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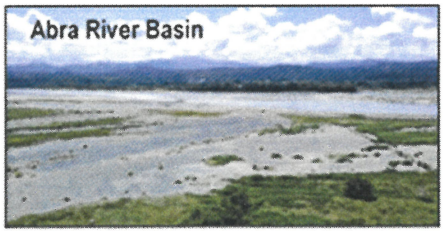
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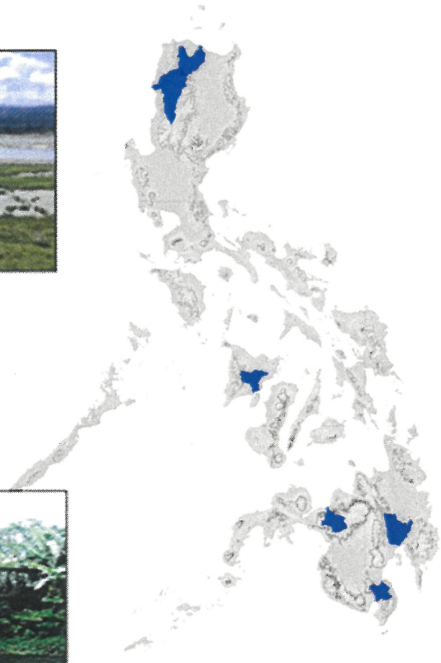
(ABRA, RANAO(AGUS) AND TAGUM-LIBUGANON RIVER BASINS)

September 30, 2021

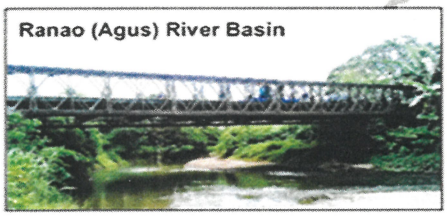
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Abbreviations

ADB	–	Asian Development Bank
BARMM	–	Bangsamoro Autonomous Region in Muslim Mindanao
BOD	–	Biological Oxygen Demand
CADT	–	Certificate of Ancestral Domain Title
CBFDRRM	–	community-based flood disaster risk reduction and management
CBFEWS	–	Community-Based Flood Early Warning System
CCA-DRRM	–	Climate Change Adaptation & Disaster Risk Reduction Management
CAD	–	Computer Assisted Design
CLUP	–	Comprehensive Land Use Planning
CDRA	–	Climate and Disaster Risk Assessment
CNC	–	Certificate of Non-Coverage
DAO	–	DENR Administrative Order
DED	–	Detailed Engineering Design
DENR	–	Department of Environment and Natural Resources
DEO	–	District Engineering Office
DGRC	–	District Grievance Redress Committee
DO	–	Dissolved Oxygen
DOF	–	Department of Finance
DOST	–	Department of Science and Technology
DPWH	–	Department of Public Works and Highways
DPWH-PMO	–	DPWH- Project Management Office
DSM	–	Digital Surface Model
DTM	–	Digital Terrain Model
ECA	–	Environmentally Critical Area
ECC	–	Environmental Compliance Certificate
ECP	–	Environmentally Critical Project
EHS	–	Environmental Health and Safety
EIA	–	Environmental Impact Assessment
EIS	–	Environmental Impact Statement
EMB	–	Environmental Management Bureau
EMP	–	Environmental Management Plan
ESRD	–	Environment, Social and ROW Division
EWS	–	Early Warning System
FFW	–	Flood Forecasting and Warning
FCMC	–	Flood Control Management Cluster
FRM	–	Flood Risk Management
FS	–	Feasibility Study
GIS	–	Geographical Information System
GRM	–	Grievance Redress Mechanism
ICC	–	Investment Coordination Committee
IEC	–	Information, Education and Communication
IEE	–	Initial Environmental Examination
IFC	–	International Finance Corporation
IFRM	–	Integrated Flood Risk Management
InFRA	–	Integrated Flood Resilience and Adaptation

IP	–	Indigenous Peoples
IPIF	–	Infrastructure Preparation and Innovation Facility
IRR	–	Implementing Rules and Regulations
IUCN	–	International Union for Conservation of Nature and Natural Resources
IWRM	–	Integrated Water Resources Management
JICA	–	Japan International Cooperation Agency
KEXIM	–	Korean Export & Import Bank
LARAP	–	Land Acquisition and Resettlement Action Plans
LGU	–	Local Government Unit
LIDAR	–	Light Detection and Ranging
MENRE	–	Ministry of Environment, Natural Resources and Energy
MGB	–	Mines and Geosciences Bureau
MIS	–	Management Information System
MPWH	–	Ministry of Public Works and Highway
NAAQGV	–	National Ambient Air Quality Guideline Values
NBS	–	Nature-Based Solutions
NCIP	–	National Commission on Indigenous Peoples
NDRRMC	–	National Disaster Risk Reduction and Management Council
NGP	–	National Greening Project
NIA	–	National Irrigation Administration
NIPAS	–	National Integrated Protected Area System
NOAH	–	Nationwide Operational Assessment of Hazards
NWRB	–	National Water Resources Board
NTP	–	Notice to Proceed
OCD	–	Office of Defense
ODA	–	Official Development Assistance
PAGASA	–	Philippine Atmospheric Geophysical and Astronomical Administration
PAP	–	project-affected-persons
PEISS	–	Philippines EIS System
PG-ENRO	–	Provincial Government, Environment and Natural Resources Office
PIP	–	Project Identification and Planning
PIU	–	Project Implementing Unit
PMO	–	Project Management Office
RARB	–	Ranao (Agus) River Basin
RBCO	–	River Basin Coordination Office
RBMC	–	River Basin Management Council
RBO	–	River Basin Organization
RCP	–	Representative Concentration Pathway
REA	–	Rapid Environmental Assessment
ROW	–	Right-of-Way
SPS	–	Safeguard Policy Statement
TRTA	–	Transaction Technical Assistance
UPMO	–	Unified Project Management Office

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(as of 15 April 2021)

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$1.00	=	₱52.136

NOTE

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EXECUTIVE SUMMARY

INTRODUCTION

1. The Integrated Flood Resilience and Adaptation (InFRA) Phase I, "the project," is proposed to reduce the flood risks in three (3) identified major river basins - Abra in Luzon, and Ranao (Agus) and Tagum-Libuganon in Mindanao by (i) improving flood risk management (FRM) planning through strengthening data acquisition and data management, and improving flood protection asset management; (ii) rehabilitating and constructing flood protection infrastructure; and (iii) raising community awareness, and preparing and implementing disaster (flood) risk reduction and management plans to reduce different groups' vulnerabilities.

2. The executing/implementing agency of the project is the Department of Public Works and Highways (DPWH) in collaboration with other related government agencies such as the Department of Environment and Natural Resources (DENR), Department of Interior and Local Government (DILG), Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA) as well as Local Government Units (LGUs).

OBJECTIVE OF THE INITIAL ENVIRONMENTAL EXAMINATION

3. The overall objective of this IEE is to provide guidance to DPWH, contractors, and operators on how to plan, build and operate the project in an environmentally sound manner. Specific objectives are to describe the proposed subproject interventions; describe the baseline natural and socio-economic resources in and surrounding the project areas; identify and assess potential significant impacts based on existing environmental conditions during project pre-construction, construction, and operation stages; identify and recommend appropriate mitigation measures to minimize any potential impacts caused by the subproject; develop environmental management plan and environmental monitoring plan including costs; describe grievance redress procedures under the subproject; and recommend institutional arrangement, including capacity building, to ensure proper environmental and social safeguards implementation during construction and operation phases.

PROJECT/SUBPROJECT OVERVIEW

4. Abra River Basin is located in the northern part of Luzon Island, and it lies in two regions: Cordillera Autonomous Region for over 90% of the area in the Provinces of Abra, Mountain Province and Benguet, and the remaining in Region I in Ilocos Sur Province. The basin area, for the purpose of this project, includes the whole river delta. The Abra River's main tributaries are Tineg River, with its sub-tributaries Binongan, Soot and Malanas, Ikmin, Bucloc and Manicbel Rivers and Baay River, all of them on its right bank, and Sinalang River on its left bank.

5. Both structural and non-structural investments shall be used in the flood management of ARB to mitigate flood hazards, alleviate exposure, and reduce flood vulnerability. The proposed structural interventions are of six types: river training structure; reinforce toe protections of new dikes; strengthen new bank protections; reinforcing existing protections; erosion protection; strengthen existing protections/ gabions/ spur dikes. Non-structural activities will comprise capacity building in the following topics: reforestation; early warning system; river basin management authority; regulation of mining and quarrying activities, maintenance and monitoring of key infrastructure; and building code and land use planning. For ARB, 22 structures were finalized in the FS. These are toe protection works on existing DPWH structures and spur dikes.

6. Tagum-Libuganon River Basin (TLRB) is located in Southern Mindanao, covering the eastern part of Region XI and extending over to the Caraga Region at Loreto, Agusan del Sur. Four provinces cover the TLRB: Davao del Norte, Davao del Sur, Davao de Oro (formerly known as Compostela Valley) and Agusan del Sur. Only three (3) barangays from Davao City are included in the river basin. The total river basin coverage is 3,258 km². The subproject uses a mix of 'Grey' and 'Green' infrastructures to manage the flood in the river basin. Grey infrastructures refer to the traditional engineering solutions by installing infrastructure (e.g. dikes, weirs, etc.) while green infrastructures pertain to Nature-based Solutions (NBS), which uses the natural environment in decreasing the flood risk. For TLRB, ten (10) priority structural investments are proposed within the river basin consisting of the development of new channels, enhancement of existing rivers and creeks, restoration of ancient meanders and providing associated mitigation measures for securing access to roads and bridges. Many are located in the downstream part of the river basin. Non-structural and other activities proposed for the river basin are: Output 1 is capacity building and developing the Strategic Flood Risk Management Planning, including the promotion of hydro-meteorological stations to enhance existing Warning Systems; and Output 3 focusing on the development of Community-Based Flood Risk Management Plans to raise community awareness and reduce vulnerability within the River Basin.

7. The Ranao (Agus) River Basin is located in the Provinces of Lanao del Norte and Lanao del Sur in the island of Mindanao. The Agus River traverses the Municipalities of Saguiaran in Lanao del Norte, Pantar, Matungao and Baloi in Lanao del Sur, and Iligan City. There are existing flood control works within the river basin funded by the National Government but have already been damaged during past typhoons and heavy rains. For RARB, 24 subprojects were finalized in the FS. Structures such as dikes, bank protections and road and bridge rehabilitations are proposed in the river basin. Dredging of river mouth going to Lake Lanao is also included. Non-structural activities include river management, early warning systems, and other capacity building.

POLICY, LEGAL, AND ADMINISTRATIVE FRAMEWORK

8. The policy and legal framework for environmental management for the overall project have been established in the Environmental Assessment and Review Framework of the InFRA. As per the framework, each component of the project shall comply with the ADB Safeguard Policy Statement (SPS, 2009) and with relevant legal and policy framework of the Philippine Government, such as the Philippine Environmental Impact Statement System. Relevant national policies and legislations, such as the Republic Act No. 11054, An Act Providing for the Organic Law for the Bangsamoro Autonomous Region in Muslim Mindanao (BARMM) in 2017, are further discussed in the main report under the same heading. International and multilateral environmental agreements to which the Philippines is a signatory are included.

DESCRIPTION OF THE ENVIRONMENT

Abra River Basin

9. The whole river basin is surrounded by steep-sloped mountains starting from the Banaoang Bridge (Zone 1) all the way to the headwaters of the Abra River in Benguet Province and Kalinga Provinces. Soil erosion and landslides have been happening way before the Flood Control Project had been implemented as evidenced by the braided river along the length of the river basin originating from a single bed waterway. The eastern divide hosts the highest point at 2000 meters above sea level (MASL) or higher and has the highest relief. To the western part, the relief is lower. The central part becomes rolling to moderately rugged with the highest elevation reaching only 500 MASL. Land cover/land use

in the Abra River Basin is mainly classified as brushlands, shrublands, and grasslands. Agriculture is the main activity in these brush/shrublands and grasslands while the rest are classified as open forest in the middle part, and closed forest at the northeast, east, and southeast part of the watershed at the ridges or border of the watershed. Built-up areas occupy a small portion of the river basin as also the barren lands. Other land cover/uses can be found at the river mouth in the deltaic portion of the basin, namely some mangrove forest, marshland swamp, and fishponds. Other parts of Abra, about 0.414% of the total land area, is covered by mining tenements as of December 2017.

10. Major rivers such as the Ikmin and the Tineg were classified as Class B waters and the Abra River was classified as Class A in 1976 (EMB Region I, 2019). The water quality of the Abra River ranges from clear at the upstream portion and in Tineg River to green because of algae in the water at the midstream to the lower part with silty and muddy substrates. Annual averages of the ten primary parameters monitored for CY 2019 were within the Water Quality Guideline for C Waters except some of the monitoring stations. The Fecal Coliform annual geometric mean of all monitoring stations, except SAN-1 (Quirino Bridge) station, did not meet the DENR water quality guideline of 200 MPN/100 ml.

11. Most of the areas in the ARB belong to Climatic Type I in the Modified Coronas Classification. Only a small portion at the eastern part of the watershed falls under Type II. The basin's annual rainfall varies approximately between 2,500 mm and 3,000 mm. Northern Luzon, where the ARB is located, is frequented by tropical cyclones, which mostly occur in the latter part of the year. Cyclones appear as early as April or May and lessen its occurrences by January. Air quality is considered fair since all parameters fall below the air quality standards.

12. The Balbalan-Balbalasang National Park is a protected area situated at the boundary of Abra and Kalinga Provinces. Flora and fauna with threatened status can be found within these PAs but they are not affected by the Project interventions. Worth noting are the invasive alien species and two endangered species of wildlife. A small population of Philippine Crocodile, a critically endangered species, is found in the remote reaches of the Tineg in the Binongan River, but nowhere within the subprojects. Plant invasive species have been identified also in the river such as the Water Hyacinth or Water Lily and the Water Lettuce. They have been in the ARB even before the Project implementation.

13. 487,651 people are living in the 37 municipalities and one city along the Abra River Basin. The largest numbers of inhabitants of the River Basin reside in Vigan City (pop. 52,230), Bangued, Abra (pop. 47,820), Bantay, Ilocos Sur (35,466), and the first-class municipality of Mankayan, Benguet (pop. 35,914). The most densely populated area of the basin is in Zone 1 which includes the whole delta, from Banaoang Bridge to the coastal area. Indigenous Cultural Communities within the ARB is 45% of the total population. The Province of Abra is covered by ancestral domains. The economy in Abra is basically agriculture-based. High-value agricultural crops grown in Abra include rice, corn, and vegetables. Other major crops are root crops, coffee, tobacco, and coconut. Cottage industries are also part of Abra's economy such as bamboo and rattan craft making, natural dye, loom weaving and embroidery. Sand and gravel operations, as well as mining, are ongoing in Abra. Small-scale mining is rampant in Licuan-Baay (Capcapo and Patok), Lacub (Magtalalang), Malibcong (Kotop), and at the boundary of Manabo and Boliney (Ableg). Tourism is another economy driver in Ilocos Sur.

Tagum-Libuganon River Basin

14. The Tagum-Libuganon River Basin (TLRB) covers a total area of 3,151 km². It is drained by three (3) main tributaries - the Tagum-Libuganon River (1,272 km²); the Saug River (1,075 km²); and the Tuganay River (804 km²). The rivers of the TLRB drain into the

Davao Gulf in the southern part of the basin. The Tagum-Libuganon River collects runoff from the hills of Kapalong and Talaingod, located in the northwestern part of the basin, with peak elevations higher than 1,000 masl. The remaining upstream areas, from north to east, do not exceed 500 masl. Only 10% of the TLRB presents elevations higher than 500 masl.

15. The western portion of the river basin is heavily forested, especially in the uplands, while the eastern side is more dedicated to agriculture. Most of the land use in TLRB are allocated to reforestation areas for timber production (37.87%), grasslands (3.24%), and wooded grasslands (34.62%). Agro-forestry (28.2%) is made up of perennial crops such as banana and fruit trees, mostly in plantations, which are two of the region's major agro-industry. Forestlands and agricultural lands of the basin are composed of shrubs occupying 15.4% and patches of built-up areas in the lowlands of the river basin. There are also the Ising Wetlands and the mangrove ecosystems at the lower and coastal areas of the TLRB.

16. Steeper areas (>18%) are dominant. The upstream presents large slopes and is likely to generate runoff and potential flash floods, and the downstream, delineated by the slope break, where it offers an area of expansion for runoff generated from upstream. The dominant soil type is sandy clay loam covering more than 45% of the TLRB. The project-affected waterbodies such as the Tagum-Libuganon River is Class C, Libuganon River as Class C, and Tuganay River as Class B. Ising River is an unclassified waterbody by the DENR XI. TSS, BOD, DO, and color are below the minimum standards. Ising, Tuganay, and Tagum-Libuganon, exceeded the set threshold for fecal coliform. The southern part of Mindanao does not register cyclones due to its low latitude. The Tagum-Libuganon River Basin belongs to Type IV climate where rainfall is evenly distributed throughout the year and has no pronounced dry season. Air quality is pegged within the 'good to fair range'.

17. Among the nine (9) protected areas and key biodiversity areas identified in the vicinity of the TLRB, two (2) are found within TLRB, three (3) are within the 10-km radius of the river basin, while the rest are outside the project area. DENR Region XI identified 35 faunal species that include two species of amphibians; 14 species of birds; six species of mammals; seven species of reptiles and six species of fish. Destruction of the natural habitat of these organisms has placed them under serious threat. Of the 35 species, seven species are categorized under endangered state (owl, hornbill, quail, monkey, wild pig, flying lemur and monitor lizard); six species are threatened (freshwater crab, eel, hawk, tikling-rail, flying lizard and Philippine king cobra); and three species are considered rare (civet cat, king fisher and Philippine oriole). Marine species of turtles and whales are also in their critical state. The municipality of Carmen is host to migratory bird species during the winter months of other countries. The Chinese Crested Tern (*Thalasseus bernsteini*), a critically endangered species and of international and global importance is a migratory species, that was sighted and first time recorded since 1905 in March 2019 in the coastal wetland feeding grounds of Carmen and Panabo City.

18. Tagum River drains into Davao Gulf, a key marine biodiversity area (KBA) that is home to cetaceans and marine turtles. Most of the vegetative cover in TLRB is concentrated in the western portion of the river basin as part of the mountain ranges of Bukidnon and Agusan del Sur. Tree species found within TLRB are almaciga, lanutan, molave, narra, red and white lauan, ulayan, yakal and other dipterocarps. Tree species such as yakal, red lauan and white lauan (almon and bagtikan) are critically endangered while narra is categorized as seriously threatened. Other flora species that thrive within the TLRB areas are agro-forest trees like rubber and fruit-bearing trees that abound in many areas of the river basin. Mangrove forests in Carmen are composed of 11 mangrove species while Tagum's mangrove forest cover is composed of 32 species (24 of which are true mangroves while 8 are associate mangrove species).

19. In 2015, of the 2,919,488 population of the cities and municipalities found in the TLRB, only 824,255 or 28.23% were the total barangay population (including those inside

and outside the TLRB). The biggest share is in Davao del Norte (687,047), followed by Compostela Valley (114,988) and Agusan del Sur (8,516). Within the Davao del Norte part of the TLRB, the most populous towns are Tagum City, with 158,462 inhabitants, and the Municipality of Santo Tomas, with 116,336 inhabitants. Mining, agribusiness and agriculture especially plantations of banana and fruit trees are the major drivers of development. Infrastructure development also contributed to the prosperity of the municipalities within the TLRB. Agriculture contributed most of the provincial income accounting for 63% or a total of PhP24.4 B followed by the industries sector (including mining) with PhP9.7 B at 25%, then the services sector with 6% or PhP2.5 B and tourism sector at 3% or with PhP1.0 B.

20. Basic elementary education is accessible to the school-going population of the TLRB. Access to secondary basic education is constrained by the limited number of schools. There are six (6) indigenous people (IP) tribes residing in the TLRB. They are the Manobo, Dibabawon, Mangguangan, Mansaka, Mandaya and the Ata-Manobo. There are seven (7) Certificate of Ancestral Domain Titles (CADTs) within the river basin that cover a total area of 161,059 hectares.

Ranao (Agus) River Basin

21. RARB watershed has a total area of 1,949.73 km^2 and consists of five (5) major subwatershed – Ramain, Taraka, Gata, Masiu, and Agus. The first four drain to Lanao Lake, while the Agus River is the outlet of Lanao Lake to Iligan Bay. RARB is divided into two (2) provinces, namely, Lanao del Norte and Lanao del Sur. There are a total of 31 municipalities and two (2) cities within the river basin.

22. Topography within the area is distributed quite evenly within 700 – 1,500 masl. Lanao Lake is located at around 700 masl elevation. Built-up areas cover less than two (2) percent, i.e., 2,744 has of the Ragao (Agus) River Basin's total land area of 198,710 has. Open and closed forest cover more than 42% while other wooded land, almost seven (7) percent. Cultivated lands cover more than 30%. Lanao Lake and other waterbodies cover over 18% of the basin. Slopes are evenly scattered across the river basin. The areas of Ditsaan-Ramain, Taraka, Poona Bayabao, Gata and Butig that are close to Lanao Lake, and parts of Baloi close to Agus River, are the areas with near-level slopes (0-3%). About 35% of the RARB is covered by mountain soils classified as "undifferentiated" soil types. The dominant soil type is clay loam with about 25% coverage, followed by clay (17 %) and sand (11%). The RARB intersects the Lanao Fault System on its northwestern section, responsible for an unusually shaped terrain.

23. Agus River has already been classified as Class C waters while Lake Lanao has been classified as Class A Water. Water quality parameters are within DENR Guideline Values for Class A Waters. The Provinces of Lanao del Sur and Lanao del Norte have a Type III Climate Type. Average minimum monthly rainfall is around 218 mm, while higest average maximum rainall is almost 428 mm. The island of Mindanao, however, is rarely affected by typhoon.

24. Lake Lanao Watershed Reservation is a declared protected area by virtue of Proclamation No. 871 Series of 1992 and is included in the initial components of Republic Act No. 7586, the NIPAS Act of 1992. There are five (5) other protected areas that are within and overlaps with the Lake Lanao Watershed Reservation. There are two (2) key biodiversity areas within the RARB, Lake Lanao and Mt. Piapayungan. Lake Lanao is also considered as one of 20 ancient lakes in the world.

25. Among the common hardwood species in the Lake Lanao sub-watersheds are almon, bagtikan, kalunti, mayapis, nato, red lauan, tangile, white lauan, apitong, bangkal, batikuling, bolong-eta, dalingdingan, ipil, kalumpit, kamagong and katmon. These species may be commonly seen in the Lake Lanao sub-watersheds but most are threatened or endangered based on DAO 2017-11. There are two (2) mangrove species that are

threatened based on IUCN Red List - *Avicennia rumphiana* and *Campostemon philippinense* BECC.

26. The IBAT result showed that there are 239 vulnerable, endangered and critically endangered species within the proximity of Ranao (Agus) River Basin. Out of the 239 species, around 36 species (15%) are land-based fauna that are either vulnerable, endangered or critically endangered. Most of the species are endemic to the Philippines. There are four (4) bird and one (1) mammal species that form part of the list of threatened species within the watershed. Eighteen (18) endemic cyprinid fish from the genus *Barbodes* are present in Lake Lanao. There is progressive decline of fish species within Lake Lanao since 1924, from 18 species to two (2) species (*P. (Barbodes) lindog* and *P. (Barbodes) tumba*). There are 41 species of freshwater crab that can be found in the lake, at least one of them is endemic.

27. The annual population growth rate across the River Basin was 2.02% bearing an increase of estimated 1.9 M in 2030. In terms of population density, in 2015 RARB has 424 persons per km^2. The cities/municipalities with high population densities are: Marawi City (3,652 persons per km^2), Tamparan (3,080 persons per km^2), Taraka (2,489 persons per km^2) and Binidayan (2,385 persons per km^2). The economy is highly dependent on agriculture, fishery and forestry where nearly 60% of the labor force is employed. The employment rate of Lanao del Norte (88.0%) is lower than the region (90.2%) but higher than the national level (87.8%).

28. The Maranaos or Meranaos of Lanao del Sur do not consider themselves indigenous peoples but ethnic minorities. However, there are indigenous communities who settled in Rogongon at Iligan City. They are the Higaonons in Rogongon. Rogongon is one of the 44 barangays of Iligan City. The provincial government has been exerting its best effort to promote its tourism industry, particularly in sports and ecotourism as its main focus.

IMPACTS AND MITIGATION MEASURES

29. The environmental impacts of the Project were comprehensively screened using parameters associated with flood control measures, project components and conditions of the Project's impact areas.

30. Pre-construction phase negative impacts are primarily associated with permanent land acquisition and associated loss of perennial and annual crops. A number of environmental management measures are also implemented in the pre-construction phase, including IEE and EMP updating (if necessary); incorporation of environmental mitigation measures into contractor's bidding documents, technical specifications, and contracts for civil constructions and equipment installations; assessment of suitability of dredged materials for reuse and appropriate disposal method if needed, implementation of the Grievance Redress Mechanism (GRM); training and capacity building.

31. The assessment of impacts of water diversion of river overflows in midstream to downstream has determined that current flood levels downstream of these new channels will not be aggravated. Other impacts of water diversion such as potential effect on fauna, groundwater, and social activities will not be significant.

32. The Project has also assessed that dredged materials are likely to be suitable for reuse as fill material. Based on a survey of possible contaminant sources, the assessment showed that mining activities are outside the watersheds and no industries that may be pollution sources are present.

33. The Project surveys indicated that there is no critical habitat, rare or endangered flora and fauna or areas of natural forest that will be affected in the three project sites. Although protected areas and Key Biodiversity Areas partially overlap with the boundaries of the river

basins, most structures entailing construction activities are found in the lower portions of the river basin, mostly in disturbed areas with significant settlements or agricultural activities. Good construction measures must be adopted to prevent unintended impacts.

34. Most of the project's potential environmental impacts are associated with the construction of the physical works. Overall, most physical works are small in scale, occurring within existing well-established areas in modified agricultural landscapes, mostly away from settlements and sensitive receptors. Potential negative construction phase environmental impacts are typical for dike construction, bridge and road works and include erosion; disposal of soil from channel construction and sediment from dredging; soil and water contamination from petroleum products and hazardous materials; construction and domestic wastes; air pollution from fugitive dust; hydrology (flow) impacts; impacts on protected areas, flora and fauna; community disturbance and safety; health and safety risks to workers and residents. These potential impacts are typically localized, short-term and small scale, and can be effectively mitigated through the application of appropriate good international construction practices and compliance with international guidelines. An Environment Management Plan has been prepared.

35. The operation phase is where the river basin will experience the effects of flood alleviation as a result of the design and construction of both structural and non-structural activities. This is also the phase where the river basin will be relieved of the detrimental effects of the construction phase. Some impacts that are anticipated in this phase are change in water levels and changes in river morphology and drainage. The DPWH District Engineer's Office will implement a Maintenance and Monitoring Plan to ensure that the subprojects meet the intended results.

PUBLIC CONSULTATION

36. Meaningful consultations were conducted in the three river basins. The concerns and issues raised by the communities and stakeholders are presented in this section. The discussion covered the subproject's structural and non-structural investments, environmental and social impacts, and resettlement and household surveys. Due to the current pandemic, adaptive methods of consultations were implemented. Online means were most often employed. Follow up consultations are planned.

GRIEVANCE REDRESS MECHANISM

37. A Grievance Redress Mechanism (GRM) has been prepared specific for the subproject to address any complaints, issues, and concerns from the project-affected-persons (PAPs) and other stakeholders. A GRM is part of project management aimed to increase accountability and responsiveness of project team members. The GRM is a process of receiving, evaluating and addressing the project-related concerns of stakeholders or PAPs.

ENVIRONMENTAL MANAGEMENT PLAN

38. The Environmental Management Plan (EMP) lists the courses of action to address the impacts identified in this report. It includes the summary of anticipated project's environmental impacts and corresponding mitigation measures, proposed monitoring plan, institutional arrangement, proposed capacity building requirement and budget for EMP implementation. The purpose of the EMP is to ensure that the implementation of the subproject activities is undertaken in a responsible manner with the objectives of: i) providing

guidance on how to address the environmental impacts identified; ii) identifying mitigating measures that could reduce impacts to minimal or insignificant levels; iii) outlining related monitoring and institutional arrangements; and iv) ensuring that safety recommendations are complied with.

CONCLUSIONS AND RECOMMENDATIONS

39. This project is classified as Category B under ADB Safeguard Policy Statement (2009) requirements. The environmental impact assessment for the project Integrated Flood Resilience and Adaptation (InFRA) - 1 shows that there will be overall moderate negative environmental impacts expected from the structural and other activities of this project. Most environmental impacts are deemed low to moderate, localized, and temporary, and can be addressed by mitigation measures in the Environment Management Plan. The potential downstream impacts associated with water diversion have been considered in the design of the structures and selection of alternatives. The mitigation measures presented addresses the transient, localized and temporary impacts of the subproject. Negative impacts that will be experienced during site works are mainly due to transient turbidity in rivers, dust, and noise emissions. Overall, the project's positive impact is the reduction in the intensity of flooding thereby reducing the impacts of floods on people and property.

40. To mitigate negative impacts arising from the Project, an Environmental Management Plan detailing mitigation measures, monitoring activities and responsibilities for implementation has been prepared as part of the IEE.

41. Public consultations involving affected people and local officials have been conducted through the Multi-Stakeholder Consultation Meetings in compliance with ADB's information disclosure and consultation requirements. Since inception and during Master plan stage, the project has already undergone several changes in structural and other activities that has significantly reduced the potential social impacts from displacement of residents and impacts of land disturbances on the environment.

42. DPWH will include the EMP in the bid and tender documents for civil works to ensure that the Project will be carried out consistent with the EMP which integrated both domestic and ADB requirements on environment, health and safety for preparation, construction and operation phase.

I. Project Description

43. The Philippine archipelago, on the western edge of the Pacific Ocean in South East Asia is in the direct path of seasonal typhoons which strikes regularly, the Luzon, Visayas and Northern Mindanao regions and brings subsequent flood disasters. The whole country is also subject to monsoon rains, which brings torrential rainfalls and flooding. The damages due to typhoons, strong wind, torrential rainfalls and landslides is significant and accounts for 2% of the Philippines national budget with high poverty incidence all over the country. More than 130 Million people were affected during the last 30 years with around $7.4 billion damages accounted which ranks the Philippines among the countries with the highest disaster risk and in the top 10 countries with the most people affected by disasters as per Office of Civil Defense records.

44. The Philippine Development Plan, 2017-2022 acknowledges that disaster and climate risks erode development gains and hamper the country's potential. The Philippine Disaster Risk Reduction and Management Act of 2010 empowers local stakeholders to directly engage in disaster risk reduction efforts, whilst recognizing the particular vulnerabilities of marginalized groups. The National Disaster Risk Reduction and Management Plan 2011-2028 covers four (4) thematic areas: (i) prevention and mitigation; (ii) preparedness; (iii) response; and (iv) rehabilitation and recovery. Following these plans, the Department of Public Works and Highways (DPWH) Strategy Map 2022 includes an outcome of lives and properties protected from natural disasters and two (2) outputs: (i) mitigating flood damage in major river basins and principal rivers and (ii) building climate-resilient structures in calamity prone areas.[1]

45. The Integrated Flood Resilience and Adaptation (InFRA) , "the project," is proposed to reduce the flood risks in three (3) identified major river basins - Abra in Luzon, and Ranao (Agus) and Tagum-Libuganon in Mindanao, by (i) improving flood risk management (FRM) planning through strengthening data acquisition and data management, and improving flood protection asset management; (ii) rehabilitating and constructing flood protection infrastructure; and (iii) raising community awareness, and preparing and implementing disaster (flood) risk reduction and management plans to reduce different groups' vulnerabilities.

46. The project has three component outputs:

i) Output 01 – Improvement of strategic flood risk management planning through (i) Capacity building of national government agencies enhanced, (ii) Hydro-meteorological system improved for strengthening planning and early flood warning in the three (3) major river basins, and (iii) Asset management information system for flood risk management (AMIS-FRM) developed and operationalized at national level.

ii) Output 02 – Development of flood protection infrastructures in three (3) major river basins (Abra, Ranao (Agus) and Tagum-Libuganon) by upgrading, rehabilitating and/or building priority flood protection infrastructures (e.g. diversion channels, dikes and spur dikes, river channel improvements, slope protections, and embankment protections) and nature-based solutions as proposed in the Feasibility Studies. Infrastructure design will factor in changes in hazard patterns due to climate change. It will also enjoin women's involvement in the workforce of the project's civil works. This project component is undertaken by the Joint Venture among EGIS (France), INCLAM (Spain), and KECC (South Korea) Consultants.

iii) Output 03 – Strengthening of community-based flood risk management by improving climate resilience of cities/municipalities in three (3) major river basins (Abra, Ranao (Agus) and Tagum-Libuganon) with high flood vulnerability through mainstreaming FRM in local development plans and building FRM capacities of LGUs and community people and supporting implementation of the community-based flood risk management activities which will complement, enhance and sustain the flood mitigation impact by the FRM infrastructure to be developed under Output 2. This project component is led by TRTA.

[1] Asian Development Bank. 2018.

47. The executing/implementing agency of the project is the Department of Public Works and Highways (DPWH) and the project preparation is being carried out through the technical assistance loan under the Output 2 of the Infrastructure Preparation and Innovation Facility (IPIF-2) which aims to prepare FRM master plans and to conduct feasibility studies and detailed engineering design of priority flood protection infrastructures for the originally targeted six major river basins on which flood control master plans have not yet been prepared.

48. This study presents the findings of the Initial Environmental Examination (IEE) for the proposed Integrated Flood Resilience and Adaptation (InFRA) project . The main objective of the IEE study is to identify and assess the potential impacts of the project life cycle of the proposed flood risk management project on the physical, biological, socioeconomic and cultural environment in order to inform the decision making and the project design to avoid and minimize the negative environmental consequences from the outset. For the residual impacts, The IEE will also recommend environmental mitigation and enhancement measures in the environmental management plan (EMP) for project implementation. The IEE/EMP has been prepared to meet guidelines and regulatory requirements of the Philippine Government as well as those of the ADB.

49. **Overall FRM Strategy.** Flood risk management master plans were previously prepared for the 3 river basins resulting in a recommended strategy for each basin. The strategies considered for the flood risk management consist of the following: (i) flood risks and potential damages can only be reduced and not entirely eliminated; (ii) uncertainties in the future conditions (e.g. land use changes and climate change) were factored in the design up to a certain margin; (iii) a combination of structural and non-structural measures were applied whenever suitable; (iv) designs that limit potential impacts particularly on the downstream areas were adopted; (v) multi-criteria analysis which incorporates not only economic aspects but also social, ecological, and biodiversity, were employed; (vi) cooperation among concerned stakeholders are promoted to ensure project success; and (vii) the room for the river approach is encouraged where the river is allowed to flow freely or with minimal disruption over its natural course.

50. **General Design Principles.** The project uses a mix of 'Grey' and 'Green' infrastructures to reduce the flood risks in the river basin. Grey infrastructures refer to the traditional engineering solutions by installing infrastructure (e.g. dikes, weirs, etc.) while green infrastructures pertain to nature-based solutions (NbS). Nature-based solutions use the natural environment in decreasing the flood risk while it also has additional benefits to the environment. Some of the subprojects include the decrease in climate change vulnerability of the local area, bank stabilization, carbon and water sequestration, improvement on food security and provision of livelihoods, and enhancement of cultural and aesthetic value.

51. The preliminary design of structures proposed for the river basin is based on the Design Guidelines, Criteria and Standards of DPWH. The design criteria employed is summarized in the next table and other design parameters are discussed in the Feasibility Study Report.

Table I-1 Design Criteria for River Basins

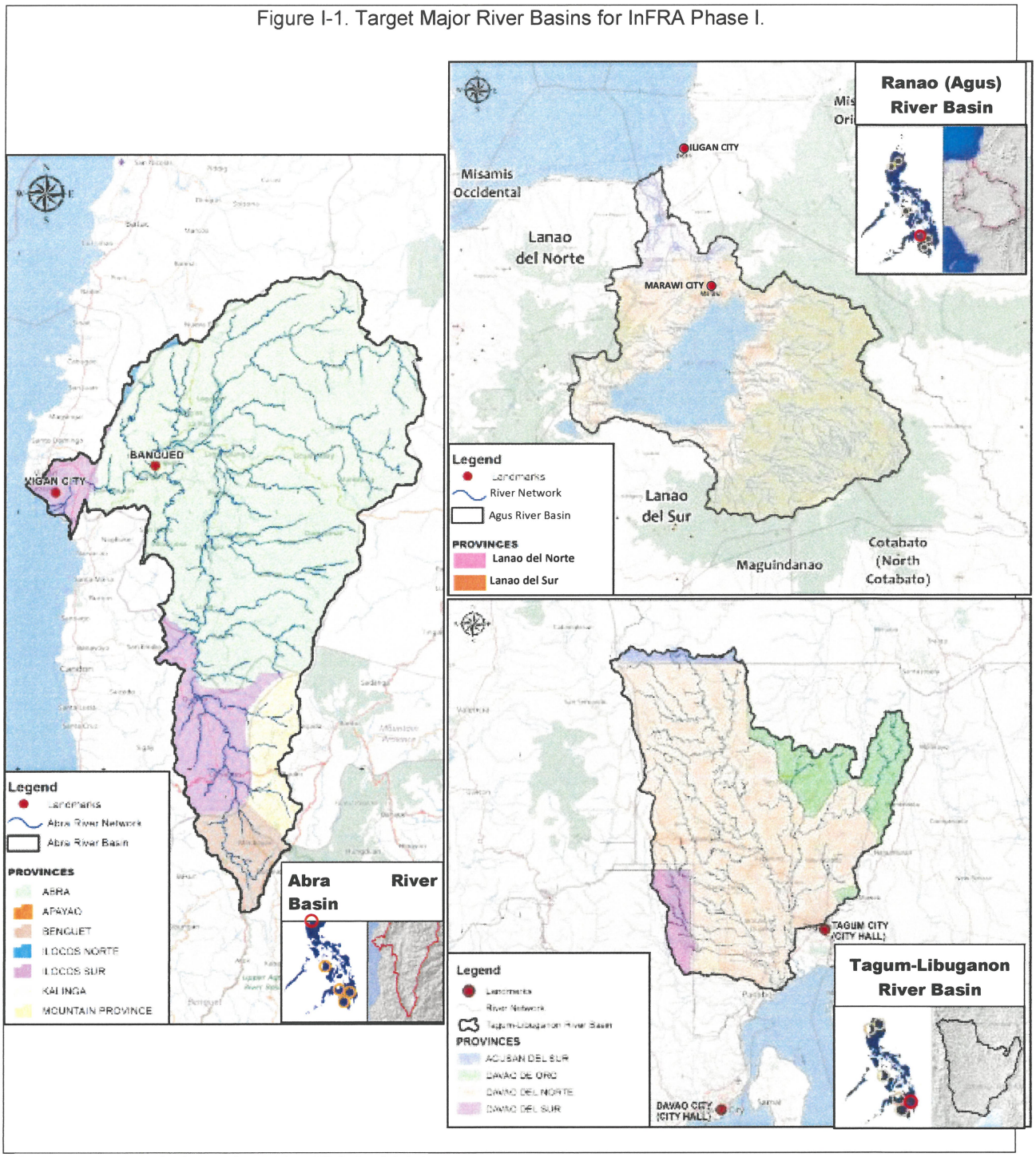
Criteria	Value
Design Return Period	50-years
Climate change	+10% rainfall + sea level rise
Freeboard (whichever is higher)	Minimum by DPWH DGCS 2015
	Q100 + Climate Change

52. **Community-Based Flood Risk Management** will be institutionalized to improve the upstream, midstream, and the downstream protection of the river basins. This project will implement capacity building activities on reforestation, agro-forestry, and conservation, riverbank stabilization through increased vegetation, regulation of mining, soil erosion control, management of nipa stands, improvement of solid waste management to reduce clogging of garbage in waterways, climate smart farming, and community early warning systems.

53. **Incorporation of Climate Change**. Climate change adaptation is incorporated into the structures by updating the hydraulic model with the additional 10% on the maximum rainfall. A

Climate Risk and Vulnerability Assessment (CRVA) was conducted as part of the master plan formulation. The results are presented in a separate report linked to the FS report.

Figure I-1. Target Major River Basins for InFRA Phase I.



Source : JV EGIS, INCLAM, KECC, 2021

Table I-2 Major River Basins Main Information

River Basin	Area (km^2)	Main streams	Area by Streams	Location	
				Region	Province
Abra	4 936	Abra River	3 381	Region I	Ilocos Sur
		Tineg River	1 555	CAR	Abra
				CAR	Benguet
				CAR	Mountain Province
Ranao (Agus)	1 949	Ramain River	199	Region X	Lanao del Norte
		Taraka River	291	BARMM	Lanao del Sur
		Gata River	237		
		Masiu River	346		
		Agus River	220		
Tagum-Libuganon	3 151	Tagum-Libuganon River	1 272	Region XI	Davao del Norte
		Saug River	1 075	Region XI	Davao de Oro
		Tuganay River	804	Region XI	Davao del Sur
				Region XIII	Agusan del Sur

Source : JV EGIS, INCLAM, KECC, 2019

A. Abra River Basin

1) Structural investment

54. The flood risk management strategies for ARB are carried out by zones based on its corresponding physical characteristics (geography, land use), hydraulic, and morphodynamic characteristics (flow regime, riverbed slope) to properly focus on the diverse problems in each area. Structural work include a barrier to flood waters, stabilizing and protecting banks from erosion, reorienting flow, or moderating sediment transport.

55. The summary of the selected and developed investments in the ARB is given in Table I-3.

Table I-3. Abra river basin summary of the type of protections per zone.

Zone/Municipality/Barangay	New	Type of Protection	Project Dimensions	NBS[1]
Zone 1 **Bantay - Banaoang Santa - Sacuyya Sur, Ampandula, Basug, Cabangaran, Manueva**		The project will provide protection from erosion to important assets such as agricultural lands and the Manila North Road by providing loose boulders/artificial blocks toe protection to the existing structures in Bantay and Santa using loose boulders or artificial blocks with the structure in Santa to be subjected to local repair.	Z1P0-RS-01 toe protection L = 1,650 m	1a
			Z1P0-RS-02 toe protection L = 2,200 m Z1P0-RS-02 section for repair L = 85 m	1a
Zone 2 **San Quintin - Poblacion**		Toe protections using loose boulders or artificial blocks to the existing gabion revetments protecting assets along the banks of San Quintin from erosion during heavier flows or due to meander evolution. The height of the existing gabion structure will be raised to 2.3m to ensure that the settlements and agricultural area in Poblacion are also protected from flooding. The existing height of the gabions of the upstream section is estimated to be 3.0m while the downstream section is an estimated 2.7m.	Z2P2-RS-02 toe protection L = 650 m Z2P2-RS-02 section for heightening L = 650 m	1a
Zone 3 **Langiden – Dalayap, Poblacion**		Toe protections against scouring using loose boulders or artificial blocks to strengthen existing bank protections in Langiden and Pidigan where villages and agricultural areas are found along banks which suffer from constant erosion. The concrete apron in Dalayap to be repaired and extended on both sides to ensure it covers the vulnerable banks in the municipality.	Z3P1-RS-01 toe protection L = 220 m	1a
Pidigan – Suyo, Pamutic, Poblacion West, Monggoc	✓*		Z3P1-RS-02 toe protection L = 450 m Z3P1-RS-02 section for repair L = 140 m Z3P1-RS-02 extension L = 310 m	1a
			Z3P2-RS-01 toe protection L = 1,320 m	1a
			Z3P2-SC2-02 17 spur dikes along 980 m of bank	
Bangued – Cabuloan, Santa Rosa	✓*	Two sets of spur dikes in Pidigan and Bangued to be carried out to distance the main channel from the bank and naturally refill it, thus protecting the large agricultural area and scattered houses in the floodplains.	Z3P3-SC2-01 28 spur dikes along 4,500 m of bank	
Zone 4 **Tayum – Deet, Gaddani La Paz – Mudeng**		Toe protections against scouring are proposed for the existing revetment protecting Deet and Gaddani located on the outside curve of the meander, and the set of existing spur dikes protecting a small urban area in Mudeng at risk to erosion. The existing structure in Tayum is to be locally repaired and heightened to prevent floods from overlowing into the urban area.	Z4P2-RS-01 toe protection L = 1,590 m Z4P2-RS-01 section for repair L = 365 m Z4P2-RS-01 section for heightening L = 1,125 m	1a
			Z4P3-RS-03 toe protection L= 865 m	1a
Zone 6 **Lagangilang - Aguet, Balais, Lagben**		Toe protections against scouring using loose boulders or artificial blocks are proposed for the existing gabion revetment in Aguet, Balais, and Lagben as well as for the existing bank protections in Banglolao and Labon to ensure that the most populated areas and agricultural land in Lagangilang and Bucay are protected from erosion.	Z6P1-RS-01 toe protection L = 2,480 m Z6P1-RS-01 section for repair L = 55 m Z6P1-RS-01 extension L = 95 m Z6P1-RS-01 section for heightening L = 1,590 m	1a
Bucay - San Miguel,			Z6P2-RS-01 toe protection L = 1,250 m	1a

Zone/Municipality/Barangay	New	Type of Protection	Project Dimensions	NBS[1]
Labon, North Poblacion, Abang, Banglolao		The gabion protection in Lagangilang is to be locally repaired, extended, and heightened to improve its capacity to address flood risk in the area. Its existing height is around 1.1m while it is proposed to be heightened with an additional 2.0m.	Z6P3-RS-01 toe protection L = 940 m Z6P3-RS-01 embankment slope protection L = 470 m	1a
		The embankment on the landside of the spur dike in Banglolao and the backfill on top of the spur dike in Abang are to be provided with supplemental protection in concrete and gabion walls, respectively	Z6P3-RS-02 toe protection L = 911 m Z6P3-RS-02 backfill slope protection L = 780 m	1a
Zone 7 **Bucay – Layugan, Madalipay, Salnec, Patoc Manabo – Catacdegan Viejo, Catacdegan Nuevo**		The gabion wall in Layugan, the concrete dike in Madalipay, the gabion revetment in Catacdegan Viejo and Catacdegan Nuevo, and the spur dike in Patoc to be strengthened at the toe using loose boulders or artificial blocks. Local repairs to be undertaken for all existing structures except for the spur dike in Patoc. New sections from heightening and extension to be carried out to the structures in Layugan and Catacdegan Nuevo, respectively. The existing height of Z7P1-RS-01 is around 3.3m where it will be heightened will an additional 1.0m. Its existing length is 1,069m and will be extended with an additional 72m.	Z7P1-RS-01 toe protection L = 1,100 m Z7P1-RS-01 section for repair L = 200 m Z7P1-RS-01 section for heightening L = 350 m	1a
			Z7P1-RS-02 toe protection L = 1,870 m Z7P1-RS-02 section for repair L = 200 m	1a
			Z7P2-RS-01 toe protection L = 1,141 m Z7P2-RS-01 section for repair L = 35 m Z7P2-RS-01 extension L = 72 m	1a
			Z7P2-RS-03 toe protection L = 700 m	1a
Zone 8 **Bucay Manabo – San Juan Norte, San Juan Sur**		Toe protections using loose boulders or artificial blocks and the heightening of the downstream section are proposed for the existing gabion structure in San Juan Norte and San Juan Sur to protect the agricultural land and scattered populations within the floodplain. Its current height is 2.0m while it will be additionally heightened with 2.2m.	Z8P1-RS-01 toe protection L = 1,150 m Z8P1-RS-01 section for heightening L = 320 m	1a
Tributaries **San Juan - Colabaoan, Lam-Ag, Guimba, Badas, Culiong Lagangilang – Dalaguisen, Taping Sallapadan – Subusob, Gangal**		Toe protections using loose boulders or artificial blocks are proposed for protective structures susceptible to failure in order to protect assets in Malanas tributary in San Juan, in Baay tributary in Lagangilang, and in Ikmin Tributary in Sallapadan. Heightening and extension of the existing structures to be undertaken for sections in Malanas and Baay tributaries to increase the level by which exposed assets are protected from flooding and erosion. Section a of TRBM-RS-01 is currently 2.0m in height and will be heightened with an additional 2.0m. Section b, on the other hand, is currently 1.0m high and will be heightened with an additional 1.6m.	TRBM-RS-01 toe protection L = 2,040 m TRBM-RS-01 extension L = 530 m TRBM-RS-01 section for heightening L = 320 m	1a
			TRBB-RS-01 toe protection L = 1,570 m TRBB-RS-01 extension L = 380 m	1a
			TRBI-RS-01 toe protection L = 1,540 m	1a

Notes:

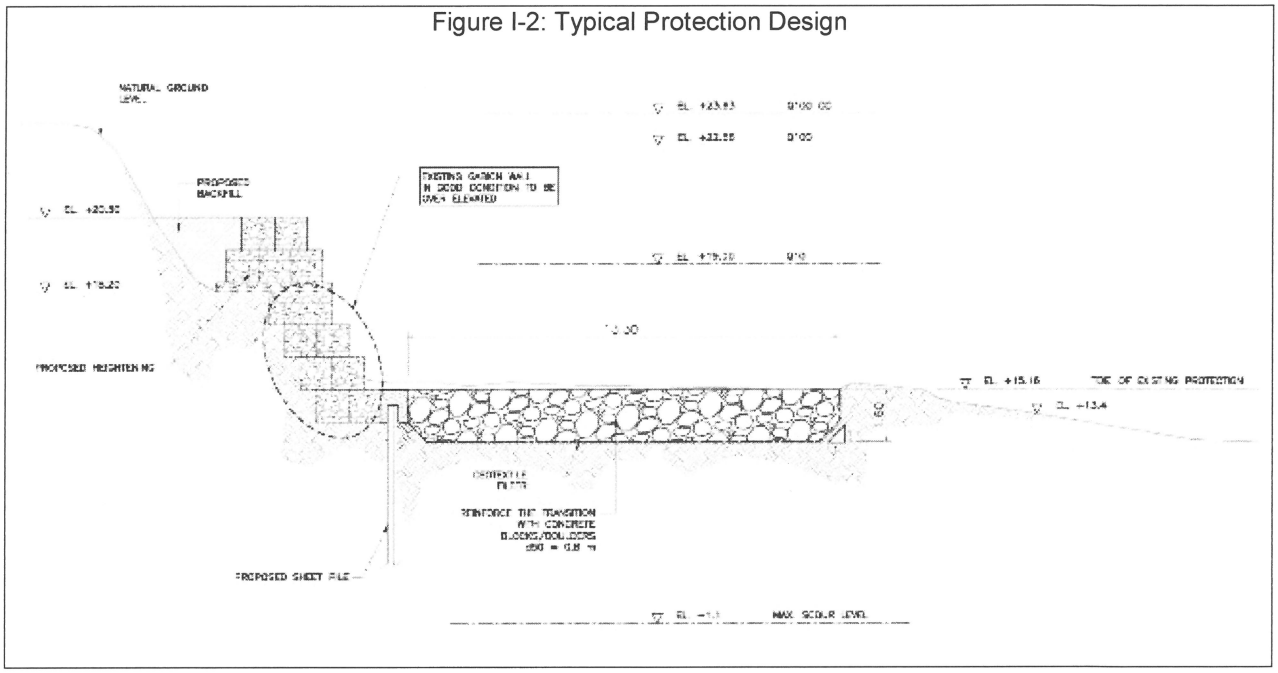
*** - Z3P2-SC2-02 and Z3P3-SC2-01 in Zone 3**

[1]NBS – Nature-Based Solution

1 – Room for the river (i.e. floodplain restoration) :

(a) strengthening of dikes –reinforcement of existing structure (embankment/dike) for erosion (bank) protection

Figure I-2: Typical Protection Design



56. Toe protections (Figure I-2) will be a combination of sheet piles, loose boulders, or pre-fabricated artificial blocks. Implementation of the strategy will involve innovative products and approach to be possibly replicated for other future projects in the river bed and in the river delta.

57. The implementation of the structures will be done as follows:

1) Creation of the access roads;
2) Excavation of the anti-scour structure, temporary deposit in cord (cofferdam against floods);
3) Implementation of the geotextile;
4) Implementation of the natural boulders;
5) Variant: If artificial boulders, implementation of a transition layer (before implementation of the concrete blocks.
6) Backfill of banks with the temporary deposited materials.

2) Other project activities

58. To complement the structural investment, other activities, mostly nonstructural, will be implemented under the project (Table I-4).

Table I-4. Other project activities for Abra river basin

Activities	Description/Objectives	Key Activities	Locations/Beneficiaries
A. Output 1.2 - Hydrometeorological Monitoring Systems (HMS) and Early Flood Warning Systems (EFWS) Enhancement			
1. Early Warning System and Preparedness	Upgrading of the existing HMS-EFWS including additional radar rainfall stations (X-Band Radar), enhancement of discharge measurements,	Provision of one (1) acoustic doppler current profiler (ADCP) and installation of one (1) radar velocity measurement equipment to enhance flood discharge measurement at a water level gaging station preferably	Dolores Municipality for the X Band Radar / Basin-wide
B. Output 3 - Community Based Flood Risk Management Project (CBFRMP)			
1. Building Code and Land Use Planning	CLUPS and/or policies to prevent urbanization and forbid continued development in areas near the erosion/flood protection structures	Development of CLUPs/ building code/ policies	All municipalities with no CLUPs
2. Capacity Building and Training on FRM			
Quarrying regulation	To minimize risks associated with uncontrolled quarrying, smart quarrying locations (where mining regulation is critical) are identified	Promotion of smart quarrying in identified locations at risk for erosion. Policy discussions with government agencies and stakeholders.	Critical areas for smart quarrying: San Quintin, Tayum, Lagangilang/Tineg Confluence
Resilience Measures	To educate and capacitate affected people about resilience measures aimed at reducing the flood vulnerability and damages.	Educate affected people about resilience measures such as flood defenses (sandbags, pallet barriers, etc.) and building design (wet proofing, dry proofing, flood avoidance)	Bucay Mun. (Brgys. San Miguel, Labon, North Poblacion)
Reforestation	To improve soil cover through watershed stabilization	Identification of sites at risks and with training/ workshops where tree planting activities can mitigate for erosion risks (can also be part of Land use planning)	Areas with high erosion risk (majority of the areas within the RB)
	To strengthen the coastal areas and mitigate flood damage (river delta and river mouth)	Identification of sites and with training/ workshops where Mangrove or Kandroma (Cinamomum mercadoi) plantation can be done for strengthening coastal areas (can also be part of Land use planning)	Municipalities in the Ilocos Sur delta (Caoayan, Santa, Vigan)
	To reinforce the floodplain reinforcement along the main river to reduce flow velocity thereby decreasing soil erosion risks and damages	Identification of areas and with training/ workshops for tree planting in buffer areas (can also be part of Land use planning)	Municipalities of Bangued, Pidigan, Tayum, Manabo, and La Paz

B. Tagum-Libuganon River Basin

1) Structural investment

59. The structures recomended in the Feasibility Study are products of the development design based numerous analysis including an updated hydraulic model and coastal model. Some of the changes also aim to mitigate impacts to the environment and the people, citing the heavy impact to mangroves in D1-1 for example. The list of structures is described in Table I-5.

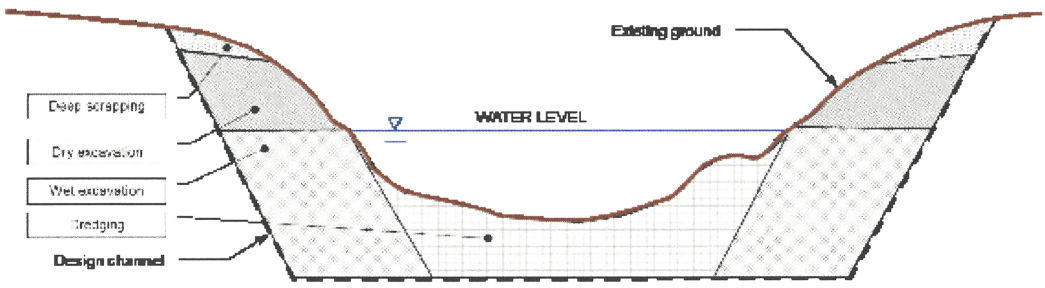
60. *Diversion channel (D1-1a and 1-1 cutoff channel)*. This structure aims to reduce the flood depth along the Tagum-Libuganon River by diverting its flow through a proposed overflow diversion channel which will reconnect the Ancient Libuganon River to the Tagum-Libuganon River through an old meander (commonly known as Tangkuan Creek). Most of the old meander's sections are now overlain with plantations and road segments. This subproject is an example of meander restoration. The diversion channel will have a length of 3.3 kilometers and a design riverbed width of 40 meters (already including the original width). The intake elevation of the diversion channel is designed higher than the bed of Tagum-Libuganon River, such that the flow is maintained along the source river during dry season and will only enter the intake during high flood condition. The banks of the diversion channel are proposed to be covered with vetiver grass as protection from scouring and erosion. Single lane roads (width = 3.5 m) are to be constructed along both banks of the channel as access for maintenance. Downstream of this new channel, a 700-m cutoff channel will also be constructed in this river system.

61. Other diversion channels (D1-4, D1-2, and M4-12) are discussed in the next table. A total of four (4) new diversion channels are to be constructed.

62. Removal of soil material is divided in to two categories:

- Deep scrapping and excavation (dry material) - removal of soil material on landside above the normal water elevation, estimated to be about **2.08 Million cubic meters** in total,
- Excavation (wet material) – removal of soil material on landside, below the normal water elevation, approximately **2.37 Million cubic meters** in total.
- Dredging – removal of soil / sediment soft material in wet conditions on riverside, approximately **0.64 Million cubic meters** in total

Figure I-3. Differences in Soil Extraction Methods in Channel Construction



63. Deep scrapping utilizes standard motorized scraper to loosen the topsoil. Excavation on the other hand utilizes backhoe crawler for soft soil material and hydraulic backhoe with breaker / shear cutter for hard materials (rocks). Dredging on areas accessible by land utilizes the crane with clamshell equipment. This can be mounted on a deck barge to be able to dredge areas accessible only by water.

Table I-5: Summary of the development of design of proposed structures for TLRB

Zone/Barangay	New	Type of Protection	Project Dimensions	NBS[1]
D-1-1 Bincungan - Liboganon – Madaum	✓*	Activities include dredging the riverbed and clearing obstructions along the channel, from the National Highway (Tangkuan Creek) to the mouth of the Ancient Libuganon River. Coastal jetty will be constructed at the river mouth to protect Barangay Liboganon coastline from coastal erosion. Two new channels will be constructed within the D1-1 system which are the D1-1a new diversion channel and the D1-1 cutoff channel.	- (**D1-1a**) new diversion channel – 3.3 km long, 40m wide - improvement of Libuganon River – 2km long, 90w wide - jetty – 100 m long - construction of 2 bridges - new **D1-1 cutoff channel** 700m long	1a, 1b, 1c, and 2
D-1-2 Busaon	✓	The project includes an Overflow Channel to help reduce flood height along the Tagum-Libuganon River and prevent overflow. The new channel will also help drain the floodwater from Barangay Busaon. Two coastal jetties will be constructed at the river mouth to protect coastline from coastal erosion and prevent sediment from deopositing in the channel mouth	- overflow channel 1.8km long 64 m wide - wider channel intake - construction of 1 bridge - construction of 2 coastal jetties (100m and 40 m long, respectively)	1a, 1b, 1c
D-1-4 Tuganay-Guadalupe-Taba	✓*	The Tuganay Cut-off Channel (existing with ~20m) is to be dredged and widened to help reduce flood depth and duration in the barangays of Anibongan and Tuganay. Also proposed is a diversion channel starting from Carmen towards the Cut-off Channel. The new diversion channel will carry part of the flood from Lasana River into the Cut-off Channel, and efficiently drain the flood in Carmen.	- diversion channel 2.1km long, 20m wide - cutoff channel rehabilitation 3.1km long, 50m wide - construction of 2 bridges - improve Ising River downstream of highway, 727m long, 20m wide	1a, 1b, 1c, and 2
D-1-5 La Paz -Taba-Santo Niño		The Lasana (also known as Old Tuganay) riverbed (existing width ~30m) is proposed to be dredged and widened to increase the capacity to help drain the flood from Carmen City. The dredging starts from Carmen City and ends at the junction with the Tagum-Libuganon River, and will also help drain flood water from Barangay Sto. Nino.	- improvement of Old Tuganay River 6.5 km long, 40m wide	1a, 1b, and 2
D-2-1 Alejal – Mangalcal – New Camiling		Flood wall along Sto. Tomas – Carmen Road is to be extended from Barask Bridge towards Barangay Alejal to prevent overflow of the ditch along the road.	Extension of parapet wall along Sto. Tomas – Carmen road, 4.1km long	
D-2-3 Ising – Santo Niño		The perimeter canal on the western side of Carmen (existing width ~15m) is to be enlarged to help reduce flood depth along the dike in Santo Tomas-Carmen Road and to help drain the flood from the agricultural areas in Barangay Ising. The height of the existing dike along the canal is to be raised to prevent the flood from overflowing into Carmen. In parts of the dike with lowest elevation, the top of dike is to be raised by at most 1.8 meters. The total design dike width is identical to the existing (about 10 meters). In narrow areas with existing buildings near the foot of the dike, stability is achieved with minimum Righ-of-way by replacing the dike slope with concrete wall (less footprint).	- improvement of dike 1.6km long, 3m wide at the top - improvement of west ring canal 1.6km long, 25m wide- - construction of 1 bridge - construction of drainage culvert for the protected area, 3 barrels 1.5x1.5m RCBC - improvement of canal downstream of highway 2.0km long, 30m wide	1a, 1b
D-2-6 Guadalupe –		Two (2) creeks are to be restored, deepened, and widened to drain the agricultural areas along the National Highway and convey the flood into the	- ditches 471m, 665m, and 714m long, all 4m wide	1a, 1b

Zone/Barangay	New	Type of Protection	Project Dimensions	NBS[1]
Tuganay		Tagum-Libuganon River. Accompanying the drainage channels along the highway is the construction of two (2) bridges to connect the drainage into the creeks. The proposed project helps drain the flood from the agricultural areas of Tuganay and Guadalupe, upstream of the highway.	- D2-6b culvert: 3 barrels, 4x3.2m RCBC - D2-6c culvert: 4 barrels, 4.62x4m RCBC" - (D2-6b) creek restoration 2,270 long, 13m wide - (D2-6c) creek restoration 714m long, 20m wide"	
D-3-2 Tuganay		Local protection (dikes) to protect the residential areas of Brgy. Tuganay	- creation of 2 dikes 1.14km and 546m long - construction of drainage culvert for the protected area, 2 barrels 1.5x1.5m RCBC and 1 barrel 1.2m dia RCP	
M-4-12 Guadalupe	✓*	Construction of new channel to divert the flow from Anibongan Creek in Brgy. Mabaus and redirect the water to the main Tagum-Libuganon River. A new bridge shall also be constructed. Project aims to reduce the inflow into the residential area of Brgy. Anibongan and act as the main drainage of Brgy. Guadalupe.	- diversion channel 3.6km long, 20m wide - weir at intake 20m long - culvert 1: 4 barrels, 4.62x3.44m RCBC - culvert 2: 4 barrels, 4.62x3.44m RCBC	1a, 1b, 1c
SG-1 to 8 Canocotan, San Miguel (Camp 4), Mankilam / Guadalupe, Mabaus	✓*	Repair, rehabilitation, and provision of sluice gates for culverts within the Tagum dike system to prevent backflow	"8 locations 14 sluice gates (maximum 2mX2m)"	

Notes:

* only for certain sections of the channel or some of the sluice gates

[1]NBS – Nature-Based Solution

1 – Room for the river (i.e. floodplain restoration):

(a) removal of obstacles –removing obstructions that restrict flow; also includes provision or resizing of river crossings (e.g. bridge, culvert)

(b) deepening the summer bed - excavating/dredging the surface layer of the river bed to increase river capacity; also includes river widening

(c) high water channel – construction of secondary channel to divert some of the excess water through the floodplain; also includes reactivation of an old meander to increase river capacity

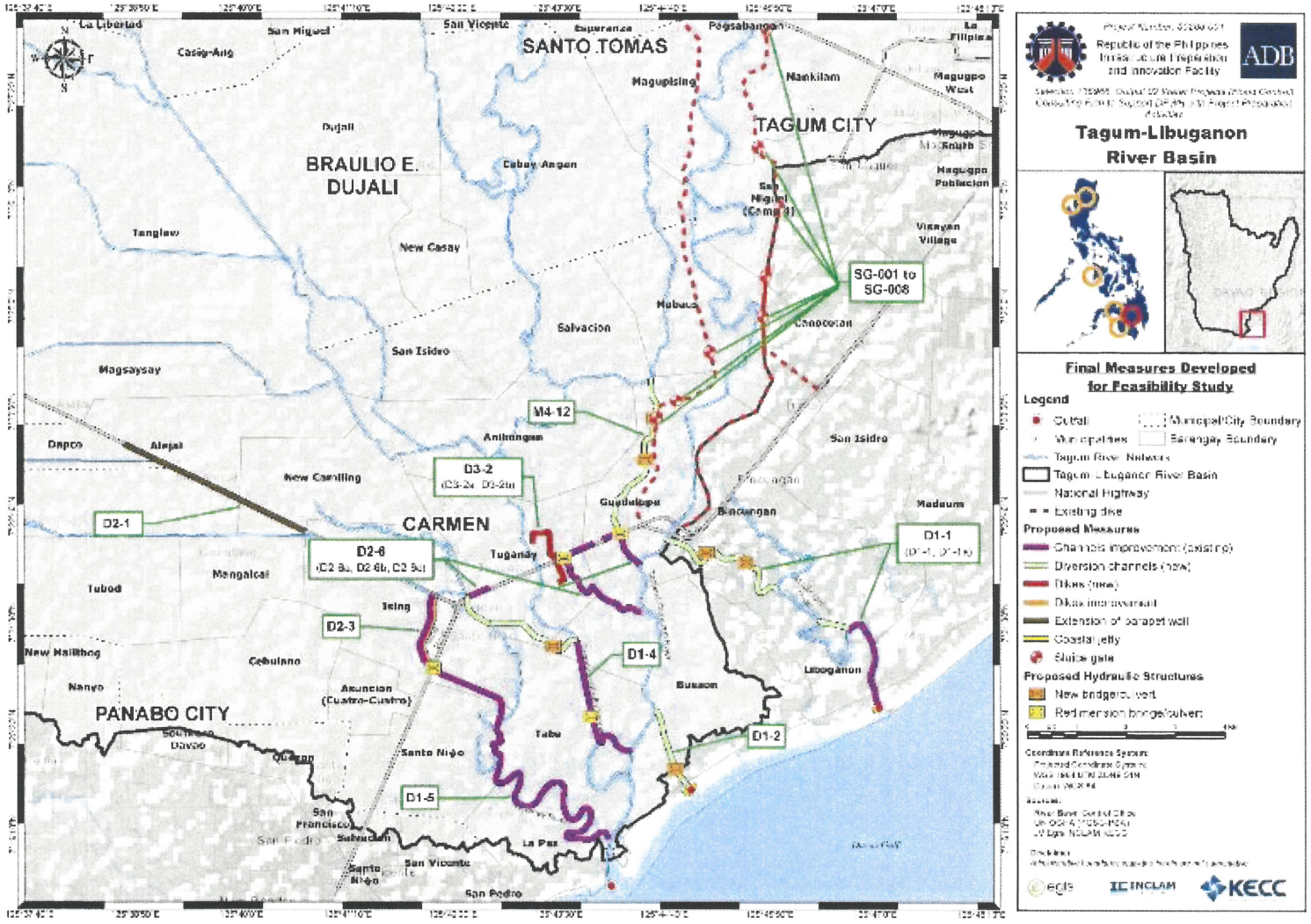
2 – Coastal protection – maintaining/enhancing coastal vegetation (mangrove system) to protect from storm surges and erosion and to enhance biodiveristy

2) Other Project Activities

Table I-6. Other project activities for Tagum-Libuganon river basin.

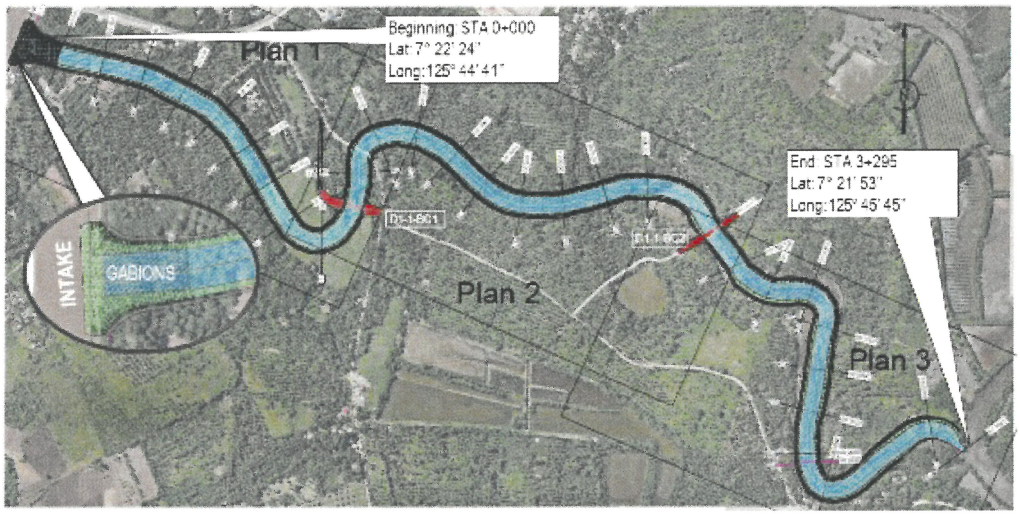
Other Activities	Description	Key Activities	Locations/Beneficiaries
A. Output 1.2 - Hydrometeorological Monitoring Systems (HMS) and Early Flood Warning Systems (EFWS) Enhancement			
1. Early Warning System and Preparedness	Upgrading of the existing HMS-EFWS including additoinal rain and water level gages, updating of ASTI stations and radar srainfall stations, enhance discharge measurements		Basin-wide
C. Output 3 - Community Based Flood Risk Management Project (CBFRMP)			
1. River intervention and Land Use Management	Areas experiencing flooding incidents in the TLRB shall be proposed with land use management schemes in the effort to reduce risk exposure	Development of CLUPs/ building code/ policies	Basin-wide
		Promoting Mangrove rehabilitation - in identified locations, to reduce impacts of the Project on the mangroves and compensate for the affected mangroves	Tagum City – Brangays of Busaon, Libuganon, Bincungan, and Madaum Carmen – Barangays of Taba, Santo Niño, and La Paz
		Planning Activities for Reforestation in the river basin uplands - at around 20% of the identified areas considering that there are exisiting tree stands, to improve soil permeability and to act as buffers to slow down runoff	Areas beside Saug River: New Corella – Barangays of Santa Cruz, Del Pilar, Mesaoy, Cabatan, Cabaywa, Cambagonoy, Buclad
		Promoting Wetland restoration and preservation - Preservation of the Ising lowland to serve as natural wetland/ detention basin during high flood conditons	Carmen – Barangays of Ising, New Camiling, and Tuganay
2. Capacity Building on FRM		- Development of IEC materials for FRM - Capacity Enhancement Training Project (CETP) for FRM	Basin-wide

Figure I-4 Location of Structural Investments in TLRB



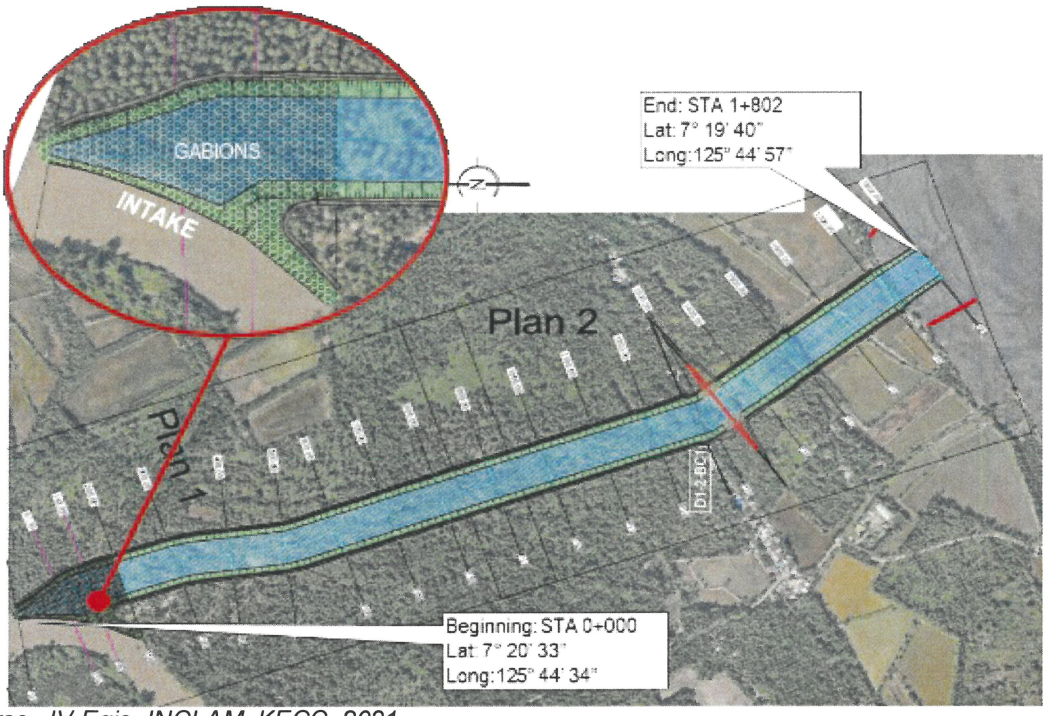
Source. JV Egis, INCLAM, KECC, 2021

Figure I-5. Plan view of the diversion channel in D1-1



Source. JV Egis, INCLAM, KECC, 2021

Figure I-6. Plan view of the overflow channel in D1-1

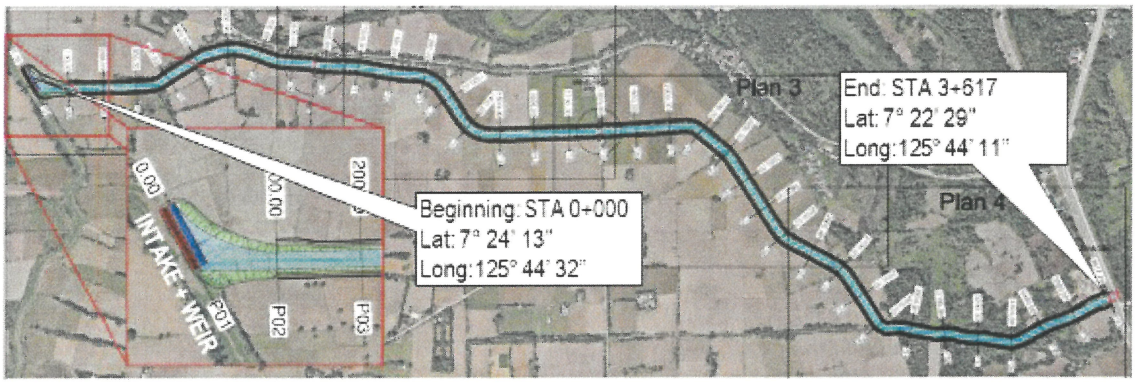


Source. JV Egis, INCLAM, KECC, 2021

64. The diversion channels are designed to be utilized via gravity flow only during high flooding conditions to ensure that the flow is maintained along the source water body during summer or normal conditions. Excavation works for new diversion channels will start from the downstream outfall and work the way towards the intake at the upstream. The intake is designed to have a higher elevation than the riverbed at the source. In case of M 4-12 where the ground elevation is very low, a concrete weir is installed at the intake to act as a flow control structure, to achieve the same purpose of maintaining flow along the source water

body during normal conditions. Gabion mattresses are to be installed to protect the riverbed and banks of the intake from scouring. Vetiver grass are to be planted on the slopes along the riverbanks as protection from erosion. Roads are to be constructed alongside the riverbank for access during operation and maintenance activities.

Figure I-7. Plan view of the overflow channel in M4-12



Source. JV Egis, INCLAM, KECC, 2021

Description of Mangrove Rehabilitation in TLRB

65. Mangrove Rehabilitation will be undertaken in conjunction with the compliance to the tree-replacement regulation (1:100) discussed in Chapter II. Before any transplanting, the permit required for earthballing / transplanting of mangroves will be secured in accordance with these regulations and will contain the Final and Approved Infrastructure Development Plan with tree charting, indicating the geotagged location of individual trees affected by the project, as basis of validation by the DENR-CENRO during actual earthballing.

66. During execution, all activities of the project implementing unit and its contractor for mangrove rehabilitation (including transplanting of mangroves) shall be coordinated with the CENRO of Tagum who has jurisdiction on this matter. From the IEC of Output 3 on capacity building on Mangrove Rehabilitation, it is expected that people at community (barangay level) will be mobilized to assist the CENRO in the implementation of mangrove rehabilitation and will subsequently manage the mangrove plantations.

67. Mangroves (smaller trees and saplings) are excavated manually by shovel or mechanically using a backhoe excavator (larger trees), transported with the root ball wrapped in burlap. For mature tree, the mangroves will be removed with the use of a 10-t excavator to uproot the trees. The best mangroves to be transplanted are those with more pneumatophores or aerial roots. The trees, attached with their earth balls, should be placed in a container already filled with soil and/or sand from the location they have been extracted from. Once inside, the trees and their roots should be secured with the soil[2].

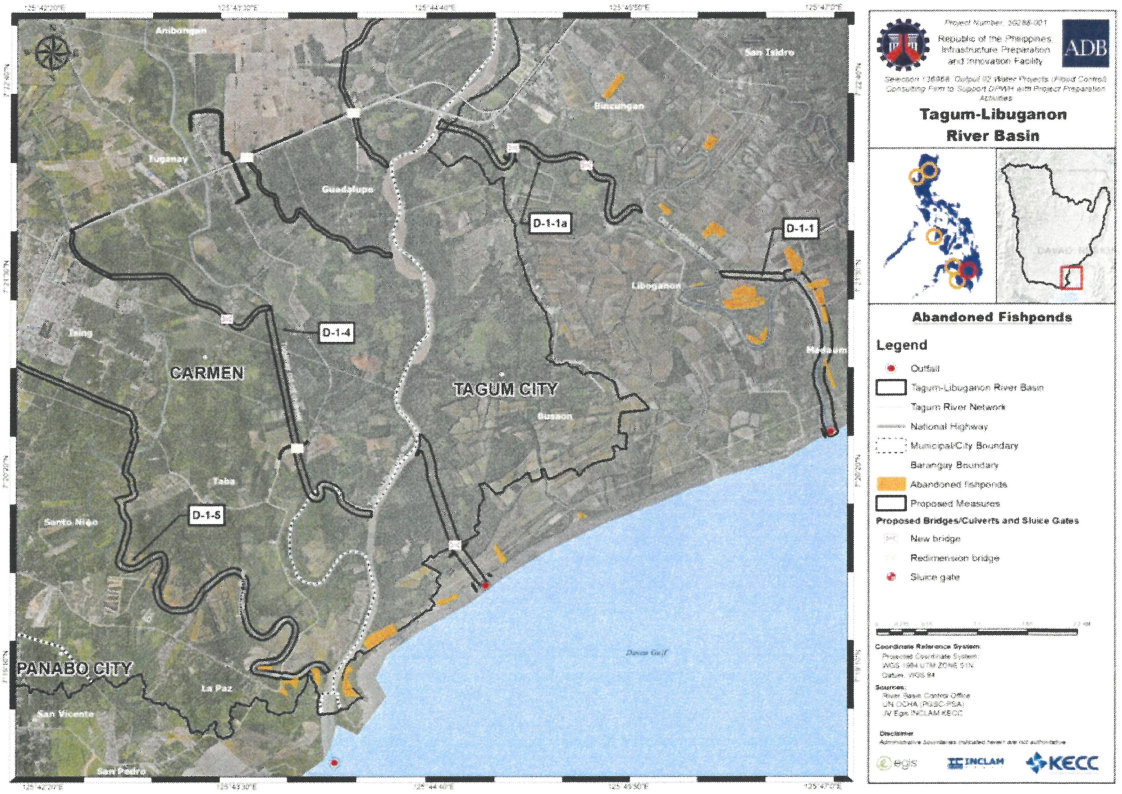
68. The area where the mangroves will be transplanted should have similar conditions of tidal elevation, salinity level, substrate, and flood duration. The mangroves to be removed for D1-1, D1-4, and D1-5 will be transplanted along the new riverbanks of the respective channels for soil embankment protection.

69. There are abandoned fishponds in adjacent areas as seen Figure I-8. The identified

[2] John Abbot and Jennifer Marohasy. The excavation and cultivation in containers of mature grey mangroves,Avicennia marina. Wetlands Ecol Manage. 23 May 2014

fishponds have good access to brackish water as they are near the Ancient Libuganon River and Tala River. The 31 fishponds identified may suffice the mangrove replantation needs as the ponds have a size range of 3,000 to 45,000sqm and having a total combined area of 407,420 m2. These are recommended as sites for transplantation and mangrove rehabilitation. Utilizing fishponds for mangrove rehabilitation, however, entails tenure issues on actual and perceived ownership of fishponds. These issues will be settled through the CENRO of Tagum, who will decide on the final location of the mangrove rehabilitation areas.

Figure I-8 Abandoned Fishponds for Potential Mangrove Reforestation Sites



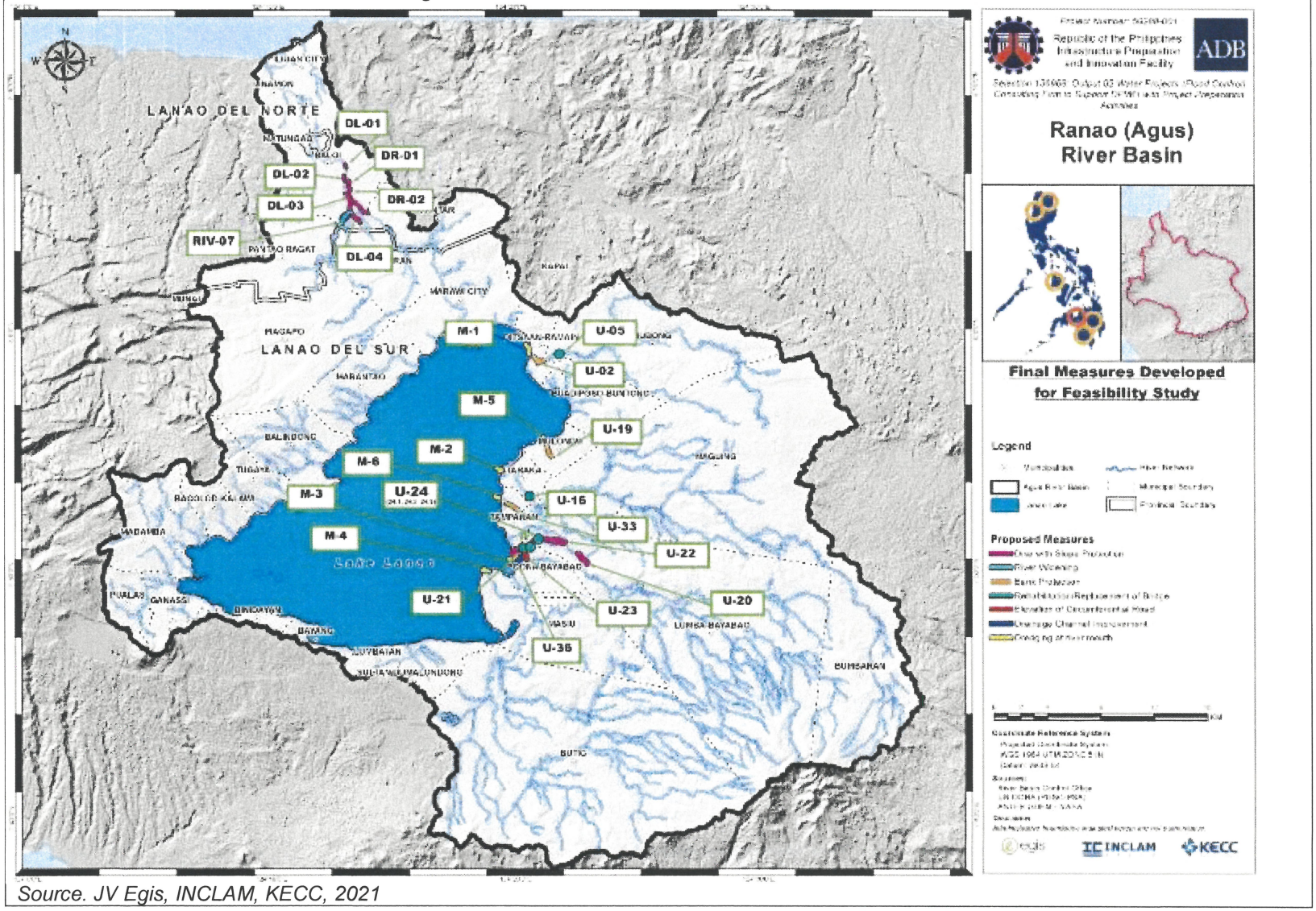
Source. JV Egis, INCLAM, KECC, 2021

C. RANAO (AGUS) RIVER BASIN

1) Structural investment

70. The structures are detailed in Table I-7, and are shown in the location map in Figure I-9.

Figure I-9. Location of Structural Investments for RARB



Source. JV Egis, INCLAM, KECC, 2021

Table I-7: Summary of structures in RARB

Zone/Barangay	New	Type of Protection	Dimensions	NBS[1]
A. Agus (Baloi) Subbasin Structures				
RIV-07 **Baloi – Angayen (Balut), Mamaanun**		The tributary located southwest of Balut Island contributes mainly to the flooding on plains west of Agus River. The SW tributary would be widened and improved to 60 m (currently 15 m) in top-width with 3.0 m-depth on average to increase its capacity.	Length: 1,850 m Top-Width: 60 m	1a
DL-01 **Baloi – Pacalundo, Batolacongan (Basagad)**	✓	The Phase 1 dikes of the DPWH Baloi Flood Control will be extended to contain this increased flow on the downstream portion of the river. DL-01 is a dike extension downstream of the Phase 1 dike, left of Agus river, to Poblacion area. It is about 1.80 m height in average.	Length: 405 m	1b
DL-02 **Baloi – Batolacongan (Basagad)**	✓	DL-02 is a dike extension upstream of the Phase 1 dike, left of Agus river, from DPWH. It is about 1.60 m height in average.	Length: 785 m	
DL-03 **Baloi – Lumbac, Mamaanun**	✓	dike DL-03 extends downstream along the west of Agus River. The dike is about 2.5 m in height, with 1.0 m freeboard based on DPWH requirements, and is designed to accommodate 50-year flood.	Length: 2,656 m	
DL-04 **Baloi – Angayen (Balut)**	✓	dike DL-04 is proposed downstream of SW Tributary to S Tributary, located south of the island. The dike is about 2.8 m in height, with 1.0 m freeboard based on DPWH requirements, and is designed to accommodate 50-year flood.	Length: 2,001 m	
DR-01 **Baloi – Adapun-Ali (Dariat)**	✓	To protect the agricultural plain east of Agus River, dike DR-01 is proposed with 2.0 m height on average.	L=242 m	
DR-02 **Baloi – Adapun-Ali (Dariat), Kalanganan Lower**	✓	To protect the agricultural plain east of Agus River, dike DR-02 is proposed with 2.5 m height on average.	L=2,511m	
B. Gata Subbasin Structures				
U-20 **Lumba Bayabao – Gambai, Mapantao**	✓	The proposed dike U-20 would prevent the transfer of flows during rainfall events and confine flood within the main channel of Gata River. This U-20 dike is intercepting the Ruris Irrigation Main channel upstream which would be re-established with a proper culvert equipped with sluice gates. The gates would be normally opened to supply sufficient water especially during dry season to the perimeter. The gate would be closed during rainfall events. The right bank is with geotextile or concrete lining.	Length: 1,380 m	
U-22 **Lumba Bayabao – Macaguiling, Cabasaran, Salaman, Kasola, Calilangan, Taluan, Lama; Poona Bayabao - Liangan, Cadayonan, Gadongan,**	✓	Further downstream of Gata River, parts 1 and 2 of U-22 dike would be constructed with the same objective to confine flood within the main river channel. The dike extends downstream to about 150 m east of Lanao Lake. Both of the dikes are proposed to be constructed with geotextile/fiber lining for slope protection.	Length: 4,931 m (part 1) and 366 m (part 2) Total L: 5,297 m	

Zone/Barangay	New	Type of Protection	Dimensions	NBS[1]
A. Agus (Baloi) Subbasin Structures				
Poblacion, Dimayon				
U-23 Poona Bayabao – Poblacion (Gata Proper), Bansayan		In addition, U-23 is the raising of the Circumferential Road to provide immediate access for evacuation during large flood events to population. Box culverts would be installed below this road to convey the flood coming from upstream of the road to the Lanao Lake. Alongside is proposed the re-construction of the Gata Bridge of low capacity as part of the "common structures".	Length: 1,090 m	
U-24.1 Lumba Bayabao – Lama, Taluan	✓	Replacement of Bridge 1	Length: 60.9 m	
U-24.2 Lumba Bayabao – Gadongan	✓	Replacement of Bridge 2	Length: 50.9 m	
U-24.3 Poona Bayabao – Poblacion (Gata Proper)	✓	Replacement of Circumferential Road Bridge	Length: 73.9 m	
U-36 Poona Bayabao – Poblacion (Gata Proper), Bansayan. Dongcoan, Rogan Cairan, Lumbac		, the improvement of the existing drainage channel downstream of the CR to ease the drainage of floodwater flows from the upstream. The proposed 1.5-km drainage channel's dimensions are 15 m-top width by 1.5 m-depth with side slope of 1 vertical to 3 horizontal.	Length: 1,500 m Height: 1.5 m	
		C. Common Structures in Gata, Taraka, Ramain Subbasins		
U-02 Ditsaan-Ramain – (left bank) Bagoaingud, Dangimprampiai, Bubong Dangiprampiai, Dado, Talub, Mandara (right bank) Bayabao, Lumbatan Ramain, Sundiga Bayabao, Baclayan Raya		The bank protection with concrete or sodded with coconet for both banks of the river in measure U-02 is proposed to be constructed.	Length sodded: 1,010 m Length concrete: 1,652 m Total length: 2,662 m	1c
U-05 Bubong – Pindolonan, Poblacion (Bubong)		Ramain Bridge located along the Circumferential Road would be rehabilitated as per measure U-05.	Length: 56 m	
U-16 Taraka – Lumbac, Pitakus,		Taraka Bridge located along the Circumferential Road would be rehabilitated under measure U-16.	Length: 31.5 m	

Zone/Barangay	New	Type of Protection	Dimensions	NBS[1]
A. Agus (Baloi) Subbasin Structures				
Sunding				
U-19 **Mulondo – Buadi-Abala, Buadi-Insuba, Lilod Raybalai, Cairatan**		Mulondo River, located north of Taraka River, is part of the micro-watersheds discharging into the Lanao Lake, within the "Basak" area. During high flood events in Taraka River or Gata River, Mulondo River also contribute to the flows of the already flooded areas and the riverbanks collapse or erode away during the floods. Hence, minor re-profiling of the riverbanks and the construction of bank protections (with concrete or sodded with coconet) along is proposed.	Length: 1,207 m each side Total length: 2,414 m	1c
U-21 **Poona Bayabao – Dimayon, Rogan Tandiong Dimayon, Rogan Cairan**		The meandering part of Gata River about 0.55 km upstream of Lanao Lake is proposed to be improved with bank protection (with concrete or sodded with coconet) .	Length: 1,840 m	1c
U-33 **Tamparan – Tubok, Lumbac, Picarabawan, Lalabuan**		Tamparan River, located south of Taraka River, is part of the micro-watersheds discharging into the Lanao Lake, within the "Basak" area. Hence, minor re-profiling of the riverbanks and the construction of bank protections (with concrete or sodded with coconet) along river	Length: 2,666 m	1c
M-01 **Ditsaan-Ramain – Baclayan Lilod**		The mouth of Ramain River would be dredged under measure M-01.	Length: 780 m	1a
M-02 **Taraka – Supangan, Gapao Balindong**		The mouth of Taraka River would be dredged under measure M-02.	Length: 1,500 m	1a
M-03 **Poona Bayabao – Rogan Tandiong Dimayon, Rogan Cairan**		Dredging of Gata River mouth is also proposed under measure M-03.	Length: 500 m	1a
M-04 **Masiu – Dalog Balut, Tamboro Cormatan**		Dredging is proposed at the river mouth as measure M-04.	Length: 1,025 m	1a
M-05 **Mulondo – Buadi-Abala, Lilod**		The mouth of Mulondo River would also be dredged under measure M-05.	Length: 500 m	1a
M-06 **Tamparan – Lilod Tubok**		The mouth of Tamparan River would be dredged under measure M-06.	Length: 500 m	1a

71. Proposed dredging works M-1 to M-6 produces a total of about 162,000 m^3 excavated volume. The dredging on areas accessible by land utilizes the crane with clamshell equipment which can be mounted on a deck barge for areas accessible only by water. The bank protection structures U-02, U-21, U-19 and U-33 and CR Bridge rehabilitation structures U-05 and U-16 will also yield a total of about 198,000 m^3 of excated volume.

Figure I-10. Site photos location of proposed bank protection and bridge rehabilitation



Location of proposed slope protection in Tamparan (M-06)



Location of proposed slope protection in Taraka (M-02)



Downstream of Ramain Bridge (U-02)



Eroded Butig access road

Source. JV EGIS, INCLAM, KECC, 2019

2) Other Project Activities

Other project activities (mostly non-structural activities) have been proposed as presented below:

Table I-8. Other project activities for Ranao (Agus) river basin.

Non-structural	Description	Key Activities	Locations/Beneficiaries
A. Output 1.2 - Hydrometeorological Monitoring Systems (HMS) and Early Flood Warning Systems (EFWS) Enhancement			
1. Early Warning System and Preparedness		• Installation of (1) one X-band radar within Marawi City • Installation of one (1) acoustic doppler current profiler (ADCP) and one (1) radar velocity measurement equipment to enhance flood discharge measurement at automated water level gaging station	Marawi City / Basin-wide
B. Output 3 - Community Based Flood Risk Management Project (CBFRMP)			
1. Land Use Management Plans	Technical assistance in the preparation and implementation of eCLUP, LDRRMP, and CBDRRMP		Basin-wide
2. Capacity Building and Training	Consist of activities proposed to capacitate LGUs and communities	Training on CDRA, technical assistance on drainage master plans preparation, FRM workshops on topics such as: • Forest protection through bio-fencing in closed forest areas in the upstream portions • Agro-forestry in the middle stream and downstream areas • Riverbank stabilization, rehabilitation, and livelihood development (i.e. tree plantation and enterprises, nipa-based products processing using cleared nipa palms) • Nursery development and establishment in selected LGUs	Basin-wide

II. Policy, Legal, and Administrative Framework

A. National Policy and Regulating Framework of the Philippines

72. The Philippines Government established the process of EIA and preparation of an Environmental Impact Statement (EIS) by virtue of Presidential Decree No. 1511 or the Philippine Environmental Policy (PD 1511). Section 4 of PD 1511 requires all government agencies, government-owned and controlled corporations, and private companies, firms and entities to, "..prepare, file and include in every action, project or undertaking which significantly affects the quality of the environment..". Presidential Decree No. 1586 further strengthens the Philippines EIS System (PEISS) by authorizing the Environmental Management Bureau as the lead agency to receive, review and evaluate EIS, requiring an Environmental Compliance Certificate (ECC) for projects that are deemed critical, and allowing projects which are not considered environmentally critical to be exempted from preparing an EIS and securing an ECC.

73. DENR Administrative Order No. 30, Series of 2003 (Implementing Rules and Regulations (IRR) of the Philippine Environmental Impact Statement (EIS) System) resulted to the issuance of a Revised Procedural Manual which streamline the process for PEISS and EIA report type through the revision of project categorization. The guideline for coverage screening and categorization was amended by EMB Memorandum Circular No. 005, Series of 2014 (EMB MC 14-005). Under EMB MC 14-005, projects are classified into the following groups, namely:

- **Category A** - projects or undertakings are classified as environmentally critical projects (ECPs). A list of ECP's is provided in MC 2014-005. Proponents of these projects implemented from 1982 onwards are required to submit and Environmental Impact Statement (EIS) and secure an ECC.
- **Category B** - projects or undertakings which are not classified as ECPs under Category A, but which are likewise deemed to significantly affect the quality of the environment or located in an environmentally critical area (ECA). Proponents of these projects implemented from 1982 onwards are required to secure an ECC. These are further subdivided into two subcategories, those requiring submission of an EIS and those which may use EMB-prescribed IEE checklists. The subdivision is based on thresholds (production capacity, or size of project) established in MC 2014-005.
- **Category C** - projects or undertakings not falling in Category A or B, which are intended to directly enhance the quality of the environment or directly address existing environmental problems. These projects, however, still need to submit a Project Description and EMB verifies its actual categorization.
- **Category D** - projects or undertakings that are deemed unlikely to cause significant adverse impact on the quality of the environment according to the parameters set forth in the Screening Guidelines. These projects are not covered in the PEISS and are not required to secure an ECC. However, such non-coverage shall not have construed as an exemption from the compliance with other environmental laws and government permitting requirements. Projects under Category D are only required to submit a Project Description for issuance of a Certificate of Non-Coverage (CNC).

74. Philippine Category A projects and those in Category B which fall inside ECA (e.g., protected areas) will most likely be equivalent to ADB Category A (described in a latter section). The rest of Philippine Category B will likely fall into ADB Category B. Some environmental enhancement projects tagged as PHI Category C may also fall into ADB Category B depending on scale. MC 2014-005 also categorizes some environmental projects (wastewater treatment,

sanitary landfill, and even reforestation) as PHI Cat B based on the thresholds established. Those categorized as D in PHI will likely be equivalent to the ADB Category C (minimal or no adverse impacts thus no impact assessment is needed/required).

75. Activities in this project vary from construction of dike, bank protection, and construction of bridges to reforestation and capacity-building subprojects by communities. The table below presents the EIA requirements applicable to activities under this project with reference to EMB MC 2014-005:

Table II-1 Excerpts from Annex A of EMB Memo Circular 005, July 2014

Revised Guidelines for Coverage Screening and Standardized Requirements Under the Philippine EIS System					
Project / Description	**Covered (Required to Secure ECC)**			**Not Covered (may secure CNC)**	**Project Site parameters / Remarks**
	Category A: ECP	**Category B: Non-ECP**		**Category D**	
	EIS	**EIS**	**IEE Checklist**	**PD (Part 1 only)**	
2. Resource Extractive Industries					
2.1.3 Extraction of Non-metallic Minerals such as minerals such as - Limestone/shales/silica/clay/placer and other non-metallic minerals/ores - Aggregates (sand, stone, gravel including dredging with/intended for recovery/use of materials	≥75,000 MT or Area ≥20 hectares (regardless of capacity)	≥20,000 MT but <75,000 MT AND Area <20 hectares	<20,000 MT AND Area <20 hectares	Dredging only (of river, bay & other natural water bodies as environmental enhancement)	Dredging of channel for drainage improvement.
2.2.1 Community Based Forest Resources Utilization, other forestry projects	≥ 10,000 m^3 (annual vol. of trees cut)	≥ 5,000 m^3 but <10,000 m^3	≥100 m^3 but <5,000 m^3	≤100 m^3	Community-based reforestation
2.3 Fishery Projects – Dikes for/and Fishpond Development Projects	Dikes for/and Fishpond Development Projects shall refer to natural or artificial water impoundment involving dike construction and harvesting the same as marketable size and quantities				
2.3.1 Fishery/Aquaculture Projects using fresh or brackish water including pearl farm and similar activities	≥25 hectares	≥5 hectares but <25 hectares	>1 hectare but <5 hectares	<1 hectare OR seaweed farming	Concrete dike Toe protection of existing dikes
Note: Project / Description 2.3 and 2,3.1 are only used for reference for dike component of the proposed project as there are no existing threshold set for dike projects for flood control purposes					
3. Infrastructure Projects					
3.1 Dams, Water Supply and Flood Control Projects					
3.1.1 Dams (including those for irrigation, flood control, water source, and hydropower projects) including run-off-river type	≥25 hectares OR ≥20 million m^3	≥5 hectares but ,25 hectares OR >5 million m^3 but <20 million m^3	≤5 hectares AND ≤5 million m^3	None	Bank protection, no impoundment
3.1.2 Irrigation Projects (distribution system only)		≥1,000 hectares Service area	>300 but <1,000 ha	≤300 ha	Rehabilitation of existing sluice gates
3.4 Roads and Bridges					
3.4.2 Roads, widening, rehabilitation, and/or improvement	None	≥50% increase in capacity (or in terms of length/width) AND ≥20.0 km, (length, with no critical slope) OR ≥10 km (length with critical slope)	>50% increase in capacity (or in terms of length/width) AND >2 km but <20.0 km (length with no critical slope) OR >2 km but <10.0 KM	≤50% increase in capacity (or in terms of length/width) but ≤2 km increase in length	Improvement/Elevation of road, no increase in capacity is expected

Revised Guidelines for Coverage Screening and Standardized Requirements Under the Philippine EIS System					
Project / Description	**Covered (Required to Secure ECC)**			**Not Covered (may secure CNC)**	**Project Site parameters / Remarks**
	Category A: ECP	**Category B: Non-ECP**		**Category D**	
	EIS	**EIS**	**IEE Checklist**	**PD (Part 1 only)**	
2. Resource Extractive Industries					
			(length with critical slope)		
3.4.4 Bridges and viaducts (including elevated roads) rehabilitation and/or improvement	None	≥50% increase in capacity (or in terms of length/width) OR ≥10 km	>50% increase in capacity (or in terms of length/width) but <total length of 10 km	<50% increase in capacity (or in terms of length/width) but ≤2 km increase in length	Rehabilitation of bridges
3.8 Waste Management Projects					
3.8.4 Materials Receiving and Recovery Facilities (for paper, plastics, and other materials)	None	≥10.0 MT (annual treatment/processing capacity)	<10 MT	None	Capacity-building project

76. Categorization of the projects based on the above Philippine regulations have already been determined by the respective regions. Based on the results of Scoping Sessions conducted, the following categorization were communicated by the respective regulators:

- ARB : for the Cordillera Administrative Region, the structures and subprojects (21 in all) will secure a Certificate of Noncoverage. Two of the subprojects are under Region I and will also secure CNC's.
- RARB : the entire river basin project will require an EIS and secure an ECC. As these are non-environmentally critical projects, they are thus classified as Category B.
- TLRB : similarly, the entire river basin project will require an EIS and secure an ECC. As these are non-environmentally critical projects, they are thus classified as Category B.

77. In 2017, the DENR issued DENR Administrative Order No. 15, Series of 2017 on Guidelines on Public Participation Under the Philippine Environmental Impact Statement System (DAO 2017-15) which requires proponents to submit to EMB proof of Information, Education and Communication (IEC) campaigns, stakeholder engagement activities, and initial perception survey prior to undergoing Public Scoping. The latest circular MC 2019-003 now allows the processing of ECC for Category B projects via online application.

78. Republic Act No. 11054 (RA 11054), An Act Providing for the Organic Law for the Bangsamoro Autonomous Region in Muslim Mindanao (BARMM) applies to RARB. This law provides the Bangsamoro Government to exercise authority over its jurisdiction, without prejudice to the general supervision of the President of the Republic of the Philippines, on matters including environment, parks, forest management, wildlife and natural reserves conservation. The law provides for BARMM to establish the Environmental Management Services (EMS) under the Ministry of Environment, Natural Resources and Energy (MENRE). The EMS has the same function as EMB in receiving and reviewing applications for ECC within its jurisdiction. As a recently established agency, the EMS of MENRE still refers to the issuances of DENR and EMB with regard to project categorization, EIS process, and requirement for application for ECC. The ECC application for Lanao del Norte is under the purview of EMB Region 10 office for Non-ECP and EMB Central Office for ECP, while Non-ECP

and ECP within Lanao del Sur are under the jurisdiction of EMS.

79. **Other relevant laws, and regulations**. The following are considered in this study and applicable to the project:

Table II-2. Relevant Laws and Regulations

Category	Title of Act/Regulation	Application to Project
Air Quality	RA 8749 -Philippine Clean Air Act of 1999 DENR Administrative Order (DAO) 2000-81	Requiring construction projects to comply with air quality standards (including PM10). Requires Permit to Operate for generator sets, mobile equipment, and other sources.
Water Quality	RA 9275 - Philippine Clean Water Act of 2004 DENR Administrative Order (DAO) 2016-08 – Water Quality Guidelines and General Effluent Standards	Applies to water quality management in all water bodies. Primarily applies to abatement and control of pollution from land-based sources including construction projects. Prohibits any activity from impairment of a water body's beneficial use. Sets the effluent parameters to be followed. Requires Discharge Permit for any entity generating effluents.
Hazardous Waste Management	Republic Act No. 6969 (1990) - An Act to Control Toxic Substances and Hazardous and Nuclear Wastes DAO 36 Series of 2004 – Procedural Manual for Hazardous Waste Management	Mandates control and management of of toxic substances and hazardous wastes. Provides the classification of hazardous materials. Requires the controlled disposal of hazardous wastes through accredited treaters and disposal sites. Contractors need to secure a Hazardous Waste ID and follow disposal requirements.
Solid Waste Management	Republic Act No. 9003 - Ecological and Solid Waste Management Act of 2000. DAO 01-34 - Implementing Rules and Regulations (IRR) of RA 9003	Provides guidelines for ecological solid waste management. Requires waste segregation at source, materials recycling or recovery, and disposal in sanitary landfills (for nonhazardous waste). Prohibits dumping of waste.
Pollution Control Officer and Self-Monitoring Reports	DAO 1992-26 and DAO 2014-02 DAO 2003-27	Requiring establishments discharging wastes to appoint a Pollution Control Officer. Requiring the submission of Quarterly Self-Monitoring Reports to EMB.
Forestry/Flora	DENR Memorandum Order No. 02 Series of 2012 effective 05 November 2012. DENR Administrative Order (DAO) 2018-16, amended by DAO 2020-06, and DPWH Department Order 2017-116 DENR Memorandum Circular (MC) No. 2011-01 - Guidelines on the implementation of the National Greening Program (NGP) DENR Administrative Order (DAO) 2019-03, which revises the	Uniform Replacement Ratio for Cut or Relocated Trees. Provides the requirements for replacement of trees (1:100 ratio) affected by proponent of any project, including DPWH. Guidelines in the Processing of Permits on the Removal and Relocation of Trees affected by DPWH Projects. Provides the procedure for obtaining permits. The new guidelines extend the National Greening Program and promote planting indigenous species, especially within protected and watershed areas, as well as high-value crops and fast-growing trees in production forests.

Category	Title of Act/Regulation	Application to Project
	implementing rules and regulations for EO 193 (National Greening Program)	(specific procedures discussed below)
Biodiversity	Republic Act No. 9147 Wildlife Conservation and Protection Act Republic Act No. 7586 otherwise known as National Integrated Protected Area System Act of 1992	Provides for conservation and protection of wildlife resources. Restricting collection of wildlife. Establishing threatened species list. Establishing protected areas. Providing restrictions on activities in these areas and requiring permission and approval from protected area management organization.
Cultural Heritage	Republic Act No. 10066- National Cultural Heritage Act of 2009 (An Act Providing for the Protection and Conservation of the National Cultural Heritage)	Defining cultural properties and establishing state ownership thereof. Prohibits those that "Modifies, alters, or destroys the original features of or undertakes construction or real estate development in any national shrine, monument, landmark and other historic edifices and structures without the prior written permission from the Commission."
Climate Change	Republic Act 9729 - Climate Change Act of 2009	Mainstreaming of climate change in national, sectoral and local development plans and programs. DPWH encouraged to conduct climate risk assessment.
Right of Way for Projects	Republic Act 10752 (2016)	The Right-of-Way Act. Aims to streamline the basis for valuation, as well as the process for the negotiation and acquisition of right-of-way for government infrastructure projects.
Disaster Risk Reduction and Management	Republic Act 10121 Philippine Disaster Risk Reduction and Management Act of 2010	Strengthening the Philippine Disaster Risk Reduction and Management System, providing for the National Disaster Risk Reduction and Management Framework and Institutionalizing the National Disaster Risk Reduction Management Plan. DPWH to adopt the above framework in project planning and design.
Occupational Health and Safety	Republic Act 11058 (2018) An Act Strengthening Compliance with Occupational Safety and Health Standards	Aims to ensure a safe and healthful workplace for all workers by affording them full protection against all hazards in their work environment. Rules apply to contractors and subcontractors including projects in the public sector.

80. The specific procedures and guidelines for tree cutting and replacement are as follows:

a) DPWH will obtain a tree cutting and/or earth -balling permit following the requirements and steps in DAO 2020-06. No tree cutting will be undertaken without the necessary permit to be issued by the Community Environmental and Natural Resources Office (CENRO) of the DENR.

b) The tree cutting program, which will be undertaken by DPWH through a contractor, will be based on the Tree Chart approved by the CENRO. The said chart will be generated through a tree inventory (CENRO may opt to conduct ocular inspection) detailing the

species, diameter at breast height and global positioning system (GPS) reading of each tree. The Tree Chart will also include a site development plan/road alignment plan indicating the location of each tree to be cut.

c) Marking of each tree will be carried out by a joint inventory between the CENRO staff and DPWH. Tree cutting can only be undertaken under close supervision of CENRO staff and DPWH who will be present at the site throughout the duration of cutting activities. Cut trees will be turned over to the CENRO.

d) DPWH will undertake replacement of cut trees in compliance with DENR Memorandum Order no. 05 of 2012: Uniform Replacement Ratio for Cut or Relocated Trees which mandates that "*For planted trees in private and forest lands not covered under item (i.e., private lands and forest lands exclusively established for tree plantations/timber production purposes) tree replacement shall be 1:50 while naturally growing trees on the same areas, including those affected by development projects shall have 1:100 ratio in support of the National Greening Program (NGP) and climate change initiatives of the Government*". Such tree replacement is further mandated in a Joint Memorandum Circular No. 2, series of 2014: Guidelines for the Implementation of the DPWH-DENR-DSWD Partnership on the Tree Replacement Project co-signed by the Secretaries of the DPWH, DENR and Department of Social Welfare and Development (DSWD).

B. DPWH Guidelines on Management of River Dredging

81. **DPWH Order No. 2014-139. Guidelines on River Dredging Operations for Flood Control.** DPWH shall have direct control and supervision in the case of river and/or delta dredging activities. The guide requires submission of surveys, soil investigation, environmental clearances, design reports, and Dredging Plan. Approval of Plan and Permit to Dredge shall be issued by DPWH offices.

82. **Joint Memorandum Circular No. 2019-01 (DPWH-DENR-DILG). Guidelines on the Issuance of Clearance and/or Permit for Dredging Within Waterways**. This guide reiterates the DPWH mandate for flood control projects and delineates it from those with commercial utilization of dredged materials, which are covered by mining permits but still require a dredging clearance from DPWH. LGU-initiated flood control projects with no commercial utilization of dredged materials also secure a permit from DPWH. A succeeding issuance DENR AO No. 2020-07 further states that "no Operations Permit shall be issued by the Provincial Government unless it has secured a dredging clearance from DPWH, a valid MOA with the DENR Regional Office, be accredited as a trader, and has obtained an ECC.

83. The requirement for "identification and designation of disposal areas in accordance with DENR requirements" is expressed in both regulations. These regulations, however, do not explicitly mention the management of contaminated dredged materials. The following regulation may shed light on this matter.

84. **DPWH Department Order No. 2015-168. Guidelines in the Disposal and Management of Spoils and Debris Generated from Ongoing and Completed Construction and Maintenance Projects**. This regulation stipulates proper management of construction spoils and debris and reiterates disposal in permitted landfills. Prohibition of mixing with

hazardous wastes is also expressed, requiring that in case of mixing, the waste will be handled in accordance with hazardous waste management regulations.

C. International Agreements

85. The Philippine International Commitments on Environment and Natural Resources: Roadmaps and Updates (2019) prepared by the DENR outlines the existing commitments that the Philippine Government ratified. These commitments include the following:

- United Nations Framework Convention on Climate Change (Kyoto Protocol and Paris Agreement)
- Convention on Wetlands (Ramsar Convention)
- Convention on Biological Diversity (Cartagena Protocol on Biosafety and Nagoya Protocol on Access and Benefits Sharing)
- International Union for Conservation of Nature and Natural Resources (IUCN)
- Convention on International Trade in Endangered Species
- Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention)

D. Environmental Assessment Requirements of ADB

86. ADB's definitions and criteria for different level of environmental impacts thus category are summarized in the table below:

Table II-3 ADB Project Environmental Safeguards Categories

ADB's criteria for environment category	ADB eviron requirements
Category A: If a proposed project is likely to have significant adverse environmental impacts that are irreversible, diverse, or unprecedented. These impacts may affect an area larger than the sites or facilities subject to physical works.	EIA is required.
Category B: if its potential adverse environmental impacts are less adverse than those of category A projects. These impacts are site-specific, few if any of them are irreversible, and in most cases mitigation measures can be designed more readily than for category A projects.	IEE (i.e. simplified EIA) is required
Category C: if it is likely to have minimal or no adverse environmental impacts. No environmental assessment is required although environmental implications need to be reviewed	No need for impact assessment but Environ code of Practice (ECOP)

87. The category for this project by ADB is B after screening on environmental impacts based on information available. An IEE will need to be prepared for a Category B to assess the project's impacts.

88. **Access to Information Policy.** ADB also requires public disclosure for Category A and

B projects in accordance with the Access to Information Policy (2018).[3] The policy recognizes the right of people to seek, access, and impart information about ADB's operations, and it aims to provide clear, timely, and appropriate disclosure of information. It establishes the disclosure requirements for documents produced such as the IEE, EMP, and the environmental monitoring reports of the project. Chapter on disclosure and consultation describe detailed requirements.

89. **International good practice**. ADB SPS 2009 requires that during the design, construction, and operation of any project, the borrower/client will apply pollution prevention and control technologies as well as practices consistent with international good practice, as reflected in internationally recognized standards such as the International Financing Corporation (IFC) / World Bank Group's *Environment, Health and Safety Guidelines* (EHS Guidelines).[4] Table 2 presents applicable IFC guidelines to all activities supported under the Integrated Flood Resilience and Adaptation) and should be referred to in environmental safeguard documents, i.e. IEE and EMP.

Table II-4. International Financing Corporation Guidelines

EHS Guideline	Description, Relevance to InFRA
EHS General Guidelines (2007)	Define general and Good International Industry Practice that must be applied for facilities and activities to be supported under the InFRA. Key sections of the General Guidelines of relevance to InFRA include: • Environmental Guidelines (covering air emissions, wastewater and ambient water quality, hazardous materials management, waste management, noise) • Occupational health and safety • Community health and safety • Construction and decommissioning (including debris removal and clearance). The General Guidelines are designed to be used together with the relevant Industry Sector EHS Guidelines which provide guidance to users on EHS issues in specific industry sectors (see below).
EHS Guidelines for Port and Harbor (2017)[5]	Provide guidance on works in estuaries and rivers, particularly including dredging and foreshore works. Potential environmental issues may include: • Dredged Materials Management • Dredge Planning Activities • Dredging Techniques • Reuse and Disposal of Dredged Material

EHS = Environmental, Health, and Safety, InFRA = Enhanced Water Security Investment Project

E. Applicable Environment Standards

90. ADB generally recognize national environmental standards for projects. If national environmental standards do not exist or are considered inappropriate, internationally recognized standards are used. If national environmental standards differ from international standards,

[3] ADB. 2018. *Access to Information Policy*. Manila

[4] IFC EHS Guidelines are found at:https://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/sustainability-at-ifc/policies-standards/ehs-guidelines

[5] https://www.ifc.org/wps/wcm/connect/ddfac751-6220-48e1-9f1b-465654445c18/20170201-FINAL_EHS+Guidelines+for+Ports+Harbors+and+Terminals.pdf?MOD=AJPERES&CVID=ID.CzO9

moreover, more stringent standards are adopted. However, if sufficient justification exists, the country's national standards are applied. Given the project's activities, the environment standards that are applied for the project are shown below.

Table II-5 Environmental Standards Applied to the Project

Item	Revised Standard
Ambient Air Quality	DAO No. 2000-81, Ambient Air Quality and Emission Standards DAO No. 2013-13, Provisional National Ambient Air Quality Guideline Values for Particulate Matter 2.5 microns (PM2.5)
Surface and Effluent water Quality	DAO No. 2016-08, Water Quality Guidelines and General Effluent Standards of 2016
Groundwater Quality	Department of Health Administrative Order No. 2017-0010, "Philippine National Standards for Drinking Water (PNSDW)" DAO No. 2016-08, Water Quality Guidelines and General Effluent Standards
Ambient Noise Quality	World Bank-International Finance Corporation's (WB-IFC) EHS Guidelines of 2007
Ambient Vibration Quality	U.S. Federal Transit Administration Noise and Vibration Manual 2006 (FTA-VA-90-1003-06)
Soil Quality	The Bureau of Soils and Water Management Soil Fertility Rating DAO No. 2013-22
Soil Contamination	DAO 36 Series of 2004 – Procedural Manual for Hazardous Waste Management

1) Ambient Air Quality Standards

91. The DAO No. 2000-81, otherwise known as the Implementing Rules and Regulations of Republic Act No. 8749, Clean Air Act of 1999, establishes the national ambient air quality standards for total suspended particulate (TSP), particulate matters (PM_{10}), sulfur dioxide (SO_2), nitrogen dioxide (NO_2), carbon monoxide (CO), ozone (O_3) and lead (Pb), while DAO No. 2013-13 establishes the provisional national ambient air quality guideline for $PM_{2.5}$ values.

92. Table II-6 shows the applicable national standards on ambient air quality which are in agreement with the WHO guidelines except for SO2. Hence for SO2, the WHO guidelines will be adopted and apply in the project.

Table II-6 National Ambient Air Quality Standards

Parameter	Averaging Time	Philippines DAO 2000-81, DAO 2013-13*	International standard (WHO guidelines)
TSP	24 Hours	230 µg/NCM	-
PM10	24 Hours	150 µg/NCM	150 µg/NCM[a]
PM2.5*	24 Hours	50 µg/NCM	50 µg/NCM[b]
SO2	24 Hours	180 µg/NCM	125 µg/NCM[a]
NO2	24 Hours	150 µg/NCM	200 µg/NCM (1 hr guide)
CO	1 Hour	35 mg/NCM	-
O3	1 Hour	140 µg/NCM	160 µg/NCM (8 hr daily max.)

Parameter	Averaging Time	Philippines DAO 2000-81, DAO 2013-13*	International standard (WHO guidelines)
Lead (Pb)	24 Hours	1.5 µg/NCM	-

Notes: All all values are max. allowed. [a]Interim Target 1; [b]Interim Target 2

Source: DAO 2000-81 and DAO 2013-13

2) Surface and Effluent Water Quality Standards

93. The DAO No. 2016-08 provides water usage and classification as well as water quality guidelines and general effluent standards. Table II-7 shows water quality criteria by class.

94. Table II-8 and

95. Table II-9 present the comparison of applicable national standards on surface water and effluent.

Table II-7 Water Body Classification

Class	Description
Class AA	Public Water Supply Class I – Intended primarily for waters having watersheds, which are uninhabited and/or otherwise declared as protected areas, and which require only approved disinfection to meet the latest PNSDW
Class A	Public Water Supply Class II – Intended as sources of water supply requiring conventional treatment (coagulation, sedimentation, filtration and disinfection) to meet the PNSDW
Class B	Recreational Water Class I – Intended for primary contact recreation (bathing, swimming, etc.)
Class C	1) Fishery Water for the propagation and growth of fish and other aquatic resources 2) Recreational Water Class II – for boating, fishing, or similar activities 3) For agriculture, irrigation, and livestock watering
Class D	Navigable waters

Source: DAO No. 2016-08

Table II-8 Surface Water Quality Guidelines

(all values are max. allowed except Dissolved Oxygen which is the minimal to maintain.[1])

Parameter	DAO 2016-08				
	Units	Class A	Class B	Class C	Class D
Color	TCU	50	50	75	150
Temperature	°C	26-30	26-30	25-31	25-32
pH (Range)		6.5-8.5	6.5-8.5	6.5-9.0	6.5-9.0
Dissolved Oxygen (DO)[1]	mg/L	5	5	5	2
Biochemical Oxygen Demand (BOD)	mg/L	3	5	7	15
Total Suspended Solids (TSS)	mg/L	50	65	80	110
Surfactants (MBAS)	mg/L	0.2	0.3	1.5	3
Oil and Grease (Petroleum Ether Extracts)	mg/L	1	1	2	5
Nitrate as Nitrogen	mg/L	7	7	7	15
Phosphate as Phosphorus	mg/L	0.5	0.5	0.5	5
Phenolic Substances and Phenols	mg/L	<0.001	<0.001	0.05	0.5

Parameter	DAO 2016-08				
	Units	Class A	Class B	Class C	Class D
Fecal Coliforms	MPN/ 100mL	1.1	100	200	400
Chloride as Cl	mg/L	250	250	350	400
Copper (Dissolved Copper)	mg/L	0.02	0.02	0.02	0.04
Arsenic (As)	mg/L	0.01	0.01	0.02	0.04
Cadmium (Cd)	mg/L	0.003	0.003	0.005	0.01
Chromium (Hexavalent)	mg/L	0.01	0.01	0.01	0.02
Cyanide (CN-)	mg/L	0.07	0.07	0.1	0.2
Lead (Pb)	mg/L	0.01	0.01	0.05	0.1
Total Mercury (Hg)	mg/L	0.001	0.001	0.002	0.004
Organophosphate as Malathion	µg/L	1	1	3	6

Source: DAO No. 2016-08
Note: Dissolved Oxygen should not be less than 5.0 mg/L

Table II-9 General Effluent Standards

(all values are max. or range allowed to discharge into specified water body classification)

Parameter		DAO 2016-08				IFC – EHS[b]
	Units	Class A	Class B	Class C	Class D	
Color	TCU	100	100	150	300	-
Temperature	°C change	3	3	3	3	-
pH (Range)		6.0-9.0	6.0-9.0	6.0-9.5	5.5-9.5	6-9
BOD	mg/L	20	30	50	120	30
Chemical Oxygen Demand (COD)	mg/L	60	60	100	200	125
Total Suspended Solids (TSS)	mg/L	70	85	100	150	50
Surfactants (MBAS)	mg/L	2	3	15	30	-
Oil and Grease (Petroleum Ether Extracts)	mg/L	5	5	5	15	10
Nitrate as Nitrogen	mg/L	14	14	14	30	10
Phosphate as Phosphorus	mg/L	1	1	1	10	2
Phenolic Substances and Phenols	mg/L	0. 01	0.01	0.5	5	mg/L
Total Coliforms	MPN/ 100mL	3,000	3,000	10,000	15,000	400[a]
Fecal Coliforms	MPN/ 100mL	4	200	400	800	-
Chloride as Cl	mg/L	350	350	450	500	-
Copper (Dissolved	mg/L	0.04	0.04	0.04	0.08	-

Parameter	Units	DAO 2016-08				IFC – EHS[b]
		Class A	Class B	Class C	Class D	
Copper)						
Arsenic (As)	mg/L	0.02	0.02	0.04	0.08	-
Cadmium (Cd)	mg/L	0.006	0.006	0.01	0.02	-
Chromium (Hexavalent)	mg/L	0.02	0.02	0.02	0.04	-
Cyanide (CN-)	mg/L	0.14	0.14	0.2	0.4	-
Lead (Pb)	mg/L	0.02	0.02	0.1	0.2	-
Total Mercury (Hg)	mg/L	0.002	0.002	0.004	0.008	-
Organophosphate as Malathion	µg/L	1	1	3	6	-

Source: DAO No. 2016-08
[a]Not applicable to Centralized Wastewater Treatment System;
[b] IFC Environmental, Health, and Safety (EHS) Guidelines. GENERAL EHS GUIDELINES: ENVIRONMENTAL WASTEWATER AND AMBIENT WATER QUALITY

For the project water bodies concerned, the table below summarize which class they fall in thus which class of ambient water standard and discharge standard will apply:

Table II-10 List of Rivers Affected by Project and their Classification

Name of Basin	Rivers	Water quality class
ARB	Abra River (Ilocos Sur)	Class A
	Abra River (Abra Province)	Class A
	Tineg	Class B
TLRB	Tagum River	Class C
	Libuganon River	Class C
	Tuganay River	Class B
RARB	Agus River	Class C
	Lake Lanao	Class A

3) Groundwater Quality Standards

96. The Department of Health (DOH) AO No. 2017-0010, otherwise known as the PNSDW of 2017 establishes the criteria for drinking water quality. In cases where the criteria for certain parameters are not available in the PNSDW, the guideline values from DAO 2016-08 Water Quality Guidelines (WQG) for Class AA Waters are used. Table II-11 shows the comparison of applicable national standards on groundwater quality which are based on WHO guidelines.

Table II-11 Groundwater Quality Standards

Parameter	PNSDW
pH	6.5-8.5
Color	10 CU
Temperature	26-30°C
Sodium (Na)	200 mg/L

Parameter	PNSDW
Chloride (Cl-)	250 mg/L
Sulphate (SO-2)	250 mg/L
Nitrate (NO3-)	50.00 mg/L
Arsenic (As)	0.01 mg/L
Cadmium (Cd)	0.003 mg/L
Chromium (Cr)	0.05 mg/L
Cyanide (CN-)	0.05 mg/L
Lead (Pb)	0.01 mg/L
Mercury, total (Hg)	0.001 mg/L
Total Coliforms	<1.1 MPN/100mL
Fecal Coliforms	<1.1 MPN/100mL

Source: DOH AO 2007-012 – Philippine National Standards for Drinking Water (adopted from WHO standards).

4) Ambient Noise Quality Standards

97. The National Pollution Control Commission (NPCC) in 1978 specified the noise control regulations and defined the environmental quality standards for noise in general areas. Table II-12 shows the environmental quality standards for noise in general areas. There is, however, no provision in this issuance or other subsequent issuances by the DENR-EMB on the method to measure noise levels for background or compliance monitoring. For compliance monitoring, Section 79 of NPCC (1978) only specifies median of seven (7) highest noise levels; however, the measurement methodology (number of samples to be taken and the frequency of sampling time) are not explicitly specified in the said NPCC rules. Also, for construction noise, the maximum noise level of 85 dBA is permitted for work (designated as Class 2) which require rock drills, jackhammers or pavement breakers.

Table II-12 Environmental Quality Standards for Noise in General Areas (NPCC 1980)

Category	Maximum Allowable Noise (dBA) by time periods			Application to
	Daytime (9A.M. to 6 P.M.)	Morning/Evening (5-9A.M./6- 10P.M.)	Nigthtime (10P.M. to 5A.M.)	
AA	50	45	40	TLRB: Schools etc, RARB: churches, mosques
A	55	50	45	Res. Areas in all RBs
B	65	60	55	
C	70	65	60	
D	75	70	65	

Class AA- a section of contiguous area which requires quietness, such as areas within 100 meters from school site, nursery schools, hospitals and special house for the aged
Class A - a section of contiguous area which is primarily used for residential area
Class B - a section of contiguous area which is primarily a commercial area
Class C - a section of contiguous area reserved as light industrial area
Class D-a section which is primarily reserved as heavy industrial area

98. The IFC-WB (2007) provides guideline values on noise, which apply beyond the property boundary of facilities. The noise emitted beyond the property of facility should not exceed the values provided in Table II-13 or result to an increase of 3 dBA from the background noise of the nearest receptor. The noise parameter used is the one-hour LAeq, which is obtained using a

sound level meter capable of measuring noise levels at very short interval (i.e., 1 sec).

99. The adoption of the 3 dBA increase for construction activities results in a more stringent requirement than that of the PHI standard (85 dBA for class 2 activities). The IFC standard will henceforth be applied during construction and operation for all project-affected areas, especially in the formulation of mitigation measures. Both noise parameters, however, need to be obtained since complaints settlement may still require reference to PHI standards.

Table II-13 Guidelines for Community Noise of World Bank Group EHS Guidelines of 2007

Receptor	One Hour LAeq (dBA) [1]	
	Day Time (7:00 A.M. – 10:00 P.M.)	Nighttime (10:00 P.M. – 7:00 A.M.)
Residential, institutional and educational [2]	55	45
Industrial and commercial	70	70

Notes:
[1] Guideline values are for noise levels measured out of doors.
[2] Acceptable indoor noise levels for residential, institutional and educational settings refer to WB-EHS (2007).
Noise impacts should not exceed the levels presented in Table II-13, or result in a maximum increase in background levels of 3 dB at the nearest receptor location off-site.
Source: WBG Guidelines for Community Noise, 2007.

5) Sediment and dredged materials (dredgeate) related standards

100. DPWH has released a guideline (Department Order No. 2015-168- Guidelines in the Disposal and Management of Spoils and Debris Generated from All Ongoing and Completed Construction and Maintenance Projects) to address the reckless dumping of spoils and debris and the inconsiderate stockpiling of materials and construction wastes. This guideline states that "Non-hazardous contaminated soils are soils taken from excavation of specific sites which are part of a construction project and in which soils do not exhibit any signs of ignitability and/or toxicity." Dredged materials are planned for beneficial use as fill material. To qualify as such, the following soil standards from Philippines, a neighboring country (Vietnam), and USEPA Regulatory Determinations for Pollutants in Biosolids are presented for comparison. The PHI standard presented here is applied to any material that will be used for soil application as soil conditioner. These are comparable to VIE standard for application in forest land and more stringent than USEPA biosolids and will be for adopted. In case the materials exceed the PHI standard for soil conditioner but are still within those prescribed by the VIE standard for Inhabited or Industrial Land and still very much within the USEPA norm, clarification with the regional EMB on the intended disposition of the material will be sought.

Table II-14: Soil quality standard (applicable to land based dredgate disposal)

Viet Nam							PHI std	USEPA
Parameter	Unit	Land Type					soil conditioner	biosolids
		Agricult-ural land	Forest land	Inhabited land	Industrial land	Service land		
Arsenic (As)	mg/kg of dry soil	15	20	15	25	20	20	75

Viet Nam							PHI std	USEPA
Parameter	Unit	Land Type					soil conditioner	biosolids
		Agricult-ural land	Forest land	Inhabited land	Industrial land	Service land		
Cadmium (Cd)	mg/kg of dry soil	1.5	3	2	10	5	5	85
Lead (Pb)	mg/kg of dry soil	70	100	70	300	200	50	840
Chromium (Cr)	mg/kg of dry soil	150	200	200	250	250	150	3,000
Copper (Cu)	mg/kg of dry soil	100	150	100	300	200		4300
Zinc (Zn)	mg/kg of dry soil	200	200	200	300	300		7500

Notes:
Viet Nam standard is QCVN03MT:2015/BTNMT.
Philippine Standard; PNS/BAFS 40:2016. Maximum allowable level of heavy metals for solid and liquid fertilizers, compost/soil conditioner, and organic plant supplements.

Table II-15: Vietnamese sediment quality standard, QCVN43:2017/BTNMT (select values).

Parameter	Unit	Fresh Water	Salty water, brackish water
Cadmium (Cd)	mg/kg of dry soil	3.5	4.2
Arsenic (As)	mg/kg of dry soil	17.0	41.6
Mercury (Hg)	mg/kg of dry soil	0.5	0.7
Iron (Fe)	mg/kg of dry soil	-	-
Lead (Pb)	mg/kg of dry soil	91.3	112
Copper (Cu)	mg/kg of dry soil	197	108

Source: QCVN43:2012/BTNMT, national technical regulation on sediment quality.
Notes: Sediments are matter particles, located at a depth not exceeding 15 cm from the bottom surface of the water body, with particles less than 2 mm in size or passing through a 2 mm pore (US # 10 sieve) sieve.

101. Materials are also assessed for potential hazardousness using the IFC EHS Guide on Contaminated Land (Sec. 1.8 of the General EHS Guidelines). The guidelines require an assessment of potential sources of contamination in the area based on historical operational information.

102. In case materials are suspected as contaminated with heavy metals to the extent of hazardousness, the following screening guides will be used. Characteristics of toxicity are defined in the implementing rules of RA 6969. For heavy metals, these are as follows:

Table II-16 Concentration of heavy metals for classification as hazardous waste

Parameters	TCLP Limits (mg/L)
Arsenic	>1
Barium	>70
Cadmium	>3
Chromium	>0.3

Lead	>1
Mercury	>0.1

Source: DAO 2004:36

103. In case dredged materials are contaminated with pesticides, the Philippine Guidelines for Site Remediation (MC 2017-004) provides for screening values. They are listed in the following table. Most of these pesticides have already been banned in the country as part of the Stockholm Convention but illegal usage may not be precluded.

Table II-17 Screening Values for Pesticide Contaminated Sites

POPs Parameter	Residential Use Soil (mg/kg)	Industrial Use Soil (mg/kg)	Surface Water (µg/L)	Groundwater (µg/L)
Aldrin	0.029	0.1	1	0.004
Chlordane	1.6	6.5	3	0.2
Total DDT (DDT+DDE+DDD)	4	4	50	1
Dieldrin	0.03	0.11	1	0.0015
Endrin	18	180	0.6	0.6
Heptachlor	0.11	0.28	0.3	0.3
HCB	0.3	1.1	0.042	0.042
Mirex	0.027	0.096	0.0037	0.0037
Toxaphene	0.44	1.6	5	0.013
PCBs Total	0.22	0.74	1	0.017
Dioxins (I-TEQ)	0.00018	0.00018	0.0001	0.0001

Notes:

1. *For Soil, these were all taken from USEPA RSLs but since there are no USEPA RSL values for Total DDT and Dioxins so the DIV values have been chosen.*
2. *For Surface Water, those available from the DENR Standards were selected except for the Endrin and heptachlor values were taken from the Philippine Drinking Water Standards. The rest were selected from USEPA RSL Tap water if available but if not, then from DIV.*
3. *For Groundwater, the USEPA RSL's for Tap Water have been mainly chosen except where existing Philippines Drinking Water values already exist. The Dioxins value is the US National Drinking Water Standards value.*
4. *The USEPA RSLs are regularly updated twice a year, thus, please refer to the latest values at the following link: https://www.epa.gov/risk/regional-screening-levels-rsls*

Source: MC 2017-004

104. Dredged materials that would exhibit the above concentrations will be classified as hazardous wastes and require disposal through dedicated hazardous waste landfills or treatment by accredited hazardous waste treaters. Alternatively, other practical methods of disposition may be sought through dialogue with EMB.

III. Baseline of the Environment

105. Information on the current environmental conditions in the project areas constitutes the baseline against which the impacts of the projects are to be assessed. Baseline environmental data was obtained from secondary sources including routine monitoring carried out by regional or provincial centers for environmental and natural resources monitoring of air, noise and water, as they are more representative by nature, e.g. in terms of seasonal variation.

A. Abra River Basin

106. Abra River Basin (ARB) covers a total area of 4,936 km², making it the sixth largest river basin in the Philippines. The area drained by the Abra River is 3,381 km², while its major tributary, the Tineg River, drains 1,555 km². The river is estimated to be 208 km long, extending over two regions in Northern Luzon (Region 1 and Cordillera Administrative Region) and four provinces: Ilocos Sur in Region 1, and Abra, Benguet and Mountain Province in Cordillera Administrative Region (CAR). The sub-tributaries of the ARB include: Binongan, Soot and Malanas, Ikmin, Bucloc and Manicbel Rivers and Baay River, all of them on its right bank, and only Sinalang River on its left bank.

107. Two main urban centers are found in the basin: the Vigan area (in the river delta comprising of Vigan City, Bantay, Caoayan, and Santa), and in the middle of the basin, Bangued City (and its neighboring minor municipalities Tayum, La Paz, and Dolores). In the upper basin, the population density is very low, with only Manabo and Cervantes as significant urban centers.

108. In recent years, the Abra River basin has been hit with seasonal flooding during monsoon time. A major destructive flood that occurred in 2001 triggered by Tropical Storm Feria caused partial destruction of Quirino Bridge (Banaoang Bridge) near the mouth of the Abra River. Though not a very strong storm, it brought heavy rain over Northern Luzon and caused 197 fatalities and nearly $300 million (2001 USD) in damages.

1) Physical Environment

109. **Location**. Abra River Basin is located in the northern part of Luzon Island and it lies in two regions: Cordillera Autonomous Region for over 90% of the area in the Provinces of Abra, Mountain Province and Benguet, and the remaining in Region I in Ilocos Sur Province. With a total area of 5,125 km^2, it stands as the 6th largest river basin in the Philippines. The basin area, for the purpose of this project, includes the whole river delta. The area drained by the Abra River is 3,381 km², while its major tributary, the Tineg River, drains 1,555 km².

110. **Topography.** From the western portion to the eastern side of the watershed, the topography ranges from flat (making up only 10% of the watershed found at the river valley comprising of alluvial terraces and in-fill valleys) to rugged and mountainous at the north - northeast, east, and southern parts The eastern divide hosts the highest point at 2000 meters above sea level (masl) or higher and has the highest relief. To the western part the relief is lower. The central part becomes rolling to moderately rugged. Its relief is moderate to low with the highest elevation reaching only 500 masl.[6]

[6] DENR-RCBO. 2015. Formulation of Integrated River Basin Management and Development Master Plan for Abra River Basin. Manila

111. **Soils.** Sandy clay loam dominates the eastern section of the watershed and rough stony soil at the northern peaks. Clayey soil is found in the areas of Licuan-Baay, Sallapadan and Lagangilang in Abra and Besao and Sagada in Benguet. Fertile loamy soil is found in the flood plains from Benguet up to Ilocos Sur provinces. Clay loam soil is found in Tayum, Pidigan, San Quintin and San Juan.

112. **River morphology.** Abra River shows different morphologies or characteristics. It shifts from a single channel river to a meandering and braided river.[7] As observed during a site visit in 2018, at the narrowest point of the Abra River (Calaba bridge, very close to Bangued) the river width is 900 m. This is remarkably wide for a 5000 km^2 river basin area. Within a minimum width of 900 m, and often 2 to 3 km wide, the river shows different morphologies.

113. **Sediment transport.** The Abra River is capable of transporting a high amount of sediment and that it does so effectively in floods. The very wide river channels with meandering, wandering and braided planforms are proof of a high potential for bed material sediment transport. Likewise, floodwaters reach from side to side of the valley so that the whole bed width is made active by floods.[8] The alluvial beds of the Abra River are subjected to the heavy action of quarrying.

114. **Hydrology**. The Abra River peak discharges at Banaoang Bridge for the 10- and 100-year return periods were estimated at 9,000 and 17,000 m^3/s respectively, based on the statistical analysis of available DPWH records.

115. **Flood**. Population in the Abra basin are vulnerable to a number of flood-related issues because all flat lands in steep relief areas are inhabited and also prone to flooding. Flood depths are considerable throughout the Abra River Basin. The highest flood levels are encountered at bottlenecks and the lowest ones where the Abra River broadens. Upstream of the Tineg-Abra confluence three significant bottlenecks generate substantial flood depths: Upstream Manabo, Ikmin-Abra confluence, and Don Mariano Marcos Bridge. Downstream of the confluence, the San Diego constriction (the narrowest bottleneck) and the subsequent series of bottlenecks generate higher and higher water levels as the Abra River finds its way through the Ilocos Cordillera. The maximum value for the 100-year flood is at 17.9 m downstream of San Quintin.

116. In the vast and braided sections flood depths decrease but remain large. The diversion channels fill in with water levels commonly reaching 4 m and 6 m high for the 5- and 100-year flood, respectively. On the sand bars and river islands, flood depths are lower but still reach above 2 m for the 100-year flood.

117. Flood velocities are also considerable in the ARB. They reach their maximum where flow sections decrease (>3 m/s) and also where slopes are significant (i.e., mainly in the tributaries). Floods from the tributaries arrive fast (>4 m/s) as observed on the Baay and Ikmin Rivers that worsens the flooding situation downstream. In the flood plains velocities tend to decrease as flows disperse (<1 m/s). However, a multitude of diversion channels funnel the excess waters resulting in high velocities crossing the floodplains (up to 3 m/s).

118. **Hydraulics**. The river system has a hydraulic behavior fully in line with the heavy sediment transport process: the upper reaches of the Abra River and its east side tributaries behave like mountain torrents with flash floods and permanent high velocity flow. In the plain areas the rivers show meanders or braided beds with high sediment deposits in the major bed

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[8] DPWH. 2018. Abra Final Site visit Report. Manila

and minor beds that can change at any flood event.

119. The river delta in the vicinity of the Vigan urban area is fairly stable. To protect constructed or commercial areas and agricultural fields, riverbank protection structures have been constructed. However, the impact of the dike would reduce the delta width and cause an increase in flow velocity and hence in sediment transport towards the sea in the usual (annual) flooding conditions with possible consequences on the neighboring coastline.

120. **Climatic Conditions.** Most of the areas in the ARB belong to Climatic Type I in the Modified Coronas Classification. Only a small portion at the eastern part of the watershed falls under Type II characterized by two pronounced seasons, wet from May to October and dry during the rest of the year. According to the Integrated River Basin Management and Development Master Plan for Abra River Basin[9], the basin's annual rainfall varies between 2,500 mm and 3,000 mm.

121. Northern Luzon, where the ARB is located, is frequented by tropical cyclones. In a 71-year data, tropical cyclones mostly occur in the latter part of the year. Cyclones appear as early as April or May and lessen its occurrences by January.

122. **Climate Change.** A detailed Climate Change study[25] was carried out on the river basin based on the international greenhouse gas concentration trajectory made by the Intergovernmental Panel on Climate Change (IPCC) with Representative Concentration Pathway (RCP). The results of the climate change modelling for the Abra River Basin are as follows:

i. The temperature will rise between 1°C and 1.8 °C. The change will have an impact on the rainfall and the seasonal pattern.

ii. Rainfall is more likely to be almost stable in dry season (December, January, February) and to significantly decrease in monsoon season (June, July, August) as well as in the intermediate conditions.

iii. Sea level rise between 2020 and 2060 is assessed within the framework of the Project: around +10 cm for both RCP 4.5 and RCP 8.5 scenario. Considering the uncertainties of such assessments, an average SLR between now and 2050 around +10 cm was considered. The sea level rise will not influence the Abra River flooding.

2) Biological environment

123. **Land Use and Classification.** Agriculture is the main activity in the river basin while the rest are classified as open forest in the middle part, and closed forest at the northeast, east, and southeast part of the watershed at the ridges or border of the watershed. Built-up areas occupy a small portion of the river basin as also the sparse/barren lands. Other land uses can be found at the river mouth in the delta of the basin, namely some mangrove forest, marshland swamp, and fishponds. Data on Land uses based on the Global Forest Watch (2020) Satellite Data shows that agriculture occupies 650,000 ha or 57%, while forests consist of 486,000 ha (42%). In Abra, about 0.414% of the total land area is covered by mining tenements as of December 2017.

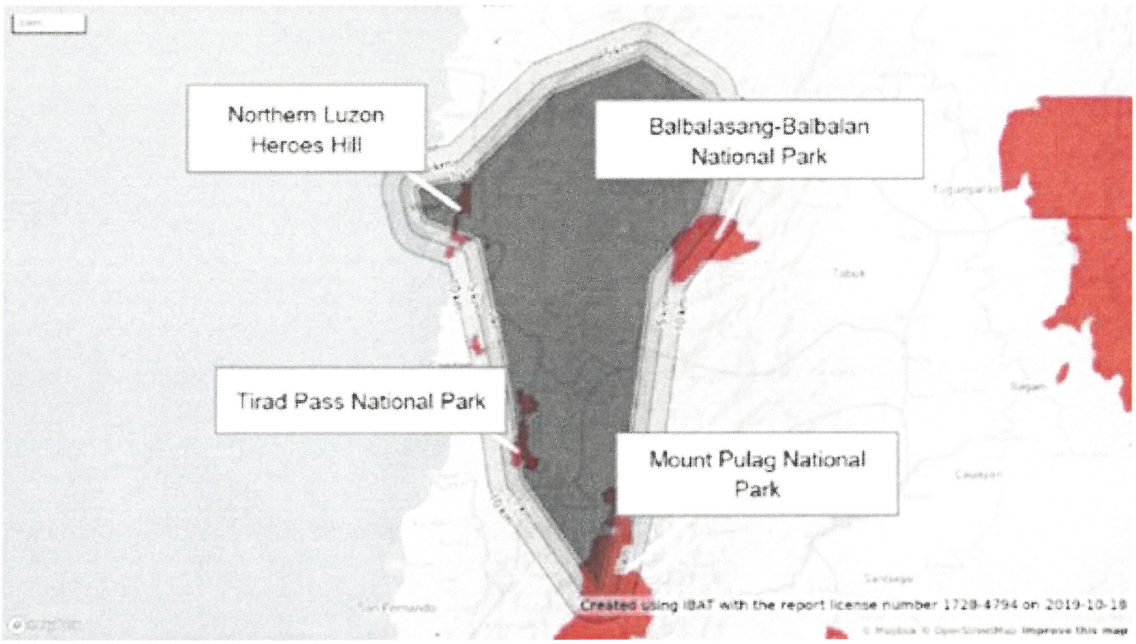
124. **Protected Areas, Key Biodiversity Area and Nature Reserves.** The Abra River Basin Watershed includes some national legally protected areas and key biodiversity areas (Figure III-1) located mostly in remote, high altitude areas. The proposed works will be concentrated in

[9] Berkman International, Inc. 2015. Formulation of Integrated River Basin Management and Development Master Plan for Abra River Basin. Manila

populated areas in the floodplain of the river outside of these protected areas.

125. The ARB by itself is classified as a critical watershed. A critical watershed is defined by DENR as a drainage area of a river system supporting existing and proposed hydroelectric power, irrigation works, or existing water facilities needing immediate protection and rehabilitation to minimize erosion and improve water yield. The Abra River Basin Management Council is mandated to carry out this function.

Figure III-1: Protected Areas in Abra River Basin



Source: JV Egis, INCLAM, KECC 2019

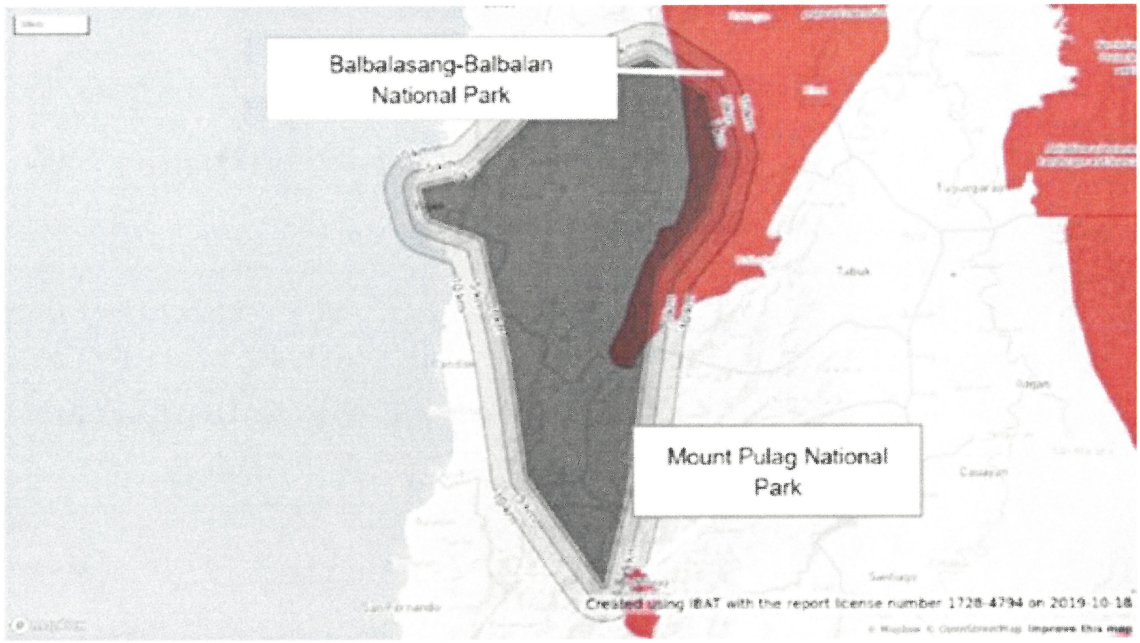
126. Within the ARB, agroecosystems as modified habitats also have Protection Agricultural Sub-Zones. These are areas within the Agricultural Zone of cities/municipalities that include the Network for Protected Areas for Agriculture and Agro-Industrial Development (NPAAAD). (Republic Act No 8435).

Table III-1 List of National Protected Areas and KBA's in ARB

Protected Area	Location	Distance to nearest subproject*	Area (has.)	Remarks
Casamata Hill National Park. Proclamation (Proc No. 1305, Aug 1974)	Bangued, Abra	2.5 km Z3P3-SC2-01	57	For delisting as NIPA (co-management with LGU)
Balbalasang-Balbalan National Park, (RA 6463; Proc 1357. Jun 1974)	Balbalan, Kalinga and Apayao	27 km TRB1-RS-01	1,338	
Northern Luzon Heroes Hill National Park (NLHHNP). (Proc 132. Jul 1963)	Santa and Narvacan, Ilocos Sur	4.0 km Z1P0-RS-02	1,316	For delisting (co-managed with the Municipality of

Protected Area	Location	Distance to nearest subproject*	Area (has.)	Remarks
				Santa)
Santa Watershed Forest Reserve. (Proc 844 Sep 1935)	Santa, Ilocos Sur	4.0 km Z1P0-RS-02	25	For delisting (to be incorporated with NLHHNP co-managed with the Municipality of Santa)
Bessang Pass National Monument/Landmark. (Proclamation No. 284, Apr 2000)	Ilocos Sur	50 km Z8P1-SC2-01	581.05	
Mt. Pulag National Park (Proc. No. 75 Feb 1987)	Pasaleng, Ilocos Norte to Cordillera Prov.	95 km Z8P1-SC2-01	11,550	

Figure III-2: Key Biodiversity Areas in Abra River Basin



Source: JV Egis, INCLAM, KECC 2019

127. **Terrestrial and Aquatic Wildlife.** The Wildlife Act of 2001 or RA 9147 seeks to conserve the country's wildlife resources and their habitats. The threatened fauna species that could be found in the ARB or its vicinity are shown in Table III-2.

Table III-2. List of Threatened Fauna that might be found in the Abra River Basin

Species	IUCN	DAO 2019 - 09
Reptiles (1)		
1. *Crocodylus mindorensis* (Philippine Crocodile) – Endemic	CR	CR
Birds (7)		
1. *Pithecophaga jeffreyi* (Philippine Eagle) – Endemic	CR	CR
2. *Acrocephalus sorghophilus* (Speckled Reed Warbler) – not endemic	EN	CR
3. *Calidris tenuirostris* (Great Knot) – not endemic	EN	EN
4. *Gorachius goisagi* (Japanese Night Heron) – not endemic	EN	EN
5. *Nisaetus philippinensis* (Philippine Hawk Eagle) – endemic	EN	VU
6. *Numenius madagascariensis* (Far Eastern Curlew) – not endemic	EN	CR
7. *Prioniturus luconensis* (Green Racket-Tail) – endemic	EN	CR
Mammals (2)		
1. *Acerodon jubatus* (Giant Golden Crowned Flying Fox) - endemic	EN	CR
2. *Crateromys schadenburgi* (Luzon Bushy-Tailed Cloud Rat) - endemic	EN	VU

Source: IBAT 2019

128. The Ludong was mentioned in the DENR RBCO report and also included in the IBAT Report (2019) as one of the "near threatened" species. Per IBAT Report (2019), the Ludong has a "vague identity and its biodiversity value" remains uncertain. The local fishermen in the ARB call the fish they catch "Ludong" but so far the scientific identity of the fish remains uncertain.

129. Manalo (2008)[10] confirmed the presence of the Philippine Crocodile, *Crocodylus mindorensis*, an endemic and critically endangered species in the ARB. The habitat of the reptile is found above 800 masl at the Binongan River, Tineg Municipality (Figure III-3).

130. **Vegetation.** There are 141 species of plants that could be found in the forests of the upper reaches of the ARB. Of these, 106 are endemic of which 19 have medicinal value. There are 35 exotic or introduced species but only eight of these are medicinal.

131. *Forest Ecosystem.* From 2002-2019, Abra lost 970 ha. of the primary forest; Ilocos Sur lost 26 ha.; Mt. Province lost 291 ha; and 330 ha. were lost in Benguet.[11] As of 2016, the Global Forest Watch revealed that the remaining intact forest, with more than 30% forest cover in Abra, was only 3.7% of the Abra's tree cover.[12] The municipalities of Tineg and Lacub alone had the highest combined tree cover loss, covering 62% between 2001-2018. No more intact forest cover was observed in Ilocos Sur, Benguet, and Mt. Province.

132. Different species of rattan (Uay) were documented in the forestlands of the municipalities of Danglas, Licuan-Baay, Lagayan, Daguioman, Tubo and Villaviciosa, in Abra (Guzman 2015). *Calamus merrillii*, *C. ornatus*, *C. microcarpus* and *Calamus* sp. were most abundant in Tubo, Daguioman, Danglas, and Lagayan, and least diverse in Baay-Licuan. The 'Lapat system' was the conservation and preservation method of rattan in Tubo and Daguioman, Danglas, Lagayan, Baay-Licuan and Villaviciosa. These help the Abrenians

[10] Manalo, R. 2008. Occurrence of Crocodylus mindorensis in the Cordillera Central, Abra Province, Luzon Island. National Museum Paper. Vol 14 p. 7.

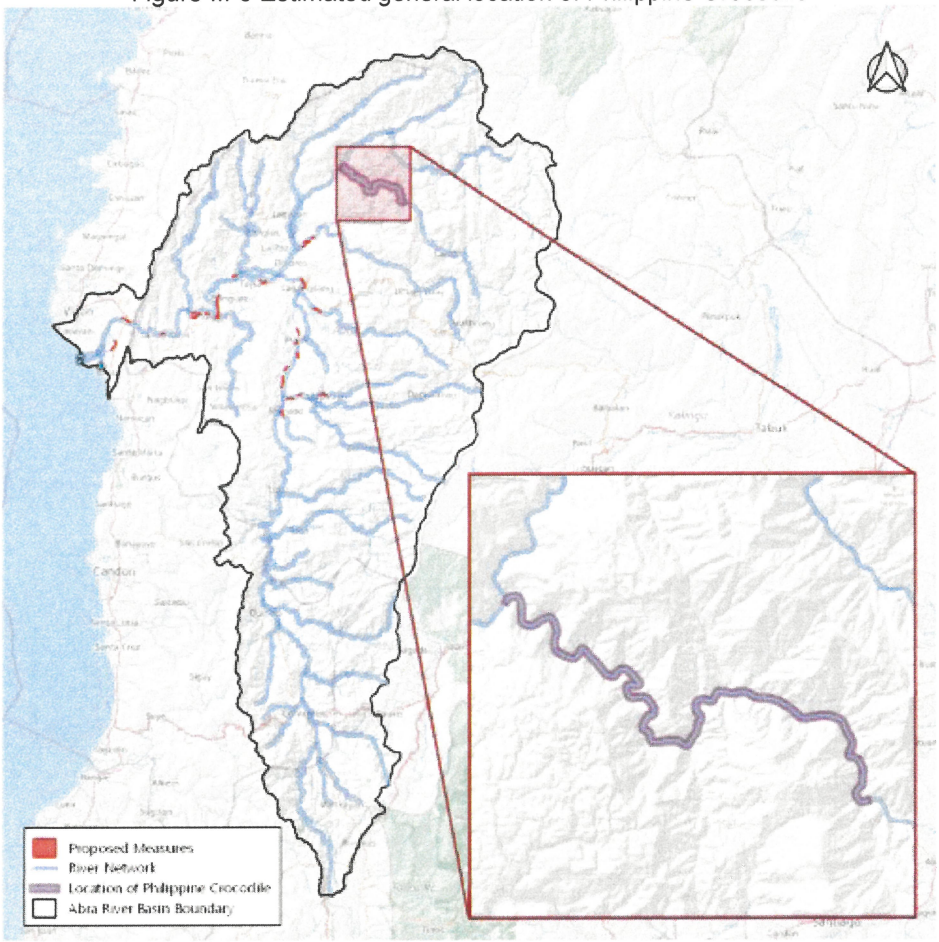
[11] www.globalforestwatch.org (accessed on 2 October 2020).

[12] Bio-physical presence of trees; may take the form of natural forests or plantations existing over a range of canopy densities. All vegetation taller than 5m in height (www.global forestwatch.org)

generate income for their daily sustenance.[13]

133. *Riparian Ecosystem*. The absence/presence of sparse/dense vegetation in riparian ecosystems in the ARB is determined by fluctuations in riverflow from normal to large flooding events. These events contribute to the difficulty of bigger trees to establish a foothold along the riparian areas. Pioneer species can survive and colonize, usually invasive species. Individuals of *Homonoia riparia, a* hardy riparian shrub species also survive by anchoring its roots underneath stable rocks.

Figure III-3 Estimated general location of Philippine Crocodile



Source: Manalo, R. 2008. Occurrence of Crocodylus mindorensis in the Cordillera Central, Abra Province, Luzon Island. National Museum Paper. Vol 14 p. 7.

134. *Grassland Ecosystem*. In the grassland/shrubland ecosystem, slash and burn farms (kaingins) were observed. Around 51 plant species have been identified. Of these, 18 were introduced and two have medicinal value. On the other hand, 33 are found to be endemic and six of them have medicinal value.There are several species of bamboo in the Municipalities of

[13] https://ejournals.ph/article.php?id=12438 (accessed 11/11/2020)

Sallapadan, Licuan-Baay, Boliney, Bucloc, Luba, Tubo, Tayum, Lagangilang, San Juan, Penarrubia and Bucay. *Gigant ochloa levis* is used for general construction, basketry, furniture and edible shoots. *Bambusa blumeana* is used for making fishpens as well as the round pole market. Around 390,000 poles are harvested annually in Abra. Other species such as puser (*Cyrtochloa puser*), ingrio and bolo bamboo are also sold as unprocessed poles. Puser is a climbing bamboo endemic to Abra like *S. lumampao*.[14] Buho (*S. lumampao)* alone covers about 15,000 ha of land in Abra.

135. *Agricultural ecosystem*. The Provinces inside Abra River Basin are predominantly agriculture-based. Mango is already widely cultivated in the province of Abra. Mango and cashew are moderately suitable in 15,456 has over Bucay, Dolores, Lagangilang, Licuan-Baay, La Paz, Manabo, Tayum and Cervantes. Cashew planting was scattered in Boliney, Bucay, Danglas, Dolores, La Paz, Lagangilang, Lagayan, Luba, Malibong, Manabo, Oidigan, Pilar, Sallapadan, San Isidro, San Juan, San Quintin, Tayum, Tineg, Tubo and Villaviciosa. The highlands of Abra River Basin hosts two of the province's highly productive key commercial crops (pomelo and coffee).

136. *Delta Flood Plain Ecosystem*. Downstream of the ARB are urban and built-up areas, along with agricultural and grazing areas in the floodplains. Here one can find 98 species of plants of which 45 are exotics or introduced. Fifteen (15) are found to be edible whereas five have medicinal value. From the 98 plant species, 53 are endemics and there are 16 which are edible and 12 have medicinal value.

137. Inland into Barangay Raois, Vigan City, pasture lands for horses, cattle and goats were observed. These horses are grazed there until the tourism industry would improve and the horses can again be used for the "Kalesa" touring around Vigan's World Heritage Spanish era streets and houses in the city. Cattle Egrets (*Bubulcus ibis*) were found to congregate and feast on insects and other small organisms in the newly-plowed areas being prepared for planting (Mission Report Environment Safeguards Team October 2020).

138. Some plantations of banana (*Musa sp*), Cassava (*Manihot esculenta*), Corn (*Zea maize*), rice (*Oryza sativa*) and trees in plantation of Yemane (*Gmelina arborea*) flourish at the floodplains. Individual trees such as Kakauate (*Gliricidia sepium*), Alim (*Macaranga multiglandulosa*), Kamachile (*Pithecellobium dulce*), Bangkal (*Nauclea sp*), and other common brushland species that are most likely spread via bird droppings or from mammals, also find nourishment there.

139. *Mangrove Ecosystem*. Only 30.85 ha of mangroves were reported to be found in the coastal areas of the Zone 1 host municipalities of Santa and Caoayan, and Vigan City. Natural/Old stand is 5.31 ha found in Barangay Magsaysay, Municipality of Santa. True mangrove species that were reported to be found in Ilocos Sur are as follows: saging-saging; bungalon; api-api; pototan; pototan lalaki; busain; malatangal; tubau; nipa, taualis; bantigi; bakauan-babae; bakauan-lalaki; bakauan-bato; pagatpat; and pedada. On the other hand, mangrove associated species/beach forest species found in Ilocos Sur are: tubli; tui; buta-buta; lambayong; talisai; botong; bitaog; malobago; dampalit; and aroma.

140. *Invasive Species*. Aroma (*Prosopis juliflora*) is an invasive species known to displace native species. It is not a true mangrove species. It was observed to abound in the beach area of Rancho Island as well as in Poro Island as seen from afar.

141. Around the gabions in Barangay Basug, Santa, Ilocos Sur, the flood plains and

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https://www.inbar.int/wp-content/uploads/2020/05/1489483924.pdf (accessed 01 November 2020).

embankments were dominated by invasive plant species. The species are identified as the following: Cogon grass (*Imperata cylindrica*), Water Hyacinth (*Eichhornia crassipes*), *Panicum repens, Lantana camara, Jatropha gossypiifolia,* Cadena de Amor vine (*Antigonon leptopus), Cassia tora,* and other herbaceous plant species.

3) CURRENT ENVIRONMENTAL CONDITIONS

142. **Water Quality**. The proposed classification of Ikmin River in accordance with DAO 2016-08 and upon the evaluation of the EMB-CAR Personnel Monitoring Team is Class B freshwaters. EMB Region I (2019) stated that the Abra River was classified as Class A in 1976 and Tineg River is classified as Class B waters.

143. Table III-3 shows the water quality on-site reading and water quality laboratory results undertaken by EMB-CAR in 2019. Monthly sampling were undertaken and the averages are reported.-The results show that samples were all within the respective guide values and water quality are in compliance.

Table III-3. Water Quality Results from EMB-CAR

Station no.	Description	Classification	On site Results			BOD	TSS (mg/L)	PO-P (mg/L)	NH3-N (mg/L)
			pH	DO (mg/L)	Temp (°C)				
SS-1	San Quintin-Abra River	Class A	7.31	11.12	25.53	<1	2	0.034	<0.017
SS-2	Pidigan-Abra River	Class A	7.27	10.77	25.36	<1	6	0.031	<0.017
SS-2-1	Sinalang Bridge-Pidigan-Abra River	Class A	6.89	8.67	24.74	<1	14	0.030	0.035
SS-4	Calaba Bridige, Calaba-Abra River	Class A	7.35	9.11	24.72	2	5	0.033	<0.017
SS-5	Upstream Abra River (Bumagcat, Tayum, Abra)	Class A	7.75	8.12	24.42	1	6	0.035	<0.017
SS 4-1	Salocag, Dolores, Abra-Tineg River	Class B	7.89	9.41	23.67	1	<1	0.03	<0.017
	Water Quality Guide	Class A Class B	6.5-8.5 -do-	5 -do-	26-30 -do-	3 5	50 65	0.5 -do-	0.05 -do-

WQG = Water Quality Guidelines, DO = Dissolved Oxygen, Temp = Temperature
Source: EMB-DENR-Region 1 (2019)

144. **Air Quality and Noise**. EMB has deployed continuous ambient air monitoring stations throughout the country. Most, however, are in urban areas and monitor only PM10. The nearest station for the project site is in Vigan City. Two subprojects are near Vigan City and along the national highway, while the rest are centered around Bangued, a 1st class municipality. Data

from an environmental study conducted in Bugallon, Sison, Pangasinan[15] is presented here to approximate the rural setting air quality.

The Ambient Air Quality Monitoring for Vigan City Hall are shown in Table III-4. The overall PM10 monitoring recorded annual average of 93 ug/NCM which is within the DENR criteria for PM10. The annual geometric PM10 value of 87 µg/Ncm did not meet the annual Ambient Air Quality Criteria of 60 µg/Ncm for one-year monitoring reflecting a FAIR Air Quality Index.[16] This is also above the WHO Ambient Air Quality Guideline of 70 ug/NCM (Interim Target 1).

Table III-4. PM10 Ambient Air Quality Monitoring for Vigan City

Quarter	Min.	Max.	Average	DENR Criteria 24-hr sampling	Remarks
1st	42	137	98	150	Within criteria
2nd	21	171	88	150	Within criteria
3rd	40	132	90	150	Within criteria
4th	24	137	87	150	Within criteria
Annual Average	93 µg/Ncm				
Annual Geomean	87 µg /Ncm			60	Above criteria

Source: EMB-DENR Region 1. 2019. Regional State of Brown Environment Report. San Fernando, La Union.

145. The results of 24-hr ambient PM10 monitoring conducted in Bugallon, Sison, Pangasinan near the schools indicated in the table were all below the DENR ambient guide value of 150 ug/NCM

Table III-5 PM10 24-hr monitoring in representative site

	Location	Date of Sampling	PM10
A1	Labayug National Highschool	25 July 2019	7.2
A2	Inmalog Elementary School	25 July 2019	10.1
A3	Sitio Saguitlang Elementary School	25 July 2019	15.0

4) Socio-economic conditions

146. **Demographic Profile**. Based on the Philippine Statistics Authority (2015) data, 487,651 people are living in the 37 municipalities and one city along the Abra River Basin. The male were 51 and female was 49%, similar to the national male-female ratio (male 50.48%, female 49.52%). The largest numbers of inhabitants of the River Basin reside in Vigan City (pop. 52,230), Bangued, Abra (pop. 47,820), Bantay, Ilocos Sur (35,466), and the first-class municipality of Mankayan, Benguet (pop. 35,914). The province with the highest concentrations of residents in the ARB is Ilocos Sur with a population density of 266 inhabitants for every squarekilometer, according to the Philippine Statistics Authority (2015). This is largely due to the urban areas in Vigan City, Bantay, and Caoayan towns in the delta zone. On the other hand,

[15] NORTHERN CEMENT CORPORATION Environmental Performance Report and Management Plan. NCC Cement Plant and Quarry Expansion Project. August 2019.
[16] EMB-DENR Region 1. 2019. *Regional State of Brown Environment Report*. San Fernando, La Union.

abra province has an average density of 57 inhabitants per squarkilometer.

Economic Profile

147. *Abra*. The economy in Abra is basically agriculture-based. High-value agricultural crops grown in Abra include rice, corn, and vegetables. Other major crops are root crops, coffee, tobacco, and coconut. Cottage industries are also part of Abra's economy such as bamboo and rattan craft making, natural dye, loom weaving and embroidery. Sand and gravel operations proliferate in the municipalities of Peñarrubia, Tayum, Pidigan, La Paz, Lagangilang, Bangued, Manabo, Dolores, Bucay and San Juan.[17] On the other hand, small-scale mining proliferates in Licuan-Baay (Capcapo and Patok), Lacub (Magtalalang), Malibcong (Kotop), and on the boundary of Manabo and Boliney (Ableg).[18]

148. *Benguet*. Benguet has 13 municipalities of which two municipalities are located within the river basin, Bakun and Mankayan. Bakun's economy is focused on growing agricultural crops, specifically on temperate climate vegetables. The key crops being planted are field crops (rice, legumes, coffee, corn, tiger grass, and ginger), root crops (sweet potato, cassava, and gabi), vegetables and fruits. Major vegetables grown are cabbage, potato, carrot and Chinese cabbage. Fruit growing include citrus/oranges, banana, avocado, blue berries, passion fruit. Locals are also engaged in cutflower production. Small scale mining (SSM) is also another source of livelihood in Bakun.

149. The municipality of Mankayan is predominantly agriculture based with 7,515 ha devoted to agriculture. Only 140 ha are irrigated. Subsistence farmers grow highland vegetables as their source of livelihood. Next to farming the other source of livelihood is mining.[19]

150. *Mt. Province*. Only two municipalities of Mt. Province, Besao and Tadian, lie within the river basin. The local economy of Mt. Province depends mostly on agriculture and tourism. The key crops are rice (the major crop), fruits, vegetables, coffee, and corn amongst others. Mining also drives the economy in Mt. Province.[20]

151. *Ilocos Sur*. A total of 9 municipalities in Ilocos Sur are within the boundary of the river basin. The economy of these municipalities is mostly based on agriculture where rice, corn, vegetable, root crops, onions and fruits are produced for domestic consumption. Other crops include tobacco, cotton, and tiger grass. Another source of livelihood are the cottage industries which include loom weaving, furniture making, jewelry making, ceramics, blacksmithing, and food processing. Weaving is the most extensive handicraft in the region. Tourism is another economy driver in Ilocos Sur. There are two sites in Ilocos Sur that have been inscribed by UNESCO in the World Heritage List: i) the Heritage City of Vigan[21] and ii) the Santa Maria Church.[22]

152. **Education**. In the Cordillera Administrative Region, there are 57 higher education institutions (HEIs), 47 of which are private. In the Province of Abra, the Abra State Institute of Science and Technology (ASIST) provides higher education programs in the Abra River Basin. In Region I, there are 114 HEIs, 83 of which are private.

153. ***Public Health***. The top 3 leading causes of morbidity recorded in CAR and the Ilocos

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[17] http://abra.gov.ph/tag/sand-and-gravel/
[18] https://mb.com.ph/2019/02/03/abra-tightens-screws-on-quarrying/
[19] *"Municipality of Mankayan, Benguet"*. Department of the Interior and Local Government - *Cordillera Administrative Region (official website)*. 29 April 2013.
[20] http://www.piplinks.org/Loreta+Yocogan+.html
[21] *ttp://whc.unesco.org/en/list/502*
[22] *http://whc.unesco.org/en/list/677*

Provinces in 2016 are as follows: 1) Acute Respiratory Infection; 2) Hypertension; and 3) Urinary Tract Infection. Other ailments in CAR include acute water diarrhea; bronchitis; ALRTI and Pneumonia; Influenza; Acute bloody diarrhea; dengue fever; and acute hemorrhagic fever. In the Ilocos, the other ailments include dengue; bronchitis; influenza; acute watery diarrhea; diseases of the heart; TB Respiratory; and ALRTI pneumonia.[23]

154. The number of COVID-19 cases in ARB is very much controlled due to: effective management at the provincial boundaries' entry points requiring very recent results of swab or antigen tests (within 48 hours); allowing only short visits in the areas; observing health protocols such as social distancing, wearing of face shields and masks; and frequent washing of hands.

5) Physical Cultural Resources and Sensitive Receptors

155. The Historic City of Vigan, a UNESCO World Heritage site, is around 7 km from the nearest construction subproject (Zone 1). Apart from this, there are no other PCR's are located near any of the subprojects.

156. The location of sensitive receptors along the subprojects is listed in the table below. These are within 100-m from proposed structures, hence, the appropriate mitigation measures for impacts during construction will take these receptors into account.

Table III-6 Location of Sensitive Receptors near the ARB Project Area

Sub Project Interventions	Location	Specific Barangays	Sensitive Receptors
Subproject			
Reinforce toe protections of new dikes	Vigan City, Bantay, Ilocos Sur (Zone 1)	Bgys Paing, Banaoang, Pantay, Tamurong, Nansuagao, Villamar, Naguilian, Raois, Rugsuanan, Don Dimas Querobin, Anonang, Camangaan Taguiporo, San Isidro, Puork-a-dackel	Restaurant near Banaoang Bridge None in the rest of the sites
Reinforce existing (bank) protection structures	Santa, Ilocos Sur (Zone 1)	Bgys Dammay, Quirino, Calungboyan, Tabucolan, Bucalag, Pasungol	Residential houses about 50m from gabions
		Bgys Lagben, Aguet, Laang	None
(left bank)	Lagangilang Abra (Zone 6)	Bgys San Miguel, Labon	None
	Bucay Abra (Zone 6)	Bgy Banglolao	None
	Bucay, Abra (Zone 6)	Bgy Layugan	None
	Bucay Abra (Zone 7)	Bgy Madalipay	None
	Bucay Abra (Zone 7)	Bgys Patoc, Catacdegan Viejo	Residential houses about >50m away
	Manabo Abra (Zone 7)	Bgy Santo Tomas	
Reinforce existing bank protection structures (Upstream)	Langiden, Abra (Zone 3)	Bgy Dalayap	None
Reinforce existing bank protection structures (Downstream)	Langiden, Abra (Zone 3)	Bgy Dalayap	None
Reinforcement of existing structures	Manabo / Sallapadan Tributary 2	Ikmin Tributary, Bgys Patoc, Subusob, Gangal	None
Erosion protections (upstream)	Pidigan, Abra (Zone 3) Bangued, Abra (Zone 3)	Bgys Suyo, Pamutic, Nagurayan, Poblacion East, Poblacion West,	Residential houses near toe of ZP3P-SC2-02; None in

[23] https://www.doh.gov.ph/sites/default/files/publications/2016_PHILIPPINE-HEALTH-STATISTICS.pdf (accessed 14 November 2020).

Sub Project Interventions	Location	Specific Barangays	Sensitive Receptors
		Pangtud, Yuyeng	Pidigan
	Bucay Abra (Zone 7)	Bgys Santa Rosa, Palao, Lipcan	
	Manabo Abra (Zone 7)	Bgy Abang	None
		Bgy San Jose Norte, San Jose Sur,	None
	(Zone 8)	Bgy San Ramon West, Ayyeng	None
		Bgy San Juan Norte	None
		Bgy San Juan Sur	None
			Residential houses near toe of Z8P1-SC2-01
Erosion protections (downstream)	Pidigan, Abra (Zone 3)	Bgys Suyo, Pamutic, Nagurayan, Poblacion East, Poblacion West, Pangtud, Yuyeng	None
		Bgys Santa Rosa, Palao, Lipcan	None
Strengthen existing protections	Tayum Abra (Zone 4)	Bgy Cabaroan, Poblacion	None at Z4P1-RS-01
.		Bgys Deet, Gaddani, Pias, Cosili West, Macray, Lubong, Agtangao, Angad, Dangdangla, Poblacion, Patucannay	Residential houses near toe at Z4P2-NW-01 and behind Z4P2-RS-01;
.			
Along branch of Tineg River	La Paz Abra (Zone 4)	Bgys Bulbulala, Cardona, Poblacion, Buli, Isit, Mudiit,	None
	La Paz / Danglas Abra (Tributary 1)	Bumagkat	None
		North – Saquet Tributary	
		Bgys Liguis, San Gregorio, Caupasan, Padangitan, Abaquid	
New bridge/ford on the tributary	Bantay, Ilocos Sur (zone 2)	Bgy Sallacong	None
Protect existing road with gabions	Bantay, Ilocos Sur (Zone 2)	Bgy Sallacong	None
Strengthen new bank protection	San Quintin, Abra (Zone 2)	Bgys Labaan, Poblacion, Villa Mercedes	None
River training structure	Bangued Abra (Zone 3)	Bangued Urban Zones, Bangbangar, Calaba, Lingtan	None
Complete protection for Q100 to close the entry	Tayum Abra (Zone 4)	Bgys Deet, Gaddani, Pias, Cosili West, Macray, Lubong, Agtangao, Angad, Dangdangla, Poblacion, Patucannay	None
Strengthen existing structures (Gabions)	La Paz Abra (Zone 4)	Bgy San Gregorio	Residential Houses at toe of Z4P2-RS-02
		Bgy Mudeng	None
	Lagangilang, Abra (Zone 4)	Bgy Lagben	None
(Right bank abutting Bridge)		East – MalanasTributary, Bgys Colabaoan, Padangitan, Abaquid	None
	San Juan Abra (Tributary 1)	East – Baay Tributary, Bgys Bangbangcag, Dalaguisen, Taping, Calao, San Isidro	None
	Lagangilang / Bucay Abra (Tributary 2)		
Strengthen existing 10 spur dikes	La Paz, Abra (Zone 4)	Bys San Gregorio, Toon	None
Scour protection for DMM Bridge	Tayum Abra (Zone 4)	Bgy Bumagcat	None

B. Tagum – Libuganon River Basin

157. Tagum-Libuganon River Basin is in Southern Mindanao, extending over Region XI,

Region XIII and four provinces: Davao del Norte, Davao del Sur, Davao de Oro (formerly known as Compostela Valley), Agusan del Sur, and three (3) barangays from Davao City. The total river basin coverage is 3,258 km² - the sixth largest river basin in the Philippines. For this study, the coverage includes a 35 km² downstream area (barangay Libuganon) that is not part of the river basin stricto sensu, but which is affected by Tagum-Libuganon River flood events.

1) Physical Environment

158. **Topography and Soils.** The dominant soil type is sandy clay loam covering more than 45% of the TLRB. In the plain, along the banks of the TL and Saug Rivers, silty clay loam soils appear, as slopes decrease. The rest of the floodplain, away from the main riverbeds, displays thinner deposits (clay loam), which occupy 15% of the TLRB. The description of soil types in the TLRB presents some gaps with 30% of the watershed being labeled as "Undifferentiated".

159. The Tagum-Libuganon River collects runoff from the hills of Kapalong and Talaingod, located in the northwestern part of the basin, with peak elevations higher than 1,000 meters above sea level (masl). The remaining upstream areas, from north to east, do not exceed 500 masl. Only 10% of the TLRB presents elevations higher than 500 masl.

160. **Hydrology.** The Tagum-Libuganon River Basin (TLRB) covers a total area of 3,151 km². It is drained by three (3) main tributaries: Tagum-Libuganon River (1,272 km²); Saug River (1,075 km²); and the Tuganay River (804 km²). The outlet of the TLRB is the Davao Gulf, in the southern part of the basin.

161. **Floods.** One major issue as encountered when assessing flood risk over TLRB refers to both very high frequency and abnormal duration of inundation. Inundation appears to be caused not only by flooding from main rivers, but also from tributaries and from local heavy rains.

162. **Climatic conditions.** Tagum basin falls under Type IV climate based on Coronas Modified climate classification. It is characterized by rainfall more or less evenly distributed throughout the year. The geographic location of the basin has moderate effects of the northeast monsoon, the trade winds, the southwest monsoon and tropical cyclones or typhoons. Temperature in Tagum varies from 26.7°C in Dec-Feb, to 27.8°C in Mar-May. The months of Jun to Nov exhibit almost similar temperature of 27.4°C.

163. The mean annual rainfall in the country varies from less than 1,000 mm to over 4,000 mm. For Tagum, the observed annual rainfall (1971-2000) was 2,225 mm. Seasonal variation was 637 mm for December – February, 497 mm for Mar-May, 536 mm for Jun-Aug, and 556 for Sep-November.

2) Biological Environment

164. **Land Use and Classification.** The western portion of the river basin is heavily forested, especially in the uplands, while the eastern side is more dedicated to agriculture. Most of the land use in TLRB are allocated to reforestation areas for timber production (37.87%) comprised of grasslands (3.24%) and wooded grasslands (34.62%). This is followed by agro-forest uses (28.2%) made up of perennial crops, mostly banana plantations which is one of the region's major industries. Dividing the forestlands and agricultural lands of the basin are timber production areas, composed of shrubs, occupying 15.4%. Patches of built-up areas settled in the lowlands of the river basin sum up to 37,814.42 sq.km. or 2.99%.

165. The DENR- River Basin Control Office (RBCO) identified nine (9) protected areas (PAs) and Key Biodiversity areas (KBAs) in and nearby the river basin as listed in Table III-7.

Table III-7. List of PAs and KBAs nearby TLRB

Classification	Name	Approx. Distance to TLRB structures (Km)
KBA	Agusan Marsh Wildlife Sanctuary	86.77
KBA	Bislig	68.29
KBA	Davao Gulf	14.89
KBA and PA	Mabini Protected Landscape and Seascape	8.86
KBA	Mt. Apo Natural Park	43.01
KBA	Mt. Kaluayan-Mt. Kinabalian Complex	74.8
KBA	Mt. Kampalili-Puting Bato	22.15
KBA	Mt. Sinaka	52.2
PA	Mainit Hotspring Protected Landscape	34.14

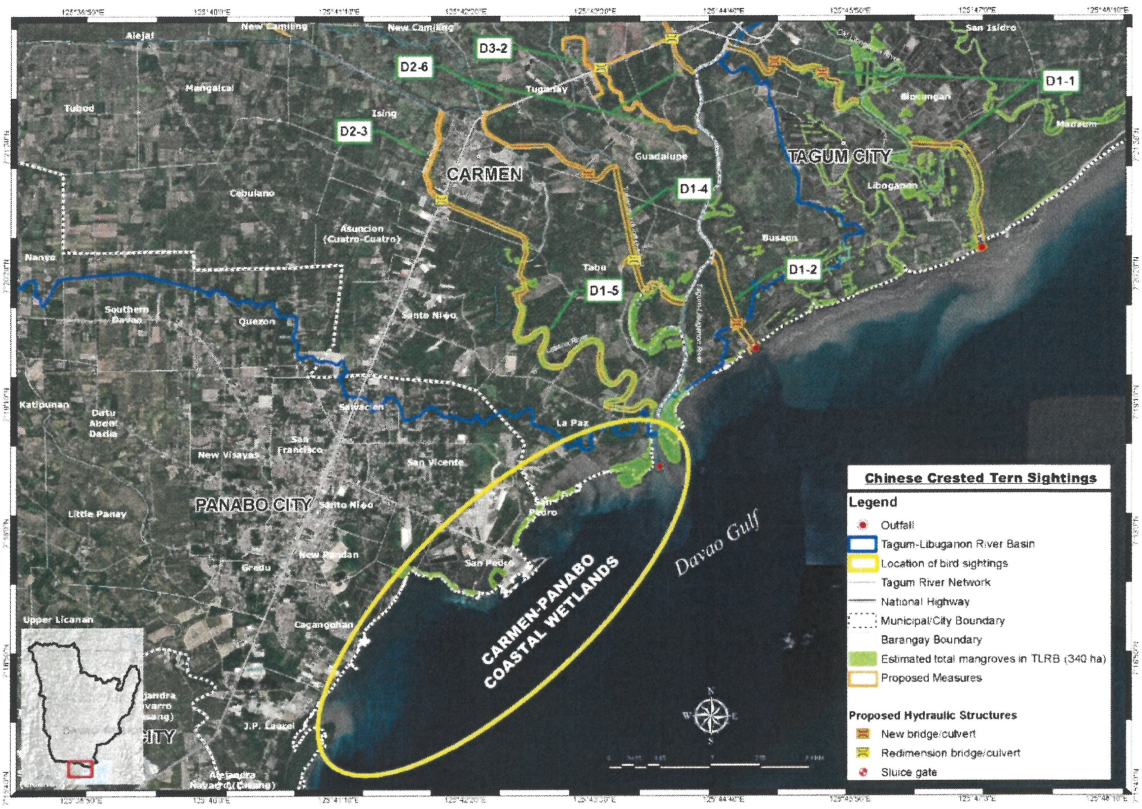
166. Two (2) KBAs are in the TLRB: Mt. Kaluayan-Mt. Kinabalian Complex and the Pantaron Area, both found on the western side of the river basin and both forested areas. Although these areas overlap with the boundary of TLRB, most structural investments entailing construction activities are found in the lower portions of the river basin.

167. **Terrestrial and Aquatic Wildlife**. DENR Region XI identified 35 faunal species that were sighted by local residents, which include 2 species of amphibians; 14 species of birds; 6 species of mammals; 7 species of reptiles and 6 species of fishes. However, destruction of the natural habitat of these organisms has placed them under serious threat. Out of the 35 identified species, 7 species are categorized under endangered state (owl, hornbill, quail, monkey, wild pig, flying lemur and monitor lizard); 6 species are threatened (freshwater crab, eel, hawk, tikling-rail, flying lizard and Philippine king cobra); and 3 species are considered rare (civet cat, king fisher and Philippine oriole). Marine species of turtles and whales are also in their critical state. The tarsier can also be found in the municipality of Kapalong.

168. The recently sighted and photographed Chinese crested tern (*thalasseus bernsteini*) in the Carmen - Panabo coastal wetlands (Figure III-4) on 10 March by Andrew Collins (Travel Mindanao, 28/03/2014) and again in 2018 was first recorded in the Philippines since 1905. It was again recorded during the DENR's Annual Water Fowl Census in January 2021 (DENR Region XI, 2021). It was described by Kennedy, et al as "probably extinct" with very limited sightings in the coast of China (2000) and South Korea (2017). It is critically endangered, with an approximate world population between 50 to 100 birds known to be wintering only in Seram, Indonesia (Collins, 2018). Two other migratory bird species were identified to be endangered in the Carmen-Panabo coastal wetlands that was included in the IUCN Red List: Far Eastern Curlew (*Numenius Madagascariensis*); and Great Knot (*Calidris tenuirostris*).

169. The ACB JAIF Wetlands International census report (Simpson, 2021) concluded that the Panabo and Carmen Coastal Wetlands qualify for the Ramsar site criteria for identifying wetlands of international importance and the East Asia-Australasia Flyway Partnership criteria for inclusion in the Flyway Site Network.

Figure III-4 Location of Sighting of Chinese Crested Tern



Source. Egis, Inclam, KECC, 2021

170. **Vegetation.** Most of the vegetative cover in TLRB is concentrated on the western portion of the river basin part of the mountain ranges in Bukidnon and Agusan del Sur. Some relatively large amounts of vegetative cover can also be seen in the Municipality of Asuncion while there are patches of vegetation scattered all throughout TLRB. The total vegetative cover sums up to 597,783.29 hectares which are divided into protection and production areas. The protection areas are mostly closed forests and open forests in the more elevated areas of the river basin while as production areas are composed of shrublands, grasslands, and wooded grasslands.

171. The mangrove forests in Carmen are composed of 11 mangrove species (Carmen LGU, 2020) while Tagum's mangrove forest cover is composed of 32 mangrove species (24 of which are true mangroves while 8 are associate mangrove species) (Tagum LGU & UP Mindanao, 2021). Mangrove forests are highly valued for their various ecosystem services, such as regulating (flood control, carbon sequestration), provisioning (wood), supporting (breeding, spawning and nursery habitat for various species), and cultural services (ecotourism, aesthetics). The location of mangrove forestlands in TLRB are located in Barangays Liboganon, Madaum, Busaon in Tagum City and in Barangays La Paz and Taba in Carmen. Total mangrove area is estimated at 340 ha (see *Figure IV-4 Location of the Mangroves and Structures in Tagum-Libuganon River Basin*).

3) Current Environmental Conditions

172. **Water Quality.** The DENR EMB XI released a list of major water bodies within Region XI. Among this list are the project-affected waterbodies found in TLRB, such as Tagum-Libuganon River which is Class C, Libuganon River as Class C, and Tuganay as Class B (DENR EMB XI, n.d.). The results of their sampling and analysis conducted in October 2020 are presented in the table below.

Table III-8 Results of Water Quality Analysis in TLRB

Station no.	Description	Classification	On site Results							
			pH	DO (mg/L)	Temp (°C)	BOD	TSS (mg/L)	PO-P (mg/L)	NO3-N (mg/L)	Fecal Coliform
WQ1	Ising River	Unclassified	6.34	0.81	27.5	4.4	8	0.37	1.6	2300
WQ2	Tuganay R	Class B	6.2	6.2	27.6	3.1	<3	0.3	1.2	3400
WQ3	Tagum-Libuganon R	Class C	6.22	6.3	27.9	5.6	70	0.26	0.84	4000
WQ4	Ancient Libuganon R	Class C	6.18	5	29	10.6	57	0.09	1.2	140
	Water Quality Guide	Class B Class C	6.5-8.5 -do-	5 -do-	26-30 -do-	5 7	65 80	0.5 0.5	7.0 -do-	100 200

DO = Dissolved Oxygen, Temp = Temperature
Source: EGIS, INCLAM, KECC, 2020

173. Based on the results of the water sampling, it can be observed that generally the stations complied to its respective classification except for pH and fecal coliform. Ising River has not been classified by DENR, its headwaters are from irrigation areas in the surrounding farmlands and its results are better suited with Class C standards, although FC is also high.

174. **Sediment quality.** The "Study on the Nationwide Flood Risk Assessment and the Flood Mitigation Plan for the Selected Areas in the Republic of the Philippines(Initial Environmental Examination)" conducted for DPWH in 2008 provided a sediment sampling and analysis for stations in Tuganay River. None of the stations sampled exhibited any heavy metal.

Table III-9 Results of Sediment Sampling in Tuganay River from DPWH Study

Parameters (in mg/L)	Stn 1 7° 19' 9.05"N 125° 44' 3.99"E	Stn 4 7° 23' 32.0" N 125° 41' 23.0"E
Arsenic (As)	<0.01	<0.01
Cadmium (Cd)	<0.003	<0.003
Copper (Cu)	0.42	<0.05
Lead (Pb)	<0.005	<0.005
Mercury (Hg)	<0.001	<0.001
Chromium (Cr)	<0.006	<0.006
Cyanide (CN)	<0.002	<0.002

Based on the results of the sediment sampling in 2008, heavy metals were not detected in any of the sediments in Tuganay River and these sediments will pass the criteria for land application set in Table II-14: Soil quality standard (applicable to land based dredgate disposal). Present day situation may well yield the same result since economic activity remains largely agricultural in these areas. No mining activities that may serve as sources of heavy metal contaminants were also mapped within the watershed. Sediment sampling is thus not necessary.

175. **Air Quality and Noise.** In the Environmental Impact Assessment Report for the Mindanao Railway Project (MRP, 2020), ambient air sampling was conducted in areas within the TLRB, specifically in Carmen and Tagum near the proposed structures. Ambient air sampling was conducted for Sulfur Dioxide (SO2), Nitrogen Dioxide (NO2), Total Suspended Particulates (TSP), Particulate Matter 10 (PM10) and Particulate Matter 2.5 (PM2.5). The values for all parameters were consistently below the NAAQS and IFC-EHS guide. Station 21 showed the highest concentration for SO2 with 163 µg/Nm3, which is around 8km away from the nearest subproject (M4-12). The upwind Tagum Station is described to have a mix of different plants such as coconuts, mangoes, cacacao, and banana trees.

Table III-10 Air Quality Monitoring Results in TLRB from Mindanao Railway Project

Station ID	Location	Latitude	Longitude	PM 2.5	PM 10	TSP	SO_2	NO_2
Station 5	Ising, Carmen (Upwind)	7.352100	125.687500	10	10	10	16	10
Station 6	Ising, Carmen (Downwind)	7.350000	125.687200	10	10	10	16	10
Station 17	Tagum Station (Upwind)	7.323611	125.661944	10	10	10	87	4
Station 18	Tagum Station (Downwind)	7.323611	125.660556	10	10	10	16	4
Station 19	Tagum Depot (Upwind)	7.473056	125.781389	10	72	92	55	10
Station 20	Tagum (Downwind)	7.470833	125.782500	10	10	10	79	4
Station 21	Tagum Depot (Upwind)	7.467778	125.777500	10	10	10	163	4
Station 22	Tagum (Downwind)	7.466111	125.773889	10	10	112	16	5
Station 23	Tagum Depot (Upwind)	7.468889	125.777778	10	10	81	75	4
Station 24	Tagum (Downwind)	7.468611	125.775000	10	10	10	16	11
National Ambient Air Quality Standards (NAAQS)				50	150	230	180	150

Source: Mindanao Railway: Tagum-Davao Digos (TDD) Segment, Department of Transportation, 2020

176. **Sensitive receptors** within a 100-m radius of the structures were recorded. Sensitive receptors are the recipients of potential noise and air pollution caused by the construction of the Project, such as residential structures, schools, places of worship, health facilities, among others. A total of 2,547 receptors are listed composed mostly of 2,541 residential structures, 2 health centers, 3 schools, and 1 mosque.

Table III-11. Sensitive Receptors within TLRB

Structures	Barangay	Sensitive Receptors

Structures	Barangay	Sensitive Receptors
D1-1	Bincungan, Liboganon, Madaum	150 houses
D1-2	Busaon	52 houses
D1-4	Busaon, Guadalupe, Ising, Taba, Tuganay	451 houses, 1 Carmen Central Elementary School
D1-5	La Paz	99 houses
	Santo Niño	15 houses
	Taba	47 houses
D2-1	Alejal, New Camiling, Mangalcal	662 houses, 1 Alejal Barangay Hall/Health Center, 1 Alejal Elementary School
D2-3	Ising, Santo Niño	378 houses, 1 Ising Barangay Hall/Health Center, 1 Masjid Carmen mosque
D2-6	Ising, Tuganay, Guadalupe	202 houses
D3-2	Tuganay	366 houses,1 Anibongan Elementary School
M4-12	Guadalupe, Mabaus	91 houses

4) Social-Economic Conditions

177. **Demographic Profile.** In terms of land and housing tenure status, data from the 2018 Regional Social and Economic Trends in the Davao Region and the 2010 Census of Population and Housing for Agusan del Sur show that more than half of the population (ranging from 52% to 58%) own or amortize their land (Table III-12).

Table III-12. Households by Tenure Status, by Province and Highly Urbanized City (TLRB)

Province	Number of Households	Number of households owning house and lot	Percent of total number of households
Davao del Norte	232,695	131,023	56.31
Compostela Valley	169,441	88,283	52.10
Agusan del Sur	133,985	78,868	58.86
Davao City	409,951	230,871	56.32

Source: Philippine Statistics Authority XI, Regional Social and Economic Trends in the Davao Region

178. **Population Distribution.** Of the 2,919,488 population of the cities and municipalities found in the TLRB in 2015, only 824,255 (28.23%) were the total barangay population. The biggest share is in Davao del Norte (687,047), followed by Compostela Valley (114,988) and Agusan del Sur (8,516). Within the Davao del Norte portion of TLRB, the most populous towns are the City of Tagum (with 158,462 inhabitants) and the Municipality of Santo Tomas (with 116,336 inhabitants). Tagum City is the seat of government of Davao del Norte and is the center of education, health, commerce and industry in the province.

179. **Population Size and Density.** In terms of population density in 2015, TLRB has an average of 182 persons for every square kilometer. The following have high population densities: Tagum City (1,513 persons per km^2), Carmen (507 persons per km^2), Santo Tomas (495 persons per km^2) and Braulio E. Dujali (360 persons per km^2). These municipalities/cities have population densities higher than than the Philippines (337 persons/sqkm).

180. **Economic Profile.** The economy of the whole province of Davao del Norte is based in

agriculture devoted to production of staple and industrial crops. Davao del Norte adopts the cluster development approach or the nodal / growth center concept of development utilizing the integrated area development approach. Consistent with the Philippine Development Plan (PDP), 2017-2022, the following are the proposed growth centers in Davao Region.

181. The Municipality of Braulio E. Dujali is an agriculture-based municipality that depends on agricultural production in terms of income. Its vast flat terrain and type of soil are its prime physical assets that make it advantageous in agricultural farming. The LGU of Carmen, being an agricultural area, depends most of its income to rice production with coconut and banana as rising agricultural commodities. Banana industry shares 12% of total laborers while 7% are employees, professionals, self-employed individuals and seasonal workers. The remaining 1% are overseas workers (Municipality of Carmen, 2017). The City of Tagum is classified as first-class component city and is the capital and center of government of Davao del Norte. As such, provincial and national government offices are still located in the city. It is primarily an agricultural city with 59% of the total land area devoted for agricultural use. Of the 23 barangays, 17 are engaged in agricultural production of coconut, durian, banana and other high value crops.

182. **Education.** Basic elementary education is accessible to the school-going population of the TLRB. There are 442 elementary schools located in the 274 barangays within TLRB Municipalities. In Compostela Valley, there is at least one elementary school in each barangay. Davao del Norte has a similar situation: there are five (5) elementary schools for every four barangays, which results in at least one (1) elementary school per barangay.

C. Ranao-Agus River Basin

183. Ranao (Agus) River Basin is divided into two (2) provinces, namely, Lanao del Norte and Lanao del Sur. The former is within the jurisdiction of Region X, while the latter is within Bangasamoro Autonomous Region of Muslim Mindanao (BARMM). Currently, the management of the river basin is still being transitioned to be within BARMM. There are a total of 31 municipalities and two (2) cities within the river basin.

1) Physical Environment

184. **Location**. Lanao del Sur Province, including Marawi City has a total land area of around 4,103 km². The province occupies the extensive plateau of Northern Central Mindanao at an elevation of around 700 masl. Out of the total land area, around 387 km^2 of the province are water bodies comprised of lakes, rivers and swamps. There are eight (8) lakes within Lanao del Sur, with Lake Lanao having the biggest area of 354 km^2. Lanao del Sur has 39 municipality and 1 city (Marawi City). The total number of barangays in the province is 1,159.

185. Lanao del Norte Province, including Iligan City has a total land area of around 2,638 km². The province occupies the northern-central section of Mindanao, bordered from the North by Iligan Bay. Lanao Del Norte has 22 municipalities and 1 city (Iligan City). Total number of barangays in the province is 506.

186. **Topography**. The Province is characterized by a rugged terrain with about 48% between 3-18% slope and 43% at about 18% to 50% and above. Only 9% is within the 0% - 3%

slope category.[24] The watershed divide comes close at the south end of the lake where the volcanic dam that led to the formation of the lake is located. Topography within the area is distributed quite evenly within 700 – 1,500 masl. Only 10 percent of the catchment is beyond 1,500 masl. Lanao Lake is located at around 700 masl elevation.

187. **Soils**. The first dominant soil type to appear is clay loam, with about 25% coverage, followed by clay (17 %) and sand (11%). Complex soils and silt loams cover an approximate 5% of the catchment, followed by loams and bog deeps that occupy a small portion of the watershed. The RARB is mostly covered by Pliocene-Quaternary formation, encompassing all the hills surrounding the watershed. The second dominant formation is formed by recent sediments and is located on the Basak area, where both the lake water level variations and river discharges bring sediments. Oligocene-Miocene formations are found at the foothills, upstream of the Basak area. A few patches of Pliocene-Pleistocene are found in the northern part of the basin. About 35% of the RARB area is covered by mountain soils. The characteristics of these soils vary greatly from one region to the other, and accurately discriminating their soil textures is a hard task. Consequently, the areas covered by mountain soils are classified as "undifferentiated" soil types. They are essentially found on the upstream parts of the watershed.

188. **Slopes.** The slope within RARB are quite evenly scattered across the river basin. The areas of Ditsaan-Ramain, Taraka, Poona Bayabao, Gata and Butig that are close to Lanao Lake, and parts of Balo-I close to Agus River, are the areas with slopes of 0-3 percent (level).

189. **Sediment Transport**. Lanao del Sur is considered to be an erosion prone province – 16% of the land area is prone to severe erosion, 60% is susceptible to moderate erosion, about 5% have slight erosion problems, and about 19% is considered erosion free because of its almost level topography.

190. **Fault Lines**. The RARB intersects the Lanao Fault System on its northwestern section. These faults are responsible for an unusually shaped terrain traversed by the Lipatan River upstream stretch from south to north. As mentioned previously, the nature of topography in these hills offer the conditions for overbank flooding from the Lipatan River to the RARB. The faults activity could emphasize this phenomenon in the future, perhaps deviating fully the upstream Lipatan River to the RARB. A large amount of earthquakes with magnitude exceeding 4 were reported on the basin.

191. **Hydrology**.The RARB collects run-off from the northern and western flanks of Mount Piapayungan, also called Mount Ragan or Blue Mountain. Mount Piapayungan, at Lumba Bayabao, is a volcano with its highest point reaching around 2,799 m above sea level (masl). North of Mt. Piapayungan and south of Lake Putian is Mt. Maranat (1,858 masl). At the southeastern part of the RARB are the mountain ranges comprising Butig Mountains with peaks ranging from 1,860 to 2,060 masl, Mt. Makaturing, an active volcano, and Mt Latukan (2,328 masl), an inactive volcano.

192. The major river systems are located in the eastern portion of the watershed: Ramain River (40 km), Taraka River (69 km), Gata River (38 km), and Masiu (Malaig) River (49 km). The only outlet of the lake is the 36-Km Agus River, the main channel of the Agus River watershed system, which starts from a northern point of Lake Lanao flushing down an annual

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[24] INREMP. 2010.

runoff of 1910 × 106 m3 to the main exit of the river at the Maria Cristina Falls in the coast of Iligan City and a minor exit at Linamon (Tinago) falls in the Municipality of Linamon, Lanao del Norte. The amount of precipitation falling into the river basin and into the lake influence the quality, flow, volume and dynamics of water that enters into and out of the lake.

193. The RARB have seven (7) other lakes other than Lake Lanao. The lakes cover a total area of about 387 square kilometers. The smallest lake are Lake Latakan and Lake Amai Kurut with about 0.50 square kilometers each.

194. **Climatic Conditions.** The provinces of Lanao del Sur and Lanao del Norte have a Type III Climate Type based on the Modified Coronas Climate Classification. Type III Climate does not have a pronounced maximum rain period. Dry season lasts only from one (1) to three (3) months either between December to February, or March to May.

195. Mean monthly recorded by PAGASA from 2001-2018 shows that the average minimum monthly rainfall is around 218 mm, while higest average maximum rainfall is almost 428 mm. Highest minimum rainfall measured was almost 330 mm for the month of June, while lowest is in April with 123 mm. Maximum rainfall was recorded in May with around 588 mm while lowest maximum is around 264 mm.

196. The basin is located in an area of the country that is least exposed to typhoons. Historical records show long periods with no typhoons passing by the island. Extreme rainfall events typically occur from December to February on Mindanao. Recently, however, the island of Mindanao suffered from three major storm events: Tropical Storm Sendong in December 2011, Typhoon Pablo in December 2012 and Typhoon Vinta in December 2017.

2) Ecological Resources

197. **Land Use**. The National Mapping and Resource Information Authority (NAMRIA) Land Cover map in 2010 shows that built-up areas cover around 2,744 hectares (<2%) of the total land area of RARB. Other land uses include: Open and closed forest (>42%); other wooded land (7%); cultivated lands (30%); and Lanao Lake and other waterbodies (18%).

198. **Terrestrial and Aquatic Wildlife**. The Integrated Biodiversity Assessment Tool (IBAT) showed that there are 239 vulnerable, endangered and critically endangered species within the proximity of RARB. Out of the 239 species, around 36 species (15%) are land based fauna that are either vulnerable, endangered or critically endangered. Most of the species were observed to be endemic to the Philippines, with a few noted to be endemic only in certain parts of the country, including Mindanao Island. Further biodiversity studies revealed that there are four (4) bird and one (1) mammal species that form part of the list of threatened species within the watershed of the RARB. The list is provided in Table III-13.

Table III-13. List of Threatened Fauna Within Ranao (Agus) River Basin

Species Name	Common Name	IUCN Category
Pithecophaga jefferyi	Philippine Eagle	Critically Endangered
Gorsachius goisagi	Japanese Night Heron	Engangered
Lonchura oryzivora	Java Sparrow	Endangered
Nisaetus pinskeri	Pinsker's Hawk Eagle	Endangered
Acerodon jubatus	Giant golden-crowned flying fox	Endangered

199. Lake Lanao is one of the key biodiversity areas in the Philippines. Myers (1960)[25] reported about the endemic genera *Mandibularca*, *Spratellicypris*, *Cephalolakompsus* and *Ospatulus* as among the large species flock that are all members of the Cyprinidae, the largest family of primary freshwater fishes. Eighteen (18) endemic cyprinid fish from the genus Barbodes are present in Lake Lanao (see Annex V). *Sundathelphusa woltericki*, a freshwater crab species, was also noted as endemic to Lake Lanao. It was reported that about 41 species of freshwater crab can be found within the lake. Aside from this endemic species list, Abdulmalik-Labe and Quilang (2019)[14] stated that a total of 36 fish species were reported in Lake Lanao (Annex V) . Genetic diversity of population of *B. tumba* in the lake remains high (Abdulmalik-Labe and Quilang (2020).[26]

200. **Vegetation**. There are about 40,000 ha of old growth dipterocarp forest in the RARB; 35,000 ha of residual forest; 5,500 ha of sub-marginal forests and 2,200 ha of mossy forests. In alienable and disposable lands, there are about 1,300 ha of residual dipterocarp forests. Non-dipterocarp tree species in this 0-1000 masl forest zone include *Nauclea orientalis, Ficus variegata* and *Leucosyke capitellata*. The lower montane forest (1000-1500 masl) is represented by species from families Fagaceae (the family of oaks) Araliaceae, Staphyleaceae, and Lauraceae. Many tree ferns, epiphyte communities such as orchids, and ferns and their allies increase in importance. The upper montane forest (1500-2400 masl) is inhabited by species belonging to families Ericaceae, Myrtaceae and Theaceae.[27]

201. Limestone forests below 1000 masl exist in the watershed and keystone tree species molave (*Vitex parviflora*), lingo-lingo (*Viticipremna philippinensis*), alagao (*Premna odorata*), and batete (*Kingiodendron alternifolium*) are common in these areas. Most of these plants have been regarded as threatened species (DAO 2017-11) particularly those belonging to the Family Dipterocarpaceae (Genus: *Hopea*), Orchidaceae and Palmae (Arecaceae). Some critically endangered Dipterocarps are *Shorea astylosa* and *Vatica pachyphylla*. The Genus *Paphiopedilum* has the highest number of threatened species in the Orchidaceae Family and the Genus Hetorospathe and Pinanga for Palmae. Other threatened species belong to the Family Cyatheaceae, Asclepiadaceae and Melastomataceae (DAO 2017-11). Representatives of these families are found in the watershed.[28] Note that although many of these species are threatened, many still are commonly seen locally in the RARB.

202. Old growth dipterocarp hardwoods account for about 44% of the stand, construction and furniture wood about 40%, and other species account to 16 %. Among the hardwoods are almon (*Shorea almon*), bagtikan (*Parashorea plicata*) kalunti (*Shorea kalunti*), mayapis (*Shorea squamata*), nato (*Palaqium luzoniensis*), red lauan (*Shorea negrosensis*), tanguile (*Shorea philippinensis*) and white lauan (*Shorea contorta*). The furniture and construction wood species

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[25] https://onlinelibrary.wiley.com/doi/pdf/10.1111/j.1558-5646.1960.tb03094.x accessed 12/12/2020. Myers, G.S. 1960. The endemic fish fauna of Lake Lanao, and the categories of higher taxonomic categories. Evolution of higher taxonomic categories. Evolution 14:323-333.

[14] https://www.researchgate.net/publication/333049854_DNA_barcoding_of_fishes_from_Lake_Lanao_Philippines accessed 12/12/2020.

[26] https://www.threatenedtaxa.org/index.php/JoTT/article/view/4851/6306 accessed 15/12/2020. Genetic diversity among the endemic barb Barbodes tumba (Teleostei: Cyprinidae) Populations from Mindanao, Philippines. Journal of Threatened taza 11(7):13822-13832.

[28] Metillo, E.B. and C.O. Garcia-Hansel. 2016. A review on the ecology and biodiversity of Lake Lanao (Mindanao Is. The Philippines). Jour. Metrics. Thomson Reuters. Vol. 18 March 2016. ISSN 2244-1573.

are apitong (*Dipterocarpus grandiflorus*), bangkal (*Nauclea orientalis*), batikuling (*Litsea leytensis*), bolong-eta (*Diospyros pilosanthera*), dalingdingan (*Hopea foxworthyii*), ipil (*Instia bijuga*), kalumpit (*Terminalia microcarpa*), kamagong (*Diospyros philippinensis*) and katmon (*Dillenia philippinensis*).

203. Grasses and sedges dominate the shoreline marshes and they coexist with human inhabitants. The sedge species *Fimbristylis miliacea* locally known as sesed is an important material for the weaving of Maranao mats. There are dicot emergent plants at the littoral zone of the lake such as *Polygonum* sp. A water-loving tree species along the shoreline is *Erythrina fusca*. Floating-leaved plants in the littoral area include water lilies *Nymphaea* sp. and the lotus *Nelumbo* sp. On the lake surface itself are large areas of the water hyacinth *Eichhornia crassipes*, an invasive species. Submerged at 5-15m are beds of the aquatic macrophyte *Potamogeton* sp. where fishes feed and reproduce.[29]

204. As of 2013, the DENR has planted various tree species in a total of 895 ha in different areas within the river basin. Although tree cover gain of 305 hectares was also recorded by Global Forest Watch from 2001-2012, this cannot yet compensate for tree cover loss of 11,629.04 hectares). More planting is necessary particularly in Maguing and Lumba-Bayabao. The highest tree cover losses in areas with >30% tree cover was recorded in Maguing (5,246 has.) within the Taraka sub-watershed; followed by Iligan City (3, 855 has.) within Agus sub-watershed; and Lumba-Bayabao (1,646 has.) within Gata sub-watershed. Peak losses were recorded during the Years 2010, 2016, and 2017. Only 14% of Maguing, 69% of Butig and 78% of Lumba-Bayabao were the remaining intact forests as of 2016. On the same year, no intact forests were observed in Bubong, Ditsaan-Ramain, Balo-I, Iligan City and Marawi City.[30]

205. Among the common hardwood species in the Lake Lanao subwatersheds are almon, bagtikan, kalunti, mayapis, nato, red lauan, tangile, white lauan, apitong, bangkal, batikuling, bolong-eta, dalingdingan, ipil, kalumpit, kamagong and katmon.[31] While these species may be commonly seen in the Lake Lanao subwatersheds, most of these are vulnerable or endangered species based on DAO 2017-11 or the National List of Threatened Philippine Plants and Their Categories (Table III-14).

Table III-14. List of tree species found in the Lake Lanao Watershed and their category based on the Philippine Red List

Common Name	Scientific Name	Family	Threatened Category under DAO 2017-11
Almon	*Shorea almon*	Dipterocarpaceae	Vulnerable
Bagtikan	*Parashorea plicata*	Dipterocarpaceae	
Kalunti	*Shorea kalunti*	Dipterocarpaceae	
Mayapis	*Shorea squamata*	Dipterocarpaceae	
Apitong	*Dipterocarpus grandiflorus*	Dipterocarpaceae	Vulnerable
White lauan	*Shorea contorta*	Dipterocarpaceae	Vulnerable
Red lauan	*Shorea negrosensis*	Dipterocarpaceae	Vulnerable
Tangile	*Shorea polysperma*	Dipterocarpaceae	Vulnerable

[29] Metillo, E.B. and C.O. Garcia-Hansel. 2016. A review on the ecology and biodiversity of Lake Lanao (Mindanao Is. The Philippines). Jour. Metrics. Thomson Reuters. Vol. 18 March 2016. ISSN 2244-1573.

[30] www.globalforestwatch.org (accessed on 24 March 2021)

[31] https://forestry.denr.gov.ph/inremp/lanao.html accessed 25/03/2021

Common Name	Scientific Name	Family	Threatened Category under DAO 2017-11
Dalingdingan	*Hopea foxworthyii*	Dipterocarpaceae	Critically Endangered
Kamagong	*Diospyros philippinensis*	Ebenaceae	Vulnerable
Ipil	*Intsia bijuga*	Fabaceae	Vulnerable
Kalumpit	*Terminalia macrocarpa*		
Katmon	*Dillenia philippinensis*	Dilleniaceae	
Batikuling	*Litsea leytensis*	Ebenaceae	Endangered
Nato	*Palaqium luzonensis*		Vulnerable
Bolong-eta	*Diospyros pilosanthera*	Ebenaceae	Vulnerable
Bangkal	*Anthocephalus chinensis*		

206. There are two (2) mangrove species that were identified as threatened based on IUCN Red List. These mangrove species are *Avicennia rumphiana* and *Campostemon philippinense* BECC. Mangrove species are known to inhabit estuarine areas along the coast. As such, these species may be present near the mouth of Agus River, which is far from any of the project structures.

207. The agricultural or open / cultivated areas are either covered with cash crops, fruit trees and or cogon grasses. The principal crops grown in the RARB are rice, corn, coconut, coffee, cassava, sweet potato, vegetable, cacao, abaca, lanzones and durian. Farmers also propagate tree crops such as falcata, mahogany and gmelina. About 14,221 ha are planted to paddy rice and 4,873 ha are planted to upland rice. About 10,575 ha are planted to corn and about 240 ha are planted to fruit trees. The eastern portion is an extensive alluvial deltaic plain that is used for rice production while the rest may be alienable and disposable land with scattered patches of forest.

208. Two (2) traditional rice varieties used by the locals,"Lanti" and"Kotong" were poor storers but have yields of 6.6 t/ha and 3.9 t/ha, highest and lowest yields, respectively compared to modern varieties.[32] In Lanao del Sur, however, selling of rice varieties had a strong relationship to the level of conservation.

209. **Protected Areas, Key Biodiversity Areas and Nature Reserves**. Within RARB is the Lake Lanao Watershed Reservation, a declared protected area by virtue of Proclamation No. 871 Series of 1992. The watershed is included in the initial components of the National Integrated Protected Area System (NIPAS) of Republic Act No. 7586 or otherwise known as NIPAS Act of 1992. There are five (5) other protected areas that are within and overlaps with the Lake Lanao Watershed Reservation. The list of protected areas and their respective proclamation are enumerated in Table III-15 and shown in Figure III-11. Key Biodiversity Area and Protected Area within Ranao (Agus) River Basin. Activities within national parks will only be allowed in areas designated for such based on national park management plans.

210. There are two (2) key biodiversity areas within RARB, Lake Lanao and Mt. Piapayungan. Mt. Piapayungan is a mountain range comprised of Mt. Butig, Mt. Ragang and Mt. Makaturing. Other areas within the river basin that are considered key biodiversity areas are Mt. Munai (Tambo), Salikata National Park, Pantuwaraya Lake, Lake Butig, Libungan and Sacred Mountain.

[32] Dimaporo, Indhira and Pamela Fernandez. 2007. Indigenous seed, knowledge and rice production practices of the Maranaos in Mapantao, Lumba-Bayabao, Lanao del Sur. Crop Protection Newsletter. 32(2):77-91

Protected Area	Location	Proclamation No.	Area (Hectares)	Approx. Distance to Nearest Subproject
Lake Lanao Watershed Reservation	Lanao del Sur (LDS)	Proclamation No. 871, s 1992	180,460	
Lake Butig National Park	Butig, LDS	Republic Act No. 4190/5-5-65	68	11 km to M-04
Lake Dapao National Park	Pualas, LDS	Republic Act No. 4190/5-5-65	1,500	Outside RB
Pantuwaraya Lake National Park	Saguiaran, LDS	Republic Act No. 4190/5-5-65	20	5 km to DL-04
Rungkunan National Park	Ramain, LDS	Republic Act No. 4190/5-5-65	Not Determined	Outside RB
Salikata Park	Lumba Bayabao, LDS	Republic Act No. 4190/5-5-65	Not Determined	21 km to U-20
Sacred Mountain	Marawi City, LDS	Republic Act No. 4190/5-5-65	94	5.3 km to M-01

Table III-15. List of Proclaimed Protected Areas Within Ranao (Agus) River Basin

Source: Technical Bulletin No 2013-01

211. Lake Lanao is also one of 20 ancient lakes in the world. Ancient lakes are waterbodies that are believed to have been continuously carrying water for at least one (1) million years. Lake Lanao is estimated to have formed some 2-2.5 million years ago. These waterbodies provide a great source of information on evolutionary characteristics. Further, Lake Lanao is part of the Alliance for Zero Extinction or AZE. Areas that are included in AZE aim to identify conserve and preserve critical habitats of endangered or critically endangered species based on IUCN.

3) Current Environmental Conditions

212. **Water Quality**. Secondary water quality data on Lake Lanao (Angagao, et. al, 2017) showed that levels of Total Suspended Solids (TSS), pH, Dissolved Oxygen (DO), Phosphate (as PO_4-P) and Nitrates (as NO_3-N) wer within the DENR guideline values for Class A.

213. Sampling of water and analysis of Agus River and Lake Lanao was conducted in September 2020 through the Marawi Roads Project. Agus River is categorized as Class C while Lake Lanao is Class A. The data is reported in the table below (the rest are in Annex IV). Based on the results, parameters such as color, pH, dissolved oxygen, biological oxygen demand, total suspended solids, surfactants, oil and grease, nitrates, phosphates, phenols, chloride, dissolved copper, Arsenic, Cadmium, hexavalent Chromium, cyanide, Lead, Mercury and organophosphates as Malathion are below the threshold limit of DAO 2016-08. Meanwhile, Fecal coliform count at two stations which are near residential areas and bridges exceeded the standard for Class C waters. Stations which are located at lake Lanao and was classified as Class A waters also failed to comply for Fecal coliforms.

Table III-16 Water Quality Sampling Results for Marawi Roads Project (2020)

PARAMETERS	SWQ11[A]	SWQ12[C]	SWQ13[C]	SWQ14[C]	SWQ15[C]	SWQ16[C]	SWQ17[C]	SWQ18[C]	Regulatory Limit DAO 2016-08		REMARKS
									Class A	Class C	
Color (CPU)	<5	25	10	<5	<5	<5	<5	<5	50	75	PASSED
Temperature (°C)	25	26	25	26	25	25	26	26	26-30°C	25-31	PASSED
pH	8.5	7.4	8.0	7.1	7.1	7.1	7.1	7.1	6.5-8.5	6.5-9.0	PASSED
Dissolved Oxygen (mg/L)	7	9	7	8	9	7	9	9	5 (minimum)	5 (minimum)	PASSED
Biological Oxygen Demand (mg/L)	<1	<1	1	<1	<1	2	4	3	3	7	PASSED
Total Suspended Solids (mg/L)	4	9	264	5	5	6	<3	5	50	80	FAILED (SWQ13)
Surfactants (mg/L)	<0.10	<0.10	0.13	<0.10	<0.10	<0.10	<0.10	<0.10	0.2	1.5	PASSED
Oil and grease (mg/L)	<1	3	<1	<1	<1	<1	1	1	1	2	FAILED (SWQ12)
Nitrates (mg/L)	<0.01	0.19	0.60	0.69	0.64	0.71	0.88	<0.01	7	7	PASSED
Phosphates (mg/L)	<0.01	0.04	0.11	0.09	0.07	0.12	0.09	<0.01	0.5	0.5	PASSED
Phenols (mg/L)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	0.05	PASSED
Fecal Coliform (MPN/100mL)	23	210	41	9.2	22	32	40	32	1.1	200	FAILED (SWQ11 SWQ12)
Chloride (mg/L)	1.5	<0.5	2.0	18.8	5.9	5.9	2.5	5.9	250	350	PASSED

Source: IEE for Marawi Roads Project (2020)

214. **Sediment quality.** The DPWH study in 2008 (cited earlier) evaluated the bottom sediment quality for five river basins in the country which included Meycauayan and Tuganay. The assessment concluded that concentrations of heavy metals were within the allowable Maximum Concentration Limit set by USEPA (cited in Table II-14: Soil quality standard (applicable to land based dredgate disposal)). Meycauayan in 2008 would be highly urbanized compared to RARB at present and its river far more polluted. Although the DPWH study did not include any of the rivers in RARB, it can be inferred that rivers in RARB would also not exhibit heavy metals in its bottom sediments. There are also no mining areas within the vicinity of the project site. Hence, this IEE deemed that sampling and analysis of sediment is not necessary.

215. **Air Quality and Noise**. Air quality data from the Marawi Ring Road Project showed that the ambient levels for Total Suspended Particulates (TSP), Particulate Matter 10 (PM_{10}), Nitrogen Oxides (NO_x), and Sulfur Oxides (SO_x) were well within the National Ambient Air Quality Guideline Values (NAAQGV) as provided for in DENR Department Administrative Order No. 81, Series of 2000. Air quality levels were taken in Barangay Bubong, Saguiaran in Lanao del Sur.

Table III-17. Air Quality Sampling Results at Bgy. Bubong, Marawi City

Station No.	Location	Date and Time Sampling	TSP (µ/g/Ncm)	PM10 (µ/g/Ncm)	NO2 (µ/g/Ncm)	SO2 (µ/g/Ncm)
A1	Bgy. Bubong, Saguiran,	18-19 January 2018	15.7	11.7	3.9	ND

Station No.	Location	Date and Time Sampling	TSP (µ/g/Ncm)	PM10 (µ/g/Ncm)	NO2 (µ/g/Ncm)	SO2 (µ/g/Ncm)
	Lanao del Sur	1415H-1415H				
*DENR National Ambient Air Quality Guideline Values (NAAQGV)		24-hr Sampling	230	150	150	180
Remarks			Passed	Passed	Passed	Passed

Source: IEER Marawi Ring Roads, March 2018.

216. Results for noise level in the area is homogenous. Exceedances can be observed especially compared with the Philippines standard values for evening and nighttime. It can be assumed that the air quality and noise level in the RARB project site will also be similar considering the sampling location and Project site have similar conditions.

Table III-18 Noise level monitoring at Bgy. Bubong, Saguiaran

18-19 Jan. 2018 Sampling Time	Average dB(A)	DENR Standard Maximum Allowable Noise Level A dB (A)	Remarks	Noise Sources
1415H	53.3	55	Within	Residential area, cows, dogs, passing vehicles
1615H	51.3	55	Within	Residential area, cows, dogs, passing vehicles
1815H	52.8	50	Exceeded	Residential area, cows, dogs, 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

Source: IEER Marawi Ring Roads, March 2018

4) Socio-economic Conditions

217. **Demographic Profile.** In 2015, Lanao del Sur registered a total population of 1,045,429. More than half (51%) of the total population were female. The average household size in the province was 6.5, while population density was at 69 individuals per square kilometer. From 2010 to 2015, the province registered an annual population growth rate of 2.18 percent and total

fertility rate[33] of 4.23 for the same period. Children below one year of age made up 2.4 percent of Lanao del Sur's total population, while those from the 1-4 age group comprised 12.4 percent. Children aged 5-9 years old accounted for 15.1 percent of the total population. Senior citizens, or those 60 years old and over, comprised 2.5 percent of the total population and of this, 53 percent were male.

218. The number of households in the province stood at 160,132 in 2015. Of this, 11.9 percent were headed by women, or 13,414 female household heads. About a third (29.4%) of these female household heads belonged to the 40-49 age group with an average household size of 6.1. Those from the 50-59 age group closely follow at 23 percent with the same average household size.

219. The employment rate of Lanao del Norte (88.0%) is lower than the region (90.2%) but higher than the national level (87.8%). The employment rate in the Lanao del Sur for 2010 was recorded at 50.98% of the total workforce or 28.11% of the total population ranking as 56th in terms of labor and 19th in terms of employment in ARMM (NCSB in CDP-ELA).

220. Iligan City is a highly urbanized city in Lanao del Norte. In 2015, it posted a total population of 342,618, with 50.1 percent as males. The average household size in the city for 2015 was 4.4 while population density was at 421 individuals per square kilometer. From 2010 to 2015, Iligan City posted an annual population growth rate of 1.14 percent. Children below one year of age made up two percent (2%) of Iligan City's total population, while those from the 1-4 age group comprised 12.4 percent; those aged 5-9 years old accounted for 15.1 percent. Senior citizens comprised 2.5 percent of the total population. Of this, females made up 47 percent.

221. In 2015, Lanao del Norte had a total of 140,350 households. Of this, 14.1 percent were headed by women, or 19,822 female household heads. The largest group belonged to the 50-59 age group at 21.3 percent with an average household size of 4.2.

222. **Population Distribution**. In terms of population density in 2015, RARB has 424 persons per km². In the same censal year, the cities/municipalities with high population densities are: Marawi City (3,652 persons per km²), Tamparan (3,080 persons per km²), Taraka (2,489 persons per km²) and Binidayan (2,385 persons per km²). Based on the Philippine Statistics Authority (PSA) statistical records, the following maps show the population of the Ranao (Agus) River Basin by City/Municipality in 2015.

223. **Economic Profile**. The economic activities in the river basin are basically dependent on agriculture with 40% of land area being cultivated. The economy is highly dependent on agriculture, fishery and forestry where 60% of the labor force is employed. Classified major crops of ARMM, and Region X are cereals, non-food or industrial crops and fruits. Lanao del Norte also relies on livestock and poultry, export of coconut-based products and tourism. Besides agriculture, the economic activities in Lanao del Sur includes commerce and trade, and small-scale industries such as food processing and cottage industry and other manufacturing industries. The province is also rich in mineral resources such as copper, gold, silver, coal, limestone, and clay,

224. **Education**. Lanao del Sur registered a high literacy rate of 94.1 percent among the 727,267 household population aged 10 years and over in 2015. Of the literate population, more than half (51.5%) were females, while the remaining 48.5 percent were males.

225. Lanao del Norte posted a high literacy rate of 97 percent among the 498,332 household population aged 10 years and over in 2015. There were more literate females at 50.03 percent

[33] Number of children per woman.

while males accounted for the 49.97 percent.

226. Iligan City had a high literacy rate of 98.3 percent among its 266,566 household population aged 10 years and over in 2015. Literate females were larger by 1,754, accounting for 50.33 percent of the literate population while males made up the remaining 49.67 percent.

IV. Assessment of Potential Environmental Impacts

227. Anticipated positive and negative environmental impacts of the proposed project were assessed based on feasibility studies and technical review by sectoral experts; site visits conducted; water and sediment tests, screening by Integrated Biodiversity Assessment Tool (IBAT) and consultations with key stakeholders and affected persons.

228. The project area of influence should be the river basin or command area of canals, especially biodiversity related issues. More indepth investigation under the IEE in terms of air, water, noise, and solid wastes is defined as:

i) 500 m to either side of proposed new and upgraded dikes, channels, bridges and roads;
ii) 500 m around construction camps (including batching plants and crushing plants), borrow pits and disposal sites;

229. For biodiversity the investigation and assessment scope is broader, and more indepth investigation encompassing: 1.0 km beyond a spatial boundary incorporating all the physical works and work areas for each subproject[34]; and, 500 m upstream and downstream of riverbank project activities.

230. A survey of all sensitive receptors (schools, hospitals or clinics, residences) in the general vicinity of the subproject sites was undertaken based on field visits and consultations with local authorities.

A. Assessment of Design Phase Impacts/ Alternative analysis

231. At each RB, a Master Planning phase was undertaken to identify the strategies for flood control. Potential environmental impacts were already considered therein. At project design phase, different alternatives proposed by the PMUs and in the draft FS or other sources for project activities are analyzed of their potential environmental impacts. Comparison is made from environmental perspective with recommended options, including no project, to optimize and inform the project design. Potential impacts that may arise from improper design and selection of options for project activities are discussed herein.

No Project Option

232. The main objective of the project is to reduce the impacts of flooding on population, agricultural lands, and structures. Without the integrated flood risk management project, flooding would persist at current levels, causing loss of lives and properties; riverbank scouring and erosion; and limited economic development. Thus, the "no project" option was not further considered in this assessment.

Subprojects Selection

233. The combination of structural and other activities for Community Based Flood Risk Management proposed in the river basin is set to protect the residents and infrastructures from

[34] *The impacts of roads and other infrastructure on mammal and bird populations: A meta-analysis.* Ana Benítez-López, Rob Alkemade, Pita A. Verweij. The study showed the "effect of infrastructure on bird populations extended over distances up to about 1 km."

flood hazards. Project operation is expected to result in a number of significant positive impacts.

234. From the Masterplan study, the proposed structures were studied further at the FS stage. An optimized strategy was developed through a Cost-benefit Analysis (CBA) and Multi-Criteria Analysis (MCA). The CBA took into account the cost and damage reduction efficiency of the proposed structures. The MCA considered the protection level, the results of the CBA, the necessary land acquisition and potential resettlement, as well as the environmental and social acceptability of the project. Thus, the finalized structures have taken due consideration of environmental aspects and were either adjusted in their design or removed from the list if impacts were significant.

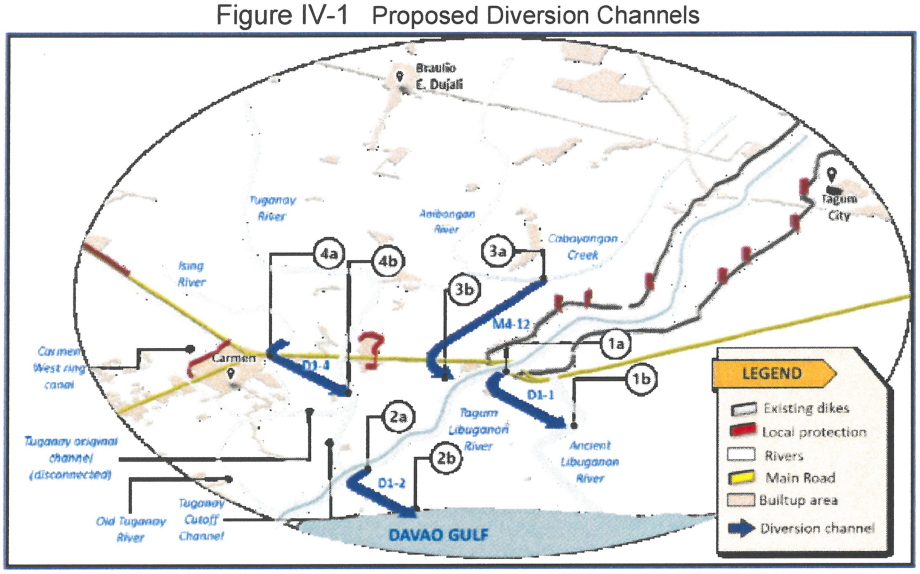
235. For ARB, 22 structures were finalized out of 37 studied in the FS. These are mostly toe protection works on existing DPWH structures and a spur dike. For TLRB, there were around 80 structures considered during the MP. A total of 10 groups of structures that include channel improvement works, bridges, and river dredging, or widening were finalized during the FS.For RARB, 24 structures were finalized in the FS. Structural investments such as dikes, bank protections and road and bridge rehabilitations are proposed in the river basin. Dredging of river mouth going to Lake Lanao is also included.

236. **Hydrologic changes from new channels and river widening**. The potential impacts of changes in flow regimes, changes in existing flood levels have been considered during the master planning and feasibility studies stage. Changes in flow and flood levels were considered during the hydrologic modelling. Only the TLRB has new diversion channels which were designed so as not to affect existing flow and water levels in the source body. Diversion channels will partly be built on existing ancient riverbed and partly connect existing stream, details see chapter 1. Their environmental impacts for TLRB are discussed below.

Impacts of water diversion in TLRB

237. All diversion channels are designed such that the flow is always maintained along the source water body, especially during dry condition. Only a portion of the floodwater enters the diversion channels during high flow, and both the source water body and the diversion channel have flow during this time. All outfalls of these diversion channels are also existing water bodies, either along the drainage system further downstream or in the coastline. Figure IV-1 shows the overall scheme for the proposed diversion channels.

Figure IV-1 Proposed Diversion Channels

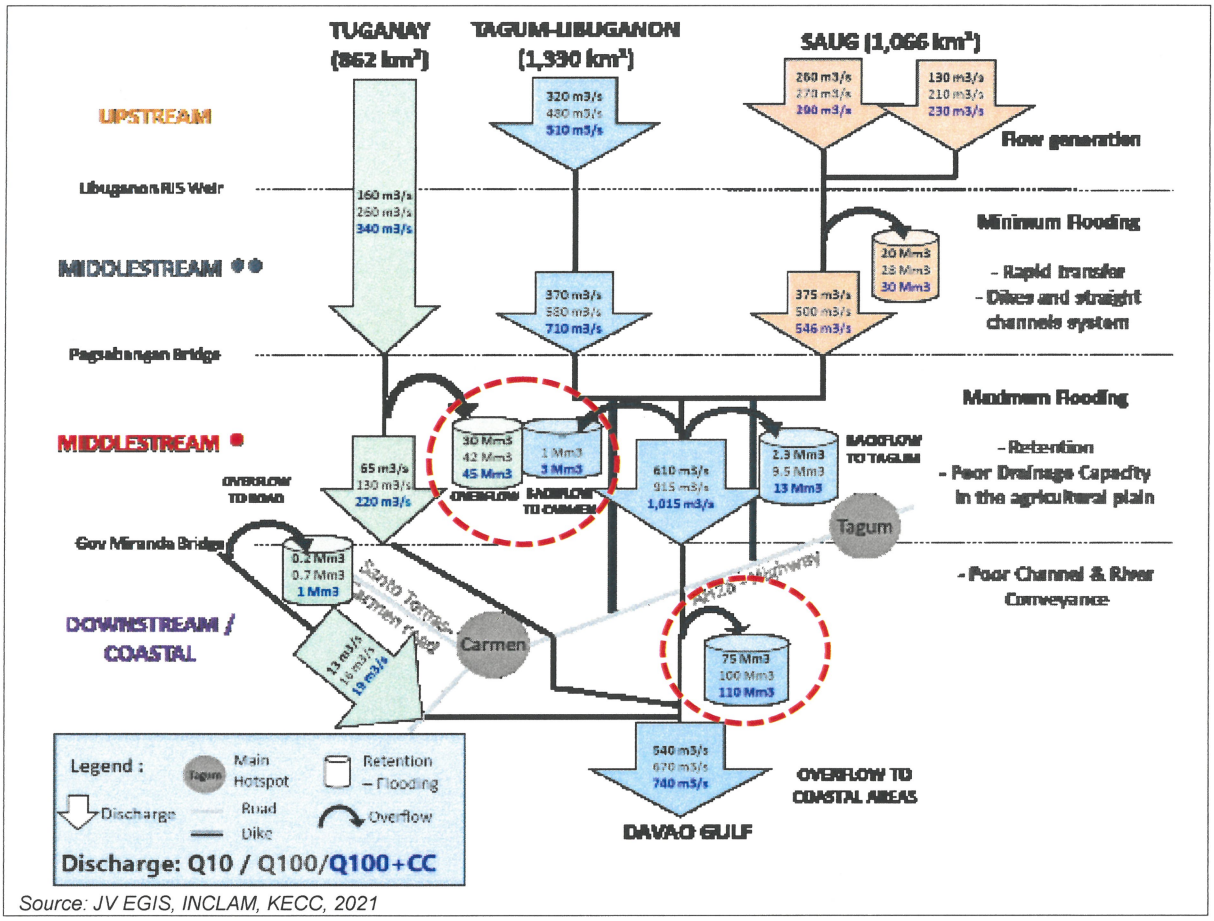


238. The hydraulic impact of the proposed structural investments in TLRB are analyzed using 2-dimensional flood propagation model. This hydraulic model utilized a high-precision digital elevation model (DEM) as well as the latest land use data. A short discussion of the results are as follows.

IMPACT TO FLOW BEHAVIOR

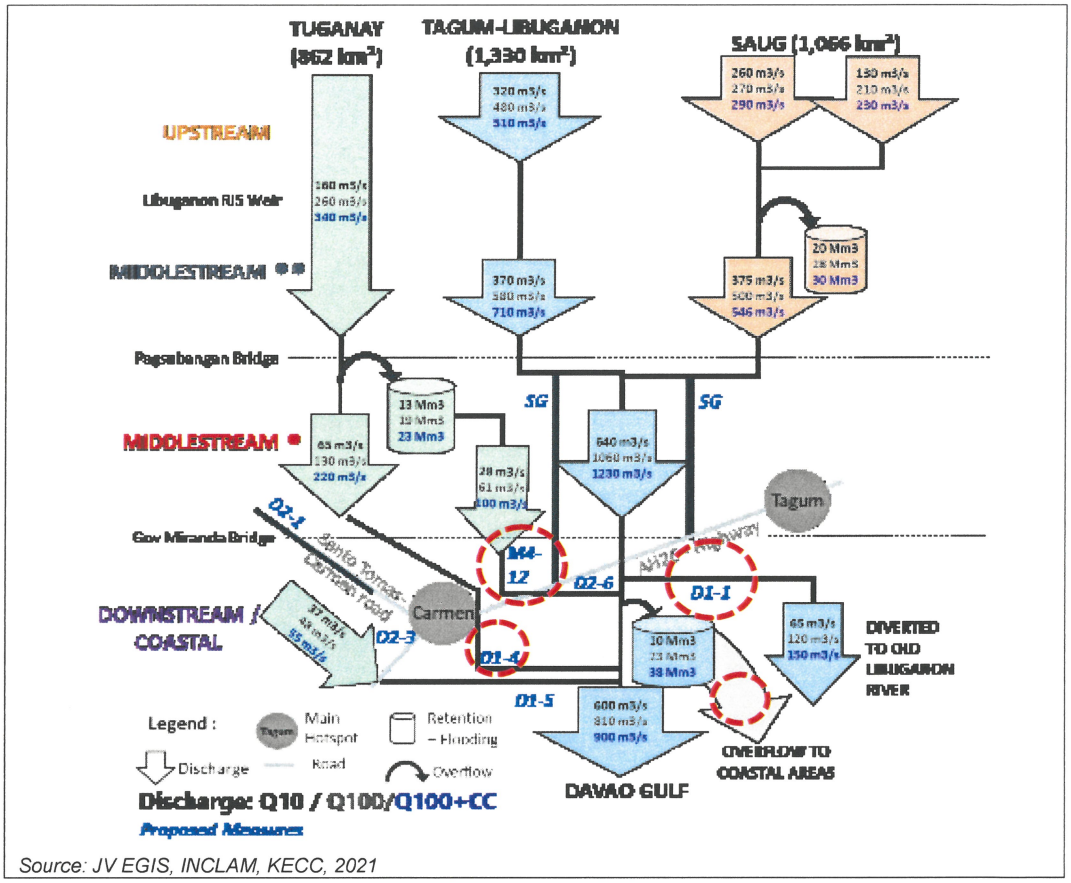
239. Figure IV-2 shows a generalized hydraulic behavior of the TLRB basin for the current situation. Encircled in red are the volumes of water overflowing into the agricultural and built-up areas under the current situation. As part of the flood risk mitigation, diversion channels are proposed to convey part of the said overflow volumes and redirect them back into the drainage network further downstream, in order not to overload the existing drainage network upstream.

Figure IV-2 : Schematic Diagram of Volumes Spread Over the Plain (Current Situation)



Source: JV EGIS, INCLAM, KECC, 2021

Figure IV-3 Schematic Diagram of Volumes (With the project)



Source: JV EGIS, INCLAM, KECC, 2021

240. A summary of the impact to flood depth is included in Table IV-1.

Table IV-1 : Summary of volumes and flood impact (see Figure IV-1 for reference points)

	Water Body	Total volume ($M m^3$)	Diverted Volume ($M m^3$)	Discharge Capacity (m3/s)	Water Surface Elevation (m)		% of water diverted
					Current	w/ project	
D1-1	Source (Point 1a): *Tagum-Libuganon River*	206	19.5		3.33	3.45[c]	9.5%
	Receiving (Point 1b): *Ancient Libuganon River*			> 150[a]	1.18	0.86	
D1-2	Source (Point 2a): *Tagum-Libuganon River*	206	64.5		1.97	1.79	31.3%
	Receiving (Point 2b): *Davao Gulf*			[b]	1.20	0.79	
D1-4	Source (Point 3a): *Ising River*	53	30.2		1.98	1.58	57%
	Receiving (Point 3b): *Tagum Cut-off Channel*			400	2.14	1.63	

	Water Body	Total volume ($M m^3$)	Diverted Volume ($M m^3$)	Discharge Capacity (m3/s)	Water Surface Elevation (m)		% of water diverted
M4-12	Source (Point 4a): *Cabayangan Creek*	23	12.2		3.74	3.33	53%
	Receiving (Point 4b): *Tagum-Libuganon River*			400	3.33	3.33	

Note: All values pertain to 100-year return period flood event
a – improved capacity
b – outfall already at sea
c – increase in depth is not caused by diversion channel but by containing all backflow into the dike system of Tagum-Libuganon River

IMPACT TO FLOODING

241. All diversion channels are to be located in areas that are already flooded during extreme storms. At the "with project" scenario, the diversion channels are effective in storms up to 25-year return period. Areas around the said channels will still be flooded by storms with higher return period (50-100 year), but the flood depth and duration are already reduced compared to the "without project" scenario of the same return period.

242. There is no inter-basin diversion in the case of TLRB. Aside from D1-1, the proposed diversion channels still drain the floodwater to the same water body at the receiving end (Tagum-Libuganon River or Davao Gulf), but on different routes, in order not to overload the smaller channels which the floodwater originally traverses. In the case of D1-1, the proposed receiving body (Ancient Libuganon River) is an old outfall of the Tagum-Libuganon River, and the "new" diversion channel D1-1a mainly revives the connection between the two water bodies to improve the hydraulic capacity of the TLRB drainage network as a whole.

SEASONAL FLOW

243. Specifically, the design riverbed are below mean sea level and are already submerged by tide water elevation even during dry season. The projected depths of the new channels are shown below. Thus, the channels act as permanent water bodies, although D1-1a is a recovery and expansion of an existing waterbody from its current agricultural use.

Table IV-2 Depths along diversion channels (in m.) during dry season and storm events

Structure	Dry Season	Storm event (100-yr Return period)
D1-1 (D1-1a + cutoff channel)	1	2 - 3
D1-2	3.5	4.5
D1-4	1	2 - 3
M4-12	0.5 - 1	3

244. **Water diversion Impact on groundwater.** Creating new channels with water all year round can lead to changes in groundwater flows and may lead to a rise in height of the groundwater table. This is closely related to the water ponding depth. In the vicinity of the new channels, this may lead to an increase in the water table during flood events.

245. During dry period, the channels may potentially draw water from the surrounding water

table and thus decrease the groundwater level. However, this may occur if the channel bed intersects with groundwater level. Based on the JICA study which surveyed water sources in Tagum, wells in Carmen have depth level of 20-60m and hence, will not intersect with the new channels. Therefore, the impacts on groundwater level is expected to be low.

246. The new diversion channels D1-2 and D1-4 are close to the sea. Brackish water conditions are already reported in the area since most of the existing riverways are affected by tidal flow. The JICA study on water availability in Tagum also showed that groundwater quality is already brackish, with about 70% of wells being brackish. Hence, further alteration to the existing groundwater quality is expected to be limited.

247. **Water diversion impacts on Ecosystem.** All new diversion channels are located in existing agricultural areas. Provincial Tax Map land classification confirms these to be agricultural areas already. With the new diversion channels, these will become permanent waterways, having depths as shown in Table IV-2 with riparian ecosystems planted with vetiver grass in the banks.

248. In the case of the cutoff channels (in D1-1 and D1-4), channelizing the stream produces a straight, uniform channel with fewer features, such as pools, riffles, and undercut banks, that are important habitat for aquatic animals. Habitat may also be lost if the works result in a shallower stream. Low water levels may expose riffles and cobble substrate in high gradient streams, and logs and snags in low gradient streams – all of which are important habitat for fish and other aquatic animals. To maintain water levels at the existing streams, these channels were designed to act as overflow, thus conveying water only during flooding events and minimizing lowering of water levels in the existing waterways. Impacts on aquatic habitat will thus be reduced by this design measure and overall impact is assessed as low.

249. The impacts on ecosystem changes of diversion channels (from agriculture to riparian) can be positive and should be harnessed through the Output 3 activities. Safety hazards introduced by the new channels can be addressed through the operations mitigation measures.

250. The proposed water diversion will convert existing agricultural lands into permanent diversion channels or water bodies. The total area is around 80 ha, all in the downstream section of the watershed. Under the present condition, these areas are flooded during the wet season and dry to waterlogged during summer. These are already close to the sea and thus, none of the areas in the vicinity of the channels will experience water levels beyond flood levels happening at present. Therefore, little increase in seawater intrusion is expected.

251. **Dredged materials disposition and selection of disposal sites**. River widening in some areas of RARB and TLRB will generate dredged materials that will mostly be used for beneficial purposes (e.g., backfilling) based on assessment of suitability. The potential for spread of contaminants from dredged materials management was assessed using the IFC-EHS guidelines on contaminated land which require: (a) Identification of the location of suspected highest level of contamination through a combination of visual and historical operational information; (b) sampling and testing of the contaminated media (soils or water) according to established technical methods applicable to suspected type of contaminant; (c) evaluation of the analytical results against the local and national contaminated sites regulations; (d) verification of the potential human and/or ecological receptors and exposure pathways relevant to the site in question.

252. The risk assessment made use of updated tenement maps from Regions X and XI to verify that mining areas are not within the watersheds of the project sites. It also identified the potential for pesticides from banana plantations upstream of Tuganay R.

253. Available studies on soil/sediment sampling in the Philippines were used to infer upon

the sediment quality in the project sites. The DPWH 2008 study was cited earlier in the baseline report and shows sediment quality in five areas (including Tuganay) to be within the levels acceptable for land application (Table II-14).

254. The Final Report for the Detailed Design of the Pasig-Marikina River Channel Improvement Project (Phase III, Feb 2013) has shown that "all concentrations of heavy metals and other inorganic and organic toxic substances analyzed were generally not present in concentrations that are considered harmful to humans. This indicates that the sediments along Lower Marikina River are not hazardous, and no significant levels of toxicity will occur in the river water during dredging." Marikina River in Metro Manila in 2013 is by far more polluted than the rivers at TLRB and RARB at present. Thus, it can be inferred that dredged materials from both TLRB and RARB are amenable to the soil quality standards in Table II-14.Therefore, sediment test does not need to be conducted.

255. Regarding possible pesticide runoff to rivers and accumulated in sediment, the study conducted by Carvalho, et.al[35] determined organochlorine pesticides (OCs) in sediments and oysters' soft tissues (Cassostrea gigas) collected in selected sites of Manila Bay. Overall, the concentration levels were very low. In general, results showed that concentrations of organochlorine pesticide residues, such as DDT, hexachlorocyclohexane, chlordane, lindane, endosulfan, and heptachlor in sediments and oysters were low in comparison with other coastal areas in Asia. Current concentrations of persistent organochlorine contaminants in sediments were under threshold effect levels (TELs) and chronic toxic effects are, thus, unlikely to generate impairment of marine biota in Manila Bay. A similar study was also cited in a WB report[36] saying that "Pesticide residue analysis of soil samples showed that levels of organochlorine, organophosphates, and pyrethoids, are below the limit of quantification (LOQ) at 0.005 mg/kg." for Manila Bay samples.

256. The rivers to be dredged in this project are far less polluted than the Pasig/Marikina River in 2013 or Manila Bay in 2012, owing to the rural environment it is situated and the absence of pollution sources such as minesites, dumpsites, and industrial activities near or upstream of the dredging sites. Mining in the provinces of the projects is outside the catchment areas of these river basins. Hence, the dredged materials in both TLRB and RARB are likely to be ~~u~~ amenable for beneficial use such as backfill material, no need for special landfill or treatment.

Impact on mangroves.

257. The loss mangroves due to the project will mainly take place in TLRB (there will be no mangrove cutting in the other two RB's). The main negative impacts are the permanent loss of around 24 ha of mangrove stands, which constitute 7% of the total mangroves (340 ha) in the project site, shown in the table and figure below.

Table IV-3 Summary of Mangrove Loss

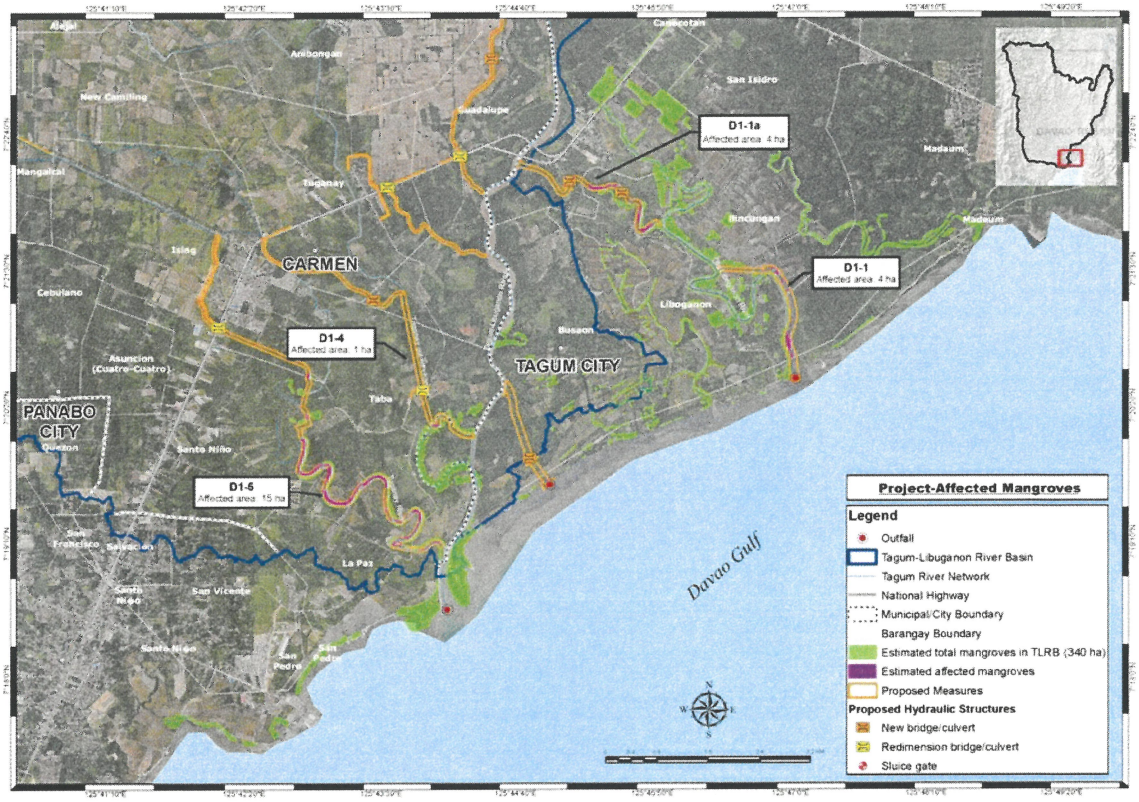
Measure	Mangroves Area (ha)	Mangroves tree count (estimate)
D-1-1	7.04	3,524
D-1-1a	4.10	2,052

[35] Organic contaminants in the marine environment of Manila Bay, Philippines. Fernando P Carvalho 1, Jean-Pierre Villeneuve, Chantal Cattini, Inmaculada Tolosa, Cristina M Bajet, Mariafe Navarro-Calingacion. Arch Environ Contam Toxicol 2009 Aug.

[36] An Overview of Agricultural Pollution in the Philippines. The Crops Sector. 2016. The World Bank's Agriculture and Environment & Natural Resources Global Practices.

Measure	Mangroves Area (ha)	Mangroves tree count (estimate)
D-1-2	0.15	77
D-1-4	0.44	221
D-1-5	12.7	6,344
Total	24.43	12,218

Figure IV-4 Location of the Mangroves and Structures in Tagum-Libuganon River Basin



Source. Egis, Inclam, KECC, 2021

258. The loss of mangroves will result to decreased habitat and breeding grounds for some flora and fauna within the affected locations. The mangrove trees and canopy provide important habitat for a wide range of species while the space between roots provides shelter and food for fauna such as prawns, crabs and fishes. This impact will be felt in the coastal portions of D1-1 and D1-5, extending about 2 km upstream from the shore where some fishing activities are conducted. Hence, this impact is assessed as moderate due to small percentage affected.

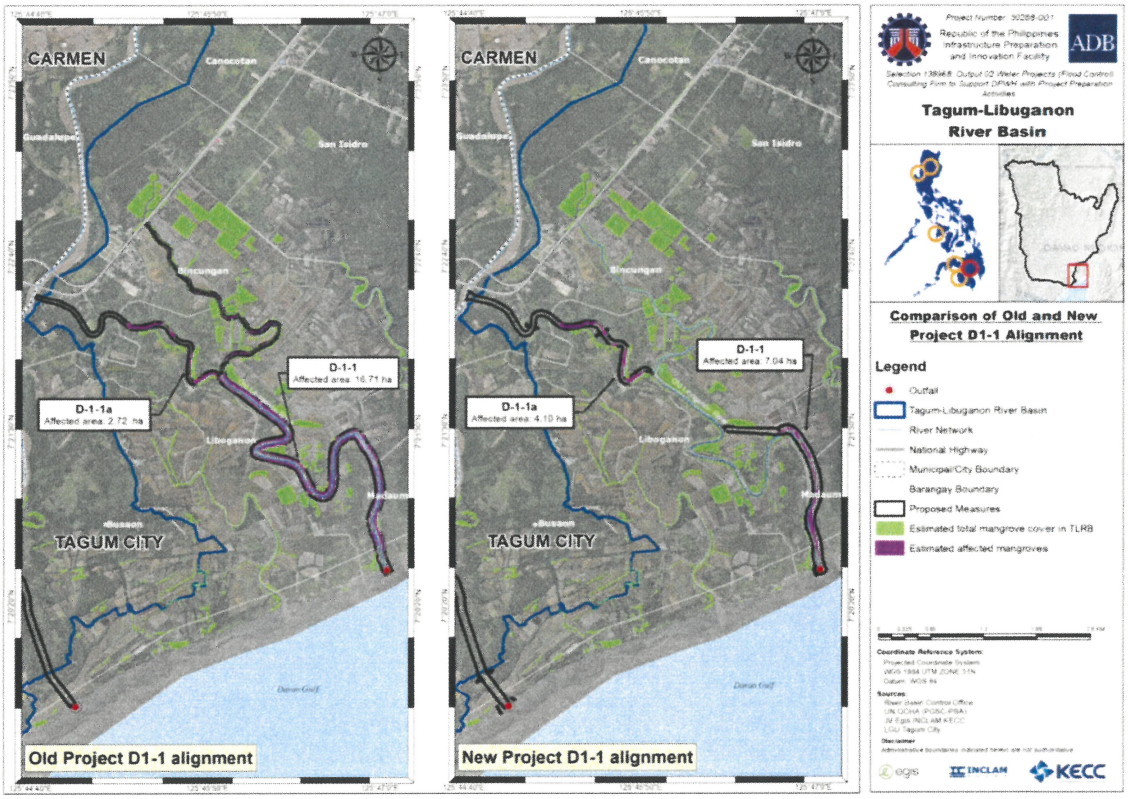
259. Alternative design was adopted, keeping most of the affected area to one side and introducing the cutoff channel. The previous design of D1-1 would have resulted in 17 ha of mangroves removed in that area. To mitigate the impacts, the design was innovated to reduce the number of mangroves to be cleared in D1-1. Instead of widening the whole stretch of the Ancient Libuganon River, widening will only start from the diversion channel seaward. With this alternative design, the need for mangrove clearance was reduced from 17 ha to 7.04 ha in D1-1 (Figure IV-5).

260. Mangrove clearing also has an impact to coastal water quality, neighboring ecosystems such as seagrasses and coral reefs. The mangroves filter nitrates and phosphates that rivers and streams carry to the sea and keep seawater from encroaching on inland waterways. For the D1-1, there is a significant area of mangroves upstream of subproject site that will not be cleared and the total mangrove in this river is around 60 ha. which can still provide the filtering function of mangroves. The mangroves to be cleared are mostly in the downstream section of the Old Libuganon River totaling only around 4.0 ha (6.8%).

261. Mangroves are carbon sequestration ecosystems. Cutting and uprooting mangroves will release the stored carbon (GHG) in soils. This will not be significant as only 7% mangrove cover will be affected. The project will require to offset the loss, see the EMP.

262. The receptors of this impact of mangrove loss include the local community who derive benefits from the mangrove forests. The overall impact from mangrove loss is assessed as medium or moderate. Design changes have reduced the extent of the impact from 10% to 7%. The loss, however, needs to be addressed through offsetting by tree transplantation and additional planting in accordance with regulatory requirements. The success of these measures needs to be ensured up to the operations stage.

Figure IV-5. Comparison of Old and New Project D1-1 Alignment



Source. Egis, Inclam, KECC, 2021

B. Assessment of Construction Phase Impacts

263. Given the nature of a project dominated by civil works, most of the project's potential

environmental impacts are associated with the construction of the specific flood control structures. Physical works occur mostly within existing roadways in modified agricultural landscapes. There are also dikes and bridges construction works where residents are located adjacent to the river. Most of the environmental impacts can be mitigated with the use of good construction practices. The mitigation measures are presented in detail in the EMP.

Impacts on Water

264. Subproject construction activities such as excavation and filling activities may lead to surface erosion and sedimentation of adjacent water bodies. These may occur for toe protection works, dike and channel construction work in all RBs.

265. River dredging, excavation works and filling activities for channel widening and dike works, and bridge construction would disturb the bottom sediment and increase suspended solid (SS) concentration in water bodies.

266. Run-off from machinery, material and workers' camp can also contaminate the water bodies. This may become significant during the wet season and high rainfall events.

267. Materials for filling may be sourced from existing borrow pits or quarries in the area and may result to new borrow areas. Inappropriately sited and improperly managed borrow pits and spoil disposal areas can impact on surface water also through erosion and sedimentation. Erosion and sedimentation can negatively impact water quality of rivers, and fisheries and aquatic habitats, resulting in lower fish population. These potential impacts will be localized to the subproject construction sites, and are short-term (only during the construction period).

268. For ARB and TLRB, there are no known rare or endangered aquatic fauna or flora that will be affected. There are also no significant commercial or community fisheries in the receiving water bodies in these areas, thus potential impact is also low in significance. Impacts on fisherfolks and fishpond owners will be addressed in the RAP.

269. For RARB, the impact of river widening near Lake Lanao may become significant if structures to mitigate runoff and resuspension of silt during excavation and dredging is not mitigated. The dredging methods discussed in Chapter I are intended to reduce these impacts. A dredging management plan will be discussed in the EMP.

270. Inappropriate disposal of domestic wastewater (from construction workers or worker camps) or construction wastewater (from drainage of excavation and dredged materials, washing aggregates, washing construction equipment and vehicles, pouring and curing concrete, and oil-containing wastewater from machinery repairs) may cause surface or groundwater contamination. These impacts will be localized to the construction sites and possibly to nearby surface water bodies, and will occur only during the construction period. Mitigation of these impacts are already part of good construction practices and will be included or emphasized in the EMP.

Impacts on Land /Soil

271. Cut and fill construction activities will generate spoil and borrow sites for fill materials. Inappropriately sited borrow and improperly operated pits and spoil disposal areas can cause loss of productive farmland. Project activities that will require fill and generate spoil include channel construction and dike works, river widening works, bridge and road rehabilitation works.

272. Widening of the river mouths near Lake Lanao will be undertaken in two subprojects at RARB (RIV-07 in Agus R and U-36 in Gata R). For Tagum, excavations mainly along the river

channels will be undertaken to enlarge the river and part of the excavation on the embankment is in water. This will affect 17.88 ha. of mangroves and generate excavated soil material (see Table *IV-4*). Diversion channels will also be constructed in TLRB to improve flood protection. These are mostly agricultural lands and some fishponds. Compensation for these economic losses will be addressed in the RAP.

273. The excavation activities in the construction of these diversion channels involve permanent removal of soil cover and soil loss in these areas. These topsoil will be reused in other subprojects and in the replanting activities as planned.

274. Soil erosion may lead to loss of soil fertility. The most vulnerable soil erosion areas include waterfront civil work, slope side construction, excavation sites, spoil sites, temporary construction sites, and other areas where surface soil is disturbed. Washing construction materials such as stone and sand can also cause sedimentation. Soil fertility may also decrease in quality in areas where movement of construction equipment, vehicles, and personnel is frequent.

Solid wastes and their handling and disposal

275. Solid waste generated during construction will include construction and demolition (C&D) waste, excavated spoil during earth works (for construction of road, embankment, and river channel widening), dredged sediment from the rivers (discussed earlier), and refuse generated by construction workers on construction sites.

River Dredging and excavation of dry and wet materials

276. **Dredging** is the removal of sediments from the bottom of water bodies. The removed material (or spoil) is partly dewatered on site to reduce load, cost of transport, and leakage along the way before transported for disposal. Excavation, on the other hand, is conducted in several areas such as riverbanks and in some roadworks. Construction methods to be used will enable excavation to be conducted under "dry" conditions.

277. Dredging and disposal of dredged material may lead to impacts on water quality from increased turbidity and from release of contaminants to the water column due to re-suspension of sediments and/or changes of certain chemical compounds in the dredged materials when exposed to different level of oxygenation.

278. In the case of Abra, there will be no excavated materials to be disposed and no dredging. The excavations needed to install the toe protection of the existing or proposed structures will be used at site as backfill, to be supplemented by materials from quarries/borrow pits.

279. The table below provides the estimate for the excavation works. For Abra, the excavated materials are not of the same nature as for Tagum and Agus, as they are mainly sand and gravel. In Tagum and Agus, the materials are clayey and cohesive.

Table IV-4 Estimated Volume of Excavation Materials ((m^3))

River basin or subproject	Deep scrapping and excavation of dry material	Excavation of wet material	Sediment to be dredged
ABRA RIVER BASIN	446,428	148,006	none
Tagum-Libuganon River Basin	2,081,655	2,368,900	637,100
Ranao Agus River Basin	-	295,010	162,239
Total	2,528,083	2,811,916	799,339

280. For TLRB, dredging activities are found in D1-1 in Tangkuan Creek and in the mouth of the Ancient Libuganon River, D 1-4 in Tuganay Cut-off Channel, and D 1-5 in Tala River. For RARB, there will be dredging activities for river mouth widening. Estimated dredged materials are as follows.

Table IV-5 Estimate of dredging materials

Measure	**Dredging (m^3)**		
ARB	none	RARB	
TLRB		M-01	*13,085*
D1-1	155,100	M-02	*79,116*
D1-2	17,500	M-03	*13,614*
D1-4	25,500	M-04	*29,196*
D1-5	439,000	M-05	*13,614*
		M-06	*13,614*
SUBTOTAL	637,100	SUBTOTAL	162,239

281. The impacts on water quality from dredging directly affects these bodies of waters including the receiving downstream meanders. Dredging can disturb the natural ecological balance through the direct removal of aquatic life. In freshwater environments, bottom-dwelling organisms on which fish depend for food may be temporarily or permanently eliminated from the food chain. There are no rare or endangered aquatic or terrestrial flora or faunae present. Overall, potential dredging impacts are localized, short term, and low in significance.

282. Inappropriate disposal of spoils and dredged materials may cause loss or contamination of farmland, damage to or pollution of rivers and groundwater, wetlands and soil, or flooding or hydrological changes in rivers and streams.

283. Silt or sediments released from dredging activities can cover and destroy fish feeding and breeding habitats. Furthermore, contaminants may accumulate over long periods of time in the sediments, and can then contaminate the disposal site where they are deposited.

284. The dredged materials will most likely be nonhazardous, as there are no dredging sites near metallic mining or mineral processing areas. Based on the Mining Tenements Control Map of Region XI (Feb 28, 2021), most of the approved mineral production areas are in the Compostela Valley area, which are outside of the TLRB watershed. In RARB, there are also no mining areas near or upstream of the proposed dredging sites.

285. The subprojects have initially identified potential disposal sites for dredged materials during the FS (tabulated below for TLRB). For RARB, the Municipalities in Lanao del Sur that have expressed that they will get all the dredged materials are Tamparan, Mulondo and Poona Bayabao (Gata). They have a storage area at their respective Municipal Hall compounds. The

EMP has included siting criteria for disposal of dredged material and excavated materials.

286. Wet and dry excavated materials can be transferred to potential disposal sites identified during site visits. Residents also commonly request excavated soil to be utilized as fill material for agricultural areas, or as perimeter embankment in fishponds.

Table IV-6. Proposed Location of Disposal Sites

Description	Location	Area (sqm) / *Vol (m^3)	Material
Provincial Government Recommendation (open areas)	Barangay Mabaus in Carmen, Barangay San Miguel, Mankilam, Pagsabangan, Bincungan in Tagum City and Barangay Cambanogoy, Asuncion	131,719.98	Wet and dry material
Tagum City Motorpool	Barangay Magugpo East, Tagum City	44,278.82	Clean, dry material
Carmen open area (residential land use)	Barangay Ising, Carmen	34,007.34	Dry material
Abandoned Fishponds	Barangay Bincungan, Madaum, and Liboganon, Tagum City	388,836.32	Wet and dry material
Coastal Refilling	Baragay La Paz and Taba, Carmen, Barangay Busaon, Liboganon, and Madaum, Tagum City	245,036.07	Wet material
	TOTAL	**843,878.53**	

** Volume capacity calculated at an average depth of 1 meter*

287. Preliminary assessment of the proposed disposal sites for Agus and Tagum was conducted using orthophotos (high resolution satellite images) based on the site selection criteria in the EMP. These are presented in Annex VI Disposal Sites Suitability Assessment and summarized here. Some of the proposed sites are depicted in the following photos.

288. The potential disposal sites for TLRB do not encroach any surface water courses and will not impede any water flow. The sites will not cause damage to agricultural lands nor any other productive sites as the general land cover of the areas are mostly grassland which are presumed to be previously cultivated farmlands. Remnant dividers for separation of rice paddies into blocks are retained and could provide impediment to mud flow.

289. Similar to TLRB's sites, the potential disposal sites for RARB are seen as abandoned agricultural lands and vacant lots as well. They are located near the municipal halls of the affected Local Government Units (LGU). They will not cause obstruction to any waterway nor any destruction to farmlands, irrigation, vegetated areas, forests, and other productive sites.

290. The results show that all sites are abandoned agricultural areas, away from water bodies, and located on stable slopes and are thus suitable for the disposal of dredged materials or as its holding area pending deployment.

Plate IV-1. Location of Potential Disposal Site in Barangay Pagsabangan, Tagum City



Plate IV-2. Potential Disposal Site in Barangay Cambanogoy, Asuncion



Garbage and Hazardous Wastes

291. Inappropriate transportation, storage, use and spills of petroleum products and hazardous materials during construction can cause soil, surface and groundwater contamination. Oil is toxic and harmful to plants and animals and oil pollution can have a devastating effect on the water environment. It spreads over the surface in a thin layer that stops oxygen getting to the plants and animals that live in the water. It harms animals and insects, prevents photosynthesis in plants, disrupts the food chain, and takes a long time to recover. Wildfowl are particularly vulnerable, both through damage to the waterproofing of their plumage and through eating the oil as they preen. Freshwater mammals may also be affected. In the ground and soil, oils coat or kill the organisms which are necessary to maintain environmental balance.

292. Inappropriate disposal of hazardous wastes such as solvents, chemical, electronics, batteries and other wastes from construction sites and worker camps can have both short-term effects on surface and groundwater quality, and long term effect in terms of mutations in animals, impacts on habitats, and even disease in humans. To prevent this good hazardous materials handling and disposal practices will be implemented, including treatment and disposal to an accredited treater.

Air Pollution

293. Anticipated sources of air pollution from construction activities include: (i) dust generated from earth excavation, filling, loading, hauling and unloading; (ii) dust generated from disturbed and uncovered construction areas, especially on windy days; (iii) dust generated from construction material storage areas, especially on windy days; (iv) dust generated by the movement of vehicles and heavy machinery on unpaved access and haul roads; (v) dust generated from aggregate preparation and concrete-mixing; and (vi) emissions (gaseous CO and NO_2) from transport vehicles and heavy diesel machinery and equipment along access roads.

294. A dispersion modeling result for a bridge construction project in an urban setting[37] has

[37] IEE Report for Metro Manila Three Priority Bridges, ADB Project, 2021.

shown that PM10 concentrations 100-m downwind of unpaved construction sites can exceed the 1-hour guide value of 200-ug/NCM (Philippine air quality and IFC standard). The study showed that mitigation using frequent watering will reduce the fugitive dust levels to that below the guide level. Hence, the importance of these mitigation measures will be emphasized in the EMP.

Noise and Vibration

During construction, anticipated impacts will have medium, temporary and localized impacts. Noise quality during construction will deteriorate due to the mobilization of equipment, construction materials, vehicles, batch mixing, and excavation. The overall impact of noise to the receptors will depend on the position of equipment and their cumulative actions. The baseline noise levels have not been determined but are anticipated to be within or even below the guide values, owing to the predominantly rural setting.

295. The anticipated noise impact of the proposed project at nearby residents/receptors during construction period is calculated using the Roadway Construction Noise Model (RCNM) of the U.S. Federal Highway Administration (FHWA). The RCNM was developed as a screening tool to check compliance with applicable noise limits or standards during operations of heavy equipment during construction period. As provided in the User's Guide of RCNM (FDA Final Report, 2006), RCNM calculates equivalent noise level (Leq) as provided below. These calculated values are then compared with applicable limits.

Leq = LmaxCalc + 10log (U.F%/100)
where,
U.F% = time-averaging equipment usage factor, in percent

296. The Noise Level Guidelines from IFC-WB/EHS are used for comparison. A daytime (0700-2200) one-hr LAeq of 55 dBA and nighttime (2200-0700) value of 45 dBA for residential, institutional, and educational areas is set. Noise impacts should not exceed these levels or result in a maximum increase in background levels of 3 dB at the nearest receptor location off-site.

297. During construction stage, ambient noise will increase temporarily and intermittently in the close vicinity of active construction fronts and camps. Noise level assessed at varying distance due to each equipment operated singly, are given in the table below, and shows distances at which the daytime Leq of 55 dbA could be achieved.

Table IV-7 Predicted Noise Level (Leq) for various equipment (dBA)

Distance of receptor from noise source (m)	Jackhammer	Dozer	Excavator	Backhoe
20	79.5	75.3	74.4	71.2
50	71.6	67.4	66.4	63.3
100	65.6	61.4	60.4	57.2
130	63.3	59.1	58.1	55.0
184	60.3	56.1	55.0	
207	59.2	55.0		
336	55.0			

Source: Calculated using RCNM 1.1

298. The construction sites are mostly in rural agricultural non-residential areas located at sufficient distance that noise is not expected to significantly impact sensitive receptors. It is anticipated that construction noise will be in compliance with the IFC guidelines as well as that

of NPCC 1980 Guidelines (MC-002). Overall, potential noise and vibration impacts will be localized, medium-term in duration and low in significance. Any potential impacts will be effectively mitigated through good construction noise management measures.

299. There are, however, excavation and constructions sites where residents are within a 10-20m distance (e.g. in RARB). In these cases, background noise levels will be exceeded. Where practicable, noise reduction equipment will be used. Otherwise, administrative controls such as scheduling noisy activities during daytime and other measures detailed in the EMP will be implemented. The operation of noisy equipment will be coordinated with the nearby residents and appropriate mitigation measures provided. The Contractor will develop its Noise Management Plan in consultation with the community residents and other sensitive receptors.

Impacts on Biological Resources, Ecology and Biodiversity

300. **Impacts on Biodiversity.** The Project surveys indicated that there is no critical habitat, rare or endangered flora and fauna or areas of natural forest that will be affected in the three river basins' project sites. Although protected areas and key biodiversity areas partially overlap with the boundaries of the river basins, most subprojects entailing construction activities are found in the lower portions of the river basin, in areas with significant settlements or agricultural activities. Good construction measures will prevent unintended impacts.

301. *Table III-1* (ARB), Table III-7 (TLRB), and Table III-15 (RARB) showed the relative distance of the protected areas and KBAs from the nearest subproject. For ARB, the closest protected area is 2.5 km from the proposed spur dike (Z3P3-SC2-01). Construction impacts including dust emissions and noise would not affect the PA.

302. From the map (Figure III-3 Estimated general location of Philippine Crocodile), the habitat of the Philippine Crocodile is very far from the proposed subproject sites. Their range is only a 4-km stretch of the Binongan River at an approximate elevation of 850 masl; hence, their habitat is not affected by the Project. During high water or flooding, however, some juveniles may be washed downstream. Management of this potential impact needs to be addressed.

303. Although some of the subproject structures in RARB are within the Lake Lanao Watershed Resource, these are mostly in disturbed areas where settlements are already present. Recommendations on areas in LLWR that will be considered as strict protection areas indicate that the upper watershed forest areas will likely be the ones covered. In any case, coordination with concerned agencies of MENRE-BARMM will need to be undertaken to make sure that the necessary approvals are secured, when necessary.

304. Channel improvement in Gata Lake (RARB) may affect aquatic species endemic to Lake Lanao as a result of erosion. Channel improvement works should be undertaken during dry days to limit the transport of disturbed materials from the riverbed into Lanao Lake. The use of silt traps is highly recommended.

305. Construction workers may poach or collect wildlife species within the forested areas. The prohibited acts as stated in Section 20 of the IRR of NIPAS Act of 1992 and ENIPAS Act of 2018 should be strictly implemented. The Contractors' EMP shall contain these strict guidelines.

306. If not properly managed, afforestation can result in a reduction of local biodiversity, the modification of particular biomes, the introduction of non-native and potentially invasive species, reduced stream flow, and lost revenue from agriculture.

307. **Vegetation clearance and habitat loss.** For TLRB, the general land cover of the areas for the construction of new diversion channels are, for D1-2, mostly populated with trees although classified as agricultural, while M4-12 is a cultivated agricultural land. On the other

hand, channels to be dredged which require vegetation clearance are in D1-1, D1-4, and D2-6. The woodland areas of D1-1, D1-2, D1-4, and D2-6 are naturally thriving with trees and shrubs. There is an estimated 340 has of mangrove forest in these locations.

308. Vegetation clearance may lead to loss of some economically valuable timber stands and decrease in habitat for wildlife. As an effect, animal species may evacuate the area and migrate to a neighboring habitat. The Study Team also observed the presence of migratory birds located in moist areas within Ancient Libuganon River and Tuganay River in D1-5. Potential impacts on migratory birds which may be nesting on existing structures, vegetation, or gravel substrate within the project limits at any time of the year, but especially during the nesting season, must be considered in the mitigation plan.

309. An estimate 7,086 trees will be cleared in TLRB (Table IV-8). The subprojects in these areas will include the 24 ha or 7% of the total 340 ha of mangrove forest discussed earlier. The number of trees for D1-1, D1-4, and D1-5 are inclusive of mangrove trees which will be earth balled or transplanted, which may lessen the loss (impacts discussed earlier).

310. Overall, however, this constitutes permanent loss of vegetation and habitat, which need to be offset by a replacement plan that will be implemented in accordance with regulations cited in Chapter II and in support of the National Greening Program. For RARB, the estimated number of trees affected is 4,014 which are mostly along the riverbanks. No trees will be cut in ARB.

Table IV-8. Summary of Tree Cutting (Estimated)

Measure	Number	species	Planned solution
TLRB			
D1-1	1,215	Coconut, mango, timber, mangrove	Limited number of trees to be cut through reduction of footprint, planted trees will have a replacement ratio of 1:50 while as naturally growing trees have replacement ration of 1:100, coconut tree replacement shall be dealt by Philippine Coconut Authority, earth balling will be done for mangrove trees
D1-2	1,434	Coconut, banana	Planted trees will have a replacement ratio of 1:50 while as naturally growing trees have replacement ration of 1:100, coconut tree replacement shall be dealt by Philippine Coconut Authority
D1-4	2,032	Coconut, banana, mango, timber, mangrove	Same as D1-2
D1-5	214	Coconut, banana, timber, mangrove	Same as D1-1
D2-3	979	Coconut, banana, timber, mango, marang	Same as D1-2
D2-6	776	Coconut, banana, mango, timber	Same as D1-2
D3-2	151	Coconut, Banana	Same as D1-2
M4-12	285	Coconut, banana, jackfruit, marang	Same as D1-2
--subtotal	7,086		
ARB	0	None	Not applicable
RARB	623		
Baloi	332	Coconut, Banana,	Planted trees will have a replacement ratio of 1:50 while as

Measure	Number	species	Planned solution
		Lanzones, Rambutan, Mangosteen, Durian, Jackfuit, Marang, Timber	naturally growing trees have replacement ration of 1:100, coconut tree replacement shall be dealt by Philippine Coconut Authority
Taraka	155	Coconut, Banana, Lanzones, Rambutan, Durian, Timber	Same as Baloi
Gata	136	Coconut, Banana, Lanzones, Rambutan, Mangosteen, Durian, Jackfuit, , Marang, Timber	Same as Baloi
Total	7,709		

311. The domestic guidelines for tree-replacement discussed in Chapter II shall be followed in the case of mangrove balling. According to these, cutting of mangroves is disallowed, hence, the government issues mangrove balling or transplanting permit to areas of similar environments.

Social Disturbance

312. Given the linear nature of the Project, its construction will cut cross many areas and thus have the potential to cause considerable social disturbance to affect local people's daily life and work, religious activities and their accessibility. Other impacts on traffic and roads are: (i) transport of construction materials and goods can result in congestion, temporary delays and potential safety risks; and (ii) transportation of heavy equipment and loads may cause damage to roads, including surface damage and subsidence.

Occupational and Community Health and Safety

313. Project construction may cause physical hazards to workers from electrical shocks, welding, noise and vibration, dust and poor air quality, eye hazards, handling heavy materials, heavy equipment, industrial traffic, work on slippery surfaces, falls and falling objects, falling into water, fire hazards, chemical hazards, etc. These health and safety hazards pose a risk that will be present throughout the project construction period. However, these are also typical risks faced on construction projects throughout the country and the rest of the world with standard measures to prevent and mitigate. The country's Republic Act 11058 provides for adequate regulations to control and mitigate construction OHS impacts. The IFC EHS Guidelines will also be adopted.

314. Project construction has the potential to cause public safety risks from injuries suffered as a consequence of authorized or unauthorized entry into work areas, including:

- Injuries suffered because of falls or contact with heavy equipment.
- Injuries from construction site fires.
- Drowning in rivers
- Respiratory distress from dust, fumes, or noxious odors
- Exposure to hazardous materials.

315. There is also the potential for negative social interactions between workers and local community members, and the potential for transmission of communicable and sexually-transmitted diseases (STDs) such as HIV/AIDS. However, camps will be small and transitory, and will be located away from housing areas. Health and safety hazards may also be experienced by adjoining communities due to activities that will generate elevated noise levels excessive dust, and unsafe construction practices.

316. The impacts of construction activities on OH&S will be localized, with the duration limited to the construction stage, and thus the significance of these impacts are assessed as low.

Physical Cultural Resources

317. There are no known PCRs at or near the project sites. The baseline study showed the location of some PCRs in ARB, such as Vigan Heritage City, Bessang Pass National Monument, and Northern Luzon Heroes Hill, all of which are outside of the project impact zone. In TLRB and RARB, there are also no PCRs near the subproject sites. Cultural resources in RARB are in Marawi City. This impact is deemed as not significant.

318. However, construction activities have the potential to disturb underground PCRs. A construction phase chance find procedure has been included in the EMP.

C. Assessment of Operation Phase Impacts

319. The operation of the flood control activities in the project is expected to mitigate the flood hazards in the river basins and are not expected to generate major negative impacts. Flooded areas will be reduced, and population, agricultural lands, and infrastructures affected by flooding will be lessened.

320. **Water diversion impacts.** The creation of new diversion channels will result to conversion of around 80 ha of mostly agricultural land to water bodies that connect the existing waterways. During operations, the new channels will open possibilities for fisheries and other water activities. This impact is largely positive and will be enhanced through the Output 3 activitiies.

321. The four diversion channels in TLRB can have the potential to induce habitat loss in the existing streams due to altered flows and habitat fragmentation for aquatic species and wildlife. The effect on land-based fauna are expected to be low, because these areas are mostly agricultural lands with minimal wildlife. The channels cut mostly agricultural lands (disturbed) and hence, impact on fauna movement will be low. The effect on aquatic species are also deemed as low since the diversion channels will not affect the exsting rivers as they are designed such that the existing rivers is still well inundated all year round (see *Table IV-2 Depths along diversion channels (in m.) during dry* season and storm events).

322. All diversion channels will have water all year round for both wet and dry seasons. During operation phase, fluctuation in flow is limited, thus impacts on spawning, hatching, feeding grounds and migrating corridors for any aquatic species are deemed to not fluctuate much.

323. **Periodic river channel maintenance.** The flood flow capacity of the project rivers may be severely impaired as a result of accumulations of sediments, garbage, uncontrolled plant growth, and the illegal construction of weirs built to provide irrigation water. Periodic maintenance activities will be planned and conducted. These activities will generate garbage and sludge. Improper management of these wastes may generate soil and water pollution through runoff.

324. **Hydrological impacts from river embankments.** River embankments may result in higher water velocities and/or volumes moving downstream, posing risks to communities and lands downstream of the project area, as well as changes in channel morphology.

325. Prior to the project, the natural hydrology of the river basin has already been altered due to human interventions of land use change, infrastructure implementation, drainage modifications, and irrigation in the downstream portion of the river basin. The project will restore old meanders of the TLRB and improving the hydraulic capacity of the channels, thereby improving the hydrology of the river basin.

326. During the design phase, hydrologic modelling has been conducted to determine changes in velocities. Thus, anticipated impacts from velocity changes and downstream volumes are deemed as low. Monitoring of river flows will be improved as part of the Early Warning System component of this project and as part of DPWH regular activity.

327. On the long term, dike construction may lead to the so-called "levee effect". Higher dikes lead to a feeling of safety, resulting in more people / companies settling behind the dike. This increases possible damage in case of dike failure. Policy measures under this Project (Output 3) will take this into consideration. This includes policy restriction on land use behind dikes.

328. **Solid Wastes**. Solid wastes will be generated during the O&M activities for the established structures and CBFRM project activities such as river cleanup. Clearing of drainage canals, waterways, creek, and riverbanks will generate garbage carried in waterways and built-up sludge, improper management of which may contaminate soils and water bodies from runoff. To mitigate these potential impacts, solid waste management practices will be implemented and also as part of the community demonstration activities (guidance and measures see EMP, Chapter V). The dredging management plan provided in Chapter V should also be used.

329. **Health and safety risks for community**. Local people, especially farmers and children, also face additional risks of water-related accidents (falling, drowning) from new diversion channels, especially during heavy rains or floods. These risks will be addressed through operation phase OHSPs and ERPs in compliance with relevant workplace regulations (see EMP, Chapter V).

330. The creation of additional waterways in TLRB may increase the risk from waterborne diseases such as schistosomiasis. Schistosomiasis remains a public health problem in endemic areas in the Philippines with approximately 12 million people residing in 28 endemic provinces located across 12 different geographical zones at risk of S. japonicum infection.[38] However, Davao Del Norte is not listed in the endemic areas and the neighboring province of Davao del Sur was listed as having reached elimination level (Leonardo, 2015)[39].

Induced Impacts

331. The creation of new waterways may induce further agricultural activities in the surrounding areas, thus altering existing land uses. The new channels, however, are in irrigated agricultural areas already. However, more water in diversion channel might induce farmers to use it open more farmland currently grassland, wetland or woodland. The designed

[38] Schistosomiasis in the Philippines: Innovative Control Approach is Needed if Elimination is the Goal. Remigio M. Olveda and Darren J. Gray. Trop Med Infect Dis. 2019 Jun; 4(2): 66.

[39] Lydia Leonardo, et.al.Schistosomiasis in the Philippines: Challenges and Some Successes in Control. Southeast Asian J Trop Med Public Health. Vol 47 No. 4 July 2016.

embankments and channels have considered this potential impact and provides for reduced or limited access by way of clear boundaries.

V. Environmental Management Plan

A. Objectives

332. The project Environmental Management Plan (EMP) is a set of actions and arrangements to mitigate the adverse impacts assessed and found during the IEE process. It has been developed in line with applicable domestic and ADB guidelines and standards, and has drawn on experience in the EMPs of similar projects, WB/IFC's EHS guidelines, and related international good practice. It includes a number of components crucial to effective environmental management within the project: (i) organizational responsibilities and arrangement; (ii) mitigation measures for impacts during design, construction and operation phases; (iii) an EMP training plan; and (iv) monitoring scheme and reporting requirements.

B. Implementation Arrangements and Responsibilities

333. The Department of Public Works and Highways, as executing agency of the project, will be primarily responsible in ensuring the timely implementation of environmental mitigation and monitoring measures. Effective EMP implementation, however, is a joint effort of all key players on the project. Table V-1 presents the roles and responsibilities of the various units in environmental management.

Table V-1: Environmental Management Responsibilities.

Phase	Major parties involved	Environmental Responsibility
Design and preparation	EA : Department of Public Works and Highway (DPWH) and its environment dept. All IAs: including UPMO-FCMC etc	• Ensures environmental safeguard requirements. • Ensure that EMP design measures are incorporated in the detailed design. • Ensure that relevant provisions of the EMP are included in the bid and contract documents for design, civil works and supervision. • Ensure compliance with domestic environmental, health and safety permits, approvals and requirements
	EIA team – TrTA Consultant Detailed Engineering Design (DED) Consultant	•Prepares IEE on behalf of EA. •Incorporate into the project design the environmental protection and mitigation measures identified in the EMP for the design/pre-construction stage; and •Assist UPMO to ensure that all relevant mitigation and monitoring measures from the EMP are incorporated in the bidding and contract documents for project supervision and civil works.
	EMB Regional Offices (same regions above)	Approves EIA/IEE or CNC for the proposed subprojects.
	Local Government Units (all levels)	Provide inputs on environmental concerns and coordinate with UPMO for stakeholder's engagement including the setup of GRM.
Construction	UPMO-FCMC, all IAs and PIUs	Has overall responsibility for environmental management to meet environmental requirements of PHI and ADB. Ensure that EMP provisions are strictly implemented, supervise and monitor during construction to mitigate

Phase	Major parties involved	Environmental Responsibility
		environmental impacts to acceptable levels
	Project Implementation Consultant (PIC + PIC-Env)	• Support the EA and IAs to supervise on-site EMP implementation. • Provides construction and operation EMP training. • Assists in quantitative monitoring of EMP. • Assists in preparing semi-annual monitoring reports. • Other tasks according to their ToR
	DPWH Regional Offices Supervision engineers (SEs) and resident ones	- Coordinates with UPMO in the supervision of environmental management of SP construction within its region/district and adherence to EMP requirements. - Supervise daily on site the EMP implementation by contractor and their workers.
	Contractors (per package)	•Implements all EMP construction mitigation measures. •Assign competent environment (PCO) and safety officer to ensure compliance with environmental statutory requirements, contractual obligations and EMP provisions. •Reports to the PIC on its EMP compliance and overall environmental performance. •Implement additional environmental mitigation measures, as necessary, to avoid, minimize and/or compensate for adverse impacts due to construction works and related activities performed by the contractor.
	LGUs, DENR Provincial Office	Coordinates with the PIC, UPMO and DEO for the effective operation of the GRM.
Operation period	UPMO-FCMC	Provide smooth transition for turnover of the management of flood control structures to the DEO's.
	DPWH-DEO's	Overall operator of the structures after turnover. Has overall responsibility for project operation environmental management and adherence to environmental requirements of PHI and ADB Conduct maintenance work in accordance with DPWH plans and guidelines.
	EMB Regional Offices	Reports on the performance of the flood control structures and other project components.
	LGU's	Ensure the effective implementation of capacity-building projects.

C. Mitigation Measures

334. Based on the impact assessment and risk analysis, past experience of similar projects, applicable national requirements and international good practice as reflected in the IFC's EHS guidelines, measures to mitigate adverse impacts and risks during preparation, construction and operation phase are presented in Table V-2. In general the EMP applies to all SPs, though the EMP also indicates any issues that are specific to one or more SPs.

Table V-2 Environmental Management Plan

Potential Impacts/Issues	Recommended Mitigation and Enhancement Measures	Implement by	Supervisor
PREPARATION AND PRE-CONSTRUCTION PHASE			
Environmental Management Preparation	– Incorporate EMP into bidding documents and contracts. – All necessary construction and development permits will be obtained from the relevant authorities.	DPWH/UP MO PIC Contractor	DPWH
Grievance Redress Mechanism	– IAs to set up GRM and operationalize at all sites – GRM training will be provided for EA, IAs, and GRM access points. – IAs will issue public notices to inform the public within the SP areas of the GRM. – Contact information (phone number, fax, address, email address) for IAs and local entry points (e.g., contractors, ward/commune PCs) will be disseminated at SP construction and other sites.		
EHS related training for construciton	– Training will be provided to staff of EA and IAs, and SP contractors and foremen. Detailed content and arrangement see Training plan	PIC	DPWH
Site selection criteria for borrow pits	1. For commercial borrow pits and quarries, the contractor will ensure that only facilities with necessary environmental permits will be used for the project. 2. For project-specific borrow pits, i.e., those that will be established and solely operated for the project, the contractor will ensure that these are covered by necessary environmental permits. Copies of the permits shall be provided to DPWH. 3. Prior to operation of these facilities, the contractor will submit to the LGU and DPWH a plan showing the location/s of borrow pits and quarries to be used, as well as timeframe and mitigation measures to be implemented to rehabilitate project-specific borrow pits and quarries. 4. In case there are new candidate sites that have not been assessed in this IEE or during the DED, Contractors need to follow criteria below for selecting/ proposing a new borrow pit for approval by the PIU. - No sensitive habitat should be encroached in candidate borrow pit areas. - No historical sites shall be encroached. - The buffer distance from any watercourse should be around 100 m. - To minimize footprint of the excavation for borrow pits flat and shallow sloping		Local PIUs PIC SEs

Potential Impacts/Issues	Recommended Mitigation and Enhancement Measures	Implement by	Supervisor
	grounds should be avoided, if possible.		
Site selection criteria for disposal sites of dredgate	For other sites that have not been assessed for suitability, the following criteria will apply: 1.Disposal sites will not encroach on surface water courses, will not cause sedimentation or obstruction of stream/river flow and will not cause damage to agricultural land, irrigation, densely vegetated areas, forests, properties and other productive sites. Watercourse buffers of 100 m should be maintained. 2. Disposal site will be on stable slopes, located as close to the construction site as practical. If available, land with existing depression should be selected. 3. No disposal site will be allowed on farmland, on or adjacent to surface waters, wetlands, or culturally or ecologically sensitive areas.		
	CONSTRUCTION PHASE		
Erosion due to cut and fill, borrow pits, construction sites. Impacts on farmland, surface water quality **Stormwater** Flooding	**Implement good site management erosion and stormwater control practices:** – The potential for storm water runoff will be assessed at each SP site and appropriate storm water drainage systems to minimize soil erosion will be implemented, including perimeter bunds and, if appropriate, temporary settling ponds to control topsoil erosion and runoff. – Protective berms or sheet fencing will be placed between all earthworks and adjacent surface waters. Biodegradable erosion and sediment control materials will be used whenever possible, and all exposed non-biodegradable erosion and sediment control materials will be removed once site is stabilized. – Land excavation and filling will be balanced to the extent possible to minimize the requirement for fill and generation of spoil (see also Borrow and Spoil measures, below). – During earthworks the area of soil exposed to potential erosion at any one time will be minimized through good project and construction management. – Earthworks will be conducted during low or no rainfall periods as much as possible. – Depressions with standing water suitable for disease vector breeding will be filled in. – Disturbed surfaces including borrow pits, spoil pits, and temporary borrow and spoil storage areas will be restored to pre-construction conditions as soon as possible. Vegetation cover will also be provided during rehabilitation of the site. – Upon completion of extraction activities, quarries and borrow pits will be dewatered, signages and fences installed, as appropriate, to minimize health and safety risks.	Contractor	Local PIUs PIC SEs
Borrows and Spoils	**Implement good cut and fill practices:**	Contractor	Local PIUs

Potential Impacts/Issues	Recommended Mitigation and Enhancement Measures	Implement by	Supervisor
from Dredging and Excavation Impacts on farmland, surface water quality	• Dredged materials and Spoil will be reused on-site as fill to the maximum extent feasible based on assessment of suitability (conducted already based on Table II-12 and II-13). Adopt Dredging Management Plan (Table which follows). • Excess spoil/dredgate that cannot be used on-site will be transported to permanent spoil disposal sites. For spoils requested by LGUs, approval of PIC is required to ensure proper handling and use. • The contractor will also ensure that topsoil will be properly removed, stockpiled, and preserved for later use during restoration of the borrow pit. • Vegetation cover will be provided during rehabilitation of the site.		SEs PIC
Construction and Domestic Solid Wastes Inappropriate disposal, impacts on farmland, surface and groundwater quality -	**Implement Solid Waste Management Plan (WMP)** Key principles to be followed are: - In order of priority and to the extent possible, minimize waste production, reuse, recycle, and appropriately dispose; and treat and dispose different waste streams according to their nature in order to properly manage them in the most cost effective and environmentally sound manner. – Littering by workers will be prohibited. – Domestic waste containers will be provided at all work sites. Domestic waste will be collected on a regular basis by a licensed waste collection company and transported for recycling, reuse, or disposal at a licensed landfill, in accordance with regulations and requirements. – Construction waste dumpsters will be provided at all work sites. Construction waste will be collected on a regular basis by a licensed waste collection company and transported for recycling, reuse, or disposal at a licensed landfill – If suitable, wastes such as spoil or excess fill will be used as backfill. – Burning of waste at or near construction sites will be strictly prohibited. – There will be no final waste disposal on site. Contractor will be held responsible for proper removal and disposal of any significant residual materials, wastes, and contaminated soils that remain on site after construction. – Under no circumstances shall the contractor dispose of any material in culturally or ecologically sensitive areas – Proper IEC for construction workers and offices on RA 9003 or the Ecological Solid Waste Management Act to be conducted prior to commencement – Proper treatment and disposal with an accredited waste contractor or with the Local Government Unit (LGU) – Observance and implementation of the 3R's for all waste generation activities – For demolition of structures for implementation of ROW, reduction may be done by residents salvaging materials prior to demolition such as electrical appliances,	Contractor	Local PIUs SEs PIC

Potential Impacts/Issues	Recommended Mitigation and Enhancement Measures	Implement by	Supervisor
	furniture, cloth, and papers – Recyclable materials (e.g., plastics, metals, glass, and unclaimed electrical appliances) may be sold or donated to recyclers, junkshops, or other interested parties – Reuse of wood, concrete, asphalt, and metal bars in good condition for new construction – Temporary fencing to limit vegetation clearing and therefore reducing waste – Smaller wood pieces may be sold or donated to individuals to be used as charcoal or firewood for cooking – Waste from trees such as twigs and leaves may be transferred to the composting site of LGUs – Oil and chemicals (point, solvent containers, etc.) to be temporarily stocked under strict management then treated by accredited waste contractor to be reused, disposed according to the RA 6969 or the Hazardous and Nuclear Wastes Control Act – Asphalt may be milled and reused to pave barangay earth roads – Machinery parts may be used in maintenance and repair of construction equipment – Materials to be disposed must be properly stockpiled		
Hazardous Materials and Hazardous Wastes Transportation, storage, use, disposal and spills, impacts on farmland, surface and groundwater quality	**Implement good hazardous materials and hazardous waste management practices:** – Wherever possible/practical, hazardous materials will be substituted by nonhazardous materials. – Suppliers of chemicals and hazardous materials must hold proper licenses in accordance with regulatory requirements. – Storage facilities for fuels, oil, chemicals, and other hazardous materials will be within secured areas on impermeable surfaces provided with dikes, and at least 300 m from drainage structures, important water bodies and other sensitive receptors. – Absorbents and spill cleaning equipment will be provided. – All spills will be cleaned immediately, and contaminated materials stored temporarily in secure storage areas, following RA 6969 requirements. – Vehicles and equipment will be properly maintained to ensure they are leak free. Vehicles should be refueled and serviced either off-site in local garages or other similar facilities (preferred option), or in designated service areas on impermeable surfaces provided with oil traps, at least 300 m from drainage structures and important water bodies. Washing or repair of machinery in or near surface waters is prohibited.	Contractor	Local PIUs SEs PIC

Potential Impacts/Issues	Recommended Mitigation and Enhancement Measures	Implement by	Supervisor
	– Relevant construction personnel will be trained in handling of fuels/hazardous substances and spill control procedures. – All personnel will be provided orientation on hazardous waste management. – Contractors must secure Hazardous Waste ID and dispose hazardous wastes only through authorized hazardous waste transporters and treaters duly listed in the EMB Registry. – Restoration of temporary work sites will include removal and treatment or proper disposal of oil contaminated soils.		
Physical Damage and Disturbance to Vegetation and Wildlife - Topographic modification - Soil erosion - Vegetation clearance and loss of valuable trees - Disturbance, displacement, or loss of fauna species due to vegetation clearance and change in condition of habitats	- DPWH (through contractor) will obtain a tree cutting permit in compliance with DENR Memorandum Order No. 2012-02. No tree cutting will be undertaken without the necessary permit from the Community Environmental and Natural Resources Office (CENRO) of the DENR. - Tree cutting can only be undertaken under close supervision of CENRO, DPWH and PIC staff who will be present at the site throughout the duration of cutting activities. Only trees marked based on the Tree Chart prepared by the CENRO will be cut. Cut trees will be turned over to the CENRO for disposal. - Tree balling / transplantation will be done for mangroves and Narra trees as applicable - To avoid unnecessary impacts to vegetation, the contractor will prohibit cutting of trees for firewood and for other uses in the Project and will ensure that tree cutting is limited to areas as approved by the CENRO. - Provide temporary fencing to delineate areas for clearance and vegetation retention	Contractor	Local PIUs SEs PIC
	- If possible, avoid construction during rainy weather to minimize erosion. - Contractors should be aware through IEC, that there is the possibility that migratory birds may be nesting on existing structures, vegetation, or gravel substrate within the project limits at any time of the year, but especially during the nesting season. - The timing of construction near the habitats of migratory birds will consider the migration cycle and avoid unnecessary disturbance. - Construction activities limited to daytime only to minimize artificial lighting and noise and vibration disturbances - Prohibit workers from hunting wild animals and/or purchasing any wildlife. Local guidelines, if any, to protect endangered species will be strictly observed. - Conduct education/awareness for construction workers on the protection of endangered species (including juvenile crocodiles) - In the event that juvenile crocodiles are sighted, these will be turned over to the CENRO - Conduct education/awareness on environmental impacts on migratory birds	Contractor	SEs PIC
Impacts on Water			

Potential Impacts/Issues	Recommended Mitigation and Enhancement Measures	Implement by	Supervisor
Water quality degradation - Dredging and excavation - All construction works near water bodies - Increased TSS concentrations - Water pollution from oil and grease and waste from construction camps	- Use of silt curtains, sediment ponds, or other sediment capture technologies near the mouth of the river - When practicable, silt and sediment traps maybe installed near the river mouth to allow resuspended materials to settle at the bottom of the river. - For river-widening works near Lake Lanao, mitigation measures such as the use of silt curtains will be implemented. - Contractor to monitor suspended solids upstream and downstream of site. - Avoid or limit construction works during rainy weather - Construction site wastewater will be directed to temporary detention and settling ponds. - Proper solid waste management in work camps should be strictly observed. - Use of containment boom to capture oil and grease - Portable or constructed toilets with storage must be provided on site for construction workers and must be emptied (or siphoned) in an appropriate manner into an existing off-site septic treatment system	Contractor	Local PIUs SEs PIC
Wastewater from domestic and construction Impacts on farmland, surface and groundwater	**In addition to measures described above in erosion and stormwater control practices:** – Construction site wastewater (if any) will be directed to temporary detention and settling ponds. The locations of the settling pond will be determined in consultation with local environmental authorities. – Portable or constructed toilets with storage must be provided on site for construction workers and must be emptied in an appropriate manner into an existing sewerage treatment system or collected by accredited treaters.		Same as above
Fisheries and aquatic biota Negative impacts on fisheries and Aquatic biota especially for waterfront work, dike works, and dredging	**Implement good aquatic construction practices in areas where fisheries is present:** - Time works to avoid spawning periods. - Works will be conducted during low or no rainfall periods as much as possible. - Maintain fish passage by minimizing changes to flow or water levels to the extent possible. - Minimize obstructing or interfering with the movement and migration of fish. - Regularly monitoring the watercourse for signs of sedimentation during all phases of the work. In case of sedimentation from runoff (and not in-situ works), stop work and contain sediment-laden water to prevent dispersal. - As much as possible, bridge works will be scheduled in dry season to minimize adverse impacts to fishery, river water quality and other aquatic resources. Conduct activities during high water levels to limit impact on fish life - Installation of silt curtains, sediment ponds, or other sediment capture technologies - Accomplishment and implementation of Erosion and Sedimentation Control Plan	Contractor	Local PIUs SEs PIC

Potential Impacts/Issues	Recommended Mitigation and Enhancement Measures	Implement by	Supervisor
	- Use of containment boom to capture oil and grease during spills		
Marine Ecology Impacts - Construction of coastal spur dike in D 1-1 will cause local disturbance - Dredging and excavation in D 1-1, D 1-2, and D 1-5	- Where practicable, conduct activities during high water levels to limit impact on fish life - Installation of silt curtains, sediment ponds, or other sediment capture technologies in the channels to prevent sediments from eventually depositing on the estuaries - Implement Dredging Management Plan - Avoid construction works during rainy weather - Use of containment boom to capture oil and grease	Contractor	SEs PIC
Mangrove transplanting - Disturbance or loss of mangroves - Disturbance or loss of mangrove-dependent species	- Conduct consultations with CENRO and LGU for implementation of balling and tree nurseries - Follow tree-compensation measures as instructed by CENRO - Provide temporary fencing to limit number of mangrove trees to be transferred to those which are marked. - Careful treatment towards mangroves during the entire duration of balling, dredging, and widening activities (see Environmental Guideline on Mangrove Rehabilitation after this table)	Consultant, Contractor, DENR	Local PIUs SEs PIC
The Air			
Generation of dust particles during construction and gas emission from vehicles and heavy equipment	**Implement good site and equipment management practices:** - Regular water spraying/dampening dust emissions from disturbed soil, roadway construction surfaces and haul roads wherever there are sensitive receptors (such as houses, churches, businesses, schools, medical facilities) nearby is undertaken. Spraying will be done twice daily or at such frequency as is needed to suppress dust emission to acceptable levels - Construction camps which include rock crushing, concrete batching plant, fabrication yards and similar facilities will be located at least 500 m from habitations and community environments including other sensitive receptors such as churches, schools, and medical facilities. The facilities shall secure all required government permits from DENR, EMB and LGUs prior to their establishment. - At construction sites near houses or settlements, all construction piles (spoil, aggregate other construction materials) with the potential to generate dust will be covered and/or regularly watered. - Construction and material handling activities will be limited or halted during periods of high winds if nuisance dusts are being generated. - Speed limits will be imposed on construction vehicles to minimize dust emission along areas where sensitive receptors are located. Provide signages informing public and contractor staff to observe speed limit of at least 25 kph in populated areas (sensitive receptors) of the community	Contractor	Local PIUs SEs PIC

Potential Impacts/Issues	Recommended Mitigation and Enhancement Measures	Implement by	Supervisor
	- Transport loads will be covered to avoid spillage or fugitive dust generation. Fine materials such as cement will be transported in fully contained trucks. - Construction site roads will be well maintained and watered on an as-needed basis. Roads will be regularly cleaned to remove tracked mud, cement, and other dirt. - Transport routes will avoid residential neighborhoods and other sensitive areas to the maximum extent practical. Limit vehicular movement with identified planned shortest route from destination to destination. - All equipment, machinery and vehicles used for the project must be well maintained to ensure proper functioning thereby minimizing contribution to air pollution. - Burning of waste at or near construction sites will be strictly prohibited. - Excavated materials must be properly handled during temporary storage and immediately be disposed of - Provision of cover on stockpiles during temporary storage and on loads of trucks during transportation. Stockpiles of sand and aggregate greater than 20 m3 for use in concrete mixing will be enclosed on three sides, with walls extending above the pile and two meters beyond the front of the piles. - Scheduled cleaning of spilled or settled materials on the road and other affected locations. - Ensure the vehicles and equipment to be used are new or in good working condition.		
Generation of noise • Disturbance of recipient residents and flora and fauna species	**Implement good construction noise management measures:** - Limit the duration of noisy construction activities to daylight hours, whenever possible, in the vicinity of sensitive receptors. Noisy equipment will not be operated during nighttime to early morning (19:00H –06:00H). - Temporary noise barriers and other sound minimization procedures will be utilized if monitoring indicates sound impacts on sensitive receptors. - Equipment and machinery will be equipped with mufflers in accordance with relevant regulations and will be properly maintained to minimize noise. - Any stationary equipment that produces high noise levels (e.g., portable diesel generators, compressors, etc.) will be positioned as far as is practical from sensitive receptors. - Machines in intermittent use near sensitive receptors will be shut down in the intervening periods between work or throttled down to a minimum. - Transportation routes and delivery schedules will be planned during detailed design to avoid densely populated and sensitive areas and high traffic times. This will be coordinated with local officials. - Vehicle speeds will be reduced around sensitive receptors. Minimize back-up alarm noises on construction vehicles where practical and feasible. - Concrete batching and rock crushing plants will be located at least 500 m away from	Contractor	Local PIUs SEs PIC

Potential Impacts/Issues	Recommended Mitigation and Enhancement Measures	Implement by	Supervisor
	sensitive receptors. - The contractors will provide prior notification to the community on the schedule of noisy construction activities. - Prior to undertaking noisy activities, the contractor will consult with residents, community leaders, and representatives from the religious sites and schools near the project sites regarding construction schedule so as to minimize disturbance to important events such as ceremonies, examination period and the like. - The Contractor will develop its Noise Management Plan in consultation with the community residents and other sensitive receptors.		
The People			
Community and Worker Health and Safety - Accidents during construction works - Disease and sicknesses from construction works - Harassment and gender inequality treatment	- Use of personal protective equipment (PPE) such as safety shoes, safety hat, goggles, safety belt, ear protection or other garments or equipment designed to protect the wearer's body from injury will be strictly observed during construction. Personnel working in batching plants should avoid direct contact with construction materials, particularly cement. - Provision of first aid kits that are readily available to workers as well as access to or availability of a health worker to attend to any immediate health needs of workers and in case of untoward incidents. - Health and safety training on RA 11058 or the Occupational Health and Safety (OHS) law Women and Gender trainings and seminars on the proper and equal treatment for women and LGBTQ+ following DPWH GAD tool kit - Employment of women, comprising of at least 20% of the workforce in monitoring, bookkeeping, occupational health and safety, among others	Contractor	Local PIUs SEs PIC
Community Disturbance - In-migration due to temporary employment opportunities - Competition in local resources and LGU services	**With respect to the recruitment of workers:** - Workers will be locally recruited to the extent practical. - Workers will receive health examinations and education on sexually transmitted diseases (STDs). - Worker camps will be avoided where possible, and contractors will arrange for workers to stay in locally rented house that are equipped with power, water supply, cooking facilities and adequate sanitation facilities (at minimum, pit latrines that are not located near wells or surface waters). - Foreign workers will receive orientation briefings on fitting in with local norms. **If temporary worker camps are required, all camps will be located away from existing housing areas, and will be equipped with:** - Adequate housing and Adequate potable water supply. - Adequate solid waste management, including solid waste bins that are emptied on a regular basis, with wastes directed to an approved solid waste disposal facility.	Contractor	SEs PIC

Potential Impacts/Issues	Recommended Mitigation and Enhancement Measures	Implement by	Supervisor
	- Adequate drainage in workers camps to avoid water logging/accumulation of stagnant water and formation of breeding sites for mosquitoes. - Separate clean housing with sufficient ventilation and separate hygienic sanitation facilities for male and female workers. Treatment of wastewater emanating from workers camps, construction camps and other project- related activities and facilities consistent with national regulations.		
Traffic impacts and disruption Disturbance of travelling residents, goods, and services along routes and roads	**Traffic and Road Management subPlan:** - Transportation routes and delivery schedules will be planned in consultation with relevant road management authorities to avoid densely populated areas, sensitive receptors such as residential communities, schools and hospitals, and high traffic times. Coordination with the LGU and residents for traffic management, especially if rerouting is needed - Transport vehicles will be required to comply with local speed limits and will slow down and not use their horn when passing through or nearby sensitive receptors. - Any required traffic detours will have adequate information and warning signs and flag persons. - Loads will follow vehicle capacities and relevant road regulations, particularly with respect to large or heavy loads. - Loose truck loads will be covered. - Contractors will be responsible for repairing any roads damage that may occur. - Transportation of equipment and materials limited to daytime - Education of drivers on safe driving and respect for other drivers - Provision of medical staff and supplies	Contractor, LGU	Local PIUs SEs
Employment - Generation of jobs - Loss of livelihood for fisherfolk and fishpond caretakers	- Hiring of skilled personnel with the Local's First Hiring Policy where the priority for hiring is within the project location barangay or the adjacent barangays of the project affected LGU	Contractor	SEs Local PIUs PIC
Possible spread of infectious disease - Local increase in HIV/AIDS infections - Local increase in COVID-19	- Comply with government guidelines and protocols related to COVID-19. - Health screening to take place prior to deployment such as RT-PCR tests and 14-day quarantine to monitor and detect any kind of COVID-19 symptom - In addition to construction PPE, medical PPE to be also provided such as face masks, alcohol, soap, and water - Conduct orientation for construction workers regarding health and safety measures, emergency response in case of accidents, fire, etc., and prevention of HIV/AIDS, COVID-19, and other related diseases.	Contactor	Local PIUs SEs PIC
Impacts on Physical Cultural Resources	**Chance Find Procedure:** – Contractor to immediately cease operations at the site of discovery. Protect the site,	Contactor	SEs PIC

Potential Impacts/Issues	Recommended Mitigation and Enhancement Measures	Implement by	Supervisor
(PCR)	destroying, damaging, defacing, or concealing PCRs will be strictly prohibited – Contractor to inform the PIC and Environment Officer of the Office of the District Engineer. PIC to relay information to DPWH. - DPWH to notify the National Historical Commission of the Philippines (NHCP) and/or other concerned government agencies for the next steps. Construction activities will resume only after thorough investigation and with the permission of the local Cultural Heritage Bureau. - Resume work only after NHCP has provided official notification accordingly.		
	OPERATION PHASE		
Water diversion resulted in change in hydrology - Changes in flow, groundwater level -	- Monitoring of flow will be conducted as part of the EWS - Monitoring for encroachment or unintended use by local community in new channels.	EMB Region DPWH-DEO	DENR DPWH-UPMO FCMC
Magrove Rehabilitation	- Monitoring of mangrove transplantation and planting success rate in TLRB - Monitoring of tree replacement success in all RB's	CENROs	MENROs
Dumping of Domestic waste and Hazardous Wastes to water channels of the project	Implement good practice waste management practices: – Domestic waste containers will be provided at all work sites, and in the areas. – Domestic waste will be collected on a regular basis by a licensed waste collection company and transported for recycling, reuse, or disposal at a licensed landfill, in accordance with regulations and requirements. -	Community , LGUs	LGU's
Health and safety risks	Provision of adequate signages in embankments and new channels is part of design. Maintenance of safety signages to warn people of risks of water-related accidents.	DPWH-DEO	DPWH-UPMO FCMC

Table V-3 Construction phase dredging management and disposal plan

Stepwise Mitigation Measures	Implemented by	Supervised by
– Sediment quality have been assessed during IEE preparation. During DED, conduct additional analysis if required and judged necessary by the IA's environmental specialists.	IA	EA and PIC-Env
– Determine dredging process. Options include: – suction cutter dredger, pontoon mounted excavators, or emptying the reservoir and using earth moving equipment. – Select most suitable method for site conditions and to minimize environmental impacts, health and safety risks.	Dredging Contractor	IA and PIC-E
– Dredgeate will be sun-dried at temporary storage areas to reduce transport cost and leakage along the route. Temporary storage areas will be at least 20 m from water bodies or settlements or other sensitive receptors, with compacted floors and surrounding bund to prevent leakage to water or soil /farmland and covered as necessary to control dust.	As above	As above
– contaminated dregeate that can't be used as backfill or applied to agriculture land as per the national technical regulation on soil quality (PNS/BAFS 40:2016). Other options for disposal need to secure approval from EMB. The option to apply as fill material for less stringent environment (e.g. industrial) may be sought from EMB. – In case values in **Table II-13** and Table II-14 are exceeded, they will be transported in covered trucks by accredited hazardous waste transporters and carried to hazardous waste treaters.	Dredging Contractor	IA, PIC-E,
– For all dredgate that is not contaminated thus can be reused: – Dredgate will be disposed at the disposal yard. The site will be stabilized and graded as soon as possible to avoid erosion. – Farmers will have the option of using dredgate as fill if they choose. If this option is selected, farmers will be advised if they need to first digest or compost the materials to kill pathogens and prevent disease spread. Instructions will be posted in the disposal areas for clarity. Training program to be implemented on this. – LGUs who will take the dredge materials for backfill will secure approval from the site engineer.	Dredging Contractor	IA, PIC-E,

Table V-4: Occupational Health and Safety Plans (including Covid-19 measures) and Emergency Response Plans.

Mitigation Measures	Implemented by	Supervised by
Construction Phase		
Occupational Health and Safety Plan (OHSP): – All relevant OSHC(DOLE) safety regulations will be strictly enforced. – All workers will be equipped with appropriate personal protective equipment (PPE), including hard hats, insulating and/or fire-resistant clothes, appropriate grounding, hot line and uninsulated tools, safety gloves, safety goggles, fall protection system including safety belts and other climbing gear (for work at heights), ear protection, etc. PPE will be maintained and replaced as necessary. – All construction equipment and tools will be inspected before use to ensure proper and safe operation (at least every 6 months for climbing safety gear). – All workers will receive a health assessment by a competent medical practitioner and be deemed sufficiently healthy to undertake their job before commencing hazardous site activities. – Construction sites will be equipped with adequate potable water and temporary sanitation facilities. – The OHS Plan will be aligned with relevant government's regulations and guidelines on COVID-19 prevention and control, or with international good practice guidelines as updated in the future.[40] COVID-19 prevention and control measures, to be adopted as required, include the main key measures: – 1) disinfection/cleaning of construction sites and equipment, – 2) on-site temperature checks every day before the work, – 3) social distancing measures – 4) mandatory use of PPE, i.e., wear facemasks all the time – 4) provision of handwashing stations and hand sanitizers etc.at all construction site and camp, – 5) in the event any worker is infected with COVID-19: procedure on reducing risk of infection is executed. – Training will be provided to workers in all aspects of the OHSP prior to the start of construction and on a regular basis (e.g., monthly).	SP Contractors	DPWH Site Supvng Engr (SE)
Emergency Response Plan (ERP)	SP	SEs

[40] *See:*
- *World Health Organization. 2020. Considerations for public health and social measures in the workplace in the context of COVID-19. Geneva. Available at: https://www.who.int/publications-detail/considerations-for-public-health-and-social-measures-in-the-workplace-in-the-context-of-covid-19.*
- *HM Government. 2020. Working safely during COVID-19 in construction and other outdoor work. Guidance for employers, employees and the self-employed. Available at: https://assets.publishing.service.gov.uk/media/5eb961bfe90e070834b6675f/working-safely-during-covid-19-construction-outdoors-110520.pdf.*
- *The Canadian Construction Association – COVID-19 Standard Protocols. Available at: https://www.cca-acc.com/wp-content/uploads/2020/04/CCA-COVID-19-Standardized-Protocols-for-All-Canadian-Construction-Sites-04-16-20.pdf.*

Mitigation Measures	Implemented by	Supervised by
– SP specific emergency response procedures will be in place, including communication protocols for interaction with local and regional emergency response providers, protocols for shutting down power, firefighting response procedures, provision of appropriate firefighting equipment, training for workers on fire response, and record keeping. – SP specific Medical especially covid-19 related emergency response procedures covering both workers and community members (when affected by project related activities), include the followings: 1) communication protocols for interaction with provincial or regional hospitals – 2) Have first aid equipment on site, contact information for the nearest ambulance and medical facilities, – 3) protocols for informing and transferring injured workers to local medical facilities/ ambulance or provincial health centers, and record keeping. – 4) At least one trained first-aid worker will be available at the construction site as focal point. – Training will be provided to workers in all aspects of the ERP prior to the start of construction and on a regular basis (e.g. monthly).	Contractors	
Operation Phase		
Occupational Health and Safety Plan (OHSP): – All relevant safety regulations will be strictly enforced. – All workers will receive a health assessment by a competent medical practitioner and be deemed in sufficient health to undertake their job before commencing hazardous site activities. – All workers with access to electrical and hazardous conditions will be appropriately trained and certified to work on SPs. – All relevant electrical safety standards will be strictly adhered to. – The OHSP will be aligned with relevant government's regulations and guidelines on COVID-19 prevention and control, or with international good practice guidelines as updated in the future.[41] COVID-19 prevention and control measures, to be adopted as required, include disinfection/cleaning of construction sites and equipment, on-site temperature checks, social distancing measures, mandatory use of personal protective equipment such as facemasks, provision of handwashing stations and hand sanitizers etc., and procedures to be adopted in the event any worker is infected with COVID-19. – Workers will be provided with appropriate PPE, including hard hats; safety gloves; safety goggles; ear protection, etc. PPE will be inspected, maintained and replaced as necessary. – Training will be provided to workers in all aspects of the OHS plan.	DEO/DPWH	DPWH Region

Mitigation Measures	Implemented by	Supervised by
Emergency Response Plan – SP specific **emergency** response procedures will be in place, including communication systems and protocols for interaction with local and regional emergency response providers, protocols for shutting down power, firefighting response procedures, provision of appropriate firefighting equipment, training of workers in fire response, and record keeping. – SP specific **medical emergency** response procedures to be developed, covering both workers and community members, including communication systems and protocols for interaction with local and regional emergency response providers, first aid equipment on site, contact information for nearest ambulance and medical facility, training for workers on initial on-site emerge response, protocols for informing and transferring injured workers to local or provincial health centers, and record keeping. Training will be provided to workers in all aspects of the ERP.	DEO/DPWH	DPWH Region

Environmental guideline for mangrove rehabilitation in TLRB

335. The following step by step guideline is to guide the mangrove rehabilitation:

- The project implementing unit for TLRB, through its contractor, will secure the permit required for earthballing / transplanting of mangroves in accordance with the regulations discussed in Chapter II. The permit will contain the Final and Approved Infrastructure Development Plan with tree charting, indicating the geotagged location of individual trees affected by the project, as basis of validation by the DENR-CENRO during actual earthballing.
- The planning and exécution of all activities for mangrove rehabilitation shall be coordinated with the CENRO of Tagum who has jurisdiction on this matter. The mangroves to be removed for D1-1, D1-4, and D1-5 will be transplanted to the new riverbanks of the respective channels for soil embankment protection. Additional sites will be selected based on criteria specified above and approved by the CENRO.
- **Site selection criteria for transplanting and replanting** : well protected away from strong waves like coves, lagoons, bays and abandoned and reverted fishponds ; open areas along rivers ; gaps within natural stands ; stable mudflats with barrier island ; barnacle free areas ; logged over areas, and should have similar conditions of tidal elevation, salinity level, substrate, and flood duration.
- **Excavation of samll Mangroves and saplings:** should be manually by shovel, and tree is transported with the root ball wrapped in burlap.
- **For mature trees removal: should** use of a 10-t excavator to uproot the trees. The best mangroves to be transplanted are those with more pneumatophores or aerial roots. The trees, attached with their earth balls, should be placed in a container already filled with soil and/or sand from the location they have been extracted from. Once inside, the trees and their roots should be secured with the soil[42].
- **Planting of earthballed trees (wildlings)** requires extra care to protect against damage on the roots. Other planting methods are direct planting of propagules (for species such as bakawan, pototan and tangal); potted seedlings which are used for trees with tiny seeds that are difficult to sow. For propagules, spacing can be up to 16 individuals per sq m.
- **Maintenance activities in the early years**: regular visits (daily or every other day, best during low tide); removal of debris; installation or fence repair (if necessary); removal of barnacles and other pests; uprooting and replacement of sick or dead plants.

D. Environmental Quantitative Monitoring

217. A quantitative monitoring plan (see table below) is designed to monitor (i) the actual discharge and impacts of the SP against the predicted and baseline before the project; (ii) the effectiveness of the EMP mitigation measures, (iii)compliance with pertinent environmental rules and regulations and standard (in chapter 2 of the IEE); (iv) any need for additional measures corrective actions if non-compliance is observed. The concerned PIUs and operators will be responsible overall with assistance by environmental specialists.

[42] John Abbot and Jennifer Marohasy. The excavation and cultivation in containers of mature grey mangroves,Avicennia marina. Wetlands Ecol Manage. 23 May 2014

Table V-5 Environmental Monitoring Plan

Aspect	Location	Parameters	Who and How to Monitor	Frequency
CONSTRUCTION				
Surface Water	Sampling stations in: ARB – Agno R., at the discharge points of all construction camps and workers' camps. TLRB – Tagum R-, Liboganon R., at the discharge points of all construction camps and workers' camps. RARB - Agus R., Gata R, Taraka R, at the discharge points of all construction camps and workers' camps.	- pH - Total Suspended Solids - BOD - Fecal Coliform - Nitrate - Phosphate - Oil and Grease	DENR-approved methods of laboratory analysis. Contractor commissions 3rd party lab. PIC-Env supervises.	Quarterly as required based on compliance inspections or complaints received.
Air and Noise Quality During construction	ARB – air – one stn near Z3P3-SC2-01, Bgy Poblacion East; one stn near Z1P0-RS-01, Bgy Basug; one stn near Z7P2-RS-01, Bgy Patoc TLRB - One station within the center of Carmen, near the water quality station for Ising River; 1 station near the water quality station for Ancient Libuganon River RARB – receptors near DL-01; receptors near M-measures; receptors near U-22 All construction camps (200 m downwind or at nearest receptor)	- TSP - PM10 - Noise-level in dBA	Air and noise-level sampling and analytical procedures specified in DAO 2000-81. For noise, conduct daily monitoring using handheld meters, esp during noisy activities. If problems observed or complaints received, recruit qualified Independent Environmental Monitoring entity to conduct tests.	- Once before construction - Daily, by observation - Annually during construction phase as required by Permit (PTO)
H&S and others	Incidents of complaints and grievance H&S accidents	number and briefing in Logbook/register	Daily site safety inspection and reporting Site safety officer	Daily
Operations				
Water	-Monitoring of flow will be conducted as part of the EWS routine work; -Water quality (including GW) will be regularly monitored as part of EMB routine activity.	Flow TSS, BOD and Coliform for Surface Water TDS and Salinity of GW	DPWH installed water flow monitoring system EMB Regional and CENRO regular water quality monitoring activities Water Resource Agencies for GW	Installed as continuous (remote) Quarterly surfaceWater and GW
Mangrove Rehabilitation	-Monitoring of mangrove transplantation and planting success rate in TLRB	Survival rate of transplanted stands and newly planted seedlings	LGU (bgy) to conduct frequent visits CENRO to conduct regular visits DPWH DEO to coordinate with CENRO	LGU weekly CENRO qrtrly -do-

Cost Estimate of Environmental Quantitative Monitoring Plan

Project Stage	Mitigation Measure	Parameters to be Monitored	Location	Measurements	Frequency	Responsibility	Cost
Construction Phase							
	Water pollution	pH Total Suspended Solids BOD Fecal Coliform Nitrate Phosphate Oil and Grease	Upstream and downstream of river channels	Laboratory analysis	Once before and after channel improvement	Construction contractor	PHP 250,000
	Air Quality	Dust	Within construction site	Visual inspection	Daily	Construction contractor	PHP 375,000
	Noise	Sound level (in d(B)A	Within construction site	Sound level meter	Weekly	construction contractor	PHP 50,000

E. Inspection and reporting Requirements

336. The PIU will undertake regular inspections of compliance with the EMP assisted by its environmental staff and consutlants. The PIU will need to supervise onsite as DIRECT means to ensure the EMP implementation and environmental compliance, implement corrective actions, and follow-up the implementation of corrective actions for effectiveness..

337. Experience shows that Reporting is good tool of stocktaking and managing any projects. It is one of the Indirect means to monitor and encourage EMP implementation to control EHS impacts and riskswhich is the end objective. Experience has shown that direct field supervision and inspection is an effective means to monitor EMP implementation. A "multi-layer" supervision and reporting arrangement will be implemented.

338. During **construction**, supervision, monitoring and reporting of EMP implementation will have the following layers in order to be more efficient and cost-effective:

a. **First layer:** Routine on-site mitigation compliance inspections by resident SP Supervision Engineer(s), who are to be on site **daily**, and submit to PIC/DPWH at minimum monthly reports on civil work progress and quality, and EMP implementation performance (including spills and responses, accidents, and grievances and actions taken) since most EMP measures for construction are inseparable from good construction practice.
b. **Second layer:** DPWH/PIC, assisted by environmental staff, will carry out on-site supervision and inspection on a regular basis (at least once a month), and record the findings and remedies or corrective action plans in writing.
c. **Quantitative monitoring**: To be undertaken (air and water quality, noise) if problems are observed during inspections or complaints received, by a qualified external monitoring entity engaged by DPWH. The monitoring contract should request the monitoring entity to submit the testing results with explanations on compliance and analysis of any reasons for non-compliance. In addition, the required tests specified under the contractors' permits (for water and air) are conducted.
d. **Reporting:** Based on work of a-c, DPWH will prepare semi-annual reports to the ADB on environmental performance of the project and EMP implementation. The periodic reports will be posted in project areas accessible to the public and on ADB website within 14 days of receipt.

339. During **operation**, supervision and reporting will be undertaken primarily by DPWH District Office:

a. **Supervision and Inspection:** The DPWH (supported by environmental staff) will carry out on-site supervision and inspections on random or regular basis, and record the findings and remedies or corrective plans in writing;
b. **Quantitative monitoring**: To be undertaken if problems are observed during inspections or complaints received, by a qualified external monitoring entity engaged by the DPWH. The monitoring contract should request the monitoring entity to submit the testing results with explanations on compliance and analysis of any reasons for non-compliance.
c. **Reporting:** Based on work of a-b, the DPWH will prepare annual reports to the ADB on environmental performance of the project and EMP implementation (Table V-6).

Table V-6: Key content and indicative outline of an environmental monitoring report.

1. Introduction:
    a. Concise project description.
    b. Project progress in this reporting period.
2. Mitigation measures: their implementation status (fully followed or not, if not, which parts are not and why; actual performance and findings, any issues and gaps, reasons for them, corrective actions proposed and/or remedy already taken.
3. Quantitative monitoring: summary of results and conclusion, explain if comply with applicable standards or not, and analyze the reasons of non-compliance. (Note: full data and original reports' scans submitted in an annex).
4. Training: carried out during this period, how, to whom, results and effects. If no training carried out during the period, say so in Introduction or Conclusion without this chapter.
5. Any complaints through GRM: what, when and where, how they are resolved etc. all spills, accidents (both workers and community members). If no grievances or accidents during the period, say so in Introduction or Conclusion without this chapter;
6. Requirements for the changes in the project: explain the change and impacts, implications for compliance with domestic EIA requirements and ADB requirements.
7. Conclusion on this reporting period and recommendations/work plan for the next.

F. Capacity Building

340. A capacity building program will focus on the environmental safeguards' requirements of relevant Philippine laws and regulations and ADB's SPS reflected in the EMP; means for effective implementation of the EMP, the environmental monitoring plan, and the GRM; and international good environment, health, and safety construction practices. Trainers will be mainly environmental officers and consultants of EA and IAs.

Table V-7: Environmental, health and safety (EHS) training Program.

Phase	Attendees	Contents	Frequency	Duration (days)	No. of Persons	Budget (USD)
Pre-construction Preparation	EA/IA staff	- EMP content - Environmental monitoring and reporting - GRM	Twice	½ day course	12 (2 from EA, 2 from each IA)	2000
Construction Phase Environmental Management	EA/IA staff, Contractor(s) senior and EHS staff	- laws and regulations. - EMP measures on EHS for construction. - GRM.	Twice	1-day course	24 (2 from EA, 3 from each IA, 10 from Contractors /foremen, workers)	5000
Operation Phase Environmental Management	EA, IA/ operator staff	- Relevant laws and regulations. - EMP measures for operation, GRM - Good EHS practices for operation.	Twice	1-day course	24 (2 from EA, 3 from each IA, and 10 from Operators)	5000

G. Grievance Redress Mechanism

341. A project grievance is defined as an actual or perceived project-related problem that gives ground for complaint by an affected person (AP). As a general policy, the EA and IAs will work proactively to prevent grievances through the implementation of impact mitigation measures and community liaison activities that anticipate and address potential issues before they become grievances. Nonetheless, it is possible that unanticipated impacts may occur if the mitigation measures are not properly implemented or unforeseen issues occur. In order to address complaints, a project grievance redress mechanism (GRM) has been developed in accordance with ADB requirements and Government procedures. A GRM is a systematic process for receiving, recording, evaluating and addressing AP's project-related grievances transparently and in a reasonable time period. The GRM will operate during the pre-construction, construction and operation phases.

342. The ADB SPS 2009 requires the EA and IAs to establish a GRM to receive and facilitate resolution of AP's concerns and complaints about the Project's environmental performance during the construction and operation phases. The GRM should i) be scaled to the risks and adverse impacts of the project; ii) address affected people's concerns and complaints promptly using an understandable and transparent process; iii) be readily accessible to all sections of the community at no cost and without retribution; and iv) not impede access to the judicial or administrative remedies and ADB's Compliance Review Panel.

343. The project GRM integrates resettlement, environment and technical issues into a single structure. The structure takes into account Philippine laws and provisions for complaint handling as well as nuances of the operating environment and cultural attitudes toward lodging complaints. Specifically, The GRM includes the following elements:

(i) a focus on addressing complaints at the local level, and only advancing to higher levels if a satisfactory solution cannot be found.
(ii) a grievance receipt and registration system to provide ways for community members to register complaints and confirm they have been received.
(iii) grievance eligibility assessment to determine if the issues raised in the complaint fall within the mandate of the GRM.
(iv) grievance assessment and investigation to clarify concerns raised in the complaint, to gather information on the situation, and to identify how the issues might be resolved.
(v) joint problem-solving, in which all relevant project stakeholders engage in a dialogue and action planning to resolve the problem.
(vi) grievance tracking, including maintenance of written records of grievances, monitoring, public information disclosure and reporting to the affected people; and
(vii) grievance closure, including community feedback and confirmation of resolution of the problem.

344. Eligible complaints are those regarding any aspect of project affected environment, land acquisition and resettlement, such as noise, air and water pollution, entitlements, rates and payment and procedures for resettlement, income restoration programs, and other issues.

345. The GRM will be established in the DPWH District Engineering Offices (DEO). The responsibilities of the GRM is to receive, assess, and facilitate the complaints or grievances of the affected persons regarding the subproject's environmental performance. During public consultations on environmental assessment, this mechanism will be disclosed.

346. An Environmental Officer will be appointed by each DEO to organize the District Grievance Redress Committee (DGRC) to be chaired by the DPWH District Engineer. The

members of the DGRC will include the following: (i) environment officer of DEO, (ii) Construction Manager / Construction Superintendent or the contractor's highest official at the site; (iii) contractor's environment officer, (iv) barangay captain; and (v) environment specialist of the construction supervision consultant. The GRM stages are presented below.

GRM stepwise Procedure

a. First, complainant can submit complaints by telephone, email, letter, or going to the neariest project entities (contractor/foreman at the site) provide the background and file the complaint directly either verbally or in writing to the on-site contractor representative(s), and Barangay through its officials for immediate corrective action.
b. the contractor(s) representative is then required to act immediately on valid complaints and record such complaints in a complaints registry that must be maintained on site;
c. complaints that cannot be immediately attended to by the Contractor shall be filed either verbally or writing to the DEO, and or the DEO's Environment Officer who will assist the complainant in filling-up the grievance intake form;
d. within 2 working days, the Environment Officer, contractor's representative, and complainant will discuss if the complaint can be resolved without calling for a GRC meeting;
e. within 3 days of lodging the complaint, the DEO's Environment Officer will provide the complainant a written feedback on the process, steps and timeframe for resolving the complaint.
f. if the complaint cannot be resolved, a GRC meeting with the complainant will be called within 5 working days;
g. the GRC will have 15 days to resolve the complaint;
h. the complainant will receive feedback from the DEO's Environment Officer within 5 working days after the various steps of the GRM are completed.
i. if unsatisfied with the decision, the existence of the GRC will not impede the complainant's access to the Government's judicial, administrative remedies or through concerned government agencies (e.g., Community Environment and Natural Resources Office and Provincial Environment and Natural Resources Office of DENR, Regional offices of the Environmental Management Bureau.

347. The DGRC will record all complaints, investigations, follow-up and prepare monthly reports. These reports will include all complaints, questions or disputes received about the subproject and necessary actions taken to resolve the issues. A summary report on DGRC complaint logs will be included in the semi-annual social and environmental monitoring reports to be submitted to DPWH, IAs and ADB.

VI. Information Disclosure and Consultation

348. Disclosure of relevant information about a proposed project and its potential impacts helps stakeholders to understand the impacts, risks and opportunities of the project. Sufficient disclosure of infromation is the pre-condition for meaningful consultation. This process should commence early in the project cycle and continues throughout the life of the project.

349. Meaningful consultation goes well beyond information disclosure. It involves two-way communication between the borrower and the affected communities and stakeholders, and active participation of affected communities and stakeholders at various stages in the project design and implementation. Meaningful consultation provides opportunities for the borrower to learn from the knowledge, experience and concerns of the affected communities.

350. The objective of the disclosure and consultation is to inform, present preliminary impacts and benefits, and obtain opinions of affected households, potential beneficiaries and relevant stakeholders, about the proposed SPs. Consultation with specific groups (IP's, women) will also be conducted through focus group discussions.

A. Philippines and ADB Requirements

1) PHI Requirements

351. Philippine EIA requirements for public consultations in development projects are stipulated in the Philippine EIA Law (PD 1586) and reiterated in DAO 2017-15 which provides the guidelines for public participation in the EIA process. The guidelines stipulate that public participation be initiated early and sustained, well planned and timely public disclosure of relevant information to stakeholders. It requires stakeholder identification and analysis, information education campaign, and public scoping.

2) ADB Requirements

352. ADB's SPS has specific requirements for information disclosure and public consultation. Information disclosure involves delivering information about a proposed project to the general public and to affected communities and other stakeholders, beginning early in the project cycle and continuing throughout the life of the project. Information disclosure is intended to facilitate constructive engagement with affected communities and stakeholders over the life of the project.

353. To ensure meaningful consultation of IEE, SPS environmental principle 6 requires the borrower to "Disclose a draft environmental assessment (including the EMP) in a timely manner, before project appraisal, in an accessible place and in a form and language understandable to affected people and other stakeholders" (this usually means not in English only). To translate this policy into practice, the following procedure and requirements are adopted by the project.

Step 1. Draft an announcement about it with key content below:
- Objective of the disclosure and the follow-up consultation
- A brief summary of the project and EIA/IEE including EMP
- Weblink to e-version of draft documents and
- Addresses/locations to get or view the hardcopies (local gov office, community centers, public library, etc);

- Deadline for feedback from the public: the longer the better to allow sufficient time for the public to read, think, discuss, consult and coordinate to form opinions (at least two weeks between draft EIA/IEE disclosure and consultation dates)

Contact information for the public to send feedback: names of persons, email and post address, telephone numbers, websites, social media, or other means; Step 2. Publicise the announcement in advance widely at:

- Traditional media: bulletin board, popular newspaper, TV/radio channels
- Social media to the public: facebook, Instagram, Whatsapp, Telegram etc
- Mobile phone text messaging or mass emails to key stakeholders

Step 3. Consultation, usually a combination of typical methods below

1. Get feedback through contacts in the anouncement: deadline by last consultation;
2. Questionaire or Online surveys: anonymous, efficient, broader, less interactive;
3. Meetings or interviews etc: costlier, limited participants, afraid to speak out at meetings, but more interactive (might be difficult during covid19 restriction).
4. Representativeness of the PAP and stankeholders: by age, gender, ethnicity, profession, educaiton level etc.

354. The draft IEE will also be posted on ADB website for feedback from the public at large. A Stakeholder Engagement Plan was developed and implemented to ensure the conduct of meaningful consultations in all project sites and to all stakeholders also during implementation following the above process and requirements for this IEE or the equivalent that fits.

B. Information disclosure

355. Several stakeholder engagement activities were conducted in each river basin as part of information disclosure on the Project. The Feasibility Studies were started with the Multi-stakeholder's Consultation (MsC) to present to key stakeholders the results of the Master Plan Study, the selected investments for Feasibility Study, and the different environmental and social aspects of the Project. Focus Group Discussions (FGDs) were also held to extract the perception, recommendations, and issues and concerns of the stakeholders regarding the implementation of the Project.

Figure VI-1. Information Disclosure Activities



Abra River Basin Stakeholder Engagement Activities





Tagum-Libuganon River Basin Stakeholder Engagement Activities





Agus (Ranao) River Basin Stakeholder Engagement Activities

C. Public Consultations

356. **Abra River Basin.** The public consultation was constrained by restrictions put in place by different level of government in the Philippines in relation to protecting the population against infection with COVID-19. Requirements included that people from outside the Abra region could come to the area for a maximum of 48 hours, and required permits. As such, although the participation was meaningful, the participants were invited over a short period of time and focused on community leaders, since this is what was possible within the constraints.

357. The MSC held in Vigan City, Ilocos Sur was attended by various stakeholders (Table VI-1 and Annex III) which include the mayors, planning officers and city environment officers of Vigan, Bantay, and Santa. Moreover, personnel of DENR and DPWH were also present as their inputs are necessary in the successful implementation of the project.

358. The MSC held in Abra was attended by 55 participants, 32 are males and 23 are females (Annex III).

359. As far as the environmental safeguards is concerned, only the Ludong fish was raised during the open forum. It was explained to the participants that the identity of the Ludong was still scientifically uncertain and that more taxonomic studies should be done to establish its actual identity. Despite this issue, the BFAR has put in place conservation strategies to prevent the fish from being overfished.

Table VI-1. Summary of attendance in ARB Multi-Stakeholder Consultations

Multi-stakeholder Consultations	Participants		Affiliation (organization)
Meeting 1: Date: Venue: Hotelinda, Vigan City	Total 42	Female 36%	Vigan LGU, Santa LGU, DPH, DENR, UNP, DA, DILG, DPWH, NIA 1 Private Organizers (Egis, TRTA, REECS)
Meeting 1: Date: 16Oct 2020 Venue: Abra City	55	42%	LGU Bucay SB Secretary-LGU Lagangilang Barangay Aguet- LGU Lagangilang Barangay Lagben-LGU Lagangilang Barangay Poblacion West, LGU Pidigan LGU La Paz LGU Manabo LGU San Juan LGU Tayum LGU Manabo NCIP DPWH Abra DEO DPWH CAR PPDO Abra NIA- Abra OCD-CAR DENR CAR PENRO Abra NEDA CAR DPWH UPMO CCAGG CorDIS

DA = Department of Agriculture, DENR = Department of Environment and Natural Resources, DILG = Department of Interior and Local Government, DPWH = Department of Public Works and Highways, LGU = local government unit; NIA = National Irrigation Administration, REECS= Resource Economics & Environmental Conservation Services, TRTA = Transaction Technical Assistance, and UNP = University of Northern Philippines

360. The stakeholder consultations were followed by focus group discussions (FGDs). FGDs were conducted in the various barangays in the river basins (table which follows). The anticipated (perceived) effects expressed by the various groups are summarized below.

Table VI-2 FGD Workshops in the Abra River Basin

MUNICIPALITY	DATE	VENUE	NUMBER OF PARTICIPANTS
La Paz, Abra	Nov 18, 2020	Poblacion, La Paz, Abra	6
Bucay, Abra	Nov 23-24, 2020	Poblacion, Bucay, Abra	11
Tayum, Abra	Nov 26, 2020	Poblacion, Tayum, Abra	6
Bangued, Abra	Dec 06, 2020	Sta. Rosa, Bangued, Abra	9
Bantay, Ilocos Sur	Nov 05, 2020	Bantay, Ilocos Sur	7

MUNICIPALITY	DATE	VENUE	NUMBER OF PARTICIPANTS
		TOTAL	39

Table VI-3 Anticipated Effects on Selected Community Groups During and After Construction (ARB)

Issues / Concerns Raised	Response
What will happen to the affected parcels of land?	Necessary survey activities shall be done to identify the affected households as well as the extent of the project impact for eventual proper compensation, entitlement, and assistance.
"What will happen to the parcel of lands that have been acquired by the project (dike)? The proposed dike/flood control structure should be constructed at the boundary of rivers and property line. In one of the properties, almost 167 meters will become part of the river (there is an improper placement of structures).	Engr.Cuadra requested the details for this concern so they can be able to locate the areas being affected by the structure. She also pointed out that part of the FS will be a survey interview for all the directly and indirectly affected individuals for possible assistance and compensation.
Compensation for land, structures and improvements	The affected land, structures, and improvements will be properly compensated, and relevant entitlement and assistance shall be given to the affected households or persons.
Information Dissemination Information education campaign should be carried out with families who will be affected by land acquisition and resettlement We just want to request that before project implementation, we will be informed so that my barangay mates can prepare also especially those who have fish cages. So that when construction is started, they have already harvested their tilapia. Efforts of info dissemination should be reinforced by the government. For example, develop community education and awareness-raising initiatives on disaster risk and measures to strengthen resilience through radio spots, text messaging campaigns, and street theater, particularly targeting women and girls in rural communities.	The project will incorporate these suggestions in the RP that will be prepared.

Issues / Concerns Raised	Response
Livelihood Vigan LGU Representative suggested that the project employ those whose livelihood will be affected with the implementation of the project to augment their income. Request for livelihood trainings to be provided before the implementation of the project. They mentioned pig/cow farming, mushroom production and business enterprise.	The project will incorporate these suggestions in the RP that will be prepared.

361. **Tagum-Libuganon River Basin.** The Study Team conducted a series of consultation meetings and Focus Group Discussions (FGD) as part of the IEC Campaigns from September to December 2020.

Table VI-4 Summary of Consultations Conducted in TLRB

Activity	Participants	Date	Attendees		
			Total	Female	Male
Multi-Stakeholders' Consultation	LGUs and NGAs	30 Sept 20	43 physical attendees; 32 online attendees	22 physical attendees; 14 online attendees	21 physical attendees; 18 online attendees
Public Consultation	Bgy Alejal	09 Oct 20	21	10	11
Public Consultation	Bgy Bincungan	13 Oct 20	13	8	5
Public Consultation	Bgy Mabaus	13 Oct 20	55	30	25
Public Consultation	Bgy Salvacion	09 Oct 20	15	11	4
Public Consultation	Bgy Sto. Nino and La Paz	09 Oct 20	16	4	12
Public Consultation and FGD	Bgy Cabay-Angan	10 Oct 20	19	3	16
Public Consultation and FGD	Bgy Guadalupe	14 Oct 20	24	13	11
Public Consultation and FGD	Bgy Ising	06 Oct 20	67	49	18
Public Consultation and FGD	Bgy Liboganon	13 Oct 20	19	7	12
Public Consultation and FGD	Bgy Mangalcal	11 Oct 20	23	9	14
Public Consultation and FGD	Bgy New Camiling	16 Oct 20	7	3	4
Public Consultation and FGD	Bgy Taba	15 Oct 20	21	13	8
Public Consultation and FGD	Bgy Tuganay	12 Oct 20	31	17	14
Public Consultation and FGD	Bgy Busaon	12 Oct 2020	16	9	7
		TOTAL	**422**	**222**	**200**

362. The Multi-Stakeholder's Consultation (MsC) served as an opening activity for the Feasibility Study activities for the Tagum-Libuganon River Basin held on 30 September 2020

(Plates 15 – 17). This event aimed to present to key stakeholders the results of the Master Plan Study, the proposed subprojects being studied during this Feasibility Study Stage, and the various activities of the Project such as site visits to the subprojects, Socio-economic Surveys, and Inventory of Loss Surveys. The attendees of this event are from the affected Local Government Units (LGUs) such as Carmen, Tagum, Braulio E. Dujali and National Government Agencies (NGAs) such as the Environmental Management Bureau (EMB) XI, Department of Environment and Natural Resources (DENR) – River Basin Control Office (RBCO), National Irrigation Administration (NIA), National Commission on Indigenous Peoples (NCIP), among others.

363. After the presentations, the attendees were randomly distributed into Small Group Discussions (SGDs) to extract their insights on the project, such as relevant problems to flooding within the community, positive and negative impacts of the project during construction and operation phase, disaster management, etc. The plenary sessions after the SGDs dedicated time for the presenters of the small groups to share the results of their discussions. They agreed that engineering solutions are needed to mitigate the flooding problem in the community which are caused by several problems such as deforestation, siltation, land conversion, etc. Flooding has caused detrimental effects to agriculture and economic activities which causes residents and the private sector to adapt to these situations such as repairing their homes, requesting loans and subsidies, and event migration to another area. They perceive that the proposed flood control project will lead to a better quality of life within Tagum City and Carmen. Results of the plenary session are found in the Minutes of the Meetings.

364. After the MSC are the series of Public Consultations held in all Project-affected Barangays (Annex III). The Public Consultations were held to present the Project Description, announce the various surveys to be conducted in the barangay, and to engage with the participants in an open forum to collect their views, opinions, reactions, and suggestions regarding the Project for incorporation into the Study.

Table VI-5. Issues and Concerns during the Consultation Meetings in TLRB

Issues / Concerns Raised	Response
FLOODING/DESIGN 2. The problems are riverbank erosion, no road improvement, no water supply, no power supply, and flood. 3. One of the AP's areas is not being flooded and they are scared the Project will cause more flooding.	1. It will be studied whether the edges of the rivers will be riprapped for bank protection. 2. Issues in flooding are being studied in the Feasibility Stage right now to provide a solution to flooding. Models are being studied to assess the flooding in the area to propose interventions.
ENVIRONMENT 4. The mangroves being affected by the Project will be cut 5. Worsening of water quality in the rivers	3. Should there be mangroves that will be affected by the Project, the proper procedure with the EMB will be done with acquisition of necessary permits 4. Water samples are collected in the project-affected rivers to study their water quality
LANDS AND PROPERTIES 6. The APs own only a very small piece of land. 7. Some AHs do not have lands of their own but they only have houses. If tagged as affected, they are scared they will lose their compensation for houses too since they might not be eligible for compensation of land.	5. One of our objectives in the design is to limit the project footprint to lessen the need to acquire lands and structures. 6. Informal settlers will also be surveyed and studied in this Project to assess possible compensation for them. The LGU will also be supportive of any issues concerning their constituents.

Issues / Concerns Raised	Response
8. An AP stated their concern that the river might cause erosion and reduce the size of their land eventually after implementation.	7. It will be studied whether the edges of the rivers will be riprapped for bank protection.
LIVELIHOOD 9. APs derive their livelihoods from their farmlands and are concerned about their income when resettlement activities commence. 10. The Project might conflict with NIA canals, affecting source of irrigation water for farmers.	8. The project alignment is still being studied and may be adjusted to limit acquisition of lands. There will be a livelihood program for those who are affected. 9. If the Project crosses the NIA canal, the engineers will make sure not to alter the irrigation system.
OTHER CONCERNS 11. Access to the other side of the channel 12. Labor opportunities during construction activities	10. Bridges are part of the considerations in the design of the Project. 11. Project-affected barangays will be the priority for hiring as long as they are qualified for the job description.

365. In the open forum of the public consultations, stakeholders commonly raise that they are worried about their lands, houses, and livelihoods being affected by the Project. They express fear that they will not be paid or they will be paid very little for their properties. Fishpond operators and caretakers said that even if they are compensated for their properties, their livelihood relies on the fishponds that will be acquired for the Project alignment and cannot be replaced easily. The DPWH DEO assured the PAP that RA 10752 or the ROW and the DPWH ROW Acquisition Manual (DRAM) will be followed in the implementation of the FRM of TLRB with proper conduct of Socioeconomic Surveys, Inventory of Losses (IoL) surveys, parcellary surveys, among others and complemented by field validations to guarantee that PAP will be properly compensated. Some environmental concerns raised are the mangrove removal and potential water pollution in the rivers. The TLRB Environmental Specialist assured that proper and legal procedures will be done for the mangroves while the Team is also studying the water quality of the rivers during the FS stage. It was also explained that NBS were developed to go hand in hand with the structures, mitigation measures are in place to curb negative environmental impacts, and necessary environmental permits such as ECC will be acquired from the DENR to guarantee that the subproject is environmentally sound.

366. Moreover, the public consultations and Focus Group Discussions conducted in the subproject-affected barangays showed that the community is against the Project if it continues the plan to widen the rivers, as it means to remove the mangroves which their livelihoods rely on. Knowing mangroves take decades to fully develop, the locals highly value each mangrove tree. Interviews discovered that the mangroves in the area are about 80-100 years old, saying that these mangroves have been growing since the time of their great grandparents.

367. Focus Group Discussion (FGDs) were held in the barangays with the highest number of affected lots and households to extract more in-depth information not captured during the Public Consultations. The FGDs were conducted immediately after the Public Consultations with the barangays. Details of each FGDs are presented in Annex III.

368. The FGD tackled several topics such as development issues in the community, impacts of flooding and Disaster Risk Reduction and Management (DRRM), poverty and livelihood, and potential impacts of the Project during its various phases. Answers of men and women were separated to detect any contrast in the responses of both sexes. The attendance sheets are presented in Annex B.

369. Some environmental concerns raised during the FGDs are the removal of mangroves raised by participants. Those whose properties affected by the Project raised that they hope to be compensated for the mangroves trees and nipa growing within their lands. Since answers of men and women were separated, it was noticeable that environmental impacts such as noise and dust pollution are more frequently found under impacts of the Project to women.

370. **Ranao- Agus River Basin.** There were several consultation meetings undertaken as part of the Feasibility Study for RARB. The list of consultation meetings are presented in Table VI-2 while the documentation of each consultation meetings are presented in Annex III.

371. For environmental concerns, flooding was the most or frequently asked question and how will the project address this and when. Many of the questions were clarificatory touching on who will be surveyed, when will the project start and who will the affected people to approach if they have problems. Generic answer by the facilitators and resource persons in all meetings was that the project so far is in the FS stage and there are still no definitive answers to specific questions. Other environmental concerns surfaced such as the cause of flooding was too much garbage and cut trees in the rivers that the drainage is hampered, soil erosion is still rampant due to damaged gabions, and will the affected households be compensated if they are affected by the Project. A recommendation was that it is preferable for the people to plant fruit trees along the river than Falcata or Mahogany since the fruit trees would provide livelihood at the same time would arrest soil erosion.

372. Summary of the positive and negative issues and concerns raised during the consultation process are provided in Table VI-3.

Table VI-6. List of Information Disclosure, Public Consultation and Public Participation Processes Undertaken as Part of FS

Type	Date and Venue	Participants
Multi-Stakeholder Consultation Meetings	13 and 15 October 2020 (Iligan City)	Representatives from the following: Provincial LGUs of Lanao del Sur and Lanao del Norte Municipal LGUs Regional Government Agencies Provincial Government Agencies
Public Consultations	October and November 2020 (Within the Municipality)	Residents and LGU Officials from Municipalities of Balo-I, Butig, Lumba Bayabao, Poona Bayabao, Ramain and Taraka
Focus Group Discussions	October and November 2020 (Within the Municipality)	• Sectoral representatives from Municipalities of Balo-I, Butig, Lumba Bayabao, Poona Bayabao, Ramain and Taraka • Provincial Planning and Development Office – Lanao del Norte • Municipal Environment and Natural Resources Office – Lumbia Bayabao • Local Government Unit of Municipality of Masiu • PAGASA Regional Director

Table VI-7. Summaries of Major Issues and Concerns During RARB Consultation Process

Issues and Concerns	Response / Remarks by the project
Negative	

Issues and Concerns	Response / Remarks by the project
• Barangays which are affected by floods are not part of the study area for Feasibility Study even if they are affected by flood	• Barangays included in the Feasibility Study are areas where the structures will be built and not barangays that experiences flooding. • There were structures previously presented but implementation will be deferred • Copy of the presentation will be provided to participants to clarify proposed measures
• Provide measures in other barangays that are also affected by flooding	• Some of the proposed subprojects will be implemented as part of the middle- and long-term plan of DPWH • Analyses were undertaken on the four (4) major rivers in Lanao del Sur. This was used in selecting the subprojects to be recommended for short-term plan and included as part of Feasibility Study. Other projects will be implemented as part of middle- and long- term (up to 2050)
• Consider dredging of major rivers as part of the subproject	These are considered in the design of the project
• Relocation of affected households/structures	These are considered in the RAP
• Farmland/Working area may be affected	These are considered in the RAP. Project design has taken this into consideration
• Risk of accidents for community when the project has been completed	These are considered in the EMP
• Conflict during acquisition of properties that will be part of the Project	These are considered in the RAP
• Disturbance to community during construction, such as traffic	These are considered in the EMP
• Flood waters will overflow to the other side / Flow of water will change course and will affect their community instead	Project design has taken this into consideration and minimized affected households. These are considered in the RAP
Positive	
• Safety of the children their houses and animals will be secured once the project is implemented	These were noted
• Employment/Livelihood opportunities for community during construction	-do-
• Minimize flooding in their community which will open up development	-do-

Second round of consultations

373. Consultations were conducted in the project preparation stage and will continue throughout the project cycle. During the first round of consultations, the concerns of stakeholders were taken into consideration as inputs to project improvement.

374. As this IEE review added crucial assessment on water diversion and dredging activities, including disposal of dredged materials, that previous IEEs by river basin didn't have, its full draft was disclosed locally during 20 October 2021. After at least two weeks to allow the public decent time to read, search infomation, consult experts and liason, consultation with stakeholders were conducted in 8 November 2021 in Vigan and Bangued City for Abra River Basin, Tagum City for Tagum-Libuganon River Basin, and Iligan City for Ranao (Agus) River Basin. Further consultations will be scheduled as necessary.

375. The feedbacks and results are sumarised below.

Table VI-8 Issues and Concerns

Issues and Concerns[43]	Remarks by the project[44]
• Flood waters will overflow to the other side / Flow of water will change course and will affect their community instead • One of the AP's areas is not being flooded and they are scared the Project will cause more flooding.	The design of flood mitigation will be presented during this consultation to show the areas that will have lower floods and those which will have no flood mitigation yet.
• Risk of accidents for community when the project has been completed	DPWH structures incorporate safety measures (to be presented).
• Mangrove removal will decrease fish population	The alignments of the structures were adjusted to significantly lessen the mangroves to be removed. Mangrove removal is through the use of earth balling where they are transplanted in the new banks of the channels.(see also discussion on LRP)
• Farmers and fishpond caretakers are worried they have no livelihood after the project	The resettlement plan reports have a dedicated Livelihood Restoration Plan (LRP) where they identify people whose livelihood are stricken by the project and are entitled to compensation. In addition, an alternative way of fishing is proposed in the existing and new channels using fishnets. The fishnets are used during normal events and can be removed during high velocity.
• No or little compensation for houses and lands	A Resettlement Action Plan report is prepared together with the DPWH with licensed engineers, land appraisers, and foresters using current market values, and not the prices at the time the lands and structures were bought.
• The construction works can	This effect will only last during construction phase. After the

[43] *These were issues raised during the 1st round of consultations and require further discussion during the consultation. Additional issues raised will be tabulated also.*

[44] *These are proposed responses and actions of the proponent that will be discussed during the 2nd round of consultations. Other actions that will be proposed during the consultation will be taken up accordingly and documented here.*

	Issues and Concerns[43]	Remarks by the project[44]
	affect businesses	construction of the project, it will bring better conditions for economic activities to continue and flourish.
•	Job opportunities for locals	As a positive result of the Project, job opportunities are open to qualified indiviuals where locals are the priority to be hired.

VII. Conclusions and Recommendations

376. The environmental impact assessment for the project Integrated Flood Resilience and Adaptation (InFRA) - 1 shows that there will be overall moderate negative environmental impacts expected from the structural and other activities of this project. Most environmental impacts are deemed low to moderate, localized, and temporary, and can be addressed by mitigation measures in the Environment Management Plan. The potential downstream impacts associated with water diversion have been considered in the design of the structures and selection of alternatives. The mitigation measures presented addresses the transient, localized and temporary impacts of the subproject. Negative impacts that will be experienced during site works are mainly due to transient turbidity in rivers, dust, and noise emissions. Overall, the project's positive impact is the reduction in the intensity of flooding thereby reducing the impacts of floods on people and property.

377. To mitigate negative impacts arising from the Project, an Environmental Management Plan detailing mitigation measures, monitoring activities and responsibilities for implementation has been prepared as part of the IEE.

378. Public consultations involving affected people and local officials have been conducted through the Multi-Stakeholder Consultation Meetings in compliance with ADB's information disclosure and consultation requirements. Since inception and during Master plan stage, the project has already undergone several changes in structural and other activities that has significantly reduced the potential social impacts from displacement of residents and impacts of land disturbances on the environment. This was an outcome of DPWH's continuous consultations with the stakeholders, specifically the LGUs and the affected persons.

379. DPWH will include the EMP in the bid and tender documents for civil works to ensure that the Project will be carried out consistent with the EMP which integrated both domestic and ADB requirements on environ, health and safety for preparation, construction and operation phase.

Annex I . Details of the Public Consultations

I. Multi-Stakeholder Consultations Attendance, Ilocos Sur

Name	Agency
John Rowin Quario	LGU Santa
Constante Sabalburo	LGU Santa
Victor Fieldad	LGU Vigan
Barbie Gale Bello	DPWH ISED 1
Teddy Boy Corpuz	LGU Vigan
Jon Joseph Tabrilla	LGU Vigan
Janette Pascua	DENR PENRO
RichelleAnged	DENR PENRO
Bonna Mae Gorospe	UNP
Christy Venezuela	UNP
Jessy Domingo	UNP
Marites Raboy	UNP
Jeremy Bueno	LGU Santa
Victor Bello	LGU Santa
Desiderius Martinez	LGU Vigan
Oscar Reoliquio	LGU Vigan
Joel Cabang	DPWH ISED 1
Edward Bañaga	DPWH ISED 1
Jan Paolo Pollisco	IPIF2
Mitzi Pollisco	IPIF2
Filiberto Pollisco Jr.	IPIF2
Camille Cuadra	IPIF2
Jean-Marc Roussel	IPIF2
Maya Tamayo	IPIF2
Melissa Navarra	IPIF2
Wilma Rojas	IPIF2
Mary Ann Botengan	IPIF2
Lily Ann Lando	Local Partner
Takashi Furukawa	TRTA
Gem Castillo	Deltares

II. Multi-Stakeholder Consultation Attendance, Abra

	NAME	AGENCY
1	Margarita Sanico	LGU Bucay
2	Grace Taeza	LGU Bucay

3	Ian Kim A. Reyes	SB Secretary-LGU Lagangilang
4	PB Joey Yunon	Barangay Aguet- LGU Lagangilang
5	PB Minerva Catalina Latawan	Barangay Lagben-LGU Lagangilang
6	PB Vladimir P. Bilgera	Barangay Poblacion West, LGU Pidigan
7	Representatives	LGU La Paz
8	Representatives	LGU Manabo
9	Representatives	LGU San Juan
10	Representatives	LGU Tayum
11	Francis Blancaflor	LGU Manabo
12	Representative	NCIP
13	Chona Luisa Ramos	DPWH Abra DEO
14	Franklin Valera	DPWH Abra DEO
15	Erlinda Flores Doliente	DPWH CAR
16	Arnel Valdez	PPDO Abra
17	Representatives	PPDO Abra
18	Jovito Tadeo, Jr.	NIA- Abra
19	Representatives	OCD-CAR
20	Gladys Jade Palberas	DENR CAR
21	Representatives	PENRO Abra
22	Zsarla Pudol	PENRO Abra
23	Leonarda Lingayo	NEDA CAR
24	Princess Ann Capistrano	DPWH UPMO-FCSEC
25	Engr. Jesse C. Felizardo	DPWH UPMO
26	Pura Sumagil	CCAGG
27	John Mark Banganan	CCAGG
28	Jomar Baradillo	CCAGG
29	Vilmor Pacapac	CCAGG
30	Levy Mangili	CorDIS
31	Lope Santos	Transaction Technical Assistance (TRTA)-Freedom, Inc.
32	Roscinto Ian Lumbres	TRTA-Benguet State University (BSU)
33	Hazel Tibangay	TRTA-BSU
34	Lynn Talkasen	TRTA-BSU
35	Lineth Lapie	TRTA - Freedom, Inc.
36	Reynel Mojica	TRTA -CTII
37	Rochelle Osayda	TRTA
	Villenas, Lope	TRTA
38	Myrna Magbitang	ADB Consultant
39	Mary Ann Botengan	ADB Consultant
40	Herbert Narisma	ADB Consultant
41	Jean-Marc Roussel	Team Leader- IPIF Flood Risk Management Project
42	Camille Cuadra	Abra RB Junior Engineer
43	Maya Tamayo	Abra RB Social Safeguards Specialist

44	Melissa Quetulio-Navarra	Abra RB IP and Resettlement Safeguards Specialist
45	Mitzi Pollisco	Abra RB Environmental Safeguards Specialist
46	Wilma Rojas	Abra RB Gender Specialist
47	Jerico Torres	
48	Takashi Furukawa	
49	Miyagi	
50	Lily Ann Lando, Ph.D.	Team Leader-Local Partner
51	Demetrio B. Millare	Local Partner
52	Carlito Daodaoen, Jr.	Local Partner
53	Reynald T. Islao	Local Partner
54	Nover M. Matso	Local Partner

TLRB Details of Public Consultations



Plate 3: Attendees during the Opening Ceremony



Plate 4:Small Group Discussion Sessions



Plate 5:Closing Activities

Date	Venue	Photo-documentation
06 October 2020	Ising Barangay Gymnasium	
08 October 2020	Salvacion Barangay Gymnasium	

Date	Venue	Photo-documentation
09 October 2020	La Paz Barangay Gymnasium	
10 October 2020	Cabay-Angan Barangay Gymnasium	
11 October 2020	Mangalcal Barangay Gymnasium	
12 October 2020	Tuganay Barangay Gymnasium	

Date	Venue		Photo-documentation
13 October 2020	Mabaus Gymnasium	Barangay	
13 October 2020	Bincugan Gymnasium	Barangay	
13 October 2020	Liboganon Gymnasium	Barangay	

Date	Venue	Photo-documentation
14 October 2020	Guadalupe Barangay Gymnasium	
15 October 2020	Taba Barangay Gymnasium	
15 October 2020	New Camiling Barangay Gymnasium	

Date	Venue	Photo-documentation
02 December 2020	Busaon Barangay Gymnasium	

Details of TLRB Focus Group Discussion

Date	Venue	Photo-documentation
06 October 2020	Ising Barangay Gymnasium	
10 October 2020	Cabay-Angan Barangay Gymnasium	

Date	Venue	Photo-documentation
11 October 2020	Mangalcal Barangay Gymnasium	
12 October 2020	Tuganay Barangay Gymnasium	
13 October 2020	Liboganon Barangay Gymnasium	

Date	Venue	Photo-documentation
14 October 2020	Guadalupe Barangay Gymnasium	
15 October 2020	New Camiling Barangay Gymnasium	
15 October 2020	Taba Barangay Gymnasium	

List of Participants for TLRB Stakeholder Activities

Activity	Participants	Date	Attendees		
			Total	Female	Male
Multi-Stakeholders' Consultation	LGUs and NGAs	30 Sept 20	43 physical attendees; 32 online attendees	22 physical attendees; 14 online attendees	21 physical attendees; 18 online attendees
Public Consultation	Bgy Alejal	09 Oct 20	21	10	11
Public Consultation	Bgy Bincungan	13 Oct 20	13	8	5
Public Consultation	Bgy Mabaus	13 Oct 20	55	30	25
Public Consultation	Bgy Salvacion	09 Oct 20	15	11	4
Public Consultation	Bgy Sto. Nino and La Paz	09 Oct 20	16	4	12
Public Consultation and FGD	Bgy Cabay-Angan	10 Oct 20	19	3	16
Public Consultation and FGD	Bgy Guadalupe	14 Oct 20	24	13	11
Public Consultation and FGD	Bgy Ising	06 Oct 20	67	49	18
Public Consultation and FGD	Bgy Liboganon	13 Oct 20	19	7	12
Public Consultation and FGD	Bgy Mangalcal	11 Oct 20	23	9	14
Public Consultation and FGD	Bgy New Camiling	16 Oct 20	7	3	4
Public Consultation and FGD	Bgy Taba	15 Oct 20	21	13	8
Public Consultation and FGD	Bgy Tuganay	12 Oct 20	31	17	14
Public Consultation and FGD	Bgy Busaon	12 Oct 2020	16	9	7
		TOTAL	**422**	**222**	**200**

List of Participants during Consultations in RARB

List of Participants for MSC

Date, time and place of the meeting:	13 October, 2020	9:00 AM	• Mahogany Hills, Iligan City (face to face) • Via Zoom
Attendance (in venue):			
egis	Teogenes Cacho	Deputy Team Leader	boicacho@hotmail.com
	Ian Borja	Environmental Specialist	ianborja@gmail.com
	Oda S Beltran	IP Specialist	odasbeltran@gmail.com
	Imee Tatel	Resettlement Specialist	imee.esc@gmail.com
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	Salic B. Ibrahim	MARADECA, Inc	CEO
	Babby Abbas	MARADECA, Inc.	Consultant
	Moctar Matuan	MARADECA, Inc.	Consultant
	Mohammad Jehad Usman	MARADECA, Inc.	Staff
	Mohammad Mustapha C. Magarang	MARADECA, Inc	Staff
	Norliah Diron	MARADECA, Inc	Staff

	Fairosa Casan	MARADECA, Inc	Staff
	Jamimah A. Pilingan	MARADECA, Inc	Staff
	Faizah A. Ali	MARADECA, Inc	Staff
	Macarompun, Nashebah	DPWH – LDN 1st Dev	Engineer II
	Mamintal, Saima	DPWH – LDN 1st Dev	Engineer Assistant
	Pangcatan, Anowar	DPWH – LDN 1st Dev	Engineer Assistant
	Abolcair S. Langilao	MPW – BARMM	OIC – ADE
	AbdulNasser A. Tabao	MPW – BARMM	Chief Planning
	Demalie A. Comonog	Iligan NCIP	Chief CSC
	Ashary P. Bantuas	Ecoweb	SCAA Specialist
	Aisah Mamosaca	Ecoweb Iligan	CDF
Attendance (Zoom):			
egis egis	Jean -Louis Carron	Team Leader	Jean-Louis.CARRON@egis.fr
	Editha J. Atienza	Sub-team Leader	ejatienza@dccd.com
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DPWH UPMO FCMC	Ms. Dolores Hipolito	Project Manager III	
	Jesse c. Felizardro	Project Manager I	
	Engr. Lorenz Atajar	Engineer III	
	Miyagi		ADB
TRTA	Takashi Furikawa		
	Jo Atienza		
	Lineth Lapie		
	Lope Villenas		
PLGU LDN	Imelda Quibranza-Dimaporo	Governor	
	PPDO -LDN		
	RPMO		
NEDA Reg X	Mezlaine jay Pacana		
	Anthony Joseph Lucero	Weather Services Chief	PAGASA Mindanao Region
	Ron Limbaco		
	RAFECHA		
	DPWH-X PDD		
	DPWH-LDN I		Planning Section

Date, time and place of the meeting:	15 October, 2020	9:00 AM	• Mahogany Hills, Iligan City (face to face) • Via Zoom
Attendance (in venue):			
egis	Teogenes Cacho	Deputy Team Leader	boicacho@hotmail.com
	Ian Borja	Environmental Specialist	ianborja@gmail.com
	Oda S Beltran	IP Specialist	odasbeltran@gmail.com
	Imee Tatel	Resettlement Specialist	imee.esc@gmail.com
	Elenor de Leon	Gender Specialist	elenordeleon@gmail.com
	Salic B. Ibrahim	MARADECA, Inc	CEO ; maradeca99@yahoo.com
	Babby Abbas	MARADECA, Inc.	Consultant
	Moctar Matuan	MARADECA, Inc.	Consultant
	Mohammad Jehad Usman	MARADECA, Inc.	Staff
	Mohammad Mustapha C. Magarang	MARADECA, Inc	Staff
	Norliah Diron	MARADECA, Inc	Staff
	Fairosa Casan	MARADECA, Inc	Staff
	Jamimah A. Pilingan	MARADECA, Inc	Staff
	Faizah A. Ali	MARADECA, Inc	Staff
	Jobaira Kiram		Site Forester
	Soraya S. Alonto		Site Forester
MPW BARMM	Laut G. Bantuas	Marawi City/MPW	Chief Const.

	AbdulNasser A. Tabao	MPW – BARMM	Chief Planning
	Abdullah Candidato	MPW – BARMM	Engineer I
	Baguinda Monte	Brgy. Mapantao Lumba Bayabao	Barangay Chairman
	Mahar P. Dagalangit	Lumba Bayabao/LGU	LCE
	Rayhana P. Pangaibat	Lumba Bayabao/LGU	ME
	Alaiden P. Dimaampao		
	Fatima L. Angintaopan	Brgy. Gambai Lumba Bayabao	Barangay Chairman
	Naziba L. Angintaopan	Brgy. Gambai Lumba Bayabao	LGU
Attendance (Zoom):			
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	Herbert Narisma	OIC	htnarisma.ipif2@outlook.com
	Mary Ann Botengan	Core Team IP/ Resettlement Expert	
DPWH UPMO FCMC	Ms. Dolores Hipolito	Project Manager III	
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	Engr. Lorenz Atajar	Engineer III	
ADB	Junko Sagara		
	Miyagi		
TRTA	Takashi Furikawa		
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	Lope Santos		
	Mr. Tony Peralta	FREEDOM	
	Lope Villenas		
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			lumbabayabao.lgu@gmail
LGU Tamparan			
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	Abdullah Candidato		4719ac@gmail.com
			louiebantus@gmail.com

List of Participants for Public Consultations (RARB)

Baloi public consultations

Barangay Pacalundo
1. Jamal D. Bonsa

Barangay Pacalundo
2. Barni C. Ozimelle
3. Omar M. Doro
4. Zenaida M. Quezon
5. Saripi H. Majid
6. Potri Dialangan
7. Abdul Karem
8. Macalnas D. Azis
9. Ahmad M. Puting
10. Jamalia D. Cosain
11.Najeb M. Dake
12. Latipah M. Doro
13. Amerhassan M. Tomawi
14. Abobacar P. Sacar
15. Tali-Ah Abdulrahman
16. Samsoding Magayoong
17. Acmad M. Lope
18. Ibrahim M. Lope
19 Daud M. Lope
20. Cosain Abdul
21. Hasanoding Doro

Barangay Mama-anun		Barangay Adapun-Ali	
1	Yasbin L. Makil	1	Elias Gerasta Lacob
2	Najib H. Tondia	2	Norjanna Japar
3	Sarip Alimar	3	Norhanie Mohammad
4	Saidona M. Arobero	4	AnnaMarie Empinado
5	Elias R. Makil	5	Naifa Mohammad
6	Aminah M. Bonsa	6	Isanor Dimnang
7	Rohanie M. Sarip	7	Cali Aminolah
8	Normina Baguil	8	Sulog Khalid
9	Norainie O. Arobero	9	Mohabila Sulog
10	H. hanifa Arobero	10	Cali, Hasbien M.
11	kamal Makil	11	Cali, Alma M.
12	Mohaimin Tondia	12	Lucman, Sittie Asyah
13	Saidamin Amantar	13	Aisah E. Mohammad
14	Omar Alangca	14	Saadani C. Rakim
15	Rakima M. Dainog	15	H.Rakim Gunda
16	Mombao R. Manalao	16	Samir Rascal
17	Aisah A. Serad	17	Muslimen Abdul
18	Mangayao Makil	18	Nor-ain M. Baute
19	Saimir Arobero	19	Norodin Gonda
20	Nabila H.Ali Tondia	20	Noraisah Diba
21	Saguira D. Makil	21	Tago S. Daud
22	janalan B. Makil	22	Aisah R. H.Abdullah
23	Amina Pala	23	Salma H. Sacar
24	Hafsah Mangotara	24	Raisa Wahab
25	Asnawi H.Ali	25	Aslinda Imam
26	Alaisah H.Ali	26	Sittii Asiyah Lucman

Barangay Mama-anun		Barangay Adapun-Ali	
27		27	Carimah A. Abdullah
28		28	Saharata S. Sarief
29		29	KarryMay A. Datimbang
30		30	Mobarak Solog

List of Participants from the Eight (8) Clustered Barangay. The 8 Affected Barangay Participants and MLGU of Municipality of Lumba-Bayabao:

Barangay Salaman	Barangay Macaguiling
1 Sahara M. Pansar	1 Jamel U. Mamaki
2 Tarhata C. Basmala	2 Nor-ainie Mamaki
3 Amanodin Matua	3 Jamelanor Mamaki
4 Said Salih Dimaampao	4 Normala Decampong
5 Malurabansa MD	5 Mambuay Amel
6 Aminodin M. Hadji omar	6 Jalanie G. Dimonador
7 Monadatu C. Macud	7 Jamaloden M. Macasabal
8 Pangoli C. Pansar	8 Mariam B. Macapado
9 Nabila C. Pansar	Barangay Taluan
10 Norkisa I. Sultan	1 Alawiya M. Maminta
11 Seddick C. Macud	2 Anisah M. Adap
12 Amirah D. Ibra	3 Bashit M. Adap
13 Adnan G. Bumbaran	4 Asnawi M. calil
14 Jalil C. Dimaampao	5 Noronisah C. Noor
15 Aminolah C. Macud	6 Fatima D. Noor
Barangay Lama	7 Jalal Alanoyod
1 Eke B. Rashid	Barangay Gambai
2 Jamila Alangadi	1 Fatima L. Angitaopan
3 Sadam Daluma	2 Sittie Ainah L. Magomnang
4 Mohaimen Daluma	3 Jonaid R. Daaunte
5 Norhalim D. Maniri	4 Sohaile
6 Warda M. Adre	5 Abdul Hasim Angitaopan
7 Anisah O. Shiekalabi	6 Babay Macalalo
8 Salam Lomontana	7 Mansawi Macalalo
9 Nashiba I. Mamalao	8 Cosain Alanya
10 Somenegay D. Basman	Barangay Cabasaran
11 Norhaina M. Rashid	1 Barodi Salic
12 Naif A. Olama	Barangay Mapantao
MLGU	1 Baguinda Monte
1 Mahar P. Dagalangit	2 Mophidah Dibaratun
2 Rayhana P. Pangaibat	3 Jabbar H. Pilagidan
3 Eddie O. Basman	4 Sahara I. Mauna
Barangay Kasola	5 Hejarah M. Basar
1 Dusonan M. Dibaratun	

Agenda for Public Consultation Meetings

egis INCLAM Water Engineering KECC

LOAN N° 3589-PHI / INFRASTRUCTURE PREPARATION AND INNOVATION (IPIF-2) — FLOOD CONTROL

TITLE / AGENDA:

PUBLIC CONSULTATION

PROGRAM OF ACTIVITIES

	TIME	ACTIVITY	PERSON RESPONSIBLE
1	7:30-8:00am	Registration	Secretariat
2	8:00-8:10am	Opening Ceremony Prayer National Anthem	 Ecumenical Prayer Audiovideo Audiovideo
3	8:10-8:20am	Welcome Message	Barangay Kagawad
4	8:20-8:30am	Introduction of Participants	LGU
5	8:30-8:45	Brief Project Orientation	Engr. Chito Rosario
6	8:45-9:00am	Environmental Impacts of the Project	Ms. Erika May Florendo
7	9:00-9:15am	Right-of-Way (ROW) Acquisition Process	DPWH DEO
8	9:15-9:45am	Open Forum	Facilitators
8	9:45-10:00am	Closing Remarks	Barangay Kagawad
10	10:00-10:10am	Orientation on the Focus Group Discussions (FGD's) Design and mechanics	Facilitators
11	10:10-11:00am	Focus Group Discussion (FGD's)	Facilitators
12	11:00-11:30am	Open Forum	Facilitators
13	11:30-11:45am	Synthesis	Facilitators
14	11:45-12:00nn	Closing Remarks	Barangay Kagawad

Annex II. DPWH Grievance Intake Form

Name of Project, Subproject and Location

Project (indicate name of project) welcomes complaints, suggestions, comments and queries regarding the project implementation and its stakeholders. We encourage persons with grievance to provide their name and contact information to enable us to get in touch with you for clarification and feedback.

Should you choose to include your personal details but want that information to remain confidential, please inform us by writing/typing "(CONFIDENTIAL)" above your name.
Thank you.

Contact Information

Name		Gender	Male Female
Home Address		Age	
		Phone No.	Phone No.
City/Province			

Complaint/Suggestion/Comment/Question
Please provide the details (who, what, where, and how) of your grievance(s) below:

How do you want us to reach you for feedback or updates on your comment/grievance?

Portion to be filled in by DPWH staff:

Date received:	
Received through:	__ In person __ mail __ email __ fax __ phone __ sms
Name of staff who received comment/ complaint	
Position of staff:	
Type of Grievance:	
Remarks	
Signature of staff	

Updates on the case:

Date:	Update	Updated by (Name, Signature and Designation)

Annex III Water Quality Analysis for Agus R. and Lake Lanao

From PHI: Emergency Assistance for the Reconstruction and Recovery of Marawi (ERRM) Reconstruction and Development Plan for a Greater Marawi, Stage 2 (CP-1A and CP-1B)

Sampling Locations

Station	Location	Date/ Time of Sampling	Coordinates
SWQ-2	Agus 1	September 1,2020 0846H	8°0'3" N 124°17'19" E
SWQ-3	Agus 1	September 1,2020 0856H	8°0'6" N 124°17'21" E
SWQ-4	Agus 1	September 1,2020 0915H	8°0'18" N 124°17'37" E
Station	**Location**	**Date/ Time of Sampling**	**Coordinates**
SWQ-9	Lanao Lake	September 7,2020 0839H	7°58'56"N 124°16'30"E
SWQ-10	Lanao Lake	September 7,2020 0915H	7°59'3"N 124°16'44"E
SWQ-11	Lanao Lake	September 1,2020 0927H	7°59'17"N 124°16'57"E

II), while SWQ9, SWQ10, and SWQ11 are Class A waters (*Public Water Supply Class II*).

Based on the results, parameters such as color, pH, dissolved oxygen, biological oxygen demand, total suspended solids, surfactants, oil and grease, nitrates, phosphates, phenols, chloride, dissolved copper, Arsenic, Cadmium, hexavalent Chromium, cyanide, Lead, Mercury and organophosphates as Malathion are below the threshold limit of DAO 2016-08 Water Quality Guidelines and General Effluent Standards of 2016 for Class C and Class A waters. Meanwhile, Fecal coliform count at stations SWQ2 and SWQ3 exceeded the standard for Class C waters which is 200 MPN/100mL. Exceedance in these stations may be due to anthropogenic activities like direct discharge or runoff of wastes to the water since they are near residential areas and bridges. Stations SWQ9, SWQ10 and SWQ11 which are located at lake Lanao and was classified as Class A waters also failed to comply for Fecal coliforms with threshold limit of <1.1 MPN/100mL and likely to fail since its water is untreated.

Water Quality Data from Baseline Survey (September 2020)

PARAMETERS	SWQ11[A]	SWQ12[C]	SWQ13[C]	SWQ14[C]	SWQ15[C]	SWQ16[C]	SWQ17[C]	SWQ18[C]	Regulatory Limit DAO 2016-08		REMARKS
									Class A	Class C	
Color (CPU)	<5	25	10	<5	<5	<5	<5	<5	50	75	PASSED
Temperature (°C)	25	26	25	26	25	25	26	26	26-30°C	25-31	PASSED
pH	8.5	7.4	8.0	7.1	7.1	7.1	7.1	7.1	6.5-8.5	6.5-9.0	PASSED
Dissolved Oxygen (mg/L)	7	9	7	8	9	7	9	9	5 (minimum)	5 (minimum)	PASSED
Biological Oxygen Demand (mg/L)	<1	<1	1	<1	<1	2	4	3	3	7	PASSED
Total Suspended Solids (mg/L)	4	9	264	5	5	6	<3	5	50	80	FAILED (SWQ13)
Surfactants (mg/L)	<0.10	<0.10	0.13	<0.10	<0.10	<0.10	<0.10	<0.10	0.2	1.5	PASSED
Oil and grease (mg/L)	<1	3	<1	<1	<1	<1	1	1	1	2	FAILED (SWQ12)
Nitrates (mg/L)	<0.01	0.19	0.60	0.69	0.64	0.71	0.68	<0.01	7	7	PASSED
Phosphates (mg/L)	<0.01	0.04	0.11	0.09	0.07	0.12	0.09	<0.01	0.5	0.5	PASSED
Phenols (mg/L)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	0.05	PASSED
Fecal Coliform (MPN/100mL)	23	210	41	9.2	22	32	40	32	1.1	200	FAILED (SWQ11, SWQ12)
Chloride (mg/L)	1.5	<0.5	2.0	18.8	5.9	5.9	2.5	5.9	250	350	PASSED

PARAMETERS	SWQ11[A]	SWQ12[C]	SWQ13[C]	SWQ14[C]	SWQ15[C]	SWQ16[C]	SWQ17[C]	SWQ18[C]	Regulatory Limit DAO 2016-08		REMARKS
									Class A	Class C	
Dissolved Copper (mg/L)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.02	0.02	PASSED
Arsenic (mg/L)	<0.0007	<0.0007	<0.0007	<0.0007	<0.0007	<0.0007	<0.0007	<0.0007	0.01	0.02	PASSED
Cadmium (mg/L)	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	0.003	0.05	PASSED
Hexavalent Chromium (mg/L)	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.01	0.01	PASSED
Cyanide (mg/L)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.07	0.01	PASSED
Lead (mg/L)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	0.05	PASSED
Mercury (mg/L)	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	0.001	0.002	PASSED
Organophosphates as Malathion (µg/L)	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1	3	PASSED

Notes:
**Regulatory Limit Reference*
DENR DAO 2016-08
A - Class A (Public Water Supply Class II
C - Class C (Fishery water for the propagation and growth of fish and other aquatic resource; Recreational Water Class II; For agriculture, irrigation and livestock watering)

Station SWQ2, SWQ3 and SWQ4 are classified as Class C waters (*Recreational Water Class*

Annex IV Endemic Species reported in Lake Lanao

i.	*Barbodes amarus* Herre (pait; dipura)	x.	*Barbodes manalak* Herre ** (manalak)
ii.	*Barbodes baoulan* Herre ** (baolan)	xi.	*Barbodes pachycheilus* Herre (Bongkaong)
iii.	*Barbodes binotatus* Valenciennes (Pait sah Gandamatu)	xii.	*Barbodes palaemophagus* Herre (bitungu)
iv.	*Barbodes clemensi* Herre (bagangan)	xiii.	*Barbodes palata* Herre ** (palata)
v.	*Barbodes disa Herre* ** (Diza)	xiv.	*Barbodes resimus* Herre * (bagangan sa erungan)
vi.	*Barbodes flavifuscus* Herre (tumba)	xv.	*Barbodes sirang* Herre sirang; (Tumaginting)
vii.	*Barbodes katolo* Herre (katolo)	xvi.	*Barbodes tras* Herre (tras)
viii.	*Barbodes lanaoensis* Herre (kundur)	xvii.	*Barbodes truncatulus* Herre (bitungu)
ix.	*Barbodes lindog* Herre ** (lindog)	xviii.	*Barbodes tumba* Regan (tumba)

Endemic, native, and introduced fish species reported in Lake Lanao

Current valid scientific name	Status/year of introduction
***Anabas testudineus* (Bloch, 1792)**	Native to the Philippines but introduced to Lake Lanao
***Anguila celebensis* (Kaup, 1856)**	Native to Lake Lanao
***Channa striata* (Bloch, 1793)**	Native to the Philippines but introduced to Lake Lanao
***Chanos chanos* (Forsskal, 1775)**	Native to the Philippines but introduced to Lake Lanao in 1955, 1962, 1963, 1964
***Clarias batrachus* (Linnaeus, 1758)**	Native to the Philippines but introduced to Lake Lanao
***Clarias macrocephalus* (Gunther, 1864)**	Unknown
***Cyprinus carpio* (Linnaeus, 1758)**	1915, 1926
***Giuris margaritaceus* (Valenciennes, 1837)**	~1975
Glossogobius aureus (Akihito and Meguro, 1975)	Unknown
***Glossogobius celebius* (Valenciennes, 1837)**	Unknown
***Glossogobius giuris* (Hamilton, 1822)**	~1963
***Oreochromis mossambicus* (Peters, 1852)**	1955
***Oreochromis niloticus* (Linnaeus, 1758)**	~1972
***Micropterus salmoides* (Lacepede, 1802)**	1915
***Trichopodus pectoralis* (Regan, 1910)**	~1938

Source: Abdulmalik-Labe and Quilang 2019

Annex V Disposal Sites Suitability Assessment

(based on Site Selection Criteria for Disposal Sites in EMP)

1. **Disposal sites will not encroach on surface water courses, will not cause sedimentation or obstruction of stream/river flow and will not cause damage to agricultural land, irrigation, densely vegetated areas, forests, properties, community water sources, and other productive sites.**

TLRB

The potential disposal sites for TLRB do not encroach any surface water courses and will not impede any water flow. The sites will not cause damage to agricultural lands nor any other productive sites as the general land cover of the areas are mostly grassland which are presumed to be previously cultivated farmlands. Remnant dividers for separation of rice paddies into blocks are noticed in the location. The sites were abandoned and natural succession processes took place for grasses and shrubs to have established and dominated the area.

Photos of potential disposal sites in TLRB

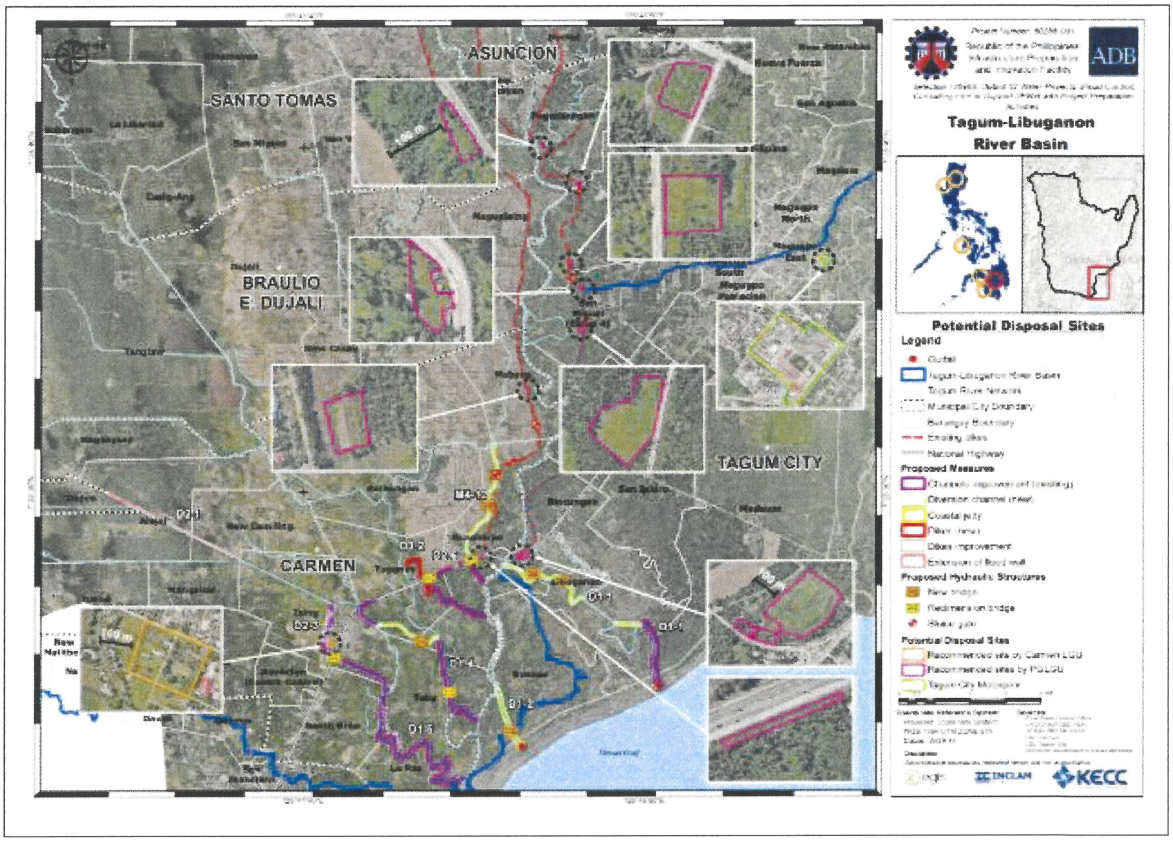








Location of the Potential Disposal Sites for TLRB

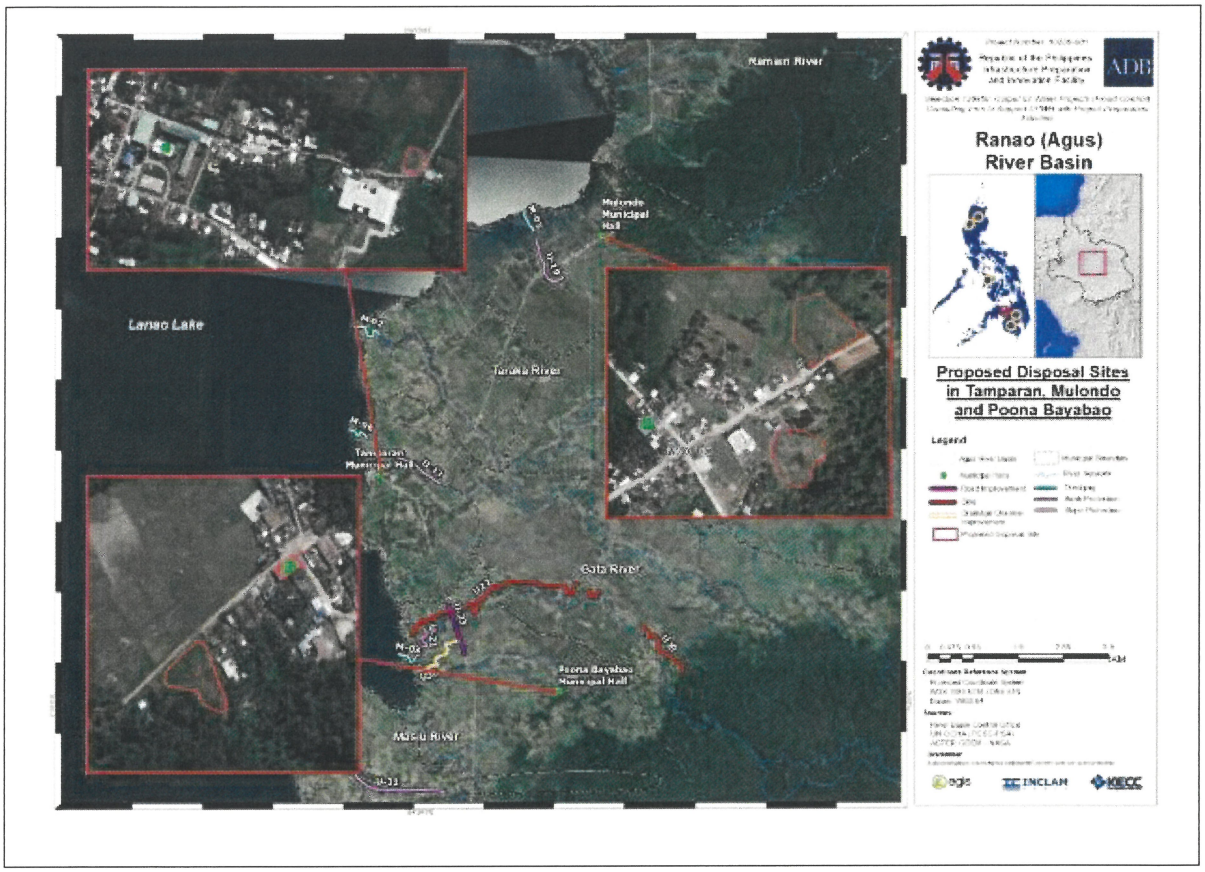


RARB

Similar to TLRB's sites, the potential disposal sites for RARB are seen as abandoned agricultural lands and vacant lots as well. They are located near the municipal halls of the affected Local Government Units (LGU). They will not cause obstruction to any waterway nor any destruction to farmlands, irrigation, vegetated areas, forests, and other productive sites.

Disposal site will be on stable slopes, located as close to the construction site as practical. No disposal will be allowed on farmland, on or adjacent to surface waters, wetlands, or culturally or ecologically sensitive areas.

Location of the Potential Disposal sites for RARB



TLRB

The disposal sites are on relatively flat terrain and on stable slopes, especially since they are observed to be previously rice paddies. The only culturally significant landmark within the river basin is the the Davao Penal colony, which is 10km away from the nearest disposal site. As for ecologically sensitive areas, the Carmen (Ising) wetland is 1km away from the nearest disposal site and will not be affecting this wetland.

RARB

Likewise, the disposal sites are on flat locations with stable slopes as they are on abandoned rice paddies or vacant lots near the municipal halls. There are no adjacent bodies of water, wetlands, nor culturally or ecologically sensitive areas.

2. **Watercourse buffers of 100 m should be maintained.**

As seen in the maps, all disposal sites are 100m away from the waterways. No disposal site will affect any waterbody.

Document Stage: Draft
Project Number: 51294

Initial Environmental Examination

of

PHI: Integrated Flood Resilience and Adaptation (InFRA) - 1

September 2021

Prepared by the Department of Public Works and Highways