REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS

ROAD NETWORK DEVELOPMENT PROJECT IN CONFLICT – AFFECTED AREAS IN MINDANAO

(MARAWI CITY RING ROAD)

INITIAL ENVIRONMENTAL EXAMINATION (IEE) 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** **Marawi City Ring Road**
PROJECT LOCATION	**Municipality of Marantao, Piagapo, Saguiaran and Islamic City of Marawi, Lanao del Sur**
ROAD WIDTH	**6.7 meters**
ROAD LENGTH (TOTAL)	**19.8 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**
CONTACT PERSON & CONTACT NUMBERS	**Mr. Mitsuo Kiuchi** E-mail: kiuchi.mitsuo67@gmail.com; kiuchi@ctii.co.jp
For ECC matters:	**KRC Environmental Services** Ricardo A. Capule Phone: (02) 5061409; (0917)713-2629 Email: racapule@yahoo.com Maria Carmela Q. Capule Phone: (917)527-6352 Email: cqcapule@yahoo.com Marilou P. Avenido Phone: (0917)510-9892 Email: alot_avenido@yahoo.com

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.

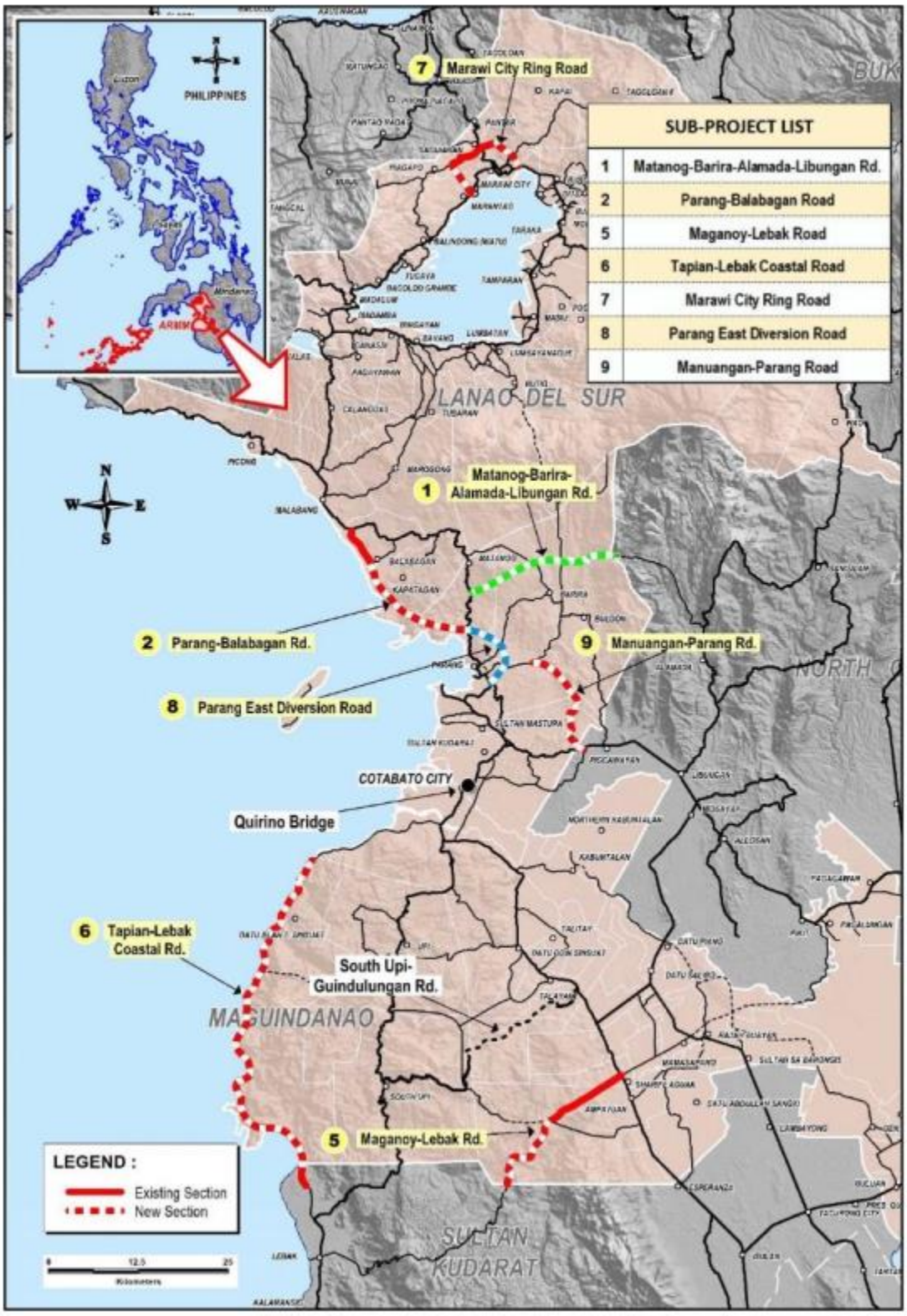
The project area has favorable natural conditions for agriculture –i.e. high temperature, plenty of rainfalls distributed throughout a year, dominant fertile soil and outside of the typhoon belt.

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

TABLE OF CONTENTS

List of Figures

Page

No. Title

List of Tables

Page

No. Title

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
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
EMB	:	Environmental Management Bureau
ESSD	:	Environmental and Social Safeguards Division
JICA	:	Japan International Cooperation Agency
JST	:	JICA Study Team
HSP	:	Health and Safety Plan
IEE	:	Initial Environmental Examination
IUCN	:	International Union for Conservation of Nature
LGU	:	Local Government Unit
LWUA	:	Local Water Utilities Administration
MGB	:	Mines and Geosciences Bureau

Acronyms and Abbreviations

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
NPCC	:	National Pollution Control Commission
NWRB	:	National Water Resources Board
OSHS	:	Occupational Safety and Health Standards
PAGASA	:	Philippines Atmospheric Geophysical and Astronomical Services Administration
PCO	:	Pollution Control Officer
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
RAP	:	Resettlement Action Plan
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** **Marawi City Ring Road**
Project Location	**Municipalities of Marantao, Piagapo, Saguiaran and Islamic City of Marawi, Lanao del Sur**
Project Size	**Width: 6.7 meters** **Length: 19.8 kilometers**
Project Component	Package 1: 8.5km (Road length: 8,500m) Farm to market road Drainage & slope protection: RCPC(910mmR 17places) 340m, RCPC(1,220mmR 2places) 39m, RCBC(1.25x1.0 place) 16m, RCBC(1.5x1.5 1place) 34m, Grout Riprap 625m^3, Stone masonry 7,554m^3, Hand Laid Rock Embankment 2,883m^3 Miscellaneous: Guardrail 4,675m, Chevron Sings 339ea, Road markings 2,125m2, Coco-net 28,099m2 Main Office/Camp: Beside of Poona Marantao (St.0+000) Branch Office: Piagapo (St.8+600) Package 2: 11.312km (Road length: 10,852m, Bridge length: 460m)3 Bridges: Bridge length: 460m Drainage & slope protection: - RCPC(910mmR 17places) 340m, RCPC(1,220mmR 2places) 39m, RCBC(1.25x1.0 place) 16m, RCBC(1.5x1.5 1place) 34m, Grout Riprap 625m^3, Stone masonry 7,554m^3, Hand Laid Rock Embankment 2,883m^3 Miscellaneous work - Guardrail 4,675m, Chevron Sings 339ea, Road markings 2,125m2, Coco-net 28,099m2 Main Office/Camp: Saguiaran (Sta.12+000) Branch Office: Gadongan (Sta.19+500) Temporary Camp & facilities
Project Cost	**Mil PhP 1,643.40**
Man Power	**1,703 man-month (skilled)** **3,653 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	KRC ENVIRONMENTAL SERVICES
Consultants with Contact Details	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 Initial Environmental Examination Report (IEER). Minimum required by DENR-EMB for the issuance of an Environmental Compliance Certificate (ECC) will be in the form of IEE checklist.

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

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

IEE TEAM

KRC Environmental Services is composed of multi-disciplinary specialists with expertise in the conduct of Environmental Impact Assessment, IEE 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

IEE STUDY SCHEDULE

The team was assigned to conduct the IEE study from January 2018 to March 2018. Public Consultations with Municipalities and Barangay Scopings were held on January and February 2018 respectively. 2nd Public consultations with Municipalities were held on 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 flora and fauna survey
- Actual investigation of socio economic profile and gathering and review of secondary data

IEE 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 Kilala, Dulay West, Papandayan Caniogan, Guimba, Pantao, Rorogagus East, Bogang and Banga in Marawi, Barangays Palao, Matampay, Bacong and Daanaingud in Marantao, Barangays Rantian, Paling and Bobo in Piagapo, Barangays Mipaga, Bubong, Pagalamatan, Lumbaca Toros, Bagoaingud, Alinun, Linao and Lombayanague in Saguiaran 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.

IEE 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 **Minor Roads and Bridges Item C.4.b (Roads, new construction, widening including RO-RO facilities)** with a total length of 18.1 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. The most recent deposit is the Quaternary Alluvium composed of alluvium, fluviatile, lacustrine and beach deposits, raised coral reefs, and beachrock. Thick, extensive, transgressive mixed shelf marine deposits, largely wackes, shales and reef limestone are also present.
Topography	In general, 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.
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 ground elevation reaches up to 825 masl while low-lying areas have an elevation of 600 masl giving rise to undulating to steep terrain
Geohazards	The proximity of active faults to the proposed road alignments indicates that strong to very strong ground shaking could be felt in the project area. SP-7 is not prone to tsunami since the area is located farther inland. The most destructive landslide events usually happen suddenly after a triggering event such as an earthquake or heavy rainfall. 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 7 may require protections of the cut slopes. This assumption should be confirmed further by appropriate geological and geotechnical site investigation prior to the construction of the Project. Flood susceptibility in the Marawi City Ring Road is generally considered low. 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. The Marawi City Ring Road is underlain by volcanic and/or sedimentary rocks which are not considered susceptible to liquefaction.
Terrestrial	
Flora	Floristic composition of the alignment is relatively low comprised of 63 species dominated by trees. Recorded species are common and naturally growing in the area. The result of assessment showed that only 1 is included in the IUCN list of vulnerable species.
Fauna	The faunal composition of the alignment is nominal with only 25 species dominated by Avifauna. Recorded species are common and locally sited in different ecosystems in the lowland areas including agricultural areas, shrub land, grassland, and settlements areas. These species also thrive even in highly disturb

	areas including cities. Four (4) species are endemic in the study area dominated by Aves. Only one (1) species is vulnerable in the category of the IUCN.
WATER	
Hydrology/Hydrogeology	The river systems that affect the proposed road alignment are the Agus River and its tributaries. Based on the data from the National Water Resources Board (NWRB) and from Local Water Utilities Administration (LWUA), twenty eight groundwater wells were listed. All of these wells are within the Marawi City area
Surface Water Quality	Surface water samples were sampled on November 15, 2017 on a sunny to cloudy weather. Surface water sample was collected on Agus River at Brgy. Mipaga, Saguiaran, 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.
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 rainfall pattern as recorded by PAGASA Agromet Station located at the Mindanao State University Campus in Marawi City shows that the shortest monthly rainfall of 8.7 mm from 2004 to 2007 happened on February 2005. The largest monthly rainfall of 554.6 mm has occurred on June 2007. The rainiest months are from May to October. The average annual precipitation recorded was 2,791 mm.
Temperature and Humidity	The annual mean high temperature is 28.1ºC with high temperature of 29.4ºC in April, whereas the average mean low temperature is 18.4 ºC where 17.8ºC was recorded in January and February. 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 on January 18-19, 2018 at Brgy. Bubong, Saguiaran, 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 for one (1) site 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	Noise measured during daytime are within the DENR standard limits of National Pollution Control Commission (NPCC) for residential areas. Ambient noise levels around the project sites during morning, evening and nighttime are slightly higher than the standards. Sources of noise may came from animals sounds such as barking from dogs, rooster's crow, sounds from insects such as crickets etc. and passing of vehicles which may have impacted the increase in sound measurement. Activities from residents near the sampling area also influenced the sound measurements during morning time.
PEOPLE	
Population	The total population of the 23 barangays is 21,704. Among the 23 barangays, Papandayan Caniogan in Marawi City has the highest population (2027) while Matampay in Marantao has the least population (551).

SUMMARY OF PUBLIC PARTICIPATION

A total of 23 stakeholders' meetings were held for SP 7 from January 2018 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 three municipal conference of Marantao, Piagapo, and Saguiaran; and Bagong Bayan Hall in Marawi City with the affected stakeholders, barangay and city/municipal

officials, and concerned LGU offices such as Assessors, MPDC. These meetings were attended by a total of 346 participants (Male-390 and Female-118) while the barangay scoping's' were attended by 272 male and 373 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
If the proposed road will upgrade the existing road constructed by NPC	No. It a new project.
Based on the presented alignment, there are missing barangays like Rorogagus Proper if the alignment will traverse the Rorogagus bridge	This is an initial road alignment and will be validated during ocular and field work
Suggestion to conduct ocular inspection before the inventory so that the affected barangays will know especially those who are not present today and not included in the shown map	This shown map is just an initial alignment and will be validated on-site. Those barangays mentioned that are not shown in the alignment will be verified. Barangays will still need to be validated. Those barangays present during the 1st public consultation but will not be included after the inventory will still benefit the proposed road. Our data will be gathered from Municipal and Provincial Assessors, DENR and DPWH ARMM offices, and overlay this to the proposed road alignment. From this data, the affected barangays can be verified.
If presented road alignment is feasible	This alignment is subject for validation.
Value of payment	We will gather data and use the prevailing price
Clarify the classifications (functions and administrative) of the road	This will be noted.
Validation of location of NPC compound near Somrorang road which will be affected by the proposed road alignment	The team will conduct an inventory and mapping on January 22, 2018 and validate if the NPC compound will be affected.
The boundaries of the barangays are not accurate	This will be validated on site. Barangays will still need to be validated. Those barangays that are included in the list and 1st public consultation, but will not be traversed in the alignment after the inventory would still benefit the proposed road. They can still use this to transport products easily from farm to market
No land title	DPWH have regulations/guidelines that are following. Legal documents are necessary to be eligible for land compensation. Assistance of the LGU in this matter is necessary
Claims of the affected lot owners because the past road projects of the government are not paid until now	During implementation, if you notice problems, you can file complaints to the Mayor's office because he is member of the steering committee of the project.
Schedule of payment	The results of the RAP will be submitted to DPWH National and Region. They will validate the results considering the basis of the prices and estimates.

	We will recommend to compensate the affected properties and lots before the start of the civil works. This payment will be used by the affected owners for their expenses on rentals or relocations. The DPWH as the implementing agency will handle all the payments.
Who will pay	The proponent
Assistance in the survey of the affected lots because the owners cannot afford the Php 20,000 for the payment of the survey. Existing tax maps are from 1970s	Our framework basis is the PD29 – since birth or more than 30 years of residences, and will be certified by barangay officials thru barangay resolutions. All alienable and disposable land can be compensated but the lots that are declared as military reserves will not be considered. We can use the cadastral map from DENR and data from provincial assessors to validate our inventory. The results of FS stage will be validated during the Detailed Engineering Design (DED) stage.
Prioritization of local hire	This will be recommended to the proponent considering that they are qualified for the job.
Request to include in your study the neglected provincial road almost near the proposed road alignment	This will be noted for consideration
Provide copy of the proposal for SP7 so that the LGU can monitor the status of the project	Being part of the steering committee of SP7, the requested will be noted and recommended to the proponent.
Utilized and align the proposed road project to the existing road to avoid the possible removal of properties or structures, and displacement of family.	The concerns will be noted and recommended to the proponent
Overlapping of alignment to the on-going project	DPWH explained that this will be validated. The ROW standard of JICA will still be consider during the implementation
Inspection of the realignment of the ring road project (four alternatives) by provincial government	The team explained that there are four alternatives for SP7. The alignment showed is the most viable and recommended by JICA and DPWH base on their assessment. Also, the team informed the chairwoman that the concerns will be noted and part of the recommendations to the proponent
Affected based n the ground inventory according to the guide 1) Brgy. Bacong – possible alignment of spring source beside mosque; 2) Brgy. Pagalamatan – Affected two storey new constructed High School building; and 3) Brgy. Bagoingud – Realign the proposed road to avoid the cemetery (between sta. 7+800 to 7+900) and the cultural heritage of Datu Ambiong	This will be clarified and subject for verification with RAP team, and further recommendation with the proponent

Compound (between stat. 8+200 to 8+300).	
Affect the Abaca Plantation within the barangay	Affected crops will be compensated
Reservoir and source that will be affected	DPWH explained that this concern will be subject for verification based on the results of the RAP survey, and will be informed the community on the results and recommendations.
Filing for the clearance of cutting trees	The team explained that the contractor of DPWH will file for the clearance during the implementation.
Livelihood program for the women/housewifes.	Mayor Sumandar suggested that all of the concerns will be should be informed to the barangays official so that this will be included in our monthly sessions
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

Photo 1: Mr. Basarie Dicamaling, Municipal Assessors inquired if the proponent can assist them for the survey of the lots of some affected people because they can afford it

Photo 2:Chairman Maning C. Dalupan, ABC President and Brgy. Chairman of Bago-Ingod expressing his support to the project

Photo 3: DPWH ARMM, Eng'r. Delion Binunbonan regarding his concern whether the NPC Compound will be affected by the proposed project

Photo 4: DPWH ARMM, Eng'r. Delion Binunbonan suggest to conduct ocular inspections along the road alignment

Photo 5: Brgy. Chairman Rasia Rascal of Rantian expressed the benefits of the project to the people

Photo 6: Chairman Ali P. Mague of Barangay Bubo expressing his support to the project

Photo 7:Jamal Mague, Private Sector of Barangay Ratian suggest that during construction, the contractors should hire locals from Piagapo Municipality

Photo 8: Ex. Chairman Jobar Matanog of Barangay Paling said that they will provide assistance to the study

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.

Project Phase	Environmental Component Likely to be Affected	Potential Impact	Options for Prevention or Mitigation or Enhancement
I. Pre-Construction Phase	This will be addressed during implementation of RAP as resettlement is expected to be done prior to project implementation or prior to construction.		
Environmental Aspect # 1	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.
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

		Traffic congestion	replacement of trees to be cut or removed • Implementation of Traffic management scheme
	Geology	Landslide: - The study area has low to moderate susceptibility to landslide	• Assess the stability of slope during construction and long-term conditions; • Study the effect of seismic loadings on the slope and road embankment.
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 during high rainfall conditions to reduce the risk of sediment loss to the environment • Set up adequate toilet facilities; ensure sufficient washrooms for workers • Construction of silt traps to contain inflow of muddy waters • Installation of oil traps and proper storage of used oil
Environmental Aspect # 3	The Air	• Dust generation during clearing of the site • Dust generation during construction associated with movement of vehicles and equipment • 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 • No Scheduling of noisy activities during the night • Regular Maintenance of Vehicles and equipment

Environmental Aspect # 4	The People	• Increase in livelihood and business opportunities • Increase in revenues • Provide job opportunities for construction workers • Health Risk	• Alleviate economy and generation of income to hosts and nearby barangays • Increased LGU revenues resulting from the purchase of locally available materials and equipment for construction, translating to additional taxes. Business establishments should be properly registered and payment of the required taxes shall be monitored. • The construction of the project will generate employment opportunities for local residents as well as migrant workers. It will bring increased income to those who will be employed. Local manpower may have to compete with migrant labor for employment. Employment of local residents during the construction stage shall be given priority, particularly those from families in the Direct Impact Area. • Use of appropriate PPE and proper training of workers
III. Decommissioning/Abandonment Phase (Immediate after Construction Phase)			
	The Land	• Land degradation • Loss of livelihood	• Proper clean-up and decontamination of affected site • Proper dismantling and demolition of equipment • Disposal of hazardous waste • Maintenance and rehabilitation of vacated temporary construction yard • Provision of alternative livelihood

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: Agus River Lake Lanao 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	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	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	-Heavy metals (As, Ba, Cd, Cr, Cu, Pb, Hg,Se,F)	Systematic sampling: Several Grab and composite Sampling	As prescribed	Contaminated sites	PCO

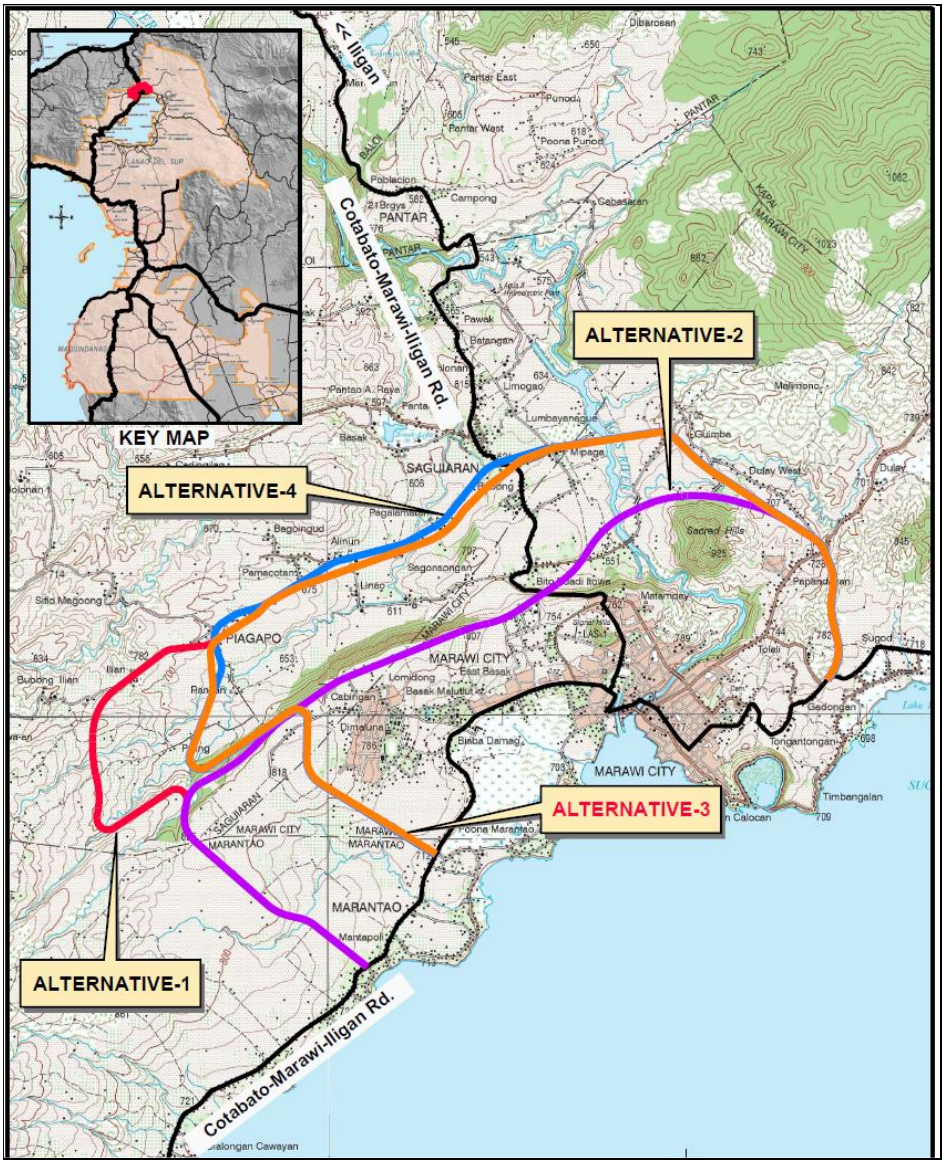
Section 1

PROJECT DESCRIPTION

1.1 PROJECT DESCRIPTION

1.1.1 PROJECT LOCATION AND AREA

The proposed road alignment will traverse the Municipalities of Marantao, Piagapo, Saguiaran and Islamic City of Marawi, Lanao del Sur. **Figure 1** shows the location map of the study area. **Table 1** shows the list of Municipalities and affected barangays.

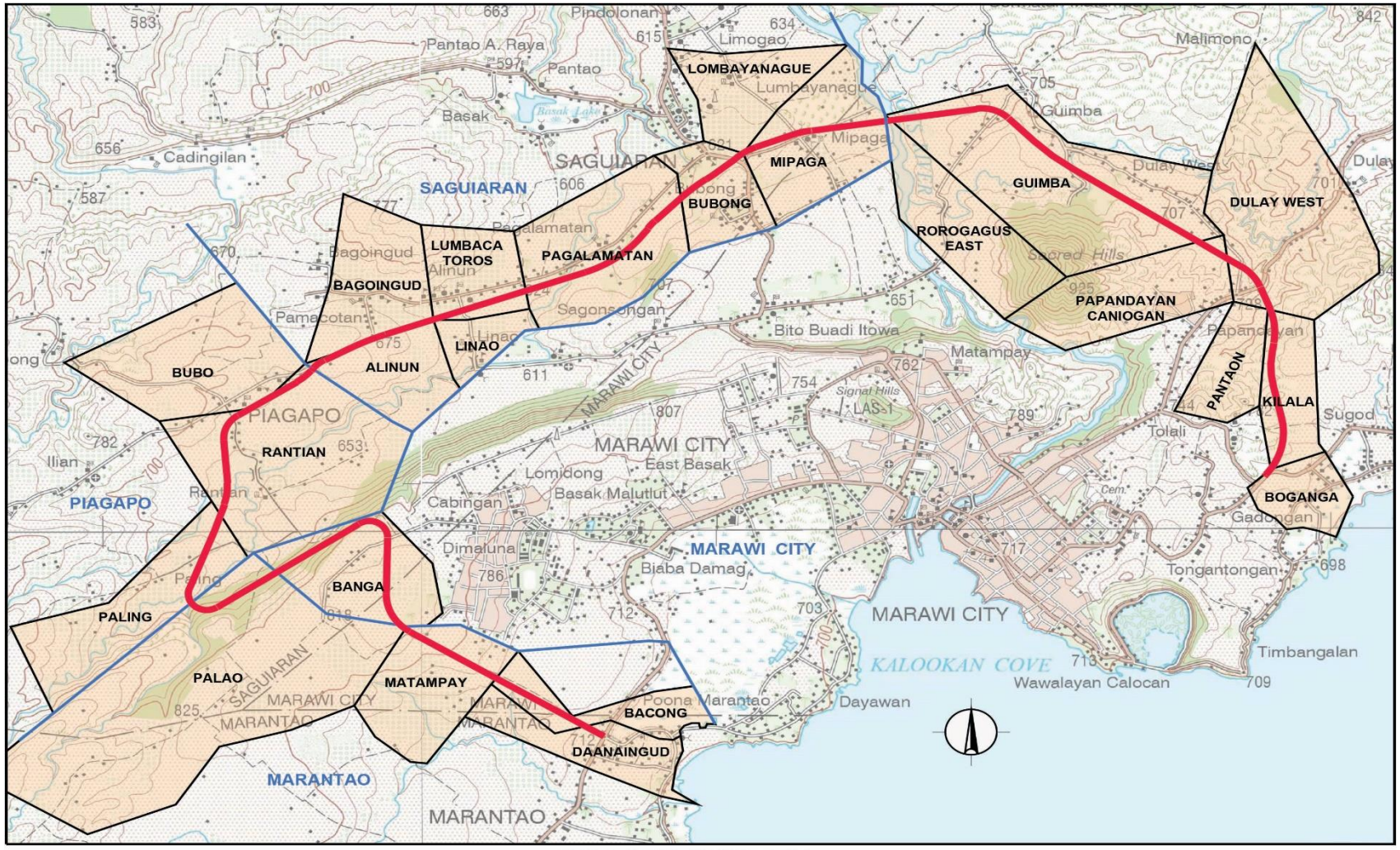


Source: JICA Study Team
Figure 1. Location Map Showing the study area

Table 1: **Marawi City Ring Road**

Municipality	Name of Barangay
Marawi	Kilala
	Dulay West
	Papandayan Caniogan
	Guimba (Lilod Proper)
	Pantaon
	Rorogagus East
	Boganga
	Banga
Marantao	Palao (Ranaranao)
	Matampay
	Bacong
	Daanaingud
Piagapo	Rantian
	Paling
	Bobo
Saguiaran	Mipaga
	Bubong
	Pagalamatan
	Lumbaca Toros
	Bagoa ingud
	Alinun
	Linao
	Lombayanague

Figure 2 shows the map of affected Barangays traversing the road alignment along the Municipalities of Marantao, Piagapo, Saguiaran and Islamic City of Marawi.



7. MARAWI CITY RING ROAD

Source: JICA Study Team

Figure 2. Map Showing the Affected Barangays at Sub-Project 7

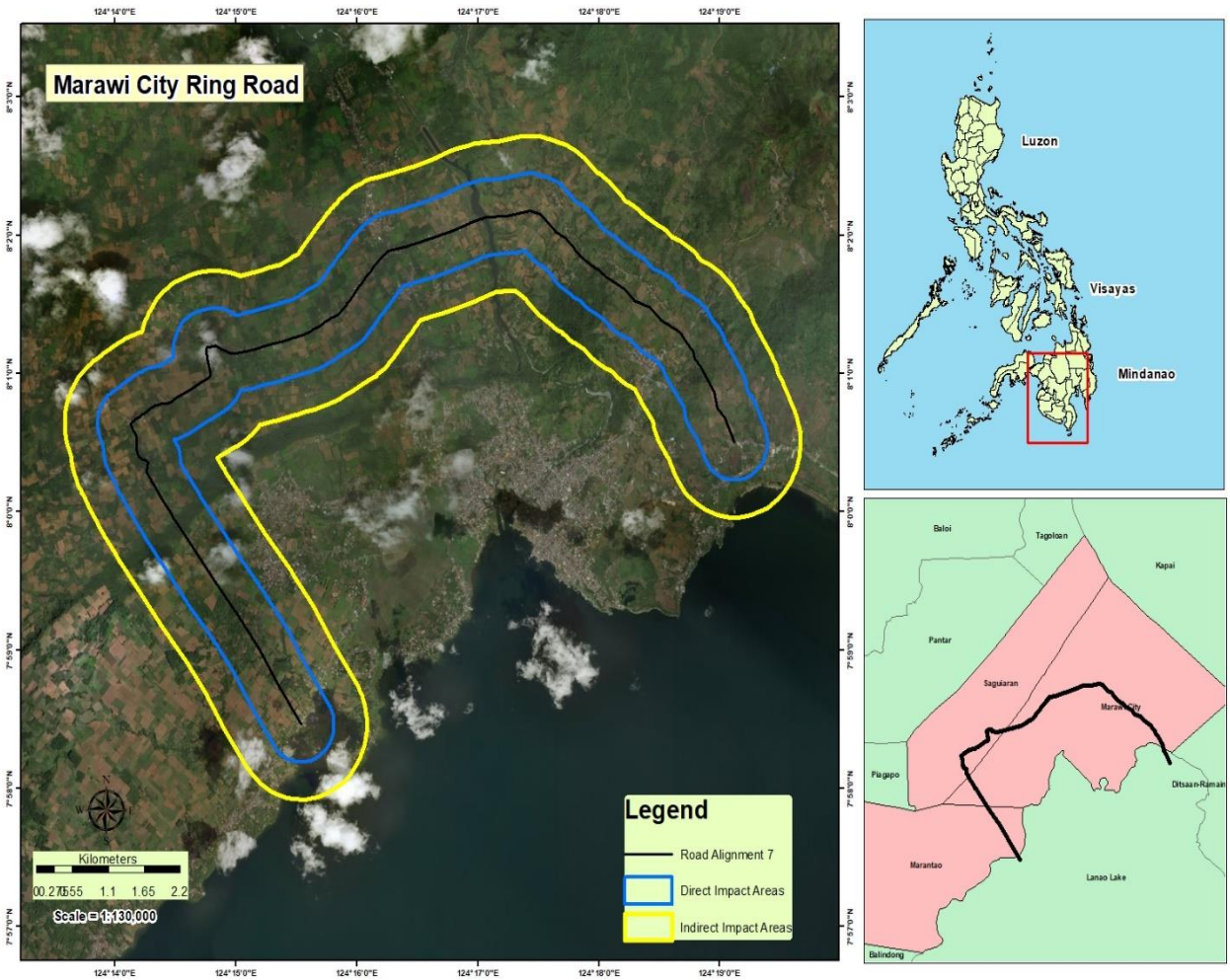
.

1.1.2 Primary and Secondary Impact Areas

As per DENR Administrative Order 2003-30 the direct impact of the project will be the areas of the whole alignment of the road or the proposed construction area. With the implementation of the proposed project, some aggregates of residential area and agriculture lands will be will be affected by the project. **Figure 3** shows the map of direct and indirect impact of the study area at 1 km radius. impact area- 100 meters from the center line in both sides (total of 200 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 meters 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.



Source: Google Earth

Figure 3. Impact Map the study area

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 7, Marawi City Ring 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

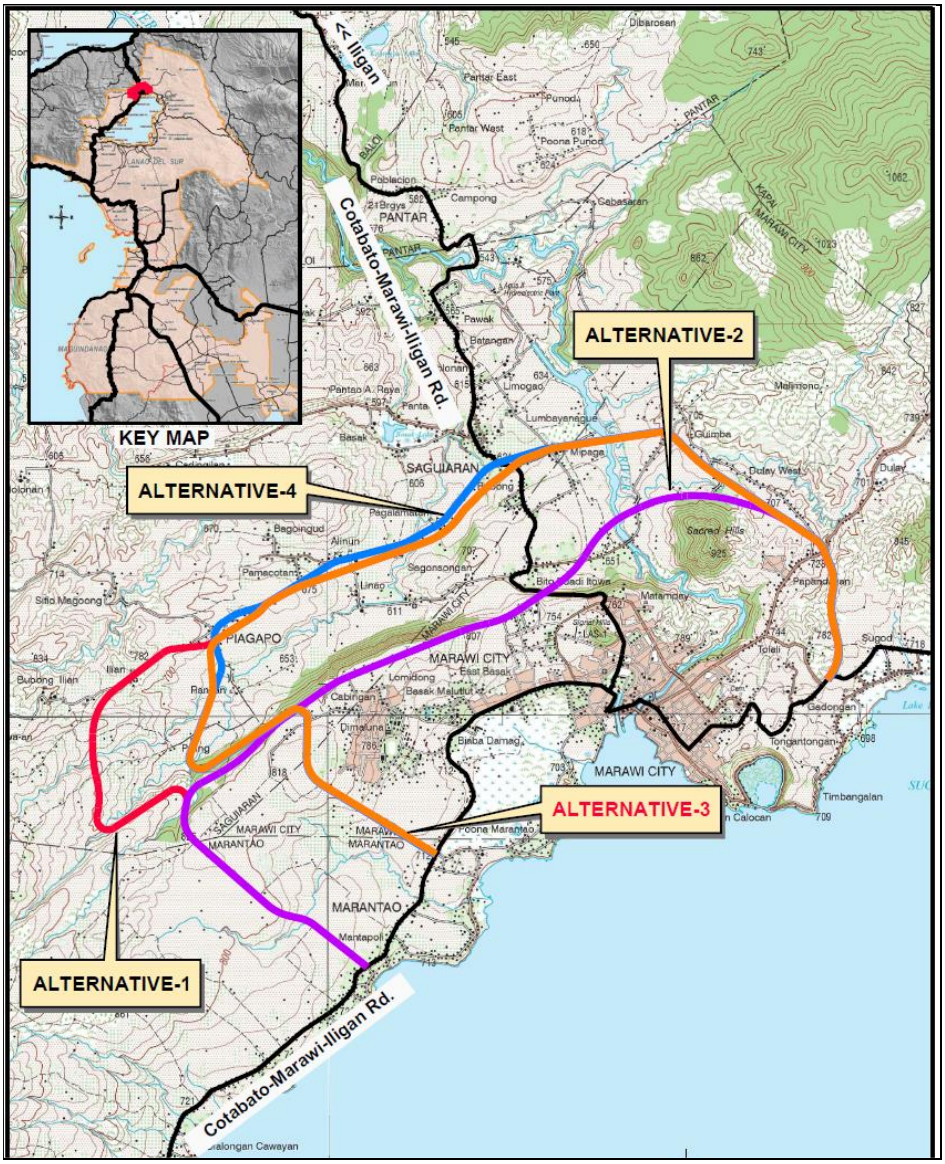
1.3.1 Design Criteria and Standards

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 here would mean the different alignment that were considered. At least four (4) 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. 7.



Source: JICA Study Team

Figure 4. Alternative Alignments for Marawi City Ring 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” △
- Within 20% to 200% Difference from the Best Alterrnative: x
- More than 200% Difference from the Best Alternative:
  Evaluated as “Bad” xx

Table 2 presents the evaluation criteria on alternative alignments. **Table 3** presents the evaluation results.

Table 2. Evaluation Criteria on Alternative Alignments

Indicators	Items		Unit	Criteria	Evaluation Item
Cost, Consruction Period	Total Road Length		km	The shorter, the better.	• Evaluated
	Utilization of Existing Road/Trail		km	The longer, the better.	• Evaluated
	New construction road length		km	The shorter, the better.	← (Not Evaluated)
	No. of bridges		nos	The lesser, the better.	← (Not Evaluated)
	Total length of bridges		m	The lesser, the better.	• Evaluated
	No. of box culverts		nos	The lesser, the better.	← (Not Evaluated)
Economic Impact	No. of Direct Beneficiaries		persons	The more, the better.	• Evaluated
	Agricultural land areas to be served		km	The more, the better.	• Evaluated
Environmental Impact	High-filling section length (H= 10m or more)		m	The shorter, the better.	• Evaluated
	High-cutting section length (H= 10m or more)		m	The shorter, the better.	• Evaluated
	Number of houses/buildings affected		nos	The lesser, the better.	• Evaluated
Technical Features	Alignment	Total no. of curves	nos	The lesser, the better.	← (Not Evaluated)
		No. of curve radius < 200m/300m	nos	The lesser, the better.	• Evaluated
		Length of vertical grade ≧ 5%	m	The lesser, the better.	• Evaluated

Source: JICA Study Team

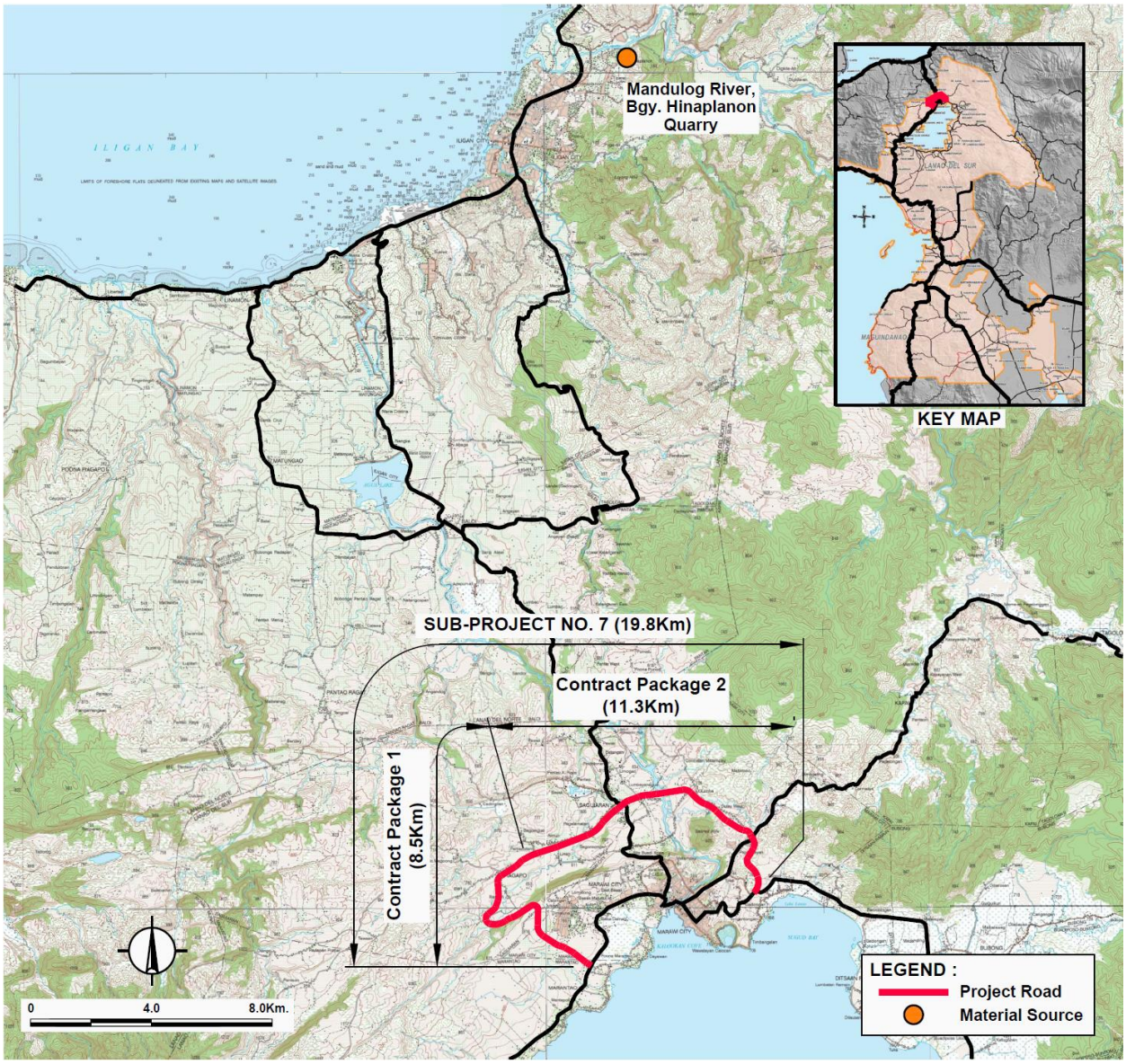
Table 3. Evaluation Results on Alternative Alignments

Alternatives			ALT-1		ALT-2		ALT-3		ALT-4	
Main Objectives			• Firm up the formation of the city's road network by providing a trunk road which would expand capacity of the network and resulted to improved flow of traffic. • Improve traffic flow and urban amenities by separating through traffic from local traffic. • Improve access to social services by providing trunk road at the edge of the built-up area. • Guide sound urbanization of Marawi City by providing trunk road at the edge of the city which would result to efficient utilization of urban space. • To contribute in early recovery of Marawi City by providing temporary jobs during construction stage.							
Concept			• Pass under the hill, and climb up the hill along the cliffs on the far west side from the city • Avoid houses/ buildings as much as possible • Furthest from the city		• Pass over the northern edge of the hill top and merge with ALT-1 at the west part • Avoid houses/ buildings as much as possible • Nearest to the city		• Pass under the hill, and climb up the hill along the cliffs on the close west side to the city • Avoid houses/ buildings as much as possible		• Basically, the same route with ALT-3 • Utilize the existing road as much as possible	
Indicators	Items		Unit	Quantities	Point	Quantities	Point	Quantities	Point	Quantities	Point
Project Cost, Consruction Period	Total Road Length		km	20.2	×	15.8	○	18.1	△	18.2	△
	Utilization of Existing Road/Trail		km	4.6	×	5.2	×	2.4	×	6.5	○
	New construction road length		km	15.6	-	10.6	-	15.7	–	11.7	–
	No. of bridges		nos	8	-	6	-	7	–	7	-
	Total length of bridges		m	1,550	○	1,750	△	1,550	○	1,550	○
	No. of box culverts		nos	2	-	7	-	2	-	2	-
Economic Impact	No. of Direct Beneficiaries		persons	39,172	×	45,536	△	53,343	○	53,343	○
	Agricultural land areas to be served		km	17.18	○	12.14	×	15.02	△	13.17	×
Environmental Impact	High-filling section length (H= 10m or more)		m	1,480	○	2,098	×	1,630	△	1,630	△
	High-cutting section length (H= 10m or more)		m	867	×	2,554	××	703	○	703	○
	Number of houses/buildings affected		nos	79	××	50	××	4	○	151	××
Technical Features	Alignment	Total no. of curves	nos	23	-	18	-	19	-	19	-
		No. of curve radius < 300m	nos	2	×	0	○	4	×	4	×
		Length of vertical grade ≧ 5%	m	4,385	○	5,433	×	5,644	×	5,644	×
	River stabilities		-	Pass through the section where the river channel is stable	○	Close to a tributary meandering	×	Pass through the section where the river channel is stable	○	Pass through the section where the river channel is stable	○
	Suitability in view of road network		-	Expected to induce the urban areas to the suburbs, however a bit far away	△	For the north side of the cliff, the expansion of urban areas is limited.	×	Expected to induce the urban areas to the suburbs	○	Expected to induce the urban areas to the suburbs	○
Evaluation				○ = 5 △ = 1 × = 5 ×× = 1		○ = 2 △ = 2 × = 6 ×× = 2		○ = 6 △ = 3 × = 3 ×× = 0		○ = 6 △ = 2 × = 3 ×× = 1	
Recommendation				-		-		Recommended			

Source: JICA Study Team

1.4 PROJECT COMPONENTS

The proposed project aims on the construction of the outer ring road of Marawi central area. Project road west end also middle part are connected with National High way (AH26) and east end is connected with Lake Lanao road. Project road mixed with new road area and existing improvement road total length is 19.8km. Regarding to construction method, it is divided to 2 segments such as West and East. Main construction office will be located in the middle point of the road and western part of the road. As shown in **Figure 5**, Sub-project 7 will be divided into two (2) contract packages (West Side section and East Side section).



Source: JICA Study Team

Figure 5. Construction Site and Packages

Table 4 and **Table 5** present the proposed Subproject 7 project components.

Table 4. Components of the Construction Plan (Package 1)

Item	Contents
Road length	8.5km (Road length: 8,500m)
Earth work	Clearing 23.4ha, Road Excavation 193,000m3, Embankment from Roadway Excavation 142,000m^3
Pavement work	PCCP(280mm) 63,734m^2
Road shoulder work	PCCP shoulder(150mm) 24,437m^2, Gravel surface shoulder 3,330m^3
Drainage & slope protection work	RCPC(910mmR 17places) 340m, RCPC(1,220mmR 2places) 39m, RCBC(1.25x1.0 place) 16m, RCBC(1.5x1.5 1place) 34m, Grout Riprap 625m^3, Stone masonry 7,554m^3, Hand Laid Rock Embankment 2,883m^3
Miscellaneous work	Guardrail 4,675m, Chevron Sings 339ea, Road markings 2,125m2, Coco-net 28,099m2
Segment Information	

West Segment	
Item	Contents
Main office / Camp	Beside of Poona Marantao (St.0+000)
Branch office	Piagapo (St.8+600)

Source: JICA Study Team

Table 5. Components of the Construction Plan (Package 2, St.8+500 – St.19+800)

Item	Contents
Road length	11.312km (Road length: 10,852m, Bridge length: 460m)
Earth work	Clearing 23.4ha, Road Excavation 193,000m3, Embankment from Roadway Excavation 142,000m^3
Pavement work	PCCP(280mm) 63,734m^2
Road shoulder work	PCCP shoulder(150mm) 24,437m^2, Gravel surface shoulder 3,330m^3
Drainage & slope protection work	RCPC(910mmR 17places) 340m, RCPC(1,220mmR 2places) 39m, RCBC(1.25x1.0 place) 16m, RCBC(1.5x1.5 1place) 34m, Grout Riprap 625m^3, Stone masonry 7,554m^3, Hand Laid Rock Embankment 2,883m^3
Miscellaneous work	Guardrail 4,675m, Chevron Sings 339ea, Road markings 2,125m2, Coco-net 28,099m2
Main office / Camp	Saguiaran (Sta.12+000)
Branch office	Gadongan (Sta.19+500)

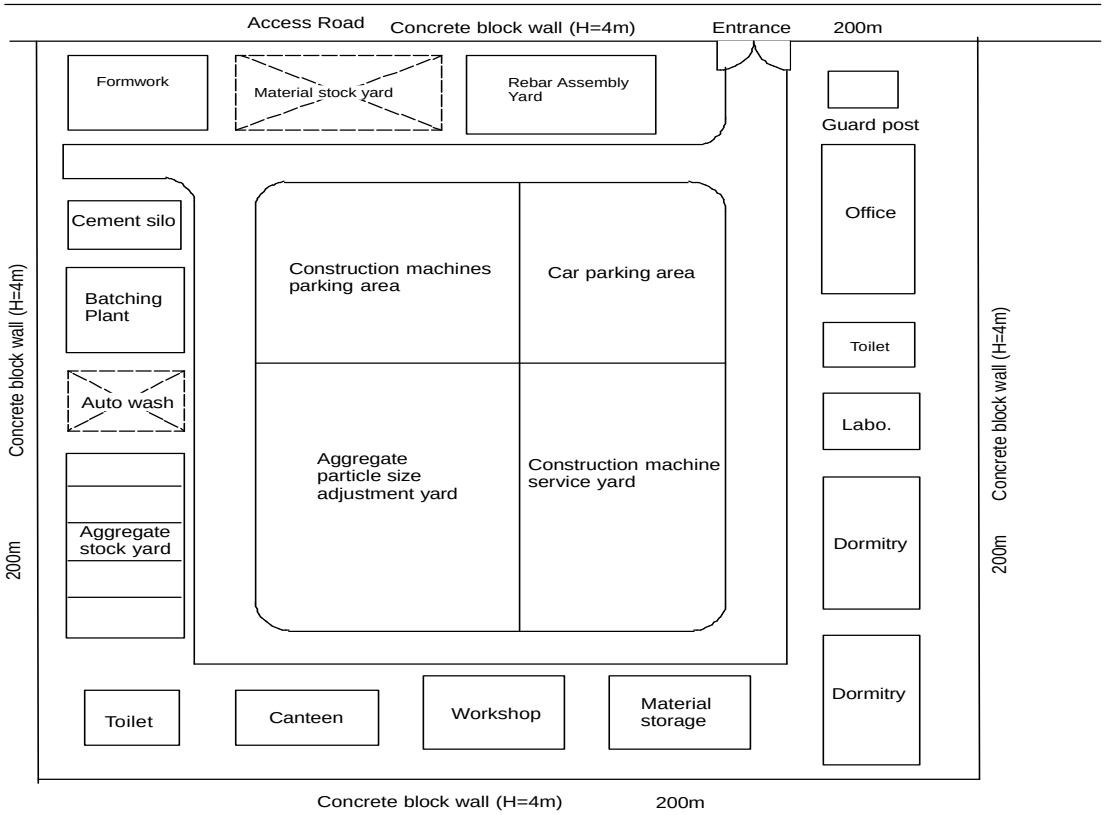
Source: JICA Study Team

Main and Branch Camp

The selection of construction yard for each package is definitely important. Appropriate locations of one main temporary camp and one sub camp for construction should be identified. Although the construction yard is only a temporary site, however, large volume of concrete materials through the concrete batching plant shall be required, hence, an appropriate area for this yard is needed in the east segment. The selection of temporary yard for construction will be decided during the detailed design stage, and the contractor will select the proper location of the construction site and its area size during tender procedure. Proposed Main Camp and Branch Camp Location and size are shown in **Figure 6** and **Figure 7**.

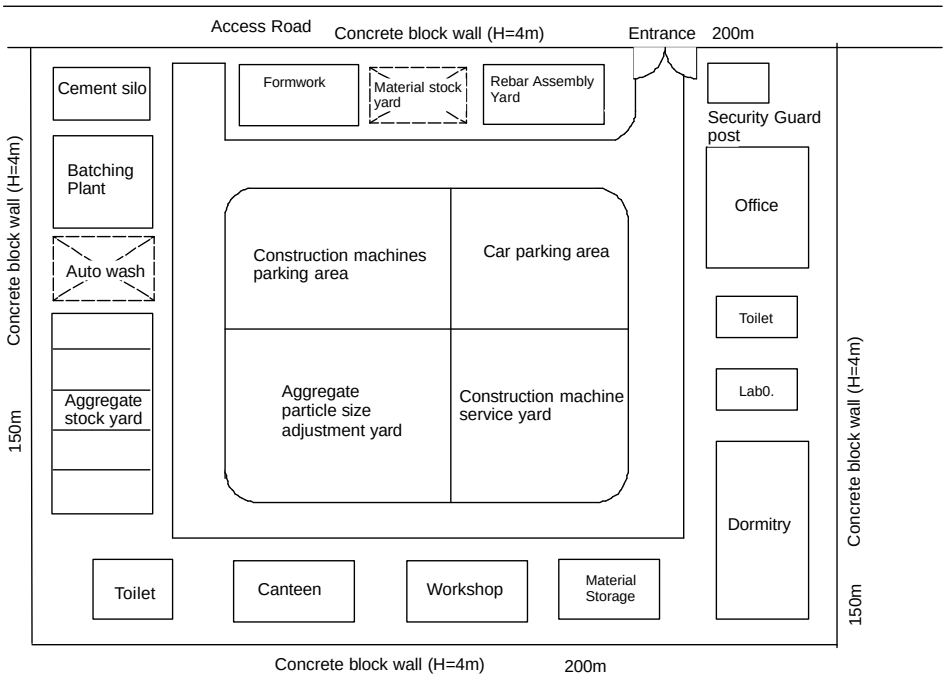
Farm-to-Market Road

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 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 7 is a 19.8-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 7

The road classification for Sub-project 7 – Marawi City Ring 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 6**.

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 6. 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 7**.

Table 7. 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 8**.

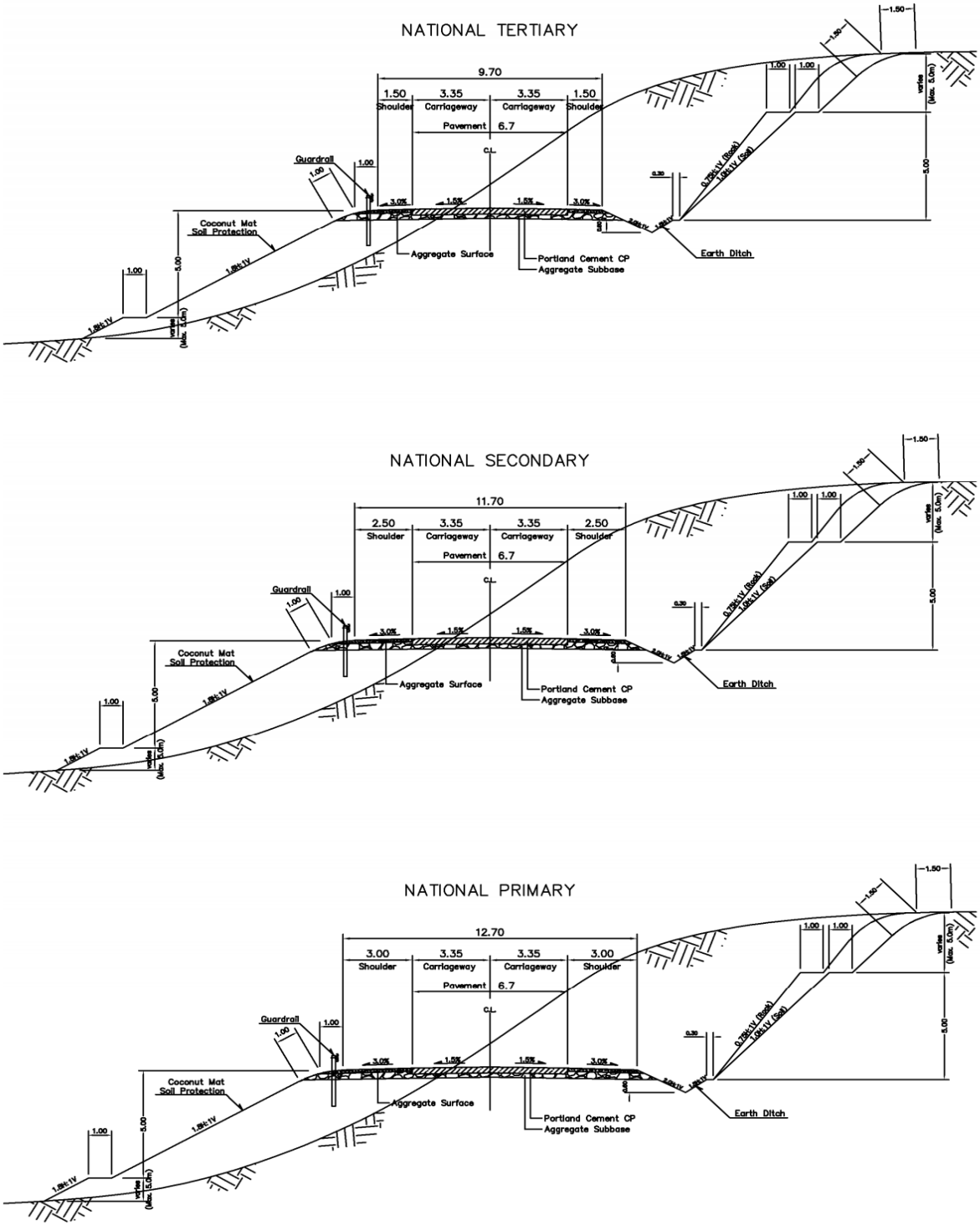
Table 8. Summary of Geometric Design Standards for Subprojects

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

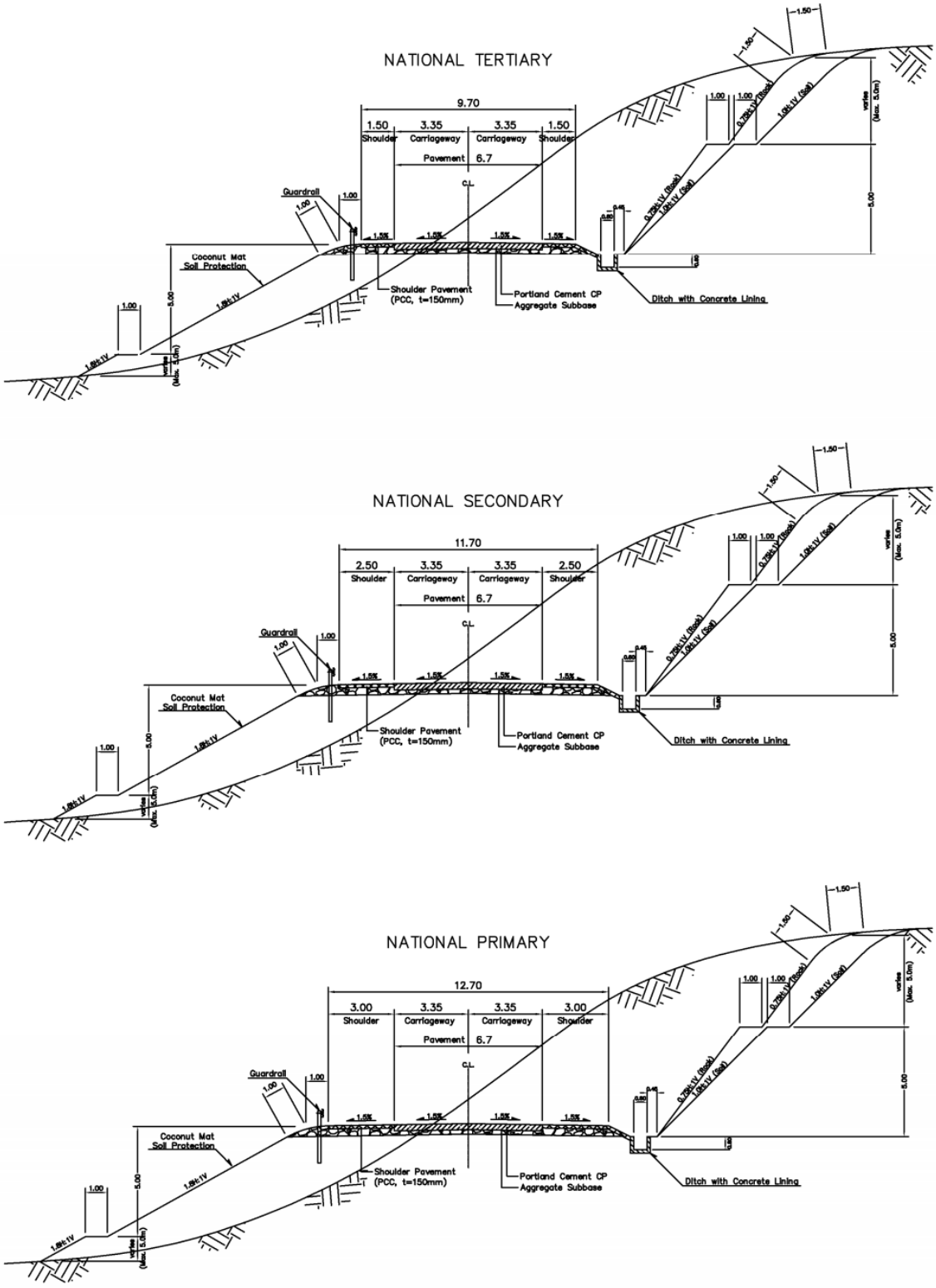
1.4.2.2 Typical Cross Sections

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 9** shall be used for dead load

Table 9. 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

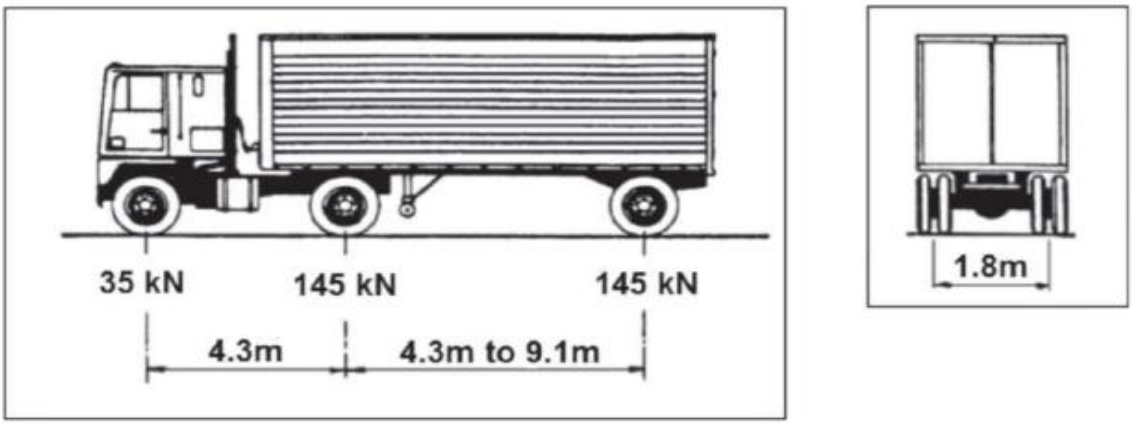
Design live loads of the bridges shall consist of:

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 10** for dynamic load allowance in accordance with DPWH Design Guidelines, Criteria and Standards (DGCS).

Table 10. 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 11**.

Table 11. 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 12.**

Table 12. 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 13.**

Table 13. 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 14.**

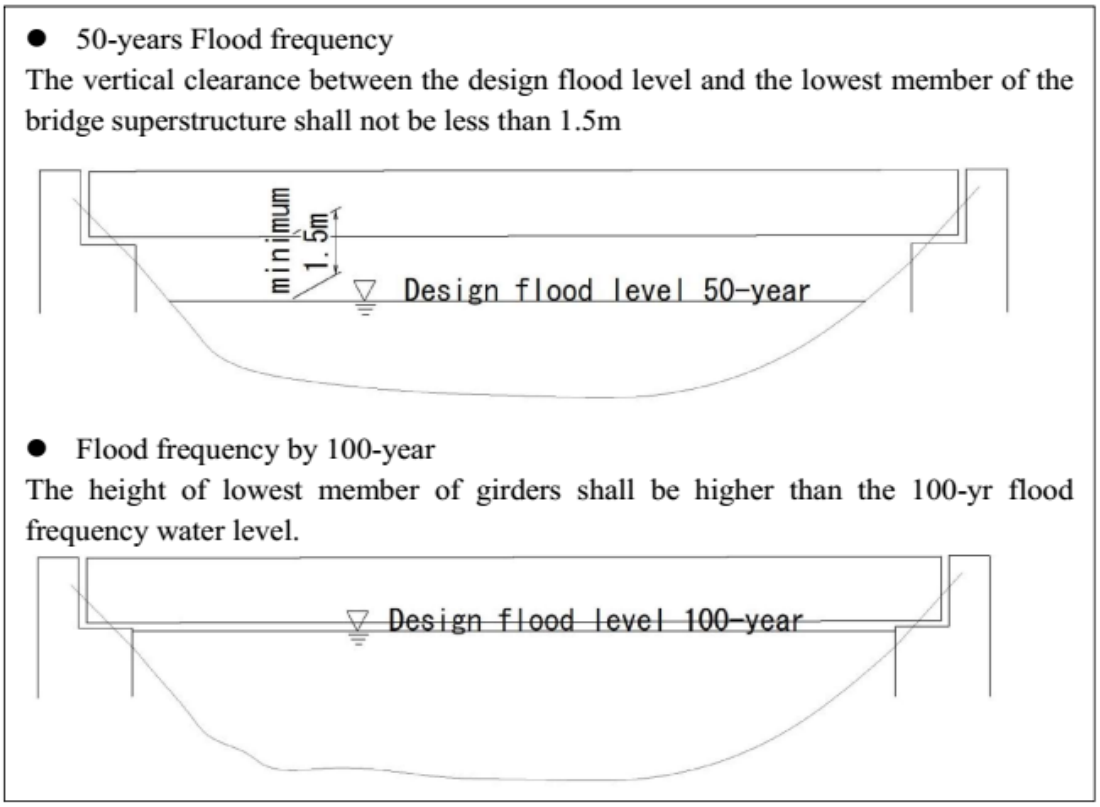
- 50 years flood frequency shall be applied for the estimation of flood level (DFL)
- 100 years flood shall be used for check vertical clearance of the bridge superstructure

Table 14. 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.**



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

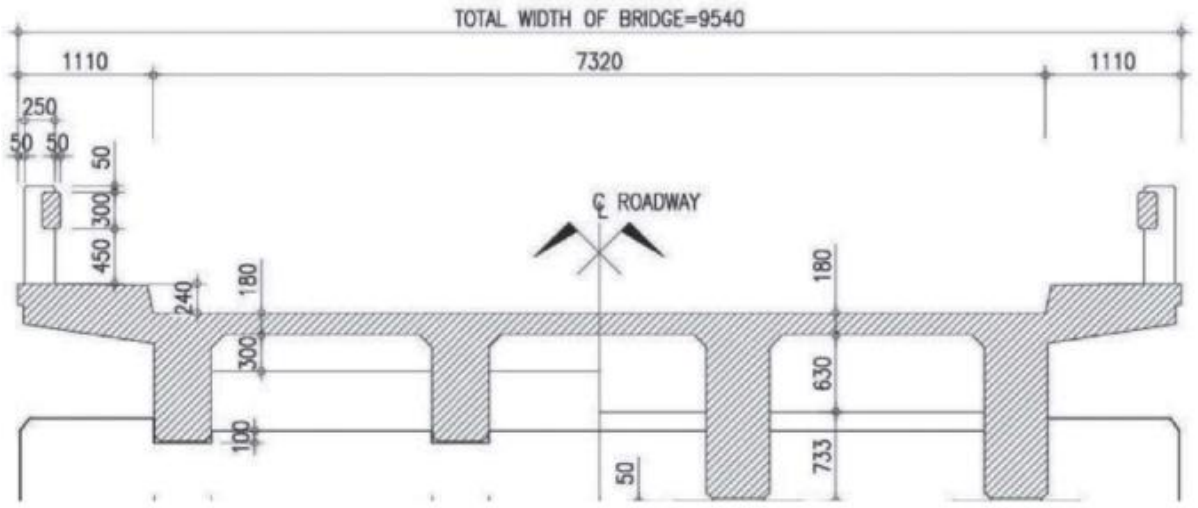
Discharge of river will be estimated in accordance with DPWH DGCS Volume 3 and 4. The Criteria for hydrological analysis are described in separate report of JICA Study Team.

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

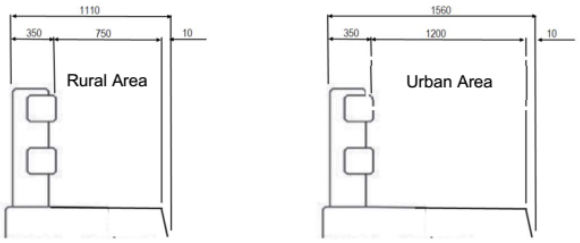
Figure 12. Typical Cross Section of Bridge

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

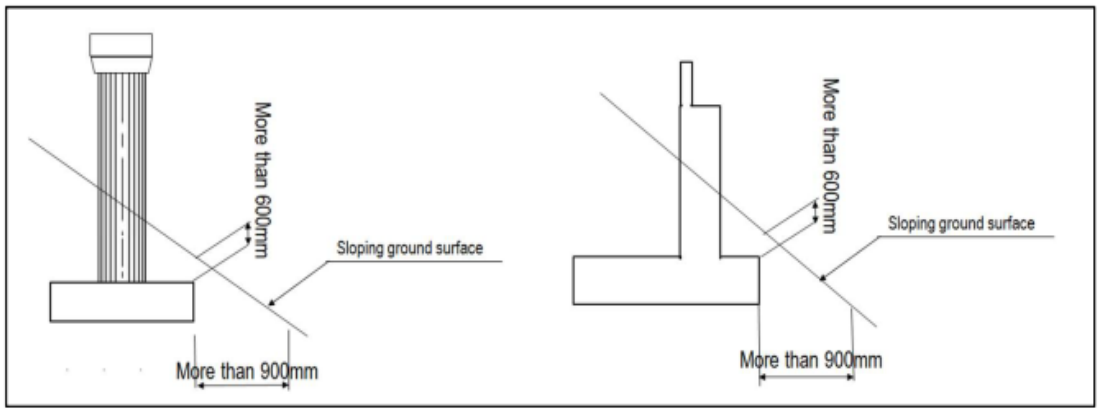
DPWH Guide Specifications LRFD Bridge Seismic Design Specifications 1st Edition 2013 will be followed.

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.



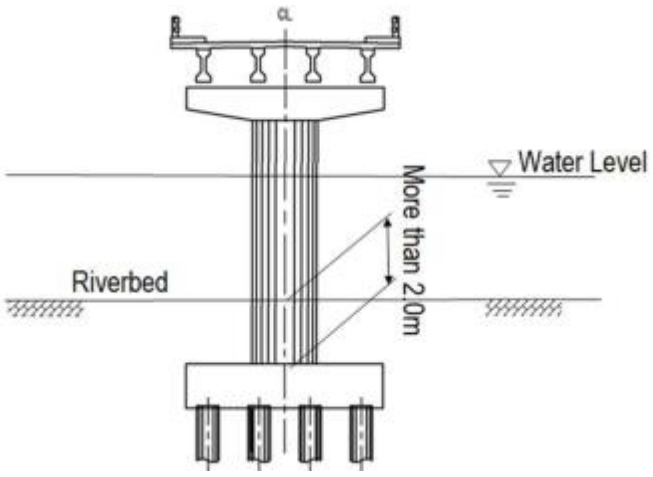
Source: JICA Study Team
Figure 14. Footing Position on Slope

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**.

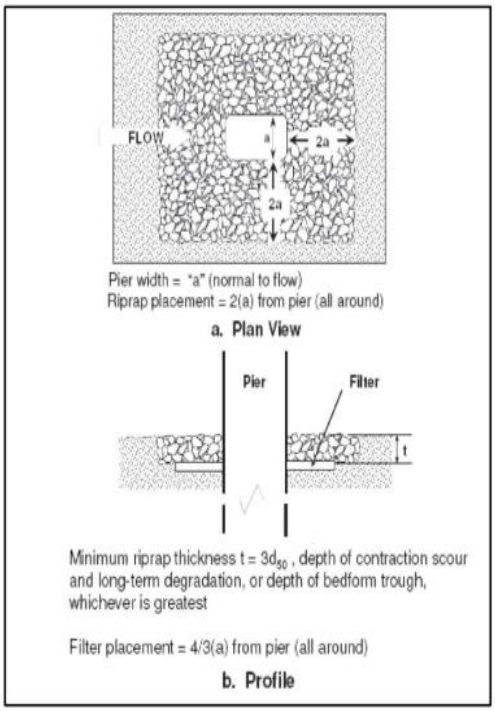


Source: JICA Study Team
Figure 15. Depth of Pier Footing in Water Way

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**.

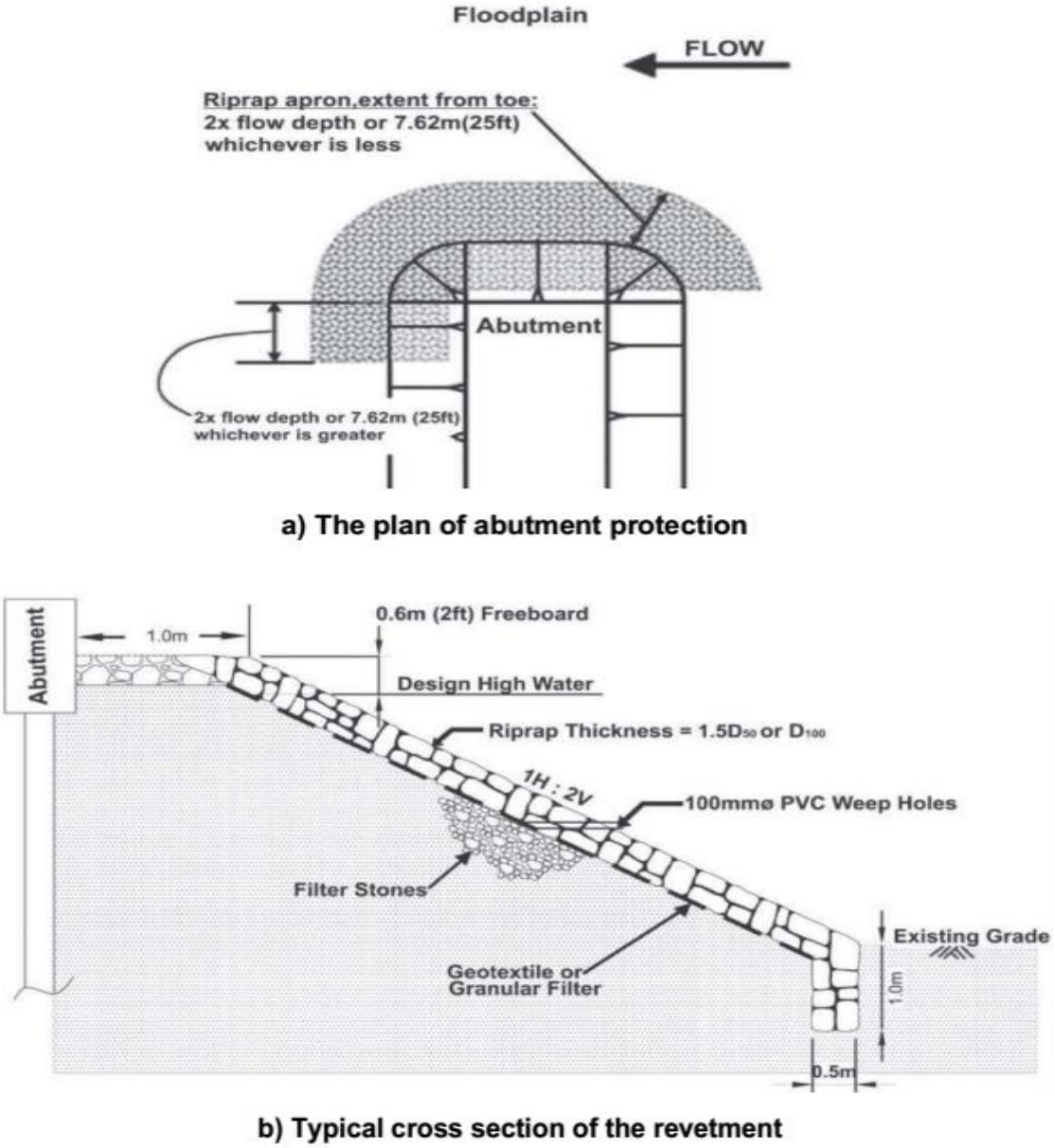


Source: JICA Study Team

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**.



Source: JICA Study Team
Figure 17. 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.

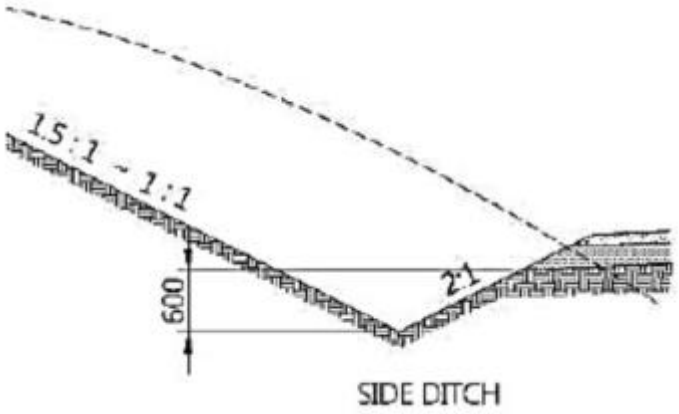
- Chapter 5 Highway Drainage DGCS Volume 4 Highway Design 2015, BoD, DPWH
- Guidelines for drainage work; Japan Road Association

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 18.**



Source: JICA Study Team
Figure 18. 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

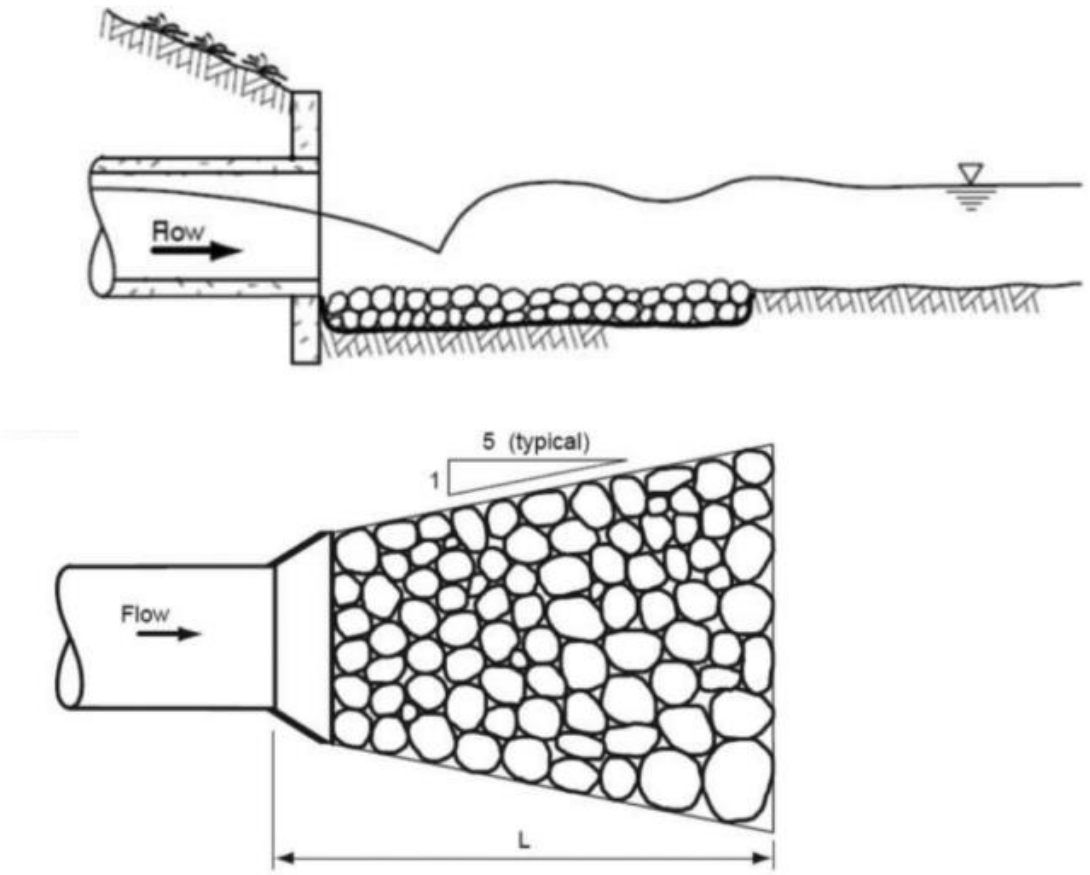
1) Discharge (Hydrologic Analysis)
2) Hydraulic and Structural Design of Culvert

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 19**.



Source: JICA Study Team

Figure 19. 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 15**, 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 15. 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). Consistency assumed to be medium dense (non-cohesive) or stiff (cohesive) or better.
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	
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	

Source: JICA Study Team

2) Cutting Slope

Based on **Table 15**, 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.

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

  Also, the following standards are referred to:

- Policy on Geometric Design of Highways and Streets, AASHTO 2011, 6th Edition

- Japan Road Association, Road Structure Ordinance, 2015

1.6 PROJECT SIZE

The total length of the project is 19.8 km with 8.5km on Package 1 and 11.312km on Package 2. Total bridge length for package 2 is 460m. Refer to **Table 4** and **Table 5** 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 16** shows the type and built-in measures.

Table 16. 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 sanitary 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 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, Decommissioning and Rehabilitation Policy for details.

1.8 MANPOWER REQUIREMENTS

Total manpower man-month is approximately 1,703 for skilled and 3,653 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 1,643.40.** The summary of quantity and total project costs for the road and bridge project are shown in **Table 17**. Details of project cost is provided in **Table 18** and **Table 19**.

Table 17. 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.7	19.812	2	240	2	1,502.4	141.0	1,643.4	63.73	1.07	82.95
No.7-1	8.500	-	-		559.2	70.5	629.7	65.79	-	74.08
No.7-2	11.312	2	240		943.2	70.5	1,013.7	63.42	1.06	89.61

Source: JICA Study Team

Table 18. Detailed Estimated Project Cost (Package 1)

Item	Contents	Qty.	Cost (php)	Cost per km (mill. Php)	Bridge/m (mill. Php)	Portion (%)
A	Facilities for engineer	1.0	8.926	1.05		1.4%
B	Other general requirement	1.0	25.659	3.02		4.1%
C	Earth work	1.0	94.248	11.09		15.0%
D	Subbase and base course	1.0	105.123	12.37		16.7%
E	Surface course	1.0	189.040	22.24		30.0%
F	Bridge structure (Total)	-	-		-	-
G	Drainage and slope protection	1.0	100.110	11.78		15.9%
H	Miscellaneous item	1.0	36.101	4.25		5.7%
I	Farm to Market road	11km	70.474			11.2%
	Grand Total		629.680	65.79		100.0%

Source: JICA Study Team

Table 19. Detailed Estimated Project Cost (Package 2)

Item	Contents	Qty.	Cost (mill. php)	Cost per km (mill. Php)	Bridge/m (mill. Php)	Portion (%)
A	Facilities for engineer	1.0	14.460	1.33		1.4%
B	Other general requirement	1.0	35.250	3.25		3.5%
C	Earth work	1.0	182.451	16.81		18.0%
D	Subbase and base course	1.0	141.057	13.00		13.9%
E	Surface course	1.0	207.571	19.13		20.5%
F	Bridge structure (Total)	240m	255.036		1.06	25.2%
	F1	160m	169.172		1.06	16.7%

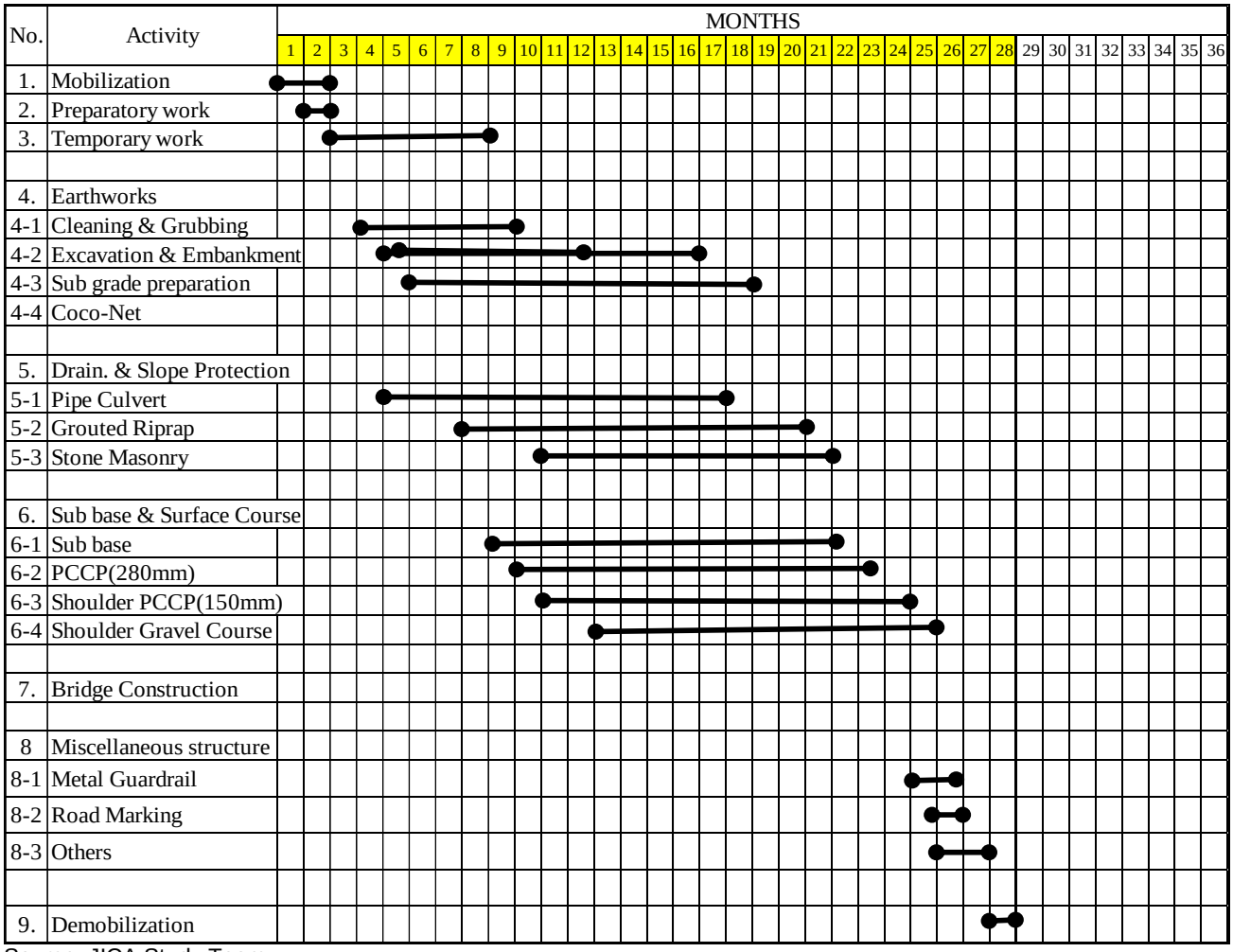
	F2	80m	85.864		1.07	8.5%
G	Drainage and slope protection	1.0	61.248	5.64		6.0%
H	Miscellaneous item	1.0	46.153	4.25		4.6%
I	Farm to Market road	11km	70.474			7.0%
	Grand Total		1,013.699	63.42		100.0%

Source: JICA Study Team

1.10 Project Duration and Schedule

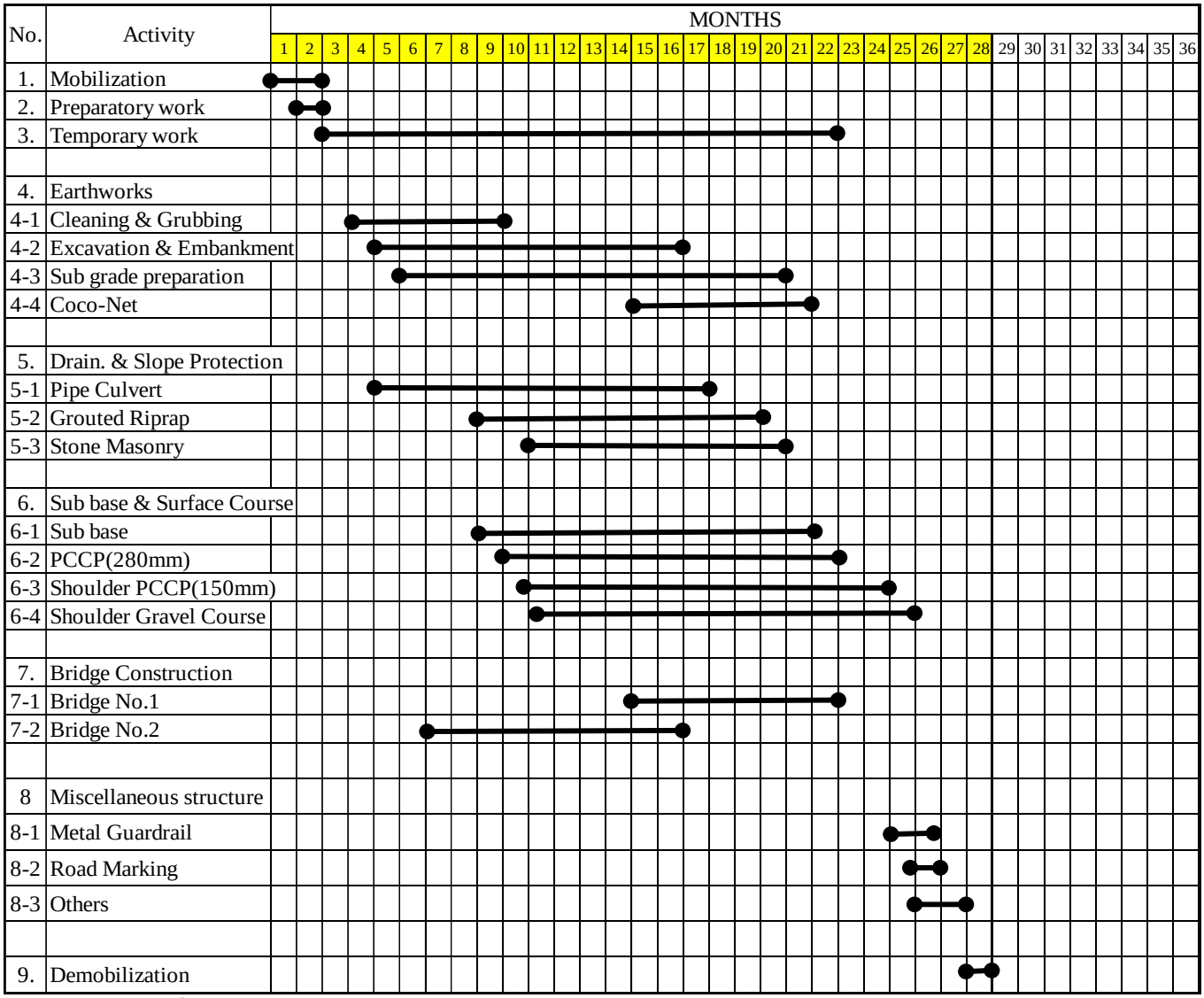
Estimated construction period is 28 months. **Table 20** and **Table 21** show the project duration and schedule.

Table 20. Estimated Project Duration Schedule (Package 1)



Source: JICA Study Team

Table 21. Estimated Project Duration 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 an Initial Environmental Examination Report (IEER). Minimum required by DENR-EMB for the issuance of an Environmental Compliance Certificate (ECC) will be in the form of IEE checklist.

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

The result of the IEER 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 22**.

Table 22. 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 23**. 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 23. 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 Minor Roads and Bridges Item C.4.b (Roads, new construction, widening including RO-RO facilities)** with a total length of 18.1 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 24** shows the policies, laws, administrative orders and memorandum circulars that are applicable and discussed in the Environmental Impact Study.

Table 24. 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 25**. Basically, the Philippines legislation deems to meet the policy of JICA's Guideline, this Philppine EIA process is applicable on this project.

Table 25. 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 outline is explained sufficiently prior to public consultation at scoping stage.	-	Not required
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 Initial Environmental Examination Report (IEE). Minimum required by DENR-EMB for the issuance of an Environmental Compliance Certificate (ECC) will be an IEE.

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

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

2.5.1 IEE TEAM

KRC Environmental Services is composed of multi-disciplinary specialists with expertise in the conduct of Environmental Impact Assessment, IEE 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

2.5.2 IEE STUDY SCHEDULE

The team was assigned to conduct the IEE study from January 2018 to March 2018. Public Consultations with Municipalities and Barangay Scopings were held on January and February 2018 respectively. 2nd Public consultations with Municipalities were held on 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 IEE 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 Kilala, Dulay West, Papandayan Caniogan, Guimba, Pantao, Rorogagus East, Bogang and Banga in Marawi, Barangays Palao, Matampay, Bacong and Daanaingud in Marantao, Barangays Rantian, Paling and Bobo in Piagapo, Barangays Mipaga, Bubong, Pagalamatan, Lumbaca Toros, Bagoaingud, Alinun, Linao and Lombayanague in Saguiaran 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 26. 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 27** shows the land use of affected barangays.

Table 27. Land Use (sq. m)

Municipalities	Barangays	Residential Area	Agricultural Area	Total
Marantao	Daanaingud	3,120	13,817.32	16,937.32
	Matampay	0	21,045.10	21,045.10
	Palao	0	5,423.14	5,423.14
Piagapo	Paling	0	29,728.13	29,728.13
	Rantian	0	5,712.07	5,712.07
	Bubo	5,250	28,962.45	34,212.45
Saguiran	Bagoingod	0	21,346.93	21,346.93
	Lumbaca Toros	0	12,782.26	12,782.26
	Pagalamatan	0	28,140.92	28,140.92
	Bubong	0	16,163.82	16,163.82
	Mipaga	0	25,237.38	25,237.38
Marawi	Banga	0	35,738.10	35,738.10
	Cabasaran	17,250	4,576.02	21,826.02
	Guimba	0	39,769.99	39,769.99
	Dulay West	0	29,564.98	29,564.98
	Kilala	0	21,325.19	21,325.19
	Total	**25,620**	**339,333.80**	**364,953.80**

Source: RAP Survey Team

3.1.2 Geology and Geomorphology

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.

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 as safeguard 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 to enable the preparation of an Environmental Assessment (EIA) report. 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 MGB, National Mapping and Resource Information Authority (NAMRIA), Philippine Institute of Volcanology and Seismology (PHIVOLCS), 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.
f) 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 is accompanied by geologic cross sections.

g) 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.

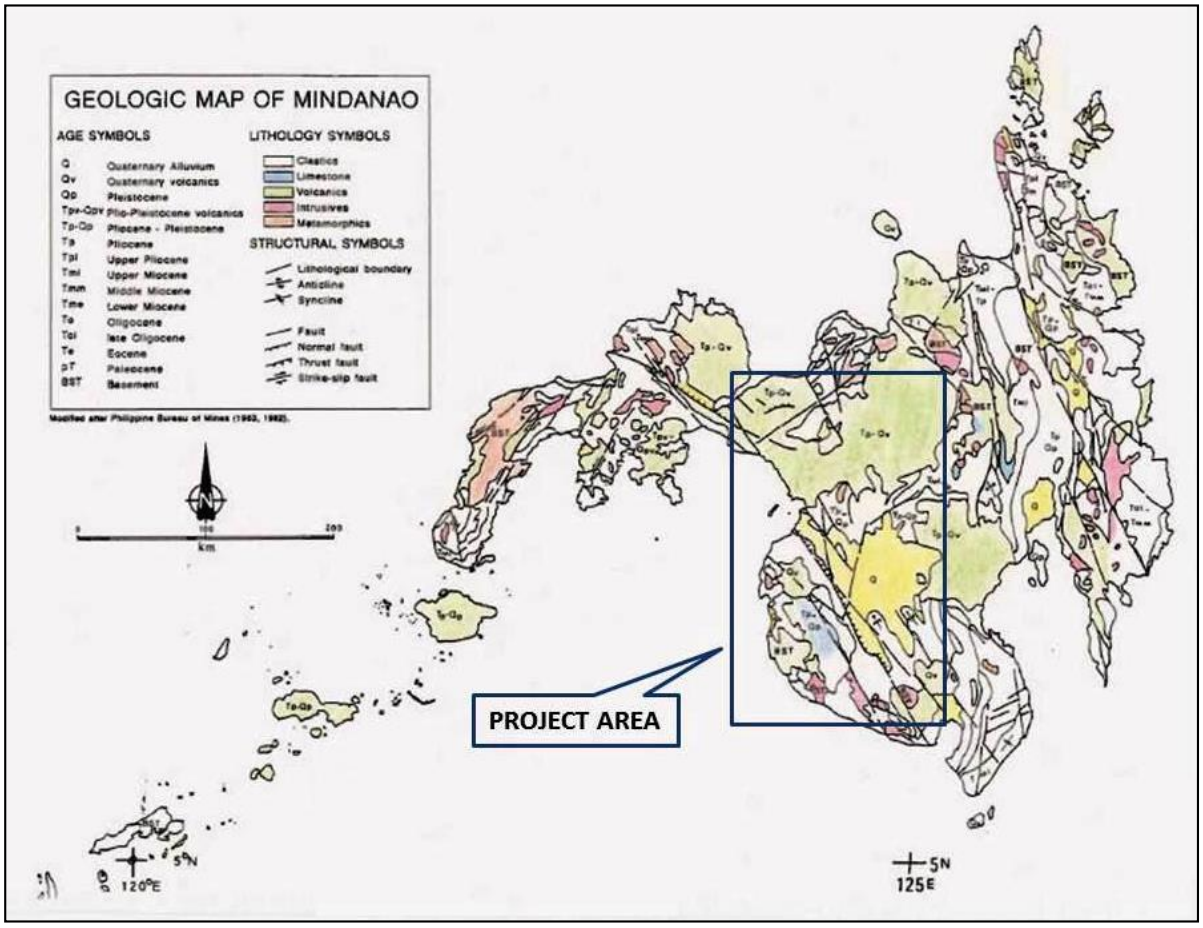
3.1.2.1 Regional Setting

3.1.2.1.1 General Geology

The 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 the island, namely a) Pacific Cordillera, Mindanao Central Cordillera and Agusan-Davao Basin; b) Tiruray-Daguma Range and Cotabato Basin; and c) NE-trending Zamboanga Peninsula and Sulu Islands. The subduction zones south of Cotabato and east of Surigao are considered most significant in the geologic development of Maguindanao 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. 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 20**.



Source: MGB, as cited in Corpuz, 1992

Figure 20. General Geology of Mindanao

3.1.2.1.2 Tectonics

Mindanao Island is a composite of at least two terrains; 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 terrains were separated by an ocean that disappeared continuously by subduction of its two edges beneath western and eastern Mindanao. The suturing of the two terrains 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).

The Central Cordillera, Agusan-Davao Basin and Pacific Cordillera are part of the Philippine Arc System. The Central Cordillera is thrust westwards over the Lanao-Bukidnon Highlands. The Pacific Cordillera is thrust westwards over the Agusan Davao Basin. The basin is asymmetrically-shaped with its depocenter located to the east.

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 as shown in **Figure 21**. 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.

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 trending fault extending from northern Zamboanga Peninsula to eastern Cotabato. The fault is physically traceable to approximately 400 km 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). 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 et al., 1991).

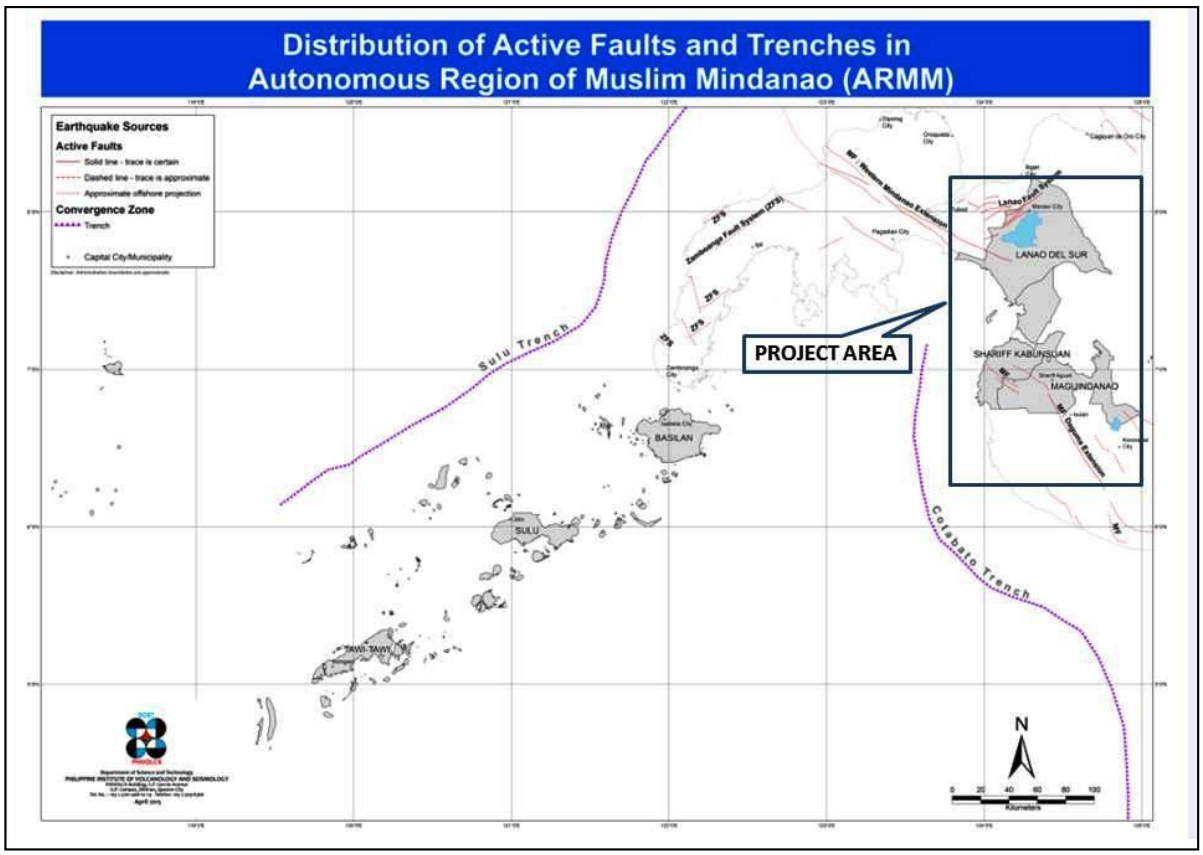
c) Philippine Fault Zone

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 This accommodates some of the stress that is not being accommodated by the surrounding trenches in Mindanao (Yumul et al., 2008).

d) Other Earthquake Generators

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.



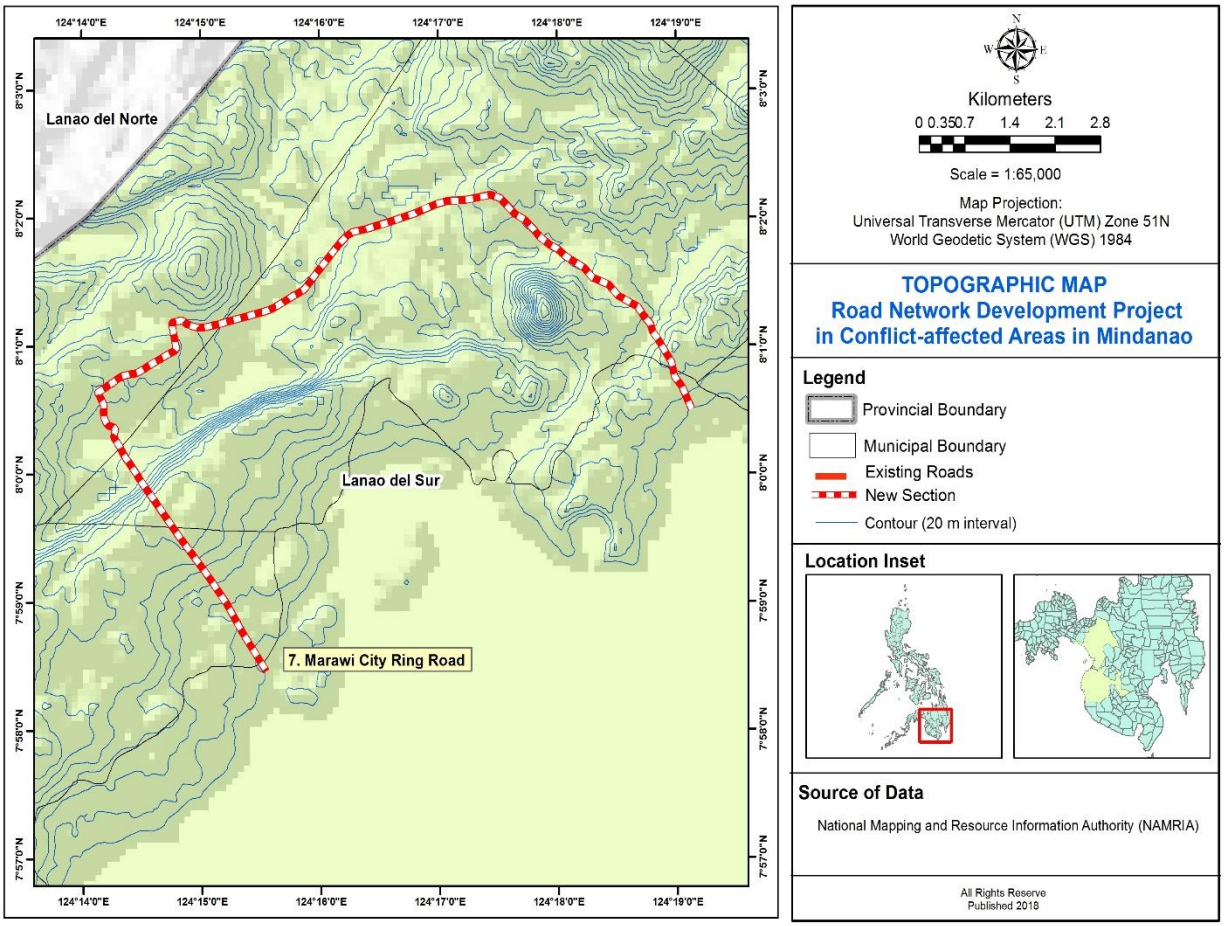
Source: PHIVOLCS

Figure 21. **Distribution of Active Faults and Trenches in ARMM**

3.1.2.2 Project Site Geologic Setting

3.1.2.2.1 Topography

In general, Maguindanao 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).



Source: NAMRIA
Figure 22. 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.

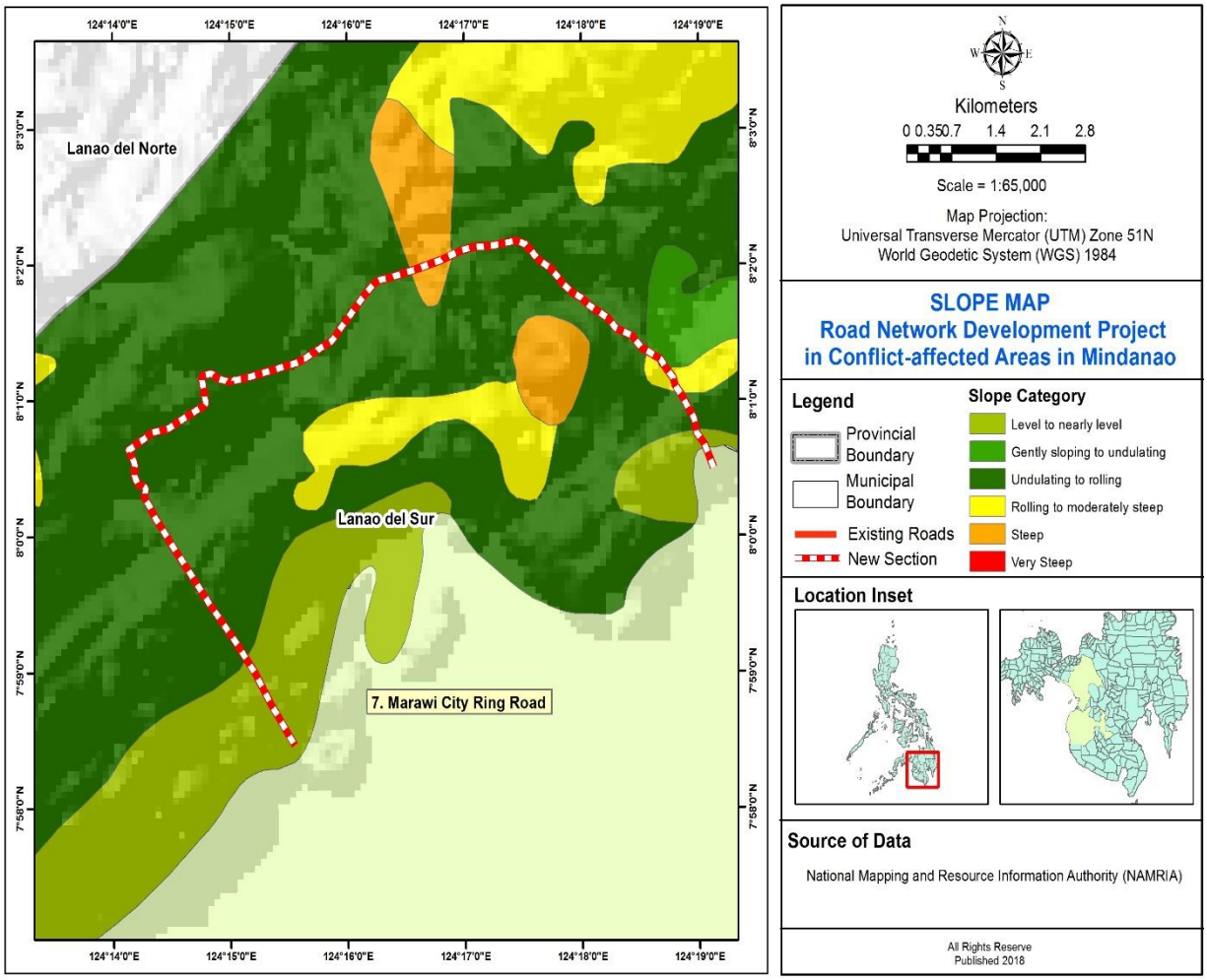
The undulating to rolling area is underlain by volcanic and/or sedimentary rock formation that gave rise to undulating to rolling ground. The ground slope ranges from 8 to 18 degree. The groundwater table is expected to be fairly deep. Most areas are covered with assorted secondary growth trees, coconuts, 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 28 shows the slope classification of the project area and **Figure 23** shows the slope map of the project site.

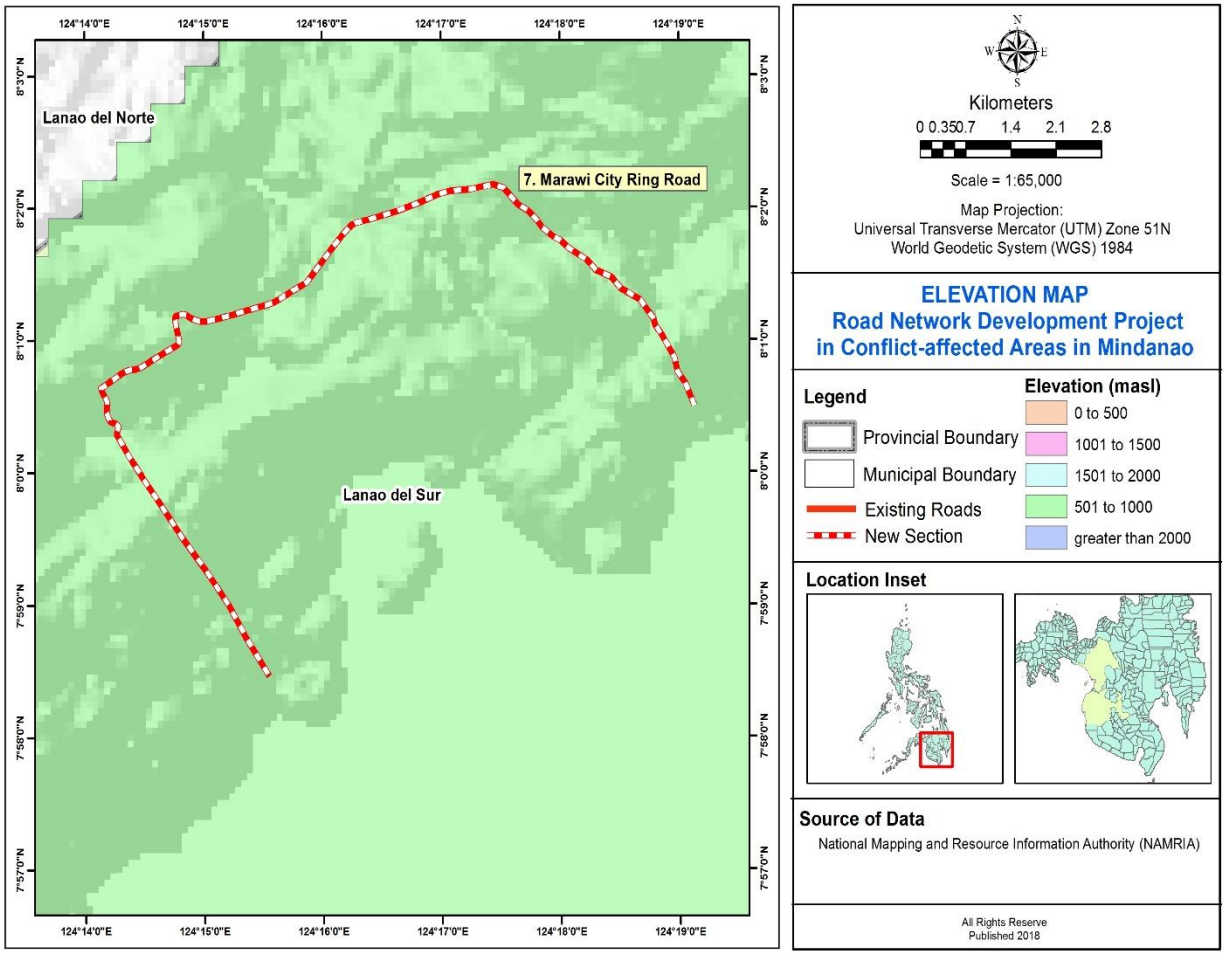
Table 28. Slope Classification of the Project Area

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 23. Slope Map of the Project Area

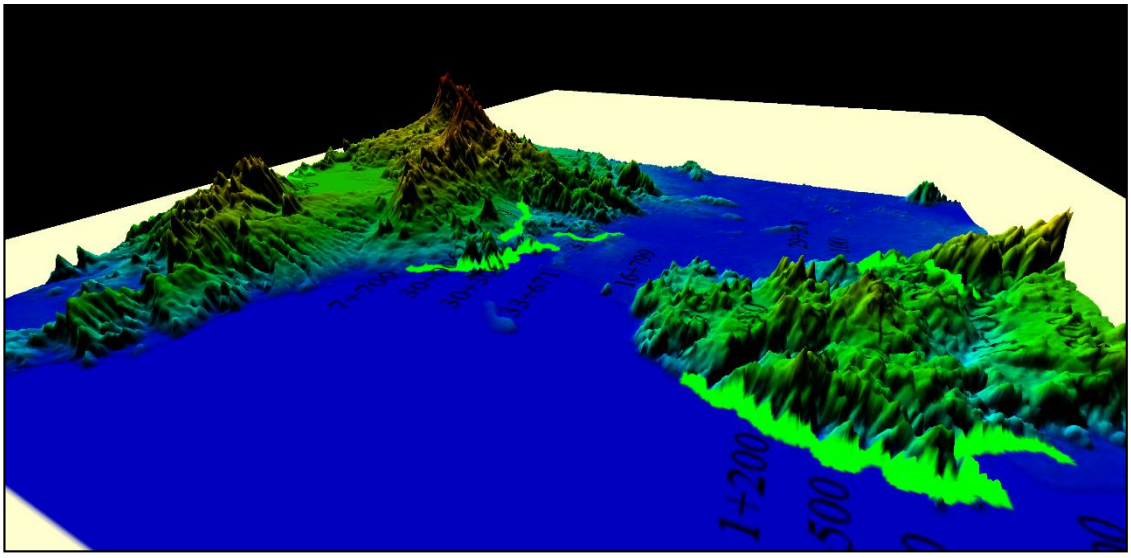
Generally, the elevation within the project area varies from 0 to 500 meter above sea level (masl) and from 501 to 1000 masl. The lower elevation is concentrated mainly at SP 7 – Marawi City Ring Road. **Figure 24** shows the elevation map of the project site.



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

3.1.2.2.2 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. **Figure 25** shows the type of rock transected by the proposed roads.

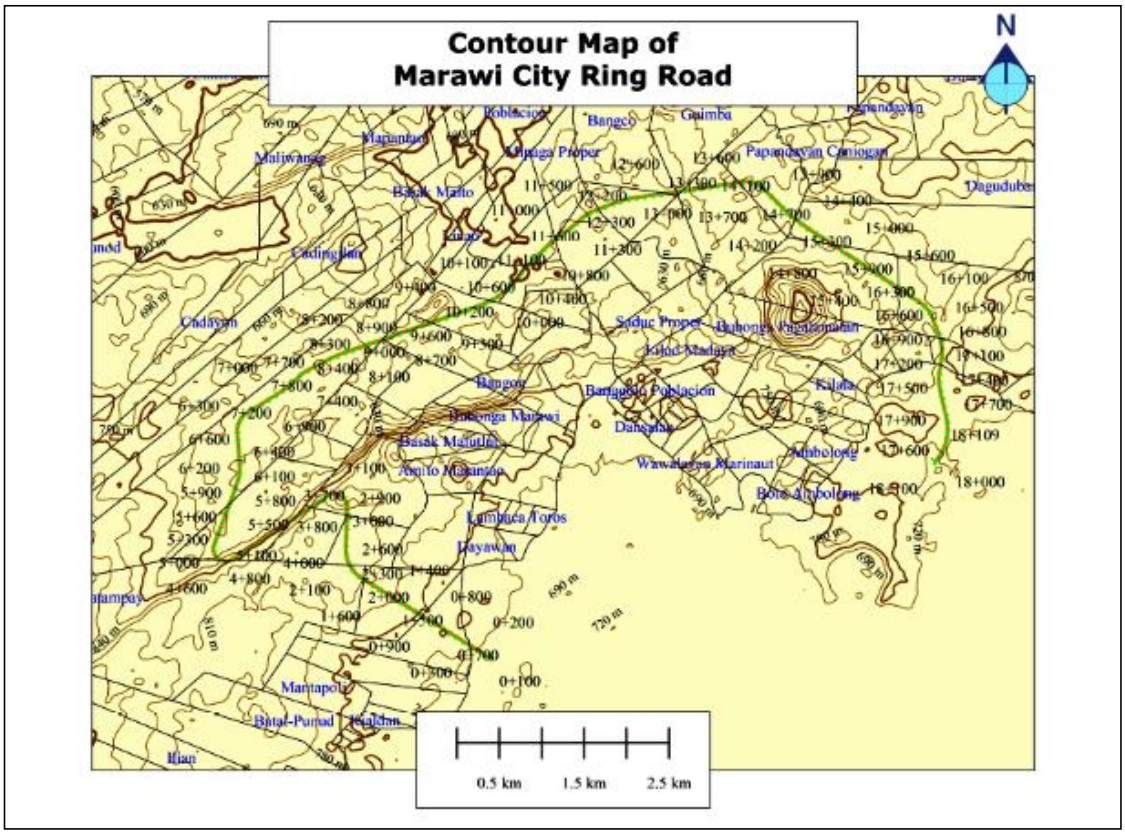


Base Map Source: JICA Study Team
Figure 25. 3D View of Type of Rock (pyroclastics/volcaniclastics/submarine rocks) Transected by the Proposed Roads.

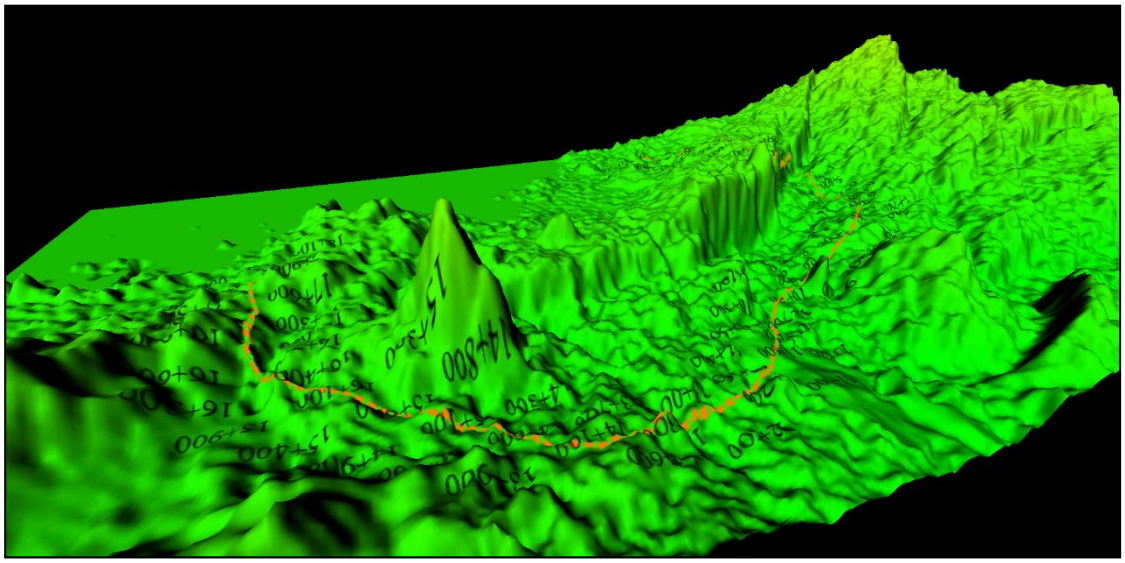
The contour maps and 3D maps of the Project are shown in **Figure 26** and **Figure 27**. The Marawi City Ring Road is one of the Bypass Road Development RSR Project in the region which aims to mitigate the congestion on the primary road AH 26: Cotabato-Marawi-Iligan Road.

Sub-Project 7 is 19.8 km long and passes through 23 barangays in Marawi City and the three municipalities of Saguiaran, Piagapo, and Marantao in Lanao del Sur. It starts from the secondary road in Brgy. Boganga in Marawi City, cuts across the northeastern portion of the Cotabato-Marawi-Iligan Road near Brgy. Dulay, crosses the NS-flowing Agus River, then proceeds in a SW-NE-SE direction.

The ground elevation reaches up to 825 masl while low-lying areas have an elevation of 600 masl giving rise to undulating to steep terrain



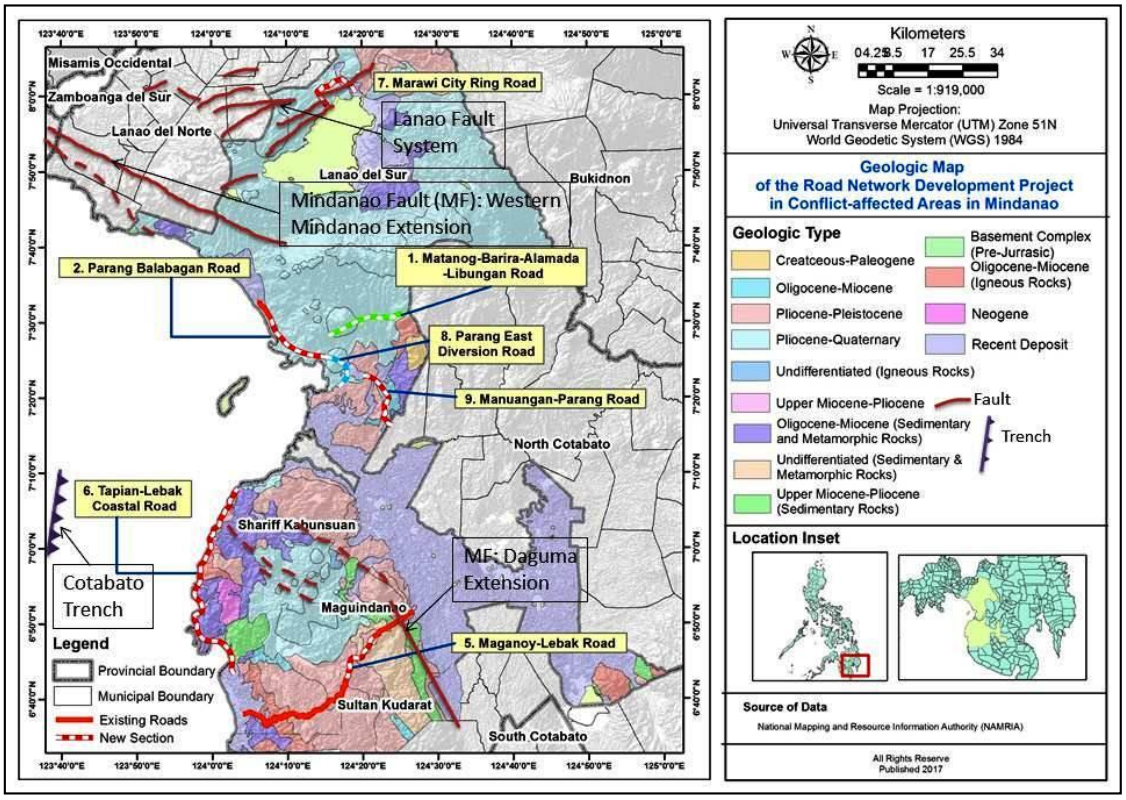
Base Map Source: JICA Study Team
Figure 26. **Contour Map of SP No. 7 Marawi City Ring Road**



Base Map Source: JICA Study Team
Figure 27. **3D View of SP No.7 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 are also present. **Figure 28** presents the geologic map of the project area.



Source: JICA Study Team

Figure 28. 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.

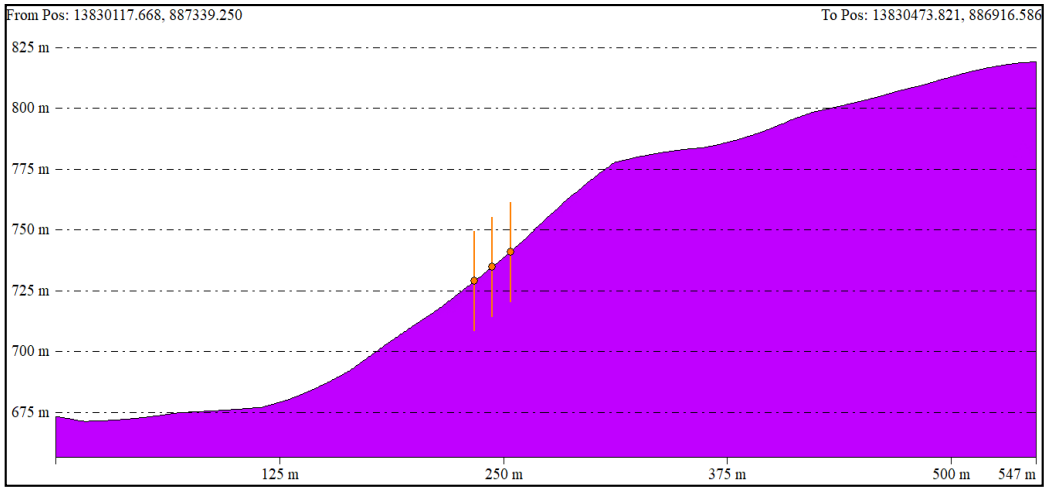
Thick, extensive, transgressive mixed shelf marine deposits, largely wackes, shales and reef limestone are also present. These are underlain by conglomerate and associated with coal measures in places. Sometimes the rock unit is associated with basic to intermediate flows and pyroclastics. They are largely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

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 red vertical lines in the cross sections represent the left, middle and right sections of the proposed road.

Figure 29 shows the proposed road section is underlain by volcanic rocks. **Figure 30** shows high gradient and relief contributed to the deposition of weathered talus materials. The road is located on a moderately sloping topography. **Figure 31** shows the talus materials are underlain by volcanic rocks. The proposed road cut may be susceptible to slope failure due to the expected thin talus materials



(Source: Google Earth Elevation Profile)

Figure 29. Sta 4+000. Representative Geologic Profiles along SP No. 7 Marawi City Ring Road

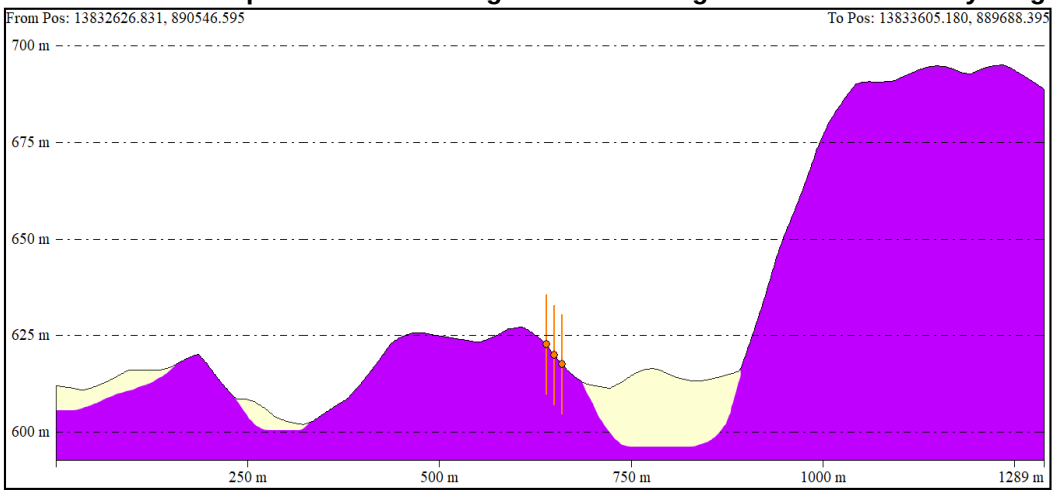


Figure 30. Sta 10+000. Representative Geologic Profiles along SP No. 7 Marawi City Ring Road

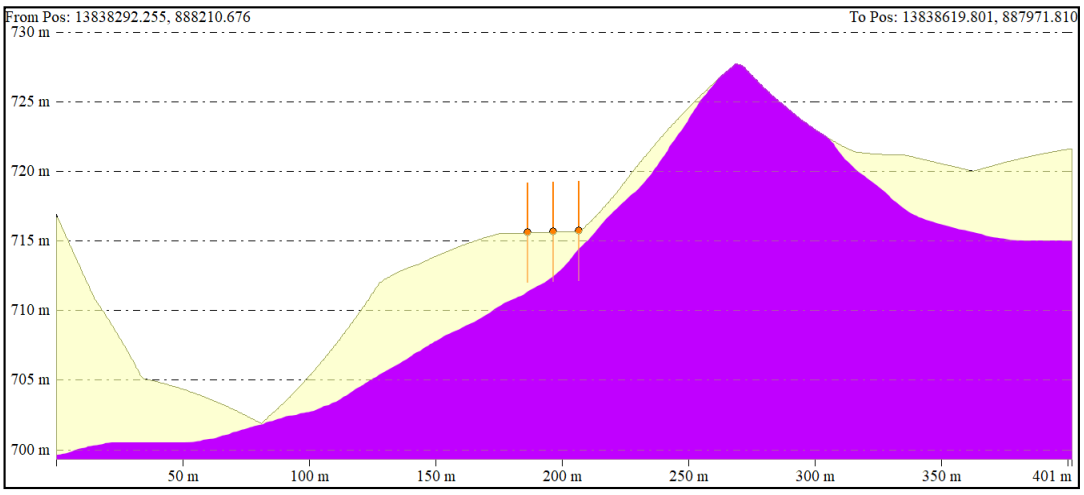


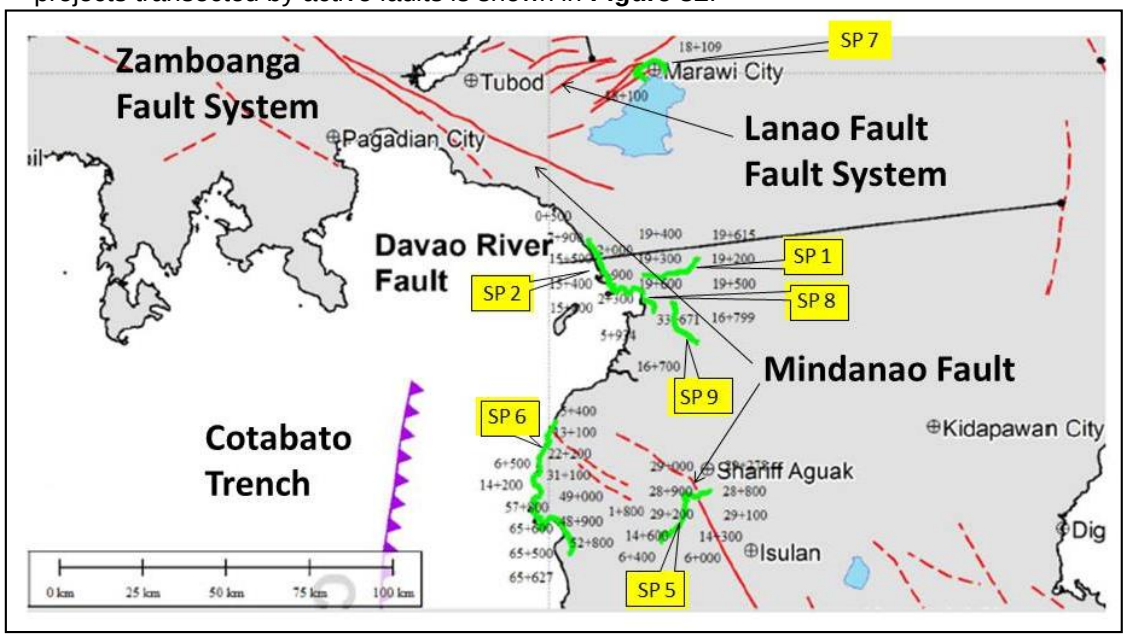
Figure 31. Sta 18+000. Representative Geologic Profiles along SP No. 7 Marawi City Ring Road

3.1.2.4 Geo-Hazard Assessment

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

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 32**.



Source: PHIVOLCS

Figure 32. Active Faults in Western Mindanao Transecting the Project Area

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.

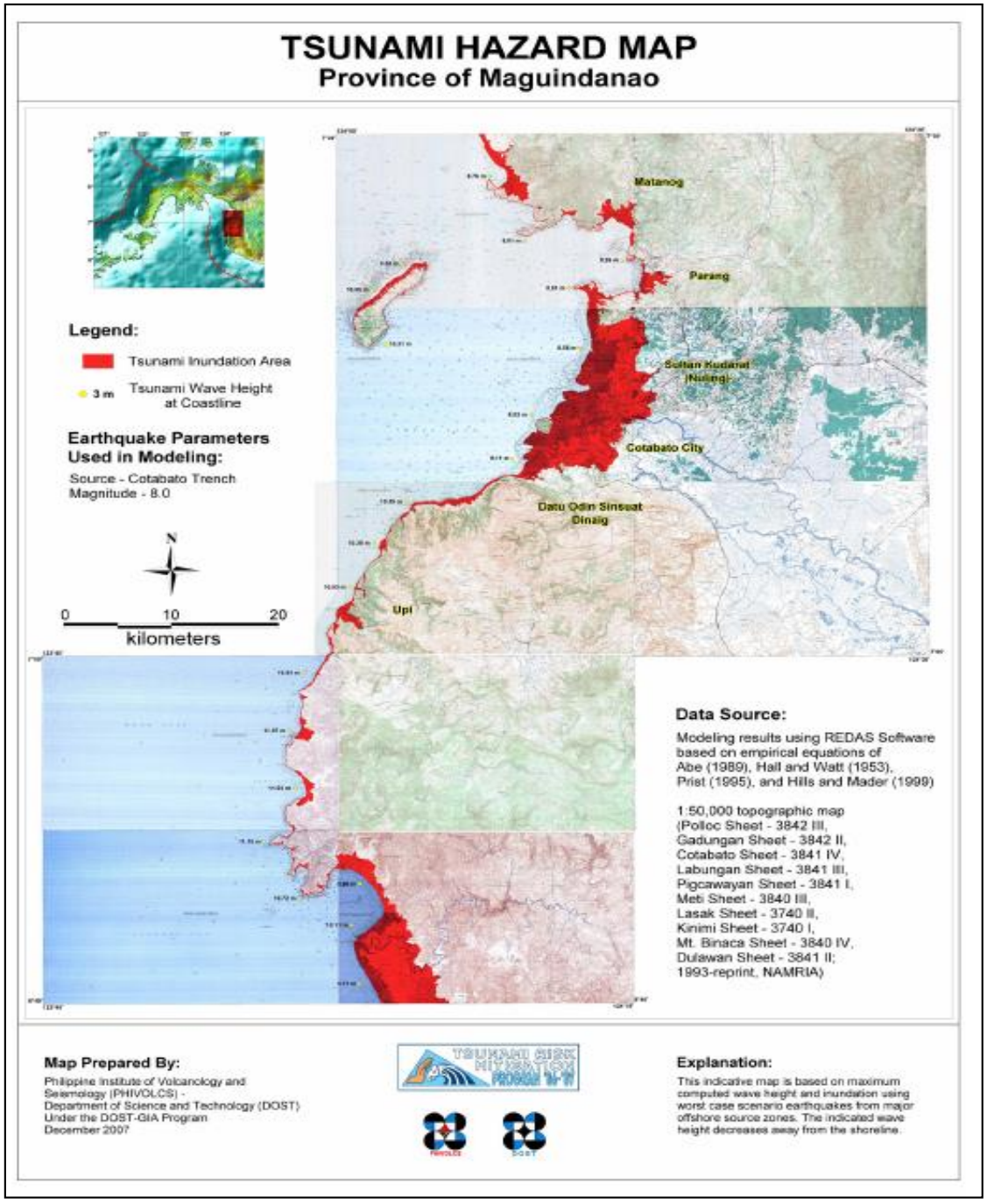
The proximity of active faults to the proposed road alignments indicates that strong to very strong ground shaking could be felt in the project area.

3.1.2.4.3 Tsunami

A tsunami is a series of sea waves commonly generated by under-the-sea earthquakes. The Moro Gulf earthquake of August 17, 1976 spawned a tsunami that damaged more than 700 km of coastline 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.

Studies have shown that the Philippine Trench is also capable of generating tsunamigenic (tsunami-generating) earthquakes. The Philippine Trench, located outside the 300-km radius of the Project Area, is the morphological expression of the westward subduction of the Philippine Sea Plate under the eastern Philippine Arc (Cardwell et al., 1980; Fitch, 1970; Hamburger et al., 1983). In 1992, two large earthquakes occurred off the eastern coast of Mindanao with the coastal areas of Davao del Sur and Surigao del Sur experiencing strong ground shaking and tsunamis. The highest tsunami wave was measured at about 6 meters (Besana et al., 2004). The location of the epicenter pointed to an event associated with the Philippine Trench (Narag et al, 1992).

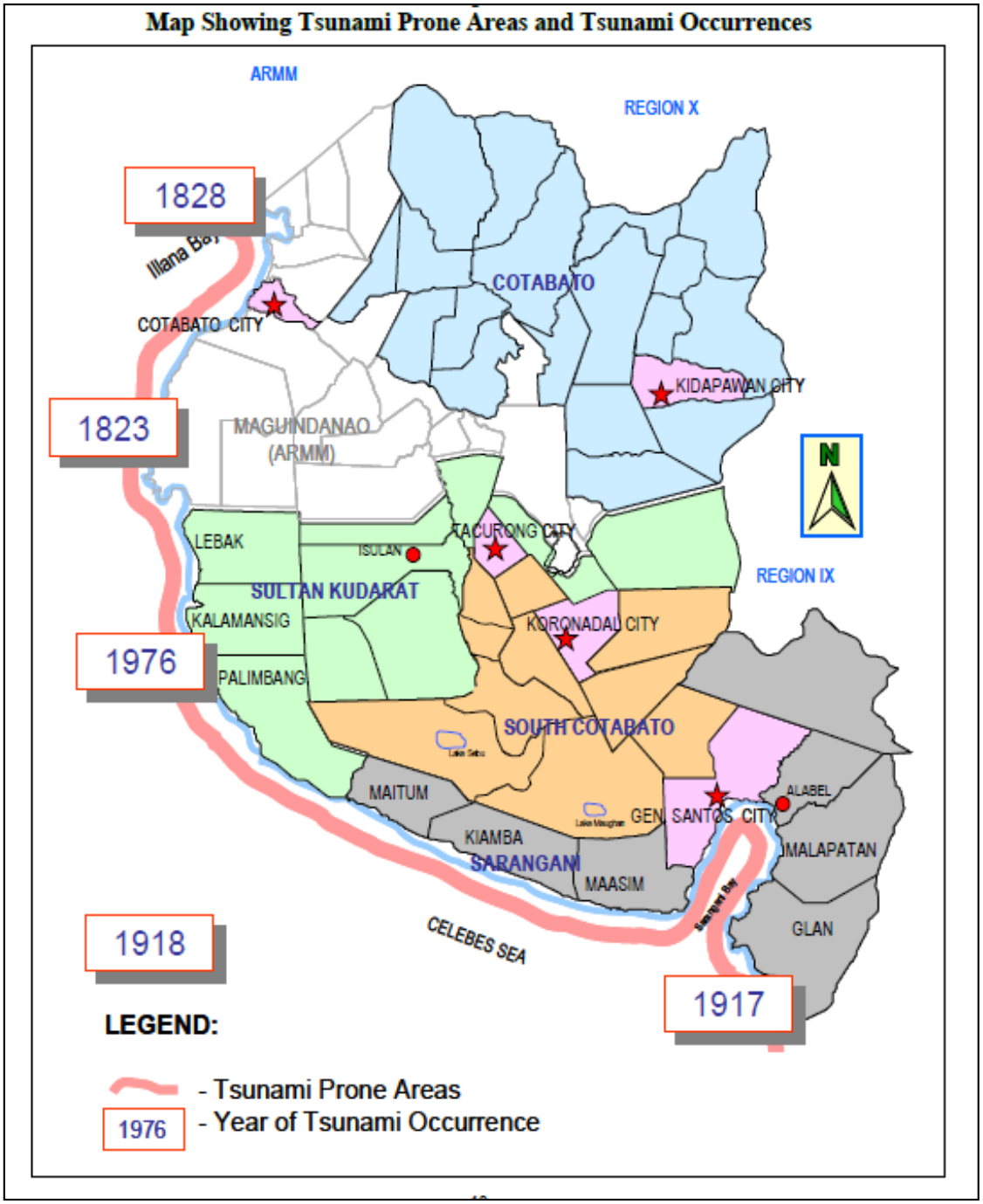
PHIVOLCS has prepared tsunami hazard map for Maguindanao as shown in **Figure 33** using a magnitude 8.0 tsunamigenic earthquake generated by the Cotabato Trench, as parameters. Based on the map, SP-7 is not prone to tsunami since the area is located farther inland.



Source: PHIVOLCS

Figure 33. Tsunami Hazard Map of Maguindanao

The historical tsunami occurrences within the region is shown in **Figure 34**.



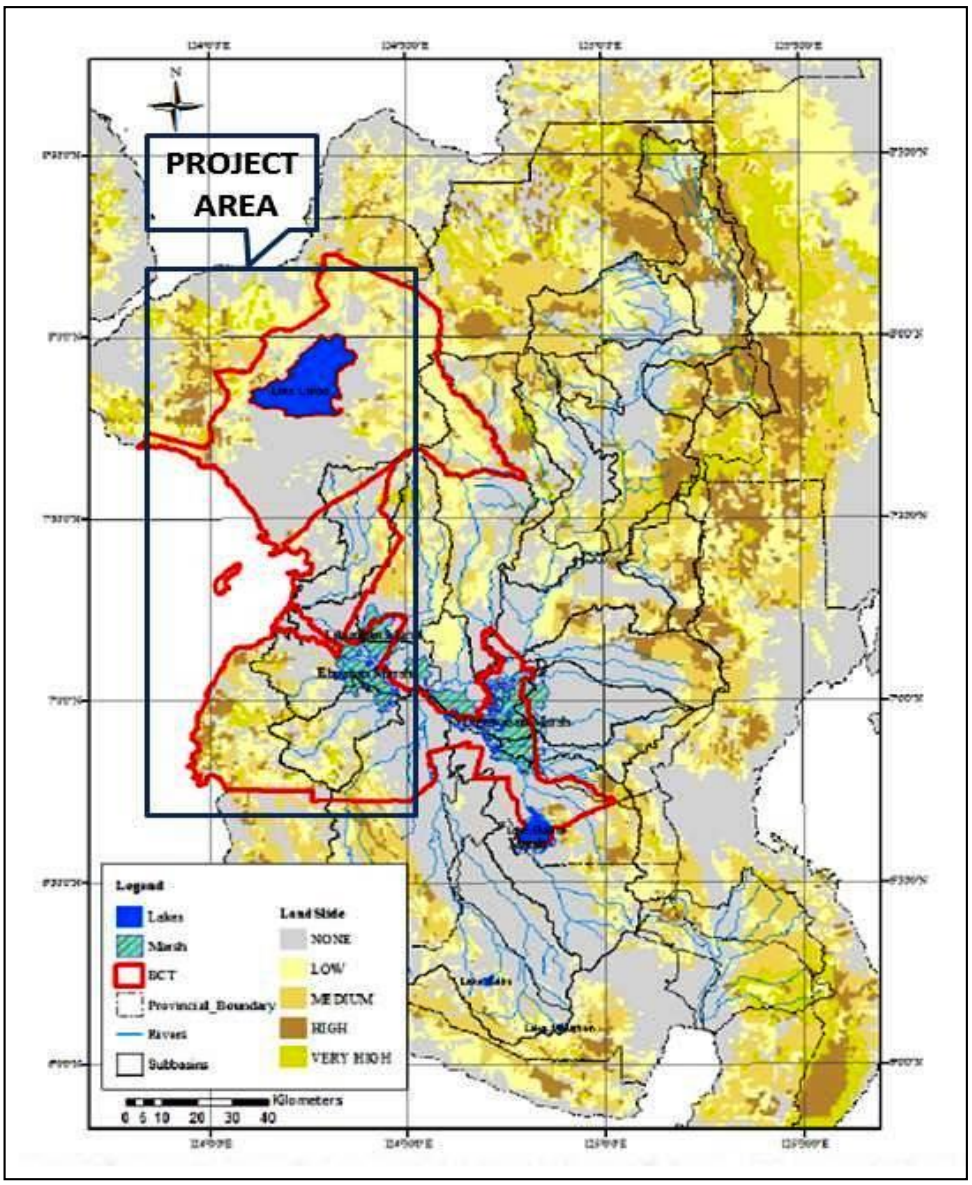
Source: Region XII DRM

Figure 34. Map showing Tsunami Prone Areas and Historical Tsunami Occurrences in Western Mindanao

3.1.2.4.4 Landslide

The primary cause of a landslide is the influence of gravity acting on weakened materials that make up a sloping area of land. The most destructive landslide events usually happen suddenly after a triggering event such as an earthquake or heavy rainfall. Landslide due to earthquake occurs 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 35**, 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 7 may require protections of the cut slopes. This assumption should be confirmed further by appropriate geological and geotechnical site investigation prior to the construction of the Project.



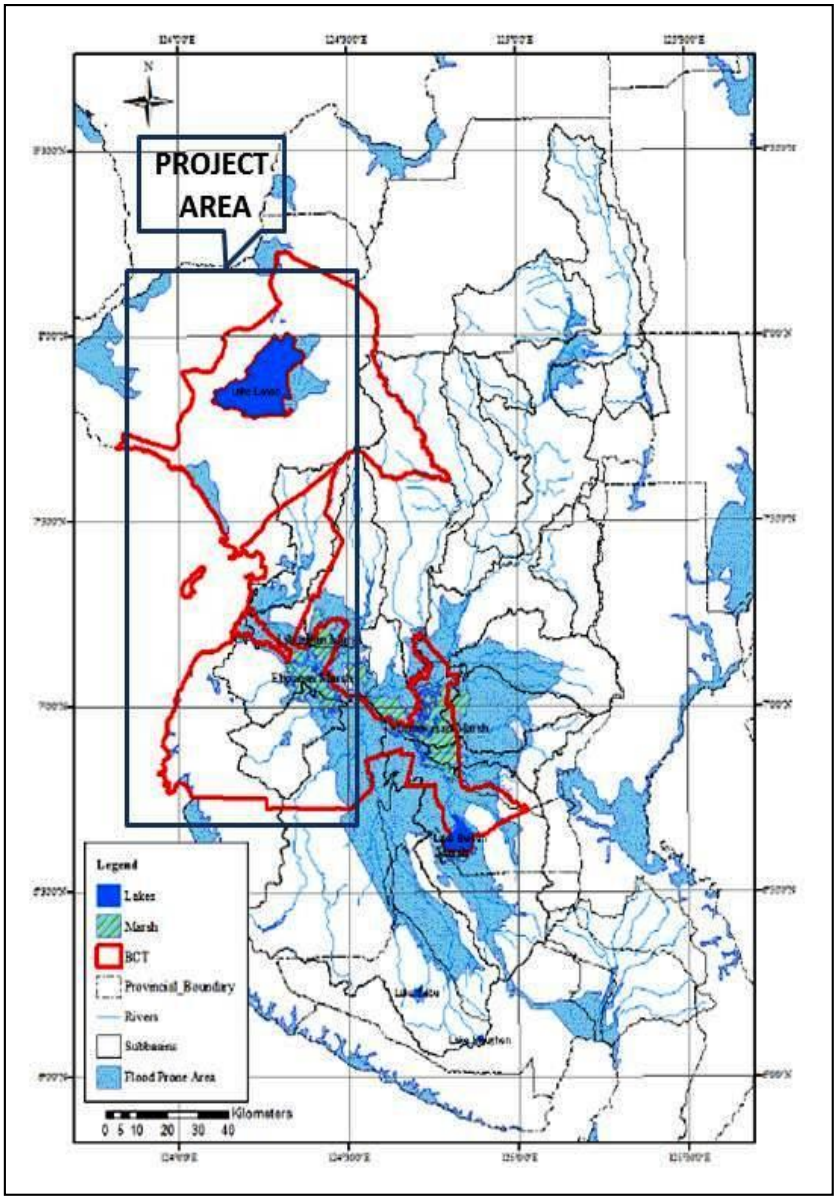
Source: PHIVOLCS

Figure 35. Earthquake-triggered Landslide Map

3.1.2.4.5 Flooding

The Office of Civil Defense (OCD)-ARMM has reported that Lanao del Sur and Maguindanao is usually associated with the occurrence of typhoons, thunderstorms and/or monsoon rains.

Figure 36 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.



Source: MGB

Figure 36. Flood-prone Areas in Bangsamoro Region

Flood susceptibility in the Marawi City Ring Road is generally considered low. 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.

3.1.2.4.6 Liquefaction

Liquefaction is the rapid loss of shear strength in cohesionless soils subjected to dynamic loading. The shear strength sometimes falls to nearly zero, while other times it only drops to a lower-than-normal value. Liquefaction occurs when the pore water pressure equals the weight of the overburden, brought about by the decrease in the volume available for interstitial fluids.

The Marawi City Ring Road is underlain by volcanic and/or sedimentary rocks which are not considered susceptible to liquefaction.

3.1.2.4.7 Volcanic Hazard

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 Active volcanoes are characterized by eruption within historical times (within the last 600 years).

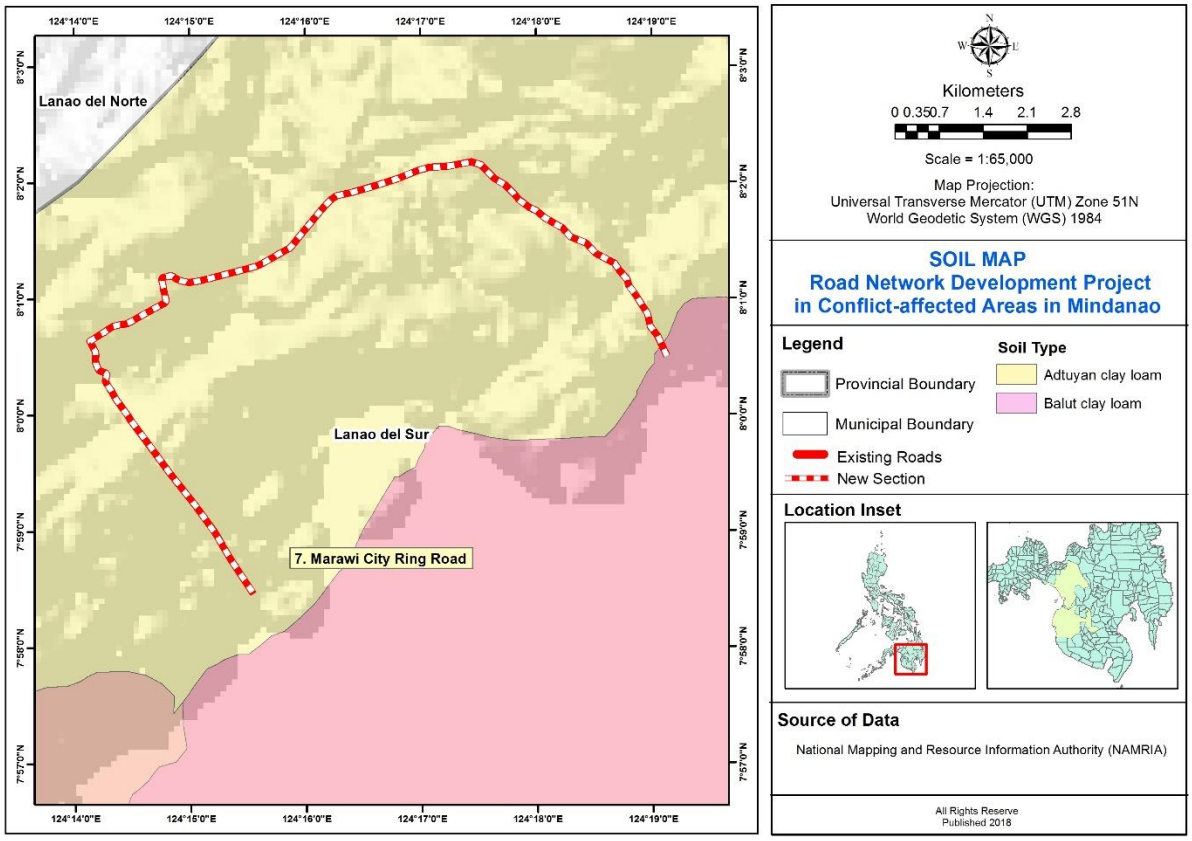
The closest active volcanoes to the Project Area are Mt. Makaturing and Mt. Ragang. However, their volcanic history is quite unclear due to the scarcity of eruption data. In the event of eruption, the impacts of hazards such as pyroclastic flows, lava flows, ashfall, lahars, volcanic gases, debris avalanches, 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. Hence, the impact of volcanic hazard to the Project Area is considered low.

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. The type of soil in the project area varies from silt clay to Adtuyan clay loam.

Figure 37 shows the soil map of the study area.



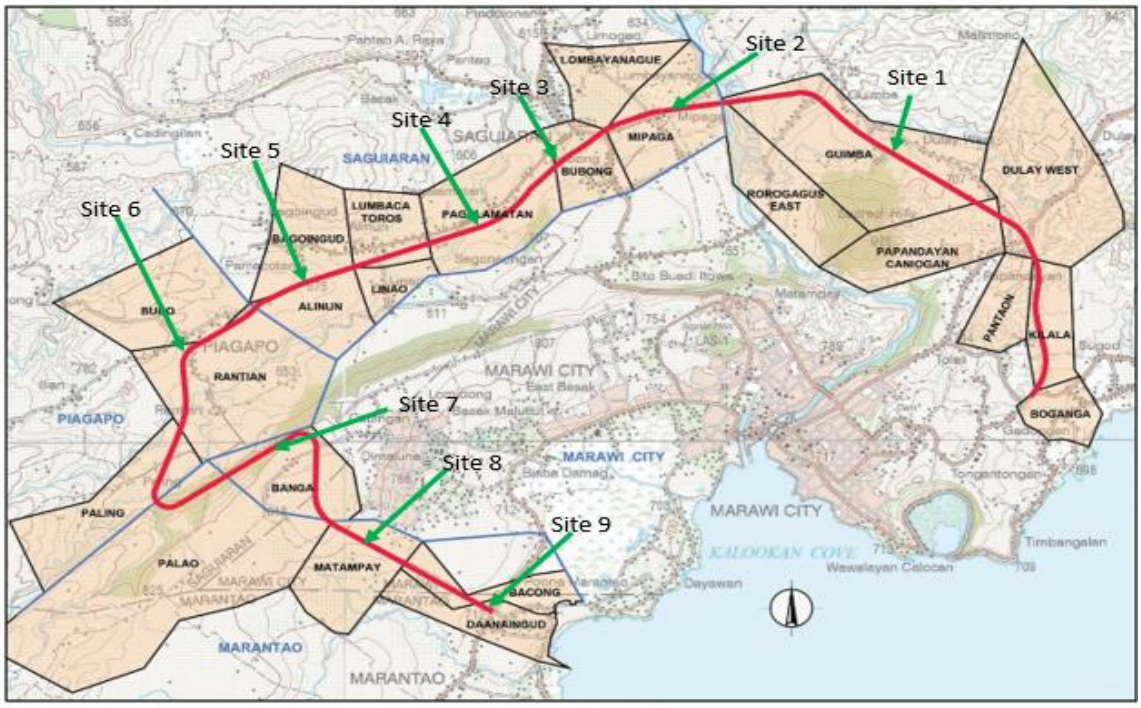
Source: NAMRIA (JICA Study Team)

Figure 37. 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 9 barangays in the municipalities of Marantao, Piagapo, Saguiaran and City of Marawi. **Figure 38** 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.



Source: JICA Study Team

Figure 38. Location of Sampling Sites within the Proposed Road Alignment

Figure 39 shows photos showing the vegetation cover within and immediate vicinity of the proposed road alignment.

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

Municipality	Sampling Site No.	Barangay	Geographic coordinates	
			Northing	Easting
Marawi City	1	Guimba	8° 1'44.89"	124°18'2.53"
Saguiran	2	Mipaga	8° 2'0.44"	124°16'44.55"
Saguiran	3	Bubong	8° 1'37.35"	124°16'6.81"
Saguiran	4	Pagalamatan	8° 1'9.66"	124°15'21.59"
Saguiran	5	Bagoingud	8° 0'57.85"	124°14'47.39"
Piagapo	6	Bobo	8° 0'30.74"	124°14'7.91"
Marawi City	7	Banga	7°59'58.01"	124°14'36.91"
Marantao	8	Matampay	7°59'19.49"	124°15'13.22"
Marantao	9	Daanaingud	7°58'58.35"	124°15'46.92"

A. Municipality of ssaguiran

B. Municpality of Piagapo

C. Municpality of Marantao

D. City of Marawi

Figure 39. Photos showing the vegetation within and immediate vicinity of 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 tree species at the canopy layer with diameter at breast height (dbh) of 10 cm and above. The species count where 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. For the identification of species immediate the ground layer a 1m x 1m sub-plots are also measured within the sampling plot.

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:

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

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

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

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

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 Biomass 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 $Y = \exp(-2.134 + 2.530 \times \ln D)$

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

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 aggregates of other perennial crops including banana, fruit bearing trees and tree crops. A total of 63 plants species were recorded within the surveyed sites, 33 species are recorded from the 9 sample plots and sub-plots and 30 species are observed outside the sample plots following the alignment. The total listed species are belonging to the 33 families dominated by Fabaceae. Species dominating in the canopy and understory layer is the Falcata or *Acacia falcata* while Wild sunflower or *Tithonia diversifolia* dominates the ground layer. The computed biodiversity index of the study area reveals a relatively low to low diversity composition. Consevation status of listed species shwod that there is no critically endangered in the IUCN category, though, the Magabuyo or *Celtis luzonica* is the only vulnerable in the category.

With regards to faunal composition of the study area, most of the species observed are common and locally found in the region. Habitats of these species are distributed in lowland habitats including agricultural areas, settlements, grassland and open areas. Diversity composition is found to be nominal which is possibly influenced by the existing vegetation cover. Further, no endangered or threatened species found within the study area. Observed faunal species has a total of 25 species domainated by avifauna. Three avifaunal species are endemic in the country and 1 herepeto-fauna (Mindanao Flying Dragon *or Draco mindanensis)* is endemic in Mindanao. Conservation status of identified species showed that there is no critically endangered species in the listing.

1) Terrestrial Flora

The conservation status of species identified on site as shown in **Table 31** 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 (2006); and DAO 2007-01 entitled “The National List of Threaten Plants under Categories. Based on the table below, out of the 63-species identified from the project area, one (1) is vulnerable (VU), and (4) are Least Concern (LC). **Figure 40** shows the photo of one vulnerable species at plot 7.

Table 31. List of Species and its corresponding Conservation Status

SPECIES			CONSERVATION STATUS
COMMON NAME	SCIENTIFIC NAME	FAMILY	
Manila palm	*Adonidia merrillii* (Becc.) Becc.	ARECACEAE	LC
American kapok	*Ceiba pentandra* (L.) Gaertn.	MALVACEAE	LC
Salingogon	*Cratoxylum formosum* (Jack) Dyer	CLUSIACEAE	LC
African Tulip	*Spathodea campanulata* P. Beauv.	BIGNONIACEAE	LC
Magabuyo	*Celtis luzonica* Warb.	CANNABACEAE	VU

Figure 40. Magabuyo (*Celtis luzonica*) located in sampling Plot no. 7

i. Floristic composition

A total of 63 species belongs to 54 genera and 33 families were identified from the proposed Marawi City Ring Road within and outside the sampling plots, following the alignment. Moraceae is found to be the dominant family in the project site in terms of species count by having both 9 (14.286%) species, seconded by Malvaceae and Poaceae with 5 (7.937%) species, respectively. While twenty-two (22) families were represented by only 1 (1.587%) species and genera.as presented at **Table 32.** **Figure 41** shows the percentage in terms of species count.

Table 32. Families with Highest Number of Genera and Species Along the Proposed Area

FAMILY	NUMBER OF SPECIES	NUMBER OF GENERA	PERCENTAGE (SPECIES)	PERCENTAGE (GENERA)
MORACEAE	9	2	14.286%	3.175%
MALVACEAE POACEAE	5	5	7.937%	7.937%
FABACEAE	5	4	7.937%	6.349%
ARECACEAE	4	4	6.349%	6.349%
ARACEAE	3	2	4.762%	3.175%

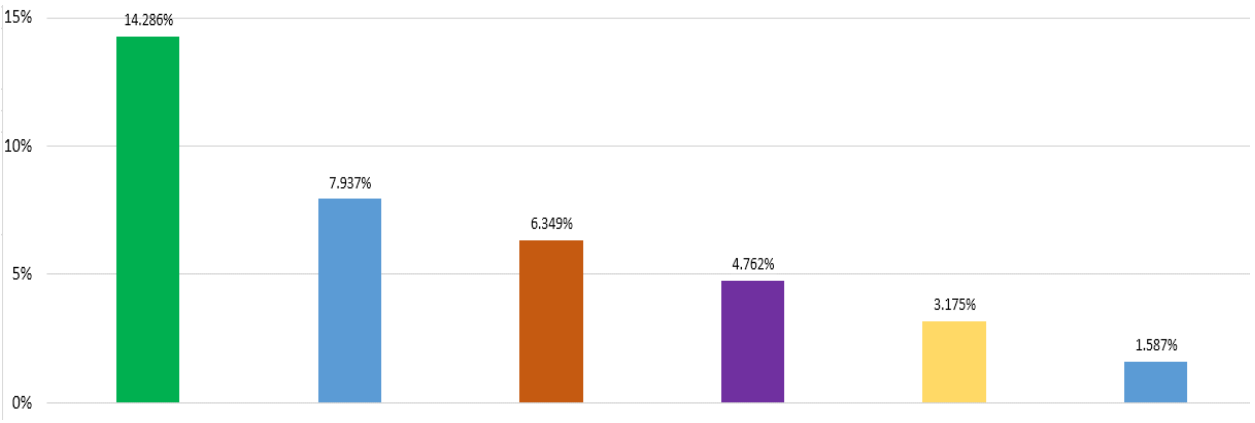


Figure 41. Family percentage in terms of species count

From the 63 plants species identified, 33 species were recorded from the 9 sample (20m x 20m, 5m x 5m and 1m x 1m) plots and sub-plots. While 29 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 (59%); seconded by herb (14%), followed by grasses and palm trees (8%); fern (6%); and the remaining 2% of the species belongs to vine as shown in **Figure 42**. On the other hand, more than half (89%) of the listed species are naturally growing and the remaining (11%) species are planted on the site (Refer to Annex 13.6.1).

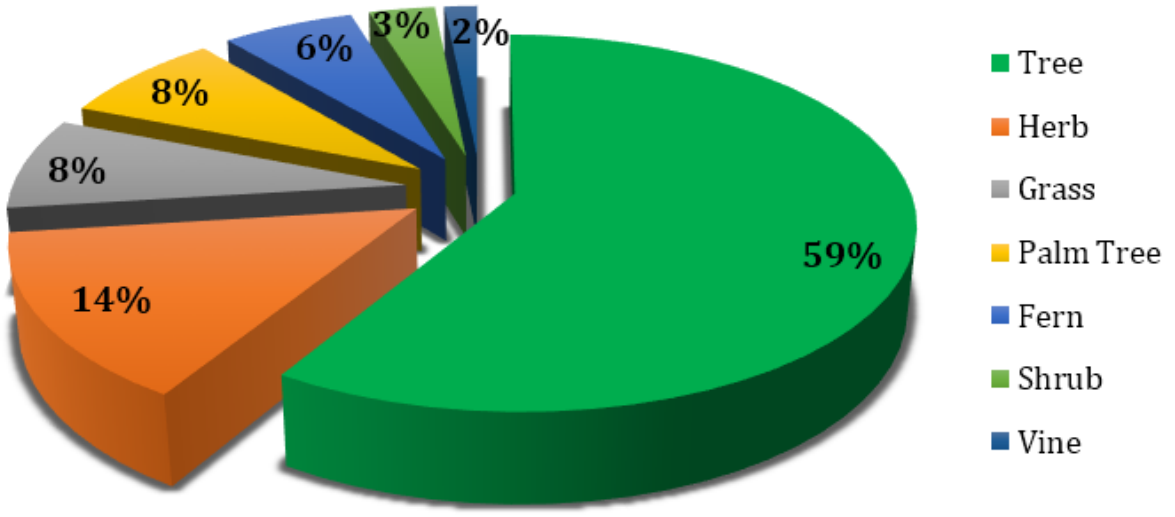


Figure 42. Distribution of plant species by their habits

ii. Canopy Layer

a) 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 43** and details in Annex 13.6.1, Falcata or *Acacia falcata* has the highest relative density (Rρ) 47% but ranked as second in relative frequency value of (Rf) 14%. It is followed by Mahogany or *Swietenia macrophylla* with Rρ 32% and has the highest Rf 24%; Marang banguhan (Rρ=6% and Rf=10%); and Kakauate or *Gliricidia sepium* (Rρ=5% and Rf=2%). While ten (10) species have only 1 species count and occurrence, and only contributed about 10 (12%) of the total 81 recorded individual trees under 14 identified species.

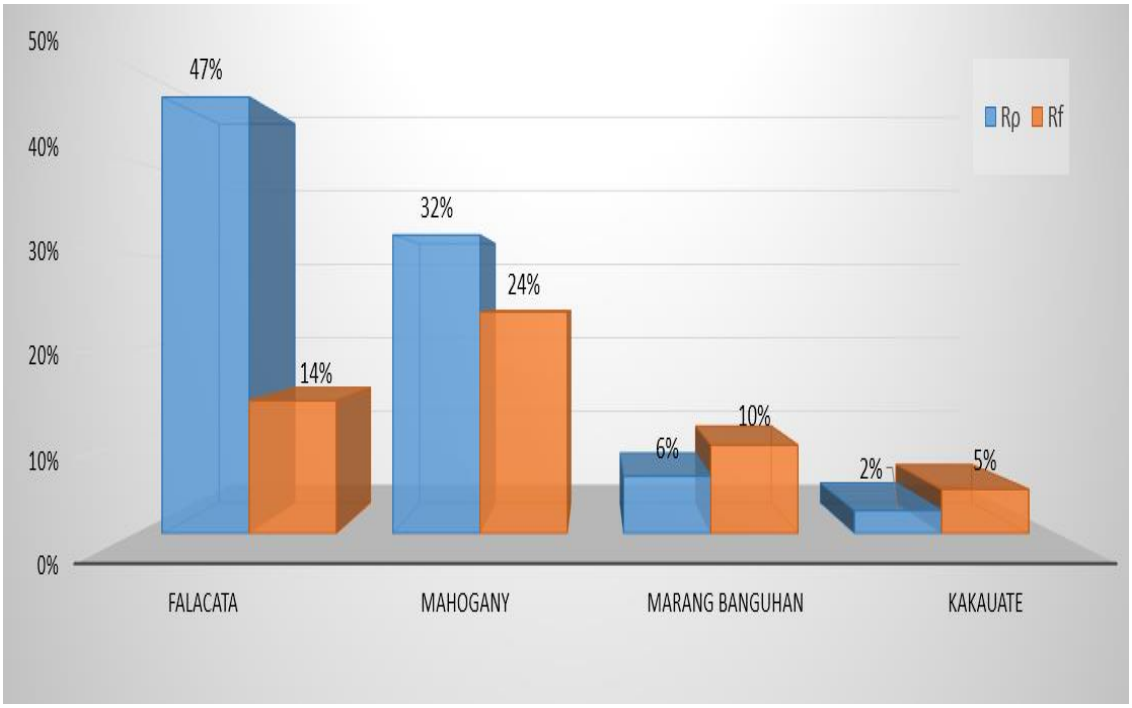


Figure 43. Species in the Canopy Layer with their Corresponding Density and Frequency

b) 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 44**, plots 1, 3, 7, and 9 have relatively low diverse community having value less than 1.705; and plots 4, 5, 6 and 8 have zero (0) computed value of Shannon H' and J which indicates that only 1 species is identified in the plot. Additionally, Plot 2 which having H'0.451 and J' 0.251 indicates a poor species richeness and evenness.

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 14) being the highest diversity as shown in **Figure 45**. Based on the figure, Simpson's D computation supports the analysis in Shannon H' stating the sample plots falls in relatively low to low diversity. Additionally, plot 4 located in Brgy. Pagalamatan, Saguiran; plot 5 in Brgy. Bagoingud, Saguiran; plot 6 in Brgy. Bobo, Piagapo; and plot 8 in Brgy. Matampay, Marantao, have the lowest value of D equals to 1 which indicates that there is only 1 species identified in the plot.

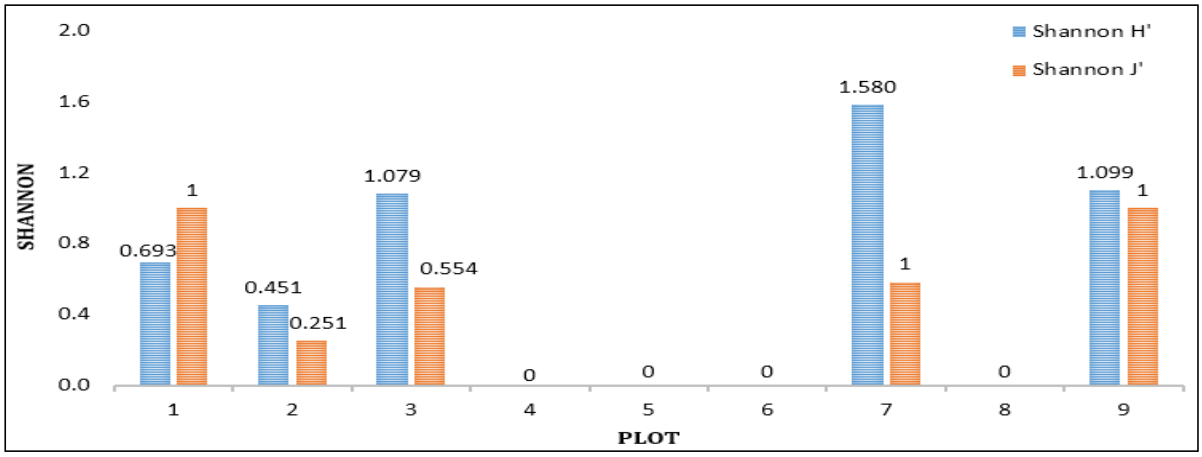


Figure 44. Shannon H' and J Diversity Index in the 9 Sample Plots in the Canopy Layer

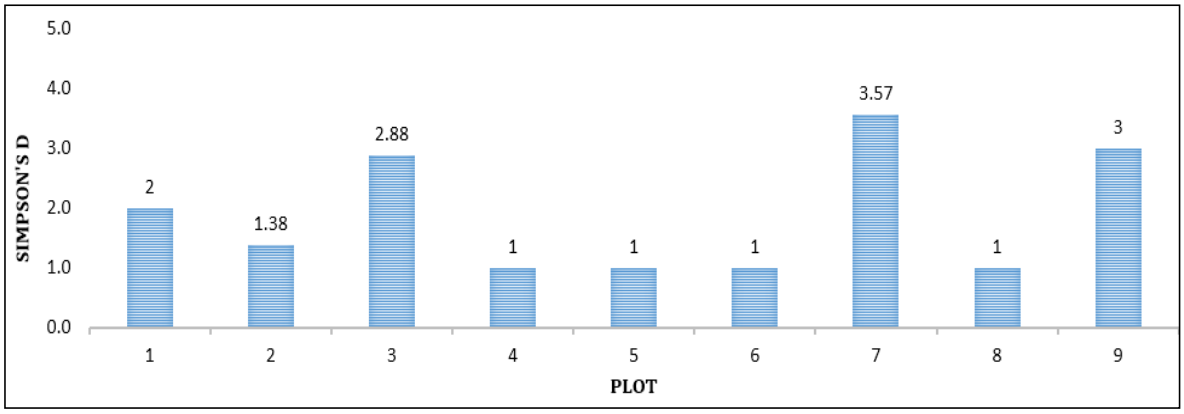


Figure 45. Simpson's D in the 9 Sample Plots in the Canopy Layer

iii. Understory layer

a) Density and Frequency

As shown in **Figure 46** and details in Annex 13.6.1, Falcata or *Acacia falcata* has the highest value in both Rρ and Rf with 30% and 20%, respectively. It is followed by Guava or *Psidium guajava* (Rρ 10% and Rf 13.33%), and Durian or *Durio zibethinus* and Kakauate or *Gliricidia sepium* (Rρ=10% and Rf. While eight (8) species have only 1 species count and occurrence, and only contributed about 8 (4%) of the total 20 recorded individual trees under 12 identified species.

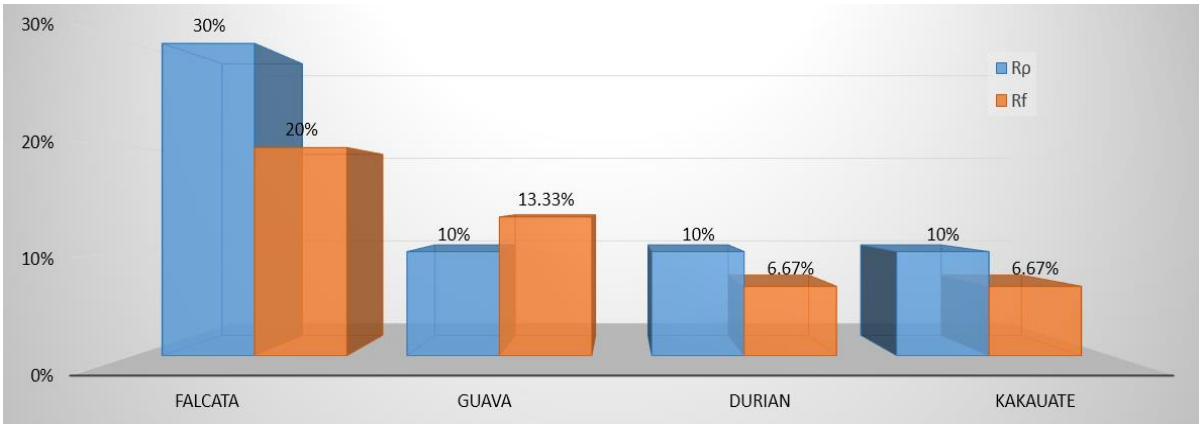


Figure 46. Species in the Understory Layer with their Corresponding Density and Frequency

b) *Biodiversity Index*

As shown in **Figure 47**, from the 9 sample plots, two (2) plots (2 and 3) have greater than 1 but less than 1.705 which indicates a relatively low diversity; three (3) plots (5,7 and 8) are identified to have low diversity with H' less that 1; three (3) plots (1, 4 and 6) have the lowest value of H' and J' equals to 0 which indicates that only one species identified in the plot. While plot 9 located in Brgy. Daanaingud, Marantao has NA (not applicable) which means, no species were recorder in the plot under understory layer.

For Shannon J, plot 1 and 2 have J' equals to 1 which indicates species are evenly abundant in the plot. In terms of Simpson's D in the understory layer, it supports the analysis in Shannon H' stating that plots in understory layer falls under relatively low to low diversity. Additionally, plot 1 in Brgy. Guimba, Marawi City; plot 4 in Pagalamatan, Saguiran; and plot 6 in Brgy. Bobo, Piagapo, have only one (1) identified species with D' equals to 1 as shown in **Figure 48**.

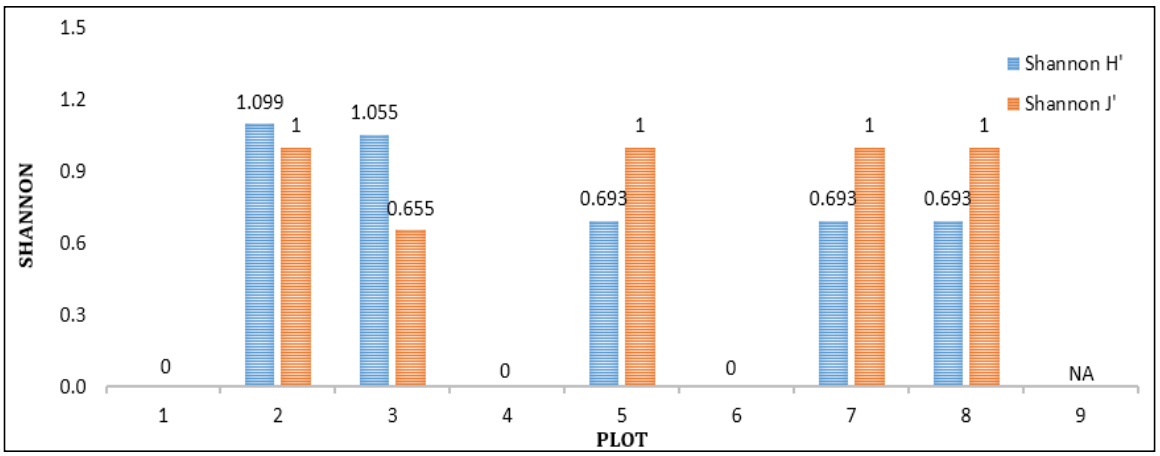


Figure 47. Shannon H' and J' Diversity index in the 9 Sample Plots in the Understory Layer

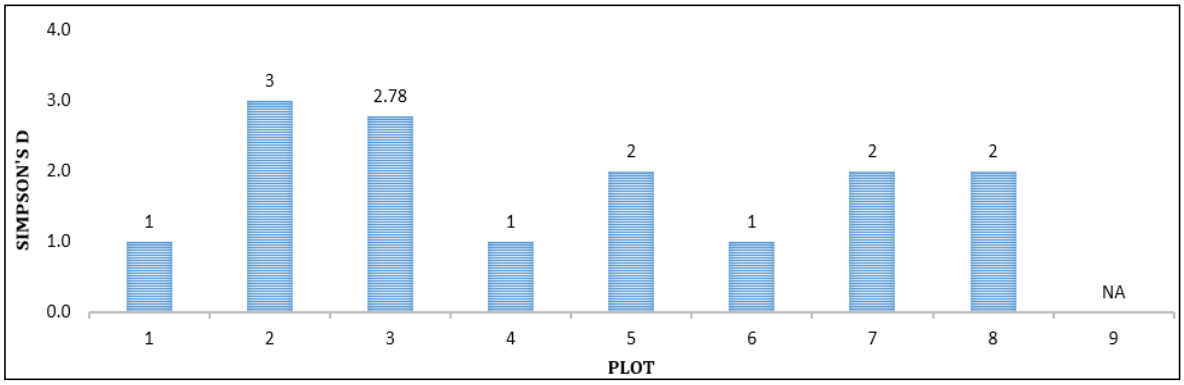


Figure 48. Simpson's D in the 9 Sample Plots in the Understory Layer

iv. Ground layer

a) Density and Frequency

As shown in **Figure 49**, Wild sunflower or *Tithonia diversifolia* has highest Rp 26.506% and Rf of 20.690%. It is followed by: Coronitas or *Lantana camara* (Rp 9.639% and Rf 13.793%); Blue fern or *Cyclopeltis crenata* (Rp 9.639% and Rf 6.89%); and Mahogany or *Swietenia macrophylla* (Rp 8.434% and Rf 6.89%). While thirteen (13) species were represented by less than 5% Rp and Rf, and contributed about 36 (43%) of the total 83 recorded individual species under 18 identified species as shown in Annex 13.6.1.

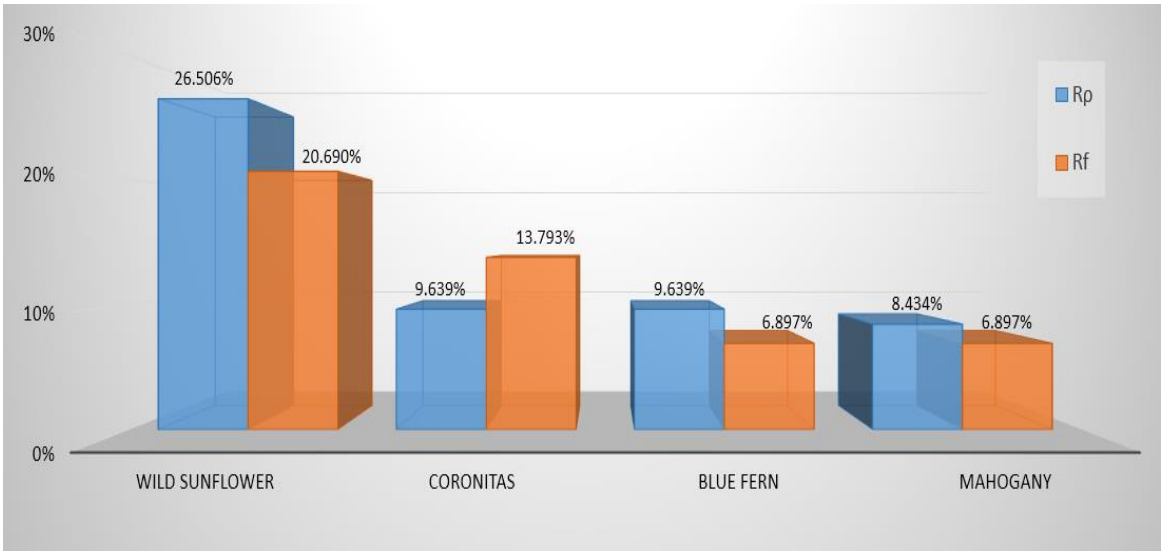


Figure 49. Species in the Ground Layer with Highest Corresponding Density and Frequency

b) *Biodiversity Index*

As shown in **Figure 50,** plot 7 has the highest Shannon H' value with 1.710, which falls under relatively diverse community; and plots 5 located in Brgy. Bagoingud, Saguiran and plot 9 in Brgy. Daanaingud, Marantao have H' and J' zero (0) velue which indicates that only one species identified in the plot. While the rest of the plots are identified as relatively low to low diversity with H' less than 1.7. With regards to Simpson's D, it supports the Shannon H' computation that Plots 7, in Brgy. Banga, Marawi City, have the highest value among the 6 plots as shown in **Figure 51**.

Photos showing the sampling plots were presented in **Figure 52 to Figure 60.**

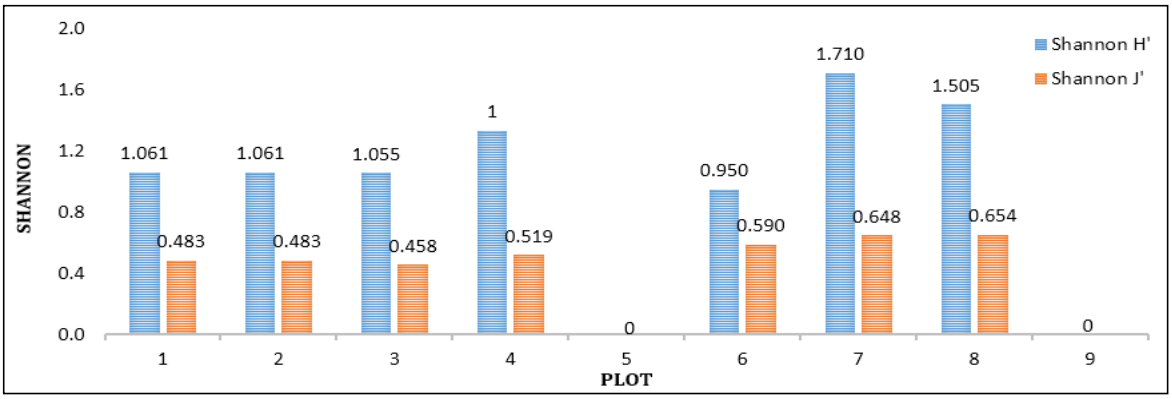


Figure 50. Shannon H' and J' Diversity Index in the 9 Sample Plots in the Ground Layer

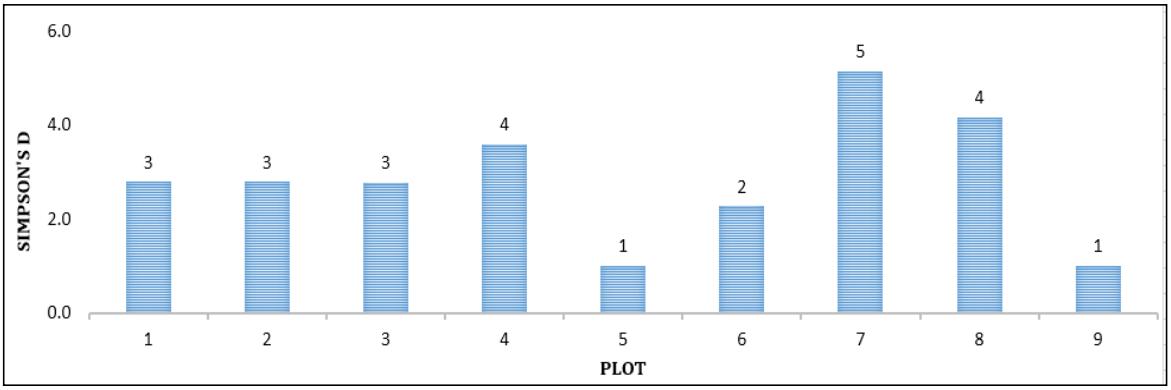


Figure 51. Simpson's D in the 9 Sample Plots in the Ground Layer

Figure 52. Photo of sample plot no. 1 in Brgy. Guimba, Marawi City

Figure 53. Photo of sample plot no. 2 in Brgy. Mipaga, Saguiaran

Figure 54. Photo of sample plot no. 3 in Brgy. Bubong, Saguiaran

Figure 55. Photo of sample plot no. 4 in Brgy. Pagalamatan, Saguiaran

Figure 56. Photo of sample plot no. 5 in Brgy. Bagoingud, Saguiaran

Figure 57. Photo of sample plot no. 6 in Brgy. Bobo, Piagapo

Figure 58. Photo of sample plot no. 7 in Brgy. Banga, Marawi City

Figure 59. Photo of sample plot no. 8 in Brgy. Matampay, Marantao

Figure 60. Photo of sample plot no. 9 in Brgy. Daanaingud, Marantao

2) Terrestrial Fauna

Survey on terrestrial fauna was undertaken in 9 sampling sites together with flora within the proposed road alignment. The sampling are situated in 9 barangays in the municipalities of Marantao, Piagapo, Saguiaran and Islamic City of Marawi.

Observation sites are mostly situated within the road alignment which land cover are aggregates of agricultural areas, Shrubland and along settlement sites. Elevations of selected observation sites is in between 600 to 820 meters above sea level. Geographic coordinates of observation sites.

i. Fauna composition and richness

a) Avifauna

The overall result of fauna survey in the proposed project site exhibited a total of 22 species of aves belonging to 20 families with a total abundance of 162. The dominant families are Laniidae and Pycnonotidae, represented by 2 species of Shrike and 2 Bulbul species, respectively. With

regard to species abundance, the Eurasian Tree Sparrow (*Passer montanus)* is the most abundant species having a total of 45 as shown in **Table 33**. This species belonging to family Passeridae.

Relative to abundance, sampling site no. 9 has the highest abundance followed by site no. 6 with an accounted population of 32 and 29, respectively. Conversely, site no. 3 has the lowest abundance with only 10 population. In terms of species richness, sampling site no. 6 has the highest richness of 10. While, site no. 3 has the lowest richness with only 4 species identified.

The general observation relative to avi-faunal composition of the area showed that most of the recorded species are found to be common in a wide range of habitats. These species are locally found in the lowland areas, agricultural areas, shrublands, grasslands and even within settlement sites.

Table 33. 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	
Laniidae	*Lanius schach*	Long Tailed Shrike	Least Concern						1				1
Alcedinidae	*Halchyon chloris*	White Collared King Fisher	Not Evaluated							2			2
Rhipiduridae	*Rhipidura javanica*	Pied Fan Tail	Least Concern	2						3			5
Apodidae	*Collocalia affinis*	Glossy Swiftlet	Not Evaluated		2			3	3			2	10
Picidae	*Dendrocopos maculatus*	Pygmy Wood Pecker	Least Concern						1				1
Sylviidae	*Megalurus timoriensis*	Tawny Grass Bird	Least Concern		1		1	2	1		2		7
Estrildidae	*Lonchura malacca*	Chestnut Munia	Least Concern			6						5	11
Columbidae	*Geopelia striata*	Zebra Dove	Least Concern					3	4	2	2		11
Accipitridae	*Haliastur inbus*	Brahminy Kite	Least Concern	1		1				1			3
Dicaeidae	*Dicaeum pygmaeum*	Pygmy Flower Pecker	Least Concern						2	4		6	12
Hirundinidae	*Hirundo rustica*	Barn Swallow	Least Concern			1	2	2				4	9
Laniidae	*Lanius cristatus*	Brown Shrike	Least Concern						1				1
Meropidae	*Merops philippinus*	Blue-tailed Bee-eater	Least Concern		1						1		2
Nectariniidae	*Nectarinia jugularis*	Olived-Backed Sunbird	Least Concern	2									2
Oriolidae	*Oriolus chinensis*	Black-Naped Oriole	Least Concern	1					1		1		3
Passeridae	*Passer montanus*	Eurasian Tree Sparrow	Least Concern	5	4		8	6	12		3	7	45
Ardeidae	*Bubulcus ibis*	Cattle Egret	Least Concern				5		3				8
Pycnonotidae	*Pycnonotus goiavier*	Yellow -Vented Bulbul	Least Concern	2			1			2			5
Sturnidae	*Aplonis payanensis*	Asian Glossy Starlings	Least Concern									8	8

Pycnonotidae	*Hypsipetes philippinus*	Philippine Bulbul	Least Concern	3	1								4
Motacillidae	*Artamus leucocrynchus*	White Breasted wood Swallow	Least Concern		4	2	1	1			3		11
Campephagidae	*Lalage nigra*	Pied Thriller	Least Concern								1		1
			Total abundance	**16**	**13**	**10**	**18**	**17**	**29**	**14**	**13**	**32**	**162**

b) Herpeto-fauna species

Other fauna species found within the assessed area also includes, 2 species of reptiles and 11 amphibian. These species are the Mindanao Flying lizard (*Draco mindanensis*), Skink/Bubuli (*Eutropis multifasciata)* and the Marine Toad (*Bufo marinus*) as shown in **Table 34**.

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 coconut plantations
- Availability of food sources for wildlife
- Disturbance to wildlife brought by anthropogenic activities
- Hunting/poaching
- Proximity of the study area to settlements
- Loss of habitat due to conversion of forest lands to other land uses

Avi-fauna species are the common species observed in the area but locally common and similar to other areas outside the assessed area.

Table 34. Summary List of Faunal Species and Their Conservation Status

Family	Scientific Name	Common Name	Conservation Status (IUCN)
Avifauna			
Estrildidae	*Lonchura malacca*	Chestnut Munia	Least Concern
Accipitridae	*Haliastur inbus*	Brahminy Kite	Least Concern
Alcedinidae	*Halchyon chloris*	White Collared King Fisher	Not Evaluated
Ardeidae	*Bubulcus ibis*	Cattle Egret	Least Concern
Apodidae	*Collocalia affinis*	Glossy Swiftlet	Not Evaluated
Motacillidae	*Artamus leucocrynchus*	White-Breasted Wood- Shallow	Least Concern
Columbidae	*Geopelia striata*	Zebra Dove	Least Concern
Picidae	*Dendrocopos maculatus*	Philippine Pygmy Wood Pecker	Least Concern
Sylviidae	*Megalurus timoriensis*	Tawny Grass Bird	Least Concern
Dicaeidae	*Dicaeum pygmaeum*	Pygmy Flower Pecker	Least Concern
Meropidae	*Merops philippinus*	Blue-tailed Bee-eater	Least Concern
Hirundinidae	*Hirundo rustica*	Barn Swallow	Least Concern
Laniidae	*Lanius schach*	Long Tailed Shrike	Least Concern

Laniidae	*Lanius cristatus*	Brown Shrike	Least Concern
Campephagidae	*Lalage nigra*	Pied Thriller	Least Concern
Pycnonotidae	*Hypsipetes philippinus*	Philippine Bulbul	Least Concern
Nectariniidae	*Nectarinia jugalaris*	Olived-backed Sunbird	Least Concern
Oriolidae	*Oriolus chinensis*	Black Naped Oriole	Least Concern
Passeridae	*Passer montanus*	Eurasian Tree Sparrow	Least Concern
Pycnonotidae	*Pycnonotus goiavier*	Yellow -Vented Bulbul	Least Concern
Rhipiduridae	*Rhipidura javanica*	Pied Fan Tail	Least Concern
Sturnidae	*Aplonis payanensis*	Asian Glossy Starlings	Least Concern
Herpeto-fauna			
Agamidae	*Draco mindanensis*	Mindanao Flying Dragon	Vulnerable
Scincinidae	*Eutropis multifasciata*	Skink/Bubuli	Not evaluated
Bufonidae	*Bufo marinus*	Marine Toad	Least Concern
Bufonidae	*Bufo marinus*	Marine Toad	Least Concern

c) Endemism and conservation status

Endemicity of the recorded fauna species in the study area showed that 3 avifauna and 1 reptile species are found to be endemic in the country. Among the endemic species are the Pygmy Flower Pecker *(Dicaeum pygmaeum),* Philippine Bulbul *(Hypsipetes philippinus*), Philippine Pygmy Wood Pecker (*Dendrocopos maculatus)* and the Mindanao Flying Dragon (*Draco mindanensis*). On the hand, 2 species of herpeto-faunal are endemic in the country- Greater Musky Fruit Dove (*Ptenochirus jagori*) and Long Tailed Macaque (*Philippine Macacque*).

Table 35 present the summary of wildlife species in the proposed project site and their conservation status (Source: http://www.iucnredlist.org/).

With reference to the International Union for Conservation of Nature (IUCN) (2017) showed that there is no Crititically endangered or endangered species found wihin the study area. Only the *Draco mindanensis* or Mindanao Flying Dragon from the herpeto-fauna is Vulnerable in category. The rest of the recorded species are under least concern category and or not yet evaluated.

Table 35. Conservation Status of Observed Fauna Species (IUCN red list 2017)

Conservation status	Aves	Mammal/s	Reptiles	Amphibians	Total
Critically endangered	-	-	-	-	0
Near Threatened	-	-	-	-	0
Vulnerable	-	-	1	-	1
Least Concern	20	-	-	1	21
Not evaluated	2	-	1	-	3
TOTAL	**22**	**0**	**2**	**1**	**25**

d) Computed Biodiversity index

Biodiversity indices particularly Shannon-Wiener Diversity Index (H') and Pielou's Evenness Index (J') were computed for this survey using the avi-faunal data. The computed biodiversity

index of the sampling sites (getting the average biodiversity index of the 9 observation sites shown in **Table 36** has a computed biodiversity index of 1.637 with species evenness value of .889. 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 has very low level of diversity with a very high species evenness. Site no. 6 have the highest computed diversity of 1.873. While site no 3 registered the lowest computed biodiversity index of 1.089.

On the other hand, computed species evenness showed that site no. 9 has the highest computed evenness value of .958, while, site no. 3 has the lowest evenness value of .785, respectively.

Table 36.Computed Biodiversity Index of Sampled Sites

Sampling site no.	Shannon-Wiener Biodiversity index (H')	Pielou's Index (J') species Evenness	Fernando's Biodiversity Scale (1998)
1	1.804	.927	Very low diversity with very high species evenness
2	1.605	.896	Very low diversity with very high species evenness
3	1.089	.785	Very low diversity with very high species evenness
4	and1.442	.805	Very low diversity with very high species evenness
5	1.650	.921	Very low diversity with very high species evenness
6	1.873	.813	Very low diversity with very high species evenness
7	1.710	.955	Very low diversity with very high species evenness
8	1.845	.948	Very low diversity with very high species evenness
9	1.716	.958	Very low diversity with very high species evenness
Average	**1.637**	**.889**	**Very Low diversity with very high species evenness**

e) Species Relative Frequency

Of the 6 observation sites, there are 22 species of avifauna were recorded with a total abundance of 162. Computed relative frequency of recorded species showed that the Eurasian Tree Sparrow (*Passer montanus)* has the highest relative frequency seconded by the Tawny Grass Bird (*Megalurus timoriensis)* with a relative frequencies of 12.069 and 8.6216, respectively. Species with the least computed relative frequencies with the same value of 1.724 include the *Lanius schach*, *Halchyon chloris, Dendrocopos maculatus, Lanius cristatus, Nectarinia jugularis, Aplonis payanensis and Lalage nigra* as shown in **Table 37**.

Table 38 shows some photodocumentation of faunal survey.

Table 37. Species Relative Frequency

Family Name	Scientific Name	Species Name	Frequency (%)	Rel. Frequency (%)
Laniidae	*Lanius schach*	Long Tailed Shrike	11.111	1.724
Alcedinidae	*Halchyon chloris*	White Collared King Fisher	11.111	1.724
Rhipiduridae	*Rhipidura javanica*	Pied Fan Tail	22.222	3.448
Apodidae	*Collocalia affinis*	Glossy Swiftlet	44.444	6.897
Picidae	*Dendrocopos maculatus*	Philippine Pygmy Wood Pecker	11.111	1.724
Sylviidae	*Megalurus timoriensis*	Tawny Grass Bird	55.556	8.621
Estrildidae	*Lonchura malacca*	Chestnut Munia	22.222	3.448
Columbidae	*Geopelia striata*	Zebra Dove	44.444	6.897
Accipitridae	*Haliastur inbus*	Brahminy Kite	33.333	5.172
Dicaeidae	*Dicaeum pygmaeum*	Pygmy Flower Pecker	33.333	5.172
Hirundinidae	*Hirundo rustica*	Barn Swallow	44.444	6.897
Laniidae	*Lanius cristatus*	Brown Shrike	11.111	1.724
Meropidae	*Merops philippinus*	Blue-tailed Bee-eater	22.222	3.448
Nectariniidae	*Nectarinia jugularis*	Olived-Backed Sunbird	11.111	1.724
Oriolidae	*Oriolus chinensis*	Black-Naped Oriole	33.333	5.172
Passeridae	*Passer montanus*	Eurasian Tree Sparrow	77.778	12.069
Ardeidae	*Bubulcus ibis*	Cattle Egret	22.222	3.448
Pycnonotidae	*Pycnonotus goiavier*	Yellow -Vented Bulbul	33.333	5.172
Sturnidae	*Aplonis payanensis*	Asian Glossy Starlings	11.111	1.724
Pycnonotidae	*Hypsipetes philippinus*	Philippine Bulbul	22.222	3.448
Motacillidae	*Artamus leucocrynchus*	White Breasted Wood Swallow	55.556	8.621
Campephagidae	*Lalage nigra*	Pied Thriller	11.111	1.724
		Total	644.444	100.00

Table 38. Some Faunal Species Photo Documented During the Survey

Photo	Common Name/ Scientific Name	Conservation status (IUCN)	Location/ Geographic Coordinates
	*Asian Glossy Starlings* (*Aplonis payanensis)*	*Least Concern*	Site 9 Brgy. Daanaingod Marantao (7°58'58.35" Northing 124°15'46.92" Easting)
	*Brahminy Kite* (*Haliastur inbus)*	*Least Concern*	Site 3 Brgy. Bubong Saguiran (8° 1'37.35" Northing 124°16'6.81" Easting)
	*White Breasted Wood Swallow* (*Artamus leucocrynchus)*	*Least Concern*	Site 2 Brgy. Mipaga Saguiran (8° 2'0.44" Northing 124°16'44.55" Easting)
	Cattle Egret (*Bubulcus ibis)*	Least Concern	Site 4 Brgy. Pagalamatan Saguiran (8° 1'9.66" Northing 124°15'21.59" Easting)

	*White Collared King Fisher* (*Halchyon chloris)*	*Not Evaluated*	Site 7 Brgy. Banga Marawi (7°59'58.01" Northing 124°14'36.91" Easting)
	*Zebra Dove* (*Geopelia striata)*	*Least Concern*	Site 6 Brgy. Bobo Piagapo (8° 0'30.74" Northing 124°14'7.91" Easting)
	*Mindanao Flying Dragon* (*Draco mindanensis)*	*Vulnerable*	Site 3 Brgy. Bubong Saguiran (8° 1'37.35" Northing 124°16'6.81" Easting)

	*Black-Naped Oriole (lower left)* *(Oriolus chinensis)* Philippine Pygmy Flower Pecker (upper right) (*Dendrocopos maculatus)*	Least Concern	Site 6 Brgy. Bobo Piagapo (8° 0'30.74" Northing 124°14'7.91" Easting)
	*Brown Shrike* *(Lanius cristatus)*	*Least Concern*	Site 6 Brgy. Bobo Piagapo (8° 0'30.74" Northing 124°14'7.91" 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.

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. There are many species in the area having a high economic importance, one of them is Narra which is widely known to have high economic value aesthetically and commercially. There are also major and/or important agricultural crops that are found in the area such as coconut and rambutan.

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 on lives and properties. Shrubs and trees, and even grasses like cogon have also a 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 Protected Area

a) Mt. Mupo National Park

The Sacred Mountain National Park (NP) is situated in the northeastern part of Marawi City within the political jurisdictions of barangay Guimba and Papandayan in Marawi City. The Mt. Mupo is an extinct volcano declared as national park in August 5, 1965 under RA 4190 covering an area of 94 hectares. The aforesaid NP is included in the 240 list of protected areas in the Philippines based on DENR, BMB and NAMRIA DENR-Geoportal. The mountain is about 270 meter high from its base with a lofty cone in shape. Activities within the national park include eco-trekking and bird watching.

Land cover is primarily vegetated with secondary growth forest while, on its foot slope is already subjected to cultivation and settlements. Agricultural crops that can be found surrounding the include coconut, falcata trees, durian, rambutan, lansones, marang banguhan, kawayan species, corn, suha and other root crops.

The proposed road alignment will not encroach the national park as shown in **Figure 61**. It will be traversing some of the cultivated lands planted with tree crops, perennial crops and other annual crops within an Alienable and disposable land adjacent the protected area. The proposed road alignment is about 400 meters from the mountain foot slope northeast of the National Park.

Source: Google Earth

Figure 61. Location of Mt Mupo National Park and the Road Alignment

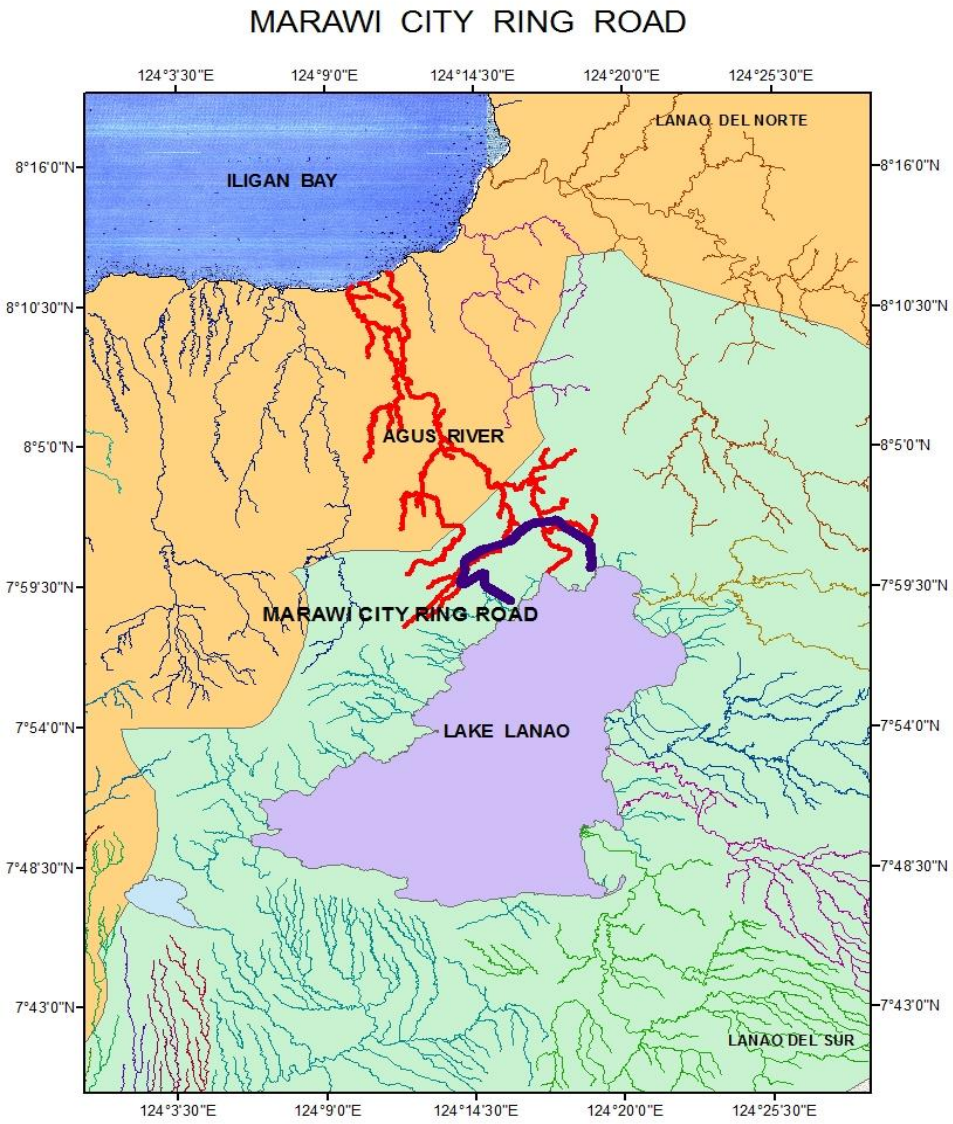
Details on key environmental impact, management and mitigation measures are provided in Section 6.1.1.

3.2 Baseline in Water

3.2.1 Hydrology

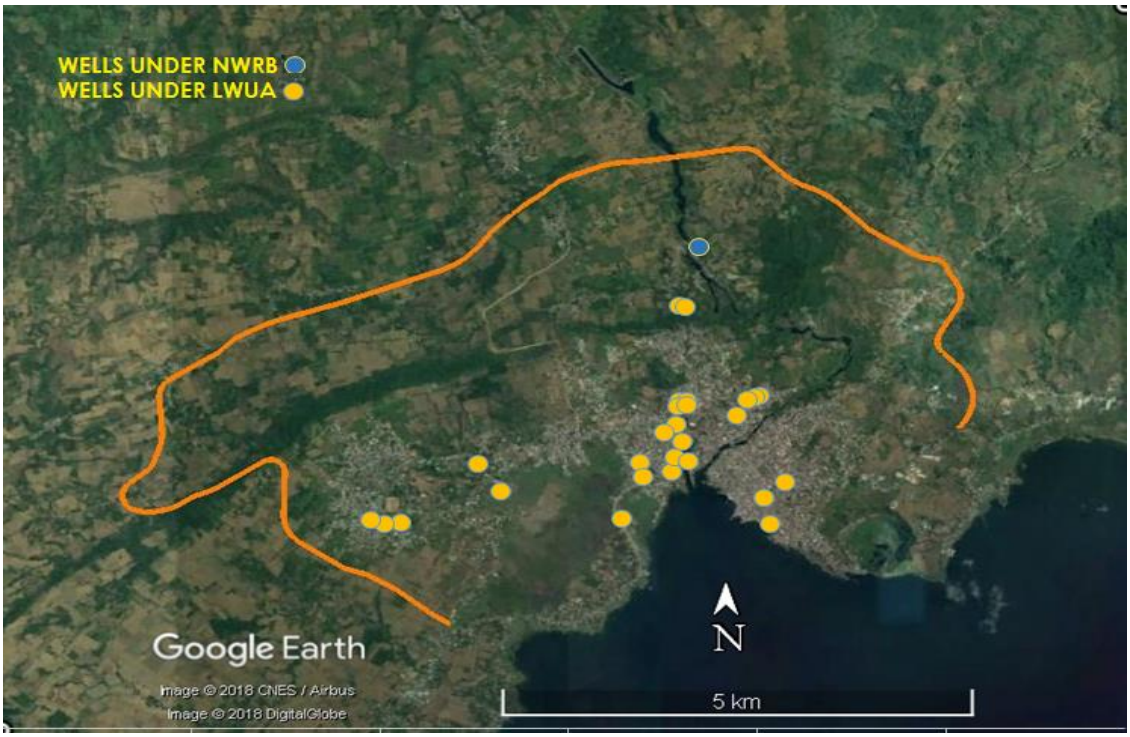
The river systems that affect the proposed road alignment are the tributaries of Agus River in the upper stream as shown in **Figure 62**. Sources of ground water wells or springs should be validated during RAP or detailed engineering survey which may impacted the source of water supply of the locals. Based on the data from the National Water Resources Board (NWRB) and from Local Water Utilities Administration (LWUA), twenty eight groundwater wells were listed. All of these wells are within the Marawi City area **(Figure 63)**.

There are four major rivers tributary to the Lake Lanao. The four major rivers have total aggregate area of 998.30 square miles with the Malaig River having the longest 345.00 square miles.



Source: PAGASA

Figure 62. Rivers affecting Marawi City Ring Road



Source: Google Earth

Figure 63. Location of Groundwater Wells or Springs affected by Marawi City Ring Road

3.2.1.1 Watershed

The province of Lanao del Sur has about 387.320 square kilometers of water area composed of lakes, rivers and swamps. There are about eight (8) lakes in the province with a total area of 376.78 square kilometers. Lake Lanao has the biggest area of 357.00 square kilometers.

Lake Lanao is a proclaimed watershed forest reserved per Proclamation No. 871/2-26-92 with an area of 357 square kilometers and noted for non-NIPAS conducted. It is the second deepest lake in the Philippines and one of the 17 Ancient Lakes in the world. Lake Lanao is use as a source of electric power generation in Mindanao area. Water in the lake is also use for irrigation in the Basak area.

Figure 64 shows the map of Lake Lanao Watershed and the Proclaimed National Parks in Lanao del Sur.

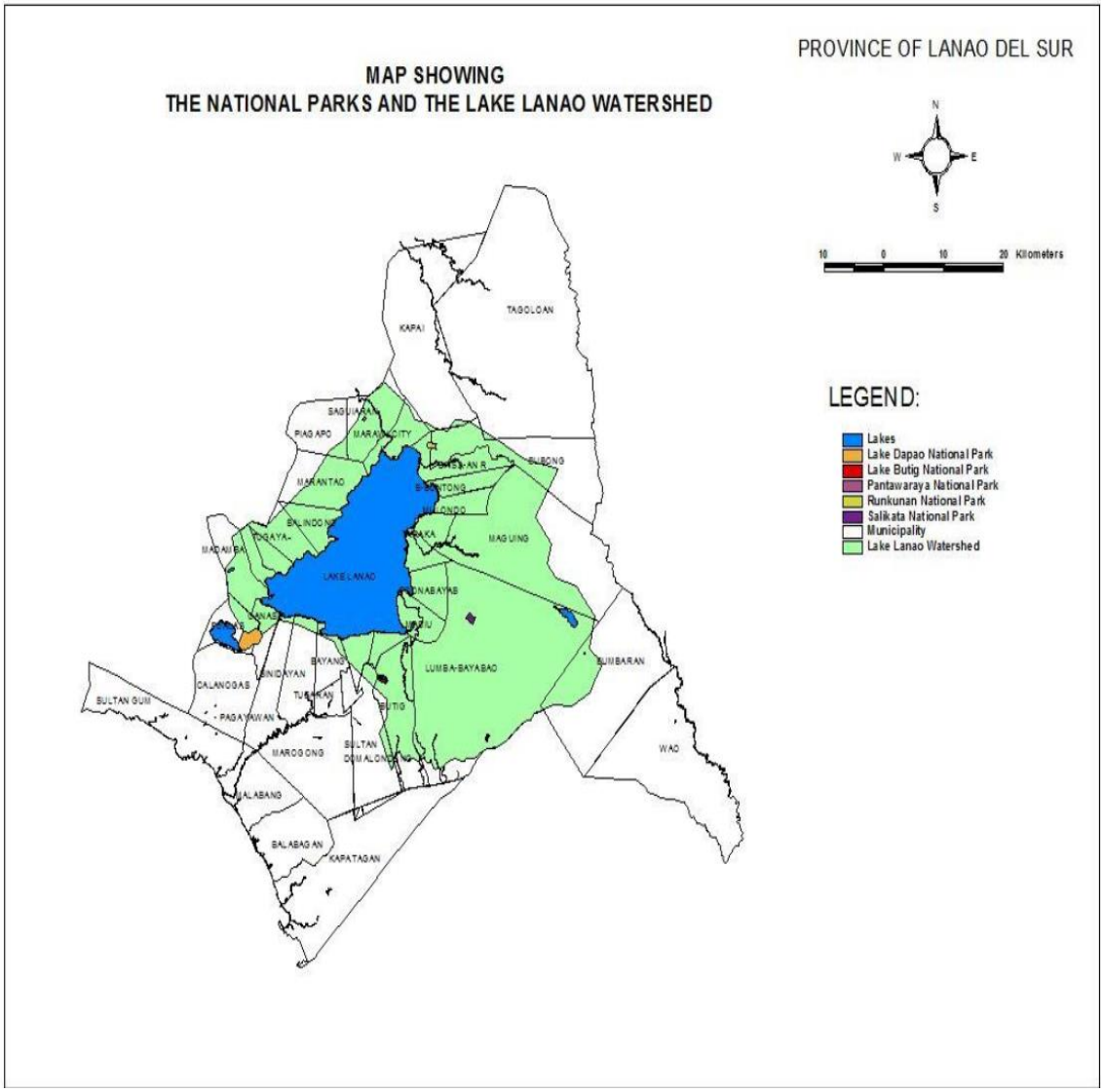
Table 39 presents the list of Municipalities declared as Watershed Reservation Area (Proclamation 871).

Table 39. List of Municipalities declared as Watershed Reservation Area

List of Municipalities	
1st District	2nd District
Buadipuso-buntong	Bacolod-kalawi
Bubong	Balindong
Ditsaan-ramain	Bayang
Lumba-bayabao	Binidayan
Maguing	Butig
Marantao	Lumbatan
Mulondo	Ganassi
Piagapo	Lumbayanague

Poona-bayabao	Madalum
Saguiaran	Madamba
Tamparan	Masiu
Taraka	Pualas
	Tugaya

Source: Provincial Development and Physical Framework Plan (2014-2020)



Source: Provincial Development and Physical Framework Plan (2014-2020)

Figure 64. Map of Lake Lanao Watershed and Proclaimed National Parks in Lanao del Sur

3.2.2 Water Quality

Grab sampling was used for surface water quality measurement. Samples were collected on November 15, 2017 on a sunny to cloudy weather. 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 Brgy. Mipaga, Saguiaran, Lanao del Sur. **Figure 65** presents the sampling map of Sub-Project No. 7.

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	Agus River, Brgy. Mipaga, Saguiaran, Lanao del Sur	8° 2'7.22"N 124°17'1.89"E	Sunny to Cloudy	January 18, 2018

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.**

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)

Source: Google Earth

Figure 65. Sampling Map of Water Quality Station Collected at Sub-Project No. 7

3.2.2.2 Results and Discussions

Table 42 shows the results of physical and chemical analyses for surface water collected in Brgy. Mipaga, Saguiaran. 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	DAO No. 2016-08, Class C Limits
pH	6.7	6.5 – 9.0
Temperature, °C	26.5	25-31
Turbidity, NTU	10	---
BOD, mg/L	1	7
TSS, mg/L	5.0	80
DO, mg/L	7.2	5.0 mg/L minimum

Hereto attached as Annex 13.6.2 are the results of Water Quality Stations. **Figure 66** shows the sampling pictures taken at SP No. 7.

Figure 66. Water Sampling at Agus River, Brgy. Mipaga, Saguiaran

3.3 Baseline in Air

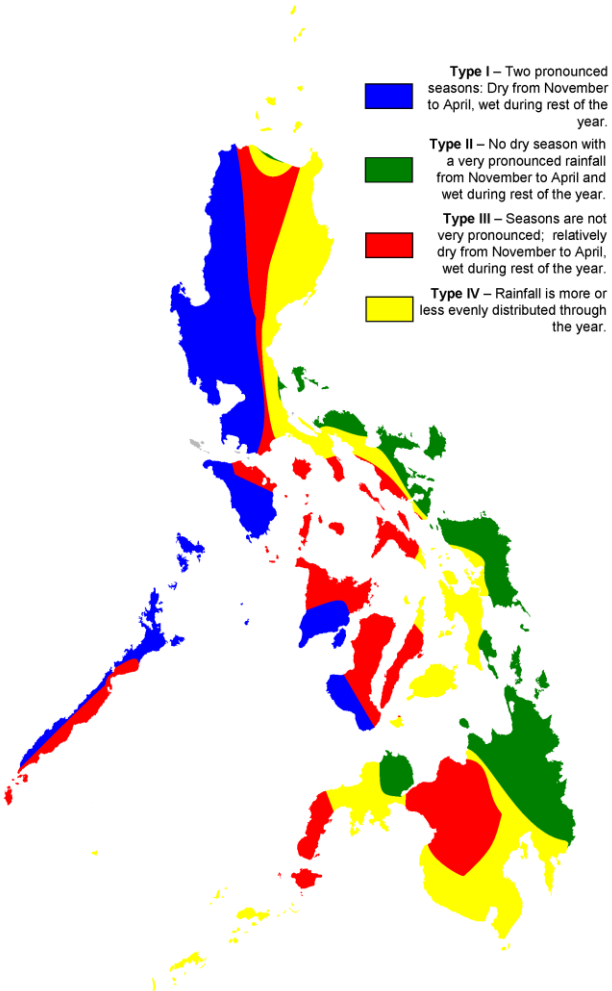
3.3.1 Meteorology

The rainfall pattern as recorded by PAGASA Agromet Station located at the Mindanao State University Campus in Marawi City shows that the shortest monthly rainfall of 8.7 mm from 2004 to 2007 happened on February 2005. The largest monthly rainfall of 554.6 mm has occurred on June 2007. The rainiest months are from May to October. The average annual precipitation recorded was 2,791 mm.

The annual mean high temperature is 28.1ºC with high temperature of 29.4ºC in April, whereas the average mean low temperature is 18.4 ºC where 17.8ºC was recorded in January and February.

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 67** from which seasons are not very pronounced, relatively dry from November to April and wet during the rest of the year.



Source: PAGASA

Figure 67. 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 68**.

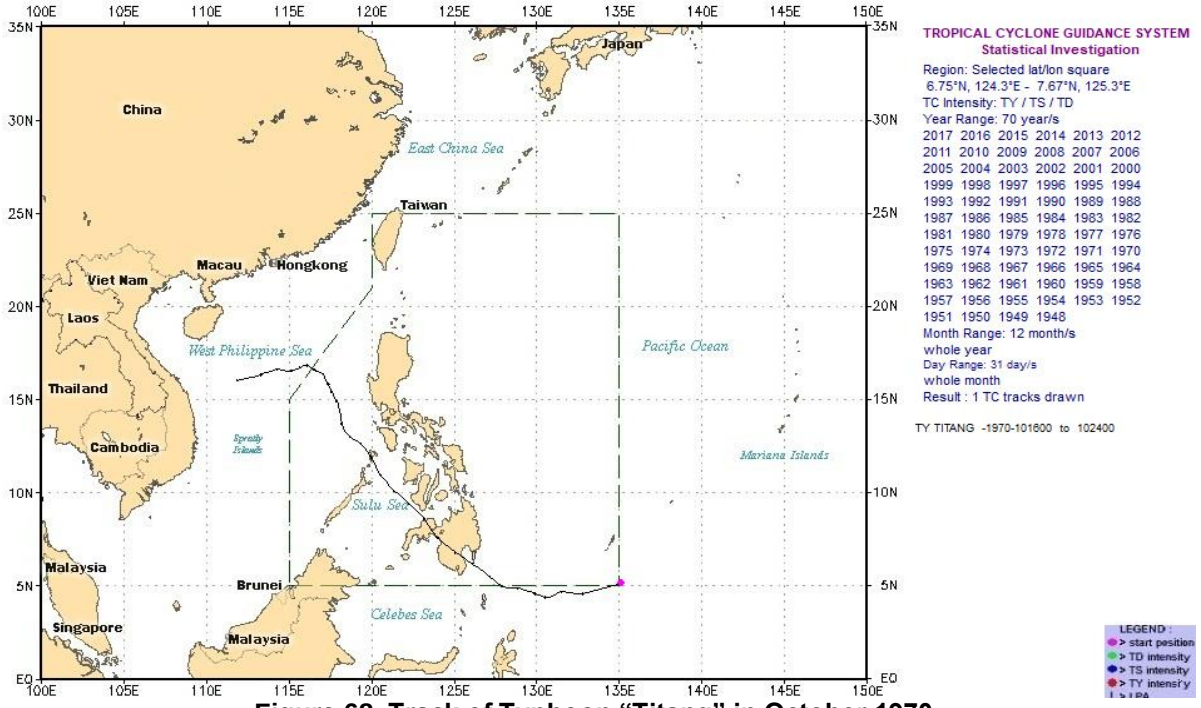


Figure 68. Track of Typhoon "Titang" in October 1970

3.3.2 Ambient Air Quality

Air Samples were collected on January 18-19, 2018 at Brgy. Bubong, Saguiaran, Lanao del Sur. **Figure 69** shows the sampling location for one station. Weather condition at the time of sampling was sunny to cloudy with slight rains. Twenty-four (24) hours measurement were sampled for Total Suspended Particulates, PM10, Nitrogen Dioxide and Sulfur Dioxide. **Table 43** presents the date and time of sampling and air sampling coordinates.

Source: Google Earth

Figure 69. Sampling location at SP 7 Marawi City Ring Road

Table 43 – Summary of Air Sampling Sites, Coordinates, Date and Time of Samplings

Station No.	Sampling Stations	Coordinates	Meteorological Conditions	Date and Time of Samplings
A1	Brgy. Bubong, Saguiaran, Lanao del Sur	8° 1'41.02"N 124°16'17.83"E	Sunny to cloudy with slight rains	January 18-19, 2018 1415H

3.3.2.1 Sampling Equipment

There were three (3) major types of ambient air equipment used as described in **Table 44 .**

Table 44. 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).

3.3.2.2 Sampling Methodologies

The ambient air quality measurement conducted by CRL Calabarquez Corporation was performed at an elevation of at least two (2) meters above the ground level and sampling was strategically stationed within the project site. After sampling was conducted for each station, the gas samples were carefully recovered in the sampling bottles and preserved at low temperature and were immediately submitted to the laboratory for analysis.

3.3.2.2.1 FILTRATION METHOD BY HIGH-VOLUME SAMPLER

3.3.2.2.1.1 Total Suspended Particulates (TSP) SAMPLING

Principle of Sampling - Ambient air was drawn through a glass fiber filter over a period of time. The filter paper containing the sample was weighed hence the final weight of the sample over that of the standard volume of air sampled gave the concentration of TSP.

3.3.2.2.1.2 PM_{10} SAMPLING (Reference Method Appendix J to Part 50)

Principle of Sampling - Ambient air was drawn at a constant flow rate into a specially shaped inlet where the suspended particulate matter is inertially separated into one or more size fractions within PM_{10} size range. The particles were collected in a glass fiber filter and determined by measuring gravimetrically. The filter paper containing the sample was weighed hence the final weight of the sample over that of the standard volume of air sampled gave the concentration of PM10.

3.3.2.2.2 ABSORPTION IN LIQUIDS FOR GASEOUS POLLUTANTS

3.3.2.2.2.1 Nitrogen Dioxide (NO_2), Sulfur Dioxide (SO_2) SAMPLING

Principle of Sampling - A known volume of air (0.4L/min for NO_2, 0.5L/min for SO_2) was sampled with a wet-chemical system where a constant air sample passes through a suitable reagent (absorbing reagent) that was reactive to the specific pollutant desired. As the air sample passes through the bubbler rack, the air diffuses forming air bubbles and slowly reacts to the chemical reagent forming a complex ion. The personal sampler was calibrated with NIST traceable digital calibrator to assure its accuracy. The samples were then analyzed using prescribed and approved methods.

3.3.2.3 Results and Discussions

Results of air quality for all parameters measured at two (2) sites are compared with National Ambient Air Quality Guideline Values (NAAQGV) of Republic Act 8749 or known as Philippine Clean Air Act. All parameters tested are within the DENR allowable limits. **Table 45** presents the results of air quality in one (1) site for Sub-project 7. **Table 46** presents the meteorological data observed during sampling.

.

Figure 70 presents the photos during the actual air sampling at one site.

Table 45. Ambient Air Test results taken at Brgy. Bubong, Saguiaran, Lanao del Sur

Station No.	Location	Date and Time Sampling	TSP (µg/Ncm)	PM_{10} (µg/Ncm)	NO2 (µg/Ncm)	SO2 (µg/Ncm)
A1	Brgy. Bubong, Saguiaran, Lanao del Sur	January 18-19, 2018 1415H – 1415H	15.7	11.7	3.9	ND
***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°C, 760mm Hg; *RA 8749 (Philippine Clean Air Act of 1999); ND – Not Detected

Figure 70. Air Sampling at Brgy. Bubong, Saguiaran, Lanao del Sur

Table 46. Meteorological Data at Brgy. Bubong, Saguiaran, Lanao del Sur

Division of 24-Hour Sampling	Prevailing Wind	Temperature (deg. C)	Barometric Pressure (mmHg)	Remarks
January 18-19, 2018 1415H	NW-SE	27.7	702.2	Cloudy
1615H	NW-SE	26.3	703.0	Rains Lightly
1815H	NW-SE	25.0	703.7	Rains Lightly
2015H	NW-SE	24.6	704.3	Rains Lightly
2215H	NW-SE	24.4	704.2	Rains Lightly
0015H	NW-SE	24.3	703.5	Fair
0215H	NW-SE	23.0	703.1	Fair
0415H	NW-SE	25.3	703.2	Fair
0615H	NE-SW	19.3	703.6	Cloudy
0815H	NW-SE	26.1	704.2	Cloudy
1015H	NW-SE	31.8	703.8	Cloudy
1215H	NW-SE	32.1	702.8	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 47** presents the sampling coordinates, date and time of noise sampling.

Table 47 – Summary of Noise Sampling Sites, Coordinates, Date and Time of Samplings

Station No.	Sampling Stations	Noise Coordinates	Date and Time of Samplings
N1	Brgy. Bubong, Saguiaran, Lanao del Sur	8° 1' 37.68" N 124°16'19.36" E	January 18-19, 2018

3.4.2 Sampling Methodologies

The noise measurements were conducted within one (1) station. 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 48 presents the results of noise level monitoring conducted from one (1) station. 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 daytime, noise levels were within the allowable levels of the DENR. Noise levels during morning, evening and nighttime are slightly higher where noise coming from animals such as barking from dogs, rooster's crow, sounds from insects such as crickets etc. and passing of vehicles may have impacted the increase in sound measurement. Most of the noise sources measured came from animal and insects during nighttime. Activities from residents near the sampling area also influenced the sound measurements during morning and evening time.

Figure 71 shows the photos of noise sampling conducted at SP 7.

Table 48. Noise Data at Brgy. Bubong, Saguiaran, Lanao del Sur

Jan. 18-19, 2018 Sampling time	Average dB (A)	DENR Standard Maximum Allowable Noise Level, Class A, dB (A)***	Remarks	Noise Sources
1415H	53.3	55	Within	Residential area, cows, dogs, passing vehicle
1615H	51.3	55	Within	Residential area, cows, dogs, passing vehicle
1815H	52.8	50	Exceeded	Residential area, dogs, cows, insects
2015H	52.3	50	Exceeded	Residential area, insects
2215H	51.1	45	Exceeded	insects
0015H	51.9	45	Exceeded	insects
0215H	51.4	45	Exceeded	Insects, roosters
0415H	51.2	45	Exceeded	Insects, roosters
0615H	53.9	50	Exceeded	Residential area, cows, dogs roosters
0815H	52.9	50	Exceeded	Residential area, cows, dogs roosters
1015H	52.4	55	Within	Residential area, cows, dogs, birds
1215H	54.2	55	Within	Residential area, cows, dogs, birds

***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 71. Sampling location at SP 7 Marawi City Ring Road

3.5 Social Condition (The People)

3.5.1 Demographic Data

3.5.1.1 Population and Growth Rate

The Marawi City Ring Road -SP 7 is located in three (3) Municipalities and one (1) City in Lanao del Sur covering a total of 23 barangays. The total population of the 23 barangays is 21,704. Among the 23 barangays, Papandayan Caniogan in Marawi City has the highest population (2027) while Matampay in Marantao has the least population (551). Populations of the barangays covered is shown in **Table 49**.

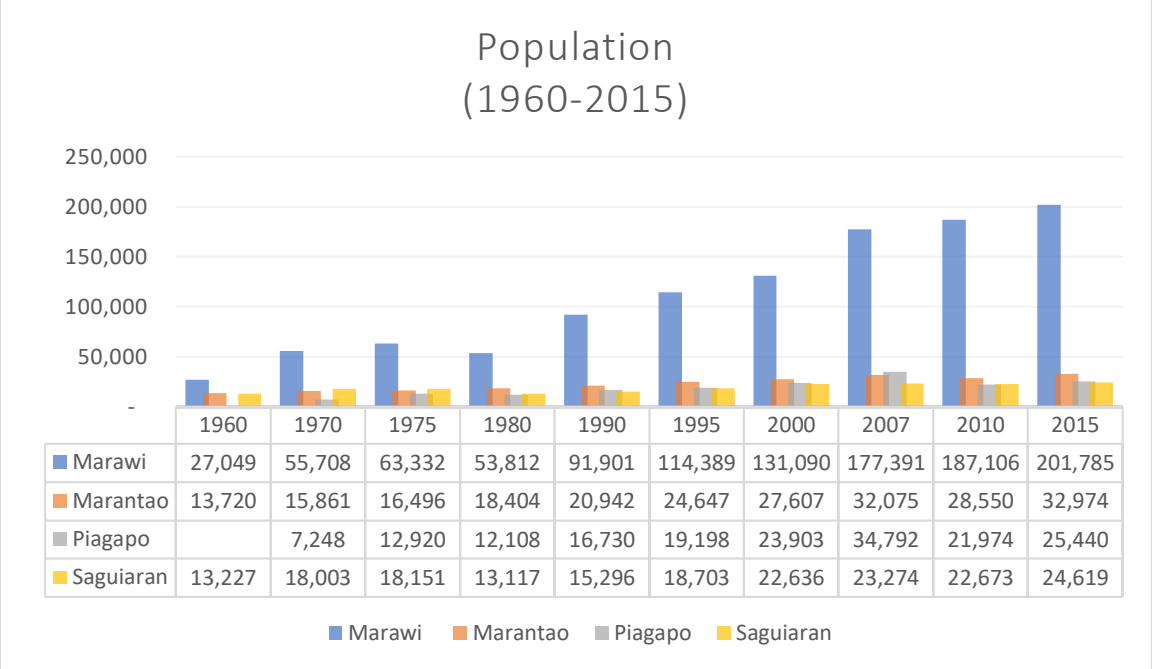
Table 49. Population per Barangay Covered by the Project (2015)

Province	Municipality	Barangay	Population
Lanao del Sur	Marawi City	Kilala	1277
		Dulay West	831
		Papandayan Caniogan	2027
		Guimba	1980
		Pantaon	696
		Rorogagus East	1587
		Banga	1164
		Boganga	1453
	Saguiaran	Mipaga	593
		Bubong	1408
		Pagalamatan	590
		Lumbaca Toros	836
		Bagoaingud	714
		Alinun	601
		Linao	692
		Lombayanague	754
	Marantao	Palao	1014
		Bacong	1039
		Daanaingud	991
		Matampay	551
	Piagapo	Rantian	605
		Bobo	811
		Paling	654
	Total		21704

Source: Philippine Statistics Authority (2015)

Historically, there are significant changes in terms of population growth in the project area. Based on PSA data, Marawi City has a continuous increase of population from 1980 to 2015. Marantao, Saguiaran and Piagapo have increase and decrease of population with the highest population of 32,974, 24,619 and 25,440 recorded in 2015, respectively.

Figure 72 shows the population affected by SP 7.



	1960	1970	1975	1980	1990	1995	2000	2007	2010	2015
Marawi	27,049	55,708	63,332	53,812	91,901	114,389	131,090	177,391	187,106	201,785
Marantao	13,720	15,861	16,496	18,404	20,942	24,647	27,607	32,075	28,550	32,974
Piagapo		7,248	12,920	12,108	16,730	19,198	23,903	34,792	21,974	25,440
Saguiaran	13,227	18,003	18,151	13,117	15,296	18,703	22,636	23,274	22,673	24,619

Figure 72. Population per Census Year in the Municipalities Affected by SP 7

In terms of population growth, Marawi City has experienced faster growth from 2000 to 2010 compared with 2010 to 2015. The annual average growth rate for Marawi City is 3.62 percent from 2000 to 2010 and 1.52 percent from 2010 to 2015. In contrast, the population growth in Sanguiaran and Marantao from 2000 to 2010 is small. The annual average growth rates are 0.02 percent in Sanguiaran and 1.48 percent for Marantao. Both municipalities have higher annual average growth rates from 2010 to 2015. Piagapo, on the other hand, has experienced faster growth from 2000 to 2010, but its annual average growth rate is negative from 2010 to 2015. as presented in the Table below.

Table 50. Population Growth in Municipalities affected by SP 7 (2000-2015)

Province	Municipality	Annual Average Growth Rate (in percent)		
		2000-2010	2010-2015	2000-2015
Lanao del Sur	Marawi City	3.62	1.52	2.92
	Saguiaran	0.02	1.66	0.56
	Piagapo	3.83	-6.07	0.42
	Marantao	1.48	2.92	1.96
	Average	3.05	0.84	2.31

Source: Philippine Statistics Authority, 2015

3.5.1.2 Population Density

Based on 2015 Census of Population and Housing by the Philippine Statistics Authority, the capital city of Lanao del Sur and the three municipalities have a total population of 284,818 and an average population density of 224 persons/km2. Marawi City has the highest population density among all the cities and municipalities in Mindanao, followed by Cotabato City (1,701 persons/km2) and Cagayan de Oro City (1,637 persons/km2). Saguiaran, Piagapo, and Marantao, located to the west of Marawi City, have much smaller populations and much larger land areas. Table below shows the population density per municipality in the project area.

Table 51. Population Density in the Municipalities Affected by SP7 (2000-2015)

Province	Municipality	Population	Land area (km2)	Population density (persons/km^2)
Lanao del Sur	Marawi City	201,785	87.55	2,305
	Saguiaran	24,619	182.89	135
	Piagapo	25,440	340.07	75
	Marantao	32,974	660.00	50
	Total	284,818	1,270.51	224

Source: Philippine Statistics Authority, 2015

3.5.1.3 Household and Household Size

In terms of household number, Marawi City has a total household of 29,732, Saguiaran has 3,646, Piagapo has 4,067and Marantao has a household number of 5,083. These households are headed mostly by male. On the average, household size of the three municipalities is 6 members of family per household as shown in **Table 52**.

Table 52. Household and Household Size in the Municipalities Affected by SP 7

Province	Municipality	Household Number			Household Size
		Male Headed Households	**Female Headed Households**	**Total**	
Lanao del Sur	Marawi City	26,571	3,161	29,732	6.6
	Saguiaran	3,360	286	3,646	6.7
	Piagapo	3,872	195	4,067	6.3
	Marantao	4,676	407	5,083	6.5

Source: Philippine Statistics Authority, 2015

3.5.1.4 Religious Affiliation

Majority of the population in Lanao del Sur belong to Islam comprising about 94% of the total population in Lanao del Sur with only 5% of Roman Catholic, while the remaining percent belongs to different religious sectors such as Aglipay, Buddhist, Baptist, among others.

3.5.1.5 Ethnicity

In terms of ethnicity, the project area is dominated with Maranao. Some are combination of Iranun, Maguindanaon, and Cebuano. No indigenous peoples declared by the community.

3.5.2 Access to Basic Services

3.5.2.1 Education

In terms of access to educational services in the four municipalities affected by SP 7**,** 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 available in Marawi, Saguiaran and Piagapo with total population of 64. Table below presents the grade level completed with corresponding numbers of population.

Table 53. Highest Grade/Year Completed in the Municipality Affected by SP 7

Highest Grade/Year Completed	Marawi	Saguiaran	Piagapo	Marantao
No Grade Completed	12,482	1,681	3,248	2,368
Pre-School	6,853	1,041	997	900
Special Education	56	1	7	-
Elementary	56,934	7,653	11,660	10,547
1st - 4th Grade	31,922	4,265	7,088	5,916
5th - 6th Grade	14,242	1,940	3,118	2,474
Graduate	10,770	1,448	1,454	2,157
High School	47,489	6,133	4,192	9,420
Undergraduate	25,062	3,198	2,748	4,850
Graduate	22,427	2,935	1,444	4,570
Post-Secondary	1,432	87	60	73
Undergraduate	51	2	8	6
Graduate	1,381	85	52	67
College Undergraduate	26,745	2,625	1,098	3,206
Academic Degree Holder	15,296	1,194	351	1,889
Post Baccalaureate	385	11	-	7
Not Stated	6,325	2	5	2
Total	173,997	20,428	21,618	28,412

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 while the least in terms of population are those age group of 60-64. Highest literacy in the data of PSA (2015) is in the City of Marawi with 140,827 population.

Table 54. Literacy by Age Group

Age Group	Marawi	Saguiaran	Piagapo	Marantao
10 – 14	24,661	3,005	3,531	4,094
15 – 19	21,690	2,399	2,665	3,490
20 – 24	20,629	2,200	2,149	3,265
25 – 29	17,095	1,896	1,890	2,669
30 – 34	13,425	1,760	1,805	2,052
35 – 39	12,643	1,472	1,650	2,009
40 – 44	9,545	1,300	1,286	1,773
45 – 49	7,817	989	932	1,526
50 – 54	5,387	579	630	978
55 – 59	3,597	426	416	664
60 – 64	2,043	261	227	370
65 years old and over	2,295	352	318	511
Total	140, 827	16,639	17,49	23,401

Source: Philippine Statistics Authority, 2015

3.5.2.2 Health Service

Local government unit (LGU) supervise the health activities of the affected barangays with technical assistance and support from the DOH-ARMM. This includes the various health services such as maternal services and immunization of children.

Insufficient health care facilities in three municipalities affected by SP 7. The municipalities have rural health unit while Marawi City have 1 government and 10 private hospitals. The government hospital is Amai Pak Pak Medical Center, a tertiary hospital with 275 bed capacity located at Barangay Datu Saber. Of 3 municipalities, only Saguiaran has birthing facilities.

Marawi City hospital called Marawi City General Hospital located at Brgy. Bito Buadi Itowa is still being constructed and not yet completed.

A number of Medical Maternity and Dental Clinics complement the provision and delivery of medical and dental services to the residents of both city and the province of Lanao del Sur. Otherwise, all tertiary medical and health needs of the people are referred to hospitals in Iligan City.

The current situation of Marawi City Health Office in terms of its overall performance has generally improved from the past five consecutive years as a result of the unrelenting effort of the City Health Office team in delivering quality health care. The health seeking behavior of the constituents of the city has slowly changed over the past years. Health services provided by the city health used to be neglected by the community as it is perceived as irrelevant in the lives of the constituents but because of the constant campaign and effort of the City Health Office in conducting regular outreach program in the different barangays, the people slowly opened up and reached out to seek health care.

To ensure the efficient delivery of health services, there is a need to improve and upgrade existing facilities such as the existing RHU and BHS. There are five (5) Rural Health Units (RHU) located at the different barangays of the city namely, Barangays Cabingan; Amito Marantao; Kapantaran; Timbangalan; and in the City Health Office which is also a Philhealth accredited birthing clinic. There are fifteen (15) Barangay Health Stations (BHS) of which two (2) have Botika ng Barangay (BnB) and one (1) with Basic Emergency Obstetric and Neonatal Care.

The City Health Office has a TB Dots for the residents of the city suffering from pulmonary tuberculosis as shown in **Figure 73**. It also has an ambulance used in bringing patients to tertiary hospital or in hospitals in Iligan City in extreme cases. The most recent acquisition of the City was a Mobile Dental Bus through the efforts of Mayor Majul U. Gandamra and ARMM Governor Mujiv Hataman.

Source: Marawi City CDP-ELA

Figure 73. DOH Mobile Service in Marawi City

All of the emergencies from the 3 municipalities were bring to Amaipakpak Medical Center in Marawi City. However, no record of the total accounts of health facilities are available the three municipalities.

3.5.2.3 Water and Power Supply

Marawi City has a local water district while the remaining three municipalities have not. But according to Marawi City Water District (MCWD), of the 96 barangays in Marawi, only 41 are covered by MCWD due to limited water sources (3 deep wells within the most affected area (MAA) which is now damage and only serve barangays within MAA, and remaining 2 deep wells are located outside MAA namely: Bangon and Agus 1 deep well stations). From the eight affected barangay of SP 7, none are served by MCWD due to located far from the deep well stations.

Deep well and spring are the water source of three municipalities namely: Saguiaran, Marantao, and Piagapo. Some barangays have level 3 connections.

3.5.2.4 Communication Networks

Cellular companies such as globe, smart, cuncellular has sites in the area which reached barangays except the remote area like Dulay west and Caniogan. In Marawi City, they cellular companies also provide internet services to city and some areas in the 3 municipalities.

3.5.2.5 Transportation and Road Networks

The three municipalities and one city are accessible to people coming in from its connected municipalities and provinces through public road transport include vans, trisikads, town ace and single motors/habal-habal.

3.5.2.7 Gender and Children Rights

The LGU has developed the Gender and Development and Program to assist socially disadvantaged families and communities in developing their capability as well as setting up viable community welfare. Majority of the women's in need livelihood project to have additional income.
They also provide educational assistance to poor but deserving students to protect and rehabilitate children and youth in difficult situation.

3.5.2.8 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.

3.5.2.9 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. Marawi is recorded to have the highest number of workers with 59,852.

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 being Manager with a total of 19,641.

Table 55. Employment/Workers in the Municipalities Affected by SP 7

Major Occupation Group	Marawi	Saguiaran	Piagapo	Marantao
Managers	15,661	1,270	562	2,148
Professionals	4,679	385	119	811
Technicians and Associate Professionals	1,263	74	20	168
Clerical Support Workers	2,422	108	26	112
Service and Sales Workers	7,938	445	204	943
Skilled Agricultural Forestry and Fishery Workers	7,587	2,545	4,978	3,082
Craft and Related Trades Workers	2,887	233	139	640
Plant and Machine Operators and Assemblers	9,363	1,027	430	1,283
Elementary Occupations	2,591	142	199	545
Armed Forces Occupations	22	4	2	10
Other Occupation Not Elsewhere Classified	-	-	-	-
Not Reported	5,439	44	47	69
Total	59,852	6,277	6,726	9,811

Source: Philippine Statistics Authority, 2015

3.5.2.10 LGU Income

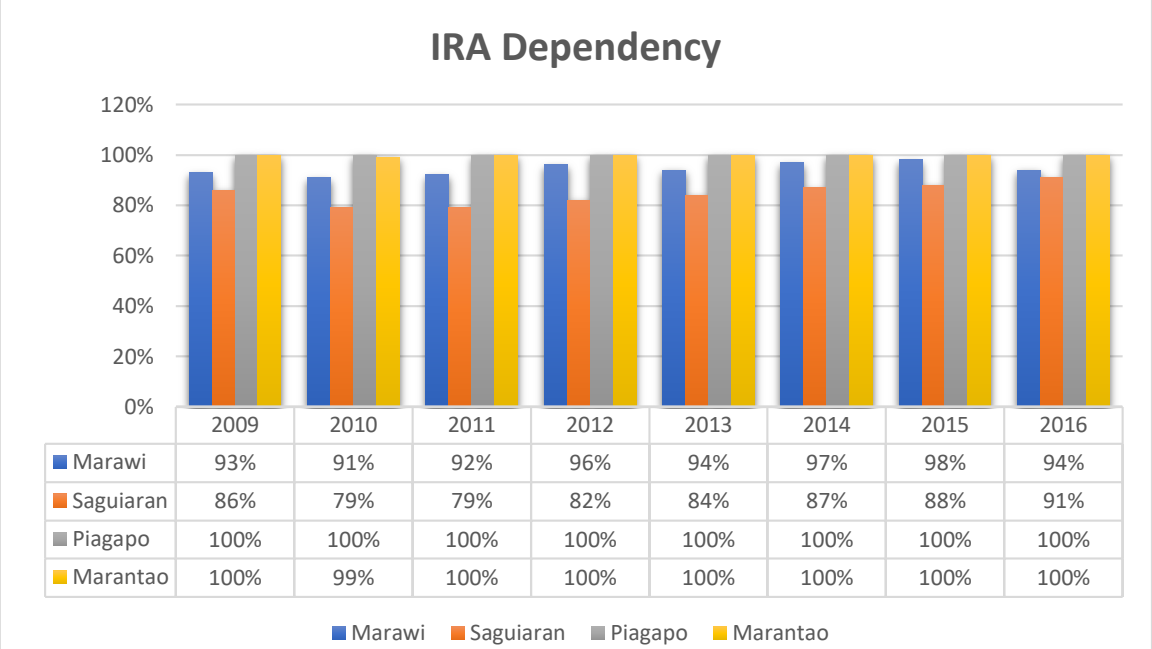
Based on the Bureau of Local Government Finance, Department of Finance CY 2014 data, Marawi City has the highest IRA with 375,077,101 pesos which includes local sourced revenues came from Municipal Taxes, Fees and other Charges. Saguiara has an IRA of 60,193,312 pesos, Piagapo has 66,830,870 while Marantaog has 101,255,593 pesos. as presented in the Table below.

Table 56. Income In the Project Area

Province	Municipality	Income
Maguindanao	Marawi City	375,077,101
	Saguiaran	60,193,312
	Piagapo	66,830,870
	Marantao	101,255,593

Source: Bureau of Local Government Finance, Department of Finance CY 2014

IRA dependency in Marantao and Piagapo is mostly 100% from 2009 to 2016. Saguiaran on the other hand has also high IRA dependency ranging from 82% to 91% of the total annual regular income of the municipalities. Marawi City in terms of IRA dependency ranges from 91% to 98% from 2009 to 2016.



	2009	2010	2011	2012	2013	2014	2015	2016
Marawi	93%	91%	92%	96%	94%	97%	98%	94%
Saguiaran	86%	79%	79%	82%	84%	87%	88%	91%
Piagapo	100%	100%	100%	100%	100%	100%	100%	100%
Marantao	100%	99%	100%	100%	100%	100%	100%	100%

Figure 74. IRA Dependency in Municipalities Affected by SP 7

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 SP7:

Table 57: Project Affected by SP 7

Loss category	Marantao	Piagapo	Saguiran	Marawi	Total
Affected House Heads	0	1	5	4	10
Affected Structures *	0	1	7	4	12
Affected Land Lot Owners	9	32	40	27	108

Source: RAP Survey Team
Note:
* There are 10 residential houses and 2 sari-sari stores

A total of 364,953.80 sq. m of land with crops and trees will be affected by the alignment as summarized in **Table 58** and **Table 59**. Majority of the cultivated crops that will be affected are corn and cassava..

Table 58: Summary of Affected Land and Types of Cultivated Crops

Loss category	Unit	Marantao	Piagapo	Saguiran	Marawi	Total
Affected agricultural lands with corn	m^2	42,000	65,400	29,100	23,850	160,350
Affected agricultural lands with cassava	m^2		3,600	19,200	5,400	28,200
Total affected land area (sq. m.)	m^2	43,405.56	69,652.65	103,671.31	148,224.28	364,953.80

Source: RAP Survey Team

Table 59: Summary of Affected Trees

Loss category	No. of Trees				Total
	Marantao	Piagapo	Saguiran	Marawi	
Affected Fruit bearing trees	70	100	1,008	126	1,304
Affected trees (Timber / non-fruit bearing)	11	138	1,029	1,066	2,244
Plant/Cash Trees		61	1,501	71	1,633

Source: RAP Survey Team

A comprehensive understanding of the socio-economic conditions and the level of participation/acceptance of households in the influence areas is deemed essential for the baseline profiling. In this undertaking, a household is defined as a unit comprising of more than one person who usually living together in the same dwelling and making common provisions for living essentials. In the absence of existing household level data, random sampling conducted, a total of 208 respondents were interviewed for this survey distributed in the 4 Municipalities with 10 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. The sample size was then allocated by barangay based on the size of the household population.

Survey Administration

In order to ensure that the requirements of the survey process are met, the study recruited municipal staff and census workers to administer the survey. These staff who have the qualifications and capacity to administer the survey, underwent a one-day preparatory training to familiarize themselves with the objectives of the survey, administration biases and strategies to minimize them, and the details provided in the survey questionnaire. The questionnaire was first pre-tested and subsequently modified when required.

Data Analysis

Data were analyzed using a standard statistical package for the social sciences (SPSS) program and Microsoft Excel. In order to control the differences in population size, the study employed weighted average in the calculation of results. The results are reported in percentages and are displayed in frequency tables and graphs.

Figure 75.Perception interview within SP 7

3.5.3.1 Respondent's Profile and Household Information

Of the 68 respondents surveyed, more than half or 52.72% are female while the remaining 174 or 47.28% are female (**Figure 76**). This indicates that majority of the women are housewives who took care of the family while the husbands are working.

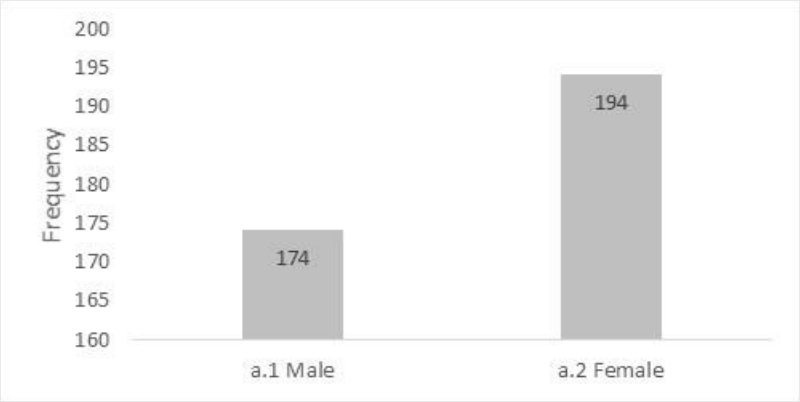


Figure 76. Gender of Respondents

In terms of age, 35 to 39 are the largest age group interviewed representing 15.76% of the respondents. A summary of the age distribution of the respondents is shown in **Table 60**.

Table 60. Age Distribution of the Respondents

Age	Frequency	% Percentage
20-24	39	10.60%
25-29	53	14.40%
30-34	40	10.87%
35-39	58	15.76%
40-44	50	13.59%
45-49	40	10.87%
50-54	29	7.88%
55-59	16	4.35%
60-64	22	5.98%
65 and above	21	5.71%

Figure 77 shows the civil status of the respondents. Majority 319 or 86.68% of the respondents are married with spouse present. While 27 of the respondents are single while the remaining percentages are widowed and separated (14 and 8, respectively).

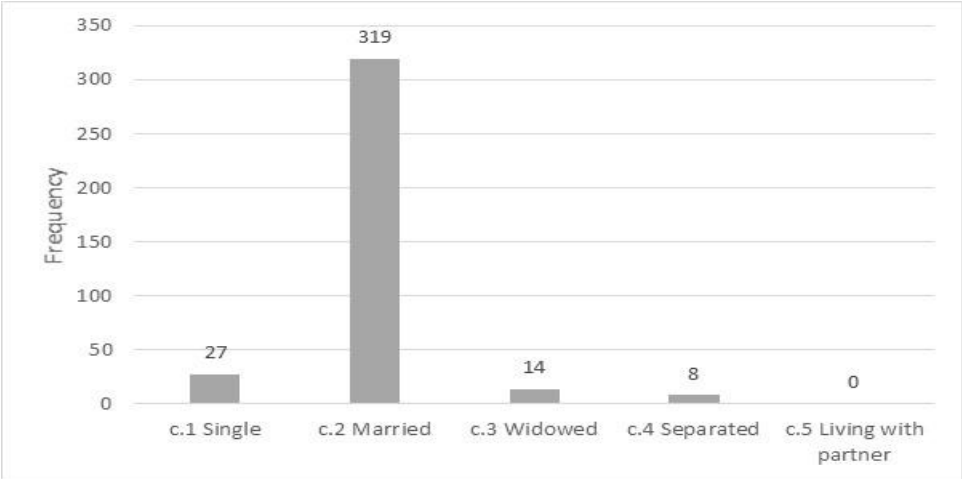


Figure 77. Civil Status of the Respondents

Table 61 shows the highest educational attainment of the respondents. Almost 28% recorded the highest educational attainment of the respondents are elementary level. While round 46.76% of the respondents reported being able to finished high school, and the remaining percentage are distributed up to college graduate and no formal education (18.21% and 7.88%, respectively).

Table 61. Educational Attainment of the Respondents

Educational Attainment	Frequency	% Percentage
Elem Level	100	27.17%
Elem Grad	35	9.51%
HS Level	76	20.65%
HS Grad	61	16.58%
College Level	36	9.78%
College Grad	31	8.42%
No Formal Education	29	7.88%

Table 62 shows the religious affiliation of the respondents. Majority of the respondents are Islam.

Table 62: Religious Affiliation of the Respondents

Religion	Frequency	% Percentage
Baptist	0	0.00%
Born Again Christian	0	0.00%
IP Religion	0	0.00%
Islam	368	100.00%
Roman Catholic	0	0.00%

Table 63 shows the number years that the respondents have lived in the barangay. The four highest frequency of stay in the barangay are 30 to 34 (13.32%), 35 to 39 (13.04%), 40 to 44 (11.96%), and 25 to 29 (11.14%). The data shows that majority of the respondents lived in the barangays or communities since their birth.

Table 63: Respondent's Years in the Barangay

Years in Barangay	Frequency	% Percentage
5 years and below	8	2.17%
5-10	9	2.45%
11-15	2	0.54%
16-20	26	7.07%
21-24	27	7.34%
25-29	41	11.14%
30-34	49	13.32%
35-39	48	13.04%
40-44	44	11.96%
45-49	35	9.51%
50-54	35	9.51%
55-59	10	2.72%
60-64	21	5.71%
65 and above	13	3.53%

3.5.3.2 Income and Employment

Table 64 shows the employment profile of the households. Based on the occupation or source of income of the respondents, most of them depend on farming 25.82% in the project area. Barangay Daaningud and Palao in Marantao Municipality, and Rantian Piagapo recorded as the highest number of farmers. Most of their crops are corn, banana, and rice. Around 16.03% are employed such as local government unit (LGU) officials and teacher. While remaining 13.59 % are engaged in business occupation from barangays in Piagapo, Marantao, and Saguiaran Municipalities. Most of the non-working or 30.43% surveyed respondents come from barangays in Marawi City. Majority of them are affected by the Marawi siege and all of their animals and livings are lost after they return home.

Table 64: Employment Profile

Household Employment	Frequency	% Percentage
Farming	95	25.82%
Employed	59	16.03%
Self-employed	12	3.26%
Business	50	13.59%
Fishing	6	1.63%
Laborers	8	2.17%
None	112	30.43%
Others	26	7.07%

The household income of the respondents reflects the status and capacity of providing the basic needs of the family. **Table 65** shows the household income reported by the respondents. As per interview, 39.13% have a total monthly income of 11,000-15,000 pesos, 26.09% earned 5,000 to 10,000 pesos, and 20.11% earned 16,000-20,000. Majority of this were provided for food, clothing, and education.

Table 65. Household Income

Household Monthly Income	Frequency	% Percentage
5,000-10,000	96	26.09%
11,000-15,000	144	39.13%
16,000-20,000	74	20.11%
20,000-25,000	33	8.97%
26,000-30,000	11	2.99%
31,000-35,000	5	1.36%
36,000-40,000	3	0.82%
41,000 and above	2	0.54%

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 is 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 Rural Health Center for their medical needs. More serious cases are referred to the Amai Pakpak Provincial Hospital or private medical practitioners in Marawi City for the 23 affected barangays. Most of the affected barangays have no barangay health center facilities while some used the barangay hall.

3.5.3.5 Access to Water

Figure 78 shows the resources of drinking water of the respondents. Majority of the respondents utilize water from deep well (50.27) and spring (49.73%) for their drinking water needs. Only Marawi City has a local water district while the remaining three municipalities have not. But according to Marawi City Water District (MCWD), of the 96 barangays in Marawi, only 41 are covered by MCWD due to limited water sources (3 deep wells within the most affected area (MAA) which is now damage and only serve barangays within MAA, and remaining 2 deep wells are located outside MAA namely: Bangon and Agus 1 deep well stations). From the eight affected barangay of SP 7, none are served by MCWD due to located far from the deep well stations.

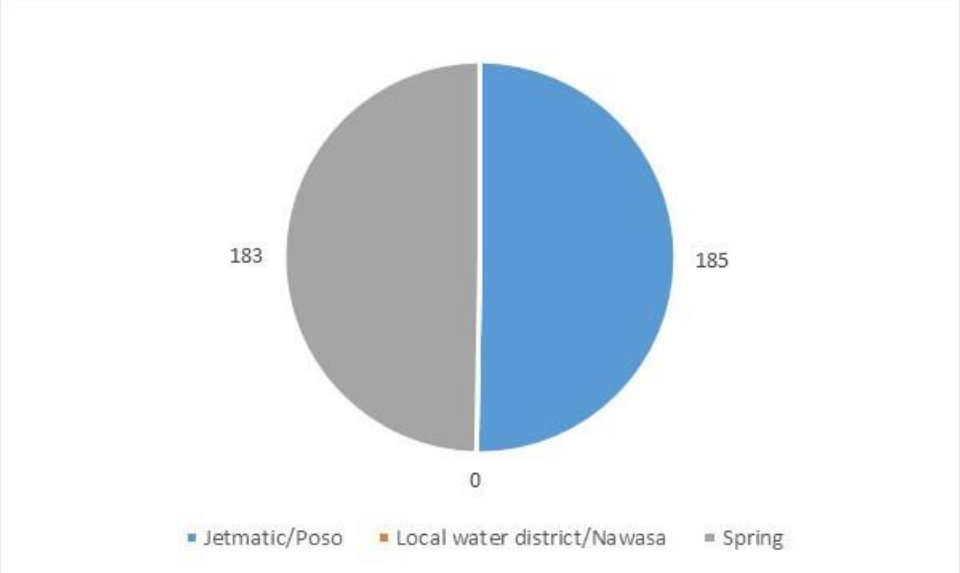


Figure 78. Source of Drinking Water

3.5.3.6 Access to Electricity

All of the surveyed respondents' source of electricity are from Lanao Del Sur Electric Cooperative (LASURECO). Agus 1 hydroelectric power plant located in Marawi City is the power provider of LASURECO.

3.5.3.7 House Types

Among the respondents, 47% of them have semi concrete house structures, 29% are made of light materials and 24.18% of them made of concrete materials.as shown in **Figure 79**.

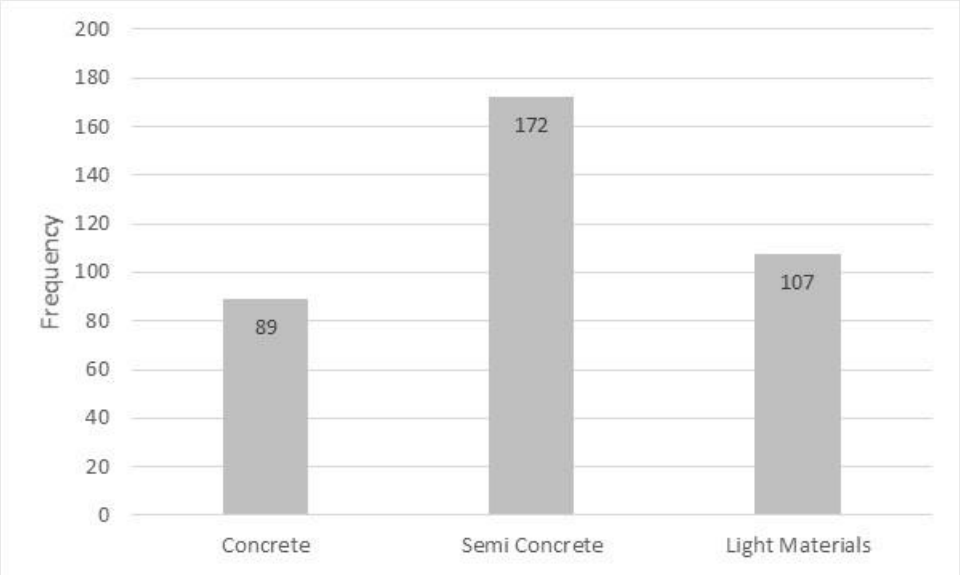


Figure 79. Type of House

3.5.3.8 Waste Management

The domestic waste disposal practiced by the respondents' shows in **Figure 80.** They stated that they are burned their waste in their respective area. Also, they stated that they practiced open pit as a means of waste disposal and the Local Barangay collects their domestic solid waste.

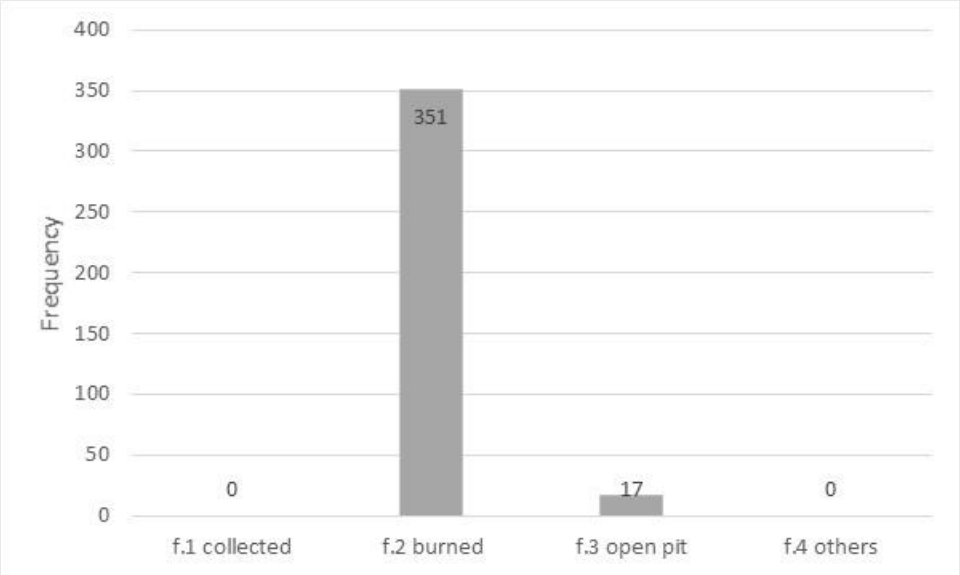


Figure 80. Waste Disposal

3.5.3.9 Type of Toilet System

In terms of type of toilet system, survey result shows that 100% of the respondents have their own private toilet system. The data indicates that the people in four municipalities are aware of the sanitation, and shows in their Islam beliefs.

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 81 shows that around 73.91% of the respondents mentioned that the project to have very beneficial while around 26.09% believe that the project would be extremely beneficial. This indicates that the project is very welcome to the respondents, and barangays that need a development especially to those barangay located in the remote area such as Dulay West and Caniogan in Marawi City that have no network connections.

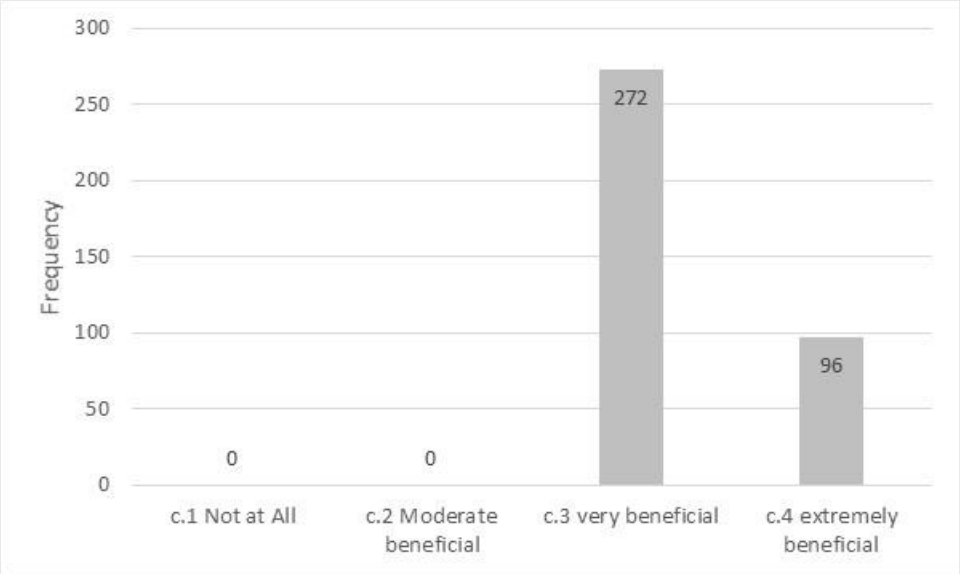


Figure 81. Perceived Beneficial Effects of the Project

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 improvement of water system and 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 starting of the construction of the project at the barangay level
- Close coordination between project proponent and the local government

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 uncertain (5.88%) are anxious that they will be displaced and loss their income.

The consultation also reflects favorability among stakeholders, however the main concern is the compensation/relocation of affected people.

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 hesitant because of the fact that their settlements might be affected during the project implementation. According to them, it is not easy to give up their properties (house, livelihood, etc.) adding to the fact that they have lived in the area for a number of years. 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.

Section 4

SCOPING

4. SCOPING

4.1 Barangay Scoping

The barangay scoping meetings were held in 23 barangays within the direct affected community as shown in **Table 66**. These meetings are discussed on the project background and objectives, and the positive and negative impacts of the proposed sub-project no. 7 to the people, health, habitat, and among others. The queries and comments on the barangay scoping checklist was responded by the Rap and EIA Study team as shown in **Table 67**. The barangay scopings were attended by 272 male and 373 female. The female or women's appealed for livelihood projects for extra income and work for their husband during the construction.

Table 66. Contents Of Stakeholder Meeting on Scoping Stage Barangay Level

Date (venues)	Objectives of the meeting	Major Agenda	Participants	No. of Participants
1. Jan 16, 2018, Piagapo barangay halls 2. Jan 17, 2018 Marantao barangay halls 3. Jan 18, 2018, Saguiaran barangay halls 4. March 5&8, 2018, Marawi barangay halls	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	a. Piagapo • Bobo: M-9, F-15 • Paling: M-3, F-19 • Rantian: M-16, F-7 b. Marantao • Matampay: M-8, F-26 • Daaningud: M-38, F-33 • Palao: M-12, F-14 • Bacong: M-15, F-5 c. Saguiaran • Mipaga: M-12, F-13 • Bubong: M-8, F-7 • Pagalamatan: M-13, F-15 • Lumbaca Toros: M-4, F-9 • Bagoingud: M-6, F-13 • Alinun: M-4, F-12 • Linao: M-9, F-9 • Lombayanague: M-11, F-12 d. Marawi • Boganga: M-7, F28

				• Banga: M-2, F-17 • Kilala: M-20, F-34 • Pantaon: M-13, F-2 • Dulay West: M-5, F-17 • Caniogan: M-3, F-8 • Guimba: M-38, F-40 • Rorogagus East: M-27, F-18

Table 67. Major Opinions in Stakeholder Meetings on Scoping Barangay Level

Date and Objectives	Agenda	Item on EIA		Major Opinion	Answers (RAP, and JICA Survey Team's answers has been accepted and understood basically)
Jan. 16-18, 2018, and Mar 7-8, 2018 Barangay Scoping in accordance with Philippines EIA Guidelines	1. Introduce the project and discuss the project objectives and the positive and negative impacts of the project.	Social / The People	Labor	1. (Bobo) Is it possible that the people in our community can work or be hired during the construction/ implementation of the project?	1. This local hire will be one of the priority of the project which is part of the barangay scoping checklist considering that they are qualified on the job.
		Social / The People	Land and Properties	2. (Bobo) What will happen to the affected properties and land without land titles?	2. Based on Philippine Law's, this will be negotiated and compensated. The land owner should submit the necessary requirements such as the tax declaration or certified documents from the barangay officials and LGUs that you owned the land.
		Social / The People	Water Usage	3. (Paling) Check on the existing springs that are sourced for drinking water, cooking, bathing among others.	3. We will inform our hydrologist to validate the spring source if this will be along or can be affected by the road alignment.

Date and Objectives	Agenda	Item on EIA		Major Opinion	Answers (RAP, and JICA Survey Team's answers has been accepted and understood basically)
			Labor	4. (Paling) Is it possible that the people in our community can work or be hired during the construction/ implementation of the project?	4. This local hire will be one of the priority of the project thru DPWH considering that they are qualified on the job.
			Realignment	5. (Rantian) (Mr. Talib Diripo) Is it possible to realign the proposed road from barangay Rantian going Barangay Laling?	5. This will be noted and included on our report because currently we are in the study stage.
		Social / The People	Labor	6. (Rantian) (Messrs. Salic Mamacol and Cabugatan Macabangkit) Is it possible that the people in our community can work or be hired during the construction/ implementation of the project?	6. This local hire is the priority of the project considering that the local is qualified in the job. DPWH will be the implementing agency and thru barangay recommendations.
		Social / The People	Sanitation	7. (Rantian) (Mr. Ismael Abdul) My query is not connected with the project but I am hoping that JICA will consider my recommendation. The garbage from MSU are mostly thrown in the river and wash out going to Barangay Rantian during heavy rains. JICA might have a solution on this problem?	7. We will noted the issue and included in our recommendations to the proponent.
		Social / The People	Livelihood	8. (Rantian) Do you have livelihood programs for the affected community?	8. This will be part of our recommendations to the proponent.

Date and Objectives	Agenda	Item on EIA		Major Opinion	Answers (RAP, and JICA Survey Team's answers has been accepted and understood basically)
		Social / The People	Properties	9. (Palao) (Mr. Ostad Lawi Sampuan) What will happen to the affected houses that will be affected by the proposed road alignment?	9. This affected lands and properties will be negotiated and compensated following the Philippine Laws. The RAP team will conduct inventory and cut-off date with the supervision of the barangay officials. In absence of land titles and tax declarations, the barangay officials and Marantao Mayor will certify so that the landowner can apply a tax declaration to the Assessor's office.
		Social / The People	Livelihood	10. (Palao) (Mr. Ostad Lawi Sampuan Can we put up a business near the construction sites and after the construction of the road?	10. All is welcome to put up a business on the safest area of the construction sites with permission from DPWH for the safety of the business owners. You can also put business beside the road after the construction.
		Social / The People	Labor	11. (Palao) (Mr. Ostad Lawi Sampuan) Is it possible to apply as worker?	11. Yes, local hires is the priority of the project thru the barangay and DPWH considering that they are qualified in the job.
		Social / The People		12. (Palao) (Mr. Ostad Lawi Sampuan) How far is the proposed road alignment from the community of barangay Palao?	12. Majority of the affected in along Palao are farm lands. Based on the development map, the alignment is far from the community.

Date and Objectives	Agenda	Item on EIA		Major Opinion	Answers (RAP, and JICA Survey Team's answers has been accepted and understood basically)
		Social / The People	Lands and Properties	13. (Palao) (Mr. Mino Lomano) If theres a possibility that there will be properties, lands, and crops affected, we are willing to be paid.	13. The Resettlement action plan (RAP) team will conduct an inventory process with the supervisions of the barangay officials. This identified landowners will be compensated based on the type of properties, area of the land that is affected by the alignment. The land owner should submit the proper requirements such as the tax declaration or certified documents from the barangay officials and LGUs that you owned the land and properties among others.
		Social / The People	Labor	14. (Bacong) (Mr. Jamal Guro) Is it possible that our youth can work or be hired during the construction/ implementation of the project.	14. This local hire is the priority of the project. DPWH as implementing agency will follow the DOLE guidelines to hire 18 years old and above, and qualified in the job.
		Social / The People	Land and Properties	15. (Bacong) (Mr. Solaiman Macabalang) What will happen to the affected land and properties?	15. The RAP team will conduct an inventory on the affected properties and land along with the supervision of the barangay officials to certify that they are the landowners. Proper documentation should be the requirements for the claims such as the certificate of land titles or tax declaration.
		Social / The People	Labor	16. (Daaningud) Is it possible that the people in our community can work or be hired during the construction/ implementation of the project?	16. This local hire will be one of the priority of project thru DPWH and barangay officials considering that they are qualified on the job.

Date and Objectives	Agenda	Item on EIA		Major Opinion	Answers (RAP, and JICA Survey Team's answers has been accepted and understood basically)
		Social / The People	Land and Properties	17. (Daaningud) (Mr. Juhari Abinac) What will happen to the affected properties and land that will be affected by the proposed road alignment?	17. The Resettlement action plan (RAP) team will identify the affected landowner thru an inventory process with the supervisions of the barangay officials. This identified landowners will be compensated based on the type of properties, area of the land that is affected by the alignment. The land owner should submit the proper requirements such as the tax declaration or certified documents from the barangay officials and LGUs that you owned the land and properties among others.
		Social / The People	Land and Properties	18. (Matampay) (Mr. Mohammad Hajidaod) What will happen to the affected land and houses that will be affected by the proposed road alignment?	18. This affected lands and properties will be compensated following the Philippine Laws. The other team will identified along the supervision of the barangay officials. In absence of land titles, the barangay officials will certify so that the landowner can apply a tax declaration to the Assessor's office.
		Social / The People	Labor	19. (Matampay) (Ms. Mohmena Ditingki) Is it possible that the people in our community can work or be hired during the construction/ implementation of the project?	19. This local hire is the priority of the project thru DPWH considering that they are qualified in the job. The DPWH is the implementing agency of the ring road project, local hire should apply thru the barangay and recommended to the DPWH.

Date and Objectives	Agenda	Item on EIA		Major Opinion	Answers (RAP, and JICA Survey Team's answers has been accepted and understood basically)
		Social / The People	Land and Properties	20. (Matampay) (Mr. Juhari Abinac) What will happen to the affected properties and land that will be affected by the proposed road alignment?	20. The Resettlement action plan (RAP) team will identify the affected landowner thru an inventory process or cut off dates with the supervisions of the barangay officials. This identified landowners will be compensated based on the type of properties, area of the land that is affected by the alignment. The land owner should submit the proper requirements such as the tax declaration or certified documents from the barangay officials and LGUs that you owned the land and properties among others.
		Social / The People	Farm to Market road and Bridge	21. Matampay Barangay Chairwoman Limbona requested a farm and market road starting from the MSUI highway across the proposed ring road project to the barangay hall of Matampay. This farm and market road can be used for the emergency and transportation of products to the market. Majority of the farm land located in the barangay proper. She further requested to construct a small bridge along the river (refer photos below) for the people of barangay Matampay.	21. This requested will be recommended to the proponent and part of the report.

Date and Objectives	Agenda	Item on EIA		Major Opinion	Answers (RAP, and JICA Survey Team's answers has been accepted and understood basically)
		Social / The People	Land and crops	22. (Pagalamatan) (Ms. Aguimah Rambago Gariel) What will happen to the affected crops and land?	22. The RAP team will conduct inventory and cut off dates with the supervision of the barangay officials. The affected land owner should submit tax declaration or land titles which is the proper documents for claims. Those without land titles will ask support from the barangay officials and Mayor's office for a certification of ownership. This certification will be applied to the assessor's office for a tax declaration.
		Social / The People	Water Usage	23. (Alinun) (Haji Said Manaradumagay) We have Pansor Spring near the proposed road alignment which supplied drinking and other uses for four (4) barangays including Barangay Alinun. This spring also a tourist spot. Can we check if the spring can be affected by the project?	23. This spring will be verified by our hydrologist and will be included in our report.
		Social/ The People	Labor	24. Bagoingud Barangay Chairman Maning Dalupan stated that portion of the work labor will be coming from the barangay.	24. Recommendations from the barangay chairman and labors should be qualified in the job. The age will be 18 and above to follow guidelines of DOLE.
			Compensation	He added that the compensation of the owner should be prior the project implementation.	DPWH will be the implementing agency and will handle the compensation of the affected.

Date and Objectives	Agenda	Item on EIA		Major Opinion	Answers (RAP, and JICA Survey Team's answers has been accepted and understood basically)
		Social / The People	Labor, and affected Land and Properties	25. (Bubong Barangay Chairman Mackil Ali) What will happen to the affected land and would it be possible local hire in the community?	25. The RAP team will conduct inventory and cut off dates with the supervision of the barangay officials. The affected land owner should tax declaration or land titles. Those without land titles will ask support from the barangay officials and Mayor's office for a certification of ownership. This certification will be applied to the assessor's office for a tax declaration. This is part of the process for the claims of compensations. For local hire, this will be the priority of the project thru DPWH as implementing agency. I would suggest that local should apply from the barangay considering that they are qualified to the job.
		Social / The People	Re-alignment	26. (Linao) What will happen to the cemetery along the alignment of the proposed road? Is it possible to reroute the alignment?	26. During the conduct of inventory of the RAP team. If there will be heritage such as cemetery will be affected by the proposed road. The RAP team will recommend to the proponent on the rerouting of the road. We respect the culture of the community.

Date and Objectives	Agenda	Item on EIA		Major Opinion	Answers (RAP, and JICA Survey Team's answers has been accepted and understood basically)
		Social / The People	No proof of ownership	27. (Lumbayanague) (Mr. H. Nasser R. Dalupang and Abubakar Jalacubin) What will happen to the affected property without land titles?	27. This affected lands and properties will be negotiated and compensated following the Philippine Laws. In absence of land titles, the barangay officials and Saguiaran Mayor will issue certification to the landowner to apply for a tax declaration to the Assessor's office.
		Social / The People	No proof of ownership	28. (Lumbayanague) (Ms. Salie Hakayo) In addition, what will happen to the lease land without land titles that will be affected by the alignment of the proposed road alignment?	28. The RAP team will conduct an inventory to the affected lands along the alignment. There will be a negotiation process for the affected lands and properties thru LGU officials and DPWH.
		Social / The People	Re-alignment	29. (Mipaga) (Messrs. Kadi Aslima Mikunug, Kadi Madali Malik, Ibrahim Dimacaling) We are suggesting that the proposed road alignment will reroute at NPC area because majority of the lands in Barangay Mipaga are owned by NPC. Our community will majority lost their property and land if this alignment will be implemented.	29. This will be noted and included on our report because currently we are in the study stage.
		Social / The People	Labor	30. (Mipaga) (Barangay Chairman) Is it possible that the people in our community can work or be hired during the construction/ implementation of the project?	30. This local hire is the priority of the project considering that the local is qualified in the job. DPWH will be the implementing agency and thru barangay recommendations.
		Social / The People	Labor	31. Boganga Brgy. Chairman Macacuna Yusoph suggested to prioritized workers for the road construction is coming from the communities because mostly the source of income of his constituents are business within the most affected area (MAA) in Marawi siege.	31. This will be noted and included in the report. Barangay chairman has a major duty in recommending the workers considering that they are fit and capable on the job.

Date and Objectives	Agenda	Item on EIA		Major Opinion	Answers (RAP, and JICA Survey Team's answers has been accepted and understood basically)
		Social / The People	Livelihood	32. (Boganga) Mrs. Ricah M. Yusok, wife of Brgy. Chairman Yusok, requested livelihood program	32. This will be part of our recommendations to the proponent.
		Social / The People	Compensation	33. Banga Barangay Chairman Junaid Awar requested the following: • Compensation should be paid in front of the landowner and barangay officials; • Avoid different value from the other barangays or municipalities;	33. • DPWH will be the implementing agency and will handle the compensation of the affected landowner. • DPWH will validated the submitted survey results and basis of the cost computations of RAP team. The value will depend on the affected properties, structures and should be the same to value to every affected communities.
			Livelihood	• Livelihood program for the housewife to help their husband which is majority are farmers; and	• This will be part of our recommendations to the proponent.
			Labor	• Worker from the barangay during the implementation of the road.	• This local hire will be one of the priority of the project which is part of the barangay scoping checklist considering that they are qualified on the job.

Date and Objectives	Agenda	Item on EIA		Major Opinion	Answers (RAP, and JICA Survey Team's answers has been accepted and understood basically)
				34. Kilala Barangay Councilor Aminola Mamli said that during the RAP inventory, the alignment will not traverse the barangay.	34. This will be noted and subject for verification by DPWH for the exact affected barangay.
		Social / the people	Farm to Market	35. Pantaon Barangay Chairman Khalil Rascal said that majority of the affected are land because the alignment is far from the community. He requested the following: • Farm to Market road (Brgy. Pantaon to Brgy. Papandayan);	35. • This will be part of our recommendations to the proponent.
			Livelihood	• Livelihood program for the women;	• This will be part of our recommendations to the proponent.
			Labor	• Worker from the community during the implementation of the road; and	• This local hire is the priority of the project. DPWH as implementing agency will follow the DOLE guidelines to hire 18 years old and above, and qualified in the job.
			Compensation	• Negotiation with the landowners with regards to the compensation on the affected land and crops; and	• DPWH will be the implementing agency and will handle the compensation of the affected landowner.
			Infrastructure	• Health center.	• This will be part of our recommendations to the proponent.

Date and Objectives	Agenda	Item on EIA		Major Opinion	Answers (RAP, and JICA Survey Team's answers has been accepted and understood basically)
				Wife of Dulay West Barangay Chairman, Ms. Camama Janisah, said that the animals like cow, goat and chicken are lost after the Marawi siege. They return in their homes on Dec. 9, 2017 with nothing and lost their sower machines. She added that majority of the women's are sower and one of the supplier of "kumbong" for the whole Lanao del Sur. She further added that they have lost everything after the Marawi siege, and at present, the women's have no income and capital.	
		Socail/The people	Labor	36. (Dulay West) Mrs. Tempo Unti requested that worker for the construction should be from their barangays because majority of their husbands are farmers. She added that after their return, her husband start a small garden for their food same as the others.	36. This local hire is the priority of the project. DPWH as implementing agency will follow the DOLE guidelines to hire 18 years old and above, and qualified in the job.
			Livelihood	37. (Dulay West) Ms. Nor-ain Didato requested JICA to donate sower machines for the women and cash support to buy cloth for a new start.	37. This will be part of our recommendations to the proponent.
				38. (Caniogan) Ms. Kintawan Samira requested livelihood projects for the affected families of Marawi siege.	38. This will be part of our recommendations to the proponent.
			Water Usage	39. (Caniogan) Chairwoman Adelaida Decampong requested rehabilitation of deep well and additional water supply for the barangay.	39. This will be part of our recommendations to the proponent.

Date and Objectives	Agenda	Item on EIA		Major Opinion	Answers (RAP, and JICA Survey Team's answers has been accepted and understood basically)
		Social /The People	Livelihood	40. (Caniogan) Dra. Rubina Macabunar , Civil Society, said that she will support assistance on any livelihood projects to be provided by JICA. Because it's her advocacy to lifted the life of the single mothers in their barangay.	40. This will be noted and part of our recommendations to JICA.
			compensation	41. (Guimba) Barangay Chairman Hadji Nassif Pundamdag asked if what will be included in the compensation with the same value like the other barangays and municipalities.	41. DPWH will be the implementing agency and will handle the compensation of the affected landowner.
			Properties	42. (Guimba) Barangay Kagawad Asnawi Padoman Daud requested on the list of landowner that will be affected by the proposed road and exact map of the surveyed road alignment by RAP team.	42. The list will be presented by RAP team to the affected barangay upon the profiling of the affected landowners are completed.
				43. (Guimba) Mr. Abdul Daud said the landowner is not present during the inventory. There are hearsay that the land of his father and mother is within the alignment. This issue should be confirmed so that the landowner will be notified by the barangay officials if they are willing to be paid to avoid problems prior the compensation schedule.	43. This will be noted and recommended to RAP team, DPWH and JICA.
			Water Usage	44. (Guimba) Barangay Kagawad Asnawi Daud requested to have additional reservoir and improvement of water system and distribution lines. He said that the water source of the barangay is spring.	44. This will be part of our recommendations to the proponent.
			Livelihood	45. (Guimba) Ms. Rica Pidao requested livelihood program for the housewives.	45. This will be part of our recommendations to the proponent.

Date and Objectives	Agenda	Item on EIA		Major Opinion	Answers (RAP, and JICA Survey Team's answers has been accepted and understood basically)
		Social /The Properties		46. (Rorogagus East) Barangay Chairman Yashier Batabor said that their barangay is not included in the alignment based on the results of the RAP survey. His requested are the following:	46.
			Livelihood	• Livelihood for the community;	• This will be part of our recommendations to the proponent.
			Livelihood	• Need food supply for the returnee residence after the Marawi siege;	• This will be part of our recommendations to the proponent.
			Water Usage	• Improvement of water system to be source from Rorogagus river; and	• This will be part of our recommendations to the proponent.
			Labor	• Worker from the barangay during the implementation of the road.	• This local hire is the priority of the project. DPWH as implementing agency will follow the DOLE guidelines to hire 18 years old and above, and qualified in the job.

Hereto attached are the results of scoping checklists and attendance sheets for SP 7.

4.2 Summary of Baseline Survey and Forecast

Table 68. Summary of Baseline Survey and Forecast

Category	No.	Impacted Item on JICA Guidelines (Philippines Item)	Rating				Summary Result		
			Pre/ During Construction	Operation Phase	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, SO2, NO2) at one station 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 as shown in Table 57
	2	Water pollution (water Quality)	B-	D	B-	D	Result of (pH, Temp, BOD, TSS, DO) are within the guidelines	During construction activities may cause turbidity of 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		Impacts may be mitigated by avoidance and other measures such as no construction during the night or use of muffler or sound proof barrier.

							during the night due to presence of insects like crickets that make noise during the dark.		
	6	Ground Subsidence	D	D	D	D	The terrain is undulating to steep. The proximity of active faults to the proposed road alignments indicates that strong to very strong ground shaking could be felt in the project area. SP-7 is not prone to tsunami since the area is located farther inland. 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 7 may require protections of the cut slopes. This assumption should be confirmed further by appropriate geological and geotechnical site investigation prior to the construction of the Project. Flood susceptibility in the Marawi City Ring Road is generally considered low. The Marawi City Ring Road is underlain by volcanic and/or	• No impact is expected	• Conduct Probabilistic Seismic Hazard Assessment (PSHA). • Detailed assessment of the identified active fault intersecting the road alignment. Appropriate geotechnical investigation to evaluate potential liquefiable soil layers.

							sedimentary rocks which are not considered susceptible to liquefaction.		
	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

Natural l Environment	9	Protected Area	B-	C	B-	C	**Lake Lanao** is a proclaimed watershed reserve by virtue of Proclamation No.871 and is included in the initial components of the National Protected Areas System (NIPAS) governed under NIPAS Act of 1992 (Republic Act No. 7586). Current land uses that will be traverse by the proposed alignment are primarily agricultural areas planted with tree crops, varieties of fruit bearing trees and cash crops. Other areas are shrublands adjacent to some settlement areas. Most of the areas traverse by the alignment are under	Implementation of the project will require to convert portions of the agricultural lands and shrublands into a road network which entails to the removal of some vegetation cover.	Prior to project implementation the proponent will coordinate with the Department of Environment and Natural Resources (DENR) and the provincial government of Lanao del Sur to seek clearance regarding the requirements of the Integrated Natural Resources and Environment Management Project (INREMP) for Lake Lanao River Basin. Conduct of tree inventory for the issuance of tree cutting permit from the DENR will be secured first by the proponent. Tree planting along roads as natural buffer and in areas that will be designated by the DENR will be undertaken in replacement of trees cut in compliance to the DENR Memorandum Order no. 05 s. 2012.

							ownership/claimed by different individuals.		
	10	Ecosystem (Terrestrial Flora and Fauna)	B-	C	B-	C	Floristic composition of the alignment is relatively low comprised of 63 species dominated by trees. Recorded species are common and naturally growing in the area. The result of assessment showed that only 1 is included in the IUCN list of vulnerable species. The faunal composition of the alignment is nominal with only 25 species dominated by Avifauna. Recorded species are common and locally sited in different ecosystems in the lowland areas including agricultural areas, shrub land, grassland, and settlements areas. These species also thrive even in highly disturb areas including cities. Four (4) species are endemic in the study area dominated by Aves. Only one (1) species is vulnerable in the category of the IUCN.	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 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.	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. 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 Agus River and its tributaries. Based on the data from	Most likely not affected as no wells were found on the alignment	It requires ground validation survey if existing wells/springs in the area will not impacted by the road alignment; otherwise, if there will be affected wells that are sources of water supply by

							the National Water Resources Board (NWRB) and from Local Water Utilities Administration (LWUA), twenty eight groundwater wells were listed. All of these wells are within the Marawi City area		residents, this may greatly impacted the shortage of drinking water.
	12	Topography and Geology	B-	B-	B-	B-	The ground elevation reaches up to 825 masl while low-lying areas have an elevation of 600 masl giving rise to undulating to steep terrain.	• The proximity of active faults exposes the project to strong to very strong ground shaking. • The project could be susceptible to ground rupture as it directly straddles or located within a narrow zone of active fault trace. • Some sections passing through steep to very steep, hilly to mountainous terrain may be susceptible to slope failure, soil erosion, and rock fall.	• Conduct Probabilistic Seismic Hazard Assessment (PSHA). • Detailed assessment of the identified active fault intersecting the road alignment. • Impacts may be mitigated by slope protection.

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 assistance in accordance with RAP is prepared to minimize adverse social impacts.
	14	The Poor (People)	B+	C	B+	C	Based on the profiles of the respondents during perception survey, 39.13% have a total monthly income of 11,000-15,000 pesos, 26.09% earned 5,000 to 10,000 pesos, and 20.11% earned 16,000-20,000. This composed of the total income of the households per month which only reflects that small percentage 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 Maranao. Some are combination of Iranun, Maguindanaon, and Cebuano. No indigenous peoples declared by the community.	Few impacts are expected on designated ethnic group. However, continuous monitoring 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
	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 25.82% in the project area. Barangay Daaningud and Palao in Marantao Municipality, and Rantian Piagapo recorded as the highest number of farmers. Most of their crops are corn,	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

							banana, and rice. Around 16.03% are employed such as local government unit (LGU) officials and teacher. While remaining 13.59 % are engaged in business occupation from barangays in Piagapo, Marantao, and Saguiaran Municipalities. Most of the non-working or 30.43% surveyed respondents come from barangays in Marawi City. Majority of them are affected by the Marawi siege and all of their animals and livings are lost after they return home.		
	17	Land Use and utilization of local resources (Land Use and classificatio n)	B-	D	B-	D	The project alignment is passing through mainly agricultural area such as plantation, particularly in Piagapo which majority of the barangay are provider in Abaca for the whole Lanao del Sur, 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/ hydrogeolog y/water quality)	B-	B-	B-	B-	Majority of the respondents utilizes water from local water district for their domestic and drinking water needs. Other drinking water sources include from spring.	Earthworks may cause turbidity of river water as being use for domestic.	Minimized by control measures like silt trap, sedimentation pond, etc.

	19	Existing Social infrastructures and services (People)	B-	D	B-	D	c/o RAP for the exact account of social infrastructure affected	The project does not give any impact to social infrastructures. Thus it is not likely to give any serious impacts on this item	Appropriate compensation and social assistance in accordance with Resettlement Action Plan (RAP) is prepared and minimize the adverse social impacts, if any impacts are expected in the detailed design
	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	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	This risk is minimized by mitigation measures such as construction of sufficient drainage, management of construction yard and health check & education for workers.

							dengue fever in incidental pond in the construction area without appropriate drainage.	of mosquito that possibly transmits dengue fever	
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	Can be minimized by installing traffic sign boards, lighting in the night, trained personnel and use of PPEs.
	30	Cross boundary impacts and climate change (Meteorology/climatology)	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 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	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 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.

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 69. **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 (230)	PM10 (150)	NO2 (150)	SO2 (180)		TSP	PM10	NO2	SO2	
		1	Brgy. Bubong, Saguiaran, Lanao del Sur	15.7	11.7	3.0	Not Detected		-	11.8	4.0	0.0006	
2	Water Pollution	St	Location	pH (6.5-9)	TempoC (25-31)	BOD (7)	TSS (80)	DO (5ppm min.)	pH	Temp, 0C	BOD	TSS	DO
		1	Agus River	6.7	26.5	1	5.0	7.2	-	-	-	-	-
5	Noise	St	Location	Morning (50)	Daytime (55)	Evening (50)	Night time (45)		Morning	Evening	Evening	Night Time	
		1	Brgy. Bubong, Saguiaran, Lanao del Sur	**53**	53	**53**	**51**		**54**	55	**54**	**52**	

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 VALUES 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 70. 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 machines at construction sites adjacent to settlement areas	(NO2, SO2 and TSP) -Setting up green buffer zone along the road (the zone and planting trees are carried out during construction)	Contractor	[During Const.] DPWH [Operation Phase] Marawi, Marantao, Piagapo, Saguiaran
	2	Water pollution (Water quality)	[Turbid water and other items] - Discharge through sedimentation pond and silt fence -Installation of portable toilet for workers - Appropriate waste and construction machines management	Not required	Contractor	DPWH
	3	Waste (Abandonment)	[Construction waste (trees and waste soil)] - After considering the possibility of reuse, construction waste is disposed at designated disposal site Note) [Muck soil from tunnel section] -Reuse or disposed at designated disposal site after treatment	Not required	Contractor	DPWH

			[Garbage from base camp] - Garbage at workers camp and waste oil shall be brought to disposal site or facility [Night soil] -Temporary sanitation facility such as septic tank shall be introduced to the workers camp.			
	4	Soil contamination (soil quality)	-Reuse or disposed at designated disposal site after treatment	Not required	Contractor	DPWH
	5	Noise and vibration (Noise)	[Construction noise] - Installing noise barrier and selecting low-noise equipment. - Avoiding works of heavy equipment during night time. -Informing the construction schedule to surrounding communities to obtain their consensus	[Traffic noise] - Establishment of green belt as buffer zone along the road - Secure sufficient distance from boundary of the road to residential area after construction of the road (secure noise decay distance) on land use plan along the road - Installation of noise barrier near sensitive facility, if required	Contractor	DPWH
	6	Sediment quality (Soil quality)	-Reuse or disposed at designated disposal site after treatment	Not required	Contractor	DPWH
	9	Protected Area (Lake Lanao watershed Reservation)	Pre and during construction phase monitoring and management plan as	-Monitoring, maintenance and protection of planted trees	DPWH, contractor	DPWH ,LGU,DENR

			required by the DENR and the provincial government of Lanao del Sur relative to the Integrated Natural Resources and Environment Management Project (INREMP) for Lake Lanao River Basin. Limit land clearing within the road ROW only (during site preparation) Establishment of vegetational buffer along the road ROW thru planting of trees (during construction and operation phase) Relocation of potentially affected trees (young) to DENR designated sites and/along the road ROW Replacement of trees cut in support to the DENR National Greening Program (NGP) in compliance to DENR MO no. 05 s. 2012 Prohibit hired workers/employees to get involved in any wildlife poaching and trading	-Installation of ecologically significant signages along road network		

			Compliance of Ecological Solid Waste Management Act of 2000 (during construction)			
	10	Ecosystem (Terrestrial Biology Freshwater or marine ecology)	- Relocation & replanting trees along the road in ROW -Tree planting at sites designated by DENR -Create ecotone habitats in consideration of Amphibia, if the existing habitats along the river are impacted by the project	- Appropriate land use management not to develop natural area along the road	[Const.] Contractor [Operation] Marawi, Marantao, Piagapo, Saguiaran	[Const.] DPWH [Operation] Marawi, Marantao, Piagapo, Saguiaran
	11	Hydrology (Hydrology and oceanography)	-Designing of roads and bridges with sufficient capacity -Installation of sufficient drainage facilities on bypass -Secure waterways in construction area	Not required	Contractor	DPWH
	12	Topography and geology (Geography, topography and landslides	- Installation of slope protection measures	Not required	Contractor	DPWH
Social Environment	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	DPWH	Marawi, Marantao, Piagapo, Saguiaran

				accordance with RAP		
	14	The poor (People)	Appropriate 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	Marawi, Marantao, Piagapo, Saguiaran
	15	Indigenous and ethnic people (Indigenous people)	Not required for designated indigenous and ethnic group However situation of 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 because NCIP has been issued. However situation of minority religious group(s) 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	Marawi, Marantao, Piagapo, Saguiaran
	17	Land use 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	[Const.] DPWH [Operation] Marawi, Marantao, Piagapo, Saguiaran	Marawi, Marantao, Piagapo, Saguiaran

	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 well	DPWH, Marawi, Marantao, Piagapo, Saguiaran	Marawi, Marantao, Piagapo, Saguiaran
	19	Existing social infrastructures and services	Appropriate compensation and/or relocation in accordance with RAP	Not Required	Contractor and DPWH	DPWH, Marawi, Marantao, Piagapo, Saguiaran
	22	Local conflict of interests	Local workforce is prioritized for construction of the 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	Not required	Contractor	DPWH,

			the contractor under observation of 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 lightning in the night time -Installation of parking for idling construction machines -Safety training for the workers -Safety patrol at the construction site by supervisors	Not Required	Contractor	DPWH
	30	Cross boundary impacts and climate change (Meteorology / Climatology)	Replanting natural native trees and other agricultural trees such as coconuts	Not required	Contractor	DPWH

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 82** 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.

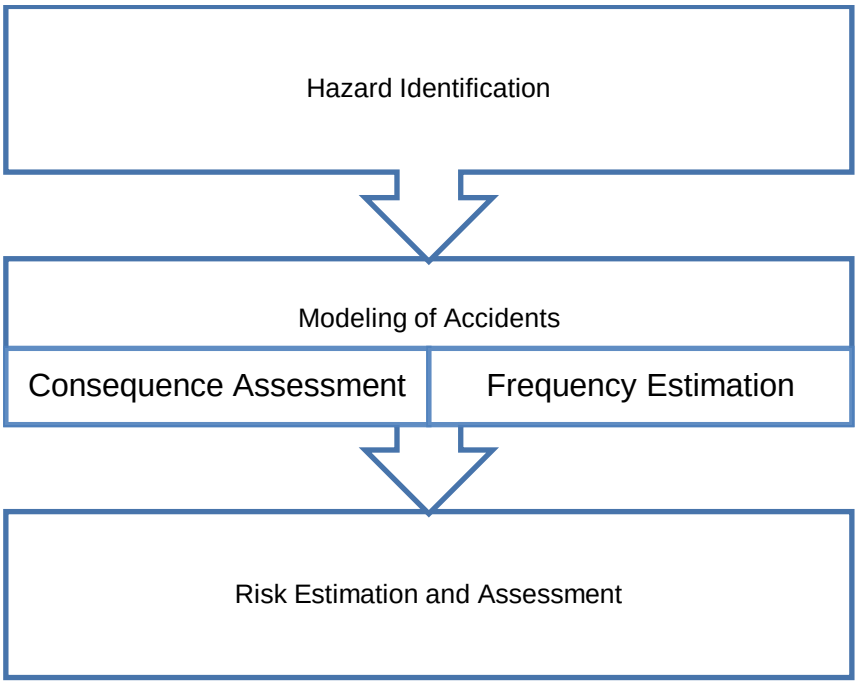


Figure 82. Overview of Quantitative Risk Assessment Procedure (IAEA, 1995)

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 71**.

Table 71. 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 $<60^0$C (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 65.6^oC, 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 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 to further disturbance of wildlife, loss of remaining habitats resulting to further decrease in biodiversity composition of the area. Trees in adjacent areas may either be damaged or removed.

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 7.62×10^{-5} and 3.45×10^{-5} 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.

b) Decrease/migration of faunal species

Further loss of vegetation cover as a result of land clearing may encourage movement/migration of wildlife species in the area aggravated by the loss of habitat and remaining sources of food for survival. Likewise, wildlife disturbance due to noise generated during construction brought about by the operation of heavy equipment's will force faunal species to migrate in other or nearby areas/habitat where disturbance is less.

c) Erosion/Siltation

The removal of vegetation cover will lead to the 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 sites. Similarly, alteration of land topography may result in heavy influx of surface run-off waters resulting to erosion in the uncovered surfaces and siltation downstream of the 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. 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".

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) Prohibition of wildlife poaching/collection

The proponent should also ensure that its employees must be prohibited/warned/informed not to engage in any mode of wildlife collection and/or hunting for the conservation and protection of remaining wildlife species. Promote wildlife protection using innovative means such as putting up of warning signage's on strategic areas for public information and warning.

c) 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, engineering technology, silt traps or sedimentation basin leading to water bodies is encourage to minimize siltation.

d) 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 City Agriculture Office (CAO).

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.

6.1.2 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.

Installation of air pollution control device for the batching plant is necessary. It is a general practice to install the dust collector and cement dust filter on the top of the cement warehouse in order to reduce the dust pollution.

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 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.

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.

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 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. 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.

Table 72 presents the Impact Management Plan and enhancement measures in each type of activity.

Table 72. Impact Management Plan

Project Phase	Environmental Component Likely to be Affected	Potential Impact	Options for Prevention or Mitigation or Enhancement	Responsible Entity	Cost	Guarantee/ Financial Arrangements
I. Pre-Construction Phase	This will be addressed during implementation of RAP as resettlement is expected to be done prior to project implementation or prior to construction.					
	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
II. Construction Phase						
Environmental Aspect # 1	The Land	Change in land use Destabilization of slope	• Set-up temporary fence around the construction area • Conduct slope stability analysis and construct silt trap and spoils disposal area	Proponent/ Contractors	Included in the Construction cost	ECC

		Removal of vegetation and habitat disturbance Soil erosion Increase run off	• 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.			
		Traffic congestion	• Preparation and implementation of traffic management scheme			
		Landslide: - The study area has low to moderate	• Assess the stability of slope during construction and long-term conditions;			

		susceptibility to landslide	• Study the effect of seismic loadings on the slope and road embankment.			
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 and suspended solids	• 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	• 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 especially during day time only	Proponent/ Contractors	Included in the operating cost	ECC

		vehicles and equipment				
Environmental Aspect # 4	The People	• Increase in livelihood and business opportunities • Increase in revenues • Provide job opportunities for construction workers • Health Risk	• Alleviate economy and generation of income to hosts and nearby barangays • Increased LGU revenues resulting from the purchase of locally available materials and equipment for construction, translating to additional taxes. Business establishments should be properly registered and payment of the required taxes shall be monitored. • The construction of the project will generate employment opportunities for local residents as well as migrant workers. It will bring increased income to those who will be employed. Local manpower may have to compete with migrant labor for employment. Employment of local residents during the construction stage shall be given priority, particularly those from families in the Direct Impact Area. • Use of appropriate PPE and proper training of workers	Proponent	Included in the operating cost	ECC

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	Proponent/ Operator / Contractors	Included in the Operating cost	ECC

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

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.						
IV. 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 23 stakeholders' meetings were held for SP 7. 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 three municipal conference of Marantao, Piagapo, and Saguiaran; and Bagong Bayan Hall in Marawi City with the affected stakeholders, barangay and city/municipal officials, and concerned LGU offices such as Assessors, MPDC as shown in **Table 73**. These meetings were attended by a total of 346 participants (Male-390 and Female-118).

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 74**.

1st Public Consultation

a) Affecting existing road will be upgrade to the standard of SP7;
b) Conduct ocular inspection for the exact affected barangays in Marawi city;
c) Boundaries of barangays are not accurate
d) Value of payment for the property, land, crops and among others are the same with other barangays;
e) Schedule of the payment of the affected by the road project;
f) Who will shoulder the ROW payment;
g) What will happen to the landowner without land titles and proof of ownership;
h) Realignment of proposed road to avoid the Muslim Cemetery and less affected households;
i) Marantao to include the neglected provincial road adjacent to SP7;;
j) Final alignment of proposed road;
k) What happen to the affected land, properties, tress and fruit bearings;
l) Necessary documents for claims and compensations; and
m) Work force from the affected communities.

2nd Public Consultation

a) Former Mayor of Marantao requested copy of implementation schedule of Marawi Ring Road project for their monitoring on the status of the progress of the project;
b) Brgy. Palao Ranaranao, utilized and align the proposed road project to the existing road to avoid the possible removal of properties or structures, and displacement of family. The proposed project is far from the community and the community could not benefit the proposed road;
c) Brgy. Daaningud, overlapping of ongoing 600 meters road construction with the proposed SP7;
d) Brgy. Matampay, realigned the SP7 along the barangay center were more communities can benefit;
e) Brgy. Bacong, Saguiaran, requested realignment of the road near the spring source beside mosque;
f) Brgy. Pagalamatan, Saguiaran, requested realignment to avoid the two storey new constructed HS building;
g) Brgy. Bagoingud, Saguiaran, requested realignment to avoid the Muslim cemetery at Sta. 7+800 to 7+900; and cultural heritage of Datu Ambiong at Sta. 8+200 to 8+300;

h) Saguiaran, realignment to NPC compound to avoid damage of property and land which is the source of income of the owner;
i) Barangay Chairman Ramal Panacawan, ABC President of Piagapo, informed the team that Abaca is the major source of income of the affected community, particularly Barangay Paling; portion of the alignment will affect the Abaca Plantation within the barangay;
j) Mr. Jamal Mague, Private Sector of Barangay Ratian, Piagapo, informed us that there are 9 reservoir and source that will be affected by the road alignment; and might cause of shortage water supply;
k) Piagapo, who will file for the clearance of cutting trees;
l) Compensate the affected owner prior the implementation to avoid problems;
m) Marawi, difference of ring road project and transition road project because he is not aware on the two ongoing study;
n) Marawi, value of the affected land, crops and property will be the same from the other barangays and municipalities; and
o) Necessary documents for claims and compensations.

During the 1st public consultations, the women's emphasized the importance of proper compensation for the affected landowners and livelihood projects for extra income during construction. While in 2nd Public Consultation, some requested realignment on the affected Muslim cemetery and cultural heritage of Datu Ambiong and ensure that compensation and coordination to affected people be undertaken.

Table 73. CONTENTS OF STAKEHOLDER MEETING MUNICIPAL LEVEL

Date (venues)	Objectives of the meeting	Major Agenda	Participants	No. of Participants
1st Public Consultations 1. Jan 15, 2018, Marawi City Bagong Bayan Hall 2. Jan. 15, 2018, Saguiaran Session Hall 3. Jan. 16, 2018, Piagapo ABC Hall 4. Jan. 17, 2018, Municipal Conference Hall in Marantao **2nd Public Consultations** 1. March 7, 2018, Municipal Conference Hall in Marantao 2. March 7, 2018,	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	**1st Public Consultation** Marawi: Male – 53, Female – 19 Saguiaran: Male – 60, Female - 25 Piagapo: Male – 40, Female - 21 Marantao: Male – 57, Female - 31 **2nd Public Consultation** Marantao: Male – 56, Female - 11 Saguiaran: Male – 56, Female – 30 Piagapo: Male – 39, Female - 24 Marawi: Male – 29, Female – 20

Date (venues)	Objectives of the meeting	Major Agenda	Participants	No. of Participants
Saguiaran Session Hall 3. March 8, 2018, Piagapo Training Center 4. March 8, 2018, Bagong Bayan Marawi City Hall				

Table 74. MAJOR OPINIONS IN STAKEHOLDER MEETINGS MUNICIPAL LEVEL

Date and Objectives	Agenda	Item on EIA		Major Opinion	Answers (RAP, and JICA Survey Team's answers has been accepted and understood basically)
1st Public Consultations Jan. 15 to 18, 2018 Information Education and Communication (IEC) in accordance with	1. Introduce the project and discuss the project objectives and the benefits that can be derived. 2. EIA and RAP Process	Socio/ The People	Infrastructures (Alignment/Boundaries)	1. (Chairman Yashier P. Batabor, Rorogagus East, Marawi) Does the affected existing road will be upgrade because this existing road was constructed by NPC year 1985. Base on the presented alignment, there are missing barangays like Rorogagus Proper if the alignment will traverse the Rorogagus bridge.	1. No. It a new project. This is an initial road alignment and will be validated during ocular and field work. There will be a geotagging and survey to determine the affected land and properties, and barangays.

Date and Objectives	Agenda	Item on EIA		Major Opinion	Answers (RAP, and JICA Survey Team's answers has been accepted and understood basically)
Philippines EIA Guidelines	3. Tentative Schedules 4. Solicit queries, comments, concerns and suggestions on the project			2. (Chairwoman Ozamah Macabagan, ABC President / Barangay Kilala, Marawi) I would suggest to conduct ocular inspection before the inventory so that the affected barangays will know especially those who are not present today and not included in the shown map. You must coordinate to MPDC the data to be used before the barangay scoping.	2. This shown map is just an initial alignment and will be validated on-site. Those barangays mentioned that are not shown in the alignment will be verified. Barangays will still need to be validated. Those barangays present during the 1st public consultation but will not be included after the inventory will still benefit the proposed road. Our data will be gathered from Municipal and Provincial Assessors, DENR and DPWH ARMM offices, and overlay this to the proposed road alignment. From this data, the affected barangays can be verified.
				3. (Mr. Sadick Mohammad, LGU Marawi Consultant) Does the presented road alignment feasible? I suggest to use the land use map to finalize the alignment. The value for payment of land and other property is the same?	3. This alignment is subject for validation.

Date and Objectives	Agenda	Item on EIA		Major Opinion	Answers (RAP, and JICA Survey Team's answers has been accepted and understood basically)
					We will gather data and use the prevailing price.
				4. (Chairman Yashier P. Batabor, Rorogagus East, Marawi) I would suggest to conduct ocular inspections along the road alignment.	4. Before the ocular inspection, we still need to gather data to establish the political boundary. We will be coordinating with the affected barangays and ask assistance from the barangay officials during the inventory. This will also include the current value of the materials to be used for the cost estimates.
				5. (Mr. Sadick Mohammad, LGU Marawi Consultant) I would suggest to clarify the classifications (functions and administrative) of the road.	5. This will be noted.
				6. (Saguiaran - Engr. Delion G. Binumbanan, DPWH ARMM) Did you check on the location of NPC compound near Somrorang road which will be affected by the proposed road alignment?	6. The team will conduct an inventory and mapping on January 22, 2018 and validate if the NPC compound will be affected.
				7. (Engr. Aga A. Sampal, MPDC Saguiaran) The boundaries of the barangays are not accurate.	7. This will be validated on site. Barangays will still need to be validated. Those barangays that are included in the list and 1st public

Date and Objectives	Agenda	Item on EIA		Major Opinion	Answers (RAP, and JICA Survey Team's answers has been accepted and understood basically)
					consultation, but will not be traversed in the alignment after the inventory would still benefit the proposed road. They can still use this to transport products easily from farm to market.
			Peace and Order	8. (Mr. Jamal Mague, Private Sector of Barangay Bubo, Piagapo) In Lanao del Sur and Norte are also affected and suffered by terrorism attacked in Islamic City of Marawi. I would like to suggest that during construction, the contractors should hire locals from Piagapo Municipality.	8. Job opportunities which will benefit the locals especially the affected barangays are included in the documentation of EIA. Local hires are priority in the project to be screened thru DPWH and Municipality. Locals should be suitable to the needed skilled workers of DPWH. Minimum age requirement is 18 years old and above. Not only local workers can benefit the project but all the residents. Like for example in Pigcawayan, the women's organization requested to have eatery for the construction worker during construction of the road.

			Properties	9. (Chairman Maning C. Dalupan, ABC President and Brgy. Chairman of Bago-Ingud, Saguiaran) Is the price of lot same? Because the problem of Maranao has no land title, we can only provide assistance to the group. We avoid to be the fore front of the project to avoid political issues. We will be wise on the claims of the affected lot owners because the past road projects of the government are not paid until now. What will be the schedule of payment?	9. Our data will be gathered from Municipal and Provincial Assessors, DENR and DPWH ARMM offices, the prevailing price will be used. This will be computed considering the factor value of the properties and among others. DPWH have regulations/guidelines that are following regarding land without title. Legal documents are necessary to be eligible for land compensation. Assistance of the LGU in this matter is necessary The results of the RAP will be submitted to DPWH National and Region. They will validate the results considering the basis of the prices and estimates. We will recommend to compensate the affected properties and lots before the start of the civil works. This payment will be used by the affected owners for their expenses on rentals or relocations. The DPWH as the implementing agency will handle all the payments.

Date and Objectives	Agenda	Item on EIA		Major Opinion	Answers (RAP, and JICA Survey Team's answers has been accepted and understood basically)
				Who will shoulder the payment of the Right-of-way (ROW)?	The proponent of this ring road project is DPWH. The expenses of the implementation will be loan to JICA. During implementation, if you notice problems, you can file complaints to the Mayor's office because he is member of the steering committee of the project. JICA contracted consultants to make sure that the ECC requirements will be gathered and documented.
				10. (Engr. Aga A. Sampal, MPDC Saguiaran) The project will be implemented within schedule if this project will be handled by LGU to shorten the procurement process. One problem we foresee is no land titles because majority are not paying taxes. How do we determine if he/she is the legal owner of the properties and lot? Mr. Basarie Dicamaling, Municipal Assessor, In addition to the questions of MPDC, can you assist us in the survey of the affected	10. We will gather data and inventory on the affected lot, properties among others. We will be coordinating with the barangay officials during the inventory and request assistance to help us certify that they are the owners of the lot and properties along the alignment. The results will be submitted to JICA and DPWH National. They will validate and will study on how to compensate those without land titles.

Date and Objectives	Agenda	Item on EIA		Major Opinion	Answers (RAP, and JICA Survey Team's answers has been accepted and understood basically)
				lots because the owners cannot afford the Php 20,000 for the payment of the survey. Can you include this survey in your study so that we can also help and support the study team on the tax map? We are requesting that this can have a land title because our existing Tax maps are from year 1970s.	Our framework basis is the PD29 – since birth or more than 30 years of residences, and will be certified by barangay officials thru barangay resolutions. All alienable and disposable land can be compensated but the lots that are declared as military reserves will not be considered. We can use the cadastral map from DENR and data from provincial assessors to validate our inventory. The results of FS stage will be validated during the Detailed Engineering Design (DED) stage. The role of the barangay officials will be needed during the inventory to identify and certify the land owners. Because the land survey is not part of the TOR. If you have problems on the presented inventory results to those without land titles, barangay official should find a solutions to avoid delays of the project. Barangays will issue resolutions to

Date and Objectives	Agenda	Item on EIA		Major Opinion	Answers (RAP, and JICA Survey Team's answers has been accepted and understood basically)
					support the inventory results and will be certified by the Mayor's office. I would suggest that the LGUs should help the project to convince the affected land and property owner's.
				Piagapo Mayor Ali L. Sumandar was very thankful on having a road project in Piagapo. He would like to encourage his constituents to pay the taxes to avoid problems during payment and claims because the owners should provide proper documents such a tax declaration or land titles before the payment. Those affected lands without land titles especially lands within the military reservation will not be compensated if there is no tax declaration. This military reservation area will be claimed by the LGU and offer for free to the project.	

				11. (Dr. Mosib P. Sarip, MPDC Executive Secretary) Majority of our land here in Marantao without land titles, how this land can be compensated? LGU should serve as the prime holder to assist the landowner to secure land titles. If no land titles how this can be paid? The LGU is very concern on this matter.	11. RAP team will conduct inventory and identify the land owner with the supervision of the barangay officials. If there will be no land titles and tax declaration, we will request the barangay to certify that he/she is the land owner of the affected properties. The certification of the barangay will be certified by the Municipal Mayor and can be used to apply for a tax declaration in the Municipal assessor's office. Then the owner will apply a parcelary survey to secure land title. Additional documents to secure a land title will also need cost estimates and land area, with the aid of the LGUs. Landowner should have tax declaration in absence of land titles because this tax declaration will be the proper document to issue land title. Tax declaration is the basis for cost estimates because during Detailed Engineering Design (DED) the parcelary survey should be conducted to know the land area or properties will be affected by the proposed road alignment.

Date and Objectives	Agenda	Item on EIA		Major Opinion	Answers (RAP, and JICA Survey Team's answers has been accepted and understood basically)
				12. (Mr. Mosib D. Sarip, Exe. Secretary of MPDC) We would like to request to include in your study the neglected provincial road almost near the proposed road alignment.	12. Noted on the request.
				13. (Mr. Quirino M. Pangandaman, LGU Technical Staff) How much is the payment of the land. We will committed to help the study team and the project such as security for the development of the municipality and community so that we will not feel difficulties in our way of life. We are asking the group to have fair value of the land.	13. Regarding the payment of the land. We will consider the highest or prevailing price considering the gathered data and information from the Assessor, DENR, DPWH, and Provincial Offices.
				14. (Mr. Nurhussien V. Batoali, MPDO Marantao) Regarding the value of the land, I'm requesting the barangay officials to be the front and supervised during the inventory. The compensation of the road alignment is separate from land, crops, and properties and among others.	14. The value of the land in the area will be much higher if the road already available.
				(Administrator H. Datu Rascal Agama) We need your coordination and unity for this road project. A matter of meter, please provide the land for the road development. This road project will be the start of the development of the municipality. Barangay officials should supported/assisted the study team for Marantao. This road project is for all of us. If this road will be constructed, we don't have problem such emergency and transporting our product to other neighboring municipalities. Please coordinates those with problems of land titles. Forgot your relatives today, think for the future of the new generations because this road is for the development. We will support the project.	

Date and Objectives	Agenda	Item on EIA		Major Opinion	Answers (RAP, and JICA Survey Team's answers has been accepted and understood basically)
				(Chairman Saidamen Naga of Barangay Daaningud) This road project is a help and project from JAPAN. We will negotiate the affected landowners for this project to be implemented. We are very thankful to the study team and JICA to have this road project.	
				(Chairwoman Mamadra "Barang"Limbona of Barangay Matampay) Thank you to the speakers and consultants. For my constituents, we should help each other for the success of the road project. This project is for the development of the community, economy, and help for the farmers to transport their products to the market, peace and order, emergency and health. In our barangay, we are located in the remote area and this road project will be a big help all of us. Our access is always our problem. The current situation of our farmers is very difficult especially bringing their products to the market. We from Barangay Matampay will support and help the road project. We will do our best to resolve any problems because this road project will help our community.	
2nd Public Consultations March 7-8, 2018 Information Education and Communication (IEC) in accordance with Philippines EIA Guidelines	1. To present and validate the results of environmental impact assessment	Monitoring		1. (Former Mayor Mohammadali Abboh Abinal, Marantao) Stated to provide copy of the proposal for SP7 so that the LGU can monitor the status of the project. Because for so many years, the municipality is blind on the progress of the municipality, particularly road projects from the Provincial Government and DPWH.	1. Being part of the steering committee of SP7, the requested will be noted and recommended to the proponent.
		Land	Properties	2. (Mr. Waida Abbas, Piagapo) Who will file for the clearance of cutting trees?	10. The team explained that the contractor of DPWH will file for the clearance during the implementation.

Date and Objectives	Agenda	Item on EIA		Major Opinion	Answers (RAP, and JICA Survey Team's answers has been accepted and understood basically)
		Socio/The People	Infrastructure (alighnment)	3. (Kagawad Rabat Omar, Barangay Palao Ranaranao, Marantao) Can we utilized and align the proposed road project to the existing road to avoid the possible removal of properties or structures, and displacement of family. The proposed project is far from the community and the community could not benefit the proposed road.	2. The concerns will be noted and recommended to the proponent
				4. (Chairman Saidamen Naga of Barangay Daaningud, Marantao)He informed us that there is an on-going 600 meters road from Brgy. Bacong which is now 300 meters completed. There will be an overlapping to the proposed SP7. Can we negotiate with DPWH to utilize the budget to other road project.	3. DPWH explained that this will be validated. The ROW standard of JICA will still be consider during the implementation.
				5. (Chairwoman Mamadra "Barang"Limbona of Barangay Matampay, Marantao) She stated that the Provincial Engineering Office (PEO) of Lanao del Sur visited the area and conducted a survey using drone camera last week. She added that the PEO team mentioned that Governor instructed them to inspect the realignment of the ring road project (four alternatives). She further added that the current alignment of the road is not beneficial to the community of barangay Matampay, and ask on the status of the conducted site visit of PEO team.	4. The team explained that there are four alternatives for SP7. The alignment showed is the most viable and recommended by JICA and DPWH base on their assessment. Also, the team informed the chairwoman that the concerns will be noted and part of the recommendations to the proponent.

Date and Objectives	Agenda	Item on EIA		Major Opinion	Answers (RAP, and JICA Survey Team's answers has been accepted and understood basically)
			Properties	6. (Mr. Khalid D. Rasuman, Saguiaran) He explained that he is the local guide during the RAP survey. He's concerns are the following: 8) Brgy. Bacong – possible alignment of spring source beside mosque; 9) Brgy. Pagalamatan – Affected two storey new constructed High School building; and 10) Brgy. Bagoingud – Realign the proposed road to avoid the cemetery (between sta. 7+800 to 7+900) and the cultural heritage of Datu Ambiong Compound (between stat. 8+200 to 8+300).	5 This will be clarified and subject for verification with RAP team, and further recommendation with the proponent.
				7. (Barangay Chairman Faharodin Ampuan, Brgy. Mipaga Saguiaran) Requested to realign the road to NPC compound to avoid damage of property and utilize the land which is the source of income of the owner.	6. The concerns will be noted and recommended to the proponent.
				8. (Barangay Chairman Ramal Panacawan, ABC President, Piagapo) He informed the team that Abaca is the major source of income of the affected community, particularly Barangay Paling; portion of the alignment will affect the Abaca Plantation within the barangay.	7. Affected crops will be compensated. The concerns will be noted and recommended to the proponent.
				(Mayor Ali Sumandar, Piagapo) He mentioned that Piagapo is the major provider of the whole Lanao del Sur.	
				(Mayor Ali Sumandar, Piagapo) He reminded the participants to apply for a tax declaration to avoid issues and problems during the negotiation process of compensation. The tax from January 2018 onwards should be paid to obtain a tax declaration.	

Date and Objectives	Agenda	Item on EIA		Major Opinion	Answers (RAP, and JICA Survey Team's answers has been accepted and understood basically)
				9. (Ms. Nor-asin Abdulrahim, Piagapo) She is not affected on the road alignment but ask if she also avail the above mentioned including the survey.	9. DENR CENRO Mangorak Macaunog said that owner should file so that you can claim amnesty for the property to received compensation.
				10. Barangay Chairman Adelaidah Decampong of Brgy. Papandayan Caniogan, Marawi requested to compensate the affected owner prior the implementation to avoid problems.	12. This will be noted and recommended to the proponent.
			Utilities	11. (Mr. Jamal Mague, Private Sector of Barangay Ratian) He informed us that there are 9 reservoir and source that will be affected by the road alignment; and might cause of shortage water supply.	8. DPWH explained that this concern will be subject for verification based on the results of the RAP survey, and will be informed the community on the results and recommendations.
			Livelihood	12. Mr. Kharis Miranda mentioned on the recommendations of livelihood program for the women/housewifes.	11. Mayor Sumandar suggested that all of the concerns will be should be informed to the barangays official so that this will be included in our monthly sessions.

Date and Objectives	Agenda	Item on EIA		Major Opinion	Answers (RAP, and JICA Survey Team's answers has been accepted and understood basically)
		Project details		13. (Mr. Talib Canayat, Marawi) Why Japan and not China is the funding agency of the project?	13. The team explained that the project is a national highway and the project proponent is DPWH Central Office. JICA has been supporting not only Philippines in rehabilitation and construction of road and bridges. We are very blessed that JICA include Lanao del Sur to be part of the master plan of the construction of new road network throughout the Philippines
				14. Engr. Zaiton Solaiman, Chief of City Planning & Design of Marawi inquired on the difference of ring road project and transition road project because he is not aware on the two ongoing study.	14. The team explained that they different project.
				15. Barangay Chairwoman Junaid Awar of Marawi inquired if the value of the affected land, crops and property will be the same from the other barangays and municipalities.	15. The team explained that the value will be the same; whatever is higher and acceptable to the community.

Pictures and attendance sheets are hereto attached in Annex 13.5.

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 purpose of the SDF is to identify the doable supports of the Project to the Host Barangays subject to the company's policy on community services and according to the priorities within the Project's vicinity. It shall cover the construction, operation and abandonment phase of the project.

Below is a summary of DPWH's community relations and development programs. **Table 70** 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 75. 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 76 presents the summary of DPWH's SDF plans and framework.

Table 76. 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)	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)	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)

d] Supplemental feeding program for malnourished children e] Assistance to senior citizens and persons with disability					
4. Education & Recreation	1. Barangay Kagawad for Education/SK; Barangay PTA 2. Project affected families	Department of Education ▪ Scholarship program for qualified students ▪ Literacy programs & non-formal education programs 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, or pastor of different denomination	Parish Priest for Catholics or Pastor for Non-Catholics and Non-Muslims	Community Relations Officer (CRO)	Construction Operation	LGU/ DPWH (according to the budget in table)
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 77** describes the IEC Plan/Framework of the company.

Table 77. 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 78** 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 78. – 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					
			METHOD	FREQUENCY	LOCATION			EQPL Range			Mgt. Measures		
								Alert	Action	Limit	Alert	Action	Limit
CONSTRUCTION PHASE													
Environmental Aspect	Fresh Surface Water Quality Stations: Agus River Lake Lanao 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,		Daily	Construction site / SW storage area	PCO	600,000			RA 9003			RA 9003

		biodegradable wastes											
	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

9.2.25 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.

9.2.26 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.

9.2.27 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

9.3.1 Management
9.3.2 Standard Setting

9.3.3 Occupational health and environmental control
- 9.3.3.1 Physical Hazards
  - 9.3.3.1.1 Ventilation
  - 9.3.3.1.2 Occupational Noise Exposure
- 9.3.3.2 Chemical Hazards
- 9.3.3.3 Biological Hazards

9.3.4 Hazardous Materials
- 9.3.4.1 Gases
- 9.3.4.2 Flammable Liquids and Combustible Materials
- 9.3.4.3 Solvents
- 9.3.4.4 Process Safety Management of Highly Hazardous Chemicals

9.3.5 Toxic and Hazardous Substances
9.3.6 Air Contaminants
9.3.7 Personal Protective Equipment
9.3.8 Hazard Communication
9.3.9 Hazardous Waste Operations and Emergency Response Procedures
9.3.10 Materials Handling and Storage
9.3.11 Medical and First Aid
9.3.12 Fire Protection
9.3.13 Electrical Safety
9.3.14 Mechanical and Machineries Safety
9.3.15 Training
9.3.16 Welfare
9.3.17 Information and Training for People Onsite
9.3.18 Consultation with People Onsite
9.3.19 Site Rules
9.3.20 Reporting of Accident Information
9.3.21 Safety Audit
9.3.22 Health and Safety Records
9.3.23 Information for Sub-contractors
9.3.24 Arrangements for Monitoring.

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
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 83** 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.

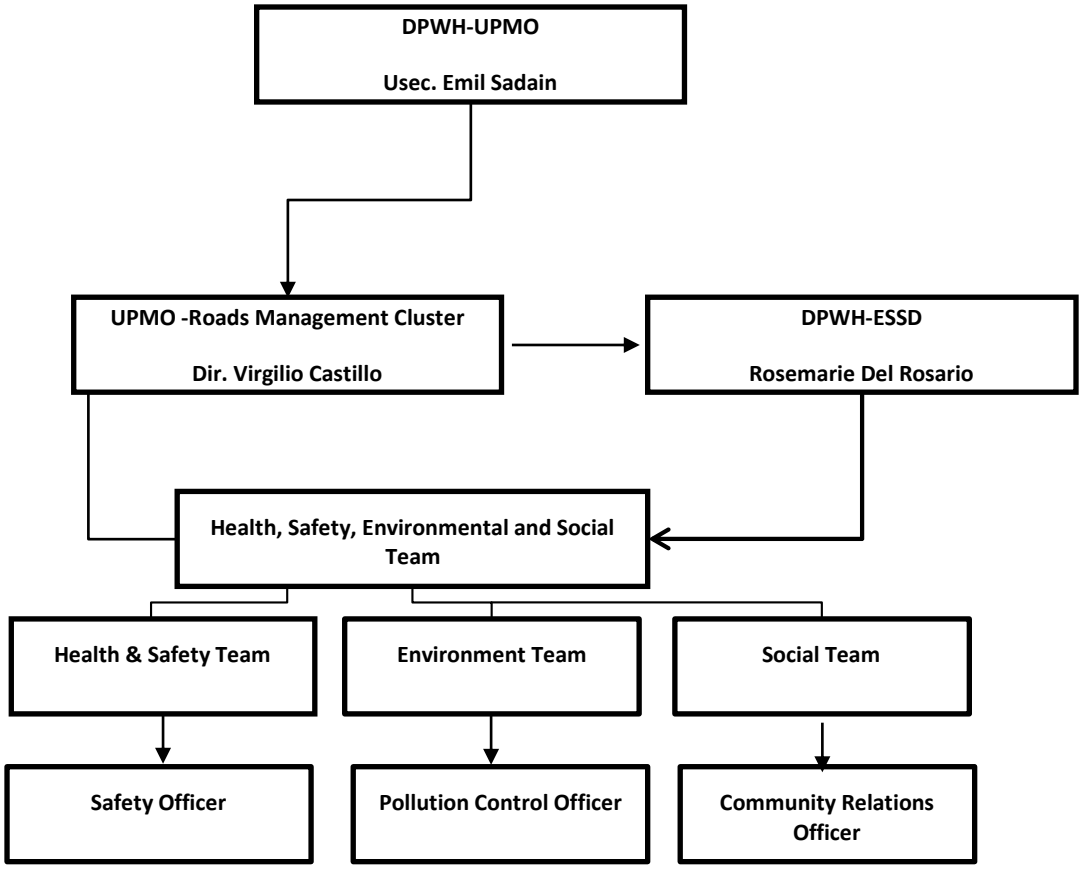


Figure 83. Organizational Chart of Environment & Social Team

Section 12

BIBLIOGRAPHY/REFERENCES

Baconguis, S., D. Cabahug, and S. Alonzo-Pasicolan. (1990). Identification and inventory of Philippine forested-wetland resource. Forest Ecology and Management (33/34). Elsevier Science Publishers, NE. pp. 21-44.

Bird Life International. (2010). The BirdLife checklist of the birds of the world, with conservation status and taxonomic sources.

Canter, Larry W. Environmental Impact Assessment. McGraw-Hill Inc., 2nd Edition, 1996.

Convention on International Trade in Endangered Species of Wild Fauna and Flora, (2006) CITES-Listed Species Database, United Nation on Environmental Protection-WCMC, 3 October, 2006.

Department of Environment & Natural Resources, Department Administrative Order No. 2003-03 Revised Procedural Manual, Quezon City, 2003

Department of Environment and Natural Resources (DENR) Administrative Order No. 2007-01 otherwise known as "The National list of threatened Philippine plants and their categories, and the list of other wildlife species".

Encyclopedia of Forest Sciences. (2004). Publisher: Academic Press.; 1 edition (May 15, 2004)

Fernando, E. S. (1998), Inventory of Forest Plants in Subic Bay Metropolitan Authority, Philippines.

Fernando, E.S., et. al. (2008). Asia Life Science- The Asia International Journal of Life Sciences "Threatened Plant of the Philippines: Preliminary Assessment".

Interim Report of the Road Network Development Project in Conflict-Affected Areas in Mindanao

IUCN. 2017. IUCN Red List of Threatened Species. (ver. 2017.2)
Fernando, E.S. (1998). Forest formations and flora of the Philippines: Handout in FBS 21. (Unpublished)

Kennedy et. al. (2000). A Guide of the Birds of the Philippines. Publisher Oxford University Press; Publication City/Country Oxford

Lawrence, David P., Environmental Impact Assessment: Practical Solutions to Recurrent Problems, Wiley & Sons Inc. Publication, 2003.

Miras, M. P. (2014). Vegetation Analysis of the Secondary Forest in Caliraya-Lumot Watershed. Practicum Report. University of the Philippines, Los Baños

PAGASA, Climatological Normals in Philippine Synoptic Stations.

Philippine Statistics Authority (2015 National Census)

Shannon, C. E. and W. Weaver (1949). The Mathematical Theory of Communication. University of Illinois Press, Urbana, Illinois. 144pp

Simpson, E. H. (1949). Measurement of diversity. Nature, 163: 688.
Wildlife Conservation Society of the Philippines. (1997). Philippine Red Data Book: Red List of Threatened Animals, Makati City Bookmark, Inc.

Socio-Economic Profile/CLWUP of Municipalities of Marantao, Piagapo, Saguiaran and Islamic City of Marawi.

World Conservation Monitoring Centre. (2000). Global Biodiversity: Earth's living resources in the 21st century. By: Groombridge, B. and Jenkins, M.D. World Conservation Press, Cambridge.

2012 Municipal and City Level Poverty Estimates (2016)