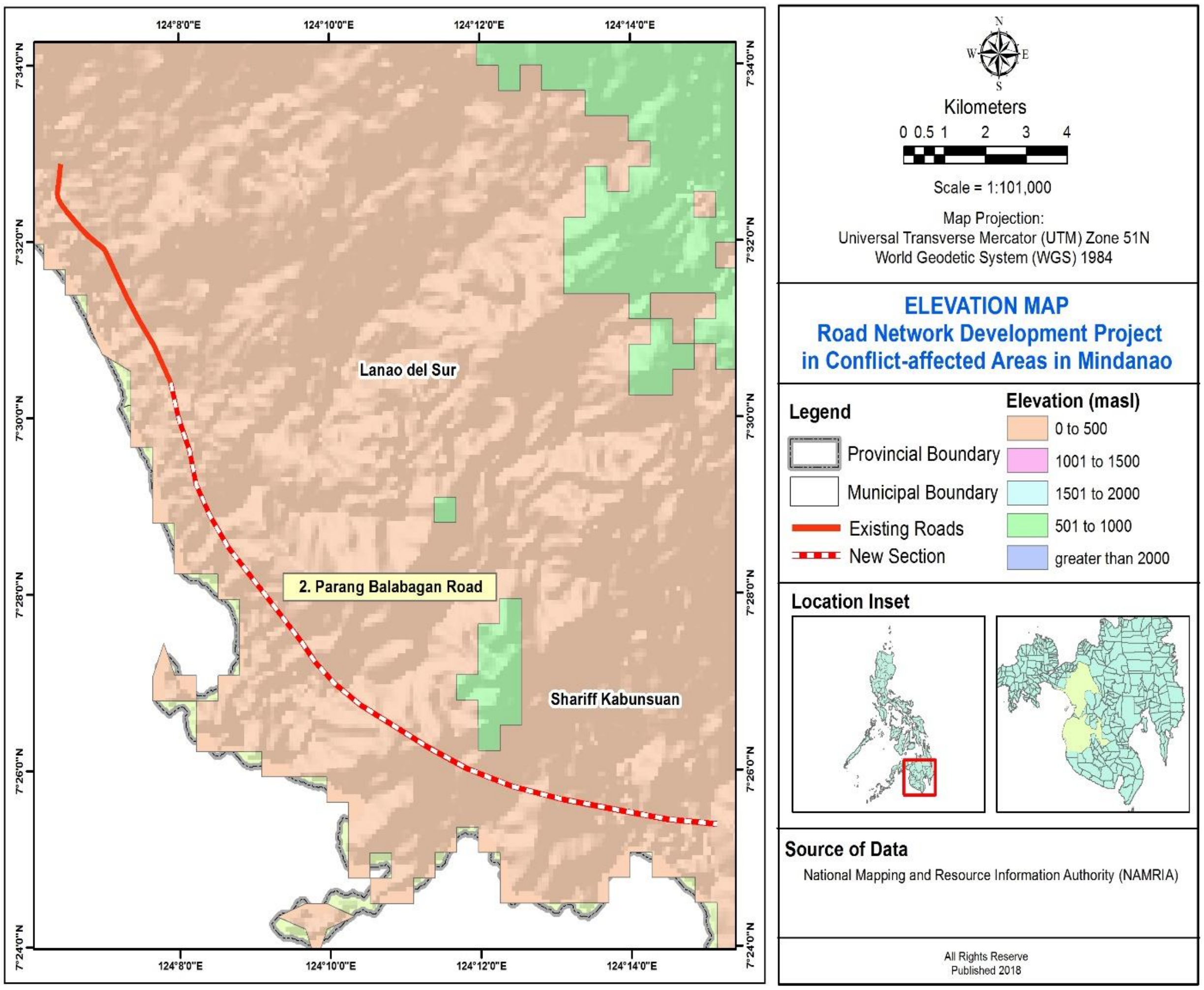
Table 27. Slope Classification of the Project Area

Slope Ranges(°)	**Description**
0-8	Gently sloping to undulating
8-18	Undulating to rolling
18-30	Rolling to moderately steep
30-50	Steep
50 and above	Very steep



Source: NAMRIA
Figure 25. Slope Map of the Project Area

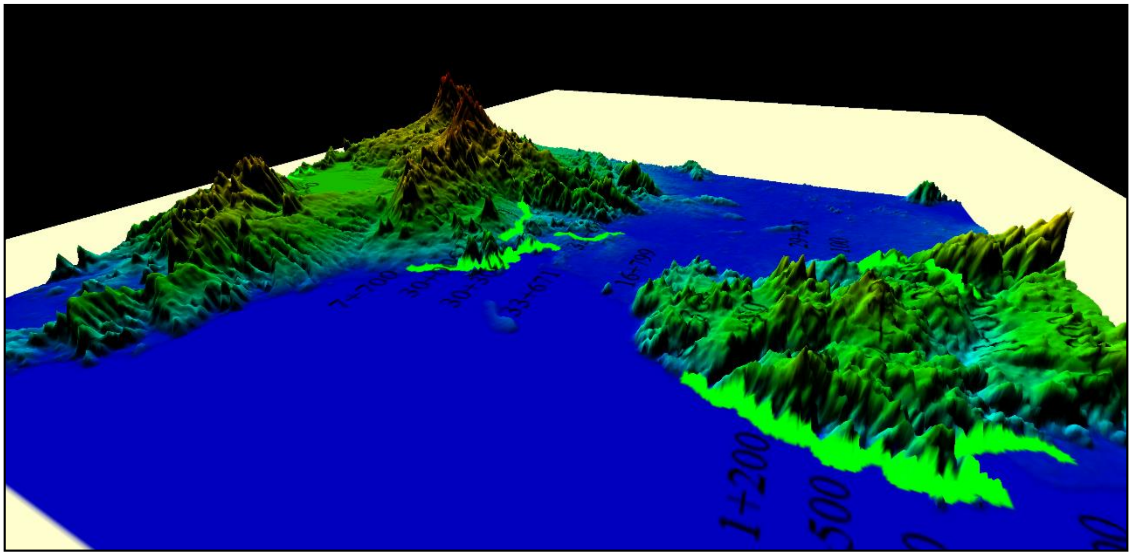
Generally, the elevation within the project area varies from 0 to 500 meter above sea level (masl) and from 501 to 1000 masl. The lower elevation is concentrated mainly at SP 2 – Parang-Balabagan Road. **Figure 26** shows the elevation map of the project site.



Source: NAMRIA
Figure 26. Elevation Map of the Project Area

3.1.2.2 Geomorphology

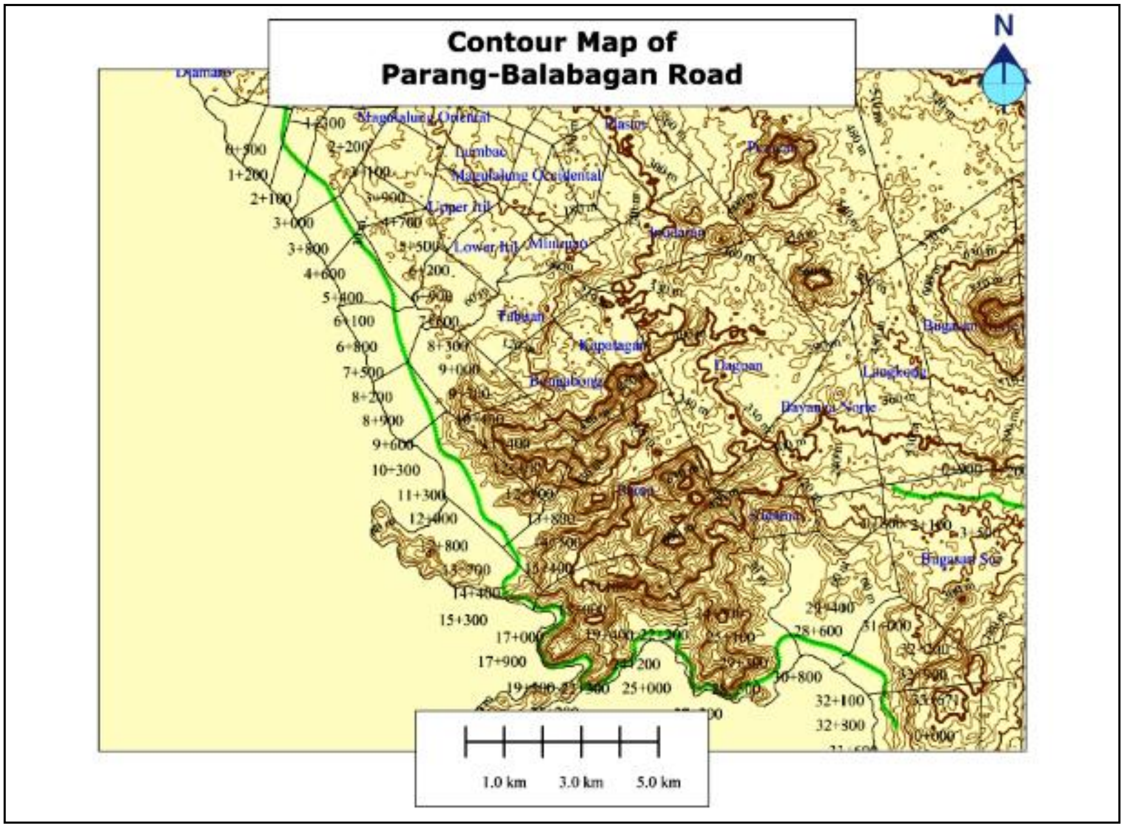
The mountainous areas in the region consist chiefly of basement and Tertiary volcanic rocks; while Tertiary sedimentary rocks predominate in lowland areas. A cluster of inactive volcanoes with associated volcanic lakes in Lanao del Norte and Lanao del Sur.is collectively called the Lanao Volcanic Complex. The volcanoes include Mt. Gadungan, Dos Hermanos Peaks, Mt. Cabugao, Mt. Iniaoan, Lake Nunungan, Mt. Catmon, Mt. Sagada, Mt. Puerai and Gurain Mountains. The Lanao Volcanic Complex is assigned an age range of Pliocene – Pleistocene on the basis of available information. **Figure 27** shows the type of rock transected by the proposed roads.



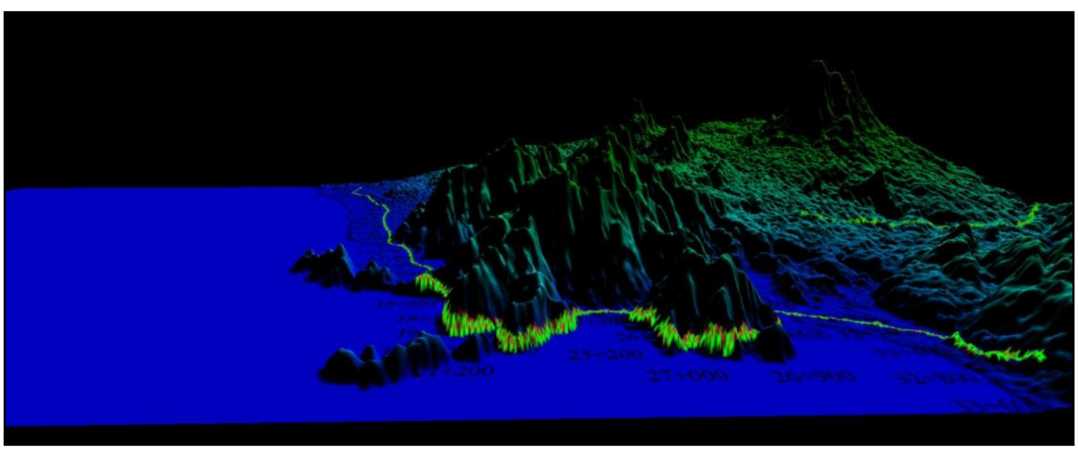
Base Map Source: JICA Study Team

Figure 27. 3D View of Type of Rock (pyroclastics/volcaniclastics/submarine rocks) Transected by the Proposed Roads.

The initial stretches of the proposed road are underlain by quaternary deposits. Stations 12+000 and above further transect volcanic rocks similar to those previously mentioned in this report. Areas of the road adjacent to high gradients (mountains) may have high susceptibility to landslide. However, this must be confirmed by means of geological and geotechnical assessment. **Figure 28** shows the contour map of Parang-Balabagan Road and **Figure 29** shows the delineation of SP 2.



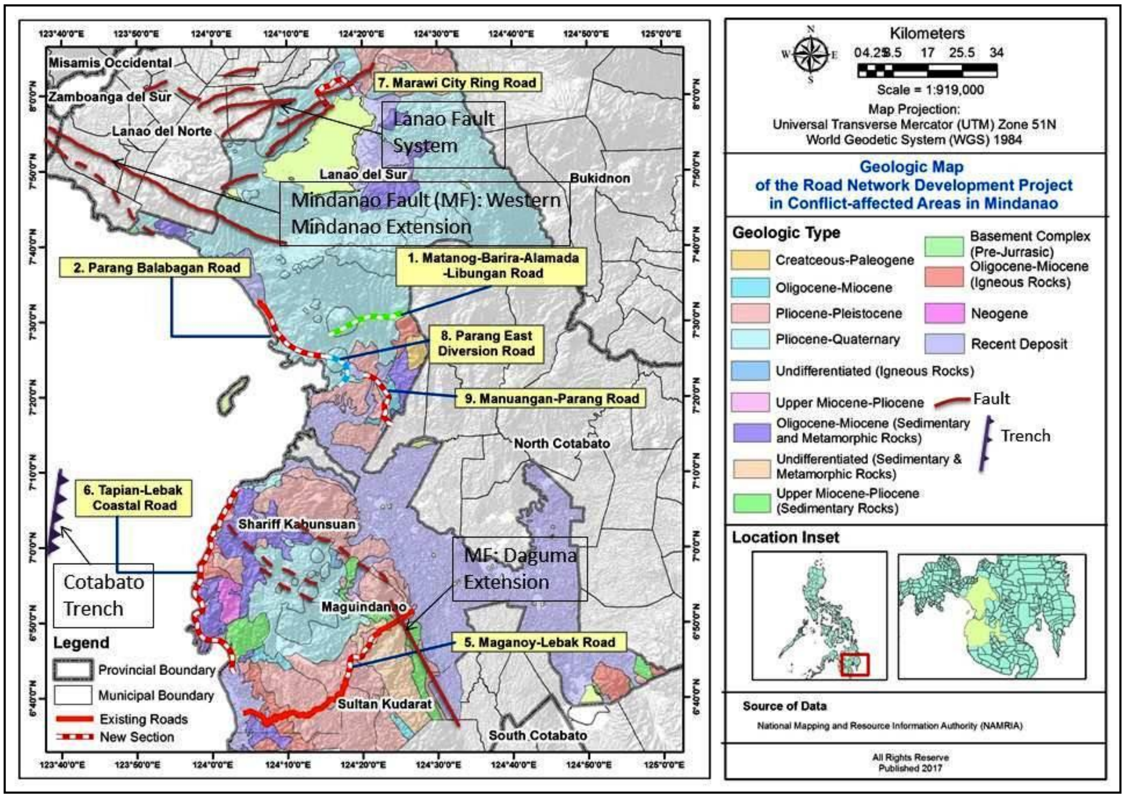
Base Map Source: JICA Study Team
Figure 28. **Contour Map of SP No. 2 Parang-Balabagan Road**



Base Map Source: JICA Study Team
Figure 29. 3D View of SP No.2 delineated by the red line

3.1.2.3 Site Geology

The Project Area is dominated by volcanic plain or volcanic piedmont deposits, chiefly pyroclastics and/or volcanic debris usually found at the foot of volcanoes. Plateau basalt in Pagadian and Lanao regions, and non-active cones (generally pyroxene andesite) are also present. **Figure 30** presents the geologic map of the project area.

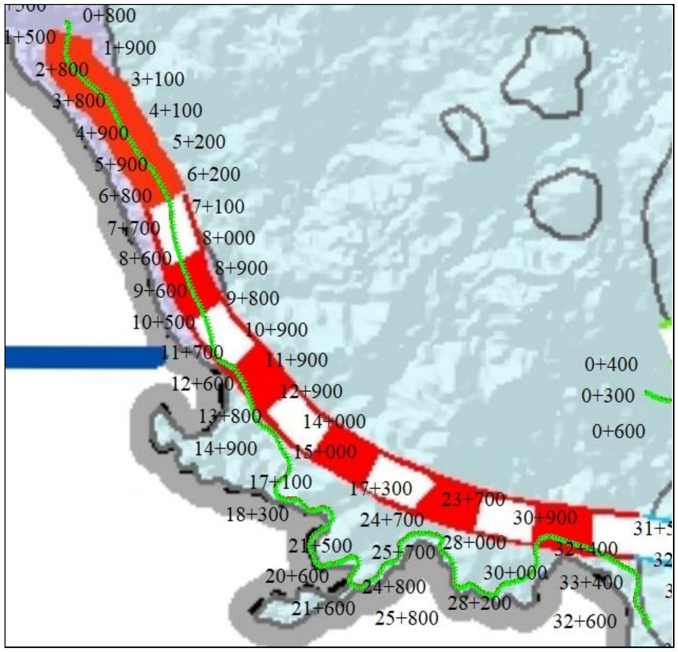


Source: JICA Study Team
Figure 30. Geologic Map of the Project Area

The most recent deposits, Quaternary Alluvium, is composed of alluvium, fluviatile, lacustrine and beach deposits, raised coral reefs, and beachrock. Other lithological facies are composed mostly of submarine andesite and basaltic flows intercalated with pyroclastics and clastic sedimentary rocks; and reef limestone lenses largely confined within the axial zones Mindanao.

Thick, extensive, transgressive mixed shelf marine deposits, largely wackes, shales and reef limestone are also present. These are underlain by conglomerate and associated with coal measures in places. Sometimes the rock unit is associated with basic to intermediate flows and pyroclastics. They are largely arkosic and quartzitic clastics, generally well-indurated, folded and locally intruded by quartz-diorite. It is the most common epidermal cover of many folded mountains in the country.

As shown in **Figure 31,** the initial stretches are underlain by recent Quaternary deposits which could be susceptible to liquefaction depending on the amount of infiltration of water. Stations 12+000 and above further transects volcanic rocks. Areas adjacent to high gradients (mountains) may be highly susceptible to landslides.



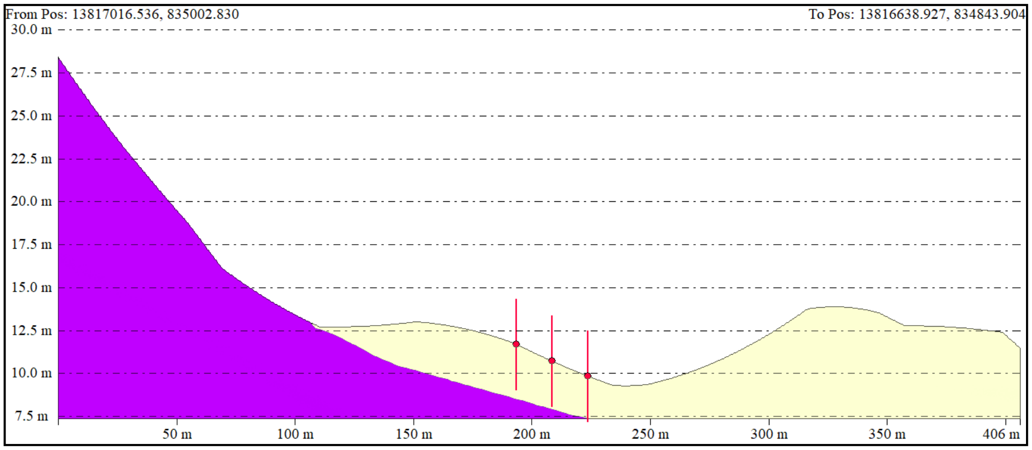
Source: JICA Study Team
Figure 31. Geologic Map of Parang-Balabagan Road

3.1.2.3.1 Geologic Profiles and Sections

Representative geologic sections are presented based on field verification of available geologic data and elevation and topographic data.

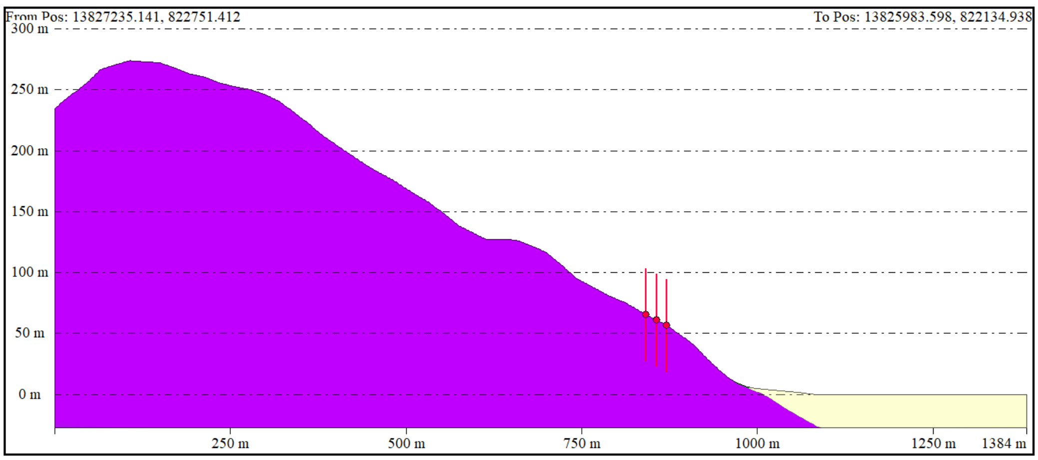
The three (3) red vertical lines in the cross sections represent the left, middle and right sections of the proposed road.

Road section underlain by recent Quaternary deposits of undetermined thickness is shown in **Figure 32**. The road section that is underlain by volcanics are shown in **Figure 33** and **Figure 34** respectively. In **Figure 34**, MGB geological maps depict hard, indurated bedrock composed of pyroxene-andesite underlying the volcanics estimated to be located at the 25 to 20 masl depth.



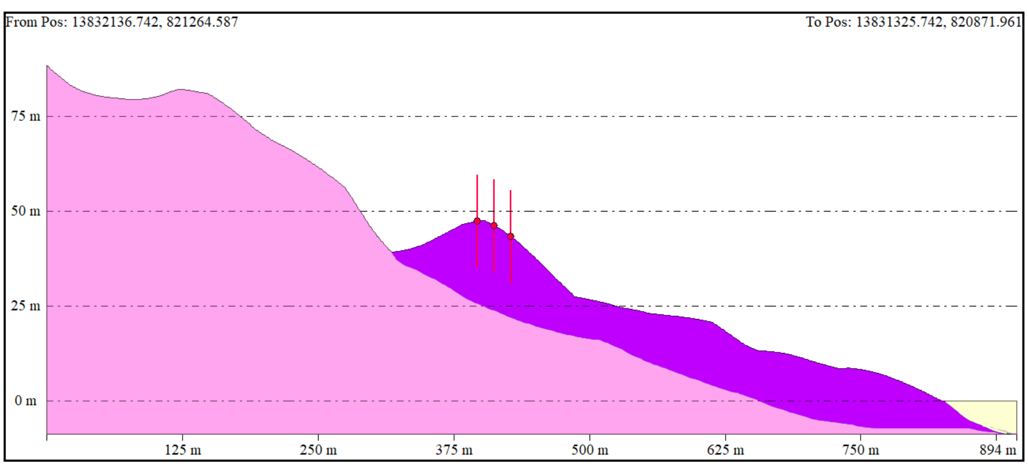
Source: Google Earth Elevation Profile

Figure 32. Sta 3+000. Section underlain by quaternary deposits. The thickness of quaternary deposits is uncertain.



Source: Google Earth Elevation Profile

Figure 33. Sta 25+000. Road section underlain by volcanics.



Source: Google Earth Elevation Profile

Figure 34. Sta 33+000. Volcanics underlie the road section

3.1.2.4 Hazard Assessment

The Project Area may be affected by natural hazards caused either by geophysical or hydrological events. In this report, the discussion of geologic hazards covers earthquake risk, ground shaking, ground rupture, tsunami, liquefaction, earthquake-triggered landslide, and flooding.

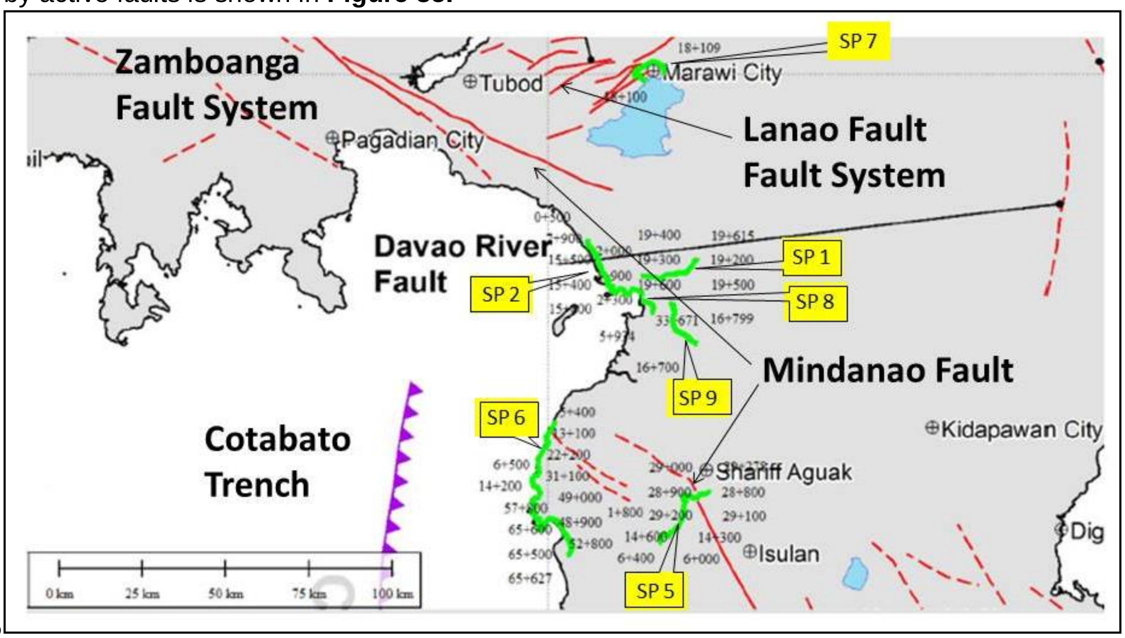
The most likely sources of destructive earthquakes within the Project Area are the Mindanao Fault and Cotabato Trench. Historically, the study area and neighboring provinces have experienced strong earthquakes in recent memory. The 7.9 magnitude 1976 Moro Gulf Earthquake was generated by Cotabato Trench. The 2002 Palimbang Earthquake with a registered a magnitude of 7.5 was also attributed by PHIVOLCS to subduction along the Cotabato Trench.

Earthquakes triggered by the Philippine Fault could also affect the Project Area. As previously mentioned, the PFZ has been the source of large-magnitude earthquakes in the past. In Mindanao, several subordinate faults are intimately linked to the evolution of the PFZ.

In addition, the Sulu Trench, Zamboanga Fault System, and the Lanao Fault System are capable of triggering moderate earthquakes

3.1.2.4.1 Earthquake Risk

The most likely source of destructive earthquakes within the Project Area are the Mindanao Fault and Cotabato Trench. Historically, the Project Area and neighboring provinces have experienced strong earthquakes in recent memory. The 7.9 magnitude 1976 Moro Gulf Earthquake was generated by Cotabato Trench. The 2002 Palimbang Earthquake with a registered a magnitude of 7.5 was also attributed by PHIVOLCS to subduction along the Cotabato Trench. The road sub-projects transected by active faults is shown in **Figure 35.**



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Source: PHIVOLCS

Figure 35. Active Faults in Western Mindanao Transecting the Project Area

Other potential earthquake generators that could generate small to moderate earthquakes are the Sulu Trench, Zamboanga Fault System, and the Lanao Fault System. The Sulu Trench located west of Mindanao has been seismically inactive for the last 120 years but PHIVOLCS considers it potentially capable of triggering a major earthquake due to stress build up.

3.1.2.4.2 Ground Shaking

Ground-shaking is measured by ground acceleration, and the peak ground acceleration (PGA) is equal to the maximum ground acceleration that occurred during earthquake shaking at a particular location. Regional ground motion hazards emanating from earthquakes were studied by Thenhaus et. al in 1994. The ground acceleration within the Project Area has been estimated to be about 0.21g for bedrock and about 0.60g for soft soils. These values should be taken into account for determining the seismic coefficient to be applied for the design of foundation of the proposed road project.

The proximity of active faults to the proposed road alignments indicates that moderately strong to strong ground shaking is expected to be experienced in SP 2.

3.1.2.4.3 Ground Rupture

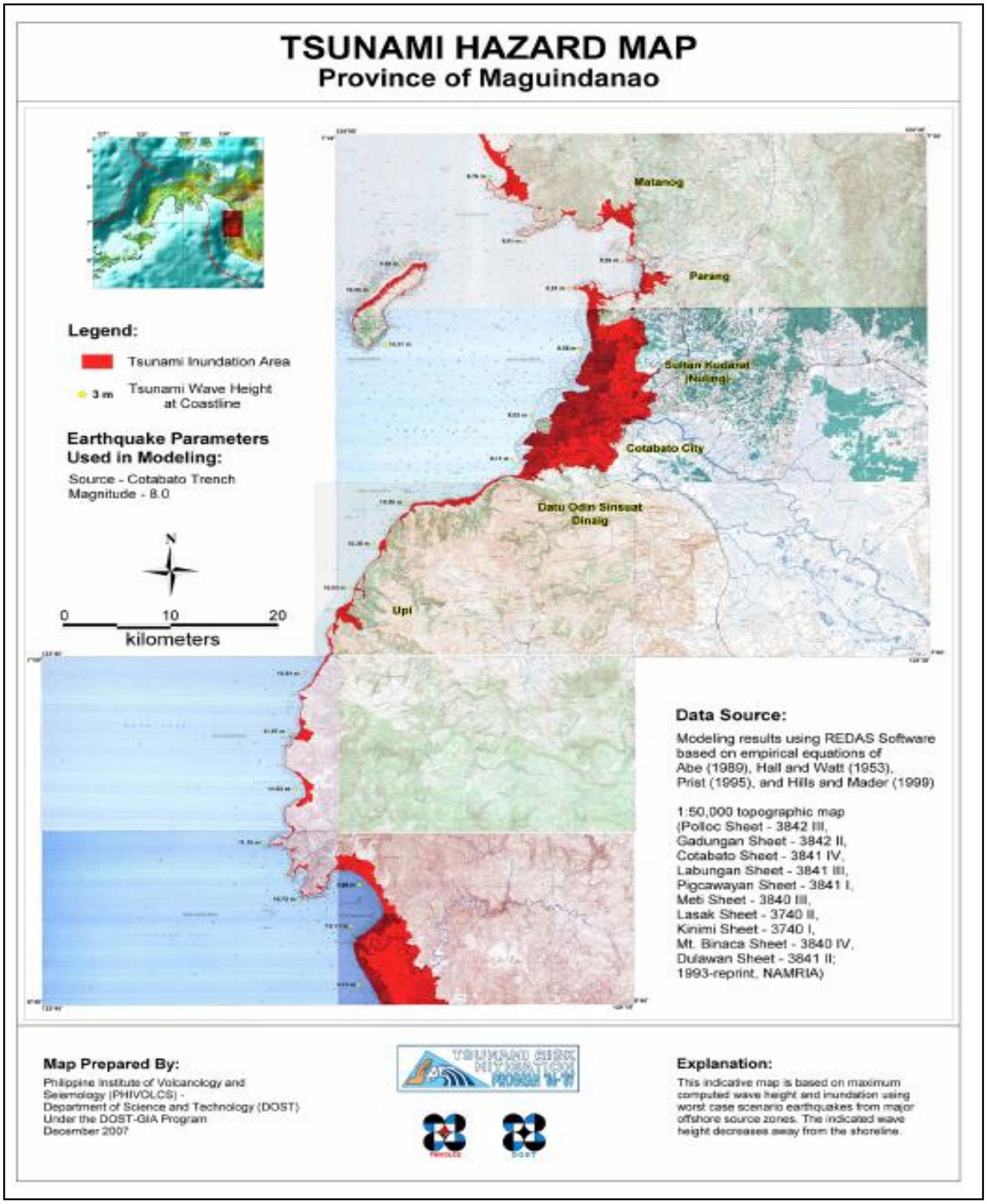
Ground rupture is the visible breaking and displacement along the trace of the fault during major earthquakes. The sub-project 2 is not prone to ground rupture.

3.1.2.4.4 Tsunami

A tsunami is a series of sea waves commonly generated by under-the-sea earthquakes and whose heights could be greater than 5 meters. Tsunamis can occur when the earthquake is shallow-seated and strong enough to displace parts of the seabed and disturb the mass of water over it.

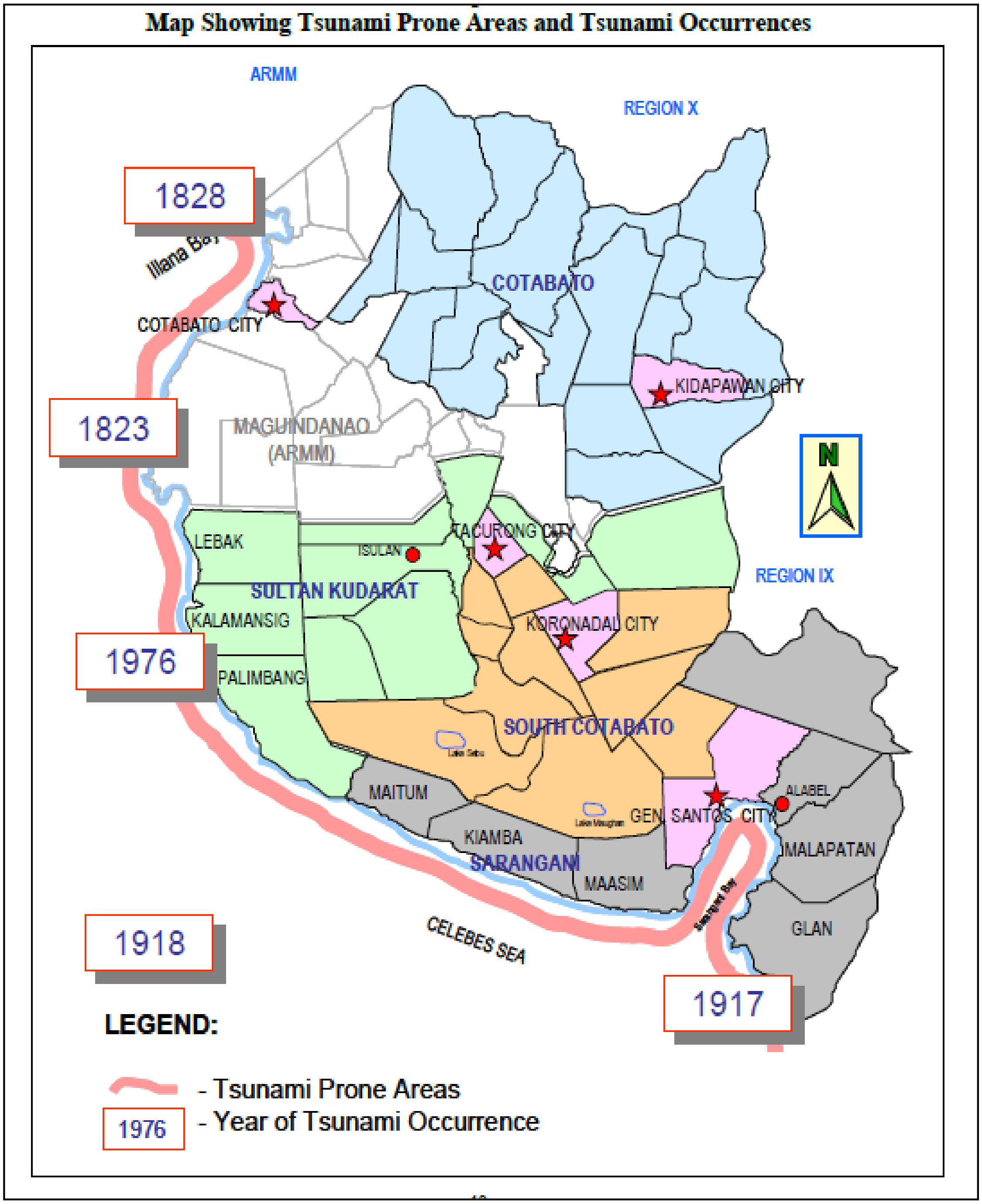
The Moro Gulf earthquake of August 17, 1976 spawned a tsunami that damaged more than 700 km of coastline bordering Moro Gulf (PHIVOLCS). The tsunami generated devastated the provinces bordering Moro Gulf especially on the shores of Pagadian City. After the sea rolled back to its natural flow, thousands of people were left dead, others homeless or missing and millions of pesos lost due to damages to properties.

PHIVOLCS has prepared tsunami hazard map for Maguindanao as shown in **Figure 36** using a magnitude 8.0 tsunamigenic (tsunami-generating) earthquake generated by the Cotabato Trench, as parameters. Based on the map, coastal barangays of municipalities covered by SP 2 are prone to tsunami.



Source: PHIVOLCS
Figure 36. Tsunami Hazard Map of Maguindanao

The historical tsunami occurrences within the region is shown in **Figure 37**.



Source: Region XII DRM

Figure 37. Map showing Tsunami Prone Areas and Historical Tsunami Occurrences in Western Mindanao

3.1.2.4.5 Liquefaction

The susceptibility to liquefaction is greatest along road alignments underlain by saturated, very loose to loose, fine to medium grained sands having uniform particle-size range. The sand is in the state of liquefaction similar to a liquid when there is no grain-to-grain contact pressure. Earthquake shock or other dynamic disturbance would transform the sand into an unstable mass responsible for large settlement. Sands were formerly considered to be the only type of soil susceptible to liquefaction, but liquefaction has also been observed in gravels and silts.

At the Project Area, parts of road sections underlain by thick deposit of alluvial materials could be prone to liquefaction. SP 2 Parang-Balabagan Road which is underlain by thick, extensive, transgressive mixed shelf marine deposits may be susceptible to liquefaction.

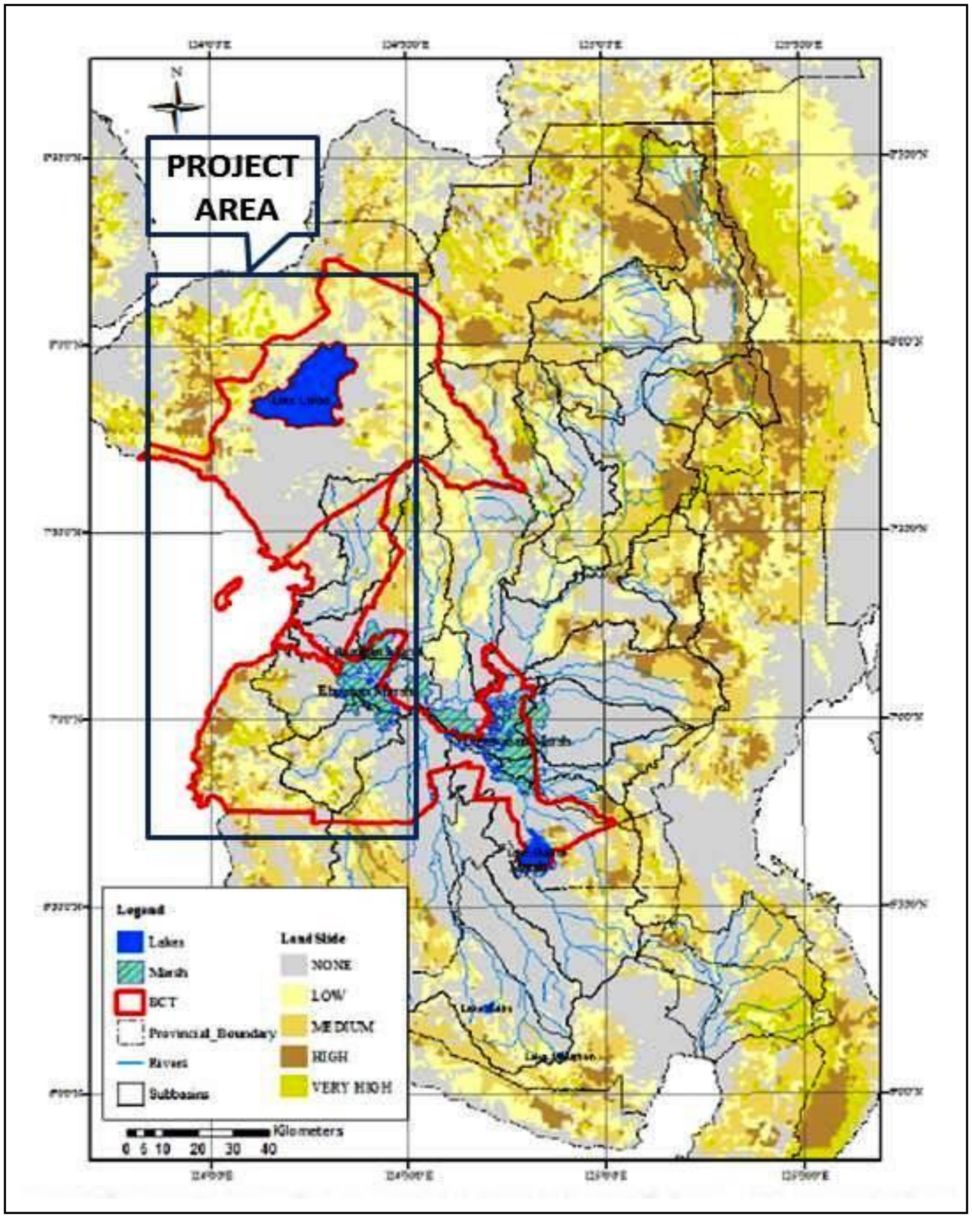
The proximity of known earthquake generators and the presence of loose/unconsolidated sediments with estimated shallow water table along the alluvial and coastal plains warrant the conduct of appropriate geotechnical investigation and laboratory tests to evaluate potential liquefiable soil layers in areas where the road alignments are planned to be constructed.

3.1.2.4.6 Landslide

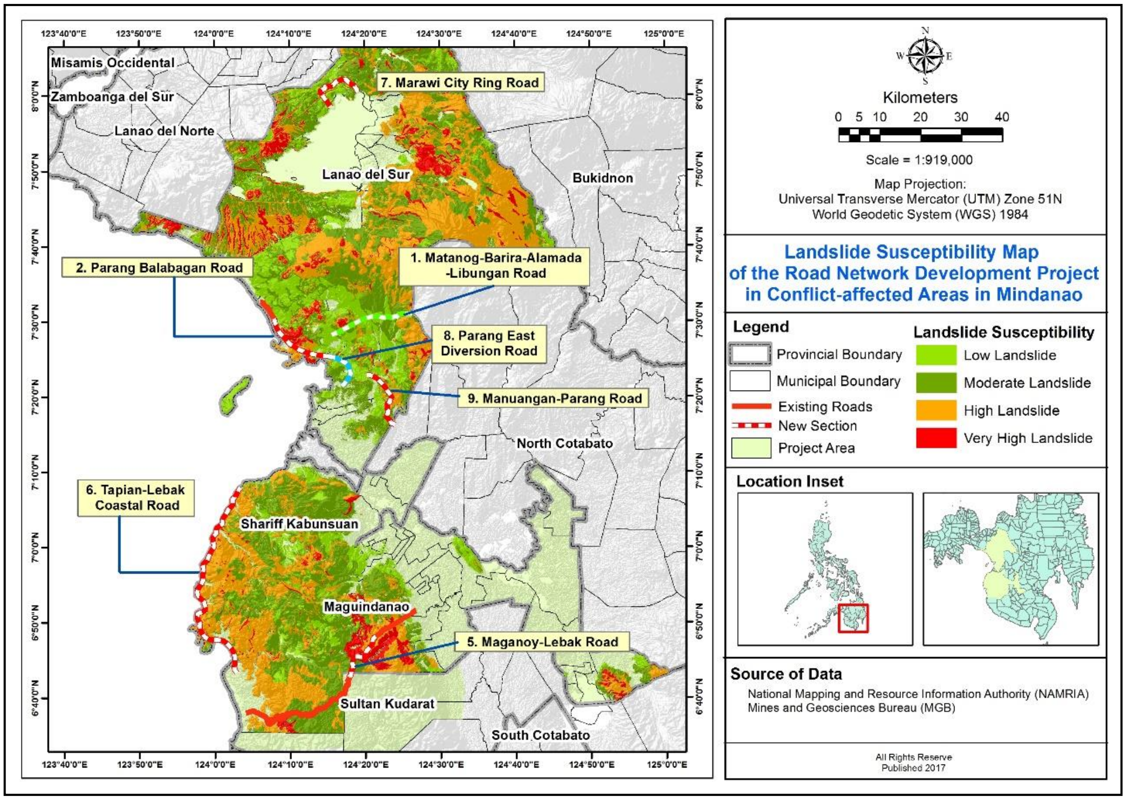
Earthquake shaking can cause landslides as a direct effect of strong ground motion when the slope become unstable by the inertial loading it imposes or by causing a loss of strength in the slope materials.

As shown in **Figure 38** by the PHIVOLCS regional map of earthquake-triggered landslide, the mountainous areas of the Project Area could experience low to moderate susceptibility to this hazard. Based on field observation, the alignment of the proposed road project passing through steep to very steep, hilly to mountainous terrain could be potentially susceptible to slope failure, soil erosion, and rock fall as shown in **Figure 39.**

Some sections of the roads located on slope of ridges, steep slopes with limited space for the alignment, and slopes with loose soil and rock materials in SP 2 Parang-Balabagan Road.



Source: PHIVOLCS
Figure 38. Earthquake-triggered Landslide Map

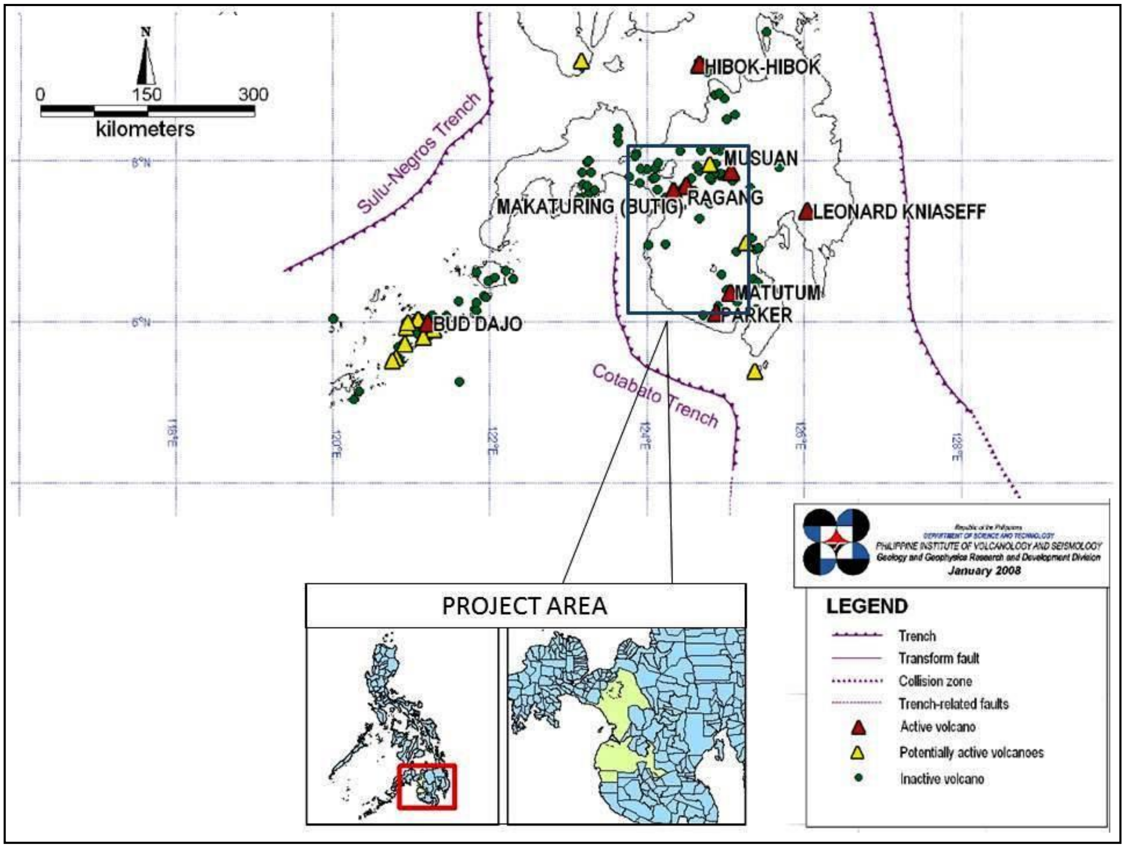


Source: PHIVOLCS
Figure 39. Landslide Susceptibility Map of the Project Area

3.1.2.4.7 Volcanic Hazard

Three major converging subduction zones framing Mindanao are attributed as source of volcanic formation in the island. These are: (a) southern portion of the East Philippine Trench; (b) West Sulu Trench; and (c) South Cotabato Trench. These subduction zones are responsible for the formation of numerous Quaternary volcanic centers and complexes (Barnett, Delfin and Espanola, 1985; Corpuz, 1992; Sajona et. al., 1992).

Five volcanoes within or proximate to the Project Area have been considered by PHIVOLCS as active. These are Mt. Makaturing in Lanao del Sur, Mt. Matutum in Cotabato, Mt. Musuan in Bukidnon, Mt. Parker in South Cotabato/General Santos/North Cotabato/Sarangani Provinces, and Mt. Ragang in Lanao del Sur and Cotabato as shown in **Figure 40**. Active volcanoes are characterized by eruption within historical times (within the last 600 years). Accounts of these eruptions were documented and eruption within the last 10,000 years is supported by analyses of datable materials. The historical data of these volcanoes are shown in **Table 28**.



Source: PHIVOLCS

Figure 40. Distribution of Active Volcanoes within the Project Area

Table 28. Historical Data of Active Volcanoes within the Project Area

Volcano	Location	Year	Description of Activity
Makaturing	Lanao del Sur	-	Eruptions previously attributed to Makaturing are now being ascribed to Ragang
Matutum	South Cotabato	1911	Steaming activity; dacitic pumicious pyroclastic flows common, lava flows and dome at the summit
Musuan	Bukidnon	1887	From a report by the discoverer, Jesuit Father Eusebio Barrado, the volcano burst into an eruption, constantly emitting vapors which burned everything around it.
Parker	South Cotabato/ General Santos/ North Cotabato/ Sarangani	1641	Oral stories from Tboli and Bilaan natives tell of “lake of fire” which burned trees around the slopes.
Ragang	Lanao del Sur/ Cotabato	1834	An eruption reportedly occurred but data is scarce/no description available.

(Source: PHIVOLCS)

The closest active volcanoes to the Project Area are Mt. Makaturing and Mt. Ragang. However, their volcanic history is quite unclear due to the scarcity of eruption data. In the event of eruption, the impacts of hazards such as pyroclastic flows, lava flows, ashfall, lahars, volcanic gases, debris avalanches, volcanic earthquakes, tsunamis, and landslides will be influenced by the type and scale of eruption.

The other volcanoes within the Project Area are classified as potentially active (morphologically young volcanoes but with no historical record of eruption); and inactive volcanoes.

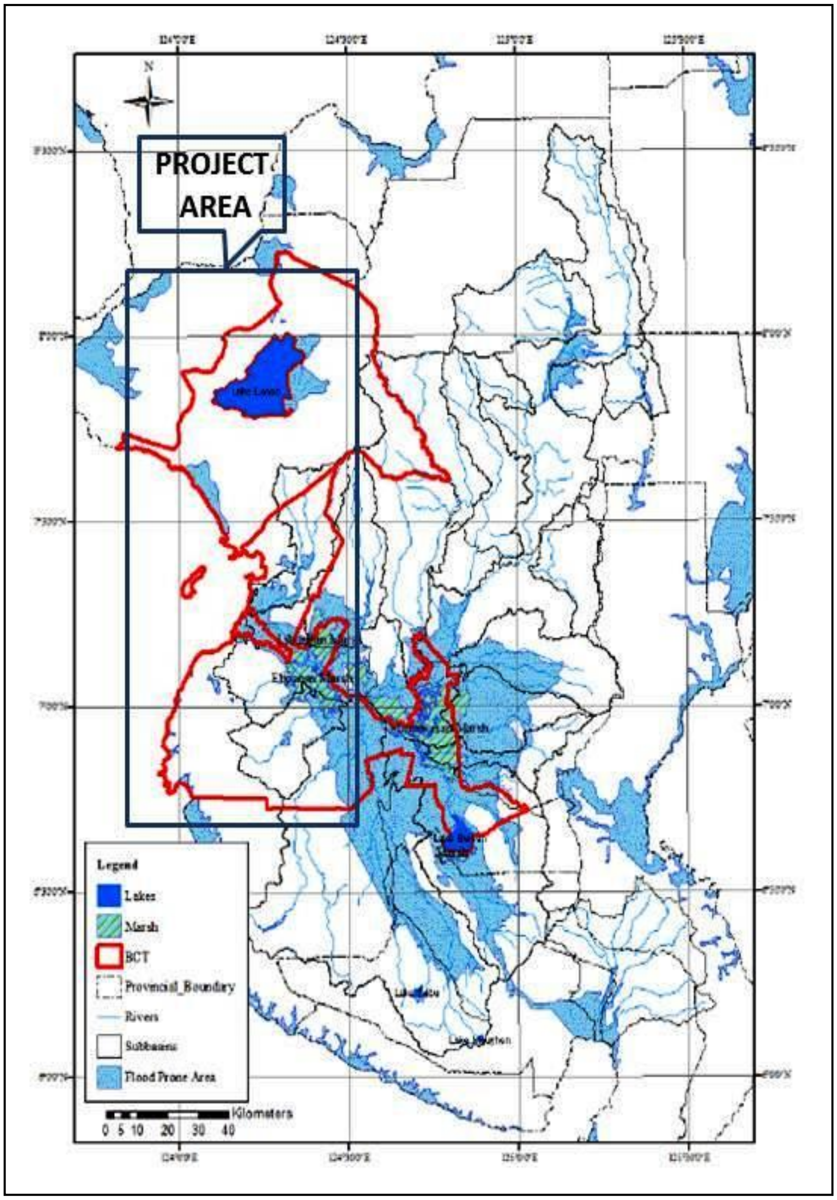
3.1.2.4..8 Flooding

The Office of Civil Defense (OCD)-ARMM has reported that Lanao del Sur and Maguindanao are more susceptible to disasters than the other provinces of the Bangsamoro region. Flooding in the area is usually associated with the occurrence of typhoons, thunderstorms and/or monsoon rains.

Figure 41 shows the flood-prone area in the Bangsamoro region. The lowland area in Maguindanao along rivers such as the Mindanao River and the Simuay River, around Lake Lanao, and some parts of the coastline are flood prone areas.

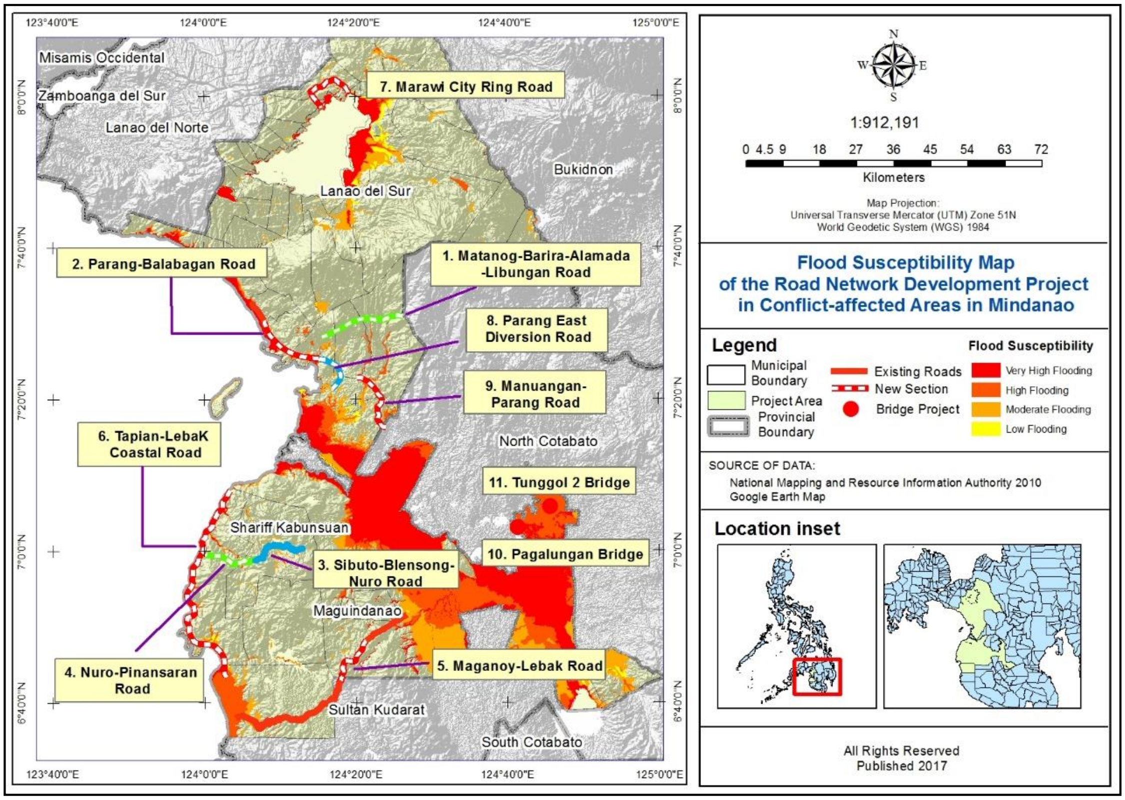
However, localized flooding may occur due to the overflowing of water from rivers and other bodies of water. This can be triggered either by inadequate river flow whenever channels are clogged by deposition of sediments and debris; or the accumulation of rainwater along drainage systems particularly during intense typhoons, thunderstorms and/or monsoon rains.

Flooding susceptibility of the Project Area is generally considered low as shown in **Figure 42**.



Source: MGB

Figure 41. Flood-prone Areas in Bangsamoro Region

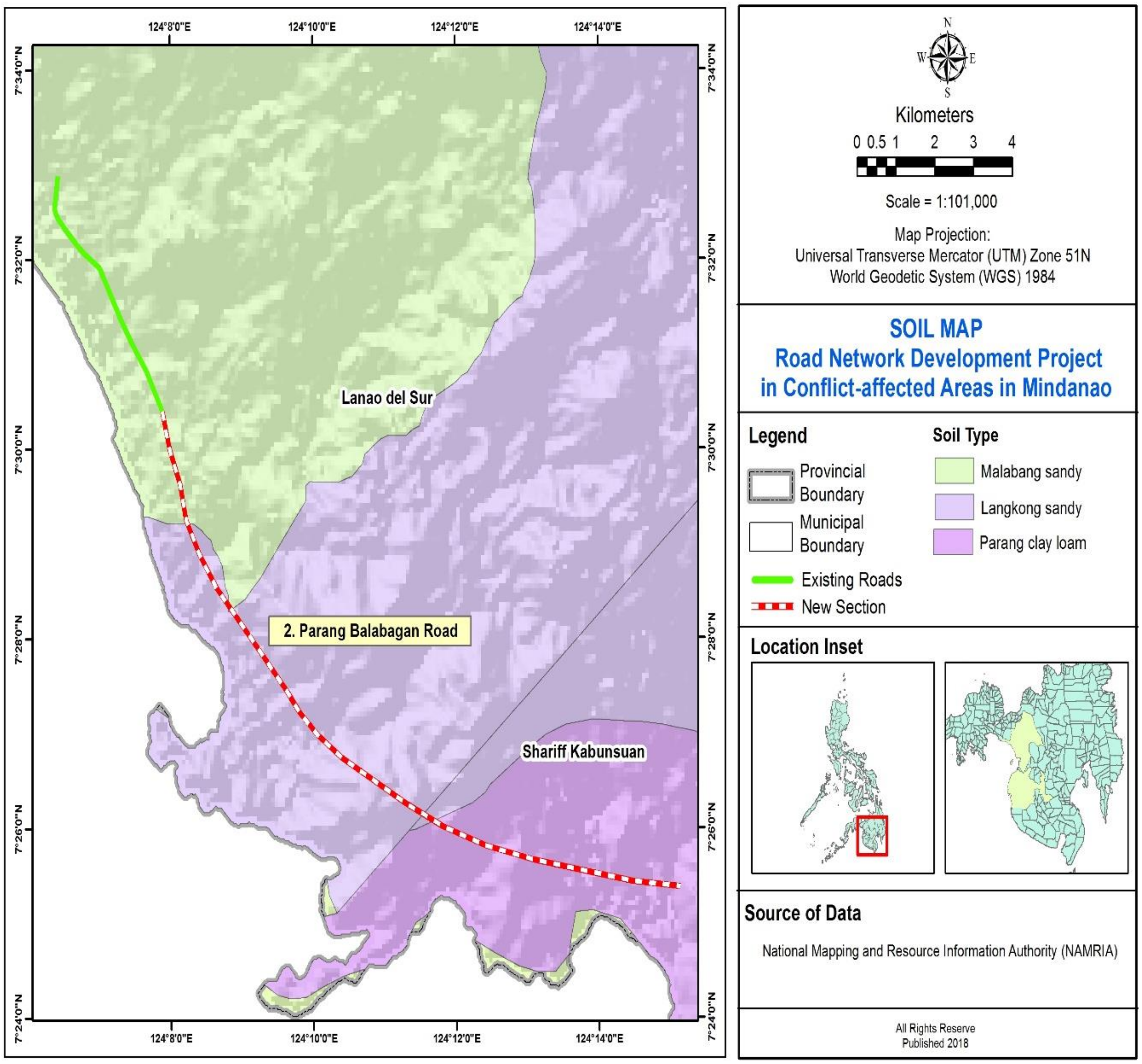


Source: JICA Study Team
Figure 42. Flood Susceptibility Map of the Project Area

3.1.3 Pedology

The geographical representation of the soils in the Study area shows diversity of soil types ranging rom loam, peat and clay. The presence, distribution, and formation of these soils can be useful in determining the land drainage capabilities of the subprojects, including their properties as engineering foundations of the proposed sub projects road alignments.

Figure 43 shows the soil map of the study area.



Source: NAMRIA (JICA Study Team)
Figure 43. Soil Map of the Project Area

3.1.4 Terrestrial Biology

3.1.4.1 Flora and Fauna

The terrestrial assessment was conducted after the desk review of the proposed project alignment, project orientation on the field, identification of sampling sites, coordination with the authorities, preparation of instruments, and field work proper. Selected sampling sites for flora and faunal species are located within the proposed road alignment covering 8 coastal barangays in 8 coastal barangays in the municipalities of Parang (1 barangay), Kapatagan (3 barangays) and Balabagan (3 barangays). **Figure 44** presents map of the proposed alignment and location of sampling plots. **Table 29** shows the geographic coordinates of sampling sites and name of covering barangays.

Base Map Source: JICA Study Team

Figure 44. Location of Sampling Sites within the Proposed Road Alignment

Table 29. Geographic Coordinates and Covering Barangays of Selected Sampling Sites

Municipality	Site No.	Barangay	Geographic coordinates	
			Northing	Easting
Parang	1	Makasandag	7°24'2.66"	124°15'19.29"
	2	Makasandag	7°24'59.87"	124°14'44.90"
Kapatagan	3	Matimos	7°26'25.97"	124° 9'49.60"
	4	Salaman	7°27'24.72"	124° 9'12.55"
	5	Bakikis	7°28'41.44"	124° 8'29.82"
Balabagan	6	Batuan	7°29'28.79"	124° 8'9.46"
	7	Narra	7°30'29.72"	124° 7'54.43"
	8	Lorenzo	7°31'25.99"	124° 7'16.12"
	9	Barorao	7°32'51.70"	124° 6'25.91"

Figure 45 shows the vegetation cover within and immediate vicinity of the proposed road alignment

A. Dominant vegetation cover in Parang

B. vegetation cover in Kapatagan

C.Vegetation cover in Balabagan

Figure 45. Photos of Sampling Sites within the Proposed Road Alignment

3.1.4.1.1 Survey on Flora

Within the selected sites following the proposed alignment, a 20m x 20m square plots were measured for the identification of (1) tree species at the canopy layer with a diameter at breast height (dbh) of 10 cm and above; (2) and agricultural crops such as niog with a height exceeding 5m. The species found were recorded for the computation and analysis of species richness, evenness, and distribution. Inside the 20m x 20m sampling plots, a 5m x 5m sub-plots were also established in one corner for the identification of pole size trees forming the intermediate canopy. All pole size trees with dbh ranging from 5cm to 9.5 cm were recorded. Additionally, agricultural plants which are an exception to the pole size tree criteria (i.e. banana) but has 2 meters and above height are also included. In the ground canopy, a 1m x 1m sub-plots are also measured within the sampling plot for the identification of species immediate the ground layer.

Trees, palms, crops and other plant species observed outside the plots but situated within the proposed road alignment was also identified and recorded. Generated data during the survey were consolidated to form a species checklist indicating the common name, scientific name and family name of identified vegetations.

The following formulas were used to compute the Density, Relative Density, Frequency and Relative Frequency of the identified species:

1) DENSITY = $\dfrac{\text{number of individuals of any species}}{\text{Area of the plot or quadrant}}$

2) RELATIVE DENSITY = $\dfrac{\text{density of a species}}{\Sigma \text{ density of all species}} \times 100$

3) FREQUENCY = $\dfrac{\text{No. of occurrence of species among n quadrant}}{\text{n quadrants}}$

4) RELATIVE FREQUENCY = $\dfrac{\text{frequency of a species}}{\Sigma \text{ frequency of all species}} \times 100$

For the Diversity index, Shannon- Wiener index (H' and J) and Simpson's Diversity Index (Simpson's Reciprocal) were used with the following formula:

1) SHANNON DIVERSITY INDEX = H' = $-\sum p_i \ln (p_i) = -\sum(n/N) * LN\ (n/N)$

where:
H' = Shannon-Wiener index/information content of the sample, index of species diversity or degree of uncertainty
p_i = represents the proportion or relative abundance of each individual species to the total (n/N)
n = the total number of taxa of particular species
N = the total number of taxa in all species
LN = Natural logarithm

2) SHANNON EVENNESS = J= sum(H'/LNS)

where:
J = evenness
H' = information content of the sample, index of species diversity or degree of uncertainty
S = number of species in the community
LN = Natural logarithm

3) SIMPSON 'S RECIPROCAL INDEX $D = {}^{1}/_{\sum (n/N)^2}$

where:
D = Simpson Reciprocal Index
N = the total number of taxa in all species
n = the total number of taxa of particular species

For Biomas and Carbon Stored

Brown (1997) defined biomass as the total amount of aboveground living organic matter in trees (leaves, twigs, branches, main bole and bark) expressed as oven-dry tons per unit area. It is also referred to biomass density expressed in terms of mass per unit area or tons per hectare.

Brown Allometric Equation $Y = \exp(-2.134 + 2.530 \times \ln D)$

$$\mathbf{T_{TB} = \frac{\sum \text{Biomass of all trees in a transect (Mg)}}{\text{Area of the transect } (m^2)} \times \frac{10{,}000m^2}{1ha}}$$

where

Y = tree biomass

exp {…} =raised to the power of {…}

ln = natural log of (…)

y = above-ground biomass in kg

D = diameter at breast height (cm)

Carbon stored will be estimated using the default value of 45% (Lasco and Pulhin 2004):

Carbon stored = Cc × 1 Mg/ha

where:

Carbon content (Cc) = Biomass × 45%

3.1.4.1.2 Survey on Fauna

For the faunal dimension, the survey covers the avifauna and herpeto-faunal groups of wildlife-vertebrates. Prior to the conduct of sampling, general habitat assessment was undertaken to consider different ecosystems in the project area for the selection of observation sites. The rapid survey method was employed in the conduct of faunal diversity assessment. Transect walk of about 200 meters was undertaken in every selected sampling points within and along the proposed road alignment. Species not encountered during the period of assessment is generated through an interview with local informants to obtain other significant information with regard to the presence of other wildlife species in the area. Photo documentation of observed wildlife was also undertaken as much as possible for documentation and for further species verification when necessary.

Birds. Point area count method was used during the survey. All species observed within a radius of about 100 meters from the transect route was recorded. Techniques employed during the survey include ocular and aural observation, identification through wildlife calls, footprints and droppings if any. All bird species seen and heard by the observer at the sampling site were recorded. As much as possible, no double counting was made.

Reptiles and Amphibians. Active search for reptiles and amphibians was done systematically in all the selected observation sites considering the immediate vicinity of the alignment 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 definitely avoided. Photos of species encountered at the sampling sites were also undertaken.

Mammals. For non-volant mammals such as rodents, interview with local informants was undertaken to generate significant information relative to the presence/absence of 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.

3.1.4.2 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 **Table 30.**
.

Table 30. The Fernando Biodiversity Scale (1998)

Relative Values	Shannon –Wiener Biodiversity (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

3.1.4.3 Determining Species Conservation Status and Endemicity

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 in determining conservation status and endemicity of each species. 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.

3.1.4.4 Results and Discussion

The assessed area is a prime agricultural area planted with coconut, corn and in aggregates of other perennial crops including banana and some fruit bearing trees. Other than agricultural crops, vegetation cover within the proposed alignment also comprised of naturally growing and planted tree species. A total of 35 species were identified in the 9 sampling plots and 53 species observed outside the sampling plots following the alignment. After consolidation and analysis of generated data, a total of 44 families were listed inside and outside the sample plots, in which, family Fabaceae are the most common in the area. For vegetation cover, species dominating in the canopy layer is Niog or Cocus nucifera while Banana or Musa sapientum dominates in the understory layer. On the other hand, blue grass or Poa sp., is the most common in the ground layer. The computed biodiversity index of the study area reveals a low diversity composition. Concerning the species conservation status showed that only the Narra (Pterocarpus indicus) is included in the IUCN list as critically endangered in the category.

On the other hand, most of the observed avifaunal species are locally common and highly adaptive in wide range of habitats and ecosystems including agricultural areas, shrub lands, grassland, within settlements areas and sometimes cited in highly urbanized areas including cities. Out of 36 faunal species, 6 are endemic in the country and the rest are common species. Of the total species listed only 1 (also endemic species- Grey-Hooded Sunbird (Aethopyga primigenia)) is found to be included in the IUCN as near threatened in the category.

3.1.4.4.1 Terrestrial Flora

The conservation status of species identified on site was based on the Asia Life Science- The Asia International Journal of Life Sciences “Threatened Plant of the Philippines: Preliminary Assessment 2008”; International Union for Conservation of Nature (IUCN) Red List of Threaten Species (ver 2017-2); and DAO 2007-01 entitled “The National List of Threaten Plants and their Categories. A

Narra (Pterocarpus indicus) found adjacent the sample plot no. 3 following the alignment of SP no.2 in Barangay Bakikis in the municipality of Kapatagan as shown In **Figure 46**.

Figure 46. Narra found in Barangay Bakikis, Kapatagan

3.1.4.4.1.1 Floristic composition

A total of 88 species belongs to 77 genera and 35 families were identified from the proposed Parang-Balabagan Road within and outside the sampling plots, following the alignment. As shown in **Table 31,** Fabaceae were found to be the dominant family in the project site in terms of species count by having 12 (13.636%) species, seconded by Moraceae with 9 (10.227%) species, respectively as shown in **Figure 47**. While sixteen (16) families were represented by 1 (1.036%) species and genera.

Table 31. Ten families with highest number of genera and species along the proposed area

Family	NUMBER OF SPECIES	PERCENTAGE (SPECIES)	NUMBER OF GENERA	PERCENTAGE (GENERA)
FABACEAE	12	13.636%	12	15.584%
MORACEAE	9	10.227%	3	3.896%
POACEAE	7	7.955%	7	9.091%
ARACEAE	5	5.682%	5	6.494%
MELIACEAE	4	5.195%	4	5.195%

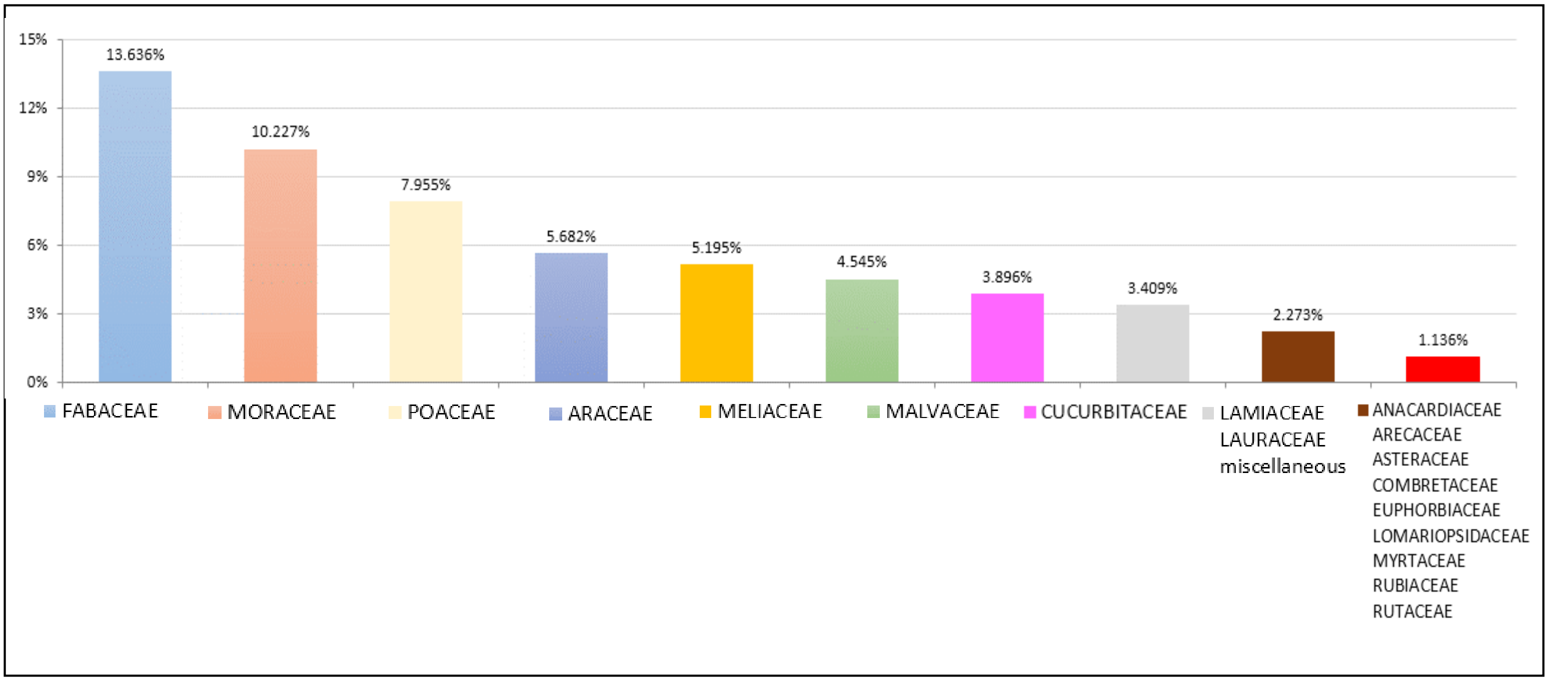


Figure 47. Family percentage in terms of species count

From the 88 plants species identified, 35 species were recorded from the 9 sample (20m x 20m, 5m x5m, and 1m x 1m) plots and sub-plots. While 53 species were identified outside the sample plots within the road alignment. Relative to the plant form or category, the majority of the plant species belong to trees (54.55%); seconded by grass and herb (11.36%), followed by shrubs (9.09%); vines (6.82%); fern (4.55%) and; the remaining 2.27% are palm trees as shown in **Figure 48.** On the other hand, 84% of the recorded species are naturally growing and the remaining 16 % are planted on the site (Refer to Annex 13.6.1).

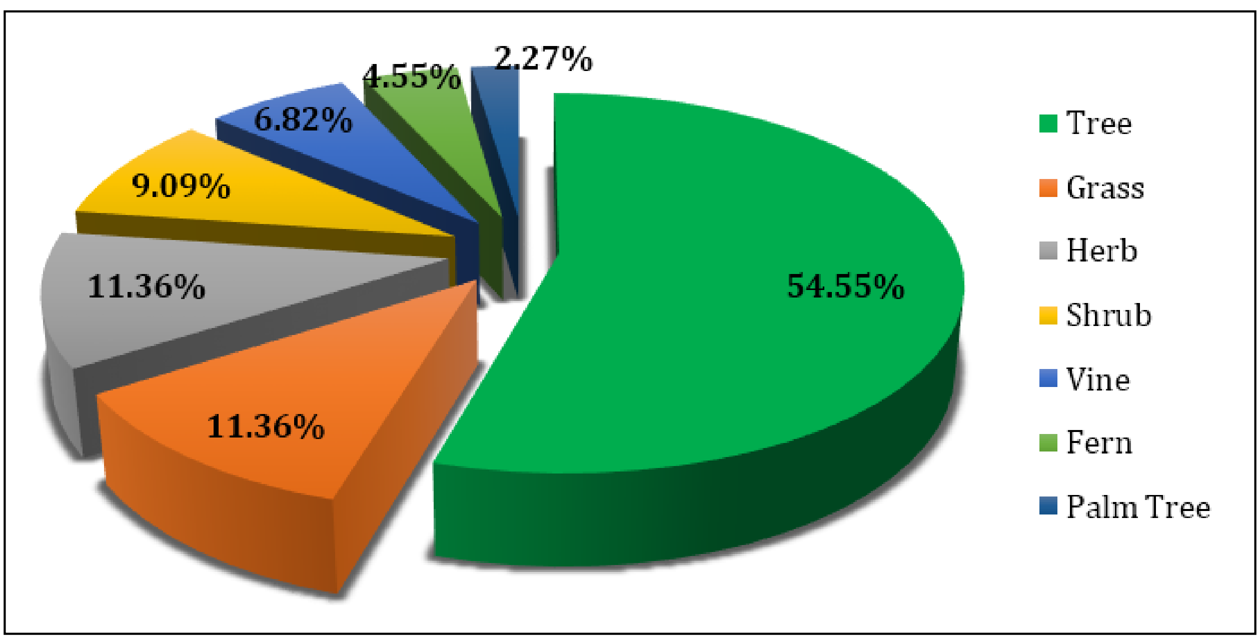


Figure 48. Distribution of plant species by their habits

3.1.4.4.1.2. Canopy Layer

3.1.4.4.1.2.1 Density and Frequency

Density (ρ) is defined as a measurement of the individuals' number in an area. This is computed by counting the numbers of any given species over the area of a sample plot. It is the degree of compactness of a species. It can be used for the thickness description of particular vegetation, extent regeneration and the extent of standing biomass or ground cover. While Frequency (f) is defined as the number of times the species occurs in a given number of small quadrants or sample points. It is expressed as a fraction of the total relative frequency (Rf). It does not matter how many individuals of species occur in each quadrant since a single occurrence carries the same weight.

As shown in **Figure 49**, out of the ten (10) species recorded in the canopy layer, Niog or Cocos nucifera has the highest relative density (Rρ) 67.50% but ranked 2nd in relative frequency (Rf) with 11.11%. It is followed by Gmelina or Gmelina arborea with Rρ 10% and ranked 3rd in Rf with 7.41%, relatively. While Tan-ag (Kleinhovia hospita) and kakauate (Gliricidia sepium) has the highest Rf of 14.81% but has low Rρ of 2.50% and 1.25% as shown in Annex 13.6.1.

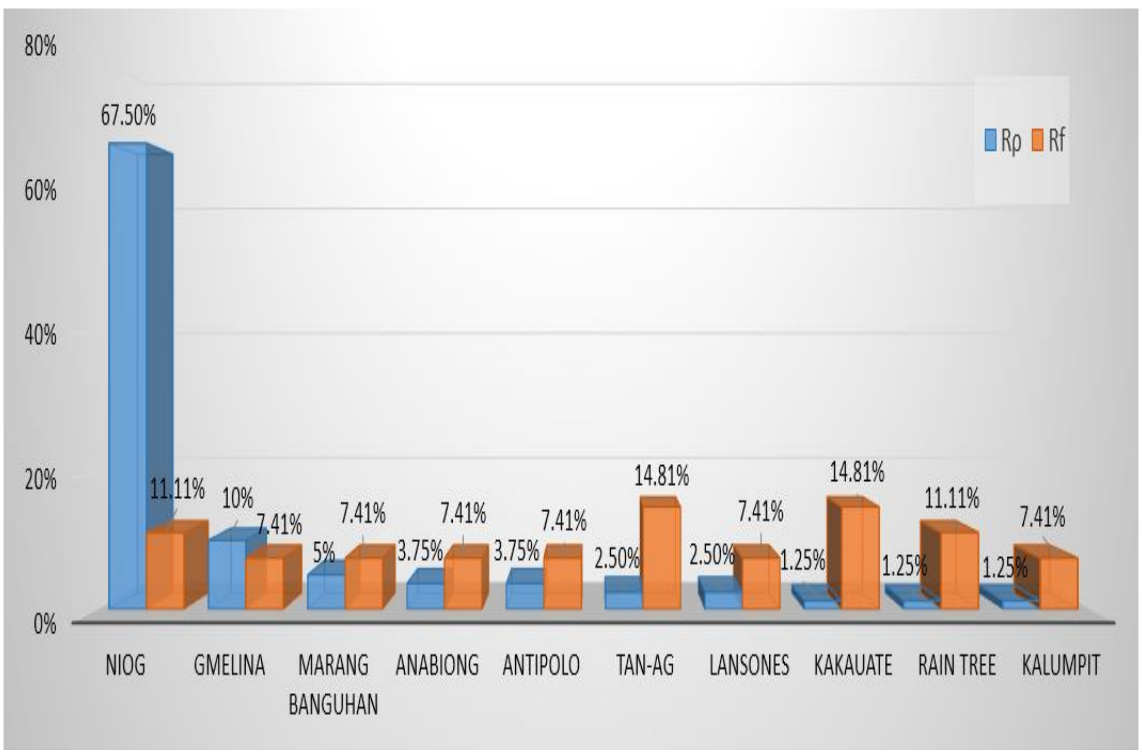


Figure 49. Species in the canopy layer with the highest density and frequency

3.1.4.4.1.2.2 Biodiversity Index

Species richness and evenness are the important factors in determining the biodiversity of an area. Richness is defined as the total number of species present in a sample while evenness is the relative abundance of the species in a sample. Richness' takes on diversity is-the more different the species in a community, the more diverse the area. Evenness takes into account the number of the individual belonging to the same species (www.countrysideinfo.co.uk). It expresses how evenly the individuals in the community are distributed over the different species.

Shannon-Wiener index (H') ranges from 0 to infinity, with zero as no diversity. In practice, though, a value of 7 indicates an extremely rich community while values below 1 suggest a community with low diversity. Often values above 1.7 are taken to indicate a relatively diverse community (Miras, 2014).

As shown in **Figure 50** , sample plots 3 and 6, located in coconut plantation, in Barangays Matimos and Batuan, have zero (0) computed value of Shannon H' and J which indicates the plots have only 1 species. While four sample plots (1,2,4 and 7) have relatively low diversity having value less than 1.7 but greater than 1. On the other hand, the remaning three plots (5,8, and 9) have a very low diversity.

In terms of the Simpson's D index, Simpson's reciprocal index (1/D) was used. The Simpson's D value starts with 1 (only one species is present) being the lowest and the maximum value is the total number of species in the sample (which is 15) being the highest diversity. As shown in **Figure 51**, Simpson's D computation supports the analysis in Shannon H' stating that plots 3 and 6 have only 1 species which is niog. While the remaining seven plots show relatively low to low diversity.0

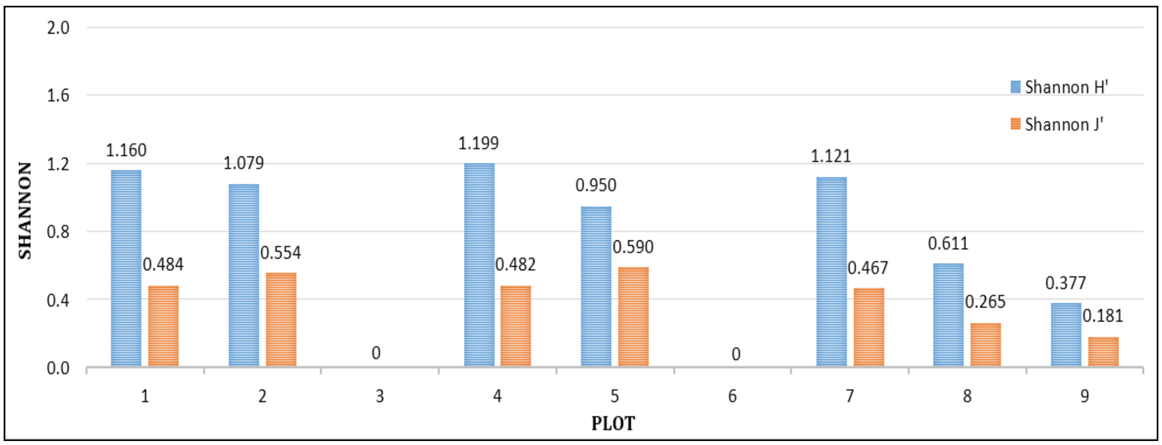


Figure 50. Shannon H' and J Diversity Index in the 9 Sample Plots in the Canopy Layer

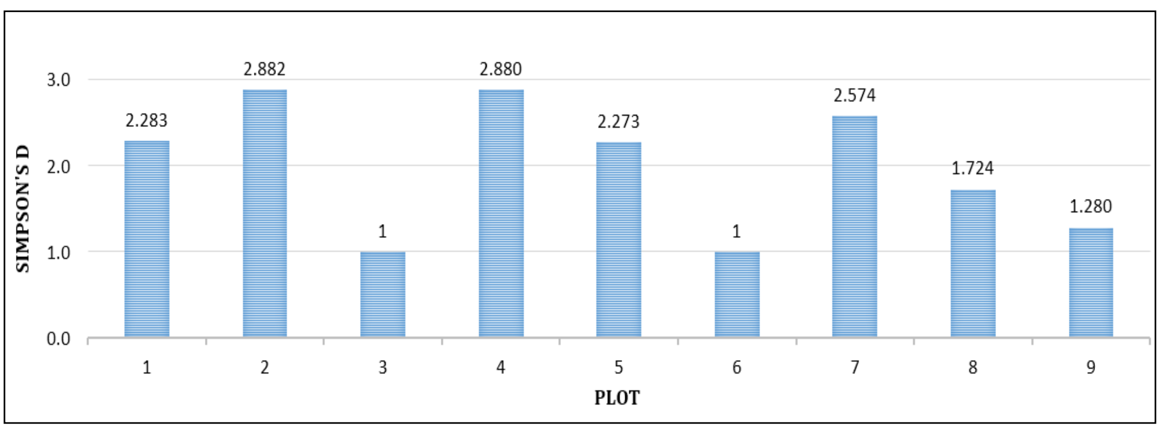


Figure 51. Simpson's D in the 9 sample plots in the canopy layer

3.1.4.4.1.3 Understory layer

3.1.4.4.1.3.1 Density and Frequency

As shown in **Figure 52**, Gmelina or Gmelina arborea has the highest in Rf (20%) but ranked 3rd in Rρ with 11.538%. While the rest of the identified species have the same relative frequency (Rf =10%). In terms of density, Banana (Musa sapientum) has highest in R Rρ of 35.615% followed by Niog (Cocus nucifera) with R Rρ 19.231%. On the other hand, 4 species have the lowest Rρ of 3.846% and contributed about 4 (15%) of the total 26 recorded individual species in understory layeras shown in Annex 13.6.1.

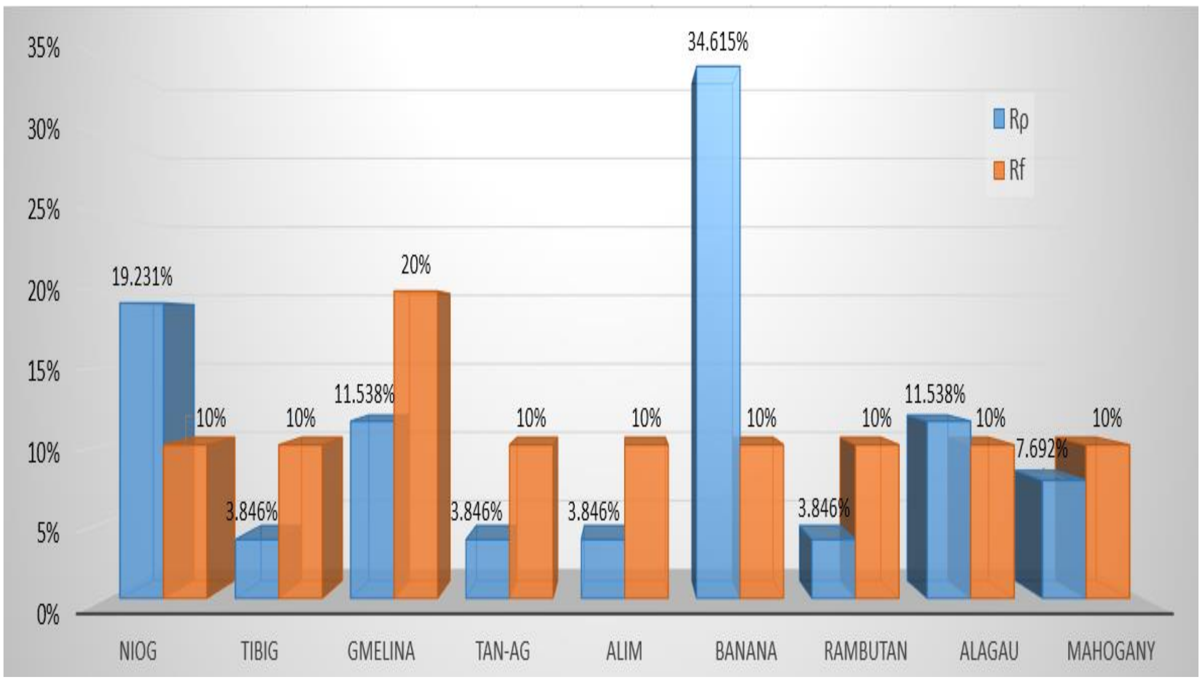


Figure 52. Species in the Understory Layer with their Corresponding Density and Frequency

3.1.4.4.1.3.2 Biodiversity Index

As shown in **Figure 53** and **Figure 54**, from the 9 sample plots: four (4) plots have NA (not applicable) which means there are no recorded understory species; two (2) have H' and J' value of 0 which indicates only 1 species is present; and the remaining 3 plots (1,4, and 5) have relatively low diversity with H' less than 1.7. In terms of Simpson's D computation, it shows that out of the 9 (maximum value of D and the total number of species can be present in the sample plots) species recorded in the understory layer, less than 3 species are present per plot which indicate a low diversity. Additionally, plots 2 and 8, located in Barangays, Macasandag and Lorenzo, have D=1 which indicates only 1 species is present.

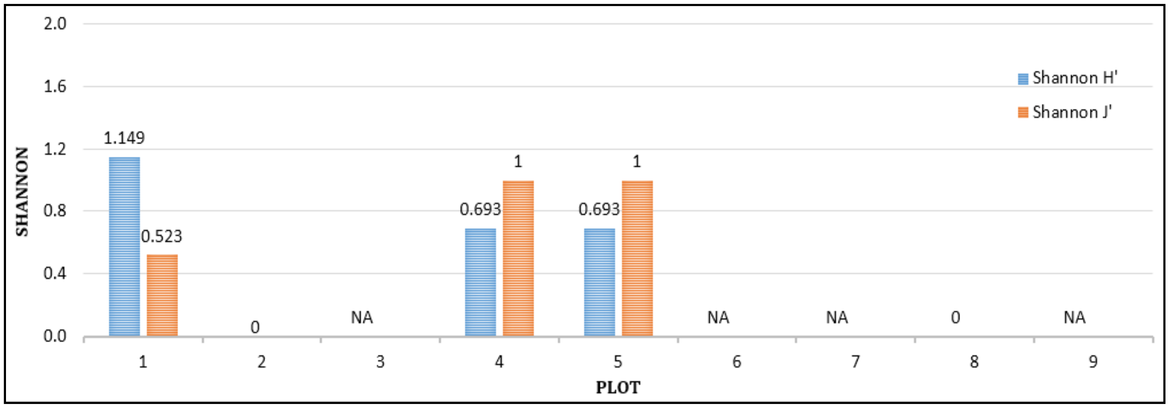


Figure 53. Shannon H' and J' Diversity index in the 9 Sample Plots in the Understory Layer

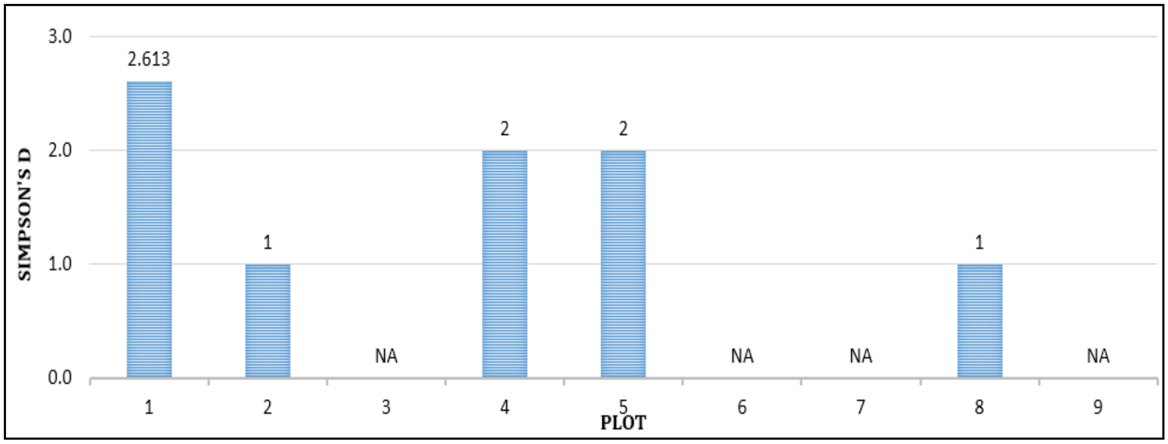


Figure 54. Simpson's D in the 9 Sample Plots in the Understory Layer

3.1.4.4.1.4 Ground layer

3.1.4.4.1.4.1 Density and Frequency

As shown in **Figure 55**, Blue gass or Poa sp. has highest Rρ 18.35%, followed by Mani-manian or Arachis pintoi with Rρ 16.06%, but both have the lowes Rf (2.78%). Whereas, Dilang Butiki or Centrosema pubescens and Kudzo or Pueraria montana has the highest Rf with 11.11% but have low Rρ of 7.34% and 4.13%, respectively. While seven (7) species have less than 3% for both Rρ and Rf and contributed about 14 (6%) of the total 218 recorded individual species as shown in Annex 13.6.1.

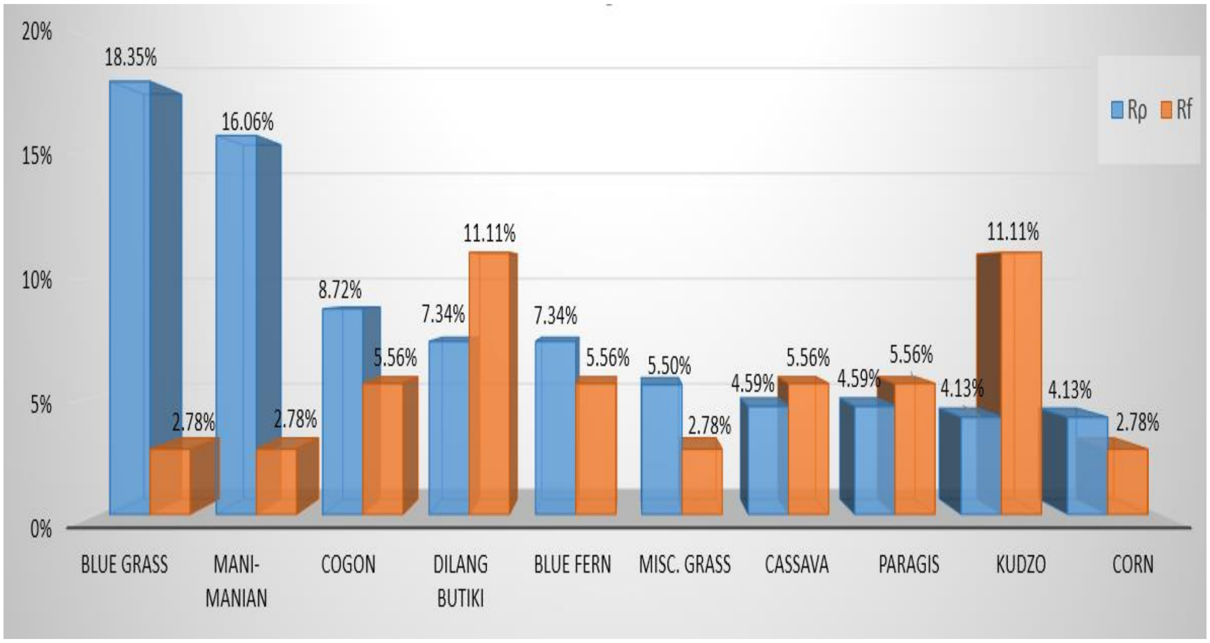


Figure 55. Top ten (10) Species in the Ground Layer with Highest Corresponding Density and Frequency

3.1.4.4.1.4.2 Biodiversity Index

As shown in **Figure 56** and **Figure 57**, sample plots having H' and J' value of 0 which indicates only 1 species is present are: plot 6 located in corn (Zea mays) field; plot 7 where there are planted cassavas (Manihot esculenta); and plot 8 where Napier (Pennisetum purpureum) is abundant. While plot 2 has the highest value of 1.868 which indicates a relatively diverse community. However, the remaining 5 plots have value lover than 1.7 which falls under relatively low to low diversity. In terms of Simpson's D compution, it shows that out of the 23 (maximum value of D and the total number of species can be present in the sample plots) species recorded in the groundcover layer, less than 5 (23%) species are present per plot which indicate a low diversity. Additionally, plots 6, 7 and 8, located in Barangays, Butuan, Narra and Lorenzo, have D=1 which indicates only 1 species is present.

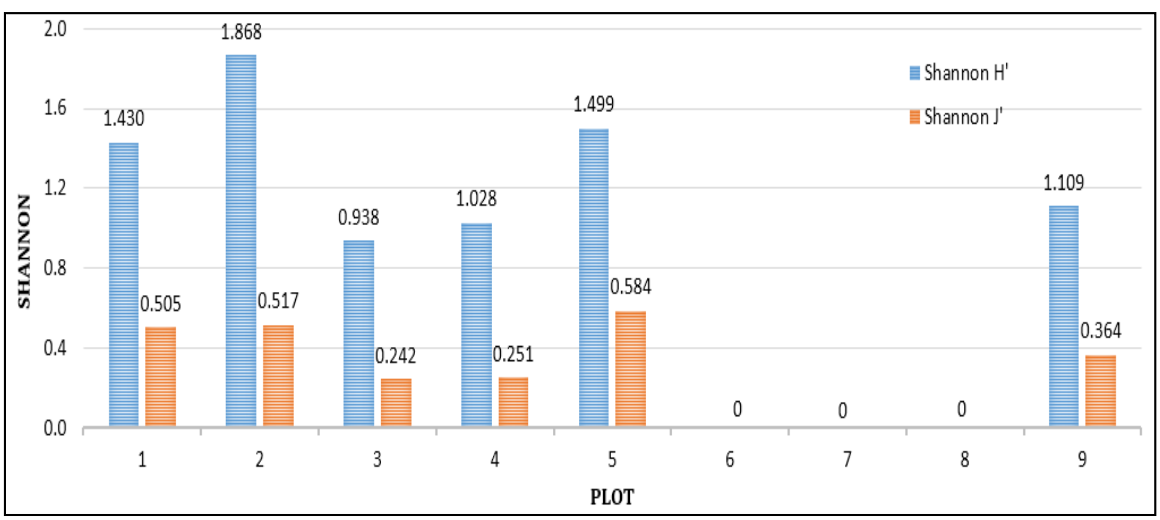


Figure 56. Shannon H' and J' Diversity Index in the 9 Sample Plots in the Ground Layer

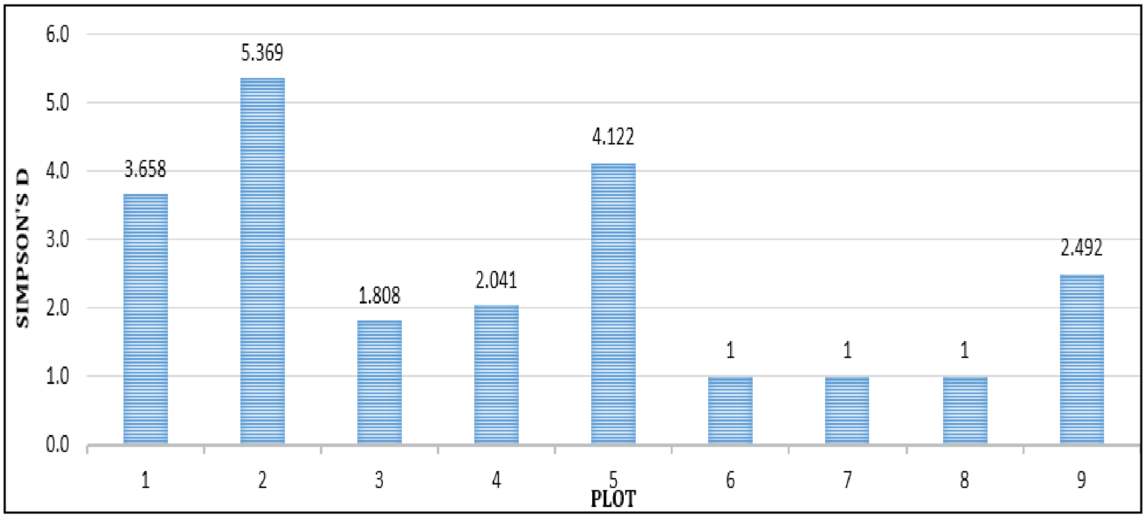


Figure 57. Simpson's D in the 9 Sample Plots in the Ground Layer

Figure 58 to Figure 60 show the photos of terrestrial flora surveyed in the area

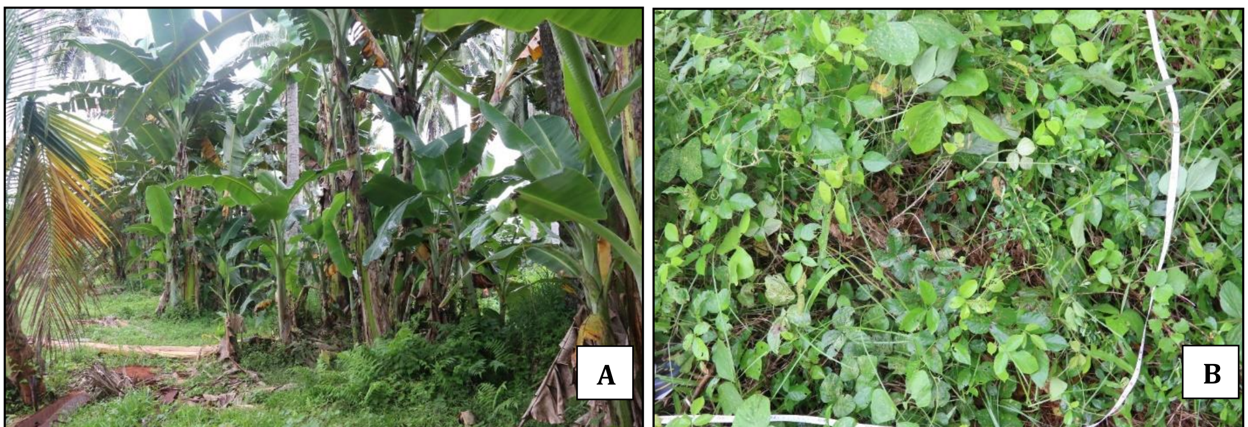


Figure 58. Photo of 20x20 (A) and 1x1 (B) Sample Plot No. in Brgy. Macasandag

Figure 59. **Photo of sample plots no 3 in Brgy. Matimos**

Figure 60.Photo of sample plot no. 6 in Brgy. Batuan

3.1.4.4.2 Terrestrial Fauna

Survey on terrestrial fauna was undertaken together with flora within the proposed road alignment in the municipalities of Parang, Kapatagan and Balabagan. Nine (9) observation sites for faunal species are situated in 8 coastal barangays which include barangay Makasandag in the Municipality of Parang, Matimos, Salaman and Bakikis in the municipality of Kapatagan, and Batuan, Narra, Lorenzo and Barorao in the Municipality of Balabagan. Observation sites are mostly situated within and along the road alignment which land cover are aggregates of agricultural areas, shrublands, grassland and along settlement sites. Elevations of selected observation sites are in between 5 to 100 meters above sea level which topography is from nearly flat to moderately sloping. Geographic coordinates of observation sites are shown in **Table 29**.

3.1.4.4.2.1 Fauna composition and richness

3.1.4.4.2.1.1 Avifauna

The overall result of fauna survey in the proposed project site shows the presence of 30 species of Aves belonging to 21 families with a total abundance of 166 accounted within the 9 observation sites. Of the 21 bird families, Columbidae and Ardeidae are the dominant families represented by 4 species of Dove and 3 species of herons, respectively.

With regard to species abundance, the Chestnut Munia (Lonchura malacca) and Pacific Swallow (Hirundo tahita) under family Estrildidae and Hirundinidae are the abundant species observed within the sampling sites. The aforesaid species has an observed population of 35 and 17, respectively as shown in **Table 32** and Annex 13.6.1. In the 9 sampling sites (Avifaunal species only), sites no. 6 has the highest abundance recorded with a total of 44. While, site no. 9 has the least no. of species with only 5 species observed.

The over-all avifaunal composition of the area showed that most of the species observed are common species including in the lowland areas. Most of these faunal species are highly adaptive in wide range of habitats and ecosystems including agricultural areas, shrub lands, grassland, within settlements areas and sometimes cited in highly urbanized areas including cities.

Table 32. Species distribution and abundance

Family Name	Scientific Name	Species Name	Conservation status (IUCN)	Abundance/Sampling site no.									Total Abundance
				1	2	3	4	5	6	7	8	9	
Accipitridae	*Haliastur inbus*	Brahminy Kite	Least Concern				1						1
Alcedinidae	*Halchyon chloris*	White Collared King Fisher	Not Evaluated			2		1	1		1		5
Alcedinidae	*Halcyon smyrnensis*	White-throated kingfisher	Least Concern			1							1
Apodidae	*Collocalia affinis*	Glossy Swiftlet	Not Evaluated					4		2			6
Ardeidae	*Bubulcus ibis*	Cattle Egret	Least Concern			6			5				11
Ardeidae	*Egretta intermedia*	Intermediate Egret	Least Concern				5						5
Ardeidae	*Butorides striata*	Little Heron	Least Concern			1							1
Campephagidae	*Lalage nigra*	Pied Triller	Least Concern									1	1
Columbidae	*Phapitreron leucotis*	White Eared Brown Dove	Least Concern			2					1		3
Columbidae	*Geopelia striata*	Zebra Dove	Least Concern		3			1		1	2		7
Columbidae	*Macrophygia phasianella*	Reddish Cuckoo Dove	Not Evaluated		1								1
Corvidae	*Corvus enca*	Slender Billed Crow	Least Concern					2	2				4
Dicaeidae	*Dicaeum pygmaeum*	Pygmy Flower Pecker	Least Concern		5		3						8
Estrildidae	*Lonchura mallacca*	Chestnut Munia	Least Concern						35				28
Hirundinidae	*Hirundo tahita*	Pacific Swallow	Least Concern					5	3	6	3		17
Hirundinidae	*Hirundo rustica*	Barn Swallow	Least Concern	2				3					5
Laniidae	*Lanius cristatus*	Brown Shrike	Least Concern						1		2		3
Meropidae	*Merops philippinus*	Blue-tailed Bee-eater	Least Concern						4				4
Meropidae	*Merops viridis*	Blue-throated Bee-eater	Least Concern					2		2	6		10
Motacillidae	*Artamus leucocrynchus*	White-Breasted Wood-Swallow	Least Concern		1				2				3
Muscicapidae	*Saxicola caprata*	Pied Bush chat	Least Concern								1	1	2

Nectariniidae	*Nectarinia jugularis*	Olived-Backed Sunbird	Least Concern			1	4						5
Nectariniidae	*Aethopyga primigenia*	Grey-hooded Sunbird	Near Threatened					1			2		3
Oriolidae	*Oriolus chinensis*	Black-Naped Oriole	Least Concern				1						1
Passeridae	*Passer montanus*	Eurasian Tree Sparrow	Least Concern	7									7
Psittacidae	*Bolbopsittacus lunulatus*	Guaiabero	Least Concern			3							3
Pycnonotidae	*Pycnonotus goiavier*	Yellow - Vented Bulbul	Least Concern		2						1	3	6
Rallidae	*Gallirallus torquatus*	Barred Rail	Least Concern				1						1
Sturnidae	*Aplonis payanensis*	Asian Glossy Starlings	Least Concern							5			5
Sylviidae	*Megalurus timoriensis*	Tawny Grass Bird	Least Concern		1				1				2
Total				**9**	**13**	**16**	**15**	**19**	**54**	**16**	**19**	**5**	**166**

3.1.4.4.2.1.2 Herpeto-fauna species

Other fauna species found within the study area also includes 3 species of mammals, 1 reptile, and 2 species of amphibian as shown in **Table 33**. Note that 2 of the recorded species (Civit Cat and Large Field Rat) are included based on the result of an interview with local informants which recurrent encounter with this wildlife had been told.

Remarkably, presence of other important wildlife in the area is nominal. Among of the observed factors that dictate the presence/absence of wildlife species in the area are possibly influence by the following:

- Existing vegetation cover of the area which is dominantly agricultural in nature
- Availability of food sources for wildlife
- Disturbance brought by human daily activities
- Hunting/poaching of wildlife
- Proximity of the study area to settlements
- Loss of habitat due to conversion of forest lands to agriculture and other land uses

Table 33. Summary List of Faunal Species and Conservation Status

Family	Scientific Name	Common Name	Conservation Status (IUCN)
Avifauna			
Accipitridae	*Haliastur inbus*	Brahminy Kite	Least Concern
Alcedinidae	*Halchyon chloris*	White Collared King Fisher	Not Evaluated
Alcedinidae	*Halcyon smyrnensis*	White-throated kingfisher	Least Concern
Apodidae	*Collocalia affinis*	Glossy Swiftlet	Not Evaluated
Ardeidae	*Bubulcus ibis*	Cattle Egret	Least Concern
Ardeidae	*Egretta intermedia*	Intermediate Egret	Least Concern
Ardeidae	*Butorides striata*	Little Heron	Least Concern
Campephagidae	*Lalage nigra*	Pied Triller	Least Concern
Columbidae	*Phapitreron leucotis*	White Eared Brown Dove	Least Concern
Columbidae	*Geopelia striata*	Zebra Dove	Least Concern
Columbidae	*Macrophygia phasianella*	Reddish Cuckoo Dove	Not Evaluated
Corvidae	*Corvus macrorhynchos*	Slender-Billed Crow	Least Concern
Dicaeidae	*Dicaeum pygmaeum*	Pygmy Flower Pecker	Least Concern
Estrildidae	*Lonchura malacca*	Chestnut Munia	Least Concern
Hirundinidae	*Hirundo rustica*	Barn Swallow	Least Concern
Hirundinidae	*Hirundo tahita*	Pacific Swallow	Least Concern
Laniidae	*Lanius cristatus*	Brown Shrike	Least Concern
Meropidae	*Merops philippinus*	Blue-tailed Bee-eater	Least Concern
Meropidae	*Merops viridis*	Blue-throated Bee-eater	Least Concern
Motacillidae	*Artamus leucocrynchus*	White-Breasted Wood-Swallow	Least Concern
Muscicapidae	*Saxicola caprata*	Pied Bush chat	Least Concern
Nectariniidae	*Aethopyga primigenia*	Grey-hooded Sunbird	Near Threatened
Nectariniidae	*Nectarinia jugalaris*	Olived-backed Sunbird	Least Concern
Oriolidae	*Oriolus chinensis*	Black Naped Oriole	Least Concern
Passeridae	*Passer montanus*	Eurasian Tree Sparrow	Least Concern
Psittacidae	*Bolbopsittacus lunulatus*	Guaiabero	Least Concern
Pycnonotidae	*Pycnonotus goiavier*	Yellow -Vented Bulbul	Least Concern
Rallidae	*Gallirallus torquatus*	Barred Rail	Least Concern
Sturnidae	*Aplonis payanensis*	Asian Glossy Starlings	Least Concern
Sylviidae	*Megalurus timoriensis*	Tawny Grass Bird	Least Concern
Herpeto-fauna			
Viverridae	*Paradoxurus hermaphroditus*	Alamid/Civit Cat*	Least Concern

Muridae	*Rattus exullans*	Polynesian Coconut rat	Least Concern
Scincinidae	*Eutropis multifasciata*	Skink/Bubuli	Not evaluated
Pteropodidae	*Ptenochirus jagori*	Greater Musky Fruit Bat	Least Concern
Bufonidae	*Bufo marinus*	Marine Toad	Introduce, Least Concern
Rhacophoridae	*Polypedates leucomystax*	Common Tree frog	Least Concern

3.1.4.4.2.2 Endemism and conservation status

In terms of avifaunal endemicity, 5 species are found to be endemic in the country and the rest of the recorded species are native/non-endemic species. Among the endemic species is the Grey Hooded Sun Bird (Aethopyga primigenius), Pygmy Flower Pecker (Dicaeum pygmaeum), Guaiabero (Bolbopsittacus lunulatus), Barred Rail (Gallirallus torquatus) and the White-Eared Brown Dove (Phapitreron leucotis). On the hand, only the Greater Musky Fruit Bat (Ptenochirus jagori) from herpeto-fauna is endemic in the country. Conversely, the Marine Toad (Bufo marinus) is introduced species in the country.

With reference to the International Union for Conservation of Nature (IUCN) (2017), conservation status of recorded species within the project area has no Critically endangered nor endangered species in category. Of the 30-fauna species observed based on **Table 34** and **Table 35**, only 1 species (Grey-Hooded Sunbird) is under Near Threatened in category, 4 species (Skink, Reddish Cuckoo Dove, Glossy Swiftlet and White Collared King Fisher) are not evaluated and the rest of the species (86 %) are under least concern category. **Table 34** summarized the conservation status of recorded terrestrial fauna species within the study area.

Table 34. **Conservation status of observed fauna species (IUCN red list 2017)**

Conservation status	Aves	Mammal/s	Reptiles	Amphibians	Total
Critically endangered	-	-	-	-	0
Near Threatened	1	-	-	-	1
Vulnerable	-	-	-	-	0
Least Concern	26	3		2	31
Not evaluated	3	-	1	-	4
TOTAL	**30**	**3**	**1**	**2**	**36**

3.1.4.4.2.3 Computed Biodiversity index

Biodiversity indices particularly Shannon-Wiener Diversity Index (H') and Pielou's Evenness Index (J') were computed for this survey using the avifaunal data. The overall computed biodiversity index of the project alignment by getting the average biodiversity index of the 9 observation sites as shown in **Table 35** has a computed biodiversity index of 1.466 with species evenness value of .853. 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 9 observation sites reveals that all of the sites have very low diversity richness with a very high species evenness. Sampling site no. 8 has the highest scale of diversity of 1.986, while, site no. 1 has the lowest scale of .530 biodiversity index. Relative to species evenness, site no. 8 has the highest computed value of .986, conversely, site no. 6 has the lowest value of .687, respectively.

Table 35. Computed Biodiversity Index of Sampled Sites (for Avifaunal Species Only)

Sampling site no.	Shannon-Wiener Biodiversity index (H')	Pielou's Index (J') species Evenness	Fernando's Biodiversity Scale (1998)
1	.530	.764	Very low diversity with very high species evenness
2	1.586	.885	Very low diversity with very high species evenness
3	1.721	.885	Very low diversity with very high species evenness
4	1.582	.883	Very low diversity with very high species evenness
5	1.910	.918	Very low diversity with very high species evenness
6	1.508	.687	Very low diversity with very high species evenness
7	1.424	.885	Very low diversity with very high species evenness
8	1.986	.904	Very low diversity with very high species evenness
9	.950	.865	Very low diversity with very high species evenness
Average	**1.466**	**0.853**	**Very Low diversity with very high species evenness**

3.1.4.4.2.4 Species Relative Frequency

Of the 9 sampling sites in the proposed project alignment, there are 30 species of avifauna were recorded with a total abundance of 166. In terms of species occurrence in every sampled site showed that the White-Collared King Fisher (Halcyon chloris), Zebra Dove (Geopelia striata), Eurasian Tree Sparrow (Passer montanus), and Pacific Swalow (Hirundo tahita) has the highest relative frequency of 7.018 %. In contrary, the lowest relative frequency is 1.754 comprised the 37% of the listed avifauna which include the Intermediate Egret (Egretta intermedia), Little Heron (Butorides striata), Pied Triller (Lalage nigra), Reddish Cuckoo Dove (Macrophygia phasianella) and other species as shown in **Table 36**.

Table 36. Species Relative Frequency

Family	Scientific Name	Common Name	Relative Frequency (%)
Accipitridae	Haliastur inbus	Brahminy Kite	3.509
Alcedinidae	Halchyon chloris	White Collared King Fisher	7.018
Alcedinidae	Halcyon smyrnensis	White-throated kingfisher	3.509

Apodidae	Collocalia affinis	Glossy Swiftlet	3.509
Ardeidae	Bubulcus ibis	Cattle Egret	3.509
Ardeidae	Egretta intermedia	Intermediate Egret	1.754
Ardeidae	Butorides striata	Little Heron	1.754
Campephagidae	Lalage nigra	Pied Triller	1.754
Columbidae	Phapitreron leucotis	White Eared Brown Dove	3.509
Columbidae	Geopelia striata	Zebra Dove	7.018
Columbidae	Macrophygia phasianella	Reddish Cuckoo Dove	1.754
Corvidae	Corvus enca	Slender Billed Crow	3.509
Dicaeidae	Dicaeum pygmaeum	Pygmy Flower Pecker	3.509
Estrildidae	Lonchura malacca	Chestnut Munia	1.754
Hirundinidae	Hirundo tahita	Pacific Swallow	7.018
Hirundinidae	Hirundo rustica	Barn Swallow	3.509
Laniidae	Lanius cristatus	Brown Shrike	3.509
Meropidae	Merops philippinus	Blue-tailed Bee-eater	1.754
Meropidae	Merops viridis	Blue-throated Bee-eater	5.263
Motacillidae	Artamus leucocrynchus	White-Breasted Wood-Swallow	3.509
Muscicapidae	Saxicola caprata	Pied Bush chat	3.509
Nectariniidae	Nectarinia jugularis	Olived-Backed Sunbird	3.509
Nectariniidae	Aethopyga primigenia	Grey-hooded Sunbird	3.509
Oriolidae	Oriolus chinensis	Black-Naped Oriole	1.754
Passeridae	Passer montanus	Eurasian Tree Sparrow	1.754
Psittacidae	Bolbopsittacus lunulatus	Guaiabero	1.754
Pycnonotidae	Pycnonotus goiavier	Yellow -Vented Bulbul	5.263
Rallidae	Gallirallus torquatus	Barred Rail	1.754
Sturnidae	Aplonis payanensis	Asian Glossy Starlings	1.754
Sylviidae	Megalurus timoriensis	Tawny Grass Bird	3.509
		Total	**100.00**

Table 37 shows some photos taken for faunal species during the field survey.

Table 37. Photo of some Faunal Species

Photo	Common Name/ Scientific Name	Conservation Status (IUCN)	Location/ Geographic Coordinates
	Blue Tailed Bee Eater (Merops philippinus)	Least Concern	Site 6 Brgy. Batuan Balabagan (7°29'28.79" northing 124° 8'9.46" Easting)
	White Throated King Fisher (Halchyon chloris)	Least Concern	Site 3 Brgy. Matimos Balabagan (7°26'25.97" Northing 124° 9'49.60" easting)
	Pacific Swallow (Hirundo tahita)	Least Concern	Site 6 Brgy. Batuan Balabagan (7°29'28.79" northing 124° 8'9.46" Easting)

	Chestnut munia (Lonchura malacca)	Least Concern	Site 1 Brgy. Makasandag Parang (7°24'2.66" Northing 124°15'19.29" Easting)
	Intermediate Egret (Egretta intermedia)	Least Concern	Site 4 Brgy. Salaman Kapatagan (7°27'24.72" northing 7°27'24.72" Easting)
	Zebra Dove (Geopelia striata)	Least Concern	Site 5 Brgy. Bakikis Kapatagan (7°28'41.44" Northing 124° 8'29.82" Easting)

	Skink /Bubuli (Eutropis multifasciata)	Least Concern	Site 8 Brgy. Lorenzo Balabagan (7°31'25.99" Northing 124°7'16.12" Easting)
	Glossy Starlings (Aplonis payanensis)	Least Concern	Site 7 Brgy. Narra Balabagan (7°30'29.72" Northing 124° 7'54.43" Easting)
	White-Breasted Wood-Swallow (Artamus leucocrynchus)	Least Concern	Site 6 Brgy. Batuan Balabagan (7°29'28.79" northing 124° 8'9.46" Easting)

	Brown Shrike (Lanius Cristatus)	Least Concern	Site 8 Brgy. Lorenzo Balabagan (7°31'25.99" Northing 124°7'16.12" Easting)
	Pied Bush chat (Saxicola caprata)	Least Concern	Site 8 Brgy. Lorenzo Balabagan (7°31'25.99" Northing 124°7'16.12" Easting)
	Common Tree Frog (Polypedates leucomystax)	Least Concern	Site 4 Brgy. Salaman Kapatagan (7°27'24.72" northing 7°27'24.72" Easting)

3.1.4.5 Environmental, Economic Significance and Threats

3.1.4.5.1 Terrestrial Flora

Flora plays an important role in the climate change moderation as sinks of atmospheric carbon dioxide. Plants managed to assimilate carbon dioxide through the photosynthesis process, and store carbon in biomass and in soil (Watson et al, 2000; Brown et al, 1996) for their growth and metabolism.

In the economic side, flora species are very important in lives of people in many aspects. People depend upon plants to satisfy such basic human needs such as food, clothing, shelter, and health care. Along the project site, the family with the highest vegetational cover is the Fabaceae, also known as legumes, helps increase soil nitrogen and provide rich sources of vegetable protein for humans, livestock, and wild animals. These species are also a good source of fodder for domestic animals. There are many species in the area having a high economic importance, such as the Gmelina which is use for medicinal purposes; and Mahogany and Narra are both widely known to have high economic value aesthetically and commercially. There are also major and/or important agriculcural crops that are found in the area such as banana, coconut and cassava.

Flora species also provide shelter, protection and medicine to man and animals. A strong gust of wind and rain can be blocked by a tree, therefore, minimizing its damaging impact to lives and properties. Shrubs and trees and even grasses have also positive impact on soil erosion. Other plants in the area are also a good source of medicine, food, etc.

Conversely, threats to flora brought by the opening of roads will require removal of the remaining vegetation within the proposed road right of way. This will result to a certain decrease of trees, crops, and species population in the ecosystem and locality. Removal of vegetation cover would result to the release of carbon dioxide in the atmosphere as well as decrease of carbon sinks or carbon storage capacity of the ecosystem.

3.1.4.5.2 Terrestrial Fauna

Faunal species are a good indicator of the existing environment of certain ecosystem or area. They play a significant role in many aspects that include enhancement of the ecological balance and food chain cycle and other natural environmental processes. Other faunal 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 the ecosystem, they also provide economic importance in various aspects. They are even valuable source of food and medicines. Commercially, some wildlife species are being exploited 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. The existence of varieties of faunal species are part of country’s cultural asset.

Continuous loss of faunal habitats due to degradation of forest cover brought by land clearing, conversion of forest lands to settlements and other land uses. Though, faunal species are mobile in nature this situation will force them to migrate to other areas to search for new habitat. Migration of other wildlife to new territory/is 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, a decrease of the population to some species in this area will be expected to happen while others may not significantly be affected. Wildlife offers a variety of commercial values and opens several livelihood sources, utilization is not regulated as to the 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.

3.1.4.6 Key impacts of the proposed project to terrestrial flora and fauna

a) Loss of Vegetation

The project development will require removal of vegetation cover to give way for the construction of road project. The removal of vegetation will also result in the reduction in the population of plant species growing within the project area. Future vegetation will face a great threat during the clearing activity. This activity will hinder the opportunity of regenerations to grow in replacement of mature vegetation.

During site preparation, clearing of the road ROW will result to the removal of of an estimated tree above ground biomass (using large of trees with dbh of 10 cm and above, and pole size tress with $\geq$ 5 cm dbh to 9.5 cm) of 1.59×10^{-4} and 2.87×10^{-4} megaram per hectare, and with estimated Carbon stored value of 3.53×10^{-4} and 6.38×10^{-4} megagram per hectare, respectively. It was computed using the brown allometric equation.

Furthermore, the removal of vegetation cover will lead to lost/removal of top soils 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 the heavy influx of surface run-off waters resulting in erosion in the uncovered surfaces and siltation downstream of the project site.

b) 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 road network. This entails furthering disturbance of wildlife, loss of habitats and reduction to biodiversity composition of the area.

c) 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 to other or nearby areas/habitat where disturbance is less.

3.1.4.6.1 Recommended Mitigating Measures

a) Replacement of trees cut due to land clearing

Prior to project implementation the proponent will coordinate to the DENR and Philippine Coconut Authority (PCA) to seek clearance for the identification of required documents for the issuance of needed tree and coconut cutting permits (PD 705). Moreover, to compensate the loss of habitats, the proponent will replace the number of trees removed/cut and plant them in 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 including Bignai, Talisai, Kalumpit, Narra, Balite/ficus sp., Lansones, Rambutan, and other fruit trees. Earth Balling of saplings of selected tree species should also be undertaken when necessary.

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 in 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”.

b) Replacement of cut coconut palms and perennial crops

Prior to clearing of the proposed ROW of the project which involves cutting of coconut and other perennial crops, the DPWH ARMM shall secure a “cutting permits” separately that will be acquired from the Philippine Coconut Authority (PCA) office in the region. Compensation for affected coconut palms shall be based on Section 5 of Republic Act No. 8048, an act providing for the regulation of the cutting of coconut palms. Replacement ratio of cut coconut palms shall be 1:1. If the applicant failed to implement replanting, fees will be collected by the PCA and shall be used to fund the replanting activity as defined in Section 5 of Republic Act No. 8048. Compensation of high value crops such as banana, mango, durian, pomelo, mangosteen, papaya, rambutan, and lanzones shall be in accordance with the existing schedule of values from the municipal/ City Agriculture Office.

c) 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 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.

d) 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 on strategic areas for public information and warning.

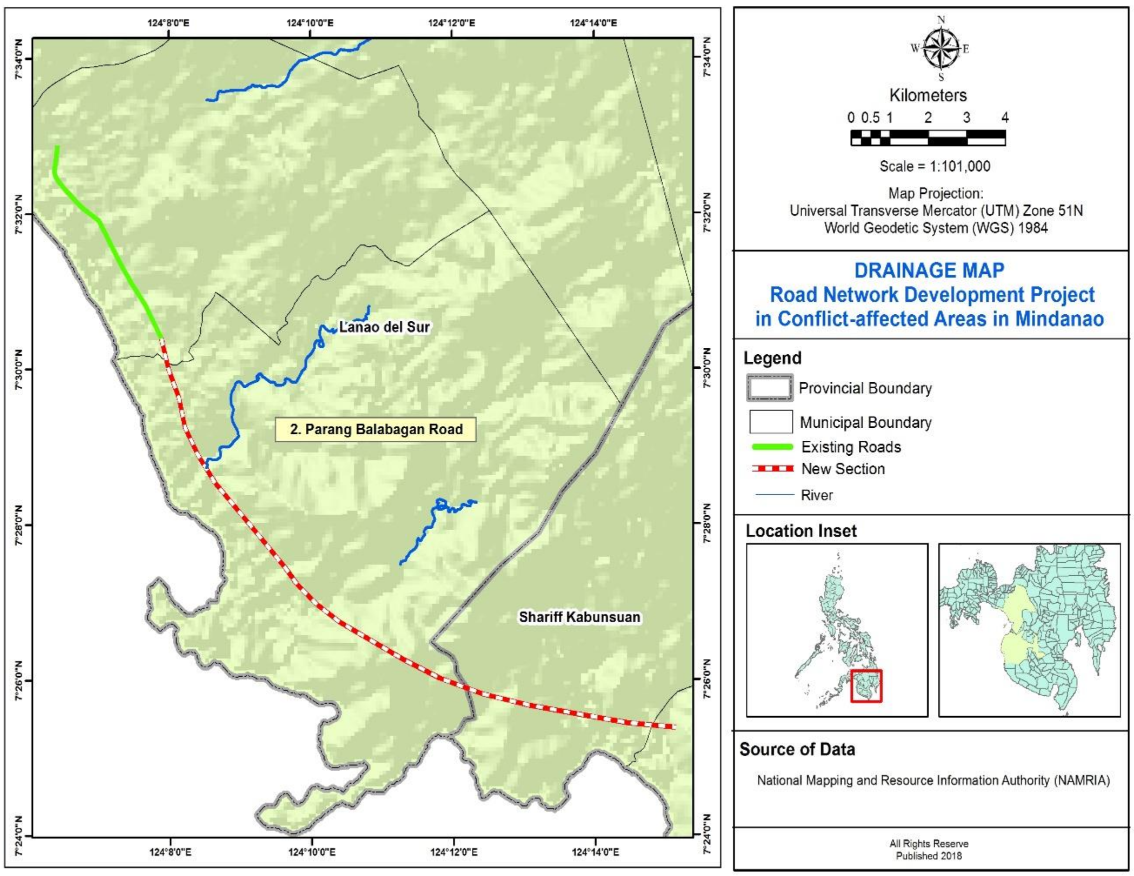
e) Establishment of natural noise buffer/natural perimeter along the alignment using landscape species or fruit bearing trees

To consider in the planning the establishment of natural buffer perimeter within the project alignment using landscape or fruit bearing trees. This method could help provide a natural abode to some wildlife as well as source of food, and improve the ecological services of the entire road network during the operation phase. It is recommended that a 2 or 3-rows of tree plantation along roads shall be established in both sides, avoiding electrical transmission lines as mandated under the DPWH Order no. 15 series of 2015.

3.2 Baseline in Water

3.2.1 Hydrology

Figure 61 shows the drainage map of the study area. The river systems that affect the proposed road alignment are the Tigatan, Matimus, Salanga, Abunabun and Muda Rivers and Diarong Creek **(Figure 62).** During the conduct of field investigation, no ground water wells or springs were found that may be affected by the project but based on the data from the National Water Resources Board (NWRB), two springs are within the vicinity of the road alignment namely; Macasandag Spring and Libuan Spring as shown in **Figure 63**. These springs are used for municipal and irrigation purposes respectively. Details of these springs are shown in **Table 38**.



Source: NAMRIA
Figure 61. Drainage Map of the Study Area

Table 38 – Summary of Surface Water Sampling Sites, Coordinates, Weather condition, Date and

Name of Spring	Location	Type/Use
Macasandag Spring	Macasandag, Parang, Maguindanao Latitiude : 7deg 25' 02" Longitude: 124deg 15' 29"	Municipal Use
Libuan Spring	Guiday St., Biruar, Parang, Maguindanao Latitude : 7deg 20' 58" Longitude: 124deg 17' 47"	Irrigation

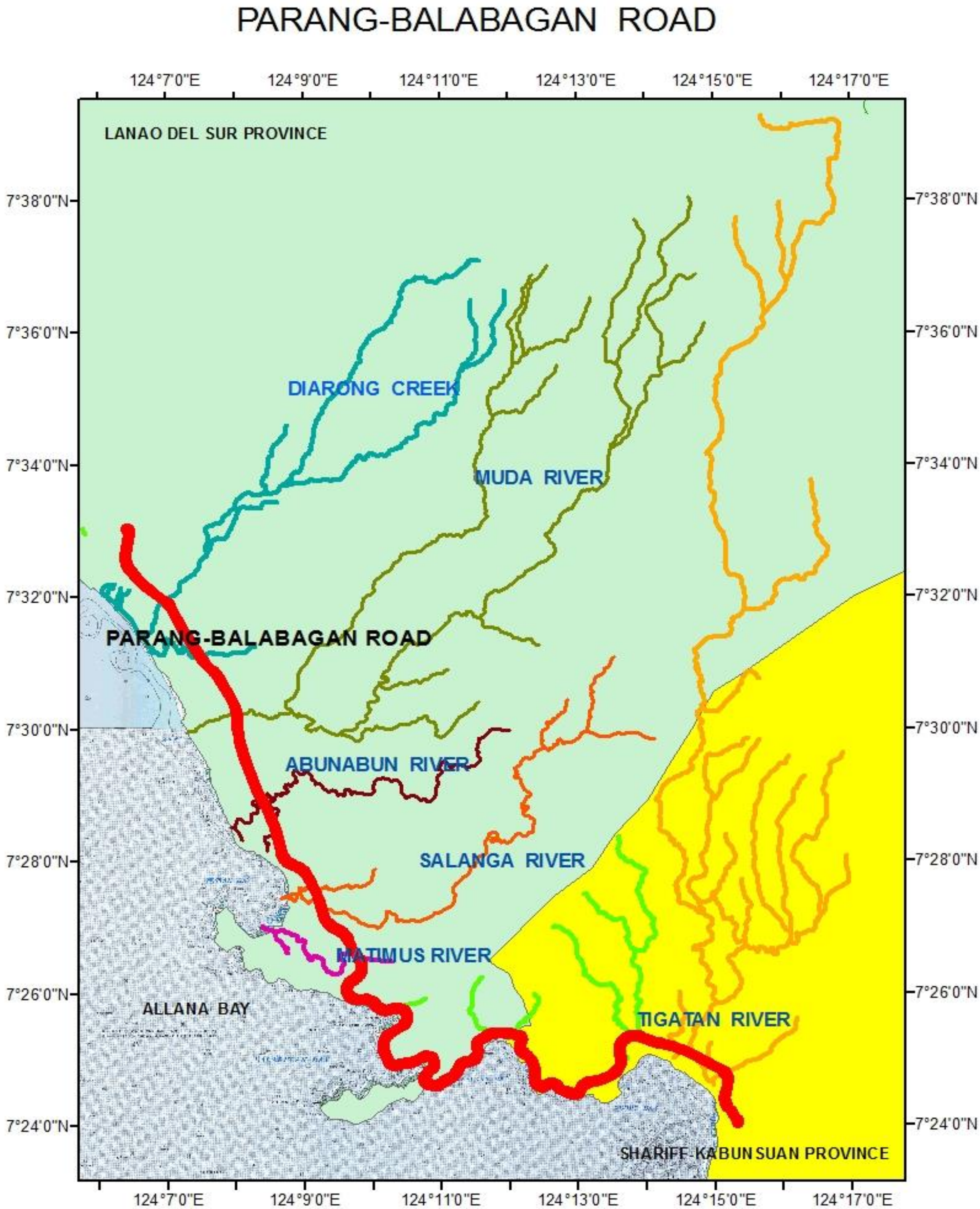


Figure 62. Rivers and Creeks Affecting Parang-Balabagan Road

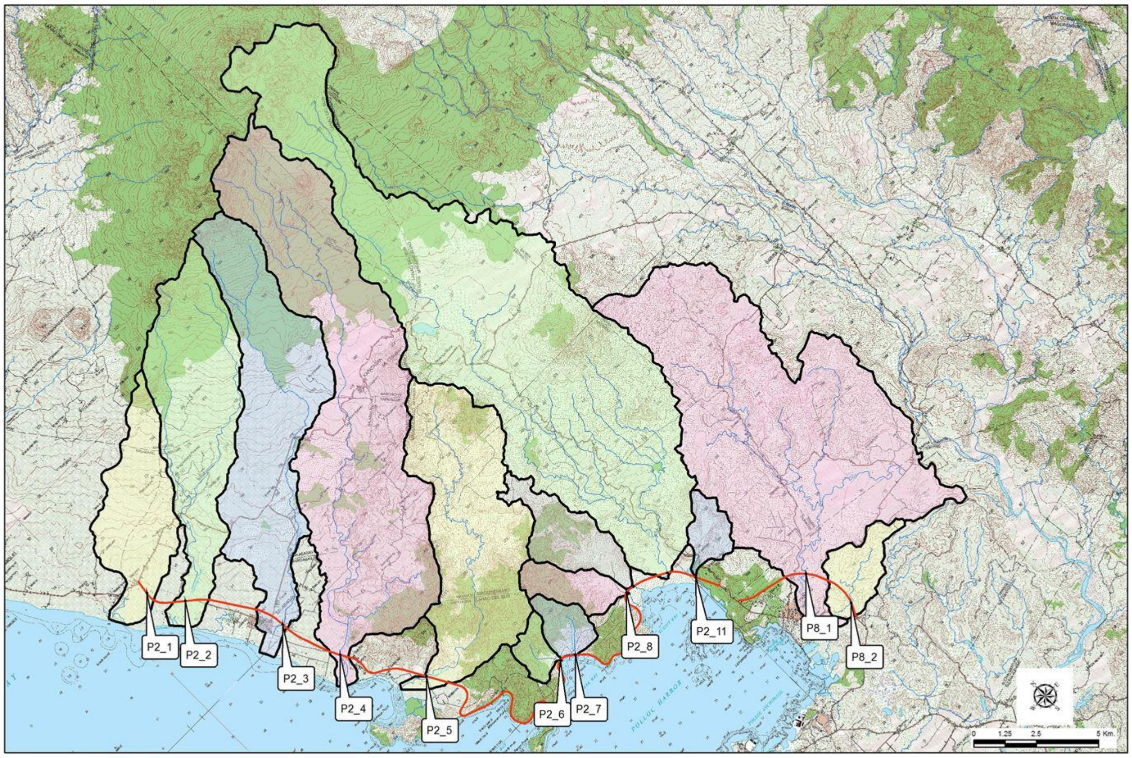
Source: Google Earth

Figure 63. Location of Groundwater Wells or Springs affected by Parang-Balabagan Road

Table 39 presents the Discharge estimation for 50-yr and 100-yr return period flood. **Figure 64** presents the proposed catchment areas in the study site.

Table 39. Flood Discharge (Q) Estimation for 50-yr and 100-yr Return Period Flood

Sub-Project	Location Name	Design Flood Discharge for 50-yr Return Period Flood (m3/s)	Design Flood Discharge for 100-yr Return Period Flood (m3/s)
2	P2_1	170	190
	P2_2	260	290
	P2_3	310	340
	P2_4	460	500
	P2_5	290	320
	P2_6	35	38
	P2_7	48	55
	P2_8	65	70
	P2_9	100	110
	P2_10	600	650
	P2_11	46	50



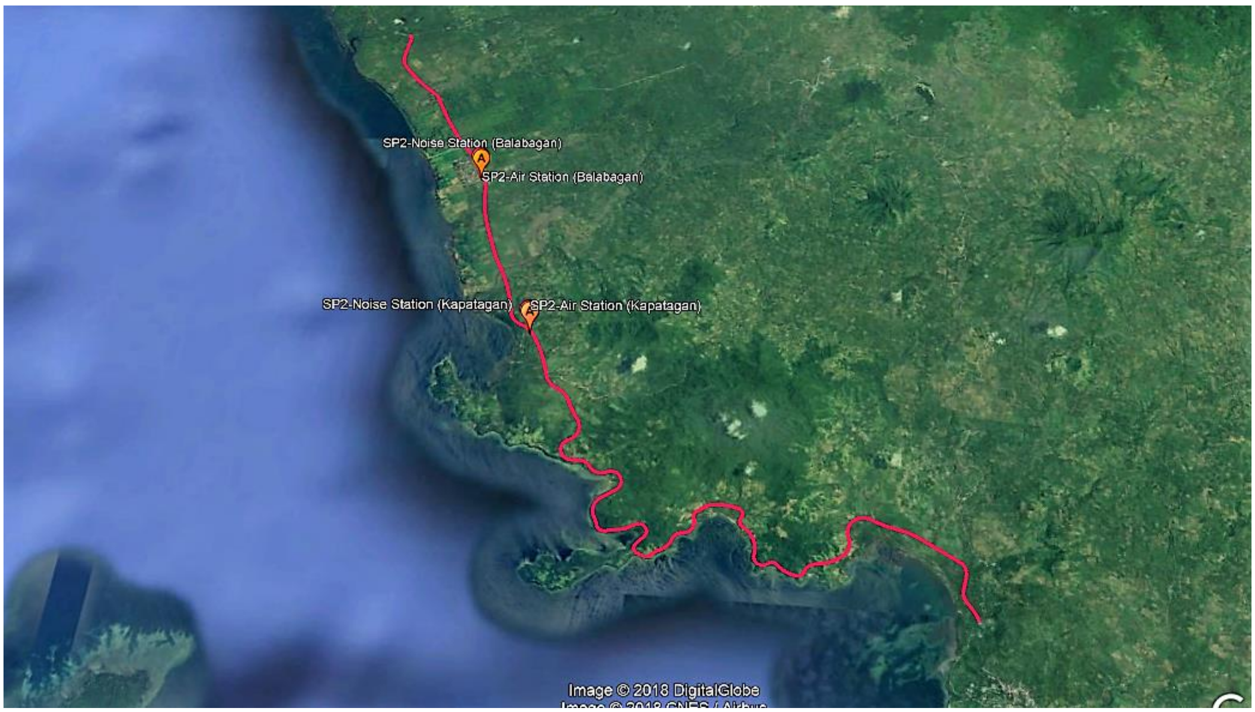
Source: JICA Study Team
Figure 64. Proposed Catchment Area Locations for SP-2 Project

3.2.2 Water Quality

Grab sampling was used for surface water quality measurement. Samples were collected during cloudy weather with slight rain showers experienced on December 1 & 2, 2017. Stainless pale and rope were 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, a recognized DENR and DOH accredited laboratory. **Table 40** presents the sampling sites, date and time of collection conducted in Balabagan and Kapatagan, Lanao del Sur. **Figure 65** presents the sampling map of Sub-project 2.

Table 40 – Summary of Surface Water Sampling Sites, Coordinates, Weather condition, Date and Time of Samplings

Station No.	Sampling Stations	Coordinates	Weather Condition	Date and Time of Samplings
S1	Budas River	7°28'49.1" N 124° 08' 25.2" E	Cloudy to slight rain showers	November 16, 2017, 1120H
S2	Matimos-Minoan River	7°27'9.8" N 124° 09' 26.9" E	Cloudy	November 16, 2017, 1337H



Source: Google Earth
Figure 65. Water Sampling Map covered by Parang-Balabagan Road

3.2.2.1 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 41.** **Figure 66** and **Figure 67** show the sampling pictures taken at SP No. 2 Parang-Balabagan Road.

Table 41. Parameters and Analytical Methodology

Parameter	Analytical Method
pH	Glass Electrode; pH Meter
Temperature	pH/Temperature meter
Turbidity	Nephelometric Method
Biochemical Oxygen Demand (BOD)	Azide Modification (Dilution Technique) Titrimetry
Total Suspended Solids (TSS)	Gravimetric Method
Dissolved Oxygen (DO)	Azide Modification (Winkler Method)

3.2.2.2 Results and Discussions

Table 42 shows the results of physical and chemical analyses for surface water collected in Balabagan and Kapatagan, Lanao del Sur. Based on the results, Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD), pH and TSS meet the criteria guidelines of the DENR Administrative Order No. 2016-08, Water Quality Guidelines and General Effluent Standards of 2016. It should be noted that DENR does not have regulatory standard for Turbidity.

Table 42. Results of Physico-chemical Analyses of Surface Water

Parameters, units	S1	S2	DAO No. 2016-08, Class C Limits
pH	7.5	7.6	6.5 – 9.0
Temperature, °C	29.0	26.6	25-31
Turbidity, NTU	0.90	0.2	---
BOD, mg/L	2	<1	7
TSS, mg/L	23	12	80
DO, mg/L	8	8	5.0 mg/L minimum

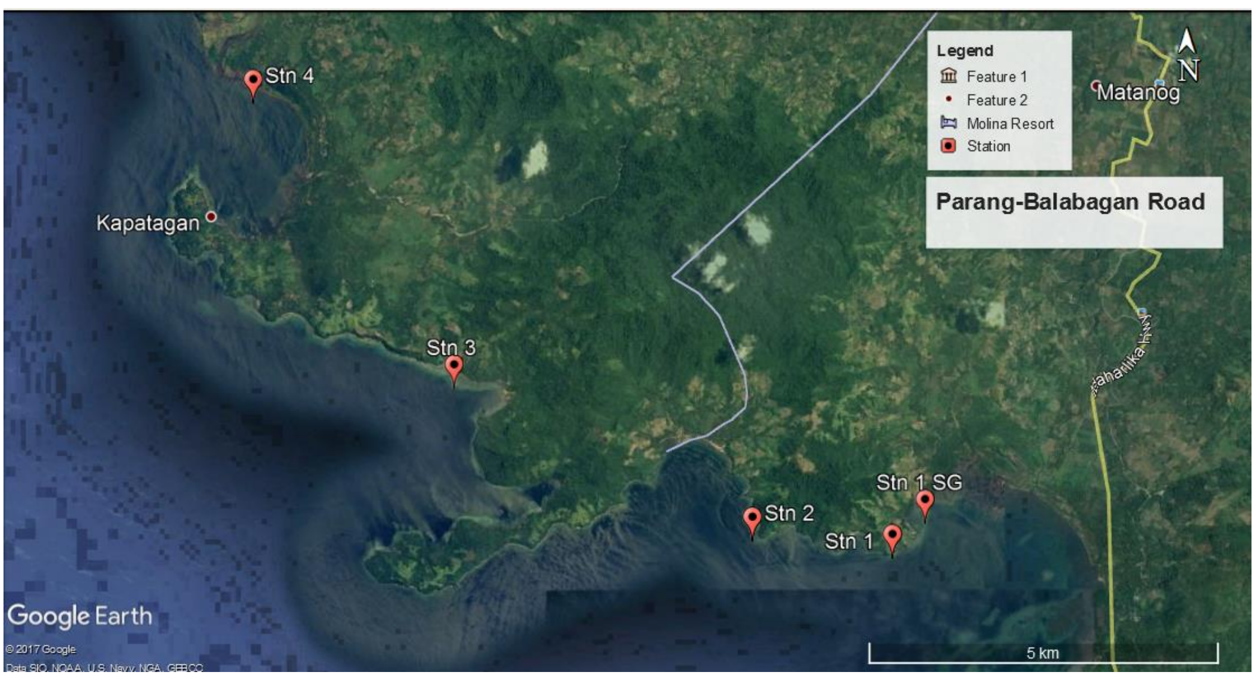
Hereto attached as Annex 13.6.2 are the results of Water Quality Stations.

Figure 66. Water Sampling at Matimos-Minoan River

Figure 67. Water Sampling at Budas River, Brgy. Budas, Balabagan, Lanao del Sur

3.2.3 Marine Ecology

The sampling program is based on the areas covered by the map presented as **Figure 68.** **Table 43** shows the coordinates and descriptions of Marine Ecology Stations.



Source: Google Earth

Figure 68. Location of Marine Ecology Sampling Stations, Parang-Balabagan Road.

Table 43. Sampling Stations for Marine Ecology located in Matanog, Maguindanao and Kapatagan, Lanao del Sur

Station No.	Location	Sampling Depth (m)	Coordinates		Description
			Latitude	Longitude	
1	Brgy. Sapad, Matanog, Maguindanao	3	07° 24' 18.4" N	124° 13' 25.2"E	Conducted Fish Visual Census and Coral Assessment (Line Intercept Technique). Underwater photo documentation. Collected Phytoplankton, Zooplankton and Macroinvertebrates.
	Brgy. Sapad, Matanog, Maguindanao		07° 24' 34.8" N	124° 13' 40.9"E	Seagrass Station. With Patches of mangroves
2	Brgy. Kidama, Matanog, Maguindanao	3	07° 24' 26.5" N	124° 12' 18.5"E	No seagrass, Conducted Fish Visual Census and Coral Assessment (Line Intercept Technique). Underwater photo documentation. Collected Phytoplankton, Zooplankton and Macroinvertebrates
3	Brgy. Lusain, Kapatagan, Lanao del Sur	7	07° 25' 38.6" N	124° 09' 56.0"E	Dive site of the municipality of Kapatagan. No seagrass in this station. Conducted Fish Visual Census and Coral Assessment (Line Intercept Technique). Underwater photo documentation. Collected Phytoplankton, Zooplankton and Macroinvertebrates. Additional marine ecology station
4	Brgy. Bakikis, Kapatagan, Lanao del Sur	4	07° 27' 54.1" N	124° 08' 19.5"E	Near Buddha River, black sand, No corals, reef fish and seagrass station. Underwater photo documentation. Collected Phytoplankton, Zooplankton and Macroinvertebrates

3.2.3.1 Methodology

Field surveys were conducted on November 16, 2017. Primary data were gathered through direct observation and field sampling. Sampling activities were focused mainly within the coastal waters of Matanog, Maguindanao and Kapatagan, Lanao del Sur with a total of 4 sampling stations. Motorized outrigger boat was used as sampling platform in collecting biological samples at the established marine ecology stations.

3.2.3.1.1 Phytoplankton and Zooplankton Sampling and Analysis

Plankton sampling was also carried out in all the 4 marine ecology stations. 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. **Figure 69** shows the conventional plankton net used in the study/sampling.

Figure 69. Convention Plankton net used in the Collection of Plankton Samples

3.2.3.1.2 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 70 shows the portable ponar grab sampler used in the collection of benthic macroinvertebrates samples.

Figure 70. A Portable ponar grab sampler used in the collection of benthic macroinvertebrates samples.

3.2.3.2 Detailed Benthic Community Assessment (Coral Assessment)

Detailed coral reef assessment was conducted in permanent stations 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 one meter interval, at a camera to substrate distance of 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 as shown in **Figure 71**. 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:

$$\text{Percent cover (\%)} = \frac{\text{Total number of points per life form}}{\text{Total number of points per transect}} \times 100\%$$

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 (Soft + hard) 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).

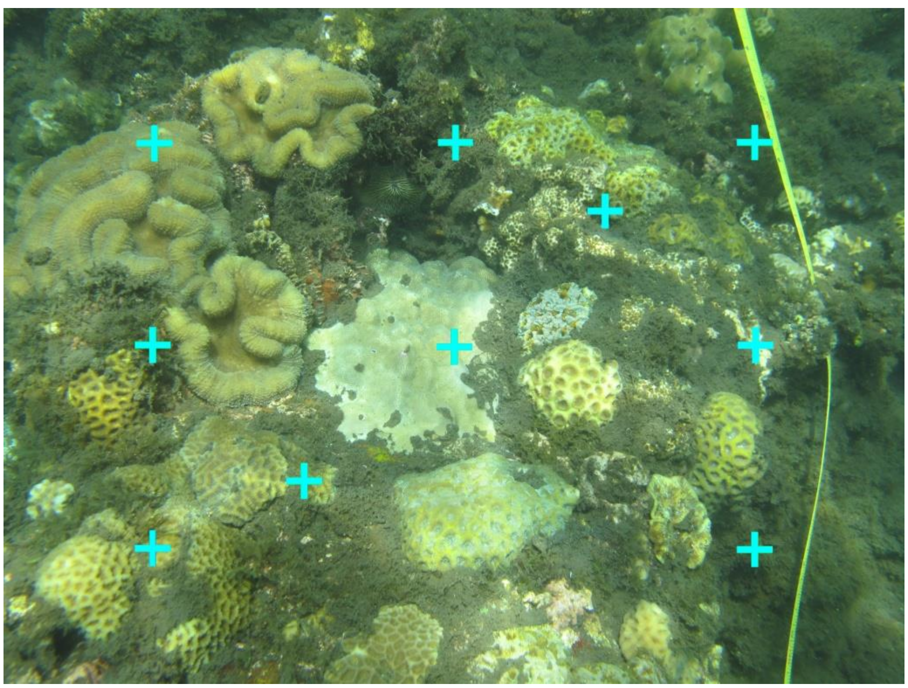


Figure 71. Arrangement of the 10 sampling points (light blue colored crosses) on the picture frame for photo-transect analysis.

Data Analysis

A quartile index was established by Gomez and Alcala (1979) classifying reef health according to the proportion of living hard coral cover compared to other benthic components (e.g. dead coral, algae, abiotic components etc., **Table 44**)

Table -44. Quartile index for reef health

Category	% Hard Coral Cover
POOR	0 – 24.9
FAIR	25 – 49.9
GOOD	50 – 74.9
EXCELLENT	75 – 100

Mortality indices (MI) (Gomez et al., 1994) of the MPAs were computed, deriving the ratio of dead to total coral cover. Computations used the following formula:

$$\mathrm{MI} = \frac{\%\ \text{dead coral cover (DC + DCA)}}{\%\ \text{hard coral cover (HC)} + \%\ \text{dead coral cover}}$$

Development (DI), condition (CI) and succession (SI) indices (Manthachitra, 1994) were also computed to further describe the status of the reefs using the following formulae:

$$\mathrm{DI} = \log[(\mathrm{HC} + \mathrm{SC} + \mathrm{DC} + \mathrm{DCA} + \mathrm{AL} + \mathrm{OT})/\mathrm{AB}]$$
$$\mathrm{CI} = \log[\mathrm{HC}/(\mathrm{SC} + \mathrm{DC} + \mathrm{DCA} + \mathrm{AL} + \mathrm{OT})]$$
$$\mathrm{SI}\ \text{(by algae)} = \log[\mathrm{AL} + \mathrm{DCA}/(\mathrm{SC} + \mathrm{DC} + \mathrm{OT})]$$

Where HC = Hard Coral Cover
SC = Soft Coral Cover
DC = Dead Coral Cover
DCA = Dead Coral with Algae Cover
AL = Algal Cover
OT = Other Animals
AB = Abiotic Component Cover

The development, condition and succession indices were categorized into the scale shown in **Table 45**. (Manthachitra, 1994).

Table 45 Scale used to determine categories of the different index scores from the survey

Scale	Category	Index Score
1	VERY POOR	< -0.602
2	POOR	-0.602 to -0.176
3	FAIR	-0.175 to 0.176
4	GOOD	0.176 to 0.602
5	VERY GOOD	> 0.602

The condition index describes the proportion of living hard coral to the rest of the living and dead organisms (all benthos except abiotic components). It assumes that a coral-dominated community is ideal regardless if the benthic community covers much or less of the reef bottom. It discounts abiotic cover in the equation since not all abiotic substrates are viable for settlement of organisms. What the index is concerned about is how much of the present community is live hard coral.

The development index describes to which degree the coral reef community has developed. A high score in this index means that the reef is highly developed, that there are only few open areas not colonized by corals, algae or other organisms. A low score in this index means that there are lots of open spaces yet to be colonized, maybe because of a lack of sources for recruitment or that the conditions are not suitable for settlement and growth of benthic organisms.

The succession index describes the likelihood that another organism (in this case, algae) will succeed hard corals in dominance. A high succession index score indicates that algae is dominant among other organisms other than hard coral and is likely to be dominant when corals die.

Figure 72 shows a diver doing line intercept survey technique (coral assessment).

Figure 72. A Diver doing Line Intercept Survey Technique (coral assessment)

3.2.3.3 Fish Visual Census Technique

Fish Visual Census (FVC) technique (English et al. 1997) was used to determine the species diversity, abundance and biomass in the area surveyed. To complement the benthic survey, FVC was conducted on the same transect lines surveyed for benthic community as shown in **Figure 73**. In the survey protocol, observers waited for about 5-10 minutes after the line has been laid, before the actual census was performed to allow for the disturbed fish community to return to their normal activity. 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 recorded their numbers and sizes. 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 of all fishes encountered within transect belt were estimated to the nearest centimeter using the total length (TL). 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; a 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). All fishes were group into Target, Coral indicator and Major species. Target is the commercially-important species, coral indicator is the coral-associated, and major species is those that belong to non-commercially important species.

Data analysis

Stations were also categorized according to species richness (**Table 46**) as adapted from Hilomen et al., 2000, abundance (**Table 47**) adapted from Hilomen et al., 2000, and biomass (**Table 48**) adapted from Nañola et al., 2006).

Table 46. Categories of Stations according to Species Richness

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 47. Categories of Stations according to Fish Abundance

Category	No. of individual per 1,000m^2
VERY POOR	0-201
POOR	202-676
MODERATE	677-2267
HIGH	2268-7582
VERY HIGH	>7592

Table 48. Categories of Stations according to Fish Biomass

Category	Biomass per km^2
VERY LOW	<5
LOW	6-10
MEDIUM	11-20
HIGH	21-40
VERY HIGH	>41

3.2.3.4 Seagrass and Seaweed Assessment

The method to assess seagrass and seaweed as described by Duarte and Kirkman (2001) and Short et al (2006) were used. A 100m transect was laid perpendicular to the shore and a 0.5m x 0.5m quadrat (0.25 m^2) placed every 10 m interval. At each quadrat or observation point, the following data were taken: type of substrate, seagrass species composition, seagrass canopy cover (percent total cover and per species) (estimated according to photo guides from SeagrassNet manual, Short et al., 2002) and shoot densities of each species; identification of seaweeds seen (genus level) and total percent cover of seaweeds in the quadrat was also done. Photos were taken and other observations were also noted (depth, invertebrates, etc.) at each site (Koch and Verduin 2001).

All data were transcribed and later encoded and added to the database. Summaries of seagrass cover, species composition and habitat features were extracted for each site and average of shoot density per species (shoots / m^2) were calculated (Duarte and Kirkman 2001).

Figure 73 shows a 0.5m x 0.5m stainless steel quadrat (0.25 m^2) placed every 10 m interval used in the seagrass/seaweed assessment.

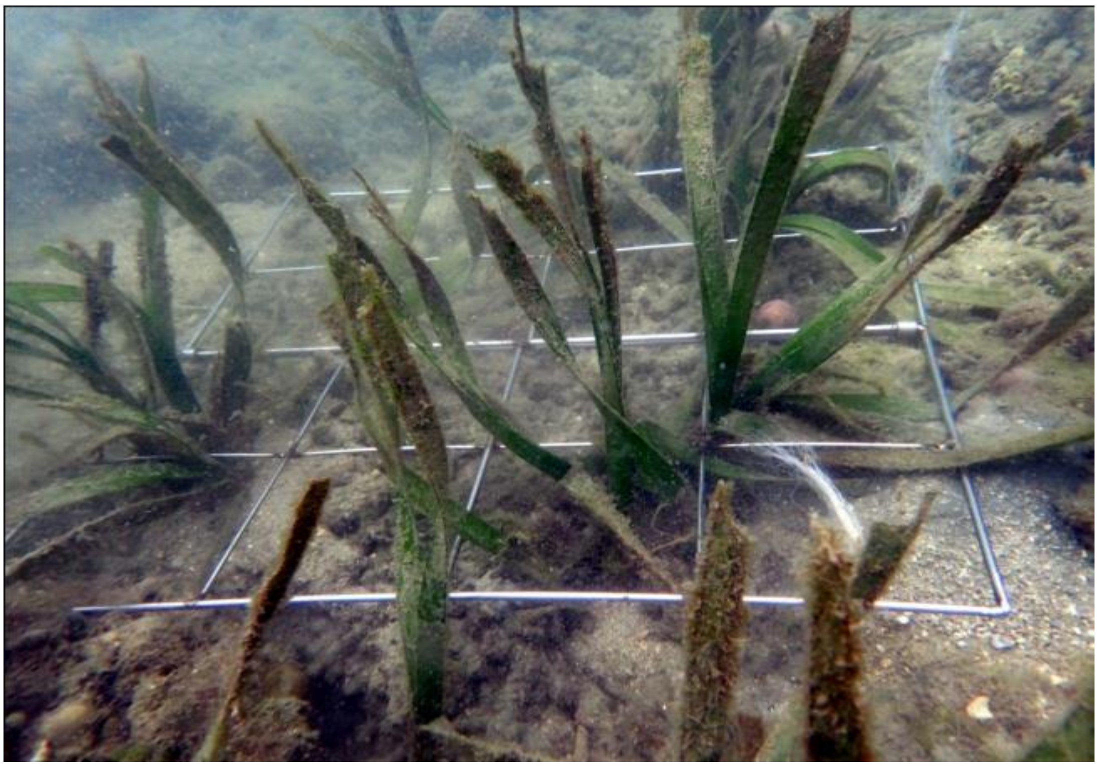


Figure 73. A 0.5m x 0.5m stainless steel quadrat (0.25 m^2) placed every 10 m interval used in the seagrass/seaweed assessment

3.2.3.5 Results and Discussion

The marine ecology assessment focused on 6 functional aquatic groups – phytoplankton, zooplankton benthic macrofauna, reef fishes, corals and seagrass/seaweeds present in the six different stations in the project site. Phytoplankton represents a diverse group of organisms that, as plants, capture the sun's energy, convert it into living tissue and thus support all life in water bodies. A wide variety of phytoplankton species exists, some living as single cells and some as colonies. A knowledge of the types of species occurring in the given water body is important to an understanding of how these organisms are utilized in the system. Certain species, for instance, can be easily consumed by zooplankton grazers to support higher life forms. Other species, indicative of eutrophic conditions, are resistant to normal phytoplankton predators and may therefore be more prone to enter the decomposition pathways which contribute to low dissolved oxygen problems.

Zooplankton are initially the sole prey item for almost all fish larvae as they use up their yolk sacs and switch to external feeding for nutrition. Fish species rely on the density and distribution of zooplankton to coincide with first-feeding larvae for good survival of larvae, which can otherwise starve. Natural factors (e.g. variations in currents) and man-made factors (e.g. dams on rivers) can strongly affect zooplankton density and distribution, which can in turn strongly affect the larval survival, and therefore breeding success and stock strength, of fish species.

Because of plankton's fundamental importance to the eutrophication process, limitation of their growth, or production, is often one of the direct targets of management actions. These actions are typically directed at reducing nutrient inputs as a means of limiting plankton growth. The limitation of plankton growth is in turn expected to improve some of the impacts that result from excessive growth. Thus, an assessment of water quality to guide and evaluate management actions logically includes the measurement of plankton communities and their growth rates.

Benthos includes familiar organisms such as clams and crabs, as well as less familiar forms, including unsegmented worms, small crustaceans, and snails. A large portion of the living and dead organic material in the water, including the plankton and plant material washed in from the microwatersheds, settles to the sediment surface and decays. The variety and abundance of organisms composing the benthic communities are likely to respond to improvement in water and sediment quality resulting from pollution. Because many benthic organisms live for 1-2 years, changes in their populations are an integration of changes in environmental conditions occurring over their life span. In addition, because benthic organisms are relatively immobile, they complete their life cycle within the given water body and often within specific regions. Thus, benthic responses to changes in water quality resulting from given activities are likely to be area specific and thus more easily interpreted. Finally, as important intermediate links in the food web, benthic responses to different activities are likely to be representative of the responses of other living resources. The benthos are, therefore, potentially good indicators of the effectiveness of pollution and cleanup efforts.

3.2.3.5.1 Phytoplankton Communities

Phytoplankton plays an important role in the primary productivity of rivers and reservoirs and certain assemblages of these organisms are also considered as good indicators of different environment conditions (e.g. hydrodynamics and trophic state) (Padisak et al., 1999). The structure of algae communities, determined by indicators such as specific composition, cellular density, species richness and uniformity, can be used to evaluate the aquatic system quality, and the specific diversity measurements could constitute an appropriate index to compare environment conditions (Rosa et al., 1988).

A total of 22 phytoplankton species belonging to diatoms (9 genera) and dinoflagellates (13 genera) was recorded during the sampling conducted in the proposed road expansion project in Matanog, Maguindanao and Kapatagan, Lanao del Sur last November 16, 2017 (**Table 49**). Diatoms dominated the phytoplankton community constituting 53% of the total count while dinoflagellates accounted for 47% (**Figure 74**). Among the diatoms, the centric diatom, Coscinodiscus spp. accounted for 21 % making it the most abundant species recorded. This species is commonly found in warm tropical marine environment and play major role in the overall primary productive of the marine environment in the area. Dinoflagellates were observed in all stations and were dominated by Protoperidinium spp. with 14%.

The potentially harmful phytoplankton species observed was Pseudonizschia spp. and Dinophysis caudata. Some species of Pseudinitzschia are known to produce domoic acid, a toxin associated with Amnesic Shellfish Poisoning (ASP). For this survey however, species identification of this genus was not feasible as it requires more powerful microscope like Transmission Electron Microscope (TEM) but for monitoring purposes, the genus Pseuodonitzschia is always considered potentially harmful. Dinophysis caudata on the other hand species is known to produce okadaic acid, a toxin associated with Diarhhetic Shellfish Poisoning (ASP). For this survey however, cell density of this species is very low and since there is no extensive shellfish farming in the area, the possibility of negative impact is very minimal and could be ruled out. In addition, there is no confirmed incidence of ASP and DSP reported in the Philippines but it is still highly recommended to continue monitoring after the project to prevent negative public health impact brought about by possible blooms of these species.

Table 49. Phytoplankton composition and abundance (cells/L) in four stations sampled

TAXA	STATION				Grand	Rel.
	Ph1	Ph2	Ph3	Ph4	Total	Abund.
Diatoms	**65**	**306**	**94**	**104**	**568**	**53.01**
Bacteriastrum	5	5			10	0.89
Chaetoceros	20	99	6	32	156	14.56
Coscinodiscus	40	149	22	9	220	20.49
Cylindrotheca		32	28	41	100	9.29
Navicula		18		18	36	3.36
Pinnularia			6		6	0.51
Pleurosigma		5	17	5	26	2.38
Pseudonitzschia			11		11	1.03
Suriella			6		6	0.51
Dinoflagellates	**45**	**252**	**121**	**86**	**504**	**46.99**
Ceratium	10	81	39	5	134	12.51
Ceratocorys		9	11		20	1.87
Dinophysis		9			9	0.84
Diplopsalis	5	23	33	18	79	7.33
Goniodoma	5	32			37	3.41
Gonyaulax	10	14			24	2.19
Gyrodinium		5			5	0.42
Lingulodinium		5			5	0.42
Ornithocercos		14	11		25	2.29
Phalacroma				5	5	0.42
Prorocentrum	5	5			10	0.89
Protoperidinium	10	54	28	59	150	14.00
Pyrophacus		5			5	0.42
Grand Total	**110**	**558**	**215**	**189**	**1,072**	**100**
Richness	**9**	**18**	**12**	**9**		
Evenness	**0.86**	**0.79**	**0.92**	**0.84**		
Diversity	**1.89**	**2.28**	**2.29**	**1.85**		

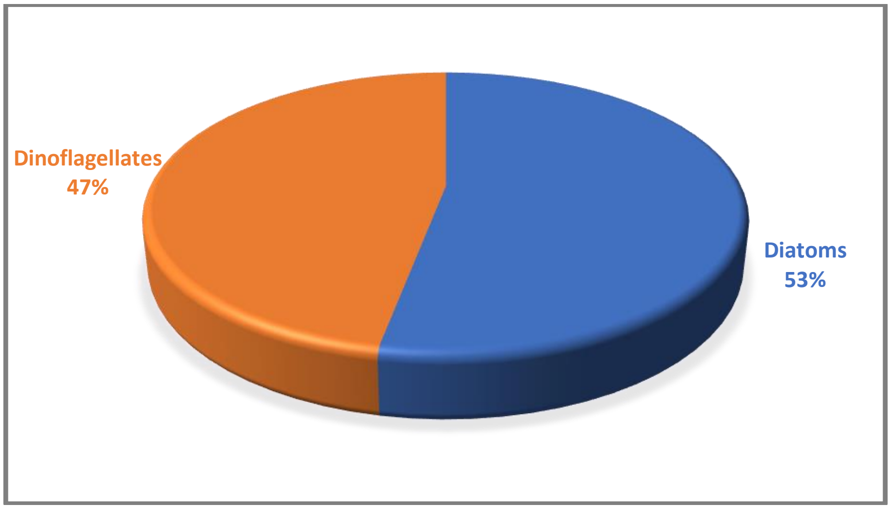


Figure 74. Percentage composition of major phytoplankton groups

Photomicrographs of dominant and common phytoplankton are shown in **Figure 75**.

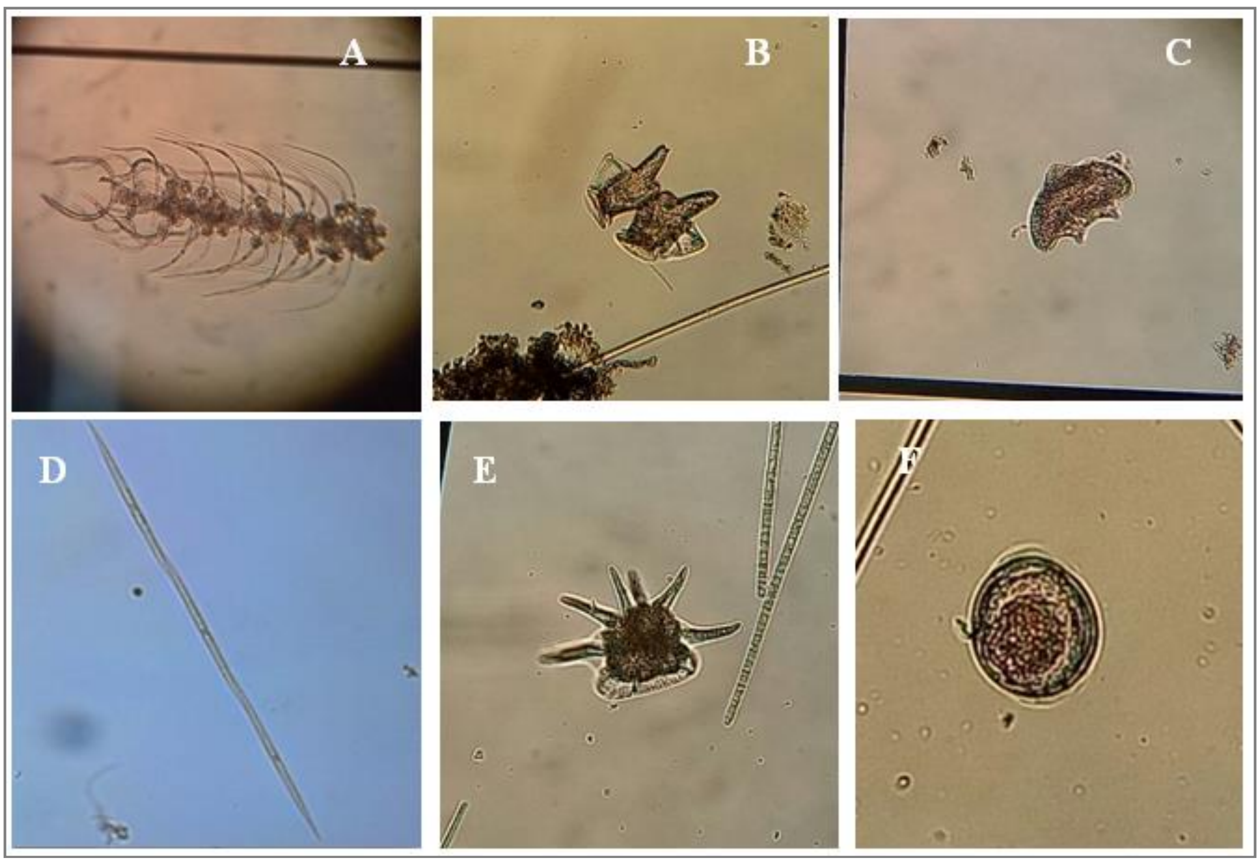


Figure 75. Photomicrographs of common and important phytoplankton observed (A)Chaetoceros (B) Dinophysis caudate (C) Protoperidinium (D) Pseudonitzschia (E) Ceratocorys (F) Diplopsalis

Generally, the mean cell density of all the phytoplankton in four stations was 268 cells/L. In terms of spatial distribution, station Ph2, a station located in Brgy. Kidama , had the most number of phytoplankton genera observed with 18 and had recorded the highest total phytoplankton abundance with 558 cells/L. Station Ph1 located in Brgy. Sapad, Matanog had the lowest total density and number of taxa with 110 cells/L and 9 recorded genera respectively (**Figure 76**). The highest calculated diversity index based on Shannon-Weiner is observed in station Ph2 located in Brgy. Tubuan with 2.28 while the lowest was observed in stations Ph4 with only 1.85 (**Table 50**). Species evenness was not so variable among the four station with values ranging from 0.79 to 0.92.

The overall impression of the phytoplankton community during this survey is poor as indicated low phytoplankton abundance, richness and overall diversity. The presence of potentially harmful species should have a good monitoring system after the project has been successfully established.

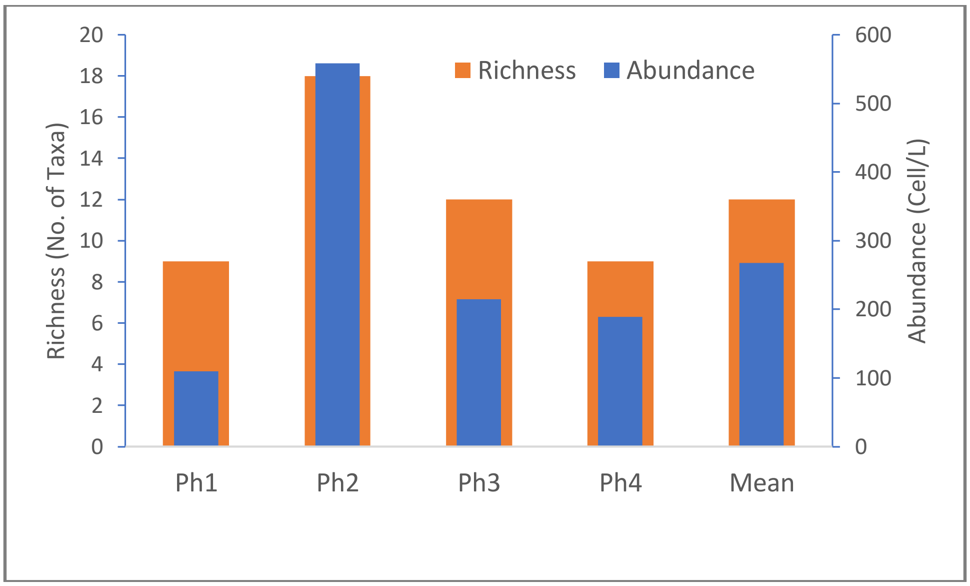


Figure 76. **Total phytoplankton density and species richness in four stations sampled**

3.2.3.5.2 Zooplankton Communities

A total of 15 zooplankton groups (adult and larval forms) were identified in four stations in the vicinities of proposed road expansion project in Matanog, Maguindanao and Kapatagan, Lanao del Sur during the November 16, 2017 survey (**Table 50**). Overall, copepod which constituted for 89% of the total zooplankton count was the most dominant zooplankton group (**Figure 77**). Zooplankton observed consisted of larval forms which constituted 71% and adult forms with 49% of the total zooplankton abundance. Larval zooplankton life forms had 9 groups recorded during this survey. The large portion of the larval zooplankton was represented by copepod nauplii with 42% and total density of 185,086 ind/m^3. For the adult zooplankton forms, calanoid copepod was the most abundant accounting for 36% at total abundance of 156,318 ind/m^3. Other important group like gastropod veliger and bivalve veliger only contributed less than 1% of the total zooplankton count with 0.94% and 0.32% respectively. Fish larvae was not observed in any samples during this survey. There were no rare or endemic zooplankton species found in the area and majority of the groups are common and cosmopolitan in distribution.

Table 50. Zooplankton composition and abundance (Ind/m^3) in six stations sampled

TAXA	STATIONS						Grand	Rel.
	ZP1	ZP2	ZP3	ZP4	ZP5	ZP6	Total	Abund.
Adult form	18,917	49,043	5,053	37,658	43,351	38,349	192,370	28.68
Cladoceran				876		1,112	1,987	0.30
Copepod calanoid	6,831	14,147	1,011	16,640	27,587	18,341	84,556	12.60
Copepod cyclopoid	8,407	16,033	2,526	8,758	11,823	9,448	56,996	8.50
Copepod harpacticoid	525	1,886	505	2,627		1,112	6,656	0.99
Larvacean	1,051	7,545		876		5,002	14,474	2.16
Radiolarian	2,102	9,431	1,011	7,882	3,941	3,335	27,701	4.13
Larval form	28,375	173,537	8,084	109,471	119,543	39,460	478,471	71.32
Balanus nauplius		943	505	2,627	2,627	1,112	7,815	1.16
Barnacle cyprid		943		876	6,568	2,223	10,610	1.58
Bivalve veliger	1,051	2,829			1,314		5,194	0.77
Copepod eggs	525	943	505	1,752			3,725	0.56
Copepod nauplius	24,171	165,992	7,074	103,341	102,465	34,458	437,502	65.22
Polychetae tropocore	1,576	943		876	1,314	556	5,265	0.78
Snail veliger	1,051	943			5,255	1,112	8,360	1.25
Grand Total	47,292	222,581	13,137	147,130	162,893	77,809	670,841	100
Richness	10	12	7	11	9	11		
Evenness	0.67	0.42	0.73	0.47	0.57	0.69		
Diversity	1.54	1.04	1.42	1.14	1.26	1.65		

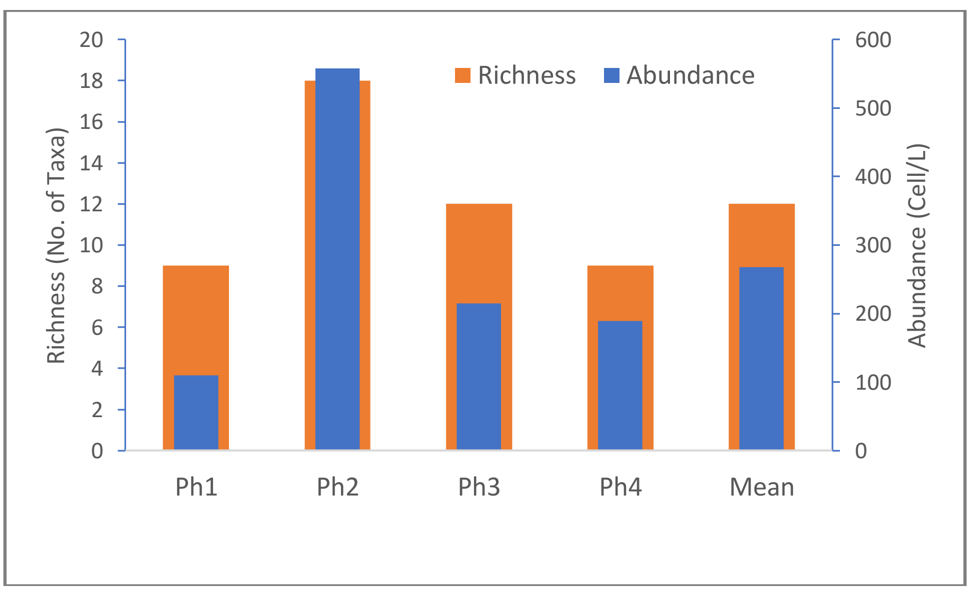


Figure 77. Percentage composition of major zooplankton groups

Photomicrograph of common zooplankton groups is shown **Figure 69.**

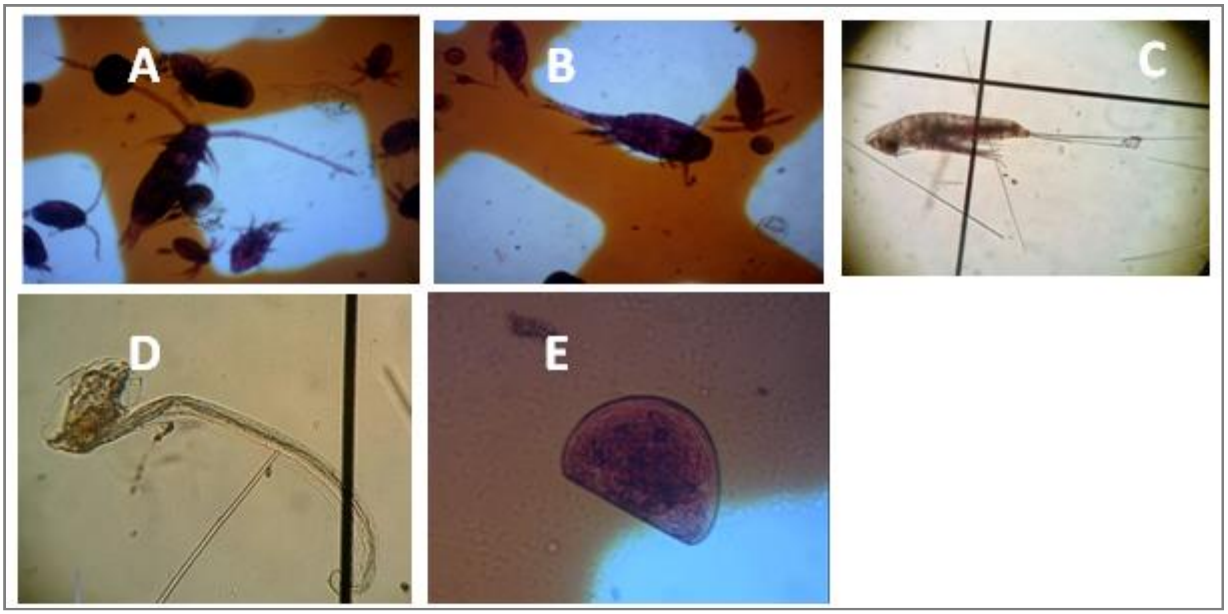


Figure 78. **Photomicrographs of common zooplankton group during the sampling period (A) Calanoid copepod (B) Cyclopoid copepod (C) Harpacticoid copepod (D)Larvacean (E) Bivalve velige**

The mean estimate of abundance was 109,873 individuals/m^3 for all sampling stations recorded during this survey (**Figure 79**). Spatially, station ZP3 located in Brgy. Lusain, Kapatagan Lanao del Sur had the most number of zooplankton group observed with 13. In terms of total density however, station ZP2 had the highest recorded density with 185,798 ind/m$^{\mathbf{3}}$. The most depauperate station was recorded in station ZP1 located in Brgy Sapad, Matanog Maguindanao with 7 while in terms of abundance, station ZP3 located in Brgy. Lusain, Kapatagan Lanao del Sur had the lowest with 71,602 ind/m$^{\mathbf{3}}$. All diversity measurements were low (<2) with the highest value observed in station ZP2 with 1.48 while the lowest in station ZP2 with 1.08. The computed index of evenness among the six stations were generally low with computed values ranging from 0.51 to 0.64 which indicates a high abundance of a particular group (i.e Copepods) . These indices indicate that zooplankton communities in the area were low and indicative a possible disturbance (anthropogenic or natural) during this sampling period.

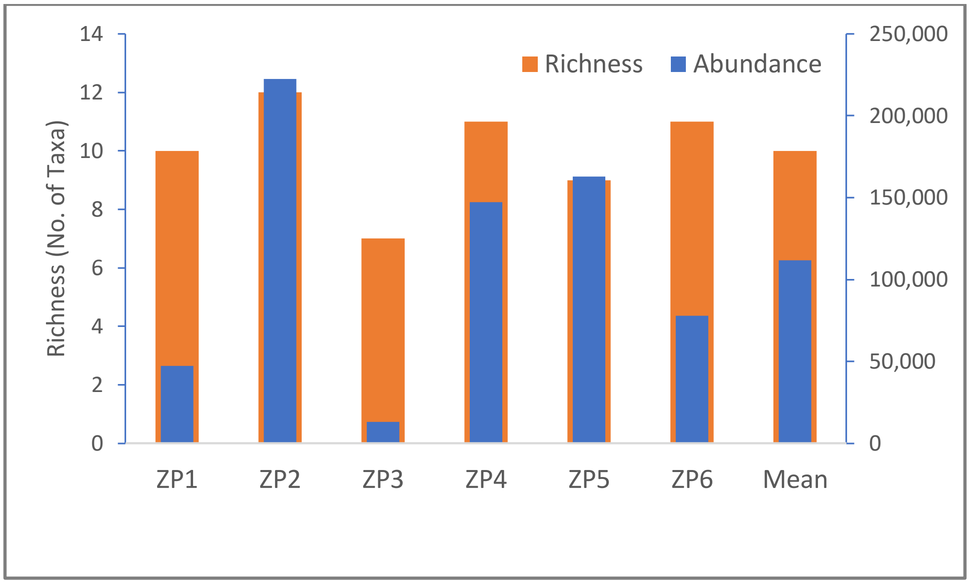


Figure 79. Total zooplankton density and taxa richness in six stations sampled

Threat to Plankton Community

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. A laboratory experiment conducted over a two week with different zooplankton showed that mortality was high at levels over 10,000 mg/L of Total Suspended Solids (TSS) but generally studies have not shown any significant impact at the levels experienced from activities such as dredging and related activities (Clarke & Wilbur 2000). In addition, many larval stages are only in the plankton for short periods and other groups have short life cycles which mean recovery can be relatively quick (less than a year) depending on the time of year and source of larvae (James et al 2015). Given, the temporary and limited extent of the effect of highly turbid waters relative to the overall area the impact on plankton community are predicted to be low in long term. Mitigating measures however needs to address for the short-term negative impacts of high turbid waters during the construction.

3.2.3.5.3 Benthic Macroinvertebrates (Soft Bottom Community)

A survey was conducted in Matanog, Maguindanao and Kapatagan, Lanao del Sur last November 16, 2017 to determine the composition, abundance and diversity of macrobenthos community as part of the assessment for the Parang Balabagan road expansion project. A total 2,818 individuals belonging to 27 groups/families were recorded in four stations. The families identified are classified to seven major phyla i.e Annelida, Arthropoda, Nematoda, Retaria, Echinodermata, Mollusca and Sipunculida, in decreasing level of abundance as shown in **Figure 80**. Among the them, the phylum Annelida accounted for 43% of the total macrobenthos abundance, followed by Arthropoda with 18%, Retaria with 16% and Nematoda with 16%. The polychaetes are the most family rich group with 13 and also among the most commonly occurring phylum. Among the polychaetes, the family Spionidae constituted 13% of the total macrobenthos making it most abundant annelid (**Table 51**).

Polychaetes play a major role in the functioning of benthic communities, in terms of recycling and reworking of benthic sediments, bioturbating sediments and in the burial of organic matter. Although Polychaete were the most dominant phyla, the arthropod belonging to class Malacostraca was the most abundant macrobenthos group recorded which accounted for 11% of the total count. The list of the identified families/orders of the macro benthos community is summarized in **Table 52**.

Table 51. List of macrobenthos taxa identified in six stations in the Vicinities of Proposed Project in the Project Area and their Taxonomic Classification

Phylum	Subphylum	Class	Order	Family	Remarks	References
Annelida	Polychaeta	Unknown	Unknown	Amphinomidae		
				Arabellidae		
				Capitellidae		
				Eunicida`e		
				Glyceridae		
				Goniadidae		
				Magelonidae	Organic rich sediments	Bridges et al. 1994, Giangrande et al 2005, Dean et al 2008,
				Maldanidae		
				Nereidae		
				Pisionidae		
				Spionidae		
				Sternaspidae		
				Syllidae		
Arthropoda	Crustacea	Decapoda	Anomura	Paguridae		
			Nantia	Penaeidae		
		Malacostraca	Cumacea	Unknown		
			Isopoda	Unknown		
			Myodocopa	Unknown		
			Mysidea	Unknown		
			Amphipoda	Gammaridea	Pollution Sensitive	Carretero et al 2011
Echinodermata	Unknown	Unknown	Echinoidea	Unknown		
Mollusca	Unknown	Gastropoda	Unknown	Turridae		
Nematoda	Unknown	Unknown	Unknown	Unknown	Organic Rich Sediments	Ferris and Bongers 2006
Retaria	Foraminifera	Unknown	Unknown	Miliodae		
				Peneroplidae		
				Amphisteginidae		
Sipunculida	Unknown	Unknown	Unknown	Unknown		

Table 52. Macrobenthos Composition Abundance and Diversity

TAXA	Sapad S1	Kidama S2	Lusain S3	Bakikis S4	Grand Total	Rel. Abund.
Annelida	91	364	409	364	1,227	43.54
Polychaeta	91	364	409	364	1,227	43.54
Amphinomidae		45			45	1.60
Arabellidae			45		45	1.60
Capitellidae				45	45	1.60
Eunicidae		45			45	1.60
Glyceridae		45	91		136	4.83
Goniadidae			91		91	3.23
Magelonidae		45			45	1.60
Maldanidae				45	45	1.60
Nereidae				45	45	1.60
Pisionidae				182	182	6.46
Spionidae	45	91	182	45	364	12.92
Sternaspidae	45				45	1.60
Syllidae		91			91	3.23
Arthropoda	45	227	136	91	500	17.74
Crustacea	45	227	136	91	500	17.74
Decapoda		45	45		91	3.23
Anomura		45			45	1.60
Paguridae		45			45	1.60
Nantia			45		45	1.60
Penaeidae			45		45	1.60
Malacostraca	45	182	91	91	409	14.51
Amphipoda		91	45	45	182	6.46
Gammaridea		91	45	45	182	6.46
Cumacea		45			45	1.60
Isopoda		45		45	91	3.23
Myodocopa	45				45	1.60
Mysidea			45		45	1.60
Echinodermata		45		45	91	3.23
Echinoidea		45		45	91	3.23
Mollusca			45		45	1.60
Gastropoda			45		45	1.60
Turridae			45		45	1.60
Nematoda	136	182		136	455	16.15

Retaria	182	136	136		455	16.15
Foraminifera	182	136			318	11.28
Miliodae	182	91	45		273	9.69
Peneroplidae		45	45		45	1.60
Amphisteginidae			45		45	1.60
Sipunculida			45		45	1.60
Grand Total	**455**	**955**	**773**	**636**	**2,818**	**100**
Richness	**5**	**14**	**12**	**9**		
Evenness	**0.88**	**0.95**	**0.94**	**0.91**		
Diversity	**1.42**	**2.52**	**2.34**	**2.01**		

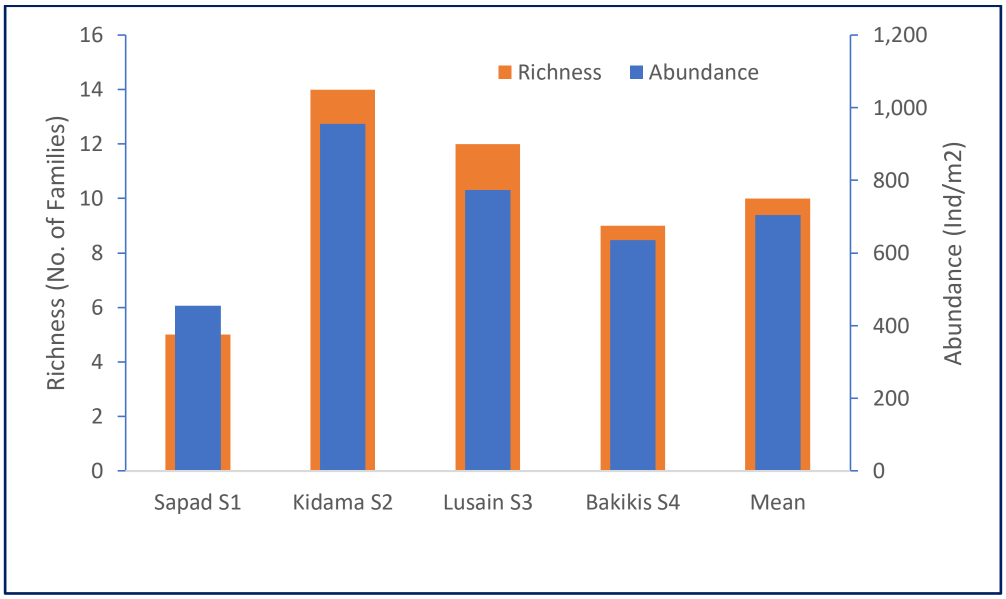


Figure 80. Percentage Composition of Major Macrobenthos Phyla

Taxa richness is the total number of distinct taxa in a sample. Generally, taxa richness and abundance had similar trend in six stations. It reflects the health of the community through measurement of the variety of taxa present which generally increases with increasing water quality (Plafkin et al., 1989). Station where high number of macrobenthos were recorded had also the highest overall abundance and vice versa. Spatially, the highest macrobenthos abundance and richness was recorded in station B4, a station located in Brgy. Kimini, with 3,045 individual/ m^2 and 20 families (**Figure 81**). This is primarily attributed to high number of nematodes (1,364 ind/m^2) and polychaetes (1,136 ind/m^2). This indicates that the sediment in this has high amount of organic materials. The lowest microbenthos count and taxa richness was observed in Station B2, a station in the river mouth located Brgy. Tubuan . It is important to note that the high number of amphipod belonging to family Gammaridae was recorded in station B6 in Brgy. Sedem. Amphipod is generally a pollution sensitive taxa and its occurrence at high counts in this area indicates a relatively good water quality. They are very sensitive to adverse environmental changes than some species of benthos groups such as polychaetes and mollusks (Reish and Barnard, 1979).

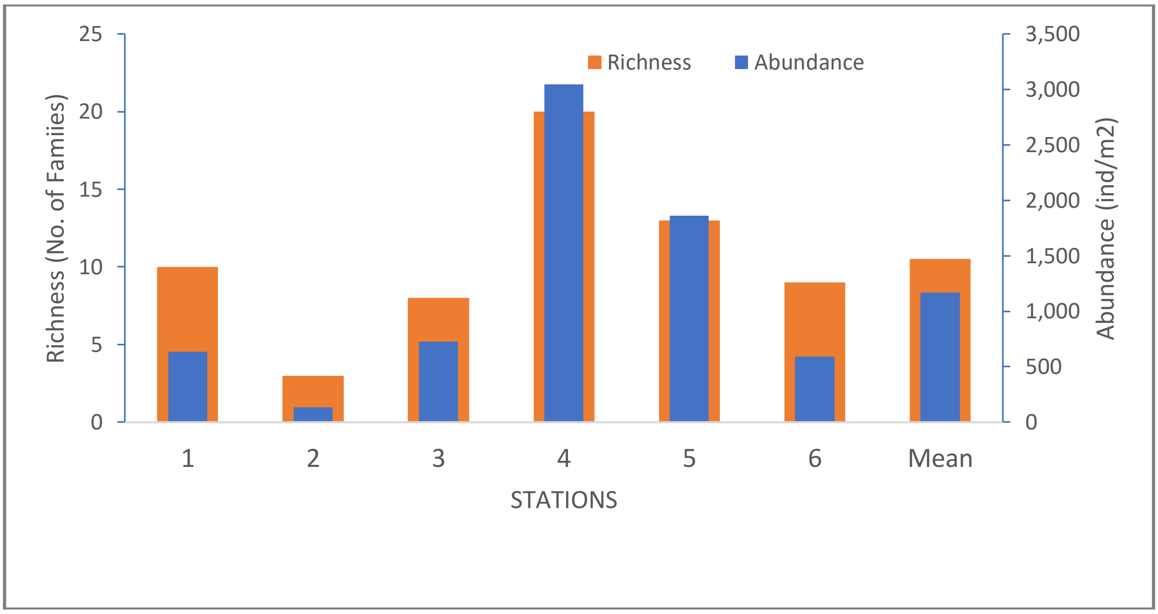


Figure 81. Species Richness and total abundance and species richness in 7 stations

Generally, the computed diversity index based on Shannon-Weiner was moderately good with the highest value recorded in station B2 with 2.52. Station B1, on the other hand recorded the lowest diversity with 1.42. This index had similar trend observed in terms of abundance and richness as discussed previously. Index of evenness is generally high for all stations ranging from 0.88 to 0.94 indicating a well distributed macrobenthic community. Generally, diversity is expected to decrease with increasing disturbances (Plafkin et al, 1989). The resulting value is generally between 1.5 – 3.5 and exceeds 4.5 very rarely. The values above 3.0 indicate that the habitat structure is stable and balanced while values lower than 1.0 indicates pollution and degradation of habitat structure (Goncalves and Menezes, 2011). One possible reason for the low diversity, richness and abundance values in is an inherent local disturbance which may be natural or anthropogenic. Macrobenthic community however are known to be resilient and has the ability to migrate in less stressful area. Moreover, there was no major economically important macrobenthic taxa recorded in the survey that could be heavily affected.

3.2.3.6 Coral Assessment (Benthic Communities)

3.2.3.6.1 Brgy. Sapad, Matanog, Maguindanao (Station 1)

Coral distribution of Sapad reef is patchy, interspersing with areas covered with sand and silt over a shallow gradually sloping reef (2-8m depth). **Table 53** presents the average benthic cover and reef health status. Coral bommies provide topographical relief for the reef. Dominant corals are the sub-massive Euphyllia, Fungiids and some encrusting Porites. Hard live coral covers 39.6%, categorized as “fair condition” in with 37.4% non-Acropora genera and only 2.1% are Acropora. Dead coral cover is relatively high with 32.6%, while Abiotic component and Other Fauna covers 15.7% and 9.4%, respectively. Other Fauna such as sponges and sea anemones (9.4%) were also observed in the reef. Abiotic component covers 15.7% of benthic with evidently with prominent siltation due to exposed to river tributary nearby as shown in **Figure 82**. **Figure 83** shows the photos taken during the survey.

Table 53. Average benthic cover and reef health status

Benthic Life forms	Benthic										
Site	code	**Parang**-Balabagan Road				**Tapian**-Lebak Road					
Station		1	2	3	**Mean**	1	3	4	5	6	**Mean**
Coral status (Gomez et al. 1981)		**Fair**	**Fair**	**Fair**	**Fair**	**Good**	**Fair**	**Fair**	**Fair**	**Fair**	**Fair**
HARD CORAL	**HC**	**39.6**	**45.1**	**39.8**	**41.5**	**53.9**	**42.7**	**28.0**	**32.9**	**44.7**	**38.2**
ACROPORA	ACR	2.1	0.0	1.6	**1.2**	27.8	3.3	4.8	4.1	27.1	**8.53**
NON-*ACROPORA*	Non-ACR	37.4	45.1	38.2	**40.3**	26.1	39.4	23.3	28.8	17.6	**29.7**
SOFT CORAL	SC	0.6	0.4	1.0	**0.7**	0.8	0.0	0.4	1.6	0.0	**0.4**
DEAD CORAL W/ ALGAE	DCA	32.6	25.7	35.5	**31.2**	22.2	20.1	24.6	16.7	24.1	**21.1**
OTHER FAUNA	OT	9.4	22.9	7.5	**13.3**	11.4	7.5	18.3	7.8	3.3	**8.91**
ALGAE	AL	2.1	1.2	1.2	**1.5**	1.8	0.7	4.1	8.0	0.8	**2.87**
ABIOTIC COMPONENT	AB	15.7	4.7	15.1	**11.8**	10.0	28.9	24.6	32.9	27.1	**28.5**
GRAND TOTAL		**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

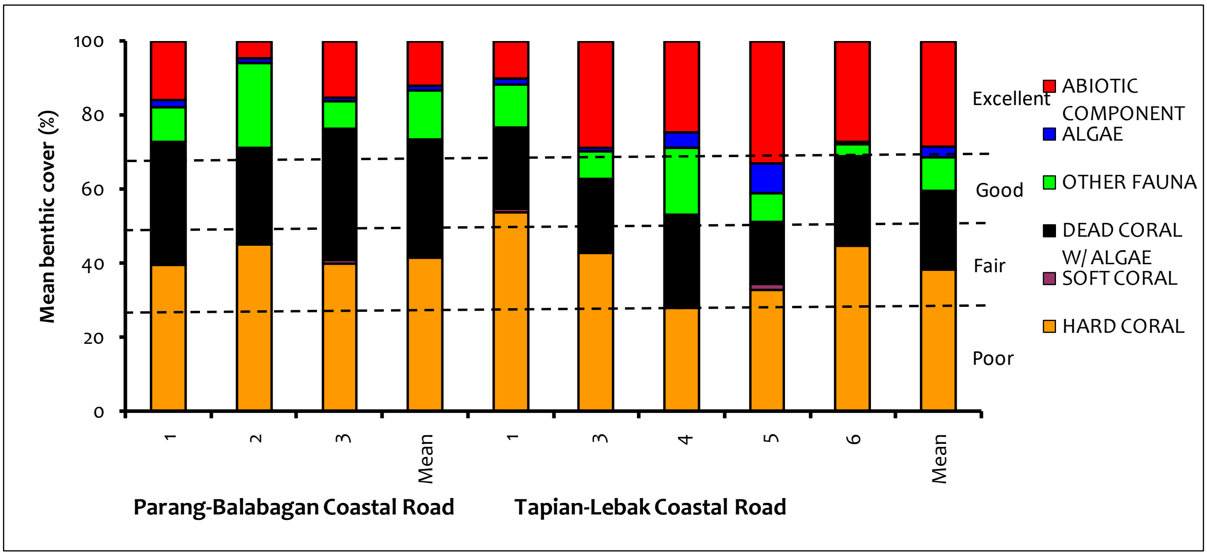
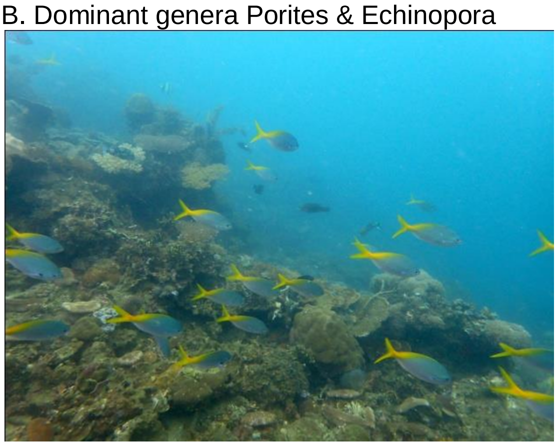


Figure 82. Average benthic cover and reef health status of coral reefs

A. Panoramic view of Sapad Reefs

B. Dominant genera Porites & Echinopora

C. Massive Diploastrea



D. Schooling Fusiliers (Caesio teres)

E. Dominant other fauna (Sponges)

Figure 83. Dominant coral and other fauna in Sapad Reef, Matanog, Maguindanao

3.2.3.6.2 Brgy. Kidama, Matanog, Maguindanao (Station 2)

The reef is not well developed extending a short strip from the coastline (<100m) fringing along Brgy. Kidama shoreline. The rich coral reef lies in shallow clear water extending in depths of 2 -8 meters. Slope is abrupt (80 to 90° declination) terminating into deep water. The reef is categorized as "fair" in condition. Live hard coral cover is 45.1% of the non-Acropora genera. Dead coral cover is moderately high with 25.7% of the surveyed area. Genus Tubipora (12.9%) and encrusting Porites (10.4%) species were observed to be common in the area. Dead coral cover is moderately high (25.7%). Other Fauna such as Sponges (19.8%), Algae (2.1%) and abiotic component (4.7%) comprised only small percentages compared to other benthic lifeforms. **Figure 84** shows the photos surveyed.

3.2.3.6.3 Brgy. Lusain, Kapatagan, Lanao del Sur (Station 3)

The survey area is part of the reef system fringing along the coastline of Brgy. Lusain in Kapatagan. The coral reef lies in depths ranging from 3-12 meters, sloping 80° downwards with 5-10m water visibility. The reef is in "fair" condition with relatively high live hard coral cover of 39.8%, with 1.6% Acropora and the dominant 38.2% non-Acropora. Among the non-Acropora genera, massive Porites dominated this station. Dead coral with algae is relatively high with 35.5% and less abiotic component (rock, sand and silt) with 15.1% cover. Other fauna and algal cover are only 7.5% and 1.2%, respectively. Among the live hard corals, non-Acropora genera dominated this station. Dominant lifeforms are Tubipora (12.9%), encrusting Porites (10.4%) and fungiids with 8.4%. **Figure 85** shows the photos surveyed in the area.

A. Panoramic view of Kidama Reefs

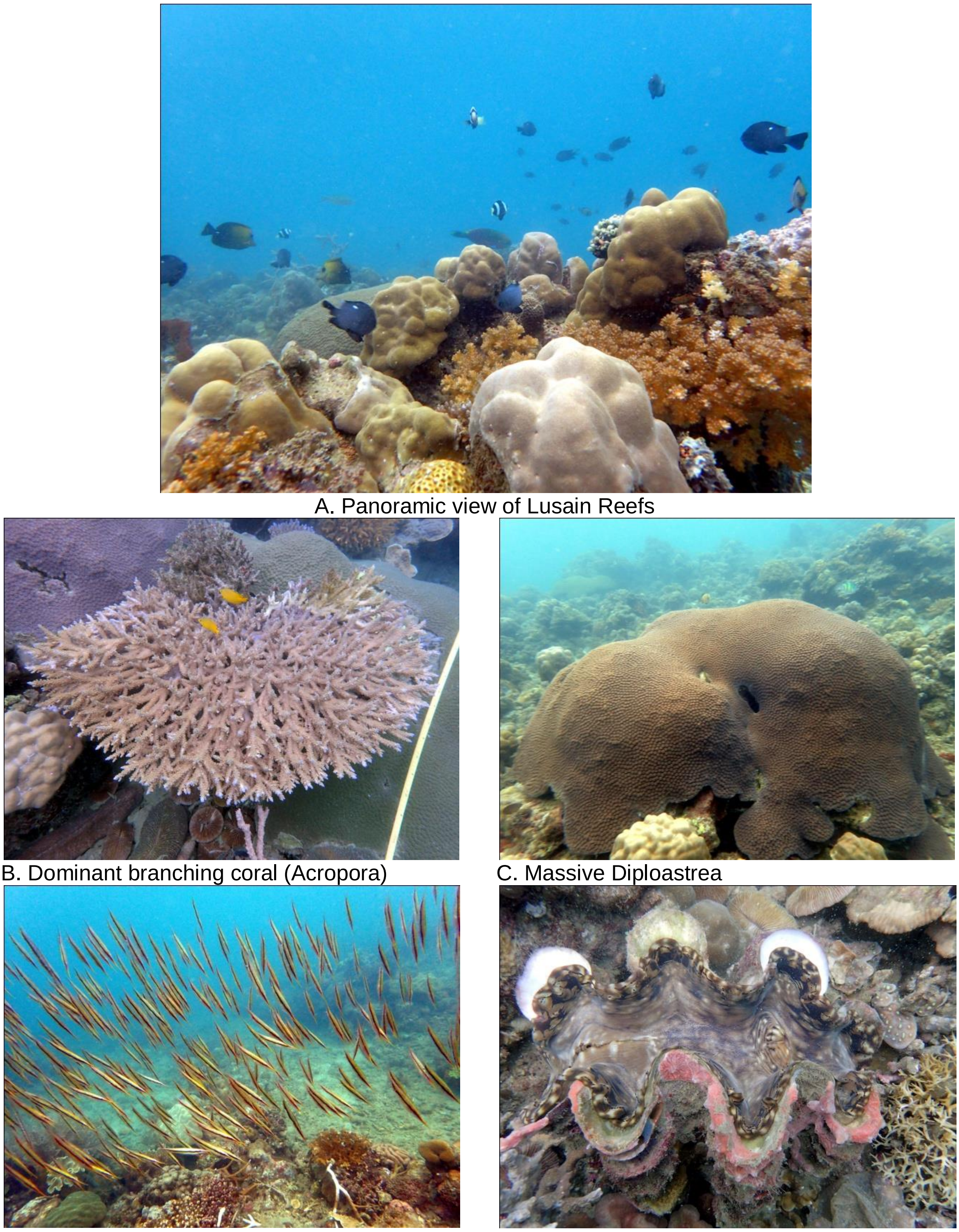
B. Dominant mushroom coral (Fungia)

C. Massive Porites

D. Schooling Fusiliers (Caesio teres) with Acanthurids & Scarids

E. Dominant other fauna (Sea whip)

Figure 84. Dominant coral and other fauna in Kidama Reef, Matanog, Maguindanao



A. Panoramic view of Lusain Reefs

B. Dominant branching coral (Acropora)

C. Massive Diploastrea

D. Schooling shrimpfish (Aeoliscus strigatus)

E. Common other fauna (Tridacna sp.)

Figure 85. Dominant coral and other fauna in Lusain Reef, Matanog, Maguindanao

3.2.3.6.4 Brgy. Bakikis, Kapatagan, Lanao del Sur (Station 4)

The coral reefs in the coast of Bakikis are not developed. It is characterized with black sandy substratum gradually sloping to deep water.

3.2.3.6.5 Overall observation

Generally, the coastline of Matanog-Kapatagan municipalities developed shallow fringing reefs that extend narrow strips along the shores. Most of the reefs sloped abruptly towards the deep water except the coral reef of Brgy. Sapad are gradually sloped down to silty bottom. The results showed that the coral reefs in these areas have a mean live hard coral cover of 41.5% and categorized to be in “fair” condition, which is high above the average live coral cover (32.3%) of the Philippines. The non-Acropora species dominated the reef areas, represented mostly of massive Porites. Some encrusting Porites and mushroom Fungia genera were also observed. On the average, dead coral with algae has 31.2% cover, while other fauna, abiotic component and algae have only 13.3%, 11.8% and 1.5%, respectively (**Tables 54 & 55**).

Table 54. The indices scores of reef health status of coral reefs

Station	1	2	3	Mean	1	3	4	5	6	Mean
MI	0.4513	0.3629	0.4714	0.4295	0.2912	0.3198	0.4669	0.33596838	0.35043	0.3557
DI	0.7285	1.3064	0.75	0.8715	0.9542	0.3905	0.4873	0.30871682	0.43066	0.39985
CI	-0.0527	-0.047	-0.0542	-0.051	0.1745	0.1786	-0.2279	-0.01523997	0.19957	0.06026
SI	-0.0888	-0.261	-0.0784	-0.1398	-0.157	-0.1239	-0.1783	-0.0234811	-0.0423	-0.1034

Table 55. The indices categories of reef health status of coral reefs

Station	1	2	3	Mean	1	3	4	5	6	Mean
DI	VG	VG	VG	VG	VG	G	G	G	G	G
CI	VP	VP	VP	VP	F	G	VP	VP	G	F
SI	VP	VP	VP	VP	VP	VP	VP	VP	VP	VP

* VP – Very Poor, P –Poor, F- Fair, G – Good, VG – Very Good. (Manthachitra,1994).

3.2.3.7 Marine Reef Fishes

3.2.3.7.1 Brgy. Sapad, Matanog, Maguindanao (Station 1)

A total of 144 individ./500m^2 were recorded from 36 species and 18 families along the four 50-m transect strips as shown in **Table 56.** Status of fish abundance is classified as poor category based on Hilomen et al., 2000. Dominant species are topped by schooling species such as Caesionidae/Fusiliers (i.e., Caesio teres) and Carangidae/Trevally (i.e., Selaroides leptolepis) and Scaridae/parrotfishes (i.e., Scarus rivulatus). Abundance is dominated by target species (commercially important species) of more than half (61%) of the total number observed while major species or the non-commercially valuable species are also high percentage (28%) and less of coral indicator species (11%). Fish biomass (30.9 mtons/km^2) is also dominated by target species and this value is categorized as "high" with regards to the national setting (Nanola et al., 2006). The biomass contributed mostly by the target species (83%), the rest are major species (11%) and coral indicator species (6%). The target species is belong to family Caesionidae (i.e., Caesio teres) and Carangidae (i.e., Selaroides leptolepis) and Scaridae (i.e., Scarus rivulatus) Juvenile recruits is almost zero (1 ind./100m^2) as shown in **Figure 86**.

Table 56. Species diversity, abundance and biomass of reef fish classified as target, coral indicator and major species in coral reefs

Site name	Parang-Balabagan Road				Tapian-Lebak Road					
Station	1	2	3	**Mean**	1	3	4	5	6	**Mean**
Species diversity (500m^2)										
Species richness	36	47	53	**45**	54	48	70	63	52	**57**
No. of families	18	19	21	**19**	21	14	17	18	15	**17**
Adult abundance (individ./500m^2)										
Target species	88	75	65	**76**	92	48	74	66	83	**73**
Coral indicator species	16	8	20	**15**	34	11	31	20	69	**33**
Major species	40	192	471	**234**	1113	387	1001	514	876	**778**
Total	144	275	556	**325**	1239	446	1106	600	1028	**884**
Juvenile abundance (individ./100m^2)										
Target species	0	0	0	**0**	0	2	2	0	0	**1**
Coral indicator species	0	0	2	**1**	0	2	1	0	3	**1**
Major species	1	6	3	**3**	162	24	230	37	108	**112**
Total	1	6	5	**4**	162	27	233	37	111	**114**
Adult biomass (mt/km^2)										
Target species	25.7	30.0	26.4	**27.3**	58.1	12.9	28.7	13.2	19.3	**26.4**
Coral indicator species	1.7	1.4	2.1	**1.7**	5.3	1.7	2.6	1.2	10.4	**4.3**
Major species	3.5	11.7	21.5	**12.2**	26.6	11.1	28.4	13.6	21.9	**20.3**
Total	30.9	43.0	50.0	**41.3**	90.0	25.7	59.7	28.0	51.6	**51.0**

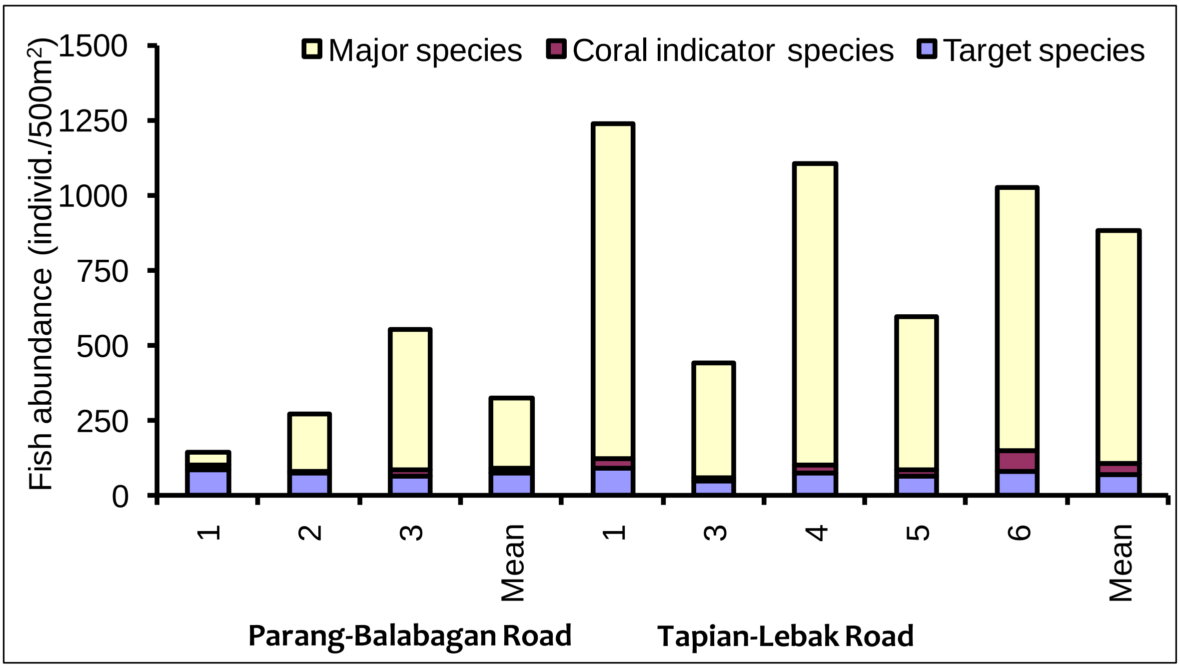


Figure 86. Fish abundance classified as target, coral indicator and major species in coral reefs

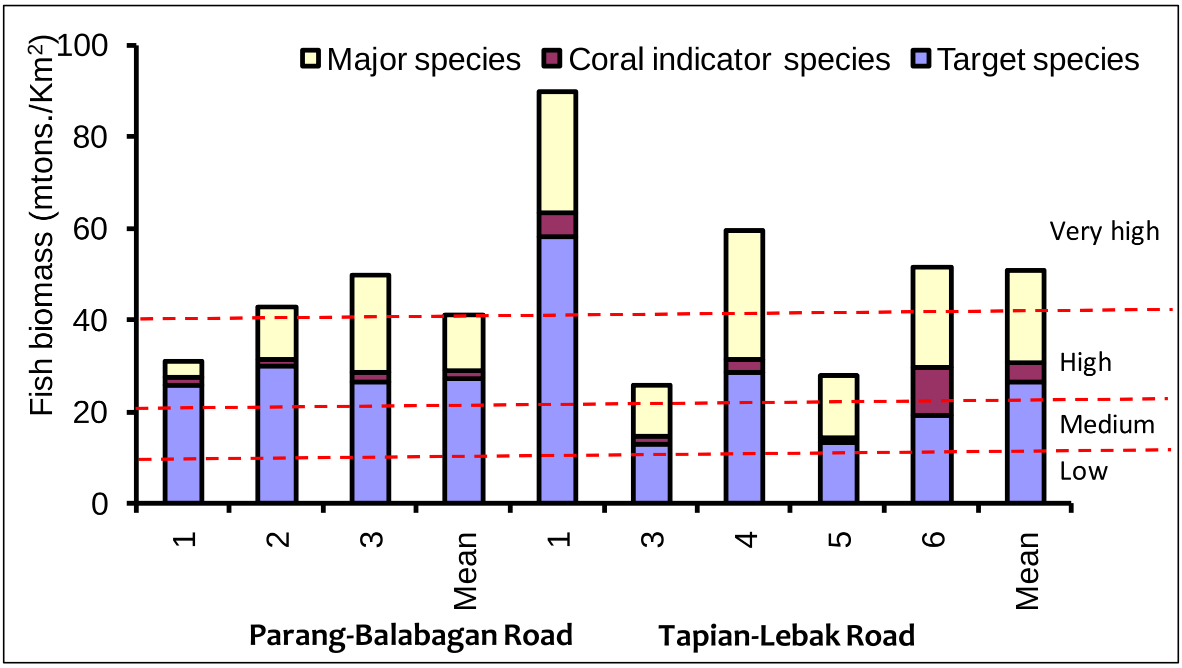


Figure 87. Fish biomass classified as target, coral indicator and major species in coral reefs

3.2.3.7.2 Brgy. Kidama, Matanog, Maguindanao (Station 2)

Based on the national standard, reef health status of Kidama reefs fish is categorized as poor in terms of species richness and abundance but high in terms of biomass. Fish abundance is mostly from family Caesionidae (i.e., Caesio teres) and Scaridae (i.e., Chlorurus sordidus & Scarus rivulatus), Labridae/Wrasse (i.e., Cirrhilabrus cyanopleura) and Pomacentridae/damselfish (i.e., Pomacentrus brachialis, P. reidi & Neoglyphidodon nigroris). Although only 27% of the average abundance (275 individ./500m2) are target species however, almost 2/3 (70%) of the biomass (43 mtons/km^2) are target species. This indicates that large sizes of target species were recorded in this reef. Large proportion of the biomass is mainly from families of Caesionidae (i.e., Caesio teres) and Scaridae (i.e., Chlorurus sordidus, Scarus qouyi & S. rivulatus), and Acanthuridae/Surgeonfish (i.e., Ctenochaetus striatus & C. binotatus). Juvenile fish recruits in this station are low and mostly contributed by family Labridae.

3.2.3.8 Seagrass/Seaweed Community Assessment

The seagrass ecosystem in along Parang-Balabagan and Tapian-Lebak coastal road is generally characterized by mono-specific Enhalus acoroides seagrass meadows with some patch of Thalassia hemprechii, Halodule sp. and Halophila ovalis. However, these long stretch coastal areas, we only found two stations with seagrass bed in cove areas between the coral reefs and mangroves strands. This may be because there are less available substrates for seagrass to grow. The reefs are narrow and rocky substrate which favourable for coral growth. Enhalus acoroides bed is usually observed in sheltered and permanently submerged in water. Other seagrass species such as Thalassia hemprechii and Halodule sp. were observed in transition between coral reefs and the E. acoroides seagrass bed. Among the seagrass species, E. acoroides had higher occurrence and cover as shown in **Table 57** and **Figure 88** and generally present in two stations. Thalassia hemprechii, on the other hand, is higher density among the seagrass species. Sedem seagrass beds in Datu Blah Sinsuat have higher seagrass species richness, density and cover as compared in Sapad seagrass bed in Matanog, Maguindanao.

A total of four (4) seagrass species as shown in **Figure 89** were recorded along Parang-Balabagan road.

Table 57. Average density (shoot/m^2) and cover of seagrass species

Station	Sedem	Sapad	Sedem	Sapad
	Density (shoot/m2)		Cover (%)	
Enhalus acoroides	28	10	3	1
Halodule sp.	17	0	0	0
Halophila ovalis	12	0	0	0
Thalassia hemprechii	76	21	1	0
Total	**133**	**24**	**4**	**2**
Total no.of species	4	2	4	2
Number of quadrat (n)	11	6	11	6

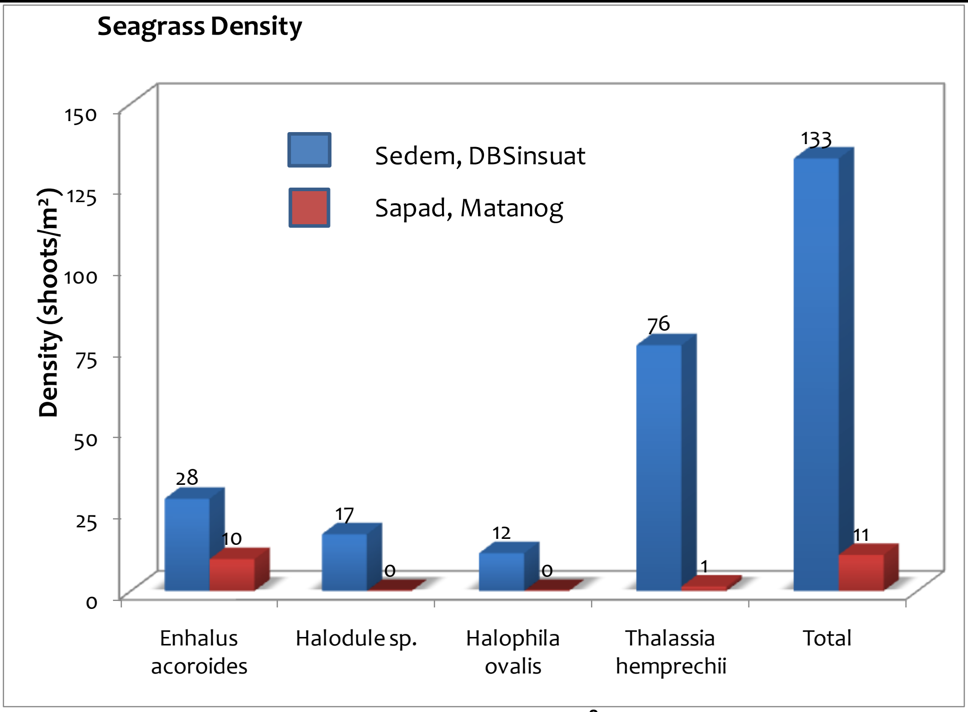


Figure 88. Average density (shoot/m^2) seagrass species

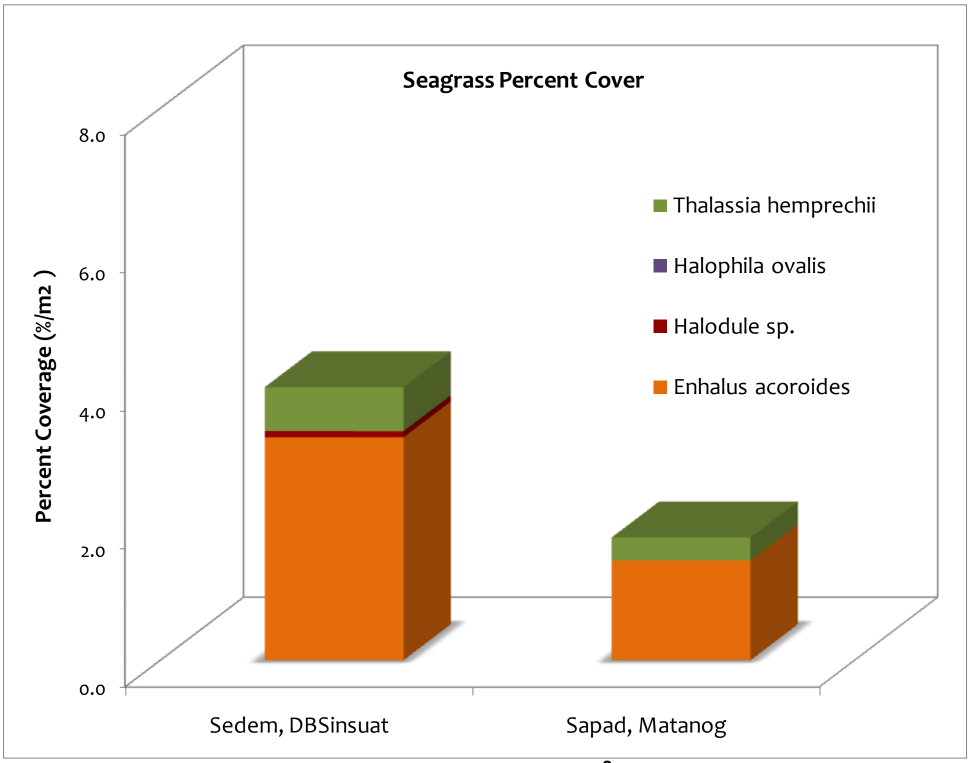


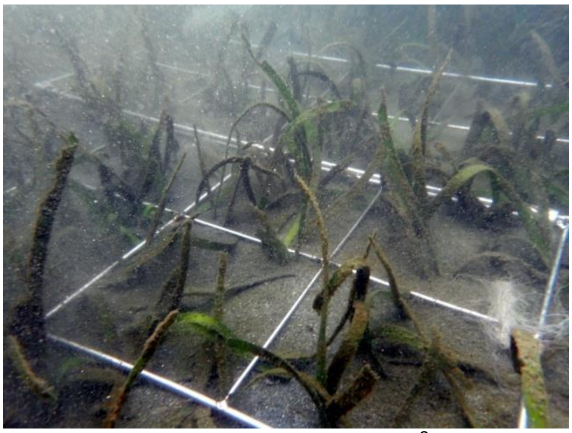
Figure 89. Average cover (%/m^2) seagrass species

Figure 90 shows the photos on seagrass assessment in Matanog, Maguindanao.


A. Top view of Enhalus acoroides bed

B. Enhalus. acoroides thalli

C. Patch of Thalassia hemprichii



D. Thalassia hemprichii within $0.5m^2$ quadrat

E. Other fauna (Sea urchin) associated in seagrass

Figure 90. Seagrass species and associated fauna in Sapad seagrass bed, Matanog, Maguindanao.

Overall impacts, management and mitigation plans are provided in Section 6.1.7.1, Impacts on Aquatic Ecology.

3.3 Baseline in Air

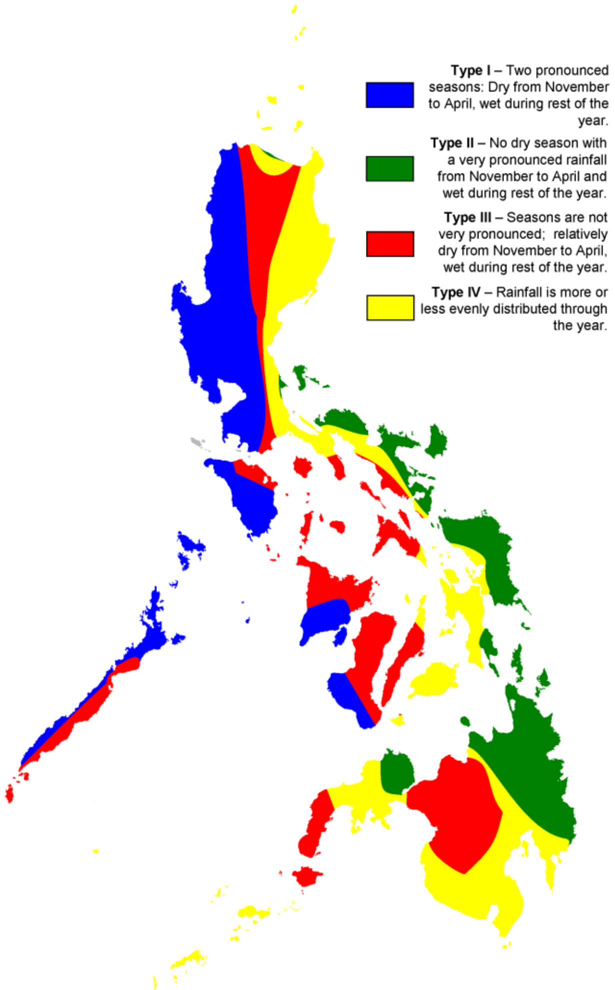
3.3.1 Meteorology

The nearest PAGASA synoptic station is in Cotabato City. Based on the data from this station the average annual rainfall from a 30-year record is 2487.8 millimeters. The rainiest months are from May to October.

The annual mean temperature is 27.8^{o}C with high temperature of 28.6^{o}C in April and low temperature of 27.3^{o}C in July. The lowest recorded temperature of 18.9^{o}C occurred on 26 January 2014 while the highest recorded temperature was 37.7^{o}C which occurred on 28 March 1997. The average wind speed is 2 meters per second distributed over the whole year at NNW direction.

Relative humidity averages from 73% to 76% and vapor pressure averages from 28.4 millibars to 29 millibars. Mean sea level atmospheric pressure varies from 1012.6 millibars to 1011.2 millibars, with higher value in February then lower in October.

The area belongs to Type III climate according to the Modified Coronas Classification as shown in **Figure 91** from which seasons are not very pronounced, relatively dry from November to April and wet during the rest of the year.



Source: PAGASA

Figure 91. Modified Coronas Classification

3.3.1.1 Natural Calamities

Per record from PAGASA, natural calamities that mostly affect the area are local flooding and landslide. There were also recorded incidents of big waves and strong winds in this coastal area. Landslides and flashfloods occur in some areas associated with heavy rainfall. There were also records of drought in 2010 and 2014 in the area.

For the past 47 years, there was only one recorded typhoon that passes over the region. This was Typhoon Titang which occurred from October 16 to October 24 in 1970 as shown in **Figure 92**.

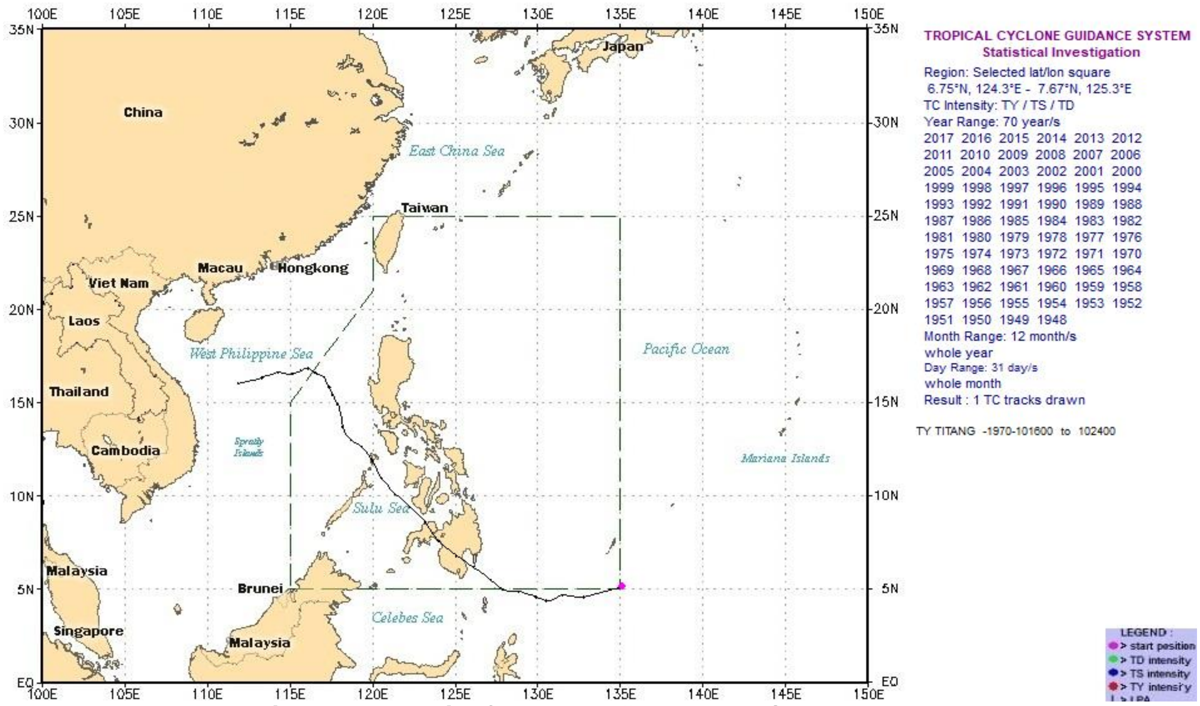


Figure 92. Track of Typhoon "Titang" in October 1970

3.3.2 Climate Change

In 2009, the Government of the Philippines initiated the implementation of the Millennium Development Goals Fund (MDGF) Joint Programme entitled "Strengthening the Philippines' Institutional Capacity to Adapt to Climate Change". It is a three-year program funded by the Government of Spain through the United Nations Development Program (UNDP) Philippines and the various UN agencies (UNEP, FAO, WHO, UN Habitat, and others). The three outcomes of this Joint Programme are:

- climate risk reduction mainstreamed into key national and selected local development plans and processes;
- enhanced national and local capacity to develop, manage and administer projects addressing climate change risks; and
- coping mechanisms improved through pilot adaptation projects.

Central to achieving the three outcomes is developing the capacity of local government units in the Philippines to mainstream climate change adaptation in their development plans, programs and activities. Planning for and implementing climate change adaptation will require detailed information on plausible future climates, such as changes in temperatures, rainfall and frequency of extreme weather events. This climate information, called climate change scenarios, is generated from climate simulations.

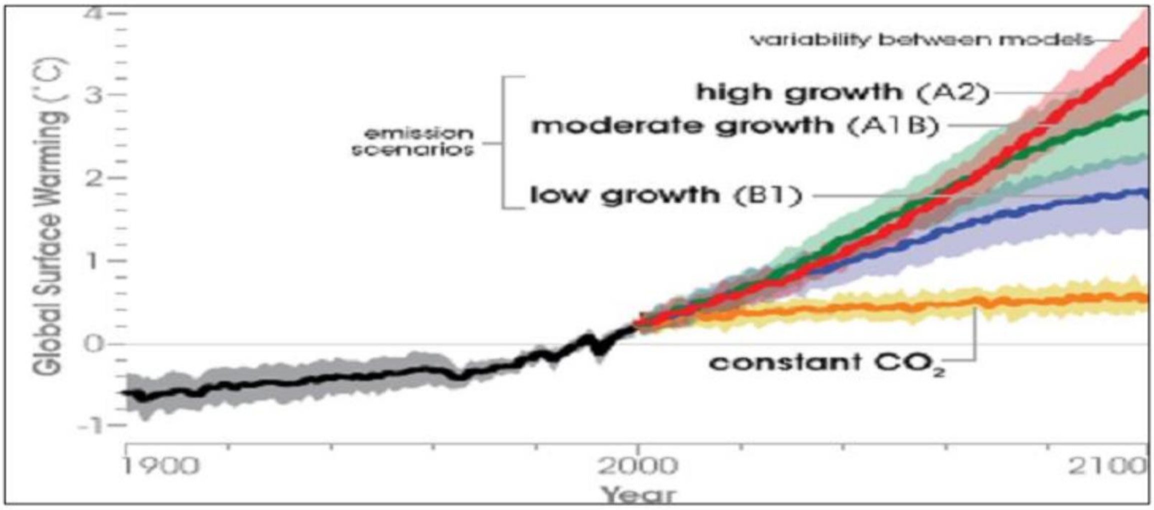
In order to generate projections of temperature increase and rainfall change in the Philippines in the future, the Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA) used the PRECIS (Providing Regional Climates for Impact Studies) model in two time frames; 2020 and 2050. This model was developed by the UK Met Hadley Centre (in the United Kingdom) to facilitate impact, vulnerability and adaptation assessments in developing countries where capacities to do climate modeling are still not fully developed or do not exist. Three of the emission scenarios developed by the Intergovernmental Panel on Climate Change in its Special Report on Emission Scenarios (IPCC-SRES) were chosen to run the models; namely, A2 (high-range), A1B (mid-range), and B2 (low-range). The A2 scenario is at the so-called higher end of the emission scenarios (although not the highest), and is preferred by most countries because from an impacts and adaptation point of view, if man can adapt to a larger climate change, then the smaller climate changes of the lower end scenarios can also be adapted. On the other hand, the A1B scenario is considered because the future climates in the next 30-40 years will be greatly influenced by past emissions, principally due to the long lifetimes of carbon dioxide. The B2 scenario representing the low-range emissions is therefore, the most unlikely, even if it represents the low end.

a) Climate Trends in the Philippines

The climate trends were analyzed using available observed data from 1951 to 2009 with the average for the period of 1971 – 2000 as the reference value. The key findings are summarized as follows:

-There has been an increase in annual mean temperature by 0.57 °C;
-In terms of maximum and minimum temperatures, the increases have been 0.35 °C and 0.94 °C;

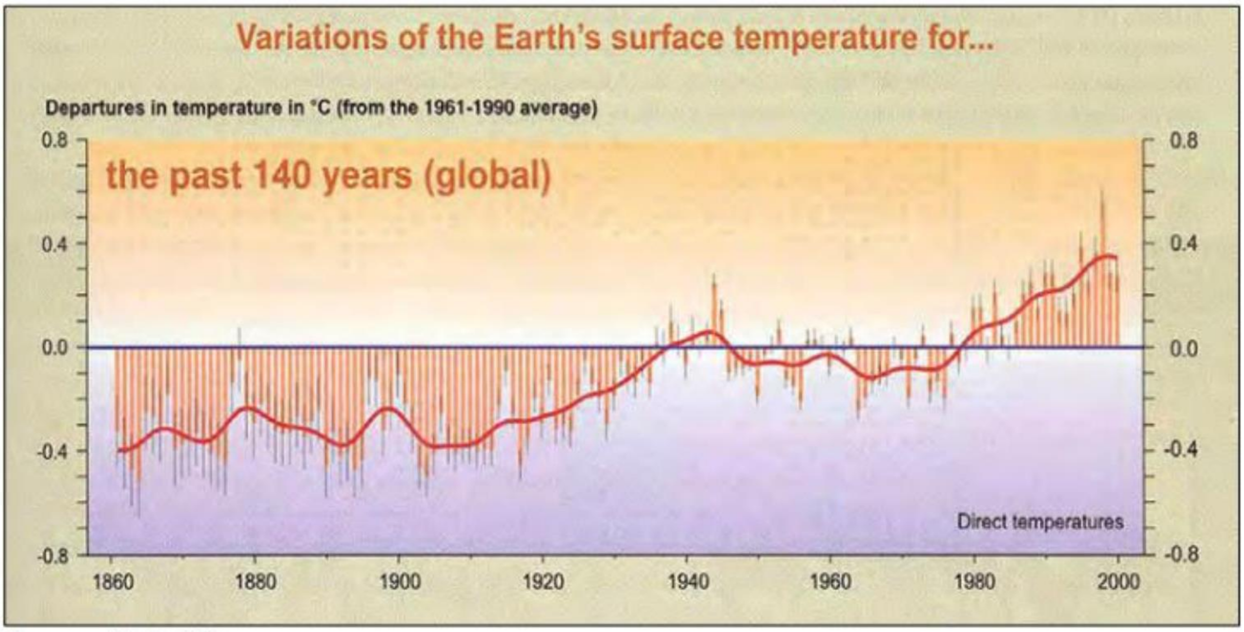
Results of analysis of trends of tropical cyclone occurrence/passage within the so- called Philippine Area of Responsibility (PAR) show that an average of 20 tropical cyclones form and/or cross the PAR per year with strong multi-decadal variability, that there still is no indication of increase in the frequency, but with a very slight increase in the number of tropical cyclones with maximum sustained winds of greater than 150kph and above (typhoon category) being exhibited during El Nino years; and
-The analysis of trends of extreme daily temperatures and extreme daily rainfall indicate significant increase in number of hot days but decrease of cool nights, and those of rainfall (extreme rainfall intensity and frequency) are not clear, both in magnitude (by what amounts) and direction (whether increasing or decreasing), with very little spatial coherence. **Figure 93** shows the scenarios that assume the highest growth in greenhouse gas emissions which provide the



Source: NASA Earth Observatory, based on IPCC Fourth Assessment Report (2007)
Figure 93. Temperature Projections to the year 2100 based on a range of emission scenarios and global climate models.

Estimates in the top end of the temperature range. The orange line ("constant CO2") projects global temperatures with greenhouse gas concentrations stabilized at year 2000 levels.

Figure 94 shows the 0.74^{0}C increase in global mean temperature during the last 150 years compared with the 1961-1990 global average. It is the steep increase in temperature since the mid-20th century that is causing worldwide concern, particularly in terms of increasing vulnerability of poor developing countries like the Philippines, to adverse impacts of even incremental changes in temperatures.



Source: IPCC AR4

Figure 94. Global mean temperature anomalies since the mid-19th century compared with the 1961-1990 average

The Philippines, like most parts of the globe, has also exhibited increasing temperatures as shown in **Figure 88**. The graph of observed mean temperature anomalies (or departures from the 1971-2000 normal values) during the period 1951 to 2010 indicate an increase of 0.648 °C or an average of 0.0108 °C per year-increase.

b) Climate Projections in 2020 and 2050 in Provinces in ARMM

The projected seasonal temperature increase, seasonal rainfall change and frequency of extreme events in 2020 and 2050 under the medium-range emission scenario in the provinces in ARMM are presented in **Table 58**.

To use the tables and arrive at values of seasonal mean temperature and seasonal rainfall in 2020 and 2050 in any of the provinces, the projections are added to the observed values (presented in each of the tables).

For example, in Maguindanao province, the projected values in 2020 are:

a. DJF mean temperature = (27.6 °C +1.0 °C) = 28.6 °C;
b. DJF rainfall = {225.3mm+225.3 (6.3%)mm} = (225.3+14.2)mm or 239.5mm;
c. number of days with Tmax > 35 °C in Cotabato City during the 2006-2035 period (centered at 2020) = 3,382;
d. number of dry days in Cotabato City during the 2006-2035 period (centered at 2020) = 5,471; and
e. number of days with rainfall > 300 days in Cotabato City during the 2006-2035 period (centered at 2020) = 3.

Table 58. Climate Projections in 2020 and 2050 in ARMM

Table a: Seasonal temperature increases (in °C) in 2020 and 2050 under medium-range emission scenario in provinces in ARMM

	OBSERVED BASELINE (1971-2000)				CHANGE in 2020 (2006-2035)				CHANGE in 2050 (2036-2065)			
	DJF	MAM	JJA	SON	DJF	MAM	JJA	SON	DJF	MAM	JJA	SON
ARMM												
LANAO DEL SUR	24.3	25.4	25.0	24.9	1.0	1.2	1.1	1.0	2.0	2.3	2.2	2.0
MAGUINDANAO	27.6	28.3	27.5	27.6	1.0	1.2	1.2	1.1	2.1	2.3	2.4	2.1

Table b: Seasonal rainfall change (in %) in 2020 and 2050 under medium-range emission scenario in provinces in ARMM

	OBSERVED BASELINE (1971-2000) mm				CHANGE in 2020 (2006-2035)				CHANGE in 2050 (2036-2065)			
	DJF	MAM	JJA	SON	DJF	MAM	JJA	SON	DJF	MAM	JJA	SON
ARMM												
LANAO DEL SUR	293.8	369.4	661.5	562.2	7.2	-6.3	-7.2	0.3	-1.1	-4.6	-7.4	-3.6
MAGUINDANAO	225.3	399.1	635.3	553.6	6.3	1.4	-7.4	3.5	5.3	-1.4	-12.6	-1.2

Table c: Frequency of extreme events in 2020 and 2050 under medium-range emission scenario in provinces in ARMM

Provinces	Stations	No. of Days w/ Tmax >35 °C			No. of Dry Days			No. of Days w/ Rainfall >150mm		
		OBS (1971-2000)	2020	2050	OBS	2020	2050	OBS	2020	2050
MAGUINDANAO	Cotabato	384	3382	5994	3516	5471	5788	2	10	5

Note:

- For Lanao del Sur, use values of Cotabato City.

c) Impacts on Land

- Loss of Vegetation

The project development will require removal of vegetation cover to give way for the construction of road project. The removal of vegetation will also result in the reduction in the population of plant species growing within the project 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 those mature vegetation in the area.

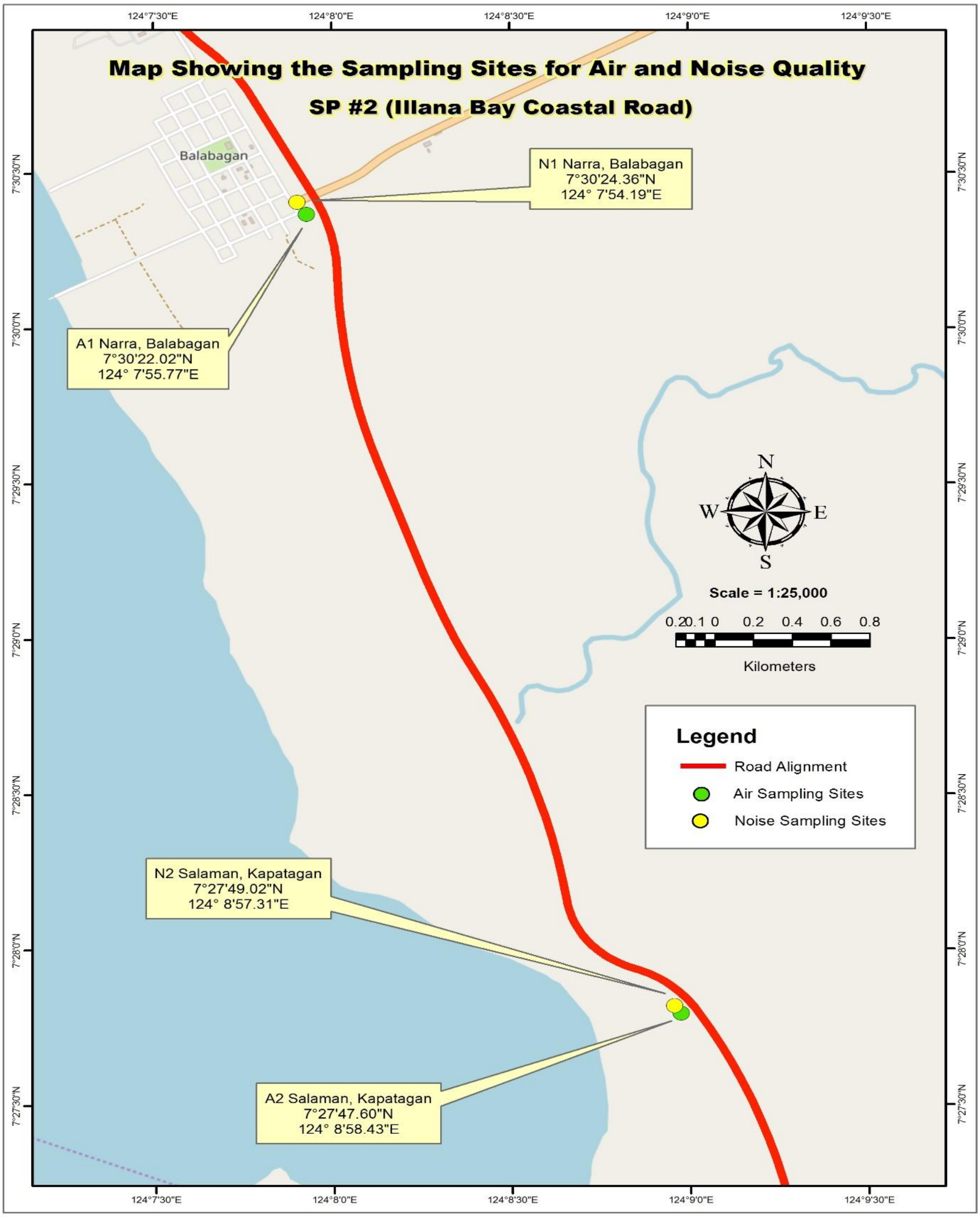
During site preparation, clearing of the road ROW will result to the removal of an estimated tree above ground biomass (using large of trees with dbh of 10 cm and above, and pole size tress with $\geq$ 5 cm dbh to 9.5 cm) of 1.59 x 10^{-4} and 2.87 x 10^{-4} megaram per hectare, and with estimated Carbon stored value of 3.53 x 10^{-4} and 6.38 x 10^{-4} megagram per hectare, respectively. It was computed using the brown allometric equation.

3.3.3 Ambient Air Quality

Air Samples were collected on December 12-14, 2017 at Brgy. Salaman, Kapatagan and Brgy. Poblacion, Balabagan, Lanao del Sur. **Table 59** shows the sampling coordinates, dates and time of air sampling. **Figure 95** shows the sampling locations for three stations. Weather condition at the time of sampling was sunny to cloudy with slight rain showers. Twenty-four (24) hours measurement were sampled for Total Suspended Particulates, PM10, Nitrogen Dioxide and Sulfur Dioxide.

Table 59. Summary of Air Sampling Sites, Coordinates, Date and Time of Samplings

Station No.	Sampling Stations	Coordinates	Weather Condition	Date of Samplings
A1	Brgy. Salaman, Kapatagan	7°27'47.60"N 124° 8'58.43"E	Fair, to Cloudy with slight rain showers	December 12-13, 2017`
A2	Brgy. Poblacion, Balabagan	7° 30’ 22.02” N 124° 7’ 55.77” E (Air)	Fair, to Cloudy with slight rain showers	December 13-14, 2017



Source: Google Earth

Figure 95. Sampling locations at Sub-project 2

3.3.3.1 Sampling Equipment

There were three (3) major types of ambient air equipment used as described in **Table 60.**

Table 60. 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; PM10 – Particulate Matter at 10µ; NO2 – 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).

3.3.3.2 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.

3.3.3.2.1 FILTRATION METHOD BY HIGH-VOLUME SAMPLER

3.3.3.2.1.1 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.

3.3.3.2.1.2 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.

3.3.3.2.2 ABSORPTION IN LIQUIDS FOR GASEOUS POLLUTANTS

3.3.3.2.2.1 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.

3.3.3.3 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 are within the allowable limits. **Table 61** presents the results of air quality in two (2) sites for Sub-project 2.
.
Figure 96 and Figure 97 present the photos during the actual air sampling at two (2) sites.

Table 61. Ambient Air Test results taken in Kapatagan and Balabagan, Maguindanao

Station No.	Location	Date and Time Sampling	TSP (µg/Ncm)	PM_{10} (µg/Ncm)	NO2 (µg/Ncm)	SO2 (µg/Ncm)
A1	Brgy. Salaman, Kapatagan	December 12-13, 2017 1050H – 1050H	18.1	4.6	1.7	1.0
A2	Brgy. Narra, Balabagan	December 13-14, 2017 1225H – 1225H	19.4	4.2	2.5	1.4
***DENR National Ambient Air Quality Guideline Values (NAAQGV)**		**24-hr Sampling**	**230**	**150**	**150**	**180**
Remarks			**Passed**	**Passed**	**Passed**	**Passed**

TSP, PM_{10}, NO_2, SO_2 – corrected at 25^oC, 760mm Hg; *RA 8749 (Philippine Clean Air Act of 1999)

Table 62 and Table 63 present the meteorological conditions observed during the sampling activities.

Figure 96. Photos of Air Sampling at Brgy. Salaman, Kapatagan, Lanao del Sur

Figure 97. Photos of Air Sampling at Brgy. Narra, Balabagan, Lanao del Sur

Table 62. Meteorological Data at Brgy. Salaman, Kapatagan, Maguindanao

Brgy. Salaman, Kapatagan, Lanao del Sur

Division of 24-Hour Sampling	Prevailing Wind	Temperature (deg. C)	Barometric Pressure (mmHg)	Remarks
December 12-13, 2017 1050H	Calm	27.5	756.2	Rains Lightly
1250H	S-N	29.4	755.0	Cloudy
1450H	N-S	31.1	754.4	Cloudy
1650H	NW-SE	29.4	754.4	Cloudy
1850H	Calm	27.3	755.5	Fair
2050H	Calm	27.1	755.5	Fair
2250H	SW-NE	27.0	755.3	Fair
0050H	Calm	25.9	755.0	Fair
0250H	SE-NW	26.3	754.1	Fair
0450H	N-S	26.7	754.9	Fair
0650H	Calm	25.8	756.0	Rains Lightly
0850H	N-S	26.1	756.3	Rains Lightly

Table 63. Meteorological Data at Brgy. Narra, Balabagan, Lanao del Sur

Division of 24-Hour Sampling	Prevailing Wind	Temperature (deg. C)	Barometric Pressure (mmHg)	Remarks
December 13-14, 2017				
1225H	SE-NW	34.5	752.7	Cloudy
1425H	NW-SE	33.3	752.6	Cloudy
1625H	NE-SW	29.9	752.8	Cloudy
1825H	NE-SW	26.9	754.0	Fair
2025H	NW-SE	25.7	755.3	Rains Lightly
2225H	NW-SE	25.1	754.2	Rains Lightly
0025H	NW-SE	24.9	754.9	Rains Lightly
0225H	NW-SE	25.2	754.6	Rains Lightly
0425H	E-W	25.5	754.3	Rains Lightly
0625H	E-W	24.6	753.8	Fair
0825H	SW-NE	26.9	753.8	Cloudy
1025H	SW-NE	28.3	754.0	Cloudy

3.4 Noise Quality

3.4.1 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 has A frequency weighting and fast time weighting with a measurement range of 30 dB to 130 dB and resolution of 0.1 dB. **Table 64** presents the sampling coordinates, date and time of noise sampling. Noise sampling stations are shown in **Figure 95**.

Table 64. Summary of Noise Sampling Sites, Coordinates, Date and Time of Samplings

Station No.	Sampling Stations	Coordinates	Weather Condition	Date of Samplings
N1	Brgy. Salaman, Kapatagan	7°27'49.02"N 124° 8'57.31"E	Fair, to Cloudy with slight rain showers	December 12-13, 2017`
N2	Brgy. Narra, Balabagan	7°30'24.36"N 124° 7'54.19"E	Fair, to Cloudy with slight rain showers	December 13-14, 2017

3.4.2 Sampling Methodologies

The noise measurements were conducted at two (2) stations. The lowest and highest noise levels monitored were manually recorded. 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).

3.4.3 Results and Discussions

Table 65 and **Table 66** present the results of noise level monitoring conducted from the two (2) stations at Brgy. Salaman, Kapatagan and Brgy. Poblacion, Balabagan of Lanao del Sur. 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 A Residential category. During morning and daytime, noise levels were within the allowable levels of the DENR. Noise levels during evening and nighttime are slightly higher where noise coming from animal such as barking from dogs, rooster’s crow, sounds from insects such as crickets etc. may have impacted the increase in sound measurement. Most of the noise sources measured came from animal and insects during nighttime and wind propagation. Activities from residents near the sampling area also influenced the sound measurements during morning time. **Figure 98** and **Figure 99** show photos of noise sampling in the study area.

Table 65. Noise Data at Brgy. Salaman, Kapatagan, Lanao del Sur

Sampling Time December 12-13, 2017	Average dB(A)	DENR Standard Maximum Allowable Noise Level dB(A)***	Remarks	Noise Sources
1050H	52.0	55	Within	Residential area, birds, passing vehicle
1250H	50.8	55	Within	Residential area, birds
1450H	51.6	55	Within	Residential area, birds
1650H	50.9	55	Within	Residential area, birds
1850H	49.6	50	Within	insects
2050H	48.8	50	Within	insects
2250H	48.2	45	Exceeded	insects
0050H	49.4	45	Exceeded	insects
0250H	49.5	45	Exceeded	insects
0450H	48.2	45	Exceeded	Insects
0650H	50.1	50	Exceeded	Residential area, roosters
0850H	51.1	50	Exceeded	Residential area, birds, roosters

***Category “A”: A section which is primarily a residential 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 (NIghtime)[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 66. Noise Data at Brgy. Narra, Balabagan, Lanao del Sur

Sampling Time December 13-14, 2017	Average dB(A)	DENR Standard Maximum Allowable Noise Level dB(A)***	Remarks	Noise Sources
1225H	52.6	55	Within	Residential area, birds, passing vehicle
1425H	52.4	55	Within	Residential area, birds, passing vehicle
1625H	51.0	55	Within	Residential area, birds, passing vehicle
1825H	51.9	50	Exceeded	Residential area, birds, passing vehicle
2025H	49.7	50	Within	Insects, wind propagation
2225H	47.6	45	Exceeded	Insects, wind propagation, rainfall
0025H	46.3	45	Exceeded	Insects, wind propagation, rainfall
0225H	45.8	45	Exceeded	Insects, wind propagation, rainfall
0425H	49.9	45	Exceeded	Insects, roosters
0625H	51.8	50	Exceeded	Insects, birds, passing vehicle
0825H	51.3	50	Exceeded	Residential area, birds, passing vehicle
1025H	52.0	55	Within	Residential area, birds, passing vehicle

***Category	“A”:	A section which is primarily a residential 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 (NIghtime)[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.

Figure 98. Noise Sampling at Brgy. Salaman, Kapatagan, Lanao del Sur

Figure 99. Noise Sampling at Brgy. Narra, Balabagan, Lanao del Sur

3.5 Social Condition (The People)

3.5.1 Demographic Data

3.5.1.1 Household and Household Size

In terms of household number, Parang has a total households of 15,307, Matanog has 4,817, Kapatagan has 2,604 and Balabagan has a household number of 4,769. These households are headed mostly by male. Matanog on the other hand has the highest household size with average of 6.2 person per household while Balabagan has the least with 5.6.

Table 67. Household and Household Size in the Municipalities Affected by SP 2

Province	Municipality	Household Number			Household Size
		Male Headed Households	Female Headed Households	Total	
Maguindanao	Parang	14,028	1,279	15,307	5.8
	Matanog	4,425	392	4,817	6.2
Lanao del Sur	Kapatagan	2,481	123	2,604	5.9
	Balabagan	4,394	375	4,769	5.6

Source: Philippine Statistics Authority, 2015

3.5.1.2 Land Area

The municipalities of Parang and Matanog in Magundanao has total land area of approximately 850.78 km² and 146.50 km², respectively. While the municipalities of Kapatagan and Balabagan has total land area of approximately 288.13 km² and 230 km², respectively. (refer to **Table 68**).

The Municipality of Matanog has the smallest land area or 0.15% of the Magundanao province land area. While Parang has 0.087% has the highest land area of Maguindanao land area.

Table 68. Barangay Land Area in the Municipalities Affected by SP 2

Province	Municipality	Land area (km2)	Percent of Total Province Land Area
Maguindanao	Parang	850.78	0.087
	Matanog	146.50	0.015
Lanao del Sur	Kapatagan	288.13	0.074
	Balabagan	230.00	0.059
	Total	1,515.41	

Source: Philippine Statistics Authority, 2015

3.5.1.3 Population

The Parang-Balabagan Road SP 2 is located in two (2) Municipalities of Maguindanao and two (2) municipalities of Lanao del Sur covering a total of 14 barangays. In terms of population of barangays in SP 2, the largest population is 6,041 in Sapad of Matanog, while the smallest is Matimos in Kapatagan. In Maguindanao province, three barangays have more than 40 percent of the total population. **Table 69** shows the population for the covered barangays.

Table 69. Population per Barangay Covered by the Project (2015)

Province	Municipality	Barangay	Population
Maguindanao	Parang	Macasandag	1,837
	Matanog	Sapad	6,041
		Kidama	1,931
Lanao del Sur	Kapatagan	Salaman	1,425
		Matimos	609
		Bakikis	894
		Lusain	950
	Balabagan	Banago	2,203
		Barorao	1,862
		Lorenzo	1,408
		Narra	778
		Batuan	1,163
		Molimoc	754
		Budas	798
		Total	22,653

Source: Philippine Statistics Authority (2015)

Historically, there are significant changes in terms of population growth in the project area. Parang has an increase and decrease of population between 1960 to 2015 with the highest population of 102,247 recorded in 2007. Matanog has a continuous increase of population from 1980 to 2007, however experienced a drastic decreased in population of about 36%.

Kapatagan in Lanao del Sur has only available data in PSA starting from year 1990 with increasing population trend except 2010 with a decrease in population of 32%. Balabagan on the other hand has increase and decrease of population between 1970 to 2015 with the highest population of 33,421 recorded in 2007.

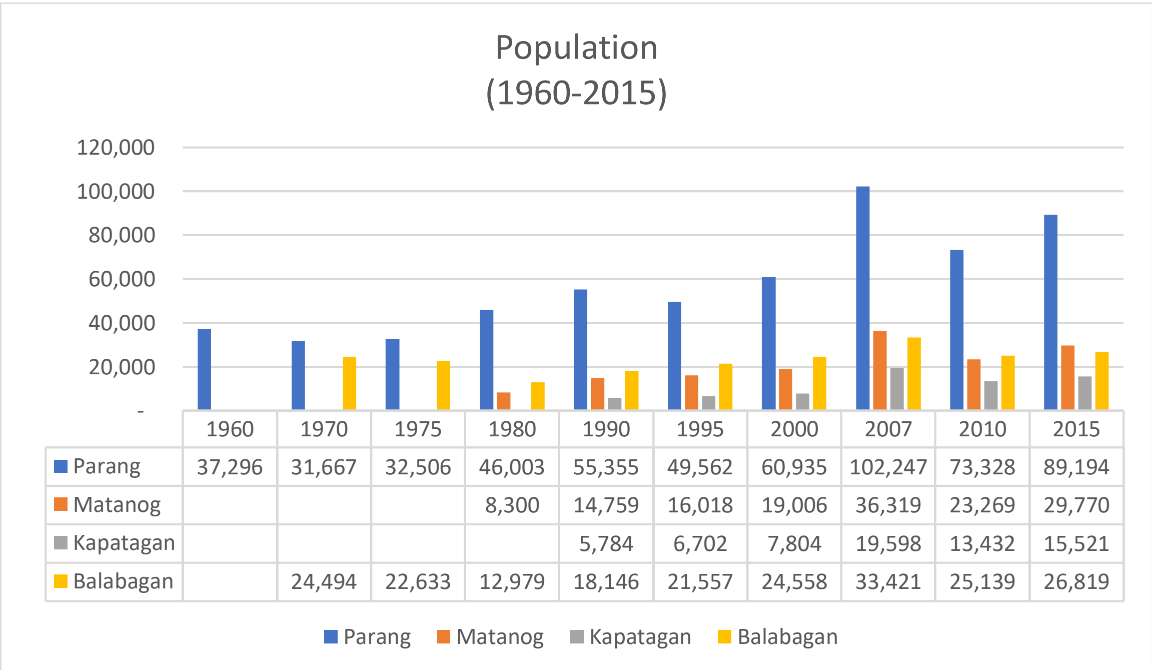


Figure 100. Population per Census Year in the Municipalities Affected by SP 2

3.5.1.4 Population Density / Growth

Based on 2015 Census of Population and Housing of Philippine Statistics Office, the four municipalities have a total population of 161,304 and an average population density of 106 persons/km2. Among the four municipalities, Parang has the largest population of 89,194. Polloc Port, an international port of mainland ARMM located in Parang, may have helped to attract many people. Because of the large land area, however, the population density of Parang is close to the average of the four municipalities. In contrast, Kapatagan has the smallest population of 15,521. Its population density is also the lowest. Table below shows the population density per municipality in the project area.

Table 70. Population Density in the Municipalities Affected by SP 2

Province	Municipality	Population	Land area (km2)	Population density (persons/km^2)
Maguindanao	Parang	89,194	850.78	105
	Matanog	29,770	146.50	203
Lanao del Sur	Kapatagan	15,521	288.13	54
	Balabagan	26,819	230.00	117
	Total	161,304	1,515.41	106

Source: Philippine Statistics Authority, 2015

In terms of population growth, Kapatagan, with the lowest population density, has the highest annual average growth rate between 2000 and 2010. Further, between 2010 and 2015, Parang and Matanog have annual average growth rates that are higher than those of the other two municipalities. The average annual average growth rate in the four municipalities from 2000 to 2015 is 2.44 percent, which is above Lanao del Sur's average and below Maguindanao's average as presented in the Table below.

Table 71. Population Growth in the Municipalities Affected by SP 2 (2000-2015)

Province	Municipality	Annual Average Growth Rate (in percent)		
		2000-2010	2010-2015	2000-2015
Maguindanao	Parang	1.87	4.00	2.57
	Matanog	2.04	5.05	3.04
Lanao del Sur	Kapatagan	5.58	2.93	4.69
	Balabagan	0.23	1.30	0.59
	Total	1.87	3.60	2.44

Source: Philippine Statistics Authority, 2015

3.5.1.5 Gender and Age Profile

There is a proposed gender and development code for the whole province of Maguindanao subject for approval to the provincial board. According to the provincial government, the code will provide equal protection to women in Maguindanao's Moro, Christian, and highland indigenous communities. The code also seeks to protect women in the province, regardless of religion and tribal identities, from exploitation, human trafficking, pornography, political and religious persecution. Women's group are organized in each barangays of all municipalities and participated municipal and provincial wide activities/programs for women's development.

In terms of the distribution by age and sex, there were more males than females in age groups 0 to 54 years in 2010, with the males comprising 51.0 percent of these age groups. In contrast, there were more females than males in the older age group 55 years old and over. The males in these age groups made up 45.9 percent[1].

[1] Philippine Statistics Authority

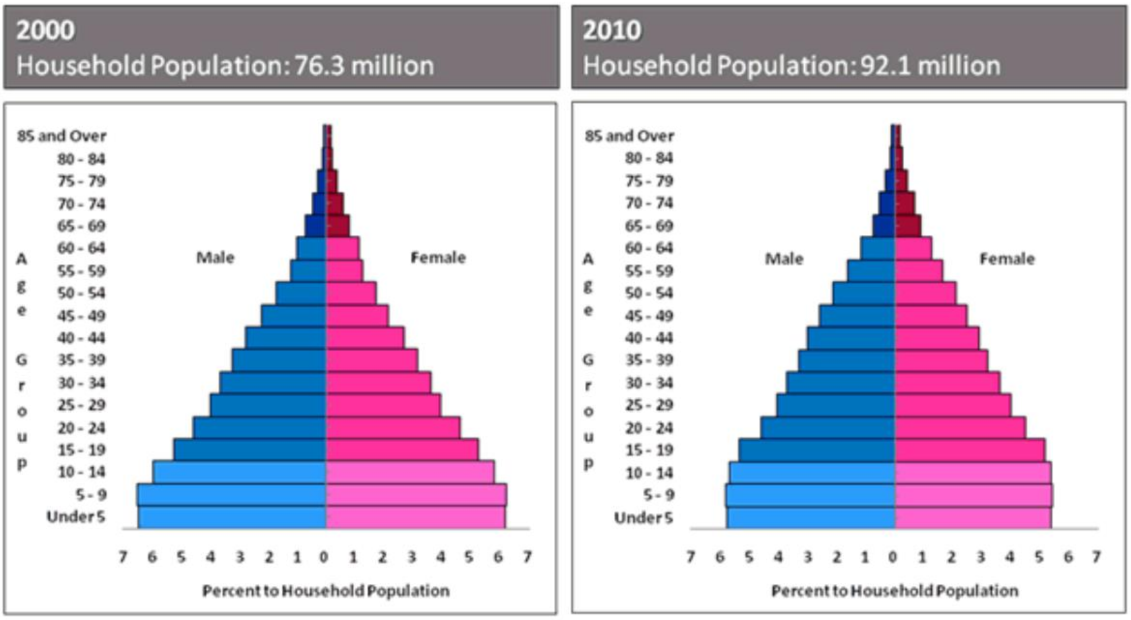


Figure 101: Age – Sex Pyramid of household Population in ARMM

3.5.1.6 Literacy Rate, Profile of Education Attainment

In terms of access to educational services in the four municipalities affected by SP 2, availability of school facilities is present in all municipalities from Pre-schools to Colleges. Based on the data of the Philippine Statistics Authority (2015), the highest grade completed of most of the population in the affected municipalities are elementary 1st to 4th grade while post baccalaureate has the least number. Special education is also available except for Kapatagan. Table below presents the grade level completed with corresponding numbers of population.

Table 72. Highest Grade/Year Completed in the Municipalities Affected by SP 2

Highest Grade/Year Completed	Parang	Matanog	Kapatagan	Balabagan
No Grade Completed	5,383	5,938	2,798	2,094
Pre-School	2,211	794	679	743
Special Education	12	29	-	3
Elementary	30,406	14,211	6,905	12,165
1st - 4th Grade	17,548	9,261	4,705	6,899
5th - 6th Grade	8,129	3,840	1,499	3,729
Graduate	4,729	1,110	701	1,537
High School	24,094	3,386	2,249	6,457
Undergraduate	11,747	2,476	1,522	3,773
Graduate	12,347	910	727	2,684
Post-Secondary	585	91	27	115
Undergraduate	52	4	3	6
Graduate	533	87	24	109
College Undergraduate	8,334	929	604	1,675
Academic Degree Holder	4,490	377	175	592
Post Baccalaureate	18	25	2	3
Not Stated	3,468	5	-	2s
Total	79,001	25,785	13,439	23,849

Source: Philippine Statistics Authority, 2015

In terms of literacy, age group from 10-14 and 15-19 has the highest population recorded in all municipalities affected. Based on the data from PSA (2015), it consistently shows that young age group have higher literacy and decreases as age group gets older except there are increased in number from the age group 65 years old and over. Highest literacy in the data of PSA (2015) is in the municipality of Parang with 67,516 population. **Table 73** shows the literacy by age group.

Table 73. Literacy by Age Group

Age Group	Parang	Matanog	Kapatagan	Balabagan
10 – 14	11,480	3,644	2,250	3,268
15 – 19	12,290	3,373	1,676	3,021
20 – 24	7,871	3,199	1,295	2,696
25 – 29	6,786	2,734	1,199	2,324
30 – 34	5,813	1,998	964	1,807
35 – 39	5,986	2,048	1,057	1,748
40 – 44	5,150	1,629	879	1,614
45 – 49	4,148	1,196	716	1,267
50 – 54	2,826	820	404	966
55 – 59	2,001	522	212	609
60 – 64	1,343	281	111	449
65 years old and over	1,822	454	189	615
Total	67,516	21,898	10,952	20,384

Source: Philippine Statistics Authority, 2015

3.5.1.7 Poverty Incidence

Data for poverty incidence at municipality level are derived from the National Color-Coded Agricultural Guide Map of the Department of Agriculture, which contains a municipal poverty database created in 2010. The table below presents poverty incidence in the four municipalities affected by Sub-Project 2. Parang municipality of Maguindanao has a very high poverty incidence of 74.00 percent. Applying the population figures of each municipality from the 2015 Census of Population and Housing, the four municipalities together would have 107,487 persons living in poverty, and the average poverty incidence in the four municipalities would be 66.64 percent. **Table 74** presents poverty incidence in the three municipalities affected by Sub-Project 2.

Table 74. Population Density in the Municipalities Affected by SP 2

Province	**Municipality**	**Poverty Percentage**
Maguindanao	Parang	74.00
	Matanog	59.30
	Kapatagan	60.40
Lanao del Sur	Balabagan	53.90
	Total	66.64

Source: Godilano, E.C. (2017). Department of Agriculture. Integrated Climate Change and Geospatial Information Systems (ICCGIS). Adaptation and Mitigation Initiative in Agriculture (AMIA) Project 1.

3.5.1.8 Income and Expenditure

According to the Family Income and Expenditure Survey 2012 of the Philippine Statistics Authority, income and expenditure estimates for Lanao del Sur province are 129,953 pesos and 110,739 pesos respectively. These figures are close to the average income and expenditure estimates for ARMM. However, the income and expenditure estimates for Maguindanao province, 108,170 pesos and 106,330 pesos respectively, are lower than those for Lanao del Sur and ARMM.

3.5.1.9 Employment and Work Force

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. Parang is recorded to have the highest number of workers with 29,520.

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 Skilled Agricultural Forestry and Fishery Workers with a total of 22,709 for the four municipalities.

Table 75. Employment/Workers in the Municipalities Affected by SP 2

Major Occupation Group	Parang	Matanog	Kapatagan	Balabagan
Managers	2,108	618	219	524
Professionals	1,052	103	69	328
Technicians and Associate Professionals	575	64	10	77
Clerical Support Workers	728	86	10	77
Service and Sales Workers	5,381	343	141	543
Skilled Agricultural Forestry and Fishery Workers	9,228	5,869	2,688	4,924
Craft and Related Trades Workers	1,016	42	10	189
Plant and Machine Operators and Assemblers	3,218	621	153	521
Elementary Occupations	3,075	705	779	934
Armed Forces Occupations	212	13	13	153
Other Occupation Not Elsewhere Classified	-	-	-	-
Not Reported	2,927	33	20	43
Total	29,520	8,497	4,112	8,313

Source: Philippine Statistics Authority, 2015

3.5.1.10 LGU Income

Based on the Bureau of Local Government Finance, Department of Finance CY 2014 data, Parang has the highest IRA with 164,731,866 pesos which includes local sourced revenues came from Municipal Taxes, Fees and other Charges. Matanog has an IRA of 57,338,518, Kapatagan has 60,696,230 and Balabagan has 67,228,216.

Table 76. Income In the Project Area

Province	Municipality	Income
Maguindanao	Parang	164,731,866
	Matanog	57,338,518
Lanao del Sur	Kapatagan	60,696,230
	Balabagan	67,228,216

Source: CY 2014 Internal Revenue Allotment for LGUs, DILG Region 12

IRA dependency in Parang based on the Bureau of Local Government Finance, Department of Finance (2017) is relatively high ranging 92%-98% of the municipality's total annual regular income from 2009-2016. In Matanog from 2009 to 2012, IRA dependency is 0% to which they rely only to the support provided by the provincial government. In 2013 to 2016, Matanog was allotted IRA with dependency percentage of 95% to 100% of the municipality's total annual regular income. (Data source: Bureau of Local Government Finance, Department of Finance, 2017). Kapatagan has the highest IRA dependency with 100% from 2009 to 2016 except in 2012 with 99%. Balabagan IRA dependency on the other hand ranges from 99%-100%.

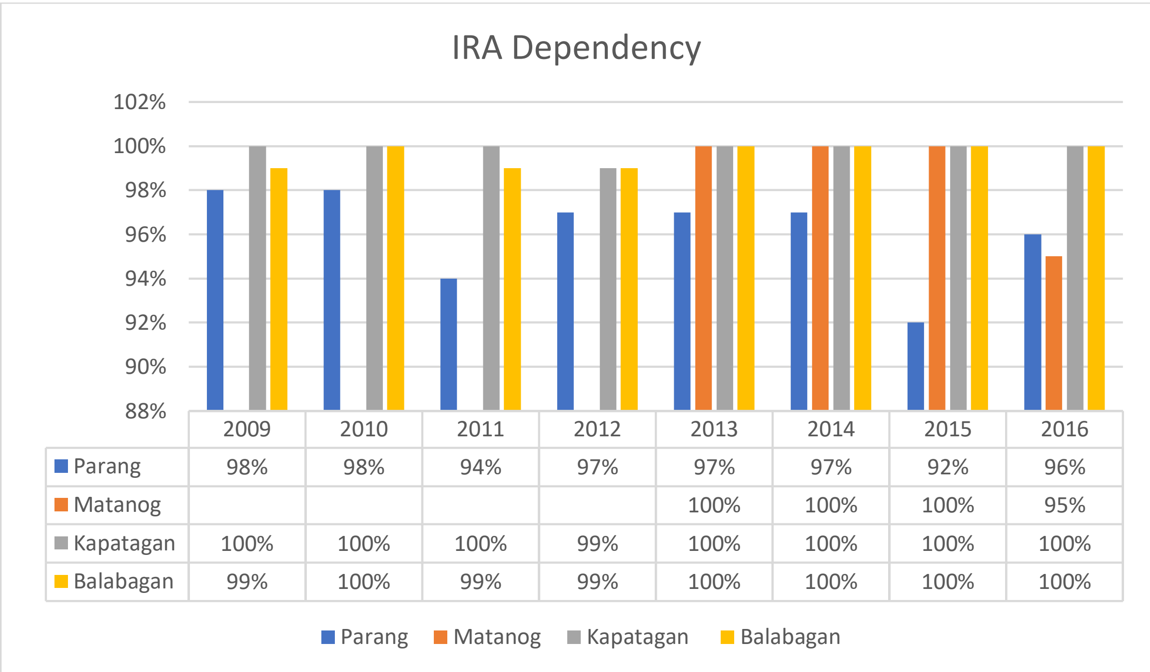


Figure 102. IRA Dependency in the Municipalities Affected by SP 2

3.5.1.11 Religious Affiliation

Majority of the population in Maguindanao belong to Islam comprising about 83% of the total population in Maguindanao with only 8% of Roman Catholic, 3% are National Council of Churches in the Philippines, and 1% Tribal Religions (PSA 2015). The remaining percent belongs to different religious sectors such as Aglipay, Buddhist, Baptist, among others.

In Lanao del Sur, 93% of the total population belongs to Islam or almost all people in the province. Roman Catholic comprised 5% of the population of the province while the remaining percent belongs to different religious sectors.

3.5.1.12 Ethnicity

In terms of ethnicity, the project area is dominated with Maguindanaon and Maranao. There are also indigenous people occupying the mountainous area such as Manobo, Subanon and Tiduray however comprises only small portion of the project area. Few are Cebuano's that is directly affected by the proposed project.

The Manobo tribe usually build their villages near small bodies of water or forest clearings, although they also opt for hillsides, valleys, and rivers. Cultivating rice and corns is a part of the Manobo way of living, some shifted to the cultivation of coconut for copra export.
Tiduray tribe on the other hand are scattered in different provinces in Mindanao. Their primary source of livelihood is farming and fishing. Majority of the farmers still practice slash-and-burn methods of farming. Thus, most of the farmers get marginal production which is very insufficient to serve the needs of their families.

Same as Manobo, Subanon tribe also living in the mountainous areas of the municipalities. These people originally lived in the lowlying areas. However due to disturbances and competitions from other settlers like the Muslims, and migrations of Cebuano speakers to the coastal areas attracted by the inviting Land Tenure Laws, further pushed the Subanen into the interior. They cultivate crops, with rice as the most important crop, but they are also known to raise livestock including chicken and pigs.

3.5.2 Basic Services

The current situation of the basic services of the project area is very poor. The implementation of SP2 will improved the life of the people that ensures all season access to the water and power supply, communications, and transportations.

Through the road, it will attract private providers to invest for water and power supply; and communication.

3.5.2.1 Water

Water supply is scarce in some portions of project affected areas. Water source comes from dugwells and springs which are used for domestic and drinking water. In Balabagan, there are water delivery trucks in some areas that supplies water which cost Php 50 pesos per drum.

3.5.2.2 Power Supply

The municipality's power source of Parang and some areas in Matanog while other areas in these municipalities used solar as alternative power source comes from Magelco. Magelco has a capacity of 10-MVA, 69/13.2KV substation. For the years starting 2010 up to 2014, MAGELCO has implemented load curtailment in its franchise area due to generation deficiency in Mindanao GRID.

The municipalities of Balabagan and Kapatagan have been without electricity for the last five years, including other municipalities of Lanao del Sur because of the issues of irregularities of the previous power provider.

3.5.2.3 Communication Networks

Communication Networks available in the project area which includes Globe, PLDT, Smart and Sun Cellular except for Lusain in Kapatagan which has weak signals.

3.5.2.4 Transportation and Road Networks

The municipalities is accessible to people coming in from its connected municipalities and provinces through public road transport include vans, trisikads, town ace and single motors. In Lusain in Kapatagan and Kidama in Matanog, boat is the primary transport vehicle used to reach these barangays.

3.5.3 Socioeconomic Profile and Perception of the Affected People

Project affected includes crop, trees and structures that might be damaged once the project is implemented. Based on the RAP Survey, the following are the project affected by SP2:

Table 77. Project Affected by SP 2

Municipality	Barangay	Crops	Trees			Structures			Post	Water System
			Fruit Bearing	Timber	Cash Crops	Wood	Semi-Concrete	Concrete		
Parang	Macasandag	-	62	13	9	-	-	-	-	-
Matanog	Sapad	72,000	86	7	9	-	-	-	-	-
	Kidama	-	128	5	-	-	-	-	-	-
Kapatagan	Salaman	-	573	-	-	1	2	1	-	-
	Matimos	-	183	-	-	-	-	-	-	-
	Bakikis	-	-	-	-	-	-	-	-	-
	Lusain	34,500	135	2	-	-	-	-	-	-
Balabagan	Banago	-	87	-	-	-	-	-	-	-
	Narra	-	177	990	-	-	-	-	-	-
	Lorenzo	10,500	150	17	-	-	-	-	10	1
	Molimoc	-	292	-	-	-	-	-	14	-
	Barorao	12,600	212	-	-	-	2	3	-	-
	Batuan	11,400	419	-	-	-	-	-	-	-
	Budas	13,500	114	-	-	-	-	-	-	-
	Total	154,500	2,618	1,034	18	4	4	4	24	1

3.5.3.1 Respondent's Profile and Household Information

In the random sampling conducted, a total of 302 respondents were interviewed for this survey distributed in the 4 Municipalities with 14 barangays covered by the project. 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 road alignment were interviewed, a total of 161,304 population in the project area. Since the project is located far from the community, a margin of error of 0.057% would yield a sample size of approximately 302 samplings using Slovin'c formula as shown below.

Slovin'c Formula:

$$n = N / (1 + Ne^2)$$

Where: n = number of samples
N = total population
e = magin of error

Figure 103. Perception interview in SP 2

Of the 304 respondents surveyed, around 212 or 70.20% are male while the remaining 90 or 29.80% are female (**Figure 104**). The religious affiliation of the respondents 100% are Islam.

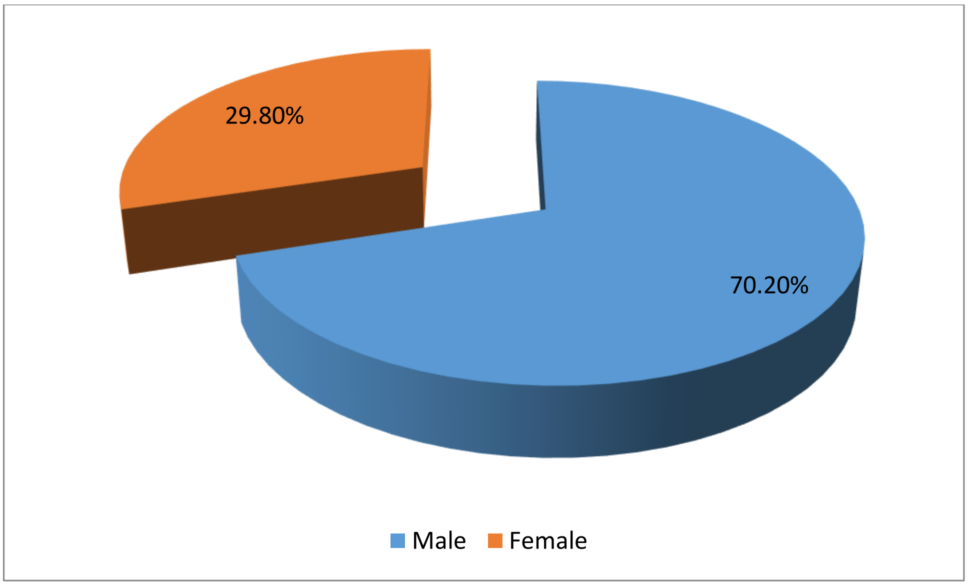


Figure 104. Gender of Respondents

In terms of age, 50 to 54 are the largest age group interviewed representing 18.21% of the respondents followed by aged 45 to 44. A summary of the age distribution of the respondents is shown in **Table 78**.

Table 78: Age Distribution of the Respondents

Age	Frequency	% Percentage
20-24	10	3.31%
25-29	22	7.28%
30-34	23	7.62%
35-39	32	10.60%
40-44	42	13.91%
45-49	46	15.23%

50-54	55	18.21%
55-59	42	13.91%
60-64	19	6.29%
65 and above	11	3.64%

Figure 105 shows the civil status of the respondents. Majority 289 or 95.70% of the respondents are married with spouse present. Only 13 or 4.30% of the respondents are single.

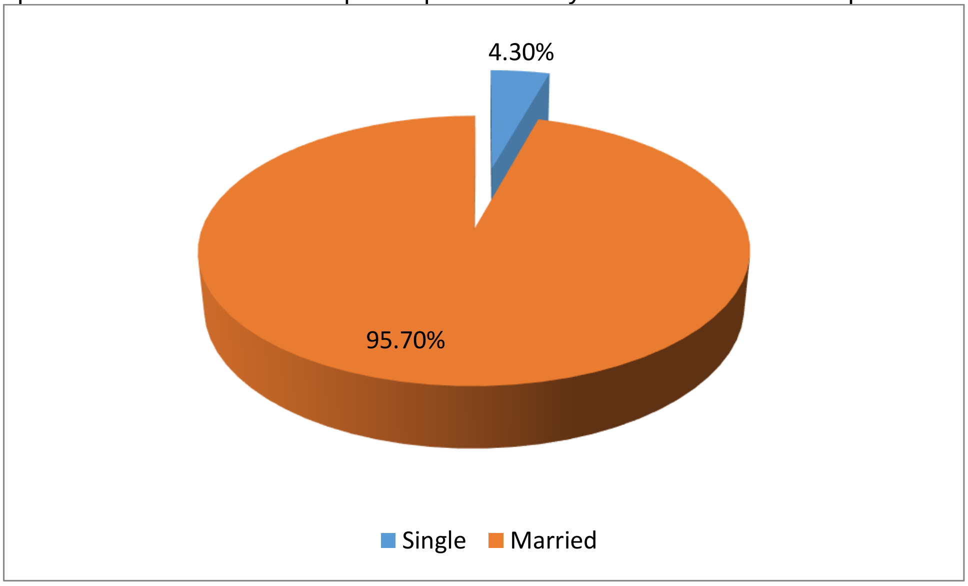


Figure 105: Civil Status of the Respondents

Figure 106 shows the highest educational attainment of the respondents. Around 93 or 30.79% of the respondents reported that they were finished up to high school while 57 or 18.87% reported being able to reach high school level only. Around 49 or 16.23% of the respondents reported being able to finish elementary level. Only around 7.28% of the respondents answered reaching college level and only around 2.32% reported finishing college. Around 12.91% of the respondents reported they have not received any formal education.

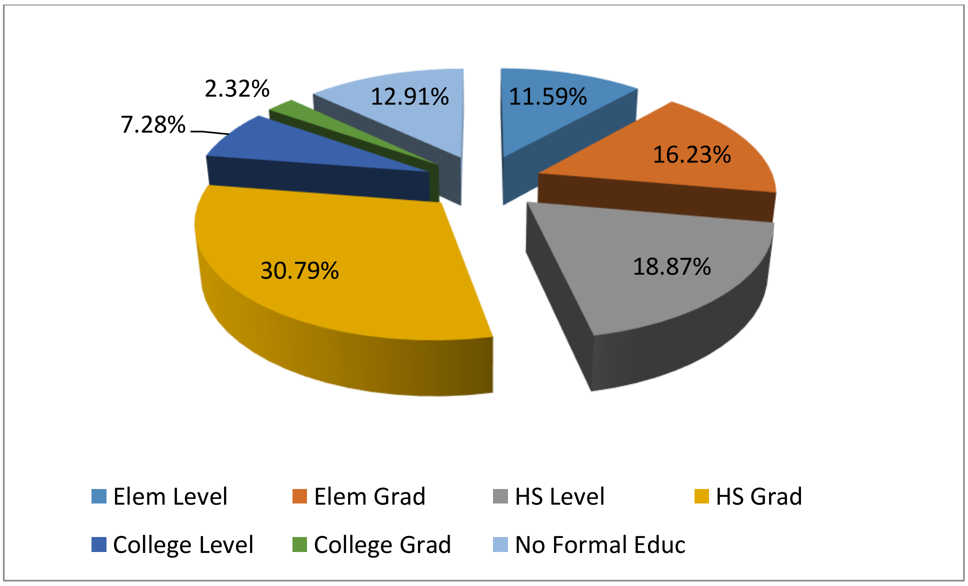


Figure 106. Educational Attainment of the Respondents

Table 79 shows the number years that the respondents have lived in the barangay. The three highest frequency of stay in the barangay are 50 to 54, 45 to 49 and 40 to 44 and 55 to 59. The data notices that most of the respondents lived in the barangays or communities since their birth.

Table 79: Respondent's Years in the Barangay

Years in Barangay	Frequency	% Percentage
5 years and below	0	0.00%
5-10	0	0.00%
11-15	0	0.00%
16-20	3	0.99%
21-24	7	2.32%
25-29	22	7.28%
30-34	23	7.62%
35-39	32	10.60%
40-44	42	13.91%
45-49	46	15.23%
50-54	55	18.21%
55-59	42	13.91%
60-64	19	6.29%
65 and above	11	3.64%

3.5.3.2 Income and Employment

Table 80 shows the employment profile of the households. Based on the occupation or source of income of the respondents, most of them depend on farming 68.87% and laborers 50.33% in the project area. Farming is the most strategic form of work due to the proximity of these people to the community. Around 20.53% are engaged in fishing, 16.56% are employed while 15.23% are engaged in others occupation. Households' employment profiles are not limited with one (1) work hence the frequency are more than the number of the respondents.

Table 80: Employment Profile

Household Employment	Frequency	% Percentage
Farming	208	68.87%
Employed	50	16.56%
Self-employed	0	0.00%
Business	0	0.00%
Fishing	62	20.53%
Laborers	152	50.33%
None	0	0.00%
Others	46	15.23%

The household income of the respondents reflects the status and capacity of providing the basic needs of the family. **Table 81** shows the household income reported by the respondents. As per interview, 40.73% have a total monthly income of 5,000 to 10,000 pesos, 33.44% are 11,001 to 15,000 pesos, 12.25% earned 16,000 to 20,000 pesos, 8.94% have an income of 21,000 to 25,000 pesos, and 4.30% earned 26,000 to 30,000.

Table 81. Household Income

Household Monthly Income	Frequency	% Percentage
5,000-10,000	123	40.73%

11,000-15,000	101	33.44%
16,000-20,000	37	12.25%
21,000-25,000	27	8.94%
26,000-30,000	13	4.30%
31,000-35,000	1	0.33%
36,000-40,000	0	0.00%
41,000 and above	0	0.00%

3.5.3.3 Gender Roles

In terms of gender role in the community, results from the household survey show that in the activity profiling, farming are dominantly performed by men, including construction activities. Reproductive activities such as childcare, home maintenance, food preparation, and other household choirs are done by women. On the other hand, based on gender access and control, the economic aspect in households is equally controlled by both genders.

3.5.3.4 Health and Sanitation

In terms of health, headache, allergy, cough, diarrhea, hypertension and flu are the most common form of illness experienced by the respondents and their family members. The common causes of death are cancer, heart disease and pneumonia.

Most respondents go the Barangay Health Center and Rural Health Center for their medical needs. More serious cases are referred to the Provincial Hospital or private medical practitioners in Cotabato City.

3.5.3.5 Access to Water

In terms of access to water, all of the respondents utilized water from spring for their drinking and domestic water needs.

3.5.3.6 Access to Electricity

Figure 107 shows that majority of respondents' source of electricity are from solar (86.42%) a and 13.58% are from local electric supply. This result indicates that the people in the area are in need of power connection especially in Balabagan and Kapatagan on which electric source are not available.

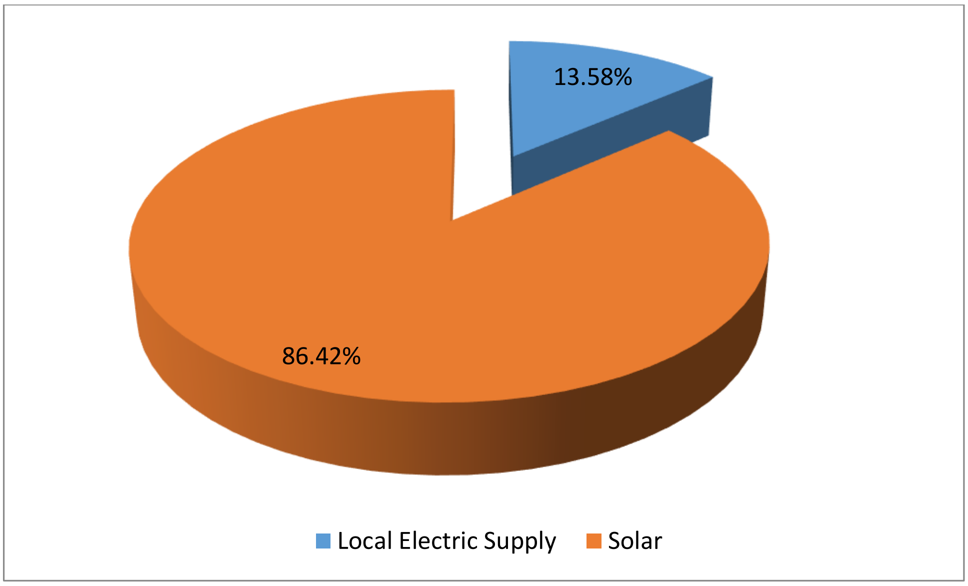


Figure 107: Source of Electricity

3.5.3.7 House Types

Among the respondents, 61.26% of them have semi-concrete house structures, 28.48% are made of light materials and 10.26% of them made of concrete materials. **Figure 108** shows the percentage of house types in the study area.

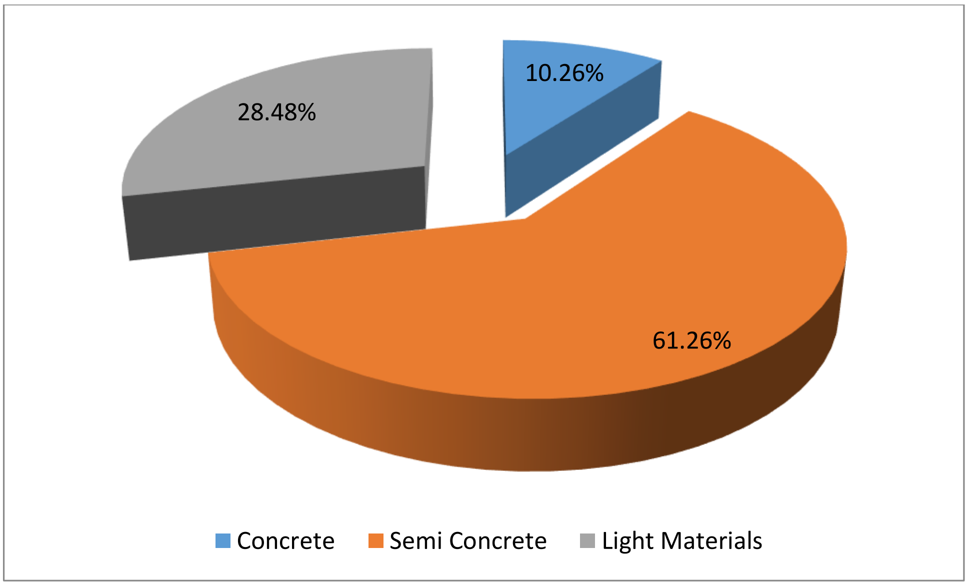


Figure 108: Type of House

3.5.3.8 Waste Management

The domestic waste disposal practiced by the respondents' shows in **Table 82**. They stated that they are burned (69.12%) their waste. Also, they stated that they practiced open pit (29.12%) as a means of waste disposal.

Table 82. Waste Disposal

Household Employment	Frequency	% Percentage
Collected	0	0.00%
Burned	199	65.89%
Open pit	86	28.48%
Others	17	5.63%

3.5.3.9 Type of Toilet System

In terms of type of toilet system, survey result shows in **Figure 109** that 274 or 90.73% of the respondents have their own private toilet system. Around 28 or 9.27% respondents mentioned that they shared by household.

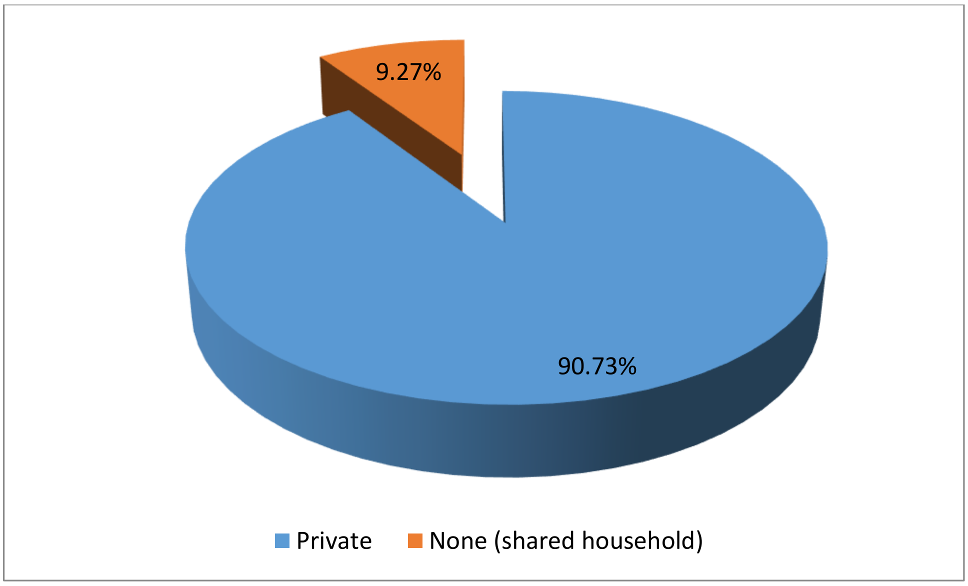


Figure 109: Type of Toilet System

3.5.3.10 Knowledge of the Project

When asked if they are aware of the proposed construction of road network development project in conflict-affected areas in Mindanao, all of the respondents mentioned that they are fully aware of the proposed project. When asked of their source of information about the project, local officials are the most common source of information for those aware of the project. Other government agencies and the project proponent were also identified as sources of information about the project by the respondents.

Figure 110 shows that around 198 or 65.56% of the respondents mentioned that the project to have very beneficial while around 89 or 29.47% believe that the project would be extremely beneficial and 15 or 4.97% mentioned that the project have moderate beneficial in their communities.

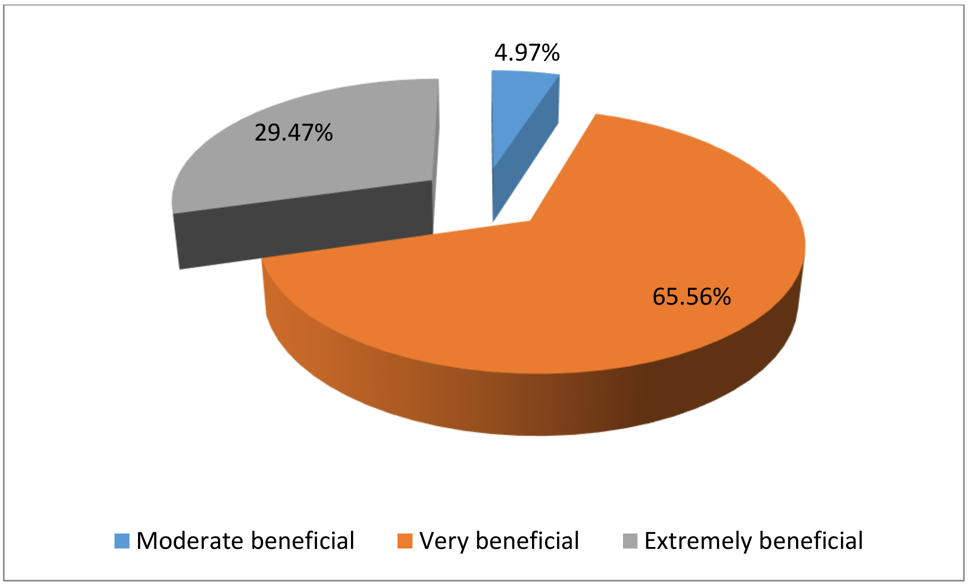


Figure 110 Perceived Beneficial Effects of the Project

a) Perceived Positive Effects

Most of the respondents mentioned that the project implementation may have positive effects on the economic aspect of the residents especially those engaged on business. Also, the respondents mentioned that the proposed project will improve accessibility, farm products delivery and quality of their life. This will also open opportunity for tourism which will benefit not only the LGUs but most especially the locals.

b) 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 that depends on the land/lot. 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. During the consultation, right of way acquisitions are the most significant issues and concern raised.

The respondents were also asked about their recommendation 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
- Provide information dissemination for the start of the construction of the project at the barangay level
- Close coordination between project proponent and the LGU

c) Project's Favorability

The results of the survey show that most of the respondents mentioned that they are in favor of the implementation of the project. There are respondents who are not in favor (4.30%) and anxious that they will be displaced and loss their income and land. The series of consultation also reflects favorability among stakeholders, however the main concern is the compensation/relocation of affected people.

Residents from Barangay Batuan and Molimoc, Balabagan have apprehension on the project because the houses and lot/land that might be affected. They requested that the project proponent will realign the location/area of the proposed project. Even though there are refusal on their side, they acknowledged that the project will still provide benefits to their community.

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.

d) Summary of the Study Conducted

In summary and conclusion, the positive effects of the proposed project are recognized by the concerned communities. The developments will provide local businesses, create employment and enhance the lives of the local government and community.

Based on the perception survey conducted, it can be concluded that the proposed project is socially acceptable at this stage. However, some are not in favor because of the fact that their settlements might be affected during the project implementation. It is possible that the residents will change their mind if extensive consultation and transparent communication are undertaken to discuss issues and concerns with the proponent, owner, tenants and LGUs and provision of measures to address such issues and concerns.

3.5.4 Health Service and Safety

3.5.4.1 Health Service

Insufficient health care facilities in four municipalities affected by SP 2. Among these are barangay heath centers, birthing facilities, and Rural Health Office from the LGU, which provides assistance to the municipalities. Another public hospital for more serious health problems, the Cotabato Regional Hospital caters to underprivileged families and individuals of the municipalities. Private hospital in Cotabato City, as well as other medical clinics complement the aforementioned government-owned hospital. However, no record of the total accounts of health facilities are available the three municipalities.

3.5.5.2 Peace and Order/Crime

On December 8, 2017, a resolution mandating local government units (LGUs) in the Autonomous Region in Muslim Mindanao (ARMM) to have a regular allocation for traditional madaris was passed during the 4th Regional Peace and Order Council (RPOC) meeting in Cotabato City on December 4, 2017.[2]

One resolution was passed to request the Supreme Court to designate special courts that will handle drug cases in the five ARMM provinces, while the other two resolutions were dedicated to the creation of an Anti-Terrorism Task Force and a Regional Anti-Drug Abuse Council.

In Lanao del Sur, the peace education has long been done in the whole province with great emphasis on dialogue of life and faith but yet institutionalize it in the regular school curriculum. According to Bishop Edwin dela Peña said that peace education is taking a key role in transforming a conflict and building a positive peace in the local communities where Muslims and Catholics co –exist. The PNP Lanao del Sur also strengthen barangay peace and order actions.

3.5.5.3 Recreational Facilities

The recreational facilities are limited in some barangays within the project area due to no budget allocation. The nearest place are the provincial capitol were recreational and sports facilities are located.

Impact of the road on the recreational facilities particularly to the direct project area would be very beneficial. The road will attracts tourist investors to develop the areas.

Section 4

SCOPING

4. Barangay Scoping

The barangay scoping meetings were held in fourteen barangays within the direct affected community as shown in **Table 83**. It was attended by 249 male and 67 female. The female or women's main concerns are the right compensation for the affected households, livelihood programs, and work for their husbands/spouse during the implementation of the sub-project No. 2.

These meetings discussed the project background and objectives, and the positive and negative impacts of the proposed SP 2 to the people, health, habitat, and among others. The major opinions of the participants are the process of land acquisitions and compensations as shown in **Table 84**. The queries and comments on the barangay scoping checklist was responded by the Study team.

Table 83. Contents Of Stakeholder Meeting on Scoping Stage Barangay Level

Date (venues)	Objectives of the meeting	Major Agenda	Participants	No. of Participants		
Jan. 8 and 9, 2018 Barangay Hall	Barangay Scoping in accordance with Philippines EIA Guidelines	1. Inform and generate awareness and understanding of the concerned public about the project; 2. To gather and address the queries and concerns and provide responses and clarifications to queries on the proposed project; and 3. To identify the foreseeable positive and negative effect of the Project based on the barangay scoping matrix.	Barangay Officials, Project-Affected Persons (PAPs), RAP, and JICA Study Team	Matanog		
				Barangay	Male	Female
				Kidama	21	4
				Sapad	22	3
				Parang		
				Macasandag	7	3
				Balabagan		
				Lorenzo	10	2
				Banago	5	1
				Narra	15	3
				Barorao	14	15
				Budas	14	7
				Batuan	14	4
				Molimoc	5	6
				Kapatagan		
				Bakikis	18	5
				Lusain	14	4
				Salaman	30	4
				Motimos	6	6

Table 84. Major Opinions in Stakeholder Meetings on Scoping Barangay Level

Date and Objectives; Agenda	Item on EIA		Major Opinion	Answers (DPWH, RAP, and JICA Survey Team's answers has been accepted and understood basically)
Jan. 8 and 9, 2018 Barangay Scoping in accordance with Philippines EIA Guidelines Agenda: Introduce the project and discuss the project objectives and the positive and negative impacts of the project.	Land	Properties, land, crops etc.	1. (Brgy. Lorenzo, Balabagan) Suggested that DPWH should closely coordinated and consulted the barangay and affected landowners before project implementation.	1. Yes, this will be noted for considerations of JICA/DPWH.
			2. (Brgy. Kidama, Matanog) What happen to the trees and lands that will be affected by the project?	2. They will be compensated as long as included in the inventory or during cut offs. DPWH will compensate the affected structures and other properties. Make sure that all affected people have legal documents like Certificate of land title, tax declaration, etc.
			3. (Brgy. Banago, Balabagan) Barangay Chairman recommends that affected properties must settled before the implementation. He is willing to intervene for any settlement.	3. The team noted the recommendations of the barangay chairman.
			4. (Brgy. Barorao, Balabagan) Farming is the main livelihood of the people in the barangay. They are seriously concerned of farm lots that will be traversing by the proposed road where their crops are planted like coconut, lansones, cassava, mango, marang, and others. Aside from these plantations, 15 households are affected by the crossing of the road.	4. Owners will be informed that properties affected by the road project are subject to a negotiation/settlement and will be compensation. They are advised to prepare proof of ownership such as certificate of land titles or tax declaration and have them presented to the RAP Team and DPWH during the survey/validation.
			5. (Brgy. Batuan, Balabagan) Who will pay for all the land/lots, structures like houses that will be affected by the project?	5. DPWH will pay the acquisition of all affected land/lots, structures based on the result of the inventory of RAP.

Date and Objectives; Agenda	Item on EIA		Major Opinion	Answers (DPWH, RAP, and JICA Survey Team's answers has been accepted and understood basically)
			6. (Brgy. Batuan, Balabagan) There is an affected private land along the alignment. The compensation should be settle before project implementation.	6. The RAP team will present the final list of the affected land, trees and structures to the affected community based on their conducted inventory. The listed affected people will be consulted for disclosure.
	Social Environment	Infrastructure	7. (Brgy. Macasandag, Parang) Based on the survey conducted by the other team, the start of the road alignment is near a water reservoir. There is also huge fishponds area to be traversed, a Muslim cemetery and creeks.	7. This will be considered in the study. Also, RAP Team already take note of this heritage since they already conducted the survey.
			8. (Brgy. Lusain, Kapatagan) Brgy. Captain stated that the proposed alignment will traversed a cemetery of the Muslim.	8. This will be considered in the design of the project for considerations of realignment
			9. (Brgy. Lusain, Kapatagan and Brgy. Salaman, Kapatagan) What are the needed documents to claim the compensation and what if the land owner has no documents?	9. The land/lot owners need to present the supporting documents such as title, certification or declaration as proof of ownership if not, they can't claim the said compensation
			10. (Brgy. Matimos, Kapatagan) What happen to the households who don't have land title?	10. DPWH is the implementing agency of the project. Secure all documents needed such as tax declaration with the help of barangay officials and LGUs so that all affected can be compensated.
			11. (Brgy. Sapad, Matanog) Requesting for farm to market road to be connected. on the proposed road.	11. The barangay officials can submit a resolution to Municipal Officials for endorsement to DPWH for considerations to their future project.
		Livelihood	12. (Brgy. Kidama, Matanog) Requested the proponent/JICA to provide livelihood program or support especially for the affected households.	12. This will be recommended to the proponent for the possibility to provide livelihood program for the affected households/families.

Date and Objectives; Agenda	Item on EIA		Major Opinion	Answers (DPWH, RAP, and JICA Survey Team's answers has been accepted and understood basically)
			13. (Brgy. Sapad, Matanog and Brgy. Budas Balabagan) Is it possible that the people in our community can work or be hired during the construction/ implementation of the project? This project is very helpful to the community if they will be hired during the implementation of the said project.	13. This local hire is priority to the project thru DPWH with the support of the LGU officials.
			14. (Brgy. Macasandag, Parang) The officials are appealing to be prioritized in labor and work when construction started.	14. This will be recommended to the proponent considering that they are qualified for the job.
		Peace and Order	15. (Brgy. Sapad, Matanog) To some residents, the proposed road project will serve as an access for the terrorist.	15. Security will be tightened when project will be implemented. The government will not allow this terrorism to happen.
			16. (Brgy. Sapad, Matanog) When will the final alignment be presented to the barangay?	16. RAP team will present to the affected community, the final alignment and will provide the list of affected households for the compensation. We suggested that you must secure necessary documents needed for the compensation ahead of time such as certificate of land title or tax declaration.
		Utilities	17. (Brgy. Narra, Balabagan) Residents are requesting for water system to be implemented in their barangay because they have been deprived from a water resources. They are buying water from private owner.	17. This is not part of the project, but the barangay officials can request through writing a resolution and submit it to the Municipal Office.
			18. (Brgy. Bakikis, Kapatagan) Requested JICA and DPWH to rehabilitated the potable water source. (Brgy. Bakikis, Kapatagan and Brgy Budas Balabagan) Provide livelihood program or support for the affected community.	18. This is not part of the project but will be noted for considerations.

Date and Objectives; Agenda	Item on EIA		Major Opinion	Answers (DPWH, RAP, and JICA Survey Team's answers has been accepted and understood basically)
		Utilities	19. (Brgy. Molimoc, Balabagan) Suggested to have a water system for their constituents.	19. This is not part of the project but be included as your concerns for considerations of JICA/DPWH
			20. (Brgy. Salaman, Kapatagan) Requested JICA and DPWH to add pipes in the reservoir of their water sources of the community.	20. This is not part of the project but be included as your concerns for considerations of JICA/DPWH
			21. (Brgy. Narra, Balabagan) The residents are also requesting for electricity because it has been 4 years that the barangay/municipal has no electricity.	21. Team noted their requests and recommendations.
			22. (Brgy. Lusain, Kapatagan) Suggestions: • The participants requested to fast track the implementation of the project. The project is very helpful for the people in the community in terms of transporting their products to other areas or barangays/municipality; and • We want the project to be implemented as soon as possible. We need the development in our community since the barangay Lusain is one of the poorest barangay in the Municiipality of Kapatagan.	22. Based on the timeline provided by JICA and DPWH, this will be implemented within President Duterte's Administration but depends on the outcome of the studies conducted.

4.2 Summary of Baseline Survey and Forecast

Table 85. Summary of Baseline Survey and Forecast

Category	No.	Impacted Item on JICA Guidelines (Philippines Item)	Rating		Rating After Bgy scoping		Summary Result		
			Pre/ During Construction		Pre/ During Con-struction	Operation Phase	Baseline	Forecast	Evaluation (Quantitative Standard)
Pollution	1	Air Pollution (Air Quality & Noise)	B-	B-	B-	B-	Result of (TSP, PM10, SO2NO2) at 2 stations are below the standard values.	Forecast value do not exceed standard values	Expected impacts by the project are not significant because all the forecasted values are within the standard values Quantitative Standards is shown in Table 75.
	2	Water pollution (water Quality)	B-	D	B-	D	Result of (pH, Temp, BOD, TSS, DO) are within the criteria guidelines	During construction activities may cause turbidity in water and oil and grease contamination. Likewise domestic waste may be discharge from the camp	Impacts may be minimized or mitigated by provision of erosion control measures such as settling traps, use of portable toilet,etc
	3	Waste	B-	D	B-	D	Not required	Clearing and deforestation activities are expected to generate construction waste such as soil, debris, cut trees Also additional domestic waste may be generated from the construction camp.	Impacts can be mitigated by proper management and disposal of waste like practice ecological waste management, segregation at source, 3R,etc

	4	Soil Contamination (Soil Quality)	B-	D	B-	D	Not required	Soil maybe contaminated from the construction equipment and transportation.	Impacts can be mitigated by proper maintenance of equipment and transportation, proper containment and disposal of oil,etc
	5	Noise	B-	B-	B-	B-	There are some measurement of noise that exceeded the standard particularly during the night due to presence of insects like crickets that make noise during the dark.	During construction, noise measurement will exceed because of the construction equipment use and transportation vehicle coming in n out of the site	Impacts may be mitigated by avoidance and other measures such as no construction during the night and dawn, use of personal protective equipment for workers such as ear plug, muffler or sound proof barrier.
	6	Ground Subsidence	D	D	D	D	Low elevations that form the transition between the coastal plain and hilly areas.	Some sections that could be prone to liquefaction may experience ground subsidence.	Impacts may be mitigated by geotechnical investigation to evaluate potential liquefiable soil layers.
	7	Odor	D	D	D	D	Not required	Few impacts are expected. Obnoxious odor may come from vehicle exhaust, clearing & dredging of river banks.	Qualitative measurements based on sensitivity of receptors against unobjectionable odor
	8	Sediment Quality	B-	D	B-	D	Not required	During construction sediment will most likely erode into the water particularly during heavy rains	Impacts may be mitigated through erosion /sedimentation control measures, or stoppage of soil clearing during heavy rains, use of silt trap
	9	Protected Area	D	D	D	D	Not required		No protected area is observed in the area.
Natural I Environment	10	Ecosystem (Terrestrial Flora and Fauna)	B-	C	B-	C	Floristic composition of the assessed alignment is vegetated with common and naturally growing species in the area. There are only 88 plant species were recorded dominated by trees. The result also showed that only 1 species is identified as	The project development will require removal of vegetation cover to give way for the construction of the proposed road project. 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	Prior to project implementation the proponent will coordinate to the DENR and Philippine Coconut Authority (PCA) to seek clearance for the identification of required documents for the issuance of needed tree and coconut cutting permits (PD 705). Moreover, to compensate the loss of habitats, the proponent will replace the number of trees removed/cut and plant them in

							critically endangered under the IUCN conservation categories. Faunal composition of the area is very low comprised of 36 species dominated by avifauna. Most of the species recorded are common and highly adaptive in wide a range of habitats and ecosystems including agricultural areas, shrub lands, grassland, within settlements areas and sometimes cited in highly urbanized areas and cities. *Six* (6) species are endemic in the study area dominated by Aves. Only one (1) species is near threatened in the category of the IUCN.	habitat/abode and remaining sources of food for survival. Likewise, wildlife disturbance due to noise pollution brought about by the operation of heavy equipment's during construction will force some faunal species to migrate to other or nearby areas/habitat where disturbance is less.	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. Planting of trees will help in sequestering carbon in the environment. 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 in 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". Compensation for affected coconut palms shall be based on Section 5 of Republic Act No. 8048, an act providing for the regulation of the cutting of coconut palms. Replacement ratio of cut coconut palm shall be 1:1.
	11	Hydrology	C	C	C	C	The river systems that affect the proposed road alignment are the Tigatan, Matimus, Salanga, Abunabun and Muda Rivers and Diarong Creek**.** During the conduct of field investigation, no ground	Earthworks may cause turbidity of river water and as to the springs reported on the alignment will most likely affected	Impacts may be mitigated by sediment and silt traps .Appropriate assistance for other source of water

							water wells or springs were found that may be affected by the project but based on the data from the National Water Resources Board (NWRB), two springs are within the vicinity of the road alignment namely; Macasandag Spring and Libuan Spring. These springs are used for municipal and irrigation purposes respectively. In general, the proposed alignment has a low susceptibility to flooding.		
	12	Topography and Geology	B-	B-	B-	B-	Characterized by low elevations at the upper half that form the transition area between the coastal plain and hilly areas. The lower half of the road alignment is generally steep due to the presence of Mt. Abunabun.	• The proximity of active faults exposes the project to moderate to strong ground shaking. • Some sections may be prone to liquefaction due to presence of loose/unconsolidated sediments with shallow water table. • Some sections passing through steep to very steep, hilly to mountainous terrain may be susceptible to slope failure, soil erosion, and rock fall. • The coastal barangays are prone to tsunami. Localized flooding may occur due to overflowing of water from rivers and other bodies of water.	• Conduct Probabilistic Seismic Hazard Assessment (PSHA). • Appropriate geotechnical investigation to evaluate potential liquefiable soil layers. • Impacts may be mitigated by slope protection. • Coordinate with PHIVOLCS regarding tsunami alerts. Impact may be mitigated by construction of physical structures, flood modeling, and early warning systems.

Social Environment	13	Involuntary resettlement (People)	B-	D	B+	D	c/o RAP for the exact accounts of affected.	Land acquisition may cause acquisition of agricultural land, crops and resettlement. Thus, RAP is prepared in accordance with JICA Guidelines and Philippine Laws.	Appropriate compensation and social assistance in accordance with Resettlement Action Plan (RAP) is prepared and minimize the adverse social impacts.
	14	The Poor (People)	B-/+	C	B+	C	Based on the profiles of the respondents during perception survey, 40.73 percent of the households are earning below poverty line (5,000 to 10,000pesos/month). This composed of the total income of the households per month which only reflects that almost half of the respondents are living in poverty.	Land acquisition by the project gives some adverse impact to poor people under poverty line.	Appropriate compensation and social assistance in accordance with Resettlement Action Plan (RAP) is prepared and minimize the adverse social impacts. Provision of livelihood/income to the poor may be consider.
	15	Indigenous and ethnic people (Indigenous People)	C	C	C	C	In terms of ethnicity, the project area is dominated with Maguindanaon and Maranao. There are also indigenous people occupying the mountainous area such as Manobo, Subanon and Tiduray however comprises only small portion of the project area. Few are	Few impacts are expected on designated indigenous and ethnic group. However, religious group(s) such as Iranun shall be monitored, and then adequate assistance and coordination shall be given, if necessary.	Appropriate compensation and social assistance in accordance with Resettlement Action Plan (RAP) is prepared and minimize the adverse social impacts. Provision of livelihood/income to the poor may be consider

							Cebuano's that is directly affected by the proposed project.		
	16	Local Economy such as employment and livelihood (People)	B	D	B	D	Based on the occupation or source of income of the respondents, most of them depend on farming 68.87% and laborers 50.33% in the project area. Farming is the most strategic form of work due to the proximity of these people to the community. Around 20.53% are engaged in fishing, 16.56% are employed while 15.23% are engaged in others occupation.	Land acquisition by the project gives some adverse impact to tenant farmers and employees of the shops.	Appropriate compensation and social assistance in accordance with Resettlement Action Plan (RAP) is prepared and minimize the adverse social impacts. Provision of livelihood/income to the poor may be consider
	17	Land Use and utilization of local resources (Land Use and classification)	B-	D	B-	D	The project alignment is passing through mainly agricultural area such as plantation and residential zone	.In terms of the Agricultural Land Zone (AG), impacts are considered as both positive and negative. Positive in the sense that the road can provide better and faster way, and as such more economical way of transporting products from these areas to trading centers and other distribution sites. Negative in the sense that there is an imminent danger of illegal conversion into other uses	some impacts are expected; thus these impacts and risks are minimized by appropriate land management
	18	Water usage (hydrology/ hydrogeology/water quality)	B-	B-	B-	B-	Water supply is scarce in some portions of project affected areas. Water source comes from dugwells and springs which are used for	Earthworks may cause turbidity of river water as being use for domestic.	Minimized by control measures like silt trap , sedimentation pond, etc Or appropriate assistance for tapping other source of water

							domestic and drinking water. In Balabagan, there are water delivery trucks in some areas that supplies water which costs Php 50 pesos per drum.		
	19	Existing Social infrastructures and services (People)	B-	D	B-	D	c/o RAP for the exact account of social infrastructure affected	c/o RAP for the exact account of social infrastructure affected	c/o RAP for the exact account of social infrastructure affected
	20	Social institutions such as social infrastructure and local decision-making institutions	C	C	C	C	Impacts are not expected, since local decision-making institute represented by local governments will continue after the road construction.	Impacts not Expected	Not required
	21	Misdistribution of benefit and damage	D	D	D	D	Misdistribution of benefit and damage caused by the road constructions not expected.	Impacts not Expected	Not required
	22	Local Conflict of interest (People)	C	D	C	D	Most of the stakeholders requested to provide work opportunities as a construction worker during construction in the stakeholder meetings on scoping stage	The local conflicts regarding work opportunities between local communities may be raised in case of unfair employment.	This risk is minimized by mitigation measures such as provision of priority in hiring during construction period.

	23	Cultural Heritage (People)	C	D	C	D	No cultural heritage affected.	Impacts not Expected	Not required
	24	Landscape	D	D	D	D	Not required	Few impact is expected	Not required
	25	Gender	D	D	D	D	LGU has implemented GAD projects	Impacts on Gender are mostly positive since opportunity for livelihood is expected (small business to women, employment to men)	Prioritization in hiring during construction and assistance for livelihood development
	26	Right of Children	D	D	D	D	Not required	Few impact is expected	Not required
	27	Infectious diseases such as HIV/AIDS (People)	B-	D	B-	D	No infectious illness recorded in the project area. Project should not to create a habitat of mosquito that transmits dengue fever in incidental pond in the construction area without appropriate drainage.	Infectious diseases such as STD are possible to be spread due to inflow of construction workers. Furthermore, alteration to ground by cut land and filling may provoke to provide habitats of mosquito that possibly transmits dengue fever	This risk is minimized by mitigation measures such as construction of sufficient drainage, management of construction yard and health check & education for workers.
others	28	Labor environment (including Work safety)	B-	D	B-	D	Not required	There are risks for workers during construction, if the construction contractor does not comply with relevant labor laws and regulations.	These risks are avoided and minimized by complying with relevant laws and regulations by the contractor under observation of DPWH
	29	Accident (Traffic Situation)	B-	B-	B-	B-	No serious problem on traffic	Construction vehicles may use existing local road near residential areas, thus number of traffic accident may increase	These risks are avoided and minimized by installation of traffic signage such as sign board, reflector/lighting in the night, safety personnel and parking for construction machines
	30	Cross boundary impacts and climate	D	D	D	D	Not required	During Construction, deforestation will incur. On loss of vegetation, the project development will require removal of vegetation cover to give way for the construction of road project. The removal of vegetation will	On loss of vegetation: During site preparation, clearing of the road ROW will result to the removal of of an estimated tree above ground biomass (using large of trees with dbh of 10 cm and above, and pole size tress

		change (Meteorology/climatology)						also result in the reduction in the population of plant species growing within the project 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 those mature vegetation in the area. During operations, generation of carbon monoxide and other gases will be generated from exhaust vehicles which will impact the ozone layer	with $\geq$ 5 cm dbh to 9.5 cm) of 1.59 x 10^{-4} and 2.87 x 10^{-4} megaram per hectare, and with estimated Carbon stored value of 3.53 x 10^{-4} and 6.38 x 10^{-4} megagram per hectare, respectively. It was computed using the brown allometric equation.

Note) Rating:
A+/-: Serious impact is expected. B+/-: Some impact is expected. C: Extent of impact is unknown (**serious impacts are not expected, but survey and analysis shall be done**) D: Few impacts are expected. Detailed quantitative survey is not necessary.
Source: JICA Survey Team

Table 86. Summary of Baseline and Forecasted Value (Air, Noise and Water)

No.	Item			Baseline Value (Standard Value)					Quantitative Forecast Analysis (Standard Value)				
1	Air Pollution	St.	Location	TSP	PM10	NO2	SO2		TSP	PM10	NO2	SO2	
		1	Brgy. Salaman, Kapatagan	18.1	4.6	1.7	1.0		-	4.7	1.8	1.0	
		2	Brgy. Poblacion, Balabagan	19.4	4.5	2.5	1.4		-	4.2	2.6	1.4	
2	Water Pollution	St	Location	pH (6.5-9)	Temp, ºC (25-31)	BOD (7)	TSS (80)	DO (5ppm min.)	pH	Temp, ºC	BOD	TSS	DO
		1	Budas River	7.5	29.0	2	23	8	-	-	-	-	-
		2	Matimos River	7.6	26.6	<1	12	8	-	-	-	-	-
5	Noise	St	Location	Morning (50)	Daytime (55)	Evening (50)	Night time (45)		Morning	Evening	Evening	Night Time	
		1	Brgy Salaman, Kapatagan	**51**	51	49	**51**		**55**	**56**	**52**	**50**	
		2	Brgy. Poblacion, Balabagan	**52**	52	**51**	**52**		**55**	**56**	**53**	**49**	

STANDARD VALUES OF AIR QUALITY

Item	TSP	PM10	NO2	SO2
Philippine Standard	230ug/Ncm	150 ug/Ncm	150ug/Ncm	180ug/Ncm
Japanese Standard	0.2 mg/m3		0.04-0.06 ppm	0.1 ppm

STANDARD VALUE FOR WATER QUALITY

Item	pH	Temp oC	BOD	TSS	DO
Philippine Standard	6.5-9	25-31	7	80	Min of 5 ppm
Japanese Standard	6.5-8.5		3	25	5ppm

STANDARD VALUE OF NOISE LEVEL

Class		Morning Time 05:00-09:00 (dB(A))	Day Time 9:00-18:00 (dB(A))	Evening Time 18:00-22:00 (dB(A))	Night Time 22:00-5:00 (dB(A))
Philippines Standard	Class AA	45	50	45	40
	Class A (General)	50	55	50	45
	Class A (facing 4 lanes road area)	50	60	50	45
	Class B (Commercial area)	60	65	60	55
	Class C	65	70	65	60
Japanese Standard	Class AA	-	(6:00-22:00) 50	(22:00-6:00) 40	-
	Class A	-	55	45	-
	Class A2	-	60	55	-
	Class B	-	55	45	-
	Class B2	-	65	60	-
	Class C	-	60	55	-
	Class C2	-	65	60	-
	Class D	-	70	65	-

Note1: Definition of Class on Philippines Standards (Agreement between DPWH, EMB and MMT as indicated in Annex 2-20 of the RPM for DAO 2003-30)
“AA” categorized areas (a section or contiguous area which requires quietness, such as an area within 100 m from school sites, nursery schools, hospitals, places of worships, and special homes for the aged)
“A” categorized areas (general residential areas)
“A” categorized areas (directly facing/fronting a 4 lanes road in residential area):
“B” categorized areas (general commercial areas)
“C” categorized areas (light industrial areas)

Note2: Definition of Class on Japanese Standards (Ministry of Environment in Japan)
“AA” categorized areas (sensitive area required to be calm such as hospital and social welfare facilities)
A” categorized areas (general residential areas)
“A2” categorized areas (directly facing/fronting more than 2 lanes road in “A” area):
“B” categorized areas (mainly residential areas)
“B2” categorized areas (directly facing/fronting more than 2 lanes road in “B” area)
“C” categorized areas (mixed area with residential, commercial and industrial areas)
“C2” categorized areas (directly facing/fronting more than 2 lanes road in “C” area)
“D” categorized areas (directly facing/fronting trunk road)

Table 87. ENVIRONMENTAL MANAGEMENT PLAN

Category	No.	Impacted Item on JICA Guidelines (Philippines Item)	Major Mitigation Measures		Responsibility	
			Pre and During Construction Phase	Operation Phase	Implementation Agency	Responsible Agency
Pollution	1	Air Pollution (Air Quality/Noise)	(Dust) ▪ Water sprinkling near residential area ▪ 20 kph speed limit for construction transportation/machines	(NO2, SO2, TSP) ▪ Setting up green buffer zone along the road (the zone and planting trees are carried out during construction)	Contractor	During Construction) DPWH (Operation Phase) LGU
	2	Water Pollution (Water quality)	(Turbidity) ▪ Discharge through sedimentation pond and silt fence ▪ Installation of Portable Toilet for workers ▪ Proper Waste and Construction Equipment management	Not required	Contractor	DPWH
	3	Waste (Abandonment)	(Construction waste (trees and waste soil) ▪ After considering the possibility of reuse, construction waste is disposed in designated disposal site) (Garbage from base camp) ▪ Garbage send to disposal site ▪ Used oil sent to TSD facility	Not required	Contractor	DPWH
	5	Noise	(Construction Noise) ▪ Installation of Noise barrier and selecting low noise equipment ▪ Avoiding works of heavy equipment during the night	• (Traffic Noise) • Establishment of green belt as buffer zone along the road	Contractor	

			▪ Informing the construction schedules to surrounding communities to obtain their consensus.	• Secure sufficient distance from boundary of the road to residential area • after construction of the road (Secure noise delay distance on land use plan along the road • Installation of noise barrier along sensitive area, if required		
	6	Sediment Quality (Soil Quality)	• Reuse or disposed at designated site	• Not required	Contractor	DPWH
Natural Environment	10	Ecosystem (Terrestrial Biology Freshwater or Marine Ecology)	• Relocation and replanting of trees along the road in ROW • Tree planting along DENR identified sites	▪ Appropriate land use management not to develop natural area along the road	During Construction) Contractor (Operation Phase) LGU	During Construction) DPWH (Operation Phase) LGU
	11	Hydrology	• Designating of bridges with sufficient capacity • Installation of sufficient drainage facilities • Secure waterways in construction area	Not required	Contractor	DPWH
	12	Topography and Geology	• Installation of Slope protection measures	Not required	Contractor	DPWH
	13	Involuntary resettlement (People)	• Appropriate compensation and social assistance in accordance with RAP	▪ Assessing whether resettlement have been met, particularly with regards to livelihood and restoration and/or enhancement of living standards in accordance with RAP	DPWH	LGU
	14	The Poor (People)	• Appropriate assistance in accordance with RAP	▪ Assessing whether resettlement have been met, particularly with regards to livelihood and restoration and/or enhancement of living	DPWH	LGU

				standards in accordance with RAP		
	15	Indigenous and Ethnic People (Indigenous people)	Not required However, situation of minority religious group (s) such as Islamic group shall be monitored and adequate assistance and coordination shall be given, if necessary	• Not required for designated Indigenous and Ethnic group specially if NCIP has been issued. • However situation of minority Religious group such as Islamic group shall be monitored and adequate assistance and coordination shall be given, if necessary	-	-
	16	Local Economy such as employment and livelihood	▪ Appropriate compensation and social assistance in accordance with RAP	Not required	DPWH	LGU
	17	Landuse and utilization of Local resources(Land use and classification)	▪ Appropriate land acquisition and compensation for Agricultural area	▪ Management of appropriate land use in accordance with approved detailed zoning map	DPWH, LGU	LGU
	18	Water Usage (Hydrology/Hydrogeology/Water Quality)	▪ Installation of alternative water distribution system when unexpected situation such as reduction of spring water and water level of wells	▪ Installation of alternative water distribution system when unexpected situation such as reduction of spring water and water level of wells	DPWF, LGU	DPWH, LGU
	19	Existing Social Infrastructures and services	▪ Appropriate compensation and/or relocation in accordance with RAP	Not required		LGU
	22	Local Conflict of interest	▪ Local workforce is prioritized for construction of road.	Not required	Contractor	DPWH

	23	Cultural Heritage	▪ Appropriate compensation and/or relocation in accordance with RAP	Not required	Contractor and DPWH	LGU
	27	Infectious diseases such as Dengue and HIV/AIDS	▪ Installation of sufficient drainage facilities not to provide habitat for vector mosquito ▪ Provision of adequate temporary sanitation facilities ▪ Enforcement of medical screening and periodical medical check up ▪ In order to prevent spread of infectious diseases such as HIV/AIDS, awareness of the labors is promoted	Not required	Contractor	DPWH
	28	Labor Environment (including Work Safety)	▪ Complying with relevant laws and regulations by the contractor under observation of DPWH	Not required	Contractor	DPWH
Others	29	Accidents (Traffic Situation)	• Deploying flagman at the gate and crossing points of the construction vehicles • Installation of safety sign board • Installing fence around the construction site to keep out local people such as children • Installation of lighting in the night time • Installation of parking for idling construction machines • Safety training for the workers	Not required	Contractor	DPWH

			• Safety patrol at the construction site by supervisors			
	30	Cross boundary impacts and climate change (Meteorology/Climatology)	▪ Replanting natural native trees and other agricultural trees such as coconuts	Not required	Contractor	DPWH

Source: JICA Survey Team

Section 5

ENVIRONMENTAL/ ECOLOGICAL RISK ASSESSMENT

5.0 ENVIRONMENTAL RISK ASSESSMENT

Introduction

This chapter on Environmental Risk Assessment (ERA) supplements the Environmental Impact Statement (EIS) study conducted for the proposed Road Network Development Project.

ERA is a process of analyzing the risks associated with a project or activity with particular focus on its impacts to human health. It deals with further analysis of hazards identified in the EIS. The basic questions in conducting an ERA are the following:

Methodology

The ERA will generally follow the revised EIA guidelines prescribed in DAO 96-37 and DAO 2003-30 to integrate risk assessment in the conduct of environmental impact assessments. This ERA addresses the following information requirements:

- Information relating to the scope of analysis used
- Information relating to the construction activities
- Information relating to every hazardous substance in the construction sites
- Information relating to possible hazardous situations in the construction
- Information relating to the consequences of major accidents and probability of occurrences
- Information relating to the safety management system.

To manage construction risks, the following source of potential risks should be included in the Risk Management Plan. **Figure 111** presents the overview of quantitative risk assessment procedure.

- Contractual risks. Missing milestone deadlines can cost time, money and a business its reputation.
- Occupational risks. The nature of a construction site means there are many risks that can cause injury and possible death. Worker behavior, technology, working methods, weather or a third party can cause accidents.
- Project risks. The lack of good project management, workplace procedures, or workplace policies and procedures that are ignored and poor time management are just few project risks.
- Financial risks. Financial risks include rising interest rates, a surge in material prices and a lack of sales.
- Stakeholder risks. Use project management software to bridge communication problems, miscommunication over changes and deliverables.
- Competition. Competitors can make life tough. They can drop prices to undercut prices and build times. This can put you under pressure to meet the same terms and put the project's profit at risk.
- Natural risks. Natural risks (storms, earthquakes) are beyond your control but can shut a construction site down.

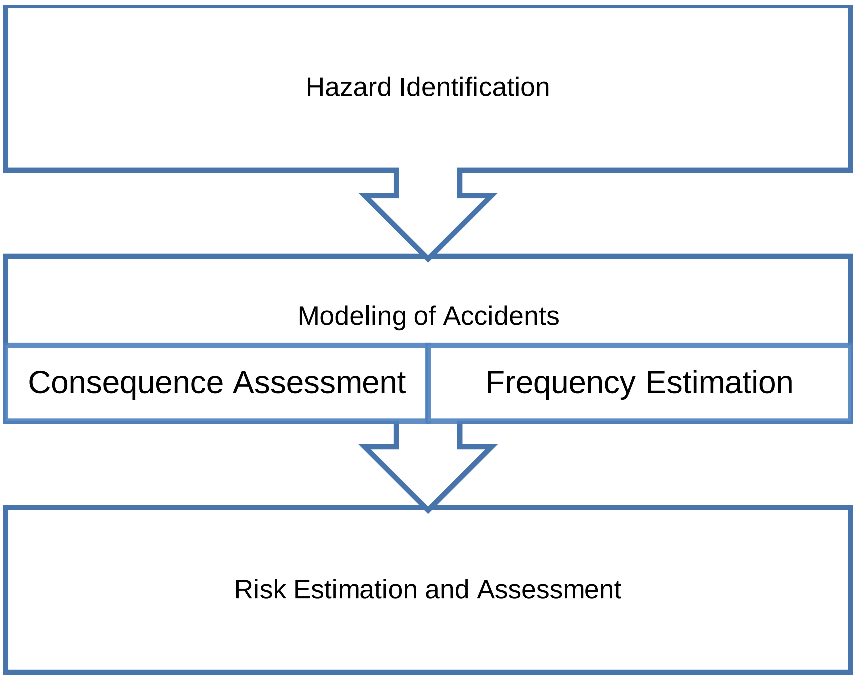


Figure 111: Overview of Quantitative Risk Assessment Procedure (IAEA, 1995)

The hazard identification phases involve the identification of hazardous substances and the potentially hazardous situations or activities in the facility. Based on the initial hazards identified, environmental pathways leading to the release of these substances due to the potentially hazardous situations will be assessed. The next steps in the procedure, which include consequence assessment and frequency estimation, are actually part of the whole risks characterization and evaluation process. This step will determine the likelihood of accident occurrences and the magnitude of impacts once they occur. The final stage involves the assessment of the resultant risks, whether they are significant from the point of view of risks unacceptability. Usually, a risk in the range of 10^{-6} frequency is deemed acceptable (ADB, 1991). Risk reduction measures should be developed for risks higher than this level. Otherwise, a risk management and prevention program is sufficient.

Assess risks for their order of importance

Assess the risks into order of importance from most likely to occur to the least likely. Also, rate each risk for the level of damage it can do if it does occur and the potential cost to your business.

5.1 Hazard Identification

A. Chemical Hazards

Hazardous Materials and Their Health Effects

Hazardous construction materials are natural or synthetic chemical substances that are harmful to humans or the environment. The chemicals and solvents to be stored and handled by the Project will be categorized according to the Revised DAO 2003-30 and Republic Act 6969 of the Department of the Environment & Natural Resources (DENR). The guidelines describe hazardous substances according to their reactivity, ignitability, corrosivity and toxicity potential. The hazardous materials that will be stored/ used by the project are presented in **Table 88.**

Table 88. Hazardous Materials that will be stored/used by the Project

HAZARDOUS SUBSTANCES
Paints
Thinners
Epoxy
Oils
Silica from cement

Based on the guidelines, paints/thinners are flammable substance with a flash point of <60^0C (closed up) or 60^0C (open cup). Ignitables are substances which can create fire under certain conditions, including but not limited to the following: liquids, such as solvents that readily catch fire and friction-sensitive substances. Ignitable liquid is any liquid with a flash point of not more than 60^0C, closed-cup test or 65.6ºC, open-cup test.

Volatile Organic Compounds (VOCs) are commonly found in solvents, paints, adhesives and protective coatings. VOCs usually cause irritation to eyes and respiratory track, dizziness, memory impairment, damage to kidney, liver and central nervous system.

Silica is a natural occurring substance found in stone, sand, concrete, tiles and bricks. It is absorbed in the body through inhalation after construction or demolition involving cutting, dressing, grinding or blasting stone or concrete release it in the air. Long term exposure to silica leads to lung infections and lung cancer.

Safety Data Sheet (SDS) of the hazardous materials to be used are required during construction activities. SDS presents a much more detailed discussion on the product, its composition, hazards identification, first aid measures, firefighting measures, accidental release measures, handling and storage, personal protection and exposure control, physical and chemical properties, toxicological and ecological information, and disposal and transport information.

Types of wastes from construction activities

Solid Wastes

Solid wastes include office waste like papers, Busted Fluorescent Lamps (BFLs), containers, e-waste, etc.; construction equipment waste like containers, expired and used solvents etc.; and domestic waste like food waste, packaging materials, etc.

Liquid Wastes

Liquid waste will be the waste water generated from the process and cleaning of equipment, and domestic waste. All waste water shall be treated before discharge to environment.

B. Mechanical and Physical Hazards

Physical Factors

Other work-related hazards may come from the following activities:

- Working around heat and electric current
- Operation of power and hand tools
- Moving along ladders, walkways, and platforms
- Lifting of heavy objects
- Test-running a machine

- Working with batteries
- Working with any machine; and
- Welding and cutting

Possible hazards that may exist during work activities:

- Slips/falls on the level
- Falls of persons from heights
- Falls of tools, materials, etc., from heights
- Inadequate headroom
- Hazards associated with manual lifting/handling of tools, materials, etc..
- Hazards from machinery associated with operation, maintenance, modification, repair and dismantling
- Vehicle hazards, covering both site transport, and travel by road
- Fire and explosion
- Violence to staff
- Substances that may be inhaled
- Substances or agents that may damage the eye
- Substances that may cause harm by coming into contact with, or being absorbed through, the skin
- Substances that may cause harm by being ingested (i.e., entering the body via the mouth)
- Harmful energies (e.g., electricity, radiation, noise, vibration)
- Work-related upper limb disorders resulting from frequently repeated tasks
- Inadequate thermal environment, e.g. too hot
- Lighting levels
- Slippery, uneven ground/surfaces
- Inadequate guard rails or hand rails on stairs
- Contractors' activities

5.2 Risk Management

Safety Management Measures

The Proponent shall ensure safety within and outside the facility at all times. A risk management program shall supplement the environmental management program presented in the EIS.

As a safety measure, Management shall include in its policies a strict adherence to environment, health and safety not only for its workers but for all those that might be involved or affected by its operation.

As part of standard operating procedures, all measures to safeguard the plant shall be strictly observed. This includes but is not limited to prohibition of smoking in the whole plant site, prohibition of entry or use of private electrical devices (mobile phones, cameras, radios, etc.) in the plant site, and through sensors and alarm devices in all areas where carbon dioxide can accumulate.,

Management shall likewise encourage good housekeeping in all phases of operations and ensure provision of adequate lighting, ventilation and working space. Use of personal protective equipment (PPE) where needed, as well as the conduct of regular training on safety and first aid, proper operation of equipment, proper handling of toxic and hazardous materials, etc.

The Proponent shall appoint a Pollution Control Officer and Safety Officer who will be assigned and responsible for implementing mitigating measures to avert environmental damage, health and safety of workers and shall conduct audits to monitor operations to ensure that such measures are being implemented.

It is recommended that environmental safety concerns in all phases of the operations should be defined, spelled out, explained and adhered to by all workers and managers alike. Top management support shall always be visible in all these undertakings.

The Pollution Control Officer and Safety Officer must be authorized to conduct audits and recommend sanctions if needed.

Company Policy on Safety and Environment

The Proponent is committed to ensure that the construction activity is hazard-free as possible and the factors leading to an accident are minimized if not totally eliminated.

The protocols to be formulated and implemented shall be as follows:
a] Emergency Response Procedures Manual
b] Medical Emergency Response Strategy Manual
c] Plant Security Manual
d] Crisis Management Manual
e] Road Transport Safety Management System Manual
f] Material Safety Data Sheet database.

The following shall be strictly observed during construction activities:

- Encouragement of good housekeeping in all phases of operations
- Provision of adequate lighting, ventilation, and working space
- Safety devices/warning systems in place within the Power Plant and Bioethanol Plant should be maintained
- Provision of safety paraphernalia like safety shoes, goggles, and breathing masks for workers
- Conduct of regular training on safety and first-aid, appropriate operation of equipment, proper handling of toxic or hazardous materials
- Maintenance of a fire truck, fire extinguishers, and fire drums in strategic locations and creation of an Emergency Response Team (e.g. fire brigade).

- Personnel Training

The personnel shall be given adequate training in coping with possible emergencies. They shall be regularly updated and trained n safety and emergency measures. Basic training shall include Signages used for danger communication and the Emergency Warning System used by the company.

Section 6

ENVIRONMENTAL MANAGEMENT PLAN

6.0 ENVIRONMENTAL MANAGEMENT PLAN

6.1 Impact Management Plan

The environmental impacts associated with the activities during the construction and operational phase have taken into the account the existing environmental conditions. It is assumed that the proposed road and bridge constructions in the area meet the requirements of the project.

6.1.1 Impacts on Land

6.1.1.1 Impacts

a) Loss/Deterioration of Current Vegetation Cover

The project development will require removal of vegetation cover to give way for the construction of road project. The removal of vegetation will also result in the reduction in the population of plant species growing within the project 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 those mature vegetation in the area.

b) 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 road network. This entails furthering disturbance of wildlife, loss of habitats and reduction to biodiversity composition of the area.

c) 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 to other or nearby areas/habitat where disturbance is less.

d) Erosion and Siltation

The removal of vegetation cover will lead to lost/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 the heavy influx of surface run-off waters resulting in erosion in the uncovered surfaces and siltation downstream of the project site.

6.1.1.2 Recommended Mitigating Measures

a) Replacement of trees cut due to land clearing

Prior to project implementation the proponent will coordinate to the DENR and Philippine Coconut Authority (PCA) to seek clearance for the identification of required documents for the issuance of needed tree and coconut cutting permits (PD 705). Moreover, to compensate the loss of habitats, the proponent will replace the number of trees removed/cut and plant them in 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 in 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".

b) Replacement of cut coconut palms and perennial crops

Prior to clearing of the proposed ROW of the project which involves cutting of coconut and other perennial crops, the DPWH ARMM shall secure a "cutting permits" separately that will be acquired from the Philippine Coconut Authority (PCA) office in the region. Compensation for affected coconut palms shall be based on Section 5 of Republic Act No. 8048, an act providing for the regulation of the cutting of coconut palms. Replacement ratio of cut coconut palms shall be 1:1. If the applicant failed to implement replanting, fees will be collected by the PCA and shall be used to fund the replanting activity as defined in Section 5 of Republic Act No. 8048. Compensation of high value crops such as banana, mango, durian, pomelo, mangosteen, papaya, rambutan, and lanzones shall be in accordance with the existing schedule of values from the municipal/ City Agriculture Office.

c) 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 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.

d) 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 on strategic areas for public information and warning.

e) 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 help provide a natural abode to some wildlife as well as source of food, and improve the ecological services of the entire road network during the operation phase. It is recommended that a 2 or 3-rows of tree plantation along roads shall be established in both side, avoiding electrical transmission lines as mandated under the the DPWH Order no. 15 series of 2015.

f) 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, away from the bodies of water/river. Installation of barrier nets, vegetative engineering technology, silt traps or sedimentation basin leading to water bodies is encouraging to minimize siltation.

6.1.1.1 Geohazards

Pre-Construction Phase

1) Ground Shaking

The proximity of active faults to the proposed road alignments exposes the f ollowing sub-projects to Moderately Strong to Strong ground shaking:

Recommendations:

- Conduct a site specific Probabilistic Seismic Hazard Assessment (PSHA) to quantify the rate (or probability) of exceeding various ground-motion levels at the Project Area given all possible earthquakes. Based on statistical analysis of past seismicity data, the Design Basis earthquake (DBE) and Maximum Considered Earthquake (MCE) can be derived. DBE and MCE are seismic design parameters that define the Peak Ground Acceleration (PGA) resulting from the movement of specific earthquake generator.
- The ground acceleration within the Project Area is estimated to be 0.21g for bedrock and about 0.60g for soft soils. These values should be considered in determining the seismic coefficient during the design of foundation of the proposed road project.

Liquefaction
The proximity of known earthquake generators and the presence of loose/unconsolidated sediments with estimated shallow water table along the alluvial and coastal plains could expose the following sub-projects to liquefaction

Recommendations:

- Conduct appropriate geotechnical investigation and laboratory tests to evaluate potential liquefiable soil layers in areas where the road alignments are planned to be constructed.
- Liquefaction potential is generally evaluated by comparing consistent measures of earthquake loading and liquefaction resistance. Among the various methods for evaluating liquefaction potential of soils, the simplified procedure of Seed and Idriss is the most widely adopted procedure.

Construction

2) Landslide (slope failure, soil erosion, and rock fall)

The alignment of the proposed road project passing through steep to very steep, hilly to mountainous terrain could be potentially susceptible to slope failure, soil erosion, and rock fall.

These include some sections of the roads located on slope of ridges, steep slopes with limited space for the alignment, and slopes with loose soil and rock materials that may require protections of the cut slope.

Recommendations:

- Conduct slope stability analyses to assess the stability of slopes during construction and long-term conditions, assess the possibility of landslides involving natural or engineered slopes, and study the effect of seismic loadings on slopes and road embankments.

- The following slope protection measures may be considered taking into account the prevailing geological and geotechnical conditions of the road alignment during construction:

  - Slope Improvement with Benching and Vegetation
  - Grouted Riprap with Vertical Anchor
  - Soil Nailing
  - Gabion Slope Protection System

Operational Phase

1) Tsunami

The Cotabato Trench and Philippine Trench are known generators of tsunamigenic (tsunami-generating) earthquakes. Studies by PHIVOLCS including historical records occurrences in the area indicate that the coastal barangays under the municipalities affected.

6.1.2 Impacts in Air

6.1.2.1 Increase 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, 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.

6.1.3 Increase Noise and Traffic during road/bridge construction

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.

6.1.3.1 Noise generating activities will be restricted to normal working hours, thus limiting noise levels at evening and nighttime to minimize the effect on the residents in the affected areas.

6.1.3.2 Contractors shall be required to ensure that construction equipment and vehicles are in a good state of maintenance. Workers are required to wear Personal Protective Equipment such as earplugs or earmuff during activities that have impact on noise like drillings.

6.1.4 Increase in Solid Wastes

Solid Waste Management Plan will be established. Segregation will be done on daily basis. Re-cycling, re-use and recovery will be employed. Solid wastes that do not exhibit the criteria and properties of a hazardous waste are picked up by local accredited haulers of the municipality.

Recommendations:

- In redevelopment of high risk areas, the following site planning techniques can be considered, namely:
  - Seawalls, hardened terraces, and berms can be built to block waves.
  - Ditches, slopes, or berms can slow down waves and filter out debris. The success of this method depends on correctly estimating the force of the tsunami.

Water can be steered to strategically-placed angled walls, and ditches. Theoretically, porous dikes can reduce the impact of violent waves.

6.1.5 Hazardous Wastes

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 by approved DENR accredited treatment and storage disposal (TSD) facilities.

6.1.6 Impacts on People

6.1.6.1 Apprehension of Locals towards the Project during Pre-construction phase

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 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. It will also serve as an initial step in the formulation of Education and Information and Campaign (EIC) Plan.

6.1.6.2 Influx of 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. 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.

6.1.6.3 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.

6.1.6.4 Displacement of Residents/Loss of Land in the Project Site and Within Its Vicinity

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.

6.1.7 Impacts on Water and Aquatic Ecology

6.1.7.1 Aquatic Ecology

Table 84 presents the potential impacts on marine ecology.

Table 89. Potential Impacts and Options for Prevention, Mitigation or Enhancement on Freshwater Ecology

Potential Impacts	Phases				Options for Prevention, Mitigation or Enhancement
	Preconstruction	Construction	Operation	Closure	
`Threat to Existence and Loss of Important Local Species		√			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.
Loss of Habitat		√			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.

a) Threat to Plankton Community

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 Taal Lake, the impact on plankton community are predicted to be low.

b) Threat to 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 marine habitat since the project will focus on the upland areas. However, as part of the monitoring program, marine ecology monitoring will be conducted congruently within the marine water quality stations. This ensures correlation of results of the biotic cover with that of the abiotic and physico-chemical parameters.

6.1.7.2 Wastewater

Domestic wastewater that will be generated during construction activities will be coming from urinals and portalets installed in the site.

Table 90 presents the Impact Management Plan and enhancement measures in each type of activity.

Table 90. 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						
	The Land Geology	Ground Shaking: - The proximity of active faults to the proposed road alignment makes it susceptible to moderately strong to strong ground shaking.	• Conduct a site specific Probabilistic Seismic Hazard Assessment (PSHA) to quantify the rate (or probability) of exceeding various ground-motion levels. • Determine the Design Basis earthquake (DBE) and Maximum Credible Earthquake (MCE) to define the Peak Ground Acceleration (PGA) resulting from the movement of specific earthquake generator. • The ground acceleration within the study area is estimated to be 0.21g for bedrock and about 0.60g for soft soils, which should be considered in determining the seismic coefficient during the design of foundation of the proposed road project.	Proponent/ Contractors	Included in the Pre-Construction cost	ECC
	The People	Communities along the Alignment significant impact identified is the apprehension of locals towards project	• Information dissemination in the community about the project through coordination with LGUs, PO's, NGOs, barangay officials and other concerned community groups	Proponent/ Contractors	Included in the Pre-Construction cost	ECC

		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.	should be conducted. This program will introduce the proposed project in the area and avert negative perception of people towards the project.			
		Loss of private lands, settlements and trees/crops	• Acquisition of private properties will be limited to the required 30 m RROW. Prompt payment of compensation at fair market values for land (DPWH R.A. 8974). Compensation and relocation concerns should be closely coordinated with the LGUs, barangay and affected community. A detailed Resettlement Action Plan will 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.			
		Affected Teduray along the alignment				

			• FPIC Process to ensure that concerns of the IP Group are considered			
II. Construction Phase						
Environmental Aspect # 1	The Land	Change in land use Destabilization of slope Removal of vegetation and habitat disturbance Soil erosion Increase run off	• Set-up temporary fence around the construction area • Conduct slope stability analysis and construct silt trap and spoils disposal area • 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 • 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.	Proponent/ Contractors	Included in the Construction cost	ECC

		Traffic congestion	• Preparation and implementation of traffic management scheme			
Environmental Aspect # 2	The Water	• Increase in run-off -Generation of domestic wastewater -Generation of wastewater from cleaning of construction equipment, vehicles and regular watering activities • Contamination of surface water with oil and grease	• Site clearing will be limited to areas needed and restricted to acceptable weather conditions • No clearance or establishment works will be undertaken along the riverbanks during high rainfall conditions to reduce the risk of sediment loss to the environment • Set up adequate toilet facilities; ensure sufficient washrooms for workers • Installation of silt traps to contain inflow of muddy waters • Installation of oil traps and proper storage of used oil	Proponent/ Contractors	Included in the operating cost	ECC
Environmental Aspect # 3	The Air	• Dust generation during clearing of the site • Dust generation associated with movement of vehicles and machinery • Exhaust fumes and noise from vehicles and equipment	• 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 trucks • Provide equipment with ear plugs, mufflers and proper scheduling of noise-generating activities	Proponent/ Contractors	Included in the operating cost	ECC
Environmental Aspect # 4	The People	• Increase in livelihood and business opportunities	• Alleviate economy and generation of income to hosts and nearby barangays • Increased LGU revenues resulting from the purchase of locally	Proponent	Included in the operating cost	ECC

		• Increase in revenues • Provide job opportunities for construction workers • Public Health Possible spread of communicable diseases due to solid and domestic wastes generated by the construction personnel	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 the construction stage shall be given priority, particularly those from families in the Direct Impact Area. • Female members of the community, particularly wives of tenant farmers can engage in small scale business enterprises such as eateries, and supply of other goods and services • Temporary sanitation facilities such as garbage bins and portable toilets must be provided by the Contractor at the construction area; • Regular disposal of the solid and domestic wastes to the designated disposal areas duly-approved by the host and affected LGUs must be strictly complied with • Weekly inspection of the work sites must be undertaken to			

		• Occupational Health	ensure proper management of the solid and domestic wastes generated • Construction personnel will be provided with Personal Protective Equipment (PPE) such as protective masks, ear muffs, and hard hats, and related gears • First aid stations supervised by the Environment and Safety Health Officer (ESHO) of the Contractor will be located within the construction site			

Environmental Aspect #5	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 – Sent cartons, steels and other recyclable materials to recyclers -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	Proponent/ Operator / Contractors	Included in the Operating cost	ECC

			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.			

III. Operation Phase

A positive impact is foreseen which will boost economic development, business opportunities, peace and order, fast travel to other municipalities etc. Expect more productive land use and utilization of local resources.
-Noise barrier along residential areas will be installed if necessary to minimize noise generated from vehicle passing.

Basic Services
The new road will provide easier transport of products from Farm to Market. Care and proper maintenance of the road to lengthen the benefits of the communities must be maintained.

IV. Decommissioning/Abandonment Phase

	The Land	• Land degradation • Loss of livelihood	• Preparation and implementation of comprehensive abandonment management plan • Proper clean-up and decontamination of affected site • Proper demolition of temporary construction yard and facilities • Disposal of hazardous waste • Provision of alternative livelihood	Proponent	Included in operating cost	ECC

Section 7

SOCIAL DEVELOPMENT PLAN (SDP), AND INFORMATION, EDUCATION AND COMMUNICATION (IEC)

7.1 STAKEHOLDERS MEETING/PUBLIC PARTICIPATION

A total of 22 stakeholders' meetings were held for SP 2**.** The stakeholders' meetings/ public consultations conducted (1st Public Consultations, Barangay Scoping and 2nd Public Consultations) are the Information, Education and Communication (IEC) based on the Philippine EIA guidelines held in the municipal halls of Parang, Matanog, Kapatagan and Balabagan with the affected stakeholders, barangay and municipal officials, and concerned LGU offices such as Assessors, MPDC as shown in **Table 91**. These meetings were attended by 596 participants (Male -441 and Female – 155).

The major questions of the participants brought out during the 1st and 2nd public consultations are enumerated below. All questions, comments and suggestions are answered by DPWH ARMM, JICA Cotabato, RAP, and EIA Study team as shown in **Table 92**.

1st Public Consultation:

a. What will happen to the landowner without land titles and proof of ownership;
b. What will happen to the land under the military reservations;
c. Realignment to avoid the Muslim cemetery, less affected community, and near the proper barangay (farm to market road) ;
d. Exact alignment of the road that will also benefits the PWD;
e. Who will compensate the affected land, crops, and other structures;
f. What will happen to the families if all of their properties will be affected;
g. Tress and fruit bearings are included in the compensations;
h. Necessary documents for claims and compensations;
i. Who will determine the price of the affected;
j. No compensation received for the affected landowner from the past projects of DPWH;
k. Avoid the proposed expansion of Air Strip in Balabagan Municipality; and
l. Proper knowledge on the process of compensations and needed documents;

2nd Public Consultation

a. What will happen to the new existing road?
b. Mayor hope that the proponent will consider the prevailing price because the assessed value is very low
c. How many meters will be occupied of the said road project?
d. When will we can submit the need requirements documents for the compensation?
e. Negative effects to the students on noise and air during construction
f. How about occurrence of flood
g. They hope that they will be compensated first before constructing the road
h. Priority to hire locals
i. Request for Realignment (Matanog)

During the 1st public consultations, the women's emphasized the importance of proper compensation for the affected landowners, work force from the community, livelihood programs, and business opportunities. While in 2nd Public Consultation, some express their support while others are still requesting for realignment of the road. This should be decided by JICA/DPWH and be discussed with the LGUs during the Steering Committee Meeting.Overall, the proposed sub-project No. 2 is socially acceptable based on the responses and feedbacks of the stakeholders. They are willing to be compensated and suggested to implement the project early from schedule.

Table 91. CONTENTS OF STAKEHOLDER MEETING MUNICIPAL LEVEL

Date (venues)	Objectives of the meeting	Major Agenda	Participants	No. of Participants
Dec. 7 and 11-12, 2017 1. Municipal Conference Room, Parang Municipality 2. Barira Municipal Conference Rm 3. Matanog Municipal, Multipurpose Hall 4. Balabagan Municipal Hall Executive Bldg.	Information Education and Communication (IEC) in accordance with Philippines EIA Guidelines	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 Preparers, Proponents and LGU 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.	Municipal Officials, Project-Affected Persons (PAPs) and Barangay Officials, RAP and JICA Study Team	Parang Male – 66 Female - 8 Matanog Male - 104 Female – 8 Balabagan Male – 37 Female – 23 Kapatagan Male – 64 Female - 17
February 27, February 28 and March 1, 2018 1. Conference Room, Balabagan, LDS 2. Conference Room, Parang, Maguindanao 3. Barangay Bakikis Covered Court, Kapatagan, LDS 4. Conference Room, Matanog	Information Education and Communication (IEC) in accordance with Philippines EIA Guidelines	To present and validate the results of environmental impact assessment	Municipal Officials, Project-Affected Persons (PAPs) and Barangay Officials,and JICA Study Team	Balabagan: Male-48 Female-38 Parang: Male-45 Female-13 Kapatagan: Male-58 Female 32 Matanog: Male-25 Female-16

Table 92. MAJOR OPINIONS IN STAKEHOLDER MEETINGS MUNICIPAL LEVEL

Date and Objectives	Agenda	Item on EIA		Major Opinion	Answers (DPWH, RAP, and JICA Survey Team's answers has been accepted and understood basically)
Dec. 7 and 11-12, 2017 Information Education and Communication (IEC) in accordance with Philippines EIA Guidelines	1. Introduce the project and discuss the project objectives and the benefits that can be derived. 2. EIA and RAP Process 3. Tentative Schedules 4. Solicit queries, comments,	Land	Properties	1. (Parang) Are the trees also included in the compensation? Is the fruit-bearing trees included to be paid or compensated?	1. Yes, they will be compensated as long as included in the inventory or during cut offs. All trees that will be affected with the project will be paid or compensated especially the fruit-bearing trees. DPWH will pay the trees based on their guidelines. It depends on the size, and height of the trees.
			Land Class	2. (Parang) What will happen to the land under military reservation?	2. The alignment of the project is not yet final. We will provide a copy of the results of the inventory per Barangay level for their information and confirmation.

Date and Objectives	Agenda	Item on EIA		Major Opinion	Answers (DPWH, RAP, and JICA Survey Team's answers has been accepted and understood basically)
	concerns and suggestions on the project	Socio/The People	Infrastructure Alignment/Project Details)	3. (Parang) Is there any way to realign the road to another area?	3. For now this is a proposed or under the feasibility study stage. There are proposed alternatives and best alignment. This consultation meeting is part of the study to discuss or confirm you if you are in favor on the proposed project. We need this road for easier access and to avoid traffic.
				4.(Parang) Can we request that the alignment avoid the cemetery of Muslim?	4. We will always considered and respect the heritage area for the benefit of the culture of the affected community. We need your cooperation during the survey in your community. Please provide us the right information so that we will not encounter any problem during the project implementation.
				5.(Parang) Affected people/areas are requesting for the possibility to move the alignment to avoid them or move to an area where there will be less affected.	5. We will request to the proponent to provide the affected community the final road alignment.
				6.(Parang) Where is the exact alignment of the project?	6. There are alternative options for the road alignment. The presented alignment is the feasible and will be finalized after the RAP inventory.

Date and Objectives	Agenda	Item on EIA		Major Opinion	Answers (DPWH, RAP, and JICA Survey Team's answers has been accepted and understood basically)
		Socio/The People	Infrastructure Alignment/Project Details)	7. (Matanog) We suggest/recommend that the best route is from Sitio 41, Sapad to Lagaan to Tubaran to Cabugao going to Kidama	7. We will see the possibility of your request/recommendations. May I suggest that the Barangay need to submit a resolution to the Municipality of Matanog thru Mayor to endorse the resolution to DPWH for inclusion of the suggested route to their future project.
				8. (Matanog) Is it the final alignment or can we realign the road?	8. No, the design is not final. We will wait the final results of the study and we will finalize the design of the proposed design of road.
				9. (Matanog) What is the route or alignment of the project road?	9. There are proposed alternatives and after the study, we will determine the best alignment favorable to the people.
				10. (Kapatagan) Currently, there is an ongoing road construction in our barangay that was implemented by Mayor, this proposed road alignment is continue with the ongoing construction?	10. This ongoing road construction implemented by DPWH ARMM was discussed during the first steering meeting in Manila. This proposed national road project is different location and far from the ongoing road construction.
				11. (Balabagan) Eng'r. Ogka Sapiano, Sr. proposed to reroute the road alignment (sta. 4+400 to 4+900) and move up to give way on the future expansion of the Air Strip. This proposed Air Strip expansion (refer google map vacant lot) is within the property of Lobregat Family.	11. The resolution will be helpful and provide advance information to JICA and DPWH on the plan of the municipality especially the Air Strip area.

Date and Objectives	Agenda	Item on EIA		Major Opinion	Answers (DPWH, RAP, and JICA Survey Team's answers has been accepted and understood basically)
				Eng'r. Sapiano said that the affected barangay in Balbalan Municipality are Narra, going to Batuan and Budas (creek). If the project will be implemented, the travel time will be less than 30 mins from barangay Poblacion going to Parang Municipality. While travel time from Balabagan to Parang will be shorten about 1 hour, and Matimos to Parang will be less than 30 mins. The product from barangay to the market will be transported easily. Everything that will be affected by the project will be included in the study such as impacts and compensations.	
		Socio/The People	Vulnerable People	12. (Parang) What is the design of the road? Is it accessible to all, with signage and PWD friendly?	12. The road will follow the design road guidelines of DPWH. It includes the signage and pedestrians especially for schools. We will always considered the needs of our PWD but there always a limitations.

Date and Objectives	Agenda	Item on EIA		Major Opinion	Answers (DPWH, RAP, and JICA Survey Team's answers has been accepted and understood basically)
			Properties	13. (Matanog) Who will determine the amount of the affected houses?	13. As part of the process of RAP, we will submit the results of inventory to DPWH. DPWH will decide the right cost or amount based on their guidelines. We will provide a copy of the results of the study per Barangay level for their information and confirmation.
		Socio/The People		14. (Parang) What are the needed documents for claims?	14. You need to secure certificate of land title or tax declaration.
				15. (Parang) Who will pay for all the structures like houses that will be affected by the project?	15. DPWH will be the implementing agency and will pay the acquisition of all affected land, structures after the inventory of RAP team.
				16. (Parang) What will happen to our families if almost all of the land area will be acquired? How can the project help us if we lose our property and livelihood?	16. DPWH along with the LGU will negotiate and help those who will be affected.
				17. (Parang) What will happen to land owners without land title?	17. Based on the discussion with JICA during our meeting in Manila last November 2017, DPWH will compensate the affected land owner. In absence of land/lot title and other supporting documents will not be compensated from DPWH. Land owners should secure proper documents. We strictly follow the guidelines of DPWH.

Date and Objectives	Agenda	Item on EIA		Major Opinion	Answers (DPWH, RAP, and JICA Survey Team's answers has been accepted and understood basically)
		Socio/The People	Properties	18. (Matanog) What happen to the houses and lands to be affected by the project?	18. DPWH will pay the acquisition of all affected structures after the conduct of RAP. Make sure that all affected people have a documents like land title and tax declaration.
				19. (Matanog) What happen to the households who don't have land title? The land came from our ancestors.	19. Without land title, no compensation from DPWH. The DPWH is in charge to pay for the affected land owner's. Must secure all documents needed so that all affected landowner's can be compensated.
				20. (Matanog) What kind of documents are we needed to be compensated? Our experienced from previous project with DPWH, they did not pay our affected constituent. Also, can you consider the amount provided by the owners?	20. Certificate of land title or tax declaration certified by LGU. For the cost, DPWH will negotiate to the land owner based on their guidelines, structures for compensation, and by what is the present cost of the said land considering the gathered data from assessor's office, local construction suppliers. Also, we will coordinate to the municipal assessor's office.

Date and Objectives	Agenda	Item on EIA		Major Opinion	Answers (DPWH, RAP, and JICA Survey Team's answers has been accepted and understood basically)
		Socio/The People	Properties	21. (Balabagan) What will happen to the affected barangay, does this will cause trouble? Possible affected stakeholders might get angry because of the damage property?	21. That is why we are gathered here because JICA avoided ROW problem. Your cooperation will be helpful because this might not be implemented if there will be a resistance. The affected property or trees will not be taken by the government for free. There will be a negotiations and process on the compensations. This is the main objective of the consultation. We need to cooperate because if we encounter resistance/oppositions, possible that this project might be delayed and Balabagan Municipality will be left on the development.
				22. (Balabagan) How to compensate those affected without land titles?	22. DPWH National will review the submitted RAP results. They will prepare a compensation plan on how to compensate those without land titles. But if the owner can provide a tax declaration, this will be considered and basis for the computations. Like the military reservation in Parang Municipality, there is no land title but the affected properties, trees and displacement of habitat will be included in

Date and Objectives	Agenda	Item on EIA		Major Opinion	Answers (DPWH, RAP, and JICA Survey Team's answers has been accepted and understood basically)
					the computations. All of this issue will be considered. We also have "agreed value", PAPs will be consulted if they agreed on the presented prices. The methodology, procedure and basis on the computations, and results will be presented during the barangay public consultations.
		Socio/The People	Properties	23. (Balabagan) Mayor Edna Ogka-Benito suggested to the Municipal Assessors office to assess and update the price of lands, trees and etc. to have a reasonable value for the benefits of the PAPs. Mayor advised the participants to apply for a land title to avoid any problem.	23. Noted.
				24. (Kapatagan) What will happen to our grandchildren, if our lot will be affected by the road alignment?	24. All affected lot will be compensated. The assessor's office will also help and assist the affected to prepare the needed documents if you have no title. This will be considered as public land.
		Soci o/T he Peo ple	Pro perti es	25. (Kapatagan) What will happen to our property without land titles?	25. This will be part of the study. All of this will be compensated especially those affected with titles and tax declaration.

Date and Objectives	Agenda	Item on EIA		Major Opinion	Answers (DPWH, RAP, and JICA Survey Team's answers has been accepted and understood basically)
					For affected without land titles, we will compensate the cost of the properties affected. The government thru DPWH will be fare for those affected with and without land titles. We will include this in our study and the estimated cost of the affected properties. All the collected data and estimated cost will be submitted to JICA and DPWH. DPWH is the implemented agency that will determine the true value of properties among others. Also, DPWH will prepare the compensation plan for the estimated cost.

Date and Objectives	Agenda	Item on EIA		Major Opinion	Answers (DPWH, RAP, and JICA Survey Team's answers has been accepted and understood basically)
		Socio/The People	Properties	26. (Kapatagan) What will happen if one affected barangay will disapproved on the proposed project?	26. All of the barangay and LGUs we have visited are very supportive on the project. In Barira Municipality, some of the barangays that are not affected on the road alignment suggested to be part of the alignment or reroute the alignment on their barangay because they want a development. The DPWH said mentioned during one of the public consultation that if the proposed national road will be constructed, the interior road going to the barangays are planned to be connected to this.
February 27, February 28 and March 1, 2018 Information Education and Communication (IEC) in accordance with Philippines EIA Guidelines	To present and validate the results of environmental impact assessment	Land	Properties	1. (Parang) Can we get those trees that will be cut?	1. This depends to DENR. They have processes regarding tree cutting.
				2. (kapatagan) What will happen to the trees that may be affected by the road project?	2. It will be compensated based on the results of the RAP assessment and considering the laws and policies adopted by DPWH
				3. (Kapatagan) How about those land with many owners	4. Those who is in the title of land will be compensated

Date and Objectives	Agenda	Item on EIA		Major Opinion	Answers (DPWH, RAP, and JICA Survey Team's answers has been accepted and understood basically)
		Socio/The People	Infrastructure Alignment/Project Details)	4. (Balabagan) What will happen to the new existing road?	4. The team explained that the proponent will check if the existing road is for improvement or for replacement.
				5. (Balabagan) How many meters will be occupied of the said road project?	5. Team responded that only 30 meters will be occupied.
				6. (Kapatagan) What is the final size that may be affected by the road project? If 60 meters will be taken, they will lose all their lands.	6.The team responded that the final size or right of way is 30 meters not 60 meters. Yes, bridge is also included in the project.
			Properties	7. (Balabagan) What is the basis of compensation? Mayor hope that the proponent will consider the prevailing price because the assessed value is very low.	7. The RAP team will explain the details with regards on the pricing or compensation
				8.(Kapatagan) We also hope that we will be compensated first before constructing the road.	8. RAP will be implemented once the project is finalized. This is before the project implementation
				9. (Balabagan) When will we can submit the need requirements documents for the compensation?	9. RAP team will explain the process for compensation. They will conduct separate scoping

Date and Objectives	Agenda	Item on EIA		Major Opinion	Answers (DPWH, RAP, and JICA Survey Team's answers has been accepted and understood basically)
		Socio/The People	Properties	10. (Kapatagan) My house, land and trees will be affected. How will my family live? Who will pay and compensate us?	10 You will be compensated considering that you have legal documents that you owned the land, house a d trees subject for assessment of DPWH
				11.(Kapatagan) Will they pay us per sq.m?	11.Yes, the RAP team will present the detail information on compensation
				12. (Matanog) The surveyor did not informed some of the people or families regarding that their properties that may be affected	12. The team will coordinate to RAP team for proper coordination and information dissemination to the affected families. The RAP team will present the detail and results of their assessment.
				13. (Matanog) Mayor Guro reiterated to the team that his request for realignment was already raised during steering committee meeting with proponent in metro manila. If the rerouting will not be followed, there will be more affected and he cannot commit to negotiate with the proponent in terms of land acquisition. Only 10 meters are allowed by the people but more than that, he is not sure.	13. The realignment will be discussed with the proponent and JICA Study Team. This will be noted for consideration.

Date and Objectives	Agenda	Item on EIA		Major Opinion	Answers (DPWH, RAP, and JICA Survey Team's answers has been accepted and understood basically)
			Livelihood	14.(Kapatagan) We hope that we will be hired as security during construction	14.This will be recommended to the proponent considering that you are qualified to the job
		Water	Flooding	15. (Kapatagan) There are houses along the river which are within the alignment of the proposed road. How about occurrence of floods?	15. There are studies to avoid flooding in the area. This will be considered in the detailed engineering.
		Air	Noise Pollution	16. (Kapatagan) Are there negative effects to the students on noise and air during construction?	16. The team explained that there will be negative effect but will be mitigated through measures identified in the study. The constructor should follow the said measures to minimize impact on noise and air. Also, the residents can monitor if the contractor will not follow the environmental management plan.

7.2 SOCIAL DEVELOPMENT PLAN AND IEC FRAMEWORK IMPLEMENTATION

The indicative Social Development Framework (SDF) of the project is aligned with the Proponent's vision to support the affected barangays and the local government units so as to help improve the economic status and quality of life of its constituents.

The construction, operation and management of the road network 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. It is the company vision to support the community by complementing barangay efforts and resources in improving the delivery of services to its residents.

7.2.1 Social Development Plan

7.2.1.1 Objective

The Social Development Framework (SDF) of the project will address the issues and concerns and impacts identified during public consultation meetings as well as the result of the SES/perception survey in affected ROW alignment through the design of mitigating measures. The social development framework will incorporate sustainable interventions and makes use of gender sensitive approaches in mitigating project.

As part of social responsibility, the project proponent, will target the primary stakeholders, especially the affected informal settlers, tenants/farmers and various sectors (youth/women/elderly/PWDS) as partners of its developments efforts.

In the long term, it will strive to develop strategies that will alleviate poverty and improve the standard of living of affected communities through programs and projects that will harness their productivity to the fullest, strengthen their self-reliance values and enhance their dignity as member of civil society.

Below is a summary of DPWH's community relations and development programs.
Table 93 details the SDMP Plan/Framework pursuant to DENR AO 2003-30.

7.2.1.2 Programs

a] Information Education Campaigns
b] Community Development Projects and Community Relations Programs
c] Health
d] Donations
e] Baseline study

Table 93. 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, etc.)	1,000,000.00
Socio-cultural, Clean & Green Activities	500,000.00
Donations	500,000.00
TOTAL	8,000,000.00

7.2.1.3 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) 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 to DPWH for 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.

7.2.1.4 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 94 presents the summary of DPWH's SDF plans and framework.

Table 94: Social Development Plan (SDP) /Framework for Road Network Development 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 *Municipal 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
2. Gender, Responsive Livelihood / Employment for Men, Women, Youth & the Elderly livelihood skills a] High-value crops for farmers b] Employment - Job priority skills training for qualified workers	1. Association Chairperson 2. Qualified Project affected men, women, youth and elderly	1. LGU Municipality Planning Office 2. LGU Municipality Social Welfare & Dev. Office TESDA/TLRC - Various skills training courses DA/BFAR ▪ Technical training farming methods	Community Relations Officer (CRO); Livelihood Specialist	Pre-Construction; Construction; Operation	LGU / DPWH (according to the budget in table 7.1)
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	1. Barangay Kagawad for Health 2. Project's affected community	1. Municipal Health Officer 2. Barangay Disaster Management Committee	Community Relations Officer (CRO)	Operation	LGU/ DPWH (according to the budget in table)

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 Municipal Engineer's Office ▪ Identification of appropriate project site, design, provide funding support, organize & implement related educational and recreation activities	Community Relations Officer (CRO)	Construction Operation	LGU/ DPWH NGAs NGOs/ POs (according to the budget in table)
5. Environment & Sanitation ▪ Brgy. Solid Waste Management Plan ▪ Bio-sand water filters	1. Barangay Kagawad for Environment 2. Project's affected community	MENRO 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	Community Relations Officer (CRO)	Pre-construction Construction Operation	LGU/ DPWH/ NGAs/ NGOs/ POs (according to the budget in table)
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)
7. Spiritual	Barangay Assigned Catholic priest, Islamic Religious leaders, or	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)

	pastors of different denomination; IP leaders	Islamic Religious leaders IP leaders			
8. Infrastructure	*LGU: City and Barangays * Barangay Kagawad for Infrastructure * MPDO	* DPWH/ Municipal Engineer's Office * MPDO * LGU: Municipal and Barangays * Repair/Improvement /Expansion of Barangay Road	Community Relations Officer (CRO)	Pre-construction Construction Operation	LGU/ DPWH (according to the budget in table)

7.3 INFORMATION, EDUCATION AND COMMUNICATION 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 95** describes the IEC Plan/Framework of the company.

Table 95. IEC Plan/Framework of DPWH

Target Sector Identified as Needing Project IEC	Major Topic/s of Concern in relation to Project	IEC Scheme/ Strategy/ Methods	Information Medium	Indicative Timelines and Frequency	Indicative Cost
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, terrestrial protection and management	-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 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 1,000,000 per annum**

Target Sector Identified as Needing Project IEC	Major Topic/s of Concern in relation to Project	IEC Scheme/ Strategy/ Methods	Information Medium	Indicative Timelines and Frequency	Indicative Cost
			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		

Section 8

ENVIRONMENTAL MONITORING PLAN

8.0 Environmental Monitoring Plan (EMoP)

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.

The proposed Environmental Monitoring Plan with Environmental Quality Performance Levels (EQPLs) is shown **in Table 96** 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.

8.1 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-ARMM.

Table 96– 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	Fresh Surface Water Quality Stations: Major tributaries	Surface Water Total Suspended Solids (TSS), pH, BOD, DO, Oil & Grease, Color, turbidity	Grab Sampling RA 9275	Quarterly	Upstream; midstream and downstream -	PCO	50,000	Siltation Surface Water: TSS-75 mg/L pH: 6.4-8.9 BOD:6.5mg/L DO: 4.9 mg/L Oil & Grease: 1.9 mg/L Color: 70 TCU	Siltation Surface Water: TSS- 80 mg/L pH:6.5-9.0 BOD: 7 mg/L DO: ≥5.0 mg/L O/G: 2.0 mg/L Color: 75 TCU; no standard for turbidity	DAO 2016-08 Class C TSS: 80mg/L pH: 6.5-9.0 BOD: 7 mg/L DO: ≥5.0 mg/L O/G: 2.0 mg/L Color: 75 TCU; no standard for turbidity			RA 9275/ DAO 2016-08
	Riverbed Sediments	-Heavy metals (As, Ba, Cd, Cr, Cu, Pb, Hg,Se,F),	RA 6969	Semi-annual	Same stations with fresh surface water quality								RA 6969
	Air Quality Proposed site locations Upwind, downwind	Total Suspended Particulates (TSP)	1-hr Sampling per RA 8749	Monthly	Upwind; downwind; NSEW direction	PCO	250,000	Fugitive dust		RA 8749		Regular sprinkling activities	RA 8749
	Noise Quality Same as Air Stns (preferably with many receptors)	Ambient Noise (especially during drilling activities)	Grab sampling	Monthly/ Weekly during drilling	Upwind; downwind; NSEW direction	PCO	150,000	Intermittent noise		NPCC 1978		Ear plugs/ ear muffs as necessary	NPCC 1978
	Solid Wastes	Construction debris, papers, plastics, biodegradable wastes		Daily	Construction site / SW storage area	PCO	600,000			RA 9003			RA 9003

	Wastewater (domestic)	TSS, BOD, pH, Oil & Grease (canteen)	Grab Sampling RA 9275	As necessary	Common septic tanks for toilets & canteens	PCO	25,000	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		Storage Area/ Motorpool	PCO		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	CRO						Relocation 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 Soil Nutrients, Plant Tissue Nutrients	Line transect/ quadrat / trap	Annual	Within project vicinity and its affected barangays	PCO	200,000 (as necessary)						Other applic able local & interna tional standa rds

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
OPERATION PHASE During this phase, environmental monitoring in air, water, noise and other compartments of the environment may not be applicable. The LGU should ensure the environmental monitoring is in placed in their EMP program.													
DECOMMISSIONING/ABANDONMENT PHASE (IMMEDIATE AFTER CONSTRUCTION)													
Environmental Aspect	Land Clearing of construction debris; removal of construction equipment	-Heavy metals (As, Ba, Cd, Cr, Cu, Pb, Hg,Se,F)	Systematic sampling: Several Grab and composite Sampling	As prescribed	Contaminated sites (if any)	PCO	500,000	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

Section 9

EMERGENCY RESPONSE POLICY AND GENERIC GUIDELINES

9.0 Emergency Response Policy and Generic Guidelines

9.1 Contingency/Emergency Response Plan

DPWH/Contractor will prepare an Emergency Response and Disaster Plan which describes programs and actions in response to various major events such as disasters and catastrophes like earthquakes, flash floods, fires, explosion regardless of cause and landslides.

The Emergency Response & Disaster Plan describes policies, the members of the response team, its roles and responsibilities, operating procedures, personnel safety, property protection, sampling and monitoring. Audit and inspection reports are included in the plan. Trainings on emergency response and safety are programmed annually. Identification of risk assessment in case of natural disaster is also planned.

An environmentally-sound and safe workplace is ensured by supporting the education of staff and supporting healthy implementation of safety management practices. A Safety & Health Program in accordance with existing occupational safety rules and regulations will be formulated and strictly enforced among all workers. Safety Officers and Engineers will be appointed during construction and decommissioning/abandonment phases to oversee and implement the programs. Periodic monitoring and inspection is conducted; reports of incidents and accidents are communicated and reported to the Administration for appropriate action.

9.2 CONSTRUCTION PHASE

DPWH will make sure that all contractors have an approved Construction Safety & Health Program (CSHP) by the Bureau of Working Conditions (BWC) of the Department of Labor & Employment (DOLE).

The following are the important components of the CSHP applicable to the proposed Project:

9.2.1 Company Safety and Health Policy

A company Safety Policy will be formulated to serve as the guiding principle in the implementation of safety and health programs onsite. The policy shall be signed by the highest company official or his duly authorized representative and should include the Contractor’s policies on occupational safety, worker’s welfare, and health and environment.

The Safety Policy will include the commitment of the General Planner and the Contractor(s) to comply with the DOLE’s minimum safety requirements, reporting requirements under Occupational Health & Safety Standards (OSHS) regulations and other relevant DOLE issuances. These are:

a] Registration (Rule 1020 and D.O. 18-02)
b] Report of Safety Committee Organization (Rule 1040)
c] Notification of Accidents and Occupational Illnesses (Rule 1050)
d] Annual Work Accident/Illness Exposure Data Report (Rule 1050)
e] Annual Medical Report (Rule 1060)

9.2.2 Specific Construction Safety & Health Program

The General Planner as well as every contractor shall be required to submit its Construction Safety & Health Program. The company shall likewise institute its own Construction Safety & Health Program.

9.2.3 Construction Safety and Health Committee

The structure and membership is consistent with the requirements of Section 11 of D.O. 13, series of 1998.

9.2.4 Safety and Health Personnel

Requirements for personnel in charge of health and safety shall be complied with, as follows:

a] First Aid personnel should be certified by the Philippine National Red Cross (PNRC) with valid PNRC ID Card
b] Safety Officer must complete the 40-hour BWC prescribed safety and health course as required by Rule 1030 of the OSHS, as amended by D.O. 16. Safety officer shall be accredited by the BWC pursuant to D.O. 16
c] External physicians and nurses must complete the BWC-DOLE prescribed Occupational Safety & Health Course pursuant to Rule 1060 of the OSHS.

9.2.5 Specific Duties and Responsibilities of the Safety Officer

Specific duties and responsibilities shall be as outlined in Rule 1047 of OSHS.

9.2.6 Applicable In-house Safety & Health Promotion and Continuing Information Dissemination

a] Information dissemination or advisories to new employees prior to on-site assignment, e.g. orientation on Company Health &Safety policies and measures, hazards related to the job, and safe work procedures

b] Continuing education program, such as first aid training and its refresher course, refresher course on toolbox handling, construction safety training

c] Activities to convey information on safety and health IEC materials such as posters, pictograms, flyers, safety signage, handbooks, manuals, and bulletin boards

d] Arrangements for setting up of committees on safety and health if necessary

e] Schedule of safety-related activities, e.g. toolbox meeting, Health & Safety committee meeting.

9.2.7 Accident & Incident Investigation, Recording & Reporting

a] Investigation and Recording of all Accidents & Incidents
b] Notification to the appropriate DOLE Regional Office within 24 hours in case of fatal accidents.

9.2.8 Provisions for the Protection of the General Public within the Vicinity of the Company's Premises during Construction and Demolition.

Measures to ensure the safety of the general public, according to appropriate Provisions and Rules of the OSHS shall be strictly observed, as follows:

a]	Rule 1412.09	Protection of the Public
b]	Rule 1412.12	Protection against Collapse Structure
c]	Rule 1412.16	Traffic Control
d]	Rule 1413	Excavation
e]	Rule 1060	Premises of Establishments
f]	DO 13 Sec. 9	Construction Safety

9.2.9 General Safety within Construction Premises

Danger signs, barricades, safety instructions for workers, employees, general public and visitors shall be provided for such as housekeeping, walkway surfaces, means of access i.e. stairs, ramps, floor openings, elevated walkways, runways and platforms and lighting.

9.2.10 Environmental Control (Rule of 1070 of the OSHS)

The following shall be faithfully complied with:

a] Monitoring and control of hazardous noise, vibration and airborne contaminants such as gases, fumes, mists and vapors.
b] Provisions to comply with minimum requirements for lighting, ventilation and air movement.

9.2.11 Guarding of Hazardous Machinery (Rule 1200 of the OSHS)

The following shall be strictly observed:

a] Provision for installation/ design of built-in machine guards
b] Provision for built-in safety in case of machine failure
c] Provisions for guarding of exposed walkways, access ways, and working platforms.

9.2.12 Provision for Use of Personal Protective Equipment (PPE) (Rule 1080 of the OSHS)

a] Appropriate types and duly-tested PPEs shall be used by workers after the required training on their use
b] Provision for maintenance, inspection and replacement of PPEs.

The basic PPE required for all types of construction projects are helmets, safety shoes and working gloves. Other PPEs shall be required depending on the type of work and hazards.

9.2.13 General Materials Handling &Storage Procedures (Rule 1150 of OSHS)

This will include, but will not be limited to:

a] Safe use of mechanical materials handling equipment
b] Secure and safe storage facilities
c] Regular housekeeping
d] Clearly-marked clearance limits
e] Proper area guarding of storage facilities.

9.2.14 Installation, Use and Dismantling of Hoist and Elevators
(Rule 1415.10**of OSHS**)

a] Testing and Examination of Lifting Appliances shall be complied with, in accordance with Rule 1220 on Elevators and Related Equipment.

b] Provisions to ensure safe installation, use and dismantling of hoists and elevators, including periodic inspection of hoists and elevators.

9.2.15 Testing and Inspection of Electrical and Mechanical Facilities and Equipment.

The following rules of the OSHS apply and be strictly observed:

a]	Rule 1210	Electrical Safety
b]	Rule 1220	Elevators and Related Equipment
c]	Rule 1410	Construction Safety
d]	Rule 1415.10	Training and Examination of Lifting Appliances.

9.2.16 Worker Skills and Certification

a] Provisions to ensure that workers are qualified to perform the work safely
b] Provisions to ensure that only qualified operators are authorized to use and operate electrical and mechanical equipment.

9.2.17 Provisions for Emergency Facilities for Workers

Rule 1963.02 of OSHS-Emergency Medical Services Applies

9.2.18 Fire Protection Facilities and Equipment

a] Fire Protection facilities and equipment as required under Rule 1940 of the OSHS shall be provided.
b] Proposed structure and membership of cooperation with fire brigade shall be determined
c] Provision for training on emergency preparedness.

9.2.19 First Aid and Healthcare Medicines, Equipment and Facilities

a] Identification of the proposed first aid and healthcare facilities that the Contractor will provide to meet the minimum requirements of OSHS

b] Identification of the medical and health supplies such as medicines and equipment to be provided

c] Mandatory provision of first aid medicines and emergency treatment.

In the absence of the required onsite healthcare facilities, the company shall attach a copy of a written contract with a recognized emergency health provider as required under OSHS.

9.2.20 Workers Welfare Facilities

a] Provision for toilet and sanitary facilities
b] Provision of shower and washing facilities
c] Provision to supply food and meals (optional)
d] Provision of potable water for drinking and washing

e] Provision of locker rooms, storing and changing of clothes for workers.

9.2.21 Proposed Hours of Work and Rest Breaks

a] Work schedules, working hours, shifting schedules shall be specified
b] Frequency and length of meals and breaks shall likewise be allotted
c] Schedule of rest periods shall also be provided.

9.2.22 Waste Disposal

Method of waste management will be provided in accordance with government-mandated laws and regulations.

9.2.23 Disaster & Emergency Preparedness Contingency

Guidelines for the following will be prepared:

a] Emergency preparedness and response on vehicular or site- road accidents
b] Response to bomb threats
c] Preparedness and response for severe weather conditions
d] Preparedness and response to fire and explosion
e] Preparedness and response to earthquake, tsunami, and storm surge
f] Oil spill contingency
g] Preparedness and response for accidents in workplace.

9.2.24 Safety Program

Specific standard work procedures should be provided for the following activities:

a] Site Clearing
b] Excavation
c] Use, erection and dismantling of scaffoldings and other temporary working platforms
d] Temporary electrical connections/installations
e] Work at unprotected elevated working platforms or surfaces
f] Use of power tools and equipment
g] Gas and electric welding and cutting operations
h] Working in confined spaces
i] Use of hand tools
j] Use of mechanized lifting appliances for movement of materials
k] Use of construction heavy equipment.

9.3 HEALTH AND SAFETY AND ENVIRONMENTAL PLANNING

An HSE Meeting shall be held at least once a month.

A Health & Safety Plan shall be prepared to cover Construction and Operation phases. The plan shall be based on Health Safety & Environmental (HSE) Guidance Notes. These documents collectively describe the arrangements for securing the health and safety of everyone carrying out the work and others that may be affected by it.
The health and safety plan (HSP) shall be regularly reviewed and periodically updated.

The following list the HSP contents but shall not be limited to these scopes:

HEALTH AND SAFETY PLAN CONTENTS

9.4 INFORMATION FOR SUBCONTRACTORS

Prior to commencing work on site, this is to describe in the first and third paragraphs on Management:

a] Post Commencement on Site

Safety induction training will be given to all personnel entering the site. This induction training will inform the subcontractor(s) and their personnel of specific safety risks and hazards onsite. It will also inform them of site procedures and dress code, personal protective equipment (PPE) requirements, as well as welfare and first aid arrangements and emergency procedures.

b] Instruction regarding health and safety that require direct/ immediate action will be conveyed verbally, followed up by instructions in writing when applicable.

c] Toolbox talks will be given.

Any design information that is revised will be issued to the Subcontractor(s) using standard proformas from the company management system or others as applicable. Any procedural changes or revision to the Health & Safety Plan will be issued in writing.

d] Contractors will be informed about risks to their health and safety at regular subcontractor safety meetings.

9.5 HEALTH, SAFETY AND ENVIRONMENT PROCEDURES

DPWH shall develop and implement a written Safety & Health Program for its employees involved in operations. The program shall be designed to identify, evaluate, and control safety and health hazards, and provide for emergency response during operations.

The written Safety & Health Program shall incorporate the following:

9.5.1 An Organizational Structure

The organizational structure part of the Safety & Health Program shall establish the specific chain of command and the overall responsibilities of supervisors and employees. It shall include, at a minimum, the following elements:

a] A General Supervisor who has the responsibility and authority to direct all process operations.
b] A Site Safety and Health Supervisor with the responsibility and authority to develop and implement the site Safety & Health Plan and verify compliance
c] All other personnel needed for process operations and emergency response and their general functions and responsibilities
d] The lines of authority, responsibility, and communication

The organizational structure shall be reviewed and updated as necessary to reflect the current status of operations.

9.5.2 A Comprehensive Work Plan

The comprehensive work plan part of the Safety & Health Plan shall

a] Address the tasks and objectives of the site operations and the logistics and resources required to reach those tasks and objectives

b] Address anticipated clean-up activities as well as normal operating procedures which need not repeat the employer's procedures available elsewhere

c] Define work tasks and objectives and identify the methods for accomplishing those tasks and objectives

d] Establish personnel requirements for implementing the plan
e] Provide for the implementation of the training
f] Provide for the implementation of the required informational programs
g] Provide for the implementation of the medical surveillance program.

A site-specific Safety & Health Plan shall also be designed, which need not repeat the employer's standard operating procedures and Safety & Health Training Program;

Program Availability

The written Safety & Health Program shall be made available to any contractor or subcontractor or their representative who will be involved with process operations, to employees, to employee-designated representatives, and to regulatory agencies.

The site Safety & Health Program, which must be kept onsite, shall address the safety and health hazards of each phase of operation and include the requirements and procedures for employee protection.

The site Safety & Health Plan, as a minimum, shall address the following:

a] A safety and health risk or hazard analysis for each site task and operation found in the work plan
b] Employee training assignments to assure compliance
c] Personal protective equipment to be used by employees for each of the site tasks and operations being conducted as required by the personal protective equipment (PPE)
d] Medical surveillance requirements in accordance with the program
e] Frequency and types of air monitoring, personnel monitoring, and environmental sampling techniques and instrumentation to be used, including methods of maintenance and calibration of monitoring and sampling equipment to be used.
f] Site control measures in accordance with the site control program
g] Decontamination procedures
h] An Emergency Response Plan Meeting for safe and effective responses to emergencies, including the necessary PPE and other equipment
i] Confined Space entry procedures
j] A spill containment program meeting.

9.5.2.1 Pre-entry Briefing

The site-specific Safety & Health Plan shall provide for pre-entry briefings to be held prior to initiating any site activity, and at such other times as necessary to ensure that employees are apprised of the site Safety & Health Plan and that this plan is being followed. The information and data obtained from site characterization and analysis work shall be used to prepare and update the site Safety & Health Plan.

9.5.2.2 Effectiveness of Site Safety & Health Plan

Inspections shall be conducted by the site Safety & Health Supervisor or, in the absence of that individual, another individual who is knowledgeable in occupational safety and health, acting on behalf of the Employer as necessary to determine the effectiveness of the site safety and health plan. Any deficiencies in the effectiveness of the site Safety & Health Plan shall be corrected by the employer.

9.5.2.3 Site Characterization and Analysis

Operations shall be evaluated in accordance with local regulations to identify specific site hazards and to determine the appropriate safety and health control procedures needed to protect employees from the identified hazards.

9.5.2.4 Preliminary Evaluation

A preliminary evaluation of a site's characteristics shall be performed prior to site entry by a qualified person in order to aid in the selection of appropriate employee protection methods. Immediately after initial site entry, a more detailed evaluation of the site's specific characteristics shall be performed by a qualified person in order to further identify existing site hazards and to further aid in the selection of the appropriate engineering controls and personal protective equipment for the tasks to be performed.

9.5.2.5 Hazard Identification

All suspected conditions that may pose inhalation or skin absorption hazards that are immediately dangerous to life or health (IDLH) or other conditions that may cause death or serious harm shall be identified during the preliminary survey and evaluated during the detailed survey.

Examples of such hazards include, but are not limited to: confined space entry, potentially explosive or flammable situations, visible vapor clouds or areas where biological indicators such as dead animals or vegetation are located.

The following information, to the extent available, shall be obtained by the employer prior to allowing employees to enter a site:

a] Location and approximate size of the site.
b] Description of the response activity and/or the job/task to be performed
c] Duration of the planned employee activity
d] Site topography and accessibility by air and roads
e] Safety and health hazards expected at the site
f] Pathways for hazardous substance dispersion
g] Present status and capabilities of emergency response teams that would provide assistance to onsite employees at the time of an emergency
h] Hazardous substances and health hazards involved or expected at the site and their chemical and physical properties.

9.5.2.6 Personal Protective Equipment (PPE)

A Personal Protective Equipment Program, which is part of the employer's Safety & Health Plan and which is also a part of the site-specific Safety & Health Plan shall be established.

The PPE program shall address the elements listed below. When elements, such as donning and doffing procedures, are provided by the manufacturer of a piece of equipment and are attached to the Plan, they need not be rewritten into the plan as long as they adequately address the procedure or element.

a] PPE selection based upon site hazards
b] PPE use and limitations of the equipment
c] Work mission duration
d] PPE maintenance and storage
e] PPE decontamination and disposal
f] PPE training and proper fittings
g] PPE donning and doffing procedures
h] PPE inspection procedures prior to, during, and after use
i] Evaluation of the effectiveness of the PPE program
j] Limitations during temperature extremes, heat stress, and other appropriate medical considerations.

Personal Protective Equipment (PPE) shall be selected and used which will protect employees from the hazards and potential hazards they are likely to encounter as identified during the site characterization and analysis.

PPE equipment selection shall be based on an evaluation of the performance characteristics of the PPE relative to the requirements and limitations of the site, the task-specific conditions and duration, and the hazards and potential hazards identified at the site.

Personal protective equipment (PPE) shall be provided and used during initial site entry in accordance with the following requirements:

a] Based on the results of the preliminary site evaluation, an ensemble of PPE shall be selected and used during initial site entry which will provide protection to a level of exposure below permissible exposure limits and published exposure levels for known or suspected hazardous substances and health hazards and which will provide protection against other known and suspected hazards identified during the preliminary site evaluation.

If there is no permissible exposure limit or published exposure level, the employer may use other published studies and information as a guide to appropriate PPE.

b] Positive pressure self-contained breathing apparatus, or positive pressure air-line respirators equipped with an escape air supply shall be used when chemical exposure levels present will create a substantial possibility of immediate death, immediate serious illness or injury, or impair the ability to escape.

c] If positive-pressure self-contained breathing apparatus is not used as part of the entry ensemble, and if respiratory protection is warranted by the potential hazards identified during the preliminary site evaluation, an escape self-contained breathing apparatus of at least five (5)-minute duration shall be carried by employees during initial site entry.

d] If the preliminary site evaluation does not produce sufficient information to identify the hazards or suspected hazards of the site, an ensemble providing equivalent to Level-B PPE shall be provided as minimum protection, and direct reading instruments shall be used as appropriate for identifying IDLH conditions.

e] Once the hazards of the site have been identified, the appropriate PPE shall be selected and used.

f] The level of protection provided by PPE selection shall be increased when additional information or site conditions show that increased protection is necessary to reduce employee exposures below permissible exposure limits and published exposure levels for hazardous substances and health hazards.

9.5.2.7 Risk Identification

Once the presence and concentrations of specific hazardous substances and health hazards have been established, the risks associated with these substances shall be identified. Employees who will be working on the site shall be informed of any risks that have been identified.

Risks to consider include, but are not limited to:

a] Exposures exceeding the permissible exposure limits and published exposure levels
b] IDLH Concentrations
c] Potential Skin Absorption and Irritation Sources
d] Potential Eye Irritation Sources
e] Explosion Sensitivity and Flammability Ranges
f] Oxygen deficiency.

9.5.2.8 Employee Notification

Any information concerning the chemical, physical, and toxicological properties of each substance known or expected to be present onsite that is available to the employer and relevant to the duties an employee is expected to perform shall be made available to the affected employees prior to the commencement of their work activities. The employer may utilize information developed for the hazard communication standard.

9.5.2.9 Training

All employees working onsite (such as, but not limited, to equipment operators, general labourers and others) exposed to health hazards, or safety hazards and their supervisors and management responsible for the site shall receive training to meet the requirements of this paragraph before they are permitted to engage in operations that could expose them to hazardous substances, safety, or health hazards, and they shall receive review training.

Employees shall not be permitted to participate in or supervise field activities until they have been trained to a level required by their job function and responsibility.

The training shall thoroughly cover the following:

a] Names of personnel and alternates responsible for site safety and health
b] Safety, health and other hazards present on the site
c] Use of personal protective equipment (PPE)
d] Work practices by which the employee can minimize risks from hazards
e] Safe use of engineering controls and equipment on the site
f] Medical surveillance requirements including recognition of symptoms and signs which might indicate over exposure to hazards.

9.5.2.9.1 Initial Training

a] General site workers (such as equipment operators, general labourers and supervisory personnel) engaged in hazardous substance removal or other activities which expose or potentially expose workers to hazardous substances and health hazards shall receive a minimum of 40 hours of instruction off the site, and a minimum of three (3) days actual field experience under the direct supervision of a trained and experienced supervisor.

b] Workers onsite only occasionally used for a specific limited task (such as, but not limited to, water monitoring, process operations, or air monitoring) and who are unlikely to be exposed over permissible exposure limits and published exposure limits shall receive a minimum of 24 hours of instruction off the site, and the minimum of one (1) day actual field experience under the direct supervision of a trained, experienced supervisor.

c] Workers regularly onsite who work in areas which have been monitored and fully characterized indicating that exposures are under permissible exposure limits and published exposure limits where respirators are not necessary, and the characterization indicates that there are no health hazards or the possibility of an emergency developing, shall receive a minimum of 24 hours of instruction off the site, and the minimum of one (1) day actual field experience under the direct supervision of a trained, experienced supervisor.

d] Workers with 24 hours of training, who become general site workers or who are required to wear respirators as necessary, shall have the additional 16 hours and two (2) days of training necessary to total the training

9.5.2.9.2 Management and Supervisor Training

Onsite management and supervisors directly responsible for, or who supervise employees engaged in, hazardous waste operations, shall receive 40 hours initial training and three (3) days of supervised field experience (the training may be reduced to 24 hours and one (1) day if the only area of their responsibility is and at least eight (8) additional hours of specialized training at the time of job assignment on such topics as, but not limited to, the employer's safety and health program and the associated employee training program, personal protective equipment (PPE) program, spill containment program, and health hazard monitoring procedure and techniques.

9.5.2.10 Recordkeeping

An accurate record of the medical surveillance shall be retained. This record shall be retained for the period specified and meet the criteria.

The record shall include at least the following information:

a] The name and social security number of the employee
b] Physicians' written opinions, recommended limitations and results of examinations and tests
c] Any employee medical complaints related to exposure to hazardous substances
d] A copy of the information provided to the examining physician by the employer, with the exception of the standard and its appendices.

9.6 EMERGENCY RESPONSE PLAN

An Emergency Response Plan shall be developed and implemented by the company to handle anticipated emergencies, prior to the commencement of hazardous operations. The plan shall be in writing and available for inspection and copying by employees, their representatives, OSHC-DOLE personnel, and other governmental agencies with relevant responsibilities.

Employers who will evacuate their employees from the danger area when an emergency occurs, and who do not permit any of their employees to assist in handling the emergency, are exempt from the requirements of this paragraph if they provide an Emergency Response Plan complying with local regulations.

DPWH shall develop an Emergency Response Plan for emergencies which shall address, as a minimum, the following:

a] Pre-emergency planning
b] Personnel roles, lines of authority, training, and communication
c] Emergency recognition and prevention
d] Safe distances and places of refuge
e] Site security and control
f] Evacuation routes and procedures
g] Decontamination procedures which are not covered by the site Safety & Health Plan
h] Emergency medical treatment and first aid
i] Emergency alerting and response procedures
j] Critique of response and follow-up
k] PPE and emergency equipment.

Procedures for Handling Emergency Incidents

In addition to the elements in the emergency response plan, the following elements shall be included for Emergency Response Plan:

a] Site topography, layout, and prevailing weather conditions
b] Procedures for reporting incidents to local, provincial, and national governmental agencies
c] The emergency response plan shall be a separate section of the Site Safety and Health Plan.
d] The emergency response plan shall be compatible and integrated with the disaster, fire and/or emergency response plans of local, state, and federal agencies.

The Emergency Response Plan shall be rehearsed regularly as part of the overall training program for site operations.

The site Emergency Response Plan shall be reviewed periodically and, as necessary, shall be amended to keep it current with new or changing site conditions or information.

An employee alarm system shall be installed to notify employees of an emergency situation, to stop work activities if necessary, to lower background noise in order to speed communication, and to begin emergency procedures.

Based on the information available at time of the emergency, the employer shall evaluate the incident and the site response capabilities and proceed with the appropriate steps to implement the site Emergency Response Plan.

9.7 SANITATION AT TEMPORARY WORKPLACES

9.7.1 Potable Water

a] An adequate supply of potable water shall be provided at the site.

b] Portable containers used to dispense drinking water shall be capable of being tightly closed, and equipped with a tap. Water shall not be dipped from containers.

c] Any container used to distribute drinking water shall be clearly marked as to the nature of its contents and not used for any other purpose.

d] Where single service cups (to be used but once) are supplied, both a sanitary container for the unused cups and a receptacle for disposing of the used cups shall be provided.

9.7.2 Non-potable Water

a] Outlets for non-potable water, such as water for firefighting purposes, shall be identified to indicate clearly that the water is unsafe and is not to be used for drinking, washing, or cooking purposes

b] There shall be no cross-connection, open or potential, between a system furnishing potable water and a system furnishing non-potable water.

9.7.3 Toilet Facilities

Under temporary field conditions, provisions shall be made to assure not less than one (1) portalet toilet is available.

9.7.4 Food handling

All food service facilities and operations for workers shall meet the applicable laws, ordinances and regulations of the Municipal and Barangay where the construction sites are located.

9.7.5 Temporary Sleeping Quarters

When temporary sleeping quarters are provided, they shall be heated, ventilated, and lighted.

9.7.6 Washing Facilities

The company shall provide adequate washing facilities for workers engaged in operations where hazardous substances may be harmful to workers. Such facilities shall be in near proximity to the worksite; in areas where exposures are below permissible exposure limits and which are under the control of the company; and shall be so equipped as to enable employees to remove hazardous substances from themselves.

Section 10

ABANDONMENT, DECOMMISSIONING, REHABILITATION POLICY

10. ABANDONMENT, DECOMMISSIONING 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.

Section 11

INSTITUTIONAL PLAN FOR EMP IMPLEMENTATION

11.0 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.

11.1 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 112** shows the organizational chart of environmental and social team.

11.2 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.

11.3 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.

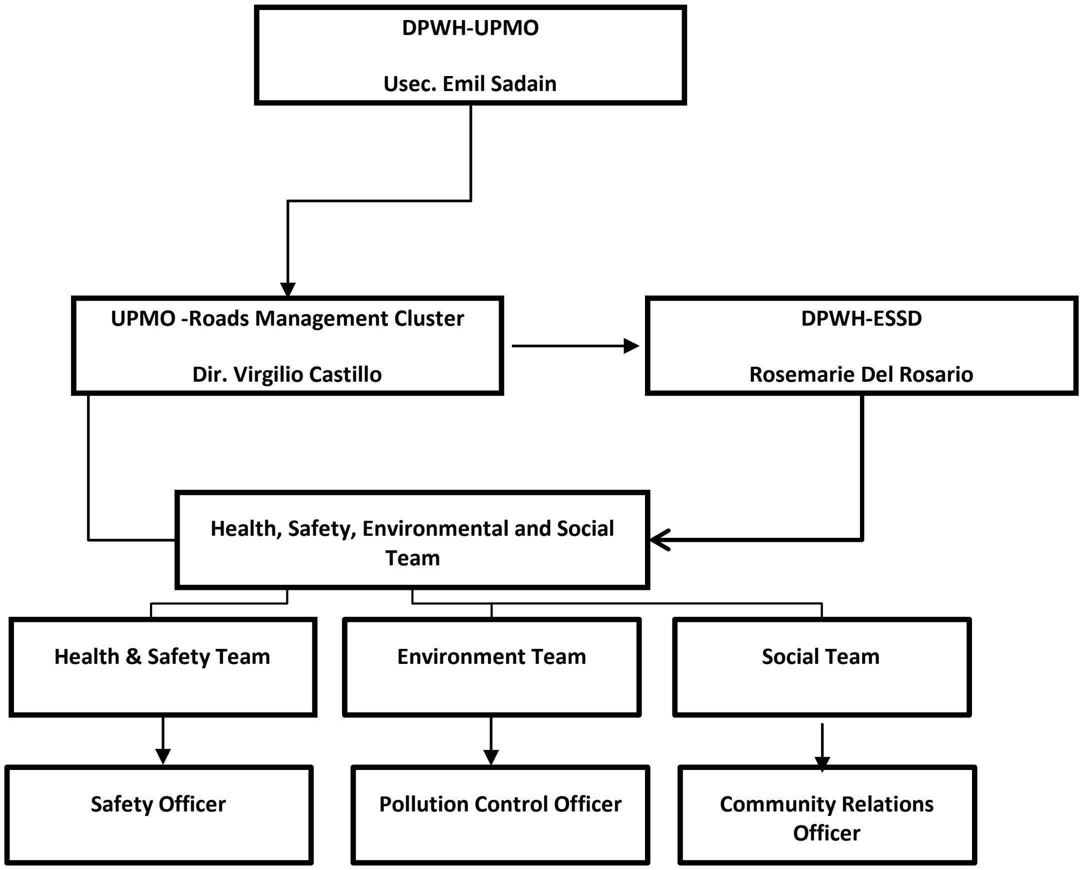


Figure 112. Organizational Chart of Environment & Social Team

Section 12

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