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Environmental Impact Statement Report (EIS)

Amnay River Restoration and Desilting Project (ARRDP)

Sablayan, Occidental Mindoro

CITY PACIFIC GROUP, INC.

2nd Flr. V&A Bldg. A. Soriano Highway
Brgy. Ibayo Silangan, Naic, Cavite

"Sustainable Rivers, Sustainable Ecosystems"
Protecting Rivers….Protecting life.

May 2023

3rd DRAFT REPORT

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ACRONYMS

AO	Administrative Order
A & D	Alienable and Disposable
ARRDP	Amnay River Restoration and Desilting Project
BOD	Biochemical Oxygen Demand
BSWM	Bureau of Soils and Water Management
CADT	Certificate of Ancestral Domain Title
CAAP	Civil Aviation Authority of the Philippines
CDR	Crude Death Rate
CENRO	Community Environment and Natural Resources Office
CMVR	Compliance Monitoring and Validation Report
CPGI	City Pacific Group, Inc.
dBA	Decibel
DAO	DENR Administrative Order
DOE	Department of Energy
DENR	Department of Environment and Natural Resources
DILG	Department of Interior and Local Government
DOLE	Department of Labor and Employment
DPWH	Department of Public Works and Highways
DIA	Direct Impact Areas
DO	Dissolved Oxygen
EN	Endangered Species
ECC	Environmental Compliance Certificate
EGF	Environmental Guarantee Fund
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
EMB	Environmental Management Bureau
EMP	Environmental Management Plan
EMoP	Environmental Monitoring Plan
EQPL	Environmental Quality Performance Level
ERA	Environmental Risk Assessment
EU	Environmental Unit
ES	Executive Summary

FS	Feasibility Study
FLA	Foreshore Lease Agreement
GHG	Greenhouse Gas
GMR	Grievance Redress Mechanism
GLC	Ground-level Concentration
IMP	Impacts Management Plan
IRR	Implementing Rules and Regulations
IV	Importance Value
IEC	Information Education and Communication
IPCC	Intergovernmental Panel on Climate Change
IUCN	International Union for Conservation of Nature
IAC	Inter-Agency Committee
IAS	Invasive Alien Species
LGU	Local Government Unit
MAR	Mean Annual Rainfall
MC	Memorandum Circular
MOA	Memorandum of Agreement
MH	Merchantable Height
MPSA	Mineral Production Sharing Agreement
MGB	Mines and Geosciences Bureau
MMT	Multi-sectoral Monitoring Team
MCLUP	Municipal Comprehensive Land Use Plan
NAAQGV	National Ambient Air Quality Guidance Values
NAAQS	National Ambient Air Quality Standards
NEIC	National Earthquake Information Center
NIOSH	National Institute of Occupational Safety and Health
NAMRIA	National Mapping and Resource Information Authority
NPCC	National Pollution Control Commission
NSO	National Statistics Authority
ND	Not Detected
OHS	Occupational Health and Safety
PM	Particulate Matter
PPE	Personal Protective Equipment
PAR	Philippine Area of Responsibility
PAGASA	Philippine Atmospheric, Geophysical and Astronomical Services Administration
PCG	Philippine Coast Guard
PEISS	Philippine Environmental Impact Statement System
PFZ	Philippine Fault Zone
PHIVOLCS	Philippine Institute of Volcanology and Seismology
PNP	Philippine National Police
PNSDW	Philippine National Standard for Drinking Water
PPCC	Philippine Plant Conservation Committee
PSA	Philippine Statistics Authority
PEMAPS	Project Environmental Monitoring and Audit Prioritization Scheme
RA	Republic Act
RDZ	River Dredging Zone
SDMP	Social Development Management Plan
SDP	Social Development Plan
TSP	Total Suspended Particulates
TSS	Total Suspended Solids
TD	Tropical Depressions
USEPA	United States Environmental Protection Agency
VFS	Valley Fault System
WWTS	Wastewater Treatment System
WS	Watershed

EXECUTIVE SUMMARY

A. PROJECT FACT SHEET

<table>
<tr><td>Name of Project</td><td>Amnay River Restoration and Desilting (ARRD) Project</td></tr>
<tr><td>Location</td><td>Barangay Claudio Salgado, Municipality of Sablayan, Occidental Mindoro</td></tr>
<tr><td>Project Type
(Based on EMB-MC 2014-005)</td><td>Extraction of Non-Metallic Minerals (Aggregates such as sand, stone, and gravel including dredging with/intended for recovery/ use of materials)</td></tr>
<tr><td>Project Area</td><td>509.322 hectares (ha) from the river mouth up to 14.5 kilometers (km) upstream
509.322 ha Pilot Channel Dredging Area
48.35 ha Buffer Zone
2.25 ha (150 m x10 m) Dredging Basin
109-hectares Offshore Navigational Working Area</td></tr>
<tr><td>Project Capacity/Output</td><td>Extraction Rate: 610,162.50 m^3/month or 7,321,950.00 m^3/year (RDZ)
Navigational Work: 945,855.00 m^3/month or 11,350,260.00 m^3/year (Offshore)</td></tr>
<tr><td>Project Description</td><td>The proposed Project involves extraction of sand and gravel (dredge materials) in the project area as fill materials for construction and reclamation projects.</td></tr>
<tr><td>Rationale</td><td>The proposed Project is targeted to increase the flood control conveyance capacity of the Amnay River, resulting in the reduction of the flood inundation area and flood susceptibility of adjoining areas in the Municipality of Sablayan. The proposed project also aims to meet the Philippines' growing demand for building materials by providing a reliable, affordable, and sustainable source of sand and aggregates and to contribute to the economic and social development of Mindoro Province.</td></tr>
<tr><td>Project Schedule</td><td>15-18 Years</td></tr>
<tr><td>Components</td><td>
<table>
<tr><th colspan="2">Project Components</th><th>Quantity/Approximate Size/Capacity</th></tr>
<tr><td colspan="2">Major Components</td><td></td></tr>
<tr><td rowspan="7">Dredging Equipment/ Vessels</td><td>Self-Discharge Barge/ Pelican Barge</td><td>10 units/ 10,000 MT</td></tr>
<tr><td>TSHD (Trailing Suction Hopper Dredger)</td><td>12 units/ 6000 m^3/hour</td></tr>
<tr><td>Cutter Suction Dredger</td><td>4 units/ 1,000-1,500 MT/hr (minimum 3,000 HP)</td></tr>
<tr><td>Backhoe</td><td>20 unit/ 1 m^3</td></tr>
<tr><td>Dump Trucks</td><td>40 unit/ 18 m^3</td></tr>
<tr><td>Wheel Loader</td><td>4 unit/ 5 m^3</td></tr>
<tr><td>Grader</td><td>5 units</td></tr>
<tr><td rowspan="5">Support Facility and Common Auxiliaries</td><td>Yard landfill/Stockpile</td><td>2.0 hectares</td></tr>
<tr><td>Staff Quarters/Barracks</td><td>1</td></tr>
<tr><td>Offshore handling area</td><td>50 has.</td></tr>
<tr><td>Administration Building</td><td>1</td></tr>
<tr><td>Jetty Port</td><td>1</td></tr>
<tr><td rowspan="3">Pollution Control Devices</td><td>Wastewater Treatment System</td><td>1 unit per vessel (12 TSHD, 2 CSD)/ 2,500-4,500 m^3</td></tr>
<tr><td>Material Recovery Facility (MRF)</td><td>2 units</td></tr>
<tr><td>Silt and Barricade devices</td><td>5.43 km perimeter/170 ha.</td></tr>
</table>
</td></tr>
<tr><td>Total Manpower</td><td>100 personnel per dredging ship or a total of 54 on 2 dredging ships</td></tr>
<tr><td>Total Project Cost</td><td>PHP 1,000,000,000.00</td></tr>
<tr><td>Profile of the Proponent</td><td></td></tr>
<tr><td>Proponent Name</td><td>City Pacific Group, Inc. (CPGI)</td></tr>
<tr><td>Address</td><td>2nd Floor, V&A Bldg. A. Soriano Highway, Barangay Ibayo Silangan, Naic, Cavite</td></tr>
<tr><td>Authorized Signatory/ Representative</td><td>Mr. Melandres G. De Sagun
CEO</td></tr>
<tr><td>Contact Details</td><td>Telephone No.: (049) 540-2238
Mobile No.: +63950-041-2017
Email Address: citypacificgroup@gmail.com</td></tr>
</table>

Profile of the Preparer	
EIS Preparer	**FORESTEREPLAN Environmental Consultancy Service**
Address	L16, B7 Villa Carangal Subd. Brgy. Putho-Tuntungin, Los Banos, Laguna
Contact Person	**Enrico L. Replan, Ph.D., RF** President/CEO
Contact Details	Tel. No. (049) 540-2238 Email Address: forestereplan.consultancies@gmail.com

B. EIA PROCESS DOCUMENTATION

EIA Team

The Environmental Impact Assessment (EIA) Study for the proposed Amnay River Restoration and Desilting (ARRD) Project of the City Pacific Group, Inc. (CPGI) was conducted by a multidisciplinary team of consultants and experts of FORESTEREPLAN Landscape Consultancy Service (FORESTEREPLAN), who have prime and strong background in environmental assessments. The EIA Study was conducted in close coordination with the project management of CPGI, which was spearheaded by Mr. Melandres G. De Sagun, CEO. **Table ES-1** presents the composition of the EIA Study Team. The signed and notarized Accountability Statements of CPGI and FORESTEREPLAN are shown in **Annex ES-1.**

Table ES-1: EIA Team Composition

Module/Section/Area of Expertise	Team Member	EMB Registry No./License No.
Flora Terrestrial Ecology/Team Leader	Enrico L. Replan	0010736
Environmental Management/EISR Integration	Fritzie Jane P. Salido	IPCO-114
Hydrology	John Carlo M. Soco	-
Geology, Geohazards, Soils, and Hydrogeology	Emmanuel P. Bate	IPCO-079
Marine Ecology	Ma. Vivian D. Camacho	IPCO-213
Reef Fish	Marion Michael A. Bacabac	-
Freshwater Ecology	Krystil Ckaye Pardo	-
Fauna (Terrestrial Ecology)	Judeline C. Dimalibot ✠	IPCO-176
GIS Mapping/Technical Dredging Expert	Elmer C. Doctor	-
Marine Water Quality	Florante D. Mendoza	0011052
Oceanography	Menche P. Lazarte	-
Socio Economics/Social Component	Florante D. Mendoza	0011052
Air and Water Quality	Mark Rezikel M. Soco	-
Environmental Risk Assessment	Ann Jenikeil S. Replan	-

EIA Schedule

The EIA Study was commenced by conducting a project briefing for the EIA concerned personnel of the Environmental Management Bureau (EMB) to Information, Education and Communication (IEC) activities and Public Scoping. Technical Scoping was conducted on July 05, 2022 with the EMB and EIA Review Committee (EIARC) members and based on the agreed scope of work, the collection of primary and secondary data was conducted. Data collected were processed, analyzed and evaluated for impact assessment and formulation of impact management plan. The data and information were written into an Environmental Impact Statement Report (EISR) and the final version of the EISR is then submitted to the EMB-Region 4B Office for ECC application. The major activities undertaken to complete the EIA are listed in **Table ES-2**.

Table ES-2: EIA Study Schedule

Activities	Date Performed
IEC Activities/Key Informant Interview/Focus Group Discussion ▪ Barangay Claudio Salgado ▪ Barangay Ilvita ▪ Barangay Pagasa ▪ Barangay Victoria ▪ Barangay Lagnas	October 1-8, 2021
Public Scoping	February 8, 2022
Technical Scoping	July 05, 2022
Baseline Data Gathering/Collection	July 10-October 20, 2022
▪ Geology and Geomorphology	July 15-18, 2022
▪ Pedology	July 15-18, 2022
▪ Hydrology/Hydrogeology	July 15-18, 2022
▪ Oceanography	July 1, 2022
▪ Water Quality (Dry Season/Wet Season)	August 21, 2021/April 9, 2022
▪ Freshwater Ecology	August 25, 2021
▪ Flora and Fauna Assessment	August 25, 2021
▪ Marine Ecology	August 2-6, 2022
▪ Noise Level Measurement	August 22, 2021
▪ Socio-economic, Health and Perception Survey	November 10, 2022
▪ Social Development Planning Workshop	February 24, 2022
Public Consultation Meeting (Public Hearing)	April 14, 2023
EISR Technical Review (EIARC)	April 15, 2023
Site Inspection with EIARC and EMB/PEMU	April 15, 2023

EIA Study Area

The EIA Study area for the proposed ARRD Project covers the offshore area (109 hectares) and from the mouth of Amnay River up to 14.5 km upstream, Barangay Claudio Salgado and barangays, and Municipality of Sablayan in Occidental Mindoro.

EIA Methodology

Pursuant to the Department Administrative Order (DAO) No. 30 Series of 2003 of the Revised Procedural Manual of the Philippine EIS System (PEISS) and EMB Memorandum Circular 005 dated July 7, 2014, the proposed project is classified under B-1 Category of Non-Environmentally Critical Projects (NECPs) which requires an EISR for ECC application.

The EIA for the proposed ARRD Project also conforms to DAO 2003-30 and DAO 2017-15 in the conduct of the following activities, to wit: (i) IEC and Scoping, (ii) collection of primary and secondary data, (iii) identification/prediction/assessment of environmental impacts, (iv) formulation of EMP and the (v) development of EMoP. The baseline information are mainly primary and secondary data which were obtained from the local government units (LGUs) and other government agencies. Data collected were based from the approved EIA Scoping and Screening Form presented in **Annex ES-2**, which was finalized during the Technical Scoping. **Table ES-3** shows the pertinent data, sources, and methodologies used for the conduct of EIA Study for the proposed ARRD Project.

Table ES-3: EIA Methodology

Environmental Component	Methodology and Description
LAND	
Land Use and Classification	▪ Review of Socio-economic Physical and Political Profile (SEPPP), Comprehensive Land Use Plan (CLUP), and LGU Profile of the Municipality of Sablayan, Occidental Mindoro to:

Environmental Component	Methodology and Description
	- Describe the existing physical features of the project area in terms of geology, hydro-geology, topography and soil conditions, among other physical features of the project area; - Identify possible physical hazards and assess the threats it poses to the project; and; - Recommend measures to minimize the impacts of the project on geologic and hydro-geologic condition and to recommend means to minimize the geologic and hydro-geologic hazards, if any. ▪ Assessment of the land uses in the coastal areas that may be affected by the dredging activities.
WATER	
Hydrology/ Hydrogeology	▪ Conduct of field survey ▪ Review of existing maps and reports from Mines and Geosciences Bureau (MGB)
Oceanography	▪ Conduct of field survey ▪ Use of Echo-sounding mapper (STRIKER™ Plus 9sv) to measure the bathymetry of coastal areas near river delta; ▪ Identification and assessment of project impact on the degree of change/ disruption of circulation pattern and the potential for coastal erosion ▪ TPXO 8.0 Global Inverse Tide Model using Delft Dashboard ▪ Delft3D modelling suite from Deltares
Marine Ecology	▪ Conduct of field survey ▪ Use of modified manta tow technique of English et al. (1997) for the coral reef survey, and assessment of coral communities using modified photo transect method. ▪ Use of fish visual census technique of English et al. (1997) for the fish survey ▪ Identification of lifeform using the standard 28 benthic life form categories of English et al. (1997). ▪ Identification of Planktonic organisms to the lowest possible taxa using references such as those of Goswami (2004), Nishikawa and Toda (2004); Sekiguchi et al. (2004) and Verlencar (2004), and their numbers counted. ▪ Marine resource characterization (e.g., municipal and commercial fisheries data) ▪ Key informant interview.
Water Quality	▪ Conduct of field survey and collection of marine water, groundwater, and surface water samples for analysis ▪ Assessment of water quality results based on DAO 2016-08 (Water Quality Guidelines and General Effluent Standards of 2016) of DENR. ▪ Conduct water sampling and analysis: 10% of the area; 3 sampling stations (Downstream, Midstream and Upstream)
Freshwater Ecology	▪ Conduct field survey ▪ Identify and assess project impact in terms of threats to existence/and or loss of species, abundance frequency and distribution species and include discussions on overall impact to freshwater ecology.
AIR	
Meteorology and Climatology	▪ Review of existing literature and maps of the project area from PAGASA, United States Environmental Protection Agency (USEPA), The Greenhouse Gas Protocol, A Corporate Accounting and Reporting Standard, Revised Edition, World Business Council for Sustainable Development (WBCSD) and the World Resources Institute (WRI). ▪ Use of climatological and meteorological data from PAGASA San Jose Station ▪ Use of Climate Trends and Projected Climate Change data from PAGASA to discuss effects of climate change in the Philippines
Noise Level	▪ Conduct of noise level measurements ▪ Assessment of recorded noise levels based National Pollution Control Commission (NPCC) Noise Standards in General Areas
PEOPLE	
Demography Socioeconomic	▪ Conduct of IEC activities at Barangay Claudio Salgado ▪ Conduct of Public Scoping

Environmental Component	Methodology and Description
Public Health	▪ Conduct of Socio-economic, Public Health and Perception Survey at Barangay Claudio Salgado ▪ Conduct of Social Development Planning (SDP) workshop with concerned stakeholders from Sablayan LGU, for the preparation of an Indicative SDP and IEC Framework. ▪ Review of the SEPPP of Sablayan ▪ Review of available secondary data, relevant studies and other information from Sablayan LGU, Philippine Statistics Authority (PSA), Department of Labor and Employment (DOLE), Department of Education (DepEd), Department of Public Works and Highways (DPWH), and others. ▪ Identification and assessment of project impact on the traffic situation in the area including congestion based on existing capacity of road system ▪ Identification and assessment of project impact in terms of threats to delivery of basic services including potential for resource competition in the area including effects of in-migration ▪ Identification and assessment of specific threats to public health and safety ▪ Identification and assessment of local benefits of the project in terms of enhancement of employment and livelihood opportunities, increased business opportunities and associated economic activities and increased revenue of LGU. ▪ Identification and assessment of project impacts on demography of affected communities. Use assessment in the formulation of SDP/IEC; and ▪ Identification and assessment of project impact due to in-migration patterns including proliferation of informal settlers

Public Participation Activities

Extensive and comprehensive IEC activities about the proposed ARRD Project were conducted to ensure a meaningful and active participation of the well-informed stakeholders – host communities, LGUs, relevant agencies, the EMB and the local DENR in the EIA process.

Information, Education and Communication

The IEC sessions, as presented **Table ES-4**, were conducted to provide updated information about the proposed ARRD Project and encourage the concerned stakeholders to participate in the EIA process. The IEC activities started with a prayer followed by the explanation of the EIA process, and the presentation of the project description and its potential associated impacts. An open forum was then held after the presentations in order to solicit the related issues, concerns, suggestions from the stakeholders regarding the Project for incorporation into the EIA Study. IEC documents such as attendance sheets, issues raised, and photos taken during the IEC sessions are presented in **Annex ES-3**.

Table ES-4 IEC Conducted for the Proposed ARRD Project

Activity Date and Venue	Attendees	Key notes
IEC at Barangay Claudio Salgado 2 October 2021 (Tuesday), 10:00 AM to 1:00 PM at Barangay Claudio Salgado hall/Covered Court	▪ Brgy. Chairman ▪ Local Residents ▪ Representatives from Municipal office (Sablayan) ▪ Host Barangays Representatives ▪ CPGI ▪ FORESTEREPLAN ▪ Concerned Community Groups (e.g., Youth, Fishermen, etc.)	▪ Dredging (Restoration) in Amnay River was the priority of the Government; ▪ Heavy silted River in which the contractor will extract gravel and sand for which it will be sold by the Contractors; ▪ 68 million m^3 of sand and gravel will be extracted from the dredging zone; ▪ Total revenue from the dredged materials will be divided into different percentages from the beneficiaries: Barangay, LGU Province and Municipality. ▪ Issues raised at different timelines and phases of the project (See Summary).

Activity Date and Venue	Attendees	Key notes
		▪ Other related aspects of the project.
IEC at Barangay Ilvita 1 October 2021 (Tuesday), 10:00 AM to 1:00 PM at Barangay Ilvita hall/Covered Court	▪ Brgy. Chairman ▪ Local Residents ▪ Representatives from Municipal office (Sablayan) ▪ CPGI ▪ FORESTEREPLAN ▪ Concerned Community Groups (e.g., Youth, Fishermen, etc.)	▪ A Grievance Redress Mechanism (GRM) will also form part of the EIA report to address the grievances of the stakeholder in all phases of the Project. ▪ Aside from MMT meetings where consultation will be conducted either quarterly or semiannually, the company will conduct direct regular consultation meetings with the LGUs, the frequency of which will be determined as needed during the EIA. This will be included in the EMP as one of the proponent's commitments. ▪ The municipal government will earn financial benefits through Local Business Taxes/permits. This is in addition to the indirect business and employment opportunities that are expected to be created by CPGI (and its contractors) if and when the Project pushes through. ▪ The Project is in early-stage development. The location of the laydown areas and housing for the contractors have yet to be determined. CPGI and its contractors will work in consultation with the host barangays in instances where laydown areas and/or contractor housing will be located outside of the project site.
IEC at Barangay Pagasa 3 October 2021 (Wednesday), 10:00 AM to 1:00 PM at Barangay Pagasa Barangay Hall	▪ Municipal Health Office ▪ Brgy. Chairman ▪ Local Residents ▪ Community Sectors ▪ BHO ▪ CPGI ▪ FORESTEREPLAN	▪ The waste expected from the dredging operation will be limited to the solid and liquid waste from the Crew of Dredging Ship and Anchor Boat. ▪ The dredger and anchor boat will be required to each have a sink-shredder such as an ink-sink aerator which will shred debris safety for discharged to the sea. ▪ Waste receptacles for the collection of non-biodegradable and recyclable waste will be required. The contents of which will be disposed properly by bringing these in properly sealed containers, to regular Municipal Solid Waste collection area. ▪ Human liquid waste is to be pre-treated at the dredger and barges in accordance with the requirements of the MARINA which is consistent with the Sanitation Code of the Philippines. ▪ The solid waste from site office will be segregated according to RA 9003 properly contained, sealed and brought to the municipal garbage pick-up point according to the garbage collection schedule. ▪ The sanitation concerns of the site Office and Barracks shall be taken-care of by the Proponent as additional sanitation facilities and will be established to handle waste treatment capacity in the area.
IEC at Barangay Victoria	▪ Municipal Health Office ▪ Brgy. Chairman	▪ The solid waste from site office will be segregated according to RA 9003 properly

Activity Date and Venue	Attendees	Key notes
4 October 2021 (Wednesday), 10:00 AM to 1:00 PM at Barangay Victoria Barangay Hall	▪ Local Residents ▪ Community Sectors ▪ BHO ▪ CPGI ▪ FORESTEREPLAN	contained, sealed and brought to the municipal garbage pick-up point according to the garbage collection schedule. ▪ The sanitation concerns of the site Office and Barracks shall be taken-care of by the Proponent as additional sanitation facilities and will be established to handle waste treatment capacity in the area.
IEC at Barangay Lagnas 5 October 2021 (Wednesday), 10:00 AM to 1:00 PM at Barangay Lagnas Barangay Hall	▪ Municipal Health Office/PGO Reps. ▪ Brgy. Chairman ▪ Local Residents ▪ Community Sectors ▪ BHO ▪ CPGI ▪ FORESTEREPLAN	▪ Sanitation concerns ▪ Road usage, safety and welfare ▪ Opportunities at the barangay for Livelihood ▪ Other concerns, etc. ▪ Employment activities should be prioritized in the Barangay; ▪ School supplies support for the affected individuals near the River.
Key-Informant-Interview 06 October 2021 (Wednesday), 2:00 PM to 3:00 PM at Ilvita Barangay Hall	▪ LGU Municipality Officials ▪ Brgy. Chairman ▪ Local Residents ▪ BHO ▪ CPGI ▪ FLCS	▪ A closely local residential facility will be rented for this purpose. All water and power supply will be sourced from existing water and power service providers. It is assumed that the residential structure is provided with adequate waste water management facility. ▪ Fuel, oil, and lubricants shall be supplied either by local fuel station or private oil company in the Municipality; ▪ The containers will be regularly brought on board the dredgers through the cargo barge. This dispensing mechanism shall be required to have latch on mechanism with the recipient fuel tank before these release petroleum fuel. ▪ Prior the dredging operation, the tug, barge and dredger crew will be oriented on petroleum fuel management (likewise waste management, safety and disaster response) protocols and these will form part of the Dredging Contractor's Health, Safety and Environmental Management Plan.
Key-Informant-Interview October 07, 2021 (Wednesday), 10:00 AM to 3:00 PM at Barangay Claudio Salgado Barangay Hall/Covered Court	▪ LGU Municipality Officials ▪ Brgy. Chairman and officers ▪ Local Residents ▪ Fishery Livelihood Group ▪ BHO ▪ CPGI ▪ FORESTEREPLAN	▪ Bridge column and flood control dike like facing will be regularly fully reinforced with armor rocks cover to protect against scouring forces as early when downward movement of river bed expose the substructures. Lowering of river bed is expected. ▪ As it is how Amnay River will regain/attain flood handling capacity for a 50-year-old ARE flood. ▪ As necessary, the Proponent may organize additional dredging teams to maintain the dredging areas as per specified dimensions, to facilitate continues flow and removal of the destructing lahar materials. ▪ The designated lahar disposal site shall have adequate facilities to handle the volume of sand materials without causing negative environmental effects. ▪ The sediment volume to be dredged by the Project will only be limited to what is available in the pilot channel and the sitting/catchment basin, which have to be maintained according

Activity Date and Venue	Attendees	Key notes
		to design as discussed in the preceding sections.
08 October 2019 (Thursday), 11:30 AM to 12:30 AM at Barangay Pagasa Barangay Health Office	▪ LGU Municipality Officials ▪ Brgy. Chairman and officers ▪ Local Residents ▪ Fishery Livelihood Group ▪ BHO ▪ CPGI ▪ FORESTEREPLAN	▪ The volume of land to be removed to restore the flood carrying capacity of Amnay River; and ▪ As raised by Brgy. Officers, Pre-construction survey shall be conducted jointly by the representatives of the implementing agency, the engineer, and the contractor. ▪ Placards showing the name of the project station limits, package number, name of contractor shall always be visible during construction until after the project has been ▪ To consider the extraction of other private sector partners in flood control and further Barangay Constituents for further decision making with the project activities.
Enumerators Training 2 December October 2020 (Wednesday), 1:00 PM to 2:30 PM at Claudio Salgado Barangay Hall		▪ Concerns of the communities regarding safety of the operation; ▪ Other questions that may be raised by the interviewee; ▪ Other related concerns should be addressed by CPGI; ▪ Scheduling and community organizing

Public Scoping

The Public Scoping was conducted at Brgy. Claudio Salgado Covered Court, Sablayan, Occidental Mindoro on February 8, 2022 at 10:00 o'clock in the morning to present the EIA Process and the proposed ARRD Project to the public and also to collect site-specific concerns/inputs and suggestions to be incorporated in the EIA Study. The issues/concerns raised, copy of the received invitation letters, attendance sheets and photos taken during Public Scoping are presented in **Annex ES-4**.

Social Development Planning Workshop

Social Development Planning Workshop, particularly the formulation of the Indicative Social Development Plan (ISDP) for the LGUs was conducted in Barangay Claudio Salgado on February 24, 2022 at 10:00 o'clock in the morning. The workshop was attended by the representatives of Provincial Environment and Natural Resources Office (PENRO) of Occidental Mindoro and the Barangay Council members of Barangay Claudio Salgado.

Public Hearing/Consultation

Public Hearing/Consultation was conducted at the covered court of the host Barangay Claudio Salgado on April 14, 2023 to present the results of the EIA study as written in the EISR. The Public Consultation was facilitated by the EMB – Region 4B.

The issues and concerns raised during public hearing are presented in **Table ES-5**. Other public hearing documents such as photos, attendance sheets, and received invitation letters are presented in **Annex ES-5**.

Table ES-5: Issues and Concerns Raised during Public Hearing

EIS Component	Issues and Concerns	Response
Project Description	Feliya Alonsabe, Claudio Zone 6	Dr. Enrico Replan (FORESTEREPLAN)

EIS Component	Issues and Concerns	Response
	Maganda ang project, huhukayin ang buhangin, saan dadalhin ang buhangin?	Nagkataon po na may commercial value yung mahuhukay na buhangin. Ito po ay gagawin pang-reclamation o panambak sa Roxas Boulevard. Walang babayaran ang Province of Mindoro. Samakatuwid 40% ng taxes ay mapupunta sa Barangay, 30% sa Sablayan at 30% sa Provincial Government
	Gaano po katagal ang dredging na iyan? Baka 5 taon o 10 taon wala pa kayo sa mismong ilog, dahil sa dami ng buhangin naka-abang bumaba sa taas ng Amnay? Di biro ang buhangin bababa dyan?	Engr. Florante Mendoza (City Pacific Group, Inc.) '15-18 years po ang dredging at na-compute na po ang volume ng Amnay in terms of cbm deposits and replenishment.
	Kapitan Paulino Pwede bang sabay-sabay ba iyong pag-drede sa ilog? Meaning, kung sa Claudio palang aabutin na ng mga 7 years, paano naman kaming nasa bandang itaas? Baka wala na kami bago dumating yung magdredge sa lugar naming.	Dr. Enrico Replan (FORESTEREPLAN) Ito po ay isang large-scale dredging na na-issuehan ng ECC ng DENR. Meron po kaming sinusunod na schedule based po sa Master Dredging Plan. Anyway, may SDMP po tayo na effective agad sa 5 Barangay na apektado kahit na nasa iisang barangay pa lang yung nadedredge. Sir Claro Zapata (City Pacific Group, Inc.) Pwede naman pong simultaneous, aaralin po namin yung need pagdating ng operation.
	Kapitan ng Brgy Pag-asa Maraming nag-aapply ng quarry permit ngayon, yung 7KM pataas, pwede po bang mag-quarry pa habang operating na CPGI?	Sir Claro Zapata (City Pacific Group, Inc.) Bawal po and 2 ECC na i-issue sa isang same na lugar. Therefore, bawal po ang pag-issue na quarry permit or pagquarry sa loob ng 14KM na ECC ng CPGI.
	Sir Rogelio / Magsasaka ng Brgy Elvita Nagrequest po ako noon ng Gabions malapit sa aking lupain, masisira po ba ito kapag nagoperate na kayo?	Dr. Enrico Replan (FORESTEREPLAN) Nagco-coordinate po ang DPWH at CPGI para po maiwasang masira ang Gabions Ninyo. Mapag-uusapan po ito sa MMT so kasama po sa consultation ito para maiwasan. Lahat po ng problema at magiging problema ay ma-monitor po ng MMT
	Kapitan Sampilo Ilang percentage na po ang documentation?	Engr. Florante Mendoza (City Pacific Group, Inc.) Last na ito, 9.5 na po out of 10. Almost malapit na po magstart.
	Chairman of BFARMC ng Claudio Zalgado Naghihintay lang po kami na magsimula po ang inyong proyekto. Lubos po kaming naniniwala na makatutulong ito sa amin	Dr. Enrico Replan (FORESTEREPLAN) Engr. Florante Mendoza (City Pacific Group, Inc.) Opo. Maraming salamat. Malapit na po magstart.
	Michael Tobias / Philippine Coast Guard Tututukan po namin ang dredging project na ito. Palagi po naming iche-check at mo-monitor ang mga barko at vessels sa vicinity.	Engr. Florante Mendoza (City Pacific Group, Inc.) Maraming Salamat po.
	Kapitan ng Claudio Salgado Anong gagawin para tumigil ang pagguho ng lupa sa ilog? Pwede po	Atty Lara (City Pacific Group, Inc.) Ito pong Master Dredging PLAN ay in-appoved po ng DPWH. Amin pong susundin ang nakapaloob sa SDMP.

EIS Component	Issues and Concerns	Response
	bang proteksyon muna bago hukay/dredge?	Dr. Enrico Replan (FORESTEREPLAN) Susundan yung course or daloy po ng ilog. Pinoprotektahan po ng CPGI na hindi magiba ang river. During operation, may 10M allowance; 5M sa kaliwa at 5M po sa kanan para po maiwasan ang anu pa mang pagguho ng lupa. Meron din po tayong ibang other protection measures like paggawa ng concrete dike, or pagtanim ng mga vegetations suitable sa area.
	Day Care Worker ng Brgy Claudio Salgado Malakas po ang ulan tuwing Amihan sa amin, at mabilis din pong natitibag ang mga lupa sa ilog. Paano po yun?	Dr. Enrico Replan It is a cycle mam, hangga't barado po ang ilog matitibag at matitibag ang lupa kaya we really need to execute the project to cut the cycle.
Land	Kapitan Paulino / Lagnas Anong katiyakan na may matatanggap ang mga may-ari ng lupa na naging ilog na?	Dr. Enrico Replan (FORESTEREPLAN) Yung may mga titulo ng lupa, talagang madadamay. Ma-cocompensate po sila sa pamamagitan ng pagbibigay ng Royalties. Kung meron claimants, i-vavalidate po natin yan. Atty. Lara (City Pacific Group, Inc.) Hindi po kasalanan ng kompanya na may nabawas o nadagdag na lupa sa pagmamay-ari ko, ito po ay natural na nangyari dahil sa daloy ng ilog. Kumbaga, may accretion na naganap dahil sa hindi pagdaloy ng tubig sa ilog. Hindi po yun Karapatan ng bawat landowner, kumbaga isa itong risk ng pagmamay-ari ng isang lupain. Need po natin ng legitimate proof na kayo po ang landowner.
	Kapitan ng Claudio Salgado Hindi po updated ang mga amilyar ng mga taong may lupa na kinain na ng ilog. Makakatanggap po ba sila ng royalties kung ganun?	Atty Lara (City Pacific Group, Inc.) Kailangan po ng pertinent records / documents na pwedeng pagbasehan ng land ownership. Hangga't kayang patunayan ang ownership, walang dahilan para hindi mabigyan ng royalties.
	Mamamayan ng Elvira Paano kung walang titulo ang lupa? Pwede po ba ang Barangay Certification para makatanggap ng royalties?	Atty Lara (City Pacific Group, Inc.) Hindi naman po sa dini-discredit ko (or dini-disregard) yung barangay certificate, pero marami pa pong documents or records ang pwede po nating tignan para ma-validate ang land ownership. Then kung legitimate owner, makakatanggap ng royalty.
Freshwater Ecology	Chairman ng Fish Vendor sa Wawa May nahuhuli po kaming isda at sugpo. Hindi po ba lalayas ang mga sugpo sa ilog kapag nagdredging na?	Dr. Enrico Replan (FORESTEREPLAN) Opo, may na record po tayo na may mga fish at shrimps sa area. Gagawa po tayo ng mga fish cages or fish reserves para mapadami pa po sila. Part po ng rehabilitation ng ilog ang pagpaparami ng isda sa lugar.
People	Kapitan Bonifacio / Lagnas Pwede po ba mag provide ng patubig sa amin sa Lagnas?	Dr. Enrico Replan (FORESTEREPLAN) Noted po ito. Part po ng SDMP ang pag-provide ng needs po ng mas nakararaming tao. Well noted po ito.
	Josephine Espanola / Dep-Ed Elem level	Dr. Enrico Replan (FORESTEREPLAN)

EIS Component	Issues and Concerns	Response
	Lahat po ng mamamayan ay makikinabang sa proyektong ito, ano naman po ang pakinabang nito sa sector ng Edukasyon?	Sa SDMP po papasok ang para sa sector ng edukasyon. Maglalaan po ng budget ang CPGI na hahati-hatian ng 5 Barangay.
	Josephine Espanola / Dep-Ed Elem level Yung maintenance ba nitong ilog, lifetime na po ba?	Dr. Enrico Replan (FORESTEREPLAN) Hangga't may buhangin na nade-dredge tuloy-tuloy po ang maintenance. Nakabantay po ang PENRO sa activities sa ilog.
	Peter ng Brgy Pag-asa / Chairman ng Senior Citizen Pwede po bang lagyan ng lupa yung mga nawalan ng lupa? Para makapag-saka sila ulit?	Atty Lara (City Pacific Group, Inc.) Papasok po yan sa SDMP. Need po sumailalim sa isang kasunduan. Basta need pa din ng tamang proseso na magsisimula sa pagrerequest ng kaunting lupa o panambak para tabunan ang nawalang lupain. Sir Clark Zapata (City Pacific Group, Inc.) Maliit lang siguro ang percentage ng bato. Pero pwede naman kaming magpadala ng bato o panambak upon request
	Day Care Worker ng Brgy Claudio Salgado Pwede po bang tumawid sa ilog ang mga farmers na magtatransport ng products kung nagooperate na po kayo?	Engr. Florante Mendoza (City Pacific Group, Inc.) No. Safety is our concern. Pero kung wala na talagang other option, pag-meetingan po natin para ma-address natin yung needs ng atin po ng mga farmers at makapag-isip ng alternative na tawiran.
	Vice Chairman ng Patubig sa Lagnas May nakukuha pa po kaming at least 15 drums ng tubig sa ilog para pan-dilig saming mga sakahan. Kung madedredge, paano po kaya ang magiging patubig sa amin? Pwede po ba kaming magpatulong sa inyo sa NIA?	Engr. Florante Mendoza (City Pacific Group, Inc.) Yung paglapit po sa NIA, noted po iyan. Makakaasa po kayo. Kung operation na kami, part po ng SDMP naming kung pwedeng magpadala ng pumps, papadala po tayo.

C. EIS SUMMARY

Summary of Alternatives

Site Selection

No alternative sites were considered since the selected site needs immediate environmental mitigation and correction to avoid further damage from flooding and other hazards that involves the river (e.g., occurrence and incidence of massive flooding). If the proposed ARRD Project will not push through, the surrounding communities of the Amnay River will be continually exposed and at the forefront in flooding risks affecting their health, lives, livelihood, welfare, properties and safety. This further affects the local and municipal economy of the area as flood hazards will deject ventures of businesses and other employment prospects in the area.

The CPGI river delta/offshore area has an estimated deposit of approximately 11,350,260.00 m^3 computed at a pentagonal block of 109-hectare offshore area at a dredging depth of 10 meters. On the other hand, the extraction capacity has an estimated of volume of 945,855.00 m^3 monthly.

Technology and Design

Project planning pre-operation and preparation phase will include the following activities which are not expected to generate adverse environmental impacts. There are a lot of dredgers that can be used for Reclamation Projects. Among them are the Typical Cutter Suction Dredger (TCSD), Trailer Suction Hopper Dredger (TSHD), Cutter-suction dredger, Backhoe dredger, Pneumatic dredger, and many others. The TCSD classified as a hydraulic machinery can work in both protected and unprotected waters and has the advantage of being self-propelled which means they can move themselves and cause minimum disruption to ship traffic. They are unique in a sense that they use their self-propulsion during excavation of sediment from a borrow area and transport the dredged material to the reclamation site.

Summary Matrix of Key Environmental Impacts and Mitigating Measures

The major impact of the proposed project given in a worst-case scenario pertains to events during typhoons. Because equipment will be left in the open sea, the proposed project's main effect, given the worst-case scenario of typhoons, is contamination of the marine environment. There could be an oil spill from the machinery. However, when that time comes, the project will have to stop working and move its equipment before typhoon warnings because it will be impractical to continue working in such a dire situation. On the other hand, sudden and abrupt river discharges such as high volumetric amount of water and river-run materials may also affect vessels positioned inside the River Dredging Zone (RDZ) during typhoons, since high amount of rainfall can be experienced and be drained in the river basin through Amnay River. Vessels and restoration equipment may be, at worst case, washed or wipe out during certain events of high river discharge.

Table ES-6 presents the summary of the key environmental impacts of the proposed ARRD Project and its corresponding mitigating measures.

Table ES-6: Summary of Key Environmental Impacts and Mitigating Measures

Environmental Aspect	Environmental Component Likely to be Affected	Potential Impact	Prevention/Mitigation/Enhancement Measures
PRE-CONSTRUCTION PHASE			
Pre-construction phase covers activities like planning, feasibility study, drawing of plans and permit procurement.			
Clearing of Offshore area for navigational work and passage (Opening of River Delta)	Water Quality Dredging site area (seabed)	Impact upon hydrodynamic regime and high increased flushing of the Project area with potential for small increases to background water quality levels	Installation of plumes and silt curtains
	Water quality	Alteration of water quality in habitats and impacts (including from altered siltation/sedimentation regimes)	Monitoring of marine water in the Project area
	Marine Ecology	Alteration of habitats and impacts (including from altered siltation/sedimentation regimes) that may have potential follow effects for trophic groups and other associated species	Silt curtains and or sediment traps should be installed during dredging at least at the River Mouth to avoid dispersal of sediments/ sedimentation/ siltation in nearby marine coastal areas. This can increase turbidity and cause a reduction in photosynthetic activity of phytoplankton, potentially decrease the abundance of zooplankton which graze primarily on phytoplankton, and smother or bury macrobenthic animals or soft-bottom fauna. To ensure compliance, monitoring of marine biodiversity will be conducted for dry and wet season.

Environmental Aspect	Environmental Component Likely to be Affected	Potential Impact	Prevention/Mitigation/Enhancement Measures
	People	Impact of Turbidity on Fish Catches Impact from impeded livelihood of fisherfolks and subsistence fishers	Implement Social Development Plan; provide alternative livelihood for fishermen and impacted sectors;
			Limited impact in comparison to TSHD, with DMP to be adopted.
			Smaller-capacity TSHD should be deployed in the project area that are near the coast, while larger-capacity TSHD should be assigned far offshore
			Limit the dredging activities in project areas near the shore especially during periods of calm wind or during low tides
		Generation of Employment	▪ Positive impact; No mitigation measure required. ▪ Priority will be given to the qualified/impacted fisherfolks and residents of host communities
		Health/Safety	Security in the dredging site to prevent collisions and other activities
			Advance information on dredging sites to warn fishermen
CONSTRUCTION PHASE			
Extraction of sediments from the project area using trailing suction hopper dredgers	Water Quality Dredging site area (riverbed)	Impact upon hydrodynamic regime and high increased flushing of the Project area with potential for small increases to background water quality levels	Installation of sediment and silt curtains
	Dredging site (River delta/mouth opening) and offshore	Possible change or modification in coastal bathymetry; generation of sediment plumes	Planning of dredging operations via bathymetric surveys, current measurements and TSS study
			Proper handling of dredged materials and transport to the reclamation area
OPERATION PHASE			
Dredging operations	Water Quality (Freshwater and Marine)	Wastewater generation aboard ships	Proper disposal of ship wastewaters upon docking
		Sea Water turbidity and Silt dispersion	Use of silt curtain enclosure on the work area during dredging and filling operation
			Periodic Water quality monitoring
		Increased possibility of Spills from vessels due to increased traffic	Proper maintenance of ship engines
			Audits of ship processes to ensure proper storage of oil and ballast
	Freshwater Ecology	Potential release of waste materials or pollutants associated with the dredger into the freshwater environment resulting in reduction of biodiversity	Adherence to waste management controls for vessel operations
			No planned refueling or maintenance of operation equipment to occur on site, nor equipment to be parked at the site for a significant time. Readily available spill kits for land and water to be kept on site with trained personnel. Emergency response procedures will be established. Adherence to waste management controls identified in the EMP for this Project.
	Water quality	Alteration of water quality in habitats and impacts (including from altered	Monitoring of freshwater ecology and other biodiversity in the Project area

Environmental Aspect	Environmental Component Likely to be Affected	Potential Impact	Prevention/Mitigation/Enhancement Measures
		siltation/sedimentation regimes) that may have potential follow effects for trophic groups and other associated species	
	Air	Ship Emission, Particulate Matter, CO and NO_2	Proper Maintenance of ship engines and pumps
		Noise Generation	Operations are far from offshore clearing and RDZ, will generate minimal noise, night time operations will be done as far as possible
		Health and Safety Risk: Physical Hazards	Proper procedures followed onboard ships
			Use of Personal Protective Equipment (PPE)
		Risk of Dredging During Extreme Weather	Implement proper procedure for dredging during weather events; No dredging during typhoon signals
		Risk of Collision between vessels especially fishing vessels	Ensure communication between vessels, Promote public awareness of activities
	People	Impact of Turbidity on Fish Catches	Implement Social Development Plan; provide alternative livelihood for fishermen;
			Limited impact in comparison to TSHD, with DMP to be adopted.
			Smaller-capacity TSHD should be deployed in the project area that are near the coast, while larger-capacity TSHD should be assigned far offshore
			Limit the dredging activities in project areas near the shore especially during periods of calm wind or during low tides
		Generation of Employment	▪ Positive impact; No mitigation measure required. ▪ Priority will be given to the qualified residents of Sablayan
		Spread of communicable diseases from migrant workers	▪ Conduct of medical examination of workers prior to hiring; ▪ Provision of medical services to employees and nearby communities; ▪ Conduct of Environmental Health and Safety; ▪ Briefing to workers and communities prior to construction
		Construction-related hazards	Conduct of Environmental, Health and Safety Training prior to work activities
		Additional Revenue for the LGU	Pay the exact taxes and Permit/Transport/Hauling fees required by law on time
			Participate in LGU's activities
		Employment Opportunities	Priority for qualified residents of Sablayan
		Health/Safety	Security in the dredging site to prevent collisions and other activities

Environmental Aspect	Environmental Component Likely to be Affected	Potential Impact	Prevention/Mitigation/Enhancement Measures
			Advance information on dredging sites to warn fishermen
			Provision of communication equipment to prevent disasters
ABANDONMENT PHASE			
Decommissioning	People	Reduction and eventual termination of employment	Promote alternative livelihood at early stage of project
	Water	Stirred-up sediments will eventually settle into the riverbed at rates dependent on particle size and the prevailing currents. The local irregularity of the dredged slope will favor deposition of the sediments coming from the northeast and southwest. The passage of currents will cause the subsequent adjustment of the slope of the project area over time in accordance with the natural angle of repose of the sediment deposit.	Allow for natural attenuation of the riverbed and offshore
	Land/ Offshore	Rehabilitation of riverbanks and offshore areas by providing biosystems that will harbor biodiversity in both river (riparian) and marine habitats	Allow for natural attenuation of the riverbed and offshore

Risk and Uncertainties Relating to the Findings and Implications for Decision Making

To determine risks and uncertainties that can be foreseen or be examined by relating to the findings, the project as well as baseline conditions and primary data information of land, water, air and people components in the project area are investigated, examined and assessed to aid decision makers and project managers of ARRD Project in formulating prevention/mitigation measures for potential risks that may result due to the activities of the proposed ARRD Project to the environment of concern.

1 PROJECT DESCRIPTION

City Pacific Group, Inc. (CPGI) intends to improve and rehabilitate the current condition of Amnay River's downstream section through the proposed Amnay River Restoration and Desilting (ARRD) Project. The primary objective of proposed ARRD Project is to remove sand and gravel from the lower section (downsteam) to upstream section of Amnay River Channel to restore the carrying capacity of the river. The proposed ARRD Project also aims to improve the local drainage of adjacent communities and prevent bank erosion/collapse, flooding, and siltation. The project is deemed urgent and necessary due to the increasing occurrences of overflows of Amnay River.

Site preparation (pre-construction period) prior to the main pilot channel dredging operation in Amnay River will include clearing of the 109-hectare rectangular block facing the river delta to make way for vessels to enter the River Dredging Zone (RDZ) to do restoration and desilting activities. The said block has impeded by massive amount of sand produced by the combined forced of water current from the river and seabed. As a result, a bathymetric range of 0-2-, 2-5-, and 5-10-meter depth has formed in the offshore area which will cause grounding of vessels intended to enter the RDZ. Offshore dredging will be conducted using Trailing Suction Hopper Dredger (TSHD), which will require to restore and desilt the Amnay River delta for enhancement, clearing for maneuvering and navigational purposes. Methodologically wise, TSHD requires a specific point of position within the given area based on the bathymetric and physical conditions of the site to suction sand underwater. Offshore dredging will also allow the entry of another vessel equipment such as the Cutter Suction Dredger (CSD) to dredge and desilt the RDZ in Amnay River. Therefore, in order to remove the existing sediments in the offshore area from the coastline of Amnay River delta, the 109-ha Offshore Dredging, as part of the pre-construction activities of the proposed ARDD Project, will be conducted.

The Amnay River is one of those river systems as part of the Amnay-Patrick River Basin that has been severely silted and blocked with sand, mud, and gravel materials in its downstream section that have come from the mountain ranges of the Occidental Mindoro provinces particularly the Upland Inner Mindoro Range It needs immediate dredging and desilting, so a specially designed CSD, TSHD, and/or mother vessel for shallow and deep draft will be used to remove river-run materials from the RDZ and offshore to ensure the safety of the nearby residential communities, increase the carrying capacity of the river, resurface the river water, and other necessary ecological protective measures. Physically, it also changes the banks of the waterways and even causes levees and channel plugs to accumulate.

Following the approved DPWH Dredging Plan, the ARRD Project would follow the original course of the river while deepening and broadening the channel beginning at the river's mouth. Desilting and dredging will reduce the likelihood of flooding in the immediate vicinity or in nearby settlements while eventually concentrating on the rehabilitation and restoration of the Amnay River. While some of the dredged materials with commercial value from the offshore will be transported immediately to remote places for reclamation work following MGB requirements and permits, while others without commercial value will be stored in a designated stockyard inside the Processing Plant and handled offshore for further size-based separation of the sand and gravel, and the minority of dredged materials will be disposed to groups or government entities which is needing filling materials for construction, rehabilitation and disaster management related activities. In the process, the dredged materials will enter a memorandum of agreement or disposal arrangement with the awarding groups or government entities or projects.

CPGI is a Philippine corporation duly registered with the Securities and Exchange Commission (SEC) since February 23, 2019 as a trading company that strongly focuses on exporting various products from the Philippines. CPGI initially aimed to provide engineering excellence in the field of dredging, river rehabilitation and desilting projects. CPGI's office is located at 2nd Floor V&A Building, A Soriano Highway, Barangay Ibayo Silangan, Naic, Cavite. **Annex 1-0** and **Annex 1-1** presents the proof of authority over the project site e.g., stockpile area, dredging basin, jetty port area, among others and site office and SEC Certificate of CPGI, respectively.

1.1 PROJECT LOCATION AND AREA

1.1.1 Description of the Project Area

The proposed ARRD Project is located at the downstream section of Amnay River in Barangay Claudio Salgado, Municipality of Sablayan, Occidental Mindoro. The project covers an area of 509.322 ha with DPWH approved Dredging Plan and Dredging Clearance starting from the river delta/mouth towards the bridge. The offshore project area includes a 109-hectares area for navigational work and passage.

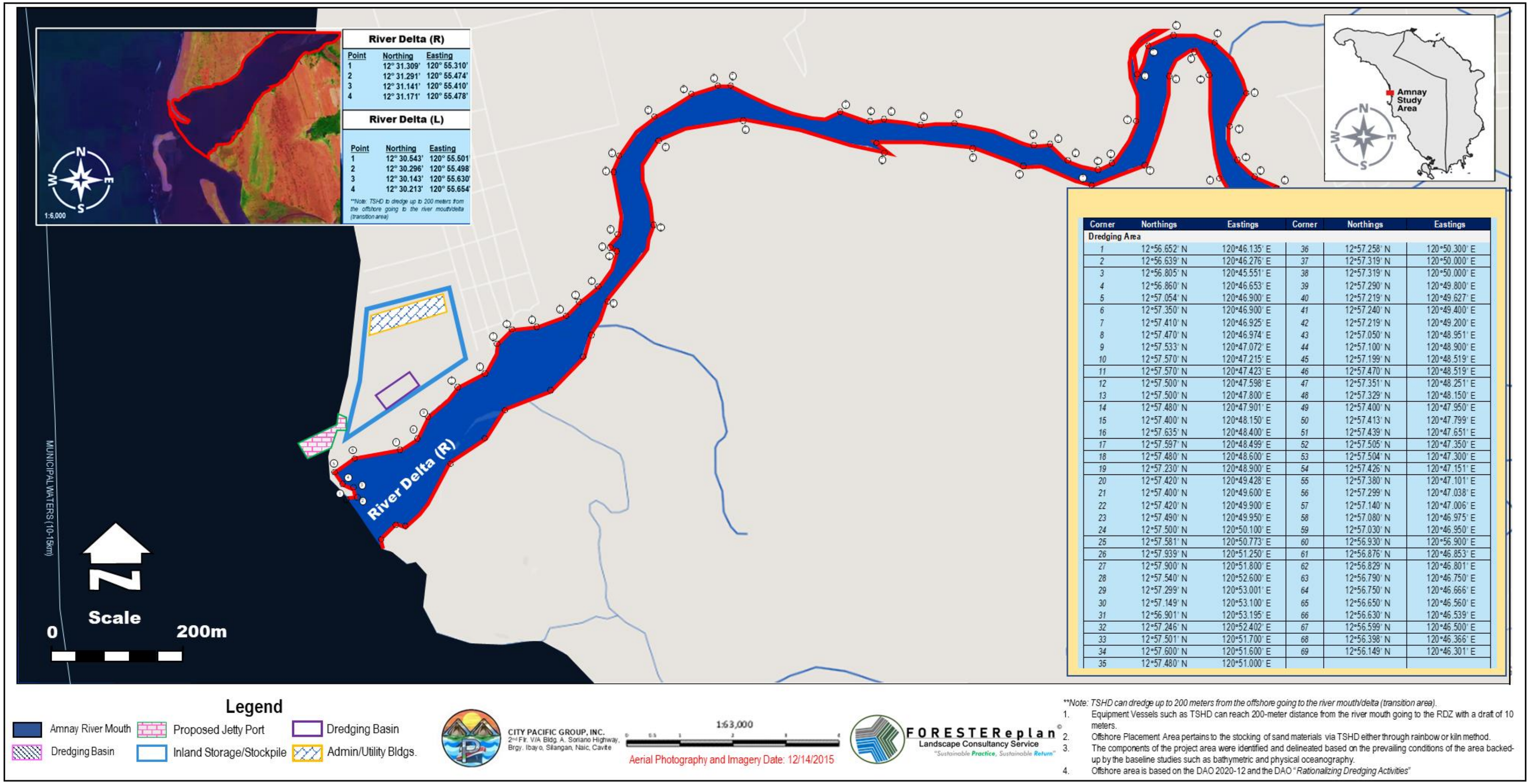
Table 1.1.1 and **Figure 1.1.1** present the coordinates and the location map of the proposed ARRD Project area, respectively. **Figure 1.1.2** presents the Vicinity Map of Amnay River.

Table 1.1.1: Coordinates of the Proposed ARRD Project Area

Corner	Northings	Eastings	Corner	Northings	Eastings
Dredging Area					
1	12°56.652' N	120°46.135' E	*36*	12°57.258' N	120°50.300' E
2	12°56.639' N	120°46.276' E	*37*	12°57.319' N	120°50.000' E
3	12°56.805' N	120°45.551' E	*38*	12°57.319' N	120°50.000' E
4	12°56.860' N	120°46.653' E	*39*	12°57.290' N	120°49.800' E
5	12°57.054' N	120°46.900' E	*40*	12°57.219' N	120°49.627' E
6	12°57.350' N	120°46.900' E	*41*	12°57.240' N	120°49.400' E
7	12°57.410' N	120°46.925' E	*42*	12°57.219' N	120°49.200' E
8	12°57.470' N	120°46.974' E	*43*	12°57.050' N	120°48.951' E
9	12°57.533' N	120°47.072' E	*44*	12°57.100' N	120°48.900' E
10	12°57.570' N	120°47.215' E	*45*	12°57.199' N	120°48.519' E
11	12°57.570' N	120°47.423' E	*46*	12°57.470' N	120°48.519' E
12	12°57.500' N	120°47.598' E	*47*	12°57.351' N	120°48.251' E
13	12°57.500' N	120°47.800' E	*48*	12°57.329' N	120°48.150' E
14	12°57.480' N	120°47.901' E	*49*	12°57.400' N	120°47.950' E
15	12°57.400' N	120°48.150' E	*50*	12°57.413' N	120°47.799' E
16	12°57.635' N	120°48.400' E	*51*	12°57.439' N	120°47.651' E
17	12°57.597' N	120°48.499' E	*52*	12°57.505' N	120°47.350' E
18	12°57.480' N	120°48.600' E	*53*	12°57.504' N	120°47.300' E
19	12°57.230' N	120°48.900' E	*54*	12°57.426' N	120°47.151' E
20	12°57.420' N	120°49.428' E	*55*	12°57.380' N	120°47.101' E
21	12°57.400' N	120°49.600' E	*56*	12°57.299' N	120°47.038' E
22	12°57.420' N	120°49.900' E	*57*	12°57.140' N	120°47.006' E
23	12°57.490' N	120°49.950' E	*58*	12°57.080' N	120°46.975' E
24	12°57.500' N	120°50.100' E	*59*	12°57.030' N	120°46.950' E
25	12°57.581' N	120°50.773' E	*60*	12°56.930' N	120°56.900' E
26	12°57.939' N	120°51.250' E	*61*	12°56.876' N	120°46.853' E
27	12°57.900' N	120°51.800' E	*62*	12°56.829' N	120°46.801' E
28	12°57.540' N	120°52.600' E	*63*	12°56.790' N	120°46.750' E
29	12°57.299' N	120°53.001' E	*64*	12°56.750' N	120°46.666' E
30	12°57.149' N	120°53.100' E	*65*	12°56.650' N	120°46.560' E
31	12°56.901' N	120°53.195' E	*66*	12°56.630' N	120°46.539' E
32	12°57.246' N	120°52.402' E	*67*	12°56.599' N	120°46.500' E
33	12°57.501' N	120°51.700' E	*68*	12°56.398' N	120°46.366' E
34	12°57.600' N	120°51.600' E	*69*	12°56.149' N	120°46.301' E
35	12°57.480' N	120°51.000' E			
Offshore Area					
1	12° 56.641'N	120° 46.239' E	*4*	12° 55.988'N	120° 45.496'E

Corner	Northings	Eastings	Corner	Northings	Eastings
2	12° 56.337' N	120° 46.328' E			
3	12° 56.330'N	120° 45.320'E			

Annex 1-2 presents the copy of DENR-DAO 2022-12 that states that the areas starting from the coastline of river deltas of the river channels of Occidental Mindoro extending all the way upstream shall be designated as exclusive RDZ. **Annex 1-3** also presents the copy of Inter-Agency Committee (IAC) Resolution No.17 S. 2022 pursuant to DENR-DAO 2022-12, granting and authorizing river mouth deposit removal or clearing the river delta (as part of the offshore) to restore the natural state and flow of the river thereby creating navigational channels and providing more depth for passage of dredging vessel/s to implement true flood control measures within the RDZ.



River Delta (R)

Point	Northing	Easting
1	12° 31.309'	120° 55.310'
2	12° 31.291'	120° 55.474'
3	12° 31.141'	120° 55.410'
4	12° 31.171'	120° 55.478'

River Delta (L)

Point	Northing	Easting
1	12° 30.543'	120° 55.501'
2	12° 30.296'	120° 55.498'
3	12° 30.143'	120° 55.630'
4	12° 30.213'	120° 55.654'

***Note: TSHD to dredge up to 200 meters from the offshore going to the river mouth/delta (transition area)*

Corner	Northings	Eastings	Corner	Northings	Eastings
Dredging Area					
1	12°56.652' N	120°46.135' E	36	12°57.258' N	120°50.300' E
2	12°56.639' N	120°46.276' E	37	12°57.319' N	120°50.000' E
3	12°56.805' N	120°45.551' E	38	12°57.319' N	120°50.000' E
4	12°56.860' N	120°46.653' E	39	12°57.290' N	120°49.800' E
5	12°57.054' N	120°46.900' E	40	12°57.219' N	120°49.627' E
6	12°57.350' N	120°46.900' E	41	12°57.240' N	120°49.400' E
7	12°57.410' N	120°46.925' E	42	12°57.219' N	120°49.200' E
8	12°57.470' N	120°46.974' E	43	12°57.050' N	120°48.951' E
9	12°57.533' N	120°47.072' E	44	12°57.100' N	120°48.900' E
10	12°57.570' N	120°47.215' E	45	12°57.199' N	120°48.519' E
11	12°57.570' N	120°47.423' E	46	12°57.470' N	120°48.519' E
12	12°57.500' N	120°47.598' E	47	12°57.351' N	120°48.251' E
13	12°57.500' N	120°47.800' E	48	12°57.329' N	120°48.150' E
14	12°57.480' N	120°47.901' E	49	12°57.400' N	120°47.950' E
15	12°57.400' N	120°48.150' E	50	12°57.413' N	120°47.799' E
16	12°57.635' N	120°48.400' E	51	12°57.439' N	120°47.651' E
17	12°57.597' N	120°48.499' E	52	12°57.505' N	120°47.350' E
18	12°57.480' N	120°48.600' E	53	12°57.504' N	120°47.300' E
19	12°57.230' N	120°48.900' E	54	12°57.426' N	120°47.151' E
20	12°57.420' N	120°49.428' E	55	12°57.380' N	120°47.101' E
21	12°57.400' N	120°49.600' E	56	12°57.299' N	120°47.038' E
22	12°57.420' N	120°49.900' E	57	12°57.140' N	120°47.006' E
23	12°57.490' N	120°49.950' E	58	12°57.080' N	120°46.975' E
24	12°57.500' N	120°50.100' E	59	12°57.030' N	120°46.950' E
25	12°57.581' N	120°50.773' E	60	12°56.930' N	120°56.900' E
26	12°57.939' N	120°51.250' E	61	12°56.876' N	120°46.853' E
27	12°57.900' N	120°51.800' E	62	12°56.829' N	120°46.801' E
28	12°57.540' N	120°52.600' E	63	12°56.790' N	120°46.750' E
29	12°57.299' N	120°53.001' E	64	12°56.750' N	120°46.666' E
30	12°57.149' N	120°53.100' E	65	12°56.650' N	120°46.560' E
31	12°56.901' N	120°53.195' E	66	12°56.630' N	120°46.539' E
32	12°57.246' N	120°52.402' E	67	12°56.599' N	120°46.500' E
33	12°57.501' N	120°51.700' E	68	12°56.398' N	120°46.366' E
34	12°57.600' N	120°51.600' E	69	12°56.149' N	120°46.301' E
35	12°57.480' N	120°51.000' E			

***Note: TSHD can dredge up to 200 meters from the offshore going to the river mouth/delta (transition area).*

1. Equipment Vessels such as TSHD can reach 200-meter distance from the river mouth going to the RDZ with a draft of 10 meters.
2. Offshore Placement Area pertains to the stocking of sand materials via TSHD either through rainbow or kiln method.
3. The components of the project area were identified and delineated based on the prevailing conditions of the area backed-up by the baseline studies such as bathymetric and physical oceanography.
4. Offshore area is based on the DAO 2020-12 and the DAO "*Rationalizing Dredging Activities*"

Figure 1.1.1: Location Map of the Project Site for RDZ

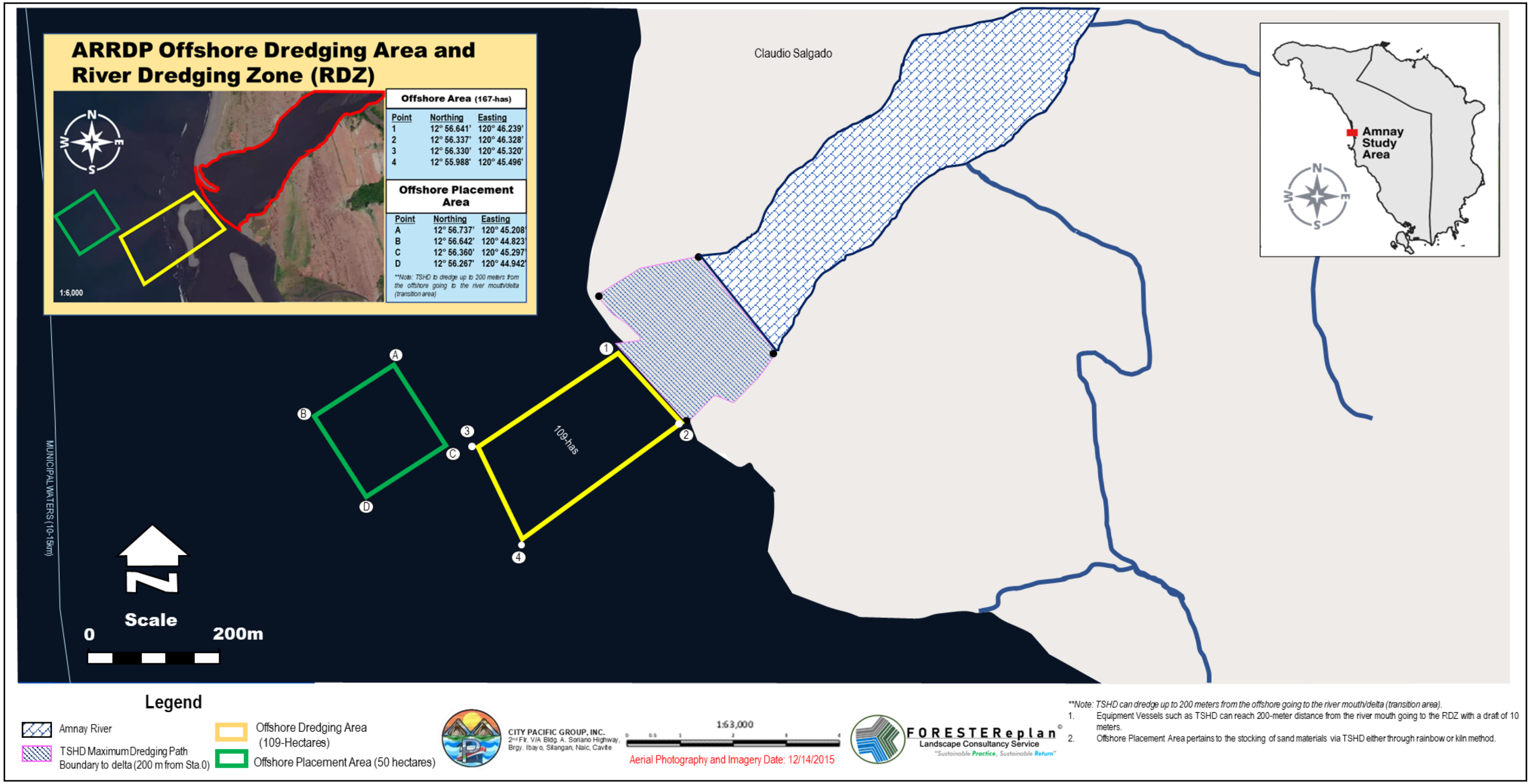
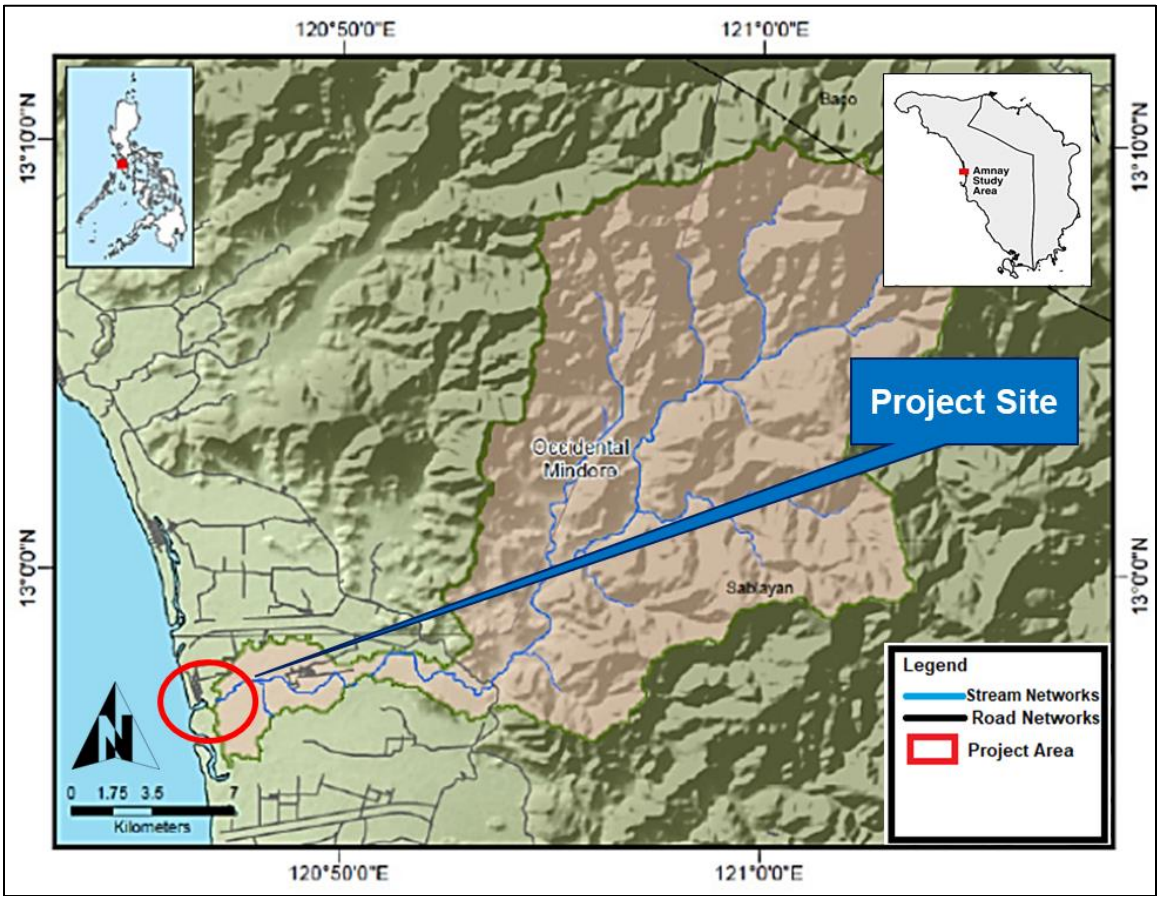


Figure 1.1.2: Amnay River Offshore Navigational Working Area

1.1.2 Accessibility

Sablayan is the central municipality of mainland Occidental Mindoro (**Figure 1.1.3**). It lies geographically between 12°45' and 13°10' latitude, and 120°45' and 121°15' longitude; and is bounded on the north by the Municipality of Santa Cruz in Occidental Mindoro, and the Municipalities of Baco, Naujan, Victoria and Socorro in Oriental Mindoro; on the east by the Municipalities of Pinamalayan, Gloria, Bansud, Bongabong and Mansalay in Oriental Mindoro; on the west by Mindoro Strait; and on the south by the Municipality of Calintaan in Occidental Mindoro. It is about 87.80 km south of Mamburao, the provincial capital, and 87.60 km of San Jose, the business and financial center of the province. Sablayan, where the proposed ARRD Project is to be located, is accessible by sea from Batangas, Manila and Visayan Islands; by land from north and south sections of the province; and by air through private aircrafts. The existing port in Sablayan is located along the coastal area of barangay Poblacion. The port serves as the municipality's direct linkage with Batangas City and Manila. Alternative routes may be through Batangas-Abra de Ilog-Sablayan, Batangas-Calapan City-Sablayan, Manila-Mamburao-Sablayan, and Manila-San Jose-Sablayan. There are five (5) bus, several jeepney, and van operators in the municipality providing transport services to Sablayeños besides other transport facilities from neighboring municipalities passing Sablayan on their way to the northern or southern parts of the mainland province.

During dredging and desilting activities, dredging ships will travel to the dredging site from an origin pier/jetty or near the port of Manila. It will conduct the needed dredging and desilting activities, extracts and carries, sets off loading and ensure compact, loads off the mud, silts, gravel and sand to the designated operational station for reclamation, which location is to be identified by the CPGI.



Map Source: Adopted and Modified from E.C. Paringit and E.R. Abucay (Eds.) (2017), LiDAR Surveys and Flood Mapping of Amnay River. University of the Philippines Diliman and University of the Philippines Los Baños 2017

Figure 1.1.3: Location and accessibility of the Project Site

1.1.3 Impact Areas

The Direct Impact Area (DIA) of the dredging and desilting project is the offshore and river channel area where the opening of delta and dredging of the RDZ activity is to be conducted, respectively. In terms of Socio-economic Sector, the DIA includes the local populations in the host Barangays Claudio Salgado and Ilvita, among other communities that will benefit from employment, business opportunities, taxes, job opportunities, knowledge resources, social benefits, and permit fees to be generated from the offshore dredging operation over the span or duration of the project. CPGI will also produce reliable reclamation, filling, and construction materials that contributes to the economic stability of the province.

The Indirect Impact Areas (IIA), on the other hand, is delineated based on project phasing, the scale of the project and the site layout approach which include the adjacent coastal area outside the offshore and river dredging area that may be affected by the operations such as sailing of ships or vessels, maritime activities involving PCG, some sedimentation and the receptors of noise during dredging activities and the installation area of silt curtains within the perimeter of the navigational working area. For offshore related areas and ecosystems, IIA includes the municipal fishing zones (e.g., fishing and fishing communities). In terms of protected marine organisms such as corals, although the project is 9-11.5km away from these protected marine areas. In terms of IIA impacts towards areas set aside as aesthetic, potential tourist spot, the Pandan Grande Islands and Apo Reef Island, which are protected areas under NIPAS, are far from the Project site with a distance of approximately 9-10 km and 38.6 km, respectively. On the other hand, an offshore monolith (Bato tabao: Iriron rock) north of the project area which is a local tourist area located in Calintaan, is located about 9-11.5km from the offshore project area and fringed by coral reef (3-ha). Additionally, IIA cover the adjacent barangays, the access areas for land-based equipment for mobilization, and the place where most of the dredging workers will stay. Further, the IIA in terms of land-based impacts along the river line/dredging zone within 14km line includes irrigation canals, rice paddies and irrigation users including groups or individuals using submersible pumps that pumps-off water laterally from Amnay River. For socio-economic impacts, the socio-economic benefits will cover the entire country, which will benefit from the competitively priced, stable and reliable sand and aggregates materials supply.

Table 1.1.2 summarizes the delineation of direct and indirect impact areas of the project. **Figure 1.1.4** shows the delineated impact areas.

Table 1.1.2: The DIA and IIA of the Proposed ARRD Project

Direct Impact Areas (DIA)
Land
▪ Access roads in Barangay Claudio Salgado in Sablayan, Occidental Mindoro
Water
▪ 509.322 ha RDZ with 14.5-km stretch zone
▪ Marine section, river delta (Offshore Navigational Working Area (109-hectares)
Socio-Economic
▪ Host Barangay Claudio Salgado, among others, Municipality of Sablayan, Province of Occidental Mindoro
Indirect Areas (IIA)
▪ Receptors of dredging equipment air emissions and noise levels with concentrations less than the criteria set by the DENR ▪ Adjacent coastal area outside the offshore and river dredging area that may be affected by the operations such as sailing of ships or vessels, maritime activities involving PCG, some sedimentation; ▪ Municipal fishing zones (e.g., fishing and fishing communities). ▪ Protected marine organisms such as corals, although the project is 9-11.5km away from these protected marine areas. ▪ Areas set aside as aesthetic, potential tourist spot, the Pandan Grande Islands and Apo Reef Island, which are protected areas under NIPAS, are far from the Project site with a distance of approximately 9-10 km and 38.6 km, respectively. On the other hand, an offshore monolith (Bato tabao: Iriron rock) north of the project area, which is a local tourist area located in Calintaan, is located about 9-11.5km from the offshore project area and fringed by coral reef (3-ha).

- Adjacent barangays, the access areas for land-based equipment for mobilization, and the place where most of the dredging workers will stay. Land-based impacts along the river line/dredging zone within 14km line includes irrigation canals, rice paddies and irrigation users including groups or individuals using submersible pumps that pumps-off water laterally from Amnay River.

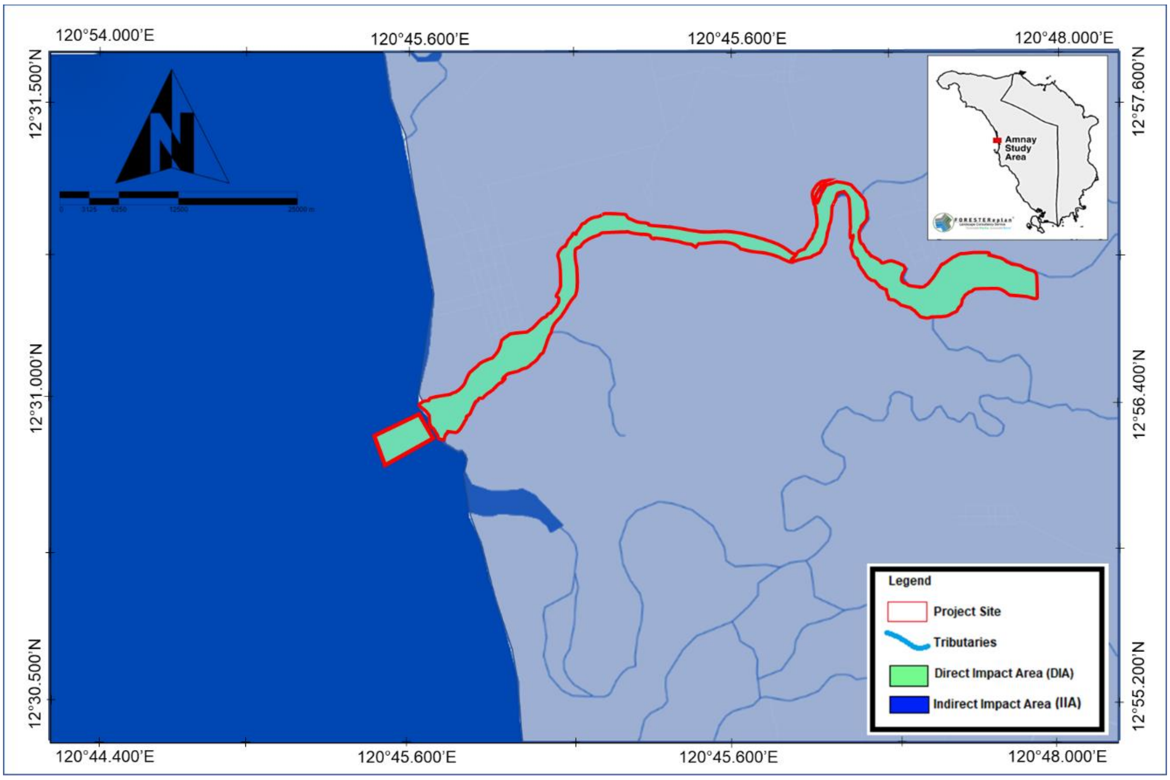


Figure 1.1.4: Direct and Indirect Impact Areas of the Proposed Project

1.2 PROJECT RATIONALE/DEVELOPMENT FRAMEWORK

1.2.1 The Need for the Project

The province of Occidental Mindoro is largely agriculture-based in economic terms and primary livelihood activities, supporting its local economy in general. Agriculture and other related activities, however, is threatened and affected by decreasing farm productivity due to increased siltation, flooding, and soil erosion, that is presently happening in the area during catastrophes. Deposition of sand and silt materials to agricultural farms and increase hazards and risk to disasters causing loss on property, livelihood, and lives are among the problems in the project area. The root causes of which, as mentioned by barangay officials and farmers interviewed, are the siltation and deposition of sand, gravel and other materials coming from the river due to increased riverbed siltation, overspill, and overflow. Moreover, as reported by Mines and Geosciences Bureau (MGB) ang LGUs, barangays dwelling near Amnay River have a high risk to flooding.

The proposed ARRD Project is targeted to increase the flood control conveyance capacity of the Amnay River, resulting in the reduction of the flood inundation area and flood susceptibility of adjoining areas in the Municipality of Sablayan. The primary objective of this project is to remove sand and gravel from the lower channel of Amnay River to restore the carrying capacity of the river.

The ARRD project specifically aims:

- To increase the flow capacity of the main channel of Amnay River downstream;

- Removal of sand gravel limited to the areas designed as the pilot channel and a silting/catchment basing along the Amnay River;
- Protection of bridge column protection measures;
- Provision of bank protection measures;
- Transport of sand and silted products to disposal destinations;
- Environmental protection and mitigation plan;
- Disaster risk reduction and climate change adaptation methodology;
- Improve the local drainage of adjacent communities and prevent bank erosion/collapse. The project is deemed urgent and necessary due to the increasing occurrences of overflows of Amnay River;
- Meet the Philippines' growing demand for building materials by providing a reliable, affordable, and sustainable source of sand and aggregates;
- Contribute to the economic and social development of Mindoro Province; and
- Work collaboratively with Barangay Claudio Salgado and Municipality of Sablayan for the mutual benefit and welfare of all parties involved.

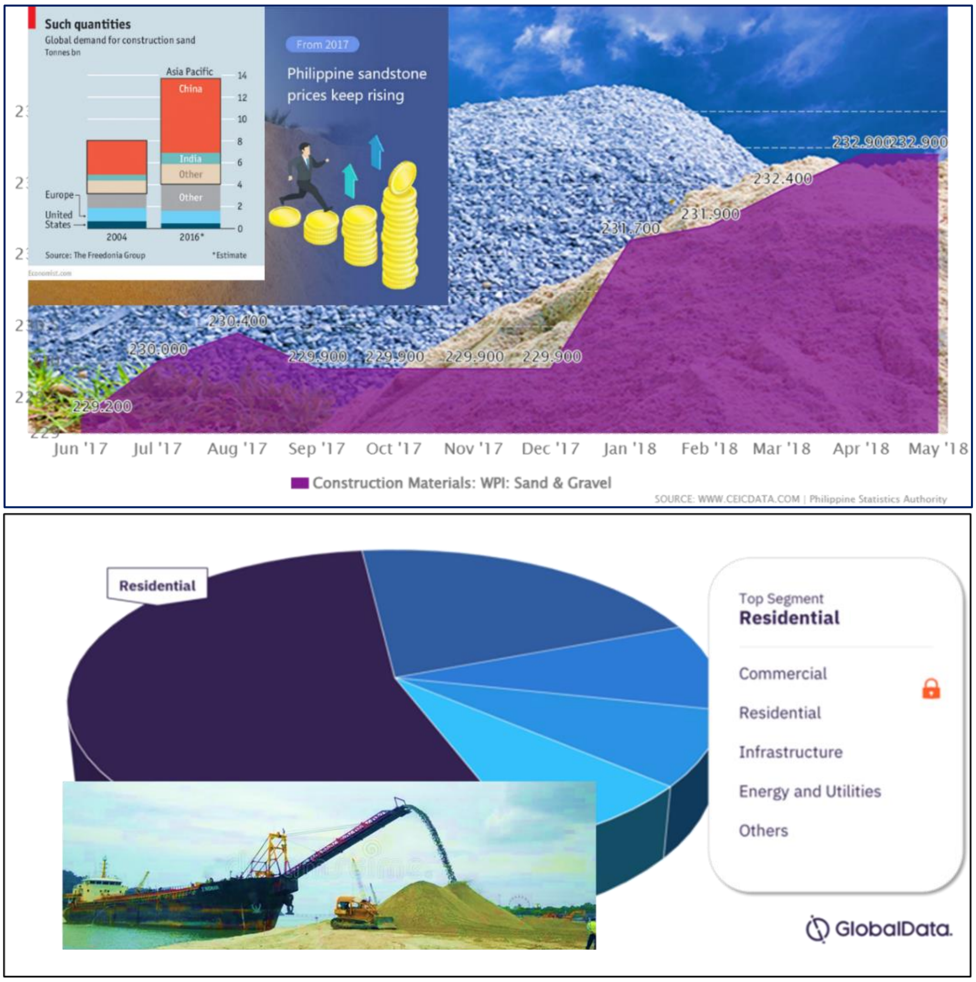
Therefore, site preparation prior to the main pilot channel dredging operation in Amnay River will include river delta and offshore dredging/opening to make way for vessels to enter the river. As to the current conditions, the delta of Amnay River is deposited and impeded by a massive sand and gravel materials that are presently blocking and clogging the river mouth. In this case, the sand deposits that blocked the channel passing through the delta will make some difficulties for small dredging vessels pass through the river mouth from the offshore to do RDZ dredging.

1.2.2 Project Need at the National Level

The context of project significance and focus for the need of this project is two dimensional: (i) contribution to the national and local economy, economic, materials for infrastructure and development; and (ii) increasing the climate resilience of local communities through dredging and desilting against adverse impact of climate change such as flooding, (iii) enhancement of the river channel to restore the corrective flow and capacity of river channel in line with the River Restoration activities through dredging activities under Section 5.4 of JMC No. 1 Series of 2019.

Dredging is beneficial both for the economy and environmental protection. Dredging can be beneficial to the environment as it will remove sediments, improving water quality and aid in the restoration of the health of aquatic ecosystems. Dredging can also provide sands and gravels for construction and reclamation projects. Based from global reports, the country is the economic tiger and center of Asia and been the focus of regional and global trade. On the other hand, the Philippines is relatively late in some infrastructure projects. However, with the continuous promotion of development projects, roads, infrastructures, businesses of private entities, the country has been increasing its capital in infrastructure and development in recent years and beyond. Sand and aggregate materials have been increasing demanded over time. According to HXJQ (2018), filling and other construction materials is contributing to the country's strength for economy and development. The country is regarded to be one of the ASEAN's major economic tigers and has invested in infrastructure in the last 10 years (over a decade). As to the present administration, the country has made infrastructure development a major government commitment since 2016. On April 18, 2017, the Philippine government announced the official launch of a large-scale infrastructure investment program called "Build, Build, Build", with recognition as well to private entities such as businesses that also contribute to the development. In addition, the construction of personal housing in the Philippines is also growing with respect to the betterment of living conditions in the country.

The country's infrastructure remains to be the top and major priority of the government that will provide jobs and opportunities, but also increase income and ultimately reduce poverty in the area of concern. Based on the estimates of HXJQ (2018), the country targets to invest between 8 trillion and 9 trillion Philippine pesos (equivalent to $180 billion) on public infrastructure between 2017 and 2022 (DPWH, 2017) (**Figure 1.2.1**). This means that eventual and ongoing need for construction materials such as sand and aggregates will grow and continue expanding. Sand and gravel resources, in general has been widely used and continue to expand with the country as one of contributors compared to other ASEAN countries.



Source: CDCDATA (2016); HXJQ (2018); PSA (2019)

Figure 1.2.1: The Continuous Demand for Building Materials Grew and Hold Fast Over the Years

1.2.3 Project Need at the Regional and Local Levels

The rationale and significance for the proposed ARRD Project has to be taken in the context of the entire Province's disaster related mitigation, management and vulnerability to climate change impacts such as flooding and siltation as well as the need for reclamation and construction materials for other areas in the country for stronger and climate proof development activities.

Flooding, siltation, landslide and creep and other climate change related disasters is one of the key challenges in the country especially in the province of Occidental Mindoro, where different flood prone areas are situated and currently suffering many cases of sedimentation and erosion near communities. Many livelihoods are affected and suffered severely due to siltation, flooding and overflow of the river with sand, sediments on farms and communities. The Amnay River is one of the heavily silted rivers in Occidental Mindoro, in which dredging and desilting activities are needed. **Figure 1.2.2** shows the current situation and bathymetric conditions of Amnay River and its delta. The project is targeted to increase the flood control conveyance capacity of the Amnay River, resulting in the reduction of the flood inundation area and flood susceptibility of adjoining areas in the Municipality of Sablayan. The primary objective of this project is to remove sand and gravel from the lower channel of Amnay River to restore the carrying capacity of the river. Dredging is an underwater excavation of sediment for various enhancements including: environmental remediation, flood protection, drainage improvements and navigable purposes. In line with DENR-EMB's environmental policy, CPGI is committed to comply with all pertinent environmental laws and regulations and put into practice these compliance requirements.

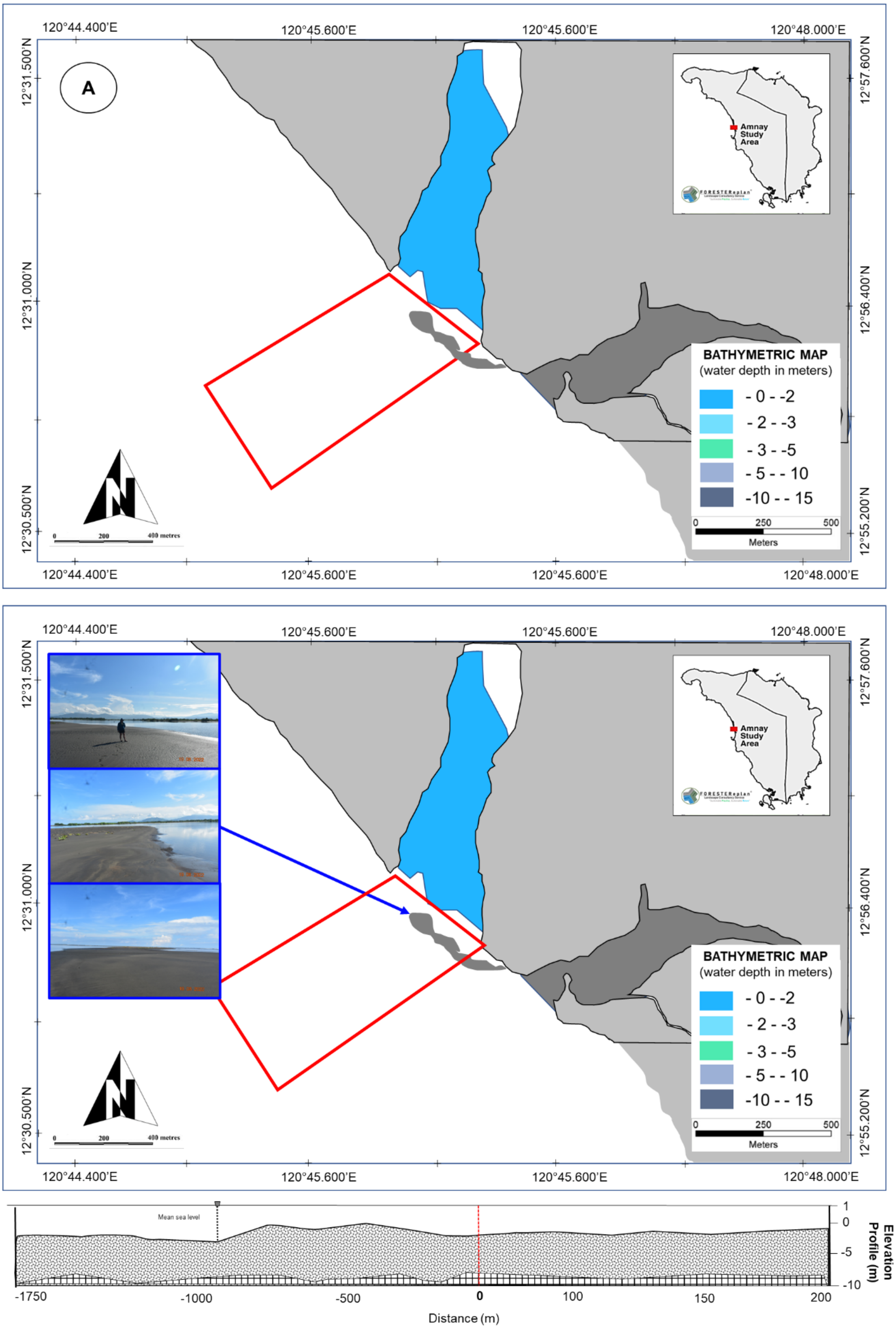


Figure 1.2.2: Current Conditions and Situation of Amnay River and its Delta

1.2.4 Socio-Economic Benefits

The proposed ARRD Project will further promote and contribute to the well-being and welfare of the people of the host Barangay Claudio Salgado, Ilvita and Victoria, among others, the Municipality of Sablayan, as well as the Province of Occidental Mindoro, especially in terms of small business opportunities, employment, and livelihood. The increase in employment opportunities for the local residents will also translate to increased purchasing capacity, household socioeconomic of the local residents, which will eventually translate into a more beneficial improvement in terms of increased sales or business opportunities to locals and their economic welfare.

Percentage (%) revenue from the project shall enable the Provincial as well as the Municipal LGU to expand and continually provide for its existing and future projects as indicated in their Comprehensive Development Plans (CDP) such as (i) school and healthcare facilities and services; (ii) medical, burial, educational assistance; (iii) financial assistance to barangays and to victims of fire and other calamities; (iv) social pension and senior citizens' welfare; (v) cash gifts and financial and emergency relief assistance; (vi) medical missions and emergency relief programs; (viii) livelihood programs and others.

With the proposed ARRD Project, there will be opportunities for economic welfare, employment, local business growth, increased government revenues (through local and national taxes and permitting fees), and livelihood development assistance to the host barangays. Small business opportunities for the local suppliers (e.g., goods and services) around the area will come and be seen as point of entry for livelihood opportunities during the operation phases of the proposed ARRD Project.

The proposed ARRD Project will generate additional jobs as it will require workforce or manpower. CPGI will prioritize hiring qualified local residents of Barangay Claudio Salgado and other barangays in Sablayan that will be needed during project implementation. It is expected that the proposed ARRD Project will need an estimated number of 100 workers during project implementation. CPGI shall closely coordinate with the other employment service offices in hiring local personnel for the proposed ARRD Project.

In addition, the host barangay will benefit from the Corporate Social Responsibility (CSR) Programs of CPGI which include the following (**Table 1.2.1**).

Table 1.2.1: Proposed CSR Programs of CPGI during Restoration and Desilting Activities

CSR Program	Type	Frequency	Budget Allocation (PhP)
Participation in Brigada Eskwela	Project level	8*	PhP 1,500,000.00
Medical Mission and basic services on health	Partnership	6**	PhP 2,000,000.00
Environmental IEC (e.g., Citizen science, public engagement)	Project level	12 (monthly)	PhP 500,000.00
Mangrove tree planting and pilot demonstration area for recovering mangrove forest (MARTI)	Project level	12 (monthly)	PhP 2,000,000.00
Projects that will be funded by CPGI such as Livelihood Programs, Educational facilities and Agroforestry, Tree planting Programs, e.g., adopting the Tree Resources for Endangered and Endemic Species (TREES) site nursery for Endemic and Native tree flora conservation (in coordination with the technical partner)	Project level	12 (monthly)	PhP 2,500,000.00
Community Organizing for Biodiversity and Coastal Clean-up (in coordination with the technical partner)	Project level	4 (Quarterly)	PhP 2,500,000.00
Sponsorship to local biodiversity research in the project site (in coordination with the technical partner)	Partnership	2 (Seasonal)	PhP 2,500,000.00

** Every 2 months, as per school year/months of preparatory, elementary, high school level.*
*** trimestral*

1.3 PROJECT ALTERNATIVES

1.3.1 Site Selection

The primary and ultimate considerations in the selection of the site for the dredging and desilting activities of the proposed ARRD Project are the following:

1. The area’s need for river rehabilitation and improvement against climate change related disasters such as flooding;
2. Availability of dredge materials for reclamation projects;
3. Availability of land and its classification;
4. Low density of habitation.
5. Accessibility by road and sea.
6. Ambient conditions and land elevation.

CPGI has pursued and executed studies to identify alternative sites for the proposed ARRD Project which aligned with the present development plans of the Province and DPWH and other infrastructure development for climate change disasters but was unable to identify the site since Amnay River urgently needs the river ecology correction project such as restoration and desilting project. CPGI and the contractor conducted a thorough selection of the location of the said project. Since site selection is the process of examining multiple options and assessing their relative advantages and disadvantages, it conducted a feasibility study on the area. Thus, it created a Site Selection Team (SST).

The site selection process involves the following coordinated activities:

- Amass an experienced site selection team. It should be a sub-team with representation from the project development team;
- Review site selection criteria, identify a site, and devise a plan for the project.

With multiple and various site options, CPGI can rank and option like project priorities (e.g., cost, location, feasibility, ecology and size). Analyzing alternative site plans allows CPGI to compare costs and design features in a practical rather than abstract way. The site selection team may find a site that is not ideal, but with a creative design plan can meet our requirements. By contrast, it may conclude that no redesign can overcome a site’s inherent deficiencies.

On the other hand, the technical and physical capability of the dredging equipment is restricted by the physical configuration of the identified 109-hectare offshore area with a distance perpendicular to the river delta. In this delineated area, a dredging ship's safe maneuverability depends on the available water depth of the navigation area concerning the vessel's draft (draught required=13.7m). Water-depth limitations will considerably change the pressure distribution around a moving dredging and desilting equipment. They will mostly cause an increase of the hydrodynamic forces due to the vessel's motion through the water. Realizing the actual situation of the offshore area, the actual 109-hectare is presently blocked by a massive and widespread deposit of sand that limits the bathymetry of the area ranging from 0-5m at first 1-km distance. With this situation, vessels and restoration equipment will not be able to operate restoration activities due to the grounding instance that may be experienced on the area. Technically, the equipment capacity is limited by the area, and through oceanographic and marine studies, the impacts for clearing the area was found to be negligible.

Besides the expansion of the dredging ship's resistance, water-depth restrictions generally decrease its maneuverability. The dependency of the maneuverability in the lower portion of the dredging ship’s body draft is very significant: a small reduction in water depth results in a considerable decrease in the maneuverability and turning circle dimensions. As a result, larger bend radii (turning point radius) are required in shallow navigation channels.

Offshore dredging will also allow the entry of another vessel equipment such as the CSD to dredge and desilt the RDZ in Amnay River. Therefore, in order to remove the existing sediments in the offshore area from the coastline of Amnay River delta, 109-ha Offshore Dredging, as part of the pre-construction activities of the proposed ARRD Project, will be conducted.

Table 1.3.1 presents the three (3) major justifications for the proposed area being applied for.

Table 1.3.1: Three (3) Major Justifications for the Proposed Area Being Applied For

Criteria (Applies to)	Justification/Needed Area
Offshore Handling Area (OHA) 50 hectares	1. The designated offshore handling area is allocated or provisioned for double handling. 2. Offshore stockpile area, placement of dredged sand offshore from river channel by CSD and to TSHD and Pelican Barges loading and transport to Manila Bay. 3. Location and area to be dredged and location where dredged sand is to be stockpiled to ensure continuous reclamation sand supply for TSHD at offshore, dewatered / drained before transport for disposal. 4. Oversized dredged materials from river channel will be discharged to the stationary inland Sand and aggregate Processing Plant by conveyor or pipe for crushing, sieving, washing for construction used. 5. Sand materials will be loaded to TSHD, and Pelican barges maintaining good draft, water level, stability and measures up to the designated delivery area (staging area). 6. Pelican barges or hopper barges cannot enter RDZ of which they have required draught. On the other hand, CSD is not self-loading, therefore sand carriage is not possible.
Dredging Area	1. Approximately 109-ha of the total offshore can be dredged and desilted due to depth bathymetric restriction. This area needs to deepen to create space, and release sand clogged from the river mouth to river channel. 2. Factors: Bathymetry of the offshore (within rectangular block (109-ha), bathymetry is ranged from 0-5 then 5-10 m deep, Capacity and Limits of offshore TSHD (draught at max. 13.7 m) while 200m going to the river mouth has a depth of 0-3 m at first 500 m and 5-10 m at 500-1.0km distance. 3. Supporting protective structures, plan for enhancement of the shoreline and river delta clearing in adjacent locations 4. On-land storage locations including infrastructure, fuel storage and refueling locations;
Navigational Area/ Working Area	1. Deployment, installation, and set up area of dredger and transport equipment including machinery, geobags, floating pipes, buoy / markers, etc. 2. Pelican barges dewatering area to dry the dredged sand before transport 3. Refueling, supplies, maintenance or waiting area, storage, handling, disposal and spill response of oils and fuels. 4. Navigational area and working space for 3 units by 3 shifts of pelican barges, TSHD, and stationary CSD at river mouth to inner river channel. 5. Deep water anchoring safe practice. Anchoring into the offshore must be carried out beyond 50 m.

1.3.2 Technology and Design

CPGI considered various dredging and desilting equipment to collect the sediments in the riverbed such as mud, sand, and gravel. Among them are the self-discharge hopper barge, TSHD, and CSD.

The TCSD classified as a hydraulic machinery can work in both protected and unprotected waters and has the advantage of being self-propelled which means they can move themselves and cause minimum disruption to ship traffic and environment. They are unique in a sense that they efficient and effective in terms of use with regards to their self-propulsion technology during excavation of sediment from a borrow area and transport the dredged material to the reclamation site.

Mechanical Dredgers

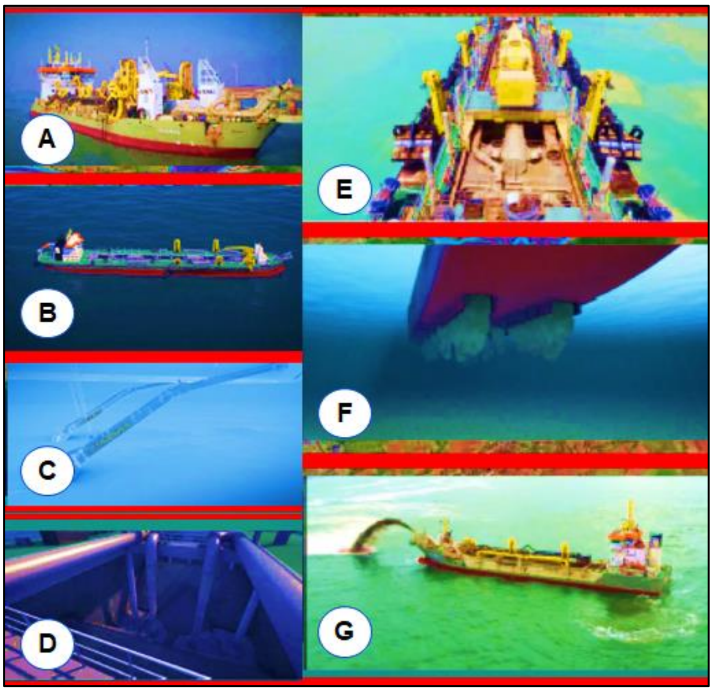
Mechanical dredging means the works are done by way of digging or cutting. Excavation works will be done by using a TSHD and CSD with many different forms. The effectiveness of these operations depends on the power that is channeled to the bucket / blade as well as the shape of the outskirts/ blade bucket stuck on the ground. Due to the large forced needed to cope with the rigors of the land, there are several types of the bucket that are used, such as:

i. Shovel shape at the Dipper Dredger;
ii. Shape backhoe on Dredger;
iii. Form chain on Dredger bucket, and;
iv. Shape grab on Dredger;
v. Shape of a wheel on a wheel excavator;
vi. Form drag on Dragline.

Trailing Suction Hopper Dredger (TSHD)

Compared to the use of other dredging and desilting equipment that may generate larger quantity of suspended and transported sediments, sand, silt and gravel (e.g., rocks) that are actually part as dredge and silt materials. TSHD can only create limited level of sediments and turbidity. This occurs when loading of the hoppers take place with an overflow of excess water and silt, sand containing fine particles. This can however be overcome by reducing the overflow of water in the hoppers or by recycling part of the overflow. An installation, called the enlargement compensator system, to compensate for the vertical movement of the ship in relation with the seabed.

The trailing suction hopper dredger has a very wide application area and is therefore called the workhorse of the dredging industry. TSHD has a carrying capacity of 24,000 tons DWT, current draught is around 13.7 m. Length Overall is 230.71 m, width is 32 m (**Figure 1.3.1**).



Note: (a, b) Physical built and Lowering of Suction arm, (c) dredging mechanism suction lowered at substrate bed, (d) Loading sand into hopper (cargo hold); (e) upper section TSHD secured suction arm; (f) Discharging by using under keel opening, (g) Discharging by rainbow method.

Figure 1.3.1: Trailing Suction Hopper Dredger

The characteristics of the trailing suction hopper dredger is a self-propelled sea or inland waterway vessel, equipped with a hold (hopper) and a dredge installation to load and unload itself. In a standard design the trailing suction hopper dredger is equipped with TCSD and Bucket Chain Dredger (BCD).

Cutter Suction Dredger

In order to protect and efficiently dredge and desilt the river channel, CPGI will employ careful and efficient dredging and desilting method by using TCSD (**Figure 1.3.2**) to collect the sediments in the riverbed such as mud, sand, and gravel. The use of silt curtains and pond at the dredging and desilting site shall also be implemented to reduce further turbidity and spread of light plumes or equivalent. On the other hand, there were other options such as anti-sedimentation infrastructures, engineering, remobilizing sediment systems, sand by-passing plants are reliable dredging alternatives.

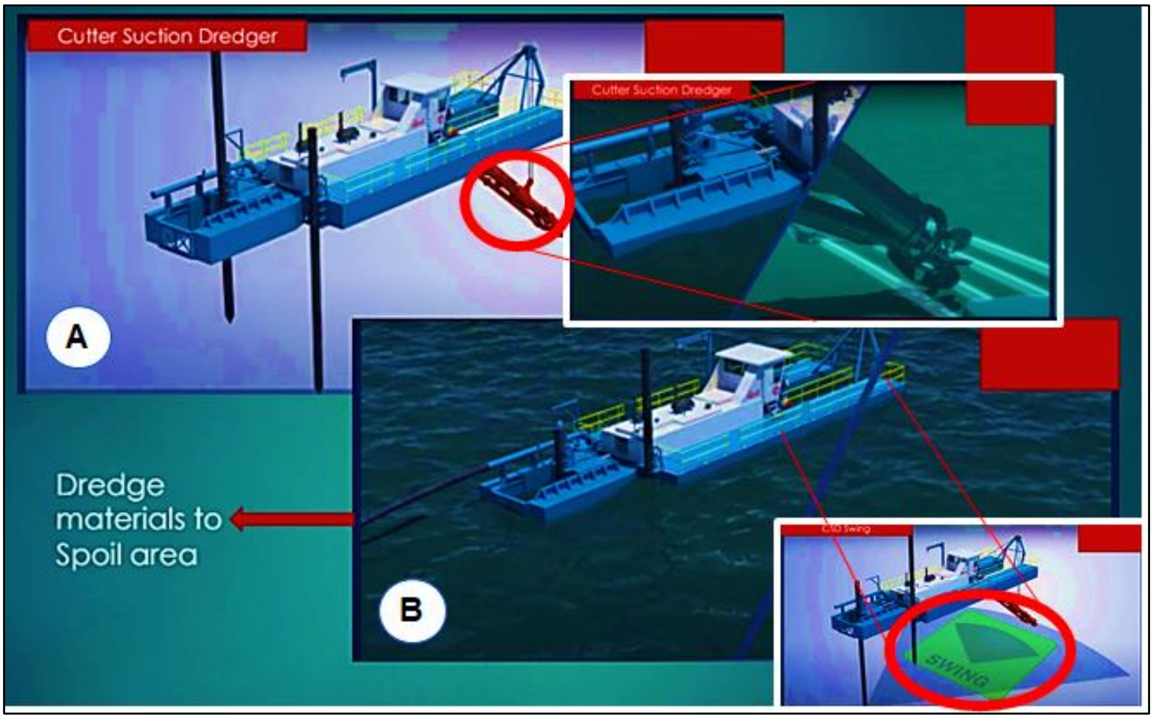


Figure 1.3.2: Typical Cutter Suction Dredger

Self-Discharge hopper barge/Pelican Barge

Final product is discharged through the chutes to the barges positioned in each side of the dredger. Output capacity is from 5,000 to 10,000 MT per hour, working 20 hours per day in two shifts of 6 hours per shift. Daily production is 20,000 to 30,000 MT, Monthly production 520,000 to 780,000 MT based on 26 working days per month. Self-discharge barges (2-4 units) shall also be utilized in the project. Its conveyor length is 34 m, with loading time of 2.5 hours and capacity of 5,000 to 10,000 MT. The discharge rate is 25,000 MT/hour.

Backhoe, Dump Trucks, Loaders and Graders

For the purpose of assisting land-based activities near and offshore, dredging basins and its accessory areas needs the assistance of in-land equipment such as backhoes, dump trucks, grader and loaders. Backhoes (20 units), dump trucks (40 units), grader (5 units) and wheel loaders (4 units) shall be used to extract water-laden sand and immediately stockpiled the sand near the jetty port for organized, clean and neat piling. The development of the said basins shall be in accordance with the direction of the dredging plan. Back hoes and wheel-loader shove the sand and load it to the hauling trucks. The loaded trucks are then unloaded the sand to the floating hopper barge steadily anchored in the jetty port until fully loaded. The barges sail towards the mother vessel to unload the sand using the vessel's clamp shells.

1.3.3 No Project Option

No other alternatives were considered other than dredging and desilting approach as an enhancement and flood control measures for the area of concern. As technically define, dredging is a type of underwater excavation of sediment for various environmental enhancements including environmental enhancement of river, ecology, remediation, flood protection, drainage improvements and navigable purposes. Dredging is a beneficial process that can be applied to the environment as it will remove and declog or clear sediments thereby improving water quality and flow and aid in the restoration of the health of aquatic ecosystems/river ecology. Dredging, on the other hand, can also provide sands and gravels for construction and reclamation projects. The dredging of Amnay River ensures clear passage through its river channel and further reduces flooding risk in the surrounding areas. The dredging and desilting of Amnay River will improve the drainage of rainfall and upland water sources, minimizing flood damages consequently improving the quality of life, capacity and flow in the surrounding communities of the river.

In order to restore the natural state, ecology and flow of the river, the project provided some estimates taking into consideration the essential role played by constant sand replenishment, all restoration activities shall be initially conducted at designated offshore area from the deltas of heavily-silted river channels for an initial period of 1.8 months or more depending on the conditions, with the objective of creating navigational channels and providing more depth for passage of dredging vessel/s to implement flood control measures within the River Dredging Zone (RDZ).

Clearing the passage starting from the river delta/mouth would be the preliminary phase of the proposed project. This extends the deltas allowing access of large trailer suction hopper dredger. Dredging the opening of the river mouth/delta shall allow sediment transport from upstream to move down the channel. The following outputs are stated below:

- Within the RDZ of 14.5 km, there is an estimated sand deposit of 7,321,950.00 m^3 while 11,350,260.00 m^3 at its 109-hectare offshore.
- This sediment volume upstream of the channel is eventually transported downwards toward the river delta area, replenishing the latter portion;
- The computed volume excludes the sand replenishment from upstream during monsoon season and the river delta sand deposit at the river channel and seabed.

The “no action – no use of the area” alternative means that the dredging and desilting project will not push through (considering factors present in the area and the dynamics of the river), and that no activity or any interventions would take place in Amnay River area. The probable and possible impacts of operation and its auxiliaries of the dredging and desilting project includes possible sources of noise, leaks from oils of ships and vessels, dust, mud, sediment plumes and the shipping emissions will not be likely to happen nor produce nor experienced at all. For some factors, this scenario would actually create drawbacks and in some aspects may fit well for the readily observable surrounding or environment as to the Amnay River and its ecology. However, such a no action would mean that there would be alternatives for those interested entities for dredge materials as sources or those approved reclamations in identified areas or those needing dredge fill materials will look for sources of much of its filling and construction materials from other companies, suppliers, contractors, location or sources, which may make it more expensive to build. Offhand, back-filling materials, sands or other construction materials may be sourced from debris flows of some known volcanoes but needs to transport using large cargo trucks leading to the site of the proposed activity areas where it is needed, causing more traffic, disturbance, congestions, emissions and other land-based risks.

1.4 SIZE, GENERAL WATER USE AND PROJECT COMPONENTS

1.4.1 Project Size

1.4.1.1 Project Area

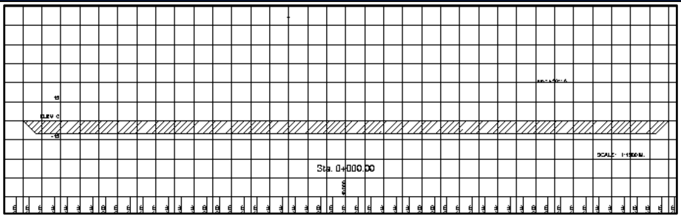
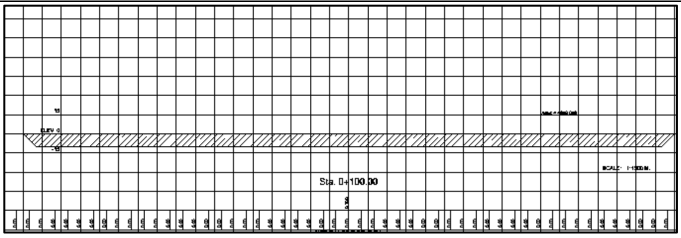
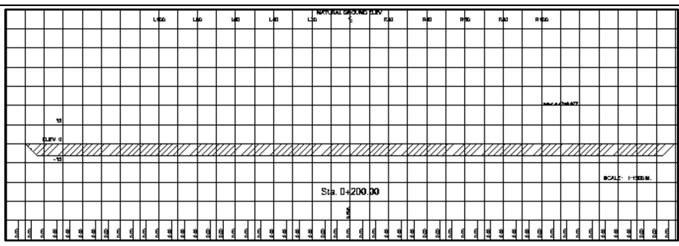
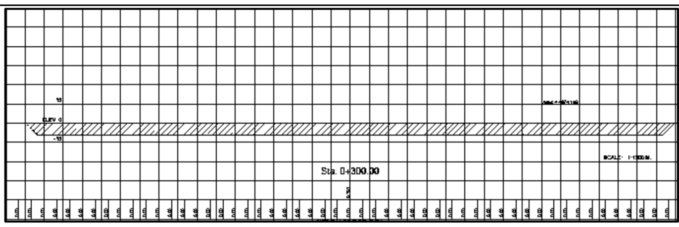
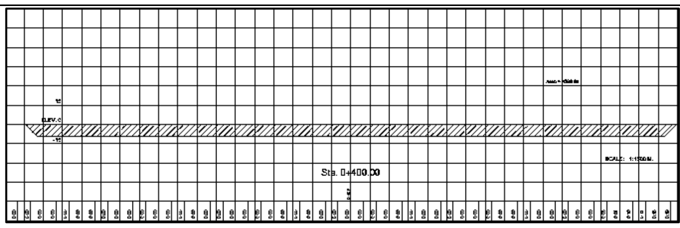
The total project area covers an area of 509.322 ha with DPWH approved Dredging Plan and Dredging Clearance starting from the river delta (14.5 km) and delta opening from river mouth (DAO 2020-12; IAC Res. No. 17, s. 2019). The purpose is to define the offshore area which the Project shall be dredging for purposes of deepening to release the sand deposit clogged at river mouth, for navigational channeling, and working area of dredging and vessel equipment.

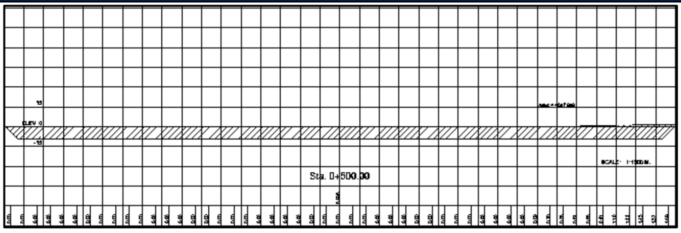
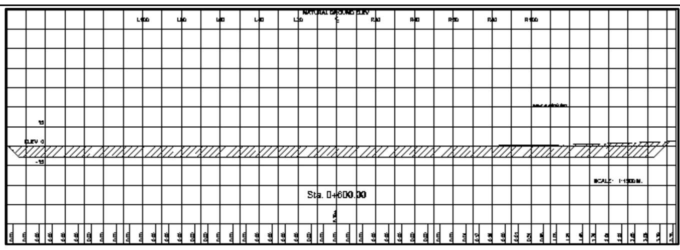
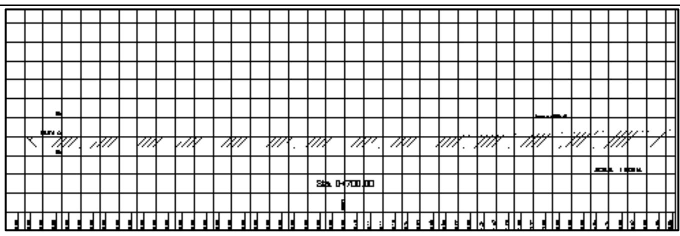
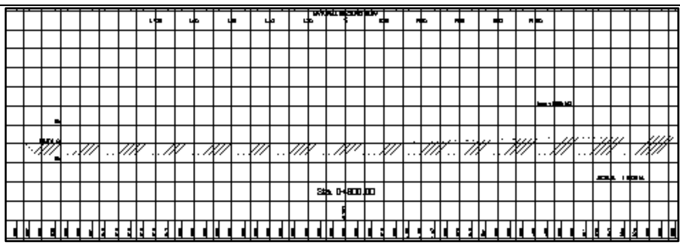
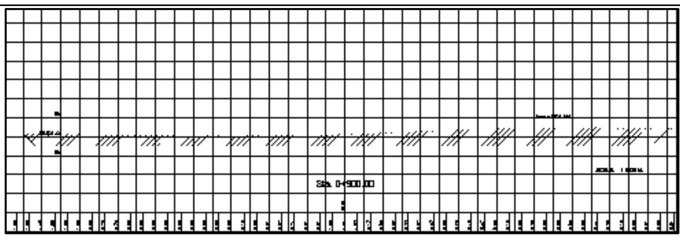
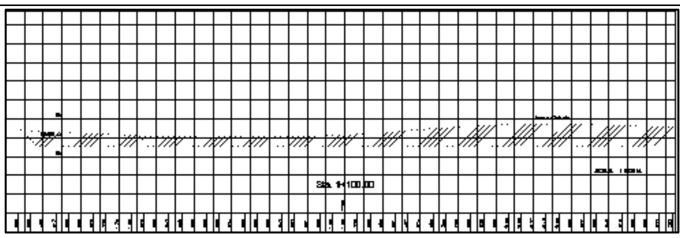
1.4.1.2 Project Capacity

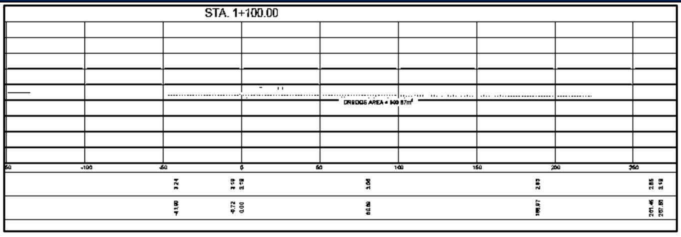
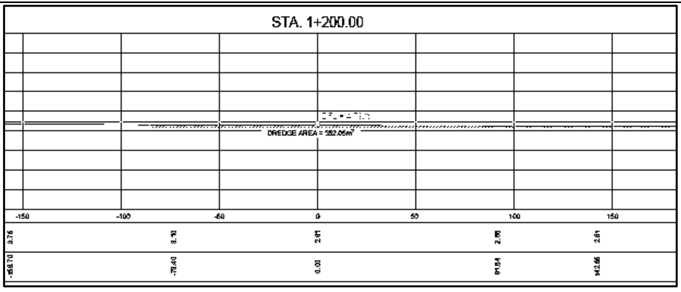
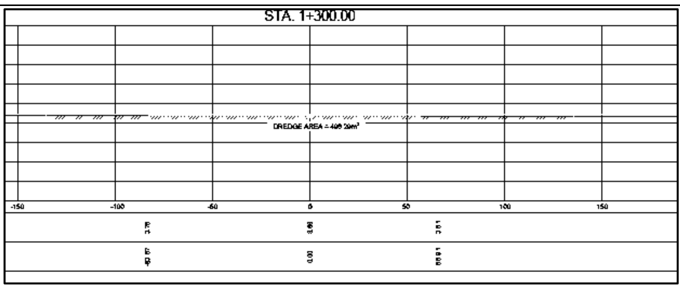
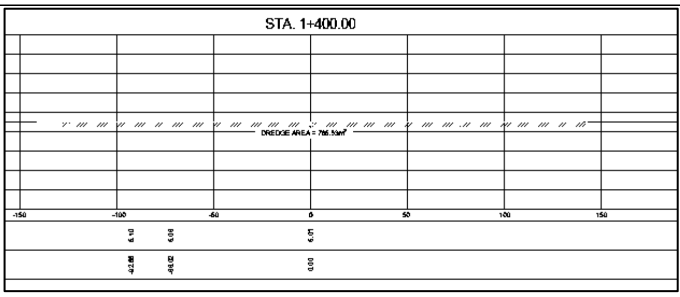
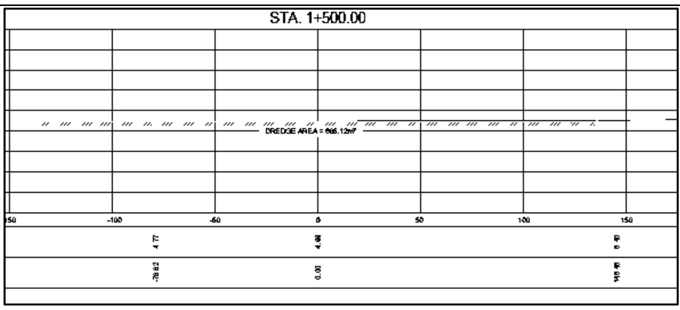
1.4.1.3 Riverbed Dredging Capacity

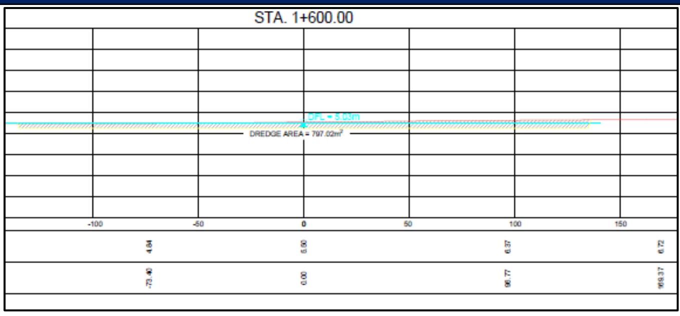
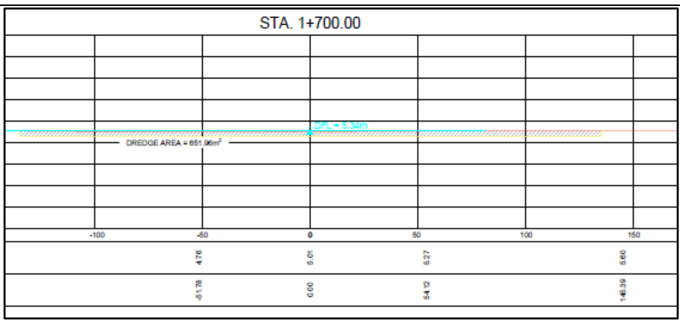
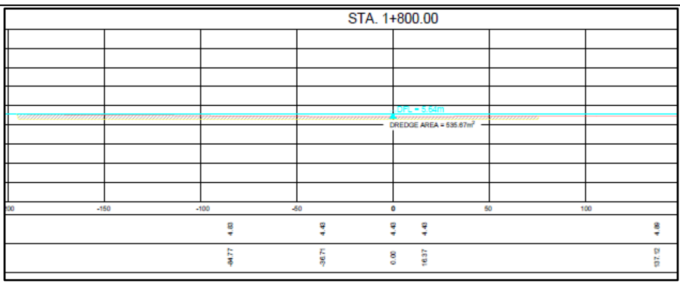
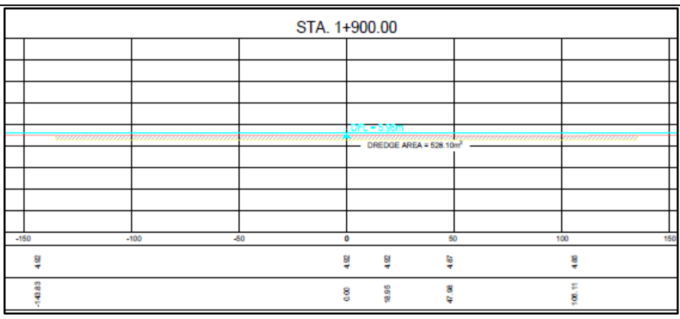
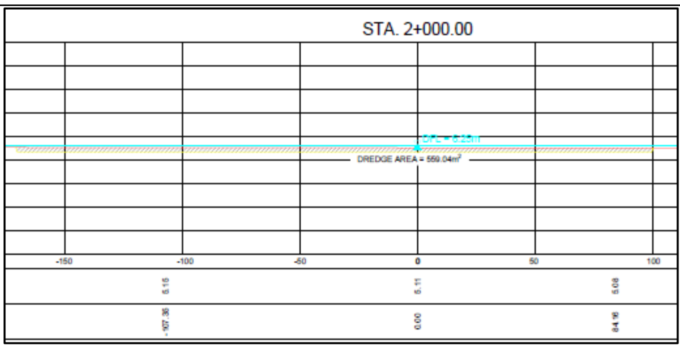
The proposed ARRD Project will have and extraction capacity of 610,162.50 m^3 per month subject to actual replenishment and riverbed flow dynamics of the Amnay River (downstream section). **Tables 1.4.1** and **1.4.2** shows the computational summary for the extraction/dredging volumes of sand indicating the station, width, depth, and volume of extraction per station based on the DPWH approved dredging plan. The calculation uses the exact area per 100-m length and station interval sectioning.

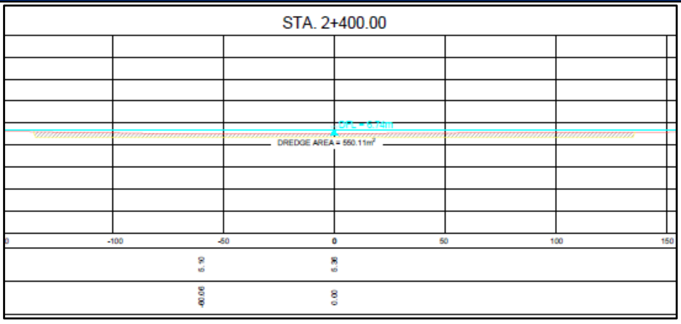
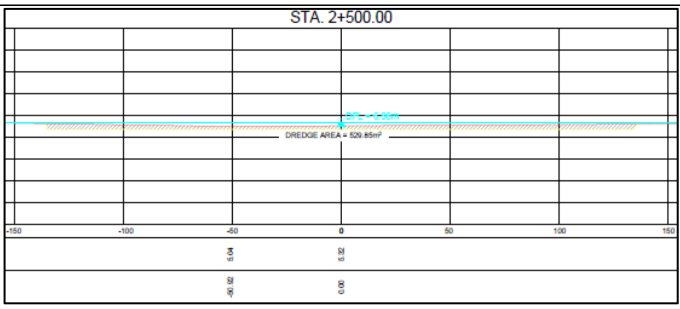
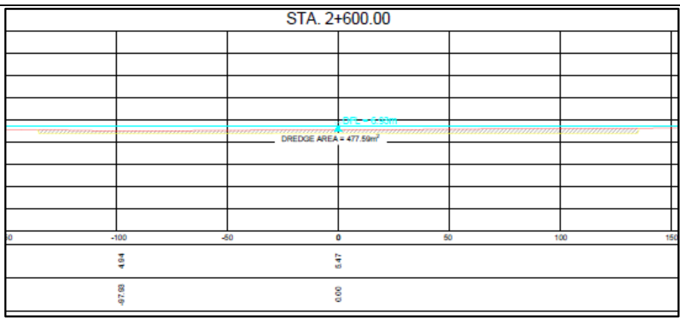
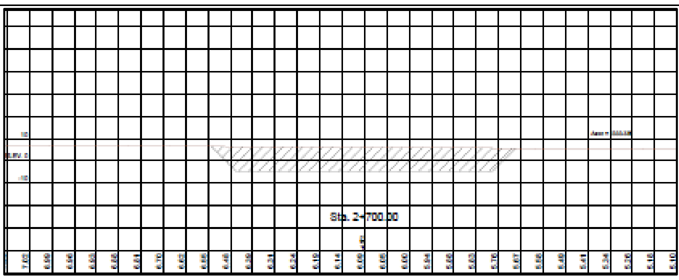
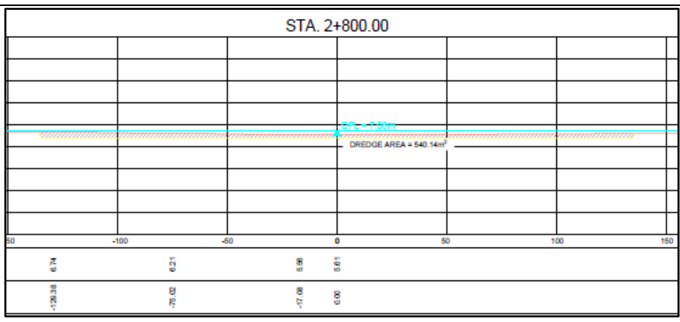
Table 1.4.1: Sectional Volumes of Sand as per Approved Dredging Plan

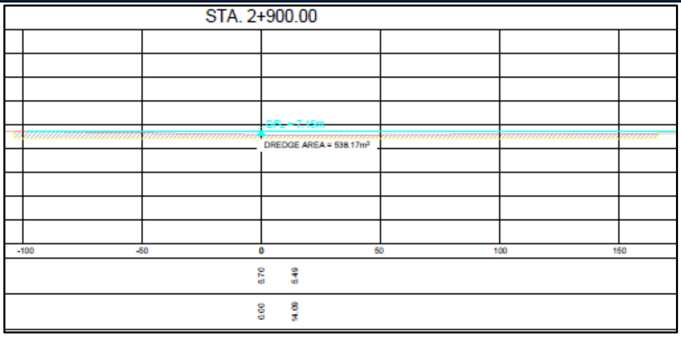
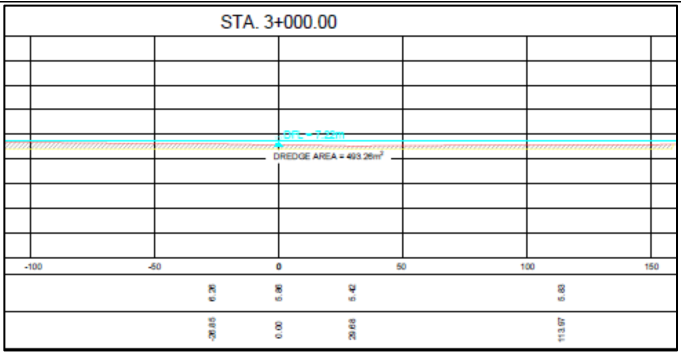
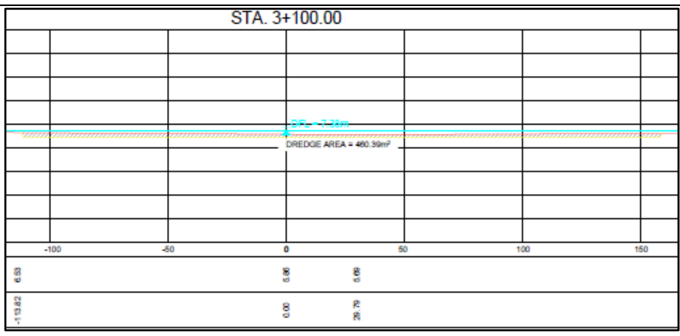
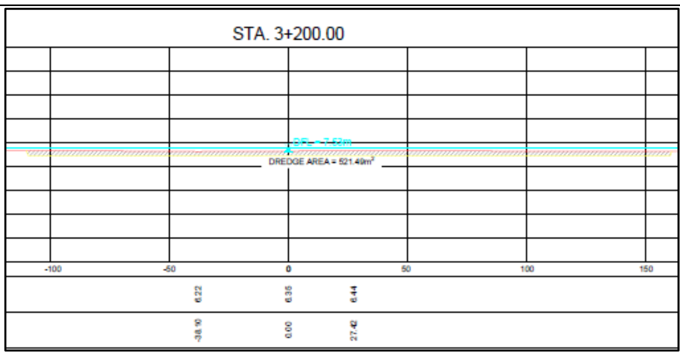
Section	Distance (m) from Center Line	Illustrative Section	Area (m^2)	Volume (m^3)
STA 0+000 to STA 0+000	0.44		921.75	75,474.50
STA 0+000 to STA 0+100	0.66		587.74	54,148.00
STA 0+100 to STA 0+200	0.76		495.22	48,030.50
STA 0+200 to STA 0+300	0.93		465.39	34,200.00
STA 0+300 to STA 0+400	1.09		353.51	42,526.00

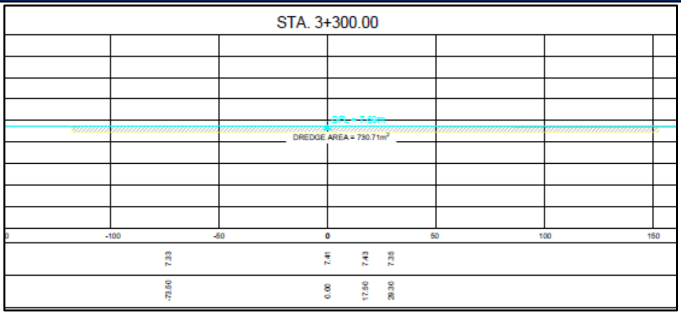
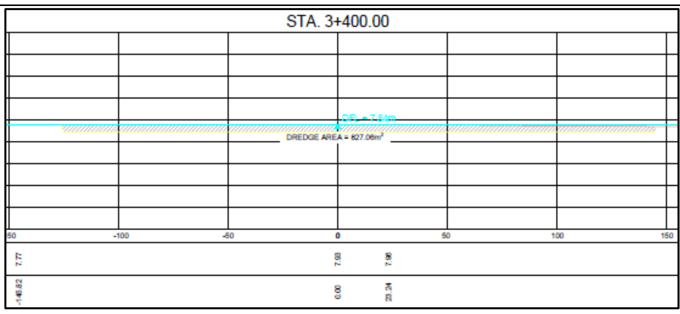
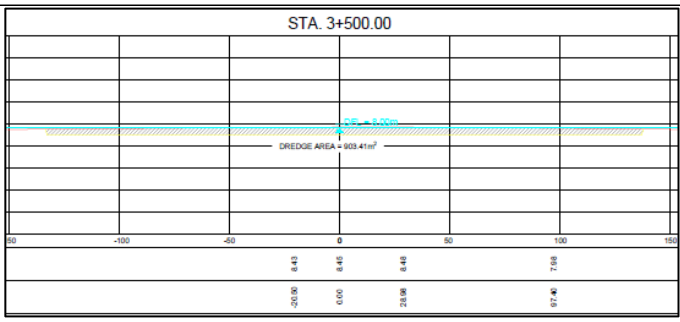
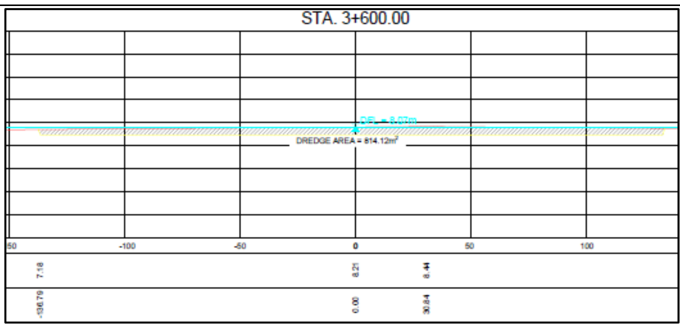
Section	Distance (m) from Center Line	Illustrative Section	Area (m^2)	Volume (m^3)
STA 0+400 to STA 0+500	1.25		330.49	67,781.00
STA 0+500 to STA 0+600	1.97		520.03	89,325.00
STA 0+600 to STA 0+700	2.68		735.50	94,496.00
STA 0+700 to STA 0+800	3.40		950.91	76,634.00
STA 0+800 to STA 0+900			939.01	54,877.00
STA 0+900 to STA 1+000			593.67	427,796.00

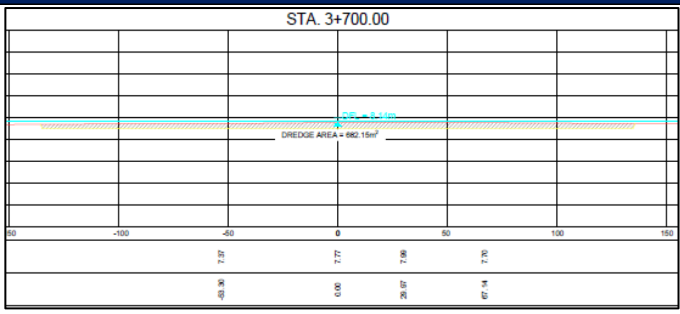
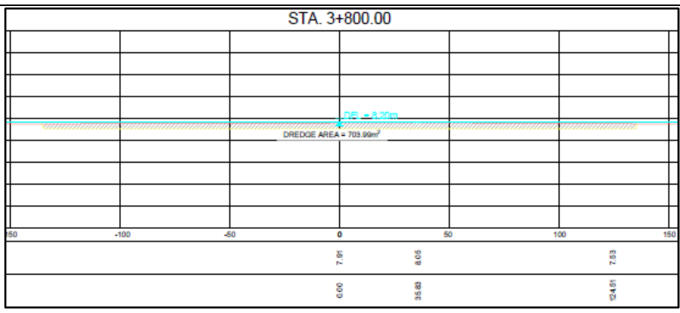
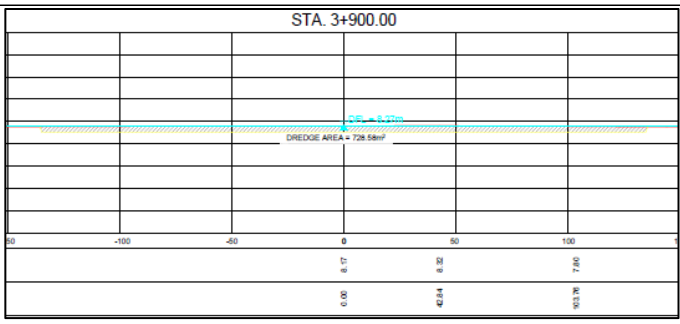
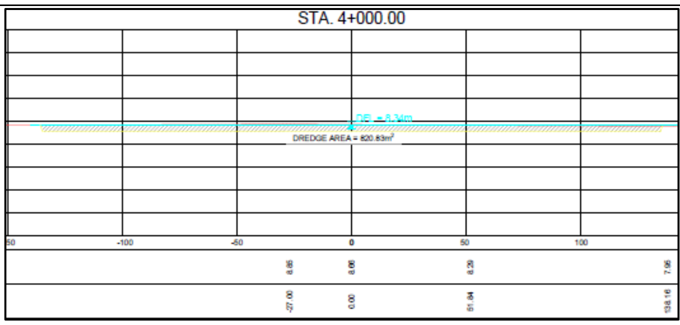
Section	Distance (m) from Center Line	Illustrative Section	Area (m^2)	Volume (m^3)
STA 1+000 to STA 1+100			503.87	42,417.00
STA 1+100 to STA 1+200			352.05	62,941.00
STA 1+200 to STA 1+300			496.29	72,382.50
STA 1+300 to STA 1+400			765.53	74,107.00
STA 1+400 to STA 1+500	4.73		685.12	72,449.00

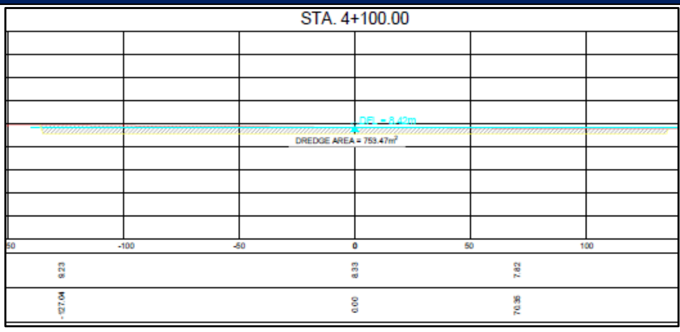
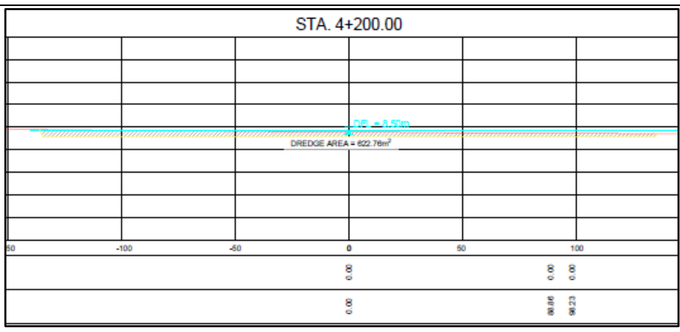
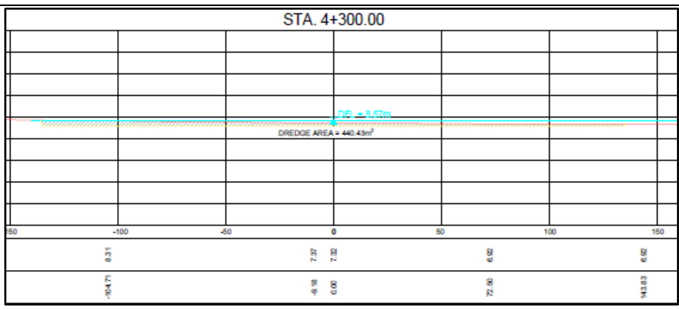
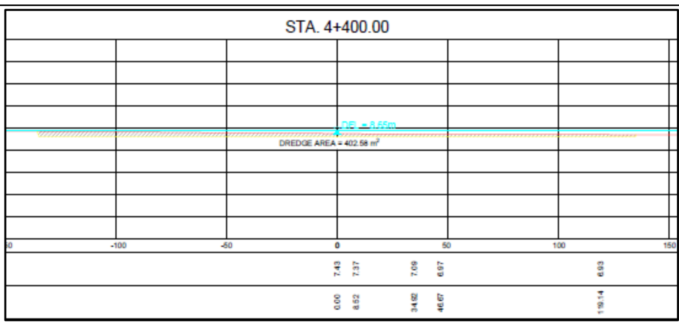
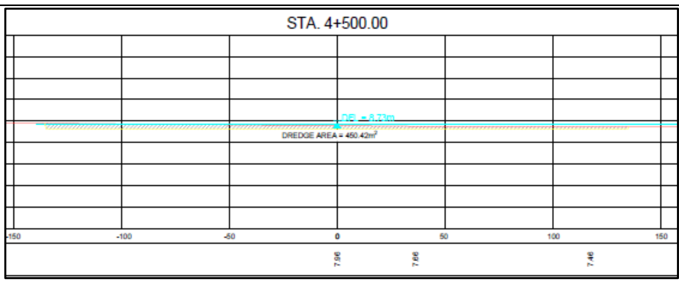
Section	Distance (m) from Center Line	Illustrative Section	Area (m^2)	Volume (m^3)
STA 1+500 to STA 1+600	5.03		797.02	59,981.50
STA 1+600 to STA 1+700	5.34		651.96	53,188.50
STA 1+700 to STA 1+800	5.64		535.67	54,357.00
STA 1+800 to STA 1+900	5.95		528.10	58,307.00
STA 1+900 to STA 2+000	6.25		559.04	62,087.00

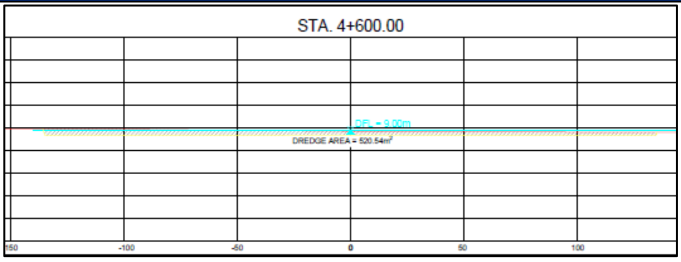
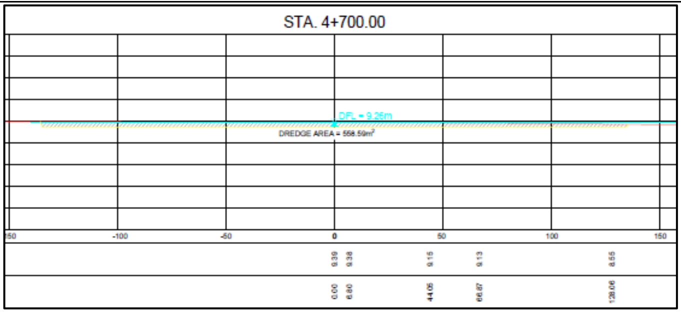
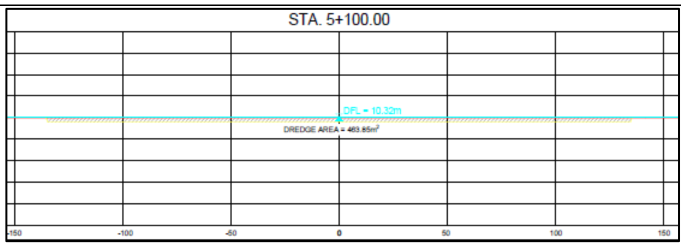
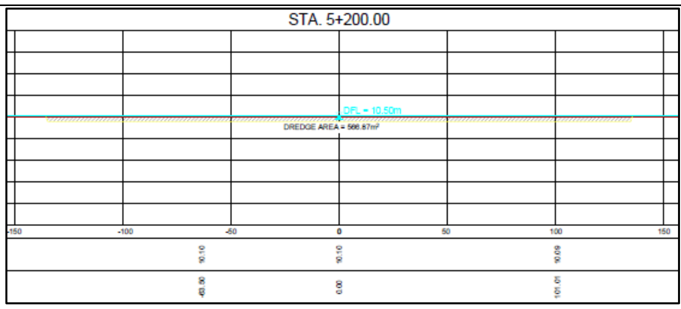
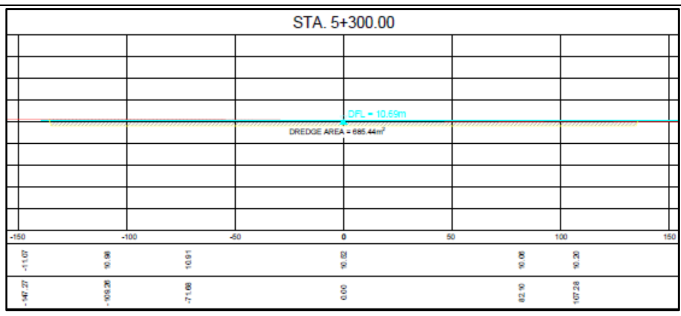
Section	Distance (m) from Center Line	Illustrative Section	Area (m^2)	Volume (m^3)
STA. 2+400.00				62,931.00
STA. 2+500.00	6.86		529.85	58,704.50
STA. 2+600.00	6.93		477.59	53,998.00
STA. 2+700.00	7.00		507.88	50,372.00
STA. 2+800.00	7.08		540.14	49,273.50

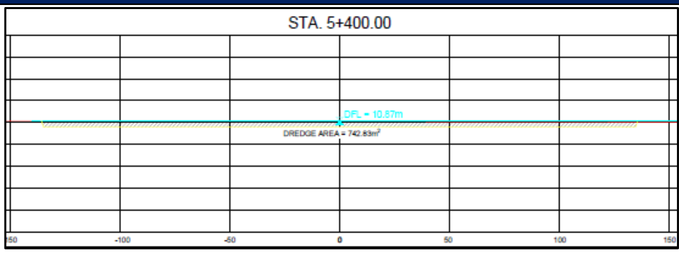
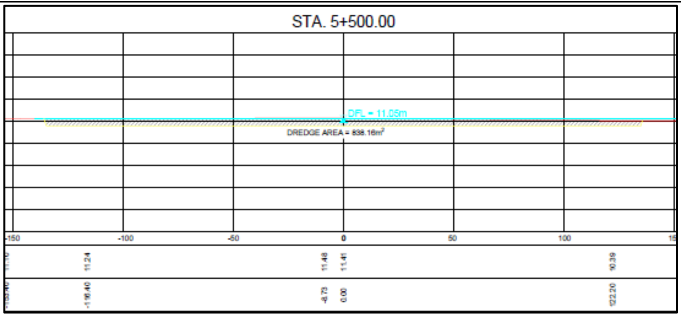
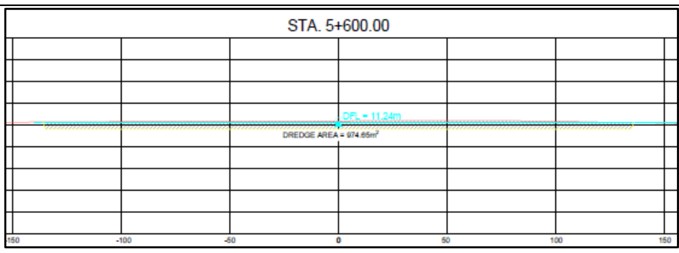
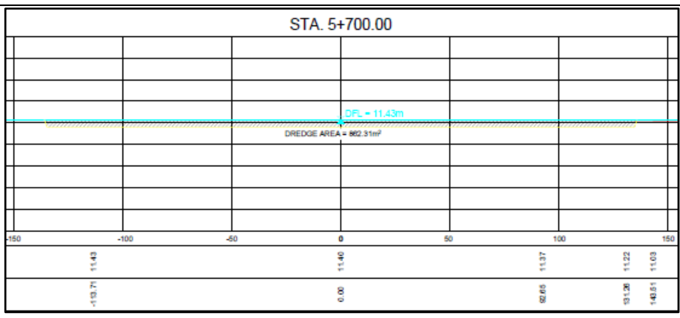
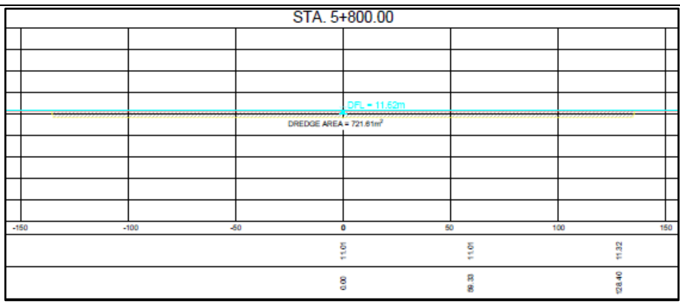
Section	Distance (m) from Center Line	Illustrative Section	Area (m^2)	Volume (m^3)
STA. 2+900.00	5.17		538.17	52,401.00
STA. 3+000.00	7.22		403.26	53,915.50
STA. 3+100.00	7.38		460.39	51,571.50
STA. 3+200.00	7.53		521.49	47,682.50

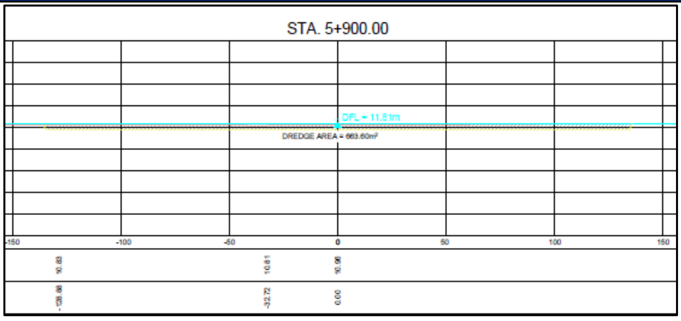
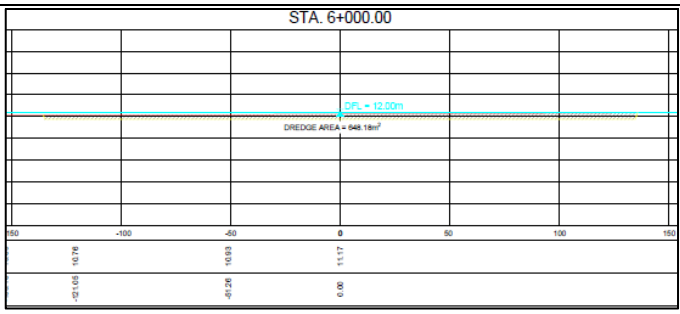
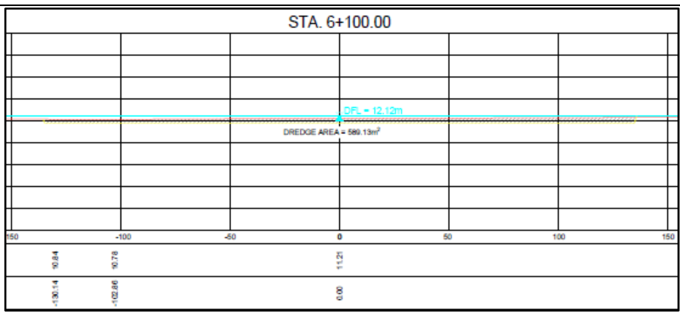
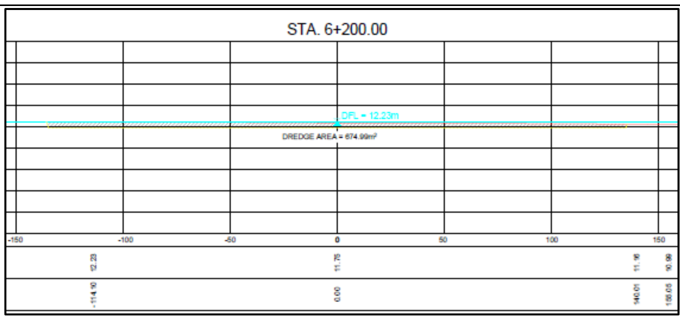
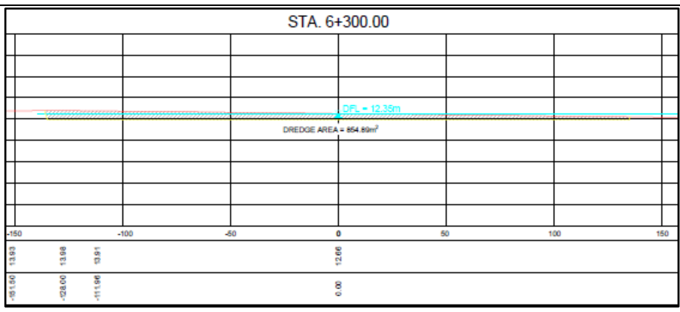
Section	Distance (m) from Center Line	Illustrative Section	Area (m^2)	Volume (m^3)
STA. 3+300.00	7.69		730.71	49,094.00
STA. 3+400.00	7.84		827.06	62,610.00
STA. 3+500.00	8.00		903.41	77,888.50
STA. 3+600.00	8.07		8.07	86,523.50

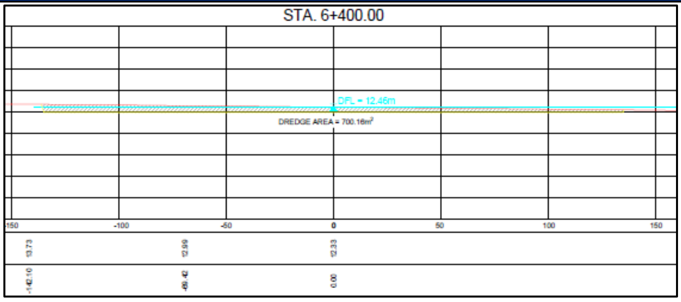
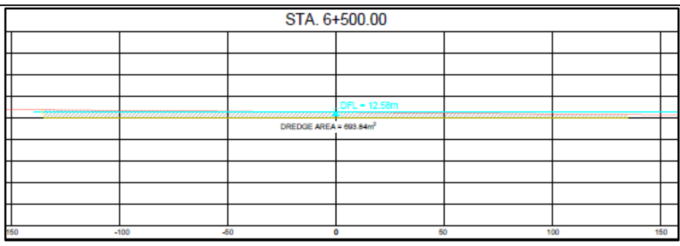
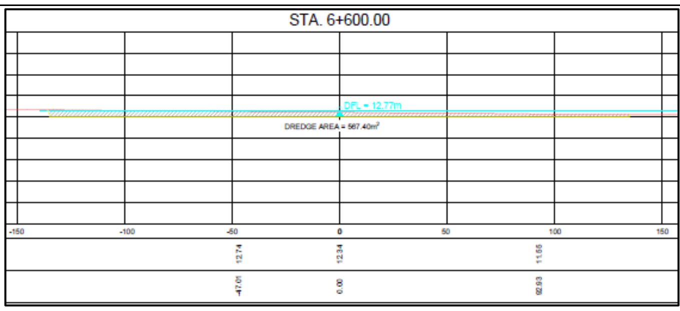
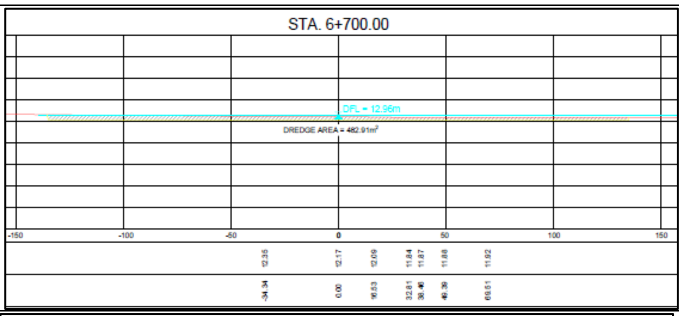
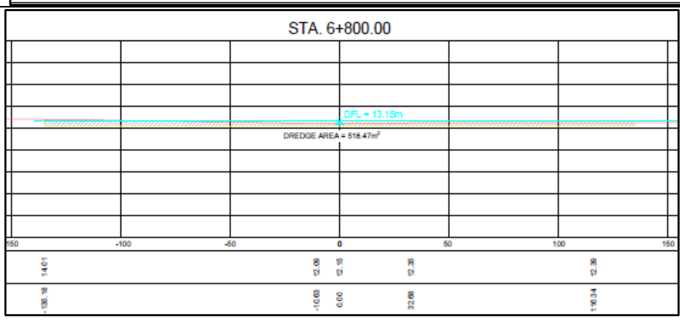
Section	Distance (m) from Center Line	Illustrative Section	Area (m^2)	Volume (m^3)
STA. 3+700.00	8.14		682.15	74,813.50
STA. 3+800.00	8.20		703.99	69,307.00
STA. 3+900.00	8.27		728.58	71,628.50
STA. 4+000.00	8.34		820.83	77,470.50

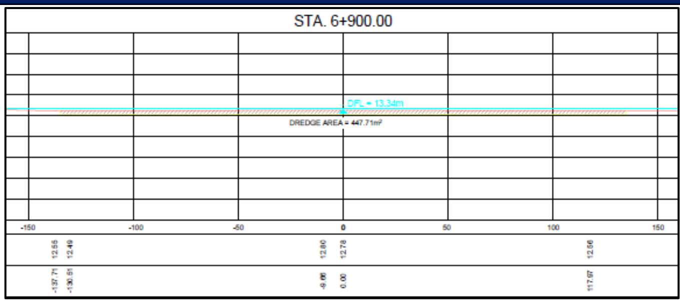
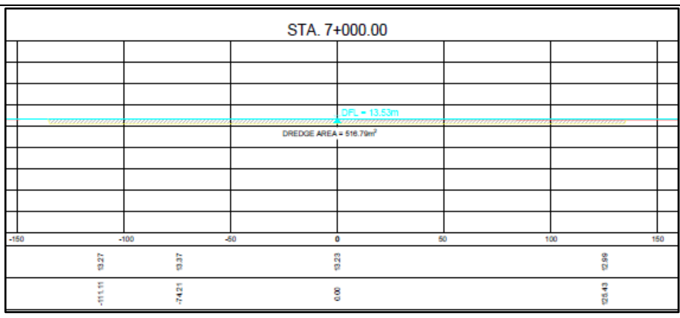
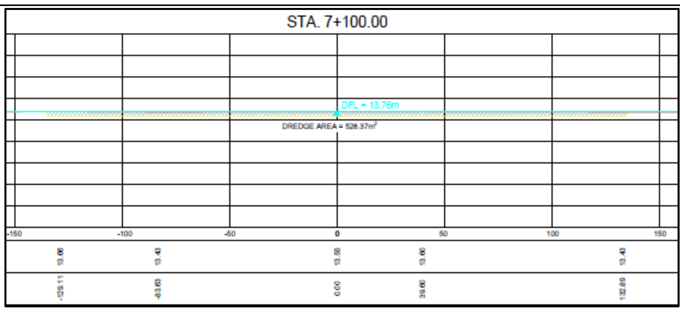
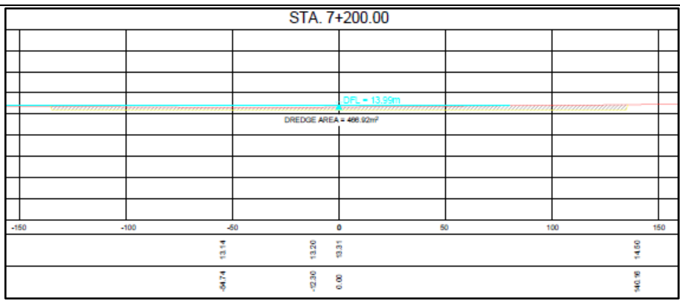
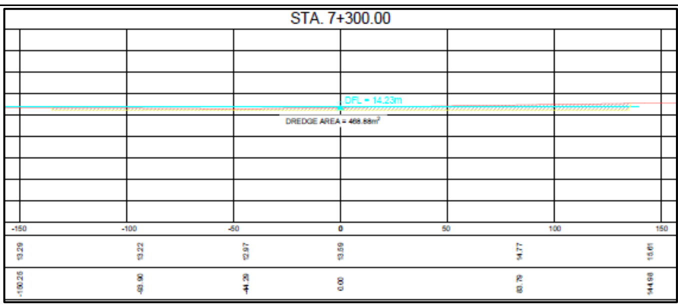
Section	Distance (m) from Center Line	Illustrative Section	Area (m^2)	Volume (m^3)
STA. 4+100.00	8.42		753.47	78,715.00
STA. 4+200.00	8.50		622.76	68,811.50
STA. 4+300.00	8.57		440.43	53,159.50
STA. 4+400.00	8.65		402.58	42,150.50
STA. 4+500.00	8.73		450.42	42,650.00

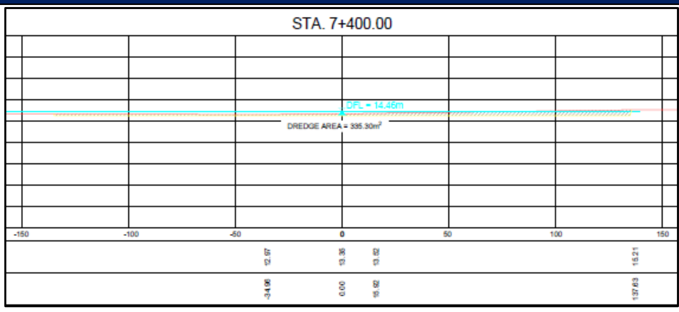
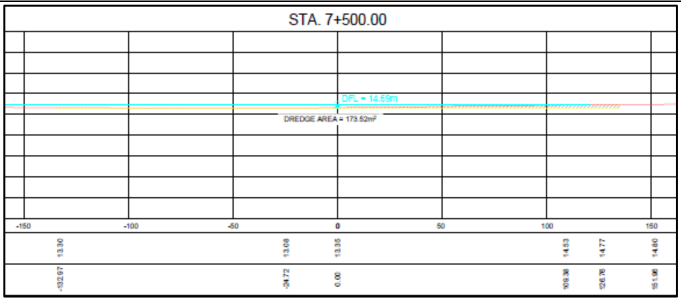
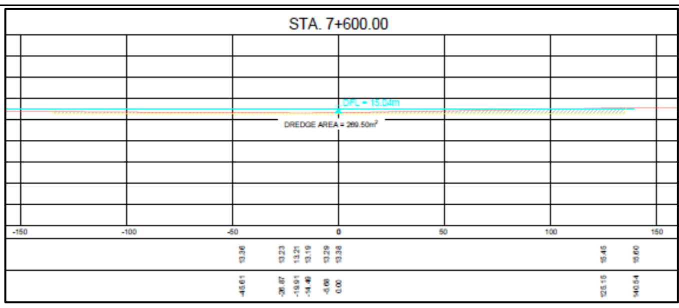
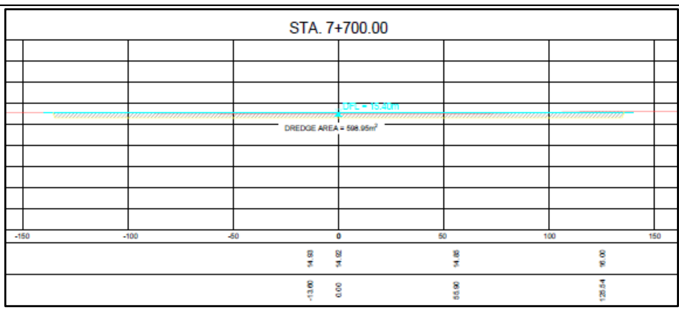
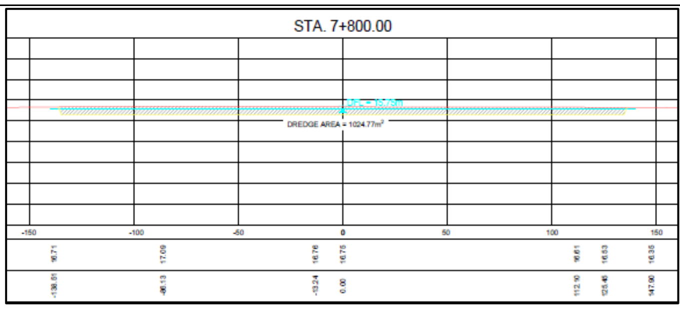
Section	Distance (m) from Center Line	Illustrative Section	Area (m²)	Volume (m³)
STA. 4+600.00	9.00		520.54	48,548.00
STA. 4+700.00	9.26		558.59	53,965.50
STA. 5+100.00	10.32		463.85	56,471.50
STA. 5+200.00	10.50		566.87	51,343.00
STA. 5+300.00	10.69		685.44	45,170.00

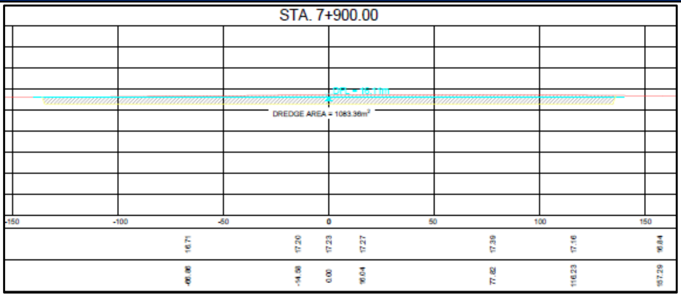
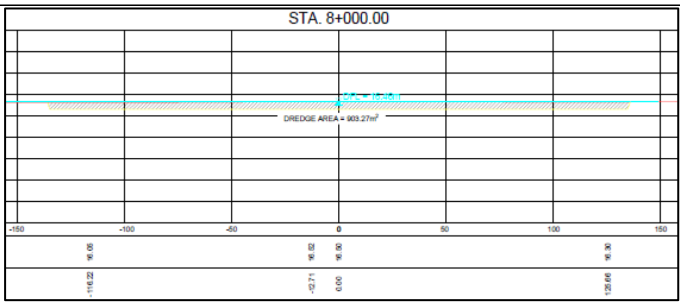
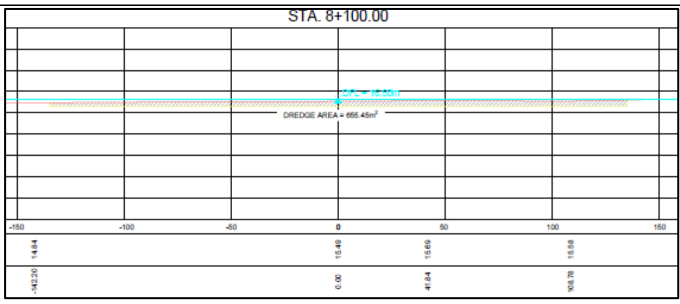
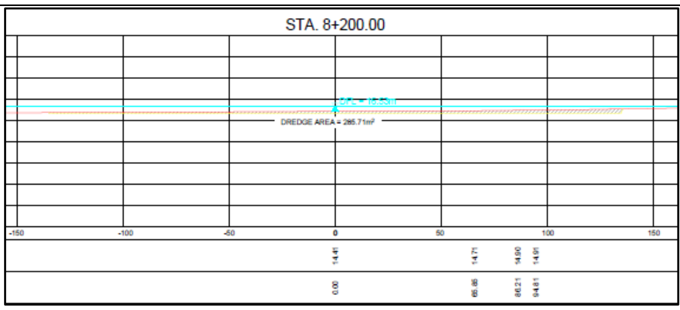
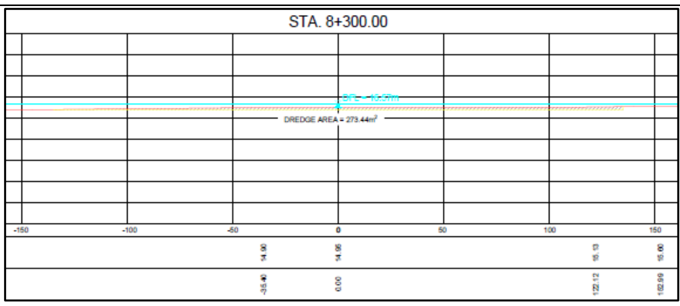
Section	Distance (m) from Center Line	Illustrative Section	Area (m^2)	Volume (m^3)
STA. 5+400.00	10.87		742.83	45,561.50
STA. 5+500.00	11.05		838.16	51,536.00
STA. 5+600.00	11.24		974.65	62,615.50
STA. 5+700.00	11.43		862.31	70,513.50
STA. 5+800.00	11.62		721.61	78,149.50

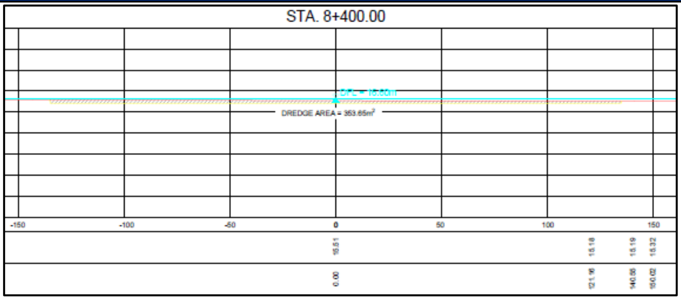
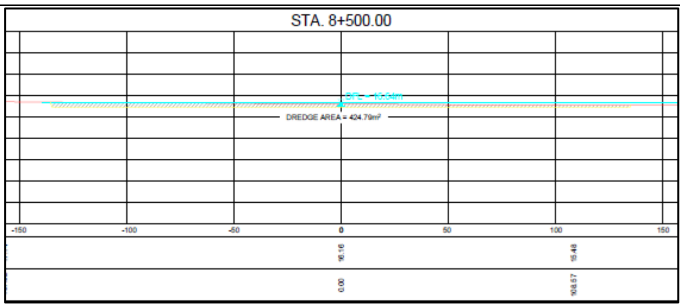
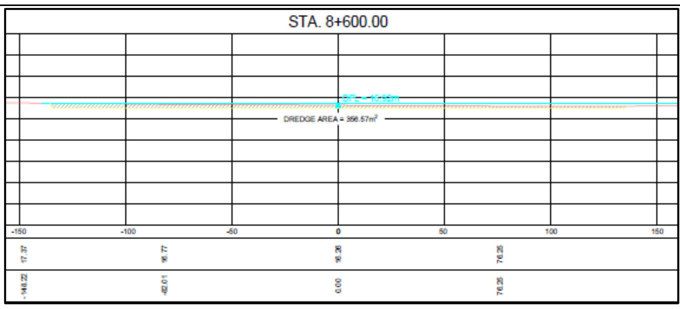
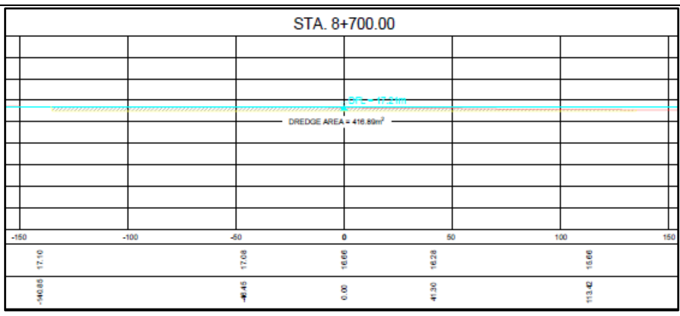
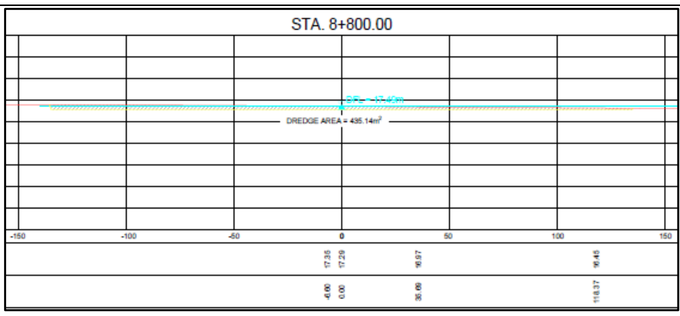
Section	Distance (m) from Center Line	Illustrative Section	Area (m^2)	Volume (m^3)
STA. 5+900.00	11.81		663.60	90,640.50
STA. 6+000.00	12.00		648.18	91,848.00
STA. 6+100.00	12.12		589.13	79,196.00
STA. 6+200.00	12.23			69,260.50
STA. 6+300.00	12.35		854.89	65,589.00

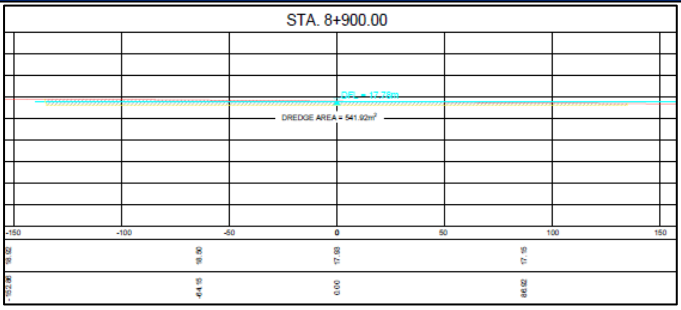
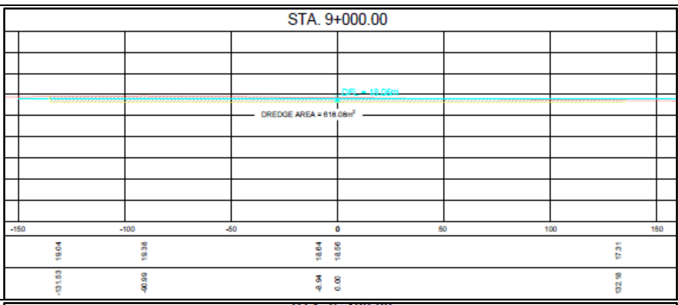
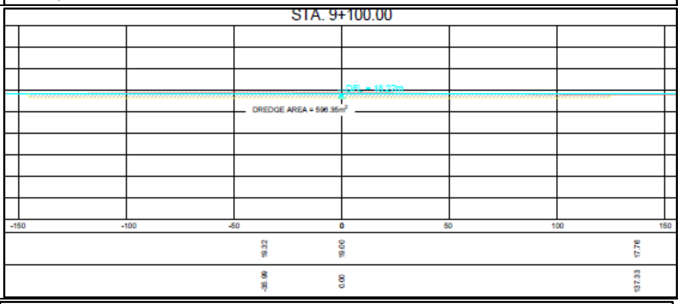
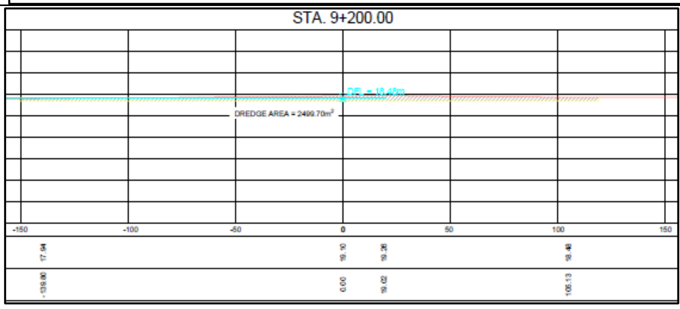
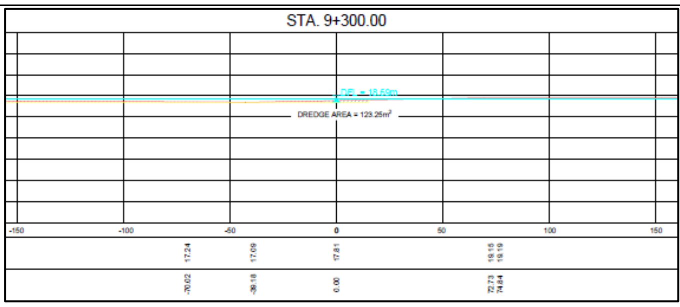
Section	Distance (m) from Center Line	Illustrative Section	Area (m^2)	Volume (m^3)
STA. 6+400.00	12.46		700.16	61,865.50
STA. 6+500.00	12.58		693.84	63,206.00
STA. 6+600.00	12.77		567.40	76,494.00
STA. 6+700.00	12.96		482.91	77,752.50
STA. 6+800.00	13.15		518.47	69,700.00

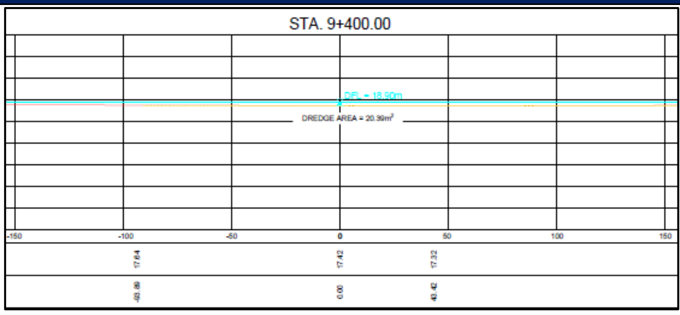
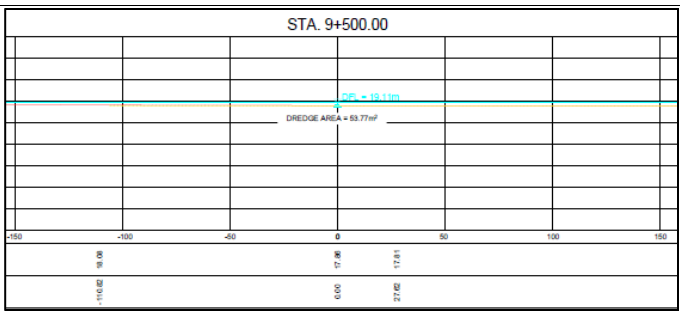
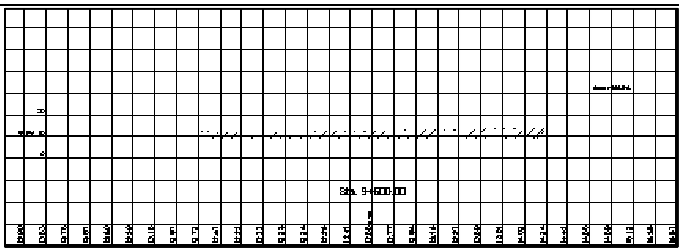
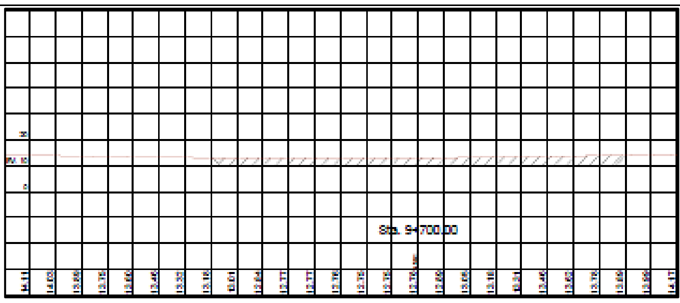
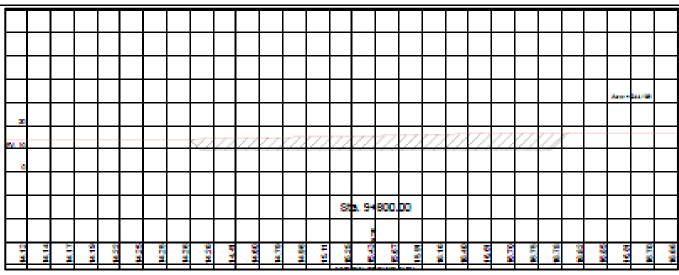
Section	Distance (m) from Center Line	Illustrative Section	Area (m²)	Volume (m³)
STA. 6+900.00	1334		528.37	63,062.00
STA. 7+000.00	13.53		516.79	52,515.50
STA. 7+100.00	13.76		528.37	50,069.00
STA. 7+200.00	13.99		466.92	48,309.00
STA. 7+300.00	14.23		468.88	48,225.00

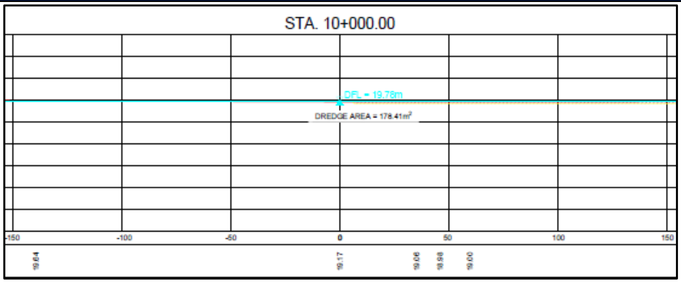
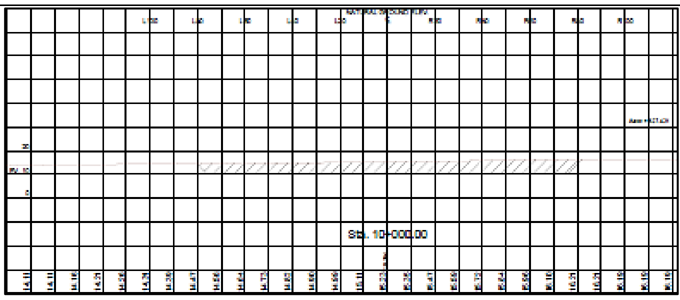
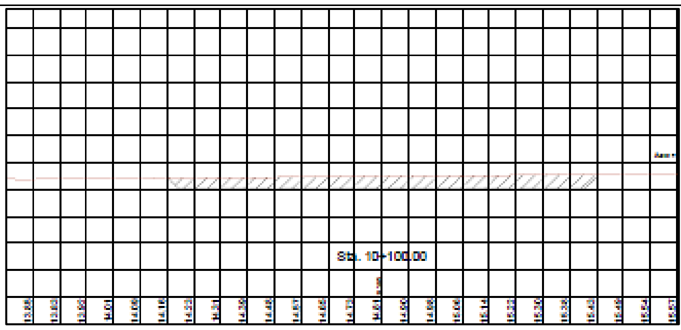
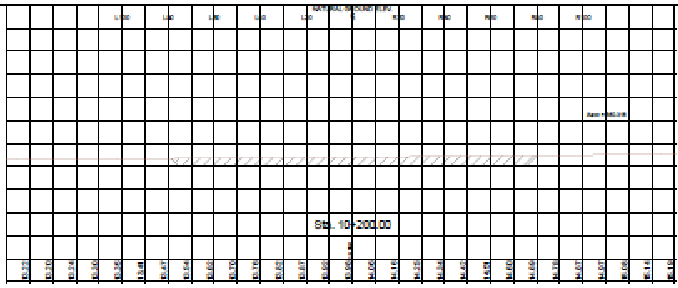
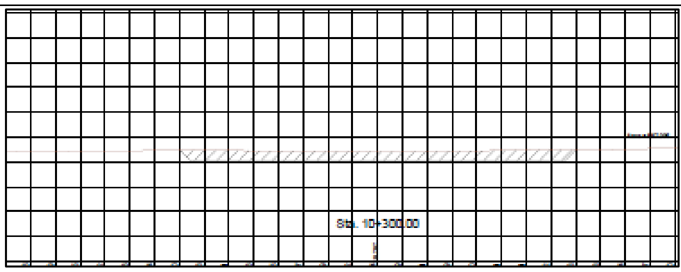
Section	Distance (m) from Center Line	Illustrative Section	Area (m^2)	Volume (m^3)
STA. 7+400.00	14.46		335.30	52,258.00
STA. 7+500.00	15.40		598.95	49,764.50
STA. 7+600.00	15.04		269.50	46,790.00
STA. 7+700.00	15.40		598.95	40,209.00
STA. 7+800.00	15.75		1024.77	25,441.00

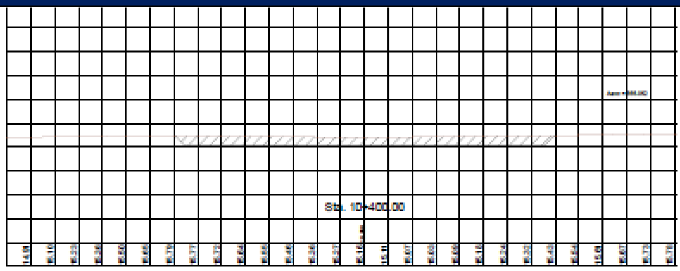
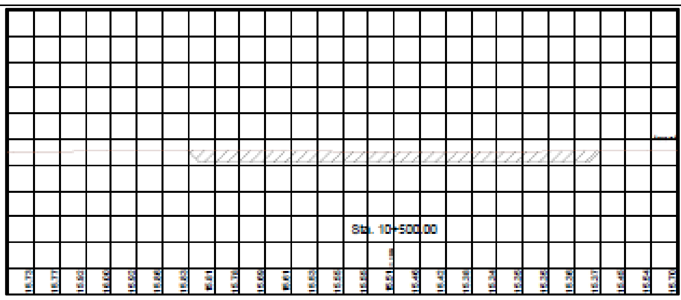
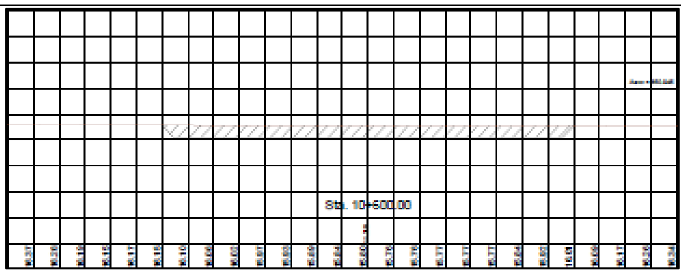
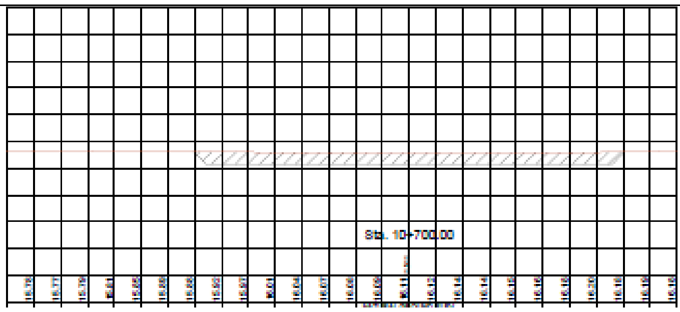
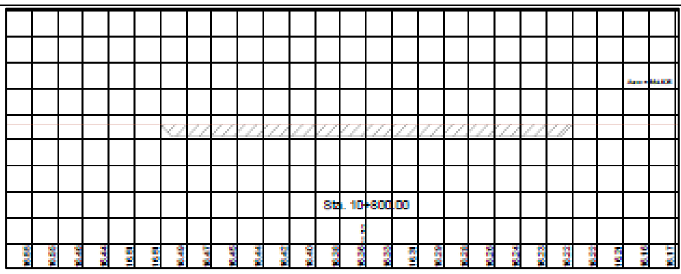
Section	Distance (m) from Center Line	Illustrative Section	Area (m^2)	Volume (m^3)
STA. 7+900.00	16.11m		1083.36	22,151.00
STA. 8+000.00	16.46		903.27	43,422.50
STA. 8+100.00	16.50		655.45m	81,186.00
STA. 8+200.00	16.53		285.71	105,406.50
STA. 8+300.00	16.57		273.44m	99,331.50

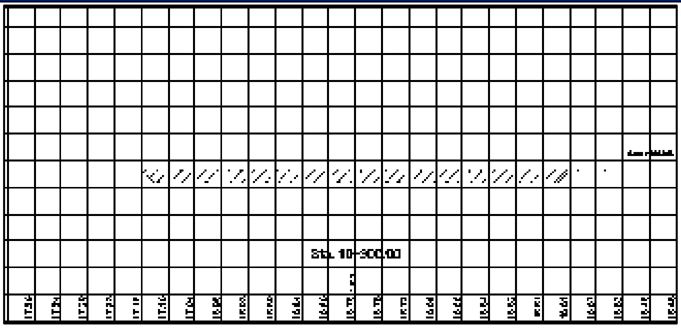
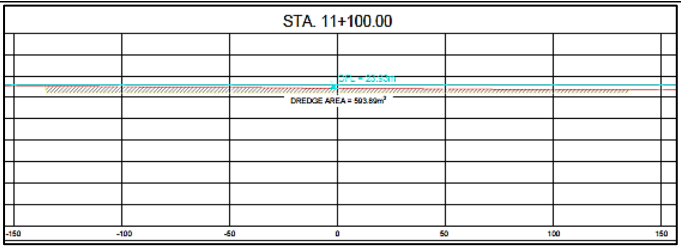
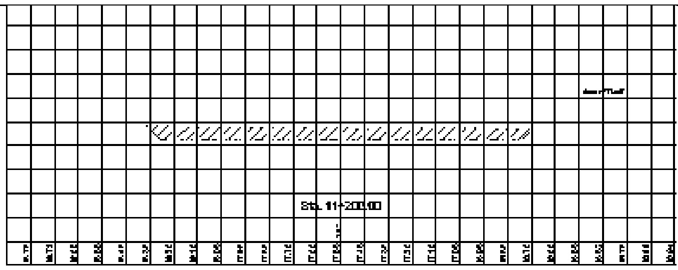
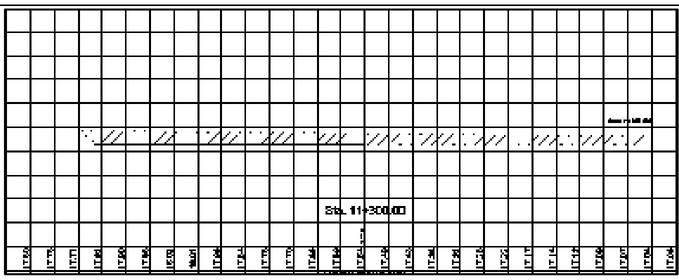
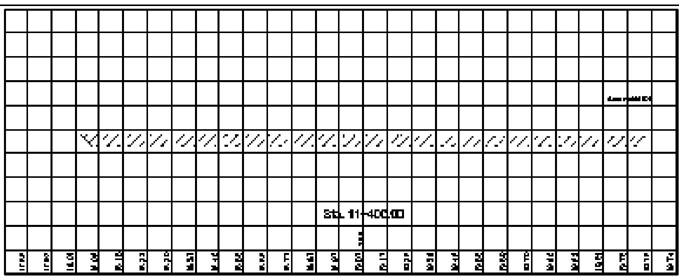
Section	Distance (m) from Center Line	Illustrative Section	Area (m^2)	Volume (m^3)
STA. 8+400.00	16.60		353.65m	77,936.00
STA. 8+500.00	16.64		424.79	47,058.00
STA. 8+600.00	16.92		356.57	27,957.50
STA. 8+700.00	17.78		416.89	31,354.50
STA. 8+800.00	17.49		435.14	38,922.00

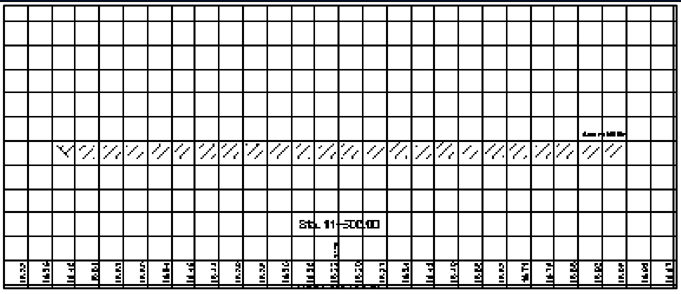
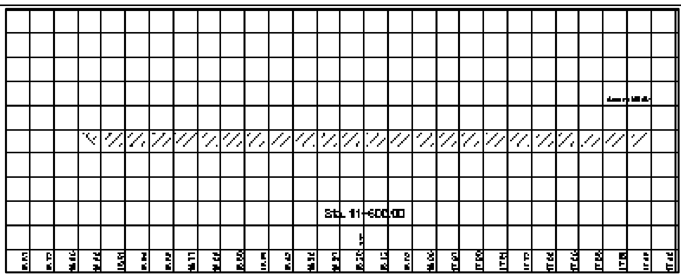
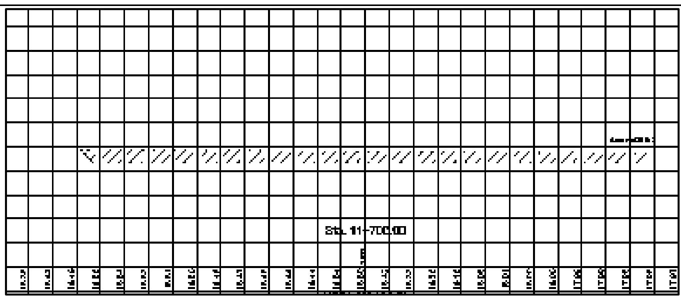
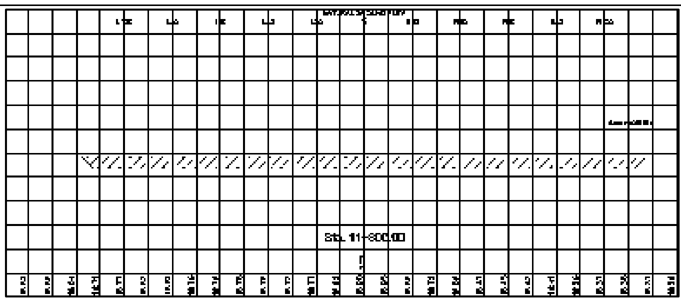
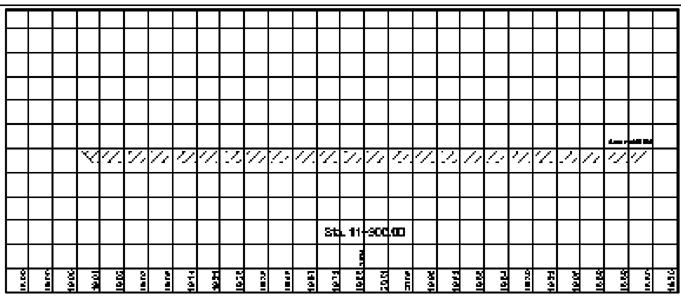
Section	Distance (m) from Center Line	Illustrative Section	Area (m^2)	Volume (m^3)
STA. 8+900.00	17.21		541.92	39,068.00
STA. 9+000.00	18.06		618.08	39,585.50
STA. 9+100.00	18.27		596.35	48,853.00
STA. 9+200.00	18.48		2499.70	58,000.00
STA. 9+300.00	18.69		123.25	60,721.50

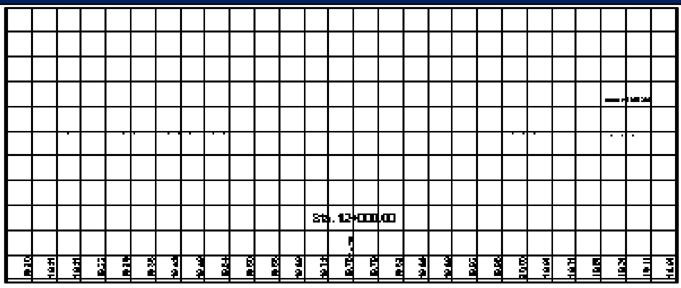
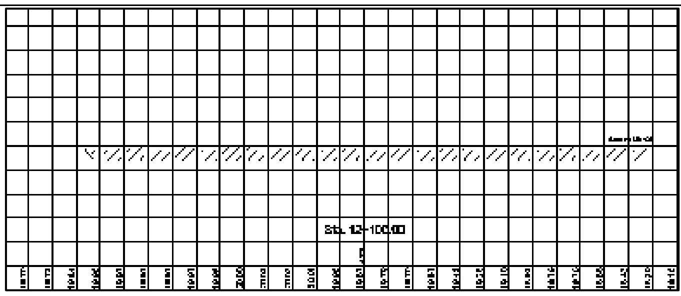
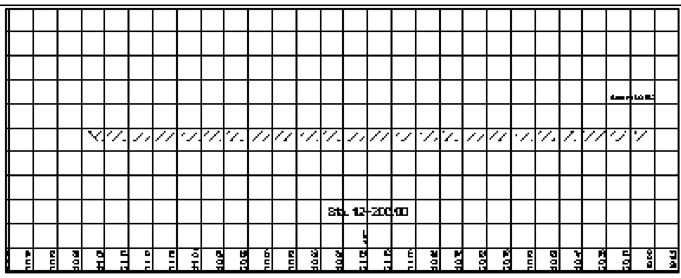
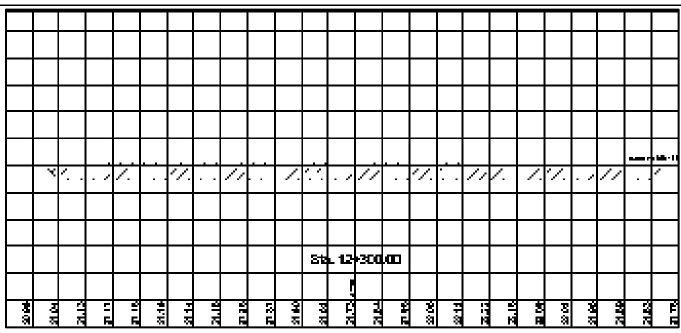
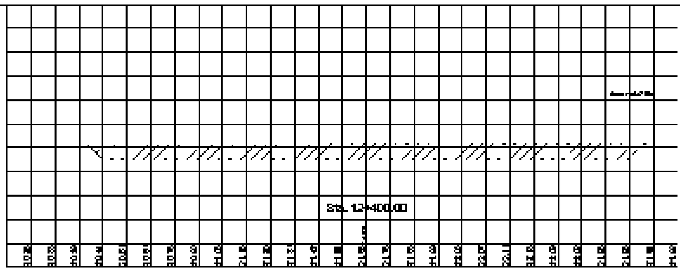
Section	Distance (m) from Center Line	Illustrative Section	Area (m^2)	Volume (m^3)
STA. 9+400.00	18.90		20.39	54,802.50
STA. 9+500.00	19.11		53.77	31,147.50
STA. 9+600.00	19.24		105.11	7,182.00
STA. 9+700.00	19.38		151.84	3,708.00
STA. 9+800.00	19.51		6.71	7,944.00

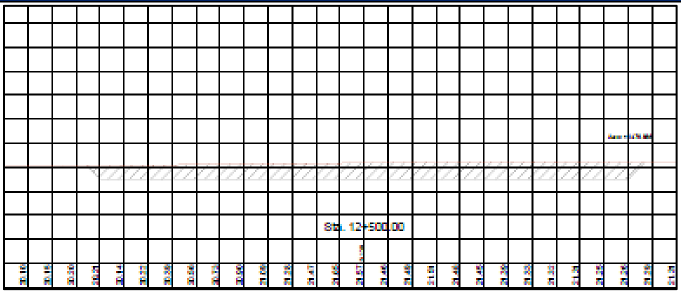
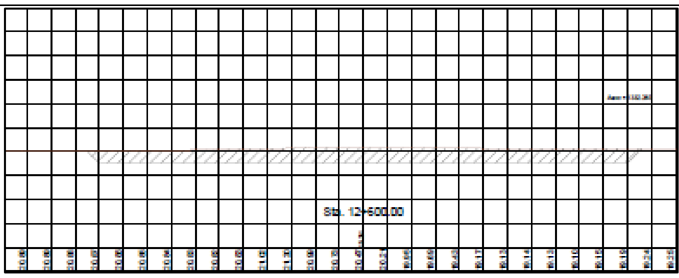
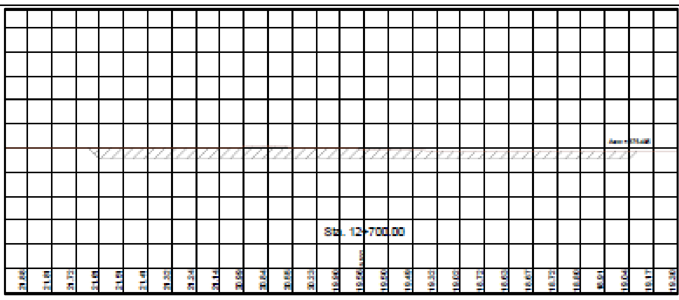
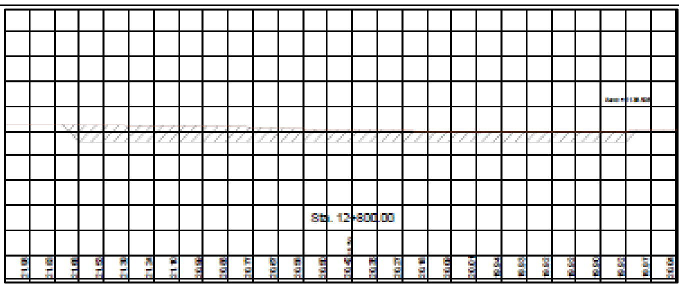
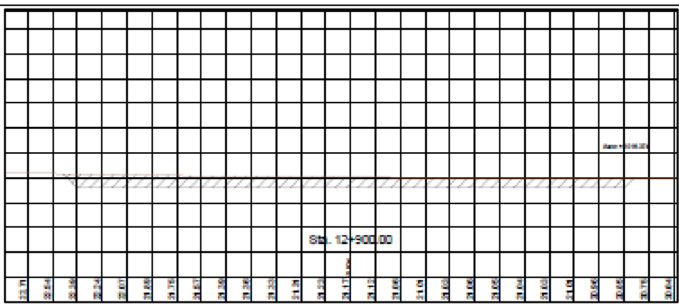
Section	Distance (m) from Center Line	Illustrative Section	Area (m^2)	Volume (m^3)
STA. 9+900.00				12,847.50
STA. 10+000.00	19.78		178.41	7,927.50
STA. 10+100.00	20.16		444.06	2,347.00
STA. 10+200.00	20.55		702.24	10,932.00
STA. 10+300.00	20.93		563.24	31,123.50

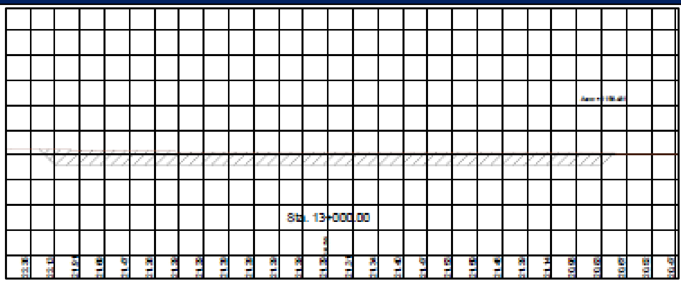
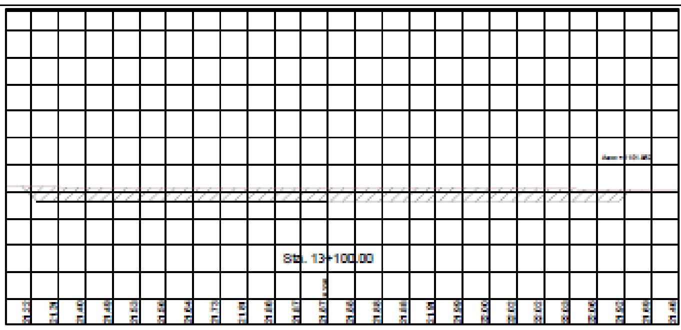
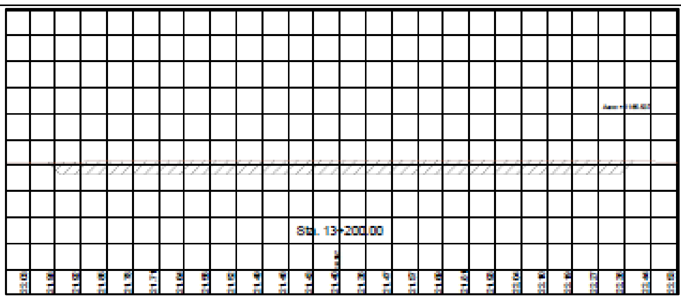
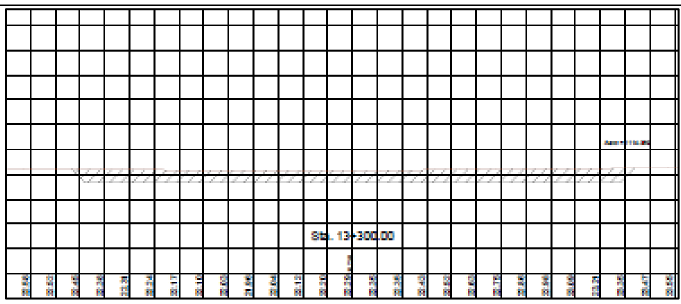
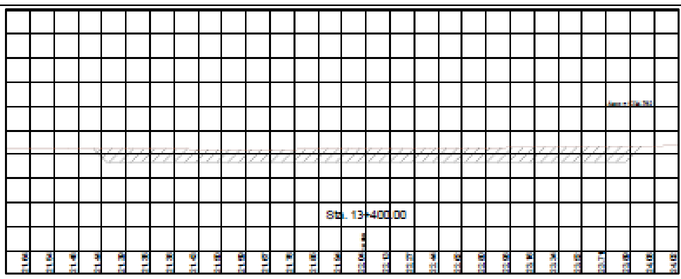
Section	Distance (m) from Center Line	Illustrative Section	Area (m^2)	Volume (m^3)
STA. 10+400.00	21.32		628.87	57,315.00
STA. 10+500.00	21.70		563.88	63,274.00
STA. 10+600.00	22.09		451.96	59,605.50
STA. 10+700.00	22.47		436.53m	59,605.50
STA. 10+800.00	22.66		468.03	50,760.00

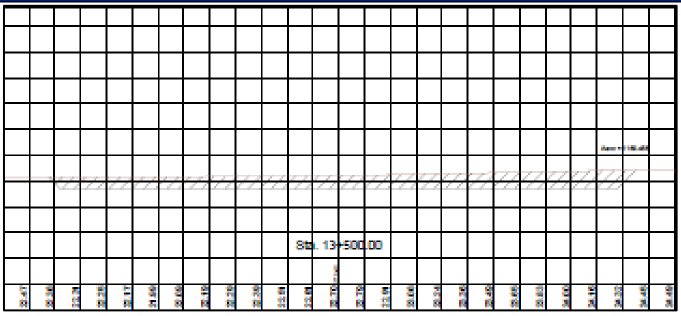
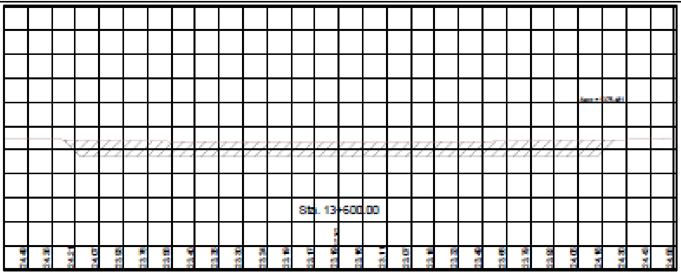
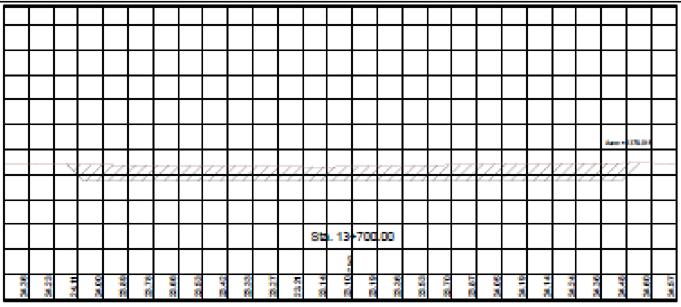
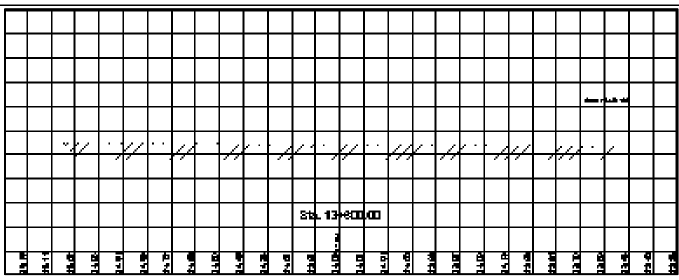
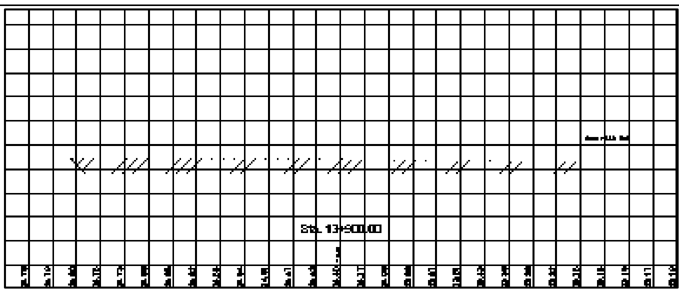
Section	Distance (m) from Center Line	Illustrative Section	Area (m^2)	Volume (m^3)
STA. 10+900.00	23.24		479.82	44,424.50
STA. 11+100.00	23.93		593.89	45,228.00
STA. 11+200.00	24.22		429.04	47,392.50
STA. 11+300.00	24.52		298.47	54,305.50
STA. 11+400.00	24.81		278.76	60,009.00

Section	Distance (m) from Center Line	Illustrative Section	Area (m^2)	Volume (m^3)
STA. 11+500.00	25.11		274.38	51,146.50
STA. 11+600.00	25.54		405.55	36,375.50
STA. 11+700.00	25.90		471.10	28,861.50
STA. 11+800.00	26.40		430.20	27,657.00
STA. 11+900.00	26.83		390.39	33,996.50

Section	Distance (m) from Center Line	Illustrative Section	Area (m^2)	Volume (m^3)
STA. 12+000.00	27.26		404.98	43,832.50
STA. 12+100.00	27.56		411.77	45,065.00
STA. 12+200.00	27.85		362.01	41,029.50
STA. 12+300.00	28.15		315.53	39,768.50
STA. 12+400.00	28.44		193.99	40,837.50

Section	Distance (m) from Center Line	Illustrative Section	Area (m^2)	Volume (m^3)
STA. 12+500.00	28.74		315.53	38,689.00
STA. 12+600.00	29.32		369.38	32,211.00
STA. 12+700.00	29.90		409.92	23,810.00
STA. 12+800.00	30.47		487.46	25,476.00
STA. 12+900.00	31.05		520.79	34,245.50

Section	Distance (m) from Center Line	Illustrative Section	Area (m^2)	Volume (m^3)
STA. 13+000.00	31.63		497.38	38,965.00
STA. 13+100.00	32.05		606.32	44,869.00
STA. 13+200.00	32.47		671.81	49,242.00
STA. 13+300.00	32.88		639.68	55,185.00
STA. 13+400.00	33.30		658.91	63,906.50

Section	Distance (m) from Center Line	Illustrative Section	Area (m^2)	Volume (m^3)
STA. 13+500.00	33.72		565.90m	65,574.50
STA. 13+600.00	34.22		511.23	64,929.50
STA. 13+700.00	34.72		421.51	61,240.50
STA. 13+800.00	35.21		503.25	53,856.50
STA. 13+900.00	35.71		586.90	46,637.00

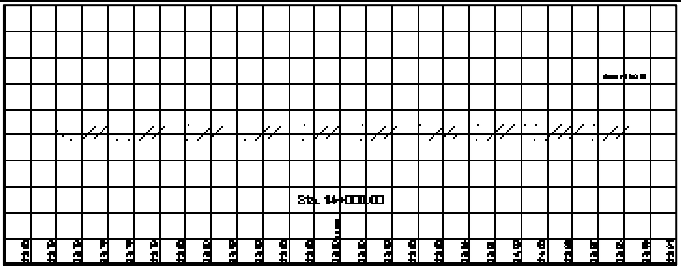
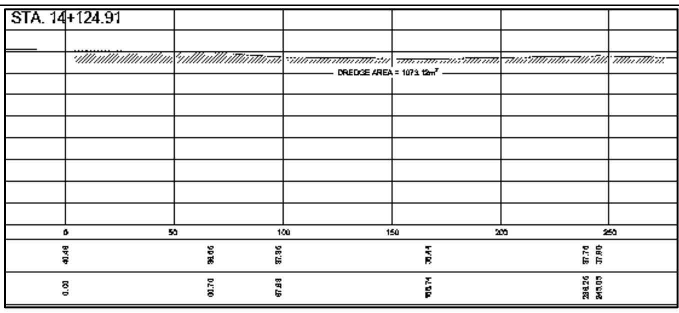
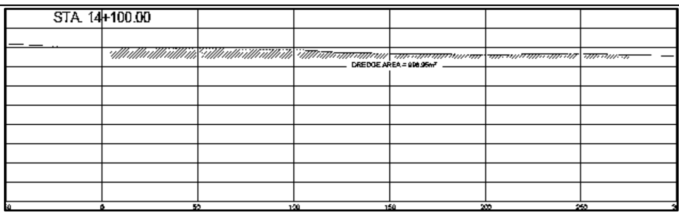
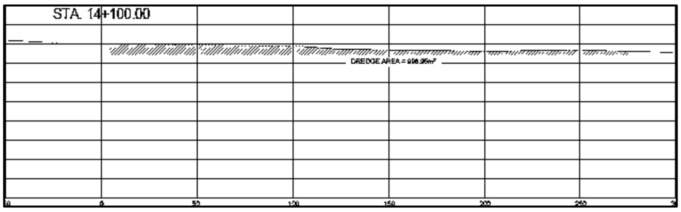
Section	Distance (m) from Center Line	Illustrative Section	Area (m^2)	Volume (m^3)
STA. 14+000.00	36.21		5220.76	46,238.00
STA. 14+100.00			996.95	54,507.50
STA. 14+124.91			1073.12	60,504.50
STA. 14+124.91			1073.12	0

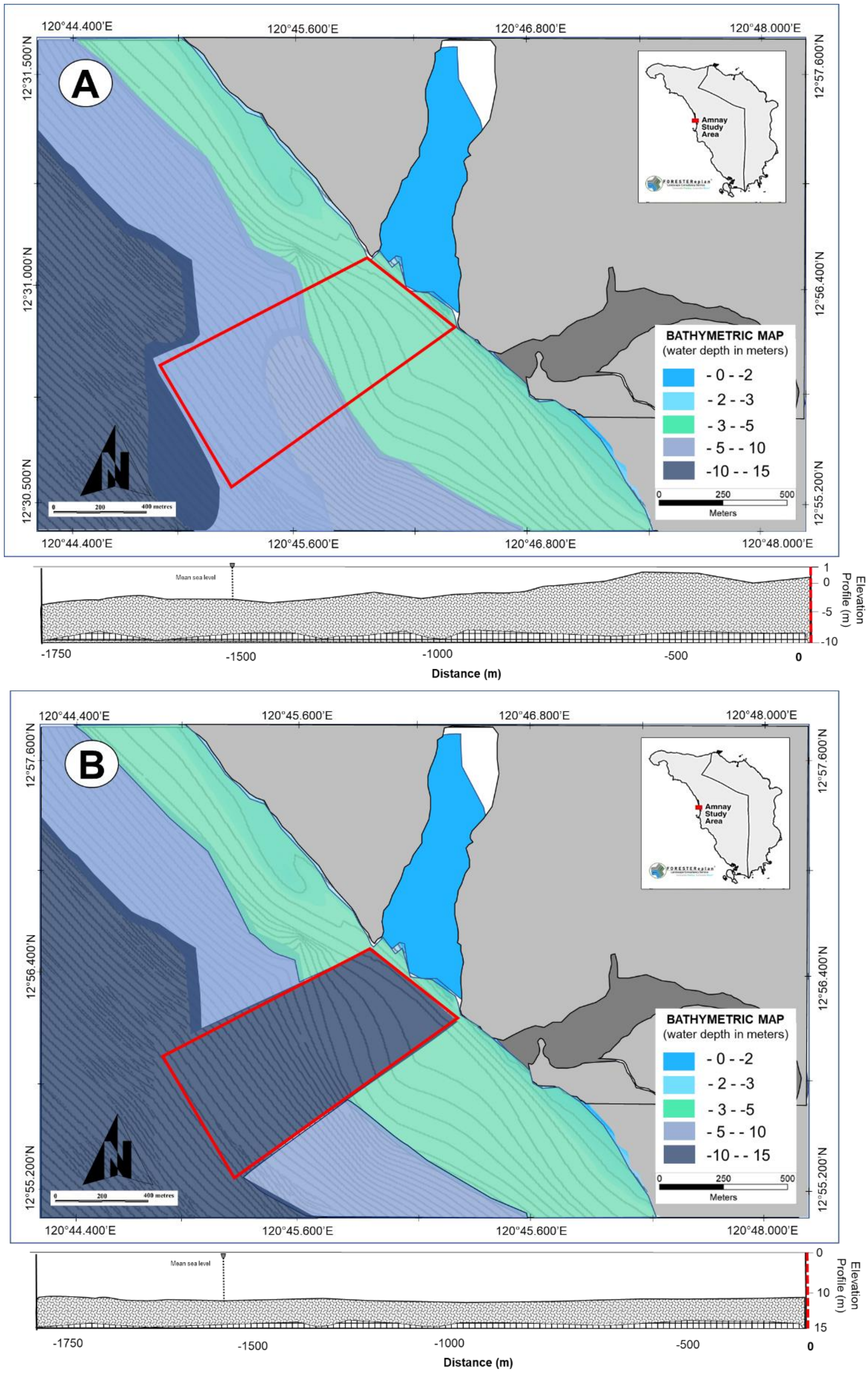
Table 1.4.2: Summary of Sectional Volumes of Sand as per Approved Dredging Plan

Stations/Dimension with Additional Projection	Estimated Volume (m^3)	Remarks
STA 0+000 to STA 1+500	637,492.00	Delta/transition (Start)
STA 1+500 to STA 2+000	977,926.50	
STA 2+500 to STA 3+000	542,396.00	
STA 3+500 to STA 4+000	716,862.00	
STA 4+500 to STA 5+000	490,555.50	
STA 5+500 to STA 6+000	732,884.00	
STA 6+500 to STA 7+000	588,149.50	
STA 7+000 to STA 8+000	588,931.50	
STA 8+500 to STA 9+000	430,412.00	
STA 9+500 to STA 10+000	204,600.50	
STA 10+500 to STA 11+000	508,852.50	
STA 11+500 to STA 12+000	371,948.00	

Stations/Dimension with Additional Projection	Estimated Volume (m^3)	Remarks
STA 12+500 to STA 13+000	466,203.00	
STA 13+000 to STA 14+000	322,984.00	
Total (RDZ) (m^3)	7,321,950.00	*subject to replenishment/ riverbed flow dynamics*

1.4.1.4 Offshore Dredging for Navigational Work and Passage

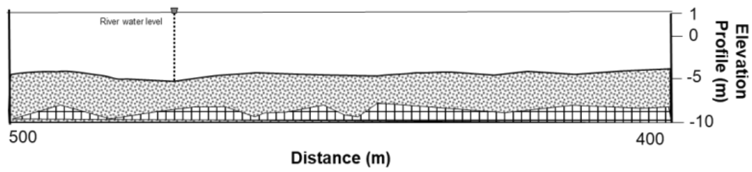
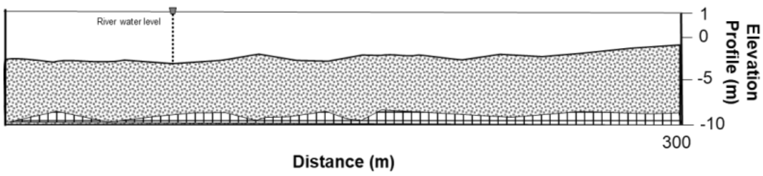
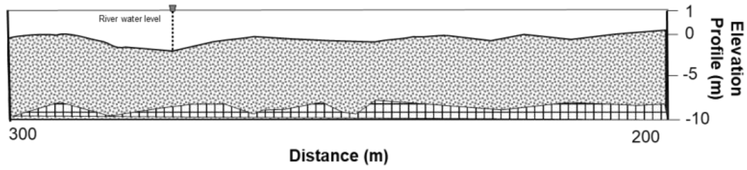
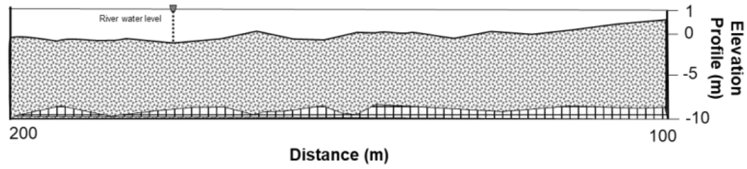
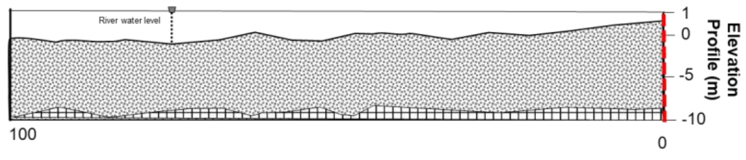
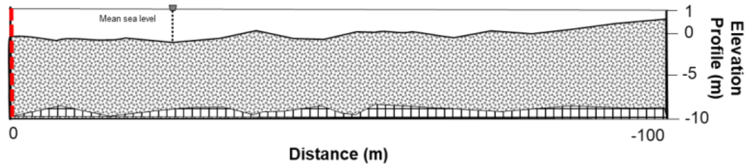
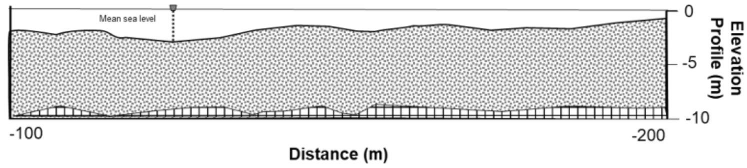
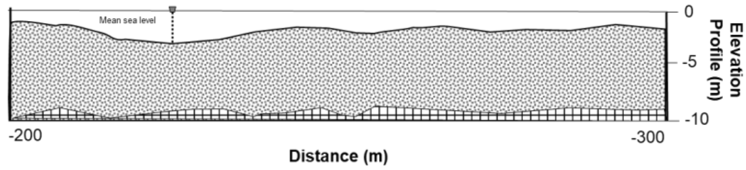
The proposed 109-hectare ARRD Project offshore dredging intended for navigational channeling and passage will have a total estimated sand volume of 11,350,260.00 m^3 or a total extraction capacity of 945,855.00 m^3 per month subject to actual replenishment and flow dynamics from the waterbodies (downstream section). **Figure 1.4.1** shows the before and after bathymetry of the offshore area for the navigational works and channel as part of the pre-construction period. It should be noted that massive sand volume was accumulated in the lower portion (southern side) of the rectangular block, hence, the farthest corner of the area is skewed to the lower right corner due to the configuration of the seabed blocked with low bathymetric position. The estimates are based from the bathymetric and oceanographic studies in Amnay River and its offshore area. It should be noted that the dynamics of both waterbodies are very extreme due to the behavior of water flows and discharges. **Tables 1.4.3** and **1.4.4** shows the computational summary for the extraction/dredging volumes of sand indicating the station, width, depth, and volume of extraction per station based on the DPWH approved dredging plan. The calculation uses the exact area per 100-m width station interval sectioning.

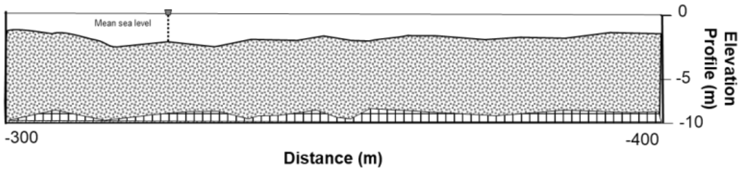
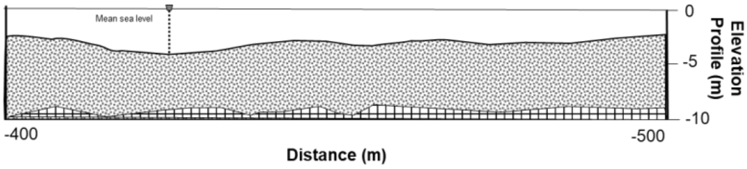
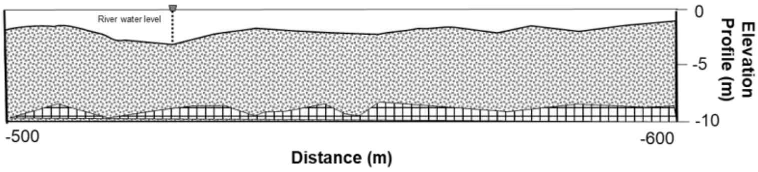
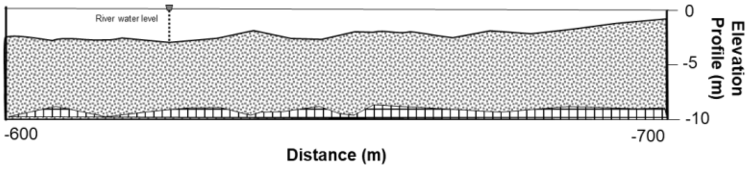
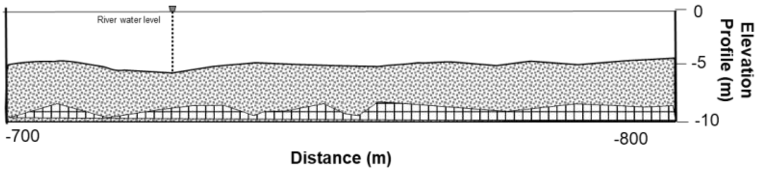
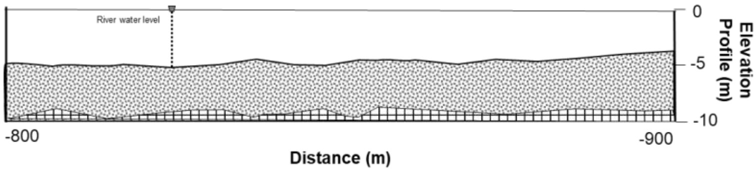
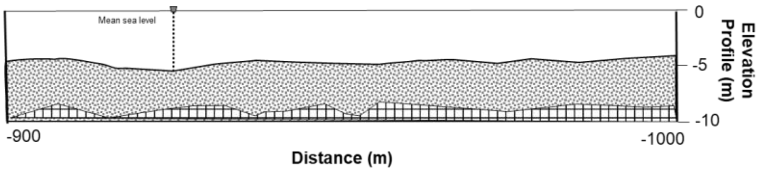
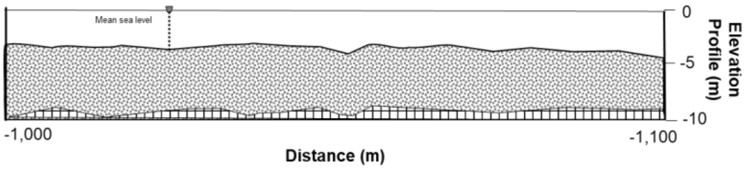


Note: (a) Before Dredging, Navigationally Blocked; (b) After, Navigationally Cleared

Figure 1.4.1: Comparison of the 109-hectare existing Bathymetry and Simulated Bathymetry Before and After Dredging Operations for Navigational Dredging

Table 1.4.3: Sectional Volumes of Sand for Offshore Area

Stations	Bathymetric Profile (meter/distance)	Volume (m^3)	Remarks
Sta. 500 + Sta. 400		75,474.50	500 meters transition to 0 delta boundary offshore
Sta. 400 + Sta. 300		54,148.00	
Sta. 300 + Sta. 200		48,030.50	
Sta. 200 + Sta. 100		34,200.00	
Sta. 100 + Sta. 0		42,526.00	Start of Navigational works (river delta)
Sta. -0+ Sta. -100		581,200.00	
Sta. -100 + Sta. -200		587,000.00	
Sta. -200+ Sta. -300		599,830.00	

Stations	Bathymetric Profile (meter/distance)	Volume (m³)	Remarks
Sta. -300 + Sta. -400		601,690.00	
Sta. -400 + Sta. -500		612,040.00	
Sta. -500 + Sta. -600		620,640.00	
Sta. -600 + Sta. -700		631,780.00	
Sta. -700 + Sta. -800		637,240.00	
Sta. -800 + Sta. -900		646,870.00	
Sta. -900 + Sta. -1000		652,650.00	
Sta. -1000 + Sta. -1100		664,450.00	

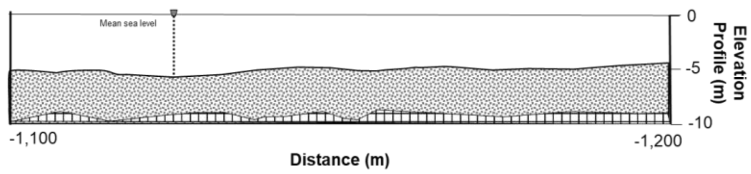
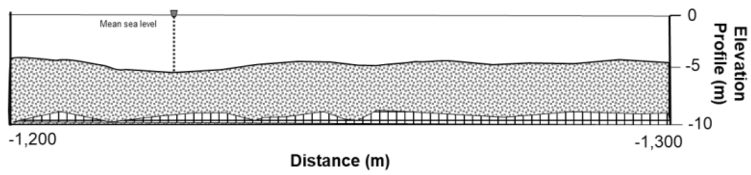
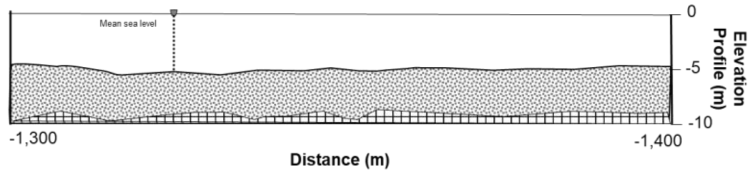
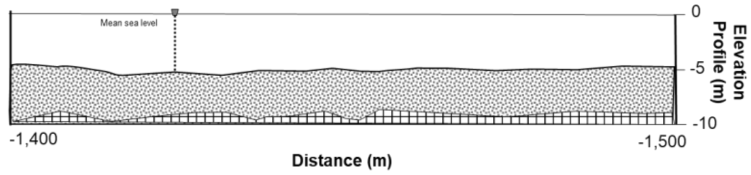
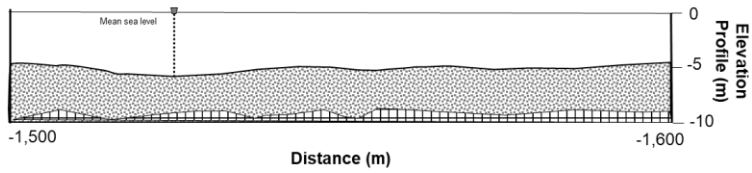
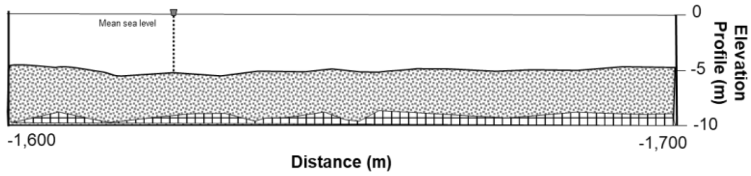
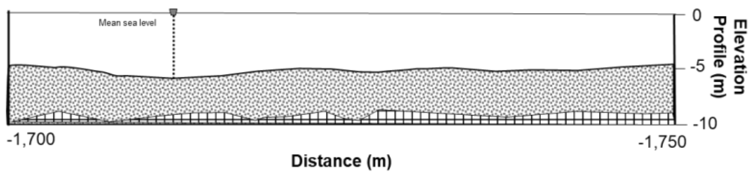
Stations	Bathymetric Profile (meter/distance)	Volume (m^3)	Remarks
Sta. -1100 + Sta. -1200		672,730.00	
Sta. -1200 + Sta. -1300		682,810.00	
Sta. -1300 + Sta. -1400		696,830.00	
Sta. -1400 + Sta. -1500		712,350.00	
Sta. -1500 + Sta. -1600		706,000.00	
Sta. -1600 + Sta. -1700		694,780.00	
Sta. -1700 + Sta. -1750		349,370.00	

Table 1.4.4: Summary of Sectional Volumes of Sand as per Bathymetric and Oceanographic Studies

Stations/Dimension with Additional Projection	Estimated Volume (m^3)	Remarks
Sta. -0+ Sta. -100	581,200.00	Offshore delta
Sta. -100 + Sta. -200	587,000.00	-

Stations/Dimension with Additional Projection	Estimated Volume (m³)	Remarks
Sta. -200+ Sta. -300	599,830.00	-
Sta. -300 + Sta. -400	601,690.00	-
Sta. -400 + Sta. -500	612,040.00	-
Sta. -500 + Sta. -600	620,640.00	-
Sta. -600 + Sta. -700	631,780.00	-
Sta. -700 + Sta. -800	637,240.00	-
Sta. -800 + Sta. -900	646,870.00	-
Sta. -900 + Sta. -1000	652,650.00	-
Sta. -1000 + Sta. -1100	664,450.00	-
Sta. -1100 + Sta. -1200	672,730.00	-
Sta. -1200 + Sta. -1300	682,810.00	-
Sta. -1300 + Sta. -1400	696,830.00	-
Sta. -1400 + Sta. -1500	712,350.00	-
Sta. -1500 + Sta. -1600	706,000.00	-
Sta. -1600 + Sta. -1700	694,780.00	-
Sta. -1700 + Sta. -1750	349,370.00	-
Total (Offshore) (m³) Amnay Offshore/Delta (LxWxD) Area: 109-hectares (blocked bathymetry) Depth: 10 meters	11,350,260.00 (945,855.00 per month extraction rate)	*subject to replenishment/ riverbed supply and seabed dynamics*

1.4.2 General Water Use

Amnay River provides irrigation to the rice producing barangays in Sablayan, namely Claudio Salgado, Lagnas, Ilvita, Pag-asa and Victoria. **Figure 1.4.2** presents NIA Intake Structures located near the Project Site.

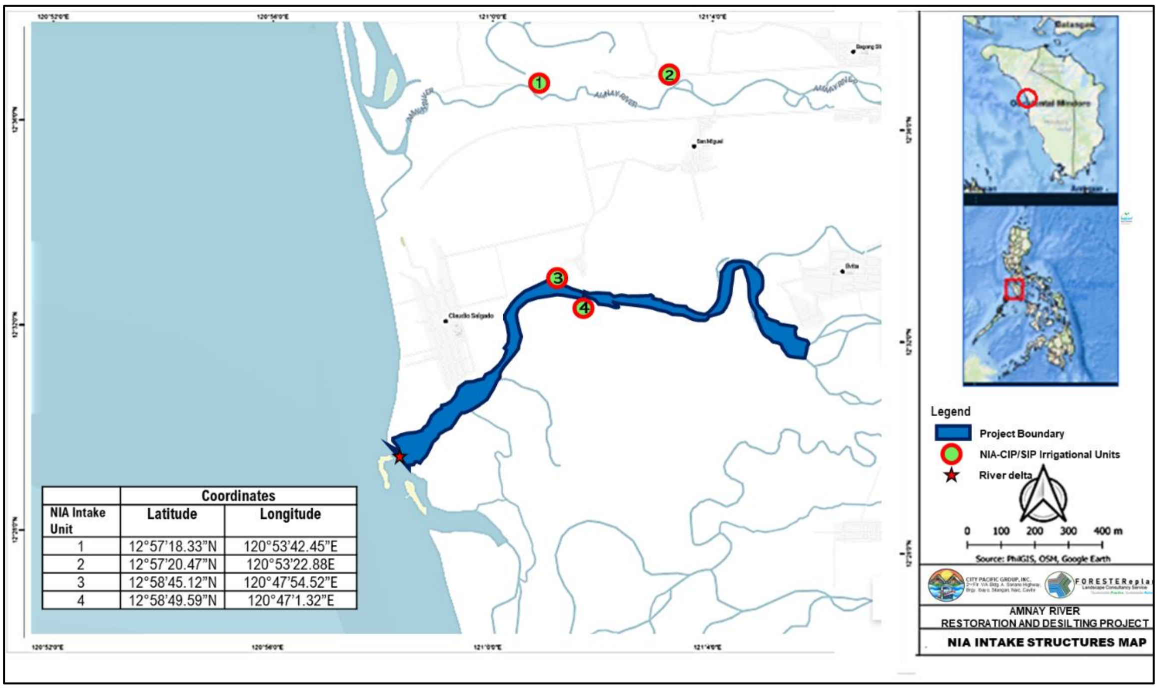


Figure 1.4.2: NIA Intake Structures located near the Project Site

The coastal barangays in Sablayan derived substantial income from fishing industry. Marine fishing is the alternative source of income while inland fishing has started to develop. However, necessary support to boost the industry is very minimal. Assistant to inland fishing is limited to distribution of fingerlings and technical support. Marketing assistance and provision of necessary support facilities is absent. Severe erosion along major river systems is also one of the major concerns that affect production performance. Areas of agricultural lands literally damaged several years ago and expected to continuously occur if not properly addressed. Magnifying effects will hamper agriculture sector and the economic performance in general.

Fishing activities are known to coastal barangays, Claudio Salgado, Ibud, Poblacion, Tagumpay, Sto. Nino, Buenavista, Poblacion, Sta. Lucia, San Nicolas and Gen. Emilio Aguinaldo. As opposed to the stagnant Philippine Sea, the West Philippine Sea off the coast of the Province of Occidental Mindoro is a suitable place for tuna to reproduce and migrate. Similar to how the waters from the Verde passage, which is the core of the center of marine biodiversity, flow via Paluan, Mamburao, and Sta. Rizal, Cruz, and Sablayan. The towns of Paluan, Mamburao, and Sta. Cruz and Sablyan are home to a number of businesses engaged in the industry, according to Bureau of Fisheries and Aquatic Resources (BFAR) records. Sablayan coast were included in the PPTST Tuna sites which is part of the 70km national waters. **Figure 1.4.3** shows the Occidental Mindoro Fishery Map.

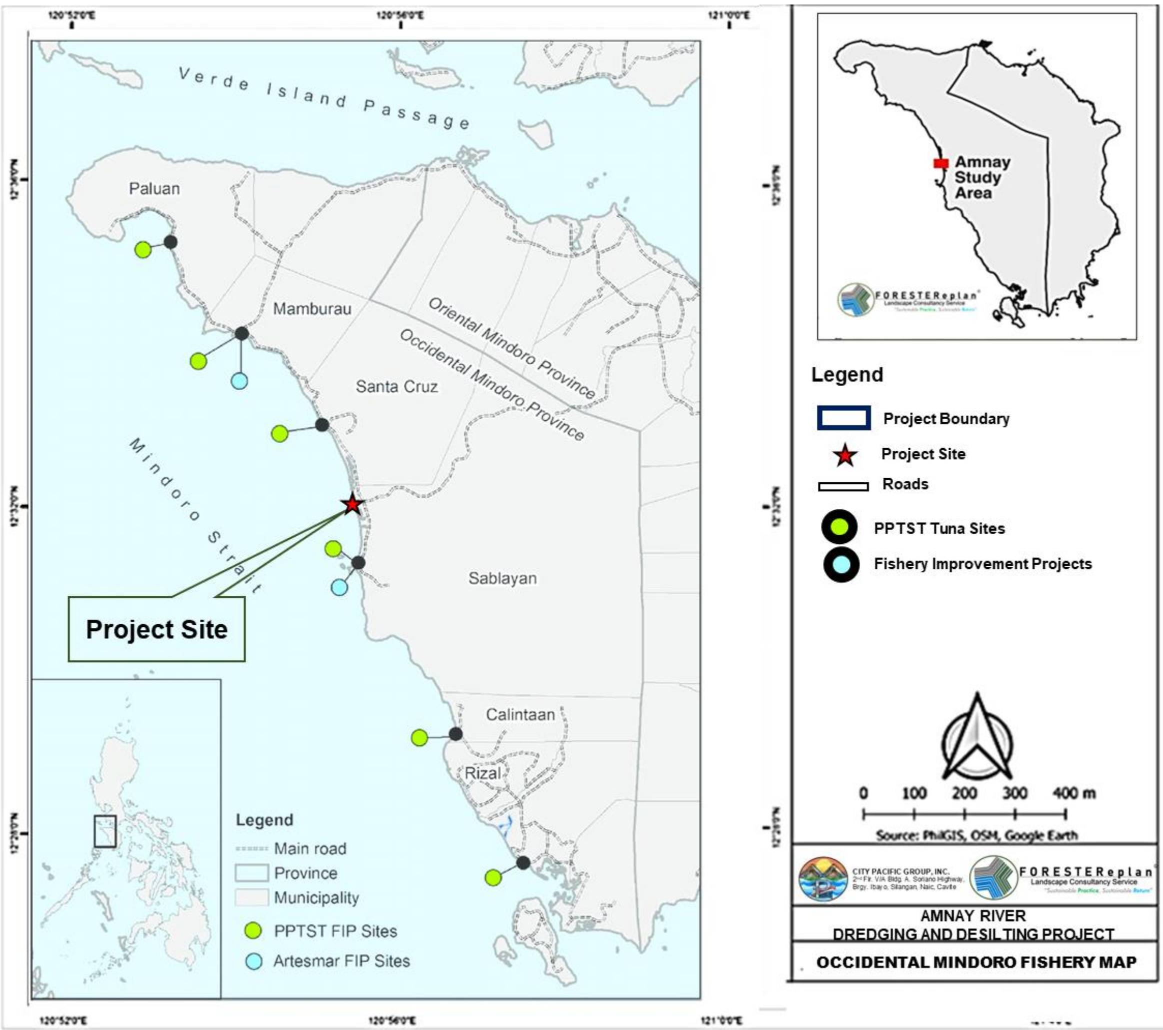
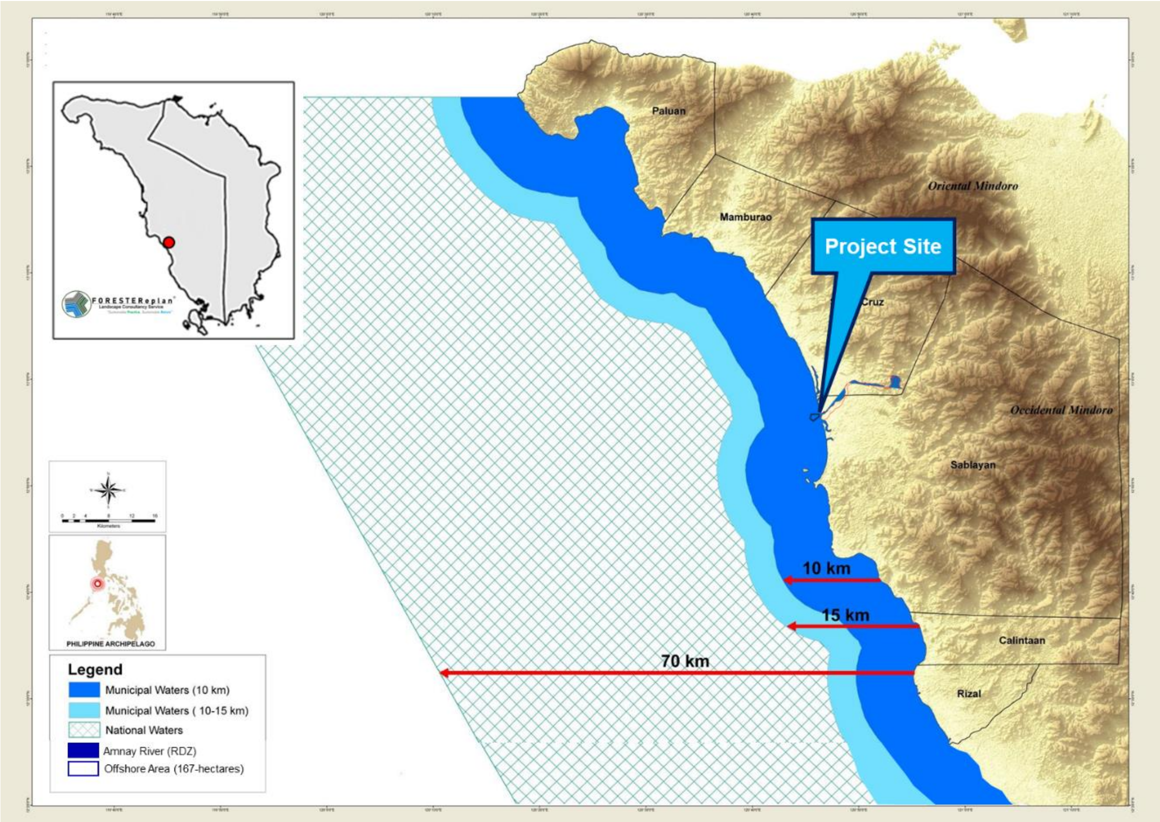


Figure 1.4.3: The Occidental Mindoro Fishery Map

In the nearby Municipality of Calintaan, there are four (4) coastal barangays such as the Poblacion, the administrative and commercial center, Iriron, and Concepcion. Barangay Ilvita contains the coastline's southernmost section. These four barangays are home to 400 fishermen who depend on the municipal waterways for their livelihood.

In Calintaan, the municipality's 19.3 km of coastline stretches from the north to the south of the Busuanga River, at the mouth of the sizable Amnay River. Rizal (to the south) and Sablayan are its neighbors (to the north). Based on reviews of available reports from BFAR (1999), CRM-Calintaan (2009) and Barr (n.d.), there is a 1.5 km long, 50 acre long nearshore coral reef in the municipality's southernmost region, close to the mouth of the Marasombol River. Between patches of sand and silt, there are isolated reef exposures, which might indicate sedimentation. The shoreline, which may be eroding, and river sediments are sources of sediment loads. The creeks also flood from June through September, and near the openings, sizable deltas are visible. The coastal fishermen maintain subsistence fishing that are heavily impacted by the weather and seasons. They use little wooden boats, either with or without motors (bancas). Between April and May, hook and line is the most common fishing equipment. Early in the morning is often when fishermen who are fishing alone set out.

As to the fish sanctuaries associated in the municipality, there is a site for catching bangus fry and a privately owned fishpond (tiger prawn and bangus sugpo) in Wawa. There is a second long, wide sandy beach to the north (Ragara Beach), which is about 8 km long, as well as the offshore monolith known as Bato Tabao (Iriron Rock), which is about 12 m above sea level. However, these areas and protected fish and conservation sites are relatively far from the project site. **Figure 1.4.4** shows the municipal waters of Occidental Mindoro with focus on the Project Site.



Source: Adopted and Modified from WWF-Philippines (2011)
The Partnership Project Towards Sustainable Tuna Fisheries (PPTST)

Figure 1.4.4: Municipal Waters of Occidental Mindoro with focus on the Project Site

1.4.3 Project Components

There will be few facilities to be constructed on site specifically for the establishment of office quarters and barracks including satellite stations for the project operations, and a Sand Processing Plant. Thus, field office, warehouse, staff house and other in-land facilities shall be built. The dredged materials will be barged and then dump in land mass in the reclamation area of Pasay, Manila and other areas where it is needed. Since there will be few land-based development that will be built, the main river channel dredging component is the operations of the shipping vessels for restoration and desilting. However, other components of the project such as support and processing facilities will be needed. The list of equipment to be used are presented in **Table 1.4.5**.

Table 1.4.5: Project Components

Project Components		Quantity/Approximate Size/Capacity
Major Components		
Dredging Equipment/ Vessels	Self-Discharge Barge/ Pelican Barge	10 units/ 10,000 MT
	TSHD	12 units/ 6000 m^3/hour
	CSD	4 units/ 1,000-1,500 MT/hr (minimum 3,000 HP)
	Backhoe	20 unit/ 1 m^3
	Dump Trucks	40 unit/ 18 m^3
	Wheel Loader	4 unit/ 5 m^3
	Grader	5 units
Support Facility and Common Auxiliaries	Yard landfill/Stockpile	2.0 hectare
	Staff Quarters/Barracks	1
	Offshore handling area (OHA)	50 hectares
	Administration Building	1
	Jetty Port	1
Pollution Control Devices	Wastewater Treatment System Material Recovery Facility (MRF) Silt and Barricade devices	1 unit per vessel (12 TSHD, 2 CSD)/ 2,500-4,500 m^3 2 units 1.5 km segment

Figure 1.4.5a and Figure 1.4.5b presents the location of the project site, and in particular, the location and components of project area, utilities and footprint of project component for the offshore area and RDZ, respectively.

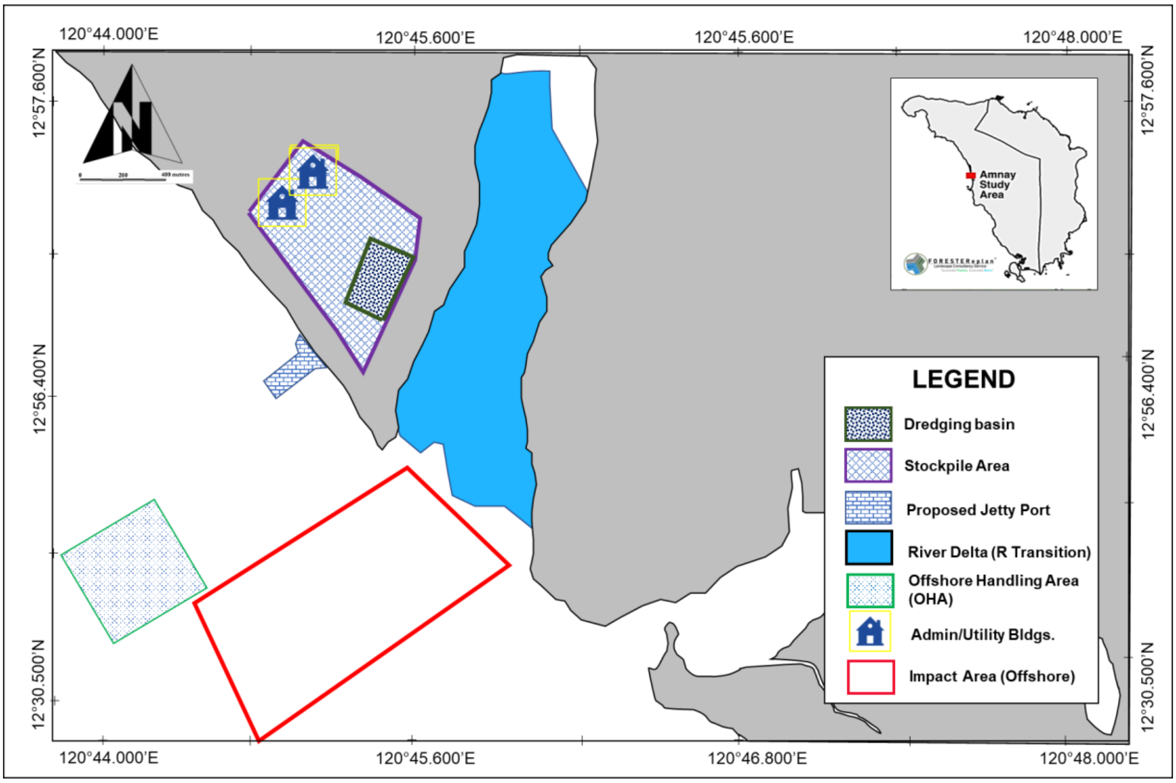


Figure 1.4.5a: Location Map of the Proposed Project Components

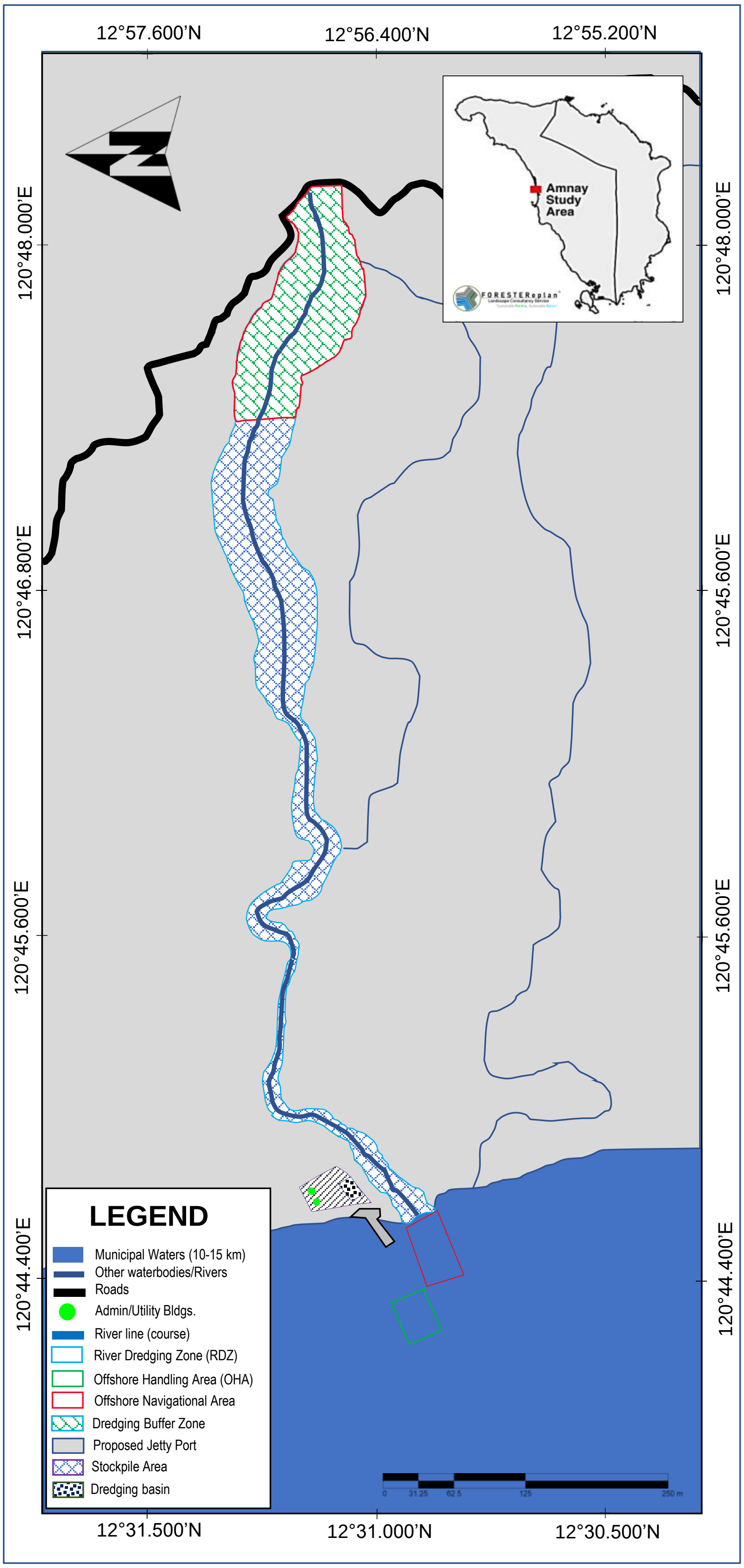


Figure 1.4.5b: Location Map of all the Proposed Project Components with respect to RDZ

1.4.4 Major Components

1.4.4.1 Dredging and Desilting Area

The project covers an area of 14-km with DPWH approved Dredging Plan and Dredging Clearance starting from the river delta/mouth up to 14-km upstream of Amnay River. The proposed Project is divided into the following:

- 14-km ha Pilot Channel Dredging Area
- 48.35 ha Buffer Zone (DPWH JMC No. 1, S. 2019) or 1-km distance from the bridge
- 2.25 ha (150 m x10 m) Dredging Basin
- 109-hectare Offshore dredging area for navigational channel opening (pre-construction activities)

Dredging area shall be provided with activated siren or alarm systems which are necessary during dredging and desilting operations for workers' quick response to avoid quick accidents (e.g., explosion, fire, among others) caused by flowing dredge materials or equipment failure. Restoration and desilting activities monitoring instruments should also be installed which can serve as gauge, check system, early deterrent and measure for water levels, warning devices, emergency shutdowns, evacuation, lights, etc.

1.4.4.2 Dump Site/Stockpile Area

The dredged fill materials shall be hauled and loaded from Amnay River to the area of the reclamation project in Manila Bay area and some other identified areas where they are needed.

Periodically, silt, sand, gravel and sediment samples at the bottom of the river and water quality samples will be analyzed (e.g., ASTM, chemical, etc.). Dredged fill and other materials shall be warranted to consider fit for use as fill, construction materials or any other purpose. A stockpile area with a total area of 1.0 ha is allocated for temporarily storing and staging undesirable dredge materials and materials that are not suitable for filling. This is located at 1.0 km away from Amnay River mouth. The proposed stockpile area is an open barren land with patches of Aroma trees and some beach plants such as *Spinifex littoreus*, *Ipomea pes-caprae* and individuals of *Acmelia sp*. species forming sparse vegetation. Substrate of the area is purely sand forming dunes near the river mouth. **Figure 1.4.6** shows the illustrative map where the stockpile is located.

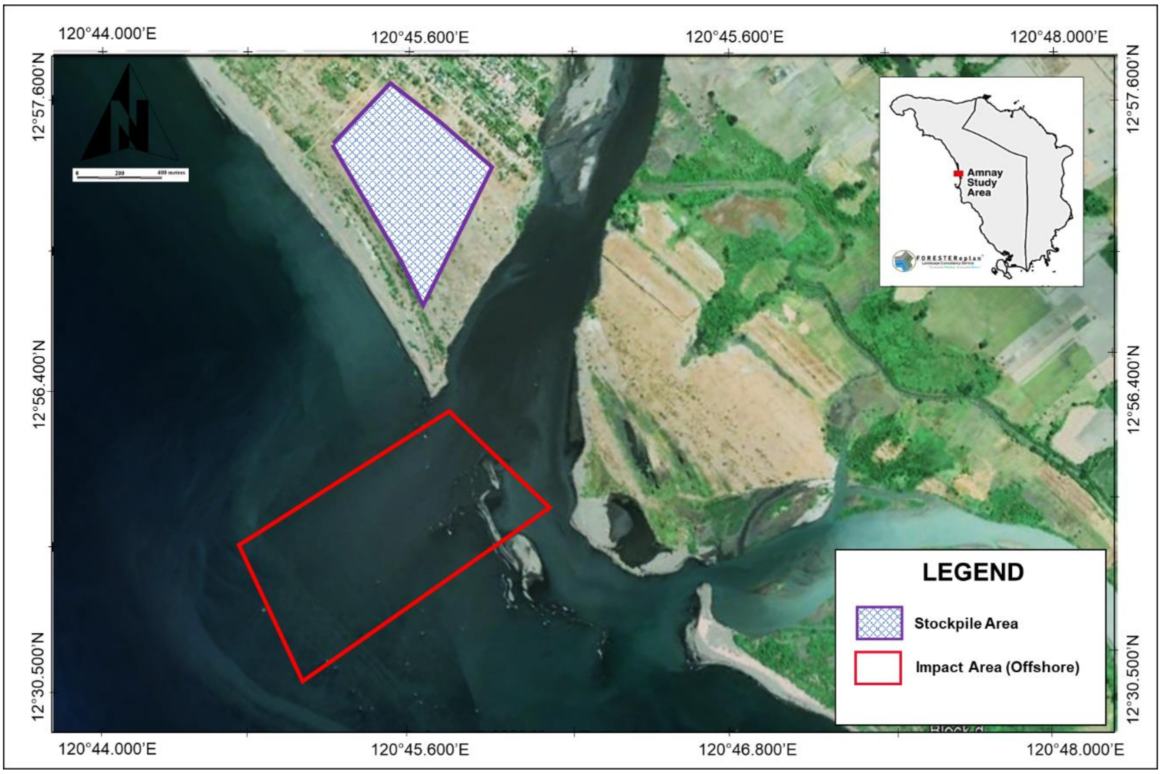


Figure 1.4.6: Location Map of the Stockpile Area

1.4.4.3 Dredging Equipment

Trailing Suction Hopper Dredger (TSHD) shall be the main equipment to be utilized with its appurtenances such as drag heads, suction pipes, swell compensators, pumps, transport tubes, overflow pipes, and hopper (storage). TSHD will be used to collect the sediments in the seabed such as mud, silt, sand, and gravel.TSHD's various components are as follows:

- Suction tubes & drag head
- Pump
- Transport tube
- Overflow pipe; and
- Hopper (storage)

Drilling rig with complete accessories and a floating bamboo platform will also provided during dredging operation.

1.4.5 Support Facilities

1.4.5.1 Temporary Port

A jetty port will be constructed to cater small vessels related to project operations. The jetty wharf will be constructed during the construction phase for transporting incoming machinery, equipment and materials. This permanent Jetty will be constructed for deliveries of light fuel and oil in bulk as well.

1.4.5.2 Motor Pool

A motor pool will be established to create avenue and spaces for service vehicles of the project such as vans, car and motorcycles. The space would also be housing for other equipment such as generators and other devices for operations.

1.4.5.3 Staff Quarters/Barracks

CPGI shall provide field offices, quarters/staff quarters/dormitories and workshops in the project area.

1.4.5.4 Administration Building,

The Administration Building houses the offices for operations management. These include the offices for the Plant Manager, Operations Manager, Maintenance Manager, Administration Manager, the Safety Officer/Pollution Control Officer, Environmental Consultant, Environmental Officer/ Auditor, Consultant Office of FTR, the Performance Engineer, the Planning staff and others.

1.4.5.5 Power and Water Supply

The power requirement for the project is minimal since the only facilities that need to be powered are the small office beside the dredge site and bunk houses during operations. In addition, an independent power supply, back-up electrical power supply is considered by provision of an emergency generator. This will supply critical equipment, essential control and protective functions required under abnormal conditions, such as a Safe Shutdown Earthquake (SSE) event.

Water supply and Fuel will be sourced from locally available supplier (e.g., use of gasoline for vehicles). For water supply during pre-construction phase, water shall be sourced from the local water district supply as well as from deep good pumps. The average water supply consumption per month is estimated to be around 30 cubic meters or 1 m^3/day since the only water requirement in the area is for quarters, office (e.g., administration building) and utilities use such as the motor pool and barracks.

1.4.5.6 Refueling

Refueling will be provisionary or incidental in the project area since dredgers are already fueled from the discharge or delivery sites before sailing in the project site. With the incidental or provisionary refueling, a temporary area for recharging the dredgers must be scheduled every 20 to 30 days because the designated dredging vessels must operate continuously. When dredge fill materials need to be dewatered or when a ship needs to dock at a jetty port or anchorage location for maintenance and repair, barges that may dock alongside the ship will refuel it.

The following special procedures and requirements if incidental or provisionary refueling will be conducted:

Before refueling

1. Ensure delivery is by authorized CPGI and licensed dredging operator;
2. Ensure the barge/vessel is moored securely and all systems are clear before refueling.
3. Ensure all engines are shut down and all batteries, devices and mechanisms are stopped.
4. Check all firefighting devices, systems and equipment and ensure it is to hand and available for use in case of fire incidents or emergencies.
5. Prohibit smoking, joking, dodging and ignition sources on or in the vicinity of the barge or vessels before refueling initiation.
6. Check spill kit, oil containers and barrels to ensure all components are readily accessible.
7. Agree on emergency shut down procedure and alerting system or protocols.
8. Check delivery hose for any damage or leaks that can affect the process or make contaminations; and
9. Adjust flow rate to suit tank size based on the dredging refueling procedures.

During & after refueling

1. Agree to the maximum amount of fuel to be dispensed to the tank for proper amount.
2. Maintain contact with the fuel nozzle and fill tank to avoid any static movement or anomalies of the system;
3. Constantly and check the sides of the vessel to monitor fill rate and to avoid overfilling and spread or contamination in vessel floor that could go to open water or sea.
4. Do not jam open the trigger on the filling nozzle that is part of the vessel.
5. Clean up all spillages with pads from spill kit and make sure that all areas within and outside the vessels are properly cleaned.
6. Ensure any used pads are suitably packaged for appropriate disposal to the ship or authorized/accredited transporter.
7. Wind up and store delivery hose for proper dismantling and disengaging on the vessel.
8. Ensure all caps are replaced on the tank/bowser for proper handling and process.

Mitigation measures

Booms for oil and gasoline spills will be kept at the ready in case there are any unintentional oil spills. In such a situation, the spilt oil will be collected by pumping from the seawater and stored in tanks or drums for onshore disposal at facilities approved by a third party.

Pollution from Wastewater and Oil from Dredging and Desilting Vessels

Transport and service ships may discharge or leak contaminated water with oil and oil during the course of activities. These pollutants may adversely affect various marine flora and fauna. To prevent this effect, it is highly recommended to include in the contract of transport and service ships a provision to dispose all forms of pollutants properly following internationally accepted conventions. Failure to follow this will result into some form of serious sanctions. Mitigating and preventive measures such as installation of curtains will be done.

Disturbance of Navigational Lanes of Fishers and Local Transport

Prior to offshore dredging, transport and service ships will be brought in the area. This may cause disruption to the usual navigation routes of fishers and local transport (if any) which can be interrupted. This impact can best be mitigated by meeting fishers and local transport and discuss to find mutually acceptable solutions. This disturbance is temporary in nature.

Impacts of the Project in Terms of Degradation of Coastal/Marine Water Quality

During pre-construction phase (opening of the delta) of the proposed ARRD Project, oil spills and water contamination is unavoidable if not properly controlled. Transport and hauling of dredged materials is also expected to increase small bancas (e.g., Traffic) within the project site. The resulting dynamics may increase the probability of oil spills. Hydrocarbon spills can endanger marine organisms both benthic and pelagic by smothering, clogging gills, and toxicity reactions. Likewise, without proper training and supervision, solid waste may be disposed or released off-vessel and wastewater from operators of dredging equipment and barge.

Accidental oil spills may also occur during operation or refueling of the vessels.

CPGI shall implement the following mitigation and prevention measures:

- Regular monitoring of water quality and deployment of additional sampling station in coordination with EMB-DENR;
- Provide sanitation facilities in the dredging operation or barracks site;
- Effective dredging management plans to prevent oil spillage based on approved dredging plan;
- Provide safe location of storage area for hazardous materials.

- Oil spill booms will be kept ready for use in an event of accidental oil spills. In such an event, the spilled oil will be recovered by pumping from the seawater, stored in tanks/drums for disposal on shore to third party accredited Disposal facilities.

To protect those organisms, marine and water quality test within the vicinity of the offshore area project will be conducted. The wastewater from domestic sewage will be treated to ensure that all discharges to the marine water comply with the DENR standard for Class SC Waters. Class SC water category is the nearest or appropriate classification that can be applied to the project site since the offshore area is suitable for recreational, commercial or sustenance fishing area. Proposed sampling stations in addition to the baseline for the areas will be conducted such as water quality sampling, marine, sediment, benthic, and other related parameters (**Figure 1.4.7**).

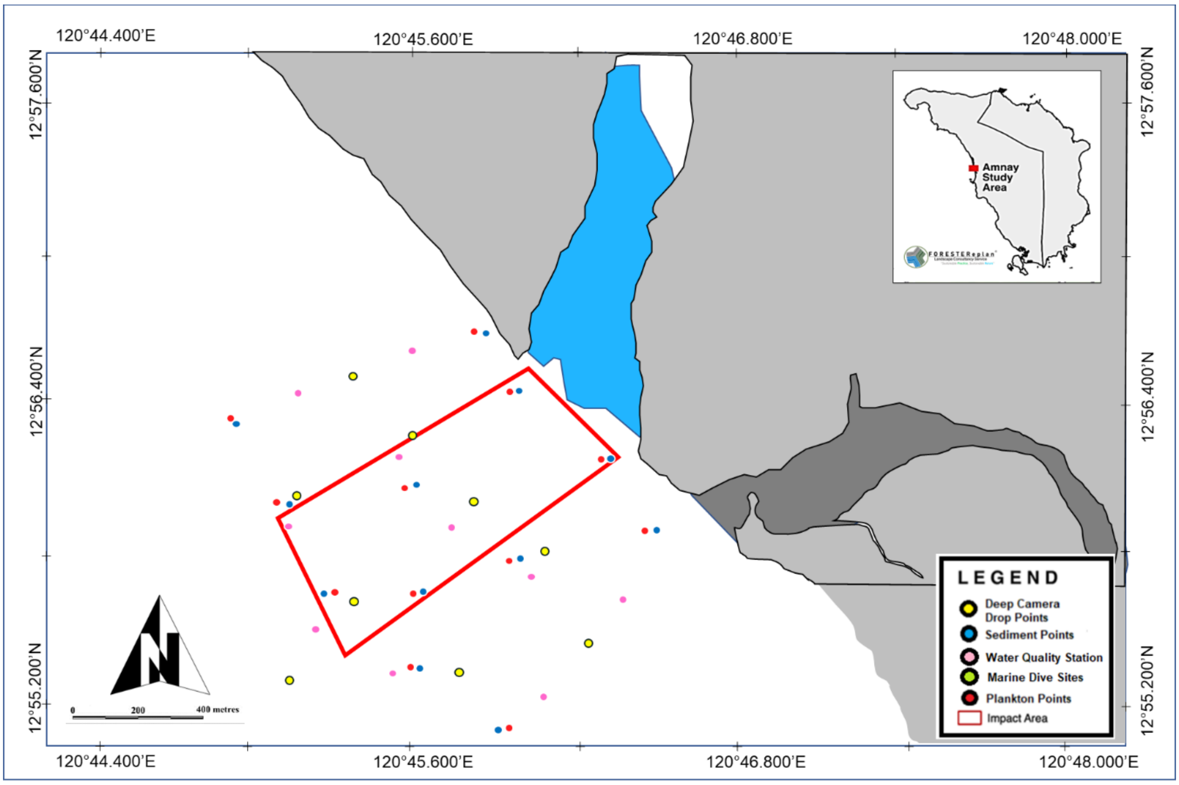


Figure 1.4.7: Integrative Map of the Proposed Additional Sampling Stations for Ecological Monitoring of the ARRD Project Offshore Project Area

1.4.6 Pollution Control Devices/Facilities

Waste collection transport and material recovery facilities shall also be encouraged to the local barangays. Transport of project hazardous waste is an activity requiring appropriate equipment and suitably trained staff. Recommended measures to prevent spills and release during waste transport. Follow applicable regulations and accepted standards for packaging, labeling and transport of hazardous materials and waste.

For all vessels, a Wastewater Treatment System including Sanitary Treatment System will receive and process all contaminated water, including but not limited to wastewater from oily effluents from vehicles and other equipment such as power generators; and sanitary wastewater.

- Oily effluents from processes, vessels and other equipment such as power generators;
- Sanitary wastewater from the buildings
- Chemical Wastewater from Water Treatment System

Collected contaminated water will be treated through Wastewater Treatment System and stored at a constructed pond for treatment (dredging basin). Potentially oil contaminated wastewater from the dredging vessels and ships will be stored and kept into tanks with treatment system. On the other hand, sanitary wastes will be collected separately from other wastewaters.

1.4.7 Silt Curtains

To mitigate the sediment dispersion resulted from dredging and desilting activities, silt curtains will be installed at the boundary of 109-ha offshore area surrounding all operating areas such as the dredging area, the OHA, and the water discharge point of the pumping area. Such full enclosures are typically associated with a higher silt containment and removal efficiency. Since the project involves an offshore location in open water, silt curtains will be constructed in all working locations, including the dredging area, the rehandling pit, the water discharge point of the pumping area, and the docking area prior to operation. The Philippine Coast Guard (PCG) standards or recommendations will serve as a reference for additional mitigating actions, such as the prevention of oil or gas spills from marine equipment. In order to prevent silt or other contaminants from the dredging work from spilling or spreading to the nearby body of water, silt curtains (**Plate 1.4.1**) will be constructed in all working areas. From the seafloor to the peak of the tide, the sand curtain will be erected (**Figure 1.4.8**).

To keep the silt curtain from slipping, the bottom half will be secured to the seafloor using large concrete blocks. In order to reduce the turbid area of the dredging operation, the upper portion of the silt curtain (floaters) will be anchored on buoys. The size of the dredging region affects how long the silt curtain is. The depth will be determined by the distance between the seafloor and the highest tide level in the water. Throughout the whole dredging process, silt curtains will be kept in place through scheduled maintenance and monitoring.

Image Source: 2022. North West Marine: Marine and Aviation Solutions
https://nw-marine.com/silt-curtains-and-turbidity-curtains/

Plate 1.4.1: Silt Curtain (Barricade) to Separate Sludge from Adjacent Water Bodies Surrounding the Offshore Dredging Area

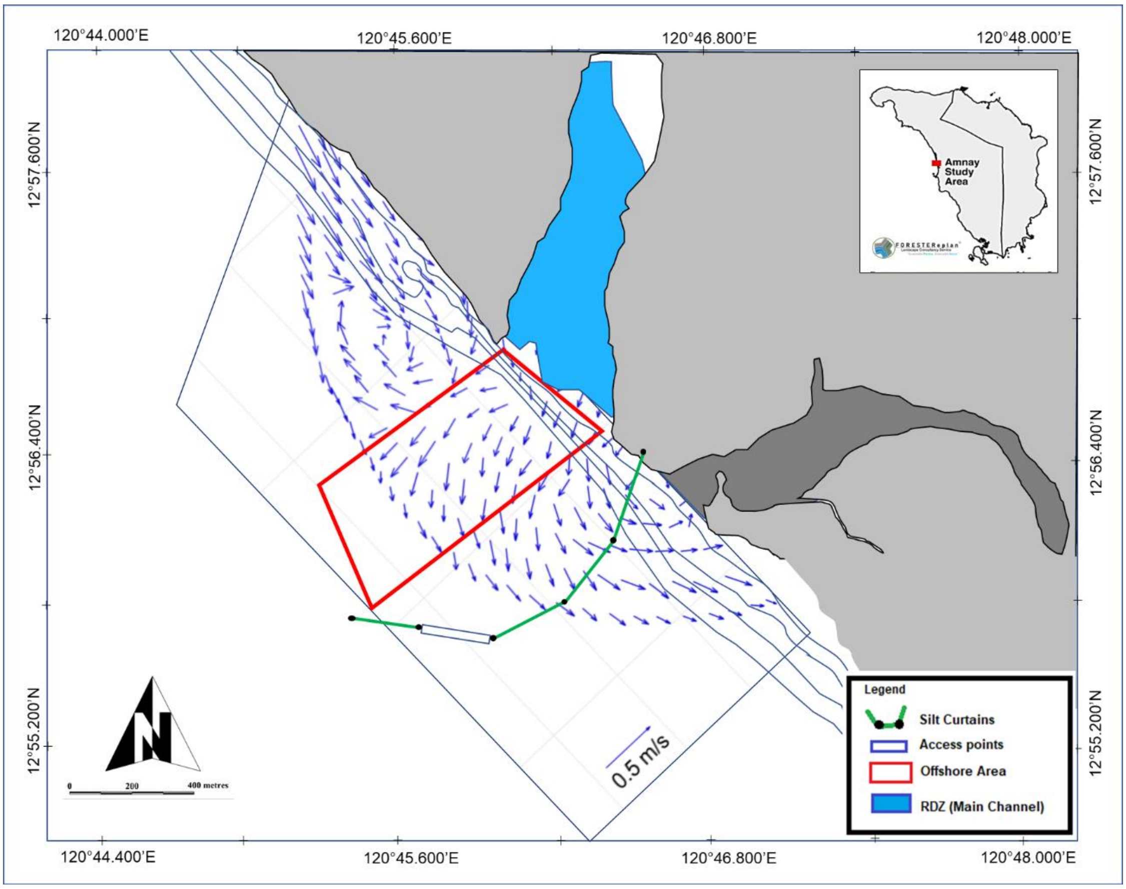


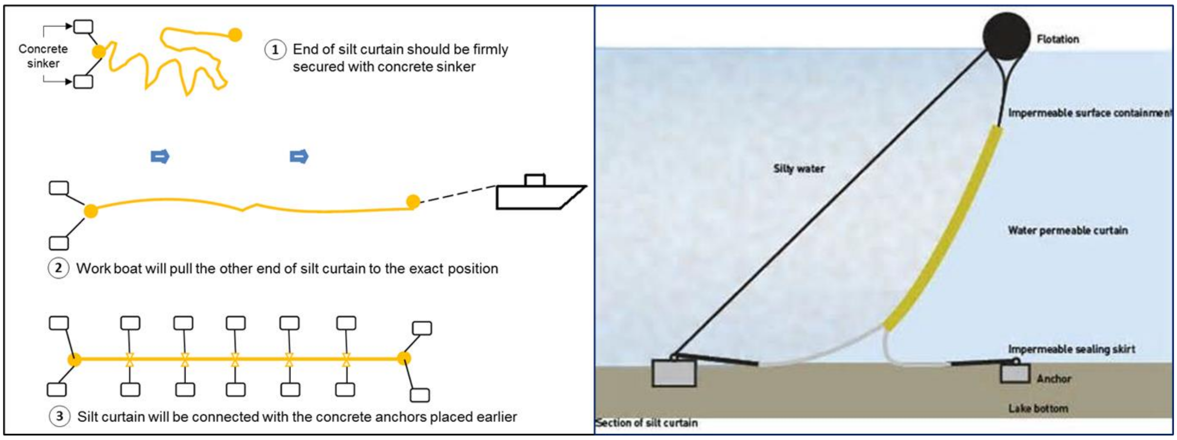
Figure 1.4.8: Indicative Location and Orientation of Silt Curtains to be Installed during Project Operation with Respect to the Movement/Water Current Velocity for Plumes

The silt curtain will be made of woven polypropylene material with a high tensile strength against the environmental forces caused by waves and currents, thus, very economical. The silt curtains will be first prepared on land and will come in 20 m sections. Curtains will be reinforced, stitched and joined together at the eyelets, and the joints will be strengthened by steel plate connectors on each section. The typical specifications of a silt curtain are presented in **Table 1.4.6**.

Table 1.4.6: Typical Specifications of a Silt Curtain

Material Description	Description/Capacity
Weight	600 g/cm^2 (minimum)
Thickness	0.90 mm (minimum)
Mean Wide Width Tensile Strength (wet condition)	100 KN/m (minimum)
Mean Tensile Extension at Maximum Load (wet condition)	15% minimum, 30% maximum Shrinkage under seawater: 0.20% (maximum)
Seawater permeability	7.5 x 10 cm^3/s (maximum)
UV Resistance	80% of mean strip tensile strength after 90 days prolonged exposure to sunlight
Installation depth	up to seabed

To install the silt curtains, concrete anchors will be positioned first on the seabed in accordance with the delineated dimension of the offshore area. From the seafloor to the peak of the tide, the silt curtain will be erected (**Figure 1.4.9**). To keep the silt curtain from slipping, the bottom half will be secured to the seafloor using large concrete anchors/blocks/sinkers. Chain slings are used to secure the curtain's one end to the concrete anchors. The segments between the curtain's two ends are joined to the corresponding anchors situated on either side of the silt curtain. In order to reduce the turbid area of the dredging operation, the upper portion of the silt curtain will be anchored on buoys/floaters to ensure that the silt curtain is always floating vertically. A work boat will be used to transport the other end of the silt curtain to the appropriate place for anchoring. The size of the dredging region affects how long the silt curtain is. The depth will be determined by the distance between the seafloor and the highest tide level in the water. The silt curtain may need to be moved as the dredging proceeds in order to meet project requirements.



Source: (a) Nik, et al (2018). MATEC Web of Conferences 203, 01016;
(b) Avalar Mining Corp. (EISR 2021- Proposed Seabed Dredging & Quarrying Project)

Figure 1.4.9: Installation of Silt Curtain

The silt curtain has one (1) emergency access point or entrance with a width of 300 m. The upper area is open for all vessels positioned to located in the northern section of the dredging area, while the silt curtain has an emergency access point to serve as entrance provisionary for marine access, emergency access and operational need of the project as well as for PCG monitoring and fisherfolks provisional access. It should be noted that the access point is to be used for provisional pass and will not be open during operation. Depending on the need to discharge outlet and the silt curtain, its location and its access point may need to be moved in accordance with the project requirements or need as the dredging and desilting process advances or necessitate and be reported to monitoring bodies.

Prior to the commencement of dredging and desilting works as well as the whole pre-construction period of the offshore area/delta for navigational purposes, silt curtains will be deployed before the operation as part of the pre-construction activity. Silt curtain will act as a measure to maintain the water quality in the vicinity of the dredging works. The contractors will also be responsible to remove the aforementioned silt curtain after the completion of the works. A layer of geotextile put on the temporary working platform and extended to the seabed level is what makes up a general type silt curtain. It is held in place by steel chain ballast. By attaching the silt curtain to the area railing (offshore section), it will enclose the area two trapezoidal dredging block. Through a series of grommets, the panels can be strung together and joined by rope. The winching rope for adjusting curtain depth as needed is positioned between overlap.

CPGI will install the silt curtain as stated in the work plan in **Table 1.4.7**.

Table 1.4.7: Workplan for the Installation and Monitoring of Silt Curtains

Procedure/Work Plan	Year 1				Y2	Year 3	Year n
	Qtr.1	Qtr.2	Qtr.3	Qtr.3			
Installation and Guidance							
Preparation of the geotextile with size suitable for the specific platform size on the barge.							
Tying of the top end of the geotextile and connected to the reinforced belt, the bottom end with the steel chain ballast							
Rowing up the top part of the silt curtain to the specific length suitable for the lift up distance.							
Lifting the silt curtain up and place it above the temporary platform, to ensure the bottom part of the silt curtain is surrounding the platform							
Lifting down the silt curtain with steel chain ballast into sea and sit on seabed. Workers with life jacket then tie the geotextile with the temporary platform by Steel plate							
Monitoring and Maintenance							
Revitalization and Repair							
Inspection & Rectification Works							
Decommissioning							

In order to maintain the position of the silt curtain especially at location with strong current, spot check will be carried out for each silt curtain before and after works every quarter. CPGI's environmental team will also conduct and submit weekly inspection with the supervisor throughout the periods of marine piling and pile cap construction to the Project Manager or Supervisor to demonstrate that the silt curtains are in good working conditions. Diver inspection would be carried out once per every three months or if necessary, such as after the adverse weather and any unforeseeable condition which might damage the silt curtain physical condition to ensure the bottom of the silt curtain is well placed on the seabed level and no damage of silt curtain under water.

For the maintenance, onboard competent environmental unit/team (EMU) with the PCO and CPGI environmental supervisors will be assigned to check the condition of the silt curtain before commencement of works every day. An inspection checklist will be prepared and filled in by the EMU and EUT supervisors. All checklists will be kept on site for record purposes and reporting with MMT and to EMB. For the tentative arrangement of silt curtain under adverse weather, the silt curtain will be removed temporarily as related works will be suspended immediately during adverse weather events until the silt curtain is and installed again. Refuse around the silt curtains will be collected at regular intervals on a daily basis so that water behind the silt curtains will be kept free from floating debris. Sufficient spare geotextile will be kept on site for replacing of damaged silt curtains. The spare geotextile shall be kept in place to avoid direct contact with water and sunlight. Removal of silt curtain shall be carried out by the contractor and CPGI. Actions upon repositioning of silt curtain will be same as deployment of a new silt curtain. The condition of the silt curtain will be jointly inspected with the CPGI environmental team and its contractor before relocation to the new position. In summary, during the dredging process, silt containment curtains will be placed in key areas as identified in the previous discussion.

1.5 SCHEDULE OF DREDGING

1.5.1 River Dredging Zone and Offshore Area

The commercial operations period is expected to commence in May 2023 and last until 2039. Preliminary activities will include site preparation (~2 months). The project will be operational for 18 years.

The total dredging operations is estimated to take place from 220 to 270 days a year; downtime due to weather may account to about 3-4 months. Considering a yearly production rate of 2,284,707.13 m^3, the total dredging operations will take some 15-18 years. This is the optimistic and projected scenario where all the dredge ships will operate almost continuously and with minimal weather delays. The timeline schedule in bar chart of project is presented in **Figure 1.5.1**.

No.	Activities/Schedule of Activities	Year 0				Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	...	Year 18
	Pre-Development/Development	Q1	Q2	Q3	Q4								
1	Site Status and Clearing (IEC)												
2	Procurement of vehicles and equipment												
3	Area rights/leases, permitting and clearances												
	from government agencies and companies												
4	Organizational expenses												
	Preparation for Dredging												
1	Call for tender bids												
2	Selection of dredging contractors												
3	Engagement of Selected Contractors												
4	Opening of Delta/Creation of Navigational channel												
	Operational Stage												
1	Dredging operations												
2	Dredging 14-km RDZ (Pilot channel)												
3	Dredge and Replenishment Assessment Reporting to EMB, MGB and DPWH Monitoring and Reporting												

Figure 1.5.1: Proposed ARRD Project Schedule

1.5.2 Offshore Maintenance Dredging

Maintenance dredging involves the removal of sediments that have built up in existing channels, berths, approaches, and associated swing basins. It is a vital component of dredging operations in the river delta of Amnay River. Channels, delta and offshore basins naturally shallow over time due to siltation and sediment transport processes. Maintenance dredging is required to maintain designated channel and berth depths to ensure the continued efficient passage of vessels utilizing the port. Most ports cannot sustainably function without maintenance dredging, and maintenance dredging has occurred in Queensland since ports were first established. Maintaining the channel and the river delta depths at an appropriate level is required to allow for safe access of dredging vessel as well as maintain barriers against ecological dynamics, all requires maintenance dredging. **Figure 1.5.2** shows the illustrative scenario of the offshore seabed showing the sediment build-up diagram. The offshore area is required to maintain a safe shipping channel and harbor to provide an efficient navigational working area for the vessel equipment. This program will also help to reduce wave action towards the river mouth.

Dredging to maintain navigation depths is critical to the effective operation of vessels and dredging equipment to facilitate RDZ dredging via TSHD and CSD. Maintenance dredging is different to capital dredging (pilot channel). Capital dredging involves the excavation and desilting of the RDZ for the first time to create or expand navigation channels, and provide corrective flow of the river system, while maintenance dredging are areas intended to stabilize and maintain certain depths that are frequently supplied by sediments and river-run materials such as river delta or offshore area.

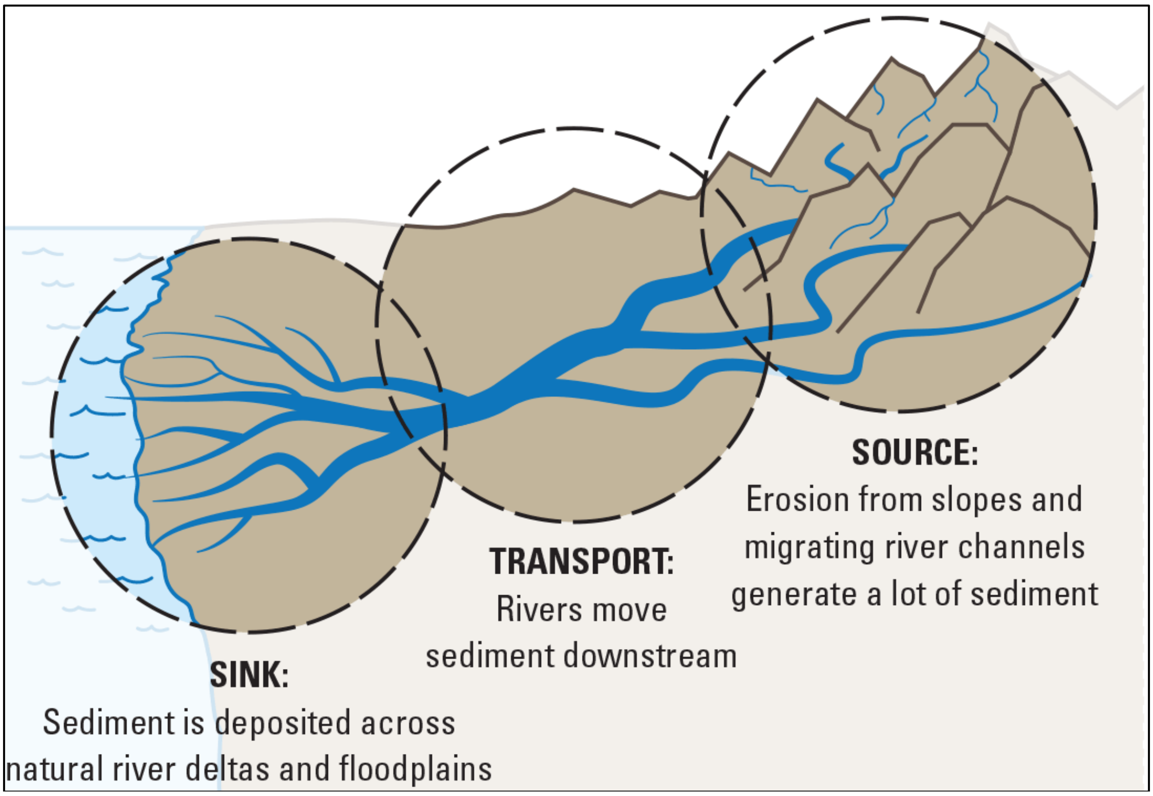


Image Source: USGS, Pacific Coastal and Marine Science Center (2010)

Figure 1.5.2: Sediment Diagram Representing the Scenario for Replenishment of RDZ and Offshore/Delta

Sediment is the sand, mud and pebbles that once were solid rock. In Amnay River, sediment flows in tributary streams and river networks of the main Amnay River Basin of which the processed would be (following *USGS, Pacific Coastal and Marine Science Center* (2010):

(1) Source: Erosion from slopes and migrating river channels generate a lot of sediment;
(2) Transport: Rivers move sediment downstream; and
(3) Sink: Sediment is deposited across natural river deltas and floodplains.

On the other hand, maintenance dredging is recurrent dredging to maintain or improve existing waterways or specifically, the river delta in accordance with the IAC Resolution No. 17, S. 2022, which provide rationale for the river mouth deposit removal within heavily-silted river channels in Occidental Mindoro such as the Amnay River Delta. After river delta clearing, even if a number of years pass between consecutive dredging activities, possibilities of vessel grounding due to unmet required draft of the vessels for navigational passage would occur. For the navigational passage and clearing, dredging vessels has an average of 8-10 m and a maximum of 15 m when loaded. In this case, the bathymetry of the offshore area should be maintained at the specified height to be able to pass through the identified navigational channel. **Figure 1.5.3** natural sediment buildup in the river delta and offshore seabed after opening of river delta and offshore clearing. It is hypothesized and modelled that river delta and the offshore area would maintain its depth for a short period of time and accretion and sedimentation would follow, creating sand river-run materials replenishment and seabed supply in both delta and the offshore area including some areas in the junction of Amnay River. With the massive force of tidal waves and river flow, the strip of land formed by deposition of sediment via longshore drift at the mouth of a river will continuously occur. **Figure 1.5.4** shows location of sand accretion and points in the project components and the location of sections of offshore/delta subject to preventive or maintenance dredging.

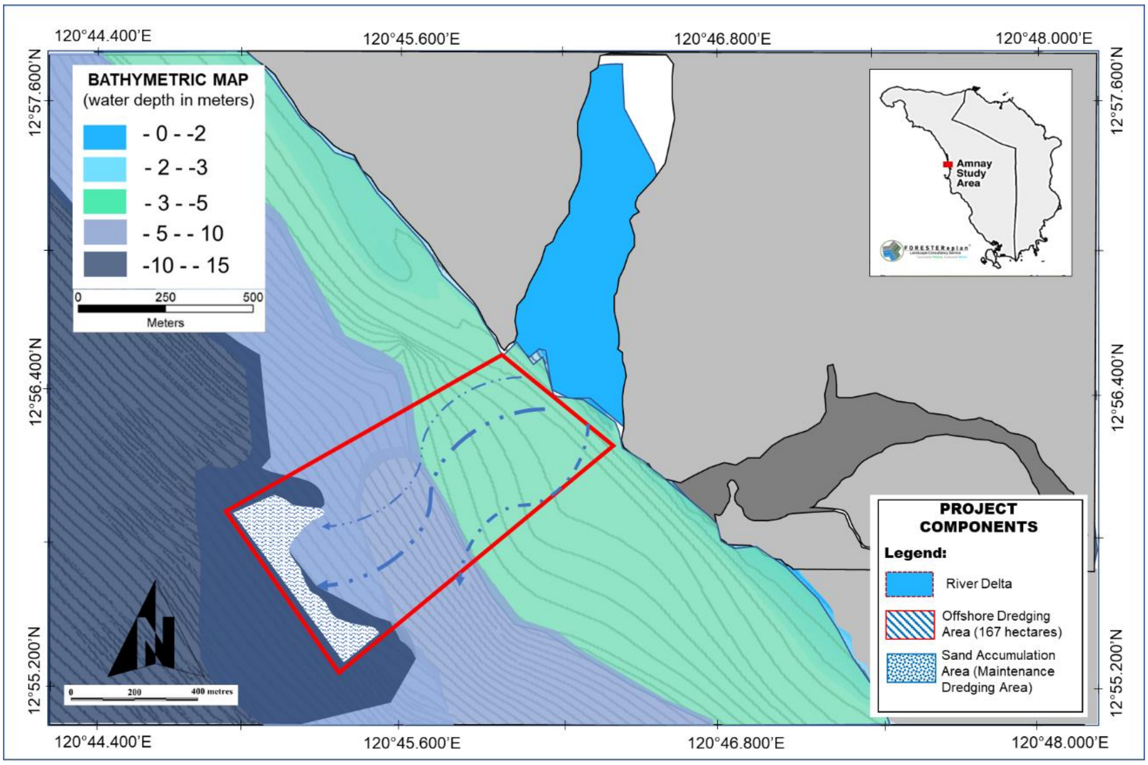


Figure 1.5.3: Natural Sediment Buildup in the River Delta and Offshore Seabed After Opening of River Delta and Offshore Clearing

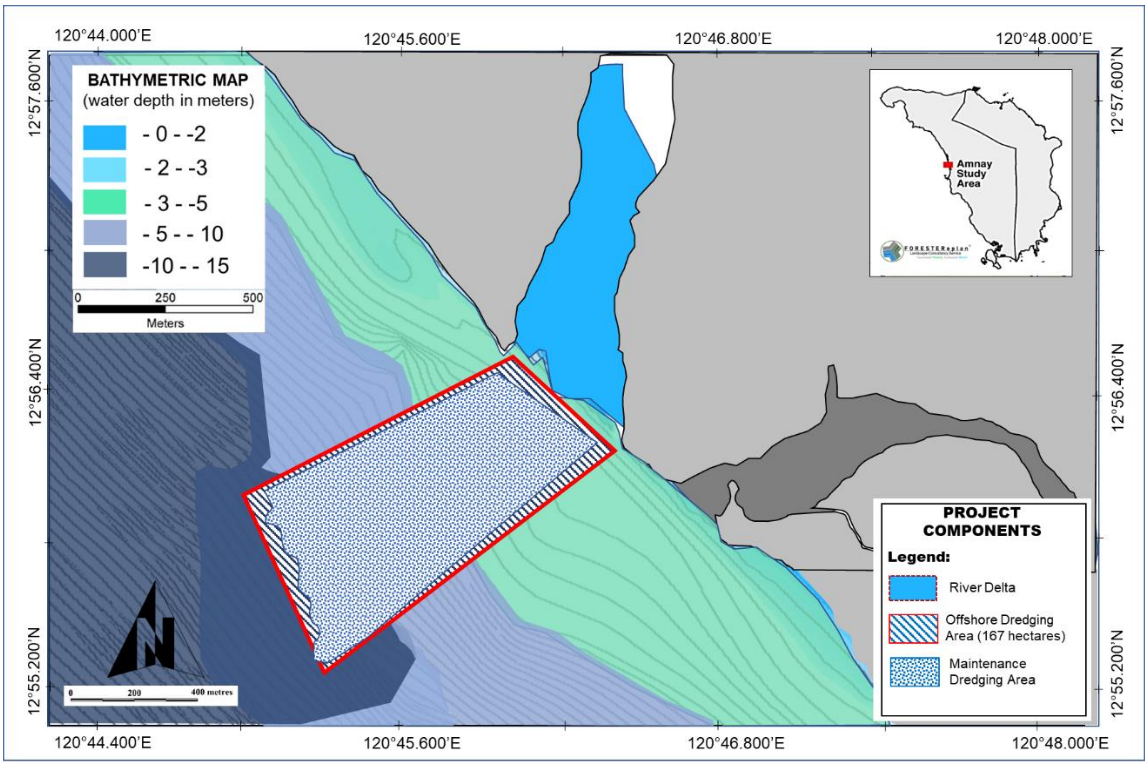


Figure 1.5.4: Project Components of the Offshore Area including the Maintenance Dredging Area

1.6 GENERAL STAGES OF DEVELOPMENT AND ACTIVITIES

1.6.1 Project Phases

1.6.1.1 Pre-Construction Phase

The activities during pre-construction phase involve preparation of engineering plans and design, and securing all regulatory requirements, such as environmental compliance certificate (ECC) from EMB, and corresponding local permits and clearances from MGB and DENR. Pre-construction activities within the project site entail the conduct of detailed bathymetric surveys to determine the configuration of the shoal and drilling of the exploratory holes and to ascertain the nature and properties of the various layers of sediments. These activities create localized and minor disturbance of the sediment layers. The major pre-construction activities also include the opening of delta (offshore dredging) and decloging of sand deposit at the dimension of 1.8-km by 3-km, of which maneuvering of TSHD for positioning of suction will be conducted.

CPGI will adopt the process technology of digging – transporting – filter and separation for offshore dredging. The offshore dredging operation will be conducted using twelve (12) TSHD. At any one time during the dredging and desilting works, four (4) TSHD are projected to be doing the dredging and the rest on the disposition of fill materials to the reclamation site. Thus, the two (2) CSD shall be used concurrently once the offshore and river delta were levelized to dredge the river delta going to RDZ and assisted by hopper barges that will deliver the dredge fill materials to identified delivery site. The TSHD will be used primarily for removing blocking sand and gravel in the offshore area. This sand deposits further blocks the river mouth and offshore of which small vessel equipment such as CSD cannot enter the RDZ for dredging operations. In order to provide clear and wide navigational channel, the dredging method to be employed is dredging using suction dredgers. The objective is to remove silts and fine sand in conjunction with the TSHD. Removal and clearing of sand materials via TSHD as pre-construction activity will include 109-hectare area from the shoreline since the bathymetric conditions within the identified area are varying. Within the delineated area, the bathymetry of the offshore enclosed is concentrated at varying depths from 1- -5 to -5 -10, and -10-15m. With this condition, dredging vessels cannot acquire enough space and clearance to make contact within the area to do dredging and desilting.

The following procedures are shown and summarized in **Figure 1.6.1**.

1. **Entry of TSHD to Offshore Area at Designated Delta.** Deployment of TSHDs for preparatory set-up and positioning to identified dredging points based on bathymetry and leveling down offshore area and river mouth. This includes the lowering of studs and mechanisms for positioning of the vessel on the right direction guided by the GPS where the bathymetric dredging points are located. The designed draft of the dredging ship when fully loaded shall be considered taking into account the water depths in the area ranging from 10-13 m. The dredge's internal, highly precise navigation systems are used to direct it as it travels to the offshore dredging location at the beginning of the dredging cycle. The hopper dredge is treated like a typical cargo vessel at this phase of the dredging process.

2. **Positioning of drag heads and lowering at strategic locations and lowering down of trailing arm**. This step is the commencement of dredging operation and desilting activity. Lowering down and positioning of TSHD trailing arm and drag head for dredging designated sections for navigational pass and working area. An RTK-DGPS system is installed on the TSHD to control the dredge's position. The TSHD additionally includes an automatic suction head control mechanism to ensure the correct dredging depth.

3. **Dredging of the identified sections for navigation and working area (dredging and desilting works) for deepening**. Dredging of the designated areas for deepening and navigation. At the bottom end of the suction tube, a specific drag head is attached which is designed for maximizing the dredging production during the loading phase. The sand pump, which is typically housed in the pump room of the dredge's engine rooms, provides the suction power. An underwater pump installed on the suction tube itself can also be used to power the suction. High dredging productions at deeper water depths are made possible by

this underwater pump. The hopper dredge will maintain a slow trailing speed throughout the dredging process while the drag heads are on the seabed. The type of materials being dredged will determine the trailing speed. The materials will be pushed into the hopper as a soil/water mixture after being so removed (dredged) from the seabed. Water content in the mixture will be kept to a minimum level. The highly automated dredging process is managed by specialized personnel. Each accountable for their own control, the dredge master and the navigating officer will work closely together. All conceivable dredging parameters are covered by the computerization, including hopper levels, drag head positions, engine and pump loads, and dredging products.

4. **Self-loading (Pumping of Soil Through Suction Pipes**). A powerful centrifugal pump known as the dredge pump powers each of the one or two suction tubes that make up a hopper dredge's dredging system. The bottom ends of the suction tubes are trailing along on the seabed while the sand pumps give the suction power to pull the materials from the seabed into the hopper during the dredging operation, which is quite similar to residential vacuum cleaning. The suction tubes will be raised over the side and lowered to the bottom as the hopper dredger draws closer to the dredging spot, Once the hopper is fully loaded, the pumping mechanism is turned off, and the suction head is raised from the bottom. The suction pipes will be elevated and fastened on deck. After loading, the TSHD leaves the dredging area and proceeds to the area where the load will be unloaded. Another batch of TSHD will take over to dredge the remaining area.

5. **Hauling of Dredge Materials to Designated/Identified Sites.** TSHD shifting and schedule turn over time would have delays and idle time depending on the dynamics of weather, sailing time and manpower (delivery of materials to designated discharge sites). Another set of 4 TSHD will be deployed to dredge the area from the shifting.

6. **Preparatory activities for the Entrance of CSDs to River Mouth.** Due to inability of TSHD to dredge the RDZ, a specialized vessel called CSD will make the entry to the delta and river mouths. CSD will be assisted by pelican or hopper barge to pump sand materials via discharge hose connected to the CSD while dredging going to the area where the barges are position, thereby creating the OPA. Hopper and pelican barges will function as alternative mode of loading/delivery to identified sites. This saves TSHD (while on sail) idling time proceeding to deployment of sand materials to sites and staging during weather events. The objective is to desilt, therefore planned volume of sand must be achieved.

7. Positioning of Pelican or Hopper Barges to Standby Offshore Near the Delta and OPA. These vessels are positioned to assist the CSD inside the river delta, as CSDs were the only vessel that can dredge the mouth going inside the RDZ. CSD are capable of sweeping materials from the riverbed based on the dredging plan and will supply the needed materials via its discharged hose connected to it going to the offshore. The output of CSD will then be suctioned by the standby carrying vessels. Discharge sand coming from the CSD will be the sea-based stockpile or offshore placement area.

8. **Peripheral delta is cleared, and draught is achieved, CSD entrance to river delta commence.** After opening the blocking sand at the periphery of the delta up to 200m, CSD will make the entry point to the river delta, since the required draught is achieved for both dredging vessels in order to operate dredging in the RDZ. With a suction pipe connected to the hopper and pelican barges, 4 CSD will suction river-run materials from the river mouth going to upstream. However, this procedure will be step by step process with a phasing of 200-500 m per phase of CSD. This will take the dredging life cycle indicated in the workplan. This is a provisionary section for offshore handling or placement area with a size of 50 ha

9. **Creation of OPA.** OPA is a temporarily stage sand materials that are dredged by CSD when all sand carriers are out for sailing and delivery to discharge sites. OPA will also serve as artificial tidal break maintaining acceptable water level in the section far away from the river delta. Eventually, the OPA will also be suctioned by TSHD once sand carriers arrived. Overall, OPA will maintain continues operation in opening the offshore and delta for navigational purposes.

10. **Dewatering of Sand Materials on Hopper Barges**. After suction of CSDs going to barges, dewatering will commence within the pelican barges from the uptake of sand materials both from OPA and CSD. Dewatering will be 3-4 hours and proceeding to discharge sites. Allowing some spillage is quite cost-effective. This indicates that the excess water is released via an adjustable overflow mechanism, while the soils in the dredging soil/water mixture will settle in the hopper owing to gravity forces. The overflow, which is integrated into the hopper, consists of a vertical cylinder with an end under the keel of the dredge and a height-adjustable funnel mounted on top of it. By discharging extra water at the lowest level possible—under the dredge—fines are spread out into the surrounding seas to the least amount conceivable. Additionally, the overflow's design prevents air from getting trapped in the water, resulting in the least amount of turbidity possible.

11. **Sailing to the discharge / dumping point.** As soon as the hopper dredge is fully loaded, the suction tubes will be hoisted back onboard, and course will be set towards the area for unloading the hopper dredge. During this transit, the hopper dredge is sailing as a regular cargo vessel. A new dredging cycle can commence by sailing back to the dredging area.

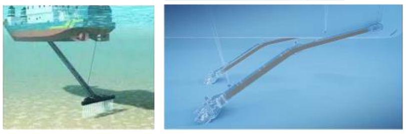
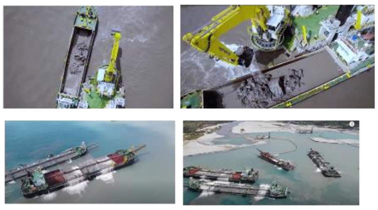
Process/Procedure	Equipment involved	Process Description
1 Entry of TSHD to Offshore Area (1.5kmby2km) at designated deltas		Deployment of TSHDs for preparatory set-up and positioning to identified dredging points based on bathymetry and leveling down offshore area and river mouth.
2 Positioning of drag heads and lowering at strategic locations and lowering down		Commencement of dredging operation and activity. Lowering down and positioning of TSHD trailing arm and drag head for dredging the designated sections for navigational pass and working area.
3 Dredging of the identified sections for navigation and working area (dredging and desilting works) for deepening		This is the first stage of the dredging and desilting activities. In order for vessels to make contact to the river delta and dredge RDZ, TSHD must clear and achieved certain level of water depth vis-à-vis required draught and its related assisting component vessel (leveling of seabed depth).
4 Self-loading and (Pumping of soil through suction pipes)		At this point, TSHD is also self-loading and will sail to designated discharging area. However, by the time it reaches its loading capacity, another batch of TSHD will take over to dredge the offshore area and delta.
5 Hauling of dredge materials to designated/identified sites		TSHD shifting and schedule turn over time would have delays and idle time depending on the dynamics of weather, sailing time and manpower. (delivery of materials to designated areas) Another set of 4 TSHD will be deployed.
6 Preparatory activities for the entrance of CSDs to river mouth		Due to inability of TSHD to dredge the RDZ, a specialized vessel called CSD will make the entry to the delta and river mouths. CSD will be assisted by pelican or hopper barge to pump sand materials via discharge hose connected to the CSD while dredging going to the area where the barges are position, thereby creating the offshore placement area (OPA).
7 Positioning of Pelican or Hopper barges standby offshore near the delta and OPA		Hopper and pelican barges will function as alternative mode of loading/delivery to identified sites. This saves TSHD (while on sail) idling time proceeding to deployment of sand materials to sites and staging during weather events. The objective is to desilt, therefore planned volume of sand must be achieved.
8 Peripheral delta is cleared, and draught is achieved, CSD entrance to river delta commence		After opening the blocking sand at the periphery of the delta up to 200m, CSD will make the entry point to the river delta, since the required draught is achieved for both dredging vessels in order to operate the RDZ. With a suction pipes connected to the hopper and pelican barges, 2 CSD will suction river-run materials from the river mouth going to upstream. However, this procedure will be step by step process with a phasing of 200-500 meters per phase of CSD. This will take the dredging life cycle indicated in the workplan.
Creation of offshore handling area or placement area (OPA)		This is a provisionary section for offshore handling or placement area with a size of 50 hectares. The purpose of Offshore Placement Area (OPA) is to temporarily stage sand materials that are dredged by CSD when all sand carriers are out for sailing and delivery to discharge sites.
9 Dewatering of sand materials on hopper barges Sailing to the discharge / dumping point		After suction of CSDs going to barges, dewatering will commence within the pelican barges from the uptake of sand materials both from OPA and CSD. Dewatering will be 3-4 hours and proceeding to discharge sites.

Figure 1.6.1: Schematic Diagram of Work Procedure of Dredging and Opening of Delta for Offshore Navigational Works

1.6.1.2 Construction Phase

Construction phase will involve construction and installation of the support facilities such as motor pool, staff quarters/barracks, administration building and power and water supply. In addition, transport of dredging vessels and other equipment needed for the operation of the proposed ARRD Project will be conducted during this phase.

1.6.1.3 Operation Phase

1.6.1.3.1 Dredging Equipment

The process technology includes dredging by suction, vessel loading, and transporting of materials to the different locations based on the bathymetric points showing high concentration of sand materials blocking the river mouth.

To clear the blocking sand within the river delta and offshore, the appropriate position to place the suction trail within the permit area will be determined to be able to systematically dredge and remove sand and silt blocking the offshore based on the bathymetry of the area (**Figure 1.6.2**). The stated dimensions of the offshore are required to place the TSHD neatly providing the vessel enough space and area to maneuver and remove sand efficiently in the designated and identified entry points. This entry points in the river mouth when cleared would create a passage for small vessels particularly CSD to pass through the river mouth and commence dredging within the RDZ up to 13-km from the boundary of the buffer zone or assisted by backhoes and other land-based equipment. When TSHD reaches the dredging area, it will slow down and throw the trailing suction pipes overboard. The suction heads at the end of the trailing suction pipes will be kept a few meters above the bottom until the required vessel draught is reached. Once it is close to the designated suction point, the dredge pumps will be turned on. The dredge pumps will be able to start pumping sand materials. When seawater is sucked in but does not yet reach the soil, it is either thrown back out to sea or, in some cases, it is allowed to remain in the hopper. The dredged material is then given time to dewater and consolidate.

As soon as the suction heads make contact with the seabed and bottom material is dragged via the suction heads and trailing pipes, the dredger operator will close the pump overboard valve to funnel the soil mixture into the hopper and prevent spilling of dredged material. Further, TSHD can make contact up to 200 m from the shore going to the inner most portion of the river mouth at depths of maximum of 10 m.

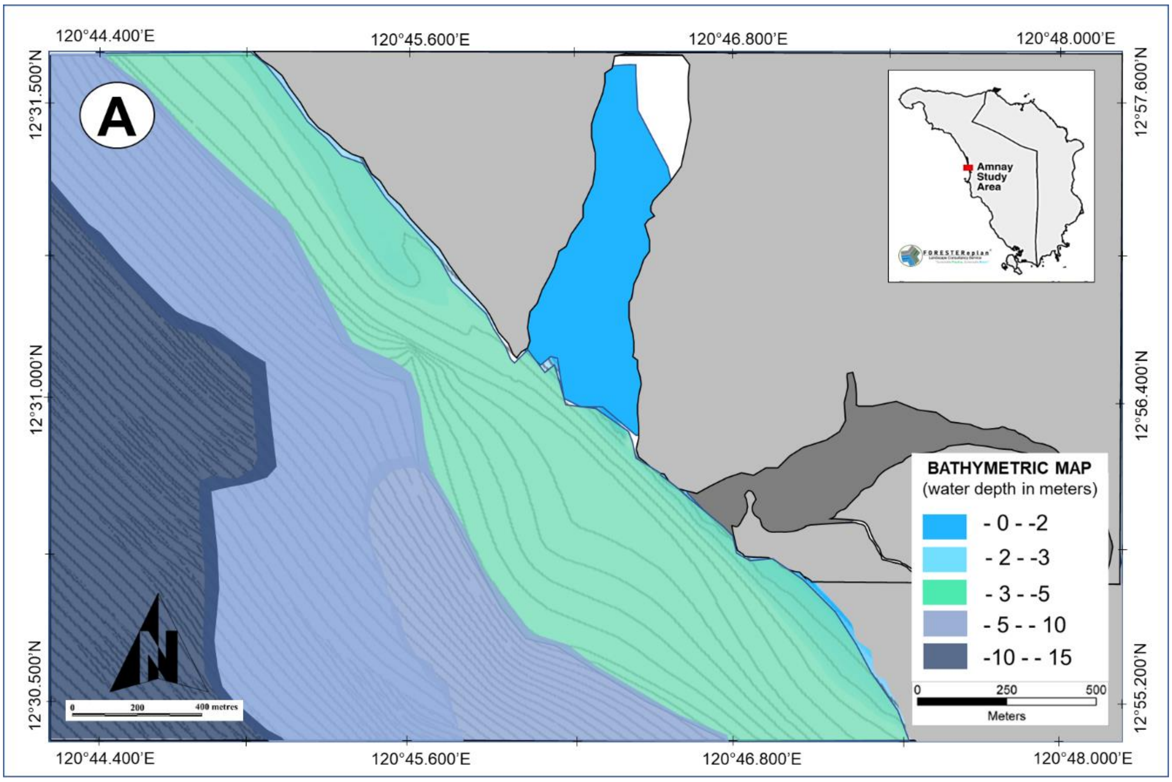
The following TSHD vessels may be utilized for the dredging operations:

1. Prins Der Nederlanden — Tonnage: 23,718
   Max. dredging depth: 92.0 m
   Dredging draught: 13.7 m
   Hopper capacity: 22,205 m^3

2. Fairway — Tonnage: 33,423
   Max. dredging depth: 70 m
   Dredging draught: 13.5 m
   Hopper capacity: 35,500 m^3

3. Queen of Netherlands — Tonnage: 33,423
   Max. dredging depth: 67 m
   Dredging draught: 13.5 m
   Hopper capacity: 35,500 m^3

Trailing Suction Method of dredging will be used to spread and minimize the potential environmental impacts of dredging and desilting as opposed to suctioning without mechanism or safe means while the ship or vessel is on anchor. This is done in a commonly manner known as interconnection deposits minimization, such as sand or weakly cemented granular deposits which are present in the river as output of the mechanism.



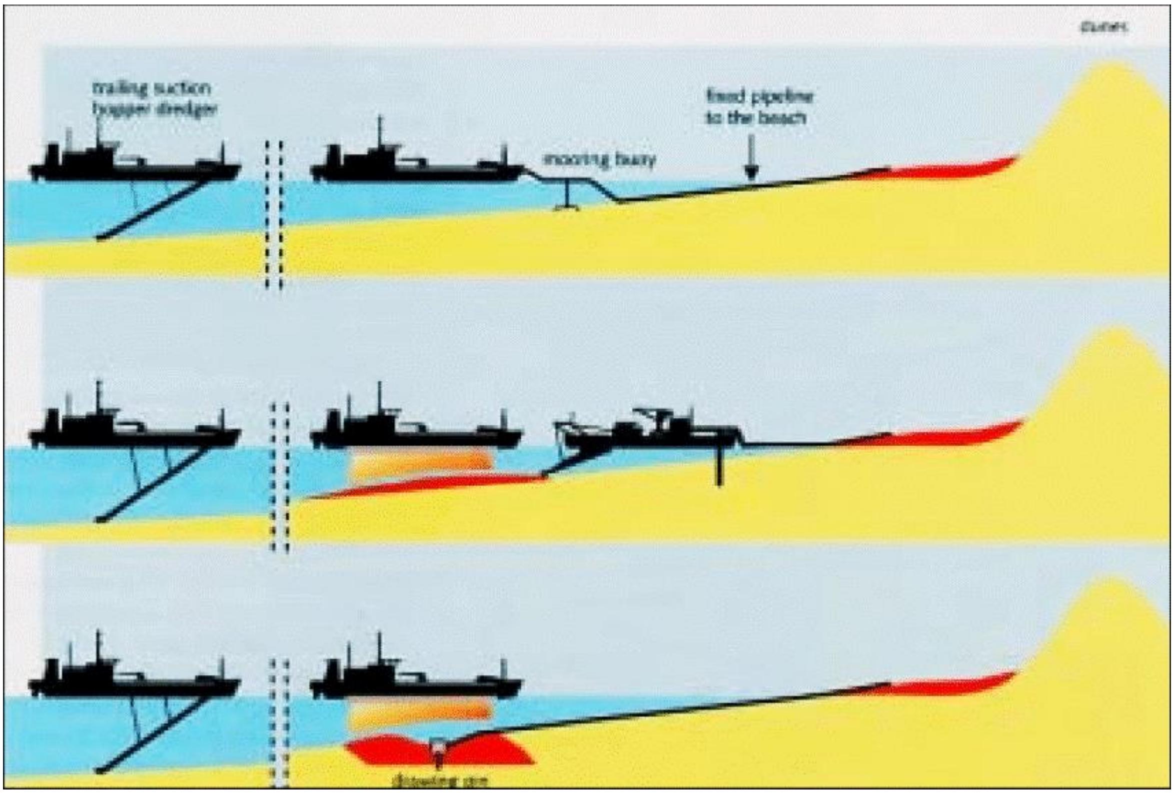
Note: Only sections with -10 m level depth will be dredged for navigational purposes.

Figure 1.6.2: Bathymetric Map of the 109-hectare Offshore Dredging Area of Amnay River

TSHD shall be the main equipment to be utilized with its appurtenances such as drag heads, suction pipes, swell compensators, pumps, transport tubes, overflow pipes, and hopper (storage). TSHD is a hopper vessel with a trailing arm put off over the side and dragged over the riverbed. **Figure 1.6.3** shows an illustration of a trailing suction dredger. TSHD will be used to collect the sediments in the seabed such as mud, silt, sand, and gravel. TSHD's various components are as follows:

- Suction tubes & drag head
- Pump
- Transport tube
- Overflow pipe; and
- Hopper (storage)

Drilling rig with complete accessories and a floating bamboo platform will also be provided during dredging operation.



Source: Sistermans, et al, 2012

Figure 1.6.3: TSHD and CSD and their Mechanisms for Dredging

The vessel usually condensates forward at around six (6) knots or about 11 km/hour, automatically recompensing for swell and water movement differences while maintaining the drag head (scour arm) in contact with the riverbed by means of a computerized hydraulic system. The water/sand mixture is drawn on board by powerful pumps, passed through a series of decanters and the solids deposited inside the internal hoppers whose capacity ranges from 2,000 to more than 25,000 cubic meters (m^3).

In this specific project, the ships to be used will have capacities of between 10,000 m^3 to 20,000 m^3. The relatively clear, decanted seawater is dumped overboard. The maximum dredging depth without intermediate pumps is around 35m. With one or even two intermediate pumps the dredging depth may be extended to 80m and 120m. These dredgers are fully automated and dredging generally takes place over a 24-hour period, continuously.

The advantages of trailing suction dredgers are:

- minimum interference to sea traffic;
- versatility in handling both cohesionless and cohesive sediments;
- the dredged load may be pumped ashore as reclamation; and
- constructed in various sizes to suit most project sizes.

The disadvantages are:

- the final dredged depth is less precise, necessitating some over-dredging; and
- mobilization costs can be considerable

1.6.1.3.2 Trailer Suction Hopper Dredger (TSHD)

The dredging operation is scheduled for 20 hours per day at 26 days per month. There will be two shifts with each shift covering 10 hours per day. **Table 1.6.1** presents the activities during operation of the proposed ARRD Project.

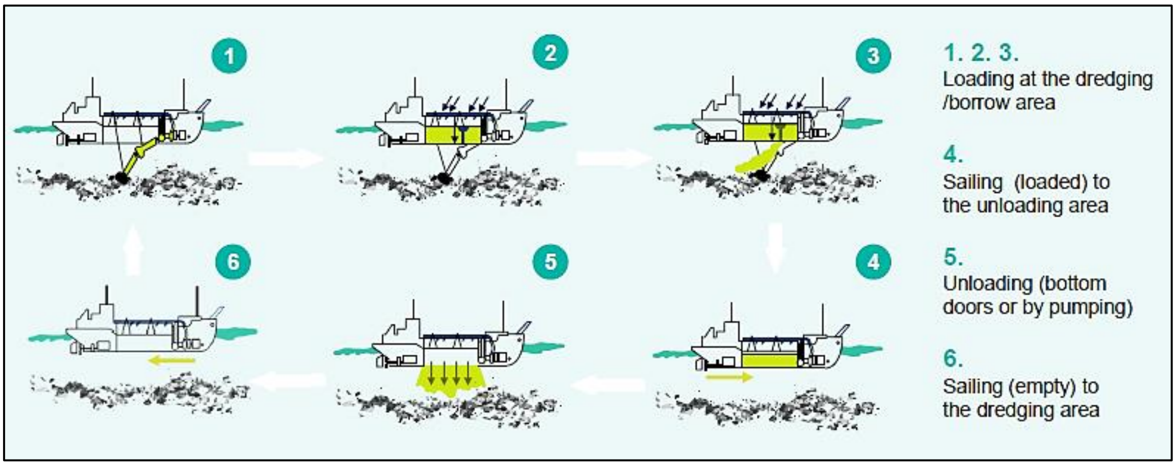
Table 1.6.1: Dredging Operation

Procedures/Steps	Concern of Navigator	Concern of the Dredging Operator
1. Commencement for Dredging	Use the locating system to further ensure the route. Report anomalies in the system or route, if needed.	Check the operating system whether there are problems, e.g., mechanisms, and ensure working running condition.
2. Put Rake to Dredge	Before reaching the dredging area, compensate for the speed and make changes in the mobility for safer start-up.	The dredger ship will signal the position and deploy mechanisms related to the commencement
3. Controlling the Dredging Operations	Control the dredger's speed, and position, signals the operator for safer excavation	Observance and look-out for any anomalies and corrections of route and volume in-takes.
4. Completion of Dredging	Ensure the proper loading and check signals for information whether the complete operation is done	Mechanisms will be operated to finally set off the shop and disengaging the vessels for sailing to the delivery site.
5. Sail to the Reclamation Area	Transport the dredge materials into the intended area where it is needed safely.	Loads the amount capacity and orders the load requirement for the dredge materials.
6. Hydraulic Reclamation	Release mechanisms and maneuver upon arrival to the unloading area	Delivers and release the materials safely.

During dredging and desilting process, the TSHD will be positioned at a specified location near the river delta to open and remove clogged materials that block the river channel. The designated excavation area to pump in sand and other materials from the riverbed carefully planned and taken into consideration based on the procedures and phase. Afterwards the ship and other vessels will carry the loaded silts and sand and bring to the designated reclamation operation location/area. This cycle will depend on the volumetric rate of the suction dredger and the capacity of the hold of each of the dredgers.

TSHD will be used in the progressive removal of the materials and sediments. A distance of 500 m to 1,500 m depending on the conditions near the delta would be applied in the opening, but based on the bathymetric data, a distance of 1,846.50 meters would be subjected to clearing due to its high sand terrain ranging from 0-2, -2-3, -3 - -5, -5-10 and -10-15. This would entail clearing the passage of the river mouth/delta based from the provisions of DAO 2020-12 in order to implement true flood control measures, provided more depth for passage of dredging vessels, the areas starting from the delta of river extending all the way to upstream is exclusively designated as RDZ, shall be initially dredged, to open heavily silted river channel, create and restore natural state and flow of the river taking into consideration the essential role played by constant replenishment. The annual volume is approximately 7,321,950.00 m^3 over a period of about 15-18 years for RDZ (subject for replenishment) and a total deposit of sand materials blocking the river delta in offshore of 11,350,260.00 m^3. Restoration and desilting will lead to the enhancement of the river mouth declogging filled sands and other materials near the shore that is blocking the river outlet.

Once all dredge materials are removed, it will be loaded on the storage containers of the vessels and dredging ships and scheduled to deliver in the designated reclamation sites for discharge or disposal either in Pasay or Manila. **Figure 1.6.4** provides the procedures of removing silts, mud, and sand from the river delta.



Source: Dewint, M. (2019). Trailer Suction Hopper Dredging. Emboodhoo Lagoon Development – Maldives, IADC

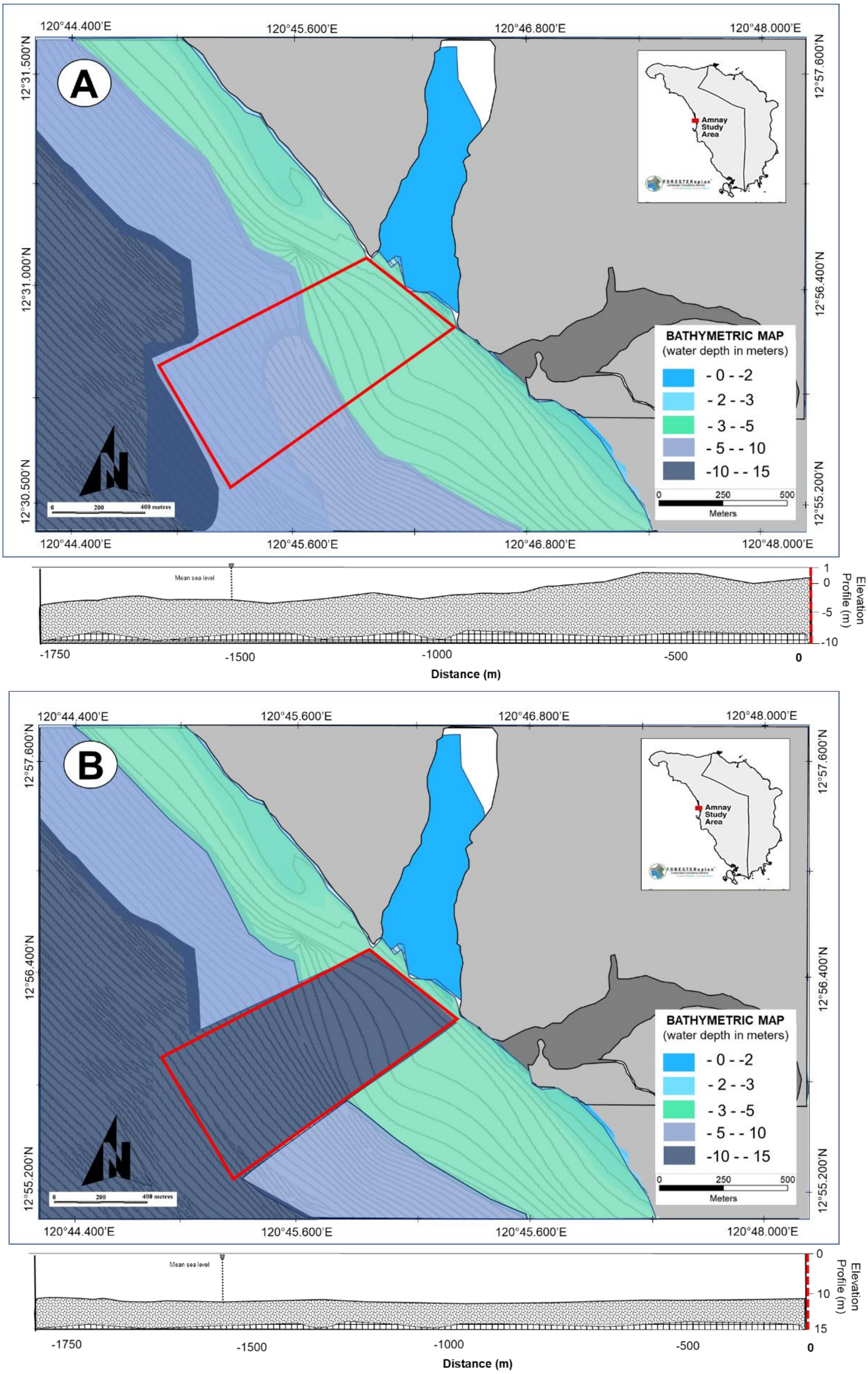
Figure 1.6.4: Flow of Dredging Operations

All dredge materials extracted upon opening of the river mouth will be set aside at a certain distance from the river mouth. The location would be far from the delta as to not go back or wash away to the shore or river mouth. It should be noted that the materials from the opening of the passage is not part of the actual volume from the RDZ dredging and desilting. Such dredged materials that will be extracted during the clearing of the river mouth for the dredge-vessel to pass through will be safely stored near the shore in accordance to DAO 2020-12 and applicable regulations and policies. The said materials will not be included in the commercials disposition but instead will be placed along the shore area for environmental and ecological conservation.

The first few hauls of dredge materials from the Amnay River may contain other materials such as wastes, debris, or scrap which have to be removed prior to use of the materials for the purposes of reclamation. These will be collected and disposed of properly or may use or commission an accredited third-party entity or whose accreditation is considered valid by MGB and DENR/EMB.

Unwanted riverbed soils will be indefinitely stored in approved safe stocking piles at a designated temporary yard at the project site. If any, it may also be disposed of in regions where it is required as preliminary dump piles or additional filling, or it may be donated to groups or government agencies through a MOA. These materials have a depth capacity of at least 20 meters. A prior approval from the LGU, the Philippine Coast Guard, the DENR/EMB, and/or other relevant agencies will be required for such disposal. In order to further examine the presence of trace elements and metals, laboratory tests must be performed on these materials first. Before final disposal, treatment or intervention will be carried out if it is discovered that the contents go beyond the relevant EMB standards and the disposal site is the sea (offshore).

Figure 1.6.5 shows the comparison of before and after bathymetry of the delineated offshore area from the river mouth. It can be seen in the simulated post-dredge map that the bathymetry was leveled based on the dredging depth of 10 m up to certain point that the dredging and desilting vessels can navigate in the identified area in order to make progressive operations in the RDZ. This consequential dredging illustrations supports the purpose of navigational channel making in the current conditions of the Amnay River offshore based on the oceanographic and physical assessment. The dredge area only touched the dredge boundaries to the aforementioned dredging depth. Changes in the bathymetry of the 109-hectare rectangular block will now be able to cater the draft/draught of the next batch of dredging vessel such as CSD.

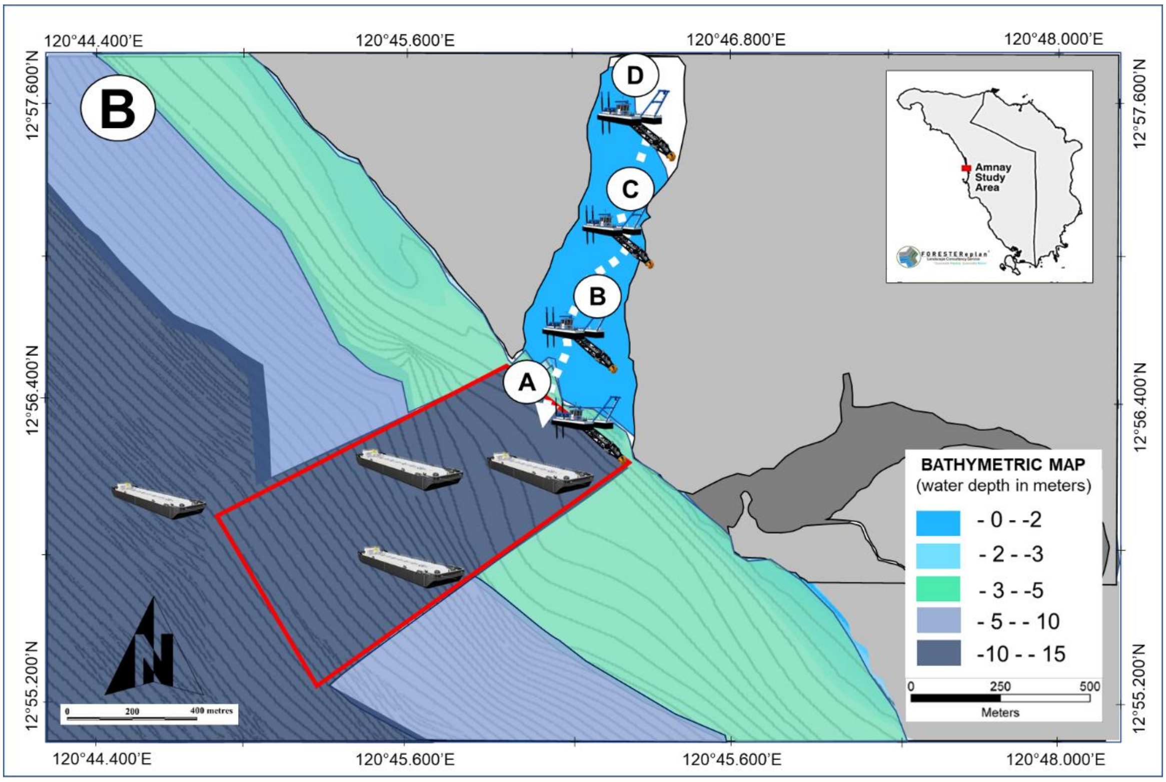


Note: (a) Before Dredging, Navigationally Blocked; (b) After, Navigationally Cleared

Figure 1.6.5: Comparison of the Existing Bathymetry and Simulated Bathymetry Before and After Dredging Operations for Navigational Dredging.

1.6.1.3.3 Cutter Suction Dredger (CSD)

After clearing the offshore area by the TSHD, four (4) CSD with a capacity of 3,000 m^3/hour are allocated to simultaneously dredge the river delta going to the RDZ. CSD will be used for the dredging operation of the delta/mouth going to the RDZ of Amnay River. The dredged materials from the river delta and upstream must be discharged onto 4-10 small floating and/or split hopper or pelican barges (**Figure 1.6.6**) each of which has a carrying capacity of 10,000 m^3. The barges alternately fill through a specialized floating discharge hose to be transferred to a sand carrier vessel and at the designated offshore placement area. Alternatively, CSD will load sand materials to pelican or hopper barges and when barges are full, CSD discharge hose will dump sand materials temporarily to the placement area to be later pump by arriving pelican or hopper barge.



Note: Dredging points (A, B, C, etc.) are shown to depict dredging schedules of CSD in dredging the river mouth up to the RDZ. The bathymetry of the offshore already reached a certain required depth required for the draft of all dredging and desilting vessels.

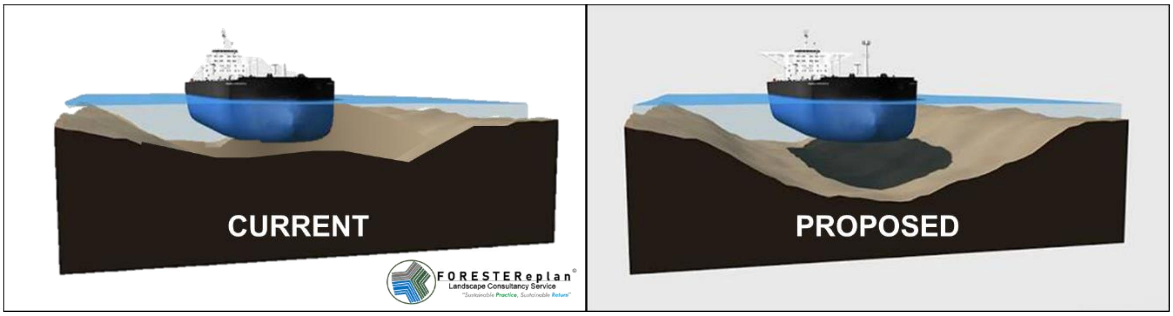
Figure 1.6.6: Activity Route of CSD After the River Delta or Offshore has been Cleared and Declog

The CSD that will be placed into operation is an effective self-propelled vessel with two hydraulic spuds and anchors to maneuver about the dredging area and a strong rotating cutter head to remove all types of material, including rock, clay, silt, and sand. When used in the building and upkeep of ports, harbors, approaches, rivers, estuaries, land reclamation, and coastal fortifications, it is particularly successful. CPGI will use the CSD to remove a sizable amount of sand from the river mouth and drastically reduce the amount of river run materials that have been excessively deposited.

During operation phase, the CPGI shall provide health, medical care and other services for the workforce to take care of their health and protect them from any work-related health risks. Proper protective gears and protection protocol shall be provided. Periodic safety orientation and strict compliance to dredging and desilting rules shall be implemented and monitored to prevent accidents. Also, since the dredging and desilting activities of the project will start during COVID-19 Pandemic, the CPGI shall set guidelines and protocols in accordance to on COVID-19 *Protocols for Construction Sites and Workers' Safety and Security* being formulated by *Philippine Constructors Association* and other guidelines formulated by different government agencies, (i.e., DOLE, DOH and DPWH). This must be implemented and observed at all times. The CPGI shall designate or hire a safety officer in charge on site for monitoring workers.

1.6.1.3.4 Offshore Maintenance Dredging

Since there will be replenishment and sedimentation of river-run materials from the river going to the offshore area via discharges, a program for continuous operation such as maintenance dredging will conducted. Sand, silt, mud, and rock that are typically river-run materials from Amnay River that is being accumulated and flowed in the RDZ channels due to weather conditions like wind, rain, storm, and water current action are removed during maintenance dredging. Maintaining the channel and the river delta depths at an appropriate level is required to allow for safe access of dredging vessel as well as maintain barriers against ecological dynamics, all requires maintenance dredging. **Figure 1.6.7** shows the illustrative scenario of the offshore seabed showing the sediment build-up (left) and the conditions after maintenance dredging. The offshore area is required to maintain a safe shipping channel and harbor to provide an efficient navigational working area for the vessel equipment. This program will also help to reduce wave action towards the river mouth.



Note: (a) Offshore Seabed Near River Delta, (b) After Maintenance Dredging for Navigational and Bathymetry Maintenance

Figure 1.6.7: Natural Sediment Buildup in the Seabed

CPGI will maintain appropriate depths so that commercial vessels (such as ferries, barges and fishing vessels) and private boats can continue to access Amnay River during operation. Maintenance dredging is usually undertaken monthly or once a year for around 4-5 weeks, depending on the amount of sediment building up in the channel and delta based on the replenishment models and scenarios. TSHD dredging and loading via its trailing arm can reach of about 15 m depth underwater to catch and load sediments and materials from the existing sand materials and after dredging.

It is hypothesized that river delta and the offshore area would maintain its depth for a short period of time and accretion and sedimentation would follow, creating sand river-run materials replenishment and seabed supply in both delta and the offshore area including some areas in the junction of Amnay River. With the massive force of tidal waves and river flow, the strip of land formed by deposition of sediment via longshore drift at the mouth of a river will continuously occur. **Figure 1.6.8** shows location of sand accretion and points in the project components and the location of sections of offshore/delta subject to preventive or maintenance dredging (**Figure 1.6.9**).

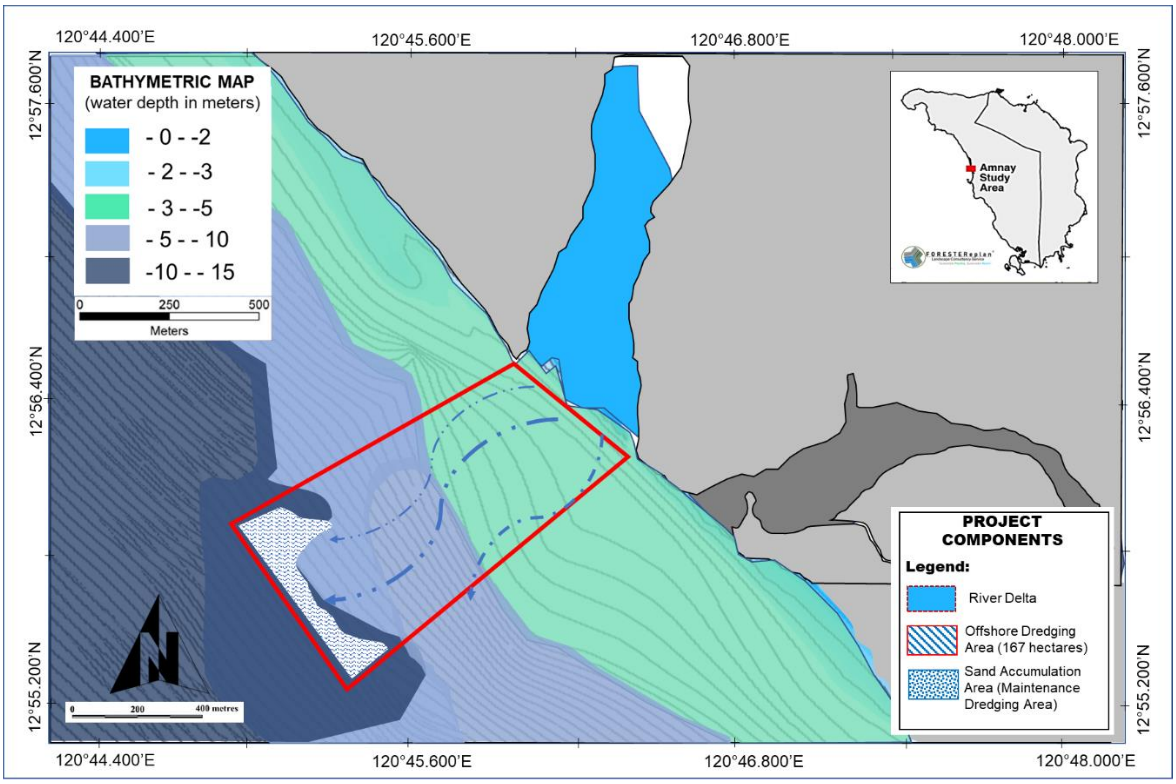


Figure 1.6.8: Natural Sediment Buildup in the River Delta and Offshore Seabed After Opening of River Delta and Offshore Clearing

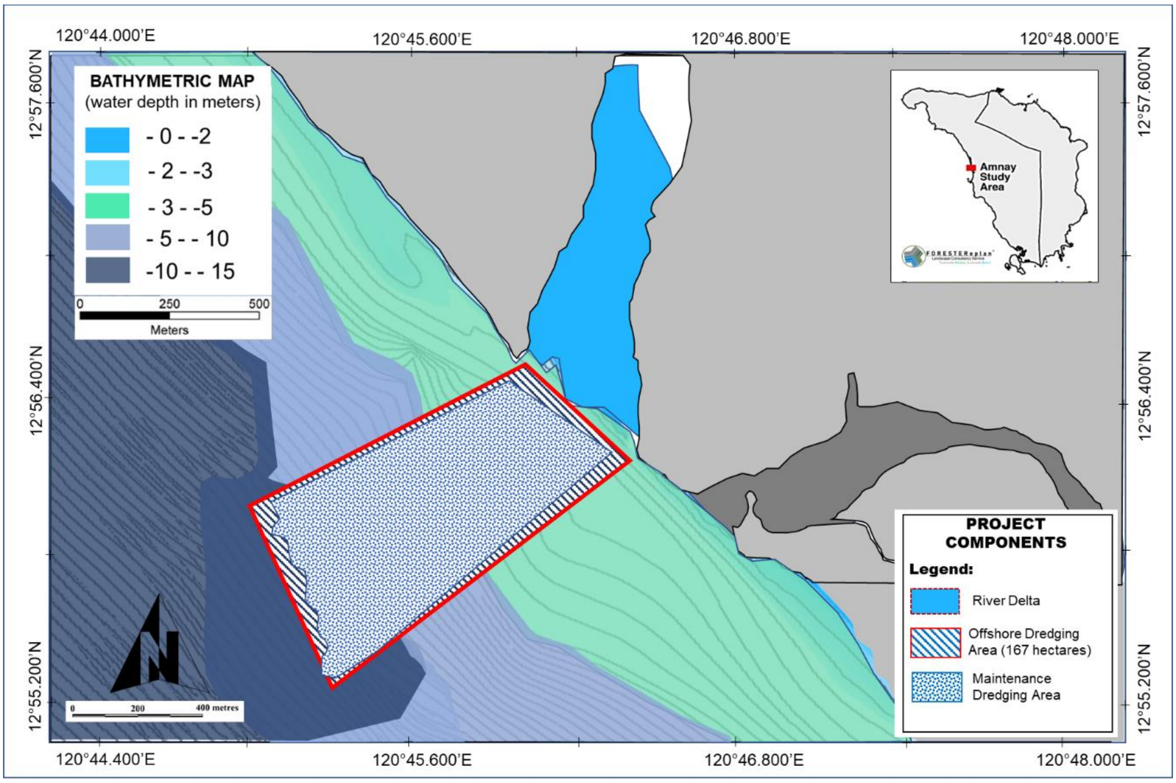


Figure 1.6.9: Project Components of the Offshore Area including the Maintenance Dredging Area

1.6.1.4 Replenishment Rate

The sediment load of a river is frequently regarded as an eroded sand materials that comes from the river through time after being altered or impacted by discharges. On the other hand, some of the sediment load (sand and gravel) might be a natural resource that can be utilized. When the sediment load is made up of particle sizes present in deposits on the riverbed that would be replenished by freshly transported sediment after dredging, its potential use is increased. As a result, river deposits are transformed into renewable resources that are regularly replaced by river sediment transport. The natural replenishment of the offshore area for dredging (clearing for navigational channel) is high considering the characteristics of the offshore configuration and bathymetry. Replenishment is highest during wet season when sand and rubble particles including sediments deposited through the Amnay River and again be released in the delta. With this, a periodic maintenance dredging is required to be able to overcome such discharges thereby maintaining the depths of the offshore for its operational and rehabilitation activities. This would extend the pre-construction period of opening the delta for an indefinite number of months or years. Based on the oceanographic studies, a tide-induced model simulation was implemented to observe the sediment discharges in the Amnay river delta in Brgy. Claudio Salgado. In the computational domain, this river is the only source of sediments. Since no river discharge rate data was provided, the discharge rate obtained from PHIL-LiDAR 1 (2017) report on Amnay river basin was utilized in the simulations. The discharge rate used in the simulations was the actual flow discharge (peak discharge at 264.50 m^3/s) during a rainfall event, measured from the Amnay bridge/Pagasa bridge. This actual flow discharge value was used constantly throughout the timeframe of the models carrying a hypothetical, conservative value of 5 kg/m^3 concentration of sediments. The time series of river discharge and sediment concentration was used in the upstream boundary in the model domain with additional layering for bathymetry with greater than -15 meters (**Figure 1.6.10**).

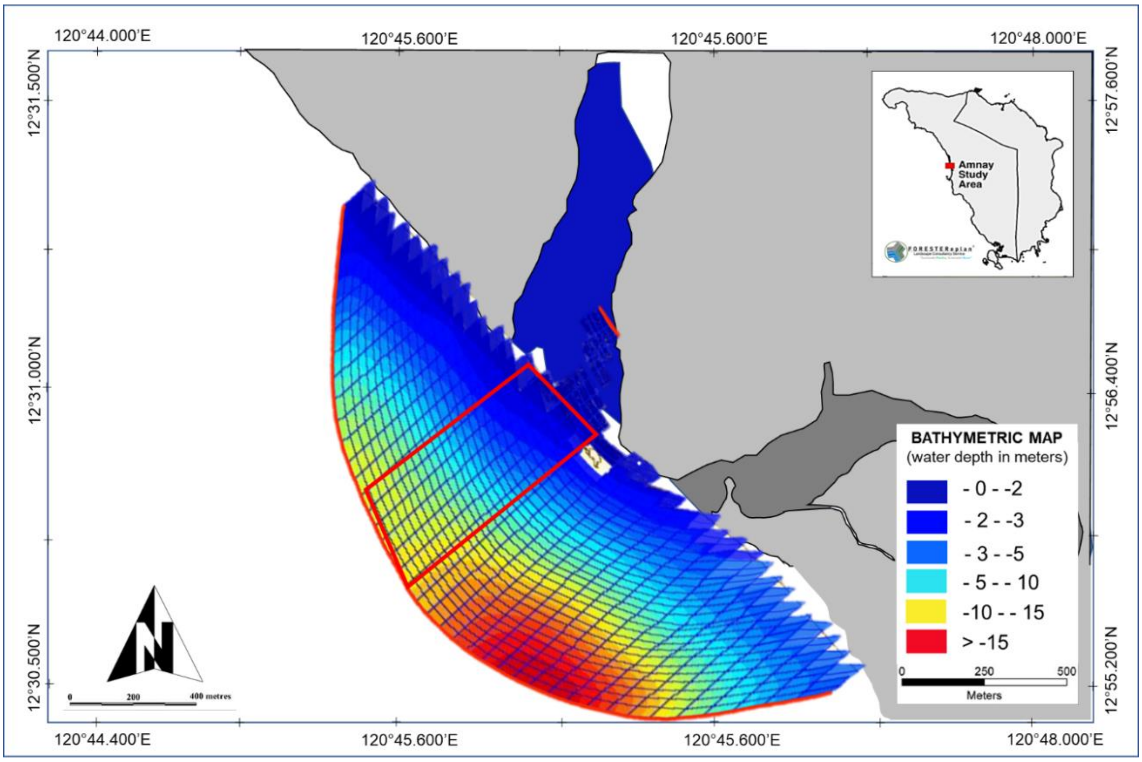


Figure 1.6.10: Grid, Bathymetry, and Model Domain showing the Upstream Boundary as Discharge Point in the Simulations of Replenishment from Amnay River

In the simulations, the sediments were treated as non-cohesive sediments. Bulk density values for non-cohesive sediments were used in the models. Based on the physical assessment conducted by the CHECC Vibrocorings in November 2022, river flow conditions have a significant impact on sediment transport loads and the requirement for dredging/desilting. The extra sediments from dredge-and-dump activities are represented in the models by adding time-series flow discharge and sediment discharge/spillage. However, the river itself forms part of other inherent source of river-run materials going to the offshore area. All sediment replenishment models employed a constant concentration of non-cohesive sediments at 1,550 kg/m^3. Together with a predicted discharge rate in the Amnay River of 264.50 m^3/s, Amnay River has an estimated discharge (towards the downstream section only) volume of 913,457 m^3 of sand materials/load discharging to the offshore monthly as replenishment coming from the river during dredging of the RDZ and during weather conditions (e.g., rains), once the river is opened or dredged. This is based on the modeling and simulation of non-cohesive sediments at 5 kg/m^3 along with the discharge rate that would yield an estimated load replenishment of 639,000 m^3 per month or with a range of two (2) months interval time, considering the model duration used with regards to monsoon dynamics. **Table 1.6.2** shows the breakdown of replenishment rate based on modeling of sedimentation.

Table 1.6.2: Theoretical Model Values and Estimates of Sediment-Discharge and Replenishment Rate at the Downstream Section of Amnay River Going to the Offshore

Station	Water discharge (ft^3/month)	Suspended Sediment		Bedload		Total Replenishment (F_t) (tons per month)
		Concentration (Scouring Rate)	Discharge, D_s (tons per mo)	Discharge, Db_s (m^3 per mo)	Median Particle Diameter (mm)	
1	4,462	4,530	32,011	264.50	0.06	34,441
2	4,590	4,250	24,014	264.50	0.07	27,341
3	3,660	1,100	55,000	264.50	0.05	39,815
4	3,770	1,400	17,015	264.50	0.05	13,069
5	5,570	5,800	13,507	264.50	0.08	22,646
6	5,700	4,000	12,014	264.50	0.08	21,094
7	5,680	4,700	45,000	264.50	0.08	78,457
8	5,770	4,960	14,000	264.50	0.08	25,189
9	4,650	2,190	33,000	264.50	0.07	38,561
10	4,630	1,180	15,000	264.50	0.07	17,377
11	5,740	3,500	20,900	264.50	0.08	37,213
12	6,450	4,260	32,000	264.50	0.09	71,944
13	6,770	4,180	19,500	264.50	0.10	48,299
14	5,662	3,780	15,500	264.50	0.08	26,853
15	5,950	2,815	20,600	264.50	0.09	39,412
16	6,740	2,100	13,500	264.50	0.10	33,142
17	5,570	2,150	20,000	264.50	0.08	33,532
18	5,450	1,760	21,000	264.50	0.08	33,708
19	4,650	1,300	15,240	264.50	0.07	17,808
20	4,450	1,000	25,000	264.50	0.06	26,754
21	4,650	1,200	45000	264.50	0.07	52,583
22	4,010	960	45,014	264.50	0.06	39,116
23	4,150	783	14,578	264.50	0.06	13,568
24	3,750	598	14,587	264.50	0.05	11,085
25	3,950	210	18741	264.50	0.06	15,802
26	5,230	210	14500	264.50	0.07	21,434
27	4,265	210	19045	264.50	0.06	18,722
28	3,550	210	25000	264.50	0.05	17,026
29	3,600	210	14470	264.50	0.05	10,134
30	3,210	210	15000	264.50	0.05	8,353
31	2,750	210	12065	264.50	0.04	4,931
32	2,450	210	16053	264.50	0.04	5,207
33	2,650	210	10000	264.50	0.04	3,795
34	2410	210	9000	264.50	0.03	2,825
35	2233	210	8250	264.50	0.03	2,223
					Total	**913,457**

Note: *1 Hectare Meter: A volume of 10, 000 m^3 created by flooding or discharge of an area of one hectare to a depth of one to five meters, thus creating a volume one hectare by one meter. 1 ha m = 10,000 m^3. May change based on actual discharge dynamics of the River Basin.*

Amnay River is continuing to deposit sediment runoff from its source, the Upland Inner Mindoro Range and its watershed areas (Amnay River Basin) which are relatively high in volume with a total volume estimate of 746 million m^3 of combined runoff materials based on the drainage area of 466 km^2 and 5 m assumption of thickness of deposits. This is suggested by initial bathymetric, depth sounding of the offshore area and the river with reference to the computations of the RBCO-Mindoro.

Sediment dynamics within Amnay River are highly complex, and related to the magnitude, duration, frequency, seasonality, and rates of water level change of the river flow (Graf, 1998). Different sediment components have different pathways as they are transported through rivers to the sea. Fine-grained sediment, which is generally derived from the physical erosion of 'soft' rocks, chemical weathering of silicate minerals and the breakdown of organic matter, tends to be rapidly transported through rivers once in suspension due to their small size (Biedenharn, et al., 2006). These materials are only deposited and stored in very low energy environments, such as deep quiescent channels, backwater environments, flood plains or the sea. Fine sediment tends to be transported year-round and is responsible for the movement and delivery of nutrients owing to their high surface area to volume ratio that provides large areas for nutrients to adsorb, and the high organic content of the material (Owens, et al., 2005). Fine sediments also affect water quality and biological activity by controlling light penetration into a waterway (Owens, et al., 2005). The dispersal of fine-grained sediments going to the offshore from the river is an effect of initial dredging operations and natural flow based on the simulation and model. However, this would only be temporary since mitigation measures are prepared for the project.

Figure 1.6.11 shows the different scenario of the offshore area that is affected by the sedimentation and discharge of Amnay River. **Figure 1.6.11-A, B, and C** are the present condition of replenishment rates and scenario as per simulation model on the Amnay River going to offshore. Once the river and offshore is dredged as part of the pre-construction period (17 months), another scenario of replenishment discharges can occur in the river going to the offshore. This instance would really require the program for maintenance dredging as indicated in Plate D, therefore bathymetry of the offshore area would be incremented and accretion of river-run materials in the delta going to the offshore would occur. Further, **Figure 1.6.11-D** shows that Patrick River located in the lower section of Amnay, provides the natural siltation compared to the maintained area of the project.

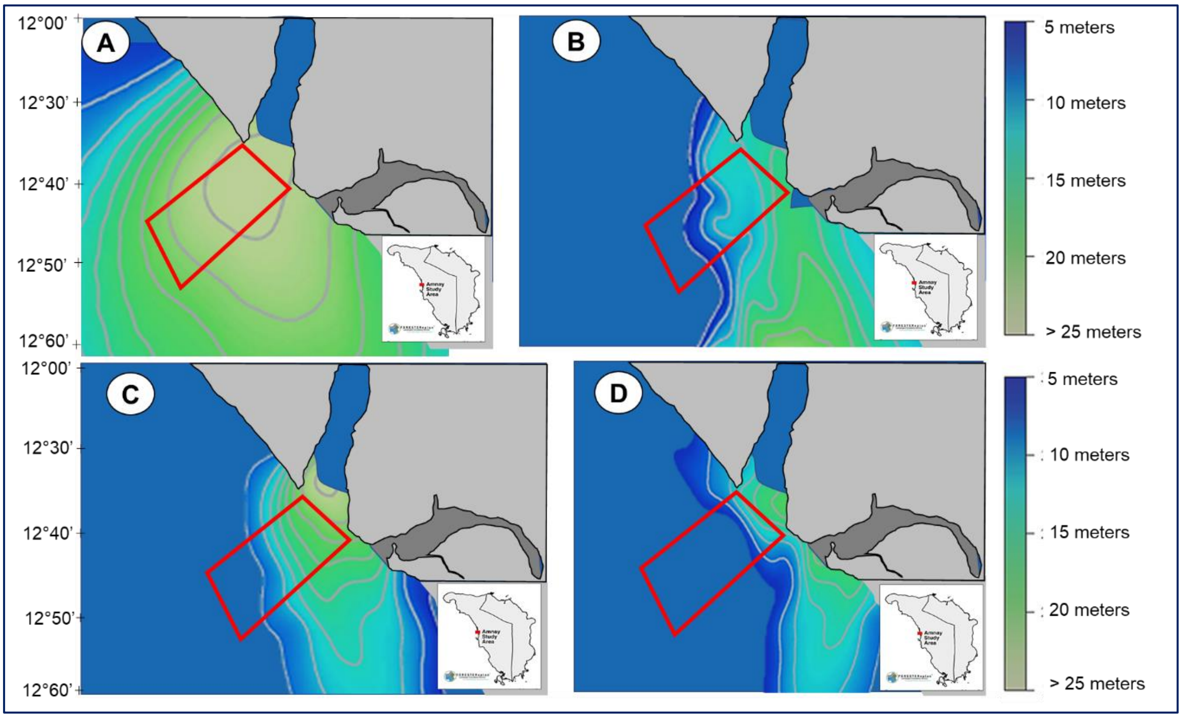


Figure 1.6.11: Sedimentation, Discharge and Replenishment Simulation and Scenario After the Initial Dredging and Desilting Activities

1.6.1.5 Abandonment Phase

For this project, CPGI abandonment phase refers to a particular phase where-in after dredging operations when the contractor will have vacated the dredge site and subsequently turn-over the completed project to CPGI. The phase will involve final inspection, turn-over and acceptance of completed structures and equipment, clean-up, and demobilization. Dredging equipment dismantling, sifters, loads, containers and other works and debris shall be properly collected and disposed of before the site is turned over by the contractor to the CPGI.

The proposed ARRD Project's predictable life is approximately 15-18 years. A decommissioning or abandonment plan will be formulated for any uncertain events that may affect the project and its components. The abandonment plan will stipulate the proposed studies to be conducted (e.g., site assessment), the dismantlement, recovery and/or replacement plans for the various equipment, and development plan of the area. The abandonment plan will also lay out the obligations to be handled by CPGI to conduct soil examination and remediation if contamination is present, and to keep the buffer areas 1.5 kilometers from the bridge.

The RDZ channel or dredge material source's stirred-up sediments and silts will eventually settle down into the riverbed and exterior portion (river delta/mouth) at rates based on particle size and the currents that are already in place. Given the predominant direction of river flow, the localized irregularity of the dredged terrain and slope as described in the dredging plan will actually favor the deposition of sediments coming from the direction of the upstream to downstream. Over time and in line with the real replenishment rate, the passage of water flow will cause the subsequent adjustment of the slope in the downstream section/subject dredging region (to be determined once operation is actualized). However, CPGI will facilitate the conduct and characterization of the following activities on the area as part of the compliance to the requirements of permits and clearances issued for the project. There is no clear-cut abandonment plan that must be implemented immediately after the completion of dredging and desilting activity.

1.7 ORGANIZATION, MANAGEMENT, AND MANPOWER

1.7.1 Organization and Management

The proposed ARRD Project is expected to an estimated that 100 professional, technical, and non-technical workers will be employed during the operation and maintenance phase. A simplified typical organization chart for the proposed ARRD Project is shown in **Figure 1.7.1**. Additional staff may need to be allocated during overhauls.

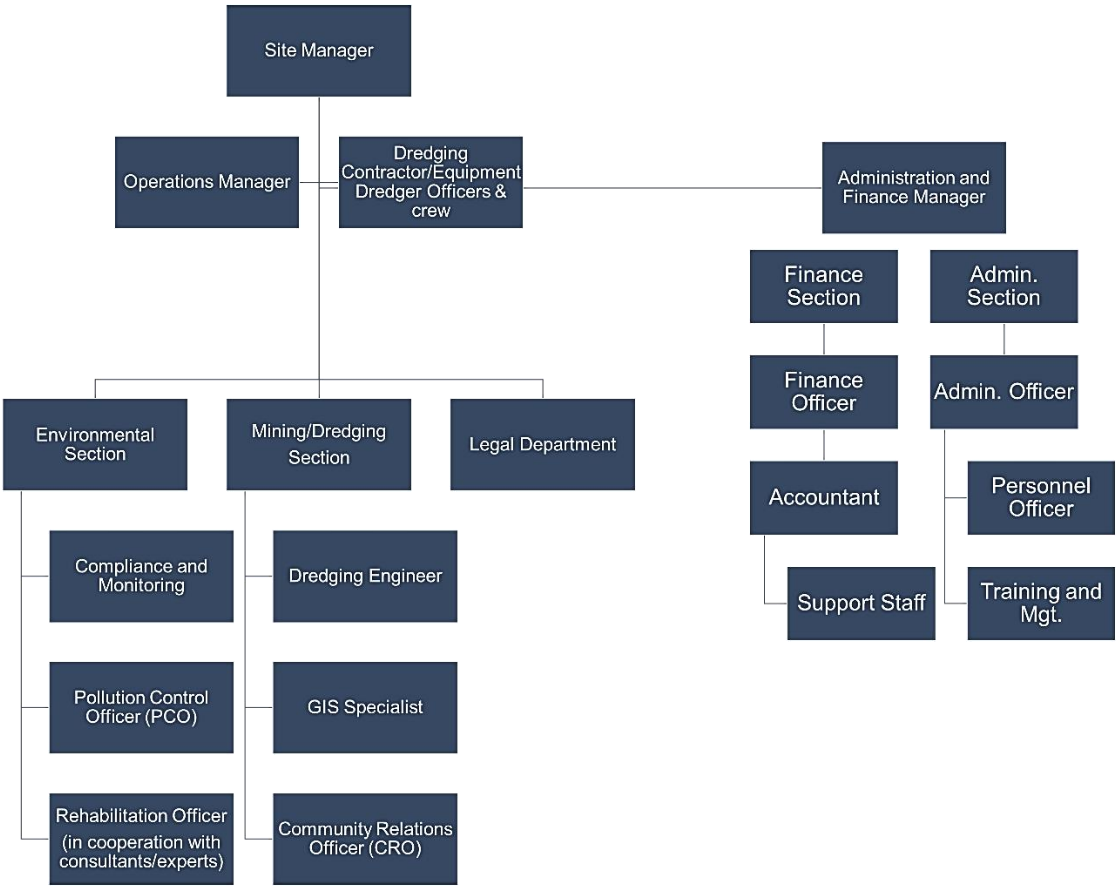


Figure 1.7.1: Organization Structure for the Proposed ARRD Project

1.7.2 Manpower Requirement

The majority of the required manpower for the proposed ARRD Project will be local skilled workers who will be hired based on formal qualifications, experience and good moral character. Residents of the host barangay and municipality will be prioritized for hiring provided they possess the necessary qualifications. A recruitment strategy will be developed to ensure the right skills required by the project can be locally sourced as much as practicable and giving equal opportunities. Training and upgrading of skills will also be provided to the labor pool as part of the sustainability strategy of the company. CPGI will also comply with the relevant provisions of the DOLE regarding local employment.

During the operation phase, the project will require about 102 personnel consisting of experts and laborers. For land-based works and activities, a total of 46 workers and personnel would be allocated. Similarly, for river dredging works and activities, 54 workers will be deployed of which 27 on each ship and 46 are working onshore for office requirements. This is on the assumption that operations of a number of dredging ships, e.g., 2 ships for dredging happens simultaneously.

The manpower requirements during operation phase of the project are presented in **Table 1.7.1.**

Table 1.7.1: Manpower Requirements

Manpower Requirement/Type	Number	Number of Ships	Total
Crew	20	2	40
Environmental Officer	4	2	8
Master	1	2	2
Chief Officer	1	2	2
2nd Officer	1	2	2

Manpower Requirement/Type	Number	Number of Ships	Total
3rd Officer	1	2	2
BOSUN	1	2	2
Dredge Operator	3	2	6
Chief Engineer	1	2	2
2nd Engineer	1	2	2
Assistant Engineer (3rd)	1	2	2
Onshore support staff	1	2	2
Offshore support staff	1	2	2
Cook	1	2	2
Messman	2	2	4
Marine Electrician	1	2	2
Assistant Electrician	1	2	2
Marine Oiler	3	2	6
Electronics Mechanics	1	2	1
Inland Support Staff	2	2	4
Signal/Look out/Spotter	3	2	6
	TOTAL	**2**	**100**

Source: CPGI Dredging Contractors

1.8 INDICATIVE PROJECT COST

The estimates of the dredging cost for the dredging and desilting works as well as the operation cost such as the mobilization, right of way, payment, clearing of access road, and service facilities.

The cost estimates for the dredging and desilting works and the appurtenant equipment are based on the Feasibility Study grade design drawings such as the dredging volumes and diagrams, approved financial and technical plan approved by CPGI, IAC and DPWH.

The capital investment cost for the dredging operations is estimated at Php1 billion. This is spread over the cost of leasing the dredge ships, manpower requirements, and fuel costs to commence the dredging operations. The cost is estimated at PHP1,000,000,000.00 with an assumed extraction rate of 2,634,124.67 m^3 per month. This estimation includes cost of equipment, support facilities, utilities and miscellaneous expenses for permits/requirements and estimated working capital for other required resources.

- Taxes, Levies and Regulatory Fees, Monitoring Expenses PHP70M (per month) = 840M/year
- Corporate Social Responsibilities/ Social Development Plans (SDPs), etc.= PhP 15,000,000.00/year
- Permits and licenses = PhP 10,000,000.00/year
- Salaries and Wages (Overhead costs), Operation Cost, etc. (PhP 5M per month) = PhP 60,000,000.00
- Rehabilitation Cash Fund = PhP 10,000,000.00

2 ANALYSIS OF KEY ENVIRONMENTAL IMPACTS

2.1 LAND

2.1.1 Land Use Classification

2.1.1.1 Existing Land Use

Based on the CLUP (2015-2042), the Municipality of Sablayan has a total land area of 229,559.17 ha including Apo Island.

About 207,815.47 ha (90.53%) of the total land area remained forest. Out of the 207,815.47 ha, 144,960.92 ha are protection forest covered by overlapping protection policies namely (1) FB Harrison Game Refuge and Bird Sanctuary (2) National Integrated Protected Areas System (NIPAS), (3) PD 705-Critical slope and 1,000m elevation asl. The rest was accounted for other forest use category. Eco-tourism activities and biodiversity conservation are among the low impact undertakings within the forest. The Pandan Grande Islands were accounted as tourism whereas the 29-ha Apo Reef Island covered by NIPAS law shall be accounted as protected area though current land uses include scattered vegetation, eco-tourism, open beach area, turtle nesting and mangrove forest.

The second dominant existing land use within the municipal territory is agricultural comprising 2,850.01 ha for mixed agriculture area (planted with coconut, fruit trees and others) and 13,131.50 ha for productive/prime agricultural area planted to major crops (rice, corn and high value crops).

Inland waters that include rivers, creeks and lakes composed of 3,053.19 ha (1.33%) used either as natural drainage, irrigation supply and eco-tourism. Urban land uses represent only 0.44% which are dominantly residential. Roads and other land uses share the least among the land use distribution.

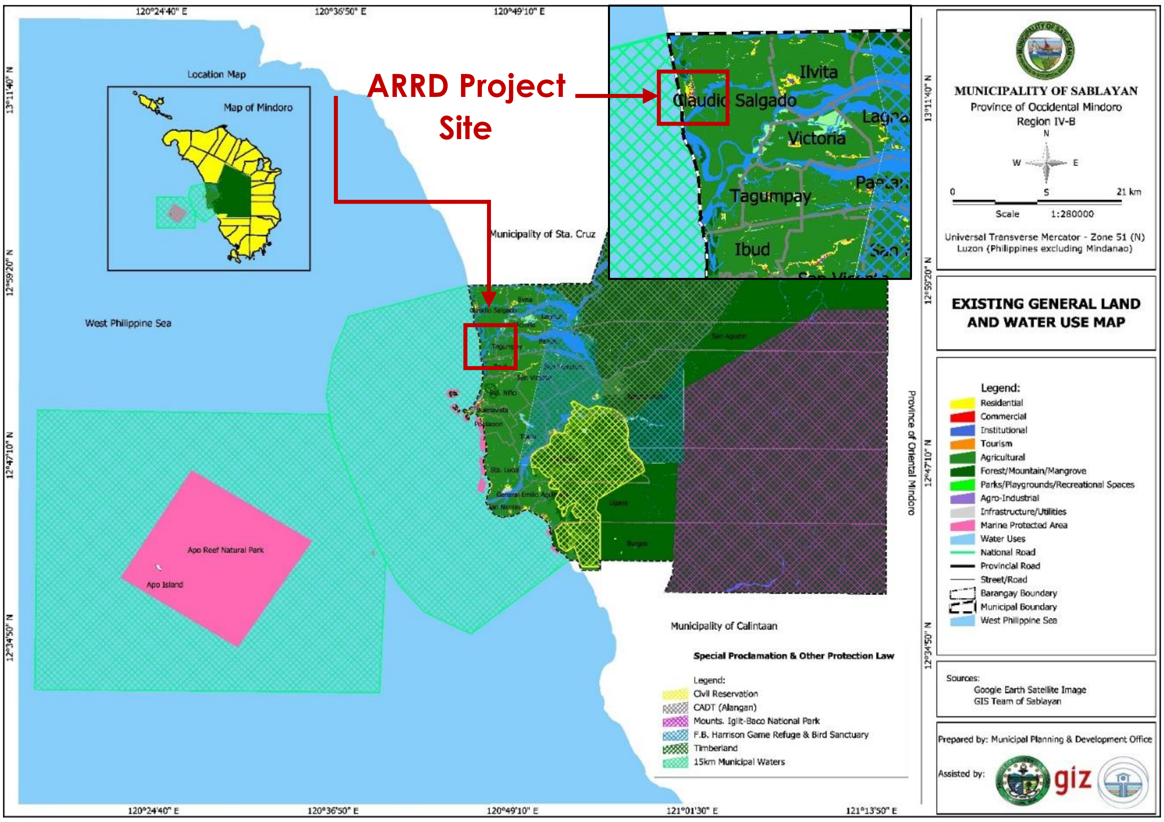
Table 2.1.1 presents the list of the existing land uses in the Municipality of Sablayan and **Figures 2.1.1** presents the Existing General Land Use Map.

Table 2.1.1: Existing Land Uses in the Municipality of Sablayan

Land Use Category	Area (ha)
URBAN USE	**1,002.55**
Residential	722.18
Commercial	65.99
Institutional	80.51
Cemeteries	5.48
Industrial (Agricultural)	7.70
Infrastructure Utilities	90.71
Parks and Playground/Recreation	29.99
FOREST USE	**207,815.47**
Covered by Special Proclamation & Other Protection Law	
NIPAS (Mounts Iglit-Baco National Park)	82,627.55
Shared Packed Parse Forest (SPPF)	15,075.30
FB Harrison Game Refuge & Bird Sanctuary	47,048.97
Timberland	180.10
Apo Island	29.00
Production Forest	2,176.46
Other Forest Use Category	60,678.09
Major Local Watershed	
AGRICULTURE USE	**13,131.50**
Irrigated Riceland	9,223.72
Unirrigated Riceland	3,647.81
Others	259.97

Land Use Category	Area (ha)
MIXED AGRICULTURE/PASTURE/SCATTERED TREES	**2,850.01**
ROADS & OTHER OPEN AREAS	**215.81**
INLAND WATER USE	**3,053.19**
Nipa/Swamp/Wetland/Lake	106.78
Mangrove	144.18
Rivers and Creeks (waterways)	2,802.23
PROTECTION BUFFER	**1,490.63**
River Protection Buffer	1,321.07
Coastal Protection Buffer	169.56
TOTAL	**229,559.17**

Source: CLUP of the Municipality of Sablayan (2015-2042)



Source: CLUP of the Municipality of Sablayan (2015-2042), Modified by FORESTEREPLAN 2023

Figure 2.1.1: Existing General Land Use Map of the Municipality of Sablayan

2.1.1.2 Encroachment in Environmental Critical Areas

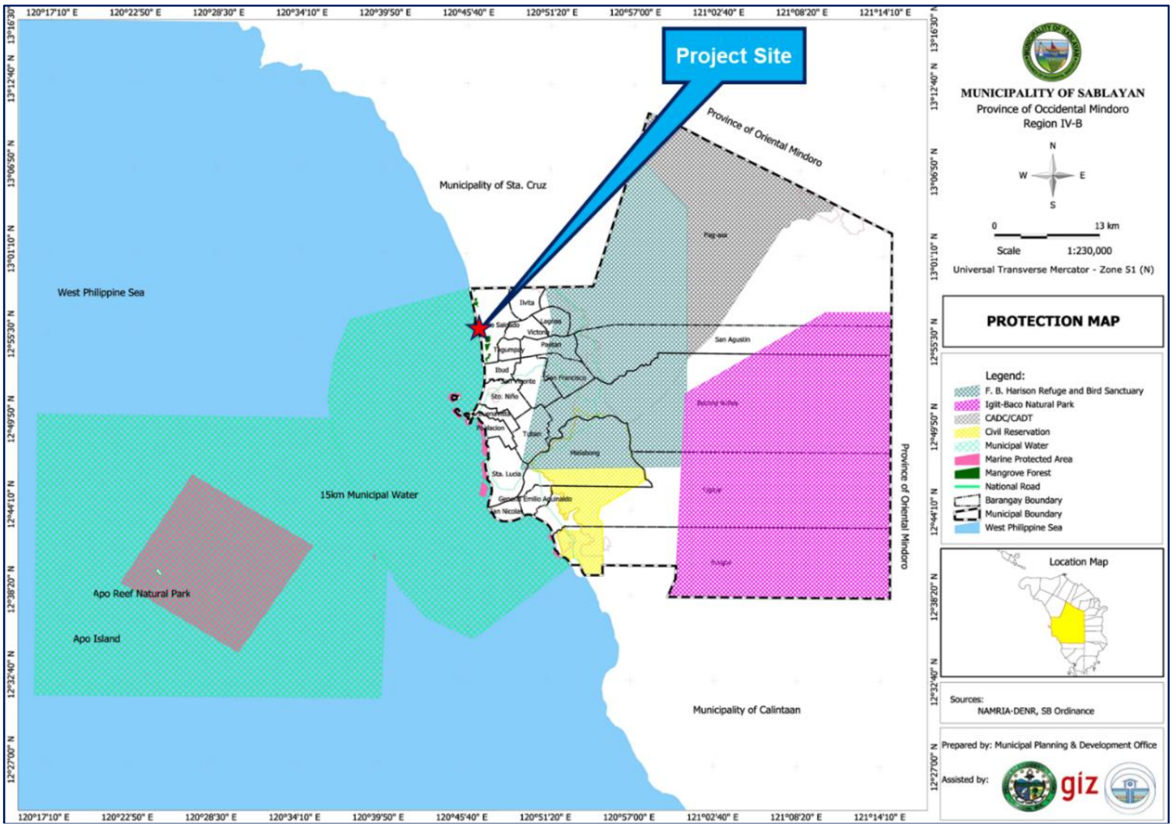
Environmentally Critical Areas (ECA) are environmentally sensitive areas declared under Proclamation No. 2146 of 1982 where significant environmental impacts and disturbance are expected if certain types/threshold or limits of the proposed projects are located, developed, or implemented on it. ECA are areas ranging from national parks to areas frequently exposed to hazards or areas that are historically interesting. Based from available reports and data, two (2) sentinel islands, Pandan Grande and Pandan Piqueo, with respective land areas of approximately 35.9828 and 31.9610 hectares each, defend the municipality. The town cove is a perfect area for boats to hide during storms thanks to these islands, which also act as windbreaks for the local government.

Table 2.1.2 presents the list of ECA and their relevance to the project site while **Figure 2.1.2** shows the ECA relevance to the Project Site.

Table 2.1.2: Assessment of ECA in the Project Area

	Environmentally Critical Areas	Relevance to the Proposed Project Site
1	Area declared by law as a national park, watershed, reserve, wildlife preserves or sanctuary	The proposed ARRD Project site will not encroach on any protected areas nor marine sanctuaries. Pandan Grande Islands and Apo Reef Island, which are protected areas under NIPAS, are far from the Project site with a distance of approximately 9-10 km and 38.6 km, respectively (**Figure 2.1.2**). On the other hand, an offshore monolith (Bato tabao: Iriron rock) north of the project area located in Calintaan, is located about 9-11.5km from the offshore project area and fringed by coral reef (3-ha).
2	Area set aside as aesthetic, potential tourist spot	
3	Area which constitutes the habitat for any endangered or threatened species of indigenous Philippine wildlife (flora and fauna) and marine biodiversity	There is little to no endangered species of fish, mammals, plants or any other wildlife in the proposed dredged areas. The closest habitat for wildlife is the FB Harrison Game Refuge & Bird Sanctuary approximately 18.4 km East of the project site (**Figure 2.1.2**).
4	Area of unique historic, archaeological, geological or scientific interest	The project site is not located in an identified unique historic, archaeological or scientific interest.
5	Area which is traditionally occupied by cultural community or tribe	The project site is not classified as an area with ancestral domain claim or occupied by tribal communities and indigenous peoples.
6	Area frequently visited and/or hard-hit by natural calamities (geologic hazards, floods, typhoons, volcanic activity, etc.)	According to MGB and PHILVOCS, the host Barangay Claudio Salgado has: • High vulnerability to flooding; • High vulnerability to storm surge and tsunami; and • Low vulnerability to landslide.
7	Area with critical slope (All lands with slope of 50% or more classified as geohazard by MGB. Such slope conditions favor their natural susceptibility to geohazards such as landslides.	None
8	Area classified as prime agricultural land (Prime Agricultural Land refers to land that can be used for various or specific agricultural activities and can provide optimum and sustainable yield with minimum inputs and development costs as determined by the Department of Agriculture (DA)	The project site is not classified as prime agricultural land.
9	Recharge area of aquifers	The groundwater resources map of Occidental Mindoro indicates that extensive and highly productive aquifers occur in alluvial and coastal areas of Sablayan within the Amnay River floodplain.
10	Waterbody (characterized by one or any combination of the following conditions: tapped for domestic purposes; within the controlled and/or protected areas declared by appropriate authorities; which support wildlife and fishery activities.)	Residents source their drinking water and water for domestic purposes from deep wells. The project area does not encroach a declared protected area.
11	Mangrove area (Mangrove areas characterized by one or any combination of the following conditions: with primary pristine and dense young growth; adjoining mouth or major river systems; near or adjacent to traditional productive fry or fishing grounds; areas which act as natural buffers against shore erosion, strong winds and storm floods; areas on which people are dependent for their livelihood)	Mangrove areas are located approximately 700 meters (within the River mouth of Patrick River) to 1-km South (Calintaan and Rizal) and 4.0 km North of the Project site.
12	Coral reef (Coral reefs characterized by one or any combination of the following conditions: With 50% and above live coralline cover; Spawning and	The substrate type in the primary impact area is predominantly sand and silt.

Environmentally Critical Areas		Relevance to the Proposed Project Site
	nursery grounds for fish; Act as natural breakwater of coastlines.	



Source: CLUP of the Municipality of Sablayan (2015-2042), Modified by FORESTEREPLAN 2023

Figure 2.1.2: Map showing the ECA Relevance to the Project Site

The project is within the municipal waters (10-15km) in the province of Occidental Mindoro. Marine Sanctuaries and other protected areas are relatively far from the Project site such as the ARNP except to some locally declared tourist, fish sanctuaries and conservation sites. ARNP was established by Proclamation No. 868, it is the largest and best-preserved atoll-formed reef in the Philippines through the Apo Reef complex (**Figure 2.1.3**). It contains Apo Island, the complex of coral reefs in the north and south of Cayos del Bajo, and Binangaan Islet. The park has a total area of 15,792 hectares, of which 99.80 hectares are water and 0.20 hectares are land. It has a range of habitats, such as fringe reefs, 10-hectare-sized sections of mangroves, and a stretch of sandy beach covered in coconut palms, scrub, and trees (Brooks, et al, 1995; Mallari, et al, 2001). Apo Reef is approximately 30-km from the Project site.

Moreover, to safeguard the coral reefs in the municipal seas, Sablayan had developed its own marine protected areas (MPAs) in addition to the ARNP. This is in accordance with General Ordinance No. 94-EDM03, which was passed for the municipality's protection, conservation, and restoration of its fisheries resources. The following are the municipal marine protected areas:

1. Bintanang Bato Reef Marine Sanctuary;
2. Burgos Reef Marine Sanctuary;
3. Laya Reef Marine Sanctuary;
4. Pandan Grande Marine Sanctuary;
5. Pandan Piqueño Marine Sanctuary;
6. Parola Reef Marine Sanctuary; and
7. Receiving Reef Marine Sanctuary.

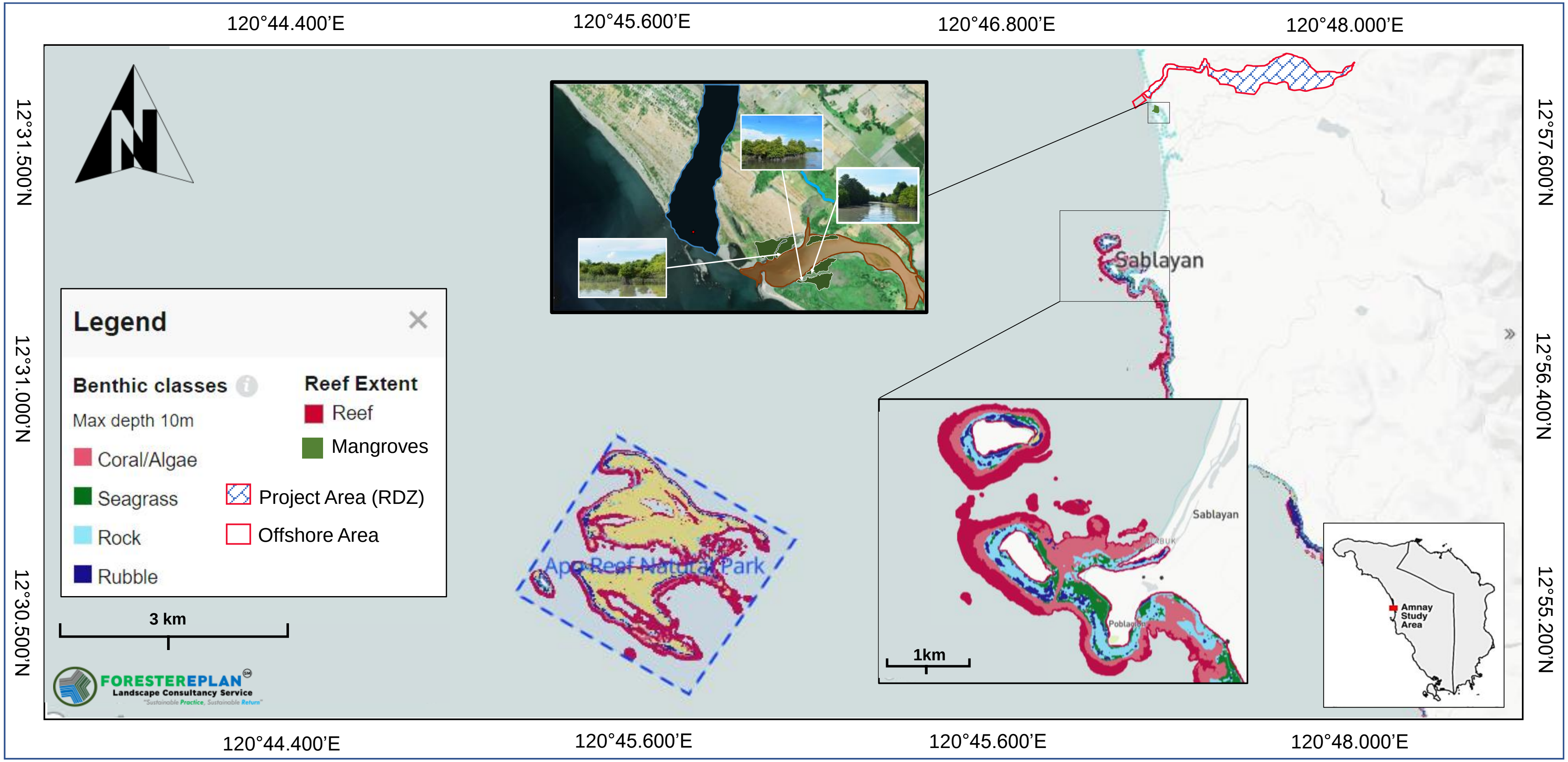
The continuous loss of coastal cover at some specific locations, which is demonstrated by the comparative coral assessments carried out by the WWF (2016), underscores the critical need for the protection and conservation of MPAs. **Table 2.1.3** compares the coral cover of Pandan, Buenavista, Ligaya, and Santa Lucia, which are the three (3) significant sites for coral habitat in the municipality. It should be noted that these coral sites are 9-11km away from the project site.

Table 2.1.3: List of Areas with Known Coral Cover/Sites in the Municipality of Sablayan

Sites / Coral Cover	May 2009	January 2010	February 2011
Pandan	38.90	27.30	22.90
Ligaya	37.60	30.20	28.10
Santa Lucia	22.40	20.50	22.90
Average Coral Cover	33.00	26.00	24.60

Source: WWF (2015) and CLUP-Sablayan (2015)

On the other hand, south of the project area is the Bato Tabao (Iriron rock) which is an offshore monolith rock standing of about 12 meters high surrounded by a small marine conservation area (fish sanctuary) located in the Municipality of Calintaan. The area is approximately 35-km from the offshore project area and considered relatively far from the project site. However, close monitoring of project vicinities and these marine and fish sanctuaries would be done in order to protect aforementioned locally declared conservation sites and sanctuaries.



Source: Benthic Map Classes ACA Data and Google Basemap, Modified by FORESTEREPLAN 2023

Figure 2.1.3: Coral and Marine Ecosystem Resource Map and Surrounding Areas with Respect to the Project Site.

2.1.1.3 Impacts in Terms of Compatibility with Existing Land Use

The proposed ARRD Project will only involve restoration and desilting operations at river channel and designated access sites and will not affect the existing land use of the area.

2.1.1.4 Impacts in Terms of Compatibility with Existing Water Use

Conflict with the existing water use is not an issue for the proposed Offshore Dredging of CPGI since the Tuna Sites and Fishery Improvement Project Sites of Occidental Mindoro is relatively far from the offshore dredging area. However, proper management of offshore management area during operation will still be done to avoid potential damage and disturbance in locally declared fish sanctuaries and fishing sites.

2.1.1.5 Impact on Compatibility with Classification ECA

Sanctuaries and other protected areas are relatively far from the Project site. The proposed ARRD Project does not encroach or may impact in any means an ECA or any sensitive areas of biological, cultural and protected reserves or areas except that Barangay Claudio Salgado is identified by the DOST to have high vulnerability to storm surge and tsunami.

On the other hand, the project is within the municipal waters (10-15km) in the province of Occidental Mindoro. Marine Sanctuaries and other protected areas are relatively far from the Project site such as Apo Reef. Apo Reef is approximately 30-km from the Project site. As to the locally declared conservation sites and fish sanctuaries associated in the municipality, there is a site for catching bangus fry and a privately owned fishpond (tiger prawn and bangus sugpo) in Wawa, Calintaan which is 4-km from the project site. This is also adjacent to a wide sandy beach to the north (Ragara Beach), which is about 8 km long, as well as the offshore monolith rock locally known as Bato Tabao (Iriron Rock) 35-km from the offshore project area. The rock formation is about 12 m above sea level high surrounded by a small marine conservation area (fish sanctuary). The said areas were 15-km away from the project site located in the Municipality of Calintaan. These areas and protected fish and locally declared conservation sites are relatively far from the project site. However, close monitoring and coordination for project activities will be conducted to monitor these sites.

As to the locally declared conservation sites of the municipality such as Bintanang Bato Reef Marine Sanctuary, Burgos Reef Marine Sanctuary, Laya Reef Marine Sanctuary, Pandan Grande Marine Sanctuary, Pandan Piqueño Marine Sanctuary, Parola Reef Marine Sanctuary and receiving Reef Marine Sanctuary. The closest locally declared marine conservation sites among the lists is the Pandan Grande Marine Sanctuary and Pandan Piqueño Marine Sanctuary (Pandan Island). However, based on the oceanographic studies, plumes and sediments from the offshore dredging will not reach the area as the site is 10-km away from the offshore navigational dredging area. However, proper management of offshore management area during operation will still be done to avoid potential damage and disturbance in locally declared fish sanctuaries and fishing sites such as the installation of silt curtains during operation.

2.1.1.6 Impact in Existing Land Tenure Issues

Since the project site is observed with some agricultural area and residential, there will be no issues related to land uses for the proposed ARRD Project. There are also no areas within or near the project site that are covered by Certificate of Ancestral Domain Title (CADT), Certificate of Ancestral Land Title (CALT), Mineral Production Sharing Agreement (MPSA), Integrated Forest Management Agreement (IFMA) and Community Based Forest Management Agreement (CBFMA).

2.1.1.7 Impairment of Visual Aesthetics

The proposed ARRD Project is relatively far from most tourist spots in the Municipality of Sablayan. Although there were some private business resorts and nature parks near the area, these will not be affected. The project is 10-km away from known ecotourism and potential tourist and tourist sites such as the Pandan Island beach, which is showcasing the Pandan Grande Marine Sanctuary and Pandan Piqueño Marine Sanctuary in Barangay Buenavista.

2.1.1.8 Devaluation of Land Value as a Result of Improper Solid Waste Management and Other Related Impacts

Generation of waste and improper waste disposal may impact the soil quality in the area resulting to the devaluation of the land.

Waste per capita in a developing country, calculated on an average income basis, is 0.74 kg/day (World Bank, 2016). With the proposed ARRD Project, solid wastes will increase due to the increase of workforce. Total estimates of 100 workers during construction and operation phases result to 74 kg/day of domestic wastes generated, respectively. Domestic solid waste will include paper, cartons, plastic, straw, cups, bottles, tin cans, rubber, food left-over, etc. In addition to domestic wastes, some amount of hazardous solid waste will be generated in the site including busted fluorescent lamps, spent industrial and car batteries, spent chemical cartridges and containers and expired chemicals. These will be generated only during maintenance or when an item reaches the end of its shelf-life.

A Solid Waste Management Plan (SWMP) shall be implemented for the proposed ARRD Project which includes minimization of waste generation and segregation. All domestic wastes will be temporarily collected and stored in the designated material recovery facility (MRF) properly sorted out into recyclables and non-recyclables before it shall be collected and disposed by the local government. CPGI shall ensure that the hazardous wastes will be properly treated and disposed of by a DENR-accredited transporter and treater.

2.1.2 Geology/Geomorphology

2.1.2.1 Surface Landform/Geomorphology/Topography/Terrain/Slope

Occidental Mindoro is situated along the western part of Mindoro Island, located south of the province of Batangas in Southern Luzon. On the north, it is bounded by Verde Island Passage, on the west and the south by Mindoro Strait, and on the east by Oriental Mindoro. Occidental Mindoro is surrounded by some strong volcanic imprint reflected by the presence of several active and inactive volcanoes. The landscape of Occidental Mindoro is generally uneven, with narrow strips of coastal lowlands. Its terrain is characterized by some mountain ranges, valleys, and elongated plateaus, with rolling lands along the coastal section of the Island.

Amnay River, where the proposed ARRD Project is to be operated, originates from the central highland divide of Mindoro, which forms the boundary between the two provinces constituting the island. The Amnay River Basin is bound on the west by the Mindoro Strait and on the north, east and south by mountain ranges with peaks reaching 2,000 masl (**Figure 2.1.4**). **Figure 2.1.5** shows the elevation map of the general vicinity of the Municipality of Sablayan, Occidental Mindoro where elevation of the plains and foothills ranges from 0-200m. From the central highlands, Amnay River flows westward and forms alluvial fans and deltas, as it discharges into Mindoro Strait.

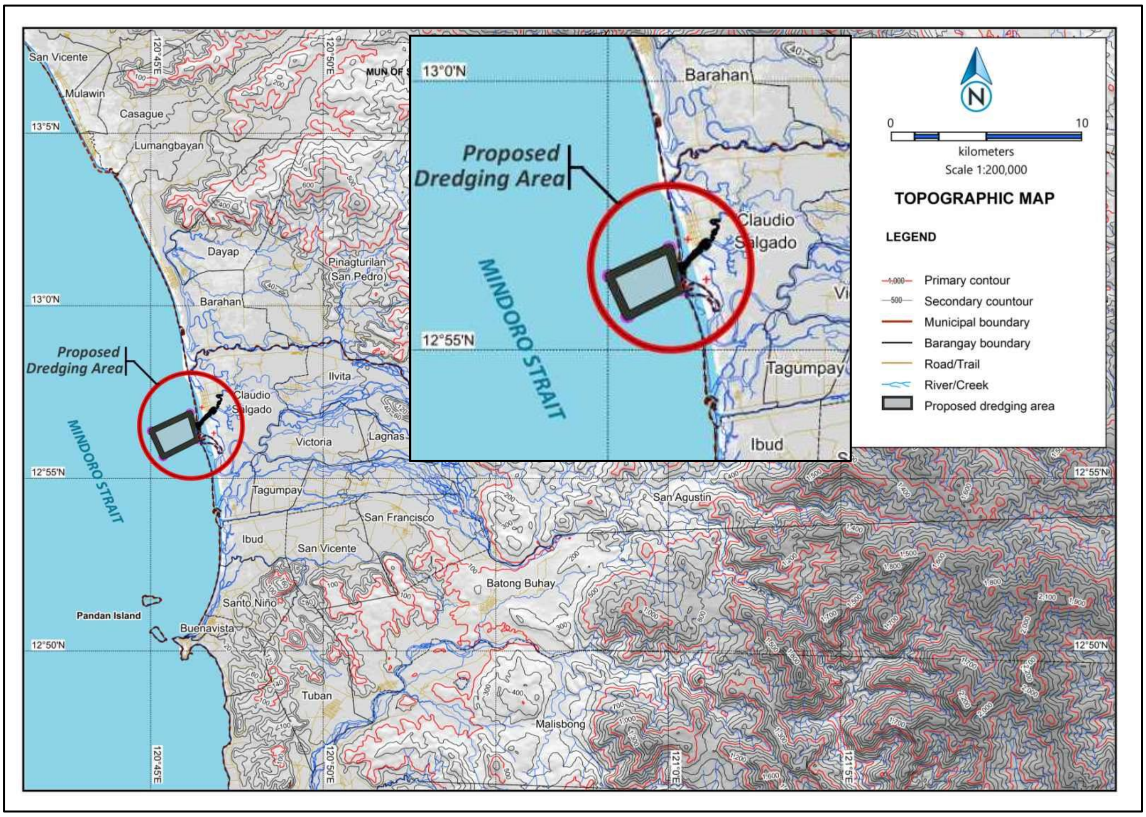


Figure 2.1.4: Topographic Map of Sablayan, Occidental Mindoro

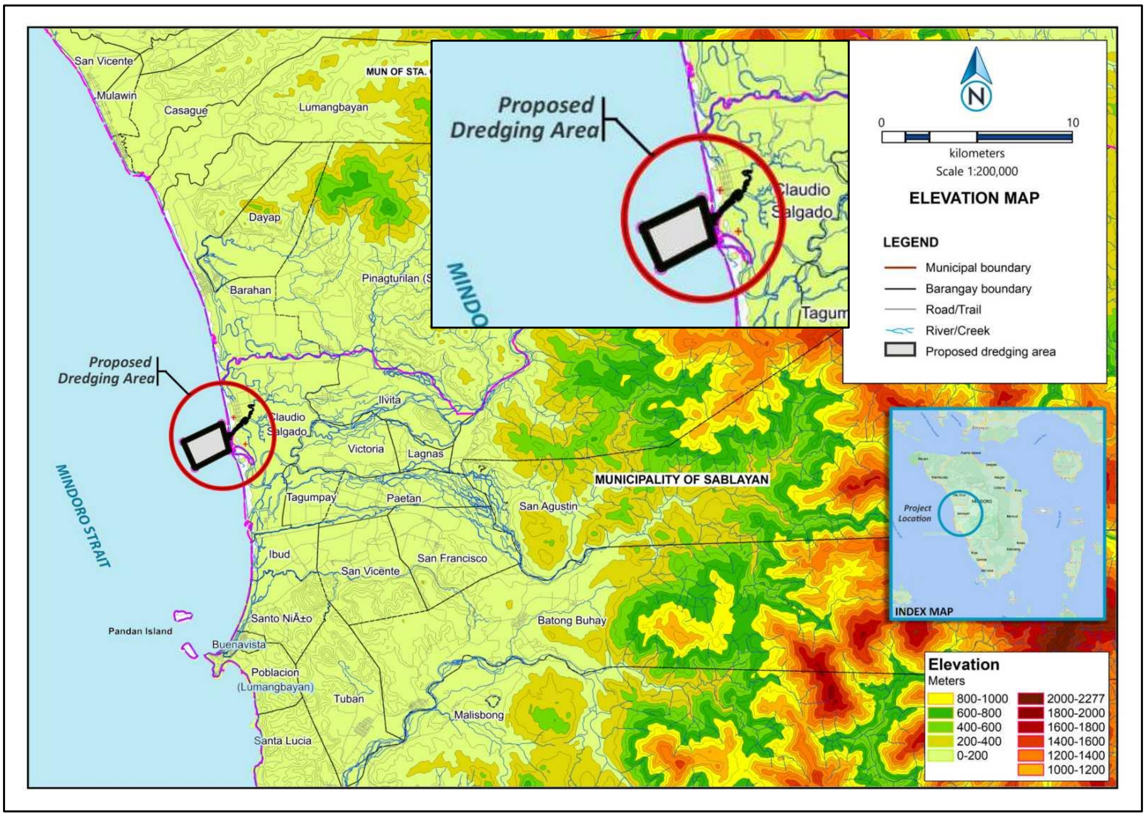


Figure 2.1.5: Elevation Map of Sablayan, Occidental Mindoro

Municipality of Sablayan, in particular the watershed of Amnay River is made of two major topographic categories, the elevated rolling to steep and rugged hinterland and the low lying flat to gently sloping lower reaches that extend up to coast. **Figure 2.1.6** shows the slope map of the Municipality of Sablayan. It depicts the extent of the lower reaches of the Amnay River watershed mainly made up of alluvial plains with slopes ranging from 0-3%. In contrast, eastward, the mountainous terrain shifts from low rolling hills with slopes ranging from 3-18% to the rugged hinterland characterized by steep to very steep slopes ranging from 18% to more than 50%.

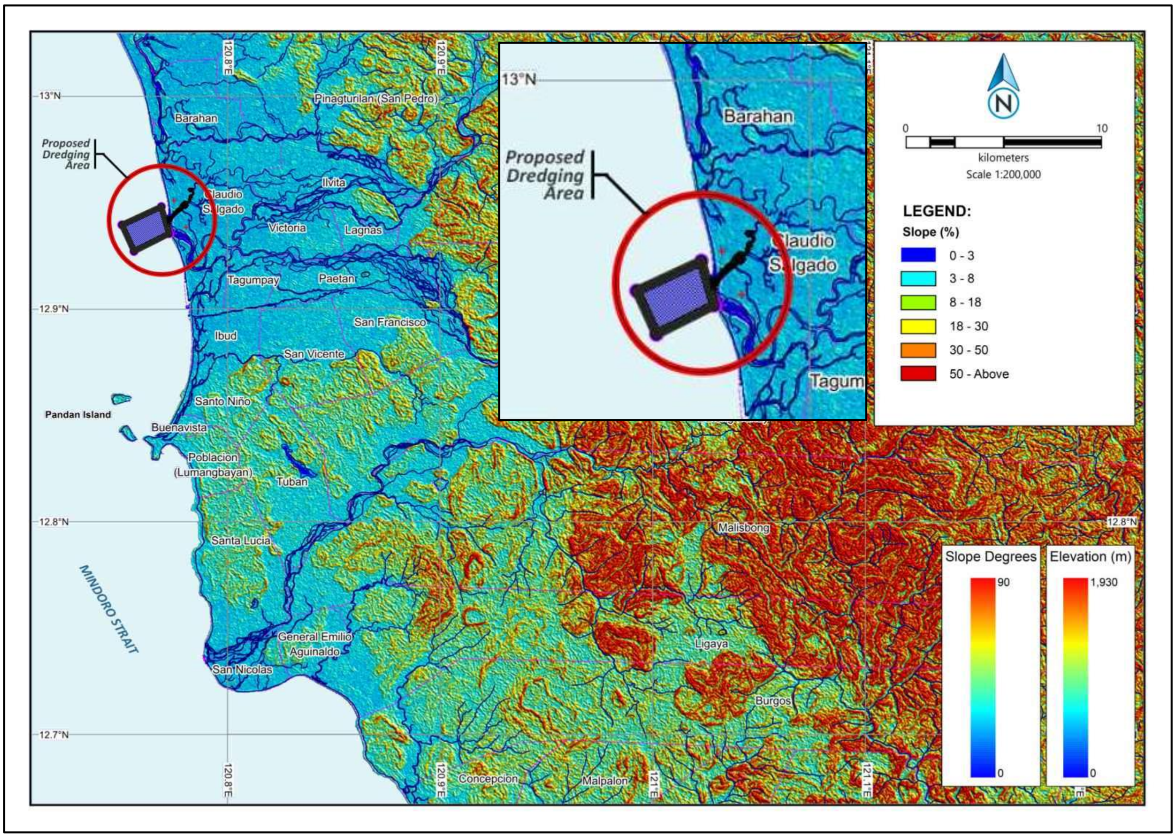


Figure 2.1.6: Slope Map of Sablayan, Occidental Mindoro.

The general geomorphology of the Municipality of Sablayan is dominated by the rugged mountainous terrain to the east and the low-lying alluvial plain to be west. The mountainous terrain displays typical features of a geomorphologically young terrain, i.e., steep valley slopes, v-shaped valleys, sharp ridges and scarps. The alluvial plain to the west is generally flat dominated by fluvial features of Amnay River. These include as braided streams and meandering active alluvial floodplains, alluvial wash, abandoned meanders, some with ponded water. At the coast, the prominent geomorphologic features include the estuary, the prograding Amnay-Patrick delta, sandbars and the rapidly accreting sandy beach. Amnay River exhibits a braided pattern as it emerges from the mountains in the vicinity of Barangay Pag-asa and meanders through the wide alluvial plain before discharging into Mindoro Strait. It also has old and buried meanders that are now mostly occupied by agricultural land and residential areas.

2.1.2.2 Subsurface Geology/Underground Condition

2.1.2.2.1 Regional Tectonic Setting

The Philippines is generally divided into the seismically active region known as the Philippine Mobile Belt and the a-seismic region of continental affinity known as the North Palawan Block or the Palawan Micro-continental Block where a marked absence of seismicity is noted. The Philippine Mobile Belt is an actively deforming zone created from the complex system of subduction zones, collision zones and marginal sea basin openings on the western and eastern sides of the Philippine

Archipelago (Aurelio and Peña, 2004). The seismically active Philippine Mobile Belt is wedged between the colliding Philippine Sea Plate and the Eurasian Plate and is bound to the east and west by opposing subduction zones. These include the Manila Trench and the Negros-Cotabato-Sulu Trenches to the west and the East Luzon Trough and Philippine Trench to the east.

The Philippine Archipelago is bound on the northwest by the South China Sea Basin, an oceanic basin whose opening is believed to have occurred between 32 and 17 mya preceded by rifting that occurred between the end of the Cretaceous and the Paleocene (Aurelio and Peña, 2004). The separation of a micro-continental block from mainland China resulted from the opening of the South China Sea and this block is now known as the North Palawan Block (or the Palawan Micro-continental Block). The subduction of the South China Sea Plate beneath the Luzon Arc at the southern terminus of the Manila Trench transformed the subduction into an arc-continent collisional deformation in Mindoro Island, where the North Palawan Block collided with the central portion of the Philippine Mobile Belt within Miocene times (**Figure 2.1.7**), with the intensity of the collision appearing to have decreased since the Pliocene (Aurelio and Peña, 2004). The collision of the North Palawan Block caused the cessation of the subduction along the southern end of the Manila Trench (Po et al., 2015).

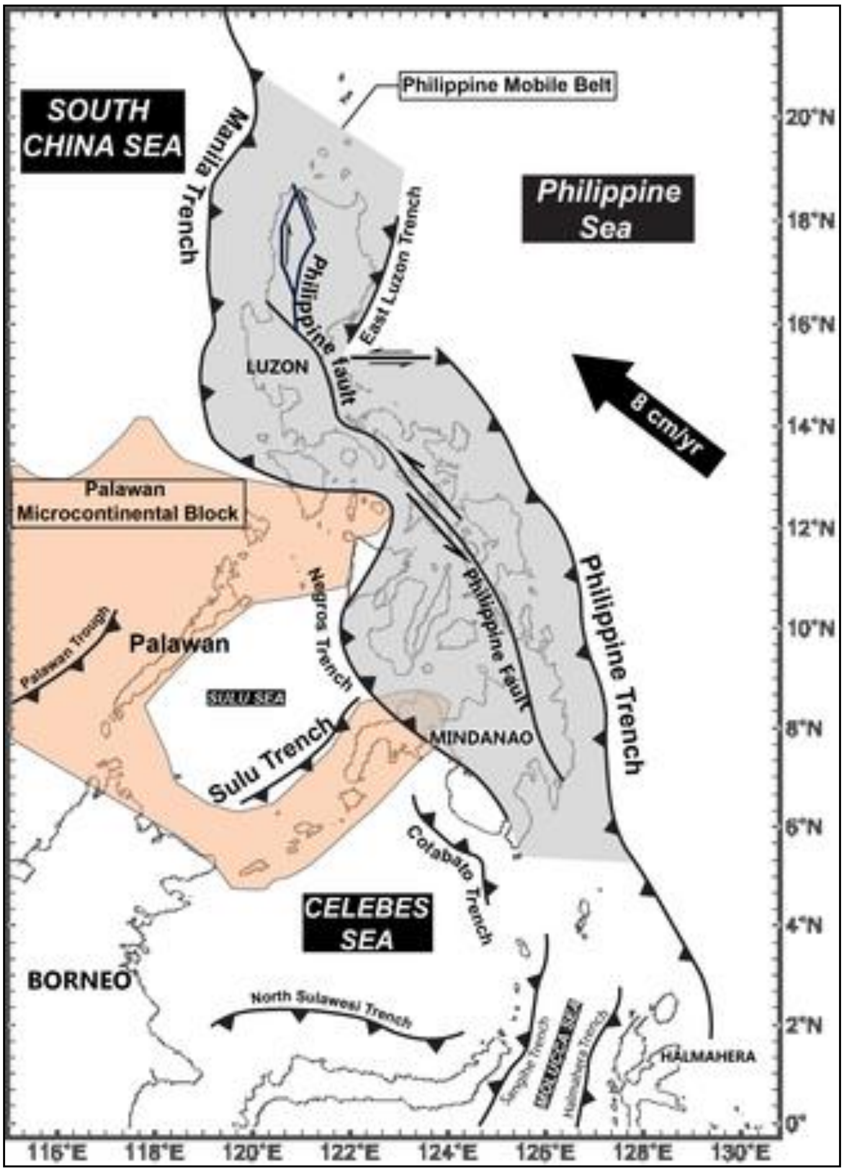
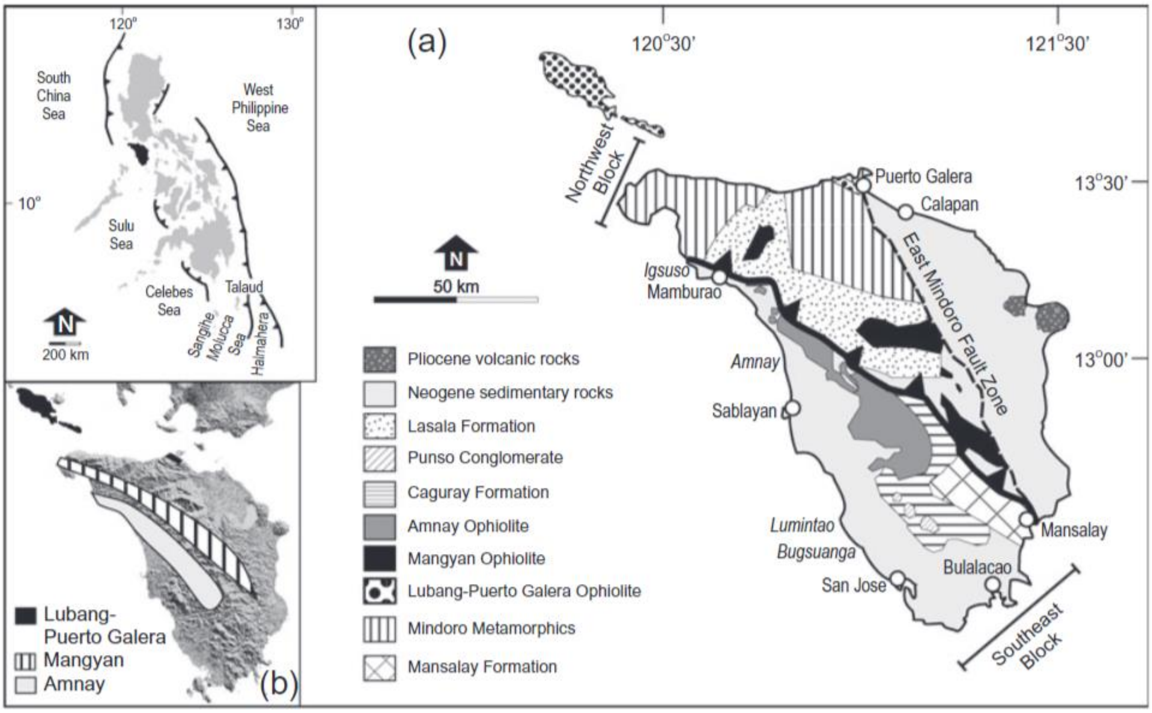


Figure 2.1.7: Simplified Tectonic Map of the Philippines showing the Palawan Micro-continental Block and the Philippine Mobile Belt

As a result, Mindoro Island exhibits two tectono-stratigraphic terranes, namely the North Palawan Block and the Mindoro Block, which is separated by a steeply-dipping lithospheric boundary known as the Mindoro Suture Zone (Sarewitz and Karig, 1986). The Mindoro Block is located on the northeast part of Mindoro Island and is part of Philippine Mobile Belt with rocks of island arc to oceanic affinity while the North Palawan Block is located on the southwest part of Mindoro Island and is considered part of the Palawan micro-continental block (Yumul et al., 2009).

There are several theories on the placement of the boundary between the two blocks, with some suggesting that the collision boundary is located offshore east Mindoro while others say that the boundary cuts through Central Mindoro or in the southwestern part of the island (Marchadier and Rangin, 1990; Sarewitz and Lewis, 1991 in Yumul et al., 2009). Yumul et al. (2009) places the boundary between the two blocks on the western edge of the Mindoro Mountain range on the central part of the island (**Figure 2.1.8**).



Source: Yumul et al., 2009

Figure 2.1.8: Geologic Map of Mindoro Island showing the Boundary Between the Mindoro Block (Northwest Block) and the North Palawan Block (Southeast Block)

The collision zone between the North Palawan Block and the Philippine Mobile Belt is marked by the Amnay Ophiolitic Complex in Mindoro. According to Yumul et al. (2009), the origin of this ophiolite complex is interpreted to be fragments of the South China Sea oceanic lithosphere that was emplaced as a consequence of the collision between the Palawan micro-continental block and the Philippine Mobile belt.

The two main tectonic structures in the vicinity of Mindoro are the Manila Trench, which bounds the island on the west, and the Verde Passage Fault located offshore on the northwest part of the island between Batangas and Mindoro as it branches out from the Philippine Fault Zone. Onshore geologic structures in Mindoro include: 1) the Central Mindoro Fault that traverses the island from north to south with the northern half separating the Upland Mindoro Mountain range from the Mindoro Basin and the southern half traversing the mountain range (Sarmiento et al., 2022); and 2) the Aglubang River Fault, a right lateral strike slip fault extending from Malaylay Island in the north to Alcate, Victoria in the south (Po et al., 2015).

2.1.2.2.2 Stratigraphy

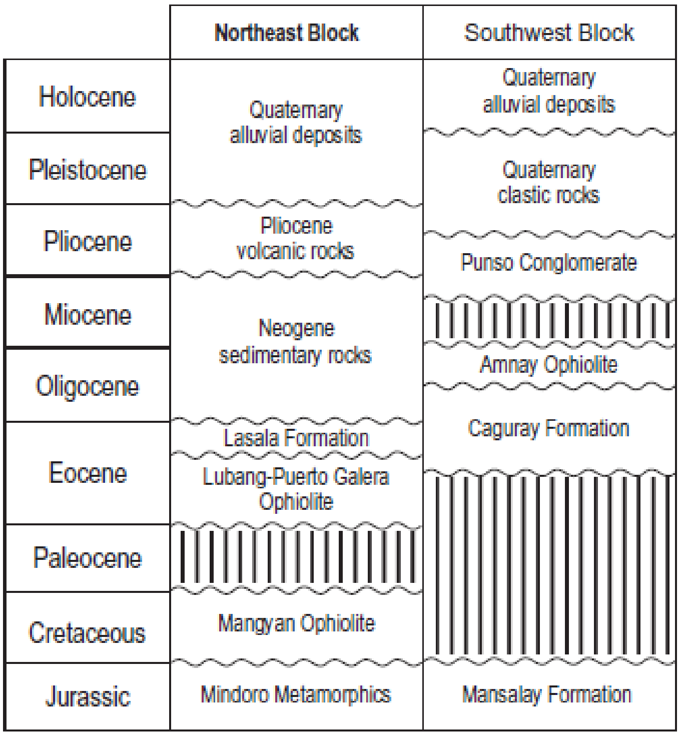
Basement rocks in northern Mindoro include amphibolites, phyllites, greenschists, metagabbros, gneisses, slates and marble belonging to the Halcon Metamorphic Complex or the Mindoro Metamorphics overlain by volcanic and sedimentary rocks belonging to: 1) Abra de Ilog Formation (greywacke, shale, chert, spillitic basalt); 2) Lasala Formation (sandstone, shale, mudstone, conglomerate, limestone, basalt flows and dikes); 3) Pagbahan Granodiorite (granodiorite, quartz diorite, quartz monzonite); 4) Amnay Ophiolitic Complex (dunite, peridotite, gabbro, basalt) although Yumul et al. (2009) places the Amnay Ophiolitic Complex in the southwest or North Palawan Block; 5) Amnay Basalt (basalt, tuff, mudstones); 6) San Teodoro Volcanic Complex (basalt, andesite, dacite, agglomerate); and 7) Dumali Volcanic Complex (andesites, pyroclastic rocks) (Aurelio and Peña, 2004).

The basement rocks in Southwestern Mindoro belong to the Jurassic Mansalay Formation consisting of sandstones, shale, siltstone, minor limestone and conglomerate deposited in non-marine, tidal and shallow marine environments (Teves, 1953 in Yumul et al., 2009). The basement rocks are overlain by: 1) Middle Eocene Agbahag Conglomerate; 2) Late Eocene to Early Oligocene Caguray Formation (fine-grained deepwater mudstone, siltstone, shale, sandstone, conglomerate, limestone); 3) Late Oligocene to Early Miocene Bugtong Formation (limestone, siltstone, sandstone, conglomerate, agglomerate); 4) Early Miocene Tangon Formation (shale, sandstone); 5) Early Miocene Napisian Formation (shale, sandstone, coal beds, conglomerate, limestone); 6) Early Miocene to Middle Miocene Pocanil Formation (limestone, shale, siltstone, sandstone, conglomerate); 7) Late Miocene to Early Pliocene Punso Conglomerate (conglomerate, sandstone, mudstone, shale) which is interpreted to document the initial juxtaposition of the two terranes in Mindoro (Yumul et al., 2009); 8) Early Pliocene Famnoan Formation (conglomerate, sandstone, shale, limestone); 9) Late Pliocene to Early Pleistocene Balanga Formation (sandstone, limestone, minor mudstone, conglomerate); and 10) Pleistocene Oreng Formation (limestone, conglomerate) (Aurelio and Peña, 2004; Yumul et al., 2009).

The stratigraphic columns of the northeast and southwest blocks in Mindoro Island are shown in **Figure 2.1.9** while the geologic map of the vicinity of the Amnay River basin is shown in **Figure 2.1.10**. The geologic map shows that rocks in the midstream and upstream sections of Amnay River include clastic sedimentary rocks, metamorphic rocks, ultramafic rocks and limestone while the floodplain of Amnay River is underlain by alluvial deposits.

Oceanic lithosphere fragments are also exposed in Mindoro Island, namely the Puerto Galera Ophiolite correlated to the Eocene Zambales Ophiolite Complex (Karig, 1983; Yumul et al., 2008 in Yumul et al., 2009), the Cretaceous Mangyan Ophiolite exposed on the central mountain range from the north to the central-southeast portion of the island (Hashimoto, 1981 in Yumul et al., 2009), and the Oligocene Amnay Ophiolitic Complex exposed on the northwest (Rangin et al., 1985 in Yumul et al., 2009).

The Amnay Ophiolitic Complex trends northwest-southeast and extends from Igsuso in the northwest to Amnay River in the southeast and is extensively exposed in the midstream section of Amnay River. Its mantle sequence is dominated by serpentinized harzburgites with lenses of dunite, websterite and lherzolite. It has no layered ultramafic complex and a well-defined transition zone dunite. Gabbroic dikes intrude the harzburgites similar to other ophiolites.



Source: Modified after Jumawan et al., 1998 in Yumul et al., 2009

Figure 2.1.9: Stratigraphic Columns of the Mindoro (Northeast Block) and North Palawan (Southwest Block)

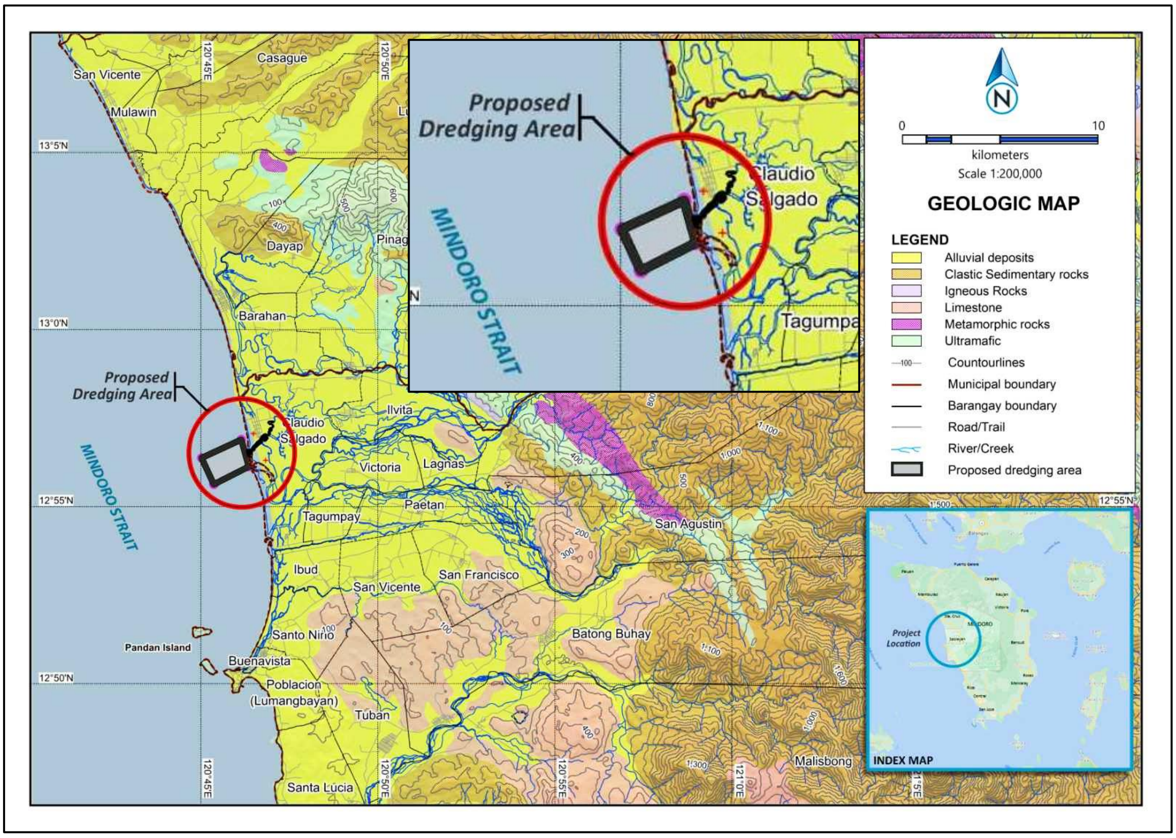


Figure 2.1.10: Geologic Map of the Vicinity of the Amnay River Basin

The volcanic sequence consists of pillow lavas, basaltic flows, basalt breccias, and diabase dike complex exposed south of Amnay River (Yumul et al., 2009).

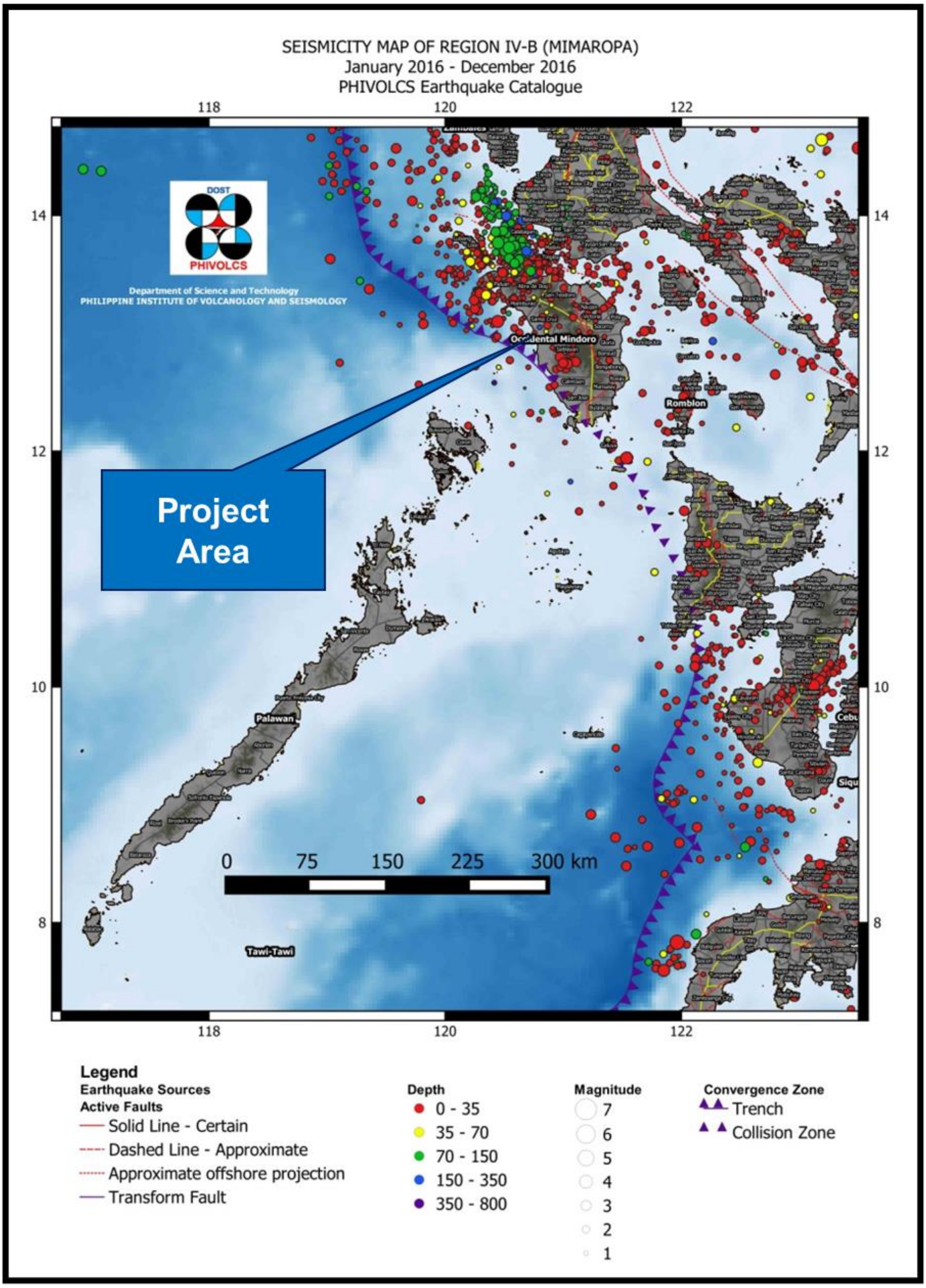
The youngest lithology in the Amnay watershed is the Holocene alluvial deposit made up of detrital materials eroded from the headwaters of Amnay River. This Holocene sediment covers the alluvial floodplains built up by Amnay River and Patrick River. The river alluvial deposits vary from gravelly alluvial at the lower reaches to fine well sorted sand towards at estuary and the coast. The sand is generally composed of silica, ferromagnesian and particles of the headwater lithology (**Plate 2.1.1**)

Plate 2.1.1: Gravelly Alluvial Sediment at the Lower Reaches of Amnay River and the Fine Well Sorted Sand at the Estuary and the Coast

2.1.2.3 Geologic and Other Natural Hazards

2.1.2.3.1 Seismic Hazard

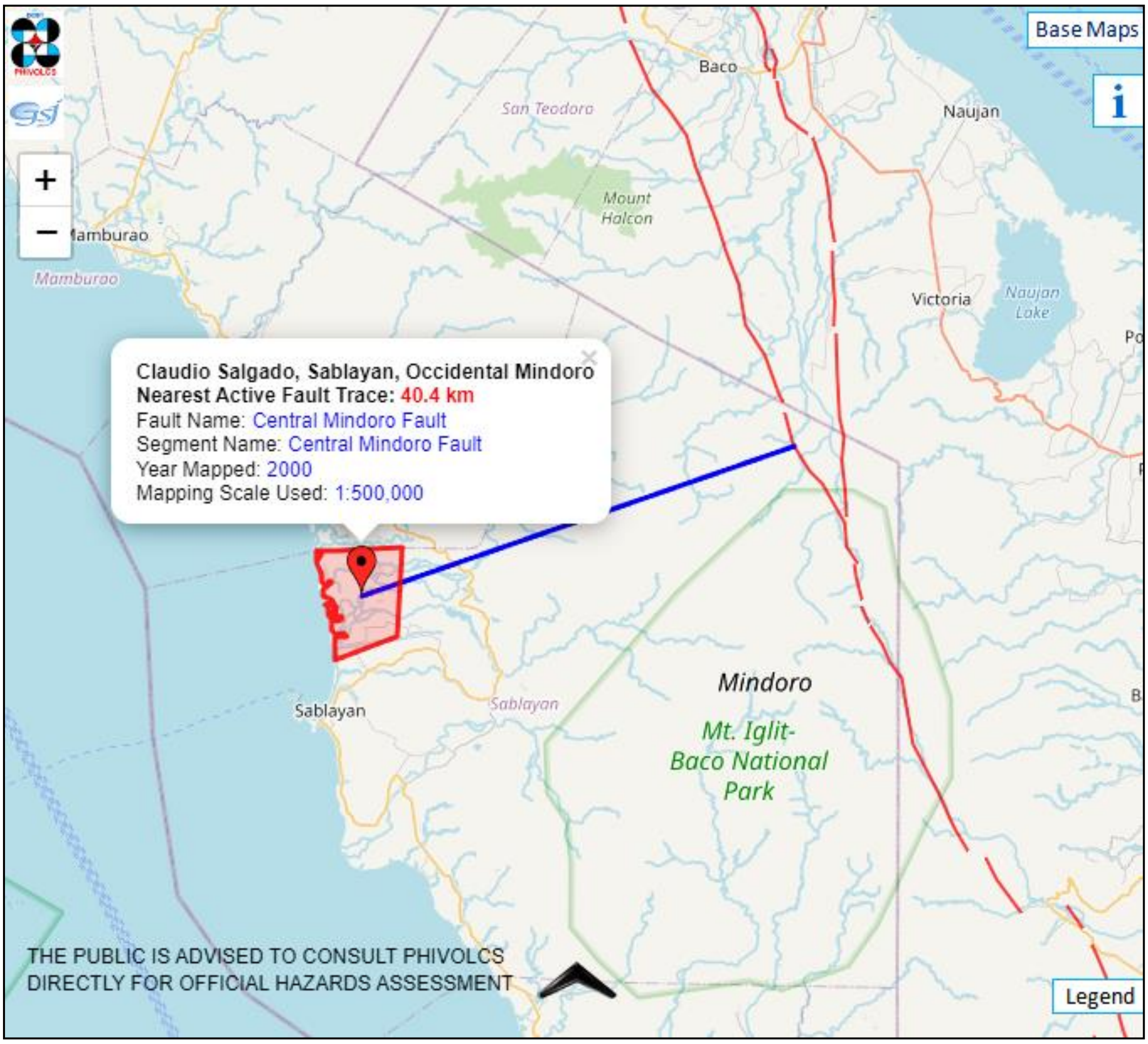
Southwest Mindoro is part of the North Palawan Block or the a-seismic region of the Philippines. However, the seismicity map of Region IV-B in 2016 (**Figure 2.1.11**) indicates the presence of earthquake epicenters of shallow depth and low to moderate magnitude in southwest Mindoro including the Municipalities of Sablayan, Calintaan, and San Jose. These earthquakes are presumed to be generated by subduction activities along the Manila Trench, although Po et al. (2015) points out that the seismic slips along the southern terminus of the Manila Trench have been insignificant for the past 40 years, suggesting a decrease in convergence rates approaching total cessation.



Source: PHIVOLCS, 2016

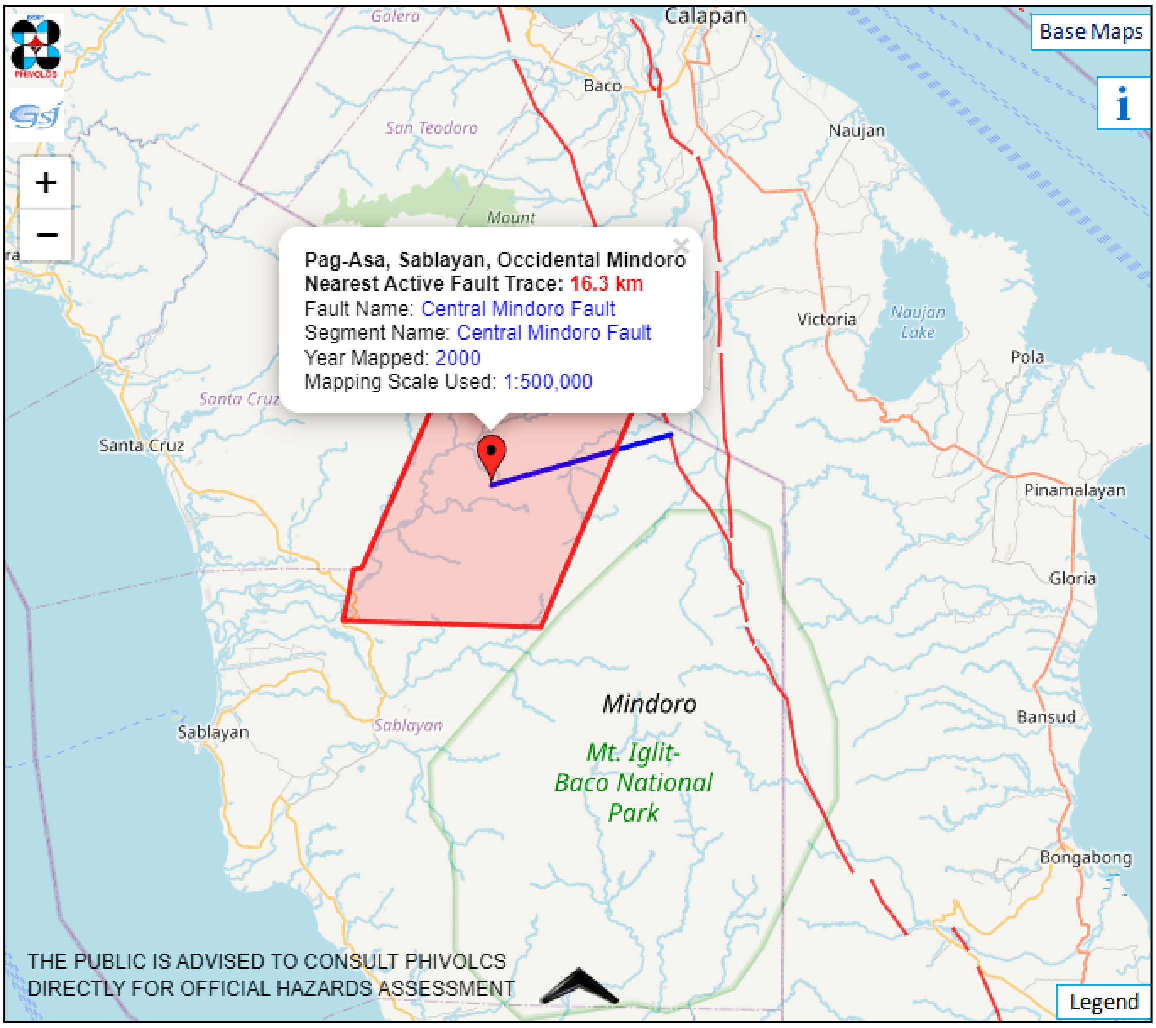
Figure 2.1.11: Seismicity Map of MIMAROPA Region

Figure 2.1.12 and **Figure 2.2.13** show the distance of Barangays Claudio Salgado (downstream-most barangay) and Pag-asa (upstream-most barangay), respectively to the nearest active fault in onshore Mindoro. As shown on the maps, the central portion of Barangay Claudio Salgado is located about 40.4 km southwest from the Central Mindoro Fault. The Central Mindoro Fault on the east and the Manila Trench on the west are the nearest active seismic generators to the Amnay Watershed.



Source: PHIVOLCS Fault Finder

Figure 2.1.12. Distance of Barangay Claudio Salgado, Sablayan to the Nearest Active Fault

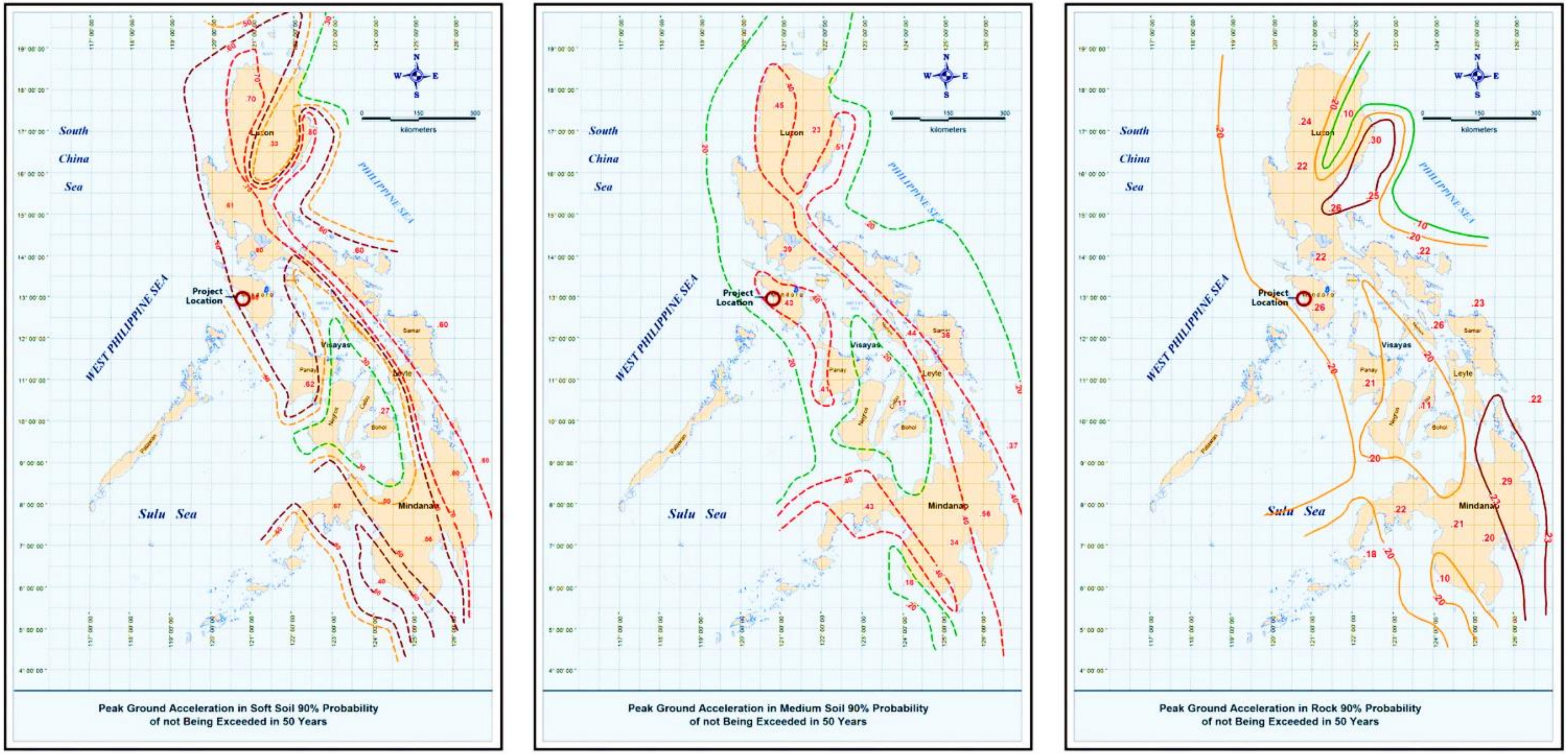


Source: PHIVOLCS Fault Finder

Figure 2.1.13. Distance of Barangay Pag-asa to the Nearest Active Fault

2.1.2.3.2 Ground Shaking and Acceleration

Ground shaking is the most familiar effect of earthquakes that results from the passage of seismic waves through the ground. Strong ground shaking often results to damage to buildings and other structures. Ground shaking is expressed in terms of peak ground acceleration (PGA), an important parameter used in earthquake engineering. Thenhaus et al. (1990) provided the probabilistic zonation maps of estimated PGA values for various soil and rock conditions in the Philippines. The PGA maps developed by Thenhaus et al. (1990) are shown in **Figure 2.1.14** and indicate that the expected PGA in the project site will range from 0.6g for soft soil, 0.4g for medium soil and 0.26g for rock. Expected PGA values in the midstream and upstream sections of the Amnay Watershed will range from 0.26g to 0.4g while PGA values for the lower reaches of Amnay River will be at 0.6g considering the unconsolidated alluvial materials underlying the Amnay River floodplain.



Source: Thenhaus et al., 1990

Figure 2.1.14: Peak Ground Acceleration Contour Map for Soft Soil, Medium Soil and Rock

Table 2.1.4 presents the various earthquake intensity scales such as the Philippine Earthquake Intensity Scale (PEIS), Modified Mercalli, and United States Geologic Survey (USGS) earthquake intensity scale in relation to PGA values, perceived shaking and potential earthquake damage.

Table 2.1.4: Various Intensity Scales in Relation to Acceleration, Ground Shaking and Potential Damage

PEIS	Modified Mercalli	USGS	Acceleration (g)	Perceived shaking	Potential damage
I	I	I	<0.0017	Not felt	None
II	II	II-III	0.0017 – 0.014	Weak	None
III	III				None
IV	IV	IV	0.014 – 0.039	Light	None
V	V	V	0.039 – 0.092	Moderate	Very light
VI	VI	VI	0.092 – 0.18	Strong	Light
VII	VII	VII	0.18 – 0.34	Very strong	Moderate
VIII	VIII, IX	VIII	0.34 – 0.65	Severe	Moderate to heavy
IX	X, XI	IX	0.65 – 1.24	Violent	Heavy
X	XII	X+	>1.24	Extreme	Very heavy

Sources: https://www.phivolcs.dost.gov.ph/index.php/earthquake/earthquake-intensity-scale; https://earthquake.usgs.gov/learn/topics/mercalli.php; https://earthquake.usgs.gov/learn/topics/mag_vs_int.php; https://en.wikipedia.org/wiki/Peak_ground_acceleration;

It may be gleaned from **Table 2.1.4** that the expected PEIS equivalent of ground shaking on soft soil will be Intensity IX while that for medium soil and rock will be Intensity VIII and Intensity VII, respectively. Structures within the Amnay floodplain are expected to experience moderate to heavy damage during strong earthquakes.

2.1.2.3.3 Ground Rupture

Ground rupture is a visible offset on the ground resulting from ground movement during strong earthquakes. This poses a major risk to structures built on active fault zones. Ground rupture hazard is low considering the distance of the Amnay Watershed to Central Mindoro Fault.

2.1.2.3.4 Liquefaction

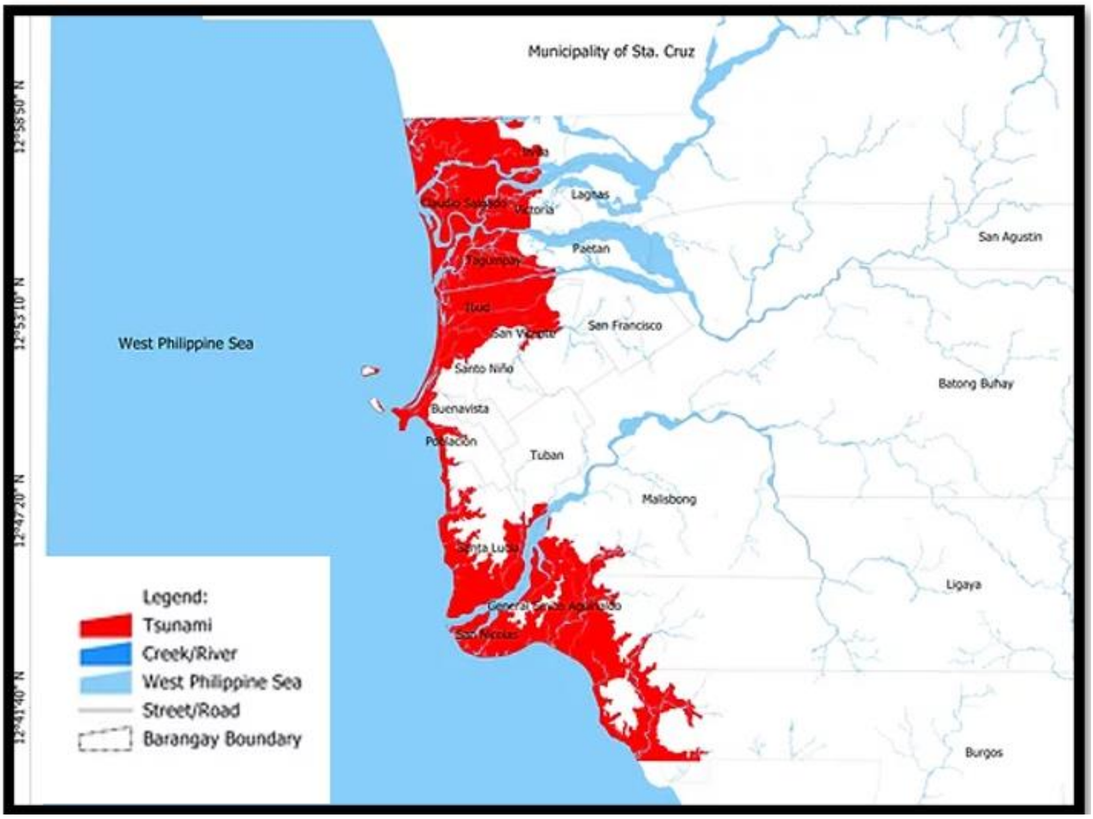
The lower reaches of the Amnay Watershed are prone to liquefaction due to the presence of unconsolidated alluvial materials (**Figure 2.1.15**).

2.1.2.3.5 Tsunami

The coastal areas of Sablayan are susceptible to tsunami (**Figure 2.1.16**) but there are no reported incidents of tsunami in the municipality in recent times.

Source: PHIVOLCS

Figure 2.1.15: Liquefaction Susceptibility Map of Mindoro Island

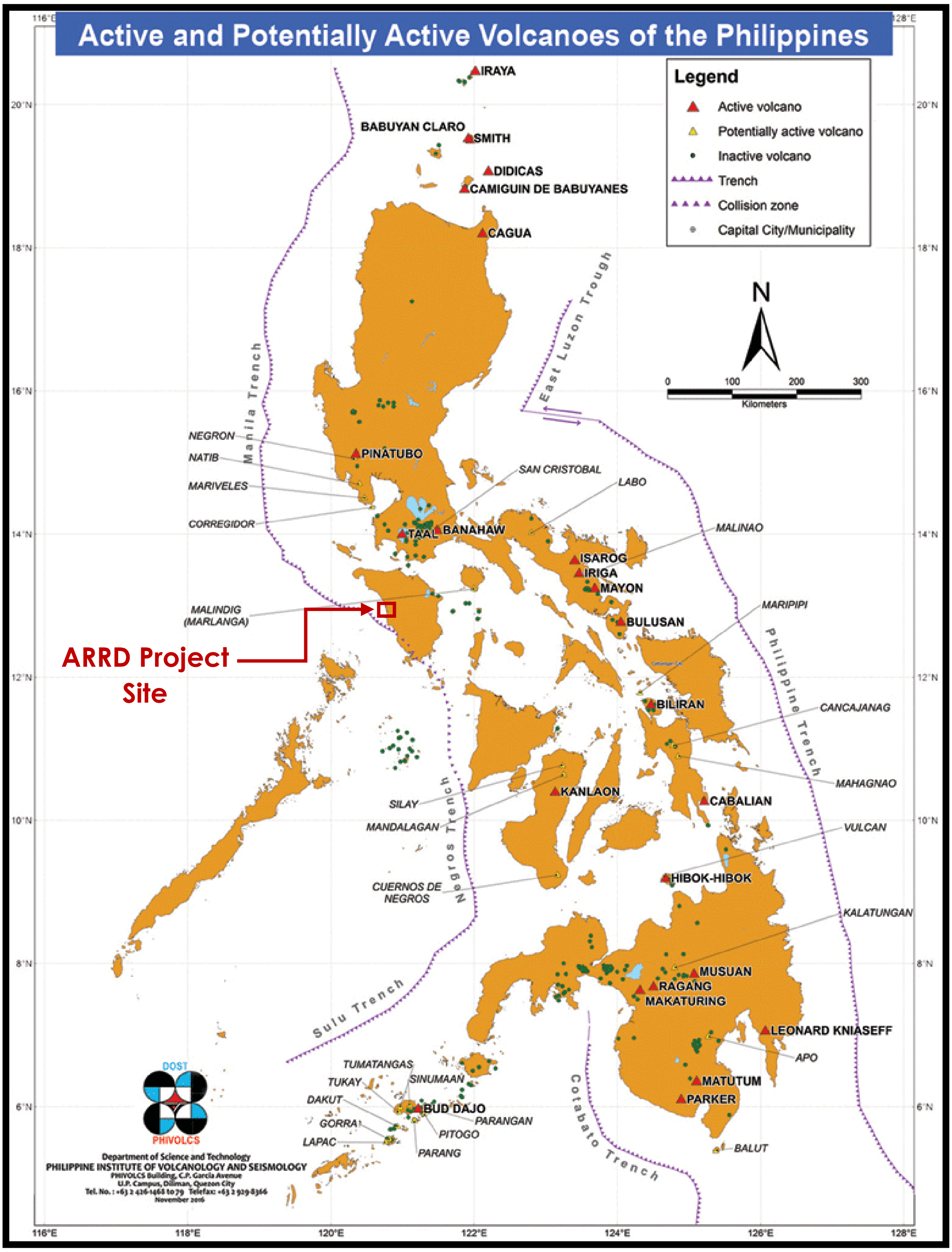


Source: PHIVOLCS

Figure 2.1.16: Tsunami Hazard Map of Sablayan

2.1.2.3.6 Volcanic Hazards

Figure 2.1.17 shows the location of active and potentially active volcanoes in the Philippines. As shown on the map, there are no active volcanoes in Mindoro Island and the nearest active volcano is Taal Volcano in Batangas. Considering the distance of the Amnay Watershed from Taal Volcano, ashfall or tephra is the most likely volcanic hazard that can affect the project site.

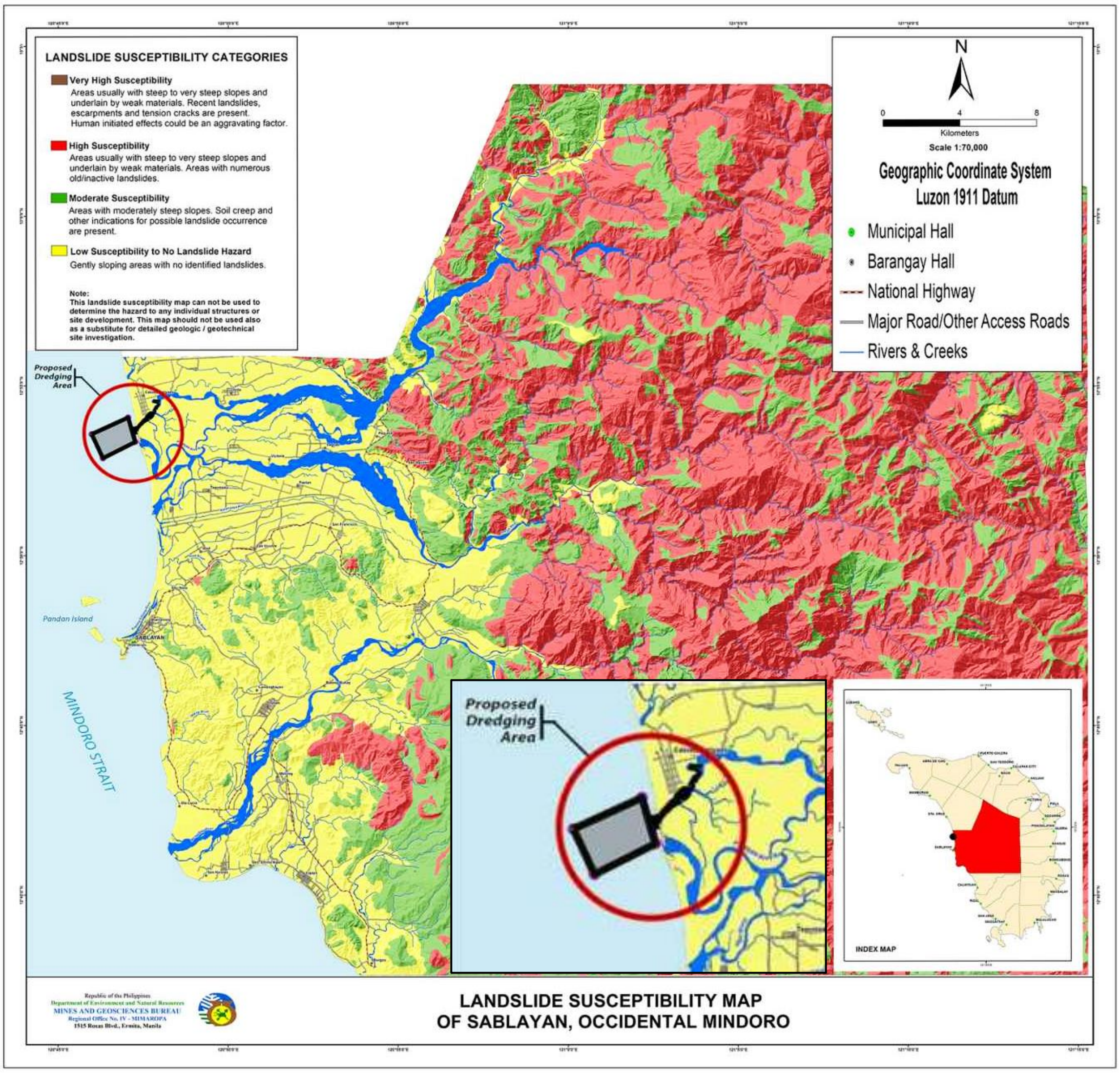


Source: PHILVOCS

Figure 2.1.17: Location of active and potentially active volcanoes in the Philippines

2.1.2.3.7 Landslide

The midstream and upstream sections of the Amnay Watershed have moderate to high susceptibility to landslide hazard while the alluvial plains in the downstream section of the watershed have low susceptibility to landslide hazard (**Figure 2.1.18**). Occurrence of landslides is reported in Barangay San Agustin in the upstream section of Patrick River and in other moderately to steeply sloping areas of the municipality. Landslides normally occur in road cuts and disturbed slopes.



Source: MGB

Figure 2.1.18: Landslide Hazard Map of Sablayan, Occidental Mindoro

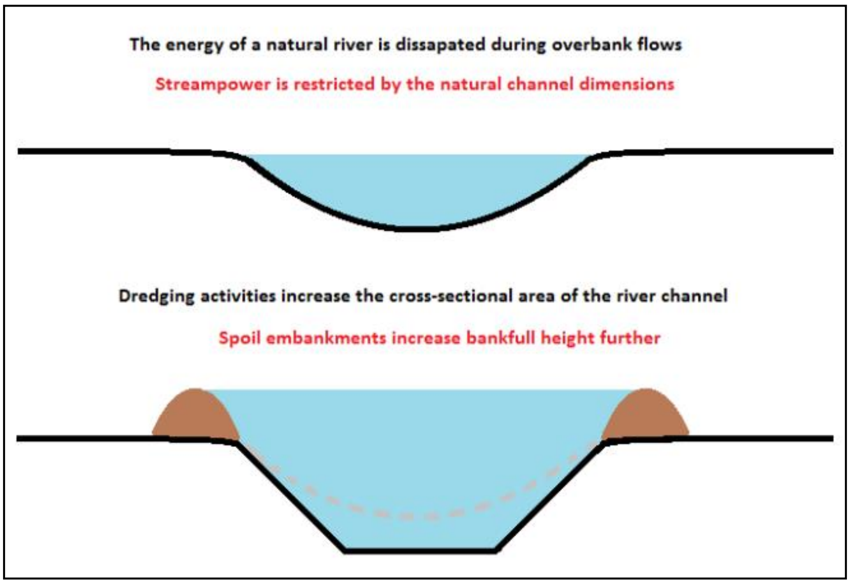
2.1.2.4 Change in Surface Landform/Geomorphology/Topography/Terrain/Slope

There will be no changes in surface landform/topography/terrain/slope of the land because no activities will be undertaken herein and on the areas of concern that will extremely cause negative effects, since the dredging and desilting activities will deal only on the rivel channel, except the dredging works and mobilization of equipment that will load and unload dredge materials. The dredging and desilting workers accommodation will not result in changes in geology.

The impacts of river dredging on geomorphology is dependent on the river type, sediment characteristics, dredging technique employed and the existing floodplain connectivity. The effects of river dredging on low energy rivers have very little information but common dredging impacts on high energy rivers are listed below:

- Reduction in bed load supply and channel slope downstream of the dredging area will occur.
- An increase in channel slope upstream of the dredging area is expected.
- Reduction in availability of sediments will lead to a simplified channel platform in braided systems.
- Vertical incision can occur and can lead to riverbank stability and potential channel widening.
- The resulting greater stream power can lead to transport of coarser sediments downstream of the dredging area, and when combined with finer sediment load, can lead to bed armouring.

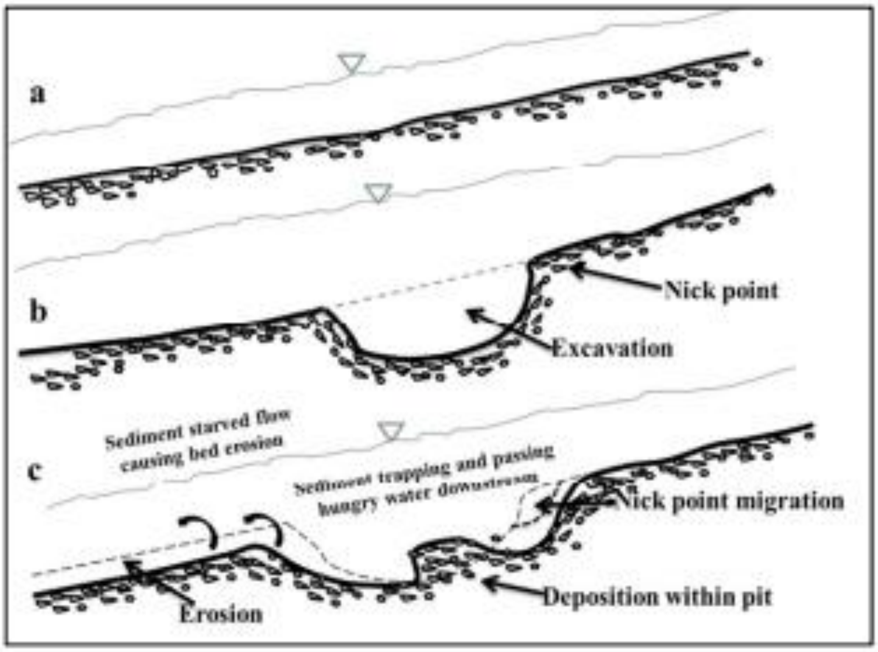
Aside from the impacts listed above, dredging can also lead to vertical incision and bank destabilization since the energy used by the river to transport sediment (that has been removed through dredging) downstream is now used to erode the riverbed and the riverbanks (Bond, 2013). Further problems can be created if the dredged material is stockpiled on the riversides since this will create an embankment that will prevent bank overflow and increase bank full discharge, stream power and sediment transport capacity (**Figure 2.1.19**).



Source: Bond, 2013

Figure 2.1.19: Diagram showing the Impact of Dredging on River Channel Morphology

The morphology of a river channel results from three variables: 1) material properties of the bed and banks, 2) flow hydraulics, and 3) sediment transport within the river. All these variables interact to produce the channel form. Changes in any of the three variables can lead to impacts on the other variables. If dredging of the river is done, the channel geometry is altered and can lead to lateral channel instability. The interruption in sediment transport (since sediments will be removed from the river bed through dredging) will result in a sediment-starved river flow. The unusual and rapid increase in riverbed depth can alter the equilibrium profile of the streambed and can create a steeper gradient upstream. This often leads to erosion upstream, commonly known as head cutting, and can propagate upstream for kilometers on the main river and its tributaries. The creation of pits on the riverbed traps the incoming sediments from upstream and the sediment-deprived water typically erodes the channel bed and riverbanks downstream to regain part of its sediment load (**Figure 2.1.20**). Bank erosion is a significant concern since these often leads to loss of land and property.



Note: a) before dredging, b) excavation creates a nick point upstream, and c) the nick point migrates upstream and the sediment starved water erodes the bed downstream, causing incision upstream and downstream.

Figure 2.1.20. Incision Produced by Instream Excavation

To address the impacts of river dredging to surface landform/ geomorphology/terrain/slope the following measures shall be implemented:

- Although it was established that dredging can directly lead to bank erosion, dredging can be done using proper techniques. The rate of bank erosion decreases as the distance of dredging location increases. Thus, a suitable distance from the riverbank must be maintained to minimize the disturbance to bank stability. A buffer zone from both banks of the river should be maintained during dredging operation.
- The extraction rate should be equivalent to or less than the annual replenishment rate of sediments in the riverbed.
- Extract sand and gravel from the downstream portion of sandbars to promote channel stability.
- Extraction activities should be concentrated or localized rather than spread out to minimize the area of disturbance of upstream and downstream effects.
- Regular monitoring should also be done to determine if the dredging activities will affect the rates of bank erosion at least 1-2km upstream and downstream of the dredging area.
- Cumulative impacts of dredging activities should be reviewed annually and a long-term monitoring program should be established to monitor changes to channel morphology and bed elevation.

2.1.2.5 Change in Subsurface Geology/Underground Condition

The construction (opening of delta) and operation phase of the proposed ARRD Project is expected not to cause negative effects, since the dredging and desilting activities will deal only on the channel, nor will put change in the sub-surface geology and underground conditions at the project site particularly in the riverbed and river delta since these activities will involve sub-surface materials and procedures.

To mitigate this (if any), proper dredging methodology will be implemented as well as use of silt curtains to prevent massive siltation and disturbance to marine resources.

2.1.2.6 Inducement of Subsidence, Liquefaction, Landslides, Mud/Debris Flow, etc.

Dredging and desilting activities will not induce subsidence, liquefaction, landslides, mud/debris flow in the project areas. The natural hazards, however, can potentially affect the project particularly, the earthquake related hazards.

CPGI shall develop and implement an Emergency Response Plan for tsunamis to ensure the safety of the employees, contractors, and visitors. Riverbank stabilization methods used for unstable banks and ditches, both natural and manmade, include modification of the river side, sufficient drainage techniques to reduce water content of the dredge materials on piles, reinforcement measures (anchors, gabions), restraining structures (retaining walls, gabions, geotextiles), and regreening shall be used solely or in combination.

2.1.3 Pedology

2.1.3.1 Soil Type

Soil types found in the Amnay River watershed include: 1) Hydrosol; 2) San Manuel sandy loam, 3) Quingua clay loam, 4) Faraon clay, 5) Umingan loam and 6) Banto clay loam (**Figure 2.1.21**). Undifferentiated mountain soils are found in the upland areas. The lowland areas within the floodplain of Amnay and Patrick Rivers are suitable for paddy rice, corn, high value crops, bamboo, fruit trees, banana and other crops.

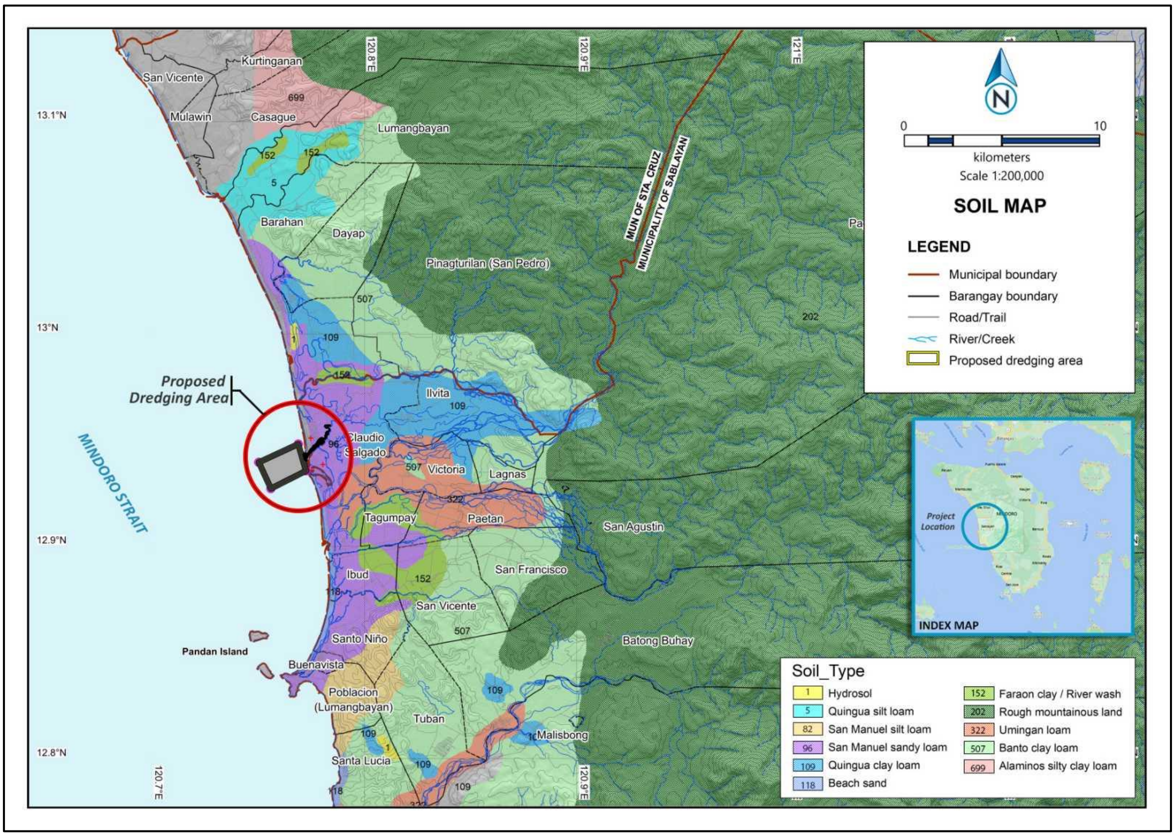


Figure 2.1.21: Soil Map of Sablayan, Occidental Mindoro

Loamy soil covers much of the alluvial plain and a typical soil profile is shown in **Plate 2.1.22**. In areas of buried meanders, the loam soil is deposited over the gravel beds, and overtopped by deposits during the subsequent flooding events.

Plate 2.1.22: Example of Soil Profile Exposed along the Bank of Amnay River

2.1.3.2 Soil Erodibility

The upland areas of Sablayan underlain by clastic sedimentary rocks have slight erosion potential while areas with rolling to undulating terrain underlain by clastic sedimentary rocks, limestone and ultramafic rocks have moderate erosion potential (**Figure 2.1.21**). There is no apparent erosion in the alluvial plains of Sablayan. Severe erosion is occurring in the alluvial areas of Barangays Buenavista, Poblacion, Tuban and Sta. Lucia as well as in the area northeast of Barangay Ilvita.

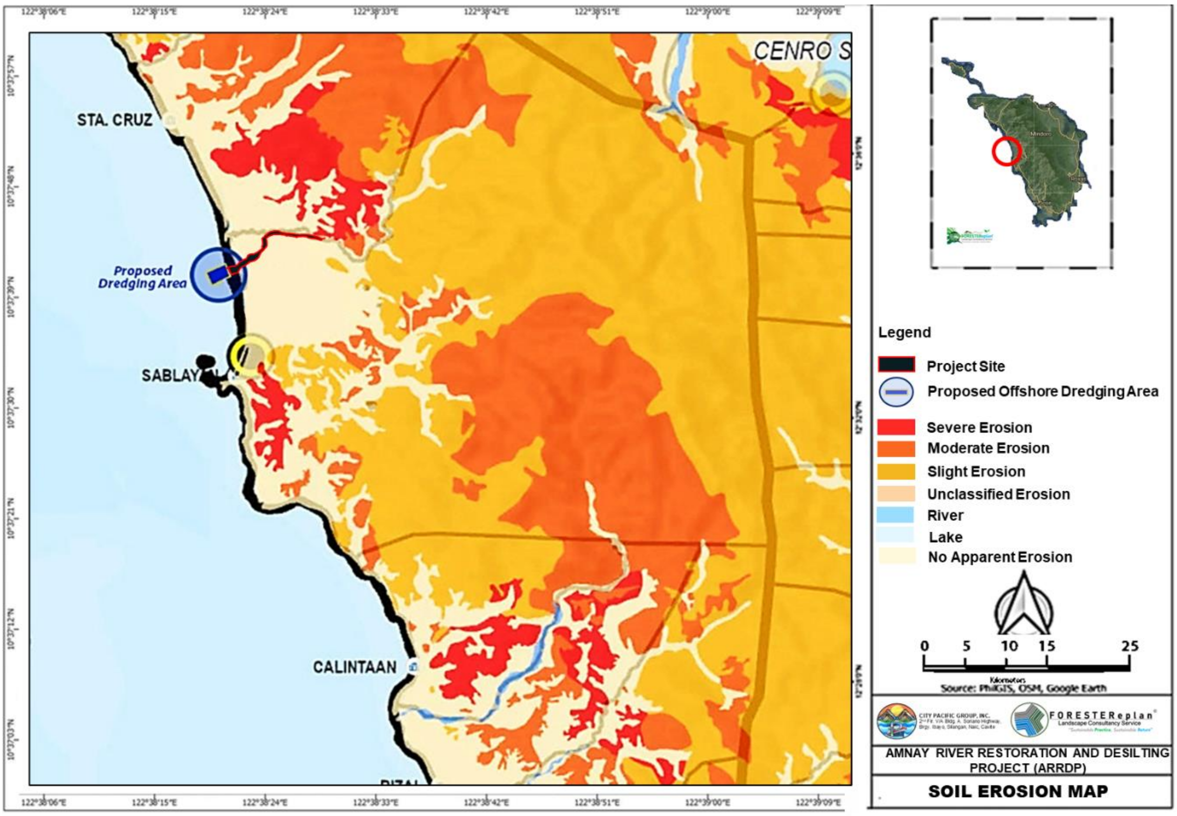


Figure 2.1.22: Soil Erosion Map of Sablayan

2.1.3.3 Soil Erosion/Loss of Topsoil/Overburden

One of the potential impacts of this project is the possible movement or transport of fleeting silt materials in other parts of the river because of the dredging and desilting activities. This concern may be prevented with the implementation of silt curtains and containments to trap or block any dispersed silt. Sand bags and soil tubes may also be used as alternative options to prevent soil erosion and at the same time the geo-tubes will serve as additional containment area and will act as filter for containment purposes and environmental mitigation. The water will go back to the river leaving the dredged material (**Plate 2.1.3**).

Note: (a) prevent soil erosion, (b) geo-tubes serve as additional containment area and will act as filter
Image Source: DRAGFLOW SRL (2012) https://www.dragflow.it/en/poland-2012-dredging-with-geotubes/

Plate 2.1.3: Placement of Sand Bags and Geo-Tubes

It is important and critical to consider, minimize and reduce the incidence of sedimentation and erosion. Control of sediments as near to the source as possible and whenever there is foreseen incidents. In this way lesser amount of sediment transport and carry load is placed on downstream section of the river with sediment controls (Sloat and Redden, 2015). Proper water management in dredge ship, dredge and other disturbed areas such as along the vicinity of the plant where the erosion and sediment control will be highly implemented in compliance with the DPWH approved dredging plan. It typically consists of containment bags, sandbags, and a small sediment pond to be installed adjacent to Amnay River. Surface runoff is minimized, thereby limiting the potential for rill and gully development near stockpiles on disturbed landscapes and saturation of the soil at specific areas on the crushing plant near the river and shore, which can produce deep seated slope failures in unstable grounds.

2.1.3.4 Change in Soil Quality/Fertility

The proposed ARRD Project will have no significant impact in soil quality because there will be no other factor or aspect that will be introduced or integrated in the planning to the project site such as other materials nor construction of any structure except for workers temporary and mobile accommodation. The project will involve dredging and desilting works only encompassing the 6-km stretch of Amnay River specifically for the river channel down to the pilot and river mouth 500 to 1.5 km from the shore depending on the level of sand blocking the delta to declog. Moreover, Zhong et al (2018) state that dredging the upper 30cm of sediment in a freshwater body can effectively reduce organic matter, total nitrogen and total phosphorus in the sediments. Thus, the plan to dredge the river bed of Amnay River will result in the significant reduction of organic matter, total nitrogen and total phosphorus in the remaining sediments.

The dredging activity also aims to reduce the occurrence of flooding in Amnay River. Flooding significantly alters the availability of nutrients in the soil. Soil lost due to erosion can take with it plant-available nutrients and organic matter while deposition from floods can increase the level of nitrogen, phosphorus, silicon and potassium in the soil (Clark, 2020). The expected reduction in flood events that bring nutrients to downstream areas can lead to the decrease in available nutrients in soil and sediments in the river and its banks as well as the surrounding floodplain

2.1.4 Terrestrial Ecology

2.1.4.1 Terrestrial Flora

The terrestrial flora survey was conducted during the wet season on September 21-28, 2021 in order to determine the overall value of the vegetation in the vicinity of Amnay River. The terrestrial flora survey was conducted at nine (9) transect plots that were established parallel to Amnay River in portions of Barangays Claudio Salgado, Ilvita, Pag-asa in the Municipality of Sablayan and Barangay Pinagturilan in the Municipality of Santa Cruz as described in **Table 2.1.5** and shown in **Figure 2.1.23**.

Table 2.1.5: Coordinates of Terrestrial Flora Survey Stations

Transect	Coordinates (DMS: 51Q TA) MGRS grid reference	Length (km)	Elevation (masl)	Brief Description
1	*Start* N 12°56'46.94" E 120°46'30.12" *End* 12°57'02.22"N 120°46'46.50"E	1.0	3.0	Open brushland/wooded land representing the mouth of Amnay River. Generally covered with some coastal beach plants species. Heavily occupied by human settlements. Sandy banks with eroded and silted sections.
2	*Start* N 12°56'50.99" E 120°46'55.32" *End* 12°57'27.36"N 120°47'27.66"E	1.0	5.0	Brushland/wooded land with large grass patches. Sparsed trees in some sections with some bare areas totally devoid of cover near rice farms. Densely populated area with human settlements encroaching the River. Banks are eroded and damaged.
3	*Start* N 12°57'34.86" E 120°47'25.46" *End* 12°57'19.25"N 120°48'54.45"E	2.0	6.0	Predominantly occupied by farmlands growing rice. Some areas are inundated due to overflow incidents in the River. Many sections of farmlands are damaged by eroded banks. Tree vegetation is minimal. Patches of vegetation near River line/banks.
4	*Start* N 12°57'3.14" E 120°48'51.37" *End* 12°57'04.82"N 120°50'13.98"E	1.1	11.0	Heavily damaged by eroded Riverbanks. Sparse tree vegetation are prominent near the banks representing few individuals such as tree species of Bangkal, Talisai and *Ficus spp.* Agricultural areas.
5	*Start* N 12°57'41.04" E 120°50'8.34" *End* 12°57'46.03"N 120°50'54.09"E	1.0	16.0	Patches of vegetation, with some sparsed tree individuals along river banks. Majority of the area are rice fields with patches of vegetation at the river line. Observed with the widest damaged by widening of the River and siltation.
6	*Start* N 12°57'15.51" E 120°50'58.53" *End* 12°57'36.95"N 120°51'23.72"E	2.0	19.0	Similar to T5, vegetation patches, with some sparsed tree individuals along river banks. Majority of the area are ricefields with patches of vegetation at the river line. Observed with the widest damaged by widening of the River and siltation.
7	*Start* N 12°58'5.70" E 120°51'14.20" *End* 12°57'48.09"N 120°52'19.39"E	0.85	22.0	Small grasslands inundated near the River, with sparse tree vegetation adjacent to rice fields. Trees are minimal and even totally devoid in some areas in this transect. Heavily damaged as well due to river bank erosion.

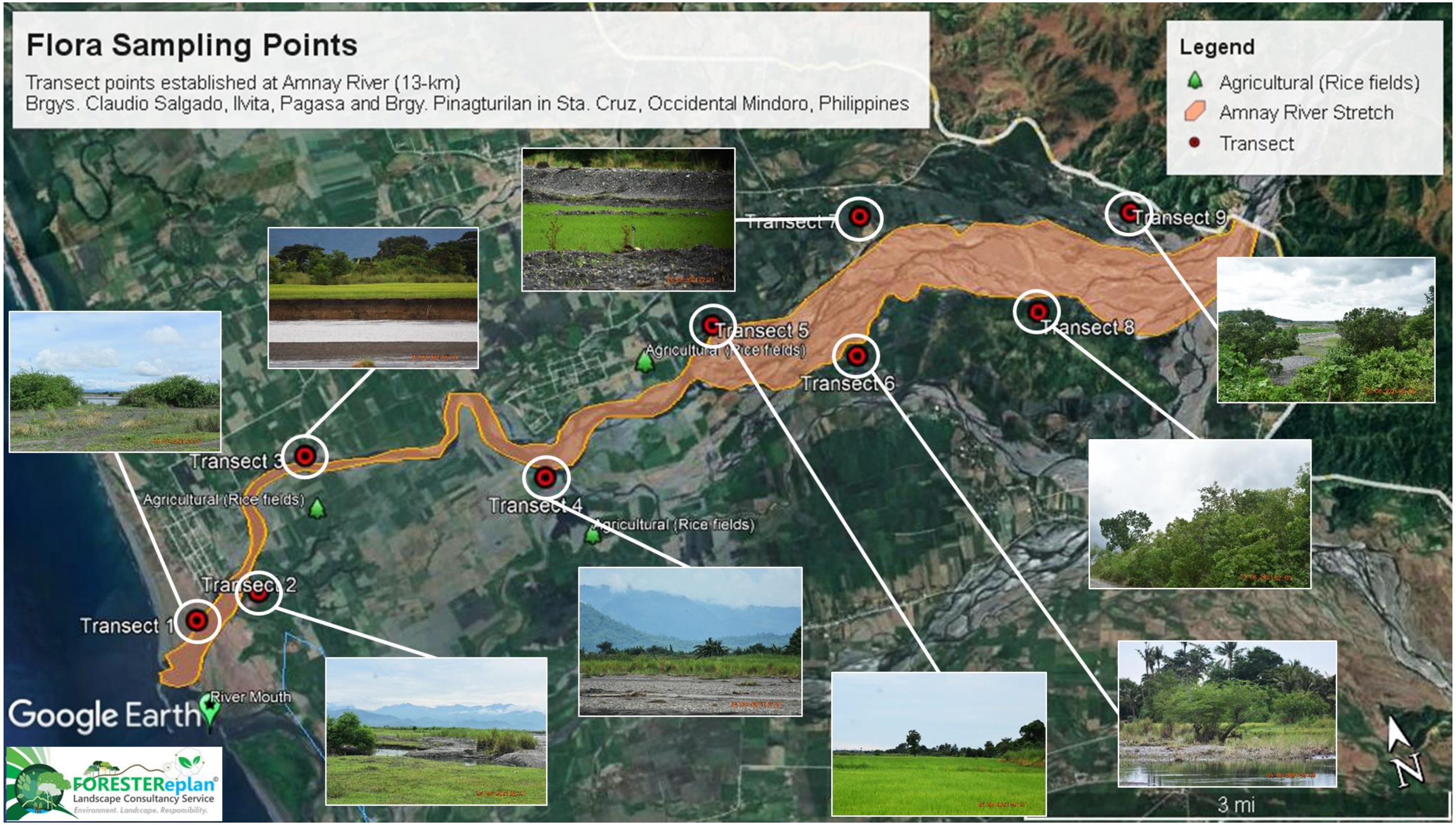
Transect	Coordinates (DMS: 51Q TA) MGRS grid reference	Length (km)	Elevation (masl)	Brief Description
8	*Start* N 12°57'13.10" E 120°52'10.04" *End* 12°56'30.25"N 120°52'52.22"E	0.75	62.0	Dense secondary growth vegetation of open brush/wooded land, with dense cover of small to medium size trees of Kakauate and pioneer tree species. Ground cover were also dense formed in the sandy and rocky substrates. Grass species were also dominant.
9	*Start* N 12°57'39.87" E 120°52'54.97" *End* 12°57'22.09"N 120°53'24.14"E	1.0	34.0	Sparse tree individuals near slopes and ditches. Heavily damaged as well by erosion and siltation. Dominated by pioneer tree species. Grass cover were dense in some sections near the bridge.

The terrestrial flora survey was conducted in all transects with reference from the proposed site of the dredging project. The vegetation was described at the proposed sites of the proposed dredging project area along established transect lines with 8 quadrat plots (20m x 20m) established at every 1.1 km intervals. There were also offsetted section of transect lines as these areas were either inundated, rocky, disturbed or near settlements. Additional foot traverses were completed to assess areas that were inaccessible by the team due to muddy ditch, rolling, inundated, flooded, precipice sections of the project area. It should be noted that transect lines were modified in the aforementioned conditions and offsetting of transect plots were done on inaccessible areas such as from Transect 4, 5 and 6. The following parameters were recorded for each transect:

- **Location**. DMS coordinates recorded in WGS84 datum (within 1m of GDA94) using a hand-held Global Positioning System (GPS), to an accuracy usually within 5 m; readings usually taken for three or four corners, occasionally for only two corners.
- **Vegetation Description.** Broad description based on the height and estimated cover of dominant species after Aplin's (1979) modification of the vegetation classification system of Specht (1970).
- **Habitat**. Description of landform and habitat.
- **Disturbance Details**. Evidence of siltation, quarrying, agricultural, mining exploration activities, coal/black sand extraction, weed invasion, frequent fires, etc. Note that fire effects were only considered as a negative impact if they appeared to be caused by repeated burning (such as that done for pastoral purposes).
- **Species composition.** Species diversity, general plant forms, abundance and importance values.

Colored photographs of the vegetation in most sites were taken using a digital camera. In addition to detailed survey, opportunistic flora collections were made to supplement the list of species recorded from the survey sites. Particular attention was paid to searching habitats and vegetation types likely to support flora species with sporadic distributions (e.g., creek lines, patches, forest fragments, and brushlands). Vegetation descriptions were based on the height and estimated cover of dominant species in sampling quadrats using Aplin's (1979) modification of the vegetation classification of Specht (1970). Additional foot traverses were completed to ground-truth the boundaries of vegetation types.

Vegetation descriptions were then grouped to arrive at vegetation units, defined on the basis of a shared suite of perennial species with a similar range of cover values. These were then grouped into similar landform/habitat types. Satellite imagery was marked up with vegetation type boundaries with the aid of satellite imagery at a scale of 1:10,000. Some of the vegetation units were either too small to show at the scale of mapping, or too variable to map individually based on the level of investigation that was possible during the field survey. These latter units were mapped as mosaics or tiled pictures focusing certain locations of the established transects.



Source: Google Maps 2021 (Basemap), Amnay River (Project Site), Administrative Boundaries (PSA, 2016), Modified by FORESTEREPLAN.

Figure 2.1.23: Terrestrial Flora Survey Stations

The data gathering activities for flora survey are shown **Plates 2.1.4** and **2.1.5**. Individual trees, with a diameter at breast height (dbh) of 10 cm or more, were geo-tagged and measured through their biometrics. The appropriate position for measuring diameter at breast height of trees was strictly followed. The following information were also generated for each individual tree and recorded systematically following the standard data collection of vegetation and tree biometrics from the terrestrial ecosystems and biodiversity assessment BMB (2017) and international standards of data collection from Food and Agriculture Organization of the United Nations (FAO) (2015) for wood and non-wood resources assessment:

a) The family name, scientific name (genus and species name) and common name (English and local name);
b) The diameter at breast height (dbh);
c) Merchantable height (mh) and total height (th)
d) GPS coordinates (latitude and longitude); and
e) Photos of trees of ecological and economic significance.

Note: (A) Site characterization and geotagging/mapping of sampling sites/survey areas and observation of plot; (B, C, D) Establishment of sub-plots and counting of species individuals.

Plate 2.1.4: Data Gathering Activities for the Flora Survey

Note: (E, F) Observation of Plots for understorey, shrubs, herbaceous layer and trees for establishment of 20x20 (10x10, 5x5m, 1x1 m plots); (G, H) Gathering of plant specimens for documentation and biometrics of (sterile and fertile specimens for plant identification) and photos of trees of ecological and economic significance; Measurement of DBH at 1.3 m above the ground and recording of tree biometrics inside sampled plots.

Plate 2.1.5: Data Gathering Activities for the Flora Survey

Opportunistic survey was also established to gather information on composition, structure and significant plant species that are also habitat of other wildlife. However, due to the disturbed and eroded sections of the whole Amnay River, there were no additional areas suitable for opportunistic survey. Only sections with remaining vegetation or intact patches were surveyed. The lack of areas for this approach only accounted for 4-5 species in total. The mouth of Amnay River is located North 12°56'5.82" and East 120°46'23.64" as reference point. **Table 2.1.6** shows the location and description of each opportunistic survey areas.

Table 2.1.6: Location and Description of Each Opportunistic Survey Areas at Amnay River

Opportunistic Survey Area	Coordinates (middle point)	Vegetation Type
1	N 12°56'50.50" E 120°47'13.60" (3 masl)	River banks of a channel/network from the main stem of Amnay River radiating from the mouth. Tree lines composed heavily by Bangkal trees.
2	N 12°56'43.73" E 120°46'42.59" (7 masl)	Open brushland on the other side of the River near the mouth. Sandy beach forms minimal vegetation cover. Grasses, weeds and small shrubs covers the shore in patches.
3	N 12°57'15.40" E 120°49'49.60" (17 masl)	Predominantly agricultural rice fields heavily irrigated. Plant species are represented primarily with weeds, grasses and some small trees.
4	N 12°57'29.45" E 120°51'33.83" (23 masl)	Open brushland with few trees (in river banks) forming tree lines. Some sections are almost devoid of vegetation. Some were damaged by silted portions of River resulting to erosion. Adjacent to a ricefield.

Opportunistic Survey Area	Coordinates (middle point)	Vegetation Type
5	N 12°57'54.01" E 120°52'42.13" (38 masl)	Secondary growth vegetation with dense human settlements. Trees are limited to agroforestry and orchards. Plants are represented by weeds. Small trees are sparsely distributed.
6	N 12°57'25.67" E 120°53'1.56" (34 masl)	Open areas totally devoid of trees and any other vegetation. Only patches of grasses and weeds covers the area. Predominantly an abandoned ricefields damaged by siltation.

The opportunistic flora survey, involving listing and photo documentation of the different plant and tree species encountered (inside and outside the project area), was also carried out to fully document the floral resources within the site. The tree and plant species were also survey by enumeration of species inside the opportunistic survey plot. All specimens collected during the survey period are photographed and systematically labelled and processed on-site. Relevant literature (Leonard L. Co Flora Compilations, Flora Malesiana, Flora of Manila, Enumeration of Philippine Flowering Plants, Lexicon of Philippine Plants, Blumea, Leaflets of Botany among others) are consulted for the initial identification of the plant materials/photographs. Specimens were then compared with the image database on type materials of the Philippines for final identification.

In terms of plant diversity and composition, nested quadrat sampling technique was used to assess and characterize the structure and species composition of the different plant communities (**Figure 2.1.24**). For large woody plants whose diameter is equal or greater than 10 centimeters, measurements of diameter at breast-height (DBH), merchantable height (MH), were done inside the 20m x 20m quadrat. Listing and photo documentation of ground cover, shrubs and other understorey species were also done to account for the intermediate and understorey species (grasses and other plants below 1m in height).

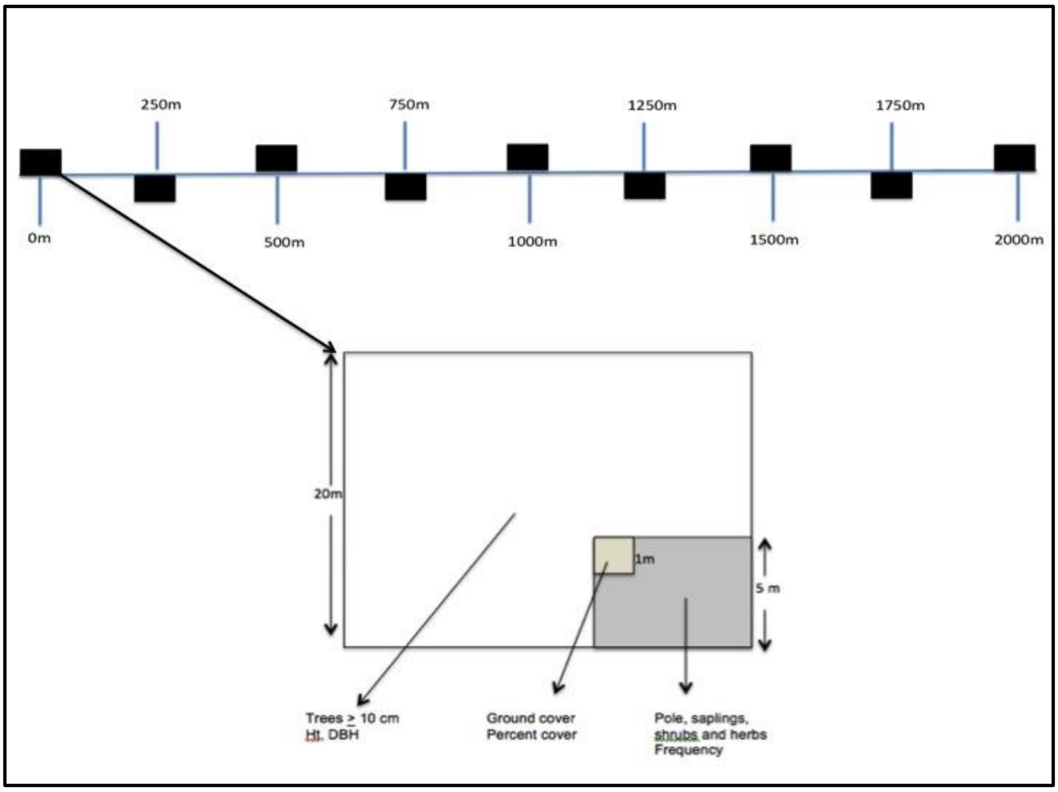


Figure 2.1.24: Nested Plot Technique Employed in the Plant Diversity Survey

In addition, diameter of trees was measured at 1.3m above ground or 10 cm above the tallest buttress/prop roots if taller than 1.3m. In case a tree forks below 1.3 m from the ground, all stems with ≥ 5 cm DBH will be measured separately. Associated species of trees < 10 cm and other plant forms such as palm, vine, shrubs, weeds, lianas, ferns, bamboos, and grasses were identified and recorded on the spot and were included in the running checklist of the plants found in the area. A separate listing for non-tree species was generated from the survey. Specimens that were not identified in the field were photographed and labeled based from the transects and plot it was collected. Species and family names followed the latest Angiosperm Phylogeny Group classification (APG 3, version 13) while the common names adapted that of Rojo (2001). Local names provided by the community guides were also incorporated.

Information gathered in the field were tabulated and analyzed to characterize floral composition within the study area. The relative density, relative dominance and relative frequency values for each tree species were determined to obtain their Importance Value (IV), which is the standard measurement in forest ecology to determine the rank relationships of species. Also, the relative frequency, relative density and relative dominance indicate different aspects of the species importance in a community. Importance values were determined using the following formula:

$$\text{Density} = \frac{\text{number of individuals}}{\text{area sampled}}$$

$$\text{Relative Density} = \frac{\text{density for a species}}{\text{total density for all species}} \times 100$$

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

$$\text{Relative Frequency} = \frac{\text{frequency value for a species}}{\text{total frequency for all species}} \times 100$$

$$\text{Dominance} = \frac{\text{basal area or volume for a species}}{\text{area sampled}}$$

$$\text{Relative Dominance} = \frac{\text{dominance for a species}}{\text{total dominance for all species}} \times 100$$

$$\text{Importance Value} = \text{Relative Density} + \text{Relative Frequency} + \text{Relative Dominance}$$

Diversity indices (Shannon, Simpson’s and Evenness) for each sampling quadrats were generated using Paleontological Statistical software package for education and data analysis (PAST version 3.12). Moreover, endemism and ecological status of the different species were assessed to determine the ecological importance of the vegetation in the area. Plant classification followed the latest Angiosperm Phylogeny Group classification (APG IV, 2016) while the common names adapted that of Rojo (1998).

As to the results of flora and vegetation assessment, the following data and outputs are generated:

- Indicative list showing sampling sites, location of observed important, endangered, and keystone species; especially sensitive sites.
- Flora species inventory or survey report in matrix form that covers species listing, abundance, richness, dominance, diversity, evenness, ecological status, and uses.
- Photos of terrestrial species observed during the survey.
- Historical occurrences of pest infestation, forest/grass fire and/or similar incidences.
- Summary of endemicity/conservation status.
- Summary of abundance, frequency and distribution; and
- Economic importance and uses of significant plant species.

Biodiversity, flora and fauna, and their habitats and communities surveyed are:

- Protected species declared as endangered or threatened species under DAO No. 2017-11, RA No.9147 the Wildlife Resources Conservation and Protection Act of 2001.
- Threatened species (grouped as EN, CR, VU) in the IUCN Red List and Philippine Red Data Book (WCSP); and
- Locally important flora species with ethnobotanical importance and livelihood significance to local residents.

2.1.4.1.1 Vegetation Profile

The identification of vegetation based on classification system involves vegetation units of similar physiognomy or appearance in the project site. Brushland vegetation and riparian cover is the general vegetation unit dominating the areas. Blaser and Sobagal (2002) defined brushland vegetation as the woody successional vegetation that regenerates after the forest cover has been removed by human intervention. Secondary vegetation appears to be a mixed composition of several trees, shrubs, climbers and tall herbaceous plants, is always more or less unstable and consists of successional stages. However, secondary forests can play an important role in carbon sequestration (Smith and Scheer, 2002). At least three (3) vegetation units/type were described per transect areas at the proposed project site based on the parameters observed. It should be noted that these vegetation units pre-identified in the area require thorough study, verification and investigation to verify more completely the existing state of the area for future studies. The vegetation units with its composition of succession emphasizes the need to monitor these dynamics through establishment of a management block or permanent plots across a range of initial vegetation ages, with management blocks in a given area.

Vegetation descriptions were based on the height and estimated cover of dominant species in sampling quadrats using Aplin's (1979) modification of the vegetation classification of Specht (1970). **Table 2.1.7** shows the location of each identified vegetation units and the corresponding transect where they were pre-identified.

Table 2.1.7: Vegetation Units Observed per Transect

Transect No.	Northing	Easting	Elevation (masl)	Vegetation Units Characterized
1	N 12°56'46.94"	E 120°46'30.12"	3.0	Brushland/wooded land with grass patches.
2	N 12°56'50.99"	E 120°46'55.32"	5.0	Brushland/wooded land with large grass patches. Sparse trees in some sections.
3	N 12°57'34.86"	E 120°47'25.46"	6.0	Agricultural land, rice farms
4	N 12°57'3.14"	E 120°48'51.37"	11.0	Agricultural land, rice farms. Sparse tree vegetation are prominent near the banks representing few individuals
5	N 12°57'41.04"	E 120°50'8.34"	16.0	Tree patches, with sparsed tree individuals along river banks
6	N 12°57'15.51"	E 120°50'58.53"	19.0	Vegetation patches along river banks. Agricultural areas
7	N 12°58'5.70"	E 120°51'14.20"	22.0	Grasslands, with sparse tree vegetation inundated.
8	N 12°31'38.63"	E 120°59'9.91"	62.0	Secondary growth vegetation. Open brush/wooded land, with dense cover of small to medium size trees
9	N 12°31'38.63"	E 120°59'9.91"	34	Dominated by sparse pioneer tree species. Grass cover were dense in some sections

Vegetation descriptions identified specifying the location in each transect to arrive at vegetation units, defined on the basis of a shared suite of perennial species with a similar range of cover values. Vegetation units were classified and mapped according to their dominant life form or structure and composition of each vegetation unit. It should be noted that some of the vegetation units were either too small to show at the scale of mapping, or too variable to map individually based on the level of investigation that was possible during the field survey. These latter units were mapped as identified areas or tiled pictures focusing certain locations of the established transects. The following vegetation units were briefly described below:

- *Grasslands.* These areas are observable in some sections of the project site either in a form of large or small areas. Grass vegetation are described in which the vegetation is dominated by a nearly continuous cover of grasses. Grasslands occur in environments conducive to the growth of this plant cover but not to that of taller plants, particularly trees and shrubs. The factors preventing establishment of such taller, woody vegetation are varied.

- *Riparian vegetation.* Riparian vegetation corresponds to all vegetation units along river networks and banks, regardless of their physiognomy or origin, and is functionally related to other components of fluvial systems and the surrounding area. Some forms a tree line or sparse tree individuals, patches and vegetation fragments.

- *Scrub/brush vegetation* (Incl. Secondary growth vegetation). A general term for vegetation dominated by shrubs, i.e., low woody plants, which typically forms an intermediate community between grass or heath and high forest. These constitute some 50% of the total areas in the project site adjacent to some human settlements and rice farms. Some 50% of the total areas are occupied by rice fields and tree orchards (Agricultural). Secondary growth vegetation can be observed in Transect 8 were dense young to mature trees of different species were recorded.

2.1.4.1.1.1 Transect 1

Transect 1 represents the mouth of Amnay River. In this transect, patches of vegetation were represented by beach vegetation such as several beach species of Lambayong (*Ipomea pes-caprae*), Aroma *(Acacia farnesiana* (L.), Kolong-Kolong (*Crotalaria pallida*) and some small species of shrubs such as Walis-walisan (*Sida acuta*) (**Figure 2.1.25**). Aroma trees formed a dense tree vegetation near the River mouth and banks. Grass areas were represented by Cogon and a Poaceae species specific to beaches, Halas (*Spinifex littoreus*). The sandy substrate provided wide spaces for more than one species of ground cover plants such as *Paspalum sp., Crotalaria pallida, Sida acuta, Ipomea pes-caprae* and cogon (*Imperata cylindrica*). Some bamboos also dominate the river banks along with Ipil-Ipil trees. The sandy beaches mixed with black sands forms the immediate substrate for dense ground cover and bushes. The whole area is surrounded by a sparse cover of sedges, herbs and grasses. Eroding banks were also observed in the river mouth forming an island traversing the whole transect sections. A small river networks also forms part of the river line vegetation in Sitio Balok-Balok. Trees such as Bangkal (*Nauclea orientalis*) and Acacia (Samanea saman) are planted in banks. The Island formation is covered with grass, shrub and tree species of Tambo (*Thysonolaena latifolia*), Cogon (*Imperata cylindrica*), Suob kabayo (*Hyptis suaveolens*) and Ipil-Ipil (*Leucaena leucocephala*).

Tree species observed in this vegetation units include Bani (*Pongomia pinnata*), some individuals of Malubago (*Talipariti tiliaceum*) and *Terminalia cattapa, Gmelina arborea, Pithecelobium dulce*, and *Samanea saman*. Human settlements were found heavily situated near the river banks and fishing is the sole source of livelihood to many of the residents. The banks covered with grasses serves as ports to their boats and makeshift rafts. In general, the area forms an open woodland/brushland following major grass covered areas in both sides of the River. Plants species that inhabit the area are specially adapted to the dynamic system of moving sand and wind. Plants that grow within the permeable, blowing substrate are either short-lived or persist through the development of deep, extensive root systems.

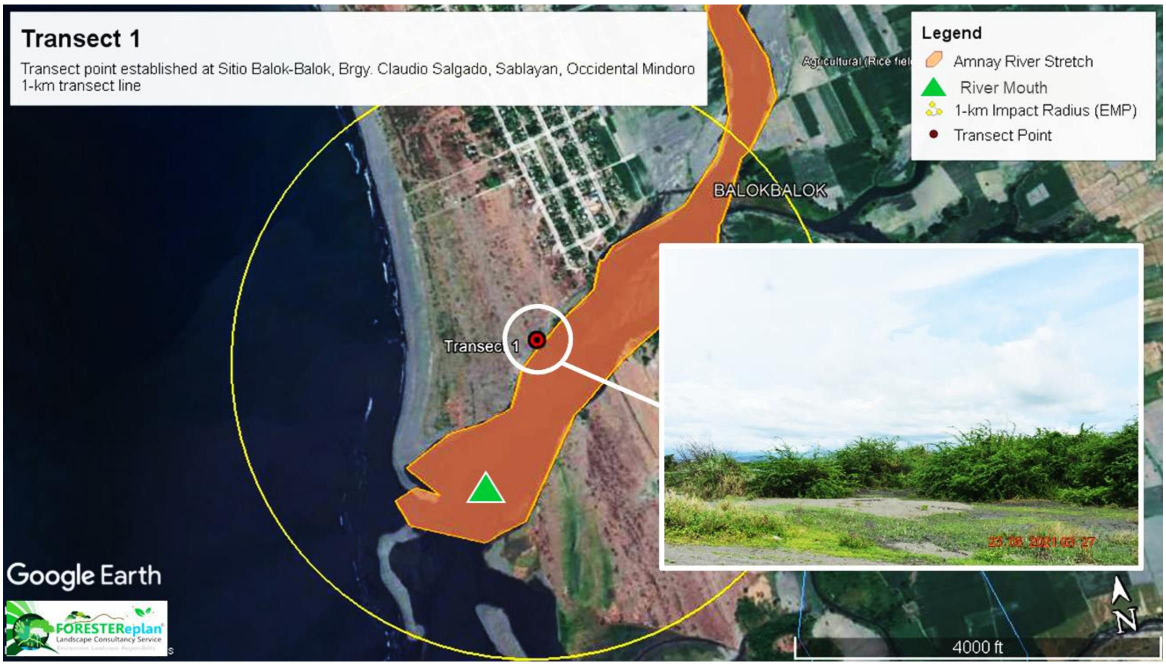


Figure 2.1.25: Vegetation Patches and Sparse Trees at Transect 1

2.1.4.1.1.2 Transect 2

Transect 2 starts the locations of rice fields where hectares of land were allocated for growing rice all the way upstream (**Figure 2.1.26**). This transect composed mainly of sparsed tree individuals and more on shrubs, herbaceous layer and some grasses. Small trees comprised this small vegetation units with Kamachile (*Pithecelobium dulce*), Is-is (Ficus ulmifolia), Lanete (*Wrightia pubescens*) and Banaba (*Lagerstroemia speciosa*). Grassland area is dominated with Cogon (*Imperata cyclindrica*), and a species of shrub, Hagonoi (*Chromolaena odorata*). Other plant species documented includes dense cover of Walis-walisan (*Sida acuta*), Palayan (*Echinochloa colona*), among others. Tree species on riverbanks include Rain tree (*Samanea saman*) and Balakat (*Ziziphus sp.*).

Figure 2.1.26: Indicative Map of Vegetation Conditions at Transect 2

2.1.4.1.1.3 Transect 3

In this transect, massive bank erosion was observed impacting rice puddies and farmlands (**Figure 2.1.27**). Trees were almost devoid in terms of cover and only occasional ground cover species dominate the area. The area is also heavily occupied by human settlements in upstream section. Sand and silted portions of the Amnay River were exposed and only Cogon grasses dominate the portion. Trees were located in upstream section with small sections no longer visible due to bank erosion and damage. There are portions of small agroforestry area, coconut adjacent to ricefields. Pioneer species dominates open areas such as Kamachile (*Pithecelobium dulce*), Kalumpang (*Sterculia foetida*), Ipil-ipil (*Leucaena leucocephala*), Anonang (*Cordia dichotoma*), Bangkal (*Nauclea orientalis*). Some *Ficus* trees were also observed in the area.

Figure 2.1.27: Vegetation Conditions at Transect 3

2.1.4.1.1.4 Transect 4

Continuous areas of eroded river banks can be observed in this transect (**Figure 2.1.28**). Dried sections of Amnay River were densely covered by Cogon (*Imperata cylindrica*). Patches of vegetation with trees species that includes Hauili (*Ficus septica*), Is-Is (*Ficus ulmifolia*) and Gmelina (*Gmelina arborea*). Some sections were almost bare and devoid of any vegetation. Weed species dominate trails and river banks such as *Ageratum conyzoides, Alternanthera sessilis, Eclipta prostrata, Eichhornia crassipes, Ludwigia octovalvis, Mimosa diplotricha, Dactyloctenium aegyptium, Digitaria ciliaris, Echinochloa colona, Echinochloa crus-galli* and Paragis (*Eleusine indica*).

In dry sections of the river banks, weeds species of *Leersia hexandra, Paspalum scrobiculatum, Fimbristylis dichotoma, Cyperus iria, Cyperus difformis, Aeschynomene indica, Alysicarpus vaginalis, Eclipta zippeliana, Hedyotis biflora, Ludwigia hyssopifolia, Melochia concatenata, Macroptilium lathyroides* and *Murdannia nudiflora.* These species were frequently observed on transect plots as influenced by the agricultural activities in the area. Note that these species are common weeds from rice fields which are dispersed by different media and means of dispersal agents. Grassland areas are frequently visited by bird species foraging on seeds and leaves. The main section of Amnay River is generally dry in the time of survey. Cogon grasses densely covered some sections while uninandated. Other species of plants in densely covered sections with trees includes Kubamba (*Piper umbellatum*), Alikbangon (*Commelina benghalensis*), and a species of aroid plant, Corazon de maria (*Caladium bicolor*) which is priced for its ornamental value.

Figure 2.1.28: Vegetation Conditions Observed at Transect 4.

2.1.4.1.1.5 Transect 5

Massive siltation and bank erosion can be observed in this area (**Figure 2.1.29**). Farmlands were destroyed by overfilling sand and gravel from Amnay River. Open areas are occupied by Cogon, but rocks and bare areas are vast. Transect 5 is generally a composition of open brushland and agricultural portions (rice fields). Almost all section in this area were completely devoid of tree cover, as utilized for settlements and agriculture. Some sparsed tree species such as Anabiong (*Trema oreintalis*) and Bangkal (*Nauclea orientalis*) were observed. Discontinuous patches serve as stepping stones connecting each patches towards to a transition of riparian vegetation. Edges of the river were occupied as well with species of grasses, *Musa sp*., some bamboos and small trees.

Weeds and other species of plants as influenced by the agricultural activities in the area are dominant near the edge of Amnay River. Weeds, sedges and broadleaves species such as from rice fields were common in the area which are represented by Paang-uwak (*Dactyloctenium aegyptium*), Crabgrass (*Digitaria ciliaris*), Palayan (*Echinochloa colona),* Bantu (*Echinochloa crus-galli), Paragis (Eleusine indica), Kater (Leersia hexandra), Kodo (Paspalum scrobiculatum), Uwan (Fimbristylis dichotoma), Flat sedge (Cyperus iria), Baong-baong (Cyperus difformis), Makahiyang lalaki (Aeschynomene indica), Banig-usa (Alysicarpus vaginalis), Higis-manok (Eclipta zippeliana), Dalumbang (Hedyotis biflora), Kahoy-kahoy (Ludwigia hyssopifolia)*, and Marasaluyot (*Melochia concatenata)*.

Figure 2.1.29: Vegetation onditions at Transect 5

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2.1.4.1.1.6 Transect 6

Since the area is predominantly occupied by rice fields, Transect 6 is more on waterlogged due to the flow of water in Amnay River (**Figure 2.1.30**). Apart from the very nature of the adjacent land use which is rice farms, waterlogging for crops from irrigation already mixed with siltation and erosion from Amnay River. Black sand deposited in volumes in rice fields which also became instant substrate for weeds species to regenerate. Sparsed tree individual barely covers the area such as Acacia (*Samanea saman*), Anonang (*Cordia dichotoma*), Anabiong (*Trema oreintalis*) and Bangkal (*Nauclea orientalis*) were observed. Grasses such as Cogon (*Imperata cylindrica*) covers the dry areas of Amnay River. Edges of the river were occupied as well with species of sedges, shrubs, *Musa sp*., some bamboos and small trees.

The high number of invasive weed species in the area in terms floristic composition of Amnay River, could threaten the integrity of the water body in terms of native flora especially in the downstream section due to various anthropogenic activities and natural (e.g., bank erosion) which can degrade its overall environmental quality. As observed in the transect plots, many of the trees in the river banks were also damaged as well by the erosion and bank slides due to widening of Amnay River beds and further exposing sand and gravel substrate. The impacts of siltation, sedimentation and deposition of different river materials can be observed in this transect plot up to the succeeding transects. Agricultural rice fields were all damaged and tree vegetation were all disrupted. Opportunistic plant species such as grasses smother areas where in previous vegetation exist in patches.

Figure 2.1.30: Vegetation Conditions at Transect 6.

2.1.4.1.1.7 Transect 7

Transect 7 similarly waterlogged with Transect 6, as the level of the river bed is low (**Figure 2.1.31)**. Dry portions were frequently covered by tall Cogon grasses. Sparsed tree individual barely covers the area such as Acacia (*Samanea saman*), Anonang (*Cordia dichotoma*), Anabiong (*Trema oreintalis*) and Bangkal (*Nauclea orientalis*) were observed. Grasses such as Cogon (*Imperata cylindrica*) covers the dry areas of Amnay River. Edges of the river were occupied as well with species of sedges, shrubs, *Musa sp*., some bamboos and small trees. Some fishes were observed in this transect, utilizing habitats under the roots of tall grasses such as Cogon. Small trees and shrubs dominate the river banks such as Kakawate (*Gliricidia sepium*), Anonang (*Cordia dichotoma*) and Hagonoi (*Chromolaena odorata*). Avian species were also observed near the area such as Egrets and Bee eaters hunting for small fishes, crustaceans and insects.

Figure 2.1.31: Vegetation Conditions at Transect 7

2.1.4.1.1.8 Transect 8

Similar conditions were observed in Transect 8 but with hilly areas covered by secondary growth vegetation (**Figure 2.1.32**). This transect is a transition from the natural state of Amnay River, in terms of vegetation. Transect 8 has some intact vegetation which composed of dense stature trees of Ipil-Ipil (*Leucaena leucocephala*), Anabiong (*Trema orientalis*) and Binunga (*Macaranga tanarius*). Sparsed tree individual barely covers the river banks such as Acacia (*Samanea saman*), Anonang (*Cordia dichotoma*), Anabiong (*Trema oreintalis*) and Bangkal (*Nauclea orientalis*) were observed. Weeds and other species of plants as influenced by the agricultural activities in the area are dominant near the edge of the River. Weeds, sedges and broadleaves species such as from rice fields were common in the area which are represented by Paang-uwak (*Dactyloctenium aegyptium*), Crabgrass (*Digitaria ciliaris*), Palayan (*Echinochloa colona),* Bantu (*Echinochloa crus-galli),* Paragis *(Eleusine indica),* Kater *(Leersia hexandra),* Kodo *(Paspalum scrobiculatum),* Uwan *(Fimbristylis dichotoma),* Flat sedge *(Cyperus iria),* Baong-baong *(Cyperus difformis),* Makahiyang lalaki *(Aeschynomene indica),* Banig-usa *(Alysicarpus vaginalis),* Higis-manok *(Eclipta zippeliana),* Dalumbang *(Hedyotis biflora),* Kahoy-kahoy *(Ludwigia hyssopifolia)*, and Marasaluyot (*Melochia concatenata)*.

Although intact in terms of vegetation, the downstream area especially the River banks is gradually being exposed due to continued erosion resulting to sedimentation. Sedimentation is also observed as a source of degradation. It has the effects to the environment compared to soil erosion. It has only smaller scope and these are: 1) loss of precious natural resources/habitat; 2) adverse effects on other water use; 3) adverse effects on fishes and downstream water quality; and 4) loss of aesthetic value/loss of environmental scenic value. There are specific areas where the macro aquatic species use as breeding, spawning, nursing grounds or even make it as habitat adjacent to some vegetated areas. When sedimentation occurs into these areas, it is not only the area that will be affected but more of the stocks that refuge in these.

Figure 2.1.32: Vegetation Conditions at Transect 8

2.1.4.1.1.9 Transect 9

Dense vegetation cover can be observed in Transect 9 (**Figure 2.1.33**). Most of the tree species documented can only be found in this plot. It is assumed that due to the intact vegetation, recruitment and nursing of native plant species become possible and assumed to be the original vegetation composition of the whole Amnay River. Native species such as Balinghasai (*Buchanania arborescens*), Batino (*Alstonia macrophylla*) and Molave (*Vitex parviflora*) are observed in sapling to mature stage. Regenerations of different species covered densely the understorey layer such as Hauili (*Ficus septica*), Zingeberaceae species such as Alpinia sp., among others. The section of Transect 9 were densely occupied shrubs and grasses and individual medium size trees such as Bitaog (*C. inophyllum*), Mangga (*M. Indica*), some Ficus spp., trees and Dalunot (*P. arborescens*) which were observed forming a dense cover on the riverbanks.

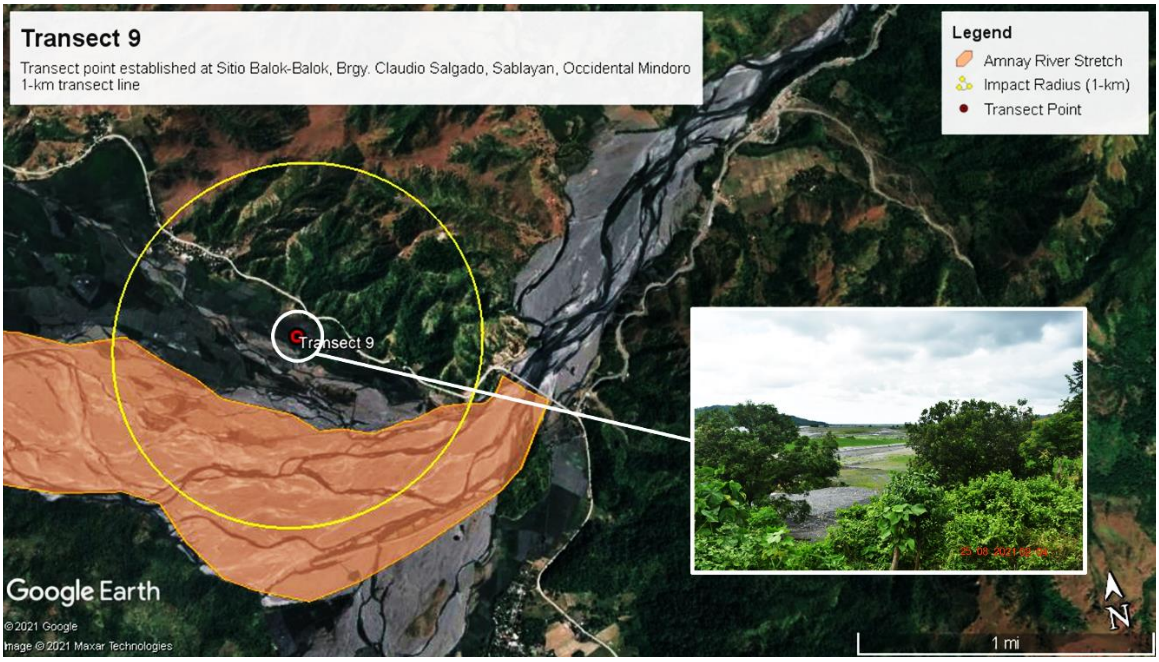


Figure 2.1.33: Vegetation Conditions at Transect 9

2.1.4.1.2 Associated Vegetation/Significant Landscapes

Associated vegetation or landscapes are important in assessing terrestrial ecology assessment since these areas can serve as either viable alternative shelter or entrance site for new plant or animal species recruits from the main ecosystems, or an area affected by any development or disturbance. Aside from the remaining small tree vegetation and shaded portions of the site, there could still be some areas that can serve as viable habitat for birds and other wildlife species in the area. Among the plant communities documented, brushland/woodlands are the most dominant vegetation in the locations of the proposed project site and along the stretch of Amnay River. Adjacent to these areas are small patches of grasslands and agricultural lands (e.g., rice fields). Below are short descriptions of vegetation based on field observation:

- **Grasslands**. These are natural, climax vegetation community comprising seasonally inundated grassland on hilly, rolling, hard substrate such as boulder or rocky sediments. Impeded drainage and thin or absent soils result in an absence of woody plants and seasonally inundated grassland with a unique assemblage of species. Such habitats host specialized assemblages of herbs and shrubs including some that are likely threatened species. Almost 40 % of all transect plots are surrounded or combined with grasslands with similar dominating species of grasses and shrubs, including small and medium size trees. Transect 4, Transect 6 and small portion of Transect 7 are notable for this kind of vegetation.

- **Open brushland/wooded lands (Incl. Secondary growth vegetation)**. Another notable vegetation community is the patches of open woodland comprising an open stand of trees with crown canopies 5-8 m in height and only 20% of the surface covered by native trees. These vegetation were represented as small patch of regenerating forest. Open woodlands are notable in the transect plots established in Transects 1 to 3, 8 and 9. Open woodland differs from forest such that canopy interlocking does not occur in woodland. Open woodland trees have thick, fire-resistant bark and if burnt to the ground in severe fires, the trees have the ability to regrow from rootstocks. Example of these tree species are Binayuyu (*Antidesma ghaesembilla*), Balinghasai (*Buchanania arborescens*), Ligas (*Semecarpus cuneiformis*), Kamachile (*Pithecelobium dulce),* Bitaog (*Callophylum inophyllum*). These features are usually absent in forest.

- **Riparian vegetation (River banks).** These are areas that are saturated with water, either permanently or seasonally, such that it takes on the characteristics of a distinct ecosystem. These areas are located in Transects 7, 1, 2 and 8, 9. Floral species are generally diverse as these areas are well supported by moisture, thus, vegetation such as grasses, aroids, ferns and shrubs are of good herbage quality. Grasses and sedges were also abundant around the edges of the river. Tree species noted in the area are Banaba (*Lagerstroemia speciosa*), Binunga (*Macaranga tanarius)*, Anabiong (*Trema orientalis*), Tangisang bayawak (*Ficus variegata*), and Bangkal (*Nauclea orientalis*).

In general, Amnay River is predominantly occupied by agricultural lands. Still, there are portions of the area that has remaining associated vegetation or alternative habitat that could serve remaining flora and fauna in the area. However, in terms of regeneration capacity, the vegetation patches that could support the regeneration is very low at all to colonize some grasslands, openings, and understock areas. From another point, the size of the project area is too large to be colonized by the adjacent patch of vegetation, sparse trees or even by the remnant vegetation. With regards to the vegetation of the sampling sites, **Table 2.1.8** shows the location and general vegetation condition of the different transects.

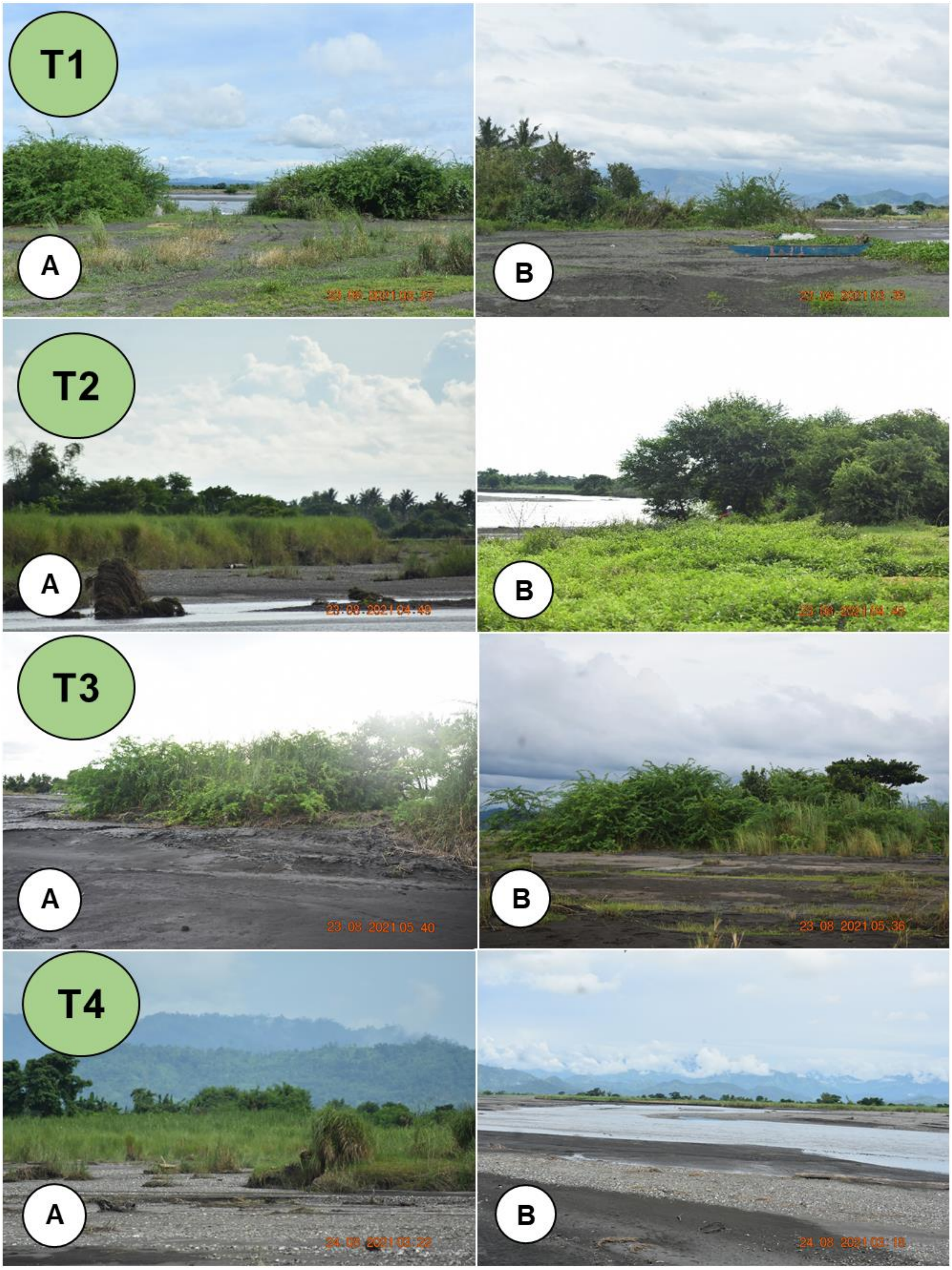
Table 2.1.8: Location and General Vegetation Condition of each Sampling Site

Transect No.	Coordinates (middle plot point)	Number of plots (P)	Profile/Dominant Species**	Vegetation Type
1	Start N 12°56'46.94" E120°46'30.12" End N 12°57'02.22" 120°46'46.50"E (3 masl)	**4**	**Tree species**: Gmelina (Gmelina arborea), Kamachile (*P. dulce*), Kakawate (*Gliricidia sepium*), Aroma (Acacia farnesiana), Rain tree (*Samanea saman*), etc. **Shrub and bamboo species**: Malubago (*Talipariti tiliaceum*), Kawayan killing (*Bambusa vulgaris*), etc. **Herbaceous layer**: Crotalaria pallida, Hyptis suaveolens, Hakati *(Paspalum conjugatum),* Dagad (*Tridax procumbens*), Walis-walisan (*Sida acuta*), among others.	Open brushland/wooded land representing the mouth of Amnay River. Generally covered with some coastal beach plants species. Heavily occupied by human settlements. Sandy banks with eroded and silted sections.
2	Start N 12°56'50.99" E120°46'55.32" End N 12°57'27.36" E120°47'27.66" (5 masl)	**3**	**Tree species**: Kamachile (*Pithecelobium dulce*), Is-is (*Ficus ulmifolia*), Anonang (*Cordia dichotoma*), Aroma (*Acacia farnesiana*), Bangkal (*Nauclea orientalis*), etc. **Herbaceous layer**: *Crotalaria pallida, Tridax procumbens, Sida acuta, Commellina benghalensis,* etc. **Shrub and Grass species**: Hagonoi (*Chromolaena odorata*), Tambo (*Thysonolaena latifolia*), etc.	Brushland/wooded land with large grass patches. Sparsed trees in some sections with some bare areas totally devoid of cover near rice farms. Densely populated area with human settlements encroaching the River. Banks are eroded and damaged.
3	Start N 12°57'34.86" E120°47'25.46" End N 12°57'19.25" E120°48'54.45" (6 masl)	**4**	**Tree species**: Kamachile (*Pithecelobium dulce*), Is-Is (*Ficus ulmifolia*), Hauili (*Ficus septica*), Binunga (*Macaranga tanarius),* Kakaute (*Gliricidia sepium*), etc. **Shrub species**: Matang hipon *(Breynia vitis-idaea* (Burm.f.), Dalunot (Pipturus arborescens), Senna sp., among others. **Herbaceous and grass layer**: *Imperata cylindrica*, *Mikania cordata, Mimosa pudica, Paspalum*	Predominantly occupied by farmlands growing rice. Some areas are inundated due to overflow incidents in the River. Many sections of farmlands are damaged by eroded banks. Tree vegetation is minimal. Patches of vegetation near River line.

Transect No.	Coordinates (middle plot point)	Number of plots (P)	Profile/Dominant Species**	Vegetation Type
			conjugatum, Chromalaena odorata, Thysonolaena latifolia, etc.	
4	Start N 12°57'3.14" E120°48'51.37" End N 12°57'04.82" E120°50'13.98" (11 masl)	**3**	**Tree species**: Tibig (*Ficus nota*), Bangkal (*Nauclea orientalis*), Balete *(Ficus balete),* Isis *(Ficus ulmifolia),* Acacia (*Samanea saman),* Ipil-ipil *(Leucaena leucocephala),* Talisai (*Terminalia cattapa*), etc. **Herbaceous, Fern and Shrub layer**: Bagan-bagan (*Lycianthes biflora*), Pandakaki (*Tabernamontana pandacaqui*), *Dioscorea sp.*, Kubamba (*Piper betle*), etc. **Grass species**: Tambo (*Thysonolaena latifolia*), *Dactyloctenium aegyptium, Echinochloa colona*, etc.	Heavily damaged by eroded Riverbanks. Sparse tree vegetation are prominent near the banks representing few individuals such as tree species of Bangkal, Talisai and *Ficus spp.* Agricultural areas.
5	Start N 12°57'41.04" E 120°50'8.34" End N 12°57'46.03" E120°50'54.09" (16 masl)	**3**	**Shrub species**: Hagonoy *(Chromolaena odorata),* Coronitas (*Lantana camara*), etc. **Tree species**: Bangkal (*Nauclea orientalis*), Hauili (*Ficus septica*), Talisai (*Terminalia cattapa*), Balete *(Ficus balete),* Isis *(Ficus ulmifolia),* Acacia (*Samanea saman),* Ipil-ipil *(Leucaena leucocephala),* Bangkal (*Nauclea orientalis*), etc. **Grass and Herbaceous layer**: *Stachytarpeta jamaicencis*, Karrunggut (*Passiflora foetida*), Cogon (*Imperata cylindrica*), Hakati (*Paspalum conjugatum),* etc.	Patches of vegetation, with some sparsed tree individuals along river banks. Majority of the area are ricefields with patches of vegetation at the river line. Observed with the widest damaged by widening of the River and siltation.
6	Start N 12°57'15.51" E120°50'58.53" End N 12°57'36.95" E120°51'23.72" (19 masl)	**4**	**Shrub species**: Hagonoy *(Chromolaena odorata),* etc. **Tree species**: Talisai (*Terminalia cattapa*), Balete *(Ficus balete),* Isis *(Ficus ulmifolia),* Acacia (*Samanea saman),* Ipil-ipil *(Leucaena leucocephala),* Bangkal (*Nauclea orientalis*), etc. **Grass species**: Palayan (*Echinochloa colona*), Kawayan killing *(Bambusa vulgaris), etc.*	Similar to T5, vegetation patches, with some sparsed tree individuals along river banks. Majority of the area are ricefields with patches of vegetation at the river line. Observed with the widest damaged by widening of the River and siltation.
7	Start N 12°58'5.70" E120°51'14.20" End N 12°57'48.09" E120°52'19.39" (22 masl)	**2**	**Shrub species**: Hagonoy *(Chromolaena odorata),* Coronitas (*Lantana camara*), etc. **Tree species**: Talisai (*Terminalia cattapa*), Balete *(Ficus balete),* Isis *(Ficus ulmifolia),* Acacia (*Samanea saman),* Ipil-ipil *(Leucaena leucocephala),* Bangkal (*Nauclea orientalis*), etc. **Herbaceous + grass layer**: Uuko (Mikania cordata), Hakati (*Paspalum conjugatum), etc.* **Grass species**: *Eleusine indica* (L.) Gaertn. *Leersia hexandra, Paspalum scrobiculatum*, among others.	Small grasslands inundated near the River, with sparse tree vegetation adjacent to rice fields. Trees are minimal and even totally devoid in some areas in this transect. Heavily damaged as well due to river bank erosion.
8	*Start* N 12°31'38.63" E 120°59'9.91"	**2**	**Tree species**: Acacia (*Samanea saman),* Ipil-ipil *(Leucaena leucocephala),* Bangkal (*Nauclea orientalis*), Banaba (*Lagerstroemia speciosa*), etc.	Secondary growth vegetation (forested area), with dense tree and shrub vegetation,

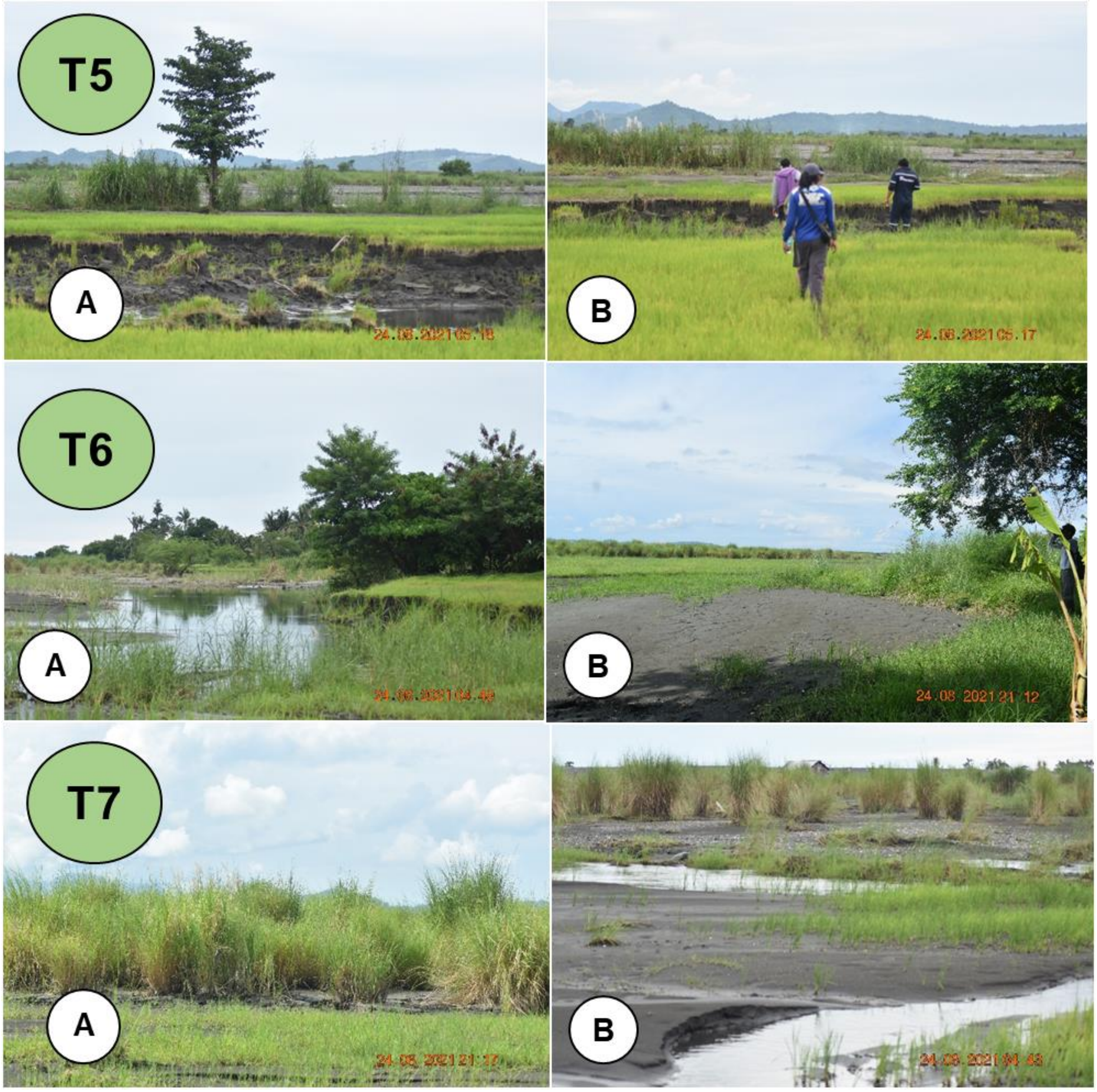
Transect No.	Coordinates (middle plot point)	Number of plots (P)	Profile/Dominant Species**	Vegetation Type
	End N 12°31'32.70" E120°59'17.95" (62 masl)		**Grass and Herbaceous layer**: Tuhod manok (*Ageratum conyzoides*), Kamot kabag, (*Mimosa diplotricha*), Crowfoot (*Dactyloctenium aegyptium*), Crab grass, (*Digitaria ciliaris*), Palayan (*Echinochloa colona*), Paragis (*Eleusine indica*), etc.	along banks. Dense vegetation fragments consisting of pole trees and some shrubs. Dominant trees include native tree species of Anabiong, Ligas, Akleng parang, Balinghasai, among others.
9	*Start* N 12°31'38.63" E 120°59'9.91" *End* N 12°31'32.70" E120°59'17.95" (34 masl)	**2**	**Tree species**: Balinghasai (*Buchanania arborescens*), Batino (*Alstonia macrophylla*), Kulis (*Paratrophis glabra*), Champereia manillana, Alagasi (*Leucosyke capitellata*), Binayuyu (*Antidesma ghaesembilla*), Pili (*Canarium ovatum*), among others. **Herbaceous and shrub species:** Payongan (*Tacca palmata*), *Physallis angulata*, Bagan-bagan (*Lycianthes biflora*), *Alpinia zerumbet*, among others.	Sparse tree individuals near slopes and ditches. Heavily damaged as well by erosion and siltation. Dominated by pioneer tree species. Grass cover were dense in some sections near the bridge.

The vegetation types of high conservation significance within the project site includes those areas with the presence of noteworthy, native, threatened or endangered plant and tree species. Additionally, the areas with notable high number of regenerants (high number of wildlings population) are also considered to be of high significance. The vegetation in the identified transect plots considered to be of the highest conservation significance within the proposed project area are Transect 8 (Secondary growth vegetation) with considerable vegetation cover forming a dense canopy of young to mature tree individuals. These sites have remnants of big diameter trees sparsely distributed and contains more native species such as Balingahasai (*Buchanania arborescens*), Molave (*Vitex parviflora*), Kulis (*Streblus glaber*), Bangkal (*Nauclea orientalis*), Lanete (*Wrightia pubescens*. subsp. *laniti*), Anonang (*Cordia dichotoma*), Isis (*Ficus ulmifolia*), Banaba (*Lagerstroemia speciosa*), Tibig (*Ficus nota*), Hauili (*Ficus septica*), Binunga (*Macaranga tanarius*), Rimas (*Artocarpus altilis*), among others. These species are native to the country and some exhibits considerable importance to some wildlife species in the area.



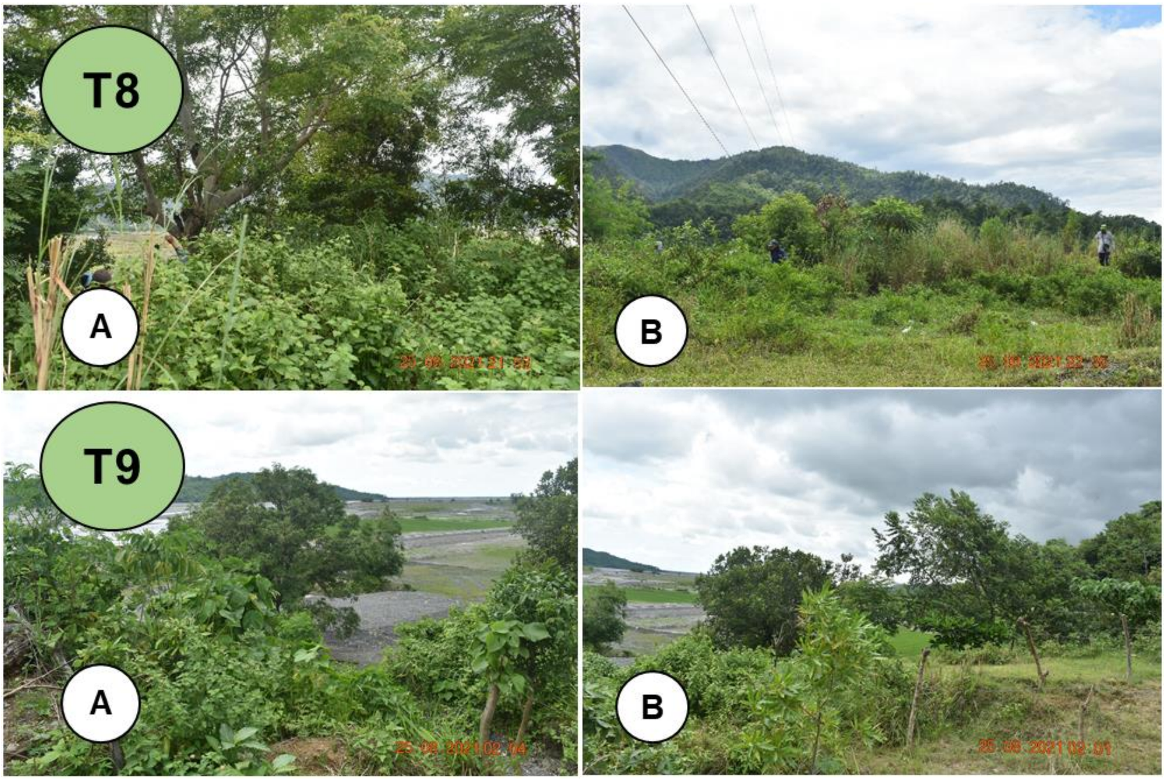
Note: (A, B) Transect 1 River mouth of Amnay, forming a beach type formation/dune. Trees and shrubs dominate the area including grasses. Dense trees of Aroma and grasses along river banks and ditches. Transect 2 Brushland/wooded land with grass patches, adjacent to agricultural areas (ricefields) and an Island formation (sand bar) dominated with pioneer and weed plant species. Sandy beach and banks forming dense vegetation of vines and creepers.

Plate 2.1.6: Photos of the Survey Stations showing the Different Vegetation Conditions at the Transects



Note: Transect 5 Predominantly agricultural (ricefields) farmlands growing rice with sparse tree individuals. Natural forests no longer exist and woodlands in the area are mostly planted. **Transect 6** Adjacent to agricultural land, rice farms; Consisted of farmland (scattered along both banks of the river, mainly rice), small tree orchards (dominated by *Mangifera indica*) and sparse tree indviduals of Kamachile (*Pithecelobium dulce*). **Transect 7** Widest portion of Amnay River, with minimal tree cover. Only cogon and other opportunistic plant species smother open and exposed areas of black sand and gravel.

Plate 2.1.7: Photos of the Survey Stations showing the Different Vegetation Conditions at the Transects



Note: (A,B) Transect 7 Small grasslands, with sparse tree vegetation adjacent to rice fields. Trees are minimal and even totally devoid in some areas in this transect. Human settlements are hardly felt in the area. Transect 8 Secondary growth vegetation, with patches and tree lines, along banks. Dense vegetation cover forms a small plant community. This section has the highest tree cover in terms of basal area as well as Transect 9 with more native tree species. Rolling to undulating areas in some sections.

Plate 2.1.8: Photos of the Survey Stations showing the Different Vegetation Conditions of each Transect

2.1.4.1.3 Vegetation Cover

Based on the results of the plant survey, a total of 125 morpho-species, with 106 genera belonging to 40 families were documented in all sampling sites established at the proposed project site (**Table 2.1.9**). **Annex 2-1 Table 1** presents the common names, scientific names, family including local vernacular names of all plant species. Twenty (20) morpho-species from the total listed species are encountered from the opportunistic survey (**Annex 2-1 Table 2**). *Dicotyledonae* represents 25 families with 62 genera and 74 species of which 52 noteworthy native species and three (3) Philippine Endemics were also identified. Only one (1) species were identified to family level. Finally, *Monocotyledonae* has 21 families with 44 genera and 51 species have been identified.

Table 2.1.9: Summary of the Observed Terrestrial Flora Orders, Families, Genera and Species

Order	Family	Genera	Species	Endemic	Species Identified to Genus Level	Species Identified to Family level
Pteridophyta	0	0	0	0	0	0
Gymnospermae	0	0	0	0	0	0
Angiospermae						
Dicotyledonae	25	62	74	3	0	1
Monocotyledonae	21	44	51	0	0	0
Total	40	105	125	3	0	1

Annex 2-1 Table 3 shows the various timber-producing trees in the project site. Around 30 species from 12 families were recorded of which at least 9 are small trees, 10 are medium-size trees and about 11 species are large trees. At least 8 species were listed as ornamental plants and 10 are suitable for landscaping (**Annex 2-1 Table 4**) while 55 species with medicinal values were identified at the site (**Annex 2-1 Table 5**). About 15 wild edible plants (**Annex 2-1 Table 6**) and 6 wild plants as sources of raw materials were tallied (**Annex 2-1 Table 7**). Dominant families include Fabaceae, Poaceae, Malvaceae, Moraceae and Lamiaceae. The most frequently occurring tree species were Bangkal (*Nauclea orientalis*), Acacia (*Samanea saman*), Kakawate (*Gliricidia sepium*), Talisai (*Terminalia cattapa*) and Kamachile (*Pithecelobium dulce*). The aforementioned species were present in all sites except for Molave, Balinghasai, Batino and Ligas which were recorded in Transect 9 and Transect 8 opportunistic survey only.

2.1.4.1.4 Species Composition, Density and Abundance

A total of 57 morpho-species with 47 genera belonging to 22 families were recorded in the whole project site. Similar to other adjacent River in the area, the average number of trees per quadrat (20m x 20m) is about 1.5 individual or an average density of 0.0037 tree/m^2 (1 tree for every 100 m^2). This is very low for a riparian ecosystem. However, the number of tree from a normal average stocking density of a riverbank vegetation or riparian vegetation range from 1.96 to 3.73 tree/100m^2 (2-3 tree for every 100m^2) (Erskine, 2003). Since the area is heavily occupied for agricultural land use, trees are intentionally minimal. On the other hand, the lower tree density of the quadrats can be attributed to the condition and state of the vegetation as well as the vegetation type present in the area (e.g., disturbed areas, site clearing and eroded riverbanks). Most areas surveyed are in the early stage of vegetation succession characterized by the dominance of small to medium-sized trees, however, other sections of the river were totally devoid of trees due to agriculture and erosion. The trees with the largest diameter are Acacia (*Samanea saman*), Kamachile (*Pithecelobium dulce*), Kalumpang (*Sterculia foetida*), Bangkal (*Nauclea orientalis*) and Talisai (*Terminalia cattapa*).

Annex 2-1 Tables 8a-8e show the computed IV for all plant species per transect. The relative density, relative dominance and relative frequency values for each tree species in all the quadrats were determined to obtain their IV, a standard measure in ecology that determines the rank relationships of species. High Importance values of species indicate a composite score for high relative species dominance, density and frequency. Based on the computed IV (**Table 2.1.10**), the three most important species (with the highest IV) are Bangkal (28.83), Kamachile (16.02), and Acacia (7.20). This clearly showed that the vegetation in Amnay was understock, which was most probably due to the anthropogenic factors, location of the vegetation surveyed, and harsh environment since most of the species were located along ditches and riverbanks. Tree height undeniably provided competitive advantages (i.e., light capture for photosynthesis). However, this could be counterbalanced by the harsh environment in Amnay River where gravel and rock substrate were prevalent. Trees in Amnay River would allocate resources for support and maintenance costs rather than for primary growth in order to adapt to the usual environmental condition (King 1990). With ongoing succession, some of the original vegetation remnants serves as nurse trees for regenerants such as bangkal, talisai and many other tree wildlings like kamachile and acacia, in part against environmental stress and to losing out in light competition with early succession species, which causes an increase in understorey species diversity.

Table 2.1.10: Top Ten Species with the Highest Importance Value

Scientific Name	Common Name	Family Name	Count	RD	IV
Nauclea orientalis (L.) L.	Bangkal	RUBIACEAE	8	3.54	28.83
Pithecelobium dulce (Roxb) Benth.	Kamachile	FABACEAE	17	7.33	16.02
Samanea saman (Jacq.) Merr.	Acacia	FABACEAE	9	3.88	7.20
Terminalia catappa L.	Talisai	COMBRETACEAE	14	6.03	6.76
Trema orientalis (L.) Blume	Anabiong	CANNABACEAE	11	4.74	5.42
Gliricidia sepium (Jacq.) Kunth ex Walp.	Kakawate	FABACEAE	8	3.45	5.15
Albizia procera (Roxb.) Benth	Akleng parang	FABACEAE	8	3.45	3.70
Cordia dichotoma G. Forster	Anonang	BORAGINACEAE	8	2.59	3.05
Melanolepis multiglandulosa (Reinw. Ex Blume) Reichb. f. & Zoll.	Alim	EUPHORBIACEAE	6	3.88	2.93

Scientific Name	Common Name	Family Name	Count	RD	IV
Lagerstroemia speciosa (L.) Pers.	Banaba	LAMIACEAE	9	2.59	2.37

Note: IV –Importance Value

Plate 2.1.9: Photos of the Documented Dominant Tree Species at the Project Site

At the same time, the light demanding pioneer species are already establishing cover in disturbed sections of along the proposed project area (e.g., Anabiong, Kamachile). Considering the density, occurrence, and dominance of trees in Amnay River, majority of the 10 most important species were also listed as dominant species in other plots, but still at low density. This confirmed that the relative dominance of each species contributed most to their IV. The removal of these trees would have the most significant effect on the alteration of the natural vegetation in Amnay River. Furthermore, the listed species with highest IV provided a basis on what species can be used for restoration of vegetation patches in Amnay River.

2.1.4.1.5 Intermediate and Understorey

A total of 176 individuals belonging to 18 species were recorded for intermediate and understorey plant species. The average density is slightly higher than that of trees, at 0.07 individual/m^2 or equivalent to 7 individuals for every 100m^2. The two most abundant understorey species are Bangkal (*Nauclea orientalis*) with 20 individuals and Bagan-bagan (*Lycianthes biflora*) with 15 individuals

(**Table 2.1.11**). It is interesting to note that one of the abundant understorey plants is an endemic species, Is-is (*Ficus ulmifolia*) which provide some food resources for birds and bats in the area. Abundance of all the understorey species recorded is presented in **Annex 2-1 Table 9**. This could signify three ecological concepts: 1) understock areas in Amnay River are wide; 2) seedlings from dominant/pioneer species were not able to grow; and 3) the vegetation survey was conducted outside the seedfall season.

Table 2.1.11: Top Ten Most Abundant Understorey Species

Scientific Name	Common Name	Family Name	Abundance
Nauclea orientalis Lam.	Bangkal	RUBIACEAE	20
Lycianthes biflora (Lour.) Bitter	Bagan bagan	SOLANACEAE	15
Stachytarpheta jamaicensis (L.) Vahl.	Bolomaros	VERBENACEAE	11
Tabernaemontana pandacaqui Poir.	Pandakaki	APOCYNACEAE	10
Lantana camara L.	Koronitas	LAMIACEAE	10
Ficus ulmifolia Lamk	Is-Is	MORACEAE	9
Chromolaena odorata (L.) R.M. King & H. Rob.	Hagonoi	ASTERACEAE	9
Senna alata	Akapulko	FABACEAE	8
Melochia concatenata L.	Marasaluyot	MALVACEAE	7
Homonoia riparia Lour.	Lumanai	EUPHORBIACEAE	7

2.1.4.1.6 Ground Cover

In terms of ground cover, majority of the individuals are represented by the family of Lamiaceae, Fabaceae, Commelinaceae, Malvaceae and Poaceae such as *Sida acuta* L., *Crotalaria pallida* Aiton, *Hyptis suaveolens* (L.) Poit., *Alysicarpus vaginalis* (L.) DC., *Alternanthera sessilis* (L.) R. Br. Ex DC. *Commelina benghalensis* L., and Kulot-kulot (*Urena lobata*). Others are leguminous and weedy ground cover species that are common to open areas and distubed setions such as from the open areas and grasslands which include Makahiya (Mimosa pudica), Balatong aso (Calopogonium mucunoides Desv.) and Dagad (Tridax procumbens). Ground cover is dense in open areas especially in areas that are cleared and shaded under rocks with dense tree vegetation.

There are 41 ground cover species recorded from all 1m x 1m quadrats (**Annex 2-1 Table 10**). It must be noted that the ground cover species referred in this survey are all species (crawling or erect) inside the 1m x 1m quadrat with height of less than 1 meter. Hence, seedlings of different tree species are included as ground cover. This treatment gives us better understanding of the stand structure of the forest from the ground to the canopy. Based on the survey, forest litter occupies more than 5% of the vegetation floor leaving more growing spaces for the ground cover species, hence, considerable species diversity. However, bare and rocky (gravel) areas are vast which only selective and adaptive plants can survive and provide ground vegetation cover. **Plate 2.1.10** shows the photos of documented ground cover species in all sampling sites.

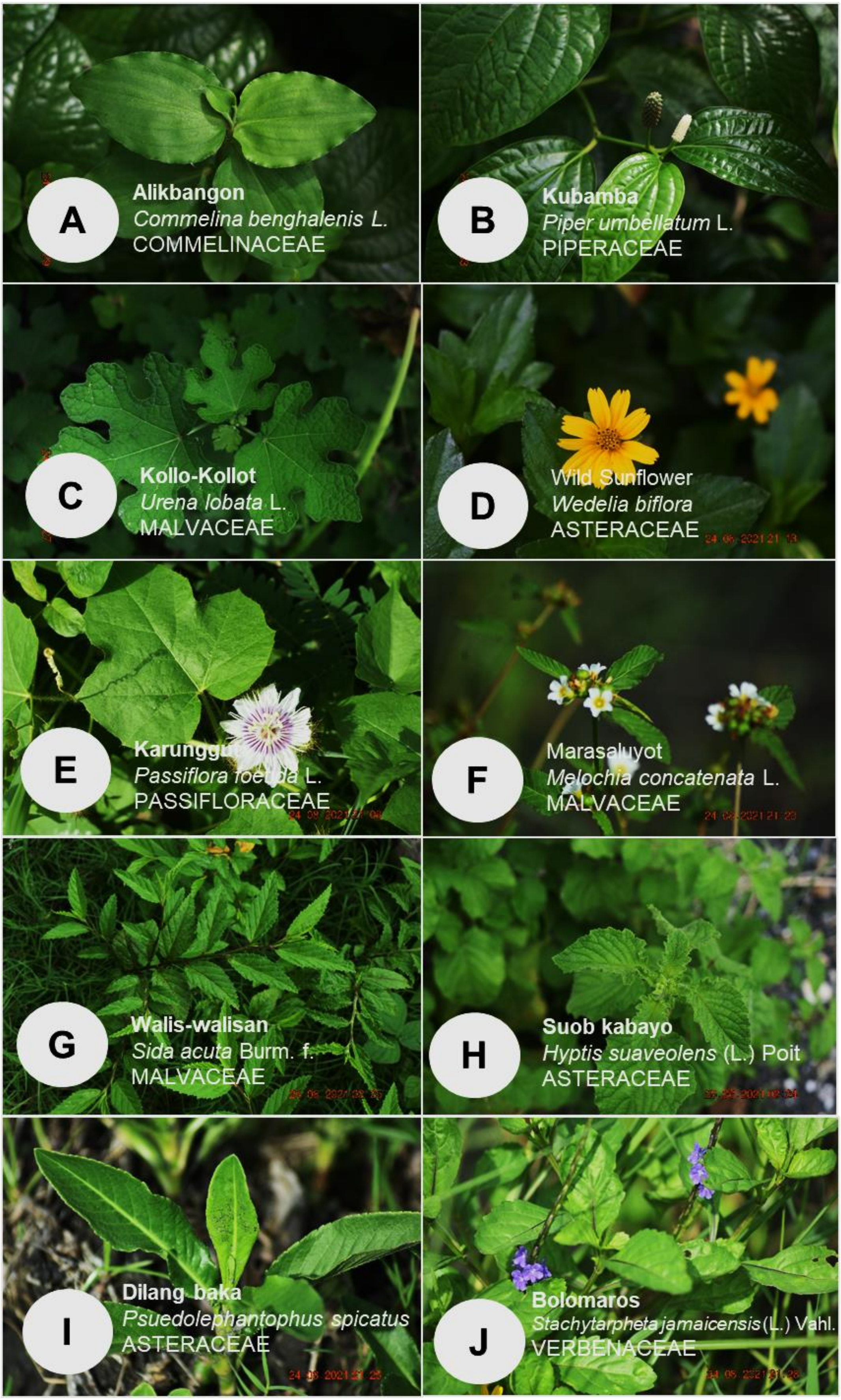


Plate 2.1.10: Some photos of the Documented Ground Cover Species in all Sampling Sites

Ground cover species are prominent in understock areas in which bare and open areas in Amnay River mostly smother such as weedy vegetation. The most dominant species that occupy the highest relative cover are Walis-walisan (*Sida acuta*) (23.21%), Payang (*Crotalaria pallida*) (1.05%), and a herbaceous species, Suob kabayo (*Hyptis suaveolens*) (1.00%). It should be noted that these ground cover species are very prominent in the area in river banks and ditches. **Table 2.1.12** shows the dominant ground cover species in the project site.

Table 2.1.12: Ten Most Dominant Ground Cover Species Recorded in the Survey Stations

Scientific Name	Common Name	Family Name	Relative % Cover
Litter	--	--	5.7
Rocks	--	--	50.0
Bare	--	--	15.0
Sida acuta L.	Walis-walisan	MALVACEAE	1.5
Crotalaria pallida Aiton	Payang	FABACEAE	1.05
Hyptis suaveolens (L.) Poit.	Suob kabayo	LAMIACEAE	1.00
Imperata cylindrica (L.) Beauv.	Cogon	POACEAE	0.1
Alternanthera sessilis (L.) R. Br. Ex DC.	Butonesan	MALVACEAE	0.1
Commelina benghalensis L.	Alikbangon babae	COMMELINACEAE	0.05
Calopogonium mucunoides Desv.	Balatong aso	FABACEAE	0.05
Dactyloctenium aegyptium (L.) Willd.	Paang uwak	POACEAE	0.05
Piper umbellatum L.	Kubamba	PIPERACEAE	0.05
Passiflora foetida L.	Karunggut	PASSIFLORACEAE	0.02

2.1.4.1.7 Species Diversity

Based on the number and abundance of all the species, Paleontological Statistical software package for education and data analysis (PAST version 3.12) was used to compute for diversity indices including Shannon (H'), Evenness (J') and Simpson's (D) index for all the transects and quadrats. Shannon Index gives an estimate of species richness and distribution. Evenness Index tells us how evenly species and/or individuals are distributed inside a plot or quadrat. Simpson's Index gives the probability of getting different species when two individuals were drawn (with replacement) inside a plot.

All transects showed very low diversity in both Shannon (H') and Simpson's (D) diversity index, following the classification scheme suggested by Fernando (1996) (**Table 2.1.13**). On the other hand, Transects 4 to 7 had less and some are totally devoid ground layer diversity mainly composed of both weeds and opportunistic species. Since the project site is disturbed, the computed low index is understandable. However, it is essential as well to know as well the conditions of the project site in terms of diversity given the poor conditions of the site to support vegetation cover. It can also be concluded that the presence of some nurse trees and some intact vegetation serves as protection buffer to the sites where remaining sparsed trees and patches are present. Transects 1, 2, 3, 9 and 8 are notable for some intact vegetation comprising some medium to large sized trees. More pioneer/gap species is also present in these areas. Other transects has few to very sparse trees and less understorey species.

Table 2.1.13: Diversity Indices and Number of Tree Species and Individuals in Five Transect Sites Established in the Project Area

Transect	Diversity Indices			No. of Plant Species	No. of Individuals
	Shannon Index (H')	Simpson Index (D')	Evenness (J)		
1	2.449	0.843	0.761	25	133
2	2.287	0.886	0.825	17	83
3	2.044	0.814	0.797	23	105
4	1.541	0.610	0.556	19	106
5	1.989	0.843	0.801	15	107

Transect	Diversity Indices			No. of Plant Species	No. of Individuals
	Shannon Index (H')	Simpson Index (D')	Evenness (J)		
6	1.951	0.819	0.785	11	95
7	1.795	0.819	0.780	19	101
8	2.676	0.792	0.806	14	111
9	2.013	0.840	0.785	24	105

Note: Code of Value interpretation for H': Very High = ≥3.5 above, High = 3.0-3.49, Moderate = 2.5-2.99, Low = 2.0-2.49, Very Low = ≤1.9 and below (Fernando, 1996).

The results of flora assessment using various estimates and parameters yielded the following further results.

1. The low diversity of the transects is understandable considering the present conditions of every sections of the whole stretch in the project area. Since the area is disturbed, it is expected that flora would cover weeds and some sparse trees. Different factors such as anthropological and natural contributed to the low diversity of species in the area.

2. Since the area is predominantly occupied by agricultural land uses (e.g., rice fields), general life forms would only be limited to grasses and some broadleaves with occasional occurrence of sparse tree individuals dominated by 2-3 species only. Therefore, the diversity of all transects would be low since abundance greatly affects the results of diversity analysis. On the other hand, Shannon index is sensitive to new species, therefore considering the number of species on each transect plot.

3. The lowest values for species counts is seen in Transects 4, 5, and 6. Although, all transects comprised of less species, the possibility of drawing the highest possible number of species is very low due to the conditions and current land use of the area. Number of species for grassland/open areas usually level with those reported for Transect 5. These consistently observed low values could be attributed to the very nature of the history and condition of the area. Agricultural lands adjacent to these transects will characteristically harbor less species because of the activities and disturbance in the area.

4. All areas are generally disturbed by anthropogenic and natural factors. However, surviving patches of vegetation remains intact in areas where there is no habitable section or being eroded due to continues flow of water in the river. It is interesting to note the survival of these patches were dependent on the level of water/groundwater available in Amnay River.

2.1.4.1.8 Biodiversity Value

2.1.4.1.8.1 Endemic Species

The geographical distribution of plant species has been very useful for assessing biodiversity values of regions, countries, and islands. Species confined to a particular site should be given particular conservation management strategies, as they are more vulnerable to disturbance due to their narrow range. Of the total 125 taxa identified to species level, 74 species (59%) were found to be native to the country (**Table 2.1.14**). Noteworthy among the list are those species that are also included in either the Philippine red list (DAO 2017-11) or in the International Union for Conservation of Nature (IUCN ver. 3-2021). **Plate 2.1.11** shows the photos of the documented endemic species in the project site at their natural conditions.

Table 2.1.14: List of Philippine Endemic Tree Species Recorded in the Project Site

Local Name	Common Name	Scientific Name	Family Name	Eco Class
Antipolo	Antipolo	*Artocarpus blancoi* (Elmer) Merr.	MORACEAE	PE
Is-Is	Is-Is	*Ficus ulmifolia* Lamk	MORACEAE	PE
Lubihan	Niog-niogan	*Ficus pseudopalma* Blanco	MORACEAE	PE

Note: **PE: Philippine Endemic species (See Appendix of all PE species)

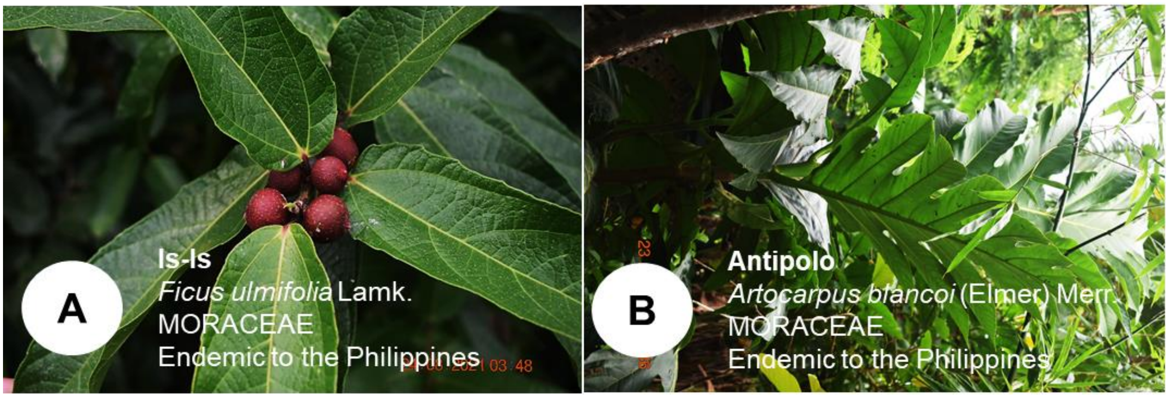


Plate 2.1.11: Photos of some the Endemic Tree Species at the Project Site

2.1.4.1.8.2 Threatened Species

The conservation status of species is based on the most recent recommendations of the Philippine Plant Conservation Committee (PPCC) of the Biodiversity Management Bureau (BMB)-DENR officially issued as DENR Administrative Order No. 2017-11 better known as *''The National List of Threatened Philippine Plants and their Categories*'. The listing of threatened species of the IUCN red list was also used as reference. Only six (6) tree species (**Table 2.1.15**) recorded from the project site are listed under either the Philippine Red List (DAO 2017-11) or the IUCN Red List of Threatened Species (2021.3).

Threatened conservation status applies to species that may become endangered if conditions surrounding it begin to or continue to deteriorate. Thus, a threatened species is one that is already vulnerable as a result of, for example, small population size, restricted range, narrow habitat affinities, significant population decline, among other factors (Conservation International, 2010). On the other hand, it is important to always consider the endemism and conservation status of species that thrives in Amnay River in crafting conservation policies and forest management plan. Species with restricted distribution particularly those that can only be found in Amnay River and in Mindoro Island, and those that are currently classified under the list of threatened species need immediate protection.

It should be noted that the recorded species were only encountered in the opportunistic plots/survey areas established in Amnay River. Three (3) of the recorded tree species were Antipolo (*Artocarpus blancoi*), Smooth Narra (*Pterocarpus indicus*) and Molave (*Vitex parviflora*) were listed with VU, and EN in the list. The transect/s and quadrat/s where the threatened species occurred were included in the table below to guide the BMB and the proponent in their species conservation efforts. Even if other tree species were not listed, appropriate management and monitoring strategies to ensure the continues survival of its population (as well as other threatened species) should be developed.

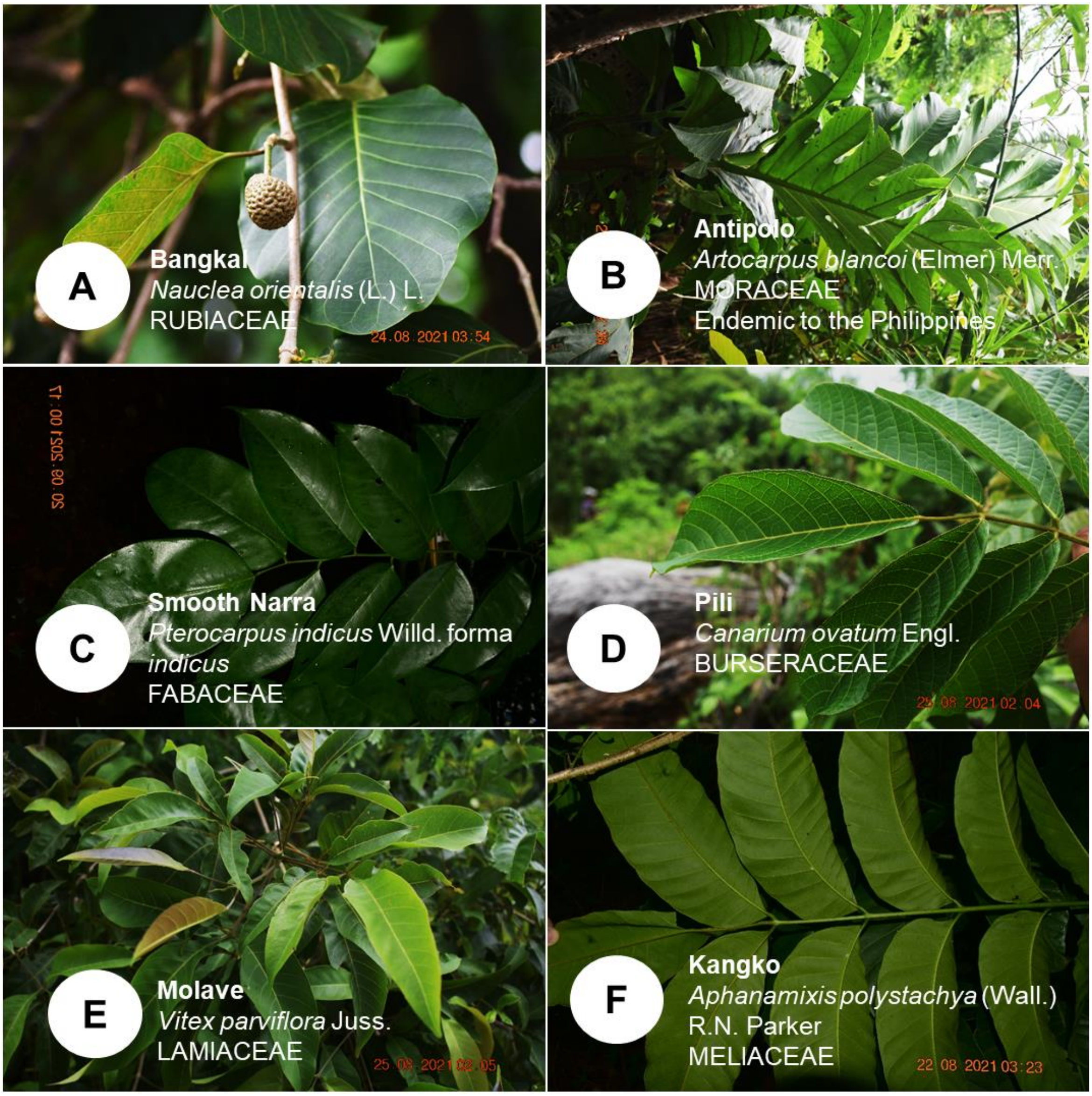


Plate 2.1.12: Photos of the Documented Threatened Plant Species at the Project Site

The transect/s and quadrat/s information where the threatened species were documented are listed in **Table 2.1.15** to guide the PAMB and CPGI in their species conservation efforts. These tree species recorded were either located on a very steep areas, crevices, dense forest patches and near creeks. Some of the tree species were also documented on their onset of fruiting and flowering (fertile) and some are sterile. It should be noted that reproductive parts of these plant species were very helpful for the identification and documentation. It should be noted that these tree species occurred only as sparse tree individuals, hence, the frequency of encountering them in every plot is very low, particularly along the stretch of Amnay River. Some of these species were encountered in opportunistic survey areas which were outside the plots. Distribution of species in the area in terms of abundance and diversity is fragmented to zero (0), meaning occurrence of species is not that abundant and imminent loss of species especially native ones is likely due to lack of vegetation cover to provide these species conducive environmental conditions for growth.

Most of the documented threatened species were located near patches and fragmented vegetation, under shade of taller trees and dense understorey. Shade trees are important for these species to thrive and propagate in the area and to restore the overall ecology of the river banks and stabilize flow of water.

Table 2.1.15: List of Threatened Species Recorded at the Project Site

Scientific Name	Common Name	Family Name	DAO 2017-11	IUCN (2021-2)	Transect/Growth stage
Artocarpus blancoi	Antipolo	MORACEAE		NT	T2 (pole stage)
Vitex parviflora Juss.	Molave	LAMIACEAE		VU	T9 and T8 (sapling stage)
Pterocarpus indicus Willd. forma *indicus*	Smooth Narra	FABACEAE	VU	EN	T9 and T8
Canarium ovatum Engl.	Pili	BURSERACEAE	OTS	LC	T9 only (sapling stage)
Nauclea orientalis	Bangkal	RUBIACEAE		LC	All Sites (except T1 and part T2)
Aphanamixis polystachya (Wall.) R.Parker	Kangko	MELIACEAE	OTS	LC	T7 (sapling stage)

Note: CR – Critically endangered; EN – Endangered; VU – Vulnerable, OTS – Other threatened species

- Critically Endangered Species (CE) - refers to a species or subspecies facing extremely high risk of extinction in the wild in the immediate future. This shall include varieties, formae or other infraspecific categories.
- Endangered Species (EN) - refers to a species or subspecies that is not critically endangered but whose survival in the wild is unlikely if the causal factors continue operating. This shall include varieties, formae or other infraspecific categories.
- Vulnerable Species (VU) - refers to a species or subspecies that is not critically endangered nor endangered but is under threat from adverse factors throughout its range and is likely to move to the endangered category in the future. This shall include varieties, formae or other infraspecific categories.
- Other Threatened Species (OTS) - refers to a species or subspecies that is not critically endangered, endangered nor vulnerable but is under threat from adverse factors, such as over collection, throughout its range and is likely to move to the vulnerable category in the near future. This shall include varieties, formae or other infraspecific categories.
- Other Wildlife species (OWS) - refers to non-threatened species of plants that have the tendency to become threatened due to destruction of habitat or other similar causes as may be listed by the Secretary upon the recommendation of the National Wildlife Management Committee. This shall include varieties, formae or other infraspecific categories.
- IUCN defines the different threatened categories as follows:
  - Critically Endangered (CR) - A taxon is Critically Endangered when it is facing an extremely high risk of extinction in the wild in the immediate future.
  - Endangered (EN) - A taxon is Endangered when it is not Critically Endangered but is facing a very high risk of extinction in the wild in the near future.
  - Vulnerable (VU) - A taxon is Vulnerable when it is not Critically Endangered or Endangered but is facing a high risk of extinction in the wild in the medium-term future.

Source: **DAO 2017-11 updated checklist (2011) pursuant to “Wildlife Resources Conservation and Protection Act 9147” defines the different threatened categories as follows:

Near threatened (NT), Least Concern (LC)
IUCN 2021. The IUCN Red List of Threatened Species. Version 2021-2. <https://www.iucnredlist.org>

2.1.4.1.8.3 Ecosystem Services

In terms of economic uses and importance, some plants and trees recorded in the project sites have potential for medicinal, ornamental, field, fodder and timber purposes. **Table 2.1.16** shows the list of some importance plant species and their relative uses and importance as source of materials. Most of the flora species recorded are tree species with known economic and human use values (tangible products) such as source of timber, fruits, medicines, ornamentals and fuel wood. These include members of the families of Anacardiaceae, Meliaceae, Moraceae, Lamiaceae, Fabaceae and Euphorbiaceae.

In terms of other economic uses, raw materials (e.g., fiber, timber, fuel wood, fodder, fertilizer) can be obtained from the following tree species known for timber such as Igyo (*Dysoxylum gaudichaudianum* (A. Juss.) Miq.), Kalumpang (*Sterculia foetida* L.), Kamachile (*Pithecellobium dulce* (Roxb) Benth.), Tan-ag (*Kleinhovia hospita* L.), Anabiong (*Trema orientalis* (L.) Blume), Binunga (*Macaranga tanarius*), Kangko (*Aphanamixis polystachya* (Wall.) R.N. Parker), Kalios (*Streblus asper* Lour.) and Pili (*Canarium ovatum* Engl.). Fodder and fuel wood uses can be derived to tree species such as Ipil-Ipil (*Leucaena leucocephala*) and Kakawate (*Gliricidia sepium*). However, cutting and utilizing some threatened tree species are banned by the DENR because of its current status in the wild or its present conservation status. Consequently, there are also species recorded that actually belongs to “lesser known or used species”.

Table 2.1.16: List of Some Economic Uses and Importance of Significant Flora Recorded in the Project Site

Species	Common Name	Family Name	Economic Uses and Importance
Sterculia foetida L.	Kalumpang	MALVACEAE	Timber; Wood is used for house construction/furniture; Reforestation species.
Pterocarpus indicus	Smooth Narra	FABACEAE	Timber; Wood is used for furniture; Reforestation species.
Pithecellobium dulce (Roxb) Benth.	Kamachile	FABACEAE	Timber; Wood is used for house construction/furniture; Reforestation species.
Kleinhovia hospita L.	Tan-ag	MALVACEAE	Timber; Wood are used in furniture making. Fruits are medicinal.
Ficus variegata	Tangisang bayawak	MORACEAE	Fruits are medicinal. Wood used as source of timber.
Ficus nota L.	Tibig	MORACEAE	Timber; The wood is used for furniture, house building, turnery, light carpentry, interior joinery and panelling, boxes and crates, boats.
Ficus nota	Tibig	MORACEAE	The fruits are edible, but have little flavor; sometimes eaten with sugar and cream. The hard and rough leaves are used to clean household materials.
Cordia dichotoma	Anonang	BORAGINACEAE	Timber; Wood is used for house construction/furniture; Reforestation species.
Canarium ovatum Engl.	Duguan	MYRISTICACEAE	The resin is primarily from volatile turpentines; Fruits are edible; Seeds are sources of oils.
Artocarpus blancoi	Antipolo	MORACEAE	Timber; paper production and being a shade provider are its primary uses, although its seeds and fruits are edible.
Melanolepis multiglandulosa *(Reinw. Ex Blume) Reichb. f. & Zoll.*	Alim	EUPHORBIACEAE	Timber; The wood is used for furniture, house building, turnery, light carpentry, interior joinery and panelling, boxes and crates, boats.
Sandoricum koetjape (Burm. f.) Merr.	Santol	MELIACEAE	Source of timber. Fruit is edible.
Lagerstroemia speciosa (L.) Pers.	Banaba	LAMIACEAE	Timber; leaves are medicinal; decoction of root, bark used for kidney and liver problems. Renal problems.

Species	Common Name	Family Name	Economic Uses and Importance
Alstonia macrophylla Wall. ex DC.	Batino	APOCYNACEAE	Young shoots are used as a vegetable and as a spice; the leaves are used in traditional medicine against fever.
Alstonia scholaris (L.) R. Br.	Dita	APOCYNACEAE	Timber; Leaves are medicinal.
Trema orientalis (L.) Blume	Anabiong	CANNABACEAE	Medicinal and source of timber.
Muntigia calabura L.	Datiles	MUNTIGIACEAE	Fruits are edible. Forage resource for Birds and biodiversity. Reforestation species
Pongomia pinnata (L.) Merr.	Bani	FABACEAE	The flowers can be used to treat diabetes; juice of the roots with coconut milk and lime water is used as a remedy for gonorrhea.
Alstonia scholaris (L.) R. Br.	Dita	APOCYNACEAE	Timber; The wood is used for furniture, house building, turnery, light carpentry, interior joinery and panelling, boxes and crates, boats.

Fuelwood which are commonly the needed materials by local residence comprises 9% which are limited to plant species of *Gliricidia sepium, Pithecelobium dulce and Nauclea orientalis*. Food sources (e.g., oils, fruits, seeds, juices/extracts) can also be obtained from tree species recorded in the project sites such as Talisai (*Terminalia cattapa*), Pili (*Canarium ovatum*), Manzanitas (*Ziziphus mauritiana*), including palm species, Niog (*Cocos nucifera)*. Medicinal and other known herbal uses from plants are also noted to some species recorded in the site such as Uuko (*Mikania cordata*) (and other species of Asteraceae), Sambong (*Blumea balsamifera)*, Kubamba (*Piper umbellatum),* among others. Other tree species includes Philippine Endemic tree species such as Is-is *(Ficus ulmifolia),* Antipolo *(A. blancoi)* are reported to be edible by their leaves and fruits (e.g., figs).

These species are observed in either patches of vegetation or as sparse individual trees within and outside the transect plots. Others are also documented during opportunistic survey present near agricultural farms and small ditches and creeks surrounded by thick vegetation of grass species such as Cogon (*Imperata cylindrica*). These tree species are regarded as keystone species for fauna such as bats, birds and other frugivorous mammals and vertebrates. They are also widely dispersed by these animals through their droppings and pollination. Vegetation in the project area provides a variety of products and services that contribute to wellbeing of the locals and biodiversity conservation. These come in the form of provisioning ecosystem goods and services, such as fuelwood, timber for construction materials, furniture, medicine, fruit, and other economic activities for the communities; regulating services in the form of erosion control.

As a standard procedure in ecological assessments, use of each species or biodiversity is emphasized to highlight not only its ecological importance but also its potential utility to man. Out of 125 species found in the transects established in the impact areas, 19 species are herbal/medicinal plants, 21 species are used for erosion control, 20 species are used for landscaping and 25 species are fruit bearing and edible. However, there was no survey conducted to document the ethnobotanical uses by the locals in the area. The figure below shows the distribution of uses of plant species found in the project study area. Other tree and plant species listed that are not known for any other uses are designated as “lesser-known species”. **Figure 2.1.34** shows the distribution of uses of plant species found in the project study area.

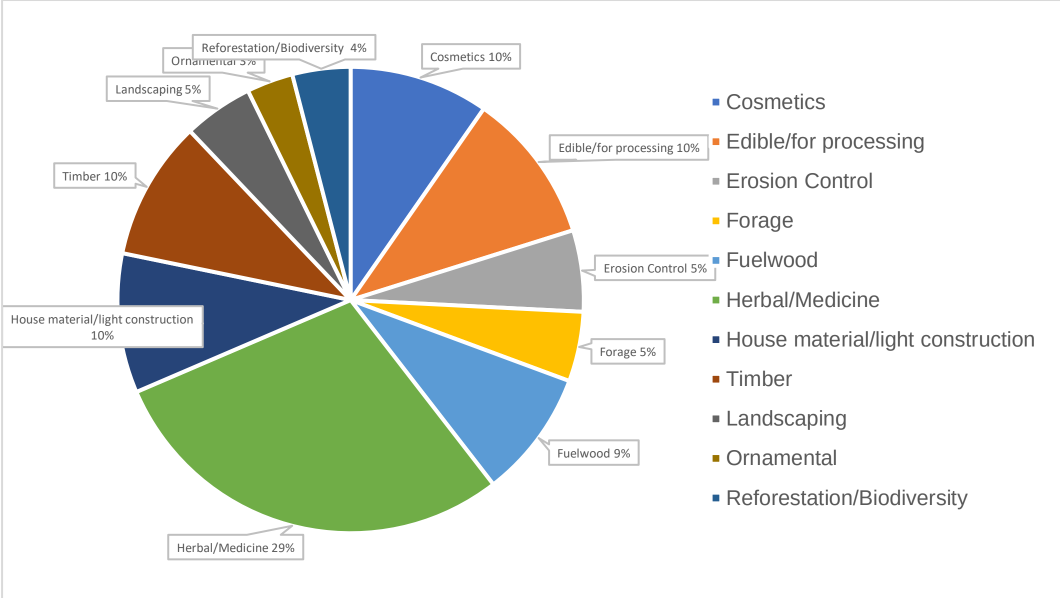


Figure 2.1.34: Distribution of Uses of Plant Species Found in the Project Study Area

Amnay River, if fully rehabilitated and restored after the proposed project would likely to provide ample ecosystem services to people and biodiversity. The provisioning services provided by the patch of grassland ecosystem present in the project area has a key role in the food chain where it supports and serves as habitat for other forms of wildlife like birds, small mammals, and various species of insects which in turn serve relevant ecological roles themselves. The ecosystem services provided by the adjoining forested or vegetated area in the Project study area also provides for erosion regulation, an ecological function provided by its species diversity, multilayered canopy structure, and litter layer trapped by the buttresses, the typical root architecture of forest over limestone because this forest type does not have a thick soil layer.

Among the major ecosystem services, medicinal uses composed of 29% which are commonly provide by weeds and grasses found in the area including some shrubs and trees. On the other hand, only 10% of the recorded flora are suitable for sources of wood for light construction and materials. Timber comprises only 10% of the recorded species. Finally, fuelwood which are commonly the needed materials by local residence comprises 9% which are limited to plant species of *Gliricidia sepium, Pithecelobium dulce and Nauclea orientalis*.

2.1.4.1.8.4 Unique Plant Species

One of the particular components of Ecosystem Services is the use values and biodiversity. The presence of unique plant species in the ecosystem provides a greater value, appreciation and understanding of biodiversity in a certain area. Amnay River has some remaining unique plant species that can be used for a variety of purposes such as biodiversity, aesthetics, landscaping and ornamental plants. Ornamental plants are plants that are grown for decorative purposes in gardens and landscape design projects, as houseplants, cut flowers and specimen display. The cultivation of ornamental plants comes under floriculture and tree nurseries, which is a major branch of horticulture. Of all the dominant plant forms in the project site, grasses, herbs and some shrubs are the prominent vegetation composition.

Based on the results of the survey, at least eight (8) species were listed as ornamental plants and ten (10) are suitable for landscaping (**Annex 2-1 Table 4**). These includes unique flora such as Corazon de Maria, Payong-payongan, among others (**Plate 2.1.13**). Ornamental grasses are grasses grown as ornamental plants. Many ornamental grasses are true grasses (*Poaceae*); however, several other families of grass-like plants are typically marketed as ornamental grasses. These include the sedges (*Cyperaceae*) and Aroids (*Araceae*). All are monocotyledons, typically with narrow leaves and parallel veins. Most are herbaceous perennials, though many are evergreen and some develop woody tissues.

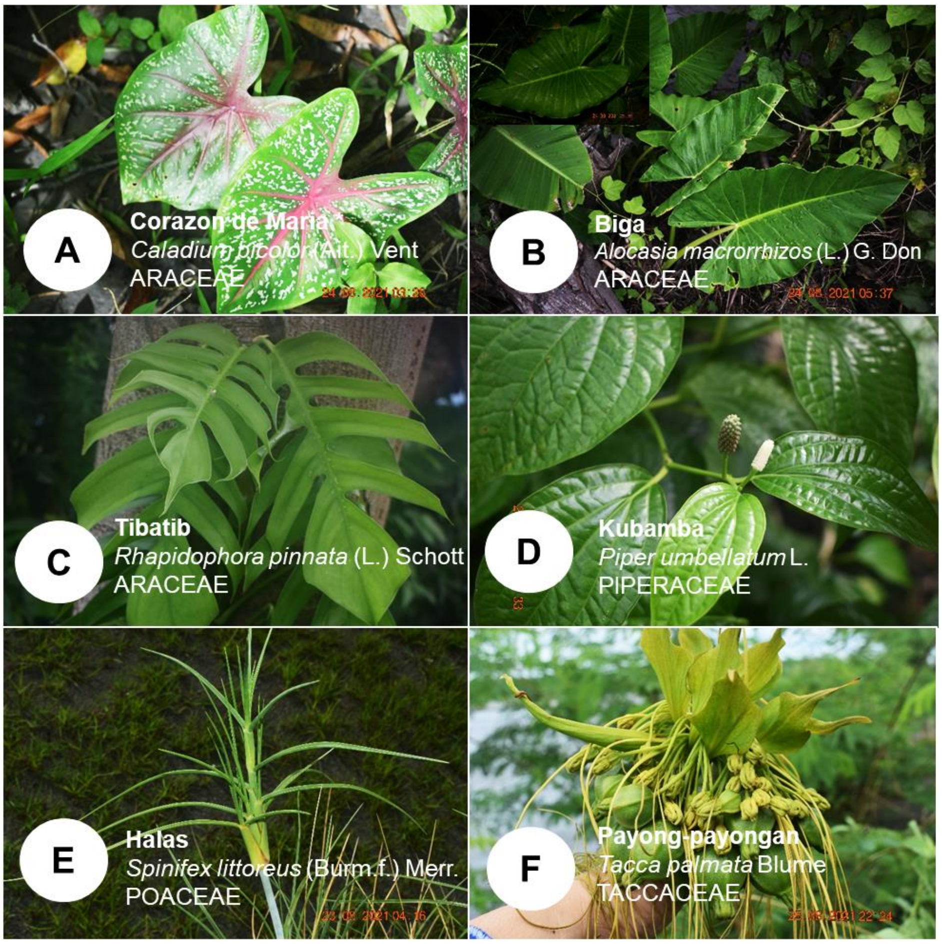


Plate 2.1.13: Photos of the Documented Unique Plant Species at the Project Site

2.1.4.1.9 Mangrove Vegetation

According to USEPA (2010), mangrove swamps are coastal wetlands found in tropical and subtropical regions. They are characterized by halophytic (saline plants) trees, shrubs and other plants growing in brackish to saline tidal waters. In Amnay River, the assessment of mangrove communities was conducted in August 2022 in the adjacent river body which is the Patrick River to assess any potential impacts to adjacent water bodies, communities or wetlands.

Assessment of mangrove flora followed a standard sampling technique. Survey and inventory of the mangrove vegetation was done to determine the composition and diversity for a more thorough analysis of the extent of mangrove vegetation unit surrounding Amnay River. The project site for the ARRDP is located adjacent to the western bank to a river estuary on an approximately 30-ha of mangrove vegetation patches as shown in **Plate 2.1.14**. The mangrove vegetation inside the riverine section of Patrick River adjacent to the river mouth of Amnay 780-1-km distance which composed of natural and planted patches or group of mangrove forest species. Approximately 30-hectares of this mangrove vegetation is near to the river mouth of Amnay composing of planted vegetation of Bakaun babae (*Rhizophora mucronata Lamk*.) and Pototan (*Bruguiera sexangula* (Lour.) Poir.). Coordinates of the sampling points for the assessment are presented in **Table 2.1.17** as surveyed in the area.

Figure 2.1.35 shows the Indicative map of mangrove forest vegetation near Amnay River located in the mouth of Patrick River.

Table 2.1.17: Coordinates of the Sampling Plots of the Patrick River Mangrove Flora Assessment

Mangrove Sampling Station	Coordinates	
	Northing	Easting
Inner Mangrove (Riverine)	12° 55.992'N	120° 46.574'E
Outer mangrove (Riverine)	12° 56.144'N	120° 46.584'E
Block A	12° 55.956'N	120° 46.647'E
Block B	12° 55.890'N	120° 46.625'E
Block C	12° 55.828'N	120° 46.659'E
Block D	12° 55.736'N	120° 46.732'E

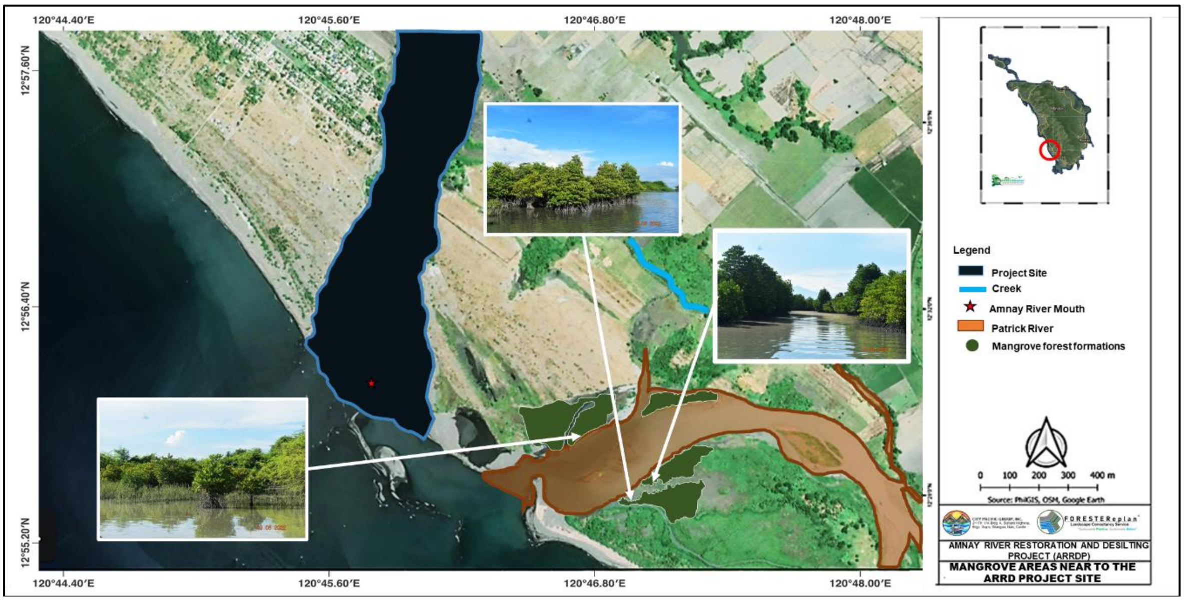
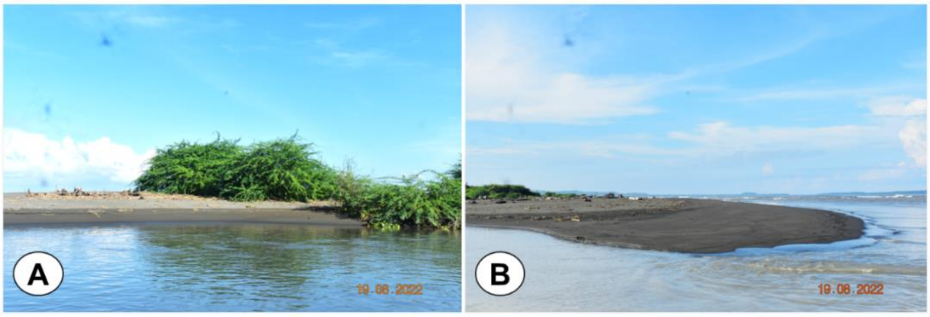


Figure 2.1.35: Indicative Map of Mangrove Forest Vegetation near Amnay River located in the Mouth of Patrick River

For the purpose of assessing all mangrove vegetation units, the quantitative vegetation analysis for the riverine mangroves were extended on the ecotone between the buffer zone and the Nipa stands near the beach area. The survey both applied sampling and enumeration of the trees with greater than or equal to 10 cm and to account the greatest number of tree species for the survey. Presently, the area is dominated by Nipa and Aroma species on both banks of the rivulet, at higher portion particularly at the riverine and landward zone, medium to large-sized diameter trees of Bakauan babae (*R. mucronata*) and Pototam (*B. sexangula*) predominate inside the river mouth section going south of the river to landward vegetation near the buffer zone. Other remaining sparse trees of Bakauan babae were located near the rivulet extending south of Patrick River which is also dominate by Aroma (*Acacia farnesiana*) and some landwards species.

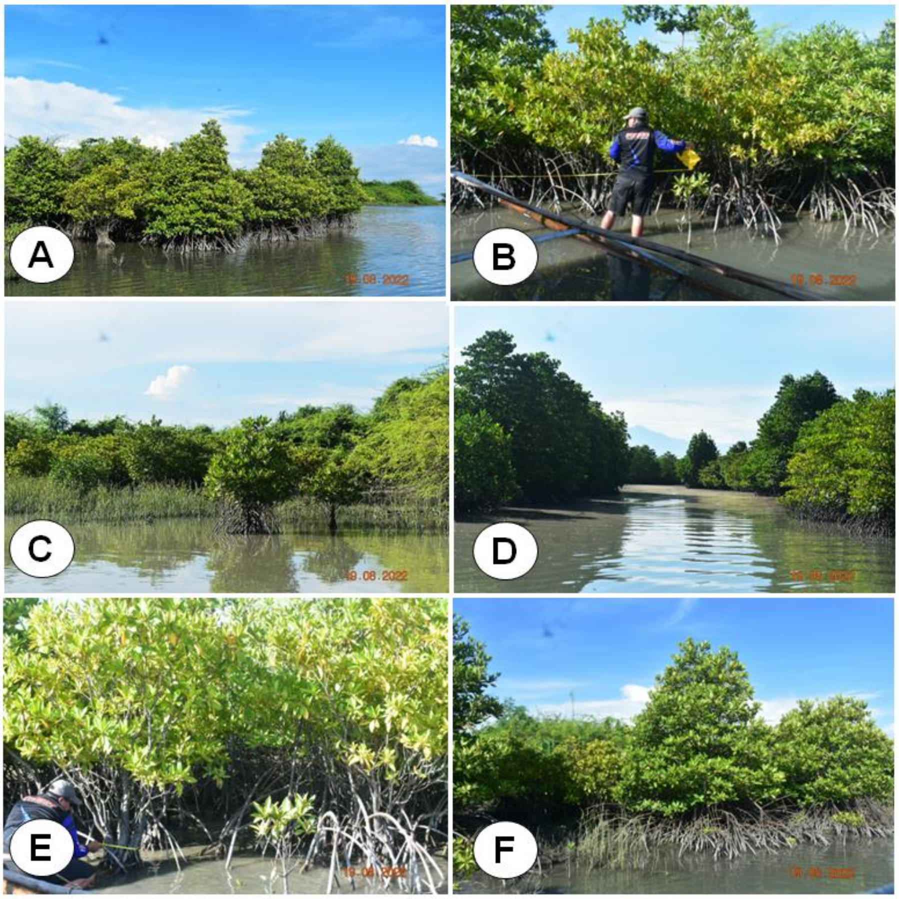
An estimate of relative coverage of the mixture are totaled by the density of stems per unit area (about 2-3 stems per 10 m^2) having approximately five (5) Nipa stems and six (6) Bakauan babae stems in 100 m^2. However, the present assessment results reveals that some local disturbance (e.g., harvesting, dieback) results to slow regenerations of mangrove trees and other flora inside and peripheral section, which are contributed by different factors over time, e.g., natural disasters and harvesting, hence, regenerating mangrove individuals were low in density such that the mangrove individuals (*S. sexangula* and *R. mucronata*) were exposed to exploitation, natural competition and imbalance.



Note: (a); Some of the bank already blocking and forming sand bar from the river mouth of Patrick River.

Plate 2.1.14: Beach Vegetation at the Western Portion of Amnay River, Near the Inner Mangrove at the Inner Bank of Patrick River

Based from the survey and actual observations, the remaining mangrove vegetation unit are mostly located on the landward and riverine zone, therefore, mangrove vegetation units are characterized forming an irregular narrow strip zone along the river, and thin strip of riverine mangroves along its rivulet as dominated by Pototan, some individuals of Bakauan babae, Aroma in the beach area and Nipa. Regenerant propagules that already germinated in the area makes the next regenerating cover represented by B. babae (*R. mucronata*). **Plate 2.1.15** shows the mangrove vegetation and the extent of its cover.



Note: (a) Mature size Bakauan babae (*R. mucronata*); (b) establishment of 10x10 m plot; (c) regenerants of Pototan (*B. sexangula*); (d) rivulet dominated by mature B. babae stands; (e) measurement of biometrics; and (f) landward and riverine zone co-dominated by Aroma (*Acacia farnesiana)*

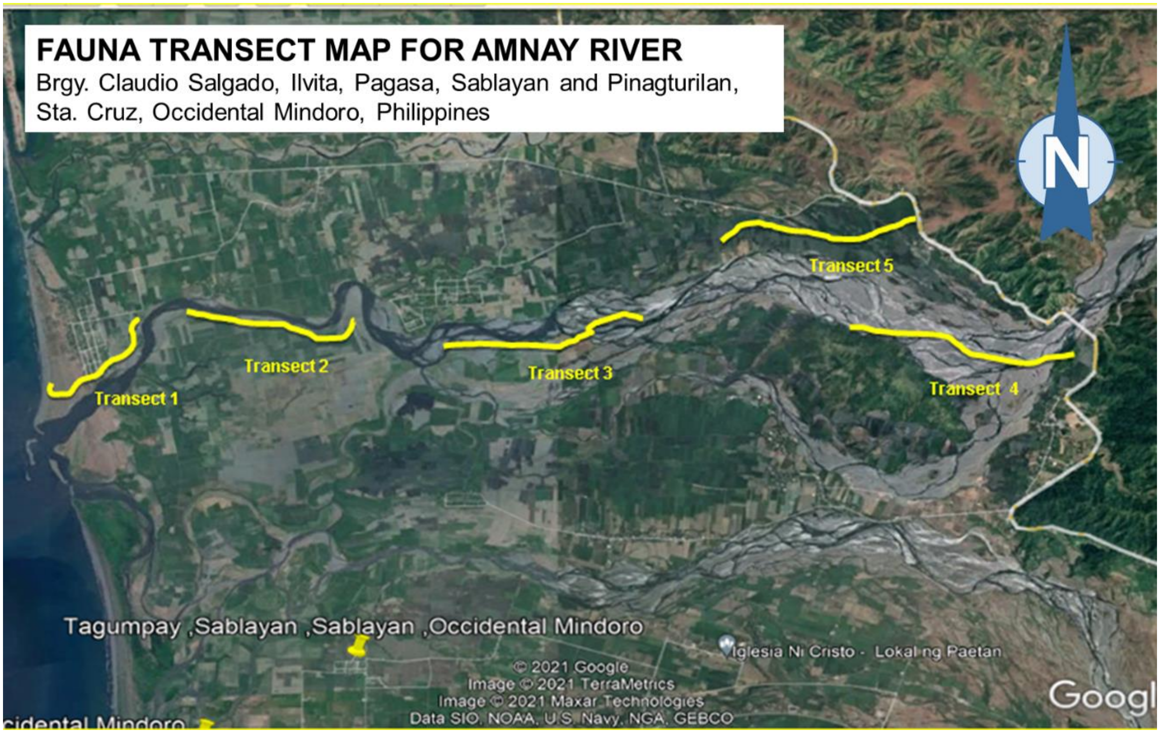
Plate 2.1.15: Mangrove Forest Vegetation near Amnay River located in the Mouth of Patrick River

2.1.4.2 Terrestrial Fauna

The terrestrial fauna survey was conducted along the banks of the Amnay River; from the mouth of the river at the Mindoro Strait upstream to the national highway at the start of the New Trans-Mindoro Road. A total of five (5) 1.8-2.0 kilometer transects were established. The descriptions of the terrestrial faunal survey stations are shown in **Table 2.1.18**. The satellite map showing the location of the survey stations is shown in **Figure 2.1.36**.

Table 2.1.18: Description of the Terrestrial Fauna Survey Stations

Survey Stations	Coordinates	Description
Transect 1 (Bgy. Claudio)	Start: 120°46'16.23"E, 12°56'45.69" End: 120°46'45.77"E, 12°56'57.72"N	Open Brush Land and Beach Vegetation/residential
Transect 2 (Bgy. Claudio)	Start: 120°47'14.65"E, 12°57'36.10" End: 120°48'17.45"E, 12°57'31.27"N	Agricultural Area, Open Brush Land
Transect 3 (Bgy. Ilvita)	Start: 120°57'21.46"E, 12°57'21.46" End: 120°50'7.64"E, 12°57'58.17"N	Agricultural
Transect 4 (Kabangkalan)	Start: 120°51'30.82"E, 12°57'57.53" End: 120°57'58.17"E, 12°52'28.71"N	Open wood land mixed with agricultural land
Transect 5 (Bgy. Pag-asa)	Start: 120°52'35.25"E, 12°57'29.35" End: 120°53'29.30"E, 12°57'31.90"N	Agricultural



Source: Google Maps 2021 (Basemap), City Pacific Group, Inc. (Project Site and Dredging Locations), PSA 2016 (Administrative Boundaries), Modified by FORESTEREPLAN.

Figure 2.1.36: Location Map of the Terrestrial Fauna Survey Stations

Plate 2.1.16 shows the photos of vegetation and terrain of each transect. The photos also show that most of the sites are barren with scant vegetation except for patches of trees, shrubs, grassland and agricultural lands newly plowed, and barren rice fields. The river is very shallow, thoroughly silted, and muddy at the same time.

Note: (A, B) Transect 1; (C, D) Transect 2 at Sito Balok-Balok. (E, F) Transect 3; (G, H) Transect 4; and (I, H) Transect 5

Plate 2.1.16: Photos of the Vegetation and Terrain of each Transect

2.1.4.2.1 Birds

Five (5) 2-kilometer transect walks were conducted in five (5) transect lines along the Amnay River. Transect walks were conducted in the morning from 5:30 to 10:00 a.m, and in the afternoon from

3:00 to 6:00 p.m., to identify species and count birds. Bird species were identified while perching or flying, using binoculars and cameras. Those which cannot be seen were identified through their songs and calls. All birds seen and heard were listed and recorded.

Mist netting was employed to confirm species occurrence and distribution as well as identification of cryptic species of birds. The nets were set in the afternoon and checked in the morning of the next day. For each transect line, two sets of nets with three nets each were set serially along the transect. These nets are also used to catch Volant mammals during the night. Nets were checked for birds every hour until noon and in the afternoon from 3:00-5:00 or an hour before dusk. Identification, nomenclature, classification and conservation status were determined based on Kennedy et al. (2000), the Wild Bird Club of the Philippines - Checklist of Birds of the Philippines 2021, DENR and IUCN.

Identification, nomenclature, classification and conservation status were determined based on Kennedy et al. (2000), Rosell (2010), and the Wild Bird Club of the Philippines - Checklist of Birds of the Philippines 2019.

2.1.4.2.1.1 Species and Number of Individuals

Forty-six (46) species of birds belonging to 29 families were observed and recorded from five transect lines located in 4 barangays along the Amnay River. The highest number of species (37) was documented in Transect 5 which had the most vegetation. The lowest was in Transect 4 with 30 species. Most of the sites along the river are bare of vegetation but Transect 4 is mostly gravel and sand along its banks. Although there were a few stunted trees along its banks. Eighteen (18) species are common to all sites where the most abundant is Passer montanus which is commonly known as Mayang simbahan or Mayang bahay with 1,293 individuals counted from Transects 1 to 5.

The list of bird species observed and recorded during the survey is presented in **Table 2.1.19**. **Plate 2.1.17** shows the photos of documented avian species on different transects established at Amnay River.

Table 2.1.19: Bird Species and Number of Individuals Documented from the Five Transects

Family	Species	Common Name	Transects				
			1	2	3	4	5
Accipitridae	*Haliastur indus*	Brahminy Kite	1	1	2		1
Acrocephalidae	*Acrocephalus stentoreus*	Clamorous Reed Warbler	2	4	6	2	8
Alcedinidae	*Halcyon smyrnensis*	White-throated Kingfisher		1			
	Todiramphus chloris	Collared Kingfisher	4		8	5	12
Apodidae	*Collocalia troglodytes*	Pygmy Swiftlet	3		6	3	3
Ardeidae	*Ixobrychus cinnamomeus*	Cinnamon Bittern			5		2
	Ixobrychus sinensis	Yellow Bittern		3			1
	Nycticorax nycticorax	Black-crowned Night Heron	2	1	1		
	Bubulcus coromandus	Eastern Cattle Egret	13	86	4	7	13
	Ardea purpurea	Purple Heron	4	5	2		
	Ardea Intermedia	Intermediate Egret			3		
	Egretta sacra	Pacific Reef Heron	0	2			
	Egretta garzetta	Little Egret	7	10	1	2	2
Artamidae	*Artamus leucorynhus*	White-breasted Woodswallow	2	6	2	6	14
Caprimulgidae	*Caprimulgus manillensis*	Philippine Nightjar	2	1	0	2	2
Charadriidae	*Charadrius dubius*	Little Ringed Plover	4	4	2	8	14
Cisticolidae	*Cisticola exilis*	Golden-headed Cisticola	0	0	0	4	6
Columbidae	*Spilopelia chinensis*	Spotted Dove	6	8	14	5	16
	Chalcophaps indica	Common Emerald Dove				1	2
	Geopelia striata	Zebra Dove	13	11	25	10	29
	Phapitreron leucotis	White-eared Brown Dove				1	3
	Treron vernans	Pink-necked Green Pigeon	1				
Corvidae	*Corvus macrorhyncos*	Large-billed Crow	2	2	2	7	15

Family	*Species*	Common Name	Transects				
			1	2	3	4	5
Cuculidae	*Centropus viridis*	Philippine Coucal				2	3
Dicaeidae	*Dicaeum australe*	Red-keeled Flowerpecker	2	6	3	4	7
Estrildidae	*Lonchura atricapilla*	Chestnut Munia	17	10	40	6	22
	Lonchura punctulata	Scaly-breasted Munia	3	21			
Hirundinidae	*Hirundo rustica*	Barn Swallow	10	13	18	13	24
	Hirundo tahitica	Pacific Swallow	11	7	21	11	22
Laniidae	*Lanius schach*	Long-tailed Shrike	3	1			1
Locustelidae	*Cincloramphus timoriensis*	Tawny Grassbird	2	5		2	4
	Megalurus palustris	Striated Grassbird	2	6	9	10	18
Megalaimidae	*Psilopogon haemacephalus*	Coppersmith Barbet	1				1
Meropidae	*Merops philippinus*	Blue-tailed Bee-eater	12	2	12	7	18
Motacillidae	*Motacilla cinerea*	Grey Wagtail	0	0	3	3	6
	Anthus rufulus	Paddyfield Pipit	2	3	4	1	1
Muscicapidae	*Saxicola caprata*	Pied Bush Chat	5	2	5	12	19
Nectariniidae	*Cinnyris jugularis*	Olive-backed Sunbird	4	10	6	4	8
Passeridae	*Passer montanus*	Eurasian Tree Sparrow	171	240	781	35	66
Pycnonotidae	*Pycnonotus goiavier*	Yellow-vented Bulbul	27	12	17	11	32
Rallidae	*Hypotaenidia torquatus*	Barred Rail				2	3
	Gallinula chloropus	Common moorhen			4		2
Rhipiduridae	*Rhipidura nigritoquis*	Philippine Pied Fantail			2		
Scolopacidae	*Actitis hypoleucos*	Common Sandpiper		2	4	6	12
Sturnidae	*Aplonis panayensis*	Glossy Starling	11	3	7		0
Turnicidae	*Turnix suscitator*	Barred Buttonquail	2				1

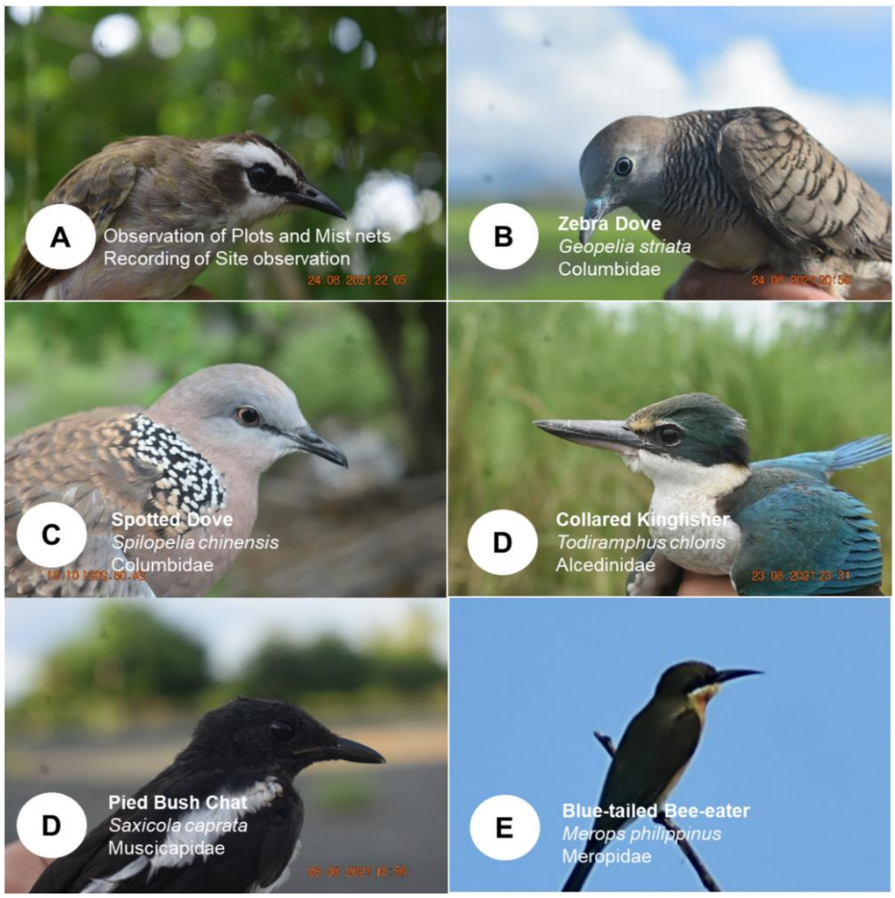


Plate 2.1.17: Photos of Some Birds Observed and Recorded from the Survey Stations

2.1.4.2.1.2 Habitats, Feeding Guild, Distribution and Conservation Status

Birds thrive in a variety of habitats and belong to different feeding guilds. Species of birds may be introduced, endemic, resident or migratory. Based on the results of the survey, there are 32 different specific habitats which birds inhabit along the Amnay River (**Table 2.1.20**). These 27 habitats are further grouped into 12 general habitats where birds dwell. Moreover, no species of birds documented during the survey is in the threatened list and are of Least Concern according to the IUCN and DENR.

Table 2.1.20: Habitats, Feeding Guild, Distribution and Conservation Status of Bird Species Recorded in Five Transects in Amnay River

Species	Habitat	Feeding Guild	Distribution	Conservation Status	
				IUCN	DENR
Acrocephalus stentoreus	Reed beds	Insectivore	Resident	Least Concern	Least Concern
Actitis hypoleucos	Coastline, riverbanks, mountains, wetlands	Invertivore/ Insectivore	Migratory	Least Concern	Least Concern
Anthus rufulus	Open scrub, grassland and cultivation areas	Insectivore	Resident	Least Concern	Least Concern
Aplonis panayensis	Forest	Omnivore	Resident	Least Concern	Least Concern
Ardea Intermedia	Aquatic/Trees close to lakes or wetlands	Carnivore	Resident, Migratory	Least Concern	Least Concern
Ardea purpurea	Wetlands	Piscivore	Resident	Least Concern	Least Concern
Artamus leucorynhus	Forest	Insectivore	Resident	Least Concern	Least Concern
Bubulcus coromandus	Forest	Insectivore	Resident, Migratory	Least Concern	Least Concern
Caprimulgus manillensis	Forest	Insectivore	Endemic	Least Concern	Least Concern
Centropus viridis	Grassland	Insectivore	Endemic	Least Concern	Least Concern
Chalcophaps indica	Forests, woodlands and mangroves	Frugivore	Resident	Least Concern	Least Concern
Charadrius dubius	Open gravel areas	Insectivore	Resident, Migratory	Least Concern	Least Concern
Cincloramphus timoriensis	Reedbeds/Grassland	Insectivore	Resident	Least Concern	Least Concern
Cinnyris jugularis	Common to all habitat types	Omnivore	Resident	Least Concern	Least Concern
Cisticola exilis	Open country	Omnivore	Resident	Least Concern	Least Concern
Collocalia troglodytes	Forest	Insectivore	Endemic	Least Concern	Least Concern
Corvus macrorhyncos	Forest and forest related habitats	Omnivore	Resident	Least Concern	Least Concern
Dicaeum australe	Forest and forest related habitats	Frugivore	Endemic	Least Concern	Least Concern
Egretta garzetta	Aquatic	Carnivore	Resident,Migratory	Least Concern	Least Concern
Egretta sacra	Coastline/Offshore islands	Piscivore/ Invertivore	Resident	Least Concern	Least Concern
Gallinula chloropus	Wetlands	Omnivore	Resident,Migratory	Least Concern	Least Concern
Geopelia striata	Grassland/open country	Omnivore	Resident	Least Concern	Least Concern

Species	Habitat	Feeding Guild	Distribution	Conservation Status	
				IUCN	DENR
Halcyon smyrnensis	Forest/areas near swamps, ponds and lakes; marsh and swamps	Carnivore	Resident	Least Concern	Least Concern
Haliastur indus	Coast and Inland Wetlands	Carnivore	Resident	Least Concern	Least Concern
Hirundo rustica	Open country, forests	Insectivore	Resident	Least Concern	Least Concern
Hirundo tahitica	Coasts to Forest	Insectivore	Migratory	Least Concern	Least Concern
Hypotaenidia torquatus	Wetlands/Agricultural lands	Insectivore/ granivore	Resident	Least Concern	Least Concern
Ixobrychus cinnamomeus	Rice paddies	Carnivore	Resident	Least Concern	Least Concern
Ixobrychus sinensis	Wetlands	Piscivore/ Insectivore	Resident	Least Concern	Least Concern
Lanius schach	Open country	Carnivore	Resident	Least Concern	Least Concern
Lonchura atricapilla	Grassland/open country	Granivore/ Herbivore	Resident	Least Concern	Least Concern
Lonchura punctulata	Forest/grassland/open country	Herbivore	Resident	Least Concern	Least Concern
Megalurus palustris	Grassland/marshland	Invertivore	Resident	Least Concern	Least Concern
Merops philippinus	Open habitats close to water	Insectivore	Resident	Least Concern	Least Concern
Motacilla cinerea	Aquatic/coastline	Invertivore	Resident	Least Concern	Least Concern
Nycticorax nycticorax	Grassland/Forests	Carnivores	Resident	Least Concern	Least Concern
Passer montanus	Forest, shrublands, open country	Granivore	Introduced	Least Concern	Least Concern
Phapitreron leucotis	Forest	Frugivore	Endemic	Least Concern	Least Concern
Psilopogon haemacephalus	Gardens, groves, woodland	Frugivore/ Insectivore	Resident	Least Concern	Least Concern
Pycnonotus goiavier	Open country	Frugivore	Resident	Least Concern	Least Concern
Rhipidura nigritoquis	Forest	Insectivore	Endemic	Least Concern	Least Concern
Saxicola caprata	Open country/grassland	Insectivore	Resident	Least Concern	Least Concern
Spilopelia chinensis	Open country	Granivore/ Herbivore	Resident	Least Concern	Least Concern
Todiramphus chloris	Mangroves, Forest, coastal areas	Carnivore	Resident	Least Concern	Least Concern
Treron vernans	Open country/Forest	Frugivore	Resident	Least Concern	Least Concern
Turnix suscitator	Grassland/scrubland/ farmland	Omnivore	Resident	Least Concern	Least Concern

Figure 2.1.37 shows that those which thrive in forests and forest related habitats (tree-dwellers/tree dependents) have the highest percentage comprising 30% of the total number of species. This is followed by species which are aquatic (15%), open country and grassland and related habitats (12 and 13% respectively) and along the coast/coastline (10%). The rest (1 species each) thrive in a variety of habitats (e.g., gardens, groves, woodlands, oceanic, etc.).

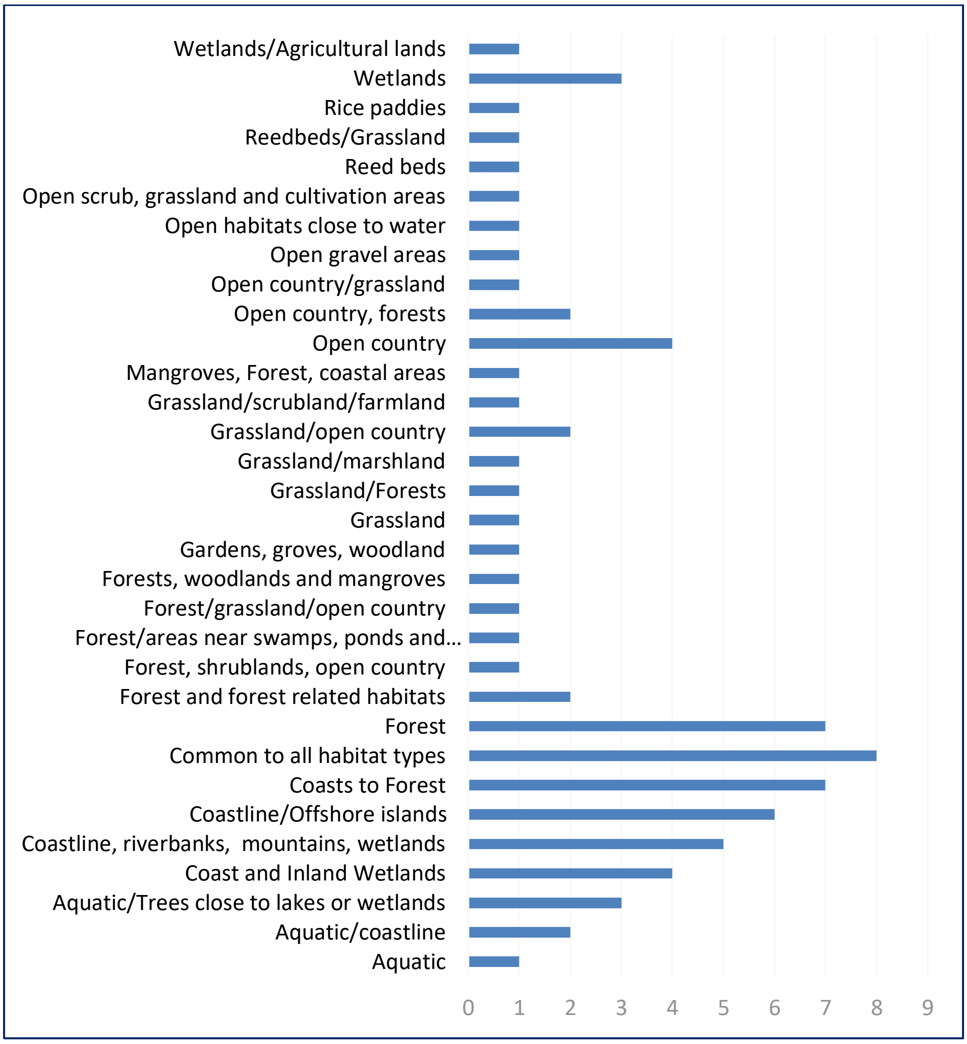


Figure 2.1.37: Percentage of Species Occupying Different Habitats

Figures 2.1.38 and **2.1.39** show that the highest number and percentage of species are those that are common to all habitats (8, 11%) followed by those which live in forests, and in both coasts and forests (7, 10%). Those that live along the coastline and offshore islands comprise 8% (6 species), coastline, riverbanks, mountains and wetlands (5, 7%), coast to inland wetlands and open country (4, 6%), in aquatic trees close to lakes or wetlands (3, 4%). The rest (1-2 species, 1-3%) live in a variety of habitats along the Amnay River.

Most species of birds are specialists when it comes to their diet. Insectivores (30%) have the highest percentage followed by omnivores (18%), and carnivores (17%) (**Figure 2.1.38**).

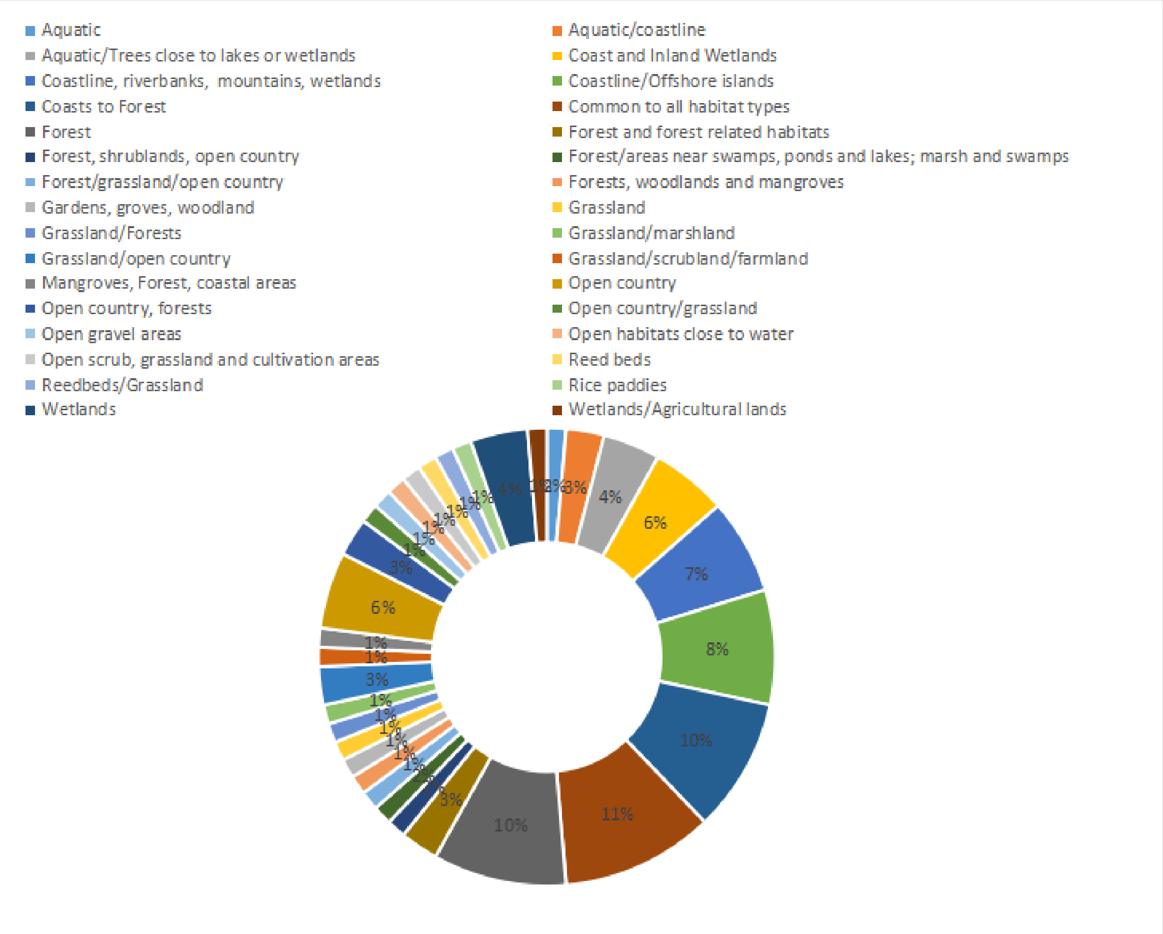


Figure 2.1.38: Percentage of Bird Species which Inhabit Different Habitats along the Amnay River

Birds feed on a variety of food. Most of species are specialists while others can be generalists. **Figure 2.1.39** shows the percentage of species which belong to different feeding guilds. The highest percentage are insectivores (31%) followed by carnivores (18%), omnivores (15%) and frugivores (11%). Insectivores can be bioindicators of environmental disturbance and/or degradation. The lower the percentage of insectivorous species would mean the greater stress the environment has experienced specially forest habitats.

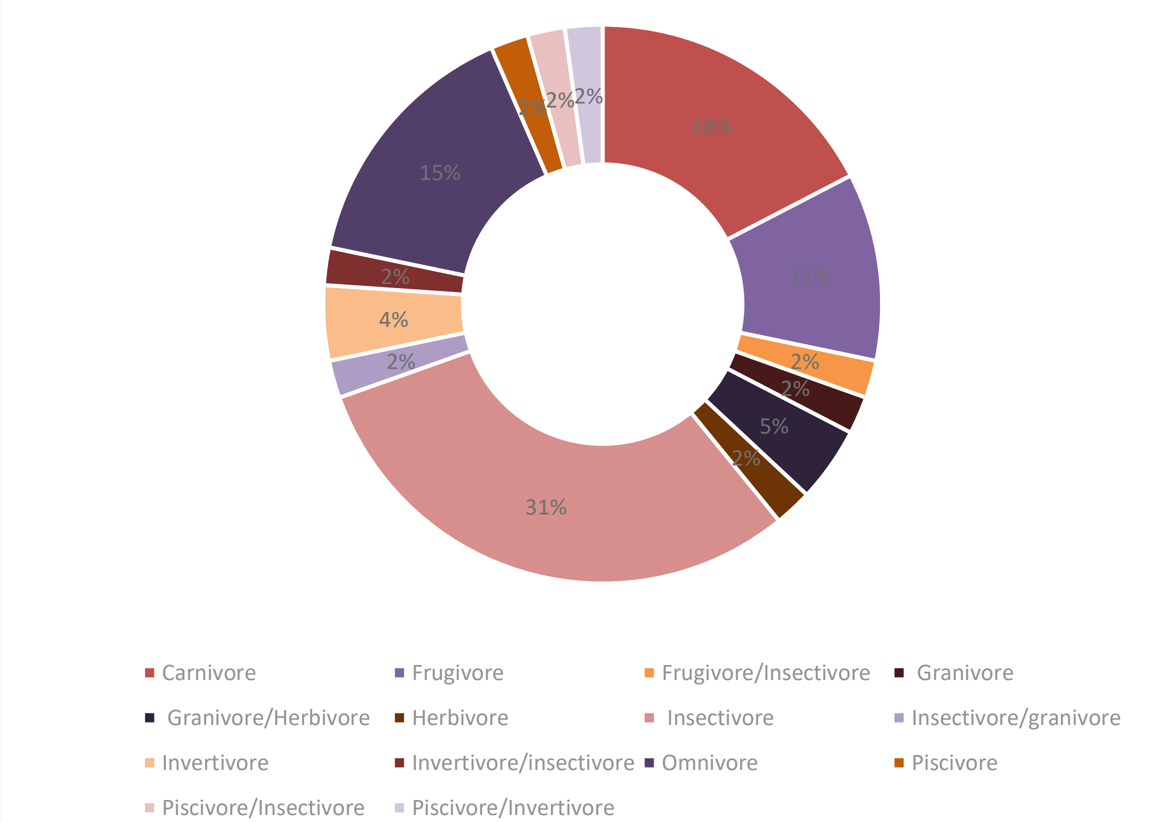


Figure 2.1.39: Percentage of Bird Species Belonging to Different Feeding Guilds

The percentage of species according to distribution are presented in **Figure 2.1.40**. Majority of the species are residents (70%). Thirteen percent (13%) are endemic while 11% are resident and at the same time are considered migratory. Four percent (4%) are migratory while one (1) species is introduced (2%), *Passer montanus*.

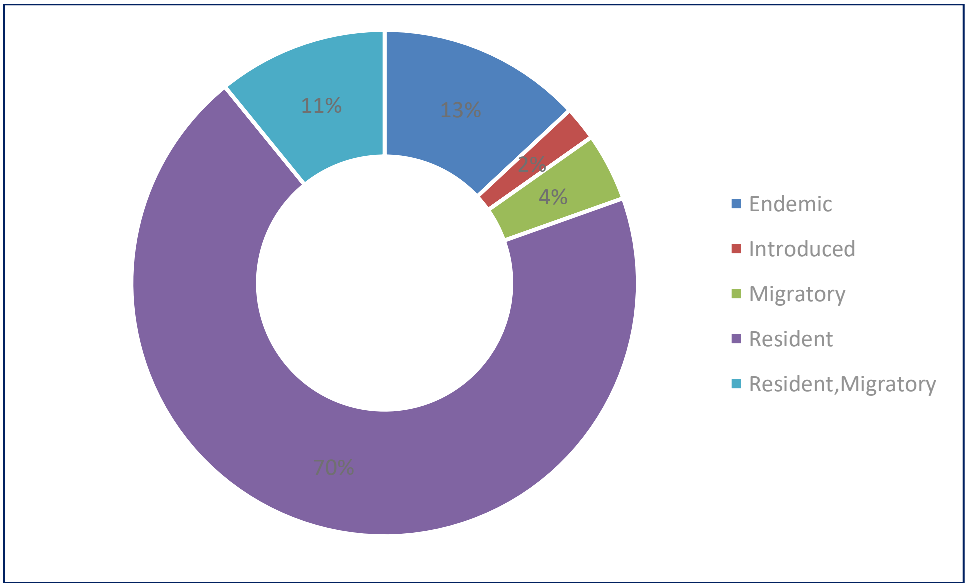


Figure 2.1.40: Percentage of Bird Species with Different Distribution Status

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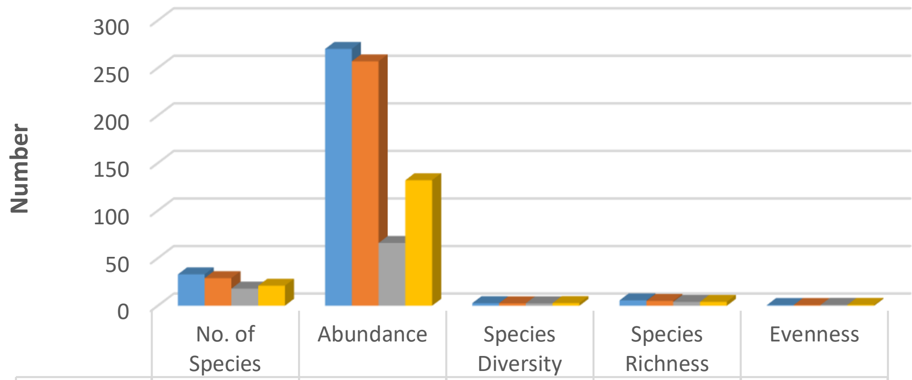
2.1.4.2.1.3 Diversity Indices

The values of diversity indices are compared between the transects (**Figure 2.1.41**). Species Diversity is very low in all the transects with Transect 5 having the highest value (0.9388), and lowest in Transect 3 (0.4086). This is because Transect 5 has the most vegetation along the transect line while Transect 3 is the barest and is mostly gravel and sand plus silt.

Species richness is moderate in Transects 3 and 4 while it is high in Transects 1, 4, and 5. Evenness is low in Transect 3, moderate in Transects 1 and 2, and high in Transects 4 and 5. The very low values of diversity indices is a manifestation of the disturbed environment along the Amnay River.



	No. of Species	Abundance	Species Diversity	Species Richness	Evenness
Transect 1	33	270	2.683	5.716	0.7674
Transect 2	29	257	2.559	5.046	0.7599
Transect 3	18	66	2.532	4.058	0.8759
Transect 4	21	132	2.801	4.096	0.92

Figure 2.1.41: Diversity Indices between Survey Stations along Amnay River

2.1.4.2.2 Mammals

Mist netting of volant species and live trapping of rodents were the two (2) main techniques employed in the survey of mammals. Mist nets were set and positioned in strategic points of the sampling sites (e.g., flyways, across established trails, near patches of trees, etc.), but away from human habitations (**Figure 2.1.42** and **Plates 2.1.18** and **2.1.19**). A total of six (6) nets per site were set serially with two (2) nets in a series. Nets were opened at 1800H until the following morning at 0600H.

Net watching for insectivores were done at 6:00-8:00pm. Live traps baited with roasted coconut laced with peanut butter were laid near the vicinity of the mist nets, foot trails, under roots of trees, and rocks, forming a trap line. The traps were checked for any capture early in the morning of the next day (**Plate 2.1.20**). Sign identification (e.g. droppings, wallowing areas, dens) and direct sighting techniques were used for terrestrial and arboreal (but non-volant) species. Tracks and droppings of non-volant mammals were identified if these are seen along the transect. Identification, nomenclature, classification and conservation status were based on Heaney et al., (1998) and the IUCN.

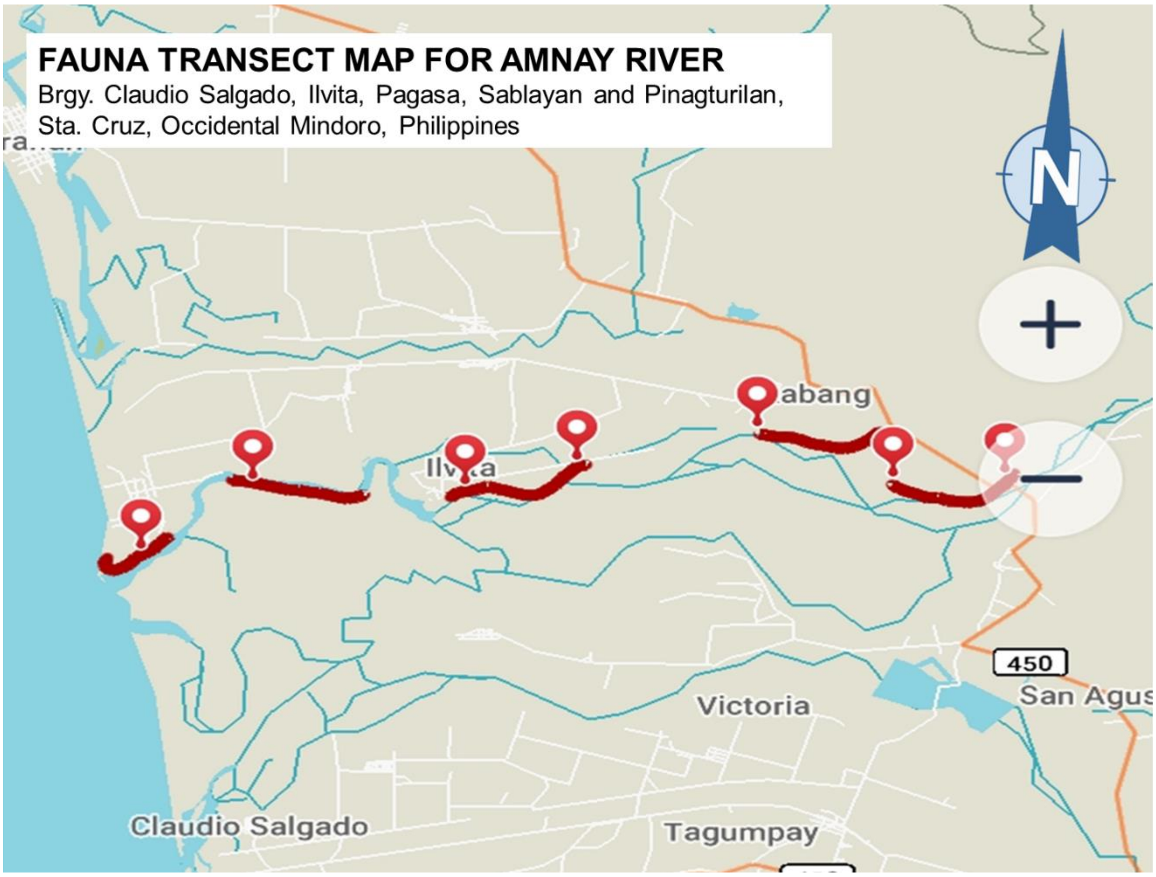


Figure 2.1.42: Map showing the Net Locations in the Transects

Plate 2.1.18: Photos of Fauna Survey Conducted at Amnay River

Plate 2.1.19: Photos of Mist Netting in the Survey Stations

Plate 2.1.20: Photos of Traps Set and Positioned in Strategic Points of the Survey Stations

2.1.4.2.2.1 Species and Number of Individuals

Very few species of mammals were documented in the transects, the list of which is presented in **Table 2.1.21**. Four (4) species of mammals; 1 non-volant and 3 volant species, were netted and trapped during the survey of terrestrial vertebrates along the Amnay River. As can be observed, there were no species documented in Transects 2 and 5. This may be because of the lack of roosting or feeding trees for bats, and pest control was in place for rodents which infest agricultural lands particularly in rice fields which proliferate in the area. The areas near the river are full of houses and farms which may disturb the bats and other mammals.

The only non-volant mammal caught in the live traps is the Asian House shrew, *Suncus murinus* and only in Transect 1. This species is usually found in agricultural areas and near or inside houses. The 3 species of volant mammals which are members of the Family Pteropodidae (fruit bats) were netted in Transects 3 and 4. Perhaps these were passing through from one side of the river to the other where fruit trees and figs (*Ficus spp*.), are present, although sparse and very few.

Table 2.1.21: Species of Mammals Documented in the Survey Stations

Family	Species	Common Name	Transects				
			1	2	3	4	5
Soricidae	*Suncus murinus*	Asian House Shrew	1				
Pteropodidae	*Eonycteris spelaea*	Lesser Dawn Bat			1		
	Cynopterus brachyotis	Short-nosed Fruit Bat			1	2	
	Ptenochirus jagori	Musky Fruit Bat				1	

2.1.4.2.2.2 Habitats, Feeding Guild, Distribution and Conservation Status

All of the species of mammals documented during the survey are common in the area because most of these are found in agricultural areas and secondary forests. The house shrew and musky fruit bat are also common in houses and residential areas. All of the species are beneficial to man because the bats are frugivores and they help pollinate fruits. The house shrew feeds on cockroaches and other house insects.

Except for *Ptenochirus jagori* which is endemic to the Philippines (except Palawan), all the other species are residents (**Plate 2.1.21**). None of them are threatened and are listed as Least Concern by the IUCN. The types of habitats where Musky Fruit Bat and others thrive, the feeding guild, distribution and conservation status of the species documented is presented in **Table 2.2.22**.

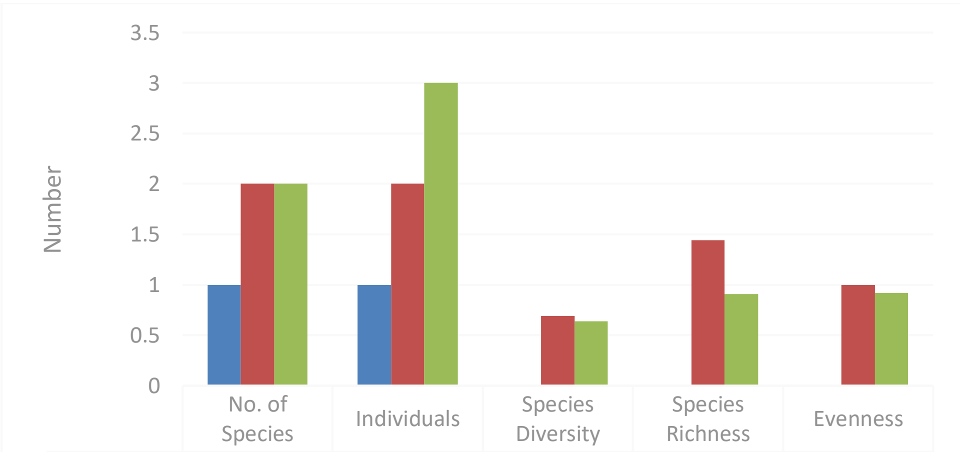
Table 2.1.22: Habitats, Feeding Guilds, Distribution, and Conservation Status of Mammals Documented in the Survey Stations

Species	Habitat	Feeding Guild	Distribution	Conservation Status
Suncus murinus	Urban and agricultural areas; inside houses	Insectivore	Resident	Least Concern
Eonycteris spelaea	Agricultural areas and secondary forest	Nectarivore/Frugivore	Resident	Least Concern
Cynopterus brachyotis	Agricultural areas and secondary forest	Frugivore	Resident	Least Concern
Ptenochirus jagori	Secondary forest, agricultural lands and residential areas	Frugivore	Endemic	Least Concern

Plate 2.1.21: Photos of Mammals Recorded from the Survey Stations

2.1.4.2.2.3 Diversity Indices

There is paucity of species of mammals along the Amnay River. Hence, all diversity values are very low. Species diversity and richness are highest in Transect 3 while evenness is highest in Transect 4 (**Figure 2.1.43**).



	No. of Species	Individuals	Species Diversity	Species Richness	Evenness
Transect 1	1	1	0	0	
Transect 3	2	2	0.6931	1.443	1
Transect 4	2	3	0.6365	0.9102	0.9183

Figure 2.1.43: Comparison of Diversity Indices between Transects

2.1.4.2.3 Herpetofauna (Reptiles and Amphibians)

The Visual Encounter/Opportunistic Survey was used in the inventory of herps while doing transect walks for birds in all of the sites. Any amphibian or reptile seen along the transect were identified and recorded. Opportunistic survey means documenting animals such as frogs, snakes and lizards as they are seen or observed along the transect line while conducting the transect walk. Frogging was done in the river bank and in the river for 2 hours after net watching (7-9pm). This was done by catching frogs seen and heard in the river or along the river banks. Individuals caught were immediately identified and photographed then released. Opportunistic survey is different from purposive because in opportunistic you catch and document what you see while walking and it is not the main purpose or objective why you are doing the transect walk.

Identification, nomenclature, classification and conservation status were based on Brown and Alcala (1978,1980) Diesmos et. al.,(2016) and the worldwide web.

2.1.4.2.3.1 Species and Number of Individuals

A total of 56 species of terrestrial vertebrates; 46 birds, 4 mammals (3 volant and 1 non-volant). and 6 herps (4 amphibians and 2reptiles) were documented from the five (5) transects (**Table 2.1.23**).

Six (6) species of herpetofauna belonging to 6 families were documented, these are; 2 species of reptiles, one (1) snake, Malayopython reticulatus and a lizard, Hermidactylus frenatus and 4 amphibians (3 frogs and a toad). The toad, Rhinella marina an introduced species and is invasive, is found all over the survey area. About 30 individuals were counted.

Table 2.1.23: List of Herpetofauna Documented from Amnay River

Family	Species	Common Name	No. of Individuals
Pythonidae	*Malayophython reticulatus*	Reticulated Python	1
Gekkonidae	*Hemidactylus frenatus*	Common House Gecko	2
Bufonidae	*Rhinella marina*	Giant Marine Toad	30
Ranidae	*Hylarana erythraea*	Common Green Frog	3
Rhacoporidae	*Polypedates leucomystax*	Common Tree Frog	2
Dicroglossidae	*Limnonectes beloncioi*	Mindoro Fanged Frog	2

2.1.4.2.3.2 Habitats, Feeding Guild, Distribution and Conservation Status

Amphibians thrive in both land and water while reptiles are more terrestrial than aquatic. The habitat, feeding guilds, distribution and conservation status of herpetofauna are presented in **Table 2.1.24**.

Except for the common house gecko which is found in urban development areas particularly in houses and buildings, and the giant marine toad which thrives in both aquatic and terrestrial habitats, the rest of the species inhabit forests, rivers and streams and agricultural lands. Species of lizards, Common House Gecko (*Hemidactylus frenatus*) dwell in human habitations and urban environments. Reticulated Python (*Malayopython reticulatus*) is found in a variety of habitats both terrestrial and aquatic.

Table 2.1.24: Habitats, Feeding Guilds, Distribution and Conservation Status of Herpetofauna Recorded in the Survey Stations

Species	Habitats	Feeding Guilds	Distribution	IUCN
Rhinella marina	Tropical and semi-arid environments	Omnivore	Introduced	Least Concern
Kaloula pulchra	Wetland, riverbank, forest edge, agricultural and residential areas	Insectivore (ants)	Introduced	Least Concern
Polypedates leucomystax	Wetlands and Forests, ponds	Insectivore	Near Endemic	Least Concern

Species	Habitats	Feeding Guilds	Distribution	IUCN
Fejervarya vittigera	agricultural areas, ditches, artificial ponds and lakes	Insectivore	Endemic	Least Concern
Malayophython reticulatus	forests, woodlands, grasslands/ rivers, streams and lakes	Carnivore	Resident	Least Concern
Gekko gecko	forest, human habitations	Insectivore	Resident	Least Concern
Hermidactylus frenatus	Urban environments	Insectivore	Resident	Least Concern
Hylarana erythraea	Forests, rice fields, marshes, gardens, human habitations.	Insectivore	Resident	Least Concern
Limnonectes beloncioi	Forests, rivers, marshes, seasonally flooded agricultural land	Insectivore	Endemic	Data Deficient? (Not yet evaluated)

All the species of frogs are insectivores. The toad feeds on a variety of prey, both plants and animals including fishes and invertebrates hence and omnivore. The reticulated python is a carnivore, its preys are from small toads and rodents to large mammals, even wild pigs. Both species of reptiles are resident to the Philippines. *Polypedates leucomystax* is deemed near endemic while *Limnonectes beloncioi* is a species which has just been described by Herr et al., 2021 as a distinct species, and not the same as *Limnonectes acanthi* which is endemic to Palawan. The newly described species has not been evaluated as to its conservation status but similar to *Limnonectes acanthi*, it is threatened by anthropogenic disturbance, deforestation and conversion of forests to agricultural lands. All the other species are of Least Concern according to the IUCN. **Plate 2.1.22** shows the documented/observed and Recorded herpetofauna from the survey sites/transects.

The values of diversity indices for herpetofauna documented along the Amnay River are presented in **Table 2.1.25**. It shows that species diversity and richness are very low while evenness is moderate.

Table 2.1.25: Diversity Indices for Herpetofauna Documented in the Survey Stations

Diversity Indices	Values
No. of Species	6
Abundance	40
Species Diversity	0.9516
Species Richness	1.355
Evenness	0.5311

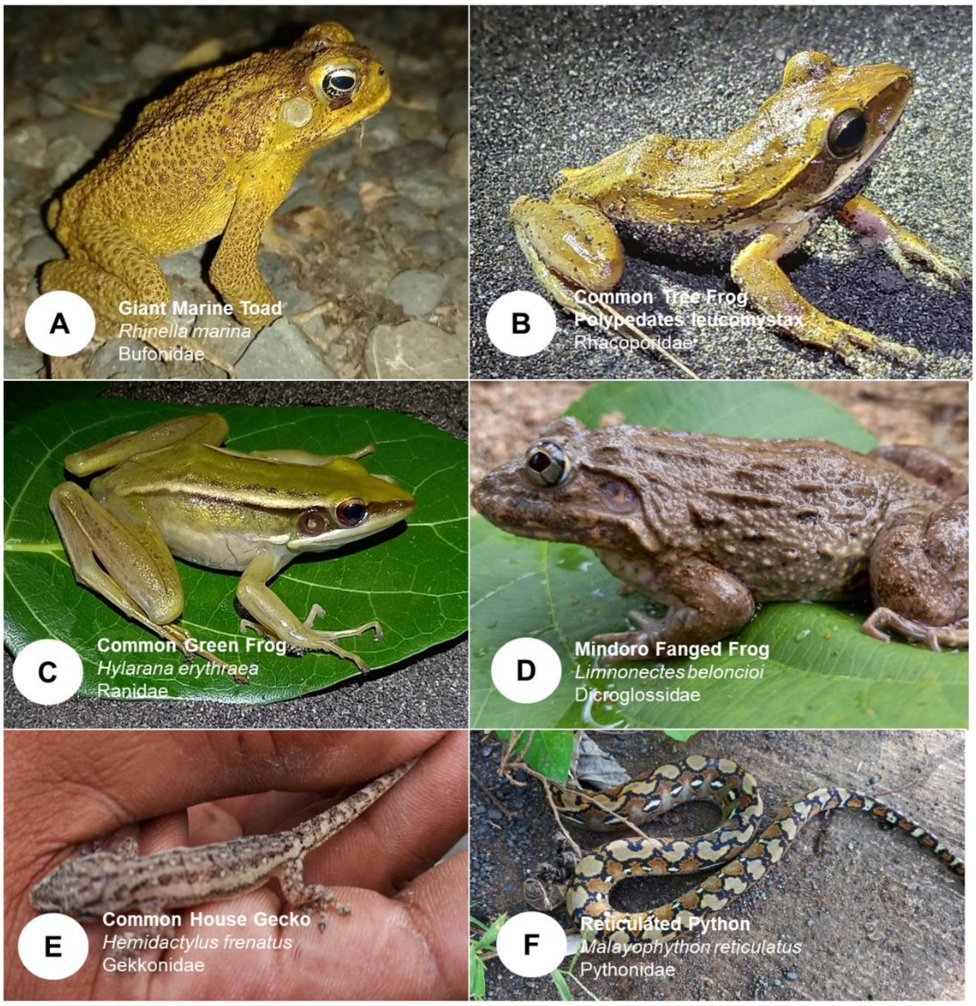


Plate 2.1.22: Photos of Herpetofauna Recorded in the Survey Stations

2.1.4.3 Vegetation Removal and Loss of Habitat, Threat to Abundance, Frequency and Distribution of Important Species, and Hindrance to Wildlife Access

The proposed ARRD Project will not cause any significant impact on the existing flora and fauna within the vicinity of the proposed project site. The restoration and desilting activities will be undertaken only within the RDZ. Moreover, Amnay River is predominantly occupied by agricultural lands. There are portions of the area that has remaining associated vegetation or alternative habitat that could serve remaining flora and fauna in the area. However, in terms of regeneration capacity, the vegetation patches that could support the regeneration is very low at all to colonize some grasslands, openings, and understock areas.

There are also no identified threats to the ecology of wetlands, except for a small mangrove vegetation that is located adjacent to Amnay River mouth, which is within Patrick River. However, the identified coastal wetland is approximately 700 to 900 meters from the river mouth of Amnay and its offshore project area. The restoration and removal of sediment from delta and offshore area of Amnay River will not affect the wetland since it is inside the confines of the river mouth of Patrick River. The "dredge material" is sucked out with the trailing arm of TSHD drawing sediment and water through a suction pipe and pumping them to the disposal site. For the disposal of the dredged sediment, the dredged material will be discharge at specified hopper barge that will contain and collect safely the sand materials. Alternatively, dredged material from the offshore area is temporarily stores or piled at the Offshore handling Area (OHA) site. More often, the sediment is mobile in a form of plumes that can somewhat affect the adjoining mangrove area, smothering the delicate ecosystem. To avoid this, CPGI will install and maintain silt curtains to filter any plumes or pollutants in the offshore area radiating from the river mouth.

In addition, unwanted riverbed soils will be indefinitely stored in approved safe stocking piles at a designated temporary yard at the project site. If any, it may also be disposed of in regions where it is required as preliminary dump piles or additional filling, or it may be donated to groups or government agencies through a MOA. Moreover, the workers accommodation will be constructed in an open area devoid of vegetation.

2.2 WATER

2.2.1 Hydrology/Hydrogeology

2.2.1.1 Drainage Morphology / Inducement of Flooding / Reduction in Stream

Amnay River is one of the largest rivers in Mindoro originating from the central highlands bisecting the island. The river is 40km long, making it the longest river in Sablayan (Sablayan website). Amnay River has a drainage area of 46,600 ha and its annual runoff is estimated at 746 MCM (DENR River Basin Control Office in Paringit et al., 2017). Others estimate the watershed area at 58,600 ha (JICA[1]), 53,880 ha (de Alban, 2010), and 74,700 ha (Paringit et al., 2017). The watershed area covers parts of the municipalities of Sablayan and Sta. Cruz in Occidental Mindoro (**Figure 2.2.1**). Amnay River drains 13 barangays of Sablayan (San Agustin, Batong Buhay, Claudio Salgado, Ibud, Ilvita, Lagnas, Malisbong, Paetan, Pag-asa, San Francisco, San Vicente, Tagumpay and Victoria) and three barangays of Sta. Cruz (Casague, Lumangbayan, and Pinagturilan).

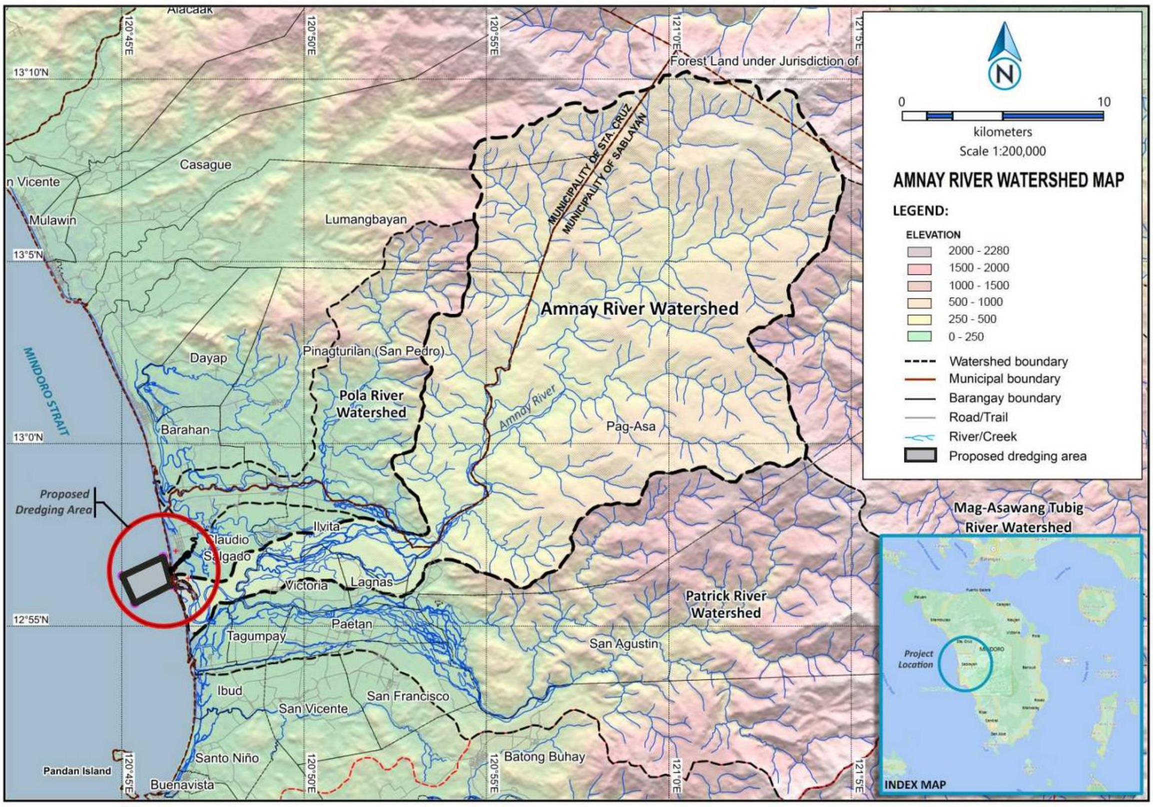


Figure 2.2.1. Watershed Map of Amnay River and Vicinity

[1] Source: https://openjicareport.jica.go.jp/pdf/11536141_02.pdf

The headwater of Amnay River is located on rugged terrain with 30% to more than 50% slope and elevations reaching more than 2,000 masl while the mid-section (**Plate 2.2.1**) is located on undulating to rolling terrain with 3-30% slope, and elevations ranging from 20-300 masl. The lower reaches of the river basin are located on flat to undulating terrain with 0-3% slope and elevations ranging from 0-20 masl (**Figure 2.2.2**).

Source: ERDB, 2017

Plate 2.2.1: Portion of Amnay Watershed and Midstream Section of Amnay River

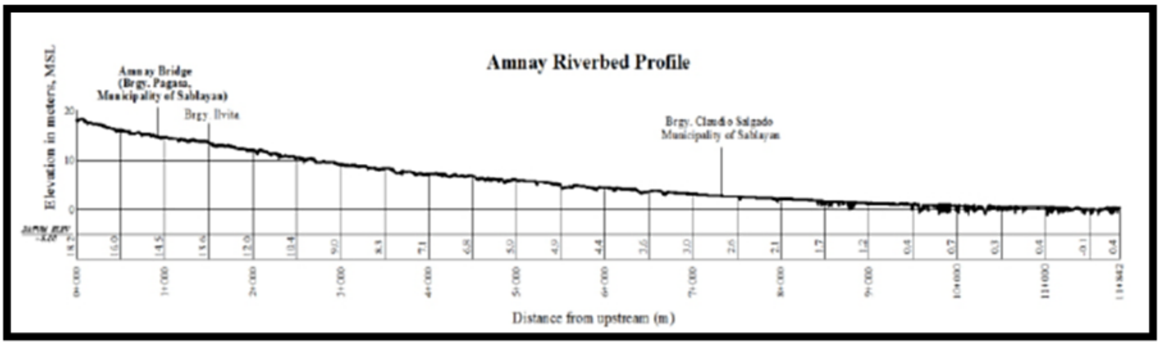


Image Source: Paringit and Abucay (2017). Phil-LiDAR 1 Flood Mapping of Amnay River

Figure 2.2.2. Riverbed Profile of Amnay River from the Estuary in Claudio Salgado to Amnay Bridge in Pag-asa

At the headwaters Amnay River is characterized by v-shaped river channels with steep slopes and generally narrow width with rapids and eddies. At lower elevations, alluvial deposits start to fill up the channels. As it emerges out of the mountainous terrain, the river spreads out and assumes a braided and meandering character in the alluvial floodplain and discharges into an estuary and eventually Mindoro Strait (**Plate 2.2.2**).

Plate 2.2.2. View of the Estuary of Amnay River in Barangay Claudio Salgado

2.2.1.1.1 Fluvial Process

As Amnay River emerges into the alluvial plains past the constriction at the Amnay Bridge, the river splits into two branches of wide active alluvial channels and the river assumes a braided and meandering character. The left branch flows southwestward and curves to the northwest in a wide arc and again curves to the southwest, tapering off to a narrow meandering alluvial channel and rejoins the main channel at the vicinity of Brgy Ilvita. The main branch with an active alluvial channel of about 800 m flows west-southwestward and slightly curves to a more westward direction as it approaches Brgy Ilvita. The width of the active alluvial channel narrows to about 200 m past Barangay Ilvita. It maintains its meander as it approaches the estuary in Barangay Claudio Salgado and empties into the Mindoro Strait. The flow channel intermittently shifts its course within the active floodplain. As it shifts, bank erosion takes place at the outer bend of a meander and point bar deposits are enlarged.

It can be gleaned in **Figure 2.2.3** that the main trunk of the river has occupied through the decade the same general position with active channel shifting in certain positions. The most notable of the shifts are the section near Barangay Ilvita and the lower sections as it approaches the estuary. It has formed and abandoned distributaries during the decade. It is also notable how Amnay and Patrick River shared distributaries in 2011 but later on, Amnay's active flow channel near the coast shifted northwards abandoning its confluence with the lower section of Patrick River.

Among the current worst consequences of the meandering is the loss of a part of the settlement of Barangay Ilvita and the erosion of agricultural land. Scouring and bank erosion tears down settlements and farmlands, leaving behind gravelly floodplains. With seasonal flooding, the active floodplain progressively widens, eroding the outer banks and at the same time enlarging the point bar deposits at the inner side of the bend.

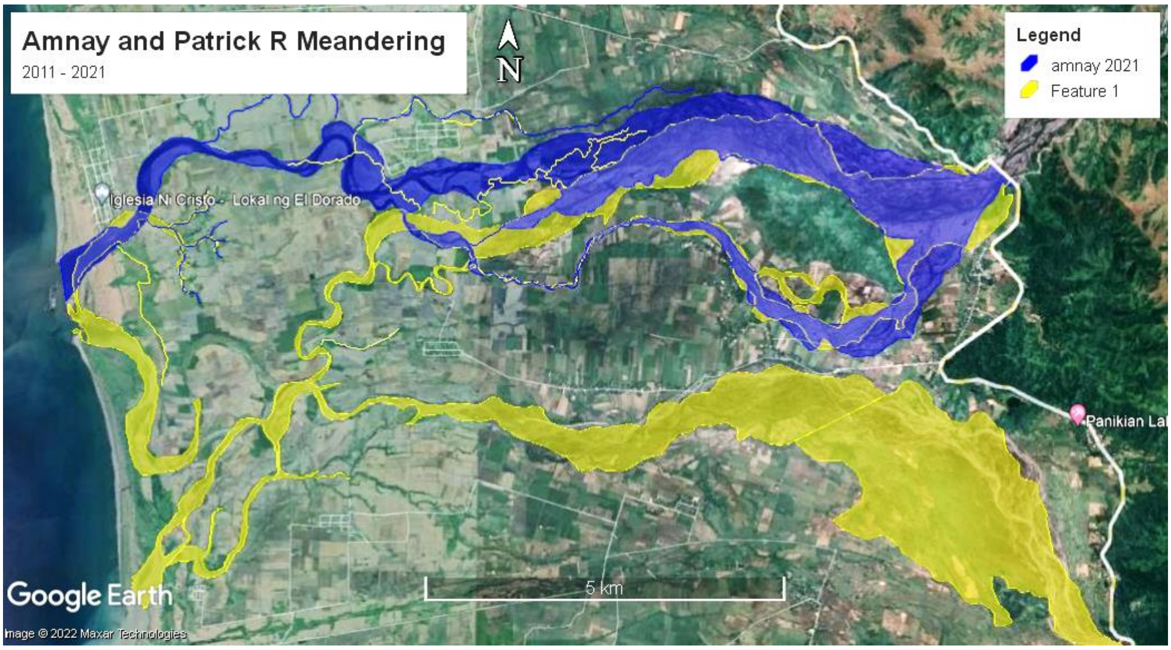


Figure 2.2.3: Google Earth Image showing the Extent of the Meandering of Amnay River between 2011 and 2021

Figure 2.2.4 shows one of the active sections of Amnay River in Barangay Ilvita. As shown in the images, prior to 2012, the active floodplain was farther south of Barangay Ilvita (bottom of the 1st imagery). In 2012 the imagery shows a dramatic shift, with the active floodplain shifting closer to Barangay Ilvita. It is presumed that the meander shift occurred in 2011 due to flooding caused by Typhoon Pedring which hit in September 2011. In 2020, the old meander is almost abandoned and have been recolonized by grass vegetation interspersed by cultivation. The new active flow channel is closer to Barangay Ilvita. In 2021, the abandoned channel is being cultivated. It can be said based on this observation that the cycle of erosion and recovery of land (to arable state) is possible but the process takes about a decade or more. **Plate 2.2.3** shows an old meander in Barangay Ilvita which is now utilized for agricultural production and a portion of the same barangay showing what appears to be old river terraces.

Plate 2.2.3: Agricultural Land in Barangay Ilvita that is Part of an Abandoned Meander of Amnay River (Left) and the Portion of the Same Barangay with what Appears to be Old River Terraces (Right)

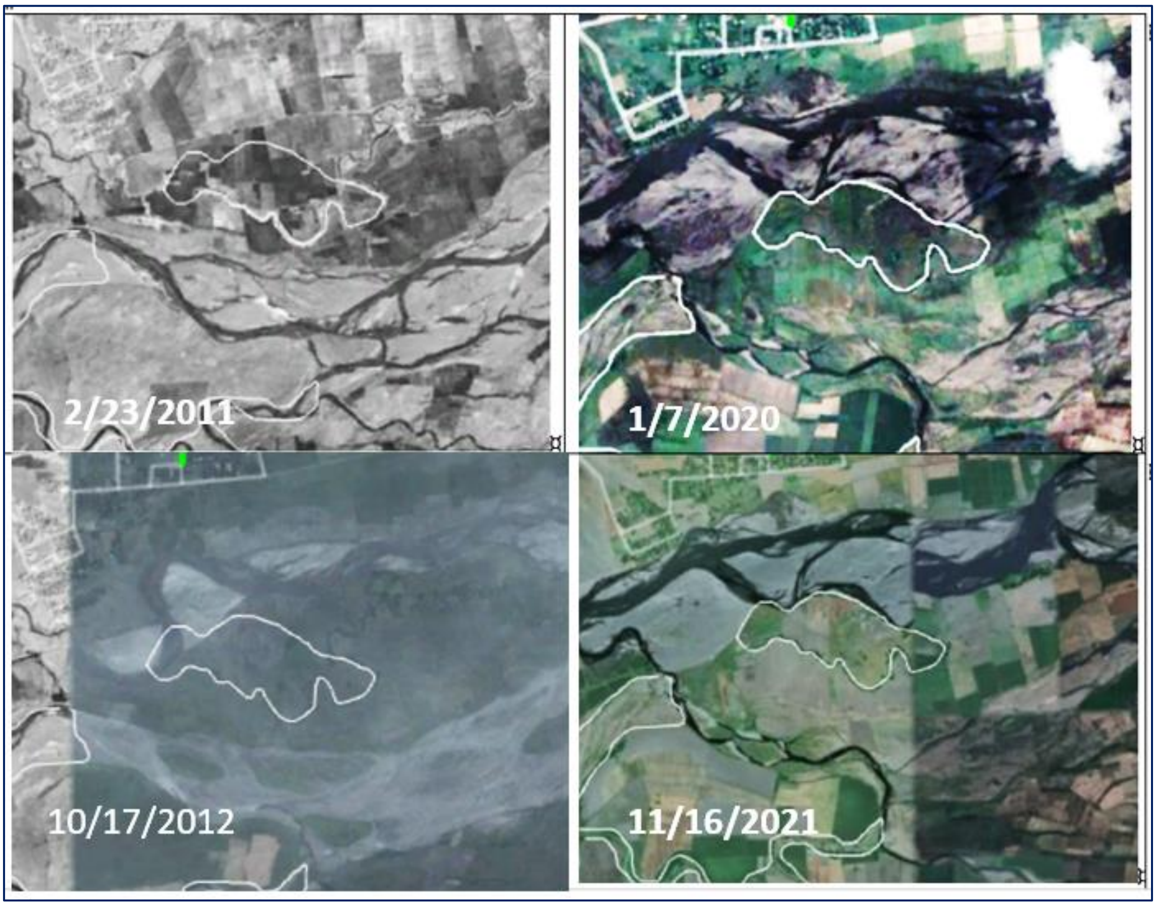


Figure 2.2.4: Active Section of Amnay River in Barangay Ilvita showing the Shifting in the Active Floodplain

2.2.1.1.1.1 Abandoned Channels and Buried Meanders

The active river meandering and flow channel migration leads to the abandonment of meander channels. The characteristic features of abandoned channels and buried meanders are oxbow lakes and arcuate outlines (ancient meanders). After abandonment, the channels are slowly filled up as sediments are deposited during repeated flooding. The presence of loamy soil, the depressed nature of the abandoned meander and the shallow groundwater table make the abandoned channel favorable for cultivation. The cultivation usually follows the outline of the abandoned channel and the presence of vegetation and cultivation makes them very recognizable from aerial and satellite imageries. Several buried meanders have been recognized in the Amnay River alluvial plain. As shown in **Figure 2.2.5**, one of the prominent buried meanders of Amnay River is its old distributary near the coast. Several other buried meanders have been interpreted. Some of the old meanders still have creeks flowing over them.

These old meanders should be considered as constrained areas since these are susceptible to reoccupation by river channels. As river water overbanks, the overflow will naturally course through depressed areas like the buried and abandoned channels. It is suspected that the shifting of river channel through Barangay Ilvita is due to the presence of abandoned channels. One such abandoned meander is the pond near Barangay Ilvita (**Plate 2.2.4**).

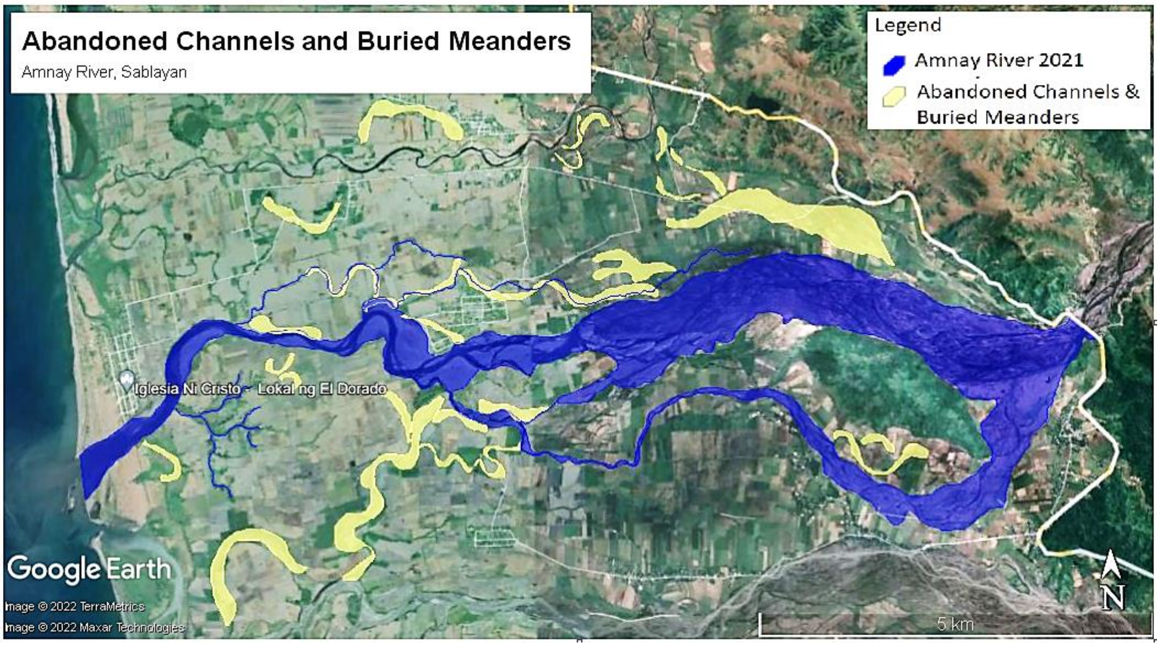


Figure 2.2.5: Old and Buried Meanders of Amnay River

Plate 2.2.4: Abandoned Meander in Barangay Ilvita

2.2.1.1.1.2 Levee Building and Avulsions

Among the active fluvial processes of Amnay River are levee building and avulsion. Both of these activities occur during flood condition. The meandering of Amnay River is associated with the occurrence of avulsion. The river changes its course as river water rises higher than the bank. During flood condition, as water elevation rises higher than the natural levees, it results to avulsion and the channel shifts. In the process, as the water breaks through the levee, it usually reoccupies old and abandoned meander channels. This occurred repeatedly in the historic past as indicated by numerous buried and abandoned meanders that are still discernible in satellite imageries.

Apart from bank erosion, levee formation and aggradation are the other active fluvial processes in the Amnay-Patrick River Floodplain. As river water rises, and flow velocity picks-up, sediments are eroded and pushed aside, creating levees on the bank. One documented incident of levee formation is the incident that occurred in Barangay Victoria, Sablayan. The población of Barangay Victoria was buried by gravelly sediment and houses were buried in about a meter of sediment. Houses, school and the church were abandoned as a consequence. **Plate 2.2.5** shows the church and a house half buried in sediments within the población of Barangay VIctoria.

Plate 2.2.5: Documented Evidence of Levee Formation in Barangay Victoria, Sablayan.

2.2.1.1.2 Flooding and Storm Surge

The Municipality of Sablayan, particularly the host Barangay Claudio Salgado is highly prone to hydrologic hazards of flooding, avulsion, bank erosion, shifting flow channels and accretion. Active channel migration, bank erosion, avulsion, accretion and other fluvial processes within the floodplain of Amnay River are discussed in the hydrology section of this report while flooding and storm surge hazards are discussed in this section.

The geohazard mapping activities of MGB MIMAROPA identified four flood prone barangays in Sablayan and these are listed in **Table 2.2.1**. The flood susceptibility map of Sablayan (**Figure 2.2.6**) shows that areas adjacent to the active river channels have high susceptibility to flooding while adjoining areas have low to moderate susceptibility to flooding. High flood susceptibility is confined to the river channel in the upstream sections of Amnay River.

Table 2.2.2 lists the estimated percentage of the municipal land areas of Sablayan and Sta. Cruz that will be affected by flooding during a 5-yr, 25-yr and 100-yr flood event. The 5-yr and 25- yr floods are expected to affect 16 barangays of Sablayan with the highest floods of 1-2m depth or sometimes 2-5m depth expected in Barangay Claudio Salgado followed by Barangays Sta. Lucia and Poblacion (Paringit et al., 2017). Five-year floods are expected to affect about 17% of the total land area of Sablayan (Paringit et al., 2017).

Meanwhile, the 5-yr, 25-yr and 100-yr floods are expected to affect four barangays of Sta. Cruz with more parts of Barangay Pinagturilan expecting deeper floods. The other barangays will expect flood depths of less than 0.2m depth but some portions of the affected barangays can experience flood depths ranging from 1-2m or 2-5m. Five-year floods are expected to affect about 21.5% of the municipal land area.

It should be noted that most parts of both municipalities will have flood depths of less than 0.2m during a 5-yr flood while areas that will experience >1m flood depths will consist only 3.4% of Sablayan's total land area and 2.2% of the total land area of Sta. Cruz.

The same barangays in Sablayan are expected to be affected by a 25-year flood event with Barangays Claudio Salgado, Santa Lucia, and Poblacion experiencing the worst floods and more areas will be subjected to 1-2m or 2-5m flood depths (**Tables 2.2.1** and **2.2.2**). About 17% of the municipal land area of Sablayan will be affected by 25-year floods while areas affected by >1m flood depths will constitute 4.5% of the municipal land area, which is higher than the 3.4% expected for five-year floods. In Sta. Cruz, more parts of Barangay Pinagturilan will have deeper floods and the municipal land area affected by >1m floods will almost double from 2.2% to 3.97%.

The percentage of the Sablayan municipal land area affected by >1m flood depths for 100-yr floods will increase to 5.38%. Similarly, the land area affected by >1m flood depths during a 100-yr flood will increase to 5.63% in Sta. Cruz.

Table 2.2.1. List of Flood Prone Barangays in Sablayan, Occidental Mindoro

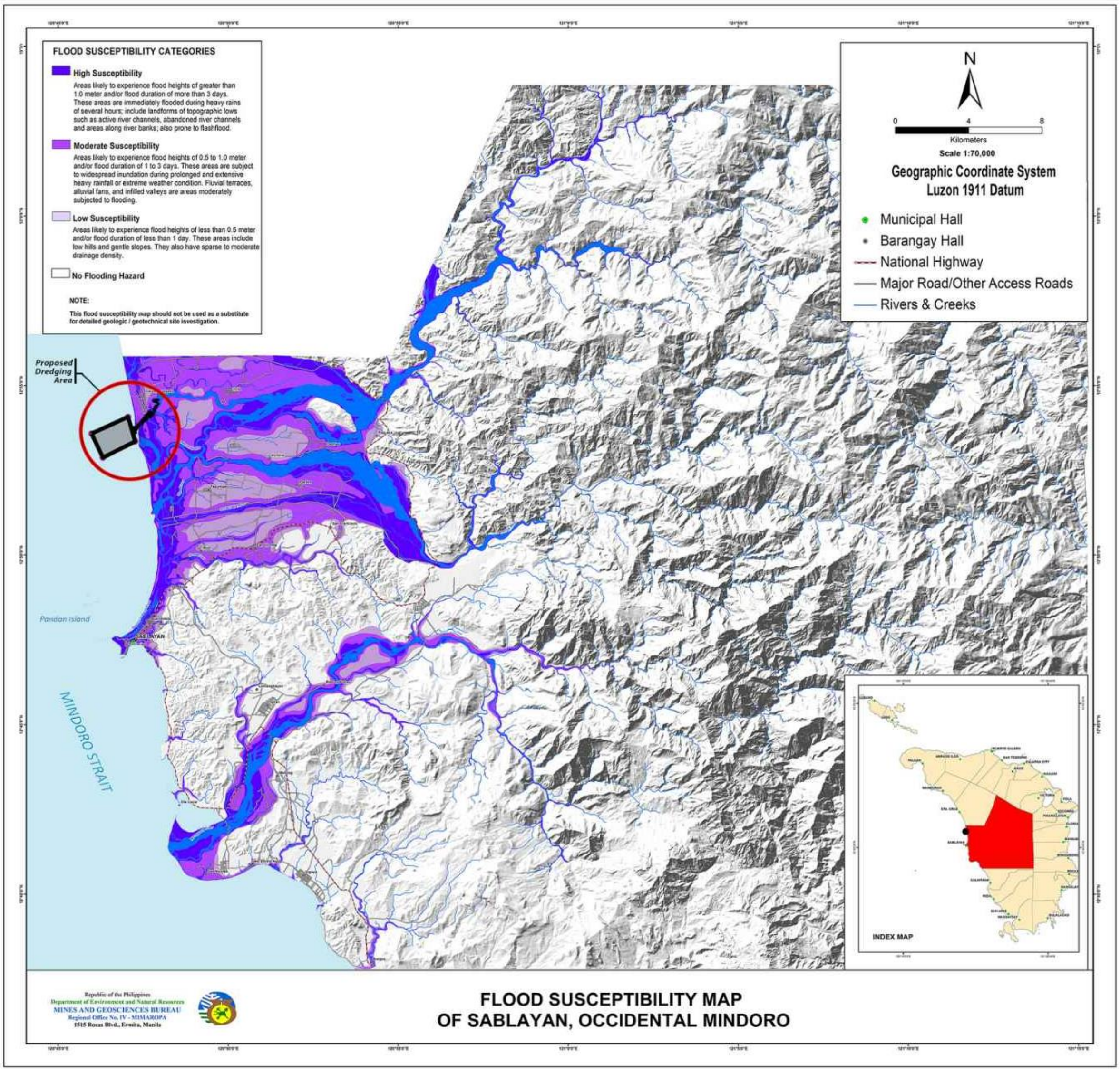
Barangay	Sitio	Flood Susceptibility	Remarks
Victoria	Old barangay proper and surrounding sitios	High	Flood prone areas are located after the confluence of Amnay and Patrick Rivers. Flashfloods and sheet flooding occur during heavy rains
Pag-asa	Zones 1, 2, 5 and 6 Cabangalan	High	The flood prone areas are located near active channels of Amnay River which swells during heavy rains. Floodwaters also inundate old stream channels of Amnay River and causes flooding in low-lying sitios.
Claudio Salgado	Barangay Proper, Pandan, Cabunulan, Butas Piliw	High	Most of the frequently flooded areas are located along the coast and near the mouths of Amnay and Patrick Rivers
Ilvita	Zones 1-5	High	These areas along the riverbank are flooded due to overflow from the heavily silted Amnay River

Source: MGB MIMAROPA

Table 2.2.2. Percentage of Municipal Land Areas that will be Affected by 5-, 25- and 100-yr Floods

Flood depth (m)	Sablayan (% of total land area)			Sta. Cruz (% of total land area)		
	5-yr flood	25-yr flood	100-yr flood	5-yr flood	25-yr flood	100-yr flood
<0.2	10.10	9.1	8.40	14.50	13.20	12.50
0.21-0.5	1.78	1.66	1.58	2.22	1.62	1.37
0.51-1	1.79	1.77	1.69	2.57	2.70	2.04
1.01-2	2.25	2.53	2.56	1.64	2.97	3.94
2.01-5	1.06	1.75	2.47	0.55	0.92	1.58
>5	0.07	0.22	0.35	0.02	0.08	0.11
Total	**17.05**	**17.03**	**17.05**	**21.5**	**21.49**	**21.54**
% land area affected by >1m floods	3.38	4.50	5.38	2.21	3.97	5.63

Source: Paringit et al., 2017



Source: MGB

Figure 2.2.6. Flood Susceptibility Map of Sablayan

Plate 2.2.6 shows the downstream sections of Amnay watershed that are frequently affected by flooding, bank erosion, levee building and avulsion.

Plate 2.2.6: Photographs of Flood-Prone Areas in the Downstream Sections of the Amnay Watershed

Previous floods in Sablayan related to overtopping of Amnay and Patrick Rivers include[2]: 1) the 1955 flood that affected Barangay Ibud; 2) the 1970 flood that affected Barangays Pag-asa and Lagnas; 3) the 1989 and 1995 floods that affected Barangay Pag-asa; 4) flooding due to Typhoons Ferdie and Gener that affected Barangays Claudio Salgado, Ilvita, Lagnas, Paetan and Tagumpay; 5) flooding due to Typhoons Maring, Odette and Habagat in 2013 that affected Barangays Burgos, Claudio Salgado, Gen. Emilio Aguinaldo, Ilvita, Lagnas, Paetan, Pag-asa, Tagumpay, San Agustin and Victoria; 6) flooding due to Typhoons Glenda, Henry and Habagat in 2014 that affected Barangays Batong Buhay, Burgos, Claudio Salgado, Ilvita, Malisbong, Lagnas, Pag-asa, San Vicente, Tagumpay, Tuban, Victoria, and Santa Lucia; and 7) flooding due to Typhoon Josie in 2018 that affected Barangays Claudio Salgado, Lagnas, Ilvita, Pag-asa and Victoria. These flood events caused inundation and massive damage to crops, structures and properties and caused riverbank erosion including large parcels of agricultural land.

Planned and/or existing flood control structures along Amnay River are located in Barangays Ilvita, Claudio Salgado, Guitong and Pag-asa[3,4]. These structures consist mainly of river training structures such as revetments, sheet piling and gabions (**Plate 2.2.7**). However, these structures are not always effective since flow channel can be diverted to the backside of the structure.

[2] Source: https://sablayan1041.wixsite.com/sablayan/physical-natural-characteristics
[3] https://www.dbm.gov.ph/wp-content/uploads/NEP2022/Details-of-DPWH.pdf
[4] https://www.dpwh.gov.ph/dpwh/sites/default/files/webform/civil_works/advertisement/Bidding%20Documents%20for%2021EB0057%20-%20Const%20of%20FCS%20-%20Amnay%20River-Ilvita%20Section.pdf

Plate 2.2.7: Existing Bank Protections and those Under Construction for Amnay and Patrick Rivers Consisting of Sheet Piles, Embankment and Gabion Walls

As technically defined in PHILVOCs technical bulletin, a storm surge, storm flood or storm tide is a coastal flood or tsunami-like spectacle of rising water commonly connected with low pressure weather systems (such as tropical cyclones and strong extratropical cyclones), the strictness of which is affected by the superficiality and direction of the water body relative to storm path, as well as the timing of tides.

The municipality of Sablayan is extremely susceptible to storm surge. Storm surges which are generated by storms could affect the Coastal Plain but will have no effect on the submerged Project site.

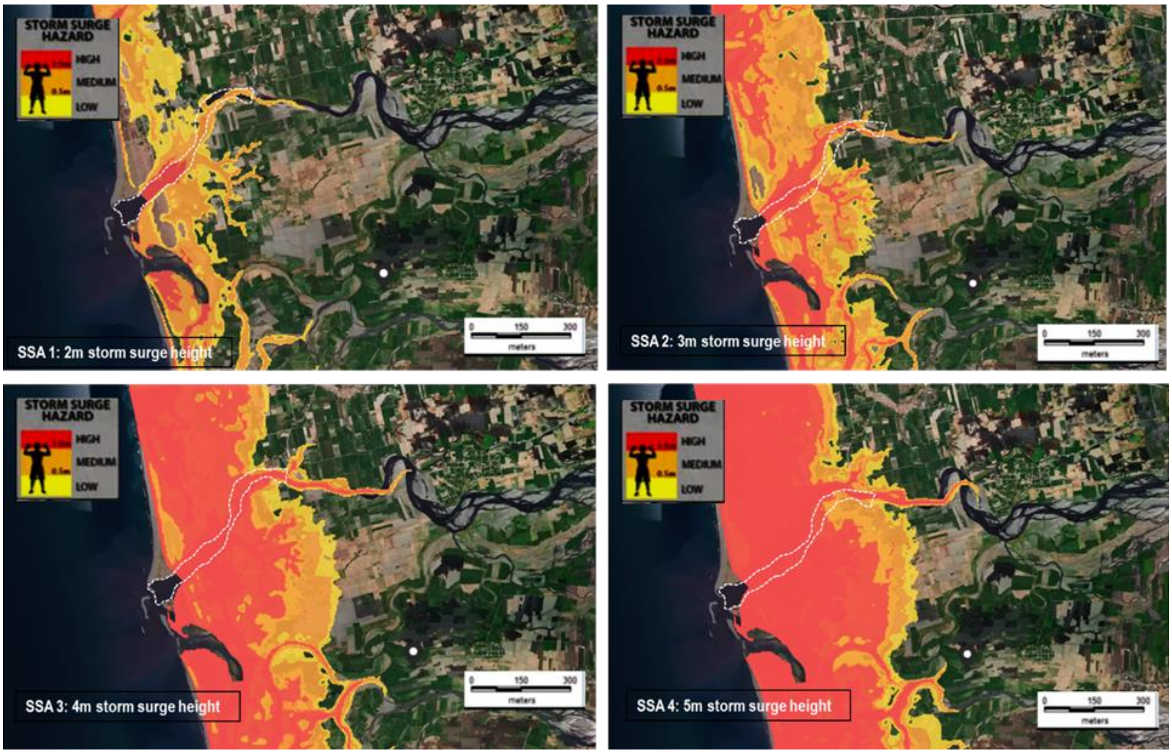
The University of the Philippines Nationwide Operational Assessment of Hazards otherwise known as Project NOAH uses the JMA Storm Surge Model developed by the Japan Meteorological Agency to simulate and predict storm surges. Based on the predicted storm surge, Storm Surge Advisories (SSA) are issued in advance of an approaching storm. SSA are categorized in **Table 2.2.3**.

Table 2.2.3: Storm Surge Height

Storm Surge Advisory (SSA)	Storm Surge Height (m)*
SSA 1	2
SSA 2	3
SSA 3	4
SSA 4	5

* SSA height is referenced from mean sea level.

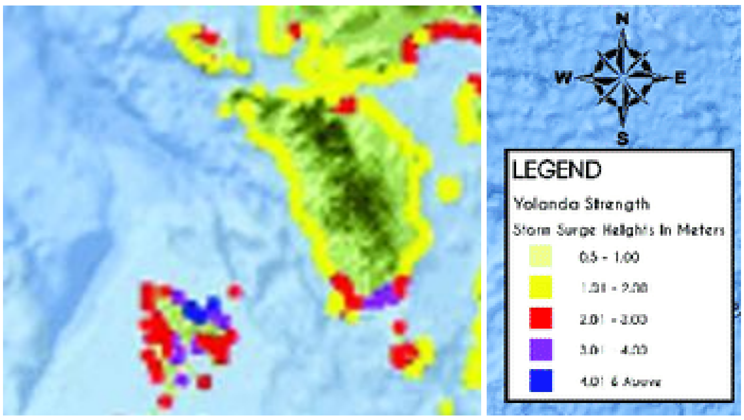
Figure 2.2.7 are the predicted storm surge hazard maps of the project area based on SSA warnings. The maps indicate that the project area facing the coast is vulnerable from low to high flooding for predicted storm surge heights at 4 m (SSA 3) and at 5 m (SSA 4). Predicted flood depth is from less than 0.5 m to 1.5 m.



Source: University of the Philippines – Project NOAH (http://noah.up.edu.ph/)

Figure 2.2.7: Predicted Storm Surge Hazard Maps of the Project Area Based on SSA Warnings

On the other hand, the coastal barangays of Sablayan are highly prone to storm surge with expected heights of 1-2m (**Figure 2.2.8**). A storm surge reportedly affected Barangays Buenavista, Claudio Salgado, Poblacion, San Nicolas and Santa Lucia in the early 1970s when the coastal waters reached 50m inland and floods reached >1m. Schools and coastal settlements were also buried in sand. Another storm surge event was reported in the late 1980s during Typhoons Unsang and Rosing which affected Barangays Buenavista, Ligaya and San Nicolas and flooded schools, churches and settlements. The latest storm surge was reported in the late 2000s and this damaged coastal settlements.



Source: Lapidez et al., 2015

Figure 2.2.8. Projected Storm Surge Heights during a Yolanda Strength Typhoon

2.2.1.2 Hydrogeology

The water resources of the Amnay Watershed consist of surface and groundwater. The surface water includes Amnay River, its tributaries, and ponds on abandoned river meanders. The groundwater resources in Sablayan[5] include springs and underground aquifers. The springs are generally located in rolling slopes and have good discharge; thus, they are developed as water source of some rural communities.

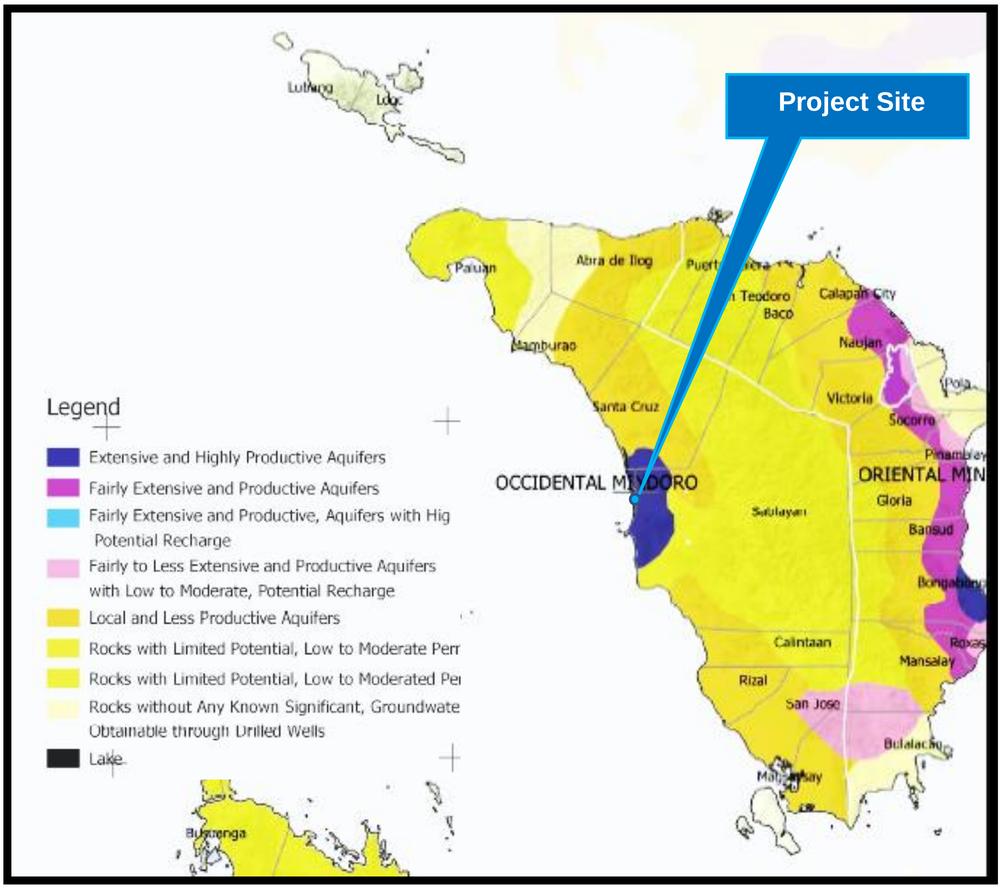
It is estimated that the watershed receives about 1,383 million cubic meters (mcm) of precipitation per year, as computed based on the average of the 30-year monthly rainfall data. It is estimated that 746 mcm of this total makes up the annual run-off of Amnay River. The difference goes into sub-surface flow, evaporation and recharge of groundwater. It is assumed that groundwater recharge within the watershed takes up about 1% to 5% or about 14 mcm per year and evaporation takes up about 600 mcm of the annual precipitation.

The groundwater resources map of Occidental Mindoro (**Figure 2.2.9**) indicates that extensive and highly productive aquifers occur in alluvial and coastal areas of Sablayan within the Amnay River floodplain while rocks with limited potential and low to moderate permeability are found in the upland areas of the municipality. The highly productive aquifers have estimated yields of 50-100 lps while the rocks with limited potential have yields of less than 1 lps (NEDA, undated). The alluvial groundwater occurs in unconfined condition. The recharge of this alluvial groundwater presumably comes from direct recharge from rainfall and from Amnay River. The alluvial groundwater is the main source of water supply for the communities within the alluvial plain where the shallow groundwater is commonly extracted through the use of pitcher pumps (**Plate 2.2.8**). For irrigation, river water is used. The irrigation systems developed by NIA serve a significant area of paddy rice fields within the alluvial plains of Amnay River

Water supply of the Sablayan Water District mainly comes from deep wells and supplies 11 of 22 barangays, namely Buenavista, Sto. Niño, Poblacion, Ligaya, San Vicente, Tuban, Ibud, Tagumpay, San Francisco, Gen. E. Aguinaldo and Sta. Lucia.

Plate 2.2.8: Pitcher Pump Commonly used by Households in the Alluvial Plain and the NIA Irrigation System

[5]https://sablayanwaterdistrict.gov.ph/pdf/new/SablayanWDActionPlantoMetigate-the-Effects-ofEl-Ni%C3%B1o.pdf



Source: National Economic Development Authority (NEDA)

Figure 2.2.9. Groundwater Resources Map of Occidental Mindoro

The 2020 population of the barangays within the watershed of Amnay River is 49,974 and given an assumed daily per capita water requirement of 140 liters, the annual water demand for domestic use is 2.5 mcm. This is well within the recharge rate of the watershed. As for paddy rice cultivation, it is estimated from Google Earth that rice paddies make up about 4,500 ha. With water demand of 400 to 750 mm of water per growing season and assuming two (2) growing seasons, annual water demand for irrigation ranges from 18 mcm to 35 mcm per year. This is well within the annual runoff volume of Amnay River.

Table 2.2.4 summarizes the water supply and demand for both groundwater and surface water sources within the Amnay watershed. It can be seen from the matrix that the annual runoff and groundwater recharge are more than sufficient to meet the irrigation and domestic requirements of the watershed residents, respectively.

Table 2.2.4: Water Demand Within the Watershed of Amnay River

Water Supply	Volume (mcm)	Water Demand	Volume (mcm)
Annual precipitation	1,383		
Annual runoff	746	Irrigation	18-35
Groundwater recharge	14	Domestic requirement	2.5
Evaporation	600		

2.2.1.3 Change in Drainage Morphology / Inducement of Flooding/Reduction in Stream / Volumetric Flow

Potential impacts of gravel extraction and removal of sediments from rivers through dredging are well documented and include the following (DID, 2009):

- Over-extraction of gravel can destabilize the channels and banks;
- Changes in channel morphology are expected due to the disturbance from dredging operations; and
- There will be direct destruction of the riverbed and riverbanks from heavy equipment operation.

Dredging in certain sections of the river can be effective in controlling flood but will not have significant impact in tidally-dominated sections such as the river mouth where dredging is not expected to lower peak flood levels. Flood level reduction is influenced by the shape of the river cross section and height of the riverbanks. Some studies indicate that dredging upstream can lead to deeper floods downstream since widening or deepening the channel cross section will decrease the arrival time of peak floods downstream (Saad and Habib, 2021). Dredging will also increase storm surge impacts further inland from the estuary (Saad and Habib, 2021).

Key impacts on the coastal processes will be significant. The removal of the sand spit will expose the mouth of Amnay River to high waves. This will cause erosion and retreat of the bank. It is uncertain how far inland the wave can penetrate. The area vulnerable to this impact is the part of Barangay Claudio Salgado nearest the estuary.

It is anticipated that the accretion of the beaches of Claudio Salgado will slow down or at worse retreat due to extraction of the sand. The most susceptible section of the beach is at the mouth of Amnay River in Sitio Balokbok.

Proper planning of the dredging shall be done. Proper width and depth shall be observed to protect the banks from erosion. Buffer zones along the river have to be determined and set as operational guideline. Installation of bank protection structures shall be done where necessary. Monitoring of bank erosion and shoreline retreat shall be conducted for the duration of the dredging work.

2.2.1.4 Change in Stream and River Water Depth

The change in river depth especially at the estuary may allow the intrusion of the salt wedge farther up river which may cause salinization of the shallow groundwater near the river bank.

Stream depth is expected to increase in river sections where dredging will be conducted. This will allow the river to contain more floodwater within its channel and reduce the duration of flooding in frequently flooded areas within the floodplain (Saad and Habib, 2021).

2.2.1.5 Depletion of Water Resources / Competition in Water Use

The National Irrigation Administration (NIA) has an irrigation facility named the Amnay RIS but the information provided identifies the water source as Patrick River[6]. This irrigation facility started operating in January 1986 and has a service area of 1,378 ha benefiting more than 900 farmers. Other sources state that Amnay River provides irrigation to the rice producing barangays in Sablayan, namely Claudio Salgado, Lagnas, Ilvita, Pag-asa and Victoria[7]. The dredging of Amnay River is not expected to affect the irrigation facilities along the river.

The dredging operation is not expected to compete or cause depletion of water resources. However, it is expected to affect the river hydrology as it progresses upstream. It is uncertain at this point how the hydrology will be affected since detailed dredging plan has yet to be completed.

[6] http://region4b.nia.gov.ph/sites/r4b/files/Profile%20of%20NIS%20AMNAY%20RIS.pdf
[7] http://nanovio.blogspot.com/2018/08/occidental-mindoro-water-world-almost.html

2.2.2 Oceanography

Oceanography study was carried out by simulating the tide-driven water circulation of the area. A 2-dimensional hydrodynamic model for waters off the coast of Brgy. Claudio Salgado in Sablayan, Occidental Mindoro was developed using Delft3D modelling suite from Deltares which can simulate time-independent tide-driven flow. The model domain is shown in **Figure 2.2.10** together with the curvilinear computational grid with approximate horizontal resolution of 50-100m for each grid cell. Tidal forcing was used in the model at the open boundary conditions generated from TPXO 8.0 Global Inverse Tide Model using Delft Dashboard. The bathymetry of the area was obtained from GEBCO 2019 and 2020, and the coastline used was digitized from Google earth.

Preliminary model runs were made to calibrate the tidal model. The tidal model ran from August 31 to October 2, 2022. This scenario was also used for the simulation of all no-wind conditions.

The other model scenarios ran for two months for the monsoon winds to be represented in the models and to allow the models to have a spin-up time to reduce errors. Meteorological data available from the Ninoy Aquino International Airport (NAIA) weather station in Pasay City was utilized in the models as the nearest weather stations in Mindoro do not have historical weather data. Wind data from the NAIA weather station was gathered from the website wunderground.com.

Actual 3-hourly wind speed and direction data for the months of January 2022 – February 2022 were extracted and added to the models to simulate the northeast monsoon circulation. Similarly, 3-hourly wind data were also extracted for the months of June 2022 - July 2022 as representatives for the southwest monsoon simulation.

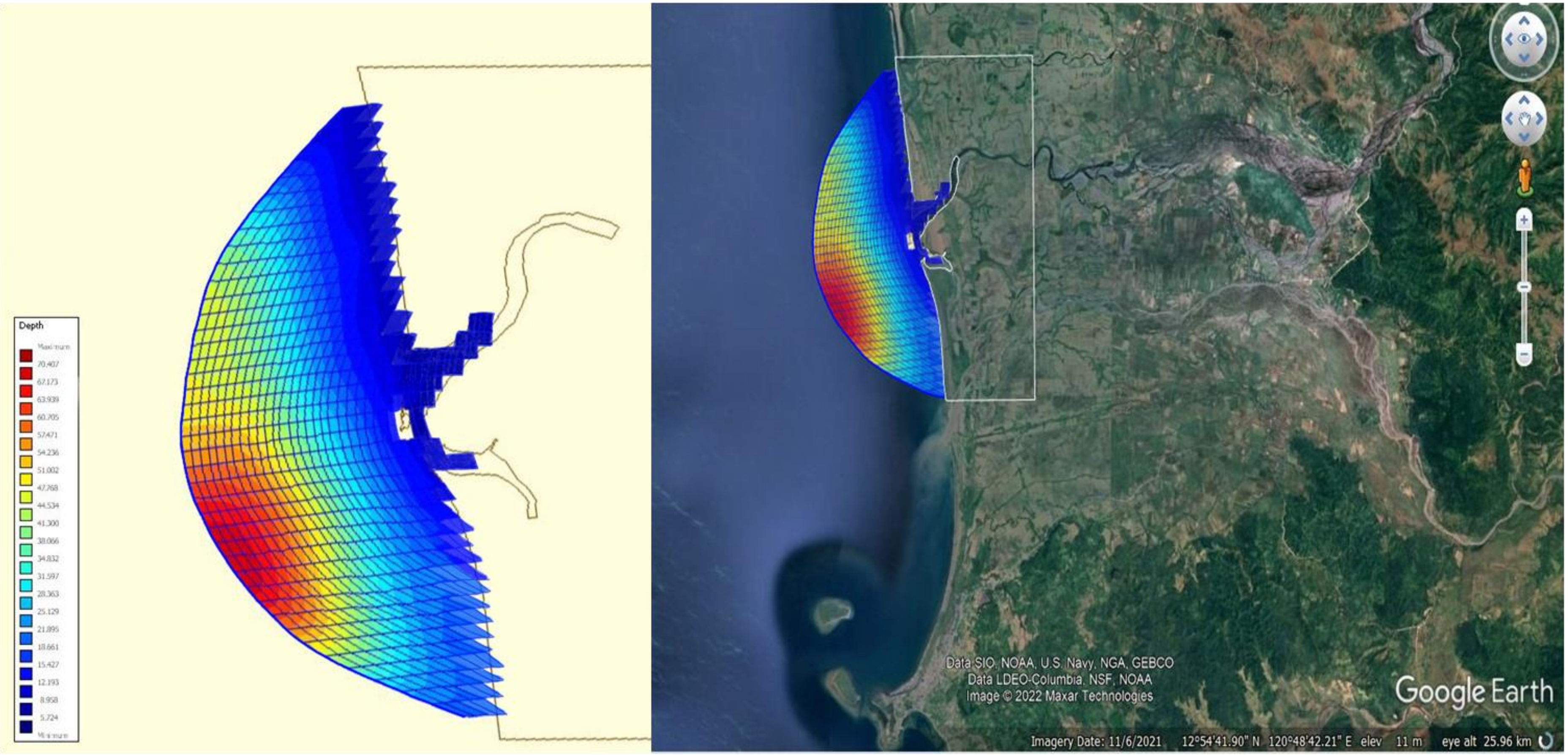


Figure 2.2.10: Grid, Bathymetry, and Model Domain

A tide-induced model was also implemented to observe the sediment plume in the Amnay river delta in Brgy. Claudio Salgado. In the computational domain, this river is the only source of sediments. Since no river discharge rate data was provided, the discharge rate obtained from PHIL-LiDAR 1 report on Amnay River basin was utilized in the simulations. The discharge rate used in the simulations was the actual flow discharge (peak discharge at 264.50 m^3/s) during a rainfall event, measured from the Amnay Bridge/Pagasa Bridge. This actual flow discharge value was used constantly throughout the timeframe of the models carrying a hypothetical, conservative value of 5 kg/m^3 concentration of sediments. The time series of river discharge and sediment concentration was used in the upstream boundary in the model domain (**Figure 2.2.11**).

In the simulations, the sediments were treated as non-cohesive sediments. Bulk density values for non-cohesive sediments were used in the models.

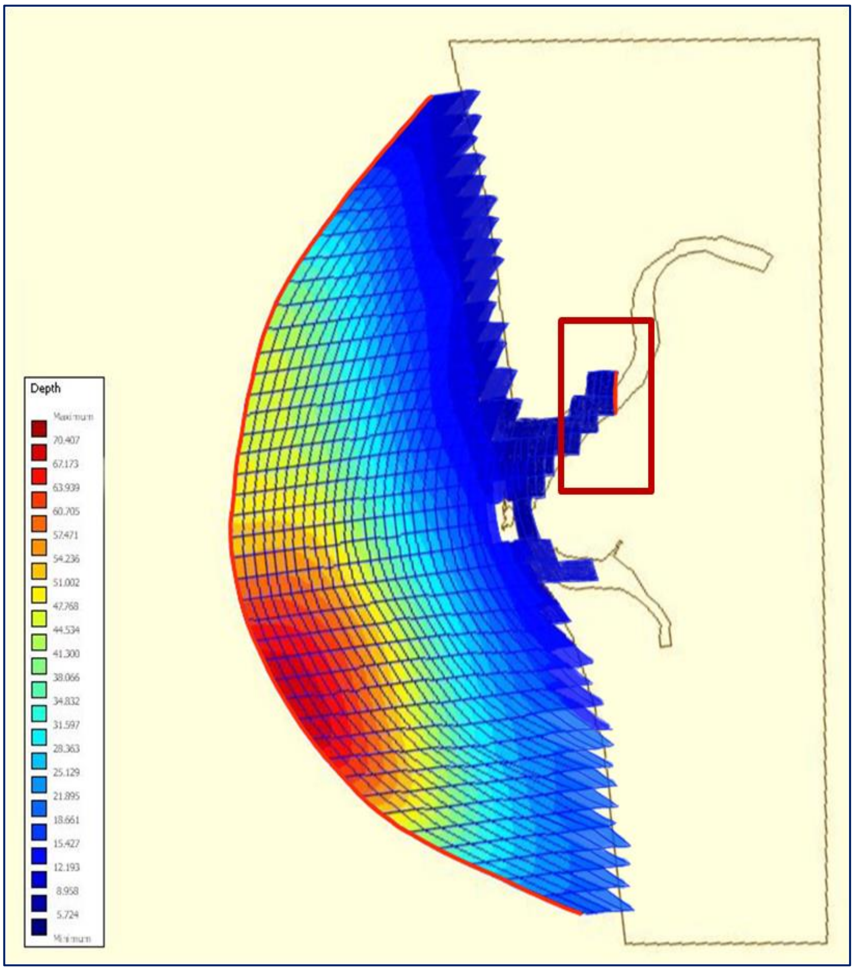


Figure 2.2.11: Grid, Bathymetry, and Model Domain showing the Upstream Boundary as Discharge Point in the Simulations

Nine (9) model scenarios were simulated to account for each prevailing monsoon season and during monsoon transition (no wind), as well as river discharge and sediment input (**Table 2.2.5**). **Table 2.2.6** presents the list of some of the model input parameters and the values used in the simulations.

Table 2.2.5: Model Scenarios

Scenario	No Wind	NE Monsoon	SW Monsoon	No Wind; with River Discharge	NE Wind; with River Discharge	SW Wind; with River Discharge	No Wind; with River Discharge; with Sediment	NE Wind; With River Discharge; with Sediment	SW Wind; With River Discharge; with Sediment
1	x								
2		X							
3			x						
4				x					
5					x				
6						x			
7							x		
8								x	
9									x

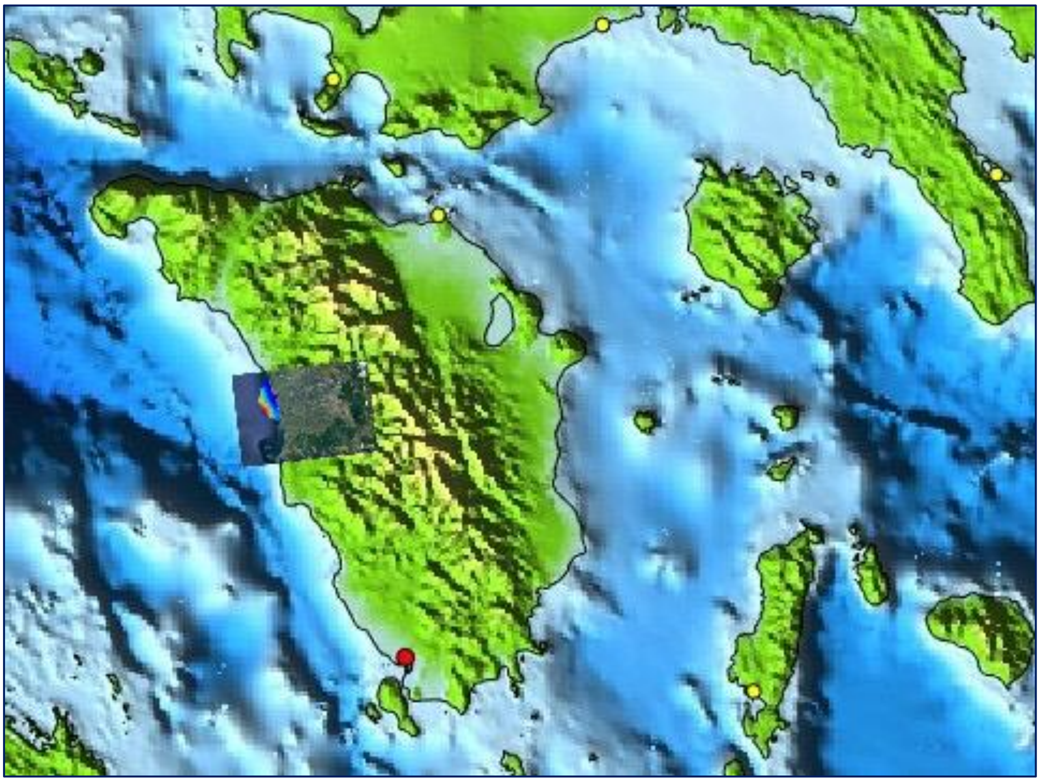
Table 2.2.6: Input Parameters Used in the Simulation

Parameters Used	Values
River discharge rate (obtained from PHIL-LiDAR 1 report)	264.50 m^3/s (peak discharge during a rainfall event)
Sediment load (at discharge location)	5 kg/m^3
Model duration	2 months for both northeast monsoon and southwest monsoon; 30 days for no-wind condition
Model time step	60 seconds
Non-cohesive sediment bulk density	1,550 kg/m^3
Manning coefficient (constant bed roughness for the whole domain)	0.2

2.2.2.1 Tide

The tide prediction table from NAMRIA offers the predicted high and low water level height reached by the rising and falling tides, respectively. The tide prediction tables give the times and heights of high and low water.

A good indication of a model performance is when the model results coincide with the predicted tides. Validation of the model was done by comparing model sea level with water level at the nearest tide station (shown in red dot, (**Figure 2.2.12**). **Figure 2.2.13** shows the water level provided by the model (red) plotted against the water level from the nearest tide station (blue) located in Mangarin, San Jose, Occidental Mindoro. While there is a very slight difference in water level height, the peaks and troughs of water level from both the model and the nearest tide station coincide at the same time (e.g., same high tide and same low tide).



Note: Yellow dots show other tide stations.

Figure 2.2.12: Location of the Nearest Tide Station (red dot) with Reference to the Model Domain

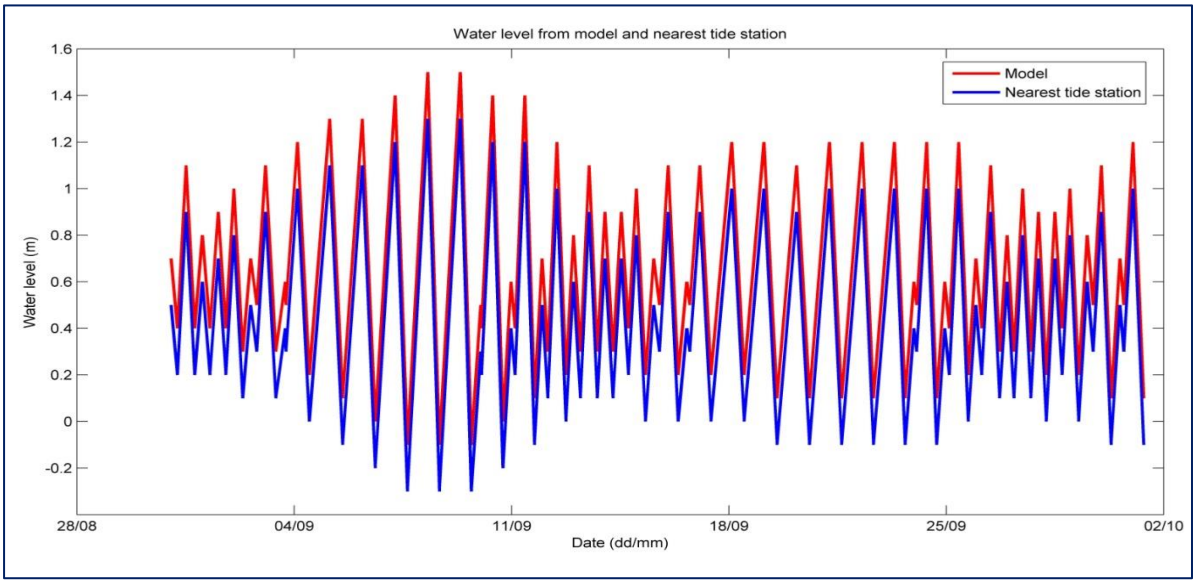


Figure 2.2.13: Water Level from Model (red) versus Water Level from the Nearest Tide Station in Mangarin, San Jose, Occidental Mindoro (blue)

The water level for the waters along the coast of Brgy. Claudio Salgado ranges from -0.3m to -1.4m. During the highest high tide (spring tide), water level can reach up to 1.4m, and -0.3m during the lowest low tide (neap tide).

2.2.2.2 Bathymetry

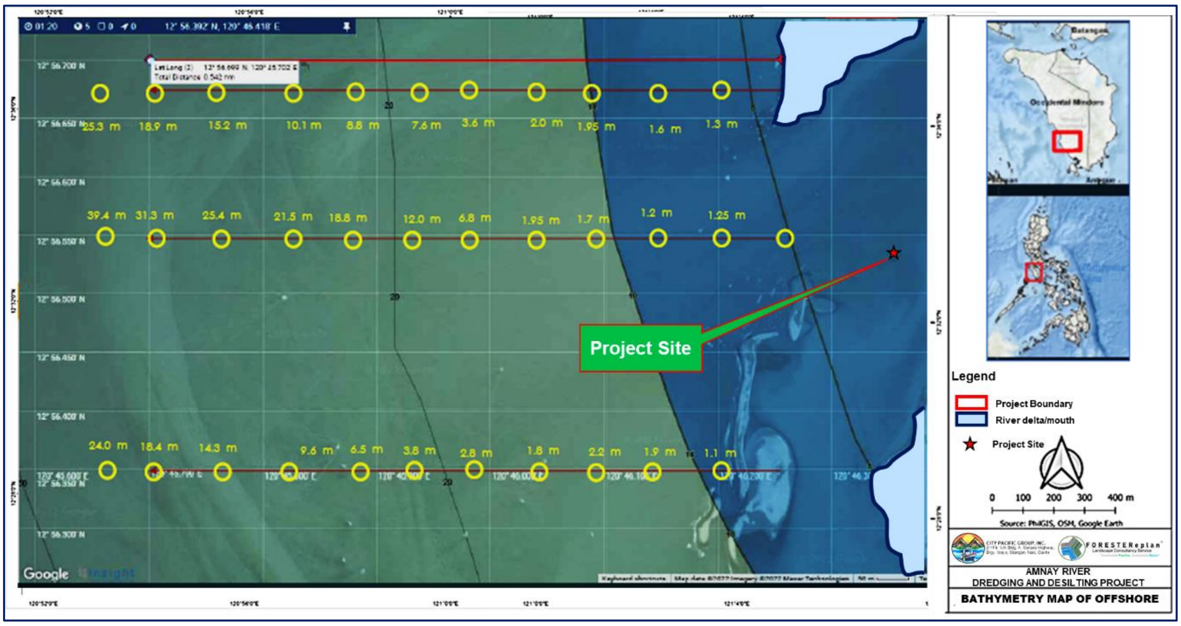
The high sedimentation rate of Amnay River is very evident at the estuary through the formation of a sandbar at the mouth of the river and the progradation of the shoreline of Barangay Claudio Salgado (**Figure 2.2.14**). From 2006 to 2021, the 2 km shoreline of Claudio Salgado has prograded by as much as 200 meters near the mouth of Amnay and tapering off several meters to the north. This progradation has added about 35 hectares of beach. To the south between the mouth of Amnay and Patrick Rivers, the 3.5 km beach has prograded by 85m to 185 m, adding a beach area of as much as 45 ha. In addition to the prograding shoreline is the formation of two sand bars formed at the mouth of Amnay River. Over the 15-year period, the average rate of beach advance is 10 meters annually. The following map shows the accreted beaches, clearly indicating a coastal process dominated by deposition.

Figure 2.2.14: Map showing the Shoreline of Barangay Claudio Salgado Near the Amnay River Mouth

The following photographs in **Plate 2.2.9** shows parts of the accreted beach of Brgy Claudio Salgado. The right photograph shows part of the community that has occupied the recently accreted beach.

Plate 2.2.9: Photos of Parts of the Accreted Beach of Brgy Claudio Salgado

Figure 2.2.15 shows the bathymetry of the area before the start of simulations (left) and after simulation of model scenario number 9 (southwest monsoon, with river discharge, and sediment concentration plugged in). The bathymetry will remain essentially unchanged because the project site is located at shallower depths. **Figure 2.2.16** shows the bathymetric map of Amnay River based on the actual echo-sounding mapping done in the offshore section and the bathymetry of the area before the start of simulations (left) and after simulation of model scenario number 9 (southwest monsoon, with river discharge, and sediment concentration plugged in). The bathymetry will remain essentially unchanged because the project site is located at shallower depths. For comparison, the water depth comparison was also illustrated in **Figure 2.2.17**.



Source: Basemap Google earth (2022)

Figure 2.2.15: Bathymetry Map of the Coastal Section at the Delta of Amnay River

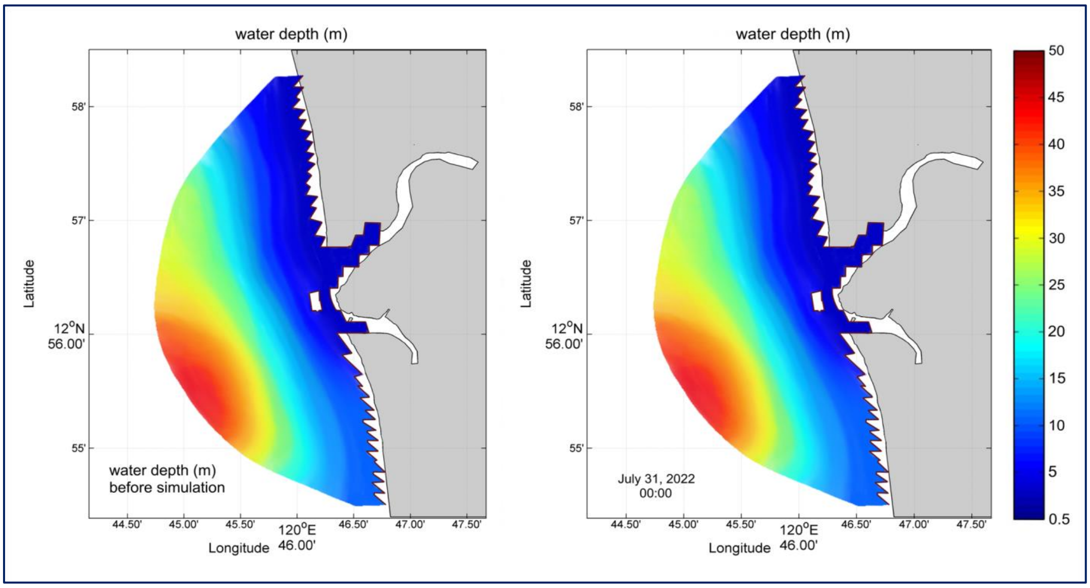


Figure 2.2.16: Bathymetry Off the Coast of Brgy. Claudio Salgado Before the Start of Simulations (left) and After Simulation of Model Scenario Number 9 (Southwest Monsoon, with River Discharge, and Sediment Concentration Plugged In)

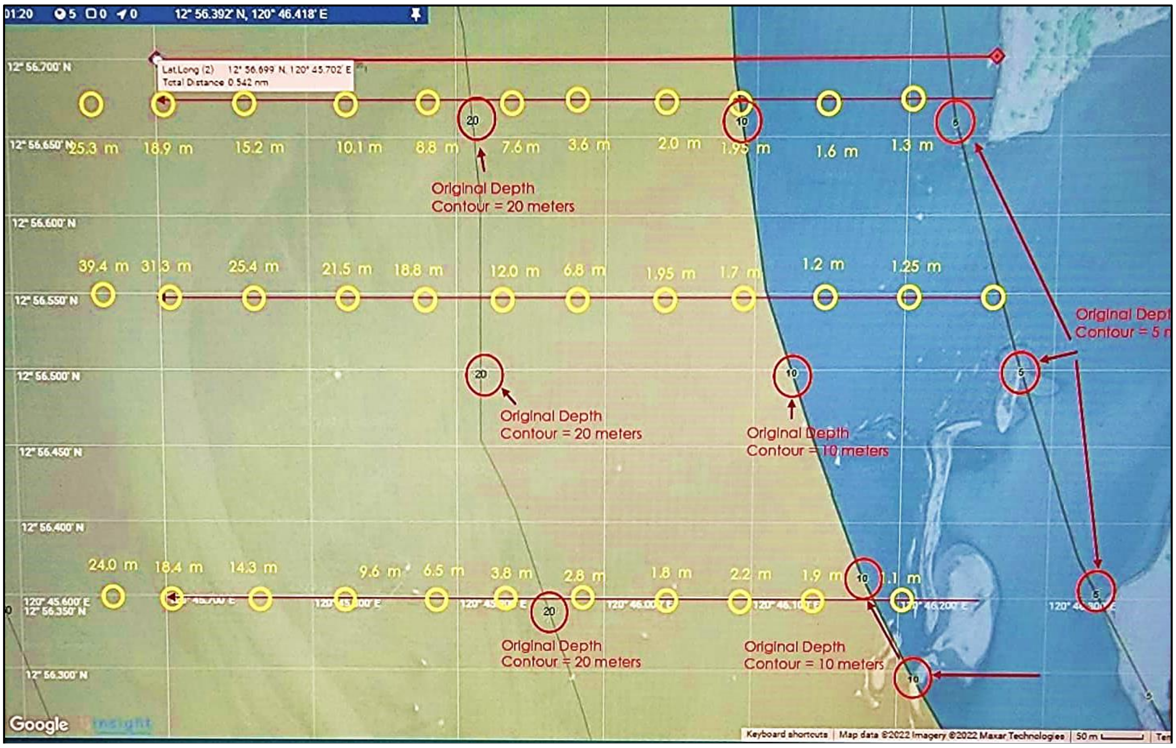


Figure 2.2.17: Amnay River Delta/Shore Water Depth Comparison

2.2.2.3 Water Current

2.2.2.3.1 Flow Velocity during No-Wind Condition, Northeast Monsoon and Southwest Monsoon without River Discharge

The first scenario in **Figure 2.2.18** shows the residual tides or the depth-averaged current velocities in no-wind conditions, without river discharge and without sediments. The current magnitude is relatively weak in areas closest to the mouth of the river, with current velocities ranging from <0.025 - 0.05 m/s.

Overall, the water current is non-uniform taking different directions; the current from the northern part of the domain seems to be moving southward and westward; in the southern part of the domain, the currents seem to converge and form a weak gyre or circular motion.

Current velocities in the whole domain range from <0.025 – 0.3 m/s, with the strongest currents coming from in the northern part of the domain.

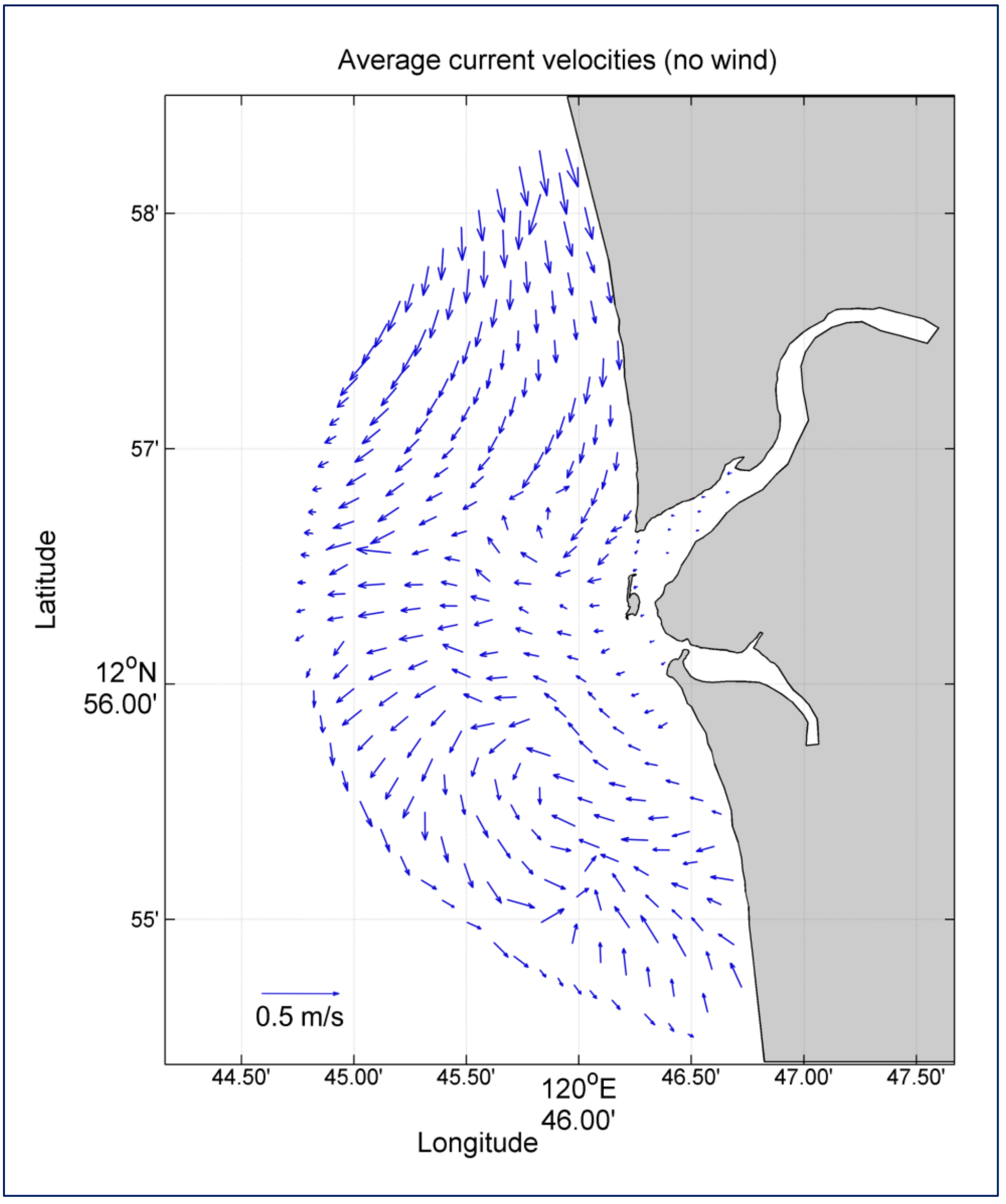


Figure 2.2.18: Depth-Averaged Current Velocities without Wind, without River Discharge, and without Sediments

During the northeast monsoon, the current direction remains essentially the same (**Figure 2.2.19**). The current seems to be moving westward and southward. However, it can be observed that that there is a slight deflection in the current direction and an increase in the current magnitude especially in the northern part of the domain. The gyre in the lower part of the domain is still present during the northeast monsoon scenario. It can be observed that another clockwise gyre is formed in the northern part of the domain, which was not present in the no-wind simulation.

It can also be noted that there is an observed slight increase in current magnitudes near the mouth of the river. The current velocities for the northeast monsoon simulation range from <0.025 to 0.5 m/s.

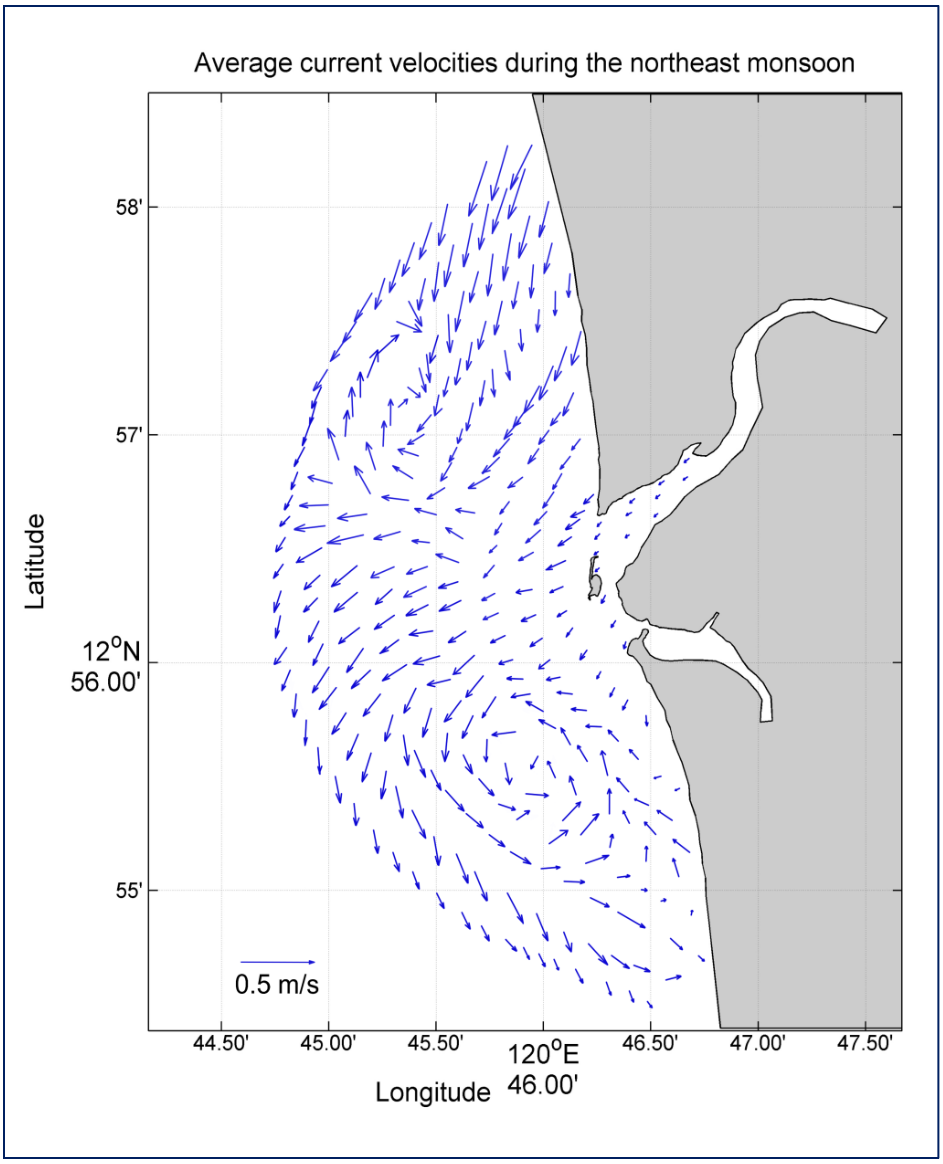


Figure 2.2.19: Depth-Averaged Current Velocities during Northeast Monsoon without River Discharge and without Sediments.

Using the southwesterly winds in the simulation, it can be observed that the current magnitude in the whole domain increased (**Figure 2.2.20**). Influenced by the winds coming from the southwest, there is an observed reversal of water current direction in the whole domain with currents moving northward, southward, and towards the middle of the domain (near the sand bar). The transport of water now is along the direction of the wind (coming from the southwest).

The observed gyres present in the residual (no-wind) and northeast monsoon simulations are no longer present in the southwest monsoon simulation. It can also be noted that the current magnitude in the whole domain increased, ranging from <0.025 to 0.5 m/s.

The flow velocity results of these simulations also coincide with the Circulation in the Philippine Archipelago study done by Hurlburt, et al., in 2011. Hurlburt and colleagues simulated ocean models from Global HYCOM and EAS NCOM to provide context for the water current circulation within the Philippine archipelago (**Figure 2.2.21**).

While the study conducted by Hurlburt and colleagues depicts a large-scale circulation model, (hence, does not focus on small-scale coastal model like this project domain), it can be used as reference to check on the current direction along the coast of Mindoro strait where the project site is located.

Moreover, in another study conducted by Sprintall, et al., (2012) on the Observations of exchange between the South China Sea and the Sulu Sea, it was observed that during the southwest monsoon, there is a strong northward transport of water from the surface down to ~170m depth along the Mindoro strait. This northward transport was seen in the simulation for southwest monsoon wind condition.

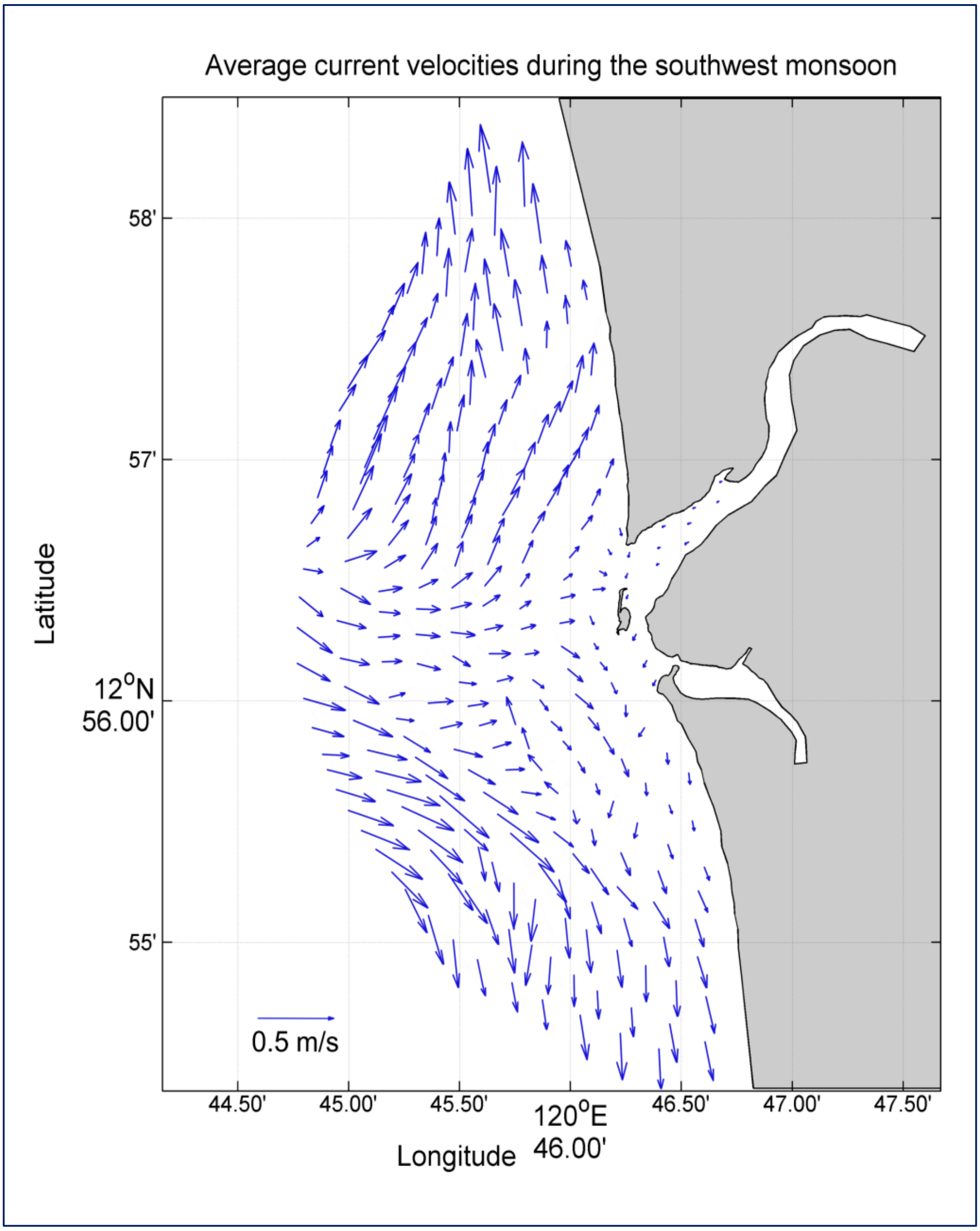
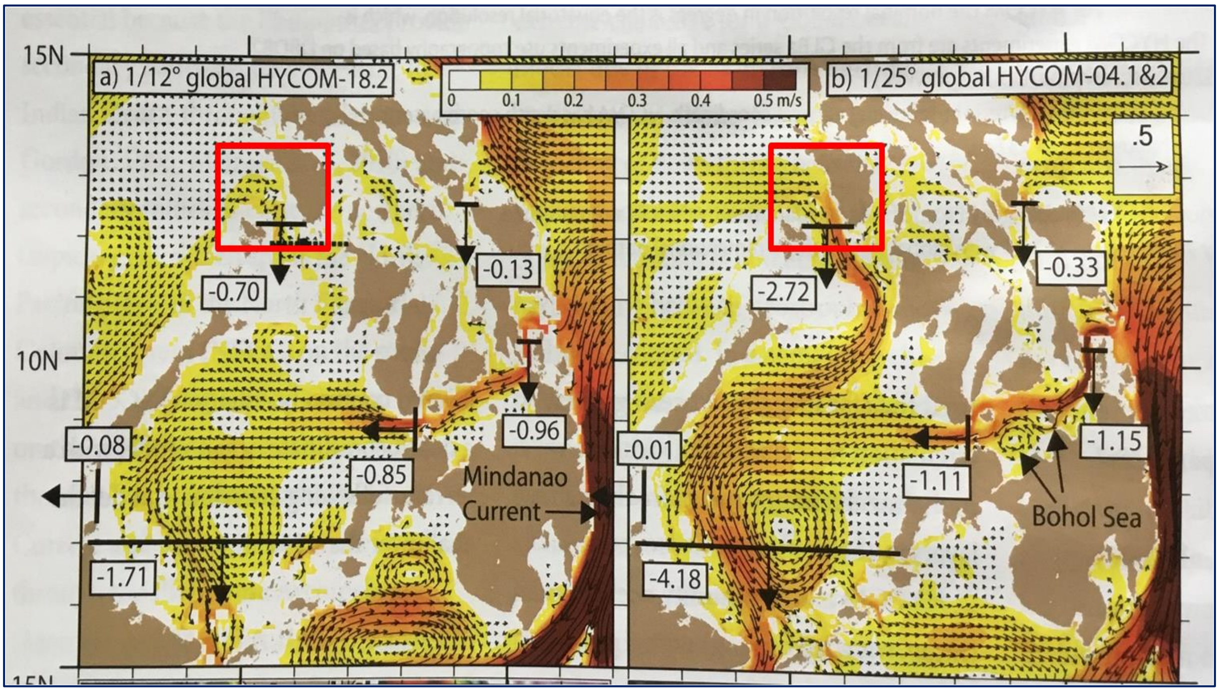


Figure 2.2.20: Depth-Averaged Current Velocities during Southwest Monsoon without River Discharge and without sediments.



Source: Photo from Oceanography magazine, Vol. 24 No.1, Special Issue on the Philippine Straits Dynamics experiment.

Figure 2.2.21: Simulated Mean Currents (m/s) Overlaid on Speed (in color) Around the Philippine Seas from (left) 1/12º Global Hybrid Coordinate Ocean Model (HYCOM) and (right) 1/25º Global HYCOM.

2.2.2.3.2 Flow Velocity during No-Wind Condition, Northeast Monsoon and Southwest Monsoon with River Discharge

Adding the peak river discharge from a rainfall event in Amnay Rriver basin in the upstream boundary as input parameter in the models, it was observed from all simulations that the discharge increased the flow velocity in the mouth of the river. Although there is an increase in velocity, this increase did not significantly affect the current velocities of the nearest waters. This can be attributed to the fact that this area around the sand bar is very shallow.

For both the no-wind and northeast monsoon simulations, there was no significant difference in current velocities (**Figures 2.2.22** and **2.2.23**). For the southwest monsoon simulation, however, aside from the observed increase in current magnitude in areas near the mouth of the river, there was an observed slight deflection of current direction northwest of the sand bar. Since the water current seems to diverge in the middle of the model domain during southwest monsoon (northward and southward transport), the water from the river converges with the current coming towards the mouth of the river and moves southward. The current velocity in other areas of the domain remains the same (**Figure 2.2.24**).

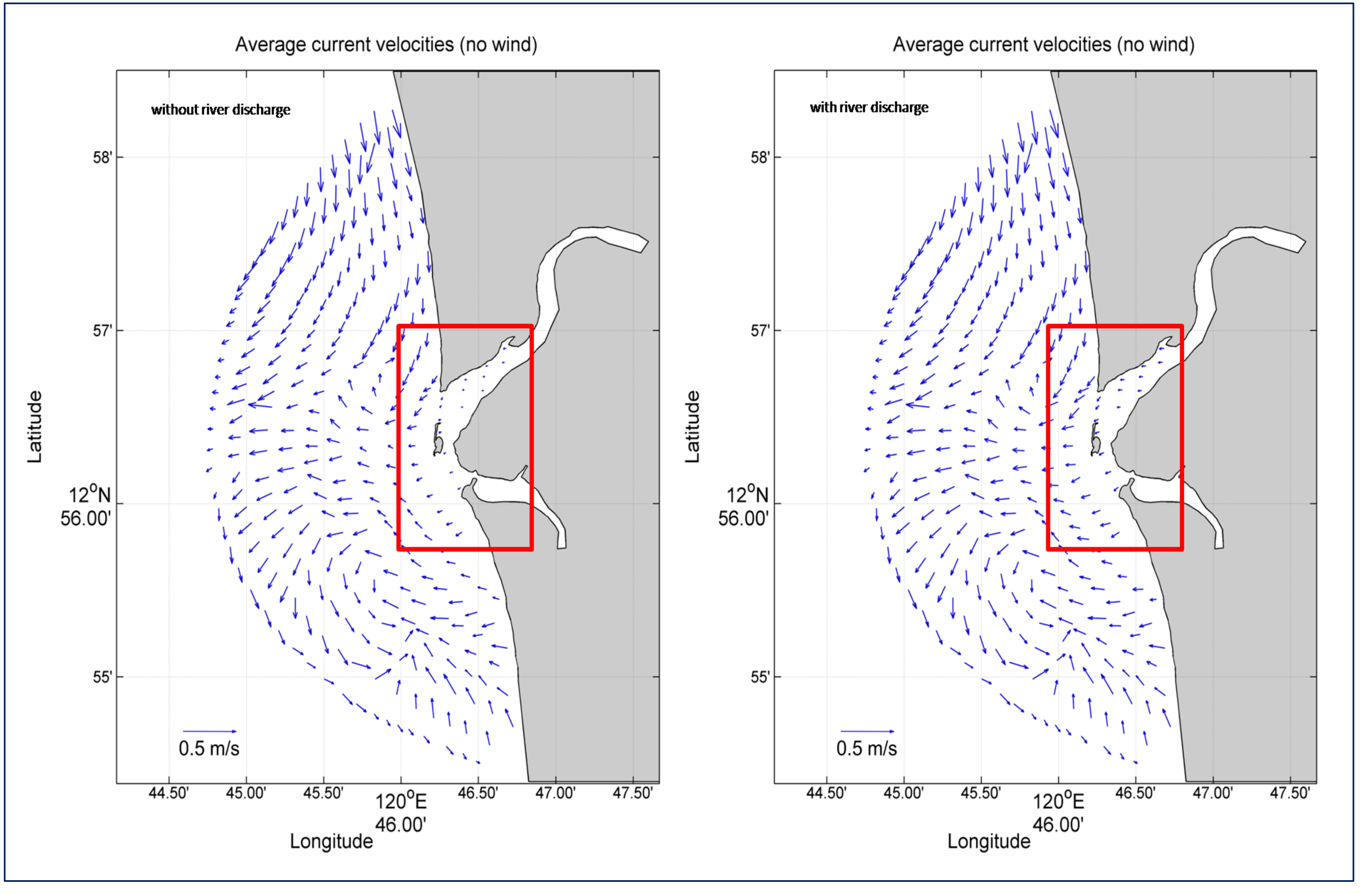


Figure 2.2.22: Depth-Averaged Current Velocities in No-Wind Conditions without River Discharge (left) and with Added River Discharge (right)

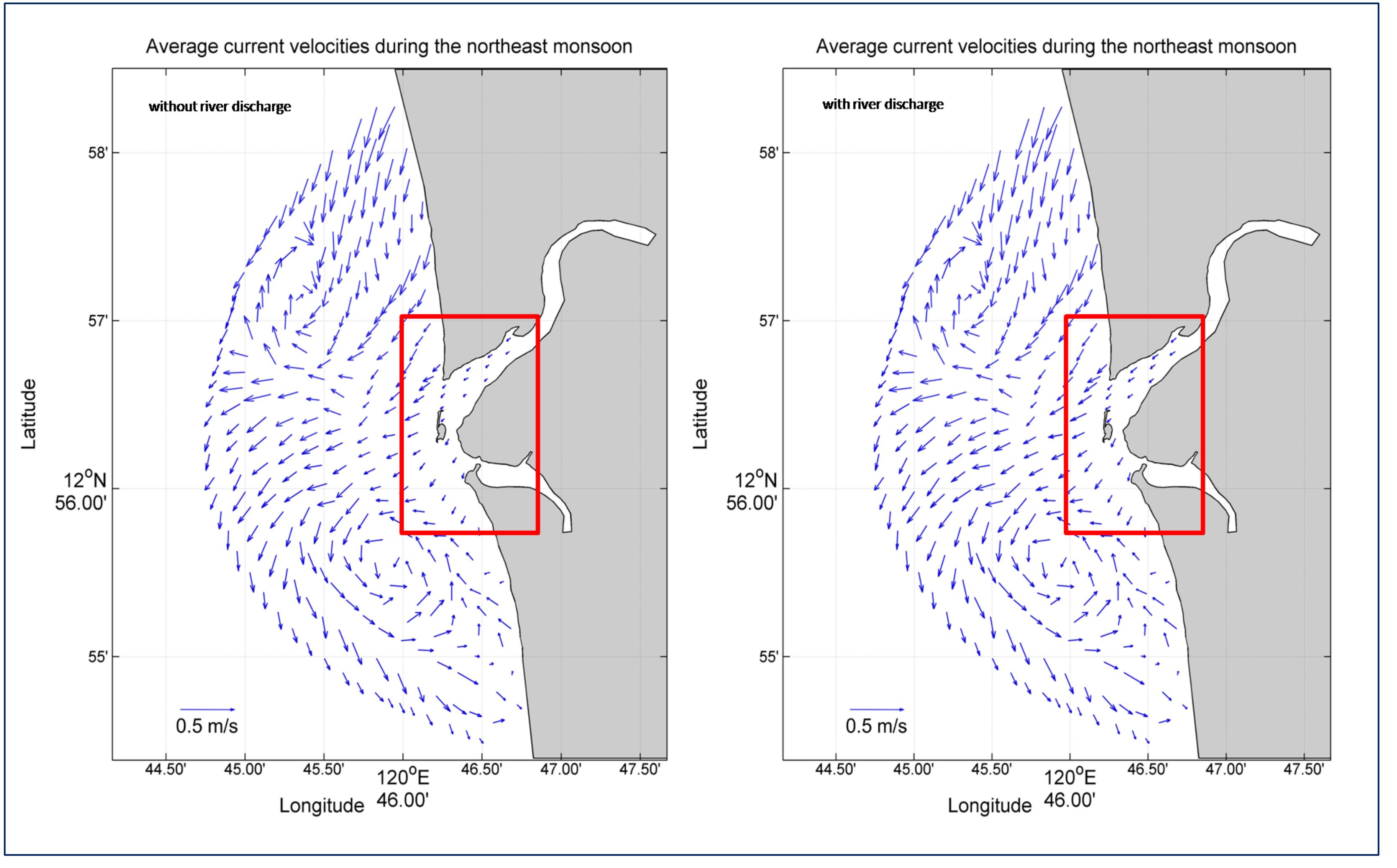


Figure 2.2.23: Depth-Averaged Current Velocities during Northeast Monsoon with River Discharge

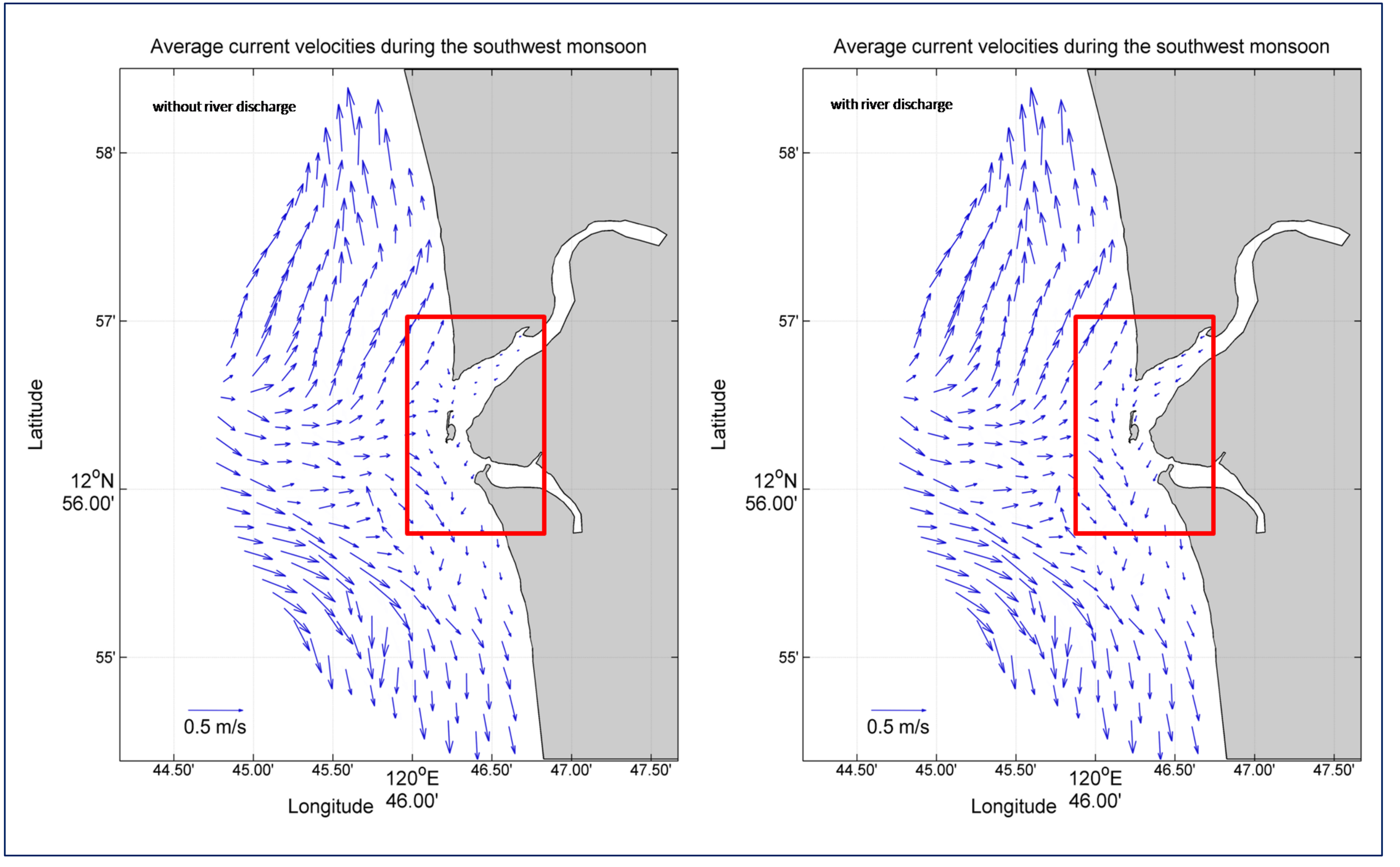


Figure 2.2.24: Depth-Averaged Current Velocities during Southwest Monsoon with River Discharge

2.2.2.4 Sediment Transport

Sediment transport loads and the need for dredging/desilting is highly dependent on river flow conditions. Adding the time-series flow discharge and sediment discharge in the models represents the excess sediments from dredge-and-dump activities. A constant concentration of 5 kg/m^3 of non-cohesive sediments was used in all sediment plume simulations, while the peak flow discharge during a rainfall event in Amnay River Bsin was used with a value of 264.50 m^3/s. At the end of all three sediment plume simulations (t [time] = after 60 days for northeast monsoon and southwest monsoon; t = after 30 days for no-wind condition), it can be observed that there is an accumulation of sediments at the mouth of the river.

After 30 days in the no-wind simulation, the highest concentration of suspended sediments can be observed from the point of discharge up to the river mouth and the surrounding areas of the sand bar. Beyond this point, the sediments are reduced in concentration, which can be attributed to increasing depth. The flow of sediments also follows the flow velocity pattern for the no-wind simulation with a mean current direction going westward and southward (**Figure 2.2.25**).

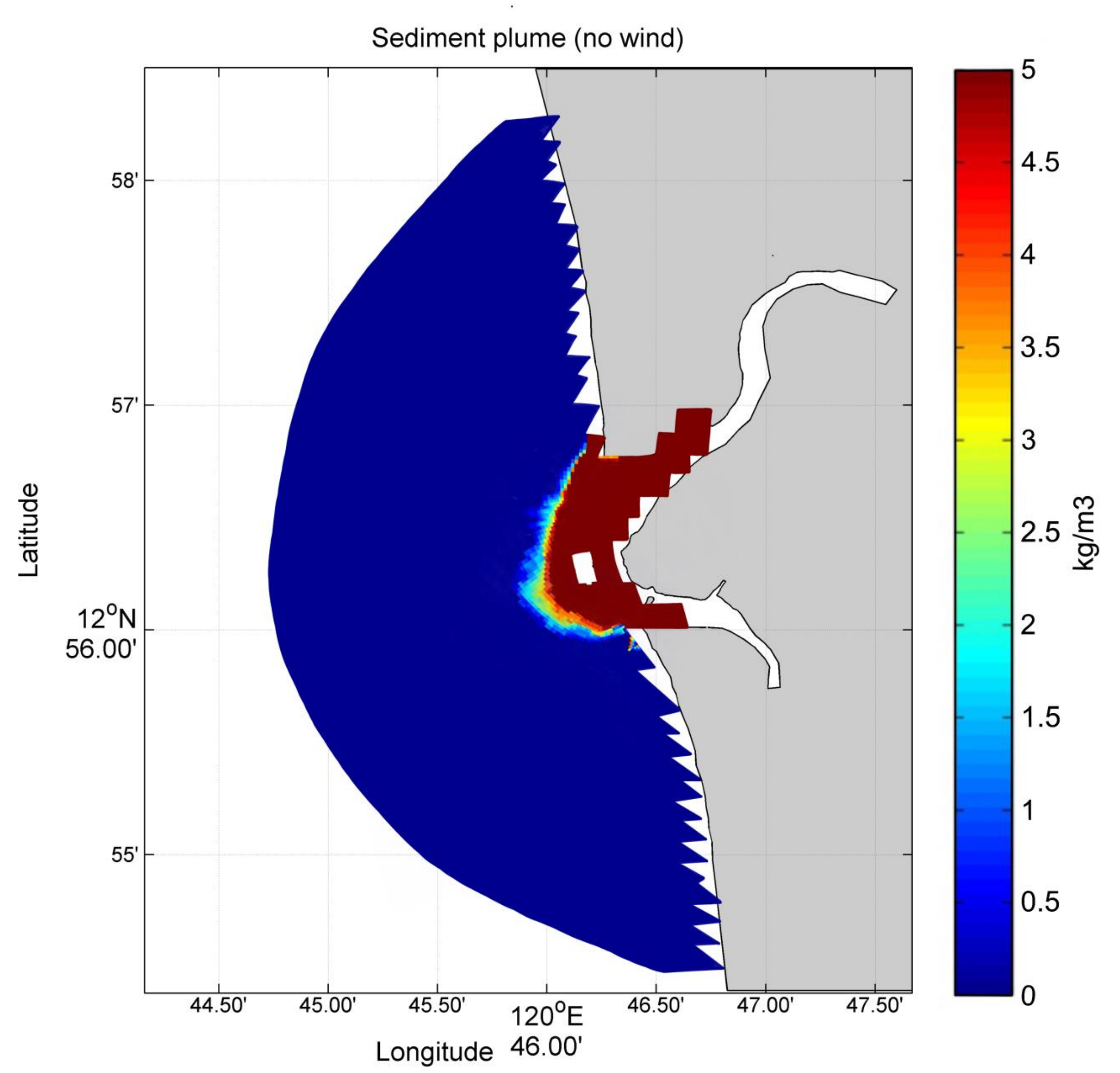


Figure 2.2.25: Sediment Plume during no-Wind Condition; T= After 30 Days

For the northeast monsoon simulation after 60 days with river discharge and sediment discharge, the concentration of sediments is essentially the same with the no-wind simulation, accumulating around the sand bar in the mouth of the river. However, in this simulation, there is a larger area with the highest concentration of suspended sediments (5kg/m^3) (**Figure 2.2.26**). Like the no-wind sediment plume simulation, the flow of sediments in the northeast monsoon simulation also follows the flow velocity pattern for the northeast monsoon.

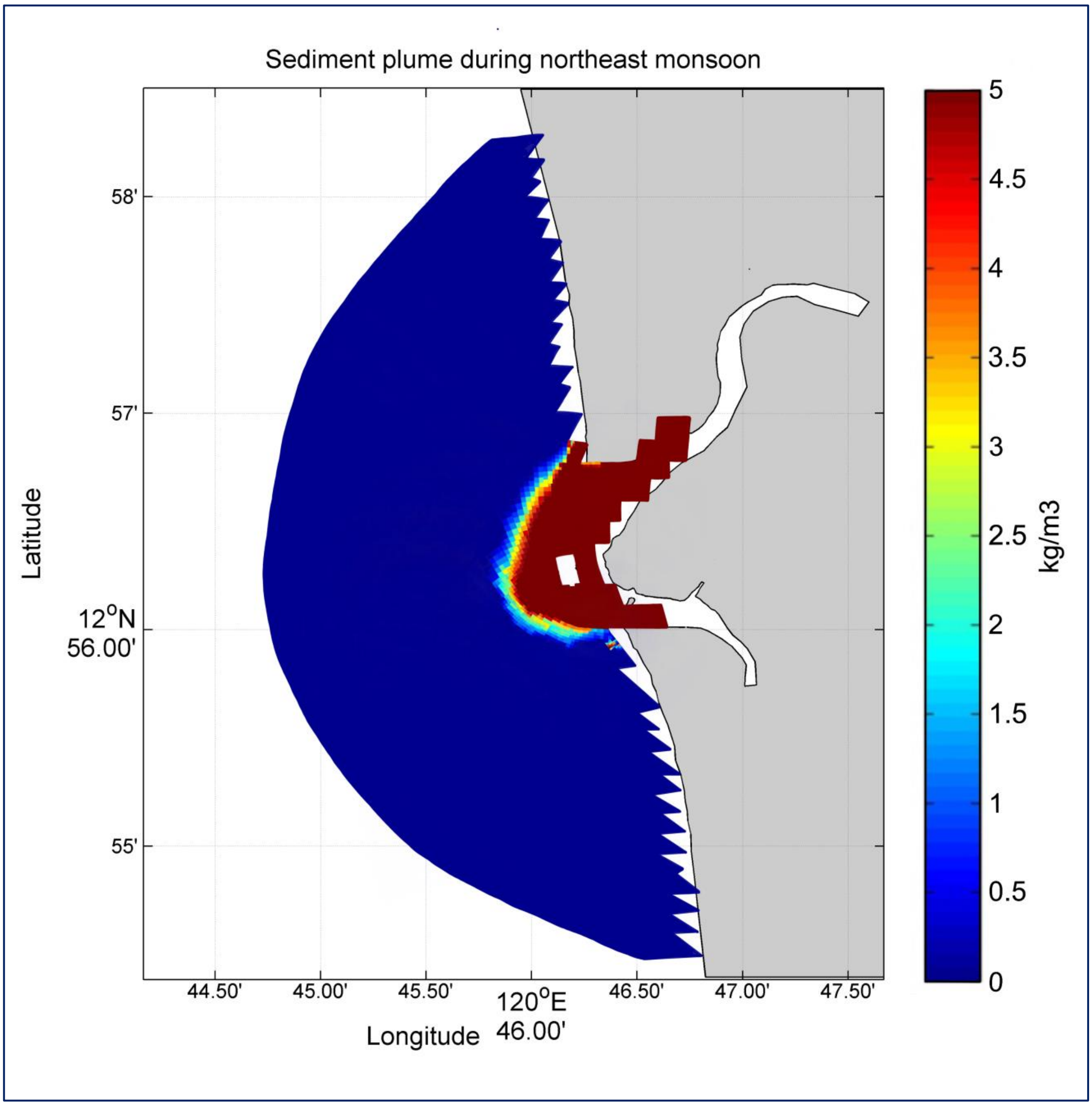


Figure 2.2.26: Sediment Plume during Northeast Monsoon Simulation; T= After 60 Days

In the southwest monsoon sediment plume, there is a significantly greater area with the highest sediment concentration, with sediment concentrations of 5 kg/m^3 extending towards the northern and southern parts of the model domain (**Figure 2.2.27**). This can be attributed to the current velocity during southwest monsoon (reversal in current direction and relatively stronger current magnitude) that transports water towards the land boundary, causing the current and sediments to diverge northward and southward.

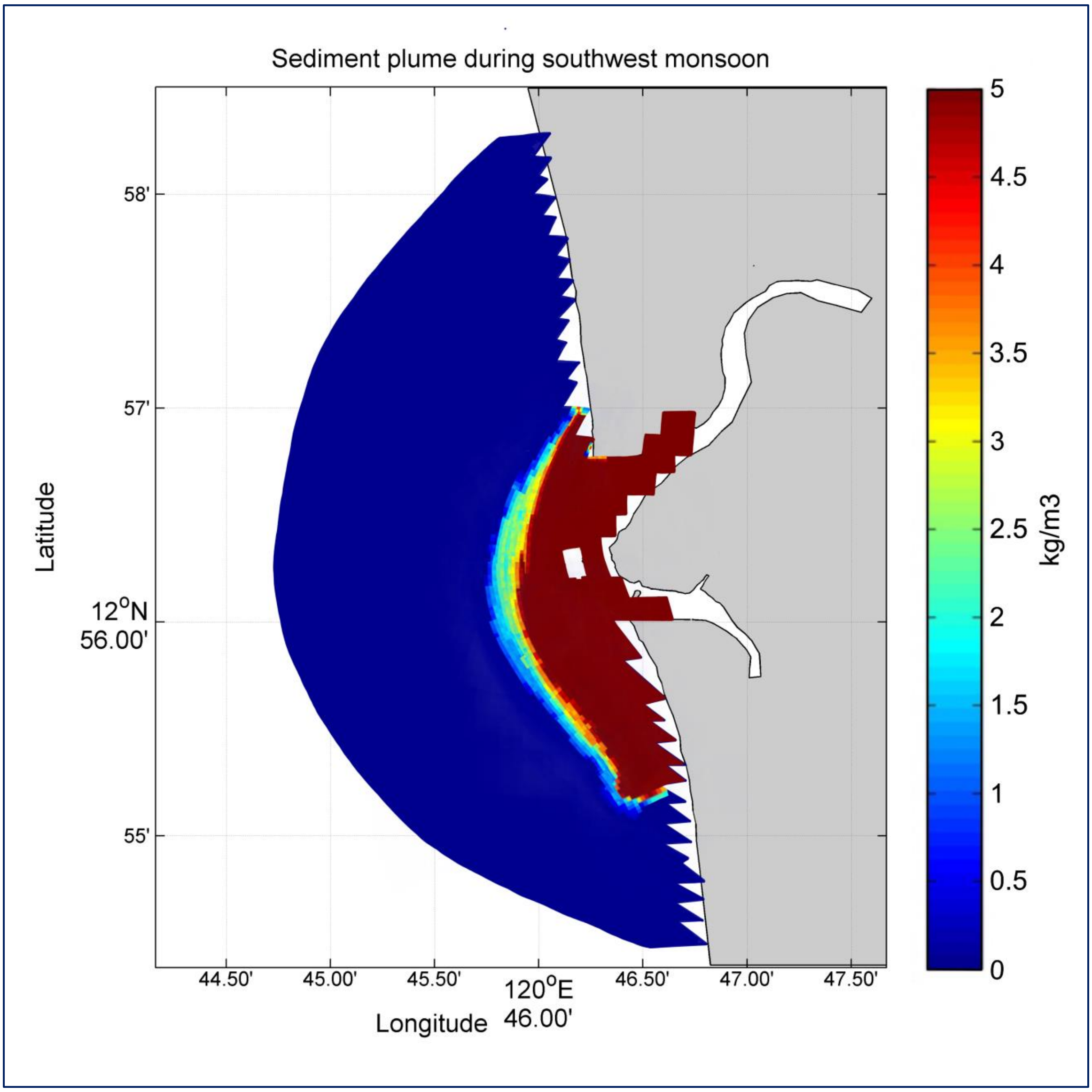


Figure 2.2.27: Sediment Plume during Southwest Monsoon Simulation; T= After 60 Days

2.2.2.5 Change/ Disruption in Bathymetry, Water Circulation Pattern, Littoral Current, Coastal Erosion and Deposition

Dispersion of sediments are expected during dredging, and if not properly mitigated, there would be an increase of background levels of total suspended solids (TSS) and/or at levels greater than the water quality guidelines prescribed for freshwater and marine waters.

Site preparation activities prior to the dredging of the main river channel will include river delta opening to achieve a desirable flow and passage of vessels in the river delta and is expected to modify the offshore terrain and the adjacent areas. This modification will, however, not be significant since the project site intends to remove sand from the delta for passage and flow of vessels for the dredging and desilting activities.

Coastal erosion and sedimentation will bury the natural coastline. However, the process is gradual to make sure that sand and other dredge materials are controlled during dredging process. Moreover, based on the result of simulation, the bathymetry in the Project area will remain essentially unchanged because the project site is located at shallower depths.

The use of trailer suction hopper dredger is an effective vessel for dredging and excavation carried out in either shallow or freshwaters with the aim to gather up the sediments located in the bottom to dispose of at another place. Siltation and turbidity resulting from coastal/river delta dredging may not adversely affect the area.

However, this impact is temporary and may only be prevalent during the opening of the river delta. River channel dredging will be scheduled during dry season and siltation and soil erosion control measures such as silt traps will be installed prior to the conduct of dredging works.

2.2.3 Water Quality

2.2.3.1 Freshwater Quality

The proposed ARRD Project will utilize the 14-km stretch of the identified RDZ section of the Lower Amnay River, which are potential impact areas of project operation. The natural waterways covered in this study were aimed at obtaining a general picture of the range of quality of surface water in Amnay River, through various parameters, as a guide in the detailed water pollution prevention planning and implementation. The study focuses on many factors such as those of related to freshwater quality. For the identified sampling sites, the data gathered would serve as part of baseline data. Amnay River is classified as Class A water by EMB-Region 4B in 1980 and not on the current list of Water Quality Management Area (WQMA) in the region.

Freshwater quality sampling was conducted for both dry and wet season to assess the physical-chemical properties of Amnay River in the lower Amnay River basin located at Barangay Claudio Salgado, Rizal, Occidental Mindoro. The wet season survey was conducted on August 22, 2021 while the dry season sampling was conducted on April 9, 2022. The freshwater samples were collected at three (3) sampling sites representing upstream, midstream and downstream section of the 14-km dredging zones of the Project. **Table 2.2.7** and **Figure 2.2.28** present the coordinates and the location map of the freshwater quality sampling stations, respectively.

Table 2.2.7: Coordinates of the Freshwater Quality Sampling Stations

Sampling Station	Coordinates	
	Latitude	Longitude
1	12.956021° N	120.889339° E
2	12.956248° N	120.820133° E
3	12.94648° N	120.775086° E

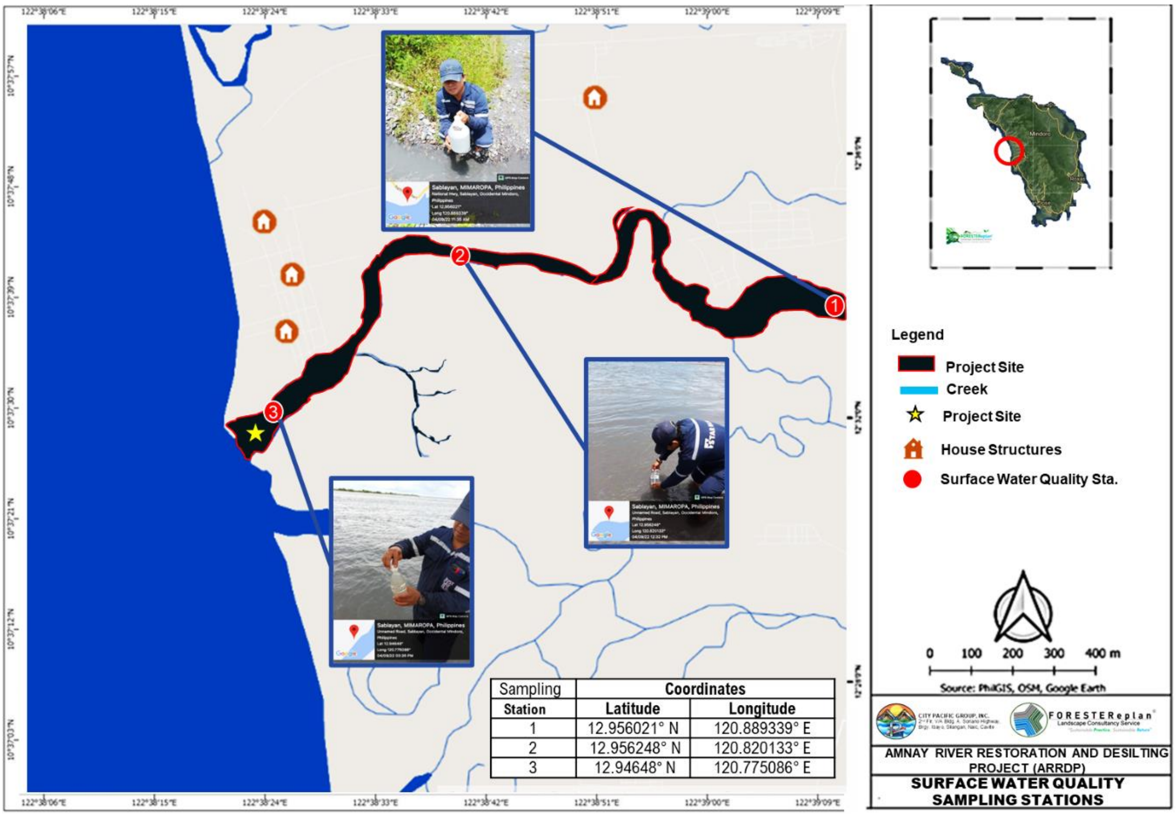


Figure 2.2.28: Location Map of Freshwater Quality Sampling Stations

Table 2.2.8 presents the results of the water quality sampling conducted on August 22, 2021, at 08:32AM during the wet season. The results indicate that the levels of Temperature, DO, pH, Color, and Phosphate recorded in all sampling stations are within the water quality guideline values set in DAO 2016-08 for both Class A and Class C Waters. On the other hand, the levels of Chlorides and Fecal Coliform in all sampling stations exceed the water quality guideline values set in DAO 2016-08 for both Class A and Class C Waters. TSS in Station SW-3 and BOD in Stations SW-2 and SW-3 exceed the water quality guideline values set in DAO 2016-08 for Class A Water.

Table 2.2.8: Results of Freshwater Quality Sampling (Wet Season)

Parameters	Results			DENR Standards [a] DENR AO 2016-08	
	Upstream SW-1 (09:01AM)	Midstream SW-2 (09:15AM)	Downstream SW-3 (08:32AM)	Class A	Class C**
Temperature, °C	29	28	28	26-30	25-31
Dissolved Oxygen, mg/L	6.6	6.5	6.8	5 (min)	5
pH	8.15	8.08	8.13	6.5-8.5	6.5-9.0
TSS, mg/L	10	13	63	50	80
Color (True), CU	5	5	5	50	75
BOD, mg/L	3	4	4	3 (max)	7
Phosphate as P, mg/L	0.0237	0.0257	0.102	0.163[b]	0.163[b]
Chlorides, mg/L	13,879	13,352	5,121	250	350
Fecal Coliform, MPN/100 mL	9,200	7,000	22,000	< 1.1	200

Note: The highlighted cells are the results that exceed the standard

[a] Reference values are maximum allowable limits unless specified as range or minimum (min).

[b] The reference values under the column of PO4-P are conversions (0.3261) of the 0.5 mg/L and 5 mg/L PO4 values in DAO 2016-08

** Reference basis if to evaluate results under Class C.

Below is the discussion of the results per parameter of surface water quality sampling along the proposed ARRD Project, as compared with the Water Quality Guidelines for Class A Water for the wet season.

Color

Water samples collected in all the stations fall within the 50 TCU and 75 TCU maximum allowable limits of DENR guidelines for Class A and Class C waters, respectively (**Figure 2.2.29**).

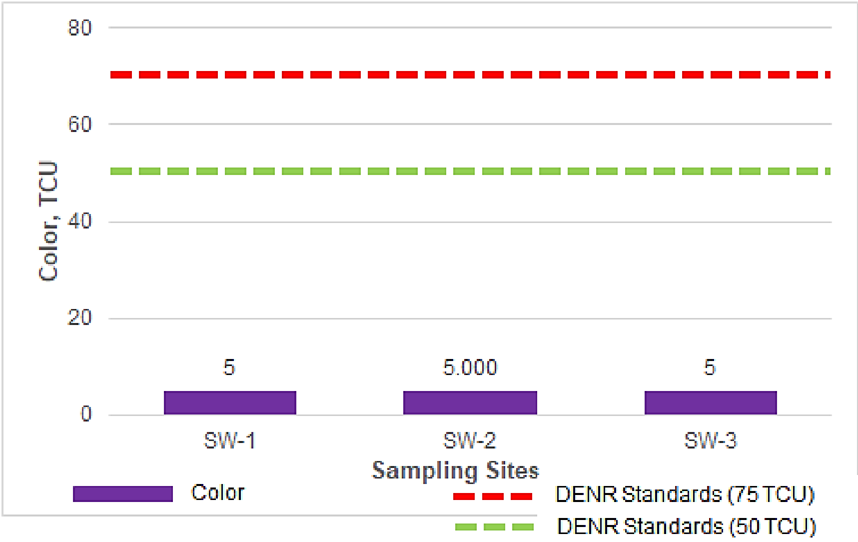


Figure 2.2.29: Results of Color Measurement of Surface Water Samples

Phosphates

As shown in **Figure 2.2.30,** all stations have phosphate concentrations below the maximum acceptable limit of 0.163 mg/L of DENR guidelines for Classes A and C waters.

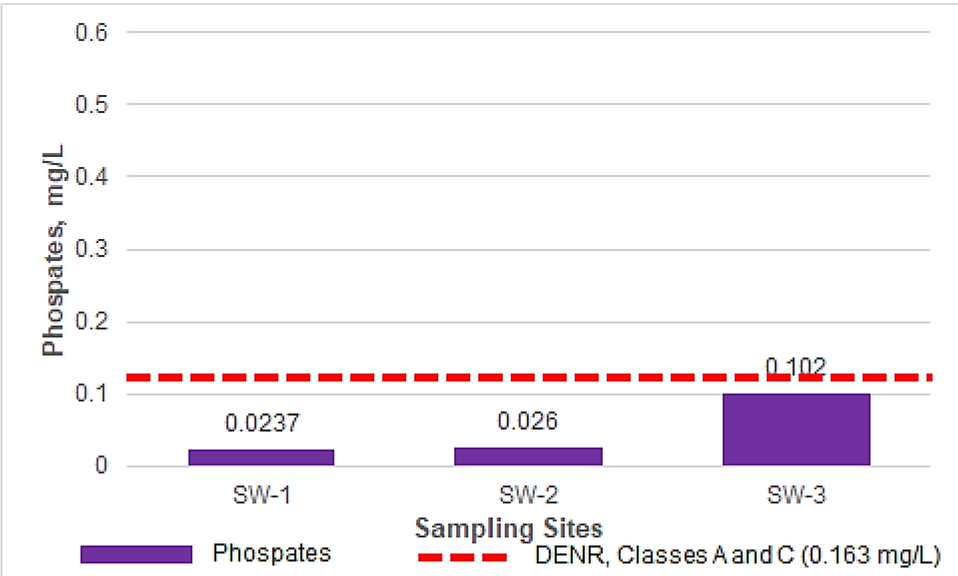


Figure 2.2.30: Results of Phosphate Measurement of Surface Water Samples

pH

As shown in **Figure 2.2.31**, the pH in all stations were within the acceptable pH range limit of 8.5 and 9.0 of the DENR guidelines for Class A and Class C waters, respectively. However, all stations exceed the minimum values standard to Class A and Class C waters which is 6.5.

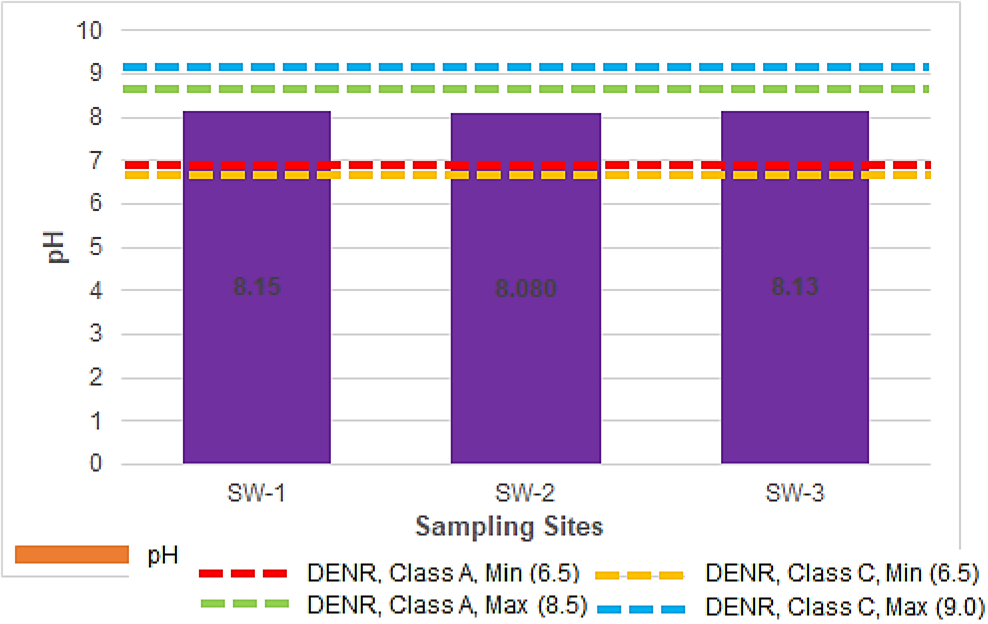


Figure 2.2.31: Results of pH Measurement of Surface Water Samples

Dissolved Oxygen

All of the stations have DO concentrations above the minimum acceptable value of 5 mg/L (**Figure 2.2.32**).

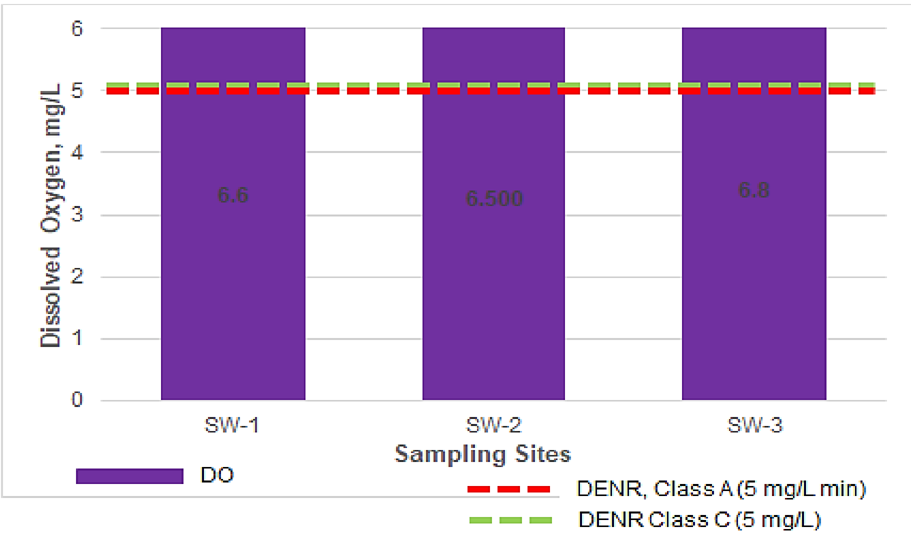


Figure 2.2.32: Results of Dissolved Oxygen Measurement of Surface Water Samples

Biochemical Oxygen Demand

The levels of BOD in all stations are within the maximum acceptable value of 7 mg/L of the DENR guidance for Class C water but exceed the maximum acceptable value of 3 mg/L of the DENR guidance for Class A water except for SW-1 which has a value of 3.0 (**Figure 2.2.33**).

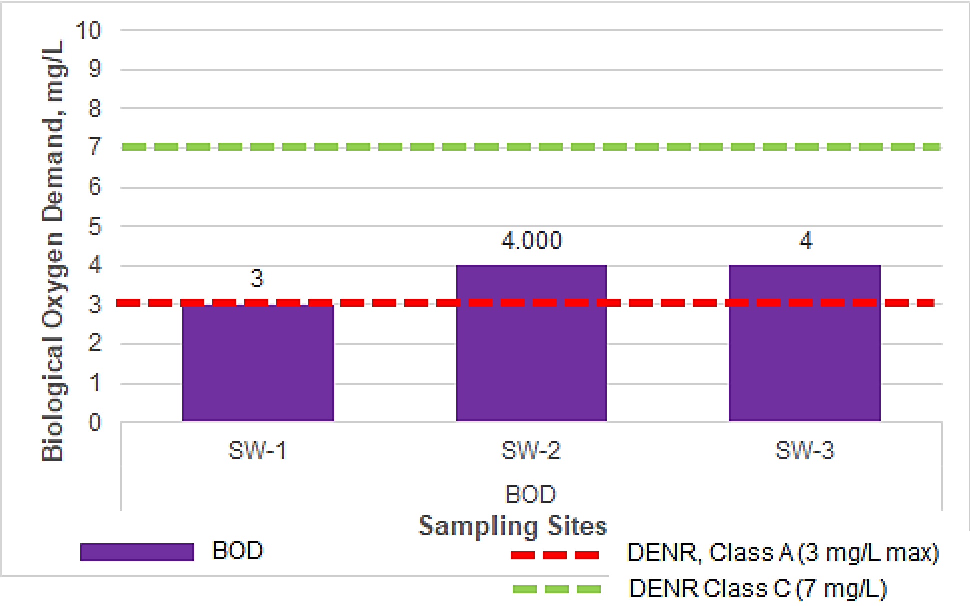


Figure 2.2.33: Results of Biochemical Oxygen Demand Measurement of Surface Water

Fecal Coliform

As shown in **Figure 2.2.34**, the levels of Fecal Coliform in all stations exceed the maximum acceptable limit of 200 MPN/100mL of the DENR Guidelines for Class C waters. The highest fecal coliform count of 22,000 MPN/100mL was measured at SW-3.

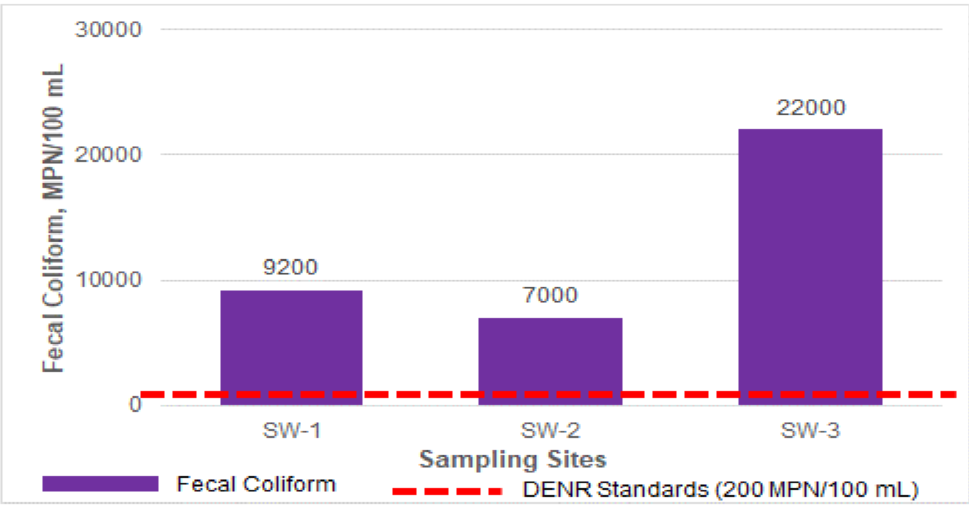


Figure 2.2.34: Results of Fecal Coliform by Surface Water Samples

Chloride

Chlorides in all sampling stations exceeds the maximum acceptable limit of 250 mg/L and 350 mg/L for both Class A and Class C Waters (**Figure 2.2.35**).

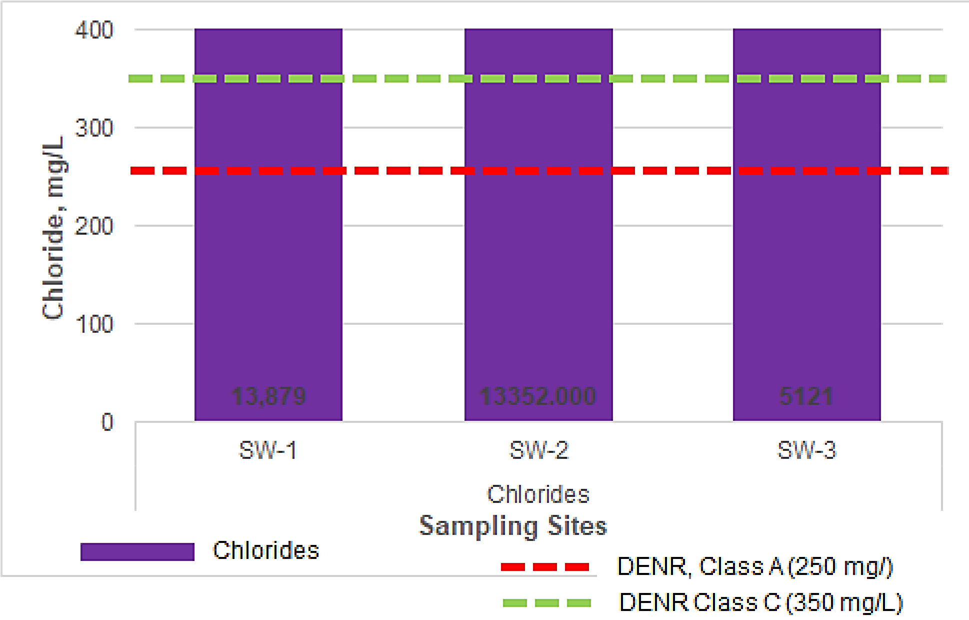


Figure 2.2.35: Results of Chloride Measurement of Surface Water Samples

Temperature

Temperatures in all sampling stations are within the acceptable range of 26°C to 30°C and 25°C to 31°C of the DENR guidelines for Class A and Class C Waters, respectively.

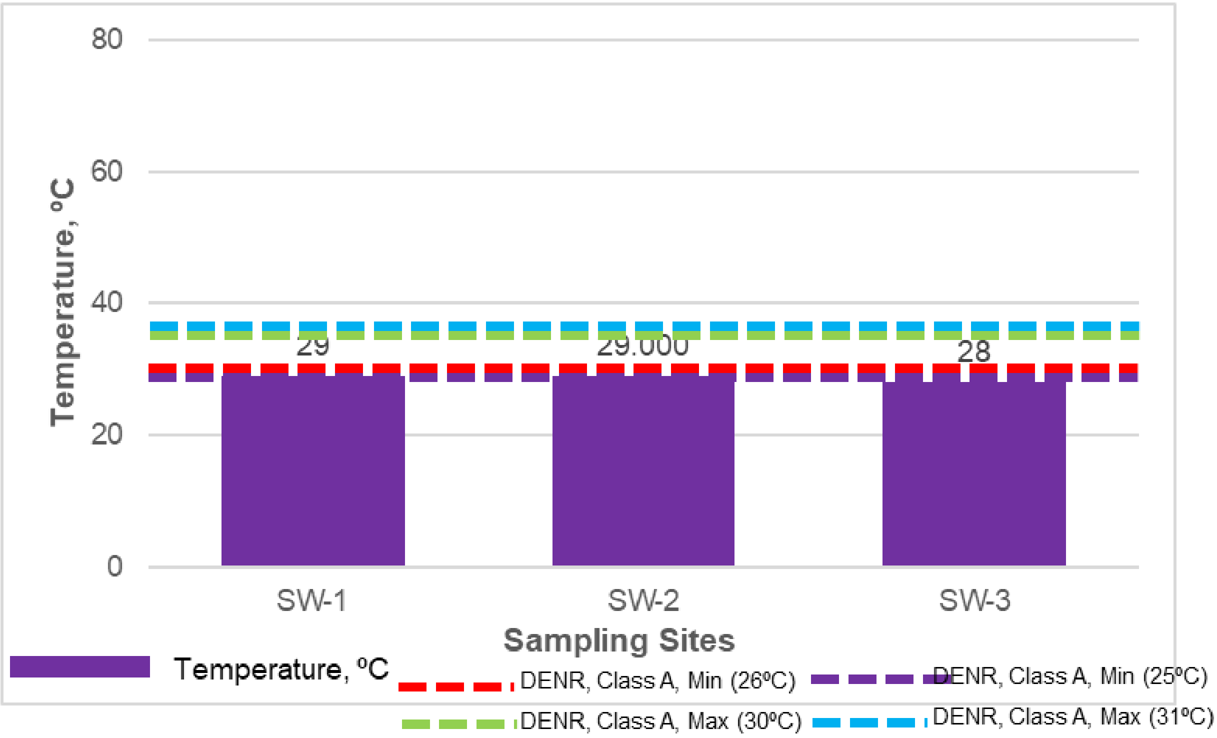


Figure 2.2.36: Results of Temperature Measurement of Surface Water Samples

Table 2.2.9 presents the results of water quality sampling conducted on April 9, 2022 at 03:26 PM during the dry season.

Table 2.2.9: Results of Freshwater Quality Sampling (Dry Season)

Parameters	RESULTS			DENR Standards [a] DENR AO 2016-08	
	Upstream SW-1 (09:01AM)	Midstream SW-2 (09:15AM)	Downstream SW-3 (08:32AM)	Class A	Class C**
Temperature, °C	29	29	28	26-30	25-31
Dissolved Oxygen, mg/L	8.9	8.5	8.0	5 (min)	5
pH	7.98	7.70	7.98	6.5-8.5	6.5-9.0
TSS, mg/L	196	188	194	50	80
Color (True), CU	25	25	3	50	75
BOD, mg/L	2	2	3	3 (max)	7
Phosphate as P, mg/L	0.052	0.052	0.064	0.163[b]	0.163[b]
Chlorides, mg/L	5	6	29	250	350
Surfactants, MBAS mg/L	<0.1	<0.1	<0.1	-	-
Oil and Grease, mg/L	1.22	1.40	1.16	-	-
Fecal Coliform, MPN/100 mL	4,600	4,900	7,000	< 1.1	200

Note: The highlighted cells are the results that exceed the standard
[a] Reference values are maximum allowable limits unless specified as range or minimum (min).
[b] The reference values under the column of PO4-P are conversions (0.3261) of the 0.5 mg/L and 5 mg/L PO4 values in DAO 2016-08
** Reference basis if to evaluate results under Class C.

Below is the discussion of the results per parameter of surface water quality sampling along the proposed ARRD Project, as compared with the Water Quality Guidelines for Class A Water for the dry season.

Color

Water samples collected in all the stations fall within the 50 TCU and 75 TCU maximum allowable limits of DENR guidelines for Class A and Class C waters, respectively (**Figure 2.2.37**).

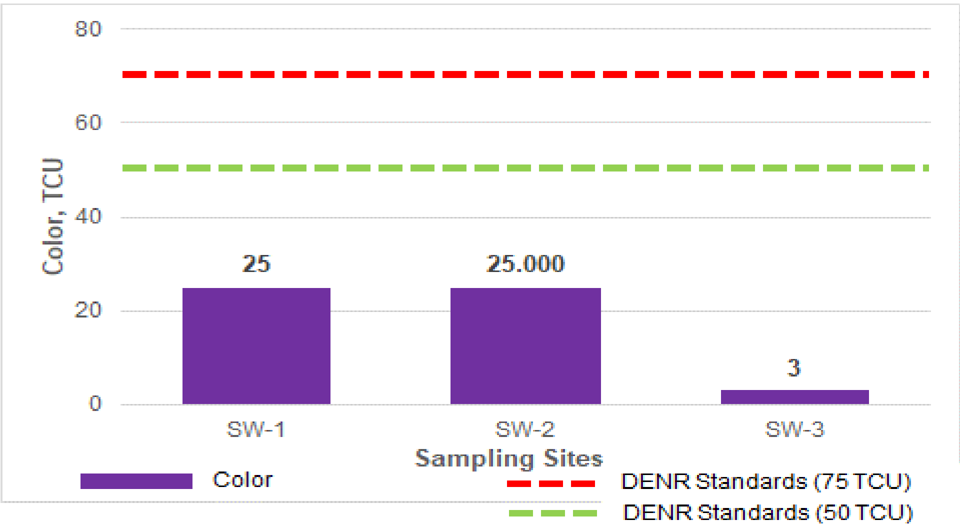


Figure 2.2.37: Results of Color Measurement of Surface Water Samples

Phosphates

As shown in **Figure 2.2.38,** all stations have phosphate concentrations below the maximum acceptable limit of 0.163 mg/L of DENR guidelines for Classes A and C waters.

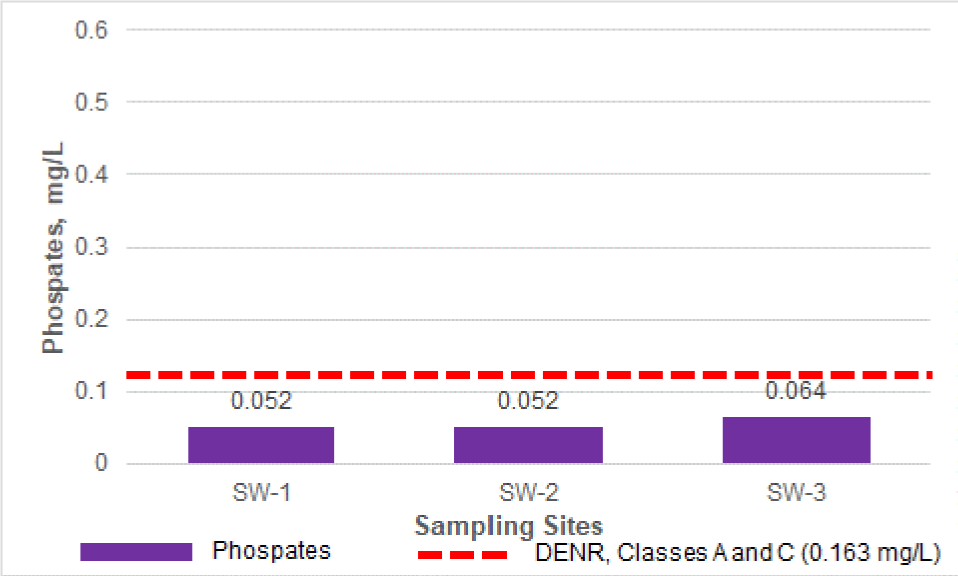


Figure 2.2.38: Results of Phosphate Measurement of Surface Water Samples

pH

As shown in **Figure 2.2.39**, the pH in all stations were within the acceptable pH range limit of 8.5 and 9.0 of the DENR guidelines for Class A and Class C waters, respectively. However, all stations exceed the minimum values standard to Class A and Class C waters which is 6.5.

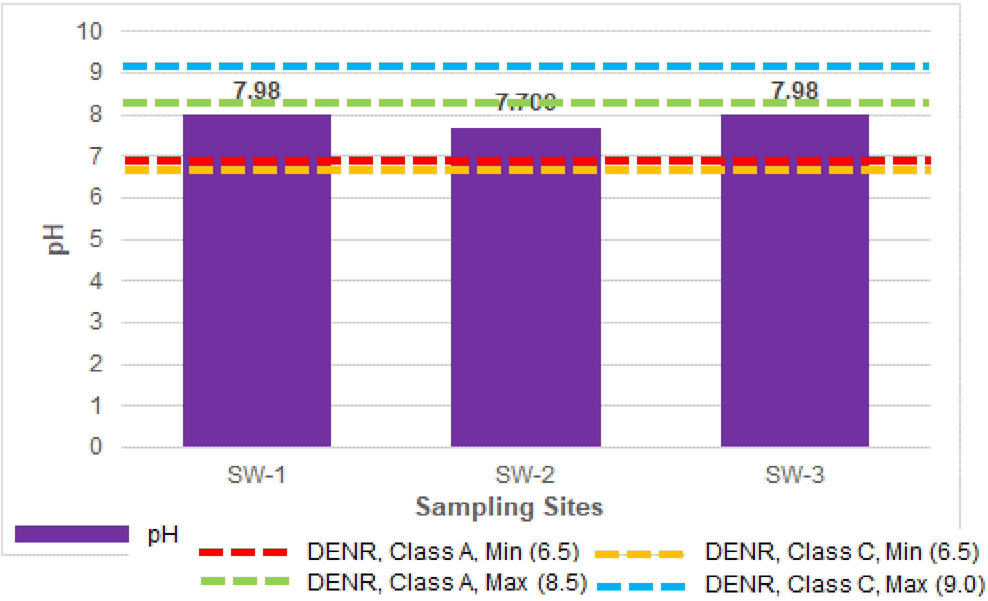


Figure 2.2.39: Results of pH Measurement of Surface Water Samples

Dissolved Oxygen

All of the stations except for SW-3 have DO concentrations above the minimum acceptable value of 5 mg/L (**Figure 2.2.40**).

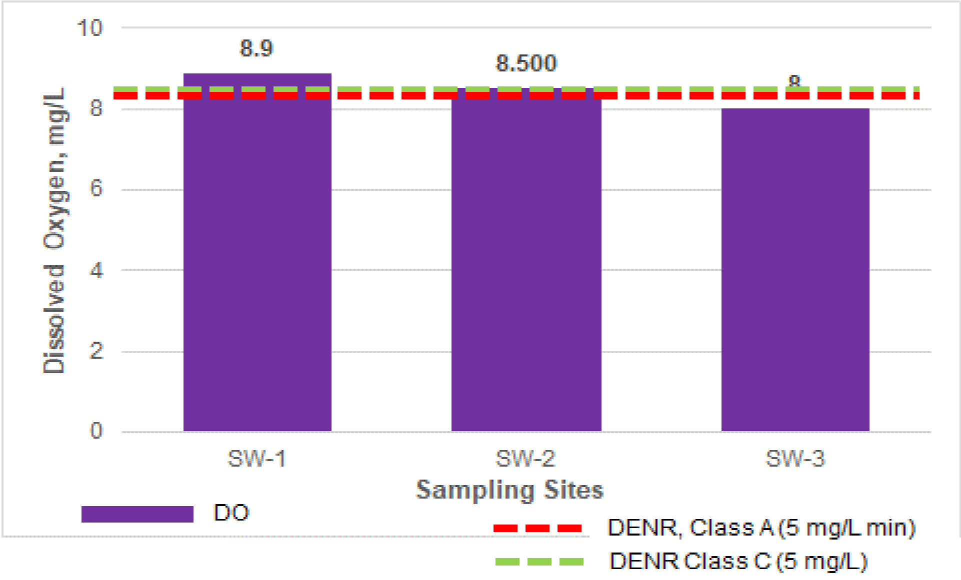


Figure 2.2.40: Results of Dissolved Oxygen Measurement of Surface Water Samples

Biochemical Oxygen Demand

All stations have a BOD value of 2.0, which is within the maximum acceptable value of 3 mg/L and 7 mg/L of the DENR guidance for Class A and Class C waters, respectively (**Figure 2.2.41**).

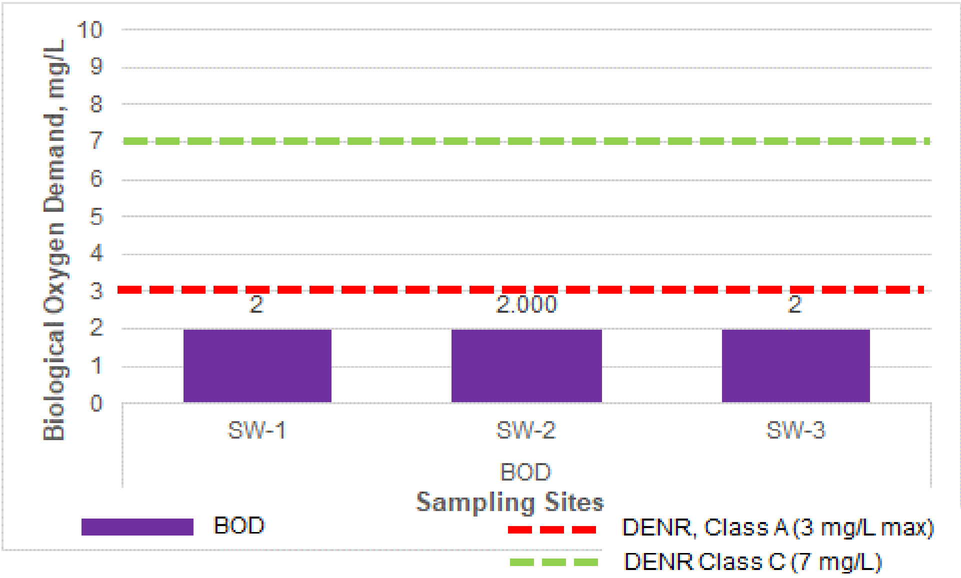


Figure 2.2.41: Results of Biochemical Oxygen Demand Measurement of Surface Water

Fecal Coliform

As shown in **Figure 2.2.42**, the levels of Fecal Coliform in all stations exceed the maximum acceptable limit of 200 MPN/100mL of the DENR Guidelines for Class C waters. The highest fecal coliform count of 7,000 MPN/100mL was measured at SW-3.

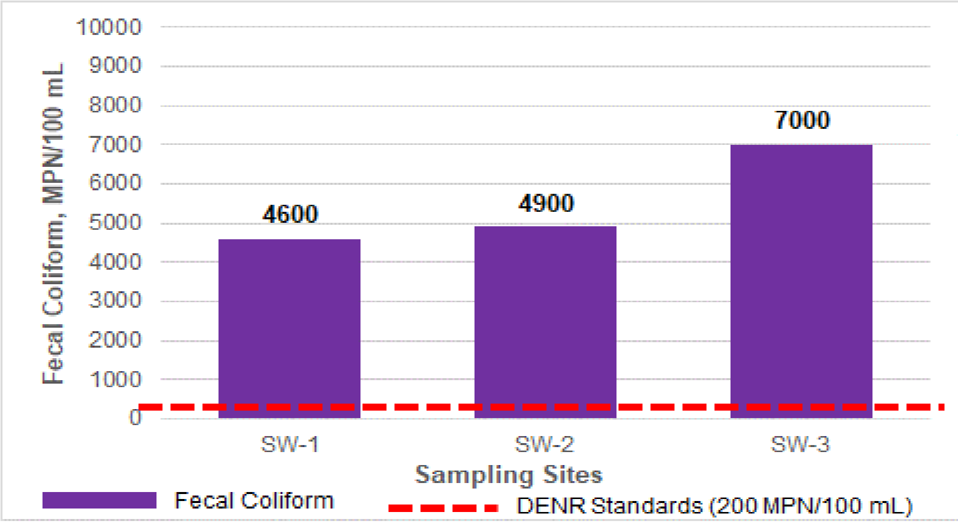


Figure 2.2.42: Results of Fecal Coliform by Surface Water Samples

Chloride

Chlorides in all sampling stations are way below the maximum acceptable limit of 250 mg/L and 350 mg/L for both Class A and Class C Waters (**Figure 2.2.43**). The lowest value was measured at SW-3 station.

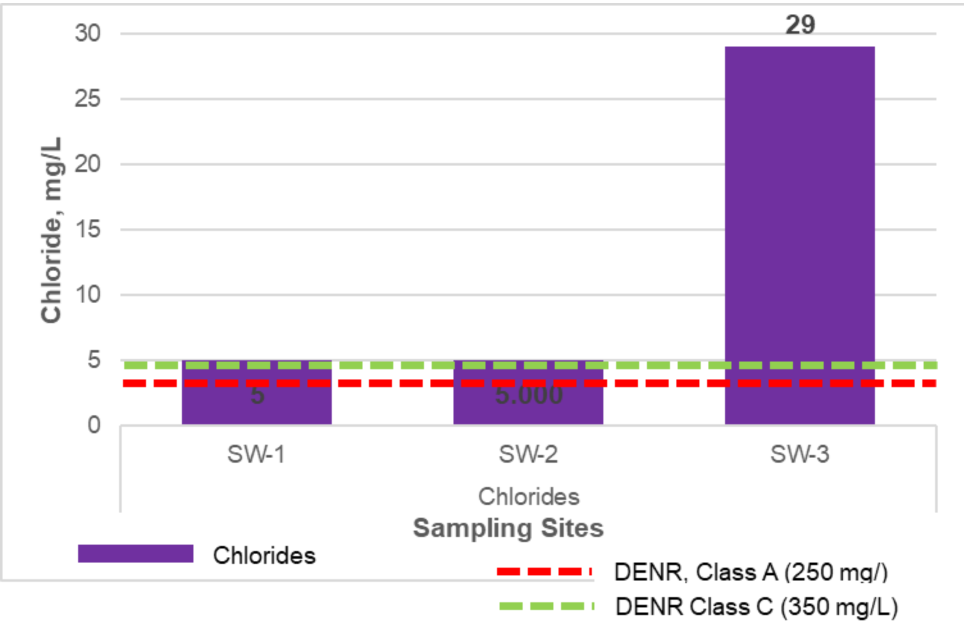


Figure 2.2.43: Results of Chloride Measurement of Surface Water Samples

Temperature

Temperatures in all sampling stations are within the acceptable range of 26°C to 30°C and 25°C to 31°C of the DENR guidelines for Class A and Class C Waters, respectively.

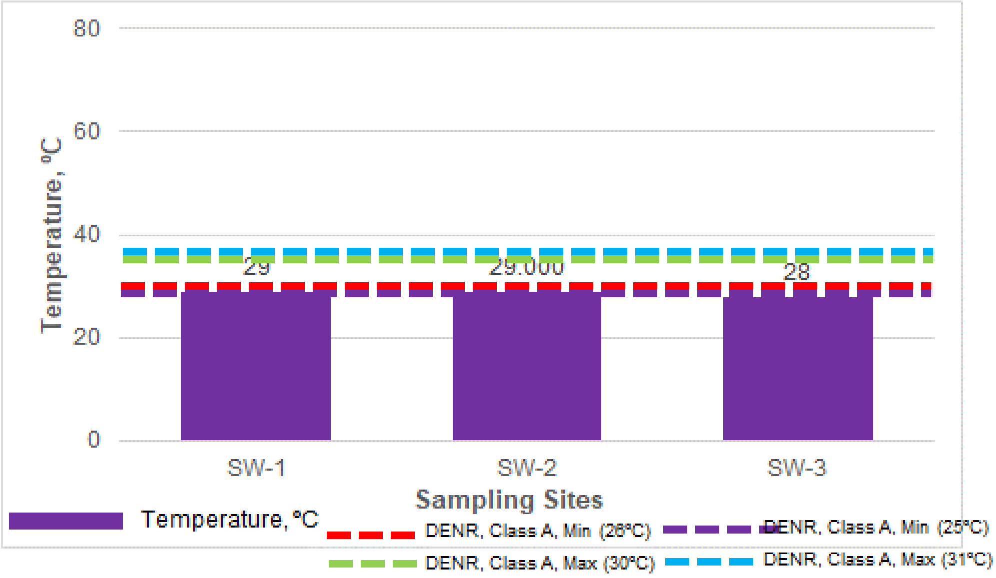


Figure 2.2.44: Results of Temperature Measurement of Surface Water Samples

2.2.3.2 Groundwater Quality

Groundwater samples were collected on April 9, 2022 at two (2) sampling stations to assess the physio-chemical properties of the groundwater within the vicinity of the Project site. The parameters tested for water quality in Amnay River are divided into five groups, namely, (1) physical - Total suspended solids (TSS), potential hydrogen (pH) -, (2) organic - 5-day biochemical oxygen demand (BOD), minimum-dissolved oxygen, Oil and grease, (3) nutrients - Nitrate, Phosphate, Ammonia, (4) heavy metals - Cadmium, Chromium, Lead, Mercury, Arsenic and (5) microbial - Total and fecal coliform. **Table 2.2.10** and **Figure 2.2.45** present the coordinates and the location map of the ground water quality sampling stations, respectively.

Table 2.2.10: Coordinates of the Groundwater Quality Sampling Stations

Sampling Station	Coordinates	
	Latitude	Longitude
1	12.956021° N	120.889339° E
2	12.956248° N	120.820133° E
3	12.94648° N	120.775086° E

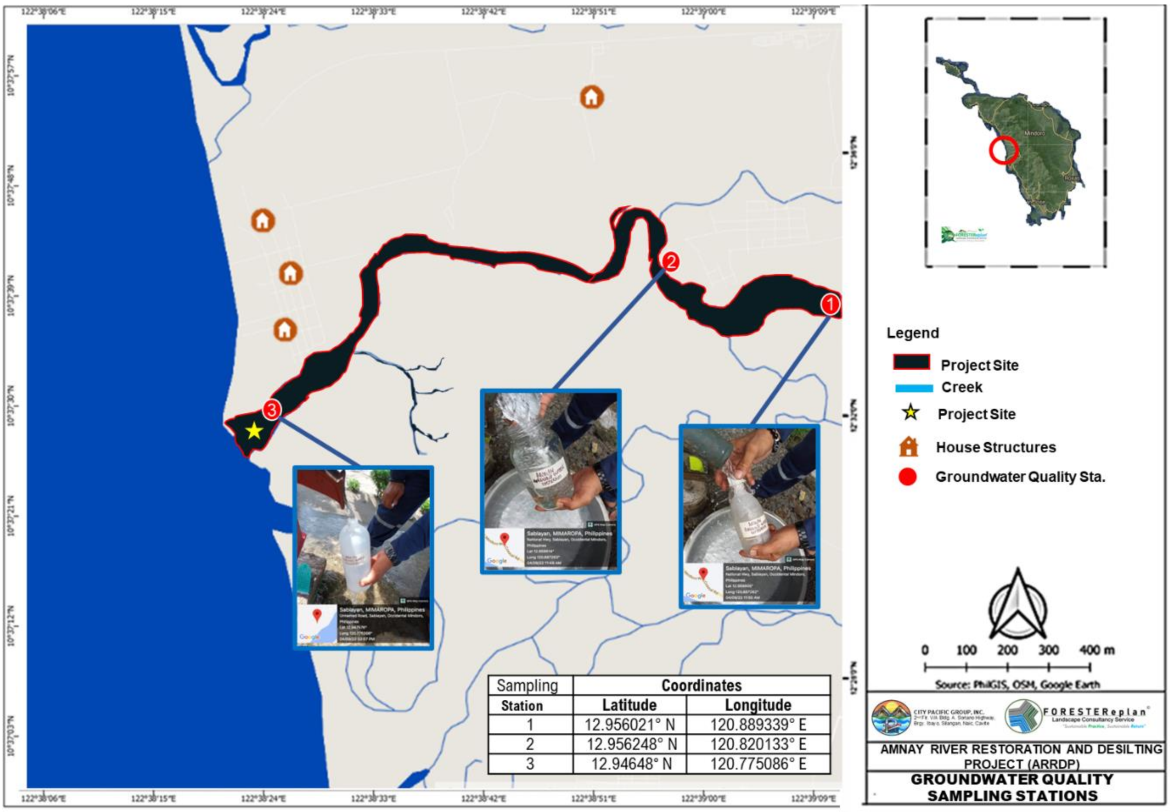


Figure 2.2.45: Location Map of Groundwater Quality Sampling Stations

Water samples were collected using grab sampling and were analyzed for physiochemical analysis to provide baseline water quality information of Amnay River 50.0 m upstream and downstream of the proposed dredge site. The samples are then put in an icebox with ice and transported to a DENR accredited laboratory for analysis. The methods of laboratory analysis are all in accordance with the guidelines prescribed by DENR (DAO 34 s. 1990) and are based on Standard Methods for the Examination of Water and Wastewater 22nd Edition. Several water parameters such as pH, Dissolved Oxygen (DO), Bio-chemical oxygen Demand (BOD) Total Suspended Solids (TSS), Oil and Grease and Total Fecal Coliform. Results are then compared to DENR Standards for Freshwater.

Sampling results presented in **Table 2.2.11** show that almost all parameters did not exceed the standard levels of PNSDW, except for levels of Mercury, Ammonia Sulfate, and Fecal Coliform in both sampling stations.

Table 2.2.11: Groundwater Quality Analysis Results, April 9, 2022

PARAMETERS	METHOD*	RESULTS		DENR Standards for Class A Water**	PNSDW*
		Upstream (Wells) HW-1 (11:50AM)	Downstream (Wells) HW-2 (02:07PM)		
***Arsenic, mg/L	Hydride Generator - AAS	< 0.0009	< 0.0009	0.01	0.70
***Fluoride, mg/L	4500-F C.Ion Selective Electrode Method	0.05	0.04	1	-
***Mercury, mg/L	Cold Vapor AAS	0.0031	0.0033	0.001	0.001
***Boron, mg/L	Carmine Method	< 0.1	< 0.1	0.5	-
***Manganese, mg/L	Flame AAS	0.02	0.02	0.2	-
***Selenium, mg/L	Electrothermal AAS	< 0.0004	< 0.0004	0.01	-
Temperature, °C	Mercury-Filled Thermometer	30.0	26.0	26-30	-

PARAMETERS	METHOD*	RESULTS		DENR Standards for Class A Water**	PNSDW*
		Upstream (Wells) HW-1 (11:50AM)	Downstream (Wells) HW-2 (02:07PM)		
Dissolved Oxygen, mg/L	Azide Modification (Winkler Method)	7.4	6.5	5	-
pH	Glass Electrode Method	6.82	6.68	6.5-8.5	-
TSS, mg/L	Gravimetric Method	< 2.5	< 2.5	50	-
Color (True), CU	Visual Comparison Method	5	5	50	10.00
Oil and Grease, mg/L	Liquid-Liquid, Partition Gravimetric Method	1.57	< 1	1	-
BOD, mg/L	Azide Modification (Dilution Technique)	3	4	3	-
Nitrates, mgNO_3-N/L	Brucine Sulfate Method**	3.03	0.923	7	50
Phosphate as P, mg/L	Stannous Chloride Method	< 0.03	0.032	0.5	250
Ammonia, NH3-N mg/L	Phenate Method	0.166	0.125	0.05	-
Surfactants, MBAS mg/L	Methylene Blue Colorimetric Method	< 0.1	< 0.1	0.2	2.00
Chlorides, mg/L	Argentometric Method	9	7	250	250
Sulfate, mg/L	Turbidimetric Method	20	19	2	-
Zinc, mg/L	Flame AAS	< 0.009	< 0.009	2	5.00
Chromium as Cr(VI), mg/L	Diphenyl Carbazide Colorimetric	< 0.009	< 0.009	0.01	0.05
Copper, mg/L	Flame AAS	< 0.005	< 0.005	0.02	-
Iron, mg/L	Flame AAS	< 0.004	< 0.004	1	-
Lead, mg/L	Flame AAS	< 0.001	< 0.001	0.01	0.01
Cyanide, mg/L	Ion Selective Method	< 0.04	< 0.04	0.07	-
Fecal Coliform, MPN/100mL	Multiple Tube Fermentation Technique	> 8.0	> 8.0	< 1.1	<1.1

* Standard Methods for Examination of Water and Wastewater, 23rd Edition APHA AWWA WEF Washington D.C., 2017
** Based on DENR DAO 2016-08 Water Quality Guidelines and General Effluent Standard.

Color

The results for both wells are below the DENR Guideline Value of 50 TCU for Class A waters and 10 TCU of PNSDW except station 3 which has reached the standard value for both parameters (**Figure 2.2.46**).

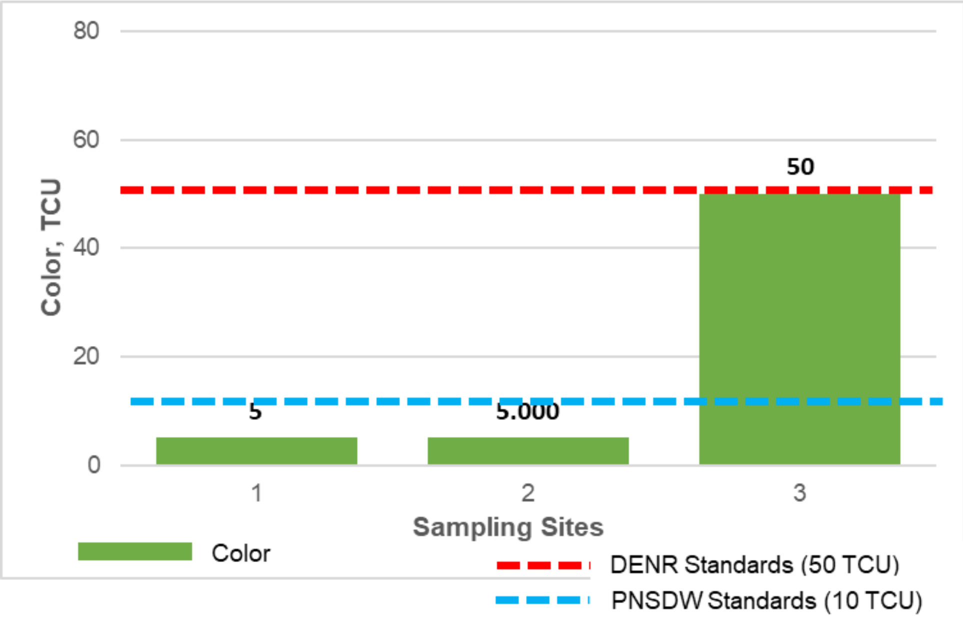


Figure 2.2.46: Results of Color Measurement of Groundwater Samples

Ammonia

The Ammonia in both stations exceed the DENR Groundwater Quality Guideline Value of 0.05 mg/L (**Figure 2.2.47**). There is no allowable limit for Ammonia under the PNSDW.

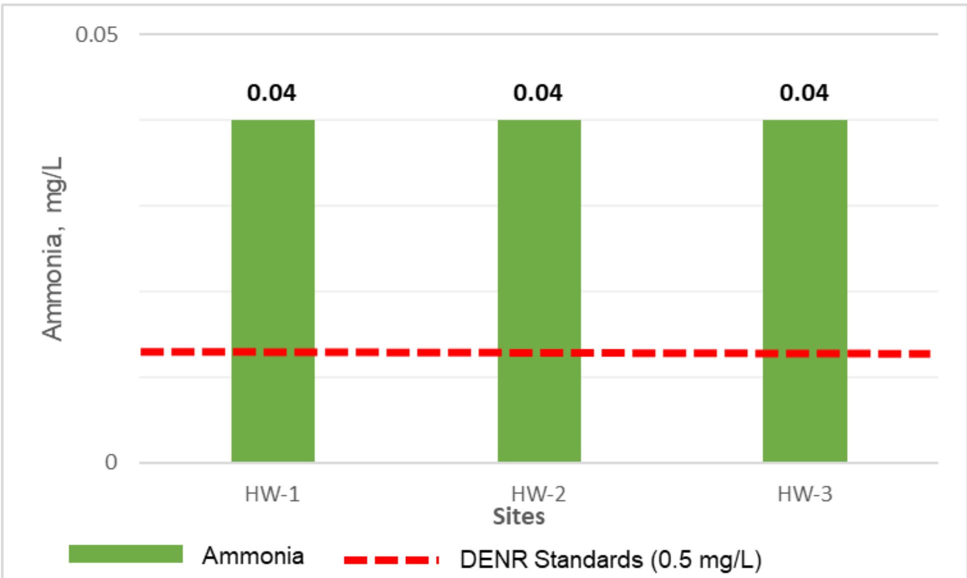


Figure 2.2.47: Results of Ammonia Measurement for Groundwater Samples

Total Suspended Solid (TSS)

The levels of TSS in both stations are way below the DENR Groundwater Quality Guideline Value of 50 mg/L (**Figure 2.2.48**). No allowable limit for TSS under the PNSDW.

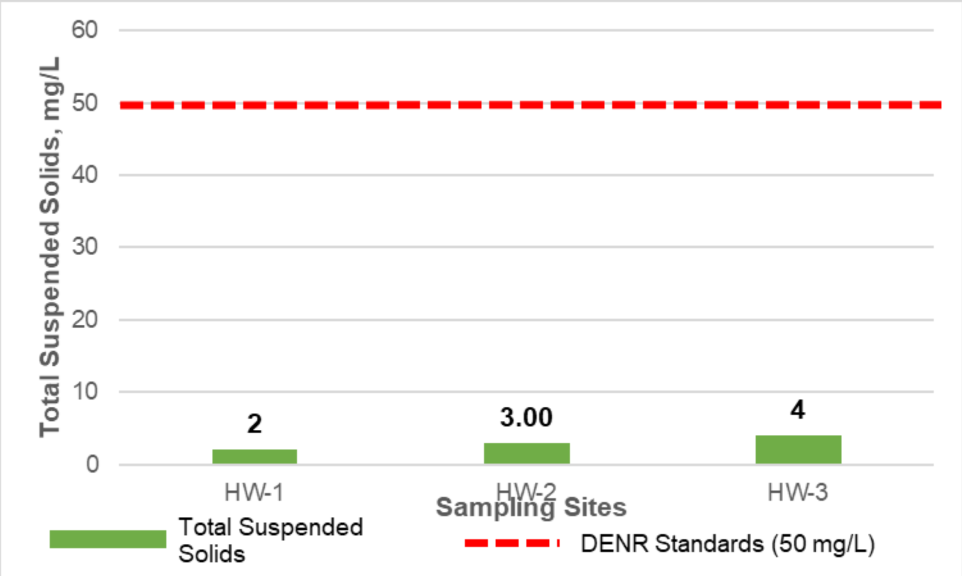


Figure 2.2.48: Result of Total Suspended Solids Measurement for Groundwater Samples

Arsenic

The levels of Arsenic in both stations are way below the DENR Groundwater Quality Guideline Value of 0.01 mg/L and PNSDW limit of 0.7 mg/L.

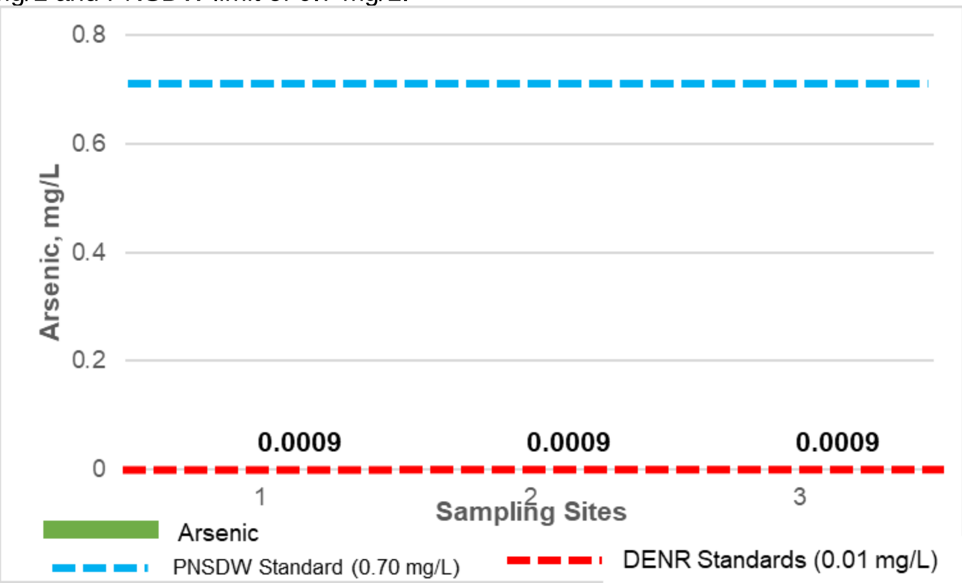


Figure 2.2.49: Result of Arsenic Measurement for Groundwater Samples

Total Coliform/Fecal Coliform

Coliform bacteria are present in the environment and in the feces of all warm-blooded animals and humans but are not likely to cause illness. However, it indicates that disease-causing organisms (pathogens) could be in the water system. Fecal coliform bacteria are sub-group of total coliform bacteria. The presence of fecal coliform in a water system indicates recent contamination and that there is a greater risk of pathogens. Fecal Coliform levels from both stations exceed the threshold for PNSDW and DENR Class A Water (**Figure 2.2.50**).

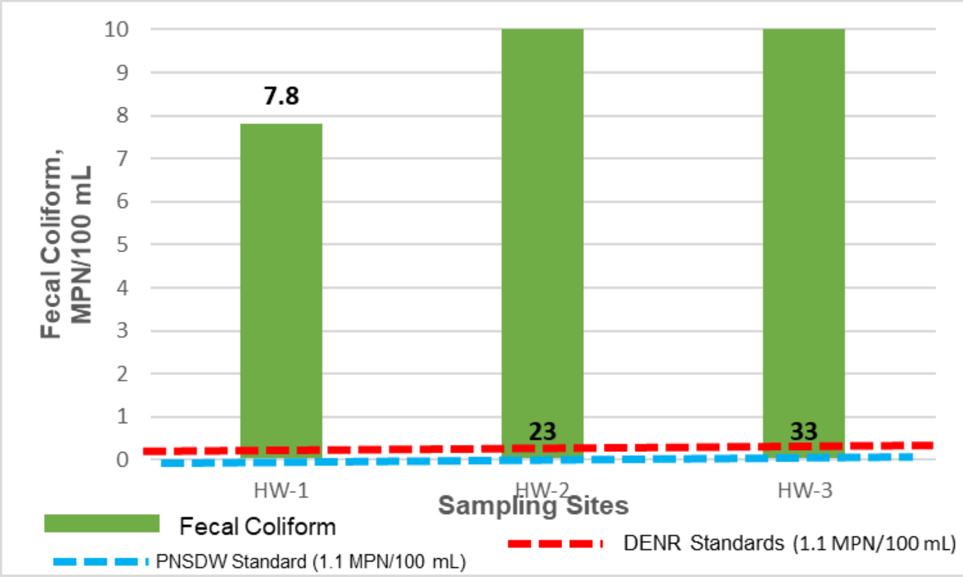


Figure 2.2.50: Result of Fecal Coliform for Groundwater Samples

Lead

The Lead concentration measured at both stations are way below the 0.01 mg/L limit for both DENR and PNSDW (**Figure 2.2.51**).

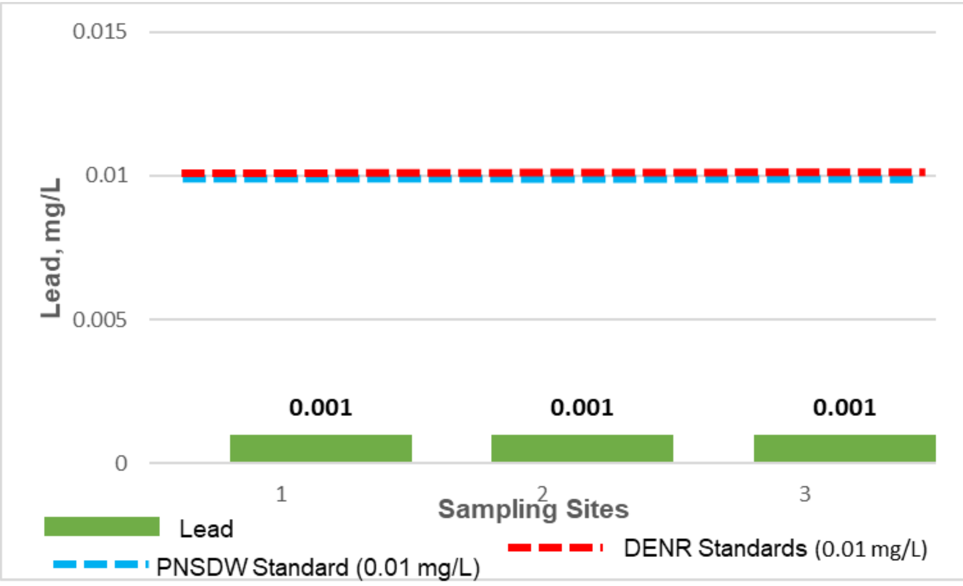


Figure 2.2.51: Result of Lead Measurement for Groundwater Samples

Chloride

The measured Chloride concentrations are 9 mg/L and 7 mg/L for HW-1 and HW-2, respectively. Levels at both stations did not exceed the 250 mg/L groundwater quality guideline value of the DENR and PNSDW (**Figure 2.2.52**).

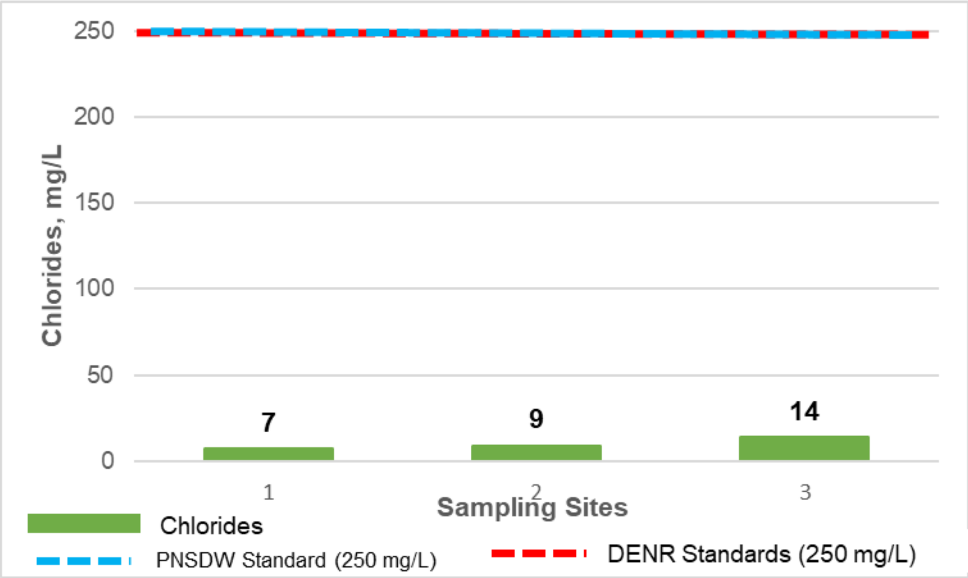


Figure 2.2.52: Result of Chloride Measurement for Groundwater Samples

Nitrates

The measured Nitrate concentration at both sampling stations did not exceed the DENR Groundwater Quality Guideline Value of 7 mg/L and the PNSDW of 50 mg/L (**Figure 2.2.53**).

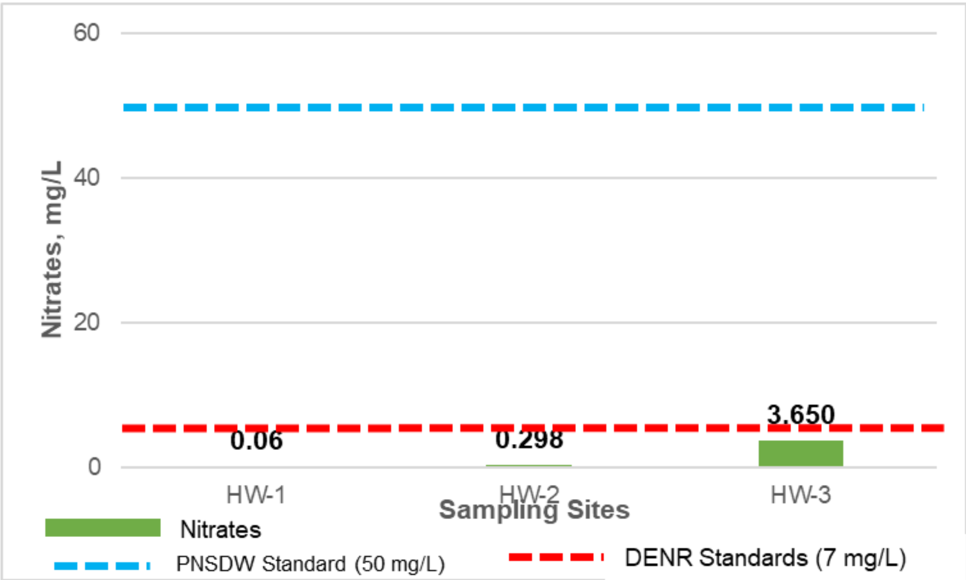


Figure 2.2.53: Result of Nitrates Measurement for Groundwater Samples

Phosphate

The measured Phosphate concentration at both stations was 0.03 mg/L and 0.032 mg/L for HW-1 and HW-2, respectively (**Figure 2.2.54**). This concentration did not exceed the DENR groundwater quality guideline value of 0.5 mg/L and PNSDW of 250 mg/L.

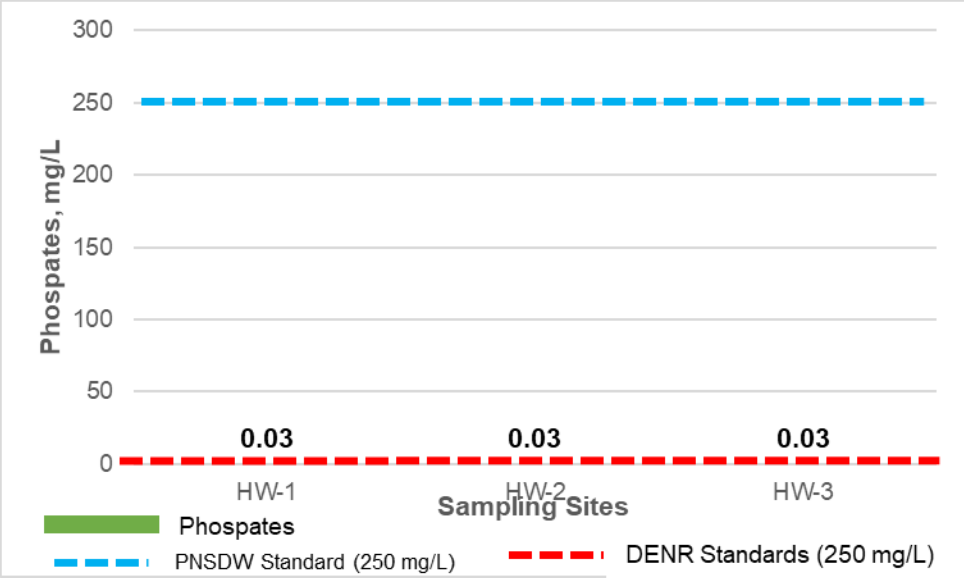


Figure 2.2.54: Result of Phosphate Measurement for Groundwater Samples

Surfactants

The Surfactant concentration at both stations was measured at <0.1 mg/L (**Figure 2.2.55**). This value did not exceed the DENR groundwater quality guideline value of 0.2 mg/L and PNSDW of 2 mg/L.

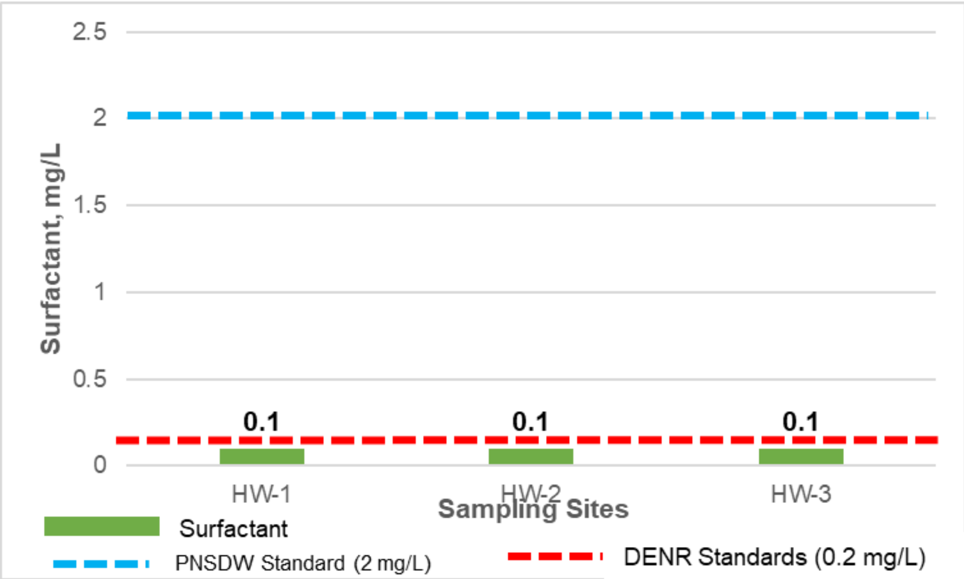


Figure 2.2.55: Result of Surfactants Measurement for Groundwater Samples

Chromium

The Chromium concentration measured at 0.009 mg/L for both HW-1 and HW-2y and did not exceed the DENR Groundwater Quality Guideline Value of 50 mg/L but almost near to the value of 0.01 mg/L limit of the PNSDW (**Figure 2.2.56**).

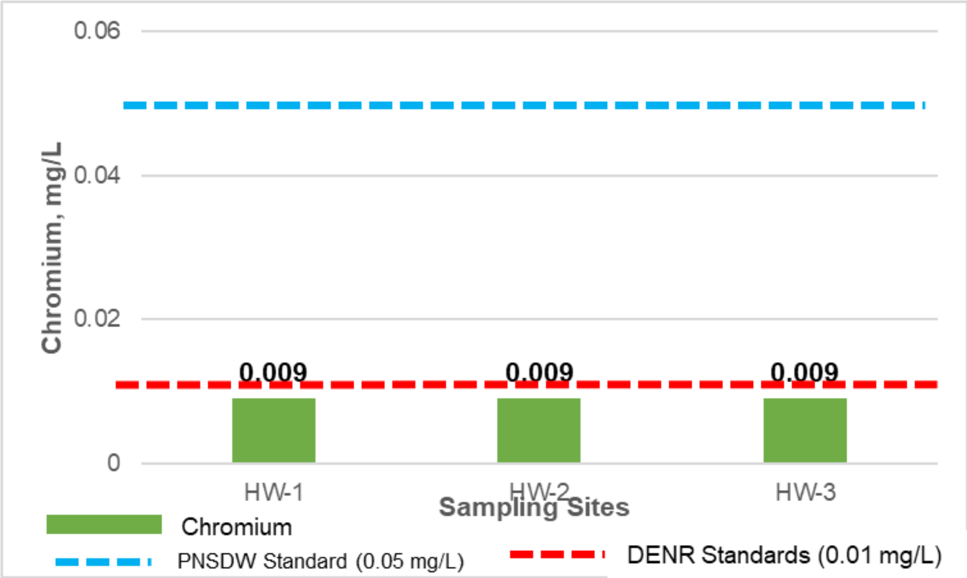


Figure 2.2.56: Result of Chromium Measurement for Groundwater Samples

Mercury

The Mercury concentration for HW-1 and HW-2 measured at 0.0031 mg/L and<0.0033 mg/L, respectively. These values exceeded both the Groundwater Quality Guidelines Value of the DENR and PNSDW limit of 0.001 mg/L (**Figure 2.2.57**).

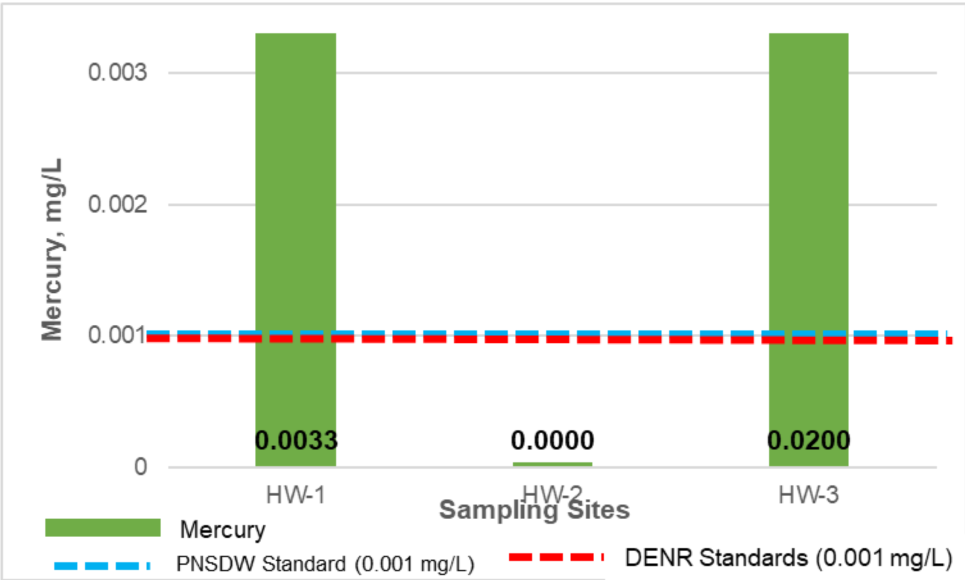


Figure 2.2.57: Result of Mercury Measurement for Groundwater Samples

Zinc

The Zinc concentration measured at 0.009 mg/L for HW-1 and HW-2, which did not exceed the DENR Groundwater Quality Guideline Value of 2 mg/L and the PNSDW limit of 5 mg/L (**Figure 2.2.58**.

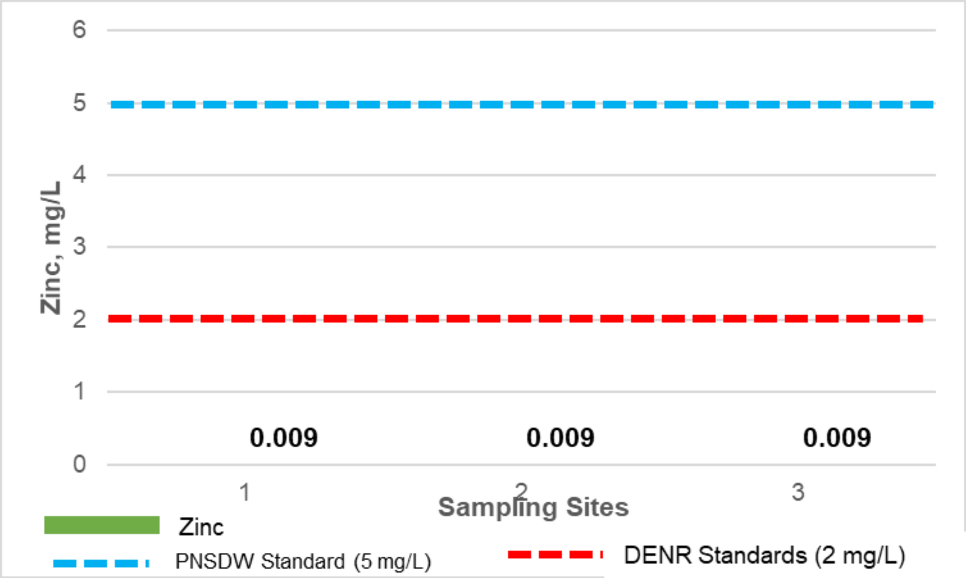


Figure 2.2.58: Result of Zinc Measurement for Groundwater Samples

Oil and Grease

The Oil and Grease concentrations for stations HW-1 and HW-2 were measured at 1.57 mg/L and 1.0 mg/L, respectively. HW-1 exceeded the values set by the DENR Groundwater Quality Guideline Value of 1 mg/L while HW-2 did not exceed the standard values. There is no allowable PNSDW limit for Oil and Grease (**Figure 2.2.59**).

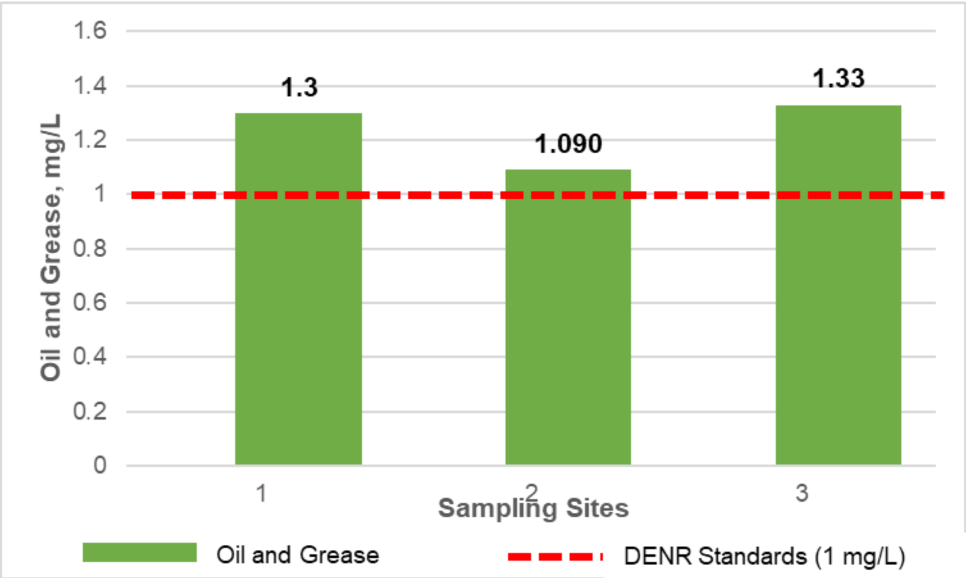


Figure 2.2.59: Result of Oil & Grease Measurement for Groundwater Samples

2.2.3.3 Marine Water Quality

Marine water sampling was carried out to assess the baseline physicochemical properties of the marine water in the vicinity of the proposed ARRD Project. **Table 2.2.12** and **Figure 2.2.60** present the coordinates and the location map of the marine water quality sampling stations, respectively.

Table 2.2.12: Marine Water Quality Sampling Stations

Sampling ID	GPS Coordinates (WGS84) UTM DATUM	
MW-1	12.939336° N	120.769673° E
MW-2	12.937876° N	120.763277° E
MW-3	12.936237° N	120.757349° E

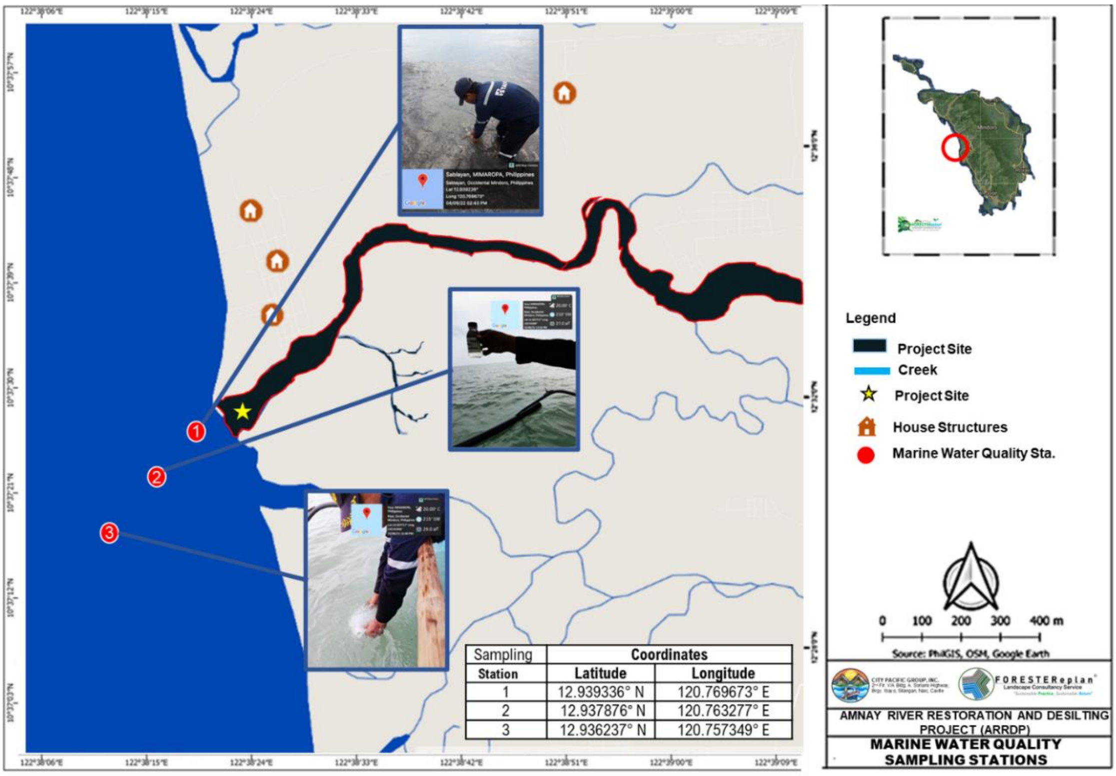


Figure 2.2.60: Location Map of the Marine Water Quality Monitoring Stations

Sampling results show that almost all parameters did not exceed the Water Quality Guideline Values of DENR DAO 2016-08 except for Phosphates, Chlorides and TSS, as presented in **Table 2.2.13**. The samples were collected on April 9, 2022 at 02:47 P.M.

Table 2.2.13: Marine Water Quality Sampling Results

PARAMETERS	METHOD*	RESULTS			DENR Water Quality Guideline Value for Class SC Water
		MW-1	MW-2	MW-3	
Temperature, °C	Mercury-Filled Thermometer	31.0	31.0	32.0	-
Dissolved Oxygen, mg/L	Azide Modification (Winkler Method)	6.4	6.6	5.8	-
pH	Glass Electrode Method	8.11	8.16	8.14	6.5-8.5
TSS, mg/L	Gravimetric Method Dried @ 1050 deg C	49	25	18	80
Color (True), CU	Visual Comparison Method	5	5	5	75
BOD, mg/L	Azide Modification Method (Dilution Technique)	3	4	4	-
Phosphate as P, mg/L	Stannous Chloride Method	0.0458	0.0257	0.0398	0.5
Chlorides, mg/L	Argentometric Method	10,624	15,267	15,889	-
Fecal Coliform, MPN/100 mL	Multiple Tube Fermentation Technique	350	350	280	200

Color

The Color range for all samples were measured at <5 TCU, which is below the DENR Water Quality Guideline Value (WQGV) for Class SC Water of 75 TCU (**Figure 2.2.61**).

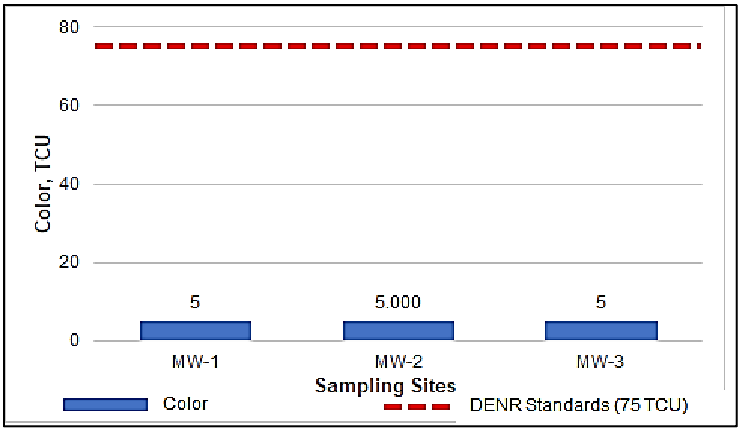


Figure 2.2.61: Result of Color Measurement for Marine Water Samples

Phosphate

The Phosphate concentrations for all stations which ranged from 0.026 mg/L to 0.0458 mg/L are all below the DENR WQGV of 0.5 mg/L (**Figure 2.2.62**).

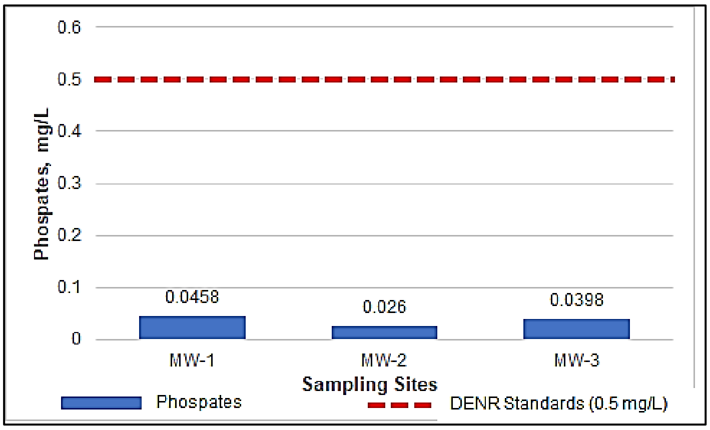


Figure 2.2.62: Result of Phosphate Measurement for Marine Water Samples

Total Suspended Solids (TSS)

Total Suspended Solids (TSS) is a measure of dust, dirt, sand, and other particles stirred up in the water; it is measured in milligrams per liter (mg/l). Excessive amounts of suspended solids can bury fish and aquatic plants, and can make rivers and streams unpleasant for recreation. In addition, other pollutants, such as oil, heavy metals, and nutrients are frequently attached to suspended solids. Thus, TSS can sometimes give a very rough indication of the presence of these other pollutants in a stream.

The levels of TSS measured at three (3) sampling stations are all below the DENR WQGV of 80 mg/L (**Figure 2.2.63**).

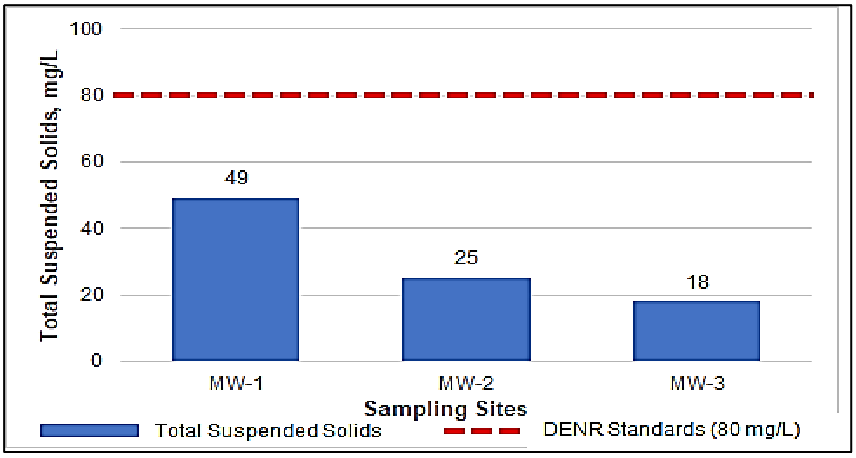


Figure 2.2.63: Result of Total Suspended Solids Measurement for Marine Water Samples

Fecal Coliform

The levels of Fecal Coliform measured at three (3) sampling stations exceed the DENR WQGV of 200 MPN/100mL (**Figure 2.2.64**).

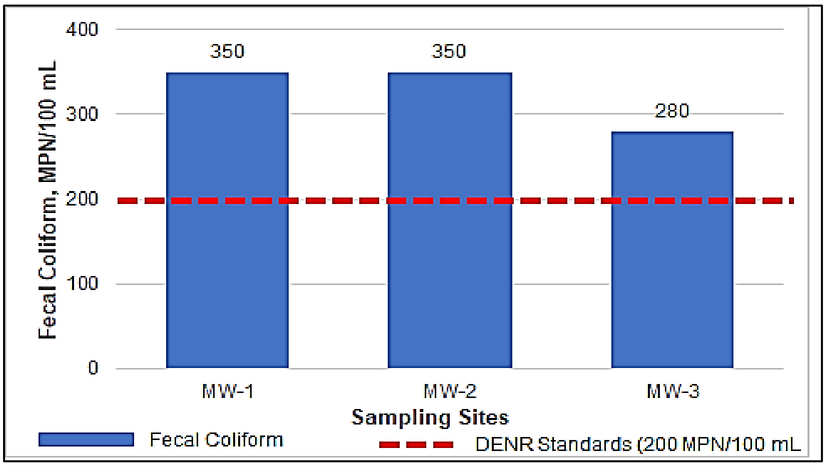


Figure 2.2.64: Result of Fecal Coliform Measurement for Marine Water Samples

2.2.3.4 Degradation of Freshwater Quality

There may be short-term considerable increase in sediments and turbidity of Amnay River along the proposed project area due to dredging activities particularly during rainy periods. Installation of geomembrane and/or silt curtain near the river delta to minimize disturbance of river will be utilized if necessary. The same sediment control measures to mitigate plumes and sediment flows will also be used to reduce the level of suspended solids to permissible levels going to the receiving water body. Appropriate study, compliance and planning water following the approved DPWH dredging design and permit will be undertaken and use of safe, efficient, and effective dredging equipment will be done.

Wastewater generated by the increased number of workers will cause deterioration of the existing water quality if inadequate portable toilets are not provided at the project site. Fuel, lubricant and hydraulic oil discharges from poorly maintained dredging equipment, machineries and heavy vehicles will also impact the water quality. During repair of equipment and machinery, containers/drip trays will be used to collect leakage for inland equipment. Any spilled or spent oil will be collected and disposed by an accredited waste hauler and transporter.

During operation, increase in oil, gasoline, lubricants usage of equipment, which is expected in the service area, could potentially expose the surface waters (i.e., river and creeks) to risk of contamination. Leaks from oil containers, accidental spills, and excessive usage, may cause surface water contamination through runoff, and/or infiltration into the subsurface, eventually finding its way into streams and rivers. Contamination of surface water will pose threat to aquatic resources, health of the community who use water from contaminated wells for drinking and livelihood of some residents engaged in fishing.

2.2.3.5 Degradation of Groundwater Quality

Potential sources of groundwater contamination are from domestic wastes, oil spills, and leaks from machineries and equipment such as dredgers, backhoes, and dump trucks. Inappropriate disposal of untreated domestic wastewater coming from the offices and known sources of water contamination could possibly subvert and contaminate the surface and loose aquifer that is tapped by nearby communities. Oil leaks from heavy equipment such as back hoes, trucks and vehicles could also impact the shallow groundwater although this impact would be lesser in comparison with domestic wastewater discharges. Proper sewage management will be implemented in the area and integrated to the overall system which include the provision of temporary toilet facilities for workers.

Dredging equipment and other vessels or vehicles should be checked regularly for oil and fuel leaks. Provision for secondary containment of lining within fuel/oil storage area and operation equipment or machinery parking area. Operation wastes will be stored in a designated area while waiting for proper disposal. During operation, domestic wastewater would still be generated as well as solid and hazardous wastes, but these will be abated through safe and planned waste management plan. Domestic wastewater will be treated to conform with the Philippine Clean Water Act before discharging to the natural environment. Proper storage of chemicals and waste materials shall be provided such as secondary containment of lining within fuel/oil storage area. A waste management program for the storage, handling and transport/disposal of toxic substances and hazardous chemicals, as well as for non-toxic waste shall be implemented in accordance with DAO 2004-36 of Republic Act (RA) No. 6969 and with DAO 2001 – 34 of RA No. 9003. A spill contingency plan shall be prepared to manage oil and chemical spills.

2.2.3.6 Degradation of Marine/Coastal Water Quality

Pre-dredging activities entail the conduct of bathymetric surveys to determine the configuration of the shoal and drilling of exploratory holes to ascertain the nature and properties of the various layers of sediments. These activities will translate to localized and minor disturbance in the seawater surrounding the area.

During operation phase, the dredging activities is expected to release fine sediment materials into the water column. Suspended materials would be carried by the water flow. Sediments have the potential to smother corals when they settled on coral surfaces. Smaller particles which are suspended over longer periods can decrease light penetration within the water column and thus impacts photosynthetic processes. Coral bleaching had been known to be severe when anthropogenic factors such as sedimentation occurs in areas where temperature of water masses is higher than normal.

Transport and hauling of dredged materials are also expected to increase small bancas within the project site. The resulting dynamics may increase the probability of oil spills. Hydrocarbon spills can endanger marine organisms both benthic and pelagic by smothering, clogging gills, and toxicity reactions. In addition, excavation of materials from underwater may potentially affect the depth contour of the river bathymetry and vehicle movement may compact soil in the area. Likewise, without proper training and supervision, solid waste may be disposed or released off-vessel and wastewater from operators of dredging equipment and barge.

In order to mitigate these impacts, CPGI will implement the following:

- Regular monitoring of water quality;
- Provision of sanitation facilities in the dredging operation or barracks site;

- Effective implementation of dredging and desilting management plans to prevent oil spillage based on approved dredging plan;
- Provision of silt curtains for any plumes or sedimentation to minimize downstream siltation in Amnay River; and
- Provision of safe location of storage area for hazardous materials.

2.2.4 Freshwater Ecology

Freshwater Ecology survey was conducted on August 23-25, 2021 at seven (7) established survey stations in Amnay River. The freshwater communities assessed for this study were plankton (phytoplankton and zooplankton), periphyton, benthic macrofauna, and fish communities.

During the survey, sampling stations located along the stretch of the Amnay River were recorded to have fast water velocities. However, it must be noted that due to the shallowing of the river channels, various channels were formed on the sides of the main river flow. There are several portions that the river branches into two to three sub-tributaries that have apparent identical water volume, thus identifying which are the main flow is uncertain. Extensive river branching is most evident on the upstream portion of the proposed project such as Stations 5, 6, and 7. Deposition of the earth materials to the central portion of the river across its width indicates that branching occurs after massive flooding. Branching of the rivers occurs mainly due to the characteristics of the channel and the amount of sediment deposition occurring.

The physical characteristics of the study area, as supported by some observations, show that the riverbank of Amnay River is highly vulnerable to erosion. All stations assessed showed signs of erosion, particularly Station 4 where according to locals, a massive erosion happened one month before the survey was conducted. Accounts from the residents also suggested portions of farmlands have been reclaimed by the riverbank due to erosion. As observed by the locals, most of the instances where erosion of the bank occurs were during strong typhoons. However, as mentioned in Paringit and Abucay (2017), massive monsoonal rains have also caused massive erosion across the Amnay River basin. During the assessment, actual rice fields that are located 100 m away from the main channel flow are still eroded (**Plate 2.2.10**). The recency of massive flooding is also evident on the roads and several houses in Barangays Iltiva and Claudio Salgado, both located near the downstream portion of the river.

Plate 2.2.10: Erosion Across a Rice Field Located Adjacent to the Main River Channel of Amnay River

In terms of sediment deposition, there is an observed pattern of deposits along the entire stretch of the Amnay River. Heavy deposits of rocks were observed on the upstream portion while the downstream portion near the mouth exhibits compact silts. It is notable that deposition of the silts is not limited to the areas proximal to the channel, but also across several hundred meters away from the river. This is very evident in the amount of silts that spans around 460 m away from the river that covers rice fields and nearby households. The recent occurrence of the massive flooding in Amnay

River indicates possible disturbances to the freshwater organisms living in the area.

Table 2.2.14 and **Figure 2.2.65** present the description and the location map of the freshwater ecology survey stations as well as the salient observations on the physical characteristics of the freshwater ecosystem of Amnay River.

Table 2.2.14: Description of Freshwater Ecology Survey Stations

Stations	Geographical Coordinates	Description of the Site	Remarks (During Sampling)	Water Velocity and Interpretation (Magbanua et al. 2013)
Station 1	12°56'39.34"N 120°46'21.44"E	Sediment in the area is mostly compact clay with minimal suspended pebbles. The area is almost devoid of dense vegetation. The majority of both banks is covered by beach forest brushes. Several densely spaced built-up areas are located proximal to the station.	The site is the mouth of Amnay River draining to the sea (estuarine). The mouth of the river is estimated to be around 400 m wide. Several portions of the mouth were used as a docking area for transport and fishing boats.	0.33 meters/sec (FAST)
Station 2	12°56'51.81"N 120°46'37.81"E	Evident substrate is compact to loosen mud and clays with a deep black coloration. No dense vegetation on both banks. The left side of the bank where the majority of the houses were found has only patches of fruiting trees found. On the right side of the bank, eroded rice fields are located.	The site is nearby several built-up areas. Access to the station requires passing to several neighborhoods in the barangay. The area is also used as a docking station for several boats.	0.41 meters/sec (FAST)
Station 3	12°57'33.48"N 120°47'21.24"E	The substrate of this site is almost entirely sandy. Evident deposition of sandy and rocky sediments forms a central mound which the residents' claim wasn't present until the year 2018. Both sides of the bank are used for agricultural purposes. Built-up areas are approximately 200 meters away from the river channel.	There are existing rice fields on both sides of the banks, and other areas that weren't used for rice production remain grasslands.	0.39 meters/sec (FAST)
Station 4	12°57'16.15"N 120°48'58.92"E	The site is predominantly sandy; however, more rocks and pebbles are suspended on the sandy sediment compared to Station 3. Several uprooted trees by the recent overflowing of the river remained in the area. A sediment mound (the majority of which are rocks) in the central portion of the channel was also observed in the area.	The erosion of both sides of the bank is very evident. Then built-up areas located just 100 meters away from the current channel were already abandoned by the residents due to the risks posed by the river. Patches of vegetation were found on both sides which are mostly shrubs and small fruiting trees.	0.49 meters/sec (FAST)
Station 5	12°57'27.12"N 120°50'36.60"E	Evident mounting of sediments is observed on different portions across the river. The substrate is sandy to rocky with significantly more rock deposits relative to the other downstream stations. Agricultural lands are found on	The extensive branching of the main channel of the Amnay River is located on this site. The extensiveness of the branching of the river flow makes it difficult to identify which is the main	0.73 meters/sec (FAST)

Stations	Geographical Coordinates	Description of the Site	Remarks (During Sampling)	Water Velocity and Interpretation (Magbanua et al. 2013)
		both sides of the bank; however, eroded rice fields and croplands were observed to be reclaimed by the river. No built-up areas are nearby the station.	flow since several branches have the same channel flow. The cumulative channel of all the branches is also much wider than the downstream portion. The channel in total spans 700 m.	
Station 6	12°57'21.69"N 120°52'38.57"E	Big flood control structures (e.g., gabion walls) were installed near the area. A wide area of rock deposits was found spanning around 300 meters from the river flow. No built-up areas were nearby the river, but both sides beyond the rock deposits were used as rice fields.	Station 6 is the same as Station 5 in terms of the general width of the channel, and the extensive branching of the water flow. However, more rock materials were observed along the banks of this site.	1.07 meters/sec (FAST)
Station 7	12°57'16.87"N 120°53'12.68"E	The site is predominantly rocky with no extensive branching There is a dominant flow serving as the main channel, with various narrow channels on the sides. Gabion walls were also installed in several portions nearby the station. Water diversion schemes were also near the station for agricultural irrigation purposes.	The site is near Amnay Bridge. The station is near the edge of a ridge where vegetation is moderately dense. Built-up areas are almost one kilometer away from the main channel.	0.83 meters/sec (FAST)

Figure 2.2.65: Freshwater Ecology Survey Stations

Note: A. Station 1, B. Station 2, C. Station 3, D. Station 4, E. Station 5, F. Station 6, and G. Station 7

Plate 2.2.11: Freshwater Ecology Survey Stations

2.2.4.1 Plankton Communities

The water samples for phytoplankton and zooplankton analysis were collected in the pre-identified sampling stations along Amnay River. A total of four (4) replicate samples were collected in each station, two (2) bottles for the analysis of phytoplankton and two (2) bottles for the analysis of zooplankton. Each sample was collected by filtering 50 liters of water to a 30-um plankton net (**Plate 2.2.12**). After filtration, the water sample collected by the plankton net was immediately placed in 500 ml polyethylene (PET) bottles and was preserved with a 10% buffered formalin solution. The collected water samples were sealed and labeled accordingly. Samples were stored in styrofoam boxes and transported to the laboratory for analysis. In the laboratory, each water sample was concentrated by filtering the collected water in a 20 µm mesh net. The residuum was then diluted with 10 ml of the water filtrate and was returned to its original container.

Plate 2.2.12: Collection of Water Samples for Plankton Analysis

The analysis of phytoplankton and zooplankton was done under a compound microscope. For each sample, a 1 ml aliquot was drawn out from the concentrated water sample using a pipette and was dispensed on a gridded Sedgwick-Rafter counting chamber (20 mm x 50 mm). The Sedgwick-Rafter counting chamber was examined under a compound microscope at a magnification of 100x. Phytoplankton and zooplankton were identified to the lowest taxon possible using various identification keys. Counting of cells (phytoplankton) and individuals (zooplankton) and computation of density were done for each sample. Phytoplankton densities were expressed as cells/liter whereas zooplankton densities were expressed as individuals/liter.

2.2.4.1.1 Phytoplankton Community

The phytoplankton community in Amnay River is composed of 12 taxa classified under two (2) major groups namely, diatoms (Bacillariophyta) and green algae (Chlorophyta) (**Table 2.2.15**). Diatoms were the most represented group with seven (7) taxa, whereas green algae were represented by five (5) taxa. In terms of the overall relative mean density, green algae were the dominant phytoplankton group comprising 95.5% of the total cells counted. Diatoms, on the other hand, have a relative mean density of 5.5%.

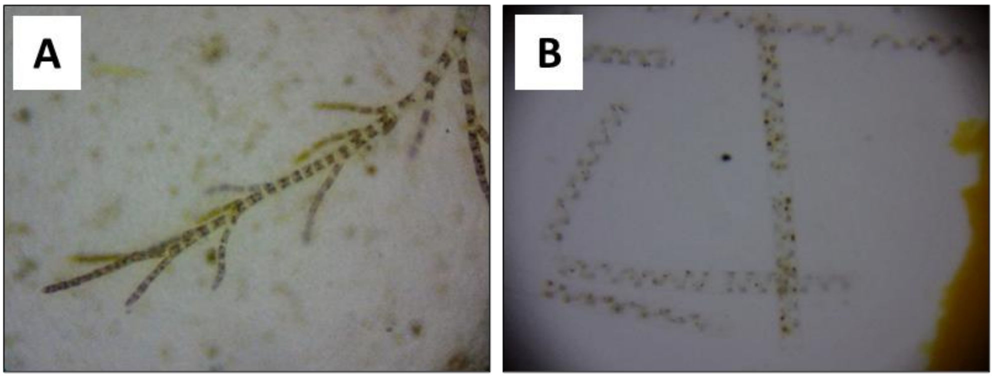
The overall mean density of phytoplankton in the study site was 23.2 cells/liter. Across survey stations, the highest mean abundance of green algae was recorded in Station 6 with 75.8 cells/liter, followed by Station 4 with 35.9 cells/liter, then Station 5 with 19 cells/liter. The rest of the survey stations have phytoplankton densities lower than 10 cells/liter. The mean density of green algae across the project site is 21.9 cells/liter. The mean abundance of diatoms across survey stations was generally low. The highest mean abundance of diatoms was recorded in Station 4 with 4.1 cells/liter, whereas the rest of the stations have densities below 2 cells/liter.

Among the identified phytoplankton taxa, *Stigeoclonium* contributed to the highest mean density at 16.5 cells/liter, where it comprised 71.1% of the total cells counted. Across survey stations, the highest mean density of *Stigeoclonium* was recorded in Station 6 with 75.8 cells/liter, then Station 5 with 19 cells/liter. Densities of *Stigeoclonium* on the rest of the survey stations were below 10 cells/liter. *Spirogyra* followed *Stigeoclonium* as one of the phytoplankton taxa that exhibited high mean abundance. Unlike *Stigeoclonium* which was present in most survey stations, *Spirogyra* was only recorded on Station 4 and Station 2. The highest mean abundance of *Spirogyra* across stations was recorded in Station 4 with 28.5 cells/liter. Notably, the mean abundance of *Spirogyra* in Station 2 was only 0.2 cells/liter. Other phytoplankton taxa have low mean densities, which were below 2 cells/liter.

The results showed that the phytoplankton abundance in the study site was low, with green algae and diatoms comprising the phytoplankton community structure. Phytoplankton growth is highly affected by the physical habitat characteristics of an ecosystem. The phytoplankton growth in rivers and streams with shallow and fast-flowing waters is often limited as phytoplankton are free-floating organisms that are easily drifted by water movement. Based on observations and recorded velocities, the entire stretch of the survey stations in Amnay River has shallow waters with fast velocities. The turbid waters of the sampling stations during the survey could also be a factor for the low phytoplankton density in the study area. The photosynthetic activity of phytoplankton is greatly limited by turbid waters as sunlight does not penetrate the water efficiently due to suspended sediment and silt (Dokulil 1994). The shallow and turbid waters of the sampling stations may be influenced by the frequent events of flooding and erosion that occur on the riverbanks. Accounts from locals mentioned that erosion is a common problem in the area as the Amnay River basin has a history of flooding incidents especially during typhoons and weather with continued heavy rainfall. The frequent disturbance brought by flooding and riverbank erosion may lead to the continued shallowing and increased turbidity of the waters in Amnay River. Hence, further affecting the phytoplankton community in the area.

Table 2.2.15: Mean (no. of cells/Liter) and Relative Densities (%) of Phytoplankton in the Seven Survey Stations

Taxa	Mean Abundance (cells/liter)							Overall Mean Density	Relative Mean Density
	S1	S2	S3	S4	S5	S6	S7		
Diatoms	1.6	1.7	4.1	0.4	0.5	0.5	0.2	1.3	5.5
1. Cymbella sp.	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1
2. Fragilaria sp.	0.4	0.8	0.7	0.1	0.4	0.4	0.0	0.4	1.7
3. Gyrosigma sp.	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.1	0.2
4. Navicula sp.	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.1
5. Pinnularia sp.	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
6. Surirella sp.	0.4	0.6	3.2	0.2	0.0	0.0	0.1	0.6	2.8
7. Synedra sp.	0.5	0.1	0.1	0.1	0.0	0.1	0.0	0.1	0.6
Green algae	6.6	6.0	4.0	35.9	19.0	75.8	6.0	21.9	94.5
8. Closterium sp.	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
9. Microspora sp.	0.0	0.5	0.0	3.3	0.0	0.0	0.0	0.5	2.3
10. Oedogonium sp.	0.0	5.3	0.0	0.0	0.0	0.0	0.0	0.8	3.3
11. Spirogyra sp.	0.0	0.2	0.0	28.5	0.0	0.0	0.0	4.1	17.7
12. Stigeoclonium sp.	6.5	0.0	4.0	4.1	19.0	75.8	6.0	16.5	71.1
MEAN DENSITY	**8**	**8**	**8**	**36**	**20**	**76**	**6**	**23.2**	**100.0**
STDEV	**7**	**8**	**2**	**41**	**27**	**1**	**9**		
NUMBER OF TAXA	**7**	**8**	**5**	**7**	**3**	**3**	**3**	**12**	



Note: A. Stigeoclonium; B. Spirogyra

Plate 2.2.13: Dominant Phytoplankton Taxa Observed in Amnay River

2.2.4.1.2 Zooplankton Community

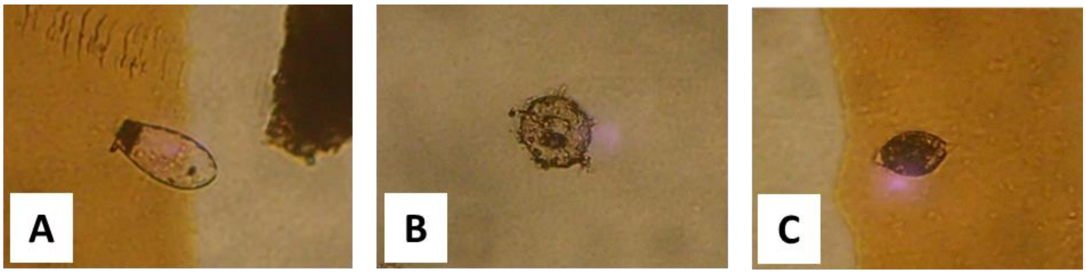
The zooplankton community of Amnay River is composed of three (3) taxa classified under three (3) major groups namely Amoebozoa, Ciliophora, and Euglenozoa (**Table 2.2.16**). All major groups were only represented by one (1) taxon each. The Phylum Amoebozoa was represented by the genus *Centropyxis*, which is one of the most abundant testate amoebae worldwide as this genus has been recorded to occur in a wide range of environments (Foissner and Korganova 2000). The microzooplankton *Tintinnid* was the sole representative of Phylum Ciliophora. *Tintinnid* is known to be common and widely distributed in marine habitats, estuaries, and rivers across the world (Li et al. 2019; Urrutxurtu 2004). *Euglena,* on the other hand, was the only representative under Phylum Euglenozoa. Similar to *Centropyxis* and *Tintinnid, Euglena* is known to be widely distributed in the world in a wide range of habitats. Often, these organisms live in fresh and brackish water habitats such as ponds rich in organic matter (Borowitzka 2018).

In general, results showed that the species abundance and mean density of zooplankton in the study site are low. In terms of the overall relative mean density, Amoebozoa (*Centropyxis*) was recorded to have the highest comprising 50% of the total zooplankton individuals counted, followed by Ciliophora (*Tintinnid*) with 37.5%, then least was Euglenozoa (*Euglena*) with 12.5%. Across survey stations, the mean abundance of zooplankton is extremely low, with Amoebozoa (Centropyxis) having the highest density in Station 5 at 0.3 individuals/liter. A value of less than one (1) individual per liter for the mean abundance could indicate that no zooplankton is present in a 50-liter water sample obtained from the site. Notably, no zooplankton individuals were recorded in Stations 2 and 7. The rest of the survey wherein zooplankton were present have the same mean abundance. In terms of species richness, only Station 1 was recorded to have two (2) zooplankton taxa present (*Centropyxis* and *Tintinnid*) and the rest of the survey stations with recorded zooplankton only have one taxon (1) each.

Similar to phytoplankton communities, the growth of zooplankton in freshwater ecosystems is highly influenced by the physical habitat features of the site and the factors affecting the water quality. Zooplankton are also free-floating organisms. Hence, they are easily drifted by water movement. Rapid flushing of plankton in rivers with fast velocities was shown to limit the growth rates and feeding capacities of zooplankton. Shallow depths with fast-flowing water could also limit the type of zooplankton present in an area. Some zooplankton are considered poor swimmers and rapid water flow limits their ability to position in the water column actively to feed (Viroux 1999). Zooplankton with larger sizes (e.g., cladocerans) were also observed to have more difficulty in swimming against water with fast velocities, limiting their feeding abilities. The abundance and species composition of the phytoplankton present in the area could also strongly influence the growth and survival of zooplankton, as the zooplankton mainly grazes on phytoplankton. Protozoans, which are mainly the zooplankton observed in this study, are very active consumers of bacteria and the smallest size classes of algae (<10 μm) (Sterner 2009). Since phytoplankton density was also low and the community composition was only of diatoms and filamentous green algae, the feeding of zooplankton may also be limited.

Table 2.2.16: Mean (No. of Individuals/Liter) and Relative Densities (%) of Zooplankton in the Seven Survey Stations in Amnay River

Taxa	Mean Abundance (Individuals/Liter)							Overall Mean Density	Relative Mean Density
	S1	S2	S3	S4	S5	S6	S7		
Amoebozoa	0.1	0	0	0	0.3	0	0	0.06	50.0
1. *Centropyxis sp.*	0.1	0	0	0	0.3	0	0	0.06	50.0
Ciliophora	0.1	0	0	0.1	0	0.1	0	0.04	37.5
2. *Tintinnid sp.*	0.1	0	0	0.1	0	0.1	0	0.04	37.5
Euglenozoa	0	0	0.1	0	0	0	0	0.01	12.5
3. *Euglena sp.*	0	0	0.1	0	0	0	0	0.01	12.5
Mean Density	**0.2**	**0**	**0.1**	**0.1**	**0.3**	**0.1**	**0**	**0.11**	**100.0**
STDEV	**0.3**	**0.0**	**0.1**	**0.1**	**0.1**	**0.1**	**0**	**-**	**-**
Number of Taxa	**2**	**0**	**1**	**1**	**1**	**1**	**0**	**3**	**-**



Note: A. *Tintinnid sp*.; B. *Centropyxis sp*.; and C. *Euglena sp.*

Plate 2.2.14: Zooplankton Taxa Observed in Amnay River

2.2.4.1.3 Periphyton Community

The samples for periphyton community assessment were collected in the pre-identified sampling stations along Amnay River. In each station, periphyton samples were collected in a standard surface area (diameter = 10 cm) by scraping algae on surfaces of rocks, logs, other stable substrates within the river (**Plate 2.2.15**). The collected samples were then placed in bottles and fixed with 10% buffered formalin. The samples collected were kept in a storage (styrofoam) box and were transported to the laboratory. Two replicate samples of periphyton were collected in each station. The periphyton samples were analyzed in the laboratory using a compound microscope under a magnification of 100x. The analysis of each sample was done by obtaining one 1 ml of the sample and dispensing it on a gridded Sedgwick-Rafter counting chamber (20mm x 50mm). The periphyton observed were counted and identified to the lowest taxa possible using various identification keys.

Note: (a) Scraping algae on surfaces of rocks, logs, other stable substrates on a standard surface area (diameter = 10 cm). (b) Periphyton collected were placed in bottles and fixed with 10% buffered formalin, (c) Two (2) replicate samples of periphyton were collected.

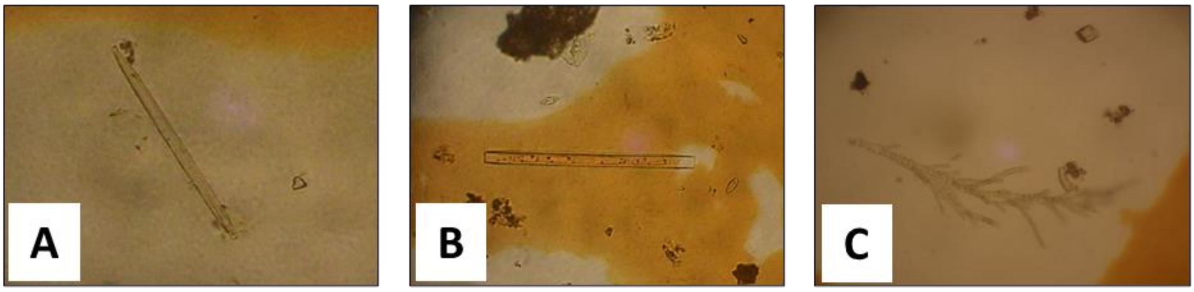
Plate 2.2.15: Collection of Samples for Periphyton Community Analysis

The periphyton community in Amnay River is composed of 12 taxa classified under three major groups namely diatoms (Division Bacillariophyta), green algae (Division Chlorophyta and Division Charophyta), and blue-green algae (Division Cyanophyta) (**Table 2.2.17**). Among the major groups, diatoms have the most representative with eight (8) taxa, followed by green algae with three (3) taxa, and the least was blue-green algae which were only represented by one. However, in terms of the relative mean abundance, green algae were dominant comprising 88% of the total cells counted, followed by diatoms with 11%, then least was blue-green algae with only 1%. Across survey stations, the highest species richness was recorded in Station 3 with 10 taxa, followed by Station 4 with seven (7) taxa, then Station 5 with six (6) taxa. The rest of the sampling stations were recorded to have four (4) taxa each. In terms of the mean abundance across stations, the highest was recorded in Station 3 with 236 cells/ml. The highest mean density of green algae and diatoms across stations was also recorded in Station 3 with a mean abundance of 212 cells/ml and 22 cells/ml, respectively. Station 7, despite having only four (4) periphyton taxa, followed Station 3 in terms of the highest mean abundance with 196 cells/ml. *Stigeoclonium* significantly contributed to the relative densities of periphyton in Stations 3 and 7. The other sampling stations have periphyton densities below 100 cells/ml where the least was recorded in Stations 1 and 2 with only 6 cells/ml each. The diatoms *Fragilaria* and *Synedra* were the most common periphyton taxa in the survey site, as these taxa were recorded to be present in all sampling stations. Notably, *Stigeoclonium* was only absent in Stations 1 and 2 but has significantly higher densities in the rest of the survey stations. On the other hand, the blue-green algae *Oscillatoria* was only recorded in Stations 3 and 5 with 3 cells/ml.

Overall, the periphyton abundance in the study site was low. Limited periphyton growth in the study site could be attributed to the same factors affecting the phytoplankton and zooplankton communities. By definition, periphyton is an association of filamentous algae, free-floating algae, and associated microbes that have settled on a stable substrate. Periphyton is often seen in rivers and streams as mats of algae attached to various surfaces (e.g., rocks, logs, macrophytes, benthic substrate). The primary substrate within Amnay River is compact sand, clay, and silt. Rocks and pebbles are also found in the entire stretch of the river. Macrophytes, on the other hand, were absent. It has also been observed that no evident algal mats were present in the study site. The absence of a stable substrate, fast water velocity in the stretch of Amnay River, and possibly the increased sediment suspension and deposition brought by the fast water flow, and reported the frequent occurrence of flooding and erosion, are the primary factors that may have affected the growth of periphyton in the study site. Specifically, periphyton growth and primary productivity in the site may have been limited by increased sediment suspension and turbidity.

Table 2.2.17: Mean and Relative Densities of Periphyton in the Seven Survey Stations in Amnay River, August 2021

Taxa	Mean Abundance (cells/ml)							Overall Mean Abundance	Relative Mean Abundance
	S1	S2	S3	S4	S5	S6	S&		
Diatoms	6	6	22	13	4	2	14	9	11
1. Fragilaria sp.	3	3	4	9	2	1	7	4	4
2. Gomphonema sp.	0	0	9	3	0	0	0	2	2
3. Gyrosigma sp.	0	1	1	0	1	0	0	0	0
4. Navicula sp.	1	0	2	1	0	0	0	0	0
5. Pinnularia sp.	0	0	1	0	0	0	0	0	0
6. Pleurosigma sp.	0	0	2	0	0	0	0	0	0
7. Surirella sp.	2	1	4	0	0	1	1	1	1
8. Synedra sp.	1	2	1	1	2	1	6	2	2
Green Algae	0	0	212	73	35	44	182	78	88
9. Microspora sp.	0	0	0	2	21	0	0	3	4
10. Spirogyra sp.	0	0	0	21	0	0	0	3	3
11. Stigeoclonium sp.	0	0	212	51	14	44	182	72	81
Blue-green algae	0	0	3	0	3	0	0	1	1
12. Oscillatoria sp.	0	0	3	0	3	0	0	1	1
MEAN ABUNDANCE	6	6	236	86	42	46	196	88	100
STDEV	1	1	41	22	16	16	50		
NUMBER OF TAXA	4	4	10	7	6	4	4	12	



Note: (a) Synedra; (b) Fragilaria; (c) Stigeoclonium.

Plate 2.2.16: Periphyton Taxa Observed in Amnay River

2.2.4.2 Benthic Macrofauna Communities

The sediment samples for benthic macrofauna analysis were collected from seven (7) pre-identified sampling stations along Amnay River. Two bags of sediment samples of approximately one liter each were collected for each sampling station. The sediment sample was collected using a metal trowel within an estimated area of 0.02 m^2. The collected samples were carefully transferred in a resealable ziplock bag and were preserved with 10% formalin. Samples were then stored in styrofoam boxes and transported to the laboratory for analysis.

In the laboratory, each bag of sediment sample was processed accordingly. Each sediment sample was initially washed with tap water to remove formalin. Sediments were then sieved through a series of 2 mm, 1 mm and 0.5 mm mesh size brass sieve. For each stage of sieving, the macroinvertebrates retained in the brass sieve were hand-picked and placed in labeled containers. Whereas sediments retained in the 0.5 mm sieve were further subjected to examination under a stereomicroscope for sorting of infaunal organisms. After the sorting of macro-and infaunal organisms, the sorted organisms were then preserved with 70% ethanol. Benthic macroinvertebrate and infaunal organisms were identified in the lowest possible taxon based only on morphological characteristics using available published references.

Plate 2.2.17: Collection of Sediments for Benthic Macroinvertebrate and Infauna Analysis

The benthic macrofauna communities in Amnay River are composed of three (3) belonging to two major groups namely Class Gastropoda and Class Insecta (**Table 2.2.18**). In terms of the overall relative abundance, Insecta was dominant comprising 80% of the individuals counted. On the other hand, Gastropoda only comprised 20% of the individuals counted. The mean abundance of benthic macrofauna across survey stations is generally low, with a mean abundance ranging from 0.5 to 3 individuals/0.02m^2. It is noteworthy that no benthic macroinvertebrates were recorded from the sediment samples collected in Stations 2, 4, and 7. Station 1 was recorded to have two (2) benthic macroinvertebrate taxa, Thiara and Chironomid larvae, whereas Stations 3, 5, and 6 have only one (1) taxon each.

Gastropoda was represented by the taxa *Stenomelania* and *Thiara*, both of which are under Family Thiardae. Across survey stations, *Stenomelania* and *Thiara* were only recorded in Station 1 and Station 6, respectively, with a mean abundance of 0.5 individuals/0.02m^2. A mean value of less than one (1) individual per 0.02m^2 indicates the occurrence and distribution of these species in the general survey area were few and sparse, respectively. On the other hand, Class Insecta was only represented by larval individuals under Order Diptera, Family Chironomidae. The abundance of chironomid larvae was highest in Station 5 with 3 individuals/0.02m^2, whereas Stations 1 and Station 3 have only 0.5 individuals/0.02m^2. Although chironomid larvae are found in more sampling stations, the overall mean abundance was also low and did not significantly differ from the abundance of thiarids.

Family Thiardiae is a group of gastropods found worldwide and inhabits a wide range of habitats, from inland freshwaters, brackish-water environments at lower, tidally influenced reaches of coastal rivers and streams (Gimnich 2015). Thiarid snails favor inhabiting freshwater ecosystems with slow to immediate flow running water, where they bury themselves in mud or sandy bottoms or attach to rock (Waikagul and Thaenkham 2014). On the other hand, Chironomidae larvae are known to occur in all types of habitats, including rivers, streams, lakes, ponds, water supplies, and sewage systems (Hall and Gerhardt 2002). Chironomid distribution is highly influenced by the nature of the substrate and hydraulic features (e.g., depth and flow) of the riverine ecosystem Statzner, Gore, and Resh 1988). More complex substrates showing persistence in the temporal dimension supported more diverse assemblages of chironomids (Epele, Miserendino, and Brand 2012).

Overall, the low abundance and sparse distribution of benthic macrofauna in the study site is indicative of the existing disturbance on the benthic habitat. As observed during the sampling, and supported by the statement of locals, flooding and erosion is a common problem in the entire stretch of Amnay River.

Although complex substrates support more diverse assemblages of benthic macrofaunal communities, frequent disturbance of the substrate brought by erosion, sedimentation, and other related phenomena could highly disturb the organisms thriving in the area. For gastropods, frequent erosion and sediment suspension could clog their respiratory and feeding apparatus that can lead to their mortality. The types of benthic macroinvertebrates thriving in the area are deemed to be limited because of environmental disturbances.

Table 2.2.18: Total (Individuals/0.02m^2) and Relative Abundances (%) of Benthic Macroinvertebrate and Soft-Bottom Fauna in Seven Stations Established in Amnay River

Taxa	Individuals/0.02m^2							Total Abundance	Relative Abundance
	S1	S2	S3	S4	S5	S6	S7		
Gastropoda	**0.5**	**0.0**	**0.0**	**0.0**	**0.0**	**0.5**	**0.0**	1.0	20
1. Stenomelania sp.	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.5	10
2. Thiara sp.	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.5	10
Insecta	**0.5**	**0.0**	**0.5**	**0.0**	**3.0**	**0.0**	**0.0**	4.0	80
3. Chironomidae	0.5	0.0	0.5	0.0	3.0	0.0	0.0	4.0	80
Mean Density	1	0	1	0	3	1	0	5	100
STDEV	1.414	0	0.7071	0	4.243	0.707	0	-	-
Number of Taxa	2	0	1	0	1	1	0	3	-

Note: (a) *Thiara sp.;* (b) *Stenomelania sp.;* (c) Chironomid larvae

Plate 2.2.18: Individuals of Chironomidae Observed in Amnay River

2.2.4.3 Fish Communities

The survey of the fish communities in Amnay River was done through opportunistic sampling. The limited methodology was done during the sampling due to the extremely shallow nature of the river. Hence, during the survey, only the fish caught by locals who were fishing along the stretch of the project site was recorded and photographed. Brief interviews were also conducted to determine their fishing activities and knowledge of the fish caught (e.g., local name of the fish). In the laboratory, the fish caught by locals were identified to the nearest taxon possible. The total length of each fish species was also measured to the nearest centimeter using the ImageJ software.

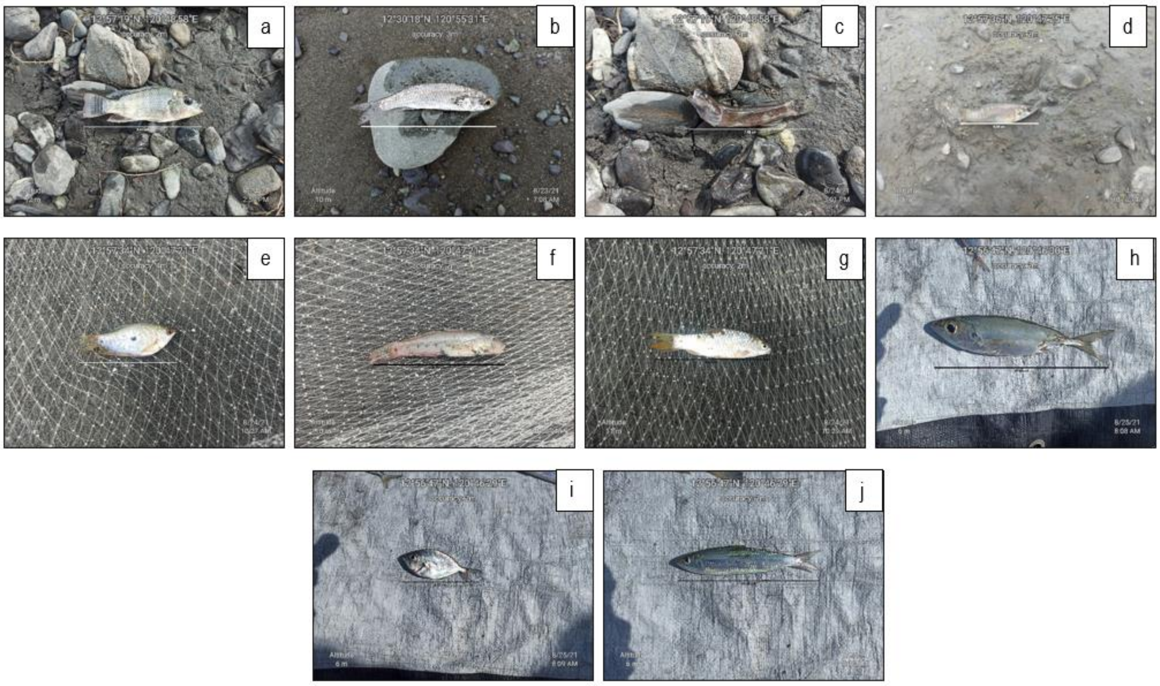
The fish caught along the stretch of the study site in Amnay River was composed of ten (10) species under ten (10) families (**Table 2.2.19**). All fish species caught in Amnay River have an IUCN status of Least Concern, indicating that the fish present in Amnay River has a low risk of extinction. The introduced *Oreochromis sp.* was the only invasive fish species recorded in the site, whereas six (6) of the fish species listed were native. Among the fish species caught in the project site, *Oreochromis* was recorded to have the longest total length with 25.39 cm, whereas the smallest fish was *Poecillia sp.* with a total length of 4.86 cm.

The fish community in Amnay River was characterized to be diverse, wherein the fish species were described to occupy a wide range of habitats. Based on the comprehensive database of Froese and Pauly (2021), the fish species occupying freshwater and brackish habitats were *Oreochromis* (Tilapia), Osteomugil cunnesius (Banak), Channa (Dalag), Poecillia (Sigi-sigi), *Osphronemus goramy*, (Gurami), *Glossogobius giuris* (Biya), and *Barbodes* (Paitan). On the other hand, species that inhabit marine waters were *Selar crumenopthalmus* (Matangbaka), *Gazza (*Sapsap), and *Sardinella* (Tamban). The listed fish species inhabiting marine habitats were caught in the river mouth (estuarine) of the Amnay River. In terms of feeding preferences, the fish in Amnay River was shown to have a wide range of diet (Froese and Pauly 2021). The majority of the fish species feed on smaller fish and other benthic animals (e.g., polychaetes, crustaceans, insect larvae). However, based on literature, fish like *Oreochromis, Osteomugil cunnesius, Poecillia,* and B*arbodes* also feed on plankton and detritus (Mills and Vevers, 1989; Sommer, Schneider, and Poutiers 1996; Bussing 1998; Lamboj 2004). The broad range of habitat and wide feeding preferences of the fish species recorded in Amnay River could indicate that the fish in Amnay River is highly adaptive to a wide range of habitat, and environmental conditions.

The survivability of fish in their environment is highly influenced by factors that have direct and indirect effects on the physical habitat structure and water quality condition of their habitat. One of the main disturbances cited by local fisherfolks on the site was the frequent occurrence of flooding and riverbank erosion in Amnay River. Frequent erosion resulting in sediment deposition with increased turbidity due to suspension of silt can highly affect the biological communities thriving in the river. For the fish communities, the fish species recorded in Amnay River were shown to be highly adapted to a wide range of conditions, as shown by the multiple feeding preferences and diverse habitat that they occupy. The current presence of a diverse fish community is indicative that the habitat in Amnay River is suitable for their growth and survival despite the frequent occurrence of disturbances like erosion. Interviews with local fisherfolks also showed that the fish caught in Amnay River are either used for personal consumption or as bait for fishing in the ocean, as the catch is often low. This indicates that the local community does not heavily rely on the fish present in Amnay River for their income and survivability.

Table 2.2.19: List of Fish Species in Amnay River Caught by Locals during the Survey

Family	Species	Common Name	Local Name	Total Length (cm)	IUCN Status	Remarks
Cichlidae	*Oreochromis* sp.	Nile Tilapia	Tilapia	25.39	Least Concern	Invasive
Mugilidae	*Osteomugil cunnesius*	River mullet	Banak	10.47		Native
Galaxiidae	*Channa* sp.	Mudfish	Dalag	7.69		Native
Poeciliidae	*Poecillia* sp.	Shortfin Molly	Sigi-sigi	4.86		-
Osphronemidae	*Osphronemus goramy*	Gurami	Gurami	6.08		-
Gobiidae	*Glossogobius giuris*	River goby	Biya	8.03		Native
Cyprinidae	*Barbodes* sp.	Barb	Paitan	7.3		-
Carangidae	*Selar crumenophthalmus*	Big-eye scad	Matangbaka	10.8		Native
Leiognathidae	*Gazza* sp.	Toothed soapy fish	Sapsap	9.87		Native
Clupeidae	*Sardinella* sp.	Sardine	Tamban	11.0		Native



Note: (a) *Oreochromis sp.*; (b) *Osteomugil cunnesius*; (c) *Channa sp.*; (d) *Poecillia sp.*; (e) *Osphronemus goramy*; (f) *Glossogobius giuris*; (g) *Barbodes sp.*; (h) *Selar crumenophthalmus*; (i) *Gazza sp.;* (j) *Sardinella sp.*

Plate 2.2.19: Fish Samples Caught at the Study Site in Amnay River, August 2021

2.2.4.4 Threat to Existence and/or Loss of Important Local Species

The primary impacts of dredging to the biological components of the freshwater ecosystem include the alteration of the existing physical landscape of the river, suspension of silt and sediment leading to turbid waters, excavation of existing benthic habitats, and pollution of waters and sediments. Alteration and excavation of the benthic substrate can lead to loss of habitat, especially to infaunal organisms and bottom-dwelling fish species.

Spawning grounds of fish and other invertebrates will also be lost especially during the actual excavation and dredging processes. Siltation and sedimentation are expected to lead to very turbid waters, affecting the productivity of phytoplankton and periphyton. Extreme sedimentation may eventually lead to loss of periphyton since silt will cover the majority of the substrate where periphyton will grow. These impacts are estimated to be localized to the areas where the actual dredging process will be taking place. Since the project will be implementing the dredging into phases, fish and macrobenthic organisms thriving in the river are expected to migrate to adjacent areas where they will be able to survive. Plankton and periphyton may decline in abundance brought by the overall decrease in primary productivity. However, this impact is also expected to be localized to areas where actual dredging activities will occur. The project is not foreseen to cause extinction to any species within the project area during its service.

2.2.4.5 Threat to Abundance, Frequency and Distribution of Species

Native and endemic species along the river banks of the proposed dredging and desilting sites are low in number; hence, the project is not expected to directly alter the frequency and distribution of endemic species in the area. The project is expected to cause changes in the structure and community composition of the aquatic communities as the habitat of these organisms will be highly affected. However, the effect of the project on plankton, periphyton, and soft bottom communities may be temporary and limited as the existing communities are characterized to be highly adapted to a wide range of environmental conditions. Moreover, several species are characteristic of eutrophic environments.

Thus, these aquatic communities are relatively tolerant of the impacts brought by the project construction and operation. For fish, the extent of the impact is unknown to moderate. Since the identified fish in the study site forage on aquatic communities that will be also impacted by the project, several species of fish may adapt by migrating to areas in the river that will be less impacted. The greatest effect on the aquatic communities is expected to occur during the operational phase of the project.

Overall, poor water quality conditions may potentially lead to a decline in abundance and frequency of plankton, periphyton, benthic macroinvertebrates, and fish. Growth of pollution-indicator species may be favored with eutrophic waters which are generally characterized to have elevated organic matter and nutrient concentrations (N and P). Air quality is identified to have very minimal influence on freshwater organisms.

2.2.4.6 Presence of economically and ecologically important species, pollution-indicator species

In general, plankton and periphyton are ecologically important since these organisms act as the primary and secondary producers of the aquatic ecosystem. On the other hand, for this survey, no species of plankton and periphyton are identified to be economically important. Several species of plankton and periphyton recorded in this study are also pollution-indicator species. The abundance and density of pollution-indicator plankton and periphyton species are low. Hence, it is important to monitor the abundance of the identified pollution-indicator species in the succeeding monitoring periods.

For macrobenthic invertebrates, all are ecologically important, and no species are considered economically important. Most of the species observed are known to tolerate a certain degree of pollution. Chironomidae, which is the macrobenthos that exhibited the highest abundance, is known to be pollution tolerant. However, since this taxon is known to tolerate a wide range of environments, its implication on the degree of pollution in the site could only be inferred with the support of water quality data.

The fish surveyed in the site may be considered economically important since these species are the source of food for artisanal fisherfolks in the area. Results of the survey showed that the fish recorded in the area can tolerate a wide range of conditions, specifically in terms of salinity. The fish observed are adapted to brackish-freshwater and marine-estuarine conditions. Some of the fish observed, such as *Oreochromis sp*., are known to tolerate environments with higher temperatures and lower pH. No fish species have been identified to be of significant use to be pollution indicators.

2.2.5 Marine Ecology

The RDZ identified for the Amnay River is focused on the main active channel, starting from the mouth of the river towards the bridge. Dredging on the river mouth is crucial in the project phase as sediment accretion is highly concentrated in this area. Increasing the depth and widening of the river mouth will also pave way for dredging ships to make their way to the upstream portions of the river. The project will also construct other facilities (e.g., a jetty port area) on the shoreline near the stockpile area. Since the project will cover a large dredging area, extending offshore, it is important to appropriately assess the marine habitats and biological communities that will be affected by the project. To do this, a benthic habitat characterization was conducted in August 2022 using standard methods. Associated fish communities within the impact area were also characterized by conducting an opportunistic fish survey. For benthic and seabed impacts, silt curtains and or sediment traps should be installed during dredging at least at the River Mouth to avoid dispersal of sediments/ sedimentation/ siltation in nearby marine coastal areas. This can increase turbidity and cause a reduction in photosynthetic activity of phytoplankton, potentially decrease the abundance of zooplankton which graze primarily on phytoplankton, and smother or bury macrobenthic animals or soft-bottom fauna. Such mitigation measures should be applied to protect the offshore area.

2.2.5.1 Plankton Communities

A total of seven plankton sampling stations (PL1 to PL7) were established at the vicinity of the proposed project site. These stations were strategically located at direct and indirect impact sites. PL1 was designated as the Control Station while the remaining stations located at the direct impact area were assigned as the Impact Stations (PL2 to PL7). The coordinates of the sampling stations were recorded using GPS and their relative locations are presented in **Table 2.2.20** and **Figure 2.2.66**.

Table 2.2.20: Coordinates of Sampling Stations for the Plankton and Soft-Bottom Study

Sampling Stations	Coordinates	
	Northing	Easting
PL1	12° 55' 58.584"	120° 46' 26.868"
PL2	12° 56' 25.692"	120° 45' 58.932"
PL3	12° 56' 52.584"	120° 45' 50.004"
PL4	12° 57' 17.244"	120° 45' 48.312"
PL5	12° 56' 0.06"	120° 45' 11.952"
PL6	12° 55' 52.68"	120° 46' 2.208"
PL7	12° 55' 29.784"	120° 46' 14.664"

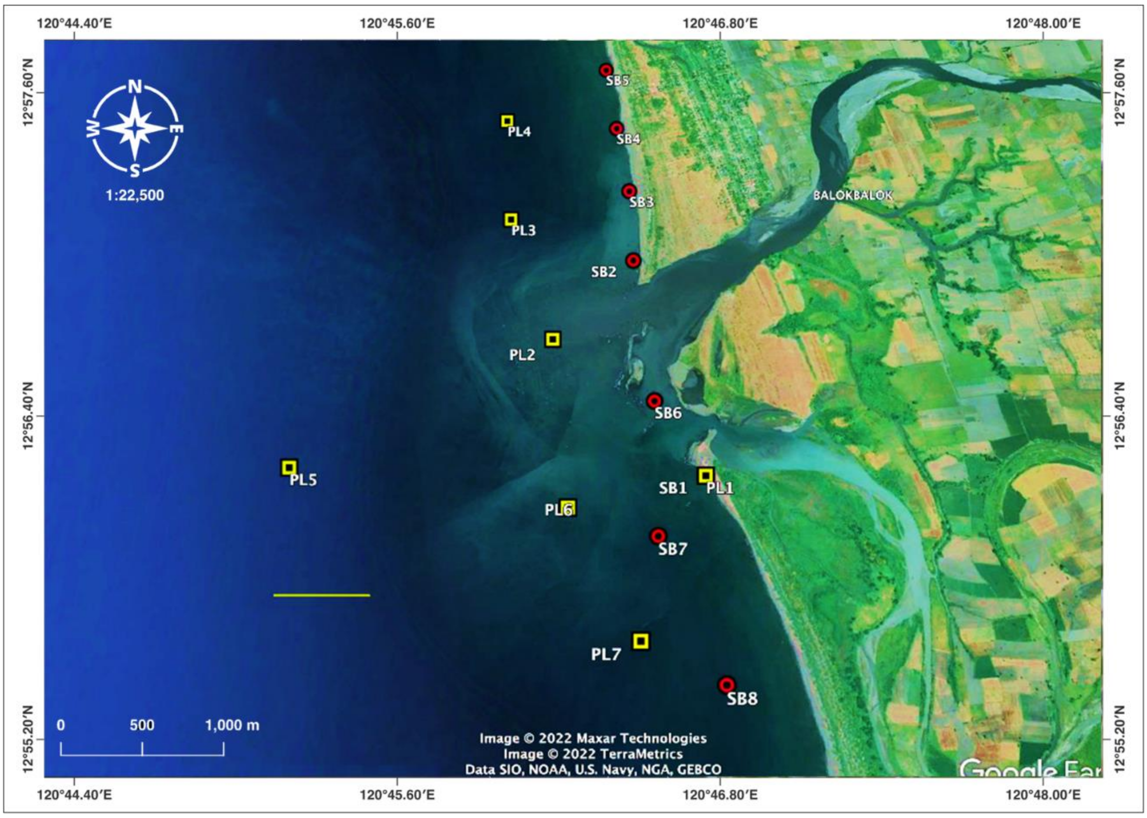


Figure 2.2.66: Relative Location of Plankton (PL1 to PL7; Yellow Square Marks) at the Project Site

Phytoplankton and zooplankton were sampled using nets with mouth diameters of 0.30 m and with mesh sizes of 25µ and 64µ, respectively. At each site, plankton net was lowered to desired depth and hauled vertically at a rate not exceeding 1m/s**.** Replicate samples of zooplankton and phytoplankton were collected from each station and placed in properly-labelled plastic containers. Phytoplankton and zooplankton samples were fixed with 70% ethyl alcohol immediately after collection. All samples were allowed to stand undisturbed for about a week to allow organisms to settle at the bottom of the container. Excess liquid was carefully decanted until about 50 ml was left. One (1) ml aliquot subsample was placed in a Sedgewick-Rafter cell counter and examined under a microscope. Planktonic organisms were identified to the lowest possible taxa using references such as those of Goswami (2004), Nishikawa and Toda (2004), Sekiguchi et al. (2004) and Verlencar (2004), and their numbers counted. Phytoplankton and zooplankton densities were expressed as no. of cells/ m^3 and no. of inds./m^3, respectively.

2.2.5.1.1 Phytoplankton Communities

At least 10 phytoplankton taxa distributed to three algal divisions were recorded at seven (7) sampling stations combined (**Table 2.2.21**). Bacillariophyta (diatoms; **Plates 2.2.20A** and **2.2.20B**) largely dominated the phytoplankton community representing 66.0% of the total count followed by that recorded for Cyanophyta (blue-green algae) with an overall relative density of 25.5%. Meanwhile, Dinophyta (dinoflagellates; **Plates 2.2.20C** and **2.2.20D**) was observed at a low proportion of 8.5% (**Figure 2.2.67**).

The phytoplankton community was comprised of five diatom taxa, four dinoflagellate taxa and a single blue-green alga taxon. Of the 10 identified algal taxa, *Chaetoceros* was the most abundant (27.7%), closely followed by that recorded for *Trichodesmium* (25.5%). *Lioloma* and *Fragilaria* ranked third and fourth in terms of overall abundance, which comprised 17.0% and 12.8% of the total density, respectively. The dominant phytoplankton taxon was variable at seven surveyed stations. *Fragilaria* dominated at PL1, *Nitzschia* at PL2, *Chaetoceros* at PL3 and at PL5, and

Trichodesmium at three remaining stations (PL4, PL6 and PL7). *Nitzschia* co-dominated with *Trichodesmium* at PL4.

Table 2.2.21: Mean (no. of cells/m^3) and Relative Densities (%) of Phytoplankton at Seven Sampling Stations (August 2022)

Taxa	Sampling Stations							Mean Density	Relative Density
	PL1	PL2	PL3	PL4	PL5	PL6	PL7		
Bacillariophyta	**424**	**212**	**1344**	**71**	**141**	**0**	**0**	**313**	**66.0**
Chaetoceros	0	0	778	0	141	0	0	131	27.7
Fragilaria	354	71	0	0	0	0	0	61	12.8
Lioloma	0	0	566	0	0	0	0	81	17.0
Nitzschia	0	141	0	71	0	0	0	30	6.4
Pseudonitzschia	71	0	0	0	0	0	0	10	2.1
Cyanophyta	**0**	**0**	**212**	**71**	**0**	**141**	**424**	**121**	**25.5**
Trichodesmium	0	0	212	71	0	141	424	121	25.5
Dinophyta	**0**	**141**	**71**	**0**	**0**	**71**	**0**	**40**	**8.5**
Ceratium fusus	0	0	0	0	0	71	0	10	2.1
Ceratium gibberum	0	71	0	0	0	0	0	10	2.1
Ceratium macroceros	0	71	0	0	0	0	0	10	2.1
Peridinium	0	0	71	0	0	0	0	10	2.1
Total Density	**424**	**354**	**1627**	**141**	**141**	**212**	**424**	**475**	**100.0**
SD	**400**	**100**	**900**	**0**	**200**	**100**	**600**		
Number of Taxa	**2**	**4**	**4**	**2**	**1**	**2**	**1**	**10**	

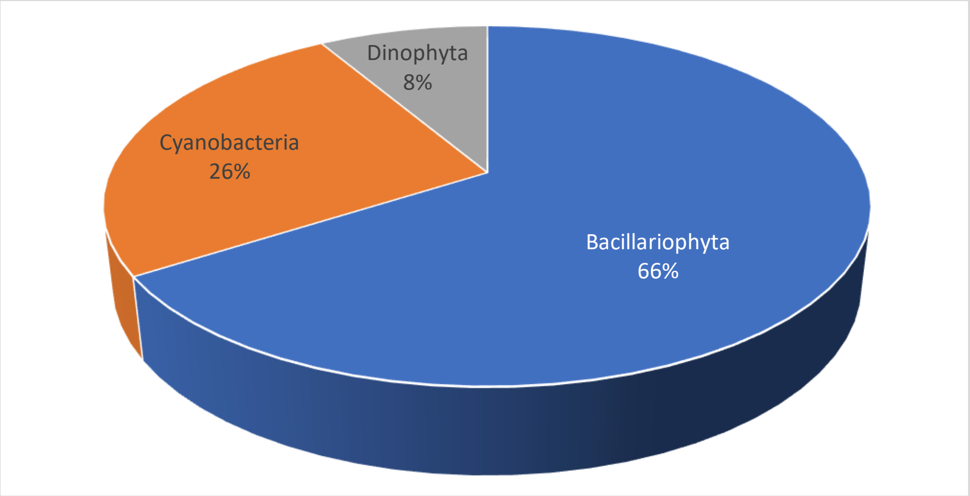
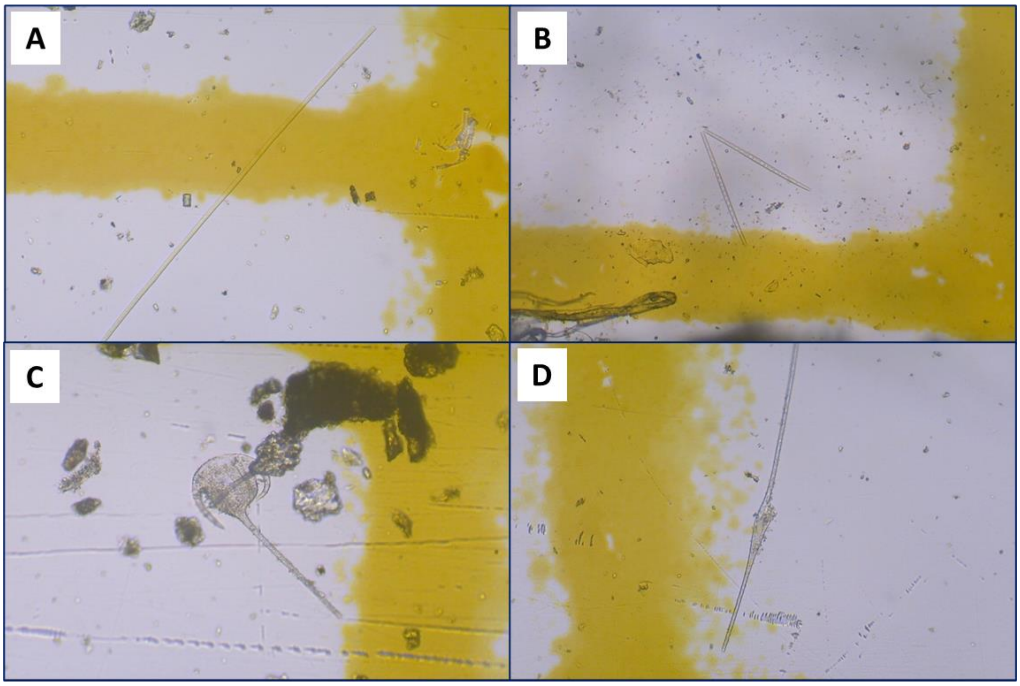


Figure 2.2.67: Overall Composition of Phytoplankton Communities at Seven Plankton Sampling Stations (August 2022)



Note: A- Trichodesmium, B- Lioloma, C- Ceratium gibberum, D- Ceratium fusus

Plate 2.2.20: Phytoplankton Taxa Observed at the Project Site

Phytoplankton mean densities were low compared with that recorded for other Philippine coastal waters such as in Quezon (unpublished report). On the average, phytoplankton abundance was highest at PL3 (1,627 cells/m^3), while only about 22% to 26% of this value was observed at PL1, PL2 and at PL7. Meanwhile, relatively lower algal mean densities were recorded at three remaining stations, with values ranging from 141 cells/m^3 to 212 cells/m^3 (**Figure 2.2.68**). Phytoplankton taxa richness was low at sampling stations ranging from 1-4 taxa. The number of algal taxa was relatively lower at PL4, PL5, PL6, and PL7 compared with that recorded at PL1 and at PL2 (**Figure 2.2.69**).

Overall composition of phytoplankton communities is suggestive of oligotrophic waters (low-nutrient levels). The occurrence and dominance of *Trichodesmium* at three surveyed stations may indicate low productivity. This taxon is known to inhabit nutrient poor tropical marine waters. They also serve as substrate and food items for a variety of marine organisms including bacteria diatoms, dinoflagellates, protozoa and copepods. The dominance of *Chaetoceros* at two other stations corroborates with this observation. This diatom taxon is cosmopolitan and is known to persist because of their ability to survive even in low nutrient level waters. Ecologically *Chaetoceros* has important role in the biogeochemical cycle of carbon and silicon and other macronutrients.

Low phytoplankton densities and taxa richness at the project site could be attributed to an interplay of factors possibly due to strong water movement (waves and current), siltation or sediment deposition from Amnay River discharge, and low nutrient levels. Siltation tends to increase water turbidity and limits light penetration resulting in decreased photosynthetic activity of light-dependent phytoplankters.

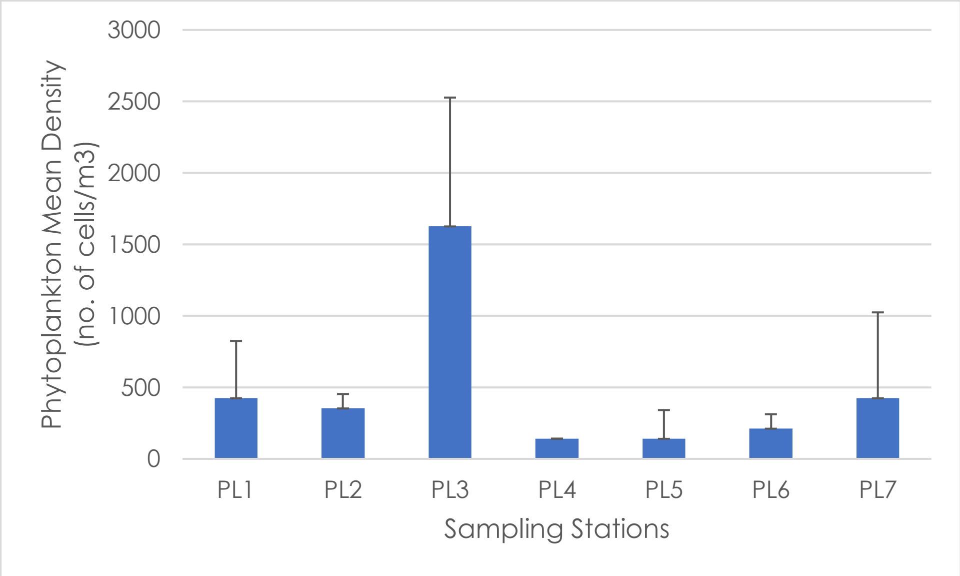


Figure 2.2.68: Phytoplankton Mean Densities (no. of cells/m^3 ± SD) at Seven Sampling Stations (August 2022)

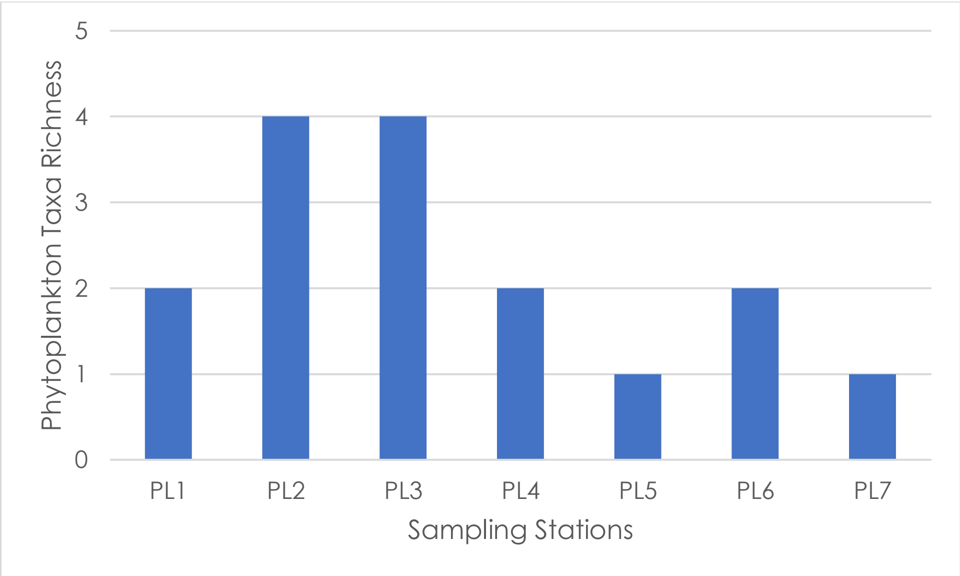


Figure 2.2.69: Phytoplankton Taxa Richness at Seven Sampling Stations (August 2022)

2.2.5.1.2 Zooplankton Communities

The zooplankton community at five of the (PL1, PL2, PL3, PL6 and PL7) seven surveyed stations in Amnay, Sablayan, Mindoro Occidental had low abundances and taxa richness (**Table 2.2.22**). Zooplankton was not observed at two (PL4 and PL5) of the seven stations. The overall mean density and taxa richness of zooplankton at the project site were low with values of 91 inds./m^3 and four taxa, respectively.

Table 2.2.22: Mean (no. of inds./m^3) and Relative Densities (%) of Zooplankton at Seven Stations (August 2022)

Taxa	Sampling Stations							Mean Density	Relative Density
	PL1	PL2	PL3	PL4	PL5	PL6	PL7		
Annelida	**71**	**0**	**0**	**0**	**0**	**0**	**0**	**10**	**11.1**
Polychaeta nektochaete larva	71	0	0	0	0	0	0	10	11.1
Arthropoda	**71**	**141**	**141**	**0**	**0**	**71**	**71**	**71**	**77.8**
Calanoida copepodite	0	0	71	0	0	0	71	20	22.2
Copepoda nauplius	71	141	71	0	0	71	0	51	55.6
Chordata	**0**	**71**	**0**	**0**	**0**	**0**	**0**	**10**	**11.1**
Oikopleuridae	0	71	0	0	0	0	0	10	11.1
Total Density	**141**	**212**	**141**	**0**	**0**	**71**	**71**	**91**	**100.0**
SD	**0**	**100**	**0**	**0**	**0**	**100**	**100**		
Number of Taxa	**2**	**2**	**2**	**0**	**0**	**1**	**1**	**4**	

Arthropoda was the most abundant phylum which comprised 77.8% of the total density, while Annelida and Chordata each represented 11.1% of the total zooplankton (**Figure 2.2.70**). Zooplankton mean densities were low ranging from 71 inds./m^3 to 212 inds./m^3, with the highest recorded at PL2 and the lowest at PL6 and at PL7 (**Figure 2.2.71**). Zooplankton taxa richness did not differ much at sampling stations, which ranged from 1-2 taxa (**Figure 2.2.72**).

Copepoda nauplius (**Plates 2.2.21A**) dominated the zooplankton community representing 55.6% of the total count, followed by that observed for Calanoida copepodite (**Plates 2.2.21B**), with an overall relative density of 22.2%. Meanwhile, Polychaeta nektochaete larva (**Plates 2.2.21C**) and Oikopleuridae (**Plates 2.2.21D**) each comprised 11.1% of the total count. Copepoda nauplius dominated at majority of the surveyed stations (PL1, PL2, PL3 and PL6), while Calanoida copepodite at PL7. It should be noted that only a single taxon was recorded at PL6 and at PL7 (Copepoda nauplius and Calanoida copepodite, respectively).

Overall composition, low abundances and taxa richness of zooplankton communities may be attributed to the generally low abundances and taxa richness of phytoplankton, since zooplankton are known to graze or feed primarily on phytoplankton. Siltation as a result of water and sediment discharge from Amnay River is another plausible explanation for these observations. Silt tends to clog respiratory and feeding apparatus of zooplankters which may lead to mortality and decrease in biodiversity.

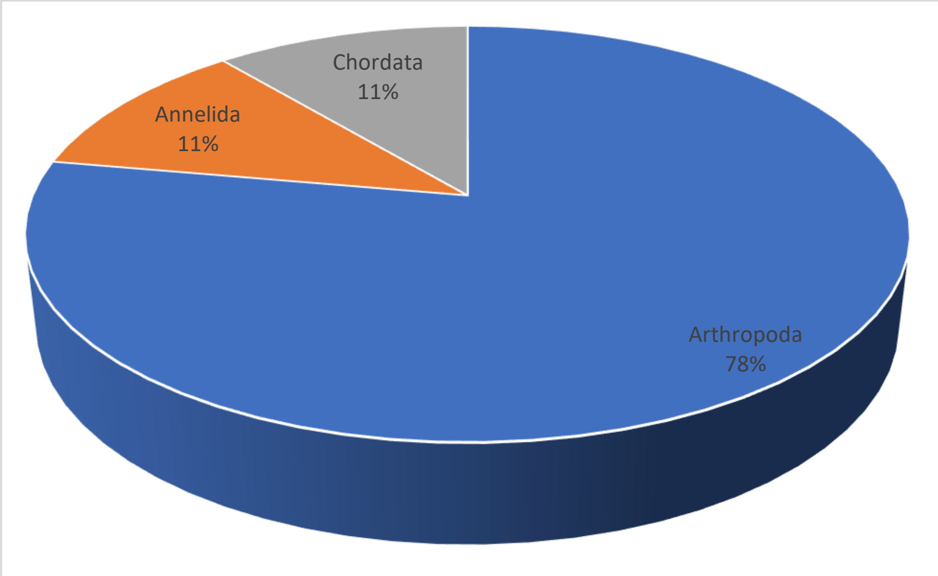


Figure 2.2.70: Overall Composition of Zooplankton Communities at Seven Sampling Stations (August 2022)

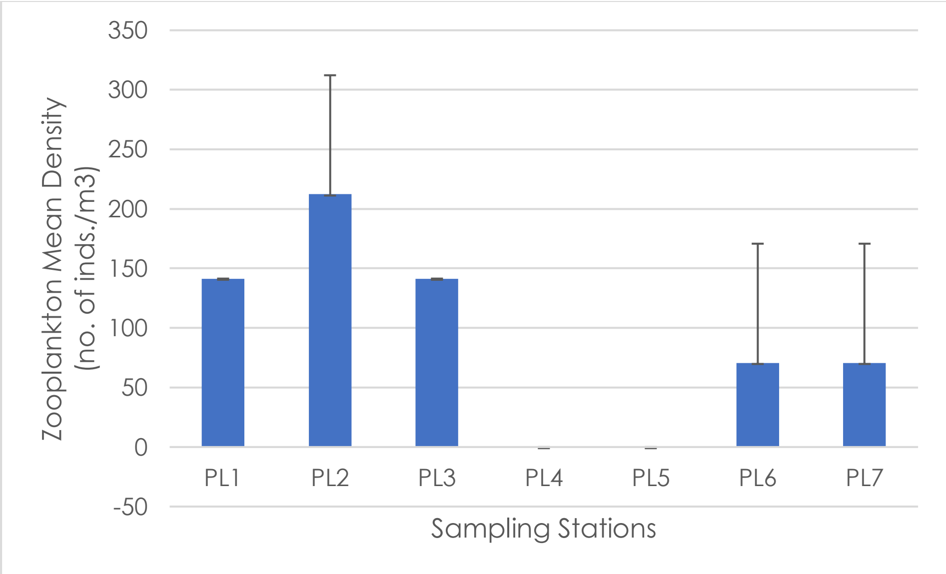


Figure 2.2.71: Zooplankton Mean Densities (no. of inds./m^3 ± SD) at Seven Sampling Stations (August 2022)

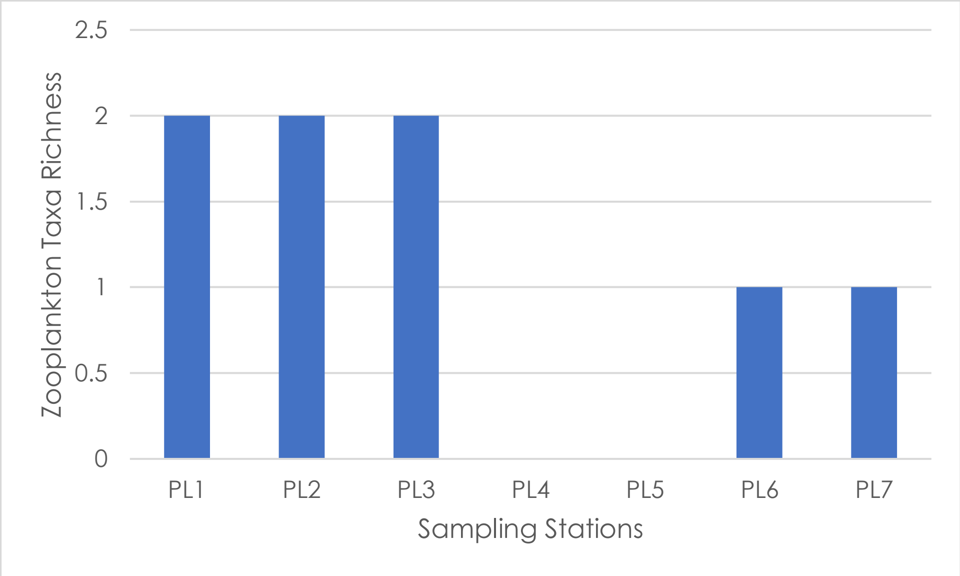
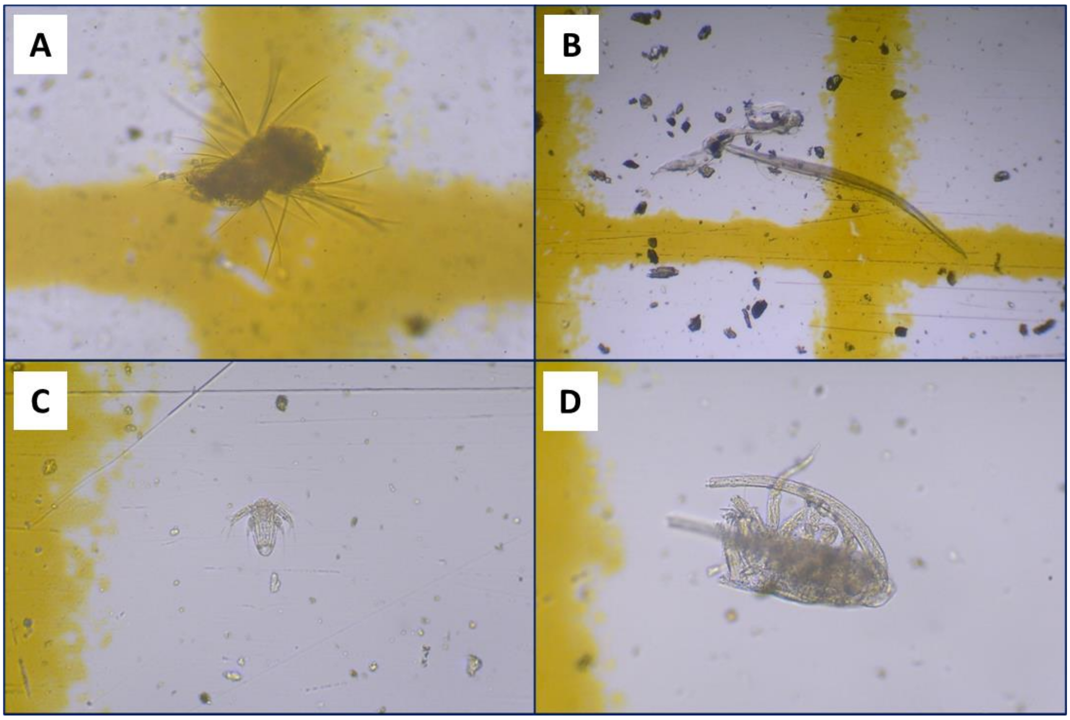


Figure 2.2.72: Zooplankton Taxa at Seven Sampling Stations (August 2022)



Note: A- Copepoda nauplius, B- Calanoida copepodite C- Polychaeta nektochaete larva and D- Oikopleuridae

Plate 2.2.21: Zooplankton Taxa Observed at the Project Site

2.2.5.2 Soft-Bottom Communities

A total of eight soft-bottom sampling stations (SB1 to SB8) were established at the vicinity of the proposed project site. These stations were strategically located at direct and indirect impact sites. SB8 was designated as the Control Station while the remaining stations located at the direct impact area were assigned as the Impact Stations (SB1 to SB7). The coordinates of the sampling stations were recorded using GPS and their relative locations are presented in **Table 2.2.23** and **Figure 2.2.73**.

Table 2.2.23: Coordinates of Sampling Stations for the Soft-Bottom Study

Sampling Stations	Coordinates	
	Northing	Easting
SB1	12° 55' 58.584"	120° 46' 26.868"
SB2	12° 56' 43.008"	120° 46' 14.592"
SB3	12° 56' 59.424"	120° 46' 14.016"
SB4	12° 57' 15.264"	120° 46' 11.568"
SB5	12° 57' 30.996"	120° 46' 9.408"
SB6	12° 56' 13.0056"	120° 46' 18.03"
SB7	12° 55' 47.568"	120° 46' 18.048"
SB8	12° 55' 22.8"	120° 46' 28.632"

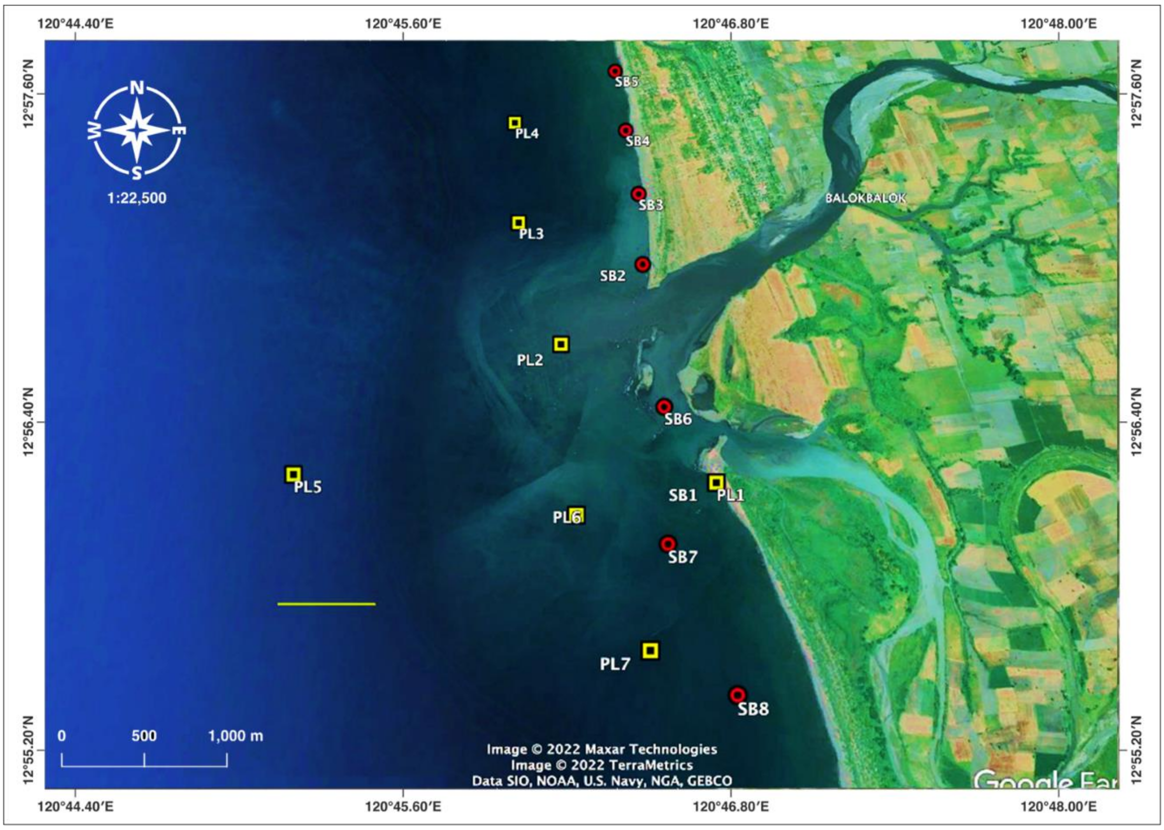


Figure 2.2.73: Relative Location of Soft-Bottom Sampling Stations (SB1 to SB8; red circle marks) at the Project Site

A total of sixteen (16) sediment samples were collected from eight (8) stations (SB1 to SB8). Two (2) replicates samples were obtained from each station.

Sediment samples were collected by a SCUBA diver using a trowel. The sediments were carefully placed inside sealed plastic bags and preserved with 70% ethyl alcohol and brought to the laboratory for further processing. In the laboratory, sediment samples were passed through a 500-1000 mm mesh-sized sieve and all animals retained were identified using taxonomic keys, illustration guides and checklists (Liberato, 2008, Poppe, 2008; de Bruyne, 2003; Tan and Chou, 1993; Leobrera, 1986) and their number counted. Abundances of soft bottom animals were reported as no. of animals/ 0.02m^2.

The soft-bottom community at surveyed stations in Amnay, Sablayan, Mindoro Occidental was depauperate (**Table 2.2.24**). Macrobenthos was only recorded at three (SB5, SB7 and SB8) of the eight sampling stations, and only few individuals of the 11 taxa identified were observed. At least 11 soft-bottom taxa distributed to four animal phyla were recorded at the project site. Mollusca had the highest taxa richness with 7 taxa, while Annelida and Echinodermata had only 2 and 1 taxon, respectively. Mollusca (shelled animals) was also the most abundant group representing 55.6% of the total abundances, followed by that recorded for Annelida (segmented worms; 22.2%) and Echiura (spoon worms; 14.8%). Meanwhile, Echinodermata was observed at a low overall relative density of 7.4% (**Figure 2.2.74**).

Table 2.2.24: Mean (no. of animals/0.02m^2) and Relative Densities (%) of Soft-Bottom Fauna at Three of the Eight Surveyed Stations (August 2022)

Taxa	Sampling Stations			Total Abundance	Relative Abundance
	SB5	SB7	SB8		
ANNELIDA	**1**	**1**	**1**	**3**	**22.2**
Lumbrineridae	1			1	7.4
Syllidae		1	1	2	14.8
ECHINODERMATA			**1**	**1**	**7.4**
Holothuroidea			**1**	**1**	**7.4**
sea cucumber juvenile			1	1	7.4
ECHIURA			**2**	**2**	**14.8**
MOLLUSCA	**2**		**6**	**8**	**55.6**
Bivalvia			**2**	**2**	**11.1**
Tellinidae			2	2	11.1
Gastropoda	**2**		**4**	**6**	**44.4**
Cerithiidae	1			1	7.4
Costellariidae			1	1	7.4
Haminoeidae			1	1	7.4
Melanoides	1			1	7.4
Nassarius			3	3	18.5
Pyramidellidae			1	1	7.4
Total Abundance	**3**	**1**	**10**	**14**	**100.0**
SD	**1**	**1**	**1**		
Number of Taxa	**3**	**1**	**8**	**11**	

Total abundances of macrobenthos were highest at SB8 (10 animals/0.02m^2), while only 3 animals/0.02m^2 and 1 animal/0.02m^2 were recorded at SB5 and SB7, respectively SB8 also had the highest soft-bottom taxa richness with eight identified taxa, while only 1 and three taxa were observed at SB7 and at SB5, respectively. The surveyed stations had low macrobenthos taxa richness with few individuals. SB5 was comprised of three taxa, 2 gastropods and one segmented worm Lumbrineridae, while SB7 only had a single taxon, annelid Syllidae. SB8 had several taxa, mostly comprised of gastropod molluscs, and few taxa of annelids and echinoderms. Each of the recorded taxa at this station had very few individuals ranging from 1-3 animals/0.02m^2.

The low taxa richness and abundances of soft-bottom communities observed at the project site could be attributed to siltation or sediment deposition as a result of Amnay river discharge/ outflow, which constantly resuspends and disturbs the bottom sediment/ substrate or habitat of macrobenthos. Silt has been known to clog gills of macrobenthic animals and when present at high concentrations tend to smother and bury them resulting in mortality.

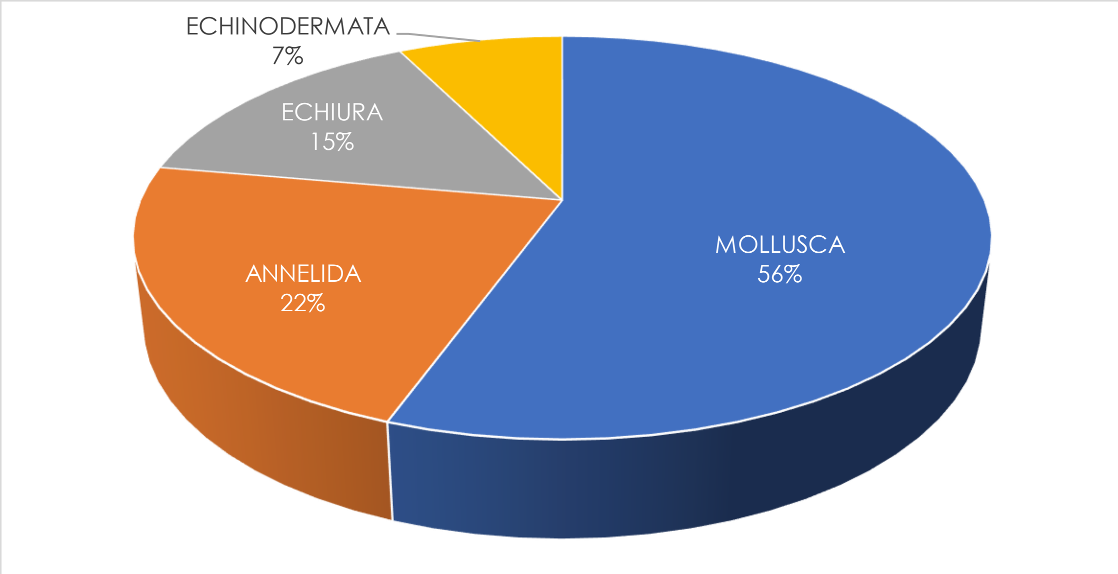


Figure 2.2.74: Overall Composition of Soft-Bottom Communities at the Surveyed Stations (August 2022)

2.2.5.3 Benthic Communities

Systematic surveys of benthic habitats were conducted in the primary impact area, specifically, the identified area where offshore and near-shore dredging activities will focus (**Figure 2.2.75**). The dredging area was delineated, dividing the general survey sites into shallow and deep areas. In the shallow site, a total of 13 points were randomly selected by dividing the shallow area into 300m^2 grids. In the offshore area, a total of 9 points separated by a distance of 500 meters were selected. The benthic feature of the majority of the shallow and deep points was documented by deploying GoPro units mounted on a metal frame (**Plate 2.2.22**). The documentation was done by mounting cameras on the metal frame. Out of the 13 shallow points, four points were observed through swimming. Deployment of a camera with a metal frame was not achievable at these points due to the strong wave action and shallow depth (~1m). In the laboratory, digital photos and videos of the benthic feature under each point were obtained and archived.

A rapid, broad area benthic habitat survey was supposed to be conducted using a modified manta tow technique (English et al. 1997), to determine the benthic features on the adjacent area of the primary impact site. However, due to rough sea conditions (i.e., strong waves and current, high sediment suspension) that resulted in extremely poor visibility, a modified manta tow technique was not feasible and spot dives were instead conducted. A total of eight sites were identified for the spot dives, covering a total of 5 km with each station having a distance ranging from 300m to 700m. In each dive, the observer characterized the benthos by obtaining in situ descriptions and digital photographs and videos of the general area. Photos and videos obtained during spot dives were further characterized in the laboratory.

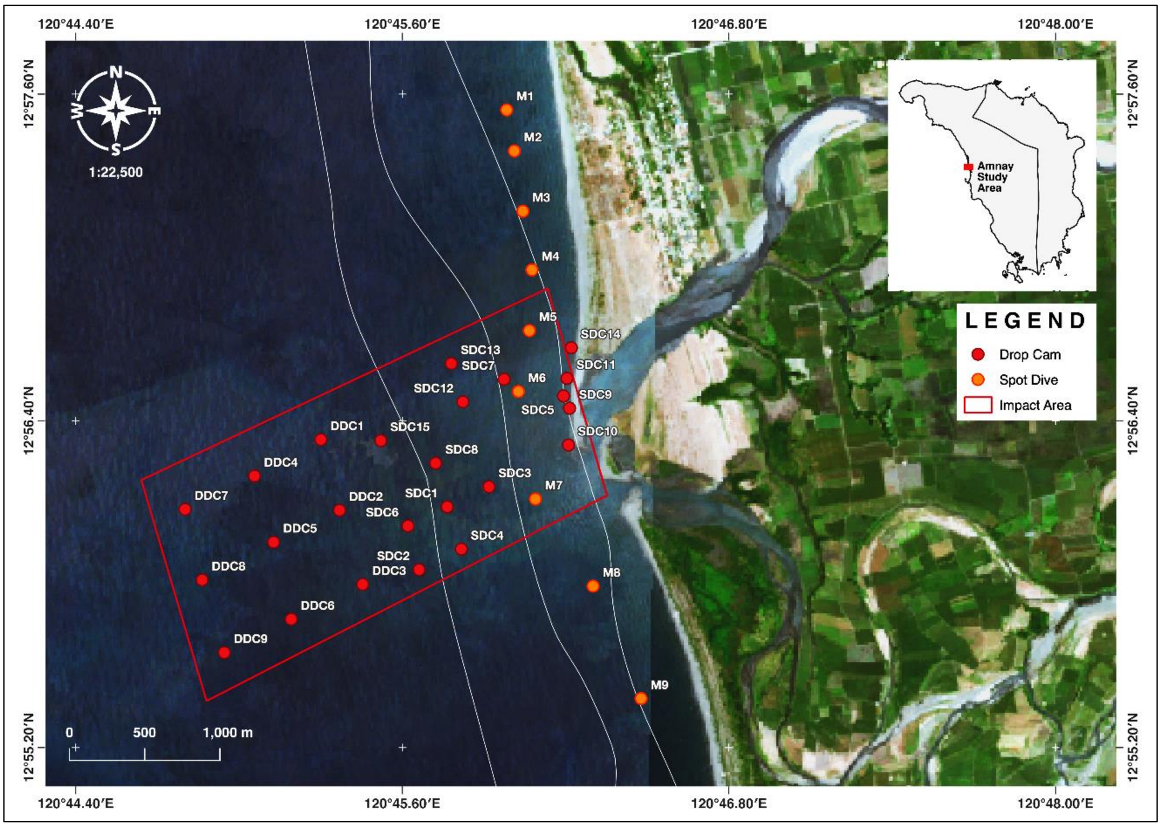


Figure 2.2.75: Location Map of the Survey Stations for Benthic Substrate Characterization

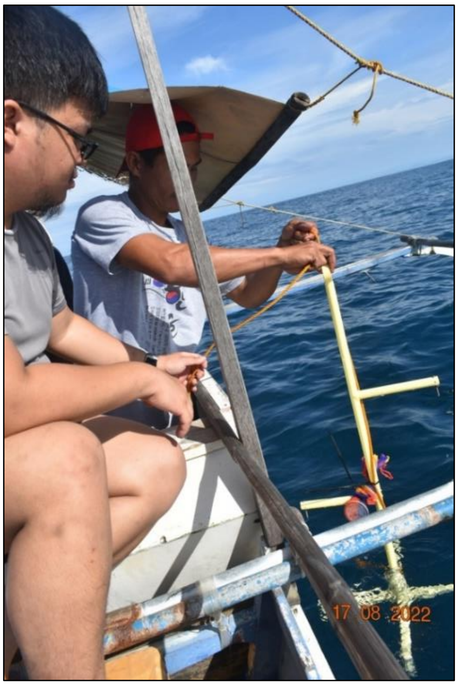


Plate 2.2.22: Deployment of a Camera Mounted on a Metal Frame to Document the Features of the Benthic Substrate

The substrate type in the primary impact area is predominantly sand and silt (**Figure 2.2.76**). Sand in the study site is characterized to be black. Black sand or magnetite, as defined by the MGB, originates from the weathering of dark rocks situated near shore or transported from inland through natural drainage. Black sand predominates the substrate type in the shallow intertidal areas and as depth increases, the substrate type becomes silty. The substrate type observed in established stations for spot dives outside of the primary impact area was predominantly sand. Overall, the assessment showed that the substrate type in the study area is primarily of sand and silt. No hard substrate was intercepted within the primary dredging site and adjacent areas. No traces of seagrass and seaweeds were also observed.

Annex 2-2 presents the photos showing the substrate type in the identified shallow and deep points within the primary impact area.

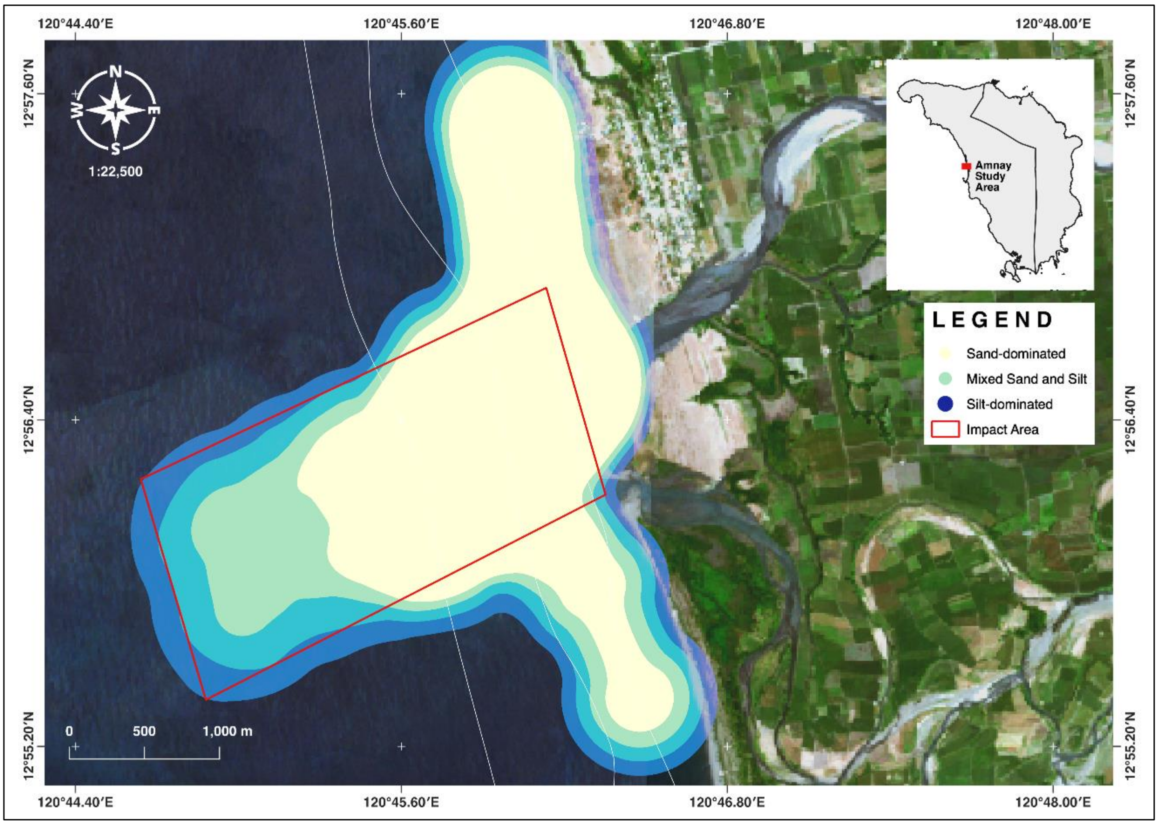


Figure 2.2.76: Substrate Characteristics Identified on the Study Site, August 2022

As the baseline survey occurred in August when the area is highly exposed to the southwest monsoon, the wave action in the site was high which resulted in the resuspension of sand and silt extending to mesophotic depths (> 30 m). Wave action is expected to be less resulting in calmer waters during the rest of the year. No remarkable change is expected to occur in the substrate type during changes in season.

2.2.5.4 Fish Communities

The survey of fish communities was done by conducting opportunistic interviews of fisherfolks who landed fish that were caught within the waters of the study site. Information such as catch composition, dominant species caught, range and volume of catch, fishing grounds, type of fishing gear, and fishing effort were collected. Among the fishers engaged in the study, two used fishing nets, two employed the hook-and-line method, and another two used both hook-and-line and fishing nets. The nets were comprised of a knotted net deployed from a small, motorized boat with a mesh size of 8 (**Plate 2.2.23**). Meanwhile, hook-and-line is made up of a hook attached to a nylon string, lowering, or raising the gear using a fishing rod or by hand. The collected fishes were identified to the lowest taxonomic level possible and measured to the nearest centimeter, counted, and photographed for reference. Other relevant information on fish identified on the site, such as spawning periods and conservation status, were obtained from Fishbase (Froese and Pauly 2010) and IUCN Red List (IUCN 2022).

Plate 2.2.23: Fishing Net (Mesh Size 8) Used by Fisherfolks at the Study Site

A total of 24 species of fish belonging to 13 families were surveyed (**Table 2.2.25**). As stated by fisherfolks, the fish were caught in the mouth of Amnay River and its surrounding waters which is approximately 16 kilometers offshore. The standard length was measured in selected fish species which range from 6.75 cm to 75 cm. The smallest fish recorded in the collection was a toothpony, *Gazza minuta*, and the largest fish among the samples was a brassy trevally, *Caranx papuensis*. The majority of the species caught in the study site had an IUCN Status of Least Concern, except for the Narrow-barred Spanish Mackerel (*Scomberomorus commerson*), known locally as tanigue, which is classified as Near Threatened (Collette et al., 2011; IUCN 2022). This suggests that the fish community along the Amnay river mouth and its surrounding waters have a low risk of extinction. Most of the distribution of fish in the area are circumtropical, particularly pelagic fishes, and are widely distributed across the Indo-Pacific region.

Among the fish species that were recorded, 11 species were identified to live in shallow estuarine waters, which includes the following: trevallies (Carangidae) such as *Caranx papuensis* and *Megalaspis cordyla*; silverbiddy and mojarra (Gerreidae); slipmouths (Leiognathidae); goatfish (Mullidae); the spotted scat, *Scatophagus argus* (Scatophagidae); bullet tuna, *Auxis rochei* (Scombridae); and cutlassfish (Trichiuridae). The fishes are known to survive in brackish and coastal waters with muddy substrates. Some juvenile forms of these fish species, particularly *C. papuensis* (Carangidae), silverbiddy (Gerreidae), and slipmouths (Leiognathidae), inhabit and feed on the silty substrate of estuarine waters and occasionally enter the lower reaches of Amnay river area. Fish species that can thrive in varying levels of salinities are classified as euryhaline and require different habitat types as part of their survival.

Table 2.2.25: Summary of Fish Species Collected in Amnay River Estuary and its Surrounding Waters

Family	Species	Common Name	Local Name	Standard Length (cm)	Habitat	Spawning Period	IUCN Status
Carangidae	*Caranx papuensis*	Brassy Trevally	*Talakitok*	75	Marine, Brackish	No available data	Least Concern
Carangidae	*Caranx sp.*	Trevally	*Talakitok*	-	Marine	No available data	Least Concern
Carangidae	*Megalaspis cordyla*	Torpedo Scad	*Pak-an*	-	Marine, Brackish	December-July[1]	Least Concern
Carangidae	*Selar crumenophthalmus*	Bigeye Scad	*Matambaka*	-	Marine	March-October[2]	Least Concern

Family	Species	Common Name	Local Name	Standard Length (cm)	Habitat	Spawning Period	IUCN Status
Clupeidae	*Sardinella sp., Herklotsichthys sp.*	Herring, Sardinella	*Manamsi*	-	Marine	No available data	Least Concern
Gerreidae	*Gerres sp.*	Silverbiddy	*Malakapas*	10.28	Marine, Brackish	No available data	Least Concern
Leiognathidae	*Devexımentum indicium*	Slipmouth	*Sap-sap*	7.86	Marine, Brackish	No available data	Data Deficient
Leiognathidae	*Gazza minuta*	Toothpony	*Sap-sap*	6.76	Marine, Brackish	No available data	Least Concern
Leiognathidae	*Nuchequula gerroides*	Decorated Ponyfish	*Sap-sap*	7.5	Marine, Brackish	No available data	Data Deficient
Lutjanidae	*Lutjanus erythropterus*	Crimson Snapper	*Maya-maya*	65	Marine	September-April[3]	Least Concern
Lutjanidae	*Lutjanus rufolineatus*	Yellow-lined Snapper	*Maya-maya*	10.38	Marine	No available data	Least Concern
Lutjanidae	*Lutjanus sp.*	Snapper	*Maya-maya*	-	Marine	No available data	Least Concern
Lutjanidae	*Lutjanus sp.*	Snapper	*Maya-maya*	18.27	Marine	No available data	Least Concern
Mullidae	*Upeneus moluccensis*	Goldband Goatfish	*Salmunete*	13.67	Marine, Brackish	February-September[4]	Least Concern
Mullidae	*Upeneus vittatus*	Yellowstriped Goatfish	*Timbungan*	13.59	Marine, Brackish	July-August[5]	Least Concern
Nemipteridae	*Nemipterus sp.*	Thredfin Bream	*Bisugo*	15.96	Marine	No available data	Least Concern
Scatophagidae	*Scatophagus argus*	Spotted Scat	*Kitang*	-	Marine, Brackish	April-August[6]	Least Concern
Scombridae	*Auxis rochei*	Bullet Tuna	*Tulingan*	-	Marine, Brackish	May-August[7]	Least Concern
Scombridae	*Katsuwonus pelamis*	Skipjack Tuna	*Gulyasan*	-	Marine	Year-round[7]	Least Concern
Scombridae	*Rastrelliger kanagurta*	Indian Mackerel	*Alumahan*	17.31	Marine	Year-round[7]	Data Deficient
Scombridae	*Scomberomorus commerson*	Spanish Mackerel	*Tanigue*	-	Marine	March-December[7,8,9,10]	Near Threatened
Sphyraenidae	*Sphyraena qenie*	Blackfin Barracuda	*Torsillo*	33	Marine	No available data	Data Deficient
Synodontidae	*Saurida tumbil*	Greater Lizardfish	*Tiki-tiki, Tabili-dagat*	23.4	Marine	Year-round[11]	Least Concern
Trichiuridae	*Trichiurus lepturus*	Largehead Hairtail	*Espada*	-	Marine, Brackish	March-June[12]	Least Concern

Source: [1] Sreenivasan 1978, [2] Honebrink 1990, [3] McPherson et al. 1992, [4] Lee 1974, [5] CMFRI 2013, [6] Cai et al. 2010, [7] Collette & Nauen, 1983, [8] Lablache et al., 1988 [9] Abdussamad et al., 2010, [10] CMFRI 2015, [11] Tiews et al., 1972, [11] Kwok & Ni 1999

The fishing grounds of the respondents were well within the mouth of the Amnay River and adjacent coastal waters up to 16 kilometers offshore (**Table 2.2.26**). The primary fishing gear that was used in the area were hook-and-line (kawil), fishing nets (lambat), and a combination of both methods. In terms of the number of hours per fishing trip, an average of nine (9) hours were spent by fishers. The volume of catch ranges from 2 kilograms during lean months and up to 40-100 kilograms during peak season. This may range from 3.5 hours to 12 hours a day, depending on the season and sea conditions. The peak season for catch as reported by fishers is during the northeast monsoon (amihan), and less catch is being reported during the southwest monsoon (Habagat) where rough sea conditions are observed brought by the monsoon winds.

As the baseline fish community survey in the study site was conducted during the southwest monsoon, time spent by fisherfolks and the type of fishing gear used was limited to adapt to the current sea condition. Hence, the fish caught by fisherfolks may have also been limited.

Table 2.2.26: Result of Interview on Fisheries in Amnay River Estuary and its Surrounding Waters

Respondent	Fishing Gear	Catch Composition	Catch Volume (kg)	Number of Hours Per Trip	Peak Fishing Season	Fishing Areas
1	Hook-and-Line (*Kawil*)	Bullet Tuna (*Tulingan*) Bigeye Scad (*Matambaka*)	10	12 hours	NE Monsoon (*Amihan*)	Estuary, Offshore
2	Hook-and-Line (*Kawil*), Fishing Net (*Lambat*)	Trevally (*Talakitok*) Torpedo Scad (*Pak-an*) Herring, Sardinella (*Manamsi*) Spanish Mackerel (*Tanigue*) Spotted Scat (*Kitang*) Largehead Hairtail (*Espada*)	7	14	NE Monsoon (*Amihan*)	Estuary, Offshore
3	Hook-and-Line (*Kawil*), Fishing Net (*Lambat*)	Herring, Sardinella (*Manamsi*) Skipjack Tuna (*Gulyasan*)	3-4 (Lean Months), 20 (Peak Months)	12	NE Monsoon (*Amihan*)	Estuary, Offshore
4	Hook-and-Line (*Kawil*)	Trevally (*Talakitok*) Snapper (*Maya-maya*) Mackerel (*Alumahan*)	2 (Lean Months), 30 (Peak Months)	7	NE Monsoon (*Amihan*)	Estuary, Offshore
5	Fishing Net (*Lambat*)	Bigeye Scad (*Matambaka*) Snapper (*Maya-maya*) Goldband Goatfish (*Salmunete*) Yellowstriped Goatfish (*Timbungan*) Threadfin Bream (*Bisugo*) Mackerel (*Alumahan*) Lizardfish (*Tiki-tiki, Tabili-dagat*)	20 kg	5	March – April (End of NE Monsoon, Inter Monsoon Period)	Estuary, Offshore
6	Fishing Net (*Lambat*)	Silverbiddy (*Malakapas*) Slipmouth, Ponyfish (Sap-sap) Snapper (*Maya-maya*) Barracuda (*Torsillo*)	40-100 (Peak Months)	3.5	December (NE Monsoon)	Estuary, Offshore

Plate 2.2.24: Fish and Macroinvertebrates Caught in the Coastal Waters of Sablayan, near Amnay River

2.2.5.5 Threat to Existence and/or Loss of Important Local Species and Habitat

No critical marine habitats were observed within the proposed dredging area and its surrounding waters. There were no coral reefs and seagrass meadows recorded on the study site. No algae and seaweeds were also recorded on the study site during the survey. The overall composition of phytoplankton, zooplankton and soft-bottom communities at the project site is already reflective of a stressed environment possibly due to an interplay of factors such as strong water movement and silt deposition from Amnay River discharge/runoff. Enhanced sedimentation due to sediment disposal/loading during dredging leads to habitat loss and mortality of planktonic and macrobenthic organisms. This will bury and smother softbottom/ macrobenthic animals. Liu et al (2010) has also demonstrated that dredging has resulted in decrease in diversity of phytoplankton and zooplankton, by affecting their growth reproduction and distribution. Siltation and soil erosion control measures such as silt traps will be installed prior to the conduct of restoration and desilting works.

In terms of fish, the estuarine and demersal fish communities will most likely be impacted by the dredging activities. Increased turbidity and resuspension of silt and sediments caused by dredging activities and ship movements will disturb the habitat of estuarine and demersal fishes. However, these organisms are highly adaptable to different levels of salinity and can occupy a wide range of habitat types. Affected estuarine and demersal fish species may be able to temporarily seek refuge in adjacent water bodies. The impact on fish communities is estimated to be temporary and localized, and these may recover as soon as water and substrate conditions become favorable and stable.

The Project aims to minimize mud and sediment disturbance arising from dredging through strict adoption of good practices of dredging control and management. CPGI will employ a scientific extraction method by using TSHD to collect the sediments in the riverbed such as mud, sand and gravel. A grill or screen will be installed on the drag head to avoid domestic wastes, debris, scrap and other solid wastes be suctioned during dredging operations and to make sure only satisfy materials will be pumped from riverbed to the dredging vessel. Silt curtains will be installed around the dredging machine and around the immediate area being dredged. As part of mitigating measure for the impacts on marine ecology, silt curtains and or sediment traps should be installed during dredging at least at the River Mouth to avoid dispersal of sediments/ sedimentation/ siltation in nearby marine coastal areas. This can increase turbidity and cause a reduction in photosynthetic activity of phytoplankton, potentially decrease the abundance of zooplankton which graze primarily on phytoplankton, and smother or bury macrobenthic animals or soft-bottom fauna.

2.2.5.6 Threat to Potential Damage from Erosion of Sediments and Silt

Sediments and silt are identified as major factors to the degradation of marine habitats such as coral communities. Potential sources of these sediments come from dredging activities on the river such as declogging/clearing activities, scouring, drag of dredgers and unprotected stockpiles of gravel and sand. Loose materials can be eroded to the marine environment and may suffocate feeding apparatus of corals. High deposition of silt and sediments, sand particles also smother fish eggs laid on the sediment floor and other benthic sessile organisms, diminishes food source by reducing the availability of light for photosynthesis.

Increased in turbidity significantly reduces light penetration and DO content in the water, which is detrimental to primary producers (net productivity) which require light for photosynthesis. The increase in sediment load increases nutrient levels in the water column which may cause localized eutrophication which is adverse to heavy nutrient sensitive planktons and seaweeds. Overall, suspended solid loading in the water column will lead to decline in primary productivity and, thereby, affecting the food pyramid in the aquatic ecosystem.

Nevertheless, it must be mentioned that the habitat disturbance and modification is not permanent. Coral reefs have been shown to be highly resistant. However, there is no coral reefs recorded in the area. Disturbed reefs are rapidly colonized by both algae and fish, which were also absent in the offshore area. Structures introduced in a reef are likewise rapidly colonized.

To avoid and reduce erosion of sediments and silt it is important to plan storage and stockpile activities. A provision silt curtains, siltation ponds around the facility and processing plant crusher to trap sediments will be helpful to reduce this impact. Planting and greenery as well can reduce the incidence. At the minimum, placement sandbags and geotubes near the stockpile areas will be implemented. Mitigating and preventive measures such as installation of silt curtains within the perimeter of the project area will be done.

2.2.5.7 Threat from Pollution from Wastewater and Oil from Dredging and Desilting Vessels

Transport and service ships may discharge or leak contaminated water with oil and oil during the course of activities. These pollutants may adversely affect various marine flora and fauna. To prevent this effect, it is highly recommended to include in the contract of transport and service ships a provision to dispose all forms of pollutants properly following internationally accepted conventions. Failure to follow this will result into some form of serious sanctions. Mitigating and preventive measures such as installation of curtains will be done.

2.2.5.8 Disturbance of Navigational Lanes of Fishers and Local Transport

Prior to offshore dredging, transport and service ships will be secured in the area. This may cause disruption to the usual navigation routes of fishers and local transport (if any) which can be interrupted. This impact can best be mitigated by meeting fishers and local transport and discuss to find mutually acceptable solutions. This disturbance is temporary in nature.

2.2.5.9 Anchor Damage

Anchor damage is another source of potential impact for the coral communities in the area. The anchors can break and crush corals. Mooring buoy will be provided to avoid adverse effects of anchor damage. However, there were no corals recorded in the area, but the project will still employ this mitigation in order to protect substrate for the lifeforms that will eventually be developed in the area.

2.2.5.10 Threat to Abundance, Frequency, and Distribution of marine organisms

In addition, siltation can increase water turbidity and significantly decrease light penetration, thereby reducing the quantity of light (light attenuation). This could potentially decrease photosynthetic activity and overall primary productivity of phytoplankton. Consequently, zooplankton which would primarily graze/ prey on phytoplankton will also decrease in abundance. In addition, sediments ending up as run-off in nearby coastal areas may contain nutrients which can potentially lead to eutrophication and alter composition of phytoplankton and zooplankton communities. Transport and service ships may also discharge or leak contaminated water with oil during the course of activities. These pollutants may adversely affect various marine flora and fauna. To mitigate this effect, it is highly recommended to include in the contract of transport and service ships a provision to dispose all forms of pollutants properly following internationally accepted conventions. Failure to follow this will result into some form of serious sanctions.

Bringing of transport and service ships in the area prior to construction phase may also cause disruption to the usual navigation routes of fishers. This impact can best be mitigated by coordinating with fishers to discuss the acceptable solutions. This disturbance is temporary in nature.

On the other hand, the potential impacts of the project on the reef fish communities may be considered secondary responses to impacts that the eventual coral reefs formation might experience during operation, if any coral reefs developed. Changes in the condition of the reef sites (i.e., improvements or declines in coral cover and/or algal cover) may result in concomitant changes in their associated fish communities. In general, the decline of water quality, and negative changes in the habitat ecosystems such as abundance of some fish species which include silverbiddies (Gerreidae) and slipmouths (Leiognathidae), an increase algal dominance, and decreases in physical complexity, can trigger changes in the fish communities (Mumby et al., 2013).

In terms of mitigating actions, the overall mitigation strategy for the Project's dredging and desilting operational phases is to make sure that silt and sediment streams originating from project dredging activities and related works won't worsen turbidity of offshore waters in order to prevent excessive impacts on the seabed and to protect fish communities and their population. To prevent silt and sediments from contaminating seawater for an extended length of time, a variety of sediment mitigation techniques and filters, most notably silt curtains, will be installed in key sites around dredging activities. As part of the plan for environmental management and rehabilitation, an improvement strategy for dredging areas will be developed to protect fish communities and their population.

Further, with the strict application of best practices for controlling and managing offshore dredging and desilting, the Project seeks to reduce mud and sediment disruption caused by dredging. CPGI will use TSHD to gather sediments from the seabed, such as mud, sand, and gravel which is backed-up with scientific dredging technique. To ensure that only acceptable materials (mud to sand size) will be pumped from the seabed to the dredging vessel, a grill or screen will be installed on the drag head to prevent seabed wastes like domestic wastes, debris, scrap, and other solid wastes from being suctioned during dredging operations. Silt curtains will be put in place all around the dredging equipment and the area being dredged.

Onshore restoration and desilting will be scheduled during dry season. Moreover, siltation and soil erosion control measures such as silt traps will be installed prior to the conduct of dredging works. During operation phase, the waste from the proposed ARRD Project may affect the other organisms nearby. To protect the organisms within the vicinity of the proposed ARRD Project, the wastewater from the domestic sewage shall be treated to ensure that all discharges to the marine water comply with the DENR standard for Class SC Waters.

2.2.5.11 Impacts of the Project in Terms of Degradation of Coastal/Marine Water Quality

During site development and construction phase (opening of the delta) of the proposed ARRD Project, soil erosion and sedimentation may bury the natural coastline especially when silt and spoil materials at the river are not controlled. However, this impact is temporary and may only be prevalent during the construction period (e.g., opening of the delta) of the proposed ARRD Project. Moreover, onshore excavation (dredging and desilting) will be scheduled during dry season and siltation and soil erosion control measures such as silt traps will be installed prior to the conduct of excavation works. During operation phase, the waste from the WWTS of the proposed ARRD Project may affect the other organisms nearby. To protect those organisms, quality within the vicinity of the proposed ARRD Project, the wastewater from the Plant and domestic sewage shall be treated to ensure that all discharges to the marine water comply with the DENR standard for Class SC Waters (Tidal salt waters). Class SC water category is the nearest or appropriate classification that can be applied to the project site since the offshore area is suitable for recreational, commercial or sustenance fishing area.

2.3 AIR

2.3.1 Climatology and Meteorology

2.3.1.1 Local Climate

Climate is classified in terms of rainfall differences due to the combined influence of topography and air storm direction received in the locality during different months of the year. As such; under the Modified Coronas Climate Classification System, the climate of the Philippines is categorized into four (4) types according to the rainfall distribution as follows:

- Type I: Two pronounced seasons. Dry from November to April, wet during the rest of the year.
- Type II: No dry season with a very pronounced rainfall from November to April and wet during the rest of the year.
- Type III: Seasons are not very pronounced, relatively dry from November to April, wet during the rest of the year.
- Type IV: Rainfall is more or less evenly distributed throughout the year.

As presented in **Figure 2.3.1**, Type I Climate prevails in MIMAROPA, where Amnay River is located.

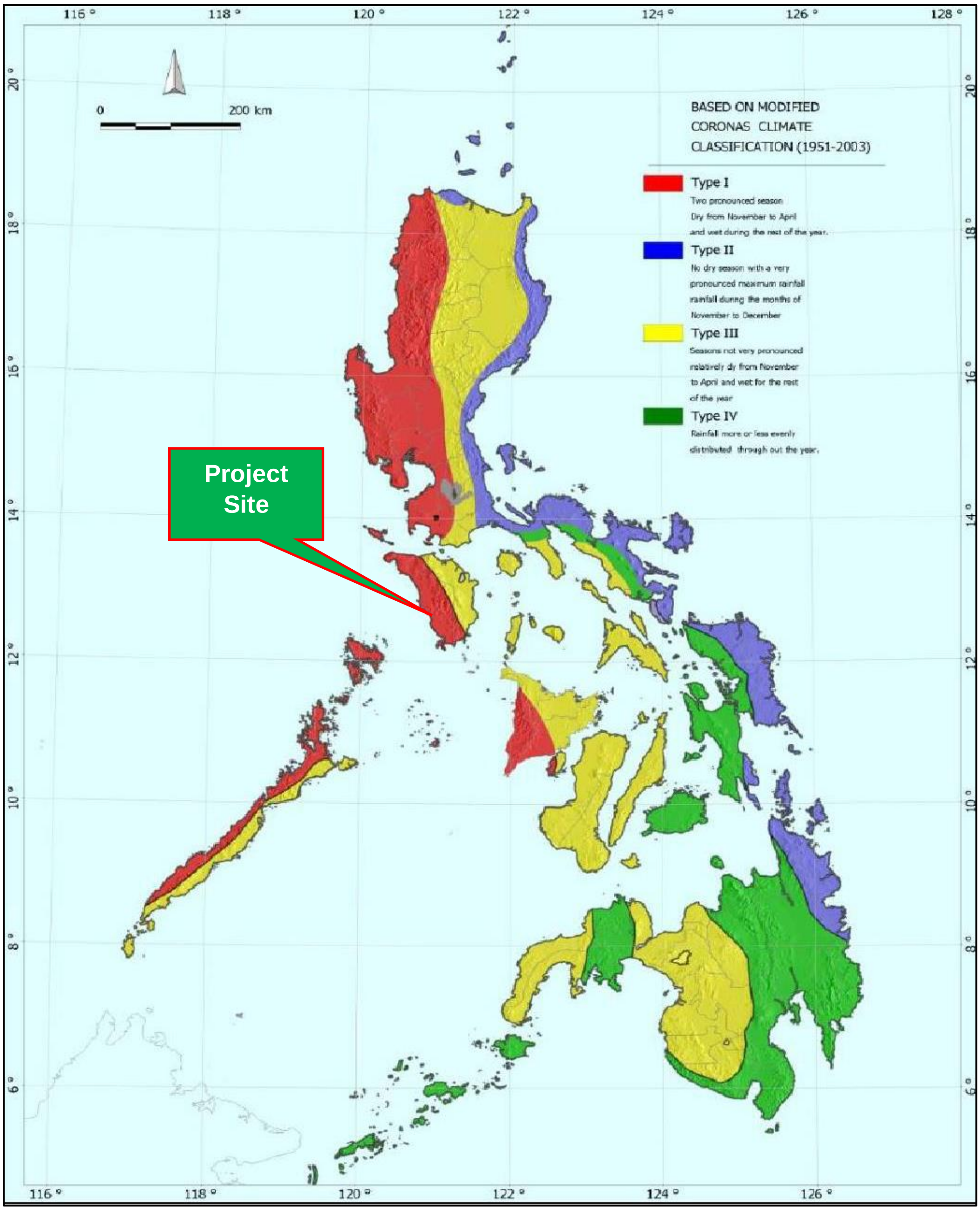


Figure 2.3.1: Climate Map of the Philippines

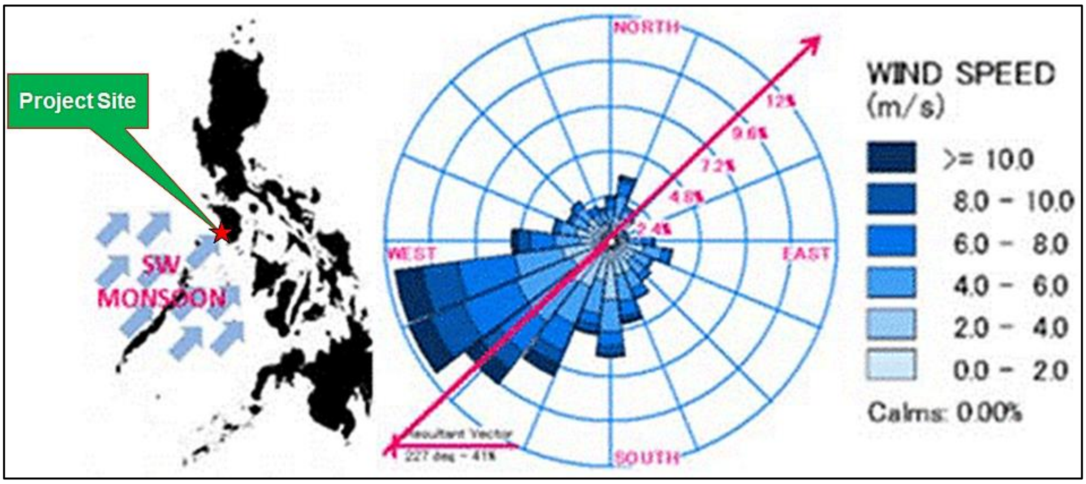
2.3.1.2 Meteorology

The meteorology in the proposed ARRD Project site was described using the data recorded at PAGASA San Jose Station located in San Jose, Occidental Mindoro, which the nearest meteorological station from the proposed ARRD project site

2.3.1.2.1 Wind Regime

The wind speed and direction in the Philippines are influenced by monsoons: Northeast Monsoon (Amihan) from October to April and Southwest Monsoon (Habagat) from May to September. **Figure**

2.3.2 shows the wind rose diagram from 2001-2014 with the prevailing wind coming from the southwest and south.



Source: Jerome, Silla & Takagi, Hiroshi. (2017). Tokyo Tech Disaster Research Report, No.1, pp.5-8., 2017.

Figure 2.3.2: Wind Rose Diagram from 2001-2014

2.3.1.2.2 Rainfall

Monthly average rainfall ranges 0 to 657 mm in 2019 (**Figure 2.3.3**). Lowest average rainfall was recorded in January and April whilst highest was in August. During the wet season, the month of June has an average rainfall of 343.9 mm and July with 465.1 mm. The months from October to December are not characterized by dry weather as compared to the months from January to April, partly due to the fact that typhoons and depressions most frequently affect the province during the months from July to December.

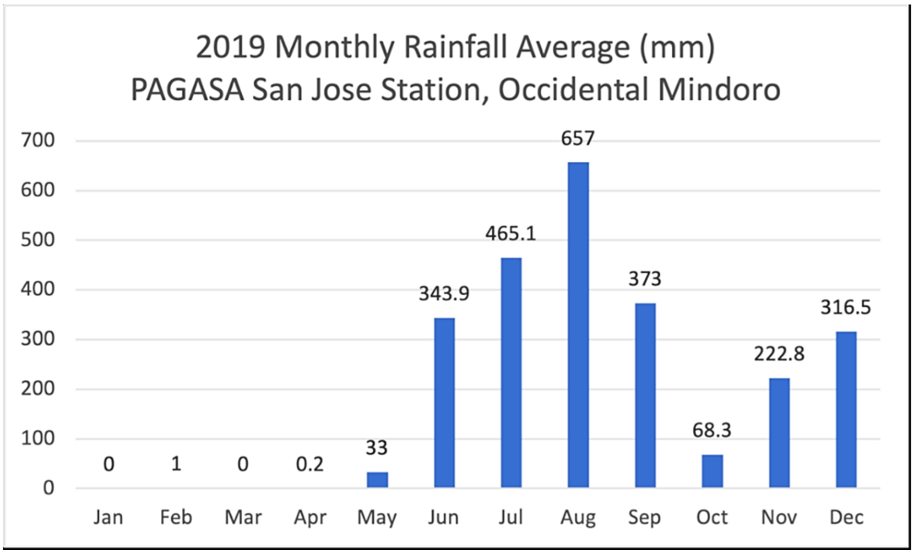


Figure 2.3.3: Monthly Average Rainfall in Occidental Mindoro

2.3.1.2.3 Relative Humidity

Relative humidity refers to the amount of water vapor in the air, expressed as a percentage of the maximum amount that the air could hot at a given time. Data on the mean annual relative humidity recorded at San Jose Station is 80% (**Figure 2.3.4**). The average annual temperature for Occidental Mindoro is 29° degrees and there is about 507 mm of rain in a year. It is dry for 170 days a year with an average humidity of 80% and an UV-index of 7. The month with the highest relative humidity is August (87.78 %). The month with the lowest relative humidity is April (73.17 %).

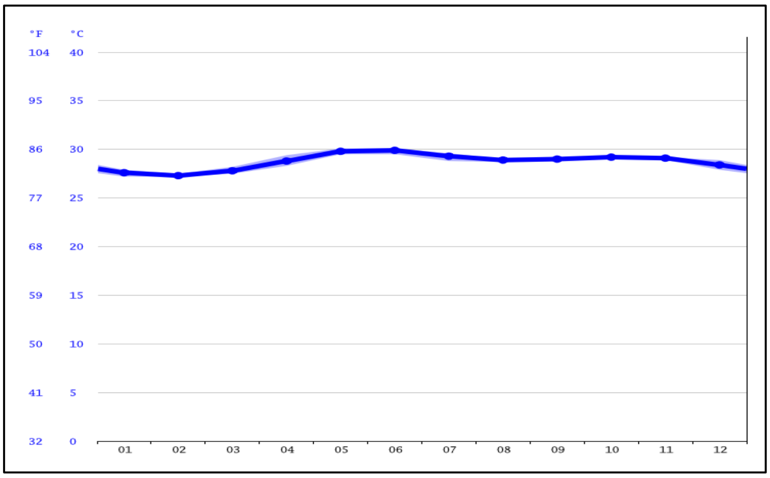


Figure 2.3.4: Average Monthly Relative Humidity in Occidental Mindoro

2.3.1.2.4 Temperature

The warmest month of the year is April, with an average temperature of 27.8 °C or 82.0 °F. January has the lowest average temperature of the year. It is 25.7 °C or 78.2 °F. The months of April is the hottest month of the year, with a recorded average mean temperature of 27.8°C based on the data from San Jose Station while January is the lowest, with an average mean temperature of 25.7°C (**Figure 2.3.5**). The mean annual average temperature is 27.8°C. Based on the temperature data from PAGASA San Jose Station, Monthly average temperature ranges from 24°C to 32°C in 2020. February had the lowest temperature readings whilst April and May had the highest.

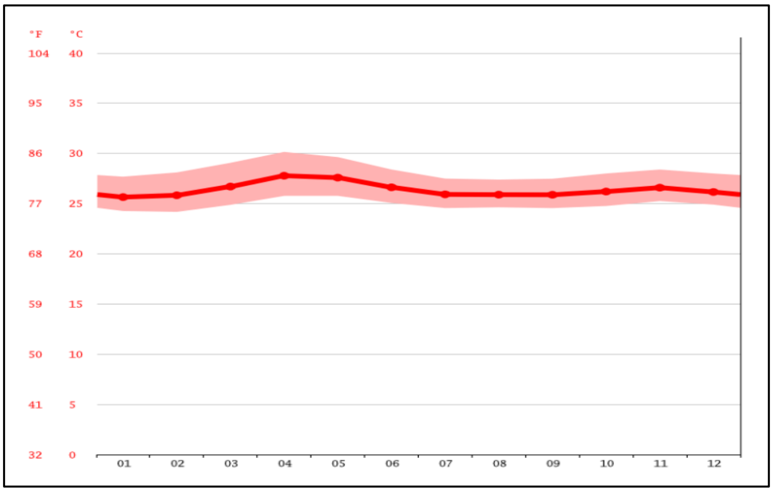


Figure 2.3.5: Average Monthly Temperature in Occidental Mindoro

2.3.1.2.5 Frequency of Extreme Event

The climatological extremes values presented in **Table 2.3.1** are from the 30-year monthly and annual summaries of temperature, rainfall, and wind speed. The recorded annual extreme high temperature is 38.5°C occurred in April 28, 1992 and May 4, 1991 while the low temperature is 15.5°C and 15.4°C occurred in January 9, 1985 and February 15, 1982. The amount of annual average extreme greatest rainfall is 286.70 mm occurred in October 21, 1998 while the annual average extreme highest wind is 35m/s westerly direction occurred in May 12, 2006.

Table 2.3.1: Climatological Extremes Recorded at San Jose Station

Republic of the Philippines
Department of Science and Technology
Philippine Atmospheric, Geophysical and Astronomical Services Administration
Climatology and Agrometeorology Division
CLIMATE AND AGROMET DATA SECTION
PAGASA Science Garden Complex, Agham Road, Diliman Quezon City, Philippines
Telefax: (632)-434-2698

CLIMATOLOGICAL EXTREMES

STATION: **SAN JOSE, OCCIDENTAL MINDORO**
YEAR: **AS OF 2014**

LATITUDE: **12°21'39.07"N**
LONGITUDE: **121°02'51.68"E**
ELEVATION: **3.314m**

MONTH	TEMPERATURE (°C)				GREATEST DAILY RAINFALL (mm)		STRONGEST WINDS (mps)			SEA LEVEL PRESSURES (mbs)			
	HIGH	DATE	LOW	DATE	AMOUNT	DATE	SPD	DIR	DATE	HIGH	DATE	LOW	DATE
JAN	35.5	01-11-1990	15.5	01-09-1985	28.1	01-21-2008	20	ENE	01-16-2001	1018.1	01-31-1998	1002.6	01-06-1999
FEB	36.2	02-27-1998	15.4	02-15-1982	50.4	02-22-1986	26	NE	02-18-2008	1018.2	02-01-1998	1002.7	02-08-1986
MAR	37.6	03-28-1992	19.0	03-03-1990	69.8	03-27-1982	22	E	03-26-1991	1017.1	03-03-1987	999.0	03-30-1995
APR	38.5	04-28-1992	20.0	04-18-1981	90.0	04-15-2014	20	E	04-04-2008	1016.1	04-04-1998	1000.6	04-28-1995
MAY	38.5	05-04-1993	20.5	05-27-1986	214.4	05-12-2006	35	WNW	05-12-2006	1013.8	05-20-1994	996.1	05-12-2006
JUNE	38.0	06-05-1991	18.0	06-19-1981	273.4	06-27-1988	30	SSW	06-21-2008	1015.0	06-31-1995	996.6	06-06-1989
JULY	37.4	07-18-1998	20.0	07-30-1980	198.0	07-15-2014	28	W	07-24-2004	1013.3	07-31-1995	996.6	07-14-1983
AUG	35.0	08-02-1998	18.0	08-29-1980	187.2	08-25-2001	26	W	08-26-2002	1019.6	08-02-1980	996.5	08-12-1987
SEP	35.4	09-06-1988	19.0	09-17-1980	198.4	09-08-1982	35	E	09-02-1984	1019.9	09-20-1980	999.0	09-30-1995
OCT	36.0	10-30-1990	19.0	10-10-1983	286.7	10-21-1998	28	SW	10-10-1989	1015.4	10-05-1987	993.7	10-24-1988
NOV	38.0	11-14-1989	19.0	11-20-1980	178.0	11-07-1988	34	W	11-20-2004	1015.6	11-03-1994	989.0	11-07-1988
DEC	36.0	12-07-1991	17.5	12-29-1996	256.6	12-11-1998	33	E	12-22-1994	1017.3	12-27-2001	980.6	12-10-2006
ANNUAL	**38.5**	**04-28-1992**	**15.4**	**02-15-1982**	**286.7**	**10-21-1998**	**35**	**WNW**	**05-12-2006**	**1019.9**	**09-20-1980**	**980.6**	**12-10-2006**
	38.5	**05-04-1993**					**35**	**E**	**09-02-1984**				
Period of Record	**1980 - 2014**				**1980 - 2014**		**1980 - 2014**			**1980 - 2014**			

2.3.1.2.6 Cyclone Frequency

According to Corporal-Lodango and Leslie (2016) study of Philippine Tropical Cyclone activity from 1945 – 2016, there are two distinct Tropical Cyclone seasons, the Less Active Season (LAS) and the More Active Season (MAS) in the country. Philippine Tropical Cyclone annual median LAS frequency is 2 (Interquartile range IQR, 2) and median landfalling frequency is 1. In contrast, the annual median MAS frequency is a lot higher at 15 (IQR 4.5) and median landfalling frequency is 6. It is estimated by Lodango and Leslie (2016) that 55% of Philippine Tropical Cyclone reach typhoon intensity.

The frequency of tropical cyclones affecting the country is rather latitudinal in nature, such that all the four climatic regions are exposed to typhoons. The southern part of the archipelago up to 8°North latitude is nearly free from typhoons with frequency of occurrence of only 1%. From 8° to 11° North latitude, which includes Mindoro Island, the occurrence is less frequent at 7%. Regions from 11° to 15° North latitude, are subject to about 19% becoming more frequent. Finally, the northern part of the archipelago from 16 of North latitude and up is mostly visited by typhoons with a 32% frequency of occurrence. **Figure 2.3.6** shows the Typhoon Vulnerability Map of the Philippines.

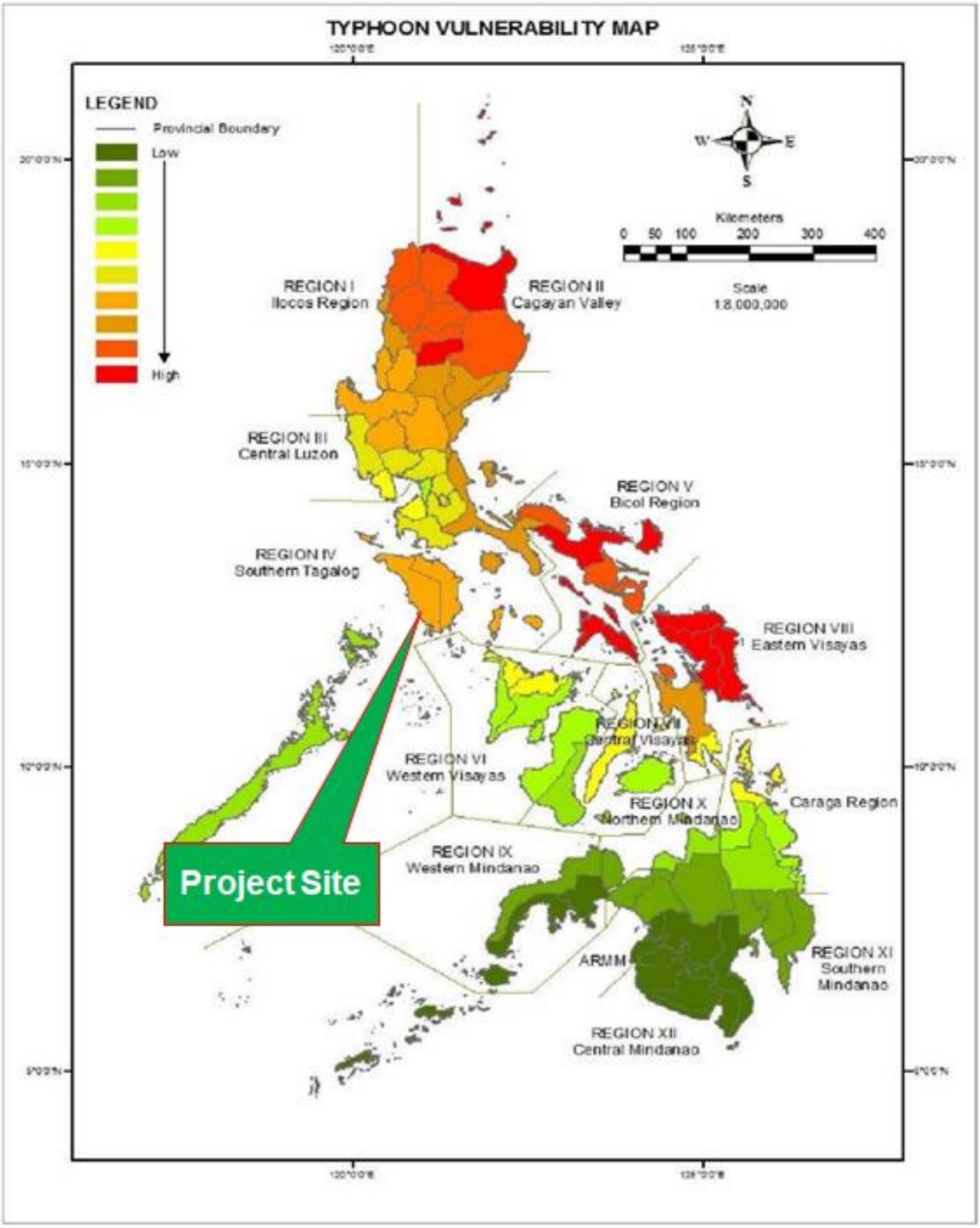
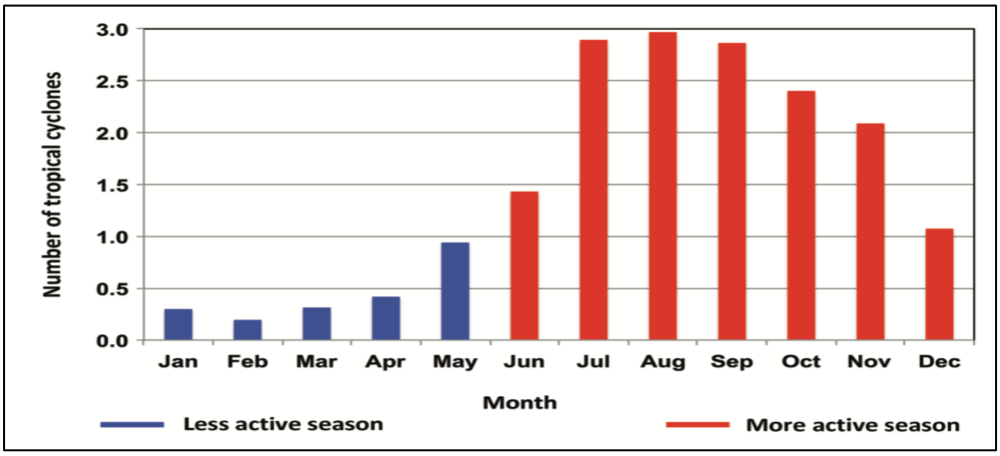


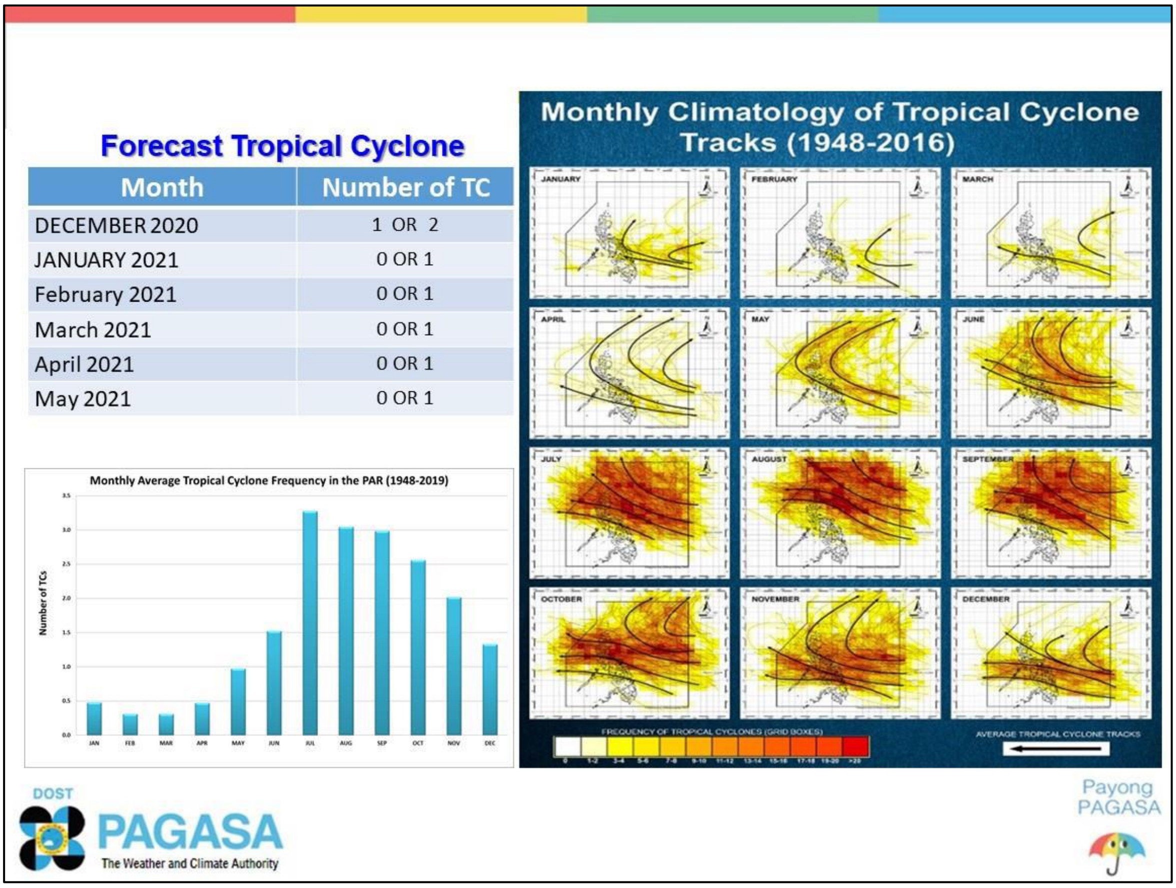
Figure 2.3.6: Typhoon Vulnerability Map of the Philippine

Typhoons usually occur in the country from June to December, with highest frequencies during the months of July, August, and September (**Figure 2.3.7**). An average of 20 typhoons enters the Philippine area of responsibility (PAR) annually, eight to nine of which pass through the southern part of Luzon Island and eastern part of the Visayan islands. (Lapidez et al., 2015). The project site is in the area traversed by about 2 tropical cyclones per year (24 cyclones in the last 12 years). **Figure 2.3.8** presents the Monthly Climatology of Tropical Cyclone Tracks from 1948 to 2016.



Source: Corporal-Londango and Leslie, 2016

Figure 2.3.7: Mean Monthly Tropical Cyclone Counts in the Philippines



Source: PAGASA

Figure 2.3.8: Monthly Climatology of Tropical Cyclone Tracks (1948 – 2016)

2.3.1.3 Change in Local Climate

Some key information on the climate change in the Philippines includes seasonal mean temperature variations, seasonal rainfall changes and occurrence of extreme events. Temperature will consistently increase in all provinces.

In the case of seasonal rainfall change, there will be a reduction in rainfall in most provinces during the summer months (MAM), rainfall increases are likely in most areas of Luzon and Visayas during the southwest monsoon (JJA) and the SON seasons. During the southwest monsoon season (JJA), larger increases in rainfall is expected in provinces in Visayas (2% to 22%) in 2050.

Projections for extreme events in 2020 and 2050 reflects those hot temperatures (indicated by the number of days with maximum temperature exceeding 35°C) will continue to become more frequent, number of dry days (days with less than 2.5 mm of rain) will increase in all parts of the country and heavy daily rainfall (exceeding 300mm) events will also continue to increase in number in Visayas.

The projected seasonal temperature increase, seasonal rainfall changes and frequency of extreme events in 2020 and 2050 under the medium range emission scenario in the provinces in Region 4-B are presented in **Table 2.3.2**, **Table 2.3.3** and **Table 2.3.4**, respectively.

Table 2.3.2: Seasonal Temperature Increases (in °C) in 2020 and 2050 under Medium-Range Emission Scenario in Provinces of Region 4B

Province	Observed Baseline (1971-2000)				Change in 2020 (2006-2035)				Change in 2050 (2036-2065)			
	DJF	MAM	JJA	SON	DJF	MAM	JJA	SON	DJF	MAM	JJA	SON
OCCIDENTAL MINDORO	26.5	28.3	27.3	27.1	0.9	1.1	0.9	1.0	1.9	2.1	1.8	1.9
ORIENTAL MINDORO	26.4	28.3	27.6	27.3	0.8	1.0	1.1	0.0	1.8	2.0	2.2	1.9
ROMBLON	26.3	28.5	28.1	27.7	0.8	1.1	0.9	0.8	1.8	2.2	1.9	1.7
PALAWAN	26.9	28.1	27.3	27.4	0.9	1.1	1.0	0.9	1.8	2.1	2.0	1.8

Table 2.3.3: Seasonal Rainfall Change (in %) in 2020 and 2050 under Medium-Range Emission Scenario in Provinces of Region 4B

Province	Observed Baseline (1971-2000)				Change in 2020 (2006-2035)				Change in 2050 (2036-2065)			
	DJF	MAM	JJA	SON	DJF	MAM	JJA	SON	DJF	MAM	JJA	SON
OCCIDENTAL MINDORO	159.5	265.9	1091.2	762.6	-14.3	-15.6	13.6	3.2	15.8	-23.8	26.7	-2.4
ORIENTAL MINDORO	260.3	269.3	894.3	791.2	-3.2	-15.1	0.5	6.2	21.6	-11.5	5.3	2.9
ROMBLON	357.0	224.0	652.9	778.0	9.0	0.2	27.6	22.6	32.6	26.3	66.2	37.9
PALAWAN	101.8	189.3	781.7	640.6	15.7	-7.2	-2.6	19.6	7.3	-9.0	1.0	6.9

Table 2.3.4: Frequency of Extreme Events in 2020 and 2050 under Medium-Range Emission Scenario in Provinces of Region 4B

Provinces	Station	No. of Days w/ Tmax>35°C			No. of Dry Days			No. of Days W/ Rainfall>200mm		
		OBS (1971-2000)	2020	2050	OBS	2020	2050	OBS	2020	2050
OCCIDENTAL MINDORO	San Jose	1075	1773	3410	5437	7010	7128	8	5	14
ORIENTAL MINDORO	Calapan	80	440	1469	7604	7057	6902	3	11	22
PALAWAN	Puerto Princesa	29	23	297	8348	6457	6455	2	7	7
	Coron	242	739	1988	7726	5542	5561	4	4	3
	Cuyo	59	195	791	7447	5382	5406	5	5	2
ROMBLON		59	235	756	7628	6125	5663	4	11	20

The proposed ARRD Project will not pose major change in the microclimate of the service area. Variations in climate, however, will affect the schedule of works such as preparatory dredging or opening of river delta for clear passage of dredging vessels, clearing of river mouth for correction of flow of water from the river, and dredging operations, potentially delaying the progress of the proposed Project. Consideration of effects of climate variabilities will mitigate the delays in the work schedule.

The changes in the rainfall pattern and significant local temperature changes shall be included in the design criteria of the Project. Dredging and desilting equipment, design, and technologies to be used in the Project will take into consideration the effects of climate variations and the effects of extreme temperature changes to operating conditions of project components and accessories. The selection of the design temperature reflects an optimization of dredging operation productivity, operational and capital costs based on historical conditions. Workers' exposure to extreme local climate conditions may have negative effects to their health and compromise their safety and productivity. Climate variations shall have to be integrated to designing work policies, proper work clothing, equipment safety features, etc. to minimize health effects and work hazards for the workers.

2.3.1.4 Contribution Terms of Greenhouse Gas Emissions

The sources of carbon dioxide emission from the proposed project are the fuels used in the operation of vessels and equipment such as dredgers and barges. The dredging activities do not involve use of air pollution generating equipment on regular basis and in case of usage this will be for power generating equipment only thus emissions are temporary in nature. These are considered minor in terms of the global inventory, in addition to the short-term use of these units. Although there are no calculations at this time estimating the number of fuels and thus of CO_2 that would be generated by the various equipment.

To minimize the contribution of the project to the global greenhouse gas production, all equipment to be utilized will be maintained regularly so as to keep it running as efficiently as possible. A reforestation program will also be implemented as part of the mitigation program. Offsetting CO_2 emissions can be done by planting trees.

Environmental changes now in progress is a buildup of atmospheric CO_2, the added CO_2 in the atmosphere is coming from the burning of fossil fuel, cutting of forests and wastage of soil humus. The build-up of greenhouse gases influences the temperature of the atmosphere and the earth surface. CO_2 emits and absorbs radiation at wavelengths typical of the earth atmosphere. If it's concentration increase, the atmosphere offer increase resistance to the necessary escape of radiation in space. Since incoming solar radiation is not much affected by the change in concentration of CO_2, surface temperatures must rise as a result of the increased resistance of the return flow.

The Philippines 2000 Greenhouse Gas inventory is the latest and the second GHG inventory conducted in the Philippines under Climate Change Commission. Inventory result shows that the annual CO_2 contribution of the Philippines as of year 2000 is 21,767.41 Gg or 21,767,410 metric tons.

2.3.2 Ambient Air Quality and Noise Level

The ambient air quality of the Project site was characterized by analyzing the results of the collected ambient air samples on August 21, 2021. During the field sampling, two (2) ambient air sampling stations were identified to represent the baseline environmental condition of the project site and its vicinity. The coordinates and the location map of the ambient air quality sampling and noise level measurement stations are presented in **Table 2.3.5** and **Figure 2.3.9**, respectively.

Table 2.3.5: Coordinates of the Ambient Air Quality Sampling and Noise Level Measurement Stations

Station No.	Location	Coordinates	
		Latitude	Longitude
1	Along Riverbanks	12°56'51" N	120°46'53" E
2	Along Riverbanks	12°57'23" N	120°53'25" E

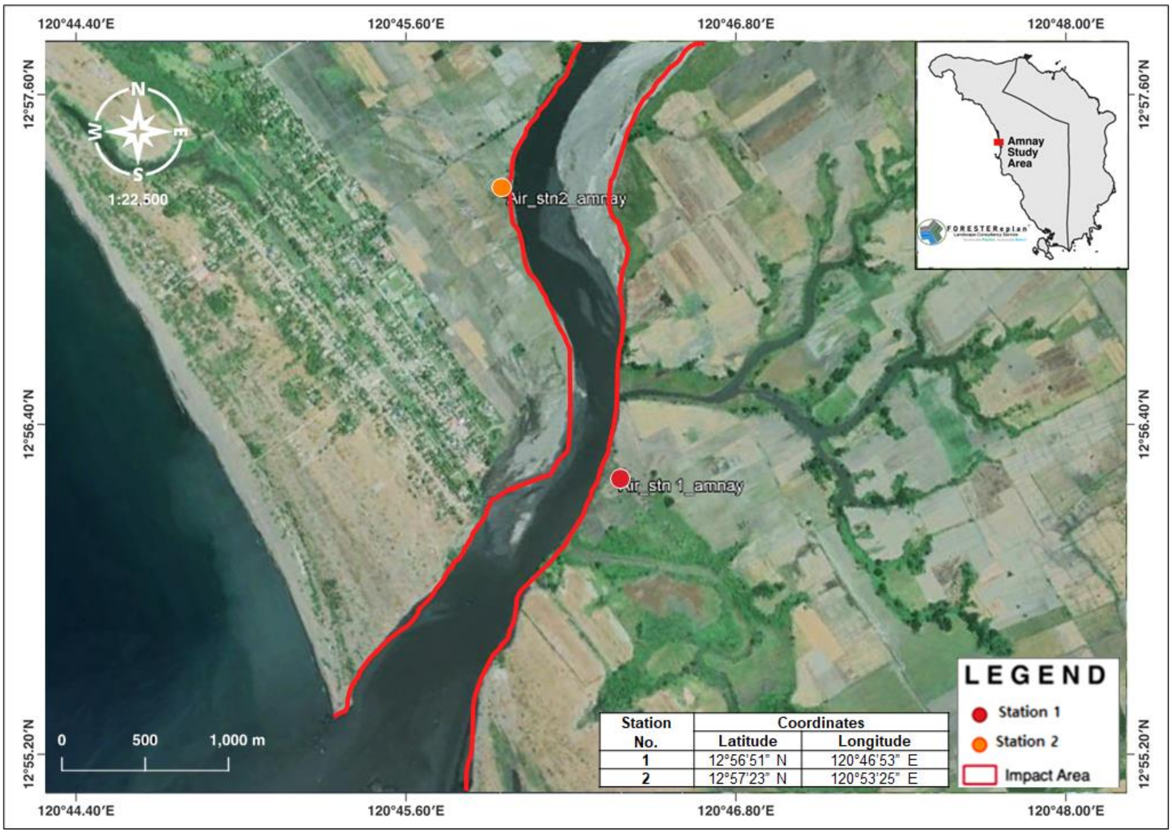


Figure 2.3.9: Location of Ambient Air Quality Sampling Stations

2.3.2.1 Ambient Air Quality

Ambient air quality in the Project site is generally very good as the surroundings are mostly devoid of industries and mostly agricultural land uses surrounds the project. The residential zones in the project area are relatively far. Air quality in the dredging area where the ships will be deployed has been measured and were very good considering the effects of land and sea breezes. Sea/Land breezes are generated by thermally induced winds due to the different heat capacities of the land and the sea water along coastal lines. The maximum speeds of the sea and land breezes can reach approximately 2.5 m/s and 1.5 m/s, respectively along the coastal line. These sea breezes can penetrate up to 25 km offshore which will suit well as it can easily disperse air pollutants.

Ambient air quality sampling was conducted at the two (2) established sampling stations to measure the levels of TSP, PM_{10}, SO_2, and NO_2. The collected ambient air samples were analyzed in Aeronics Laboratory. The results of the ambient air quality sampling are shown in **Table 2.3.6**.

Table 2.3.6: Results of Ambient Air Quality Sampling, August 21, 2021

Station	Location	Coordinates	Time	NO_2	SO_2	TSP	PM_{10}
1	Along Riverbanks	12°30'36" N 120°55'54" E	0635H – 0735H	2.8	32.5	23	27
2	Along Riverbanks	12°30'45" N 120°55'57" E	0847H – 0947H	29.5	33.5	10	22
DENR NAAQSSAP				260	340	300	200

The result demonstrated that the ambient concentrations of NO_2, SO_2, TSP and PM_{10} are within the acceptable limits of the standards stipulated DENR National Ambient Air Quality Standards for Source Specific Air Pollutants (NAAQSSSAP) in the IRR of the Philippines Clean Air Act. Air condition is perceived to be still fresh due to absence of major sources of air pollutants such as factories, machineries etc. Presence of vegetation within the immediate surroundings helps in maintaining the freshness and quality of air in the project area.

2.3.2.2 Degradation of Air Quality

The emissions during pre-dredging activities are not constant and will fluctuate based on operating periods and the combination equipment to be used at any given time. Intensive construction activities will not be generally carried out at nighttime. Potential receptors such as residents will not be continually exposed during construction for extended period and limited daily exposure.

The major sources of impacts on air quality by the Project in the construction phases are as follows:

- Exhaust emission from movement of equipment by vehicles, excavated soil carrying by vehicle and other heavy loaders or vessels;
- Stockpile generation of dust from dredge materials, waste, loose earth, and moving excavated material and transporting wastes on vehicles;
- Use of diesel-based construction machineries which may cause air quality impacts; and
- Loading and unloading of dredge materials, processed sand, gravel and undesirable dredge materials in the stock pile area.

The likelihood of significant air emissions from the Project is low as the major dredging activities will be done offshore where the effects of land and sea breeze will easily dissipate any emissions from the ships. Potential sources of air emissions during the dredging phase of the Project include:

- Dust emissions from mechanical disturbance during the placement of dredged material once it is above the high-water mark;
- Exhaust emissions from dredge vessels.

Dredge vessel exhaust emissions during operation have the potential to impact on air quality; impact is likely to be low due to the distance of the vessels from the shore, the effects of the breeze, and long-term period of operation. Dust emissions have the potential to affect health and amenity, however due to the long-term nature and design of the dredging operation, the amount of dredging activity, the actual dredging and other vessel being undertaken above water and the distance from sensitive receptors, there is a very low likelihood of dust emissions impacting on either health or amenity.

Dredging and other vessel equipment release emissions to the atmosphere depending on the use of the required power for the suction pipes and pumps for the materials. The average consumption of diesel fuel of these dredgers is at 0.36 pounds of diesel per horsepower-hour (Anderson, 2008) or 0.219 kg /kw-hr. Emissions for diesel consumption are as follows and shown in **Table 2.3.7**.

Table 2.3.7: Kg of Emissions per kg Consumption of Diesel

Substance	lbs/1000 gallons diesel	kg/l diesel	Density of diesel kg/l	kg/kg diesel
CO_2	22,543.43	13.12915	0.85	15.44606
CO	117.070765	0.068181	0.85	0.080213
NO_2	0.5661	0.00033	0.85	0.000388
SO_x	4.9956	0.002909	0.85	0.003423
PM-10	13.7727	0.008021	0.85	0.009437
VOC	11.282	0.006571	0.85	0.00773

2.3.2.3 Ambient Noise Level

Noise level measurement for the proposed ARRD Project was conducted at the same two (2) ambient air quality sampling stations established within the vicinity of the project site (**Table 2.3.5** and **Figure 2.3.9**). The measured noise levels were compared to the 1978 National Pollution Control Commission Rules and Regulations under Section 78, Table 1, Environmental Quality Standards for Noise in General Areas as amended by the NPCC Memorandum Circular No. 1980-002. The noise standards are set according to land use and time of the day, as can be seen in **Table 2.3.8**.

Table 2.3.8: Noise Standards in General Areas

Class	Maximum Allowable Noise Level, (dB)		
	Daytime	Morning/Evening	Night time
AA	50	45	40
A	55	50	45
B	65	60	55
C	70	65	60
D	75	70	65

Notes:

Morning 0500H – 0900H
Daytime 0900H – 1800H
Evening 1800H – 2200H
Nighttime 2200H – 0500H
AA a section or contiguous area which requires quietness such areas with 100m from sites, nursery schools, hospitals and special homes for the aged.
A a section or contiguous areas which is primarily used for residential purposes
B a section or contiguous areas which is primarily a commercial area
C a section primarily reserved as a light, industrial area
D a section which is primarily reserved as a heavy industrial area

Results of the ambient noise level measurement conducted in both Stations 1 and 2 for the proposed ARRD Project did not exceed the maximum allowable noise levels of the NPCC Noise Standards in General Areas during daytime, as shown in **Table 2.3.9**. The noise quality assessment was conducted last August 22, 2021.

Table 2.3.9: Results of Noise Level Measurement for the Proposed ARRD Project

Station No.	Location	GPS Location	Noise Level (dBA)	DENR STANDARD Maximum Allowable Noise Level dBA, Class "A" Residential Area Classification
1	Along Riverbanks	12°56'51" N 120°46'53" E	46.3	50 (daytime)
2	Along Riverbanks	12°57'23" N 120°53'25" E	53.6	55 (daytime)

Note: Class A - a section or contiguous areas which is primarily used for residential purposes

The source of the noise for Station 1 generally are the residential noises such as playing of music (disco type) and people talking during the day and playing basketball at the afternoon, light vehicle passing by near the road, noise from the nature itself such as sounds from the crickets, other kinds of insects, dog barking, birds chirping and wind breeze. For Station 2, noise comes from nature such as sound from the crickets, other insects, birds chirping and water flowing from nearby river, wind breeze and residential noise such as playing music (disco type). Sampling stations were also located in the same areas as the ambient air sampling which are: Station 1 (Along river banks), Station 2 (bridge and dredge Area). Station 1 and Station 2 were considered as Category A (Residential Areas). It must be emphasized that individual measurements are conducted during a certain point in time. It must not be considered universal condition of the area or process involved.

2.3.2.4 Increase in Ambient Noise Level

During construction and operation phase, noise will be generated by the dredging and other vessel equipment and moving large vehicles, and other activities in the area. Trucks are used to haul away material that cannot be stockpiled or disposed on-site and to bring in necessary operation materials. Typical vehicles include dump trucks, backhoes, excavators. During operation phase, noise and vibration may be created by several sources' vessels, barges and vehicles.

Model results are based on the propagation of sound through water or air as the "source, path, receiver" model (Richardson 1995). Noise is measured in terms of Decibels unit. The equation below expresses the relationship of pressure levels to decibel unit:

$$\text{Decibel} = 10\,Log\,(P/Po)$$

Where:

P = is the reference value
P_o = is the measured value

For various sources of sound pressures, the total equivalent sound level at the receptor point can be expressed by the following equation:

$$L_{ov} = 10\,Log\,(10_{L1/10} + 10_{L2/10} + 10_{L3/10} + \ldots + 10_{Ln/10})$$

The sound power levels derived or anticipated for each equipment identified during operation phase were based on the typical equipment noise data/sizes/dimensions extracted from dredging Industry. The list of power mechanical equipment during operation phase is presented in **Table 2.3.10**. However, it is advised that the detailed design should be updated to reflect equipment data whenever the design changes.

Table 2.3.10: Equivalent Sound Power Level (PWL) of Power Mechanical Equipment During Operation Phase of the Proposed ARRD Project

Power Mechanical Equipment	PWL (L_w), dB(A)
Generator	103
Trailer Suction Hopper Dredger (TSHD)	184 – 188
Cutter Section Dredger	179.40
Bucket Chain Dredger	--
Dump truck	84-118
Back hoe	79-89
Typical dredger	110

Dredging activities will be undertaken over stages and will not be fixed in any one area. Noise impact from dredging may not impact on residents of Barangay Claudio Salgado as they are relatively far from the dredging operation project area. However, in order to assess the potential impact on these receivers, recommended dredging designs and procedures will be followed following the NPCC guidelines and the USEPA Guidelines that is used to determine the suitable background noise levels. The project is entirely within the project limits or impact zones and therefore the receiver land use has been identified as 'residential and agricultural near the dredging area' with the receiver dominant land use being 'mixed agricultural and residential'. Project specific noise goals for the identified receivers within the covered impact barangays in close proximity to dredging are summarized in **Table 2.3.11**.

Table 2.3.11 Project Specific Noise Goals – Receivers within the Dredging Limits dB(A).

Goal Description	Time Period		
	Day (7am to 6pm)	Evening (6pm to 10pm)	Night (10pm to 7am)
Recommended operational background noise planning level	45	40	35
Specific/component noise level	48	43	38

Source: USEPA (1992a) Guidelines

Dredging noise and vibration sources associated with dredging activities of the Project will likely include the following or similar equipment:

- Large TSHD;
- Medium TSHD;
- Large cutter suction dredger;
- Medium cutter suction dredger; and
- Bucket chain dredger (BCD)

There will also be workboats, survey boats and tugboats associated with the project. The likely sound power levels (L_w) and spectra for this dredging equipment were based on a very limited number of references for dredging operations and dredging equipment manufacturing specifications. Dredging activities will likely to be undertaken or operated seven days a week, 24 hours a day (based on number of shifting). And as of such dredging activities have been assessed against the nighttime site-specific noise criteria. Major noise sources may be engine noise, generators, opening and closing gates, radios, and some reverse warning devices.

Dredging does not appear to have caused significant noise problems, as most dredging occurs well away from residential areas. However, there are certain standards to be met for dredging noise levels such as the NPCC and US EPA standards. Based on very limited literature and studies, the calculated cumulative sound power level of ta dredging activity is 113 dB (MDA, 2019). The closest residential zoned sites are Barangay Claudio Salgado, approximately 2-km north of the navigation channel. The residential zone sites are relatively far from the project area. Available data predict dredging noise levels of up to 47 dB at the closest properties fronting the Amnay River delta. Overall, dredging activity noise may be audible at times, but is predicted to be below the measured existing ambient noise environment level and compliant with the relevant noise limits. **Figure 2.3.10** shows the spectrogram of a typical TSHD based from the study of MALSF MEPF P108 (UK-MALSF, 2010).

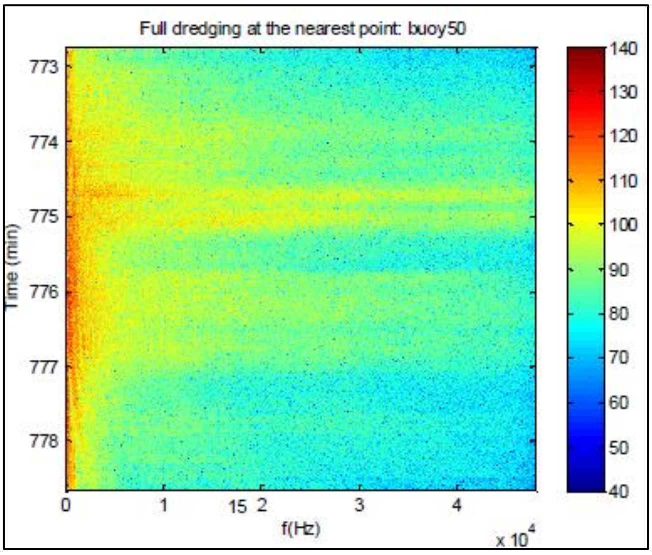
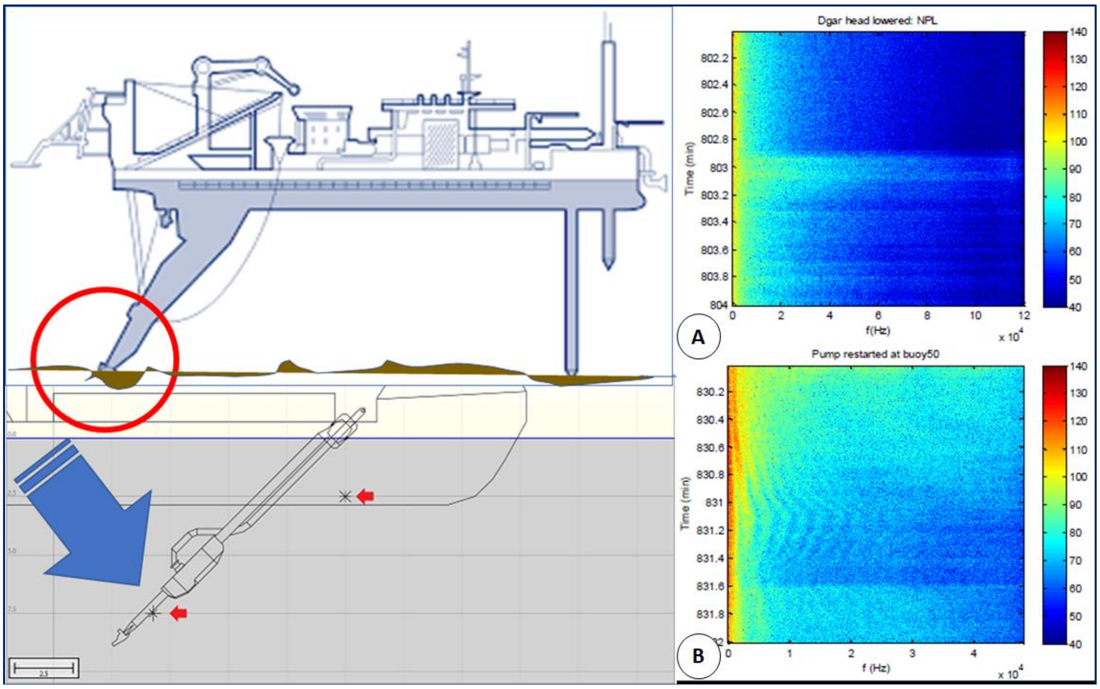


Figure 2.3.10: Full Dredging Spectrogram of a Typical TSHD Dredging Equipment

A spectrogram is a visual way of representing the signal strength, or “loudness”, of a signal over time at various frequencies present in a particular waveform. Not only can one see whether there is more or less energy at, for example, 2 Hz vs 10 Hz, but one can also see how energy levels vary over time. In other sciences spectrograms are commonly used to display frequencies of sound waves produced by humans, machinery, animals, whales, jets, etc., as recorded by microphones. Based from the UK-MALSF (2010), sound can be measured with simultaneous measurements at several ranges from the dredger with hydrophones deployed from survey vessel and recording buoys includes; (1) Co-linear arrangement of hydrophone positions; and (2) Two hydrophones at each measurement station (e.g., different depths).



Note: (a) drag head lowered (on bed pumping sand and gravel); (b) drag head raised (e.g., pumping water only

Figure 2.3.11: Power Spectral Density Spectrogram Under Two Scenarios

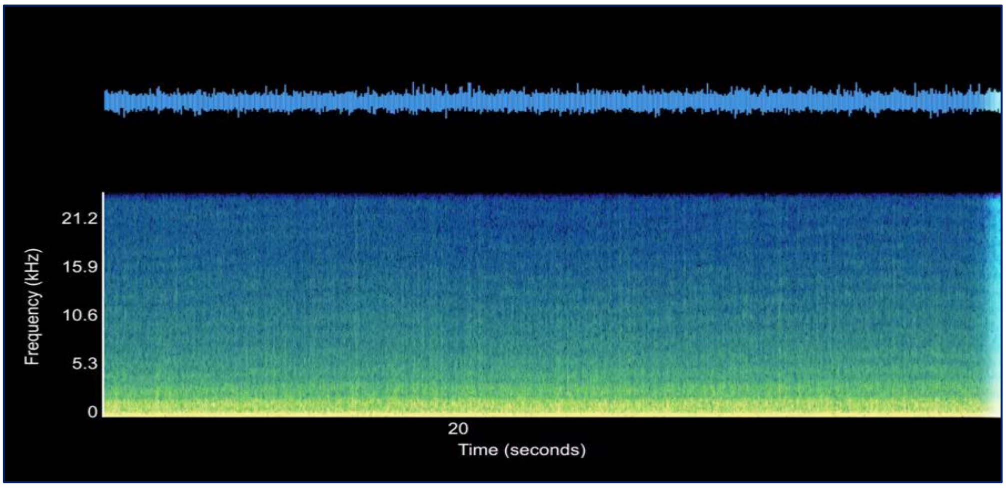


Figure 2.3.12: Spectrogram of Noise Levels Underwater from the Activity of TSHD

Underwater sounds produced by a trailing suction hopper dredging vessel (TSHD) for dredging range between 167.5 and 185 underwater dB at 1 m. However, this will also depend on the case-to-case basis where in noise levels also depend on the materials being extracted, with harder sediment extraction, the higher the noise being generated at levels than loose or soft sediment extraction. Estimated source levels for dredging range between 168 and 186 underwater dB at 1m.

Vessel Movements

Tugs will be required to move the hopper barge during dredging activities, whereas all listed vessel types will continue to use the river navigational channel up to the upstream section once the river delta is cleared prior to pre- and post the dredging works. The relevant noise limits in NPCC will apply to the operational requirements of vessels, specifically including loading vessels, tugs, other related vessels. Nonetheless, vessel movements would generally comply with the noise limits by the NPCC and other international guidelines such as US EPA. Future vessel movements may be audible for short intervals but would be perceived the same as other medium to large vessels regularly moving in the river channel and delta.

Human Comforts

Acceptable values of human exposure to continuous sound and impulsive vibration are depended on the time of day and the activity taking place in the project site. Based on International Guidelines in assessing intermittent vibration (NSW-DECC International Technical Guidelines) and US EPA, the vibration dose value (VDV) is used as reference in which vibration accumulates in a form of vibration energy received over daytime and nighttime periods. **Table 2.3.12** shows the acceptable vibration dose values for intermittent vibration ($m/s^{1.75}$) (GHD, 2009).

Table 2.3.12: Adopted Acceptable Vibration Dose Values (VDV) for Intermittent vibration (m/s1.75)

Location	Daytime [b]		Night-time	
	Preferred value	Maximum value	Preferred value	Maximum value
Critical areas [a]	0.10	0.20	0.10	0.20
Residences	0.20	0.40	0.13	0.26
Offices, schools, educational institutions and places of worships	0.40	0.80	0.40	0.80
Workshops	0.80	1.60	0.80	1.60

[a] Examples include hospitals, etc., based on the guidelines of NPCC and USEPA 1992a (values are Indicative)
[b] Daytime is 6:00am to 6:00pm and Night time 6:00pm to 6:00am (daytime/nighttime length at the Equator)

Noise Impact Projection

The sound power levels derived or anticipated for each equipment identified during operation phase were based on the typical equipment noise data/sizes/dimensions extracted from dredging Industry. The total power level takes into account assumed maximum numbers of equipment and an assumed 'on-time' for the equipment, that is, period in percentage terms during which the equipment will be operating. The operational activities are predicted to be its worst-case scenario where 24-hour operation and without barrier. The computation predicts a continuous operation where simulates continuously for 24 hours. The following were considered in predicting the impact area for noise simulation for the operation of the Project:

- Noise power (dB): This is the noise power at source position in decibels.
- Ambient Data: Ambient conditions in the area;
- Terrain – the data will use to draw topographical lines.
- Scale command – Use to set the scale in the X-axis width (in meters)
- The scale use for the model is 5000 m x 5000 m.

The noise contribution from the operation of the proposed ARRD Project is not expected to cause significant noise impacts to the surrounding environment. The predicted and indicative noise contours during the operation phase are presented in **Figure 2.3.13**.

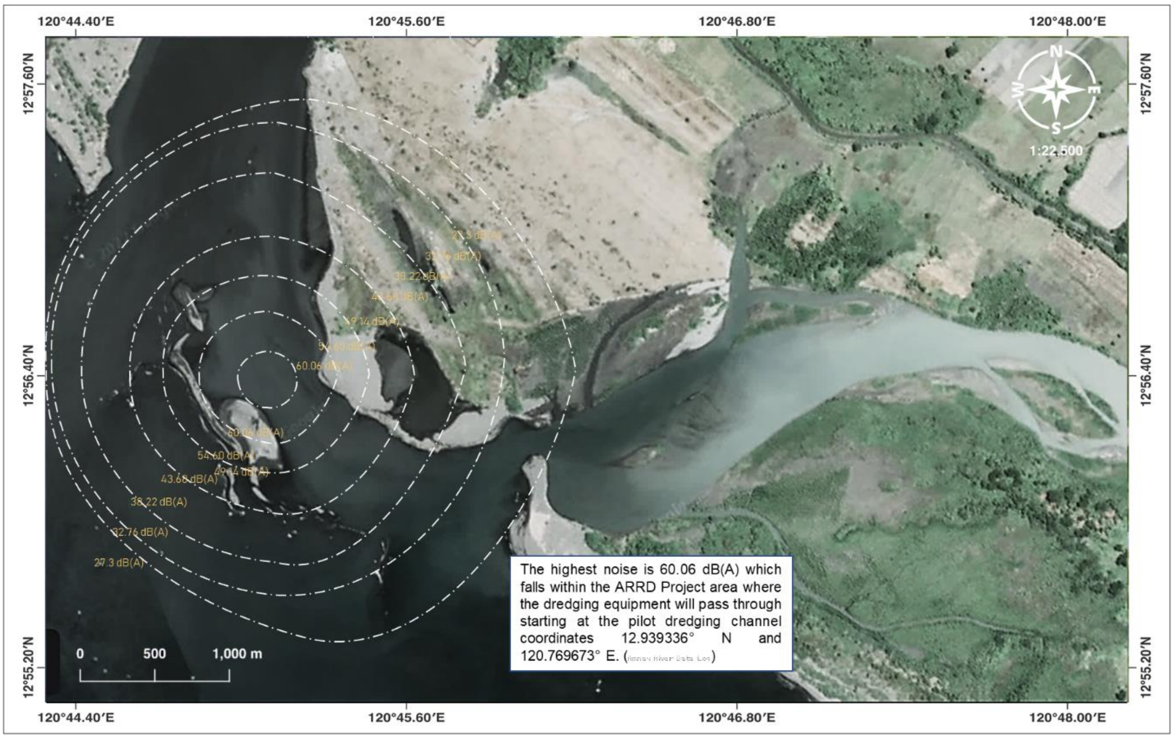


Figure 2.3.13: Indicative Plot of Noise Isolines during Operation Phase

The highest sound level is estimated and predicted to be at 60.06 dB(a) in the construction phase (opening delta point) once the project commenced as generated by TSHD. Sound levels are measured in units of decibels, dB(A). The 'A' weighting of a measured sound level approximates how the human ear perceives sound. If a sound is intensified by 10 dB(A), it seems to the ears that the sound has doubled in loudness. 60 decibels are as loud as a normal conversation between two people sitting at a distance of about one meter (3 ¼ feet). It is the average sound level of a restaurant or an office. Project specific noise levels for the identified receivers within the covered impact barangays in close proximity to dredging area would have a projected value range from 49.14 db(A) to 54.60 db(A) which is within the NPCC Guidelines. The projections were compared to the maximum permissible noise level as stated on the NPCC Memorandum Circular No. 002 Series of

1980. These values did not exceed NPCC levels and are not significant and can be reduced due to limited human population and activities.

During operation phase, dredging works and activities will undoubtedly generate noise in the area. Increase in ambient noise levels during construction period is expected to affect the nearby areas. Filtering of rocks, loading of gravel and sand, aggregates and others in the dredge areas and excavations, and construction of bunds will generate significant amounts of noise. Processing plants for crushing of aggregates will also contribute to even more noise to the environment. Filtering and loading should be controlled and regulated to ensure that noise levels are within the allowed limits. Aside from the immediate nearby community within the dredge areas, impacts are expected to be felt on the communities along the area including the installation of satellite offices and access road/transport route and the route where dredge materials will be transported. The noise generators are the heavy equipment, such as back hoes dredgers, payloaders, backhoes, dump trucks, long arm excavators, crawler crane, submersible dredge pump with fittings and pipe connections, boats and other motorized equipment.

To mitigate the noise pollution during the operation, it is recommended that the contractor use properly maintained heavy equipment fitted with appropriate mufflers or silencers. The work schedule should be limited during daytime to avoid disturbance in the surrounding/nearest community. Operators must be properly oriented in the use of the machines and heavy equipment, to avoid excessive pumping on the fuel and use of horn.

Provided that the majority of the equipment complies with the relevant equipment noise specifications, noise levels on-plant and dredging area shall meet the 85 dB(A) limit, and noise levels at all boundaries should be expected to meet the DENR and DOLE requirements.

Noise abatement can often be achieved by relatively simple measures. Protective measures for reducing the negative impacts of noise in the working and living environment include the following:

- Fit efficient muffling devices to all engines of the dredging activities. Engines of the equipment should be equipped with silencers, maintained in proper condition and used in accordance with the manufacturer's recommendations in order to prevent the creation of excessive noise;
- If the noise levels in the surrounding settlements exceed legally allowed values, barriers should be set – sound protection panels for the reduction of noise. Locate noisy equipment away from potential sources of conflict or behind sound barriers;
- Noise sources should be enclosed depending on the nature of source such as the use of enclosed generators;
- Provide personal protective equipment (PPE) (e.g., earmuffs, earplugs, etc.) to protect the hearing of the machine operators from the harmful consequences of excessive noise; and
- Defective equipment/parts with abnormal noise and/or vibration will be either repaired or replaced.
- Equipment position access and exit points away from sources of conflict. Use optical alarms in preference to audible alarms.

2.4 PEOPLE

2.4.1 Demography

2.4.1.1 Population Distribution and Density

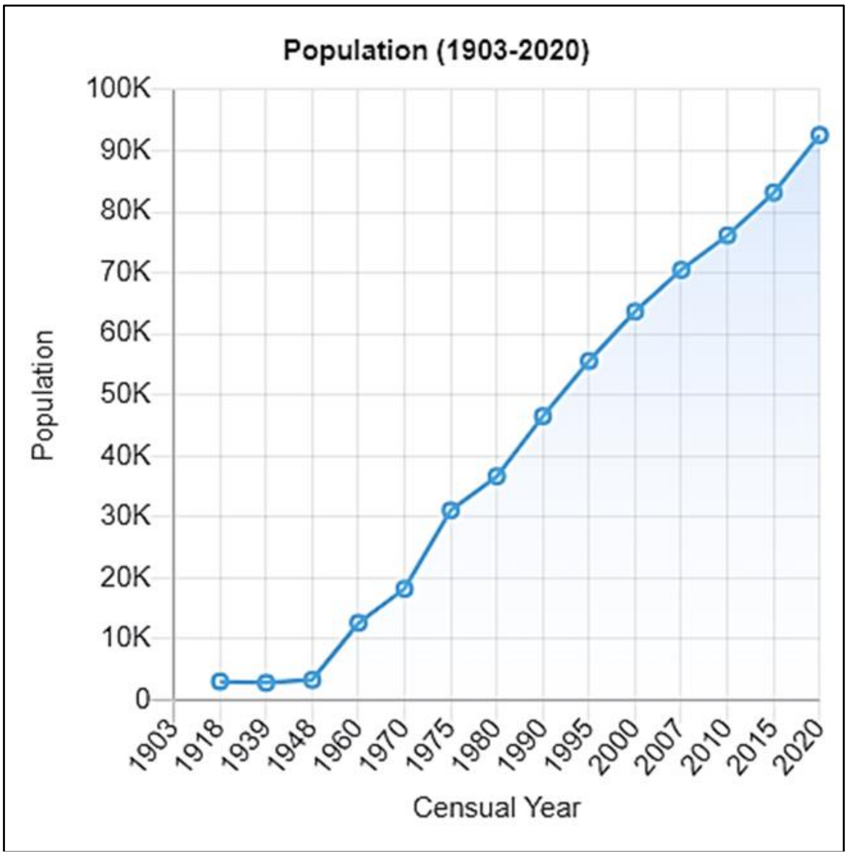
The Municipality of Sablayan posted a total population of 92,598 for the census year 2020 (**Table 2.4.1**). This represented 17.63% of the total population of Occidental Mindoro province, or 2.87% of the overall population of the MIMAROPA Region. Based on these figures, the population density is computed at 42 inhabitants per square kilometer or 110 inhabitants per square mile. In terms of Barangay demographics, Barangays Buenavista and Poblacion (Lumang Bayan) registered the greatest number of people residing with 8,758 and 6,741 that corresponds to 11.50 percent and 8.85 percent of the municipality's total, respectively. Barangay Victoria is the least populated with 1,323 that corresponds to 1.73% of the municipality's total population. In the same year, there were 16,284 number of households recorded. Average household size is five.

Table 2.4.1: Household Population By Urban and Rural Barangay and Average Household Size in Sablayan, 2020

Barangay	Population (2020)	Population percentage (2020)	Growth Rate (2015- 2020)
Urban			
BUENAVISTA	9,617	10.39%	1.63%
POBLACION	8,721	9.42%	4.57%
SANTO NIÑO	7,490	8.09%	4.10%
Sub-Total	**25,828.00**	**27.90%**	**10.30%**
Rural			
BATONG BUHAY	4,044	5.59%	2.13%
BURGOS	2,316	3.39%	4.37%
CLAUDIO SALGADO	3,899	5.05%	1.90%
GENERAL EMILIO AGUINALDO	2,229	2.91%	2.27%
IBUD	1,488	2.16%	1.01%
ILVITA	3,125	3.13%	0.62%
LAGNAS	1,733	1.96%	2.32%
LIGAYA	6,435	8.08%	-0.47%
MALISBONG	3,134	4.60%	1.36%
PAETAN	1,354	2.06%	3.11%
PAGASA	5,452	9.42%	4.57%
SAN AGUSTIN	1,529	2.69%	5.35%
SAN FRANCISCO	2,864	3.76%	1.45%
SAN NICOLAS	1,624	2.34%	2.13%
SAN VICENTE	4,250	6.13%	2.85%
SANTA LUCIA	4,528	6.08%	3.43%
TAGUMPAY	1,618	2.16%	3.43%
TUBAN	2,645	3.67%	2.88%
VICTORIA	1,323	1.59%	1.77%
Sub-Total	**71,086.00**	**76.77%**	**46.48%**
Total	**92,598**	**100%**	**11.34%**

Source: CLUP and PSA (2020)

The population of the municipality is generally expansive where ages 0 to 24 years old represents 41.39% of its total population in year 2020. In the span of 102 years, Sablayan's population increased by 89,520 from 3,078 in 1918 to 92,598 in 2020. From the previous population of 83,169 in 2015, the most recent census data in 2020 shows a positive growth rate of 2.29% (**Figure 2.4.1**), or an increase of 9,429 individuals (PSA, 2020).



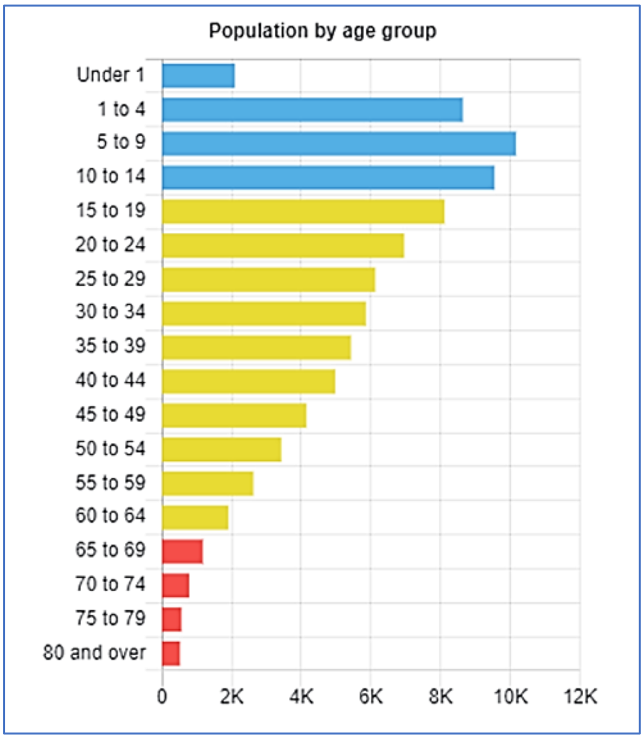
Source: Philippine Statistics Authority (PSA), 2020

Figure 2.4.1: Population growth RATE of Sablayan

The pyramid in **Figure 2.4.2** shows the population distribution by age group in Sablayan (PSA,2020). When age categories are combined, those under the age of 14 make up 36.65% (30,483) of the young dependent population, which includes infants/babies, children, and young adolescents/ teenagers. Roughly speaking, the economically active population and current or potential workers are those between the ages of 15 and 64, which makes up 59.67% (49,624) of the population. The elderly dependent population, which includes people 65 and over, accounts for 3.68% (3,062) of the total population.

According to the calculated age dependency ratios, there are 61 young dependents for every 100 people of working age in Sablayan, 6 elderly or senior citizens for every 100 people of working age, and 68 dependents (young and old) for every 100 people of working age overall. Given that the median age in Sablayan is 22, this means that half of the population is under 22 and the other half is over 22.

There is no data available to derive the fertility rate in Sablayan, however, the population pyramid below having had a very broad base indicates high fertility rate.



Source: Philippine Statistics Authority (PSA), 2020

Figure 2.4.2: Population Distribution by Age Group in Sablayan; CY 2020

The municipal gross density is less than one (**Table 2.4.2**). Additionally, the municipality has sizable forest areas that cannot support the population. The 22 barangays that make up the municipality are most dense in Barangay Buenavista, which has a gross density of 12 people per hectare, followed by Barangay Poblacion, which has a gross density of 6 people per hectare. Five people live in each hectare of urban area.

On the other hand, the built-up density is 107 persons per hectare. The densest area is barangay Malisbong with 333 persons per hectare followed by barangay San Francisco with 268 persons per hectare then by barangay San Agustin with 225 persons per hectare. The least dense among the 22 barangays is Victoria with only 53 persons per hectare.

Table 2.4.2: Population Density, Gross Density and Built-Up Density in Sablayan, 2020

Barangay	Area in Hectare	Population Density	Built-Up Area in Hectare	Built-Up Density
URBAN				
BUENAVISTA	747.5121	12	79.5000	110
POBLACION	1,097.9363	6	59.0200	114
SANTO NIÑO	1,997.4677	3	54.9000	92
SUB-TOTAL	**3,842.9160**	**5**	**193.4200**	**106**
RURAL				
BATONG BUHAY	43,193.6595	0	62.5002	65
BURGOS	30,302.0292	0	18.3909	126
CLAUDIO SALGADO	3,741.60	1	25.2720	154
GENERAL EMILIO AGUINALDO	1,006.40	2	39.0005	57
IBUD	1,278.00	1	21.7271	68
ILVITA	1,351.00	2	26.2287	119
LAGNAS	1,191.48	1	18.9460	91

Barangay	Area in Hectare	Population Density	Built-Up Area in Hectare	Built-Up Density
LIGAYA	6,435.00	0	66.9555	96
MALISBONG	11,119.58	0	9.4130	333
PAETAN	1,657.60	1	8.7960	154
PAGASA	68,181.44	0	29.7778	183
SAN AGUSTIN	15,807.85	0	6.7930	225
SAN FRANCISCO	2,128.00	1	10.6741	268
SAN NICOLAS	822.00	2	19.1475	85
SAN VICENTE	2,365.26	2	39.5814	107
SANTA LUCIA	3,646.60	1	32.8909	138
TAGUMPAY	699.40	2	11.1789	145
TUBAN	2,345.54	1	47.9706	55
VICTORIA	1,097.20	1	25.1336	53
SUB-TOTAL	**225,716.2581**	**0**	**520.3800**	**107**
TOTAL	**229,559.1741**	**0**	**713.80000**	**107**

2.4.1.2 Indigenous People

There are no indigenous people residing in the project area, therefore, there are no perceived effects of cultural change on the indigenous people. In terms of lifestyle, there is not much change projected since there is already small development activities near the project area (e.g., small markets in Pagasa). Some residents may have to increase the pace of their lifestyle to keep up with the increased demands of employment and livelihood opportunities.

2.4.1.3 Dialect

There are numerous types of languages spoken in the area. While Tagalog is widely known, a significant number of people speak Ilocano, Hiligaynon, and Kinaray-a. This may be attributed to the people's point of origin. The prominent dialect used by the locals in the project area is Tagalog.

2.4.2 Existing Social Infrastructure and Services

2.4.2.1 Educational Facilities

The municipality has a total of 69 schools including private schools, 47 of which are for elementary education, 17 secondary, three tertiary, and three Technical-Vocational schools.

The three tertiary schools operating in the Municipality are Colegio De San Sebastian (CDSS), Occidental Mindoro State College (OMSC), and Polytechnic University of the Philippines (PUP)-Sablayan Campus.

2.4.2.2 Power Supply

Power is provided by the Island Power Corporation (IPC) and the National Power Corporation (NPC) through Occidental Mindoro Electric Cooperative (OMECO). Though power is available, supply is very unreliable as manifested by power outage practically every day. This condition is considered a weakness and threat to the full economic development of the municipality especially for the processing or manufacturing sector.

2.4.2.3 Water Supply

The urban core enjoys Level III water supply system provided by Sablayan Water District (SWD). The district also provides Level III water supply in select households of Barangays Ligaya, San Vicente and Tuban. Barangays Batong Buhay, Burgos, Ilvita, Pagasa and Tuban have established

Level II water supply systems serving select households too. In the other rural areas, however, the water sources are springs, lakes, rivers and wells. The most common means of extracting ground water is the pitcher pump.

2.4.2.4 Communication

Postal service is still offered by the Philippine Post (PHILPOST) in the municipality in addition to LBC and JRS companies. L & S CATV and Capitol CATV provide network Cable TV, and Radio Natin is the sole radio station in the municipality. Aside from telecommunication cell sites other means of communication are print media and FA radios.

Four telecommunication companies are serving the municipality namely Globe Telecommunications Company, Smart Telecommunications Company, Sun Telecommunications Company, and Digital Telecommunications Company. They offer nationwide and international calls, text, and mobile internet.

2.4.2.5 Peace and Order (Protective Services)

Sablayan Municipal Police Station has 49 Police Non-Commission Officers (PNCOs) with force-population ratio is 1: 1,554. For the police services, facilities, and equipment, there is one headquarter with 41 personnel, one sub-station with four personnel, and one outpost with four personnel; two units Toyota Hi-Lux patrol vehicles; and one unit patrol multi-cab. All patrol vehicles are serviceable.

The Bureau of Fire Protection (BFP) in Sablayan was established in 1996. At present the station is manned by nine personnel. Personnel-population ratio is 1:7,079. The bureau has two units firetrucks which are both serviceable and in good condition

2.4.3 Public Health and Safety

2.4.3.1 Public Health Services

Three Rural Health Units (RHUs) serve the municipality; one in Barangay Buenavista – the town proper, the other one in the south of the municipality in Barangay Ligaya; and the third is in the northern part in Barangay Pag-asa. Resident doctors, nurses and midwives operate these RHUs.

There are 15 doctors operating in Sablayan. Eleven of them are serving government hospitals, Rural Health Units and BEMONC Facilities; and three are in a private hospital while the rest are in private practice. The ratio of doctors against population is 1:6,346 based on the 2010 PSA Census. On the other hand, there are 30 nurses working in Sablayan. Twenty-one of them work in the government and nine in private. The nurse-population ratio accounts to 1:3,046 based on the 2010 PSA Census. Moreover, there are 39 midwives working in Sablayan. Most of them work in the government than in private. The ratio of midwives in the municipality against population is 1:2,176 based on the 2010 PSA Census.

2.4.3.2 Morbidity and Mortality

Bronchial Asthma with 292 cases or 18.40% topped the leading causes of morbidity for the year 2012 followed by Respiratory Tract Infection and Acute Bronchitis which are all related to lung diseases. **Table 2.4.3** presents the ten leading causes of morbidity in the municipality.

Table 2.4.3: Ten Leading Causes of Morbidity in Sablayan, 2010-2012

2010		2011		2012	
Causes	**No. of Deaths**	**Causes**	**No. of Deaths**	**Causes**	**No. of Deaths**
Acute Bronchitis	2,353	Upper Respiratory Tract Infection	576	Bronchial Asthma	292
Acute Nasopharyngitis	828	Bronchial Asthma	358	Upper Respiratory Tract Infection	288
Acute Gastritis/ Dyspepsia	593	Acute Nasopharyngitis	255	Acute Bronchitis	232
Wound Infection	485	Acute Bronchitis	241	Acute Nasopharyngitis	184
AGE with no dehydration	481	AGE with no dehydration	159	Hypertensive Atherosclerotic Cardiovascular Disease	140
Musculoskeletal Pain	435	Hypertensive Atherosclerotic Cardiovascular Disease	137	Musculoskeletal Pain	124
Bronchial Asthma	414	Urinary Tract Infection	110	AGE with no dehydration	120
Hypertensive Atherosclerotic Cardiovascular Disease Not in Failure (HASCVD NIF)	376	Wound Infection	104	Pulmonary Tuberculosis	76
Acute Respiratory Tract Infection	347	Musculoskeletal Pain	102	Dyspepsia/ Urinary Tract Infection	68
Dog Bite	85	Mumps	66	Dog Bite	64

Cardiorespiratory Arrest was the leading cause of mortality with 84 cases or 32.80% followed by Senility - the mental and physical deterioration associated with aging - with 51 cases or 19.90 percent. **Table 2.4.4** shows the list of the ten leading causes of mortality in year 2012 (CLUP-Sablayan, 2015). On the other hand, there are two causes of infant mortality recorded in year 2012: Bronchopneumonia and Sepsis secondary to probable Meningitis.

Table 2.4.4: Ten Leading Causes of Mortality in Sablayan, 2010-2012

2010		2011		2012	
Causes	**No. of Cases**	**Causes**	**No. of Cases**	**Causes**	**No. of Cases**
Cardio Vascular Arrest	28	Electrolyte Imbalance	32	Cardiorespiratory Arrest	84
Senility	12	Cardiac Arrest	21	Senility	51
TB of the Lungs	12	Pulmonary Tuberculosis	20	Cardiopulmonary Arrest	22
Cardio Vascular Accident	11	Gunshot wound, Multiple	11	Sequelae of Stroke	20
Pneumonia	7	Stroke	8	Tuberculosis of Lungs	19
Sudden Cardiac Death	7	Pneumonia	8	Pneumonia	17
Hypertensive Heart Disease	6	Chronic Obstructed Pulmonary Disease	7	Hypertensive Heart Disease	16
Gunshot Wound, Multiple	6	Sepsis	6	Sudden Cardiac Death	14
Cardiac Arrythmia	5	Hypertensive Heart Disease	5	Chronic Obstructed Pulmonary Disease	8
Sequelae of Stroke	4	Glioblastoma Multiform	5	Drowning/ DMI Type II	5

2.4.3.3 Environmental, Health and Sanitation Profile

The LGU implements "no segregation, no collection policy" in its garbage collection, and violators for mix garbage as well as balik bayong program were penalized accordingly. Segregation at source is also being strengthened in the household level and at point of origin. At present the municipal government is guided by a Solid Waste Management Plan, 2015-2024 to achieve a clean and healthy Sablayan environment.

Of the three urban barangays served by garbage collection, the MENR Office conducted random waste analysis and characterization study in 2012 for Barangay Buenavista alone being the pilot area. One truckload of biodegradable and non-biodegradable waste was collected and characterized coming from domestic, commercial, industrial, and institutional establishments.

The most dominant type of toilet facilities in the Municipality of Sablayan is the pour flush type with 10,727 households using it (**Table 2.4.5**). The least common type used is the pail system. Based on the 2010 PSA Census, the total number of households in Sablayan is 16,284 but only 12,741 households had toilet facilities.

Table 2.4.5: Number of Households in Occupied Housing Units by Type of Toilet Facilities in the Municipality of Sablayan

Type of Toilet Facilities	Number of Households
Flush	1,251
Pour Flush	10,727
Closed Pit	290
Open Pit	305
Pail System	168

Source: Municipal Health Office

2.4.4 Socio-economic Profile

2.4.4.1 Employment Rate/Profile

Based on the results of 2012 Community Based Monitoring System (CBMS), there are more male population in the labor force than that of females. However, when it comes to those who are not in the labor force there are more members belonging to the female population.

Employed persons account to 26,034 corresponding to 56.59% of the total population ages 15 years old and over whereas those unemployed 1,749 or a mere 3.80% of the same age bracket (**Table 2.4.6**). On the other hand, those who are not in the labor force in the same survey period account to 18,224 corresponding to 39.61 percent of the population 15 years old and over.

Table 2.4.6: Labor Force By Sex and Employment Status, 2012

	Population 15 Years Old and Over	Labor Force				Not in the Labor Force
		Employed	%	Unemployed	%	
MALE	23,671	18,145	76.65	836	3.53	4,690
FEMALE	22,336	7,889	35.32	913	4.09	13,534
TOTAL	**46,007**	**26,034**	**56.59**	**1,749**	**3.80**	**18,224**

Source: CLUP-Sablayan

2.4.4.2 Sources of Livelihood

Sablayan is traditionally an agriculture surplus area. It supplies the consumption requirements of neighboring Visayan Region and Metro Manila. A total of 14,032 hectares of agricultural lands in the municipality is devoted to rice production. This accounts to 73.69% of the total agricultural area of the municipality.

Fishing is also way of life in Sablayan obviously because it is a coastal municipality. The fishing industry has three sub-sectors: (1) marine fisheries, (2) aquaculture, and (3) lakes. Of the three, marine fisheries particularly the tuna industry seem most promising.

2.4.5 Public Access

Sablayan is traversed by a national road linking it with the municipalities of Abra de Ilog in the north and Magsaysay in the south of the Province of Occidental Mindoro and all the municipalities of its neighbor province. The stretch of the national road is mostly concrete paved with patches of all-weather pavements in critical areas mostly located within the territorial jurisdiction of Sablayan.

The road network within the urban core is well established. They are made of either asphalt or concrete. New roads identified for development are given their respective timetable for construction or improvement. On the other hand, notwithstanding the availability of barangay roads, the municipal government, with the assistance and coordination with barangay officials, are continuously identifying roads to be improved, rehabilitated, upgraded or to be introduced, especially those needed in the production and settlement areas. On the other hand, bridges are mostly made of concrete especially along the national roads. Those located in the interior lands of the municipality are either bailey or timber bridges.

One strength of the municipality is its geographic location in the province. Its location will allow it to conduct economic relations with practically all mainland municipalities of Occidental Mindoro. However, the poor road condition and limited transport facilities are constraints that the municipality has to reckon with to be able to fully promote trade with the neighboring towns. Aside from this, many sections of the main thoroughfare are also exposed to hazards such as flooding and rain-induced landslide especially those sections along Kambingan and Barucan areas which become impassable during occurrence of heavy downpour. Another important concern for the municipality and the province is the issue that concrete bridges especially those traversing major rivers, are threatened by floodwaters carrying debris and silt.

The municipality is accessible by sea from Batangas, Manila and Visayan Islands; by land from north and south sections of the province; and by air through private aircrafts. Alternative routes may be through Batangas-Abra de Ilog-Sablayan, Batangas-Calapan City-Sablayan, Manila-Mamburao-Sablayan, and Manila-San Jose-Sablayan.

There are five buses, several jeepney, and van operators in the municipality providing transport services to Sablayeños besides other transport facilities from neighboring municipalities passing Sablayan on their way to the northern or southern parts of the mainland province. In the urban core, the popular means of transportation is tricycle while in the rural areas motorcycle, animal pulled carts, hand tractors, and mini-trucks.

The existing airport facility is now in poor condition and shall necessitate rehabilitation in order to meet the standards and thereby allow chartered flights. The facility covers an area of about 37 hectares which is a donation from the owner of Suntay Estate specifically for the establishment and development of an airport. It is located at barangay Santa Lucia some 12 kilometers away from town proper.

On the other hand, the existing port in the municipality, located along its coastal barangay, was established by Philippine Port Authority (PPA) and constructed under the National Feeder Ports Development Project (NFPDP), with funding assistance from Overseas Economic Cooperation Fund (OECF) under Loan Agreement No. P11-P80. Sablayan Port is managed and operated by LGU Sablayan through the Port Management Office since May 21, 2003.

2.4.6 Perception of the Project

The perception surveys for the host and affected barangays (Ilvita, Pagasa and Claudio Salgado) were conducted on 07-10 October 2021. The perception survey was conducted to determine the community's baseline knowledge about the proposed Project, and initial concerns/questions about the project description and potential environmental impacts. A copy of the perception survey questionnaire, photo-documentation, and basic respondent profile are attached in **Annex 2-3**.

2.4.6.1 Respondents' Profile

One-hundred fifty household respondents (at least 18 years old) were interviewed in both barangays (30; Barangays Claudio Salgado, 30; Ilvita; 30 in Lagnas, 30; 30 respondents in Victoria and Pagasa, 30) using a structured questionnaire with topics corresponding to the outline above-mentioned. Sampling error at the Study Area level is 10% with a confidence level of 95%. Salient features of the respondents include:

- Average age: 50 years
- 70% are married
- 63% are spouses (mostly wives) of the household head
- Average years of residence in host communities range from 2 - 79 years for an average of 38 years
- Close to 75% are Mindoro-born
- Household size ranges from 1 – 16 persons for an average of 5
- All households have Tagalog as the primary language spoken at home

2.4.6.2 Project Awareness

To put the CPGI project in context and to benchmark their awareness and knowledge of dredging, sand collection, storage facilities, Tugs/boats and similar installations (collectively known as LCTs), respondents were asked if they were aware of them (e.g., CPGI) in Barangay Claudio Salgado, Pagasa, and Ilvita and Mindoro Province.

- 85% in the Study Area (Barangay Claudio Salgado and Ilvita combined) are aware and has some knowledge of the current issues relative to the need for Dredging;
- The two most frequently mentioned sources of information about Dredging (accounting for 71.14% of multiple responses) are:
    - <u>Government officials</u> (37.58% of 149 multiple responses, reported by 64.87% % of 87 respondents in the Study Area)
        - 33.82% of 68 multiple responses, reported by 52.27% of 44 respondents in Brgy. Claudio Salgado);
        - 45.42% of 81 multiple responses reported by 78.61% of 39 respondents in Brgy. Ilvita)
    - <u>Relatives, neighbors and friends</u> (33.56% of 149 multiple responses, cited by 54.87% of 87respondents in the Study Area)
        - 35.29% of 68 multiple responses, cited by 54.55% of 44 respondents in Brgy. Pagasa;
        - 32.10% of 81 multiple cited by 60.47% of 43 respondents, Brgy. Victoria;
        - Others percentages includes Brgy. Lagnas.
- The data indicate that Government Officials (37.58% of 149 multiple responses), community meetings, gatherings and assemblies (8.72%), posters and hand-outs (1.34%), social media (4.70%), and others (3.36%) pale in comparison individually and collectively as sources and channels of information vis-à-vis a) government officials and b) relatives and neighbors and friends.[3]

The data suggest that the most frequently cited sources and channels of awareness and information regarding similar facilitiesand developments to CPGI were through ***primary and face-to-face contacts*** involving a) government officials and b) relatives, neighbors and friends accounting for 71.14% of multiple responses and reported by more than 50% of respondents. All other sources and channels trailed far behind.

When asked to rate the degree to which they agree with, and are in favor of, SFDs in a scale of '0 – 10' where '0' represents totally do not agree / totally not in favor and '10' total agree / totally in favor, respondents gave a mean rating of (**Figure 2.4.3**):

- **1.76 or strongly not in favor,** at the Study Area level,
- **1.19 or neutral** for Pagasa; (1-10);
- **9.40 or strongly in favor** for Claudio Salgado (1-10);.[4]
- **8.50 or strongly in favor** for Barangay Ilvita (1-10);
- **7.85 or strongly in favor for** Barangay Victoria (1-10);
- **0.49 for those in the 'strongly not in favor' region** (0-3 rating)
- **3.92 for those in the 'neutral' region** (0-3 rating)
- **9.65 for those in the 'strongly in favor' region** (0-3 rating)

The mean rating at the Study Area level (1.76) indicates that the barangays are generally neutral to the proposed dredging project. It is worth noting though that those who gave a rating in the 'strongly not in favor' region was in extreme disagreement with the similar facilities and developments as the mean rating was at 0.49. Those in the 'mildly not in favor to mildly in favor' region was neutral (3.92 mean rating), while those in the 'strongly in favor' region had only some reservations but were generally in favor of the proposed dredging project in their area (9.65 mean rating).

In fact, majority of the barangay residents, key officials and concern private groups were really concern of the proposed dredging project to be realized and executed as early as possible due to their experiences to disasters, threats to life and loss of livelihood. Majority has signed up petitions and appeals for the dredging project to be executed immediately based on the Focus Group Discussions (FGD), and as supported by KII survey results.

[3] Although community meetings, gatherings and meetings could have been conducted by government officials in which case the score for the former should be added to the latter

[4] The scale has three regions: 0 – 3 (strongly disagree or not in favor), 4 – 6 (mildly disagree/not in favor-neutral-mildly agree/in favor, 7 – 10 (strongly agree/in favor. The so-called 'float' or 'swing' population is '4 – 6'' whose perception could be easily swayed.

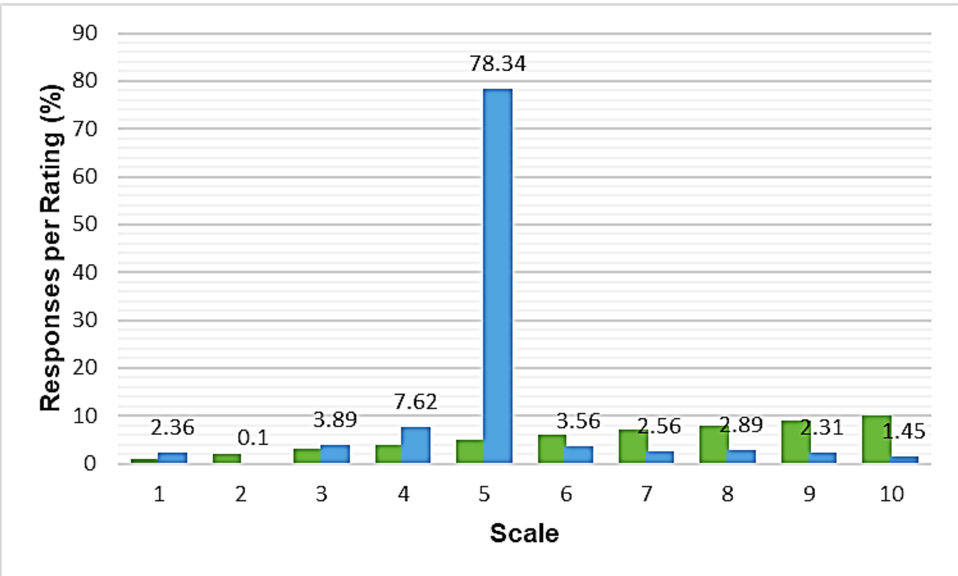


Figure 2.4.3: Percentage of Responses per Scale Rating

2.4.6.2.1 Perceived Positive Impacts from the Proposed ARRD Project

Majority or almost 70% of the respondents are expecting and viewed the proposed dredging and desilting project will have a significant and beneficial role in the development of their barangay in terms of disaster risk and reduction. On the other hand, they viewed the project as key to livelihood and economic activities to uplift their barangay and individually, in terms of employment opportunity. The other 20% of the respondents from the total surveyed barangay are neutral while 10% believe that it will have negative effect to the barangay due to the environmental degradation, noise and dust pollution it may produce.

Table 2.4.7: Perceived Positive Impacts from the Proposed ARRD Project

Perception if the project would be of help to the community (a)	Responses	
	Frequency (f)	Percentage (%)
Yes	105	70
No	15	10
Neutral	30	20
No answer	0	0.0
Total	**150**	**100.0**

Parameter Q: What do people expect from the CPGI project by way of benefits? Sixty-five (65%) percent of multiple responses are accounted by the following in descending order of frequency of mentions:

- Employment opportunities (37.5% of 150 multiple responses by 89.06% of 150 respondents);
- Business opportunities and expansion (13.82% of 152 multiple responses by 32.61% of 64 respondents) with comparatively same percentages for Barangay Claudio Salgado and Barangay Ilvita;
- Safety environment and climate change mitigations to lessen CC impacts such as disasters and natural calamities (e.g., flooding and siltation);
- Increased local revenues (13.82% of 152 multiple responses by 32.61% of 64 respondents) with comparatively same percentages.

Among the three above, employment opportunities and safety to disasters are clearly the front-runner at almost thrice the percentage of multiple responses and the number of people reporting in contrast to the barangays.

On the other hand, Respondents think that the top three ways, comprising 67% of multiple responses, CPGI can help its host communities in descending order of frequency of mentions are:

- Train locals to compete in the job market for employment in CPGI (23.4% of 141 multiple responses by 64.71% of 51 respondents, Study Area; 25.45% of 55 multiple responses by 73.68% 0f 19 respondents, Brgy. Victoria; 22.09% of 86 multiple responses by 59.38% of 32 respondents, Brgy. Claudio Salgado)
- Prioritize qualified residents of host communities in hiring (25.53% of 141 multiple responses by 70.59% of 51 respondents, Study Area; 27.27% of 55 multiple responses by 78.95% of 19 respondents, Brgy. Lagnas; 24.42% of 86 multiple responses by 65.63% of 32 respondents, Brgy. Ilvita)
- Community development and assistance (18.44% of 141 multiple responses by 50.98% of 51 respondents, Study Area; 20% of 55 multiple responses by 57.89% of 19 respondents, Brgy. Claudio Salgado; 17.14% of 86 multiple responses by 40.63% of 32 multiple responses, Brgy. Pagasa;
- Trailing closely are training local residents in business skills and priority to qualified local businessmen as goods/service providers to CPGI.

2.4.6.2.2 Perceived Negative Impacts from the Proposed ARRD Project

There does not seem to be one or two items that appear to dominate the negative impacts that could result from the CPGI project as perceived by the respondents. The following, however, make 52% of multiple responses:

- Congestion due to trucks loading and unloading aggregates (12.44% of 150 multiple responses by 74.63% of 150 respondents, Study Area; 15.63% of 139 multiple responses by 66.67% of 33 respondents, Brgy. Claudio Salgado; 10.05% of 263 multiple responses by 82.35% of 34 respondents, Brgy. Ilvita)
- Erosion (9.7% of 402 multiple responses by 58.21% of 67 respondents, Study Area; 11.51% of 139 multiple respondents by 48.48% of 33 respondents, Brgy. Lagnas; 8.76% of 263 multiple respondents by 67.35% of 34 respondents, Brgy. Pagasa)
- Traffic due to trucks and vehicles loading and unloading aggregates (8.96% of 402 responses by 53.73% of 67 respondents, Study Area; 12.95% of 139 multiple responses by 54.56% of 33 respondents, Brgy. Pagasa; 6.84% of 263 multiple responses by 52.94% of 34 respondents, Brgy. Victoria)

Water Competition (7.46% of 402 multiple responses by 44.78% of 67 respondents, Study Area; 10.07% of 139 multiple responses by 42.42% of 33 respondents, Brgy. Lagnas; 6.08% of 263 multiple responses by 47.06% of 34 respondents).

2.4.6.3 Project Knowledge

Overall, 60.91% of respondents know and have heard of the CPGI project. Their information came from three leading sources by frequency of mentions (Figure 8 & Table 8):

- Media and Public Consultation (45.45% of 99 multiple responses by 73.77% of 61 respondents)
- Relatives, neighbors and friends (36.36% of 99 multiple responses by 59.07% of 61 respondents)
- Community meetings, Posters, gatherings and assemblies (10.10% of 99 multiple responses by 16.39% of 61 respondents).

The above three easily make 91.91% of multiple responses leaving the other sources and channels of information very far behind.

2.4.7 Displacement of Settlers

No settlers will be displaced due to the proposed ARRD Project. However, conflicts such as land claims will be settled through consultative meeting and series of validation for proper course of action and settlement.

2.4.8 In-migration

In-migration is likely to occur brought about by workers coming in and out of Sablayan because of the project. Although the CPGI's hiring policy will give preference to qualified locals, in-migration may further be increased if there are no qualified applicants from the host barangay and municipality.

CPGI will encourage those migrant workers to participate in social activities and social development programs to interact with the community.

2.4.9 Impacts on Physical/Cultural Resources

There will be no direct impact on the identified tourist spots and other physical cultural resources and landscapes that have historical or cultural significance since they are relatively distant from the project site. Since the Project involves dredging and excavation activities, possible unearthing of artifacts and archeological remains is inevitable. In the event that an archaeological asset is discovered during the course of operation period, the following procedure shall be implemented:

- CPGI must preserve the potential archaeological finds and report it immediately to the National Museum.
- Closely coordinate with the National Museum on the appropriate course of action in protecting the archaeological finds.
- Cease immediately all construction activities in the vicinity of the find/feature/site;
- Hire an archaeological professional, recognized by the National Museum, to ensure the following are carried out:
- Delineate the discovered find/feature/site;
- Record the coordinates of the find location, and all remains are to be left in place;
- Secure the area to prevent any damage or loss of removable objects;
- Assess, record and photograph the find/feature/site;
- Undertake the inspection process in accordance with all project health and safety protocols under direction of the Health and Safety Officer;
- Conduct all investigation of archaeological soils by hand;
- Keep all finds, osteological remains and samples and submit to the National Museum as required;
- In the event that any artefacts need to be conserved, secure approval from the National Museum;
- Provide an on-site office and finds storage area to allow storage of any artefacts or other archaeological material recovered during the monitoring process;
- In the case of human remains, in addition to the above, contact the National Museum and adhere to the guidelines for the treatment of human remains;
- If skeletal remains are identified, tap an osteo-archaeological to examine the remains; and
- Implement the following process for conservation: Hire a conservator, if required.

The consulting archaeologist completes a report on the findings and submits to the National Museum National Museum reviews the report and informs when works can resume.

2.4.10 Threat to Delivery of Basic Services/Increase in Demand for Resources

During project operation, delivery of basic services such as power supply, food, water supply, and communication services will not be affected in any way.

2.4.11 Threats to subsistence fishers and local fishermen

For Offshore dredging, changes to species' habitats and feeding grounds have the potential to disrupt localized food chains, which can have an impact on the success of marine community recruitment efforts or ecological recovery. Widespread disruption in an offshore location where there is fish habitat may cause population declines or the exodus of whole species towards untainted regions. This is expected to seriously disrupt fishing operations and may cause local (regular), gillnet, cast-net, and hook-and-line fishers to lose income. About the mitigating measures, fishing areas will be protected by silt curtains and the leased disturbance, and disturbance of some offshore areas will be minimized. By the development of a fisheries rehabilitation plan in conjunction with the LGUs and the Bureau of Fisheries and Aquatic Resources, species diversity within the restored coastal environment will be improved over the long run. A reserve area for fish cages, or baklad, will be built in cooperation with the Barangay administration and the Municipal Fisheries and Aquatic Resources Management Council as part of the Project's support for fisheries management and stock replenishment programs (MFARMC). Based from the listings of MFARMC, a total of 400 fishermen were utilizing the area for either subsistence and major fishing. Proper coordination and development programs will be instituted for the impacted groups.

The project will also ensure that the operation of fishers using hook and line and nets within the project site and contiguous fishing grounds will not be disrupted, but in any way, be augmented by providing reserve areas for subsistence fishing by providing alternative or reserve areas and livelihood activities. Specifically, affected subsistence fishers will be compensated, guided, assisted and oriented to alternative livelihood and compensatory activities that CPGI would provide. They would be given stock enhancement activities, e.g., re-seeding and fish hatchlings (baklad), etc, that would be placed in a reserved area through the ISDMP of the Project.

2.4.12 Threat to Public Health and Safety

Accidents may occur for the passing public with the increased number of moving machineries due to dredging works. To prevent accidents for the passing public, the contractor must provide proper signage at conspicuous places and perimeter fencing of the construction area during the entire duration of construction activities.

Should construction activities not adhere to strict procedures on occupational safety, impact on the safeties of construction workers will be negative. Accidents and hazards may occur on site, thus, skilled and unskilled workers both face risks. When earth-moving activities are undertaken, the workers must be outfitted with the standard safety gears as required by law, and then oriented on the standard safety and emergency measures that will be implemented. The safety gears and orientation of workers should ensure minimization and/or prevention of accidents caused by moving machines and altered terrain.

To prevent accidents and hazards that may occur on site, thus risking both skilled and unskilled workers and possibly outsiders too, the project proponent and contractor shall require all workers to strictly observe safety standards and proper wearing of Personnel Protective Equipment (PPE) in adherence to Department of Labor and Employment (DOLE) Occupational Safety and Health Hazard Standards with emphasis on the following:

1. Personal protective equipment (Rule 1040) which specify the use and types of eyes and face protection, respiratory protection, hand and arm protection, safety belt life lines and safety nets and safety shoes;
2. Personal protective equipment, and minimum space requirements for gas, electric welding and cutting operations (Rule 1100);
3. Fire protection and control rule (Rule 1940); and
4. Notification and record keeping requirements (Rule 1050).

Safety signs must also be put up within the construction site as well as provision of potable drinking water and sanitary facilities for construction workers.

COVID-19 Protocols for Disease Prevention and Control

CPGI and its contractors will be diligent in preventing the spread of the coronavirus, or "COVID-19," a respiratory ailment caused by the SARS-CoV-2 virus. This is especially true for the proposed dredging activities, which have been considered "vital" under this Declared National Emergency. We established this COVID-19 Exposure Prevention, Preparedness, and Response Plan to be executed throughout the Company and at all of our job locations in order to be safe and maintain operations.

COVID-19 Health Protocol Information and Awareness

COVID-19 Exposure Prevention, Preparedness, and Response Plan must be familiarized by all managers and supervisors to address inquiries from staff and dredging workers. They must constantly lead and adhere to this plan. To prevent the virus from spreading, good personal hygiene and worksite safety standards in compliance with IATF and DOH health protocols are required. Managers and supervisors must urge all employees and dredge site workers to behave in the same manner.

Regarding COVID-19 control and prevention, as described and articulated in this EISR, CPGI has developed and implemented a safety toolbox and protocols for its operations once the project commenced. With so much information dissemination in its workplaces, it's critical to stay up to date on the COVID-19 virus and how it can affect worker safety. To prevent viral transmission, CPGI Occupational Health and Work Safety practices established recommendations for employees and workers. Regardless of specific exposure of all workers, it is always a good practice to:

- Wash your hands frequently with soap and water for at least 20 seconds. Use an alcohol-based hand rub with at least 60% alcohol when soap and running water are not accessible.
- Hands that are clearly filthy should always be washed.
- Avoid touching your eyes, nose, or mouth with your hands that haven't been washed.
- Avoid coming into close touch with sick people.

COVID-19 Response and Action Plan

The Contractor for the dredging ships and equipment will be urged to adopt COVID-19 health protocols both inside and outside the vessels and equipment (e.g., in-land, offshore, inshore). At the very least, the following protocols would be implemented:

- All offices and non-porous tools/equipment are cleaned and sanitized on a regular basis.
- Encourage sick employees to stay at home or take a leave of absence for quarantine.
- Allow no one to enter a construction site if;

    i. Within the last 14 days, they or a member of their family have traveled outside the country;
    ii. In the recent 14 days, they or a member of their family have experienced COVID-19 symptoms: (Fever, Cough, Difficulty Breathing, Sore throat, sneezing)

- Clean the environment on a regular basis;
- Plan to keep workers and the general public separated – follow social distancing measures.
- Avoid touching eyes, nose or mouth.
- Do not share cups, glasses, dishes or cutlery inside the ship, office and quarters.
- Have a COVID-19 kit available on site.
- Post informational posters instructing all workers and constituents on what to do if they get sick.

COVID-19 diseases would not be considered recordable during dredging operations due to the difficulties in pinpointing where the exposure occurred because dredging is not one of the specified at-risk categories. COVID-19 is only a recordable sickness if a worker becomes infected while doing work-related responsibilities and all of the following conditions are met:

1. COVID-19 has been confirmed in this case.
2. It is a work-related case.
3. The case involves one or more of the IATF's broad recordkeeping criteria (e.g., medical treatment beyond first-aid, days away from work).
4. All one-on-one contact should be limit or avoided.
5. Lunch should not be eaten in groups.
6. If at all possible, avoid in-person encounters. If an in-person meeting is required, ensure sure it is held in a well-ventilated room with enough space for attendees to separate themselves from one another. Consider dividing attendees into smaller groups for meetings and emergency planning/orientation rather than one large meeting.
7. If at all possible, avoid in-person encounters. If an in-person meeting is required, ensure it is held in a well-ventilated room with enough space for attendees to separate themselves from one another. Consider dividing attendees into smaller groups for meetings and emergency planning/orientation rather than one large meeting. Visitors should not be allowed on the jobsite unless they are absolutely necessary
8. If the job site shuts, the contractor will take the procedures necessary to secure the job site, tools, and equipment.

In the event of positive COVID-19 transmission or any symptoms, workers will be isolated from others as soon as possible. For effective case management, a health care expert or the Public Health Authority would be contacted. Washing hands and self-isolation will be used to protect others from illness. All employees and workers will be recommended to consult with their supervisor before making any trip arrangements. Employees should also think about the following limitations on their ability to return to work if they travel for personal or professional reasons "OB."

Work Site Protective Measures

CPGI has instituted the following protective measures at all jobsites. General Safety Policies and Rules:

1. Any employee/contractor/visitor showing symptoms of COVID-19 will be asked to leave the jobsite and return home.

2. If possible, safety meetings will be conducted over the phone. If safety meetings are held in person, attendance will be taken verbally and each attendee will be signed in by the foreman/superintendent.

3. Attendance will not be tracked through passed-around sign-in sheets or mobile devices.

4. Avoid meeting in groups of more than 10 people for any in-person safety meetings, and participants must be at least six (6) feet apart. Employees must avoid making physical contact with others and, where practicable, direct employees, contractors, and visitors to increase personal space to at least six (6) feet. Only necessary personnel should be allowed to enter work trailers, and all employees should maintain social distance when within the trailers.

5. There will be a cap on all in-person meetings which will be held over the phone or via the zoom app

6. Employees and site workers will be encouraged to stagger breaks and lunches, if practicable, to reduce the size of any group at any one time to less than ten (10) people. 6. Employees and site workers will be urged to stagger breaks and meals, if possible, so that no group of more than ten (10) persons is present at any given time.

7. CPGI and Contractors recognizes that access to running water for hand washing may be impossible due to the nature of the job. If alcohol-based hand sanitizers and/or wipes are available, the Contractor will provide them.

8. Employees and construction workers should utilize coworkers' tools and equipment sparingly. The Company shall offer alcohol-based wipes to clean instruments before and after usage to the extent that tools must be shared. Consult the manufacturer's guidelines for suitable cleaning techniques and limitations while cleaning instruments and equipment.

9. Employees and site workers are urged to apply engineering and work practice measures to reduce the requirement for N95 respirators. Water delivery and dust collection systems, as well as exposure duration limits, are examples of such controls. If one of the separated teams is forced to quarantine, the contractor will divide crews/staff into two (2) groups as soon as feasible so that projects may continue to run smoothly.

10. The Contractor will assign employees to dedicated shifts as part of the crew/staff division, and they will remain with their devoted shift for the duration of the project. If an employee has to change shifts for a justifiable reason, the Company will make the adjustment at its sole discretion.

11. Employees are encouraged to ride-share as little as possible. Employees must provide proper ventilation while in the vehicle.

12. Employees should use/drive the same truck or piece of equipment every shift, if possible; and

13. Employees and workers should use individual water bottles instead than a shared supply of drinking water such as a cooler

Workers Entering Occupied Buildings and Homes

When employees execute construction and maintenance activities in occupied buildings, they have particular COVID-19 exposure risks. When selecting best practices for COVID, all project personnel, contractors, visitors, and site workers must clean the workspaces upon arrival, throughout the workday, and immediately before departure. For this reason, the Company will provide alcohol-based wipes. Employees should request that other occupants maintain a personal distance of at least six (6) feet. Before beginning and after completing the work, workers should wash or sanitize their hands.

Project Site Visitors, Monitoring Guests, etc.

The number of visitors to the job site, including the trailer or office, will be limited to only those necessary for the work.

1. All visitors will be screened in advance of arriving on the job site. If the visitor answers “yes” to any of the following questions, he/she should not be permitted to access the jobsite:
    a. Have you been confirmed positive for COVID-19?
    b. Are you currently experiencing, or recently experienced, any acute respiratory illness symptoms such as fever, cough, or shortness of breath?
    c. Have you been in close contact with any persons who has been confirmed positive for COVID-19?
    d. Have you been in close contact with any persons who have traveled and are also exhibiting acute respiratory illness symptoms?
2. Site deliveries will be permitted but should be properly coordinated in line with the employer’s minimal contact and cleaning protocols. Delivery personnel should remain in their vehicles when practical

Personal Protective Equipment (PPE) and Work Practice Controls

In addition to regular PPE for workers engaged in various tasks (e.g., fall protection, hard hats, hearing protection), employers will also provide:

a. Gloves: Gloves should always be worn while on-site. The type of glove worn should be appropriate to the task and compatible with the materials being handled with the task. If gloves are not typically required for the task, then any type of glove is acceptable, including latex gloves. Employees should not share gloves.
b. Eye protection: Eye protection should always be worn while on-site.
c. Employees should wear N95 respirators if required by the work and if available.
d. Limit exposure time to the extent practicable.

Work Site Cleaning and Disinfecting

When possible, CPGI will implement routine housekeeping procedures, such as cleaning and sanitizing commonly used tools and equipment, as well as other parts of the work environment. Employees should do the same in their respective work areas on a regular basis.

- At least once a day, the work site quarters and break/lunchroom areas shall be cleaned. Cleaning employees shall be provided with appropriate personal protective equipment (PPE), such as nitrile, latex, or vinyl gloves and gowns, as suggested by the IATF/CPGI.

- Anyone wearing nitrile, latex, or vinyl gloves must change any waste gathered from the jobsite on a regular basis.

- Any portable jobsite toilets should be cleaned and disinfected on the interior at least twice a week by the leasing business. Hand sanitizer dispensers will always be stocked by the company. Items that are often touched (such as doorknobs and toilet seats) will be disinfected on a regular basis.

- Service vehicles, equipment, and tools should be cleaned at least once a day and before each change of operator or rider.

- If an employee tests positive for COVID-19, CPGI will advise if additional cleaning or decontamination of work settings is usually not required unless those areas are clearly polluted with blood or other bodily fluids. Regardless, before employees can access that workstation again, Contractor/CPGI shall clean any portions of the jobsite where a confirmed-positive individual may have come into contact.

- Any disinfection will be carried out by CPGI/Contractor using one of the following methods:

  a. Common EPA-registered household disinfectant;
  b. Alcohol solution with at least 60% alcohol; or
  c. Diluted household bleach solutions (these can be used if appropriate for the surface).
  d. CPGI/Contractor will maintain Safety Data Sheets of all disinfectants used on site.

Worksite Exposure Situations Employee/Workers Exhibiting COVID-19 Symptoms

If an employee or dredging site worker develops COVID-19 symptoms, the employee or dredge site worker must stay at home for 72 hours (3 full days) without using fever-reducing or other symptom-altering medications (e.g., cough suppressants). Employees who report to work with symptoms will be required to return home until they have been symptom free for 72 hours by CPGI/Contractor (3 full days). Employees are required, to the degree possible, to get a doctor's letter allowing them to return to work.

Employee Tests Positive for COVID-19

If an employee tests positive for COVID-19, they will be sent home to self-quarantine. Employees who test positive but are symptom-free may return to work after seven (7) days have passed since their first positive test and no further illness has occurred. Employees who test positive and are told to take care of themselves at home can return to work after: (1) 72 hours (3 full days) have passed since their recovery; and (2) seven (7) days have passed since their symptoms first emerged. (1) Fever remission with the use of fever-reducing medicines; (2) improvement in respiratory symptoms (e.g., cough, shortness of breath). Employees who have a positive drug test

Employee Has Close Contact with a Tested Positive COVID-19

Employees who have had close contact with a confirmed-positive COVID-19 individual (coworker or otherwise) shall be placed on self-quarantine for 14 days from the last date of close contact with the carrier. For a lengthy period of time, close contact is defined as six (6) feet.

If CPGI/Contractor learns that an employee or site worker has tested positive, it will conduct an investigation into coworkers who may have had close contact with the confirmed-positive employee in the previous 14 days and direct those individuals to self-quarantine for 14 days from the last date of close contact with the carrier. If an employee discovers that he or she has had close contact with a confirmed-positive individual outside of work, he or she must notify a manager or supervisor and also self-quarantine for 14 days from the last date of close contact with the carrier.

2.4.13 Generation of Local Benefits

The direct benefits resulting from this Project include the creation of employment for local residents and non-local manpower in the area. During construction of the proposed Project (opening of the delta), CPGI would provide temporary employment to local residents. During operation, an estimate of 100 new positions will be required. Potential positive effects of the manpower influx will include demand for retail and other services, which may increase economic activities and benefits for some local businesses, including food suppliers and other retailers. It is expected also to increase business opportunities in terms of the project needs for construction materials, supplies, concrete aggregates and social services. Aside from the generation of job opportunities for the direct and indirect impact barangays, opportunities for business establishments are also expected to be created by the proposed Project.

To enhance the employment opportunities brought by the proposed Project, CPGI shall regularly coordinate with the LGU of Occidental Mindoro and the two host municipalities, specifically at the barangay level regarding the hiring of temporary workers during construction phase and regular workers during operation phase to ensure that the workers being considered are legitimate residents in the area. Moreover, by hiring local residents, some of the social conflicts associated with uncontrolled in-migration can be minimized.

The respective contractor shall be responsible to provide accommodation for their workers and equipped with the necessary social infrastructure. Workers and professional personnel from outside the area will stay in temporary accommodation. Increased traffic in the project area during construction will be controlled on and off site to minimize traffic hazards to road users. Vocational and Skill Training and entrepreneurship courses will be undertaken prior to construction to enable local people to be competitive in securing employment and work contracts related to the proposed Project. These programs shall be carried out in coordination with the LGU of Occidental Mindoro and other concerned agencies.

2.4.14 Traffic Congestion

During construction (opening of delta), there is no anticipated congestion of vehicular traffic particularly near and along tertiary access roads going to the dredging site at the start of positioning of TSHD, other vessels, and equipment and hauling of in-land equipment. Cumulative traffic impact during operation phase, in conjunction with project operation, may not aggravate the traffic situation along access roads. Moreover, CPGI is committed to implement a Traffic Management Plan. The concept of the Traffic Management Plan is basically premised on the measures that will be implemented by the CPGI in coordination with and authorization of the LGU of Sablayan. The Traffic Management Plan shall include mitigation measures such as designation of traffic officer responsible for smooth traffic flow; formulation of traffic management system; provision of appropriate warning signs, lighting and barricades, whenever practicable; and observance of traffic rules such as vehicle speed.

3 ENVIRONMENTAL MANAGEMENT PLAN

3.1 ENVIRONMENTAL MANAGEMENT PLAN

The Environmental Management Plan (EMP) is formulated to minimize the potential adverse impacts while enhancing the beneficial effects of implementation of the project. This EMP shall serve as the environmental monitoring and implementing guidelines for the project.

Air and Water Quality and Ecology Monitoring Program. In order to determine the water quality conditions during construction and dredging operation, survey the degree of changes, and evaluate the effects of pollutants, monitoring of the environment in the immediate vicinity must be done. To ensure that plant pollution control measures are successful and that the DENR water quality rules and regulations will not be broken, pre-operational and ongoing water quality monitoring of ground and marine waters must be put into place. Programs to preserve marine water quality will be developed in collaboration with local government units (LGUs).

Waste Management System. Despite the fact that the restoration and desilting project will primarily concentrate on vessels and ships, land-based facilities are primarily responsible for producing solid wastes, including domestic solid wastes. For the proper handling, transport, and disposal of these wastes, a solid waste management strategy as well as a toxic and hazardous waste management plan will be prepared. Drainage and Storm Water Management Plan. A storm drainage system must be installed by CPGI, particularly along access and maintenance roads and near storm water detention/retention ponds near the stockpile area.

Emergency and Contingency Plan. For emergencies brought on by equipment/machinery failure or malfunction, disasters like floods and typhoons, significant seismic activity, or earthquakes, emergency response/procedures will be devised. At various locations around the project site, evacuation maps must be posted. Drills for evacuation must be performed to determine whether the strategy is applicable.

Fire Protection System. A facility is constructed with a complete fire detection, alarm, and fire protection system to offer a high level of safety for administration buildings and other auxiliary facilities, positioned as well in the vessels and ships. To safeguard the asset, buildings, and facilities, the fire protection system must include portable fire extinguishers, standpipes, fire hose stations, independent fire detection systems, and fire loop systems. Regular fire drills must be conducted to ensure that the staff is ready for any potential fires or fire threats.

Social Development and IEC Program. An Indicative Social Development Plan (ISDP) was developed through consultation with the decision makers of the Project, concerned barangay and the Government agencies such as the Municipal Social Welfare Development (MSWD), the Municipal Heath Officer (MHO), Department of Education (DepEd), Non-Government Organization (NGO), People's Organization (PO) and the Community Relations Officer (CRO) of CPGI. The indicative sustainable social development plan that will be formulated is based on the government requirement RA 7279/DAO 2003-30 revised and the mandated corporate responsibility of CPGI aligning the programs to the mandated development programs as required by the Department of Interior and Local Government (DILG) in the Internal Revenue Allocation (IRA).

Health and Safety Plan. The Health and Safety Plan for the community especially the directly affected/impact area involves the following: a) Medical and Dental Program; and b) Emergency Disaster Health Program. Health and safety plan for workers will also be created and implemented. Enhancement, Recovery, Restoration and Reforestation Program (E3RP) for Amnay River Buffer Zones and Riverbanks. The need for a buffer zone is clearly stressed in the light of neutralizing the impact level at the dredging operation lines, creating a habitat for displaced vegetation, rehabilitating collapsed banks, restoration of vegetation in banks and plains along the river course lines and improving the aesthetics of the project site.

Table 3.1.1 presents the key environmental impacts and proposed management measures in relation to the dredging operations.

Table 3.1.1: Environmental Management Plan

Environmental Aspect	Environmental Component Likely to be Affected	Potential Impact	Prevention/Mitigation/Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement
PRE-CONSTRUCTION PHASE						
Pre-construction phase covers activities like planning, feasibility study, drawing of plans and permit procurement.						
CONSTRUCTION PHASE						
Extraction of sediments from the project area using trailing suction hopper dredgers in Amnay River	Water Quality Dredging site area (riverbed)	Degradation of water quality	Installation of sediment and silt curtains	Dredging contractor/CPGI	Included in pre-construction activities	ECC/ Contract between CPGI and Dredging Contractor / Contractor environmental management plan
	Dredging site (River delta/mouth opening)	Possible change or modification in coastal bathymetry; generation of sediment plumes	Planning of dredging operations via bathymetric surveys, current measurements and TSS study	Dredging contractor/CPGI		
			Proper handling of dredged materials and transport to the reclamation area	Dredging contractor/CPGI		
Land	Pedology	Devaluation of land as a result of improper solid waste management	Implementation of Solid Waste Management Plan	CPGI/ Dredging contractor	PhP 100,000.00	100% efficient implementation of the Solid Waste Management Plan of CPGI
	Pedology	Soil Contamination	▪ Proper handling of fuel, lubricants and chemicals; ▪ Implementation of solid waste management program that shall include proper waste segregation and good housekeeping. ▪ Provision of mobile comfort rooms and garbage bins for domestic solid wastes	CPGI/ Dredging contractor	Include in TOR or scope of contractor	100% efficient implementation of the Solid Waste Management Plan of CPGI
	Terrestrial Ecology	Threat to existence, frequency and distribution of important species	Establishment of a nursery of endemic and indigenous species of trees, shrubs and other plant species which can be used for reforestation.	CPGI	PhP 200,000.00	100% efficient Implementation of TFA
		Threat to abundance, frequency, and distribution of important	Maintain the natural vegetation of the area and implement offset planting in other areas.	CPGI	PhP 20,000.00	100% efficient

Environmental Aspect	Environmental Component Likely to be Affected	Potential Impact	Prevention/Mitigation/Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement
		species and hindrance to wildlife access				Implementation of greening areas
OPERATION PHASE						
Dredging and desilting operations	Water Quality (Freshwater and Marine)	Wastewater generation aboard ships	Proper disposal of ship wastewaters upon docking	Dredging contractor/CPGI	PhP 500,000.00 per quarter monitoring of water quality	ECC / Requirement under current laws and regulations
		Sea Water turbidity and Silt dispersion	Use of silt curtain enclosure on the work area during dredging and filling operation	Dredging contractor/CPGI		
			Periodic Water quality monitoring in dredge sites	Dredging contractor/CPGI		
		Increased possibility of Spills from vessels due to increased traffic	Proper maintenance of ship engines and vessels, and other dredging equipment	Dredging contractor/CPGI	Maintenance cost on the part of the dredging operator	
			Audits of ship processes to ensure proper storage of oil and ballast	Dredging contractor/CPGI	P150,000 per third party auditor	
	Freshwater Ecology	Potential release of waste materials or pollutants associated with the dredger into the freshwater environment resulting in reduction of biodiversity	Adherence to waste management controls for vessel operations	Dredging contractor/CPGI	PhP 500,000.00 per quarter monitoring of fresh water ecology	
			No planned refueling or maintenance of operation equipment to occur on site, nor equipment to be parked at the site for a significant time. Readily available spill kits for land and water to be kept on site with trained personnel. Emergency response procedures will be established. Adherence to waste management controls identified in the EMP for this Project.	Dredging contractor/CPGI		
	Water quality	Alteration of water quality in habitats and impacts (including from altered siltation/sedimentation regimes) that may have potential	Monitoring of freshwater ecology and other biodiversity in the Project area	CPGI		

Environmental Aspect	Environmental Component Likely to be Affected	Potential Impact	Prevention/Mitigation/Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement
		follow effects for trophic groups and other associated species				
	Air	Ship Emission, Particulate Matter, CO and NOx	Proper Maintenance of ship engines and pumps	Dredging contractor/CPGI	Maintenance cost on the part of the dredging operator	
		Noise Generation	Operations are far from offshore clearing and RDZ, will generate minimal noise, night time operations will be done as far as possible	Dredging contractor/CPGI	Included in Dredging costs	
		Health and Safety Risk: Physical Hazards	Proper procedures followed onboard ships	Dredging contractor/CPGI		
			Use of Personal Protective Equipment (PPE)	Dredging contractor/CPGI		
		Risk of Dredging During Extreme Weather	Implement proper procedure for dredging during weather events; No dredging during typhoon signals	Dredging contractor/CPGI		
		Risk of Collision between vessels especially fishing vessels	Ensure communication between vessels, Promote public awareness of activities	Dredging contractor/CPGI		
	People	Impact of Turbidity on Fish Catches	Implement Social Development Plan; provide alternative livelihood for fishermen;	Dredging contractor/CPGI		
			Limited impact in comparison to TSHD, with DMP to be adopted.	Dredging contractor/CPGI		
			Smaller-capacity TSHD should be deployed in the project area that are near the coast, while larger-capacity TSHD should be assigned far offshore	Dredging contractor/CPGI		
			Limit the dredging activities in project areas near the shore especially during periods of calm wind or during low tides	Dredging contractor/CPGI		
		Generation of Employment	▪ Positive impact; No mitigation measure required. ▪ Priority will be given to the residents of Claudio Salgado for qualified residents	Dredging contractor/CPGI		

Environmental Aspect	Environmental Component Likely to be Affected	Potential Impact	Prevention/Mitigation/Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement
		Spread of communicable diseases from migrant workers (e.g., COVID-19, and other common diseases)	▪ Conduct of medical examination of workers prior to hiring; ▪ Provision of medical services to employees and nearby communities; ▪ Conduct of Environmental Health and Safety; ▪ Briefing to workers and communities prior to dredging works and employment	Dredging contractor/CPGI		
		Construction-related hazards	▪ Conduct of Environmental, Health and Safety Training prior to work activities	Dredging contractor/CPGI		
		Additional Revenue for the LGU	Pay the exact taxes and Permit/Transport/Hauling fees required by law on time	Dredging contractor/CPGI		
			Participate in LGU's activities	Dredging contractor/CPGI		
		Employment Opportunities	Priority for qualified barangay residents	Dredging contractor/CPGI		
		Health/Safety	Security in the dredging site to prevent collisions and other activities	Dredging contractor/CPGI		
			Advance information on dredging sites to warn fishermen	Dredging contractor/CPGI		
			Provision of communication equipment to prevent disasters	Dredging contractor/CPGI		
	Livelihood	Provision of livelihood	Enterprise and entrepreneurial activities and development	Proponent / Contractor	Integrated to SDMP	Incorporated in the work and financial plan of the company
	Hiring of staff (Administrative and Technical)	Employment opportunity	Encourage contractor to prioritize qualified residents of the host barangays /city/municipalities	Proponent / Contractor	Part of the initial project cost estimated at PhP5M.	Incorporated in the work and financial plan of the company

Environmental Aspect	Environmental Component Likely to be Affected	Potential Impact	Prevention/Mitigation/Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement
	Employment generation	Employment opportunity	The proponent will encourage its contractors to prioritize the hiring of qualified workers from the host barangays and municipalities.	Proponent/ host community / LGU / Contractor	Included in the SDMP	Integrated in the SDMP
	Subsistence fishing activities and major livelihood activities in offshore	Displacement of fisher folks	The proponents, through its SDMP, will provide alternative or other sources of livelihood for the affected communities during operation and during amihan months where fishing is not possible.	COMREL (CPGI), EMU and Technical Partner	Included in the SDMP	Integrated in the SDMP
ABANDONMENT PHASE						
Abandonment	People	Reduction and eventual termination of employment	Promote alternative livelihood at early stage of project	Dredging contractor/CPGI	P100,000 per quarter for livelihood	ECC/SDP
	Water	Stirred-up sediments will eventually settle into the riverbed at rates dependent on particle size and the prevailing currents. The local irregularity of the dredged slope will favor deposition of the sediments coming from the upstream section and possible on riverbanks. The passage of currents will cause the subsequent adjustment of the slope/bathymetry of river of the project area over time in accordance with the natural angle of repose of the sediment deposit (e.g., dredging works and depth)	Allow for natural attenuation of the riverbed and offshore	Dredging contractor/CPGI		

4 ENVIRONMENTAL RISK ASSESSMENT AND EMERGENCY RESPONSE POLICY AND GUIDELINES

4.1 ENVIRONMENTAL RISK ASSESSMENT

Human safety is the major concern of the Environmental Risk Assessment (ERA) in the context of the PEISS. DAO 2003-30 defined ERA as a process of analyzing and describing the risks associated with a project activity to ecosystems, human health and welfare.

4.1.1 Hazard Identification

There are three (3) main types of hazards that are expected to occur at the ARRD Project: (i) fires, (ii) explosions, and (iii) release of toxic materials into the ground or atmosphere. These hazards can arise from the handling, storage and processing of large quantities of flammable coming on dredge ships, vessels, equipment, and processing plant. Such accidents can occur while materials are being transferred into the storage facilities such as fuel, oil, generators or any other materials involving hazards, while the proposed ARRD Project is in operation, and while waste materials are being disposed. Fires can expose people and resources to heat radiation, explosions that cause blast overpressure, projectiles that cause harm/injuries, and toxic materials from accidental release.

- **Fires** are caused when flammable materials are ignited. The resulting flames can expose people and materials to heat. The intensity of heat is known to decrease rapidly proportional to distance from the open flame. Fire may occur in the dredging vessel, which generally pose little risk to public.

  The light fuel oil may form flammable mixtures with air when heated above the flash point. In the presence of hot spots, there is a special risk of fire or explosion under certain conditions involving accidental release of vapor or leaks of product under pressure.

  During accidental release of any dredging and desilting operation materials for ships and vessels, an immediate precautionary measure is to isolate spill or leak area for at least fifty (50) m (150 ft) in all directions. When it involves large spill, initial downwind evacuation for at least 300 m (1000 ft) shall be taken into consideration.

  Prolonged or repeated contact may cause skin irritation. Vapors or mists are irritating for mucous membranes, notably in the eyes especially during movements requiring materials having these properties inside ships and vessels. These also may cause central nervous system depression with nausea, headache, dizziness, vomiting, and incoordination. If swallowed accidentally, the product may enter the lungs due to its low viscosity and lead to the rapid development of very serious pulmonary lesions (medical survey during 48 hours).

- **Explosions** occur when flammable vapors and gases are ignited or when flammable substances are released at high temperatures and elevated pressures inside ships or on the processing plant/crushing plant. The effects of explosions include shock wave which is the sudden increase of high pressure into the surroundings.

- **Release of toxic materials** occurs when hazardous substances such as gasoline, oils and other coagulants or any other harmful crushing plant's by-products are accidentally released into the atmosphere or surroundings. Such releases occur usually during fire or other catastrophic accidents. Such a release can pose threat if the gas or materials reach populated areas outside of the crushing/processing plant.

4.1.2 Emergency Management

CPGI will adopt an Emergency Management Plan based on the recommended structure by the Philippine National Disaster Risk Reduction Management (NDRRMC) and Office of Civil Defense (OCD). The management of emergencies can be outlined into four elements – Prevention, Preparedness, Response, Recovery. **Figure 4.1.1** illustrates the four elements of Emergency Management.

Figure 4.1.1: Elements of Emergency Management

Each ship will be designated with a safety officer, who will regularly conduct safety briefings and periodically conduct emergency response drills. The safety officer will supervise the daily safety performance of operations and maintenance procedures. The safety officer will inspect the work and employee situation to ensure maintenance of and compliance to safety guidelines aboard each dredge ship. In the event of an emergency, the CPGI officer or high ranking official on-site available that is on standby, together with the Safety Officer, ER, FTR team and the rest of the Emergency Response Team (ERT), shall implement the Emergency Management Plan. The ranking official available on-site shall assume the role as an Incident Commander (IC) (**Table 4.1.1**). The IC will activate the ERT depending on the level and nature of emergency.

Table 4.1.1: Emergency Response Team

Emergency Response Personnel	Roles And Responsibilities
Incident Commander	▪ Overall in-charge of operations during an emergency event or disasters involving lives ▪ Provides direction and orders to the response team in managing the emergency ▪ Informs supervisor/project manager about the incident
Supervisor	▪ Assists at site when necessary; ▪ Know the condition of people involved in the emergency, assess the situation, give instructions to First Aid Team in case necessary; ▪ Inform family/ies concerned, providing information of hospital location and other necessary details
Safety Supervisor	▪ Supervises daily safety performance of operations and maintenance procedures, including emergency response procedures
Liaison officer	▪ Secures the necessary permits and training certification for the personnel
First Aid Team	▪ Performs the actual response, rescue and retrieval of personnel and equipment during an emergency event; ▪ Calls for ambulance or needed specialists to immediately assist case when necessary, or arrange for case forwarding to better equipped hospital, if needed equipment is not available in nearby hospital

Emergency Response Personnel	Roles And Responsibilities
Logistics team	▪ Provides the necessary supplies and equipment for the First aid team; ▪ Provides additional support/assistance to the First aid team
Finance and Administration Team	▪ Provides the assessment of expenses and allocates the necessary financial resources for the other teams ▪ Performs the disbursement of claims and compensation for affected personnel, property and the community
Environmental Team	▪ Emergency incidents relating to air pollution, chemical spill (e.g., Oil Spill, Waste Issue, Sewage Leak etc.) ▪ In many cases, major pollution incidents can be prevented if appropriate pollution prevention measures are in place or immediately available. It is the duty of the Environmental Team (e.g., Technical partner of CPGI, the FTR Group) to assist wherever possible, to such incident for rehabilitation and mitigating measures.

4.2 EMERGENCY RESPONSE AND RESPONSE PLAN

An Emergency Response Plan (ERP) shall be developed for the proposed ARRD Project to define preventive action for occurrence of accidents and response procedure in case of accidents, fire and natural hazards. CPGI is committed to ensuring the health, safety and security of its personnel, ships and facilities, and surrounding environment through the prevention of accidents by eliminating or mitigating potential threats/hazards and anticipating other probable causes. Hence, CPGI shall adhere to the primary approach to emergency response–that is the prevention of circumstances that can create emergency conditions.'

Emergencies are unpredictable events, disasters that may involve casualties or deaths, chaos, episodes that are caused by natural forces and circumstances that may result to negative effects to people, property and the surrounding environment. As a preliminary step in developing an effective emergency response policy, it is important to identify the potential emergency scenarios that would most likely occur. **Table 4.2.1** lists the most probable emergencies that could happen in future operation of the proposed ARRD Project.

Table 4.2.1: Possible Emergency Scenarios

Type of Emergency Situation	Possible Causes	Potential Effects
Occupational Safety Accidents	▪ Improper training and supervision of personnel; ▪ Equipment and facility failure; ▪ Lack of full understanding regarding the surrounding environment; ▪ Possible collapse of bench/ trench and siltation pond collapse	▪ Death and other casualties; ▪ Partial or total loss of equipment and property; ▪ Injuries and fatalities to personnel
Fire	▪ Electrical short-circuits, overloading of equipment; ▪ Accidental ignition of combustible materials; ▪ Combination of incompatible chemicals (chemicals used for water treatment)	▪ Partial or total loss of equipment and property; ▪ Injuries and fatalities to personnel
Earthquakes	▪ Movement/rupture of nearby fault lines ▪ Volcanic eruption	▪ Failure of structures on land ▪ Tsunami; ▪ Injuries and fatalities to personnel and downstream communities
Tsunami	▪ Movement/rupture of nearby fault lines ▪ Volcanic eruption ▪ Intense earth movement	▪ Failure of structures ▪ Injuries and fatalities to personnel due to capsizing of boats
Flooding	▪ Complex weather condition	▪ Collapse of structures ▪ Destruction of project facilities

Type of Emergency Situation	Possible Causes	Potential Effects
		▪ Injuries and fatalities to personnel and communities
Storm surge	▪ Complex weather systems ▪ Intense rainfall, wind and high tides	▪ Injuries and fatalities to personnel and communities

Emergency situations may also require different levels of classification and response procedures, depending on the degree of situations. These levels will be referred to as: 1) incident, 2) emergency, and 3) crisis.

Incident situations present minor events that may require partial or total mobilization of the proposed ARRD Project's resources to effectively deal with an accident. This episode may present very minimal injuries and/or partial damages to property.

Emergency situations require the utilization of the proposed ARRD Project's full resources, with the assistance of local emergency responders, and additional resources from CPGI main office. This episode may present serious injuries and some fatalities and could result to severe or total damage to the property.

Crisis situations are the worst conditions, which require the utilization of the proposed ARRD Project and CPGI's full resources, and possibly, assistance from the national government to address the event. This episode may present multiple fatalities, destruction of facilities, and severe/total damage to the surrounding community. Other circumstances not mentioned are listed below. Procedures for each of several emergency categories shall be established. The procedures shall specify actions to be performed by appropriate personnel within a time/event sequence.

These cases of emergency should be considered in the detailed design of structures to reduce the chance of their occurrence. There are design standards and codes that CPGI will have to comply with and incorporate in the specification of the projects various components, as applicable.

The ERP shall address, at minimum, the following:

- Dredging-related accidents
- Fire
- Bomb Threat
- Total Power Failure
- Structure Failure
- Transport of Dangerous Goods
- Suicide Injuries or Fatalities
- Criminal Acts
- Gender abuse (e.g., prostitution)

In order to reduce, if not eliminate, extreme emergency situations leading to loss of life and property, hereunder are the Project's initial safety guidelines which will be refined during project implementation.

The ERP shall establish what constitutes an emergency and procedure should be developed for:

- Emergency Reporting
- Notification of Emergency Response Personnel
- Dispatching of Emergency Response Personnel and Equipment to site
- Coordination of all Emergency Response activities
- Protection of people and equipment at the emergency site
- Evacuation of people
- Communication to all employees, locators, emergency response personnel
- Restoration of normal operations

Training of contractors, employees, and emergency response team shall also be undertaken. Facilities and equipment, vehicles required to copy effectively with emergency situations shall be included.

4.2.1 Safety and Health Program

CPGI gives priority on the safety of its employees and their working environment. It developed this program for accident and injury prevention through the implementation of plant rules and guidelines that shall involve management, supervisors, and employees in identifying and eliminating hazards that may develop during work process. The management will spearhead in the formation of a safety committee, develop a system for identifying/correcting hazards, prepare for foreseeable emergencies, provide appropriate trainings and establish a disciplinary policy to ensure strict compliance. CPGI shall ensure that:

- All ship personnel, staff, and crew will undergo proper and complete training and regular safety meetings to understand and internalize the job/tasks assigned and the corresponding risks and hazards involved and the necessary safety procedures.
- All working personnel shall be required to wear appropriate personnel protective equipment.
- No work will be allowed under typhoon or extreme weather conditions.
- The Safety officer and its supervisors for each phase/work sector shall regularly check and monitor other personnel compliances with safety guidelines and plan.
- Applicable safety guidelines and procedures promulgated by relevant agencies such as the OHSC-DOLE, Philippine Coast Guard (PCG), and Marina Hall be complied with accordingly.

4.2.2 Company Safety Policy

It is basic policy that no task is so important that an employee must take a risk of injury/illness or violate a safety rule. Active involvement in safety practices is then encouraged to make the area a safe place to work. It is the daily duty of every employee to be cautious of unsafe conditions. In addition to this, supervisors or accountable managers are responsible in overseeing the actions of employees and to take prompt action in eliminating unsafe practices and hazards in the workplace.

4.2.3 Hazardous Substance Safety Measures

The contractor’s dredging ships, and other vessel equipment will be installed and constructed with the following equipment and devices to mitigate and or prevent potential fire or explosion as well as spill and leaks during handling and storing. CPGI is committed to achieve installation of the following:

4.2.3.1 Spill Containment

Fuel, and other chemicals transport, forwarding, and storage can result to spillages and leakages. Spill containment provisions will be incorporated into the Project to meet all national, provincial and local regulations and requirements. Spill containment will be provided for the following areas:

- Storage drums for used oils and other materials
- Light Fuel Oil equipment (e.g., grasscutter, generators), storage, and unloading areas;
- Chemical equipment, storage, and unloading areas: (i) dredge truck unloading and loading station and (ii) water treatment equipment;
- Water washing and disinfecting stations for COVID-19 for vehicles upon entry
- Storage facilities; and
- Battery rooms.

Secondary containment areas will be provided with lockable manual drain valves or manually controlled sump pumps to release accumulated water or liquids into the appropriate drain system.

4.2.3.2 Conceptual Oil Spill Management Program

A comprehensive site-specific oil spill and fuel storage management program is still up for development since the Project has not yet reached the final detailed design stage wherein at that point, a program that is tailor fit for the Project will be adopted. The development of the program will be based on the concepts described as follows: There are three (3) areas in the Facility in which a possible oil spill can happen or incidentally occur; namely, (i) at the Fuel/Oil Storage area and (ii) at the wastewater system. As a standard, all these areas will have oily water drains that will direct water (rainwater, water for washing, etc.) possibly contaminated with oil to the WWTS. The discussion below further describes the conceptual oil spill management system for each area.

4.2.3.3 Fuel/Oil Storage Area

The fuel oil will be stored in two (2) tanks whose sizes will each range from a minimum of 100 m^3, to be installed and the other near the project site, to a maximum of 200 m^3 depending on the final design. This is to assist and carefully contain any spills and assists on the management of fuel in the area during working (dredging and desilting phase). This area is the most critical for a large volume oil spill scenario if it will be treated as separate incident as a whole.

4.2.3.4 Wastewater System in Relation to Restoration and Desilting

Wastewater from the dredging of sand and gravel will be managed carefully and designated workers to work on the system are trained personnel.

4.2.4 Personal Protective Equipment

The Personal Protective Equipment (PPE) is a set of safety gears worn by personnel that is signed to provide sufficient safeguard against occupational-related illnesses and to prevent life threatening injuries. PPE such as safety hats, safety shoes, gloves and dust mask and ear plugs will be provided as necessary. This is to ensure safe and protected personnel working in safe working environment. CPGI will make the usage of PPE a mandatory policy for personnel that are working inside the Project premises. Guests and visitors are also required to wear PPE as necessary.

4.2.5 Recording and Review

Employees are required to report any injury or work-related illness to their immediate supervisor regardless of how serious. Minor injuries such as cuts and scrapes can be entered on the first aid only log. More serious injuries are to be reported and recorded properly for future review.

4.2.6 Incident Investigation

It is imperative that an incident scene should not be disturbed except to aid in rescue or make the scene from further incidence. In case of an incident resulting in fatal death, casualties or serious injuries, a preliminary investigation and assessment will be executed by the CPGI management or heads of the injured person(s), a person designated by management or duly designated in lieu of the incident, an employee representative of the overall safety committee of the management, and any other persons or groups whose knowledge would help the search.

The investigating team will obtain draft statements from witness, photo-documentation, any documentation, records, footage of the incident scene and machines/equipment involved. The said team will also document as soon as possible after the incident, the condition of equipment and anything that may be relevant in the work area. A written “Incident Investigation Report” is necessary. The report should include a sequence of events leading up to the incident, conclusions derived from the incident and any recommendations to prevent a similar incident in the future.

5 SOCIAL DEVELOPMENT PLAN/FRAMEWORK AND IEC FRAMEWORK

5.1 SOCIAL DEVELOPMENT PLAN/FRAMEWORK

The Social Development Plan/Framework (SDP) seeks to address the issues, concerns under impacts and mitigating measures. It incorporates the proposed interventions of the project proponent in favor of the various stakeholders of the project. As part of its social responsibility, the proponent aims to empower stakeholders, especially the affected residents as partners of development. CPGI is committed to compensate and uplift the welfare of every affected resident in the area by giving them opportunities for improvement and betterment of their conditions. The SDP is anchored on the following objectives: provision of services to impact areas in a sustainable manner, partnership with local government units and other stakeholders in the promotion of social and economic development and promote a safe and healthy environment. Foremost among these programs are community health and the amelioration of the livelihood of affected individuals of the dredging project, particularly the fishermen in the project area.

The actual SDP will be prepared as a collaborative undertaking between the Municipality of Sablayan and CPGI. The framework seeks to establish the parameters in intervention to the host communities and to the various stakeholders. The social development plan framework is discussed in the following paragraphs to guide CPGI in the formulation of the SDP. These are the major features of the social development plan framework.

Proper mechanisms should be put in place to ensure that livelihood projects will continue to exist and be viable. It is an opportunity for the residents to pursue self-sustaining livelihood activities and be self-reliant in the future.

Coordination should be undertaken to identify the priority needs of the residents of the barangays affected, especially the fishermen. A mechanism should be put in place to ensure the timely payment of the taxes, fees, permits and licenses to the local government to ensure the timely provision of social services.

CPGI to conduct consultations with the host communities to discuss the above sentiments. Respectively, LGUs (Municipal and Barangay levels) should be in attendance to help facilitate the consultations.

- Preparation of Project presentation materials in print form, preferably in Filipino or the local dialect, which could be disseminated during rounds of consultations. Preferably, these materials should be illustrative and already reflective of with-Project conditions.
- CPGI should make it clear to the stakeholders that the Project is not being infused without condition, as they are aware of the need to design the Project in a manner that takes heed of environmental and social considerations.
- Gathering of views on how the communities (local LGUs and local residents) may be better represented in environmental monitoring activities. Stakeholder representation may have to be sector-based considering the range of sectors (e.g., Farmers, fisherfolks, women, youth, seniors, etc.) with significant stake in the proposed ARRD Project.
- For this project, the specific IEC plans that are recommended for implementation are presented in the next section.

5.1.1 Safety Program

Foremost among the aims of the SDP is to provide a safe area for both the dredge and desilting vessels and ships and the fishermen to practice their livelihood. This would mean trainings and discussions with fishermen on the proper way of coordination during dredging operations such as communications, signals and other signaling on water, the use of proper communications equipment, and safety within the dredge areas. Fishermen will also be provided a means for communicating with the dredge ships if emergency situations occur.

5.1.2 Employment Generation

Because of the limited number of employees required aboard the dredge ships, which must be specialized according to the fleeting requirements, the need for employment may be minimal except as support staff on the ground for crews that are on shore leave while another crew takes over. However, CPGI commits to give priority in employing qualified residents of the host Barangay Salgado.

5.1.3 Health Program

CPGI will support the riverside communities in Barangay Salgado to improve their general health situation and nutrition. This will be done by enhancing the delivery of basic health and nutritional services to the communities thru LGUs. CPGI can affiliate its program with the LGU nutritional programs when available. Among other program includes medical, feeding programs, and dental missions which may be done together with the employees. It will include monitoring the health conditions of the nearby communities through the existing RHU and /or barangay health stations as part of its SDP.

5.1.4 Livelihood Program

The SDP will surely enhance and complement the social development activities within the Municipality of Sablayan, especially the fishermen and farmers who will be affected by the dredging activities. Since the dredging will run over a number of years, the SDP will support the programs of the municipality in providing alternative means of livelihood to the fishermen and farmers in the area.

For offshore and RDZ operations, the SDP will attain harmonious undertaking of uplifting the socioeconomic conditions and development of host barangays within the Municipality of Sablayan especially those affected groups who will be impacted by the dredging and desilting activities in the identified barangays. A total of 350 fisherman identified by the FARMC (e.g., Claudio Salgado Fisher Folks Association, SLUFA, etc.) would be affected by the operations during the offshore dredging operations. They would be prioritized by CPGI for the implementation of its CSRs through its ISDMP (**Table 5.1.1**). These include those subsistence fisherfolks, hook and line users, small motorized bancas, and net casters. CPGI will validate further information to accommodate these site specific and mobile sectors and other impacted beneficiaries during the process. Since the dredging and desilting will operate for a certain period, the SDP will provide and institute the programs of the municipality in giving options, ways and means of uplifting the livelihood and socioeconomic conditions in times these subsistence or permanent livelihood groups lose their sources of income due to the project or providing them options and relief during storm and wind periods of those identified affected groups. The proponent responsible for the dredging and desilting activities will conduct community consultations to inform fishers about the potential impacts on their livelihood. They will establish fishing regulations, including restricted areas, to ensure fishers are aware of the construction zone and avoid any potential accidents.

To mitigate the possible loss of income, the proponent will implement livelihood support activities, training programs, and capacity building initiatives. These activities will be carefully planned and executed after thorough consultation with the community.

The goal of these measures is to minimize the impacts of dredging on the livelihoods of the fishers and to promote sustainable fishing practices. The proponent will work closely with the community to ensure that these measures are effective and responsive to the needs of the fishers.

5.1.5 Education and Spiritual Health

CPGI will provide assistance to both schools and churches in the area as part of its social development plan in coordination with its reclamation partner.

The ISDP for the proposed ARRD Project is presented as **Table 5.1.1.**

Table 5.1.1: Indicative Social Development Framework for the Proposed ARRD Project

Concern	Community Member / Beneficiary	Government Agency/ Non- government Agency and Services	Proponent	Indicative Timeline	Source of Funds
HEALTH					
Medical missions and emergency relief programs Medical assistance	- Barangay Chairman - Barangay Kagawad for Health - Barangay Health Workers (BHWs) - Residents of the affected barangay	LGU - Sablayan Health Office - Barangay Health Unit	Rural Health Office (RHO)/ Community Relations Officer (CRO)	Dredging Operations	Private Partner
SAFETY					
Provisions of markers near the areas and safety zones for the active fisherfolks	Fisherfolks/PCG	Municipal Fisheries Office	Safety Officer/CRO	Dredging Operations	CPGI
Guidance to identified passage of fisherfolks for the routes of fisherfolks and ships (e.g., buoys – no fishing zones, silt curtain zone, access zones)	Fisherfolks	Municipal Fisheries Office	Safety Officer/CRO	Dredging Operations	CPGI
Provision of advance information on dredging areas to the municipalities and barangays	- Municipal Mayor - Barangay Chairmen - Fisherfolks	Municipal Fisheries Office	Safety Officer/CRO	Dredging Operations	CPGI
Assistance to disaster risk reduction activities of impact communities (Host barangay), Training Program for Community, Provide assistance and health and safety gears for Brgy. Security Team (Brgy. Tanods)	- Host Barangays	LGU - Municipality of Sablayan - Barangay Claudio Salgado	CPGI	Throughout project duration	SDP / CSR Fund
EDUCATION					
School facilities and services, Annual Assistance to Brigada Escuela Program,	- Barangay Kagawad for Education - Teacher and/or Principal	DepEd Barangay LGU	Council member for Education/ CRO/ FORESTEREPLAN	Dredging Operations	Private Partner
Educational assistance (Scholarships) Provision of small library rooms “Booklatan” and school supplies	- Barangay Kagawad for Education - Teacher and/or Principal	DepEd Barangay LGU	Council member for Education/ / CRO/ FORESTEREPLAN	Dredging Operations	Private Partner

Concern	Community Member / Beneficiary	Government Agency/ Non- government Agency and Services	Proponent	Indicative Timeline	Source of Funds
	- PTA - Qualified Students of Barangay Salgado				
EMPLOYMENT AND LIVELIHOOD					
Financial and emergency relief assistance during operation/calamities	- Fishermen affected by operations	LGU CSWD	Municipality of Sablayan	Dredging Operations	Private Partner
Livelihood Programs (Delivery of supplies, Barging's, and Simple Operations, creation of business enterprise livelihood projects)	- Fishermen affected by operations - Farmers affected	LGU CSWD	Municipality of Sablayan	Dredging Operations	Private Partner
Provision of Lending Bancas for Fishermen's/Baklad, Baklad, Hiring of qualified and skilled fisherfolk	- Fishermen affected by operations - Farmers affected	LGU CSWD MAO	Municipality of Sablayan	Dredging Operations	Private Partner
Agroforestry Project for Farmers and Provision of Vegetable/Rice Seeds and fish fingerlings for ABMS and marine fish cage reserves	- Farmers affected in RDZ - Fisherfolks affected in offshore areas	LGU CSWD/MAO/ FORESTEREPLAN	Municipality of Sablayan	Dredging Operations	Private Partner
Provisions of livestock to affected farmers and subsistence fishers, and creation of cooperatives	- Barangay LGU	LGU CSWD	Municipality of Sablayan	Dredging Operations	CPGI
Gender Responsive Livelihood / Employment and Credit Facilities (Men, Women, Youth & elderly)	Association Chairperson - Qualified Project Affected Men, Women, Youth & Elderly	LGU CSWD	Municipality of Sablayan	Dredging Operations	CPGI
Agricultural and Fishing Hub and Tourism showcasing for subsistence farmers and fishers linked to tourism in the area (e.g., entrepreneurial activities, agroforestry, farm to market platforms, bamboo nursery, bamboo handicraft, peebles and shells, etc.)	- Qualified Project Affected Men, Women, Youth & Elderly - Affected farmers - Affected fisherfolks, subsistence fishers	LGU CSWD Tourism Office	Municipality of Sablayan	Dredging Operations	CPGI
SPIRITUAL					
Assistance to the Church	- Representative from different religious groups	Parish Priest · Religious Sector	Council member for Spirituality/ / CRO	Dredging Operations	Private Partner

Concern	Community Member / Beneficiary	Government Agency/ Non- government Agency and Services	Proponent	Indicative Timeline	Source of Funds
Lingap at Sagip "*Kabataan Program*" for Spiritual Development, Bible Study and Life Group (G12) and Dawn Watch, group activities	- Representative from different religious groups	Parish Priest · Religious Sector, Born Again Christians	Council member for Spirituality/ / CRO	Dredging Operations	Private Partner
ENVIRONMENT AND SANITATION					
Conduct periodic clean-up of Amnay Offshore/adjacent areas (e.g., Coastal Clean-up), River Clean-up, ABMS, Macrophyte installation System (MAIS)	- Brgy. Chairman - Residents of barangays covered.	LGU Barangay Officials and Residents/MENRO	CRO/ FORESTEREPLAN	Throughout project duration	CPGI
Reforestation and Greening Program through planting of endemic tree species at Amnay Riverbanks and adjacent forest, mangroves, installation of CPGI nursery and riverbank community nursery	- Brgy. Chairman - Residents of barangays covered.	LGU Barangay Officials and Residents/MENRO	CRO/ FORESTEREPLAN	Throughout project duration	CPGI
Mangrove Tree Planting (MARTI) and PPRD and Local Biodiversity Research (IEC)	- Brgy. Chairman - Residents of barangays covered.	LGU Barangay Officials and Residents/MENRO	CRO/ FORESTEREPLAN	Throughout project duration	CPGI

5.2 INFORMATION, EDUCATION AND COMMUNICATION FRAMEWORK

In collaboration with LGUs, CPGI has to formulate and implement an IEC Program in order to increase awareness of the Project-affected communities and Farmer-Fisherfolks beneficiaries of the positive benefits of the project and the proposed new model approach of system management.

The IEC Framework for the Project intends to guide the process of shaping public opinion and enabling stakeholders to make informed decisions on the Project. In this manner, IEC aims to contribute in fostering its social acceptability, with the informed understanding of affected people and their proactive relations with CPGI and the Province of Occidental Mindoro in generating and sharing feedback as well as discussing and jointly solving problems as these arise. The information drive should, at the same time, inculcate value formation by making the members of the community aware of their responsibilities as stakeholders.

The IEC Framework will guide the management of CPGI to effectively disseminate crucial information to advise the communities and concerned stakeholders about its plans for environmental protection and the health and safety of its local residents, fishermen, farmers and tourists. The IEC program will focus on the environmental management and monitoring plans, Social Development Plan and other project deliverables to benefit the communities. This will serve as the blueprint on how and when the participating entities would get the correct and educated information about the project and how they can contribute to the realization of the identified environmental plans and programs.

In coordination with the LGU of the Province of Occidental Mindoro, CPGI will establish a desk by which locals can submit their expressions of approval and disapproval on the Project and corresponding suggestions. These views shall be gathered by the CPGI and reviewed together with the LGUs as inputs in later public consultation and participatory planning processes.

The IEC calls for transparency on the part of the company in dealing with the stakeholders on environmental issues which affect them. Community relations will be proactive and social development activities will be institutionalized. The IEC program ensures adequate information is provided to the affected stakeholders using effective education and communication medium. This process shall enable CPGI to get feedbacks from the stakeholders and assess their level of understanding about the project. It further provides an additional venue for the proponent, combined with the MMT, to collate inputs and suggestions from stakeholders. The IEC framework for the project is presented in **Table 5.2.1**.

Central to the IEC plan is what is already outlined in the SDP, a program to provide information to the fishermen where the dredge areas will be at a particular period to as to coordinate the fishing and dredging operations. Likewise, environmental awareness will also be a central topic; people will be empowered to report excessive turbidity at the RDZ and offshore (coasts) to CPGI so that appropriate action can be undertaken.

Table 5.2.1: Proposed IEC Framework

Target Sector	Major topic of concern in relation to the project	IEC Method	Information Medium	Schedule	Source of Fund
Municipality of Sablayan Fishermen and Farmers	Communication procedures with Dredge Ships Safety During Dredging Operations Alternative livelihood opportunities	Seminars Workshop Discussion groups	Audio visual presentations/ handouts	Pre-Dredging and Dredging Phase	P50,000 initially then P100,000 for communication equipment
	ECC compliance report Environmental monitoring (e.g. turbidity)	Seminars/ workshops, meetings	Compliance/ monitoring reports Consultation meetings	Pre-Dredging and Dredging Phase	P25,000 initially then P10,000 per quarter

Target Sector	Major topic of concern in relation to the project	IEC Method	Information Medium	Schedule	Source of Fund
	Monitoring statistics SDP compliance				
Barangay officials, RHUs, barangay health workers, truckers, senior citizens, women and youth sector, leaders of affected barangay	Planned/identified livelihood/environmental programs and other benefits derived from the project Issues and concerns and suggestions to address how to smoothly pursue the implementation phase	Focus group discussions Seminars/ workshops	Reports/ consultation meetings Focus group discussions	Pre-Dredging and Dredging Phase	P10.000/ meeting
	COVID 19 prevention and control.				
LGU of the host barangay LGU of Sablayan DENR and other concerned regulatory agencies Concerned POs/NGOs	Monitoring of the project and its compliance throughout its operational lifespan to completion; Update on Project description & status ▪ EIA findings ▪ Performance against ECC/EMP ▪ Actual Impacts & Measures	Focused Group Discussions, Seminars	Project Report, Presentations	Quarterly and/or as needed	CSR Fund EMF
Professional society and individuals	Continuing consultation	Group Method	Focus Group Discussion Power Point Presentation	Quarterly and/or as needed	CPGI
NGOs., Church, School	Impacts on environment and health	Group Method	Focus Group Discussion Power Point Presentation	Quarterly and/or as needed	CPGI

5.3 GRIEVANCE REDRESS MECHANISM

There are different mechanisms through which CPGI will handle complaints and grievances and feedback management, namely:

1. Multipartite Monitoring Team (MMT) - Besides environment monitoring, the team will also be tasked to receive and verify complaints from stakeholders against the plant and its operations;

2. Formation of Grievance Redress Mechanism (GRM) Procedure. - This will manage the grievances from the stakeholders to minimize the social risks to the business. The grievance processes will provide an avenue for stakeholders to voice their concerns and give transparency on how grievances will be managed internally to reduce conflict and strengthen relationships between external stakeholders. Various channels for external stakeholders to vocalize their grievances may be through telephone, e-mail, personal appearance, and accomplishment of grievance form among others.

The GRM Procedure will serve as a process for receiving stakeholders' concerns, and the actions to address the concerns, without denying the stakeholder the right to seek other avenues for resolution.

The CPGI will establish such a procedure for following objectives:

- Receive and facilitate the resolution of project stakeholders' concerns and grievances about environment-related project impacts which cannot be settled during public consultations, paying particular attention to the impacts on vulnerable groups;
- Measure to the risks and adverse impacts of the project; and
- Address project stakeholders' concerns and complaints promptly, using an understandable and transparent process that is gender responsive, culturally appropriate, and readily accessible to the country's judicial or administrative remedies.

The GRM is composed of four (4) levels The Grievance officer of CPGI will be the contact point for receiving the grievances/complaints from the stakeholders.

Table 5.3.1: Levels of Grievance Redress Mechanism

Contact Point	Environmental Issue	Health and Safety Issue	Timeline
	Grievance Officer of CPGI		Same day
1st Level	Health, Safety and Environment Officer		3 days
2nd Level	Health, Safety and Environment Committee		10 days
3rd Level	Multipartite Monitoring Team (MMT)	CPGI Management Level	15 days
4th Level	DENR - EMB	Court of Justice	

As part of the basic policies for the GRM, a grievance will be resolved in a timely manner at the lowest level possible. However, (a) if not settled at the lowest level, (b) if the aggrieved stakeholders are not satisfied with the action taken, or (c) the case is not acted upon after 15 days, the issue or concern will be taken to the next level.

The DENR and the Court of Justice will be the final decision maker for the complaint and grievance. All cases elevated to the 4th level will be outside the jurisdiction and control of this GRM.

The guidelines for GRM are as follows:

- All complaints received in writing, verbally or transmitted electronically will be documented and filed. Upon receiving a complaint from the aggrieved stakeholder, the Grievance officer will accomplish the Grievance Action Form (GAF).
- Aggrieved stakeholder will not be charged of any fees (administrative and legal fees) in filing of their grievance.
- The GAF will be stamped with a "Received" mark with corresponding control number, date of receipt and signature of the persons who received the said letter.
- Actions and decisions made with the received complaints/grievances/appeals by the HSEC, MMT and EMB-DENR will be reported and discussed by the Grievance Officer during regular meetings.
- If the grievance indicated in the letter cannot be readily addressed, the aggrieved stakeholder will be referred to the appropriate authority. The following will be indicated in the GAF: name of the authority to look for, date when the aggrieved stakeholder can meet with the said authority, and the venue for the meeting.
- In addition, the Grievance Officer of CPGI will publicize the grievance redress process in the form of handouts such as pamphlets, brochures or leaflets that are written in Filipino. All concerned institutions, including Barangay, LGUs, and the CPGI, will use the same handouts in explaining the grievance redress procedures to the aggrieved stakeholder who will come to them to raise their issue or concern. The handout will be disseminated through LGUs and Barangay as well as CPGI. The mechanism to be publicized at the website of CPGI and LGUs.

6 ENVIRONMENTAL COMPLIANCE MONITORING PLAN

6.1 SELF-MONITORING PLAN

CPGI will conduct and commit detailed and transparent self-monitoring activity of its environmental operations and will regularly submit a Self-Monitoring Report (SMR) to the DENR. An initial Environmental Monitoring Plan (EMoP) is presented in **Table 6.1.1**. This EMoP follows Annex 2-20 of the DAO 2003-30. The plan is largely indicative and will be refined during project implementation.

CPGI will monitor the overall dredging operation. CPGI will commission a third-party testing firm to conduct monitoring activities. Together with its technical and environmental partner and arm, FORESTEREPLAN, CPGI is committed to reduce impacts and mitigate, ameliorate levels of impacts and reduce deterioration of affected environmental component to pre-impact or optimum environmental quality. CPGI will submit a SMR which includes detailed report on compliance to environmental standard specific to environmental laws to EMB-Region 4B on a quarterly basis. CPGI will also submit a Compliance Monitoring Report (CMR) semi-annually to EMB- Region 4B. The CMR will include percentage exceedance to standard in terms of pollution and permit violations, if any.

Annex 6-1 presents the Project Environmental Monitoring and Audit Prioritization Scheme (PEMAPS).

Table 6.1.1: Environmental Monitoring Plan for the Proposed ARRD Project.

Key Environmental Aspects per Project Phase	Environmental Component	Potential Impacts	Sampling & Measurement Plan				Lead Entity	Estimated Cost (PhP)	EQPL Management Scheme					
									EQPL Range			ManagementMeasure		
			Parameter	Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
Pre-Construction/Construction Phase														
Potential disturbance of water ecology during the geotechnical survey of the riverbed; mitigation is done by avoidance through appropriate selection of test sites. Impact is deemed not applicable though as pre-construction phase are essentially completed.														
CONSTRUCTION PHASE														
	LAND													
▪ Mobilization of dredging equipment and materials ▪ Construction of support workers accommodation	Pedology	Fuel spills/ Leakage	Occurrence of Leak	Visual inspection	Weekly; Daily at source of leak upon Action and limit levels		CPGI, Contractor & MMT	NA	Visible oil spill in the site, Spill Vol.: <1L	Visible oil, leak persists after cleanup; Spill Vol.: 1L to <100L	Visible oil, leak persists after clean-up; Vol.: >100L	Conduct investigation regarding the reason of the leak. Visual check of the oil tanks.	Conduct of leak test in the ship. Inspection of the tanks for the area where leakage occur. Disposal of any contaminated soil	Conduct of leak test. Do not use the ship unless the damage is fixed. Report the incident to the EMB Region 4B.
	WATER													
▪ Mobilization of dredging equipment and materials ▪ Construction of support workers accommodation ▪ Generation of domestic waste	Freshwater quality	Degradation of Freshwater quality	Color, TCU	Grab sampling PNSDW Standard DENR Groundwater Quality Guidelines	Quarterly Monthly** (TSS)	(As described in the EISR) * Additional sampling stations would be done: MW-4 MW-5 MW-6 MW-7 MW-8 MW-9 MW-10	CPGI, Contractor & MMT	500,000 per sampling	7	8	10	Review baseline conditions, which can confirm exceedances otherwise conduct investigation in the affected stations wherein exceedances occurred including external factors.	Review baseline conditions, which can confirm exceedances otherwise conduct investigation in the affected stations wherein exceedances occurred including external factors. Conduct retesting to verify exceedances. If exceedances are caused by the plant, check and correct the process: - ensure waste disposal areas are not near water bodies; - require no spillage or discharge of wastewater from supply vessels (ships)	Review baseline conditions, which can confirm exceedances otherwise hire a 3rd party environmental firm to conduct investigation in the area. If proven that the causes of exceedances are from CPGI, activities from the area of concern will be stopped until cause of the exceedances is fixed. If not, coordinate with the LGU, MMT and the
			Temperature											
			pH											
			BOD, mg/L											
			Surfactant, mg/L						1.4	1.6	2.0			
			TSS, mg/L						4.29*	4.48	4.68			
			O&G, mg/L						-	-	-			
			Fecal Coliform, MPN/100mL						-	-	-			
			Total Coliform, MPN/100mL						0.77	0.88	1.1			

Key Environmental Aspects per Project Phase	Environmental Component	Potential Impacts	Sampling & Measurement Plan: Parameter	Method	Frequency	Location	Lead Entity	Estimated Cost (PhP)	EQPL Management Scheme: EQPL Range: Alert	Action	Limit	ManagementMeasure: Alert	Action	Limit
														DENR for correction
	Marine Water Quality	Degradation of marine water quality	Color, TCU	Grab sampling DAO 2016-08	Quarterly Monthly** (TSS)	(As described in the EISR)	CPGI, Contractor & MMT	700,000 per sampling	52.5	60	75	Review baseline conditions, which can confirm exceedances otherwise conduct investigation in the affected stations wherein exceedances occurred including external factors.	Review baseline conditions, which can confirm exceedances otherwise conduct investigation in the affected stations wherein exceedances occurred including external factors. Conduct retesting to verify exceedances. If exceedances are caused by the plant, check and correct the process: - ensure waste disposal areas are not near water bodies; - require no spillage or discharge of wastewater from supply vessels (ships)	Review baseline conditions, which can confirm exceedances otherwise hire a 3rd party environmental firm to conduct investigation in the area. If proven that the causes of exceedances are from CPGI, activities from the area of concern will be stopped until cause of the exceedances is fixed. If not, coordinate with the LGU, MMT and the DENR for correction
			Temperature											
			pH											
			Surfactant, mg/L						1.05	1.2	1.5			
			BOD, mg/L						-	-	-			
			TSS, mg/L						56	64	80			
			O&G, mg/L						2.1	2.4	3.0			
			Fecal Coliform, MPN/100mL						140	160	200			
			Total Coliform, MPN/100mL						-	-	-			
	Marine Ecology	Decrease in abundances and change in composition of marine biota Sediments, soft bottom fauna, etc.	Benthic life forms, softbottom communities Monitoring of substrate and others	Plankton Net Sampling Grab sampling Grab sampling	Semi-Annually	PS-1 PS-2 PS-3 PS-4 (As described in the EISR) *Additional sampling stations would be	CPGI, Contractor & MMT	1,500,000 per sampling	15% difference from baseline data	20% difference from baseline data	25% difference from baseline data	Conduct Investigation in the area particularly where species are known to decrease.	Conduct Investigation in the area particularly where species are known to decrease – whether there is illegal fishing, etc. Determine possible sources of disturbance or distractions to the species of concern. Intensify surveillance and security in the area through coordination with the	Hire a 3rd party environmental firm to conduct investigation in the area. If the results of the investigation show that the Project is the cause of the decrease in the number of species, the section which caused the said activity will be

Key Environmental Aspects per Project Phase	Environmental Component	Potential Impacts	Sampling & Measurement Plan				Lead Entity	Estimated Cost (PhP)	EQPL Management Scheme					
			Parameter	Method	Frequency	Location			EQPL Range			ManagementMeasure		
									Alert	Action	Limit	Alert	Action	Limit
						done (see map) SDS-1 SDS-2 SDS-3 SDS-4 SDS-5							concerned agencies such as the navy or bantay-dagat.	temporarily stopped unless the issue is resolved.
	AIR													
▪ Mobilization of dredging equipment and materials ▪ Construction of support workers accommodation	Noise level and Air Quality	Increase in noise level	Noise Level (dBA) and Air Quality Sampling	Portable Noise Level Meter Air Quality Test	Once a month (Morning, daytime, evening and nighttime) Quarterly Reporting to DENR	BNL-1 – Barangay Claudio Salgado BNL 2 – Barangay Ilvita	CPGI, Contractor & MMT	1,500,000 per sampling (including noise levels)	Daytime-40 Morning/Evening-35 Nighttime-30 Daytime-40 Morning/Evening-35 Nighttime-30	Daytime-45 Morning/Evening-40 Nighttime-35 Daytime-45 Morning/Evening-40 Nighttime-35	Daytime-50 Morning/ Evening-45 Nighttime-40 Daytime-50 Morning/ Evening-45 Nighttime-40	Conduct survey at sampling stations to verify complaints. Check the sound level using sound meter. Determine possible causes.	Conduct retesting to validate the complaint/ If source of noise is from the Project, inform the Unit head in-charge to provide noise mitigation measures. Conduct noise monitoring to verify the limits are already within limits. If source of noise is not from the Project, inform the MMT regarding possible source of noise for the group's investigation and coordination with LGU.	Conduct noise sampling with the presence of the DENR or a 3rd party environmental firm. Inform the operations or the area owner to stop activity unless noise mitigation measures have been installed or the source of noise has been corrected. Upon installation of noise mitigation measures, conduct noise monitoring to verify if the noise level is already within limits.
	PEOPLE													
Hiring of workers in relation to in-migration	Local residents	Increase in local employment Increase income for residents	Composition of workforce	Semi-annually		NA	CPGI, Contractor & MMT	NA	60% of the employee are local residents (based on the skills and capacity)	55% of the employees are local residents (based on the skills and capacity)	50 % of the employees are local residents (based on the skills and capacity)	Increase employability of local residents by undertaking construction skills training prior to job hiring	Investigation of the reasons for not meeting the % local resident employment	Review employment memos, etc.
	Employment	No. of Programs implemente	No. of employees	Hiring process	Every hiring period	Sablayan	HR and Personnel Department	Part of project cost	70% implementation of	60% implementation of	50% implementation of	Revise program	Revise program	Enhance program implementation

Key Environmental Aspects per Project Phase	Environmental Component	Potential Impacts	Sampling & Measurement Plan				Lead Entity	Estimated Cost (PhP)	EQPL Management Scheme					
			Parameter	Method	Frequency	Location			EQPL Range			ManagementMeasure		
									Alert	Action	Limit	Alert	Action	Limit
		d and hired individuals					of CPGI		employment program	employment program	employment program			
Subsistence fishers and local fishermen	Alternative employment, livelihood and source of income opportunities	Number of compensate local fishers of all types (e.g., fishing lines, hook and lines, gills, nets, grabs, etc).	Number of affected/impacted local fishers of all types (e.g., fishing lines, hook and lines, gills, nets, grabs, etc).	Surveys, Hiring process, beneficiary programs, livelihood projects (e.g., provision of baklads)	Monthly and fishing season	Sablayan	SDMP, EMU, Technical Partner, and COMREL Department of CPGI	Part of project cost	70% implementation of beneficiary and livelihood program grantees/impacted fishers of all types	60% implementation of beneficiary and livelihood program grantees/impacted fishers of all types	50% implementation of beneficiary and livelihood program grantees/impacted fishers of all types	Revise program	Revise program	Enhance program implementation and validation of beneficiary list and community meetings with impacted fishers of all types
OPERATION PHASE														
	WATER													
▪ Dredging operation ▪ Generation of domestic waste	Freshwater quality	Degradation of Freshwater quality	Color, TCU	Grab sampling PNSDW Standard DENR Groundwater Quality Guidelines	Quarterly Monthly** (TSS)	HW-2 and HW-1 (As described in the EISR)	CPGI, Contractor & MMT	500,000 per sampling	7	8	10	Review baseline conditions, which can confirm exceedances otherwise conduct investigation in the affected stations wherein exceedances occurred including external factors.	Review baseline conditions, which can confirm exceedances otherwise conduct investigation in the affected stations wherein exceedances occurred including external factors. Conduct retesting to verify exceedances. If exceedances are caused by the plant, check and correct the process: - ensure waste disposal areas are not near water bodies; require no spillage or discharge of wastewater from supply vessels (ships)	Review baseline conditions, which can confirm exceedances otherwise hire a 3rd party environmental firm to conduct investigation in the area. If proven that the causes of exceedances are from CPGI, activities from the area of concern will be stopped until cause of the exceedances is fixed. If not, coordinate with the LGU, MMT and the DENR for correction
			Temperature											
			pH											
			BOD, mg/L											
			Surfactant, mg/L						1.4	1.6	2.0			
			TSS, mg/L						4.29*	4.48	4.68			
			O&G, mg/L						-	-	-			
			Fecal Coliform, MPN/100mL						-	-	-			
			Total Coliform, MPN/100mL						0.77	0.88	1.1			

Key Environmental Aspects per Project Phase	Environmental Component	Potential Impacts	Sampling & Measurement Plan				Lead Entity	Estimated Cost (PhP)	EQPL Management Scheme					
									EQPL Range			ManagementMeasure		
			Parameter	Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
	Marine Water Quality	Degradation of marine water quality	Color, TCU	Grab sampling DAO 2016-08	Quarterly Monthly** (TSS)	MW-1 MW-2 MW-3 (As described in the EISR)	CPGI, Contractor & MMT	800,000 per sampling	52.5	60	75	Review baseline conditions, which can confirm exceedances otherwise conduct investigation in the affected stations wherein exceedances occurred including external factors.	Review baseline conditions, which can confirm exceedances otherwise conduct investigation in the affected stations wherein exceedances occurred including external factors. Conduct retesting to verify exceedances. If exceedances are caused by the plant, check and correct the process: - ensure waste disposal areas are not near water bodies; require no spillage or discharge of wastewater from supply vessels (ships)	Review baseline conditions, which can confirm exceedances otherwise hire a 3rd party environmental firm to conduct investigation in the area. If proven that the causes of exceedances are from CPGI, activities from the area of concern will be stopped until cause of the exceedances is fixed. If not, coordinate with the LGU, MMT and the DENR for correction
			Temperature											
			pH											
			BOD, mg/L						-	-	-			
			Surfactant, mg/L						1.05	1.2	1.5			
			TSS, mg/L						56	64	80			
			O&G, mg/L						2.1	2.4	3.0			
			Fecal Coliform, MPN/100mL						140	160	200			
			Total Coliform, MPN/100mL						-	-	-			
▪ Dredging operation ▪ Generation of domestic waste	Marine Ecology	Decrease in abundances and change in composition of marine biota	Benthic life forms, softbottom communities	Plankton Net Sampling Grab sampling	Semi-Annually	MW-1 MW-2 MW-3 MW-4 (As described in the EISR)	CPGI, Contractor & MMT	1,500,000 per sampling	15% difference from baseline data	20% difference from baseline data	25% difference from baseline data	Conduct Investigation in the area particularly where species are known to decrease.	Conduct Investigation in the area particularly where species are known to decrease – whether there is illegal fishing, etc. Determine possible sources of disturbance or distractions to the species of concern. Intensify surveillance and security in the area through coordination with the concerned agencies such as the	Hire a 3rd party environmental firm to conduct investigation in the area. If the results of the investigation show that the Project is the cause of the decrease in the number of species, the section which caused the said activity will be temporarily stopped unless the

Key Environmental Aspects per Project Phase	Environmental Component	Potential Impacts	Sampling & Measurement Plan				Lead Entity	Estimated Cost (PhP)	EQPL Management Scheme					
			Parameter	Method	Frequency	Location			EQPL Range			ManagementMeasure		
									Alert	Action	Limit	Alert	Action	Limit
													navy or bantay-dagat.	issue is resolved.
OPERATION PHASE														
	AIR													
▪ Use of emergency generators, diesel powered equipment for power supply	Noise level	Increase in noise level	Noise Level (dBA)	Portable Noise Level Meter	Once a month (Morning, daytime, evening and nighttime) Quarterly Reporting to DENR	BNL-1 – Barangay Claudio Salgado BNL 2 – Barangay Ilvita	CPGI, Contractor & MMT	500,000 per sampling (including noise levels)	Daytime-40 Morning/Evening-35 Nighttime-30	Daytime-45 Morning/Evening-40 Nighttime-35	Daytime-50 Morning/ Evening-45 Nighttime-40	Conduct survey at sampling stations to verify complaints. Check the sound level using sound meter. Determine possible causes.	If source of noise is from the proposed Project, inform the Plant Manager to provide noise mitigation measures. Conduct noise monitoring to verify the limits are already within limits. If source of noise is not from the Project, inform the MMT regarding possible source of noise for the group's investigation and coordination with LGU.	Conduct noise sampling with the presence of the DENR or a 3rd party environmental firm. Inform the operations or the area owner to stop activity unless noise mitigation measures have been installed or the source of noise has been corrected. Upon installation of noise mitigation measures, conduct noise monitoring to verify if the noise level is already within limits.
OPERATION PHASE														
	PEOPLE													
▪ River Restoration and Desilting	Local residents	Increase in local employment Increase income for residents	Composition of workforce	Semi-annually		NA	CPGI, Contractor & MMT	NA	60% of the employee are local residents (based on the skills and capacity)	55% of the employees are local residents (based on the skills and capacity)	50 % of the employees are local residents (based on the skills and capacity)	Increase employability of local residents by undertaking construction skills training prior to job hiring	Investigation of the reasons for not meeting the % local resident employment	Review employment memos, etc.
	Develop Local residents' Skills Training	Training completion rate		Annual	NA	CPGI and EMT	NA		50% of trainees did not compete the skills training	60% of trainees did not complete the skills training	70% of trainees did not complete the skills training	Conduct investigation regarding the turn out of the training activity	Conduct perception survey and do research of what is the preferred skills training of the stakeholders	Hire 3rd party experts to conduct investigation and do some assessment regarding the effective skills training for a

Key Environmental Aspects per Project Phase	Environmental Component	Potential Impacts	Sampling & Measurement Plan				Lead Entity	Estimated Cost (PhP)	EQPL Management Scheme					
									EQPL Range			ManagementMeasure		
			Parameter	Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
														certain group of people. Intensify the IEC.
		Workers, Safety	Safe person hours, injury, near miss and other safety performance indices	Incident reporting, surveys, included in the Health and Safety Plan of CPGI	Monthly report, act immediately on occurrence of accident	Project Site	CPGI and MMT	Part of Operational Cost	1 accident per year	1 accident per semi-annual	1 Accident per quarter	Safety retraining for workers involved in accident	Conduct departmental retraining of the workers on health safety rules and regulation Inspect the area wherein most accidents happen.	Inspect the area wherein most accidents happen. Conduct monitoring. Hire a 3rd party safety practitioner to conduct safety audit in the plant site.
		Health risks and safety of workers	Record of Illness and records/detection of COVID-19	Review of medical records	Monthly	Project Site	CPGI	Part of Operational Cost	10% of workers ill	20% workers are ill	30% of workers are ill	Assess if illness is work-related; interview sick employees	Implement site-wide investigation of cause IEC campaign for illness prevention Sanitation, disinfection and compliance to IATF and DOH Protocols for COVID-19 prevention and control	Implement sitewide investigation of cause, isolate cases and prevent spread of illness and virus; IEC campaign for illness prevention
		Increased social acceptability for the proposed ARRD Project	Question on approval/ disapproval for the proposed Project and reason	Follow-up survey	Annually for 5 years and every 5 years thereafter	LGU & concerned barangay	CPGI and MMT	500,000.00	50% says that project is unacceptable/degrading the environment	60% says that project is unacceptable/degrading the environment	70% says that project is unacceptable/degrading the environment	Dialogue with the local stakeholders to check their stand on the issues to properly	Intensify IEC and community relations.	Hire a 3rd party firm to conduct investigation in the area.
ABANDONMENT PHASE														
	WATER													
▪ Demobilization of dredging equipment and materials	Freshwater quality	Degradation of Freshwater quality	Color, TCU Temperature pH BOD, mg/L Surfactant, mg/L TSS, mg/L O&G, mg/L Fecal Coliform, MPN/100mL	Grab sampling PNSDW Standard DENR Groundwater Quality Guidelines Grab sampling PNSDW	Quarterly Quarterly	HW-2 and HW-1 (As described in the EISR) HW-2 and HW-	CPGI, Contractor & MMT CPGI, Contractor & MMT	500,000 per sampling 500,000 per sampling	7 1.4 4.29* - -	8 1.6 4.48 - -	10 2.0 4.68 - -	Review baseline conditions, which can confirm exceedances otherwise conduct investigation	Review baseline conditions, which can confirm exceedances otherwise conduct investigation in the affected stations wherein exceedances occurred including external factors.	Review baseline conditions, which can confirm exceedances otherwise hire a 3rd party environmental firm

Key Environmental Aspects per Project Phase	Environmental Component	Potential Impacts	Sampling & Measurement Plan				Lead Entity	Estimated Cost (PhP)	EQPL Management Scheme					
			Parameter	Method	Frequency	Location			EQPL Range			ManagementMeasure		
									Alert	Action	Limit	Alert	Action	Limit
			Total Coliform, MPN/100mL	Standard DENR Groundwater Quality Guidelines		1 (As described in the EISR)			0.77	0.88	1.1	in the affected stations wherein exceedances occurred including external factors.	Conduct retesting to verify exceedances. If exceedances are caused by the plant, check and correct the process: - ensure waste disposal areas are not near water bodies; - require no spillage or discharge of wastewater from supply vessels (ships)	to conduct investigation in the area. If proven that the causes of exceedances are from CPGI, activities from the area of concern will be stopped until cause of the exceedances is fixed. If not, coordinate with the LGU, MMT and the DENR for correction
▪ Demobilization of dredging equipment and materials	Marine Water Quality	Degradation of marine water quality	Color, TCU	Grab sampling	Quarterly	MW-1 MW-2 MW-3 (As described in the EISR)	CPGI, Contractor & MMT	800,000 per sampling	52.5	60	75	Review baseline conditions, which can confirm exceedances otherwise conduct investigation in the affected stations wherein exceedances occurred including external factors.	Review baseline conditions, which can confirm exceedances otherwise conduct investigation in the affected stations wherein exceedances occurred including external factors. Conduct retesting to verify exceedances. If exceedances are caused by the plant, check and correct the process: - ensure waste disposal areas are not near water bodies; require no spillage or discharge of wastewater from supply vessels (ships)	Review baseline conditions, which can confirm exceedances otherwise hire a 3rd party environmental firm to conduct investigation in the area. If proven that the causes of exceedances are from CPGI, activities from the area of concern will be stopped until cause of the exceedances is fixed.
			Temperature		Quarterly									
			pH	DAO 2016-08										
			BOD, mg/L	Grab sampling			CPGI, Contractor & MMT	800,000 per sampling	-	-	-			
			Surfactant, mg/L						1.05	1.2	1.5			
			TSS, mg/L	DAO 2016-08					56	64	80			
			O&G, mg/L						2.1	2.4	3.0			
			Fecal Coliform, MPN/100mL			MW-1 MW-2 MW-3 (As described in the EISR)			140	160	200			
			Total Coliform, MPN/100mL						-	-	-			

Key Environmental Aspects per Project Phase	Environmental Component	Potential Impacts	Sampling & Measurement Plan				Lead Entity	Estimated Cost (PhP)	EQPL Management Scheme					
									EQPL Range			ManagementMeasure		
			Parameter	Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
														If not, coordinate with the LGU, MMT and the DENR for correction
ABANDONMENT PHASE														
	AIR													
▪ Demobilization of dredging equipment and materials	Noise level	Increase in noise level	Noise Level (dBA)	Portable Noise Level Meter	Once a month (Morning, daytime, evening and nighttime) Quarterly Reporting to DENR	BNL-1 – Barangay Claudio Salgado BNL 2 – Barangay Ilvita	CPGI, Contractor & MMT	500,000 per sampling (including noise levels)	Daytime-40 Morning/Evening-35 Nighttime-30	Daytime-45 Morning/Evening-40 Nighttime-35	Daytime-50 Morning/ Evening-45 Nighttime-40	Conduct survey at sampling stations to verify complaints. Check the sound level using sound meter. Determine possible causes.	If source of noise is from the proposed Project, inform the Plant Manager to provide noise mitigation measures. Conduct noise monitoring to verify the limits are already within limits. If source of noise is not from the Project, inform the MMT regarding possible source of noise for the group's investigation and coordination with LGU.	Conduct noise sampling with the presence of the DENR or a 3rd party environmental firm. Inform the operations or the area owner to stop activity unless noise mitigation measures have been installed or the source of noise has been corrected. Upon installation of noise mitigation measures, conduct noise monitoring to verify if the noise level is already within limits.

6.2 MULTI-SECTORAL MONITORING FRAMEWORK

Pursuant and in compliance to Sections 174 and 185 of DENR Administrative Order No. 2010-21 (DAO 2010-21), the Revised Implementing Rules and Regulations of Republic Act No. 7942 (RA 7942), otherwise known as the "Philippine Mining Act of 1995", Multi-Partite Monitoring Team (MMT) shall be formed. The MMT is tasked to monitor the compliance of the project as stated in the ECC conditions, EMP and other related policy. Moreover, DAO 2017-15 also states that the vigilance of the public especially stakeholders living or working near the project site shall be used as tool in effectively monitoring and managing environmental impacts of projects. The MMT will be the monitoring arm of the Mine Rehabilitation Fund Committee (MRFC). The head of the MMT shall submit to the MRFC, at least five (5) working days before the scheduled regular meetings of the MRFC, a report on the status and/or result of its monitoring activities on the performance of and compliance with the approved EPEP/AEPEP.

Major functions of the MMT include the following:

- Monitor project compliance with the conditions stipulated in the ECC and the EMP;
- Validate proponent's conduct of self-monitoring;
- Receive complaints; gather relevant information to facilitate determination of validity of complaints or concerns about the project and timely transmit to the proponent and EMB the recommended measures to address the complaint;
- Prepare, integrate and disseminate simplified monitoring reports to community stakeholders; and
- Make regular and timely submission of MMT Report based on EMB-prescribed format.

The operation of the MMT for this project will be consistent with the provisions for MMT under DAO 2017-15. **Table 6.2.1** shows the composition of the MMT.

Table 6.2.1: Possible Members of the MMT

<table>
<tr><th>Office/Agencies/Organization</th><th>Responsibilities</th></tr>
<tr><td>LGU of Sablayan</td><td rowspan="3">▪ Shall participate in actual monitoring work, prepare or concur with and sign the MMT monitoring reports.
▪ Shall provide necessary information about local policies, plans and programs affecting MMT monitoring results and standards.
▪ Shall advise the MMT of any complaints, information or reports from LGUs concerning the project.</td></tr>
<tr><td>LGU of Barangay Claudio Salgado</td></tr>
<tr><td>Municipal Planning and Development Office</td></tr>
<tr><td>EMB-DENR</td><td>▪ Shall lead the MMT as Chair, supervise the MMT Activities and provide guidance to the project</td></tr>
<tr><td>Department of Public Works and Highways (DWPH)</td><td>▪ Shall participate in actual monitoring work, prepare or concur with and sign the MMT monitoring reports.
▪ Shall provide necessary information such as update regarding the perceptible impact of the project on the sector/concern being represented.</td></tr>
<tr><td>Representative from the Local NGO/PO/Civil Society/Church as Member</td><td>▪ Shall participate in actual monitoring work, prepare or concur with and sign the MMT monitoring reports.
▪ Shall provide necessary information such as update regarding the perceptible impact of the project on the sector/concern being represented.</td></tr>
<tr><td>Fisherfolks and Farmers</td><td>Member</td></tr>
<tr><td>Representative of the Contractor/Permittee</td><td>Member</td></tr>
<tr><td>Representative from the EIA Technical Partner</td><td>▪ Shall participate in actual monitoring work, prepare or concur with and sign the MMT monitoring reports.
▪ Shall provide necessary information such as update regarding the perceptible impact of the project on the sector/concern monitored.</td></tr>
</table>

CPGI shall establish the MMT in accordance with the MMT Guideline as set forth by the DENR. An MMT member can be suspended or removed based on the set guideline. Grounds for removal or suspension can be upon conviction of the culpable violation of the code of ethics, negligence of duty, excessive absences, cessation of representation (i.e., resignation from the sector/institution being represented in the MMT), grave misconduct, etc. The MOA to be signed by the CPGI and the LGU will be followed relative to replacement and proper turnover of the MMT responsibilities.

6.3 IMPLEMENTATION OF ENVIRONMENTAL GUARANTEE FUND COMMITMENT

For resource extractive projects where the proposed ARRD Project of CPGI falls, a financial mechanism called Contingent Liability and Rehabilitation Fund (CLRF) is established in lieu of the EGF. The CLRF is an environmental guarantee fund mechanism that ensures the just and timely compensation for damages and progressive and suitable rehabilitation for any adverse effect a dredging operation or activity may cause. This fund is further broken down as follows:

- Mine Rehabilitation Fund (MRF) which is divided into Rehabilitation Cash Fund (RCF) and Monitoring Trust Fund (MTF);
- Mine Waste Tailings Reserve Fund (MWTRF); and
- Final Mine Rehabilitation and Decommissioning Fund (FMRDF).

CPGI will commit an RCF of Five Million Pesos (Php 5,000,000.00) to comply with the regulation under Consolidated DENR Administrative Order (CDAO) No. 2010-21 which stated that *"The RCF shall be equivalent to ten percent (10%) of the approved total amount needed to implement the Environmental Protection and Enhancement Program (EPEP) or Five Million Pesos (Php 5,000,000.00) whichever is lesser."*

The MTF shall be in cash and in an amount to be determined by the MRF Committee which shall not be less than the amount of One Hundred Fifty Thousand Pesos (PhP150,000.00) to cover maintenance and other operating budget for the transportation and travel expenses, cost of laboratory analysis, cost of supplies and materials, cost of communication services, cost of consultancy work and other reasonable expenses incurred by the monitoring team: Provided, that the Secretary shall be authorized to increase the said amount when national interest and public welfare so require, upon the recommendation of the Director. The Contractor/Permit Holder shall notify the Chair or the Co-Chair of the MRF Committee of its compliance with the deposit requirement through a certification from the bank.

For the FMRDF, the amount to be deposited will be compliant with the required minimum amount under CDAO No. 2010-21 to ensure that the full cost of the approved FMR/DP is accrued before the end of the operating life of the proposed ARRD Project. The FMRDF shall be deposited as a trust fund in a Government depository bank and shall be used solely for the implementation of the approved FMR/DP.

7 ABANDONMENT/ DECOMMISSIONING/ REHABILITATION POLICIES AND GENERIC GUIDELINES

In the unlikely event that the ARRD Project becomes uneconomically viable or if by force majeure or acts of God, the ARRD Project will have to be terminated. A detailed abandonment plan shall be developed prior to the closure of the Project and within the timeframe that will be specified in the ECC. The Abandonment and Decommissioning Plan will be prepared in accordance to DENR requirements and shall address the following:

- Proposed abandonment/decommissioning measures for all auxiliary facilities constructed as part of the ARRD Project.
- Removal of the existing hazardous and non-hazardous waste, if any;
- Site restoration through installation of forest tree nurseries for greening, reforestation, rehabilitation with appropriate tree species, stabilization through vegetative cover as planned and designed by CPGI Technical partner.
- Cost associated with the proposed abandonment/decommissioning activities and source of funds for the implementation of the activities; and
- Conformance to the requirements of the company, the local government, the DENR and other relevant agencies.

The plan will be submitted to the DENR for review and approval prior to the commencement of abandonment/decommissioning activities. CPGI Staff/Workers will be informed six (6) months prior to abandonment of the Project.

8 INSTITUTIONAL PLAN FOR EMP IMPLEMENTATION

8.1 ORGANIZATIONAL STRUCTURE OF CPGI

The institutional organization of the CPGI as shown **Figure 8.1.1** contains people with their assigned responsibilities that require interaction between CPGI, different departments. The objective of this organization is to achieve the following:

- Economical and safety operations and maintenance of the project's components;
- Implementation of company policies;
- Environmental compliance and sustainability; and
- Promotion and enhancement of the social acceptability of the project.

The institutional organization will involve CPGI's top level management, since this group is responsible for providing the corporate direction and policies of the company. The policies shall then be disseminated to department heads and managers for implementation of the company personnel, including those who will be working on the operations of the project.

CPGI will also establish a partnership with relevant government agencies, various stakeholders and local host communities in relation to the project. This partnership is necessary to maintain a transparent and positive relationship for the proposed Project and its stakeholders, as well as to ensure that the environmental protection and enhancement measures are complied with. The stakeholders of the project will be identified as the following:

- Municipality of Sablayan
- Residents and community organizations that will be affected by the proposed project;
- Chamber of Commerce;
- Various industry organizations;
- Local peace-and-order councils (i.e., Philippine National Police, Coast Guard, Barangay Police); and
- Other concerned non-government organizations.

CPGI commits to:

- Comply with the conditions that will be stipulated in the ECC and other related environmental laws;
- Foster mutually beneficial partnership and cooperation with host communities;
- Promote sustainable use and responsible development of resources by adopting appropriate technologies;
- Develop livelihood programs and upgrade skills of host communities to contribute and enhance the quality of life; and
- Develop training programs for its employees which will ensure that they will be continually prepared for the tasks assigned to them.

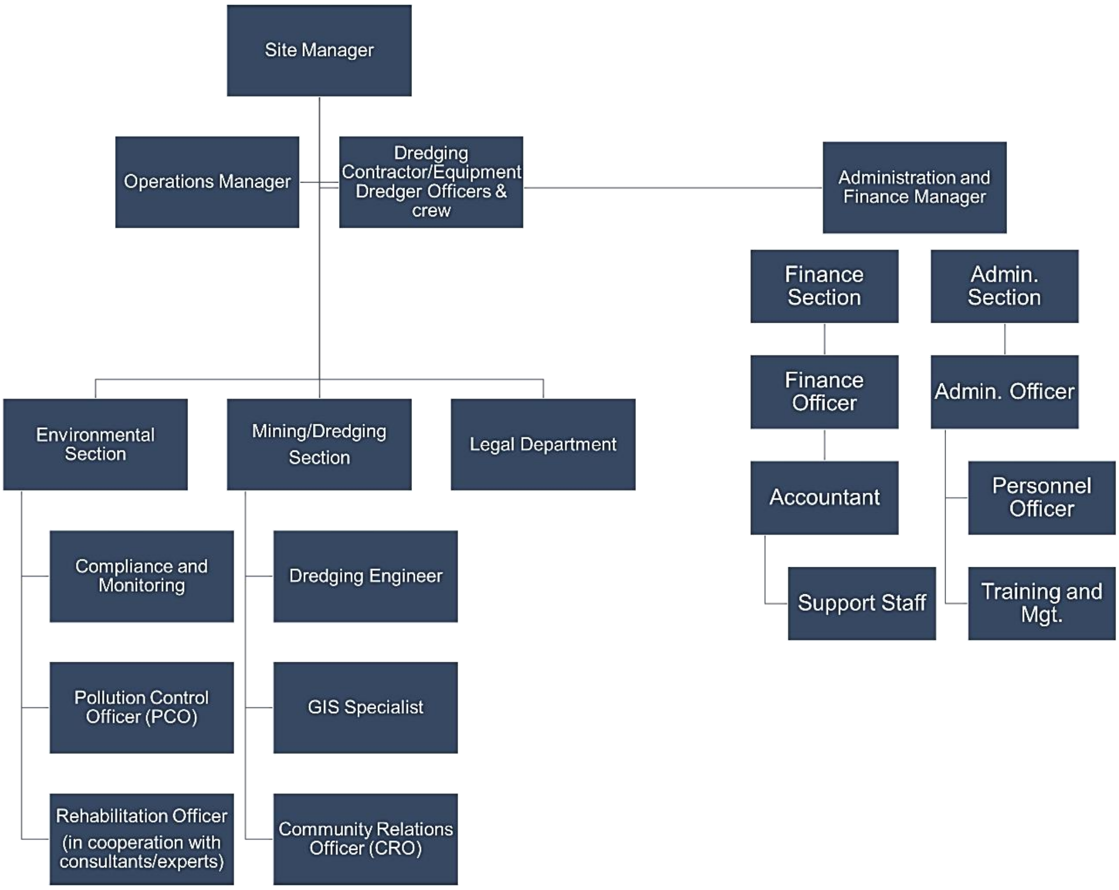


Figure 8.1.1: Organizational Structure of CPGI

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