

ENVIRONMENTAL IMPACT STATEMENT

Scrap Recycling Steel Mill Project

Sitio Kirahon, Barangay San Martin, Villanueva, Misamis Oriental



Prepared for:



Prepared by:



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EXECUTIVE SUMMARY

I. PROJECT FACT SHEET

Project Name	Proposed Scrap Recycling Steel Mill Project
Project Location	Barangay San Martin, Villanueva, Misamis Oriental
Project Area	248,035 m ²
Project Type	Steel Manufacturing
Project Capacity	500,000 MTPY Rebar 500,000 MTPY Scrap Recycling Plant
Project Description	The proposed project will be a scrap recycling steel mill for structural shapes and sections with a new generation scrap recycling facility.
Rationale	<p>The steel industry in the Philippines is one of the most significant growth industries. Steel constitutes a basic industry prerequisite in a country's pursuit of development and industrialization. The central role of the industry stems from its linkages with numerous sectors, where its products serve as an essential input to countless uses, such as building and construction, automotive, shipbuilding and repair, electronics, packaging, etc. and it is equally important contributions to employment generation, growth, and promotion of industrial activity, etc. Therefore, ensuring a strong domestic steel and steel-based industry is vital in developing the competitive edge of a country in meeting the challenges of globalization.</p> <p>The proposed project is also envisioned because of the following objectives:</p> <ul style="list-style-type: none"> • Import Substitute: The project will manufacture products which are currently 100% imported. • Job Creation: The project will create an estimated 700 jobs plant based and 3,500 outside of the plant. • Economic Value Preservation: Ensure that economic gains remain in the Philippines or the location of the mill. • Ensure Product Quality: Substitution of imported substandard steel with locally produced high quality products.
Project Components	<p>Major Component:</p> <ol style="list-style-type: none"> 1. Rebar Rolling Mill <ul style="list-style-type: none"> • Reheating furnace • Rolling train • Block mill • Quenching • Cooling bed (For Rebar) • Bundling (For Rebar) • Laying Head (For Wire Rod) • Cooling Conveyor (For Wire Rod) • Roll Shop • QA laboratory 2. Melt Shop <ul style="list-style-type: none"> • Electric Arc Furnace • Ladle Furnace • Continuous Casting Machine • Circulating Water Treatment Plant • Make-up Water System • Soft Water Cooling System • Indirect Cooling Water System • Direct Cooling Water System • Sludge Treatment System

	Support Facilities <ol style="list-style-type: none"> 1. Electrical Substation 2. Generator Set/Emergency Power System 3. Water Catchment Pond 4. Drainage System 5. Compressed Air Station 6. Cranes 7. Firefighting System 8. Fuel Tank Pollution Control Devices <ol style="list-style-type: none"> 1. Sewerage Treatment Plant 2. Flue Stack 3. Dedusting System 4. Slag Treatment System 5. Material Recovery Facility
Manpower	During Construction: During Operation: <ul style="list-style-type: none"> • Within Plant: approximately 700 • Outside the Plant: Approximately 3,500
Duration of Project	The project is expected to operate for a period of at least 40 years.
Project Schedule	Project operation will commence 19 months after securing all necessary permits, licenses and approvals.
Project Cost	Approximately PhP 10 Billion
Proponent Profile	
Name of Proponent	SteelAsia Manufacturing Corporation
Address	25th Floor Ore Central Building, 31st Street corner 9th Avenue Bonifacio Global City, Taguig City, Philippines 1634
Authorized Signatory/ Representative	Romeo R. Soliven Vice President - Rolling Mill Operations
Contact Details	Telephone No.: +63 2 858 0500 Mobile No.: 09175873348 Email address: rrsoliven@steelasia.com
Profile of the Preparer	
EIA Preparer	Mediatrix Business Consultancy
Consultant's Address	L29 Joy-Nostalq Center, 17 ADB Ave., Ortigas Center, Pasig City
Contact Person	Matilde R. Jimenez-Fernando Owner and General Manager
Contact Details	Telephone No.: (02) 689 7114 Mobile No.: +639175064499 Email Address: mrjfernando@mediatrixph.com

II. EIA PROCESS DOCUMENTATION

EIA Team

The EIA Study was conducted by a multidisciplinary team of professional experts of Mediatrix Business Consultancy (Mediatrix), who have strong background in environmental assessments, in close coordination with the SteelAsia Manufacturing Corporation (SAMC). The composition of the EIA Team is presented in **Table ES-1**. The sworn statements of accountability of SAMC and Mediatrix are presented in **Annex ES-1**.

Table ES-1: EIA Team Composition

EIA Team	Areas of Expertise	EIA Registration No.
Matilde J. Fernando	Team Leader, Socio-Economics and Legal Framework	IPCO-035

EIA Team	Areas of Expertise	EIA Registration No.
Fritzie Jae Salido	Report Consolidator	IPCO-114
Reynaldo S. Tejada	Air Module	IPCO-036
Hernani Bayani	Geology Module	IPCO-058
Mark Angelo Bucay	Terrestrial Flora and Fauna / Wildlife	-
Benjamin Francisco	Freshwater Ecology	IPCO-038
Alexis Fernando	Research and Field Assignments	IPCO-034
Ria Caramoan	Water Module	IPCO-106
Juvinal Esteban	IEC and Community Relations	IPCO-091

EIA Schedule

Mediatix, together with the SAMC, commenced the EIA Study by EIA planning, and project and stakeholder profiling for the preparation of Information, Education, and Communication (IEC) and Scoping activities. The IEC was conducted on March 13, 2018. Public Scoping was conducted on June 18, 2018, while the Technical Scoping was conducted on July 16, 2018. EIA baseline studies and impact assessment were conducted in July 2018 and the Environmental Impact Statement (EIS) Report was completed in December 2018. The major activities undertaken to complete the EIA were listed in **Table ES-2**.

Table ES-2: EIA Study Schedule

EIA Activity/Stage	Date
IEC	March 13, 2018
Initial Perception Survey	March 15 to 17, 2018
Public Scoping	June 18, 2018
Technical Scoping	July 16, 2018
Data Collection/Baseline Studies	July to December 2018
EIA Study, Impact Assessment and Mitigation Plan	
EIS Report Preparation	
Report Submission to EMB	
1 st Review	
2 nd Review	
Public Hearing	
Final Review	

EIA Study Area

The EIA Study area for the proposed project covers the 248,035 m² project site in Sitio Kirahon, Barangay San Martin and Municipality of Villanueva in Misamis Oriental.

EIA Methodology

Pursuant to Section 3 (page 3) and Table 2 (page 15) of MC 2014-005, the proposed project is classified under A-1: New Category of Environmentally Critical Projects (ECPs) which requires an EIS Report for an Environmental Compliance Certificate (ECC) application.

The EIA for the proposed project conforms to the Revised Procedural Manual for DENR Administrative Order (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 (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. The data collected were based from the EIA Scoping and Screening Form presented in **Annex ES-2**, which was finalized during the Technical Scoping on July 16, 2018.

Table ES-3 presents the detailed EIA methodology per environment sector/component.

Table ES-3: EIA Methodology

EIA Study Module	Parameters/Scope	Methodology and Approach on Impact Assessment
Land		
Geology/Geomorphology, Pedology, Land Use and Classification	Reconnaissance, land use, land classification assessment, slope, soil types and classification, erosion	<ul style="list-style-type: none"> Assessment of the compatibility of the proposed project vis-à-vis approved land use plan and zoning classification. Review of available reports, geologic literature and information from Mines and Geosciences Bureau (MGB), Philippine Institute of Volcanology and Seismology (PHIVOLCS), Philippine Atmospheric, Geophysical and Astronomical Services (PAGASA), and National Mapping and Resource Information Authority (NAMRIA) Conduct of field surveys and collection of soil samples Assessment of construction and operation impacts based on the construction and operation activities of the proposed project, and the susceptibility of the project area to natural hazards.
Terrestrial Biology – Wildlife and Vegetation	Flora and fauna species inventory, species endemicity and conservation status as per DAO 2017-11, species abundance, frequency and distribution	<ul style="list-style-type: none"> Conduct of field surveys Assessment of impacts based on the construction and operation activities of the proposed project to the existing ecosystem
Water		
Hydrology/Hydrogeology	Regional hydrogeology, catchment and drainage system	<ul style="list-style-type: none"> Review of existing literatures and maps from DENR, MGB, and JICA. Assessment of impacts based on the construction and operation activities of the proposed project to the existing environment and the susceptibility of the project area to flooding.
Water Quality	Physico-chemical and bacteriological characteristics of groundwater and freshwater	<ul style="list-style-type: none"> Collection of groundwater and freshwater samples for analysis of physical, chemical, microbiological, micro-nutrient and heavy metal analyses.
Freshwater Ecology	Benthic habitats, species, composition, density, and diversity of sea grass resources and associated macro benthic algae in front of the project site, commercially-important macro invertebrates in the inter-tidal areas, plankton community	<ul style="list-style-type: none"> Use of primary and secondary data and interviews Assessment of impacts based on the construction and operation activities of the proposed project to the existing ecosystem.
Air		
Meteorology/Climatology	Monthly average rainfall, climatological normal and extremes, wind rose diagrams, and frequency of tropical cyclones	<ul style="list-style-type: none"> Assessment of impacts based on the construction and operation activities. Calculation of GHG emissions using emission factor-based estimation method prescribed in 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), 2006 Intergovernmental Panel on Climate Change (IPCC) Guidelines for National GHG Inventories and 2014 IPCC Assessment Report. Projection of monthly average temperature and rainfall and frequency of extreme events under.
Air Quality and Noise Level	Ambient air quality and noise levels	<ul style="list-style-type: none"> Ambient air quality and noise sampling and laboratory analysis

EIA Study Module	Parameters/Scope	Methodology and Approach on Impact Assessment
		<ul style="list-style-type: none"> Conduct of ambient air quality monitoring at eight (8) established sampling stations to measure the Nitrogen Dioxide (NO₂), Sulfur Dioxide (SO₂), Total Suspended Particulates (TSP), and Particulate Matter of less than 10µm (PM₁₀) concentration in the project area and its vicinity. Assessment of operation impacts on air quality using the prediction model by AERMOD Conduct of noise level measurement at five (5) established sampling stations
People		
Socio-economic and Public health	Morbidity and mortality trends, Demographic data of impact area: - Number of households and household size - Land area - Population - Population density /growth - gender and age profile, - literacy rate, profile of educational attainment Socioeconomic data: Main sources of Income, Employment rate/ profile, sources of livelihood, Poverty incidence, commercial establishments and activities, banking and financial institutions	<ul style="list-style-type: none"> Conduct of IEC, Public Scoping, and Perception Survey Review of CLUP and other secondary data from LGU and PSA. Assessment of impacts based on the results of IEC, Public Scoping, perception survey and construction and operation activities of the proposed project.
Environmental Risk Assessment		
Risk Assessment	Safety risks and physical risks	Conduct consequence and Frequency analyses using the methodology described in the Revised Procedural Manual (RPM) for DAO 2003-30

Public Participation Activities

Pursuant to DAO 2003-30, MC 2010-14, and DAO 2017-15, SAMC has conducted a series of public participation activities through, IEC, perception survey and public scoping in Barangay San Martin and Municipality of Villanueva.

Information, Education and Communication

The IEC was conducted on March 13, 2018 at Barangay Hall of San Martin to provide information about the proposed project and encourage the concerned stakeholders to participate in the EIA process. IEC documents such as attendance, issues raised, and photos taken during the IEC are presented in **Annex ES-3**.

Initial Perception Survey

The initial perception survey was conducted after the IEC to 1,165 households of the host Barangay San Martin. The survey covers the demographic characteristics, source of income, livelihood, health and sanitation, education, employment, their knowledge and attitude towards the proposed project. The results of the initial perception survey are presented in **Annex ES-4**.

Public Scoping

The Public Scoping was conducted on June 18, 2018 at Villanueva Multi-purpose Covered Court, Villanueva, Misamis Oriental to present the EIA Process and the proposed project to the public, as well as 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-5**.

III. EIA SUMMARY

Summary of Alternatives

Siting

The following site locations were considered for the proposed project:

- PHIVIDECC Villanueva near Macajalar Bay
- Barangay San Martin near the San Martin Steel, Inc.'s Plant
- Sitio Kirahon in Barangay San Martin, Villanueva, Misamis Oriental

However, based on the following criteria, the project site in Sitio Kirahon Barangay San Martin, Villanueva, Misamis Oriental was selected as the best option for the proposed project.

- **Logistics.** Steel manufacturing is essentially a transportation business as it requires a lot of moving and handling for its raw materials and finished goods. The plant shall be sited near the port, major highways and customers to optimize the logistics cost.
- **Land.** The land area must accommodate all the facilities needed in a contiguous manner. In addition, it should not require a long time for land conversion and expensive site development. It should have sufficient elevation for flooding.
- **Carbon Footprint.** SAMC's policy is to adopt practices to minimize fuel use. These include optimized trip planning/routing to increase fuel efficiency, reducing the number of kilometers each truck travels daily and minimizing travel time.
- **Social.** Social environment was also considered in the project alternatives. The project area was considered compatible with land use because the LGU is in the process of converting the area to an industrial area.
- **Environment.** The proposed location is considerably clear and flat area. Being in a topographically flat area, hazards associated with slope instability, erosion and mass wasting are expected to be nil. The proposed location of the project facilities was also evaluated in terms of geohazard susceptibility based on information from government agencies such as the Mines and Geosciences Bureau (MGB) and the Philippine Institute of Volcanology and Seismology (PHIVOLCS). Generally, the project area's susceptibility to earthquake-triggered slope failure, rainfall-triggered slope failure, and flooding are low. With regard to seismic vulnerability and liquefaction potential, the potential ground-shaking and liquefaction susceptibility of the project site is also low.
- **Environmental Impacts of Each Alternative.** The potential impacts in all locations are the same. However, other areas were not considered because of existing mangrove plantation, lack of sustainable water and power sources and the land classification is not yet industrial. The impacts are discussed and summarized in detail in the next two chapters.

Technology and Design

The Technology that will be used for the proposed project is from one of the top steel equipment companies, SMS Group of Germany, with a track record of 140 years, and Fives Stein of France with a track record of 205 years in equipment design and engineering and manufacturing. It will use the new generation scrap recycling mini-mill technology. The basis for technology selection is the efficiency of the technology to produce the target production rate at the equipment's rated capacity.

The use of an Electric Arc Furnace (EAF) for the melt shop is the most appropriate steelmaking route to produce quality steel. It capitalizes on the abundance of steel scraps in the country, of which substantial quantity is exported. Moreover, there are various technologies available for the

EAF to capture waste heat generated during the melting process. A waste heat recovery system makes use of the waste heat to preheat the in-feeding scrap so that it attains around 500 to 600°C before being charged into the furnace. The feeding system is specially constructed to divert the hot waste gases from the EAF to heat the scrap before being ducted to the fume treatment plant (FES). Benefiting from the scrap preheating system, electrical energy consumption can be reduced to 350kW-hours per tonne of liquid steel; as compared to 550kW-hours per tonne for most of the conventional EAF's in the ASEAN region.

Summary of Key Environmental Impacts and Management Plan

The major impact of the proposed project given in a worst case scenario of drought is water resource use competition. However, when that time comes, the project will be forced to stop its operation because it will not be feasible to operate in such worst case scenario. **Table ES-4** presents the summary of key environmental impacts of the proposed project and the corresponding management plan and mitigating measures.

Table ES-4: Summary of Key Environmental Impacts and Management Plan

Major Activities Description/ Key Environmental Aspects	Significant Issues/Impacts	Impact Mitigation, Built-In Management Measures and Facilities Planned	Rating/ Performance off Mitigating Measures
Construction Phase			
Site Clearing and Construction of Facilities	Generation of construction debris such as excess fill materials from grading and excavation activities, scrap wood and metals, and small concrete spills	<ul style="list-style-type: none"> • Temporary area within the site near the construction site will be designated for storage and segregation • Implement RA 9003 thru provision for Material Recovery Facility (MRF) and practice good housekeeping through segregation of wastes • Implement RA 6969 through Proper segregation and storage of hazardous waste and allocation of Hazardous Waste Facility Area 	100% removal of construction wastes and debris
	Soil erosion due to heavy rainfall	<ul style="list-style-type: none"> • Scheduling of construction works during dry months to avoid heavy rainfall periods • Contouring and minimizing length of steepness of slopes in case cut and fill will be implemented • Providing effective short-term measures for slope stabilization, sediment control, and subsidence control until long-term measures for the operational phase can be implemented 	100% slope stabilization and sediment control achieved
	Contribute to water pollution due to domestic wastewater discharges	<ul style="list-style-type: none"> • Provision of at least 3 units portable toilets at the construction site and will be added when necessary • Provision of septic tanks in all the permanent project facilities 	100% containment of domestic wastewater

Major Activities Description/ Key Environmental Aspects	Significant Issues/Impacts	Impact Mitigation, Built-In Management Measures and Facilities Planned	Rating/ Performance off Mitigating Measures
	Dust generation due to transport of building materials	Water sprinkling during wet season will be 2x a day while four (4x) times a day during dry season.	100% reduction of fugitive dust from transport vehicles
	Noise and vibration due to operation of pile drivers, earth moving and excavation equipment, concrete mixers, cranes and transportation of equipment and materials	Consult with local communities on scheduling of activities with the greatest potential to generate noise during periods of the day that will result in least disturbance.	100% compliance to noise standards during construction
	Safety and health hazards	<ul style="list-style-type: none"> • Strict implementation of Health and Safety Policies at the Plant • Regular conduct of employee safety inspections and toolbox meetings • Regular APE and strict implementation on the use of PPEs • Regular conduct of First Aid Training • Provision of Fire Fighting System 	100% compliance to safety and health standards
	Traffic and road safety	<ul style="list-style-type: none"> • Implement traffic management through proper scheduling of delivery. • Installation of adequate signages approaching National Highway • Provide personnel to manage or direct the vehicle going in and out of the premises. • Coordination with the LGU 	100% compliance to traffic and road safety rules
	Generation of domestic wastewater discharges	<ul style="list-style-type: none"> • Runoffs will be channeled into the rainwater catchment which will be used as process water once the Plant is in operation. • Barracks is equipped with sanitary facilities such as three chamber septic tank 	100% containment of domestic wastewater
	Degradation of air quality due to SOx and NOx emissions from motor vehicles	<ul style="list-style-type: none"> • Regular maintenance of heavy equipment at least once a year and motor vehicles at least twice a year 	100% compliance to air quality standards and Clean Air Act
Operations Phase			
Operation of Electric Arc Furnace for scrap recycling	Mixing of low and high quality scrap metals to be melted	<ul style="list-style-type: none"> • Sorting out low and high quality scrap metals and putting them on separate stockpiles • Metals from filter dust, slag, and waste metals to be collected and 	100% elimination of low quality scraps to avoid production of dioxins and furans

Major Activities Description/ Key Environmental Aspects	Significant Issues/Impacts	Impact Mitigation, Built-In Management Measures and Facilities Planned	Rating/ Performance off Mitigating Measures
		sold to sintering plants or selling it as a raw material to cement plants, use it for social development / livelihood programs or corporate social responsibility.	
	Generation of particulate matter during melting, oxygen injection and decarbonizing phases (primary off gas emissions), and harging/ tapping (secondary off-gas emissions)	Quick cooling of gas emissions from EAF, followed by bag filters	99-99.7% reduction efficiency
	Generation of slag	<ul style="list-style-type: none"> • Proper stockpiling of slag in a landfill • Proper disposal thru DENR-accredited TSD 	100% containment of slags generated
	Generation of dioxins and furans	Ensure complete combustion by achieving temperature above 1200°C	100% reduction of dioxins and furans in the flue gas
		Use of oxygen injection and post combustion of the EAF off-gas to ensure complete combustion	
Operation of the Rolling and Finishing Mills	Solid waste generation	<ul style="list-style-type: none"> • Operation and maintenance of Material Recovery Facility (MRF) • Segregation or establishment segregation within the area is strictly enforced. • Coordination with the local government units for schedule of collection. 	100% reduction of solid wastes in the facilities
	Effluent generation from cooling and quenching, containing scales and emulsified oil	Construction of wastewater treatment plant for removal of oil and sediments in the process water	95% of overall water demand recycled
	Formation of sludge, containing heavy metals, and oil and grease, from wastewater	Desludging and collection of sludge from wastewater treatment facility for proper disposal at least once a year	100% elimination of sludge
	Emissions containing SO ₂ and NO ₂	Use of Low Sulfur Fuel Oil (LSFO), or a mix of LSFO and Diesel as fuel for the reheating furnace	>90% reduction of SO ₂ and NO ₂ emissions
	Possible depletion of ground water source as used by the community	Provide rainwater water harvesting system	100% containment of hazardous wastes
	Domestic wastewater generation	Provision of septic tanks in all the permanent project facilities	100% containment of domestic wastewater
	Generation of hazardous wastes such as used oil, used batteries, contaminated rags, busted bulbs and lamps	<ul style="list-style-type: none"> • Provision of a Hazardous Waste Storage Area with proper labeling, segregation and storage of wastes • Implement RA 6969 through Proper segregation and storage of hazardous waste and allocation of Hazardous Waste Facility Area 	100% containment of hazardous wastes and proper disposal thru DENR accredited third-party contractors

Major Activities Description/ Key Environmental Aspects	Significant Issues/Impacts	Impact Mitigation, Built-In Management Measures and Facilities Planned	Rating/ Performance off Mitigating Measures
		<ul style="list-style-type: none"> • Transport, treatment, and disposal by DENR accredited third-party contractors 	
	Water pollution from run-off and domestic wastes	Construction of rainwater cisterns and collection ponds	95% of overall water demand recycled
		Domestic wastewater management by connecting it to the water treatment facility for reuse as process cooling water	
	Resource use competition for use of river water for make up water and process water	<ul style="list-style-type: none"> • Recycling of water from Rainwater Catchment Basin • Construction of cooling towers • Construction of wastewater treatment plant for removal of oil and sediments in the process water 	95% of overall water demand recycled
	Possible increase in ambient concentration of PM10, CO2, CO, SOx and NOx	<ul style="list-style-type: none"> • Regular maintenance of equipment and making sure the recuperator system is always working • Use of low sulfur fuel (LSFO or mixing with Diesel at 60/40 proportion/ratio) • Use of enclosures for equipment and insulation for structures • Quarterly monitoring of the ambient air to ensure the project's operation is compliant with the clean air act 	100% compliance to air quality standards and Clean Air Act
	Degradation of air quality due to fugitive dusts from equipment and vehicles	<ul style="list-style-type: none"> • Strict implementation of speed limits in vehicles • Proper maintenance of equipment • Designation of no idling zone • Strict implementation of routine plant maintenance and good house keeping • Regular wet suppression or water spraying during dry weather condition of the access road • Regular maintenance of trucks to reduce or maintain tailpipe emissions 	100% compliance to air quality standards and Clean Air Act
	Generation of Air Pollution from all sources (Point, Area, Volume, Line, generator set, reheating furnace, rolling mill)	Regular stack test monitoring	100% compliance to air quality standards under the Clean Air Act

Major Activities Description/ Key Environmental Aspects	Significant Issues/Impacts	Impact Mitigation, Built-In Management Measures and Facilities Planned	Rating/ Performance off Mitigating Measures
	Emissions containing SO ₂ and NO ₂	Use of Low Sulfur Fuel Oil (LSFO), or a mix of LSFO and Diesel as fuel for the reheating furnace	>90% reduction of SO ₂ and NO ₂ emissions
	Noise due to plant operations (scrap and product handling, waste or by-product gas fans, process cooling and draft fans, dedusting systems, furnace charging, EAF melting processes, fuel burners, cutting activities, wire rod pay-off units, and transport and ventilation system)	<ul style="list-style-type: none"> • Enclose the process buildings and/or insulate structures • Cover and enclose scrap and plate/slab storage and handling areas • Enclose cooling fans • Insulate ventilation pipes and use dampers • Limitation of scrap handling and transport during nighttime, where required • Establishment of buffer zones planted with trees 	100% noise abatement
	Noise from vehicles	Contractor's compliance to noise standards.	100% noise abatement
	Health and safety hazards	<ul style="list-style-type: none"> • Strict implementation of Health and Safety Policies at the Plant • Regular conduct of employee safety inspections and toolbox meetings • Regular APE and strict implementation on the use of PPEs • Regular conduct of First Aid Training and proper observance of health and safety protocol • Provision of Fire Fighting System 	100% compliance to health and safety standards
Operation and maintenance of facilities	Solid wastes generation	<ul style="list-style-type: none"> • Operation and maintenance of Material Recovery Facility (MRF) • Segregation or establishment segregation within the area is strictly enforced. • Coordination with the local government units for schedule of collection. 	100% reduction of solid wastes in the facilities
	Domestic wastewater generation	Provision of septic tanks in all the project facilities	100% containment of domestic wastewater
	Generation of hazardous wastes such as used oil, used batteries, contaminated rags, busted bulbs and lamps	<ul style="list-style-type: none"> • Provision of a Hazardous Waste Storage Area with proper labeling, segregation and storage of wastes 	100% containment of hazardous wastes

Major Activities Description/ Key Environmental Aspects	Significant Issues/Impacts	Impact Mitigation, Built-In Management Measures and Facilities Planned	Rating/ Performance off Mitigating Measures
		<ul style="list-style-type: none"> • Transport, treatment, and disposal by DENR accredited third-party contractors 	
	Water pollution from run-off and domestic wastes	Construction of rainwater cisterns and collection ponds	95% of overall water demand recycled
		Domestic wastewater management by connecting it to the water treatment facility for reuse as process cooling water	
	Resource use competition for use of river water for make up water and process water	<ul style="list-style-type: none"> • Recycling of water from Rainwater Catchment Basin • Construction of cooling towers • Construction of wastewater treatment plant for removal of oil and sediments in the process water 	50% of overall water demand recycled
	Noise due to plant operations (scrap and product handling, waste or by-product gas fans, process cooling and draft fans, dedusting systems, furnace charging, EAF melting processes, fuel burners, cutting activities, wire rod pay-off units, and transport and ventilation system)	<ul style="list-style-type: none"> • Enclose the process buildings and/or insulate structures • Cover and enclose scrap ad plate/slab storage and handling areas • Enclose fans, insulate ventilation pipes, and use dampers • Limitation of scrap handling and transport during nighttime, where required • Establishment of buffer zones 	100% noise abatement

Based on the EIA conducted, there are insignificant risks and uncertainties for the Project because mitigation and management plans have been laid down and the SAMC's mother company, the SteelAsia Group of Companies has been in the business for more than 52 years now.

CHAPTER I: PROJECT DESCRIPTION

SteelAsia Manufacturing Corporation (SAMC) is the only company that operates modern steel rolling mills in the Philippines. SAMC is a provider of rebar solutions. As a manufacturer, it is part of the solution to country growth, expanding to meet the growing needs of the country. SAMC has grown as the largest manufacturer of rebar in the Philippines with a total annual production capacity of 2.1 MTPY and anticipating a multi-decade growth trajectory for the country, has another 2.5 million tons of capacity in its expansion pipeline in several locations. Locating across the archipelago, near economic and logistic hubs is solution that makes rebar products accessible, not to mention the significant cost savings from the elimination of sea freight. Production sites in five sites (and three upcoming sites) in all the major island groups is an enabler of country development, and lowers cost for both the large corporate property developer and the small home builder. Investment in technological solutions has enabled SAMC to produce the full specification range of rebar products, creating a one-stop-shop service. Technology has also helped the company push the cost of rebar down through its productivity, efficiencies and scale. Downstream added value technologies such as create handling and wastage savings. These advances put SAMC industry and its service capabilities at par with the best in the world.

SAMC is the largest steel company in the Philippines and has been manufacturing steel for more than 51 years. SAMC's office is located at B2 Bldg., Bonifacio High Street, BGC, Taguig, Metro Manila. SAMC is registered with the Securities and Exchange Commission (SEC) with as attached in **Annex 1-1**. SAMC is comprised of steel bar manufacturing companies and one (1) melt shop. Currently, six (6) SteelAsia Group rolling mills cover the major island groups of Luzon, Visayas, and Mindanao with a combined manufacturing capacity of 2.3 million tons per year. SAMC set the standard for modernization in the steel industry by being technologically at par with the best in the world. The SteelAsia Group's operation systems have been internationally certified to:

- ISO 9001 Quality Management
- ISO 14001 Environmental Management
- OHSAS 18001 Occupation Health and Safety
- ISO 17025 Testing Laboratory
- UK Certification Authority for Reinforcing Steel (UK CARES) British Standard

With increasing demand of rebars, due to the boost in infrastructure industry in the country together with the rehabilitation activities in some parts of the country, SAMC proposed to construct a new Scrap Recycling Steel Mill Project. The proposed project is a rebar and wire-rod mill with a new generation scrap recycling mini-mill to manufacture light and heavy sections, and merchant bars.

1.1 PROJECT LOCATION AND AREA

1.1.1 Description of the Project Area

The proposed project site is located at 248,035m² lot in Sitio Kirahon, Barangay San Martin, Villanueva, Misamis Oriental. The project site is privately owned by SAMC and covered by the Contract to Sell and Transfer Certificate of Title (TCT) No. T25821, T39334, T25534, and T45074, as presented in **Annex 1-2**.

The nearest community from the proposed project site is the Relocation Site in Barangay Balacanas located 1.5km northwest. On the other hand, the community of the host Barangay San Martin is located 3.5km west of the proposed project site. Industrial plants near the proposed project site are the Jacobi Carbons Philippines, Inc., Cagayan Electric Power and Light Company (CEPALCO), Steel Plant and 12MW Minergy Solar Power Plant. The proposed project site is approximately 1.5km far from Tagoloan River and 4km far from Macajalar Bay.

Villanueva is bordered by the Macajalar Bay towards the west and the Municipality of Jasaan and Claveria towards the north. The southern extension of the municipality is bounded by the adjacent Municipality of Tagoloan while the majority of the eastern regions are bounded by the Municipality of Claveria. Villanueva is accessible via Maharlika National Highway, which cuts the western section

of the municipality running through barangays San Martin, Katipunan, Poblacion 1, 2 and Looc. The proposed project site is accessible through various land-based vehicles through Iligan-Cagayan de Oro – Butuan Road passing through the existing 2-lane Phividec road.

Table 1.1.1 and **Figure 1.1.1** present the technical description and the geographical location of the proposed project site. **Figure 1.1.2** and **Figure 1.1.3** show the location and vicinity maps of the project site.

Table 1.1.1: Geographical Coordinates of the Proposed Project Site

Corner	Coordinates	
	Latitude	Longitude
1	8°33'34.89"N	124°47'3.26"E
2	8°33'32.49"N	124°47'7.30"E
3	8°33'32.07"N	124°47'8.04"E
4	8°33'29.54"N	124°47'12.31"E
5	8°33'22.42"N	124°47'5.19"E
6	8°33'19.42"N	124°47'2.41"E
7	8°33'18.67"N	124°47'3.18"E
8	8°33'15.27"N	124°47'0.32"E
9	8°33'14.62"N	124°46'56.66"E
10	8°33'17.83"N	124°46'54.43"E
11	8°33'23.57"N	124°46'49.65"E
12	8°33'27.17"N	124°46'46.64"E
13	8°33'28.50"N	124°46'45.21"E
14	8°33'32.48"N	124°46'47.37"E
15	8°33'29.78"N	124°46'57.77"E

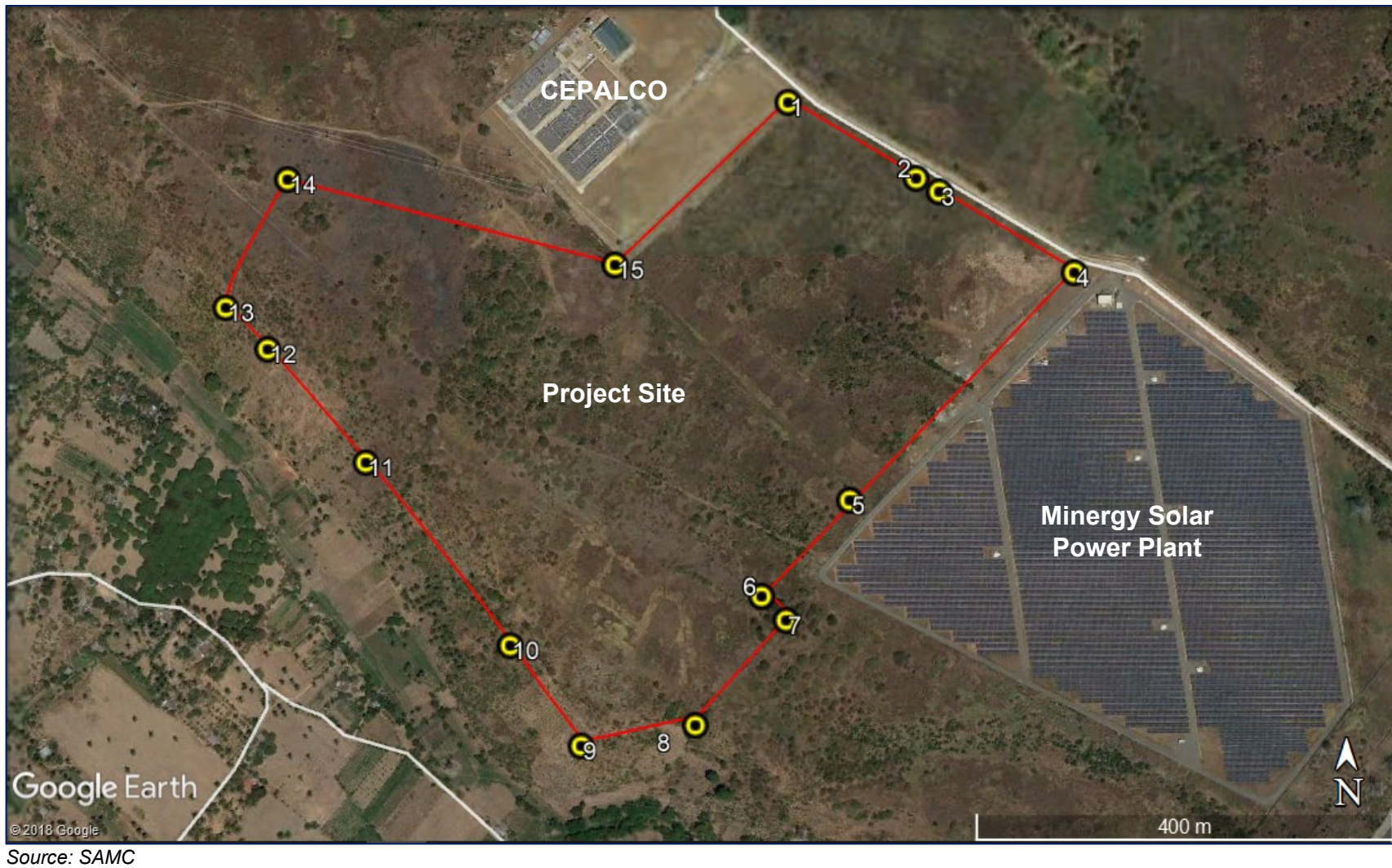
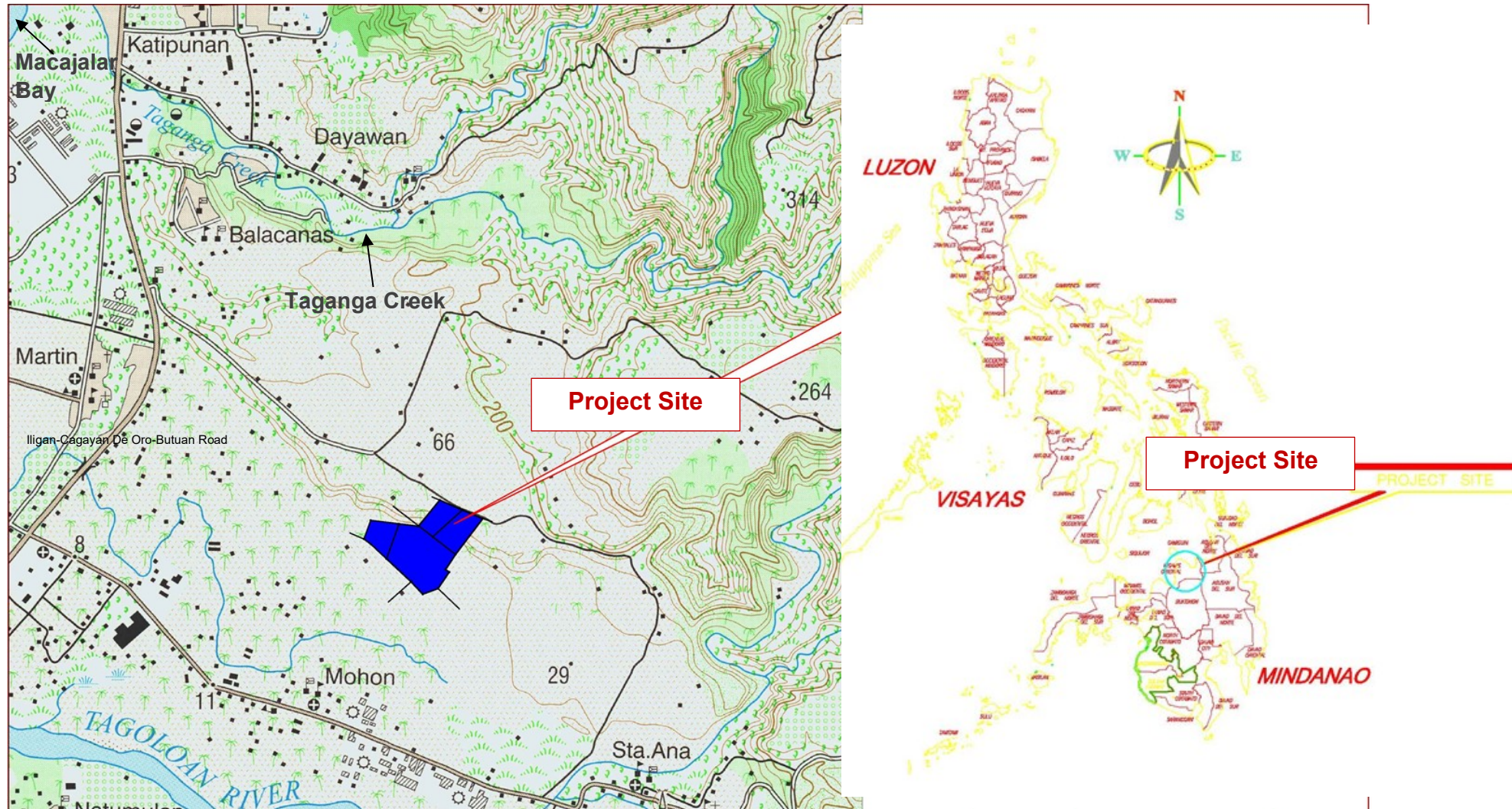
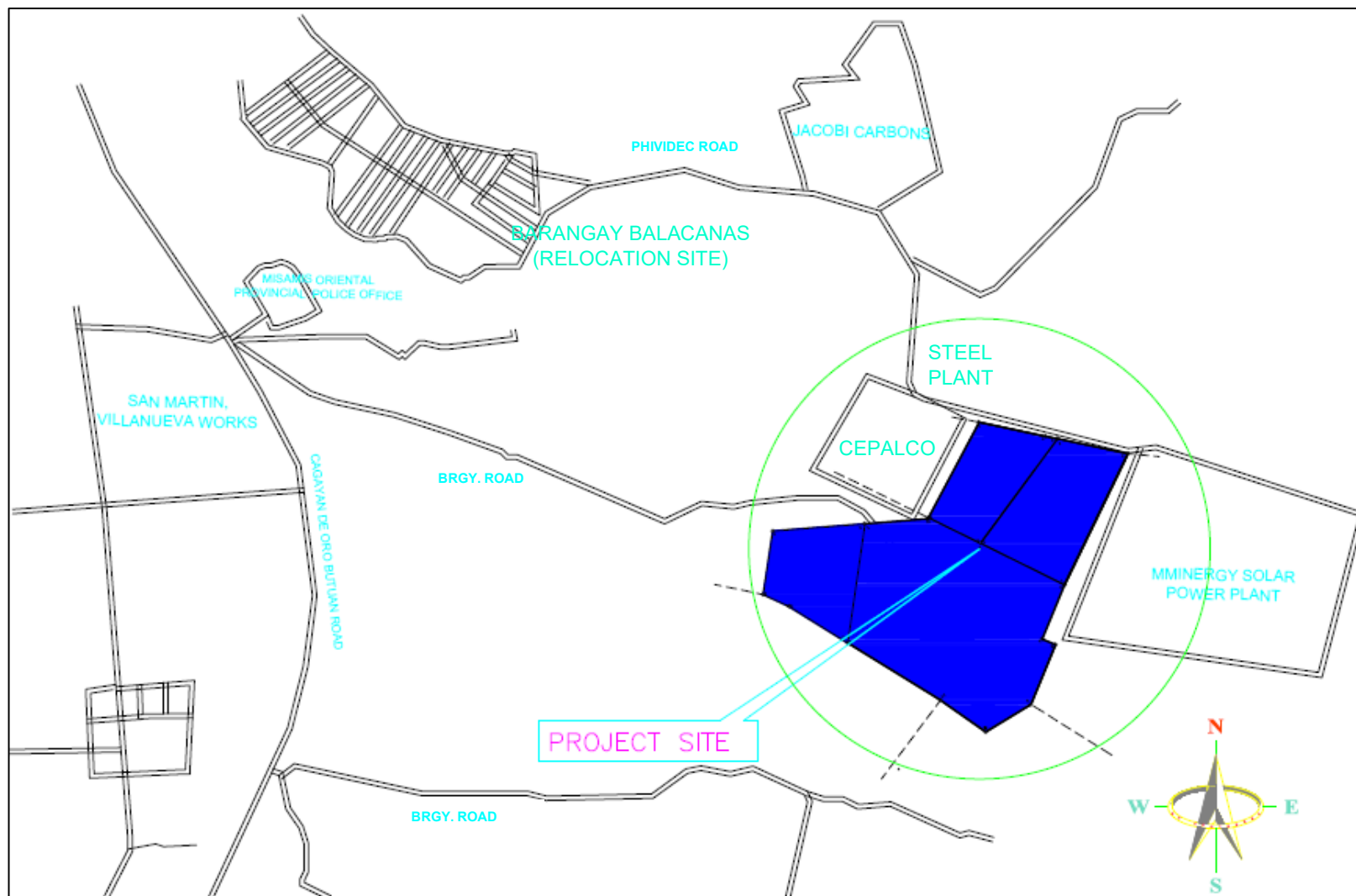


Figure 1.1.1: Geographical Location of the Proposed Project Site



Source: SAMC

Figure 1.1.2: Project Location Map Superimposing the Project Site



Source: SAMC

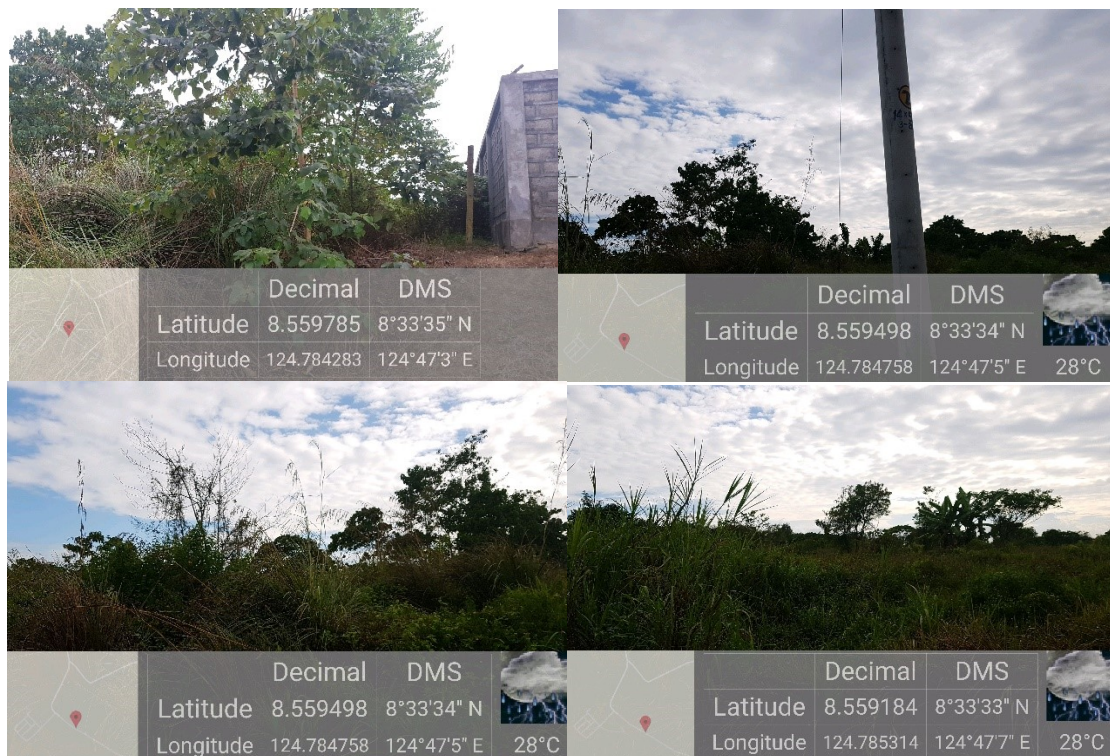
Figure 1.1.3: Vicinity Map

1.1.2 Impact Areas

The direct impact areas (DIA) cover the 248,035m² project site and the possible air receptor within one (1) km due to the expected air emissions from the proposed project including the access road immediately adjacent to the site. On the other hand, the indirect impact areas (IIA) cover the hauling route of construction materials during construction and of billets and finished products during operations and the community at the periphery of the project site. Photographs of the project site are shown in **Plates 1.1.1** and **1.1.2**. The map of the DIA and IIA is shown in **Figure 1.1.4**.



Plate 1.1.1: Aerial photograph



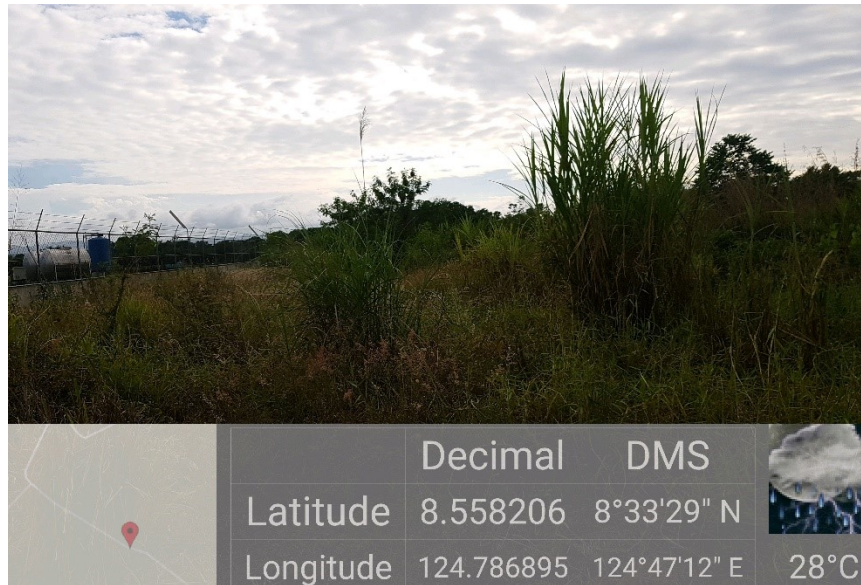
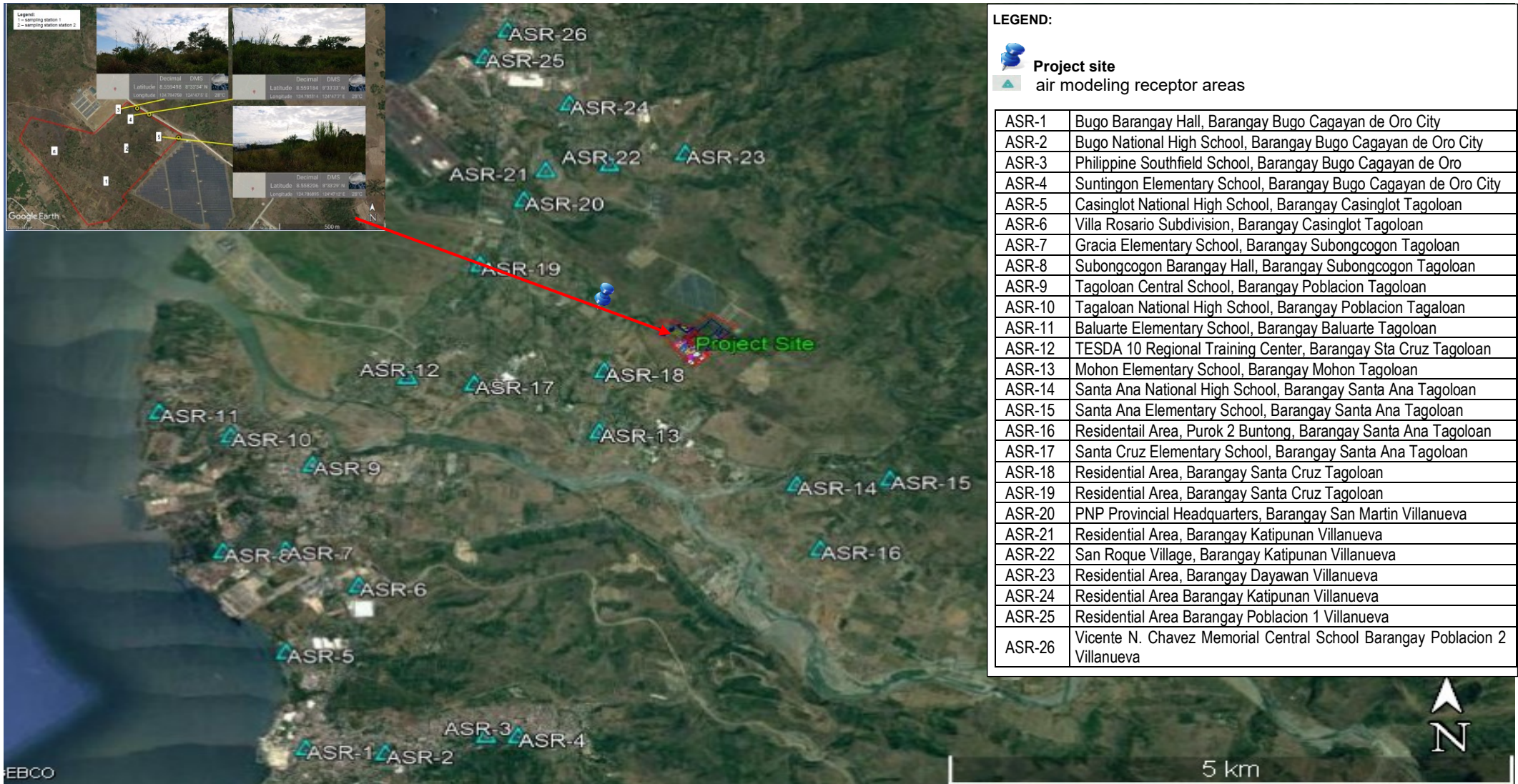


Plate 1.1.2: Geotagged Photos



Source: Google Earth Map

Figure 1.1.4: Map of the Impact Areas

1.2 PROJECT RATIONALE

The steel industry in the Philippines is one of the most significant growth industries. Steel constitutes a basic industry prerequisite in a country's pursuit of development and industrialization. The central role of the industry stems from its linkages with numerous sectors, where its products serve as an essential input to countless uses, such as building and construction and it is equally important contributions to employment generation, growth, and promotion of industrial activity, etc. Therefore, ensuring a strong domestic steel and steel-based industry is vital in developing the competitive edge of a country in meeting the challenges of globalization.

With the boost in infrastructure industry in the country together with the rehabilitation activities in some parts of the country, there will be a bigger demand for reinforcing steel bars in the future. The SAMC is investing for the establishment of a steel manufacturing facility in Villanueva, Misamis Oriental. The equipment to be used shall be among the most modern steel bar rolling facility in the world featuring new technologies. Its features give the advantage in terms of productivity and efficiency over competitors' facilities.

The following are the major rationale for the project:

- Supply the increasing demand of rebars in the Philippines.
- Support housing construction in the region. A number of housing projects is expected to be implemented thus the demand for rebars and steel products.
- Support construction of power plants, BPO, office spaces and tourism projects. Same with housing projects, construction of power plants, BPO, office spaces and tourism projects are expected to increase the demand for rebars and steel products.
- Support the Visayas and Mindanao reconstruction projects

The proposed project is also envisioned because of the following objectives:

- **Job Creation:** The project will create an estimated 700 jobs plant based and 3,500 outside of the plant.
- **Economic Value Preservation:** Ensure that economic gains remain in the Philippines or the location of the mill.
- **Ensure Product Quality:** Substitution of imported substandard steel with locally produced high quality products.

1.3 PROJECT ALTERNATIVES

1.3.1 Siting

The following site locations were considered for the proposed project:

- PHIVIDE Villanueva near Macajalar Bay
- Barangay San Martin near the San Martin Steel, Inc.'s Plant

However, based on the following criteria, the project site in Sitio Kirahon in Barangay San Martin, Villanueva, Misamis Oriental was selected as the best option for the proposed project.

- **Logistics.** Steel manufacturing is essentially a transportation business as it requires a lot of moving and handling for its raw materials and finished goods. The plant shall be sited near major highways and customers to optimize the logistics cost.
- **Land.** The land area must be sited in a bigger area must accommodate all the facilities needed in a contiguous manner. In addition, it should not require a long time for land conversion and expensive site development. It should have sufficient elevation for flooding.
- **Carbon Footprint.** SAMC's policy is to adopt practices to minimize fuel use. These include optimized trip planning/routing to increase fuel efficiency, reducing the number of kilometers each truck travels daily and minimizing travel time.

- **Social.** Social environment was also considered in the project alternatives. The project area was considered compatible with land use because the LGU is in the process of converting the area to an industrial area.
- **Environment.** The proposed location is considerably clear and flat area. Being in a topographically flat area, hazards associated with slope instability, erosion and mass wasting are expected to be nil. The proposed location of the project facilities was also evaluated in terms of geohazard susceptibility based on information from government agencies such as the Mines and Geosciences Bureau (MGB) and the Philippine Institute of Volcanology and Seismology (PHIVOLCS). Generally, the project area's susceptibility to earthquake-triggered slope failure, rainfall-triggered slope failure, and flooding are low. Specifically, the following were determined:
 - Ground rupture hazard is seemingly absent in the project area since the nearest active Tagoloan Fault is found about 2km west of the project site.
 - The area investigated is prone to ground shaking hazards due to the presence of several earthquake generators in and near the region. These possible seismogenic structures include the active Tagoloan Fault, Central Mindanao Fault, Cabanglasan Fault, and the Mindanao Fault-Western Mindanao Extension.
 - The project site is underlain mainly by alluvial deposits mostly sandy silt associated with pebble to gravel size material being located near Makajalar Bay and falls under the delineated liquefaction prone areas. It also falls under the 0.30g and 0.20g for Soft Soil and Medium Soil condition, respectively.
 - Using the deterministic method of Tanaka and Fukushima with the following attenuation relation and considering an earthquake magnitude of 7.2 and distance of the site of 2km from the Tagoloan Fault, the following peak ground acceleration (PGA) values of 0.351g, 0.509g, and 0.813g for bedrock, medium soil and soft soil, respectively. The project falls on the soft soil condition.
- **Environmental Impacts of Each Alternative.** The potential impacts in all locations are the same. However, other areas were not considered because of existing mangrove plantation, lack of sustainable water and power sources and the land classification is not yet industrial. The impacts are discussed and summarized in detail in the next two chapters.

1.3.2 Technology/Operation Process

This Project will use an Electric Arc Furnace (EAF) for the melt shop. This is the most appropriate steelmaking route to produce quality steel. It capitalizes on the abundance of steel scraps in the country, of which substantial quantity is exported. As the cities grow or renew, generation of steel scraps (among other wastes) will grow. Harnessing the locally generated scraps, and efficiently converting to useful steel befits the nation's agenda of green economy.

Moreover, there are various technologies available for the EAF to capture waste heat generated during the melting process. A waste heat recovery system makes use of the waste heat to preheat the in-feeding scrap so that it attains around 500 to 600°C before being charged into the furnace. The feeding system is specially constructed to divert the hot waste gases from the EAF to heat the scrap before being ducted to the fume treatment plant (FES). Benefiting from the scrap preheating system, electrical energy consumption can be reduced to 350kW-hours per tonne of liquid steel; as compared to 550kW-hours per tonne for most of the conventional EAF's in the ASEAN region.

1.3.3 Resources

Power

The power requirement of the proposed project will be supplied by Cagayan Electric Power and Light Company (CEPALCO). The Generator Set for Light Section Mill has a capacity of 1MVA/800kW. The Generator Set will serve as an emergency power of the rolling mill if there is power outage. The diesel

engine generator set will also supply cooling water for all key equipment and lighting, cranes. The generator sets are equipped with compatible cooling system, noise reduction system, intake and exhaust system, and electronic control system.

Water

Standby Water supply will be sourced from the proposed deep wells. In addition, rainwater collection shall be implemented to augment the need for cooling water since the climate at the proposed Project site falls under the category of Type IV climate with rainfall of more or less evenly distributed throughout the year.

During the operations phase, the project will require about 60 m³/hr make up water system; 576 m³/hr fire protection water system; 1200 m³/hr for indirect cooling water system; and 1700 m³/hr direct cooling water system. A deep well will be drilled to a depth of 50m to 90m and designed not to extract water from the shallow aquifers that are utilized by the surrounding communities. A permit from the NWRB will be secured. SAMC will invest extensively in the water treatment system that aims to recirculate all process water. Zero wastewater discharge is envisaged. Moreover, a water catchment pond will be constructed to collect rainwater to minimize usage of potable water in the cooling system. The collecting pond has a volume of 5,000 m³. Its main purpose is to provide make up water for the evaporation losses within the plant operation. The storm drainage is connected to the water catchment pond for storing rainwater.

Raw materials

SAMC will source steel raw materials within Misamis Oriental and nearby towns and provinces.

1.3.4 No Project Option

If the proposed project will not materialize, employment opportunities and social development such as livelihood projects, skills training, scholarship programs and medical assistance for the residents of Villanueva, particularly in Barangay San Martin, will not be realized. Also, the prospective LGU increase in revenue, multiplier effect of the project such as business opportunities, support to basic services like infrastructure and medical assistance and other opportunities for the community and LGU will likely lose when the project is not pursued.

The possibility of expanding and upgrading LGU's basic infrastructure services and facilities and strengthening of LGU's capacity in municipal governance, investment planning, revenue generation and project development and implementation will not also be realized. This may also include possibility of enhancing their capabilities for local leadership because the project may provide technical support and assistance to local leaders to training, seminars and workshops. All of these may be provided by the project thru its tax payments, permits and clearances and Social Development Program.

Another opportunity that the local government and the community may miss if the project will not be realized is the possibility of constructing additional infrastructure projects like roads and bridges, increasing school classrooms and improving school facilities and medical assistance such as provision of medicines, medical supplies and medical missions.

1.4 PROJECT COMPONENTS

The project is composed of the Rolling Mill and the Melt Shop Section which has separate and distinct components for each as follows:

1.4.1 Rolling Mill

1.4.1.1 Light Section Mill

1.4.1.1.1 Sub-Major Components

The Light Section Mill is composed of one (1) Walking Beam Reheating Furnace with a capacity of 100t per hour and one (1) Rolling Mill.

The Rolling Mill has the following major components:

1. Horizontal (H) and vertical (V) stands
2. High-pressure water jets with pressure of approximately 260 bar are located at reheating furnace exit
3. Pinch-roll with an emergency snap shear to assure safe operation.
4. The roughing and intermediate mills
5. Cold shear
6. Cooling bed
7. Metallic disc saws
8. Sawing equipment
9. Stacking station
10. Bundling and tying equipment
11. Electric overhead cranes

1.4.1.1.2 Support Facilities for Light Section Mill

1.4.1.1.2.1 Electrical Substation

The Electrical Substation for light section mill has a HV Power Distribution and a MV Power Distribution. The HV Power Distribution has a demand capacity of 30 MW. The main transformer output is 6.6kV, 3-phase, 60Hz for internal distribution.

The MV Power Distribution, with 6.6kV MV power distribution room, will be located in the main building of both Light and Heavy Section Mills. The MV Step-down Transformers used to reduce the incoming voltage to the adequate voltage level, suitable for the downstream MV distribution services. The MV switchboard is Metal Clad air insulated type composed of a set of standard sections assembled to form a single line-up. Each section is divided in segregated compartments.

1.4.1.1.2.2 Generator Set/Emergency Power System

The Generator Set for Light Section Mill has a capacity of 1MVA/800kW. The Generator Set will serve as an emergency power of the rolling mill if there is power outage. The diesel engine generator set will also supply cooling water for all key equipment and lighting, cranes. The generator sets are equipped with compatible cooling system, noise reduction system, intake and exhaust system, and electronic control system.

1.4.1.1.2.3 Water Catchment Pond

The Water Catchment Pond for Light Section Mill has a capacity of 5,000 m³. To mitigate the use of water, the main purpose of the ponds is to provide make-up water for the evaporation process that takes place in the rolling mill area.

1.4.1.1.2.4 Drainage System

The storm drainage is connected to the Water Catchment Pond. The water accumulated in the pond will serve as additional source of make-up water. The water from the pond will be treated in the Water Treatment Plant/System (WTP) before it will be transported into the Make-up Water System. Advanced water treatment system will be used to ensure that no wastewater will be discharged outside the plant. The capacity of the treatment plant is 800 to 1,000 cu. m/day.

1.4.1.1.2.5 Cranes

Cranes will be used in the rolling mill with a mix of Overhead Cranes and Semi- Gantry Cranes with capacity ranging from 10 tons to 30Tons, and 6 to 20 tons under magnet. Overhead cranes will be used

in the installation, production, and in maintenance. Semi-gantry cranes will be used for lifting the raw material from the truck to the piles of billet then lift to charge the rolling mill. Cranes with magnet will help to store raw materials and finish products faster and safer.

1.4.1.1.2.6 Firefighting System

The firefighting system will be installed at the rolling mill area wherein series of fire hoses are installed in all areas of the mill. Sprinkler firefighting system will be located in the Admin Building, General Stores, Canteen, Locker rooms, etc. The system shall conform to the provision of the National Fire Protection Association (NFPA). Location of water source and fire pump shall be coordinated with WTP design. Size of nozzles shall conform to pipe schedules as delineated in NFPA 13. Pipe supports, hangers and bracing shall be of the approved type and shall be independent from ceiling and duct supports.

1.4.1.1.2.7 Fuel Tank

The Fuel Tanks for storing Low Sulfur Fuel Oil (LSFO) also includes the LPG/LNG tank, unloading device, gasification unit, piping with supports, fire protection system and control system, etc.

1.4.1.1.3 Pollution Control Devices for Light Section Mill

1.4.1.1.3.1 Sludge Treatment System

The Sludge Treatment System for Light Section Mill will treat wastewater to guarantees zero discharge of untreated industrial wastewater. This Sludge Treatment System includes auxiliary systems of filter press such as lime dosing facilities, sludge storage hopper and automatic control equipment. This water treatment system will treat industrial wastewater such as the backwash water of filters and sludge from chemical degreasing device.

The wastewater with sludge firstly enters in the mud regulation tank, which will be pumped to the concentrated pool. There are two (2) sets of concentrated pool. The surface fluid of concentrated pool overflows into the underground scale pit of Direct Cooling Water. The sludge settled from concentrated pool is lifted by pumps to filter press for dewatering, followed by dehydration. The dewatered sludge cake is around 65% dryness. The cakes are collected in a cake hopper for storage and will be disposed of to a DENR-3rd Party Treater.

Auxiliary systems of filter press include lime dosing facilities, sludge storage hopper and automatic control equipment, etc. There are two (2) sludge hoppers corresponds with the filter presses. Each press has duty cycle of 8 to 16 hours per day, depending on quantity of sludge generated. The press is fully automatic. The filtrate and cloth wash water is recirculated to the underground scale pit of Direct Cooling Water. In order to accelerate sludge flocculation and sedimentation, and promote the thickening and dewatering effect, two sets of dosing device are used. Process flow of sludge treatment is presented in Figure 1.4.1.1.3.1.1

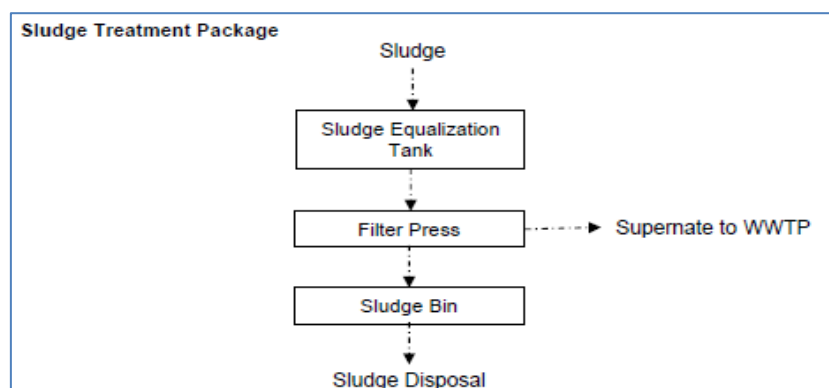


Figure 1.4.1: Sludge Treatment Process Flow

1.4.1.1.3.2 Sewerage Treatment Plant

The Sewerage Treatment Plant for Light Section Mill guarantees that no untreated wastewater will be discharged from the site.

1.4.1.1.3.3 Flue Stack

The Light Section Mill Flue Stack has a height of 75m and with sampling points according to the regulations of the government to ensure emission quality.

Provided in **Table 1.4.1** is the summary of the project components for Light Section Mill.

Table 1.4.1: Components for Light Section Mill

Components	Number of Units	Description
Horizontal (H) and vertical (V) stands	18	Used in the rolling process
High-pressure water jets		Scales remover. With pressure of approximately 260 bar located at reheating furnace exit
Pinch-roll	1	Has an emergency snap shear to assure safe operation.
Roughing and intermediate mills		Consists of roughing, intermediate and finishing stands with convertible stands for flexibility and ease of the rolling process. It has on-board utilities such as air, oil, water, power and hydraulics to minimize downtime during size change.
Cold shear	2	For cutting the cooling bed layers into finished commercial lengths
Cooling bed		For product cooling after cutting to length
Metallic disc saws	2	
Sawing equipment	1	
Stacking station	1	Equipped with automatic counting system.
Bundling & tying equipment		
Electric overhead cranes		
Support Facilities		
Electrical Substation	1	With HV Power Distribution and a MV Power Distribution.
Generator Set/Emergency Power System	1	Capacity is 1MVA/800kW and will serve as an emergency power of the rolling mill if there is power outage.
Water Catchment Pond	1	Capacity is 5,000 m ³ which main purpose is to provide make-up water for the evaporation process that takes place in the rolling mill area.
Drainage System	1	The storm drainage is connected to the Water Catchment Pond. The water accumulated in the pond will serve as additional source of make-up water. The water from the pond will be treated in the Water Treatment Plant/System (WTP) before it will be transported into the Make-up Water System. Advanced water treatment system will be used to ensure that no wastewater will be discharged outside the plant.
Cranes		Cranes will be used in the rolling mill with a mix of Overhead Cranes and Semi- Gantry Cranes with capacity ranging from 10 tons to 30Tons, and 6 to 20 tons under magnet. Overhead cranes will be used in the installation, production, and in maintenance, Semi-gantry cranes will be used for lifting the raw material from the truck to the piles of billet then lift to

Components	Number of Units	Description
		charge the rolling mill. Cranes with magnet will help to store raw materials and finish products faster and safer.
Firefighting System	1	Series of fire hoses are installed in all areas of the mill. Sprinkler firefighting system will be located in the Admin Building, General Stores, Canteen, Locker rooms, etc.
Fuel Tank	2 (1 for LSFO and 1 for LPG)	The system consists of the LSFO and LPG/LNG tank, unloading device, gasification unit, piping with supports, fire protection system and control system, etc.
Greenhouse	1	A common greenhouse/nursery which <u>plants</u> will be grown To promote production progress of plants prior to cultivation.
Pollution Control Devices		
Sludge Treatment System with auxiliary systems of filter press	1	Will treat the backwash water of filters, sludge from chemical degreasing device, etc.
Sewerage Treatment Plant	1	The Sewerage Treatment Plant can guarantee that no untreated wastewater will be discharged from the site.
Flue Stack	1	The Flue Stack has a height of 75m and with sampling points according to the regulations of the government to ensure emission quality.

1.4.1.2 Heavy Section Mill

1.4.1.2.1 Sub-Major Components

The Heavy Section Mill will have a capacity of 0.6 MTPY. The Heavy Section Mill makes use of latest state-of-the-art rolling technology from Europe. It will have the following major components: Walking Beam Reheating Furnace with a capacity of 120t per hour, Breakdown and Tandem Mills, Cooling Beds, Straightening Area and Finishing Area. The main products of the Heavy Section Mill are Round Shafts (100-250mm), H-Beam(140-750mm), Angle (100-200mm), Channel (160-400mm), Flat (150-800mm),and Sheet Piles (400x85-400x170mm).



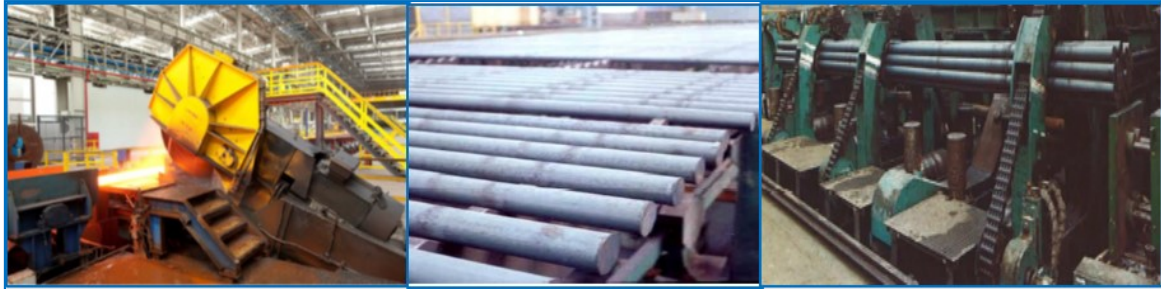
Source: SAMC 2018

Plate 1.4.1: Illustration of Walking Beam Reheating Furnace



Source: SAMC 2018

Plate 1.4.2: Illustration of Breakdown Mill



Source: SAMC 2018

Plate 1.4.3: Illustration of Cooling Bed for Big Rounds



Source: SAMC 2018

Plate 1.4.4: Illustration of Tandem Mill



Source: SAMC 2018

Plate 1.4.5: Illustration of Cooling Bed Area for Sections



Source: SAMC 2018

Plate 1.4.6: Illustration of Straightening Area for Section



Source: SAMC 2018

Plate 1.4.7: Illustration of Finishing Area for Section Mill

1.4.1.2.2 Support Facilities

1.4.1.2.2.1 Electrical Substation

The Electrical Substation has a HV Power Distribution and a MV Power Distribution. The HV Power Distribution has a demand capacity of 30 MW. The main transformer output is 6.6kV, 3-phase, 60Hz for internal distribution.

The MV Power Distribution, with 6.6kV MV power distribution room, will be located in the main building. The MV Step-down Transformers used to reduce the incoming voltage to the adequate voltage level, suitable for the downstream MV distribution services. The MV switchboard is Metal Clad air insulated type composed of a set of standard sections assembled to form a single line-up. Each section is divided in segregated compartments.

1.4.1.2.2.2 Generator Set/Emergency Power System

The Generator Set has a capacity of 1MVA/800kW. The Generator Set will serve as an emergency power of the rolling mill if there is power outage. The diesel engine generator set will also supply cooling water for all key equipment and lighting, cranes. The generator sets are equipped with compatible cooling system, noise reduction system, intake and exhaust system, and electronic control system.

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The Water Catchment Pond has a capacity of 5,000 m³. To mitigate the use of water, the main purpose of the ponds is to provide make-up water for the evaporation process that takes place in the rolling mill area.

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The storm drainage is connected to the Water Catchment Pond. The water accumulated in the pond will serve as additional source of make-up water. The water from the pond will be treated in the Water Treatment Plant/System (WTP) before it will be transported into the Make-up Water System. Advanced water treatment system will be used to ensure that no wastewater will be discharged outside the plant.

1.4.1.2.2.5 Cranes

Cranes will be used in the rolling mill with a mix of Overhead Cranes and Semi- Gantry Cranes with capacity ranging from 10 tons to 30Tons, and 6 to 20 tons under magnet. Overhead cranes will be used in the installation, production, and in maintenance, Semi-gantry cranes will be used for lifting the raw material from the truck to the piles of billet then lift to charge the rolling mill. Cranes with magnet will help to store raw materials and finish products faster and safer.

1.4.1.2.2.6 Firefighting System

The firefighting system series of fire hoses are installed in all areas of the mill. Sprinkler firefighting system will be located in the Admin Building, General Stores, Canteen, Locker rooms, etc. The system shall conform to the provision of the National Fire Protection Association (NFPA). Location of water source and fire pump shall be coordinated with WTP design. Size of nozzles shall conform to pipe schedules as delineated in NFPA 13. Pipe supports, hangers and bracing shall be of the approved type and shall be independent from ceiling and duct supports.

1.4.1.2.2.7 Fuel Tank

The Fuel Tanks for storing Low Sulfur Fuel Oil (LSFO) is consist of the LPG/LNG tank, unloading device, gasification unit, piping with supports, fire protection system and control system, etc.

1.4.1.2.2 Pollution Control Devices

1.4.1.2.2.1 Sludge Treatment System

The Sludge Treatment Systems will treat the backwash water of filters, sludge from chemical degreasing device, etc. Auxiliary systems of filter press include: lime dosing facilities, sludge storage hopper and automatic control equipment, etc. This water treatment system guarantees zero discharge of untreated industrial wastewater.

1.4.1.2.2.2 Sewerage Treatment Plant

The Sewerage Treatment Plant can guarantee that no untreated wastewater will be discharged from the site.

1.4.1.2.2.3 Flue Stack

The Flue Stack has a height of 75m and with sampling points according to the regulations of the government to ensure emission quality.

Provided in **Table 1.4.2** is the summary of the project components for Heavy Section Mill.

Table 1.4.2: Components for Heavy Section Mill

Components	Number of Units	Description
Walking Beam Reheating Furnace		Has a capacity of 120t per hour
Breakdown and Tandem Mills		
Cooling Beds		
Straightening Area		
Finishing Area.		
Support Facilities		
Electrical Substation	1	Each Electrical Substation has a HV Power Distribution and a MV Power Distribution.
Generator Set/Emergency Power System	1	Each Generator Set has a capacity of 1MVA/800kW. The Generator Set will serve as an emergency power of the rolling mill if there is power outage. The diesel engine generator set will also supply cooling water for all key equipment and lighting, cranes. The generator sets are equipped with compatible cooling system, noise reduction system, intake and exhaust system, and electronic control system.
Water Catchment Pond	1	Capacity is 5,000 m ³ which main purpose of the ponds is to provide make-up water for the evaporation process that takes place in the rolling mill area.
Drainage System	1	The storm drainage is connected to the Water Catchment Pond. The water accumulated in the pond will serve as additional source of make-up water. The water from the pond will be treated in the Water Treatment Plant/System (WTP) before it will be transported into the Make-up Water System. Advanced water treatment system will be used to ensure that no wastewater will be discharged outside the plant.
Cranes	2	Cranes will be a mix of Overhead Cranes and Semi- Gantry Cranes with capacity ranging from 10 tons to 30 Tons, and 6 to 20 tons under magnet. Overhead cranes will be used in the installation, production, and in maintenance, Semi-gantry cranes will be used for lifting the raw material from the truck to the piles of billet then lift to charge the rolling mill. Cranes with magnet will help to store raw materials and finish products faster and safer.
Firefighting System	1	Series of fire hoses are installed in all areas of the mill. Sprinkler firefighting system will be located in the Admin Building, General Stores, Canteen, Locker rooms, etc.
Fuel Tank	2 (1 for LSFO and 1 for LPG)	The system consists of the LSFO and LPG/LNG tank, unloading device, gasification unit, piping with supports, fire protection system and control system, etc.
Pollution Control Devices		
Sludge Treatment System with auxiliary systems of filter press		Will treat the backwash water of filters, sludge from chemical degreasing device, etc.
Sewerage Treatment Plant		The Sewerage Treatment Plant can guarantee that no untreated wastewater will be discharged from the site.
Flue Stack	1	The Flue Stack has a height of 75m and with sampling points according to the regulations of the government to ensure emission quality.
Dedusting System	1	The system consists of the water-cooled flue duct, combustion chamber, natural air cooler, pulse-jet bag filter, fume exhaust fan, fume exhaust device and chimney, etc. It is located at the primary

Components	Number of Units	Description
		fume exhaust pipeline, as well as above the EAF for emission capture. <ul style="list-style-type: none"> Inlet fume flow is 300,000Nm³/h. Inlet fume temperature 1300°C. Clean gas dust content <10mg/Nm³

1.4.2 Melt Shop

1.4.2.1 Light Section Mill Melt Shop

1.4.2.1.1 Sub-major Components

The Melt Shop for Light Section Mill of is 600,000 metric ton per year billet producer that feeds the operational demand of the Light Section Mill. The melt shop is equipped with the latest melting and casting technologies, embedded in the system for preheating of scrap-based raw material to produce steels of the highest quality.

Conscious efforts are made to implement the steelmaking processes with low carbon footprint and care for the environment. Each melt shop will consist of the following major metallurgical equipment and system:

1. EAF
2. Scrap Preheating and Fume Extraction System (FES)
3. Secondary Metallurgy Ladle Furnace (LF)
4. Continuous Casting Machine (CCM)
5. Make-up Water System

In case water reservoir runs short of water supply, river water will be used using Tagoloan River equipped with NWRB Water Permit.

The water is pumped at flow rate 70m³/h, with pressure of 0.2MPa. The Make-up Water System has two (2) groups of pumps:

- The makeup water supply pumps which lift water to the whole make-up water network of the plant.
 - The fire hydrant water supply pumps that lift water to the whole fire protection water network of the plant.
6. Indirect Cooling Water System

The water from the Indirect Cooling Water System has a circulation capacity of 1500m³/h. It will be used mainly for the EAF, FES, LF, Caster machinery, heat exchangers of lubrication and hydraulic systems, air conditioners, etc.

The Indirect Cooling Water System for the Light Section Mill has a circulation capacity of 950m³/h. There are two (2) sets of cooling tower adopted in this system, each has a capacity of 475m³/h. To ensure water quality and stability, corrosion-prevention and scaling of equipment and pipeline, there are two (2) sets of chemical dosing device. Dosing device dispends corrosion-scale inhibitor and biocide.



Plate 1.4.8: Illustration of Indirect Cooling Water System for the Heavy Section Mill

7. Direct Cooling Water System

The Direct Cooling Water System for the Light Section Mill has a circulation capacity of is 1700m³/h. The circulation water will be used mainly for Rolling Mill and QTB area, etc. There are two (2) sets of cooling tower adopted in this system. One is for rolling mill with a capacity of 900m³/h and the other one is for QTB with a capacity of 800m³/h. The cooling tower is reinforced steel structures.



Plate 1.4.9: Illustration of Direct Cooling Water System for the Heavy Section Mill

1.4.2.1.2 Support Facilities

1.4.2.1.2.1 Electrical Substation

For the Melt Shops, the power will be supplied by overhead lines at high voltage 138kV from the power company. The power distribution network voltages are described as shown below.

- AC 138kVreceiving voltage
- AC 22kVEAF/LF distribution voltage
- AC 3.3kVmain distribution voltage
- AC 440V(3phase) low-voltage utilization voltage (low voltage for motors)
- AC 460V(3phase) low-voltage supply voltage (transformer's secondary side rated voltage)
- AC 230V(3phase) low-voltage of illumination
- DC 110 V DC control voltage of the switchgear

1.4.2.1.2.2 Compressed Air Station

The Compressed Air Station for the Melt Shops has a capacity 5,000 m³/h at 8 Bars. On the other hand, each Compressed Air Station for the Light and Heavy Section Mills has a capacity 3,000 m³/h at 8 Bars. Compressed air is being used as atomizer of the fuel for complete combustion in the furnace, also used in pneumatics for instrumentation and controls of equipment.

1.4.2.1.3 Pollution Control Devices

1.4.2.1.3.1 Sludge Treatment System

The Sludge Treatment System for the Melt Shops will treat the main sources of the Sludge Treatment System are the backwash water of filters, sludge from chemical degreasing device, etc. Auxiliary systems of filter press include: lime dosing facilities, sludge storage hopper and automatic control equipment, etc. This water treatment system guarantees zero discharge of untreated industrial wastewater.



Plate 1.4.10: Illustration of Sludge Treatment System for the Heavy Section Mill

1.4.2.1.3.2 Dedusting System for the Melt Shops

The system consists of the water-cooled flue duct, combustion chamber, natural air cooler, pulse-jet bag filter, fume exhaust fan, fume exhaust device and chimney, etc. It is located at the primary fume exhaust pipeline, as well as above the EAF for emission capture.

- Inlet fume flow is 300,000Nm³/h.
- Inlet fume temperature 1300°C.
- Clean gas dust content <10mg/Nm³



Plate 1.4.11: Illustration of Dedusting System for the Melt Shops

1.4.2.1.3.3 Slag Treatment System for the Melt Shops

The melting process generates slag, which is collected beneath the EAF in a slag pot. The slag treatment area is equipped with ventilators to prevent spread of fugitive dusts. The slag car transports the pot full of slag to the slag bay. The 40/10t metallurgical crane in the bay lifts the pot onto a truck, to be transferred to an external treatment area. At the slag treatment area, the hot slag is poured into a holding area and being sprayed-cooled by measured quantity of water. A special excavator, fitted with high temperature protection shields, works on the slag by mixing, churning, and eventually scooped to

be cured for 24 hours. After the slag is cooled to atmospheric temperature, magnetic lumps are recovered by magnets for charging back into the EAF. The remaining slag granules can be crushed to be made into road stones and bricks. The slag treatment area is equipped with ventilators to prevent spread of fugitive dusts.

1.4.2.1.3.4 Material Recovery Facility and Hazardous Waste Storage Area

The proposed project has 2 Material Recovery Facilities (MRF) as temporary storage of solid and hazardous wastes.

Provided in **Table 1.4.3** is the summary of the project components for Light Section Mill Melt Shop.

Table 1.4.3: Light Section Mill Melt Shop

Components	Number of Units	Description
EAF	1	
Scrap Preheating and Fume Extraction System (FES)	1	
Secondary Metallurgy Ladle Furnace (LF)	1	
Continuous Casting Machine (CCM)	1	
Make up Water Supply	1	The make-up water supply is pumped at flow rate 60m ³ /h, with pressure of 0.2MPa and the fire hydrant water supply is pumped at flow rate 576 m ³ /h. The Make-up Water System for Heavy Section Mill adopts Manganese sand filter.
Indirect Cooling Water System	1	Circulation capacity is 1200m ³ /h. There are two (2) sets of cooling tower adopted in this system, each has a capacity of 475m ³ /h. The cooling tower is reinforced steel structures. In order to reduce the content of suspended solids in water circulation, part of the circulating return water flow to homogeneous sand filter.
Direct Cooling Water System	1	The circulation capacity is 1700m ³ /h. The circulation water will be used mainly for Rolling Mill and Tandem Mill area.
Support Facilities		
Power supply		Power will be supplied by overhead lines at high voltage 138kV from the power company. The power distribution network voltages are described as shown below: <ul style="list-style-type: none"> • AC 138kV receiving voltage • AC 22kV EAF/LF distribution voltage • AC 3.3kV main distribution voltage • AC 440V(3phase) low-voltage utilization voltage (low voltage for motors) • AC 460V(3phase) low-voltage supply voltage (transformer's secondary side rated voltage) • AC 230V(3phase) low-voltage of illumination • DC 110 V DC control voltage of the switchgear
Pollution Control Devices		
Sludge Treatment System	1	Will treat the backwash water of filters, sludge from chemical degreasing device, etc.

Components	Number of Units	Description
		Auxiliary systems of filter press include: lime dosing facilities, sludge storage hopper and automatic control equipment, etc. This water treatment system guarantees zero discharge of untreated industrial wastewater.
Dedusting System for the Melt Shops	1	The system consists of the water-cooled flue duct, combustion chamber, natural air cooler, pulse-jet bag filter, fume exhaust fan, fume exhaust device and chimney, etc. It is located at the primary fume exhaust pipeline, as well as above the EAF for emission capture. <ul style="list-style-type: none"> • Inlet fume flow is 300,000Nm³/h. • Inlet fume temperature 1300°C. • Clean gas dust content <10mg/Nm³
Slag Treatment System	1	The melting process generates slag, which is collected beneath the EAF in a slag pot. The slag treatment area is equipped with ventilators to prevent spread of fugitive dusts.
Material Recovery Facility and Hazardous Waste Storage Area	2	Material Recovery Facilities (MRF) will be installed as temporary storage of solid and hazardous wastes.

1.4.2.2 Heavy Section Mill Melt Shop

1.4.2.2.1 Sub-major Components

The Melt Shop for Heavy Section Mill produces 600,000 tonnes per year blooms and beam blanks semi-finished material for downstream rolling into heavy structural sections for construction industry. The melt shop is equipped with the latest melting and casting technologies for melting of scrap-based raw material and metallic iron units to produce steels of the highest quality.

The designed capacity of the melt shops is 536,120 tonnes per annum liquid steel. The steel grade is largely low-to-medium carbon blooms and beam blanks of the following specifications:

- Beam Blanks: 350x686x12,000mm; 350x430x12,000mm; 205x292x12,000mm;
- Blooms: 430x160x12,000mm;
- Billets: 200x200x12,000mm; and
- Slabs: 800x200x12,000mm (reserved).

1.4.2.2.1 Make-up Water System

In case water reservoir runs short of water supply, river water will be used using Tagoloan River equipped with NWRB Water Permit.

For the Heavy Section Mill, the make-up water supply is pumped at flow rate 60m³/h, with pressure of 0.2MPa and the fire hydrant water supply is pumped at flow rate 576 m³/h. The Make-up Water System for Heavy Section Mill adopts Manganese sand filter.

The Make-up Water System has two (2) groups of pumps:

- The makeup water supply pumps which lift water to the whole make-up water network of the plant.
- The fire hydrant water supply pumps that lift water to the whole fire protection water network of the plant.



Plate 1.4.12: Illustration of Make-up Water System for the Heavy Section Mill

1.4.2.2.2.2 Indirect Cooling Water System

The proposed project has three (3) Indirect Cooling Water Systems: one for Light Section Mill, one for Heavy Section Mill, and another one for Melt Shops. The water from the Indirect Cooling Water System for the Light and Heavy Section Mill will be used mainly for the reheating furnace, lubrication system, hydraulic system, stand motors, etc. On the other hand, the water from the Indirect Cooling Water System for Melt Shops, with a circulation capacity of $1500\text{m}^3/\text{h}$, will be used mainly for the EAF, FES, LF, Caster machinery, heat exchangers of lubrication and hydraulic systems, air conditioners, etc.

The Indirect Cooling Water System for the Light Section Mill has a circulation capacity of $950\text{m}^3/\text{h}$. There are two (2) sets of cooling tower adopted in this system, each has a capacity of $475\text{m}^3/\text{h}$. To ensure water quality and stability, corrosion-prevention and scaling of equipment and pipeline, there are two (2) sets of chemical dosing device. Dosing device dispends corrosion-scale inhibitor and biocide.

The Indirect Cooling Water System for the Heavy Section Mill has a circulation capacity of $1200\text{m}^3/\text{h}$. There are two (2) sets of cooling tower adopted in this system, each has a capacity of $475\text{m}^3/\text{h}$. The cooling tower is reinforced steel structures. In order to reduce the content of suspended solids in water circulation, part of the circulating return water flow to homogeneous sand filter.



Plate 1.4.13: Illustration of Indirect Cooling Water System for the Heavy Section Mill

1.4.2.2.2.3 Direct Cooling Water System

The proposed project has three (3) Direct Cooling Water Systems: one for the Melt Shops, one for Light Section Mill and another one for Heavy Section Mill.

The Direct Cooling Water System for the Melt Shops has a circulation capacity of 720m³/h. The water is mainly used for the CCM secondary spray system, where billet surfaces are cooled directly by jets of water. The water flows to an underground scale pit by gravity. Some of the water is pumped to scrap ditch at flow rate of about 120m³/h.

The Direct Cooling Water System for the Light Section Mill has a circulation capacity of is 1700m³/h. The circulation water will be used mainly for Rolling Mill and QTB area, etc. There are two (2) sets of cooling tower adopted in this system. One is for rolling mill with a capacity of 900m³/h and the other one is for QTB with a capacity of 800m³/h. The cooling tower is reinforced steel structures.

The Direct Cooling Water System for the Heavy Section Mill has a circulation capacity of is 1700m³/h. The circulation water will be used mainly for Rolling Mill and Tandem Mill area.



Plate 1.4.14: Illustration of Direct Cooling Water System for the Heavy Section Mill

1.4.2.2.2 Support Facilities

1.4.2.2.2.1 Electrical Substation

For the Melt Shops, the power will be supplied by overhead lines at high voltage 138kV from the power company. The power distribution network voltages are described as shown below.

- AC 138kVreceiving voltage
- AC 22kVEAF/LF distribution voltage
- AC 3.3kVmain distribution voltage
- AC 440V(3phase) low-voltage utilization voltage (low voltage for motors)
- AC 460V(3phase) low-voltage supply voltage (transformer's secondary side rated voltage)
- AC 230V(3phase) low-voltage of illumination
- DC 110 V DC control voltage of the switchgear

1.4.2.2.2.2 Compressed Air Station

The Compressed Air for the Melt Shop has a capacity 5,000 m³/h at 8 Bars. On the other hand, each Compressed Air Station for the Light and Heavy Section Mills has a capacity 3,000 m³/h at 8 Bars. Compressed air is being used as atomizer of the fuel for complete combustion in the furnace, also used in pneumatics for instrumentation and controls of equipment.

1.4.2.2.3 Pollution Control Devices

1.4.2.2.3.1 Sludge Treatment System

The Sludge Treatment System for melt shop will treat wastewater to guarantees zero discharge of untreated industrial wastewater. This Sludge Treatment System includes auxiliary systems of filter press such as lime dosing facilities, sludge storage hopper and automatic control equipment. This water treatment system will treat industrial wastewater such as the backwash water of filters and sludge from chemical degreasing device.

The wastewater with sludge firstly enter in the mud regulation tank, which will be pumped to the concentrated pool. There are two (2) sets of concentrated pool. The surface fluid of concentrated pool overflows into the underground scale pit of Direct Cooling Water. The sludge settled from concentrated pool is lifted by pumps to filter press for dewatering, followed by dehydration. The dewatered sludge

cake is around 65% dryness. The cakes are collected in a cake hopper for storage and will be disposed of to a DENR-3rd Party Treater.

Auxiliary systems of filter press include lime dosing facilities, sludge storage hopper and automatic control equipment, etc. There are two (2) sludge hoppers corresponds with the filter presses. Each press has duty cycle of 8 to 16 hours per day, depending on quantity of sludge generated. The press is fully automatic. The filtrate and cloth wash water is recirculated to the underground scale pit of Direct Cooling Water. In order to accelerate sludge flocculation and sedimentation, and promote the thickening and dewatering effect, two sets of dosing device are used. Process flow of sludge treatment is presented in Figure 1.4.15 1 below.



Plate 1.4.15: Illustration of Sludge Treatment System for the Heavy Section Mill

1.4.2.2.3.2 Dedusting System for the Melt Shops

The system consists of the water-cooled flue duct, combustion chamber, natural air cooler, pulse-jet bag filter, fume exhaust fan, fume exhaust device and chimney, etc. It is located at the primary fume exhaust pipeline, as well as above the EAF for emission capture.

- Inlet fume flow is 300,000Nm³/h.
- Inlet fume temperature 1300°C.
- Clean gas dust content <10mg/Nm³



Plate 1.4.16: Illustration of Dedusting System for the Melt Shops

1.4.2.2.3.3 Slag Treatment System for the Melt Shops

The melting process generates slag, which is collected beneath the EAF in a slag pot. The slag treatment area is equipped with ventilators to prevent spread of fugitive dusts. The slag car transports the pot full of slag to the slag bay. The 40/10t metallurgical crane in the bay lifts the pot onto a truck, to be transferred to an external treatment area. At the slag treatment area, the hot slag is poured into a

holding area and being sprayed-cooled by measured quantity of water. A special excavator, fitted with high temperature protection shields, works on the slag by mixing, churning, and eventually scooped to be cured for 24 hours. After the slag is cooled to atmospheric temperature, magnetic lumps are recovered by magnets for charging back into the EAF. The remaining slag granules can be crushed to be made into road stones and bricks. The slag treatment area is equipped with ventilators to prevent spread of fugitive dusts.

1.4.2.2.3.4 Material Recovery Facility and Hazardous Waste Storage Area

The proposed project has 2 Material Recovery Facilities (MRF) as temporary storage of solid and hazardous wastes.

1.4.2.2.3.5 Summary of Project Components

Provided in **Table 1.4.4** is the summary of the project components for Heavy Section Mill Melt Shop.

Table 1.4.4: Summary of Project Components

Components	Number of Units	Description
LIGHT SECTION MILL – ROLLING MILL		
High-pressure water jets		Scales remover with pressure of approximately 260 bar are located at reheating furnace exit
Pinch-roll		Has an emergency snap shear to assure safe operation.
Roughing and intermediate mills		Consists of roughing, intermediate and finishing stands with convertible stands for flexibility and ease of the rolling process. It has on-board utilities such as air, oil, water, power and hydraulics to minimize downtime during size change.
Cold shear	2	For cutting the cooling bed layers into finished commercial lengths
Cooling bed		For product cooling after cutting to length
Metallic disc saws	2	
Sawing equipment	1	
Stacking station	1	Equipped with automatic counting system.
Bundling and tying equipment		The stacking station is equipped with automatic bar counting system. It make section into square package, then the package is bundled into a standard count for easy storage and handling. Re-bars are bundled into a standard count for easy storage and handling
Electric overhead cranes		Overhead cranes will be used in the installation, production, and in maintenance, Semi-gantry cranes will be used for lifting the raw material from the truck to the piles of billet then lift to charge the rolling mill. Cranes with magnet will help to store raw materials and finish products faster and safer.
Support Facilities		
Electrical Substation	1	With HV Power Distribution and a MV Power Distribution.
Generator Set/Emergency Power System	1	Capacity is 1MVA/800kW and will serve as an emergency power of the rolling mill if there is power outage.
Water Catchment Pond	1	Capacity is 5,000 m ³ which main purpose is to provide make-up water for the evaporation process that takes place in the rolling mill area.
Drainage System	1	The storm drainage is connected to the Water Catchment Pond. The water accumulated in the pond will serve as additional source of make-up water. The water from the pond will be treated in the Water Treatment Plant/System (WTP) before it will be transported into the Make-up Water System. Advanced water treatment system will be used to ensure that no wastewater will be discharged outside the plant.
Cranes		Cranes will be used in the rolling mill with a mix of Overhead Cranes and Semi- Gantry Cranes with capacity ranging from 10 tons to 30Tons, and 6 to 20 tons under magnet. Overhead cranes will be used in the installation, production, and in maintenance, Semi-gantry cranes will be used for lifting

Components	Number of Units	Description
		the raw material from the truck to the piles of billet then lift to charge the rolling mill. Cranes with magnet will help to store raw materials and finish products faster and safer.
Firefighting System	1	Series of fire hoses are installed in all areas of the mill. Sprinkler firefighting system will be located in the Admin Building, General Stores, Canteen, Locker rooms, etc.
Fuel Tank	2 (1 for LSFO and 1 for LPG)	The system consists of the LSFO and LPG/LNG tank, unloading device, gasification unit, piping with supports, fire protection system and control system, etc.
Pollution Control Devices		
Sludge Treatment with auxiliary System	1	Will treat the backwash water of filters, sludge from chemical degreasing device, etc.
Sewerage Treatment Plant	1	The Sewerage Treatment Plant can guarantee that no untreated wastewater will be discharged from the site.
Flue Stack	1	The Flue Stack has a height of 75m and with sampling points according to the regulations of the government to ensure emission quality.
HEAVY SECTION MILL - ROLLING MILL		
Walking Beam Reheating Furnace	1	With a capacity of 120t per hour. Low thermal losses and recovery of energy by combustion thru air recuperator to guarantee low fuel consumption, low mechanical maintenance and high level technological automation resulting to lowest emission.
Breakdown and Tandem Mills		
Cooling Beds		Bars are air-cooled while on cooling bed. Chains carry the bars and transport them to the conveyor. Slow speed of chains allows sufficient time for bars to cool down. The cooled rolled bars shall then be cut to the desired lengths.
Straightening Area		
Finishing Area		The ends of the bars are sheared off by a shearing machine. Ends are sheared because they are often bent or cracked. The finished product shall then be sorted, bundled and stocked prior to delivery.
Support Facilities		
Electrical Substation	1	Each Electrical Substation has a HV Power Distribution and a MV Power Distribution.
Generator Set/Emergency Power System	1	Each Generator Set has a capacity of 1MVA/800kW. The Generator Set will serve as an emergency power of the rolling mill if there is power outage. The diesel engine generator set will also supply cooling water for all key equipment and lighting, cranes. The generator sets are equipped with compatible cooling system, noise reduction system, intake and exhaust system, and electronic control system.
Water Catchment Pond	1	Capacity is 5,000 m ³ which main purpose of the ponds is to provide make-up water for the evaporation process that takes place in the rolling mill area.
Drainage System	1	The storm drainage is connected to the Water Catchment Pond. The water accumulated in the pond will serve as additional source of make-up water. The water from the pond will be treated in the Water Treatment Plant/System (WTP) before it will be transported into the Make-up Water System. Advanced water treatment system will be used to ensure that no wastewater will be discharged outside the plant.
Cranes		Cranes will be a mix of Overhead Cranes and Semi- Gantry Cranes with capacity ranging from 10 tons to 30 Tons, and 6 to 20 tons under magnet. Overhead cranes will be used in the installation, production, and in maintenance, Semi-gantry cranes will be used for lifting the raw material from the truck to the piles of billet then lift to charge the rolling mill. Cranes with magnet will help to store raw materials and finish products faster and safer.

Components	Number of Units	Description
Firefighting System	1	Series of fire hoses are installed in all areas of the mill. Sprinkler firefighting system will be located in the Admin Building, General Stores, Canteen, Locker rooms, etc.
Fuel Tank	2 (1 for LSFO and 1 for LPG)	The system consists of the LSFO and LPG/LNG tank, unloading device, gasification unit, piping with supports, fire protection system and control system, etc.
Pollution Control Devices		
Sludge Treatment System with auxiliary systems of filter press	1	Will treat the backwash water of filters, sludge from chemical degreasing device, etc.
Sewerage Treatment Plant	1	The Sewerage Treatment Plant can guarantee that no untreated wastewater will be discharged from the site.
Flue Stack	1	The Flue Stack has a height of 75m and with sampling points according to the regulations of the government to ensure emission quality.
MELT SHOP LIGHT SECTION MILL		
EAF		Makes use of electric arcs that emit extremely high heat at 6000°C in the furnace sufficient to melt any steel scrap brought into contact. The continuous striking of the arcs melts all the scrap, and the bath temperature is steadily brought to around 1600°C, ready for tapping.
Scrap Preheating and Fume Extraction System (FES)		Provides sufficient suction to handle the dust being collected from the process. Hot gas is drafted from the EAF through the scrap preheater at flow rate more than 300,000 Nm ³ /h. The flue gas then flows into a combustion chamber for complete oxidation of the remaining combustibles. Larger particulates are settled at this station. The gas is further drafted to a heat exchanger to cool the temperature down to below 140°C, before going into the baghouse for dust removal.
Secondary Metallurgy Ladle Furnace (LF)		This is a secondary metallurgical refining processes to achieve clean steel of high quality at the LF station as well as attaining the precise final chemistry for the heat.
Continuous Casting Machine (CCM)		When the molten steel is ready for casting, the ladle is lifted by overhead electric crane onto a rotating turret in preparation for subsequent teeming. The cast flows from the ladle into a high capacity tundish that can hold around 14-18 tonnes of steel. Streams of molten steel are made to follow into four (4) separate molds for solidification. The high capacity tundish ensures temperature homogeneity and chemistry consistency to assure the eventual product steel quality. Drawing speed per casting strand is more than 3m/min to ensure high productivity. The caster has a casting radius of 9m.
Make up Water Supply		The make-up water supply is pumped at flow rate 60m ³ /h, with pressure of 0.2MPa and the fire hydrant water supply is pumped at flow rate 576 m ³ /h. The Make-up Water System for Heavy Section Mill adopts Manganese sand filter.
Indirect Cooling Water System		Circulation capacity is 1200m ³ /h. There are two (2) sets of cooling tower adopted in this system, each has a capacity of 475m ³ /h. The cooling tower is reinforced steel structures. In order to reduce the content of suspended solids in water circulation, part of the circulating return water flow to homogeneous sand filter.
Direct Cooling Water System		The circulation capacity is 1700m ³ /h. The circulation water will be used mainly for Rolling Mill and Tandem Mill area.
Support Facilities		
Power supply		Power will be supplied by overhead lines at high voltage 138kV from the power company. The power distribution network voltages are described as shown below. <ul style="list-style-type: none"> AC 138kV receiving voltage AC 22kV EAF/LF distribution voltage AC 3.3kV main distribution voltage

Components	Number of Units	Description
		<ul style="list-style-type: none"> AC 440V(3phase) low-voltage utilization voltage (low voltage for motors) AC 460V(3phase) low-voltage supply voltage (transformer's secondary side rated voltage) AC 230V(3phase) low-voltage of illumination DC 110 V DC control voltage of the switchgear
Pollution Control Devices		
Sludge Treatment System		<p>Will treat the backwash water of filters, sludge from chemical degreasing device, etc.</p> <p>Auxiliary systems of filter press include lime dosing facilities, sludge storage hopper and automatic control equipment, etc. This water treatment system guarantees zero discharge of untreated industrial wastewater.</p>
Dedusting System for the Melt Shops	1	<p>The system consists of the water-cooled flue duct, combustion chamber, natural air cooler, pulse-jet bag filter, fume exhaust fan, fume exhaust device and chimney, etc. It is located at the primary fume exhaust pipeline, as well as above the EAF for emission capture.</p> <p>Inlet fume flow is 300,000Nm³/h.</p> <p>Inlet fume temperature 1300°C.</p> <p>Clean gas dust content <10mg/Nm³</p>
Slag Treatment System	1	The melting process generates slag, which is collected beneath the EAF in a slag pot. The slag treatment area is equipped with ventilators to prevent spread of fugitive dusts
Material Recovery Facility and Hazardous Waste Storage Area	2	Material Recovery Facilities (MRF) will be installed as temporary storage of solid and hazardous wastes.
MELT SHOP HEAVY SECTION MILL		
EAF	1	Makes use of electric arcs that emit extremely high heat at 6000°C in the furnace sufficient to melt any steel scrap brought into contact. The continuous striking of the arcs melts all the scrap, and the bath temperature is steadily brought to around 1600°C, ready for tapping.
Scrap Preheating and Fume Extraction System (FES)	1	Provides sufficient suction to handle the dust being collected from the process. Hot gas is drafted from the EAF through the scrap preheater at flow rate more than 300,000 Nm ³ /h. The flue gas then flows into a combustion chamber for complete oxidation of the remaining combustibles. Larger particulates are settled at this station. The gas is further drafted to a heat exchanger to cool the temperature down to below 140°C, before going into the baghouse for dust removal.
Secondary Metallurgy Ladle Furnace (LF)	1	This is a secondary metallurgical refining processes to achieve clean steel of high quality at the LF station as well as attaining the precise final chemistry for the heat.
Continuous Casting Machine (CCM)	1	When the molten steel is ready for casting, the ladle is lifted by overhead electric crane onto a rotating turret in preparation for subsequent teeming. The cast flows from the ladle into a high capacity tundish that can hold around 14-18 tonnes of steel. Streams of molten steel are made to follow into four (4) separate molds for solidification. The high capacity tundish ensures temperature homogeneity and chemistry consistency to assure the eventual product steel quality. Drawing speed per casting strand is more than 3m/min to ensure high productivity. The caster has a casting radius of 9m.
Make-up Water System	1	The make-up water supply is pumped at flow rate 50 m ³ /h and the fire hydrant water supply is pumped at flow rate 576 m ³ /h.
Indirect Cooling Water System	2 sets	Circulation capacity is 950m ³ /h. There are two (2) sets of cooling tower adopted in this system, each has a capacity of 475m ³ /h. To ensure water quality and stability, corrosion-prevention and scaling of equipment and pipeline, two (2) sets of chemical dosing devices are used.

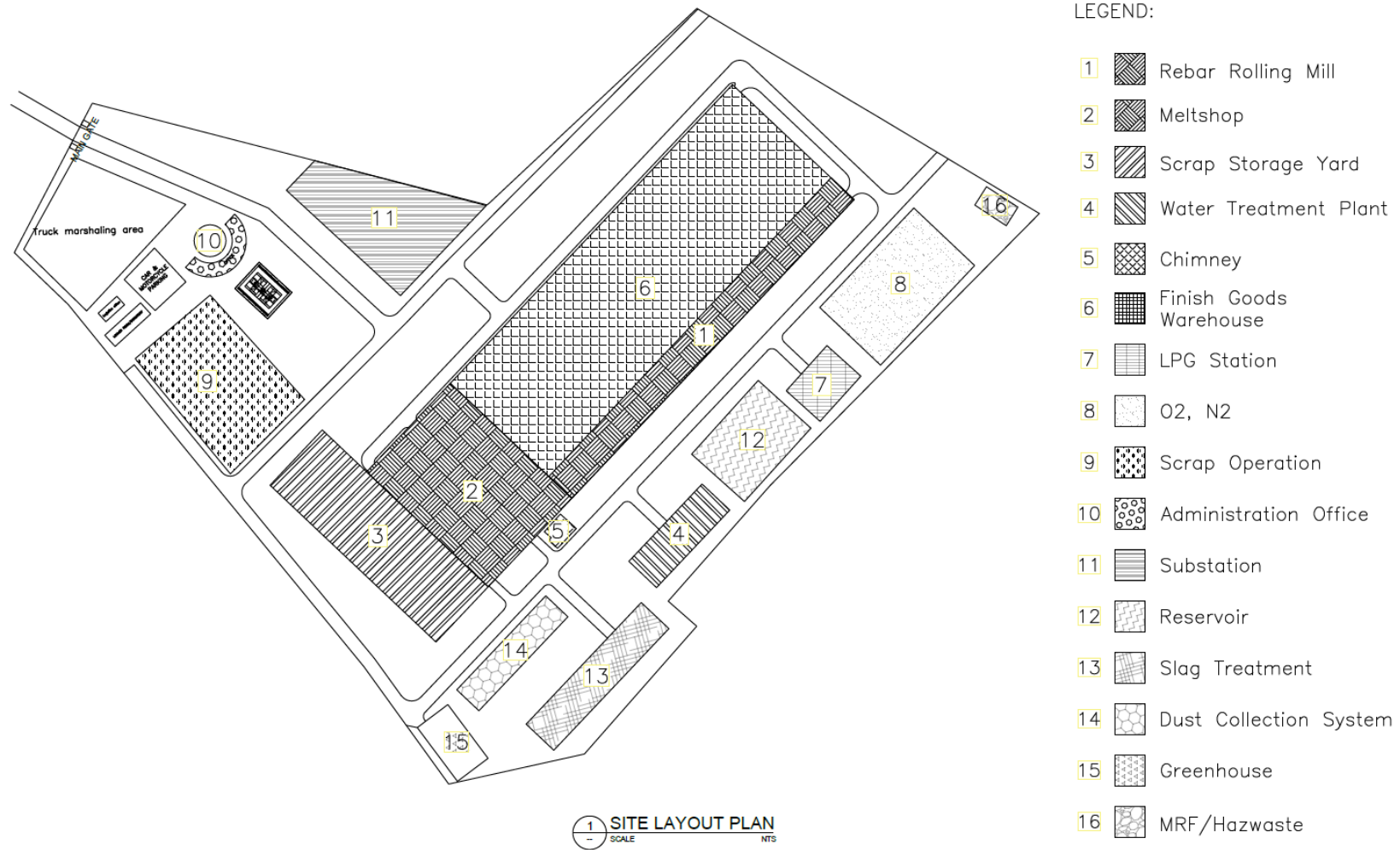
Components	Number of Units	Description
Direct Cooling Water System	2 sets	Circulation capacity is 1700m ³ /h. The circulation water will be used mainly for Rolling Mill and QTB area, etc. There are two (2) sets of cooling tower adopted in this system. One is for rolling mill with a capacity of 900m ³ /h and the other one is for QTB with a capacity of 800m ³ /h. The cooling tower is reinforced steel structures.
Support Facilities		
Power supply		<p>The power will be supplied by overhead lines at high voltage 138kV from the power company. The power distribution network voltages are described as shown below.</p> <ul style="list-style-type: none"> • AC 138kV receiving voltage • AC 22kV EAF/LF distribution voltage • AC 3.3kV main distribution voltage • AC 440V (3phase) low-voltage utilization voltage (low voltage for motors) • AC 460V (3phase) low-voltage supply voltage (transformer's secondary side rated voltage) • AC 230V (3phase) low-voltage of illumination • DC 110 V DC control voltage of the switchgear
Pollution Control Devices		
Sludge Treatment System		<p>Will treat the backwash water of filters, sludge from chemical degreasing device, etc.</p> <p>Auxiliary systems of filter press include: lime dosing facilities, sludge storage hopper and automatic control equipment, etc. This water treatment system guarantees zero discharge of untreated industrial wastewater.</p>
Dedusting System for the Melt Shops		<p>The system consists of the water-cooled flue duct, combustion chamber, natural air cooler, pulse-jet bag filter, fume exhaust fan, fume exhaust device and chimney, etc. It is located at the primary fume exhaust pipeline, as well as above the EAF for emission capture.</p> <ul style="list-style-type: none"> • Inlet fume flow is 300,000Nm³/h. • Inlet fume temperature 1300°C. • Clean gas dust content <10mg/Nm³
Slag Treatment System		The melting process generates slag, which is collected beneath the EAF in a slag pot. The slag treatment area is equipped with ventilators to prevent spread of fugitive dusts
Material Recovery Facility and Hazardous Waste Storage Area	2	Material Recovery Facilities (MRF) will be installed as temporary storage of solid and hazardous wastes.

1.4.4 General Layout of Facilities

Table 1.4.5 shows the components and the corresponding estimated footprints of the proposed project. **Figure 1.4.2** and **Figure 1.4.3** present the Site Development Plan and Drainage Plan for the proposed project.

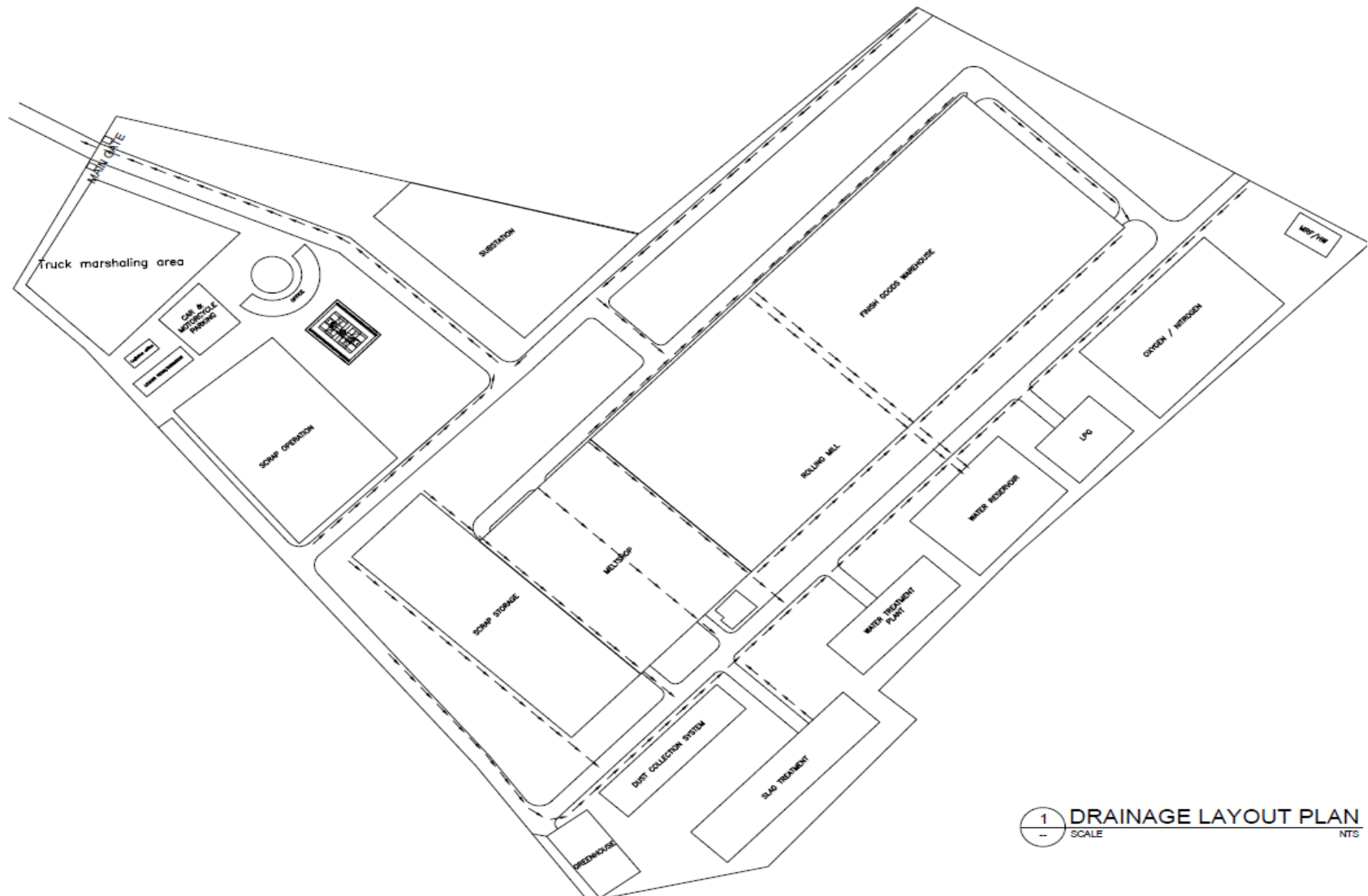
Table 1.4.5: Estimated Footprints of the Project Components

No.	Component	Area (m ²)
1	Rebar Rolling Mill	8,100
2	Meltshop	12,672
3	Scrap Storage Yard	10,800
4	Water Treatment Plant	2,520
5	Stack	340
6	Finish Goods Warehouse	34,668
7	LPG Station	1,728
8	O ₂ , N ₂	7,128
9	Scrap Operation	9,150
10	Administration Office	1,500
11	Substation	7,970
12	Retention Pond	4,380
13	Slag Treatment	3,960
14	Dedusting System	2,448
15	Greenhouse	1,600
16	MRF/Hazwaste	510
17	Logistics	180
18	Locker Room/Dormitory	456
19	Parking Lot	1,200
20	Truck Marshalling Area	7,900
21	Multi-Purpose Area	990
22	Roads, Sidewalks, Open Areas and Buffer Zone	127,835
Total		248,035



Source: SAMC

Figure 1.4.2: Site Development Plan



1 DRAINAGE LAYOUT PLAN
SCALE NTS

Figure 1.4.3: Site Drainage Plan

1.5 PROCESS /TECHNOLOGY

1.5.1 Processing/Manufacturing Technology

1.5.1.1 Light and Heavy Section Mills

Provided in **Table 1.5.1** and **Figure 1.5.1** are the Operations Process Flow of Light and Heavy Section Mill.

Table 1.5.1: Operation / Process Flow

Process		Description
1	Billet Charging	The hot or cold billets are feed into reheating furnace according to rolling cycle time.
2	Reheating	The process of reheating takes place in the furnace. The Billets will be reheated to 1150-1250 °C, suitable for rolling.
3	Descaling	To remove the scale on the surface of billet.
4	Rolling	The billet passes through a series of rollers which reduces the cross-section, and in the process, elongates the bar. At the end of this process, the final profiles and lengths are generated.
5	Slitting (For Rebar Only)	The single line is split into two during operation.
6	Universal Stands Rolling	The billet passes through universal stand rolling. This is a new technology in the Philippines and enables the manufacturing of sections as required by customers.
7	Quenching (For Rebar Only)	Rebar passes through a twin tempcore quenching system where it is rapidly cooled by a high-pressure spray of water. This process increases the yield and tensile strength of the rebars to conform to PNS49 requirements.
8	Cooling	Heat is dissipated from the process of cooling so that bars are not easily bent or damaged by succeeding processes.
9	Cutting	Sections are cut to 2 different commercial lengths – 6 meters, and 12 meters by saw or cold shear. Rebars are cut to 7 different commercial lengths – 6 meters, 7.5 meters, 9 meters, 10.5 meters, 12 meters, 13.5 meters and 15 meters by cold shear.
10	Stacking and Bundling	The stacking station is equipped with automatic bar counting system. It make section into square package, then the package is bundled into a standard count for easy storage and handling. Re-bars are bundled into a standard count for easy storage and handling.

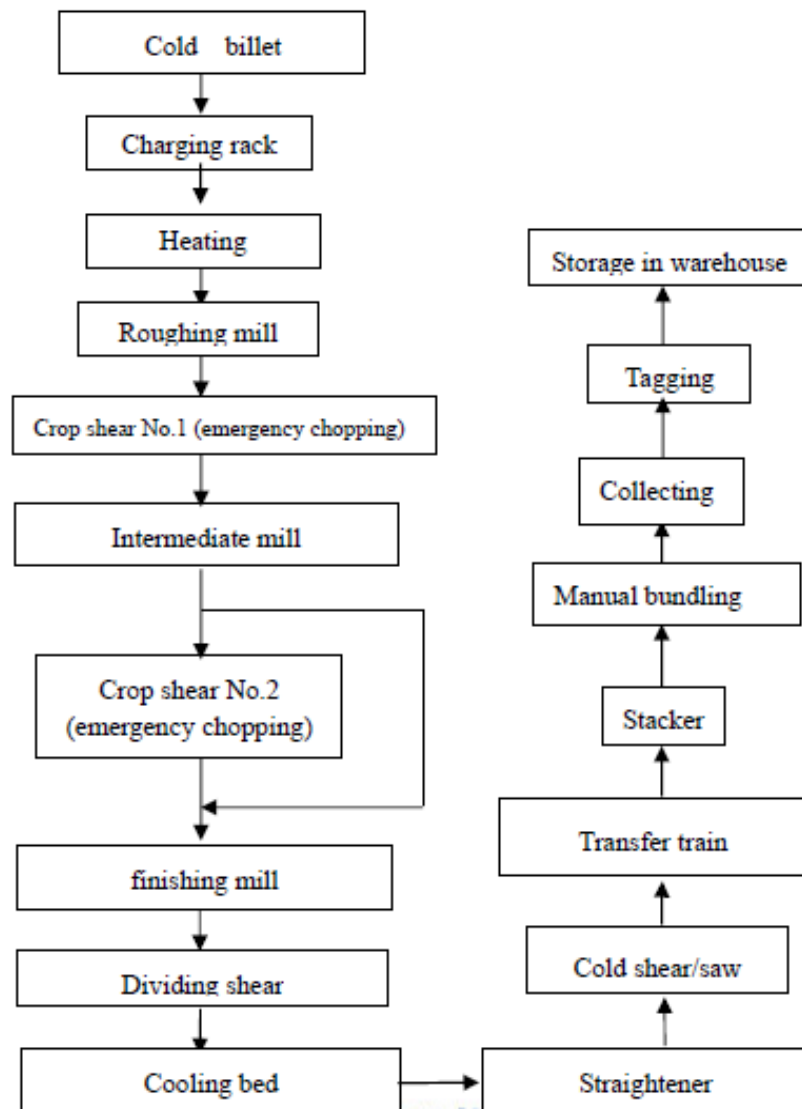


Figure 1.5.1: Light and Heavy Section Mills Process Flow

1.5.1.2 Steelmaking Process

The steelmaking process flow is: 100% Scrap – EAF – LF – CCM. The end-product of the steelmaking process will be used for steel light structural sections.

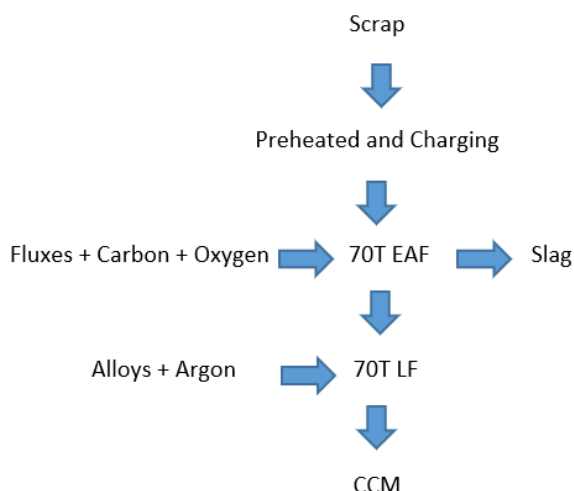
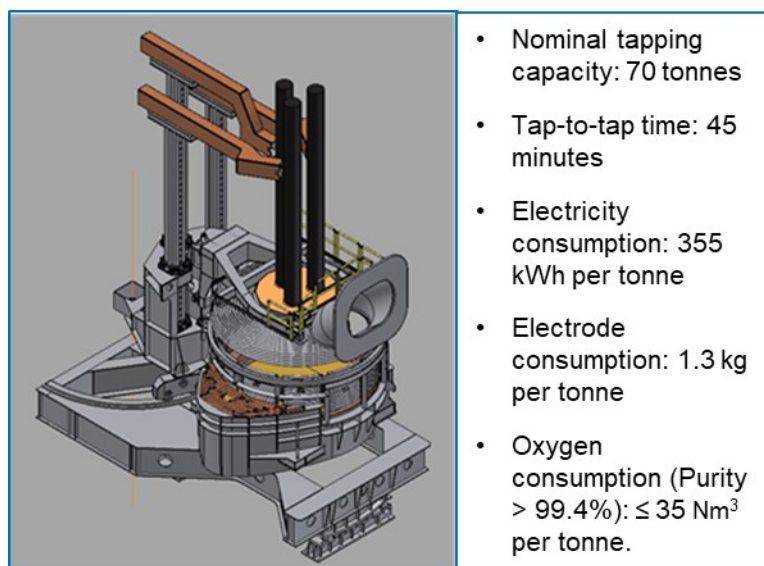


Figure 1.5.2: Steelmaking Process Flow

Electric Arc Furnace

The EAF makes use of electric arcs that emit extremely high heat at 6000°C in the furnace. The intense heat is sufficient to melt any steel scrap brought into contact. The continuous striking of the arcs melts all the scrap, and the bath temperature is steadily brought to around 1600°C, ready for tapping.

The structure of the EAF is shown in **Figure 1.5.3**. The High electrical power is connected to a set of three (3) graphite electrodes suspended from above the furnace. The furnace is a refractory-lined vessel that holds measured quantity of scrap or molten steel. The graphite electrode mast is controlled up and down the furnace so that predetermined arc currents will flow when in contact with the scrap.



Source: SAMC

Figure 1.5.3: Illustration of an EAF

There are various technologies available for the EAF to capture waste heat generated during the melting process. A waste heat recovery system makes use of the waste heat to preheat the in-

feeding scrap so that it attains around 500 to 600°C before being charged into the furnace. The feeding system is specially constructed to divert the hot waste gases from the EAF to heat the scrap before being ducted to the Fume Treatment Plant (FES). Benefiting from the scrap preheating system, electrical energy consumption can be reduced to 350kW-hours per tonne of liquid steel; as compared to 550kW-hours per tonne for most of the conventional EAF's in the ASEAN region. **Figure 1.5.4** shows a conceptual description of how the scrap is preheated before being charged into the EAF.

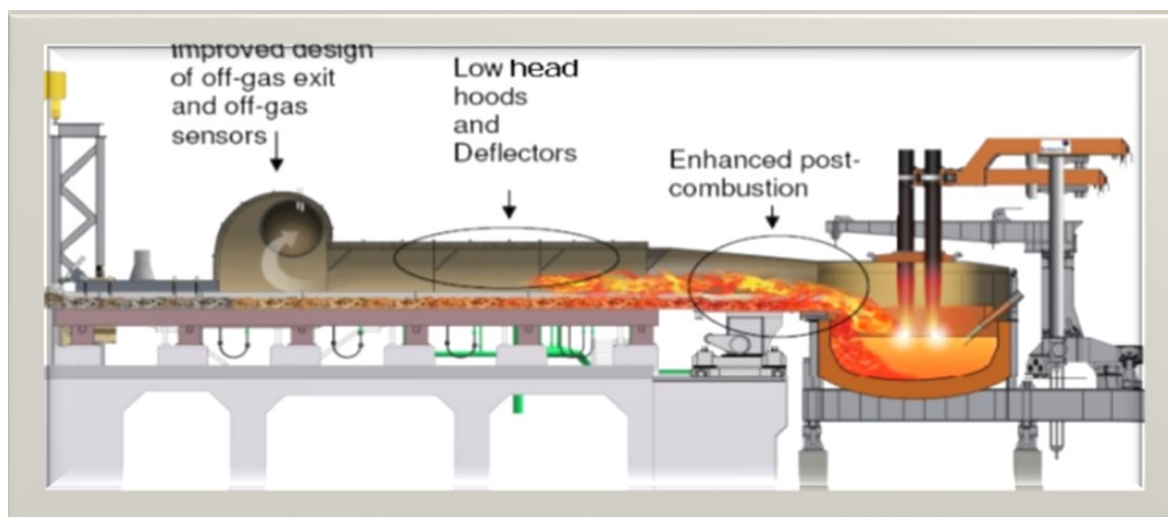


Figure 1.5.4: Description of Preheating Process of Scrap

This advance scrap preheating technology has brought about many advantages that a conventional EAF does not provide. These are summarized below.

1. The entire EAF-preheater system is predominantly kept closed for most of the melting cycle; as compared to batch-charging sequences for conventional EAF's. Much lesser fumes and heat escape from the furnace, allowing a cleaner and safer work environment. Less arcing noise will also be felt by workers around the furnace.
2. The furnace can be made to operate under flat-bath condition, whereby electric arcs are generated under the protection of a layer of slag. By so doing, the arcs become more stable hence imposing less power demand from the grid.
3. With proper tuning of the waste gas temperatures, all volatile gases can be completely oxidized along the scrap preheater system, hence negating the formation of dioxins in the stack emission.

The FES is adequately sized to provide sufficient suction and to handle the dust being collected from the process. Hot gas is drafted from the EAF through the scrap preheater at flow rate more than 300,000 Nm³/h. Thereafter, the flue gas flows into a combustion chamber for complete oxidation of the remaining combustibles. Larger particulates are settled at this station. The gas is further drafted to a heat exchanger to cool the temperature down to below 140°C, before going into the baghouse for dust removal. In the baghouse, the gas is distributed into a series of long filter bags. Dust particles gather at one side of the filter and clean gas passes through the filter medium. Gas velocity is controlled at around 1m/s to allow for maximum capture. Discharge dust concentration will be less than 10mg/Nm³, below National Standards set-limits. The gas is subsequently discharged into the atmosphere conforming to the National Clean Act, 1999 (RA8749).

Ladle Furnace

After EAF tapping, the molten steel is tapped into ladle, and being transported into the ladle furnace area for secondary metallurgical refining processes. The aim is to achieve clean steel of high quality at the LF station as well as attaining the precise final chemistry for the heat. Where needed, argon bubbling will be used to float out all impurities. For further raising and adjusting the melt temperature, the LF is provided with a set of arcing electrodes to control the amount of heat from the top surface of the molten steel.

To adjust the exact chemistry needed for the final physical properties of the material, ferroalloys are added in the LF station. Alloy addition is achieved completely remote and automatic. Recipes of alloys are already predetermined by the software and requires minimal human intervention. The system is also equipped with dust control mechanism inside and around the alloy charging system to minimize fugitive dust. A schematic diagram of the alloy charging system is shown in **Figure 1.5.5**.

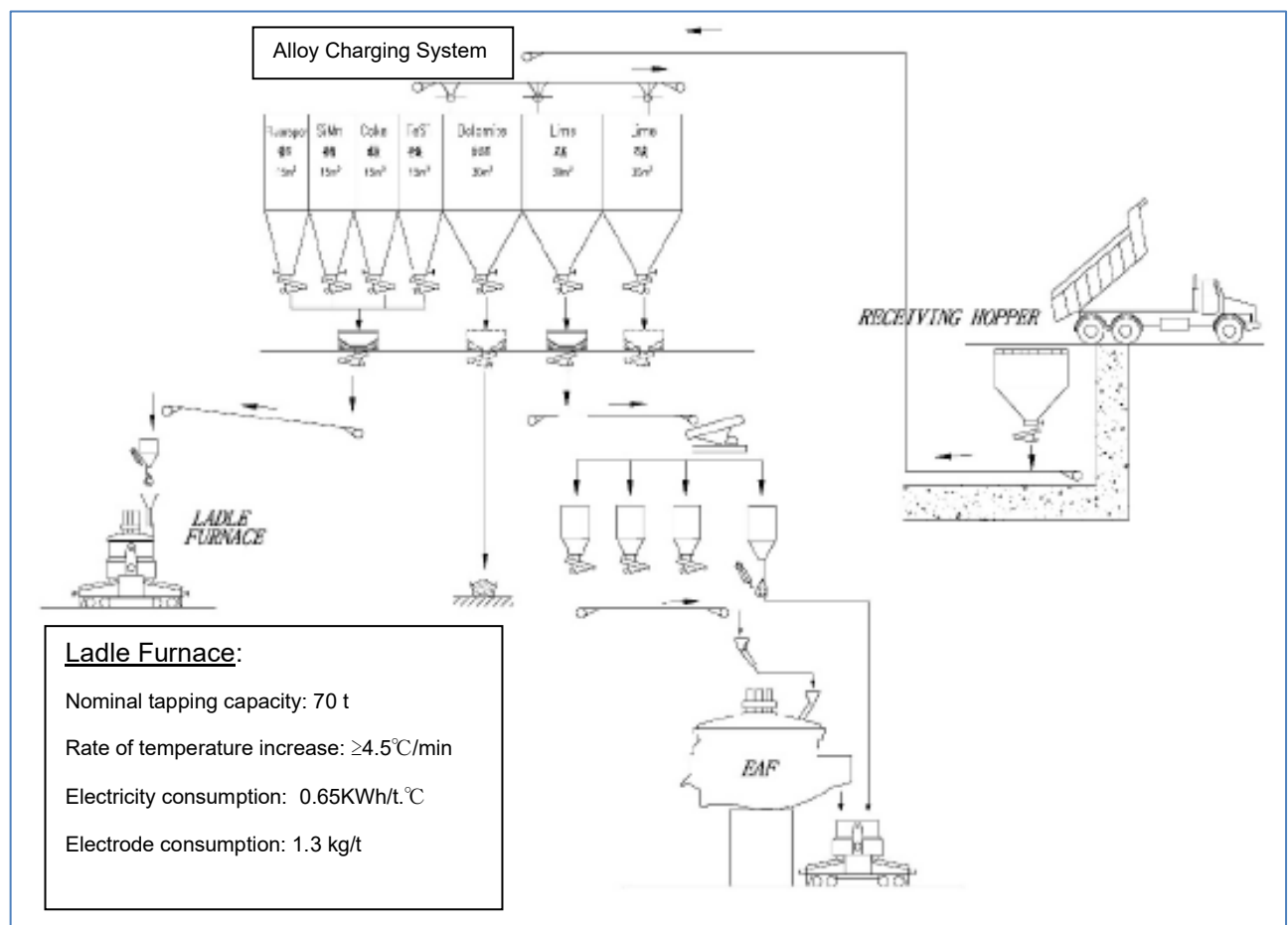


Figure 1.5.5: Schematic Diagram of the Alloy Charging System

The combined action of heat input, alloys and argon stirring result in the ultimate optimization of quality and casting needs of the melt ready to be cast into billets at the continuous casting machine.

Continuous Casting Machine

When the molten steel is ready for casting, the ladle is lifted by overhead electric crane onto a rotating turret in preparation for subsequent teeming. The cast flows from the ladle into a high capacity tundish that can hold around 14-18tonnes of steel. Streams of molten steel are made to

follow into four (4) separate molds for solidification. The high capacity tundish ensures temperature homogeneity and chemistry consistency to assure the eventual product steel quality.

The mold is made of a precision-finished copper mold tube that governs the exact shape of the eventual billet. Heat is evenly extracted from the four faces of the square mold tube by pressurized water flow through the mold assembly. The gradual formation of the shell from molten steel to solid billet comes slowly out of from the bottom of the mold passing into the secondary water spray region. Uniform heat extraction ensures good billet geometry and eliminates crack formation in any part of the material. Automatic mold level control technology and special mold oscillation mechanism are deployed. Radioactive source is used to detect and control the mold level to achieve good ferro-static pressure inside the mold. Drawing speed per casting strand is more than 3m/min to ensure high productivity. The caster has a casting radius of 9m.

Figure 1.5.6 shows the process flow sheet showing material balance, while **Figure 1.5.7** presents the water balance for the proposed Project.

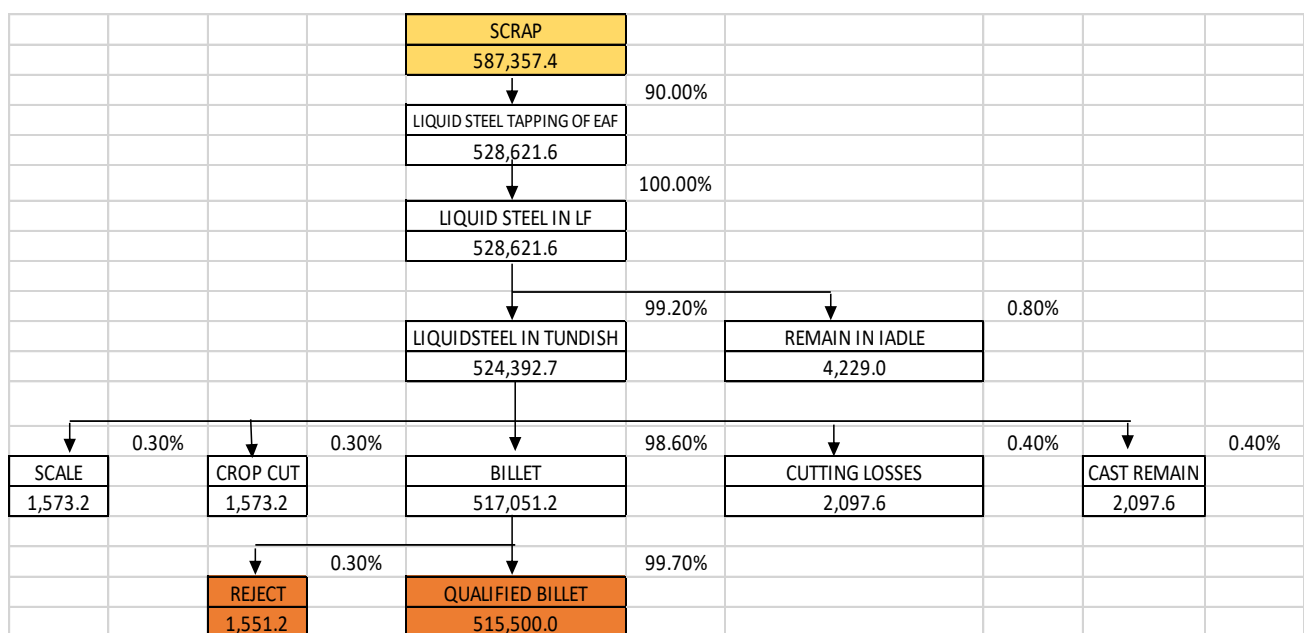


Figure 1.5.6: Process Flow Sheet with Material Balance

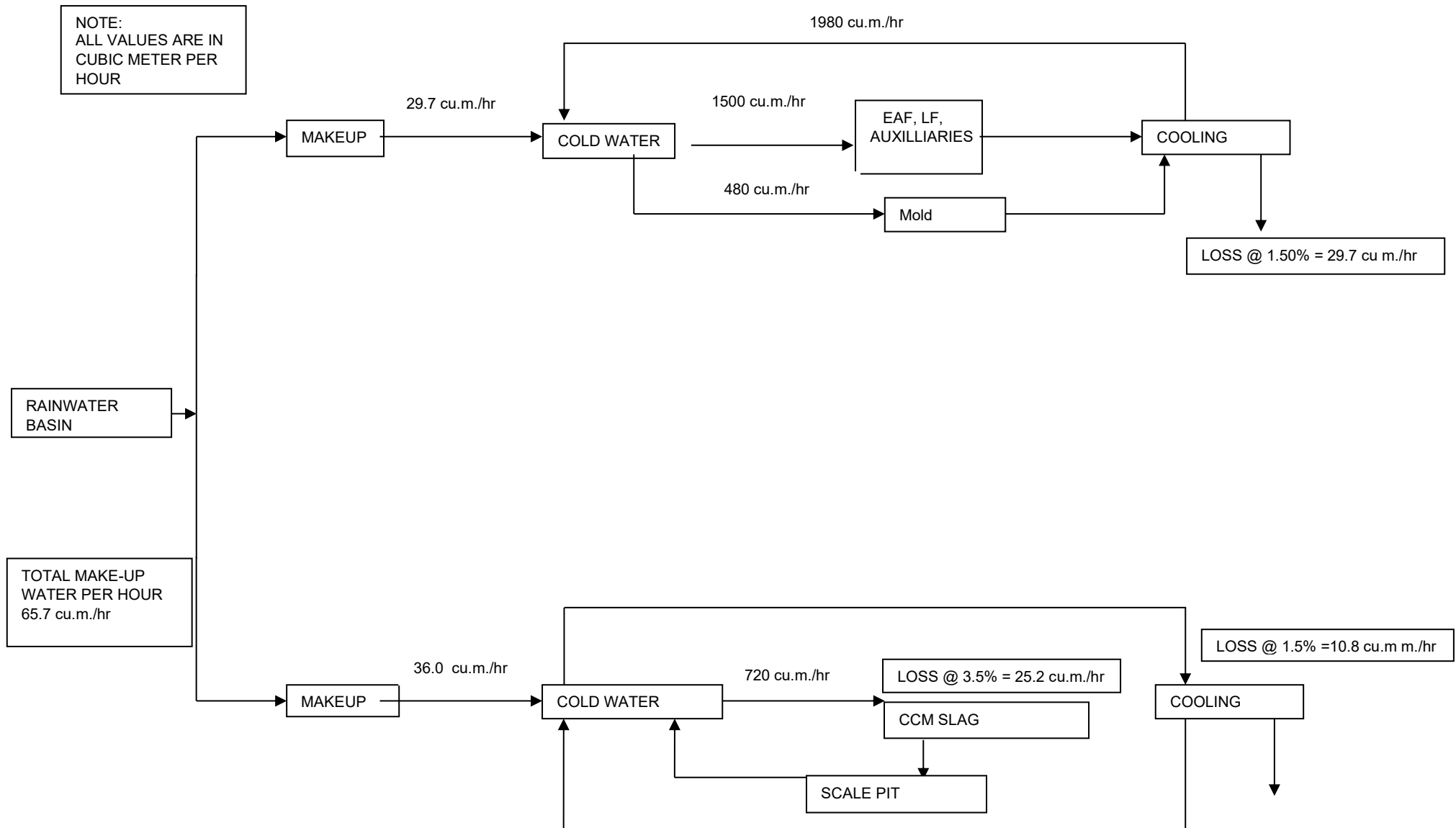


Figure 1.5.7: Water Balance

1.5.1.3 Make-Up Water System

The Make-up Water System will supply water to the whole make-up water network and fire protection water network of the plant. This system adopts Manganese sand filter. Makeup water pool is cleaned regularly. Residue from filter in this system flow into the mud regulation tank of Sludge Treatment System for combined treatment. Sodium hypochlorite (NaClO) is added at the exit of makeup water pool to inhibit bacterial growth. The Make-up water treatment process is presented in **Figure 1.5.8**.

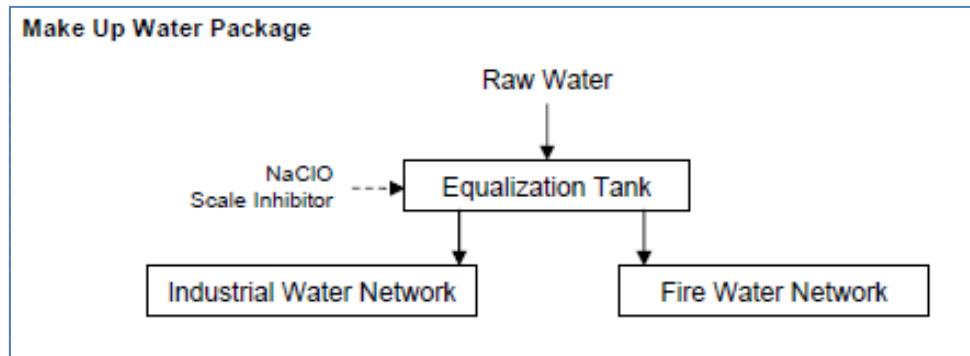
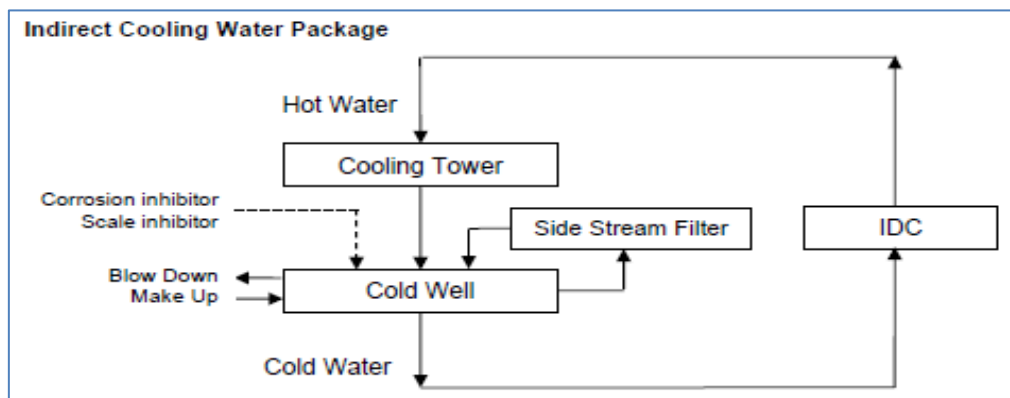


Figure 1.5.8: Make-up Water Treatment Process Flow

1.5.1.4 Indirect Cooling Water System

In the Indirect Cooling Water System, the circulating water is primarily performing heat exchange and the water quality is not contaminated by the process. The water returns to the cooling towers for cooling. The water can then be used again for all the heat exchange. Process flow of Indirect Cooling is presented in **Figure 1.5.9**.



Note: Cold waterpool → circulating pump → user → cooling tower → cold water pool. Furnace and other equipment set different pumps.

Figure 1.5.9: Indirect Cooling Process Flow

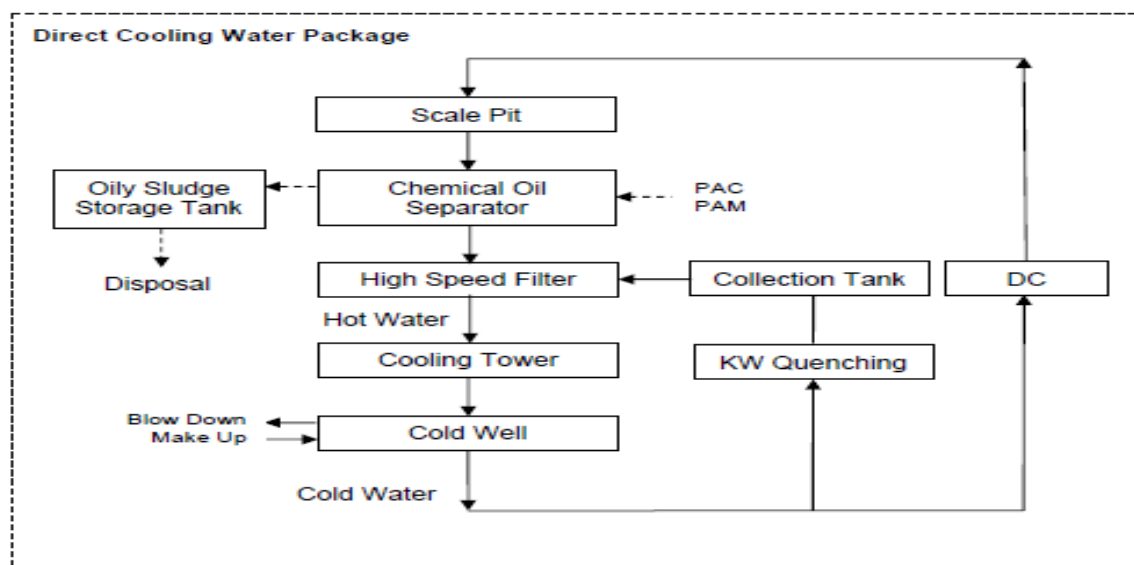
The cooling tower is reinforced steel structures. In order to reduce the content of suspended solids in water circulation, part of the circulating return water flow to homogeneous sand filter. The filtrate returns to the cold-water pool. To ensure water quality and stability, corrosion-prevention and scaling of equipment and pipeline, there are two (2) sets of chemical dosing device. Dosing device dispends corrosion-scale inhibitor and biocide. Sludge produced from filter in this system flow into the mud regulation tank of Sludge Treatment System.

1.5.1.5 Direct Cooling Water System

For the Light and Heavy Section Mills, the Rolling mill return-water flows to the underground scale pit by gravity. Some water is pumped to flush the exit furnace which is about 200m³/h. The rest of water is pumped to chemical degrease device to remove some suspended solids and grease, before being collected at the hot water pool. The water is then pumped to the cooling tower by lift pumps. The QTB return water flow to the underground return water pool by gravity. After that, part of the water is filtered. Then all the water flow to the cooling tower. After cooling down, there are two groups of pumps installed. one is for low pressure of 5 bar users; another is for 12 bar users.

For the Melt Shops, the process water flows to an underground scale pit by gravity. Some of the water is pumped to scrap ditch at flow rate of about 120m³/h. The rest is pumped to chemical degreasing device to remove suspended solids and oil. Then it is pumped to the cooling tower for cooling.

The process flow of direct cooling is presented in **Figure 1.5.10**.



Note: Return water → scale pit (water collecting pit for quenching) → lifting pump → chemical degrease device → cooling tower → cold water pool → circulating pump → self-cleaning filter → user → return water.

Figure 1.5.10: Direct Cooling Process Flow

1.5.1.6 Soft Water Cooling Water System

Soft water, after ion exchange, is used for conducting arms cooling of EAF and LF electrode masts as well as the copper molds in CCM. Total soft water flow rate is 480m³/h. The circulating water temperature rises during the process. This is returned to the soft-water pool for cooling by heat exchanger with indirect cooling water. The basic process is from Soft water pool - circulating pump - user heat exchanger - soft water pool. To ensure water quality and stability, and prevent corrosion and scaling of equipment and pipelines, there are two (2) sets of dosing devices for corrosion inhibitor and biocide.

1.5.1.7 Sludge Treatment System

Sludge Treatment System will be utilized to treat the backwash water of filters and sludge from chemical degreasing device, etc. The wastewater with sludge firstly enter in the mud regulation tank, which will be pumped to the concentrated pool. There are two (2) sets of concentrated pool. The surface fluid of concentrated pool overflows into the underground scale pit of Direct Cooling Water. The sludge settled from concentrated pool is lifted by pumps to filter press for dewatering, followed by dehydration. The

dewatered sludge cake is around 65% dryness. The cakes are collected in a cake hopper for storage and will be disposed of to a DENR-3rd Party Treater.

Auxiliary systems of filter press include: lime dosing facilities, sludge storage hopper and automatic control equipment, etc. There are two (2) sludge hoppers corresponds with the filter presses. Each press has duty cycle of 8 to 16 hours per day, depending on quantity of sludge generated. The press is fully automatic. The filtrate and cloth wash water is recirculated to the underground scale pit of Direct Cooling Water. In order to accelerate sludge flocculation and sedimentation, and promote the thickening and dewatering effect, two sets of dosing device are used. Process flow of sludge treatment is presented in **Figure 1.5.11**.

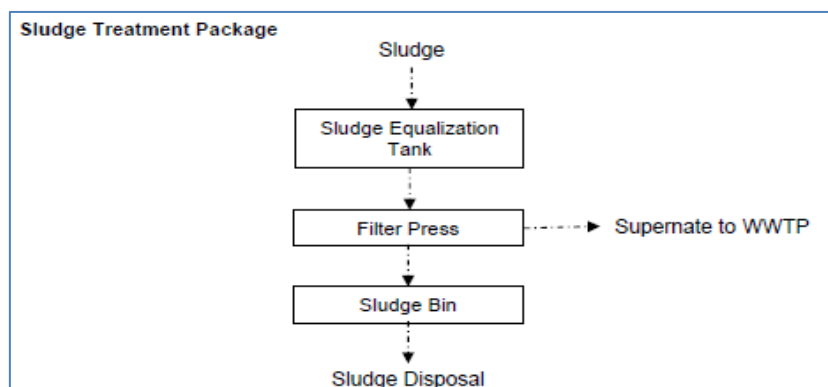


Figure 1.5.11: Sludge Treatment Process Flow

1.5.1.8 Slag Treatment System

The melting process generates slag, which is collected beneath the EAF in a slag pot. The slag treatment area is equipped with ventilators to prevent spread of fugitive dusts. The slag car transports the pot full of slag to the slag bay. The 40/10t metallurgical crane in the bay lifts the pot onto a truck, to be transferred to an external treatment area. At the slag treatment area, the hot slag is poured into a holding area and being sprayed-cooled by measured quantity of water. A special excavator, fitted with high temperature protection shields, works on the slag by mixing, churning, and eventually scooped to be cured for 24 hours. After the slag is cooled to atmospheric temperature, magnetic lumps are recovered by magnets for charging back into the EAF. The remaining slag granules can be crushed to be made into road stones and bricks. The slag treatment area is equipped with ventilators to prevent spread of fugitive dusts.

1.5.3 Operations and Maintenance of Facility

Provided **Tables 1.5.2** and **Table 1.5.3** are the operations and maintenance of the Light and Heavy Section Mills and Melt Shops.

Table 1.5.2: Operations and Maintenance of the Light and Heavy Section Mills

Equipment	Maintenance Activities	Frequency
Furnace Section		
Billet Handling (Loading Table)	Monitoring of hydraulic cylinder, solenoid valve, hose, and tube/pipe.	Daily
	Lubricating of wheel, and rotating joints.	Weekly
	Replacement of tilting arm pusher, wheel, and bearing. (Based also on the condition of tilting arm pusher, wheel, and bearing)	2 Years
	Replacement of hydraulic cylinder, and solenoid valve. (Based also on the condition of hydraulic cylinder)	2 Years

Equipment	Maintenance Activities	Frequency
Roller Table 1 (Charging Billet)	Monitoring of bearing housing temperature, lubrication, gear coupling temperature, rollers, noise, and vibration.	Daily
	Tightening of bolts and lubricating of bearing housing.	Daily
	Replacement of rollers. (Based also on the condition of roller)	2 Years
	Replacement of bearing. (Based also on the condition of bearing)	2 Years
	Dismantle of gearbox assembly. Inspection of bearing, gears and shaft condition. Replacement of driveshaft bearings and oil seals. (Note: Depends on the years of service, for less than 5 years, no need to dismantle. Base on monitoring)	2 Years
Roller Table 2 (Charging Billet Tilter), Roller Table 3	Monitoring of bearing housing temperature, lubrication, gear coupling temperature, rollers, noise, and vibration.	Daily
	Inspection of hydraulic cylinder, solenoid valve, hose, and tube/pipe.	Weekly
	Tightening of bolts and lubricating of bearing housing.	Daily
	Replacement of hydraulic cylinder, and solenoid valve. (Based also on the condition of hydraulic cylinder)	2 Years
	Replacement of rollers. (Based also on the condition of roller)	2 Years
	Replacement of bearing. (Based also on the condition of bearing)	2 Years
	Dismantle of gearbox assembly. Inspection of bearing, gears and shaft condition. Replacement of driveshaft bearings and oil seals. (Note: Depends on the years of service, for less than 5 years, no need to dismantle. Base on monitoring)	2 Years
Disappearing Stopper	Monitoring of hydraulic cylinder, solenoid valve, and hose.	Daily
	Tightening of bolts and lubricating of pin/bushing.	Daily
	Replacement of hydraulic cylinder, and solenoid valve.	Yearly
Main Fuel Pump, Zone Pump	Monitoring of pump temperature, noise, and vibration.	Daily
	Tightening of bolts.	Daily
	Replacement of pump. (Based also on the condition of pump)	2 Years
Combustion Air Fan, Waste Gas Dilution Fan	Monitoring of bearing housing temperature, lubrication, noise, and vibration.	Daily
	Inspection of belt and pulley.	Weekly
	Tightening of bolts and lubricating of bearing and pin/bushing.	Daily
	Replacement of belt.	Yearly
Discharging Door	Monitoring of air pressure and lubrication at FRL, pulley, and chain.	Daily
	Inspection of chain, and door.	Weekly
	Tightening of bolts and lubricating of pulley.	Daily
	Replacement of pneumatic cylinder, and solenoid valve.	2 Years
Billet Detector	Monitoring of air pressure and lubrication at FRL, chain, and cooling.	Daily
	Inspection of sprocket, chain, wheel and billet detector rod.	Weekly
	Tightening of bolts and lubricating of roller.	Daily
	Replacement of chain, and sprocket.	2 Years
	Replacement of pneumatic cylinder, and solenoid valve.	2 Years
Roller Table (Exit Roller)	Monitoring of bearing housing temperature, lubrication, gear coupling temperature, rollers, noise, and vibration.	Daily
	Tightening of bolts and lubricating of bearing housing.	Daily
	Replacement of rollers. (Based also on the condition of roller)	Yearly
	Replacement of bearing. (Based also on the condition of bearing)	Yearly
	Dismantle of gearbox assembly. Inspection of bearing, gears and shaft condition. Replacement of driveshaft bearings and oil seals. (Note: Depends on the years of service, for less than 5 years, no need to dismantle. Base on monitoring)	2 Years
Rolling Mill Section		
Descaler	Inspection of solenoid valve, tube, and nozzle.	Monthly
Gearbox of stands	Monitoring of bearing housing temperature, lubrication pressure and temperature, gear coupling temperature, noise, and vibration.	Daily
	Inspection of oil spray nozzles.	Monthly
	Tightening of bolt and lubricating of drive gear coupling.	Weekly
	Dismantle of gearbox assembly. Inspection of bearing, gear and shaft condition. Replacement of driveshaft bearing and oil seal. (Note: Depends on the years of service, for less than 5 years, no need to dismantle. Base on monitoring)	2 Years

Equipment	Maintenance Activities	Frequency
Stand Assembly	Monitoring of spindle carrier bearing housing temperature, air/oil lubrication, noise, and vibration.	Daily
	Monitoring of gear coupling, spindle, and cross joint.	Daily
	Monitoring of hydraulic oil pressure, temperature, and level.	Daily
	Inspection of hydraulic cylinder, solenoid valve, hose, and tube/pipe.	Weekly
	Replacement of hydraulic cylinder, and solenoid valve.	Yearly
	Monitoring and lubricating of all spindle carrier bearing.	Daily
	Tightening of bolt, and lubricating of spindle, and cross joint.	Weekly
	Dismantle of spindle carrier assembly. Inspection of bearing, and seal. Replacement of bearing and oil seal. (Note: Depends on the years of service, for less than 2 years, no need to dismantle. Base on monitoring)	2 Years
Fly Shear	Monitoring of shear blade, bearing housing temperature, lubrication pressure and temperature, gear coupling temperature, noise, and vibration.	Daily
	Inspection of oil spray nozzles.	Monthly
	Monitoring of brake assembly.	Daily
	Tightening of bolt and lubricating of drive coupling.	Weekly
	Monitoring and lubricating of roller bearing and pin/bushing at channel.	Daily
	Replacement of roller. (Based also on the condition of the roller).	Yearly
	Monitoring of blade & assembly.	Daily
	Replacement of shear blade.	As needed
	Monitoring of air pressure and lubrication at fiber-reinforced lining (FRL).	Daily
	Inspection of pneumatic cylinder, solenoid valve, and hose.	Daily
	Replacement of cylinder, and solenoid valve.	Yearly
	Dismantle of gearbox assembly. Inspection of bearing, gears and shaft condition. Replacement of driveshaft bearings and oil seals. (Note: Depends on the years of service, for less than 2 years, no need to dismantle. Base on monitoring)	2 Years
Loop Forming Device	Monitoring of air pressure and lubrication at FRL.	Daily
	Monitoring of pneumatic cylinder, valve, and hose.	Daily
	Replacement of cylinder, & solenoid valve.	Yearly
Auxiliary Section		
Quenching system	Monitoring of valves, tube, and nozzle.	Daily
	Monitoring of nozzle bores	Daily
	Replacement of nozzle bores	As needed
Roller Table (Run in / Sliding Apron)	Monitoring of pin housing, pin; air pressure and lubrication at FRL and accumulator tank.	Daily
	Inspection of rollers, pins, pneumatic cylinder, regulator, and hose.	Daily
	Tightening of bolts and lubricating of pin/bushing.	Daily
	Replacement of rollers. (Based also on the condition of roller)	Monthly
	Replacement of hydraulic cylinder, and regulator.	Yearly
	Replacement of pin & bearing.	2 Years
Rake Section (Fixed & Moving)	Monitoring of bearing housing temperature, lubrication, gear coupling temperature, noise, and vibration.	Daily
	Monitoring of brake and rollers assembly.	Daily
	Tightening and lubricating of drive coupling and spindle.	Weekly
	Monitoring and tightening of rake.	Daily
	Dismantle of gearbox assembly. Inspection of bearing, gears and shaft condition. Replacement of driveshaft bearings and oil seals. (Note: Depends on the years of service, for less than 2 years, no need to dismantle. Base on monitoring)	2 Years
Roller Table (Aligning Rollers)	Monitoring of rollers, pillow blocks, chains, and sprockets.	Daily
	Tightening of bolts and lubricating of pillow blocks.	Daily
	Replacement of rollers. (Based also on the condition of roller)	2 Years
	Replacement of pillow blocks, chain, and sprockets	2 Years
Chain Transfer System, Feeding Chain Conveyor,	Monitoring of bearing housing temperature, lubrication, gear coupling temperature, chain, sprocket, noise, and vibration.	Daily
	Tightening and lubricating of drive coupling, sprocket, and shaft.	Weekly

Equipment	Maintenance Activities	Frequency
Storage Chain Conveyor	Tensioning and lubricating of chain.	Daily
	Monitoring and lubricating of plumber block.	Daily
	Replacement of sprocket and chain. (Based also on the condition of sprocket and chain)	2 Years
	Replacement of bearing. (Based also on the condition of bearing)	2 Years
	Dismantle of gearbox assembly. Inspection of bearing, gears and shaft condition. Replacement of driveshaft bearings and oil seals. (Note: Depends on the years of service, for less than 2 years, no need to dismantle. Base on monitoring)	2 Years
Trolley Transfer System, Dual Section Trolley Transfer System	Monitoring of bearing housing temperature, lubrication, gear coupling temperature, chain, sprocket, noise, and vibration.	Daily
	Inspection of hydraulic cylinder, solenoid valve, hose, and tube/pipe.	Weekly
	Tightening and lubricating of drive coupling, sprocket, and shaft.	Weekly
	Tensioning and lubricating of chain.	Daily
	Monitoring and lubricating of plumber block and pillow block.	Daily
	Replacement of sprocket and chain. (Based also on the condition of sprocket and chain)	2 Years
	Replacement of bearing. (Based also on the condition of bearing)	2 Years
	Replacement of hydraulic cylinder, and solenoid valve.	Yearly
	Dismantle of gearbox assembly. Inspection of bearing, gears and shaft condition. Replacement of driveshaft bearings and oil seals. (Note: Depends on the years of service, for less than 2 years, no need to dismantle. Base on monitoring)	2 Years
Roller Table (Run out)	Monitoring of bearing housing temperature, lubrication, gear coupling temperature, rollers, noise, and vibration.	Daily
	Monitoring and lubricating of plumber block.	Daily
	Replacement of rollers. (Based also on the condition of roller)	2 Years
	Replacement of bearing. (Based also on the condition of bearing)	2 Years
	Dismantle of gearbox assembly. Inspection of bearing, gears and shaft condition. Replacement of driveshaft bearings and oil seals. (Note: Depends on the years of service, for less than 2 years, no need to dismantle. Base on monitoring)	2 Years
Straightening machine	Monitoring of spindle lubrication and vibration.	Daily
	Monitoring of hydraulic oil pressure, temperature, and level.	Daily
	Inspection of hydraulic cylinder, solenoid valve, hose, and tube/pipe.	Weekly
	Replacement of hydraulic cylinder, and solenoid valve.	Yearly
	Tightening of bolt, and lubricating of spindle, and cross joint.	Weekly
	Dismantle of spindle carrier assembly. Inspection of bearing, and seal. Replacement of bearing and oil seal. (Note: Depends on the years of service, for less than 2 years, no need to dismantle. Base on monitoring)	2 Years
Cold Shear	Monitoring of bearing housing temperature, lubrication pressure and temperature, gear coupling temperature, noise, and vibration.	Daily
	Inspection of gear oil spray nozzles.	Monthly
	Tightening of bolt and lubricating of drive gear coupling.	Weekly
	Monitoring of brake assembly.	Daily
	Monitoring of lubricating of bearing, pin and bushing.	Daily
	Replacement of roller. (Based also on the condition of roller)	Yearly
	Monitoring of shear blade & assembly.	Daily
	Replacement of shear blade.	As needed
	Monitoring of air pressure and lubrication at FRL.	Daily
	Inspection of pneumatic cylinder, solenoid valve, and hose.	Weekly
	Replacement of pneumatic cylinder, and solenoid valve.	2 Years
	Monitoring of hydraulic oil pressure, temperature, and level.	Daily
	Inspection of hydraulic cylinder, solenoid valve, hose, and tube/pipe.	Weekly
	Replacement of hydraulic cylinder, and solenoid valve.	2 Years
	Dismantle of gearbox assembly. Inspection of bearing, gear and shaft condition. Replacement of driveshaft bearing and oil seal. (Note: Depends on the years of service, for less than 2 years, no need to dismantle. Base on monitoring)	2 Years

Equipment	Maintenance Activities	Frequency
	Replacement of shear blade. [Note: Depends on the blade life (Tons produce) and also condition of blade. Shear = 300,000 MT	Blade Life (MT)
Gauge Stopper for cold shear and saws	Monitoring of air pressure and lubrication.	Daily
	Monitoring of pneumatic cylinder, solenoid valve, and hose.	Daily
	Tightening of bolts and lubricating of pin/bushing.	Daily
	Replacement of pneumatic cylinder, and solenoid valve.	Yearly
Transfer	Monitoring of bearing housing temperature, lubrication, gear coupling temperature, chain, sprocket, noise, and vibration.	Daily
	Tightening and lubricating of drive coupling, sprocket, and shaft.	Weekly
	Tensioning and lubricating of chain.	Daily
	Inspection of hydraulic cylinder, solenoid valve, hose, and tube/pipe.	Weekly
	Replacement of hydraulic cylinder, and solenoid valve.	Yearly
	Replacement of sprocket and chain. (Based also on the condition of sprocket and chain)	2 Years
	Replacement of bearing. (Based also on the condition of bearing)	2 Years
	Dismantle of gearbox assembly. Inspection of bearing, gears and shaft condition. Replacement of driveshaft bearings and oil seals. (Note: Depends on the years of service, for less than 2 years, no need to dismantle. Base on monitoring)	2 Years
Run out Roller Table for Transfer and Saws	Monitoring of bearing housing temperature, lubrication, gear coupling temperature, rollers, noise, and vibration.	Daily
	Monitoring and lubricating of plumber block.	Daily
	Replacement of rollers. (Based also on the condition of roller)	2 Years
	Replacement of bearing. (Based also on the condition of bearing)	2 Years
	Dismantle of gearbox assembly. Inspection of bearing, gears and shaft condition. Replacement of driveshaft bearings and oil seals. (Note: Depends on the years of service, for less than 2 years, no need to dismantle. Base on monitoring)	2 Years
Cold Saws	Monitoring of the pressure of lubrication and hydraulic.	Daily
	Monitoring of gear box condition, noise, and vibration.	Daily
	Monitoring of main shaft condition, noise, and vibration.	Daily
	Tightening of bolt and lubricating of drive coupling.	Weekly
	Monitoring and lubricating of roller bearing and pin/bushing at channel.	Daily
	Replacement of cylinder, and solenoid valve.	Yearly
	Replacement of saw blade. [Note: Depends on the blade life (Tons produce) and condition of saw blade. Typical = 200,000 MT	Blade Life (MT)
Bar Counting System	Tightening and lubrication of coupling, plumber block, and pillow block.	Weekly
	Inspection of hydraulic cylinder, solenoid valve, hose, and tube/pipe.	Weekly
	Replacement of bearing. (Based also on the condition of bearing)	2 Years
	Replacement of hydraulic cylinder, and solenoid valve.	Yearly
Magnetic Stacker	Monitoring of bearing housing temperature, lubrication, gear coupling temperature, chain, sprocket, noise, and vibration.	Daily
	Tightening and lubricating of drive coupling, sprocket, and shaft.	Weekly
	Inspection of hydraulic cylinder, solenoid valve, hose, and tube/pipe.	Weekly
	Replacement of hydraulic cylinder, and solenoid valve.	Yearly
	Replacement of bearing. (Based also on the condition of bearing)	2 Years
	Dismantle of gearbox assembly. Inspection of bearing, gears and shaft condition. Replacement of driveshaft bearings and oil seals. (Note: Depends on the years of service, for less than 2 years, no need to dismantle. Base on monitoring)	2 Years
Collecting Cradles	Tightening and lubrication of coupling, plumber block, and pillow block.	Weekly
	Inspection of hydraulic cylinder, solenoid valve, hose, and tube/pipe.	Weekly
	Replacement of bearing. (Based also on the condition of bearing)	2 Years
	Replacement of hydraulic cylinder, and solenoid valve.	Yearly
Roller Table before tying	Monitoring of bearing housing temperature, lubrication, gear coupling temperature, rollers, noise, and vibration.	Daily
	Monitoring and lubricating of plumber block.	Daily
	Replacement of rollers. (Based also on the condition of roller)	2 Years
	Replacement of bearing. (Based also on the condition of bearing)	2 Years

Equipment	Maintenance Activities	Frequency
	Dismantle of gearbox assembly. Inspection of bearing, gears and shaft condition. Replacement of driveshaft bearings and oil seals. (Note: Depends on the years of service, for less than 2 years, no need to dismantle. Base on monitoring)	2 Years
Tying Machine	Monitoring of hydraulic oil pressure, temperature, and level.	Daily
	Cleaning and lubricating of bearing, pin and bushing.	8 Hours
	Replacement of roller. (Based also on the condition of roller)	2 Years
	Replacement of bearing. (Based also on the condition of bearing)	Yearly
	Inspection of tying wire shear blade & assembly.	Daily
	Inspection of hydraulic cylinder, hydraulic motor, solenoid valve, hose, and tube/pipe.	Weekly
	Replacement of hydraulic filter.	Quarterly
	Replacement of hydraulic cylinder, hydraulic motor, and solenoid valve.	2 Years
Lifting Table Chain Bundle Transfer Devices	Monitoring of bearing housing temperature, lubrication, gear coupling temperature, chain, sprocket, noise, and vibration.	Daily
	Tightening and lubricating of drive coupling, sprocket, and shaft.	Weekly
	Tensioning and lubricating of chain.	Daily
	Inspection of hydraulic cylinder, solenoid valve, hose, and tube/pipe.	Weekly
	Replacement of hydraulic cylinder, and solenoid valve.	Yearly
	Replacement of sprocket and chain. (Based also on the condition of sprocket and chain)	2 Years
	Replacement of bearing. (Based also on the condition of bearing)	2 Years
	Dismantle of gearbox assembly. Inspection of bearing, gears and shaft condition. Replacement of driveshaft bearings and oil seals. (Note: Depends on the years of service, for less than 2 years, no need to dismantle. Base on monitoring)	2 Years
Utilities Section		
Air Compressor	Change Oil.	6,000 running hours
	Replacement of oil filter.	
	Replacement of oil separator.	
	Replacement of air filter.	3,000 running hours
	Inspection of belt/coupling.	
	Inspection of valve.	12,000 running hours
Dryer	Replacement of oil filter.	6,000 running hours
Crane		
Wire Rope	Checking by sight for any deformation, wear kinks and element disconnection. Measurement of wire rope diameter. Greasing.	Monthly
Rope Drum	Checking by sight for any deformation, wear, crack and looseness. Measurement of groove.	Monthly
Wheel and bearing	Checking of any deformation, abnormal noise. Measurement of wheel dimension (diameter, width, lip thickness).	Monthly
	Greasing of bearing.	Weekly
Frame	Check for cracks on the running saddle and girder. Inspection of hook using crack detection dye. Tightening of bolt.	Monthly
Bottom block and pulley	Greasing of bearing. Inspection of pulley groove.	Monthly
Crane Hoist	Overhauling. Pull out the hoist and inspect all parts. Replace all wheel, hoist and gearbox bearings.	2 Years
Water Treatment Plant		
Pumps	Monitor Temperature	Daily
	Visually inspect the lifting chain/rope	Every 4,000 operating hours

Equipment	Maintenance Activities	Frequency
	Check the mechanical seal leakage	Every 10,000 operating hours
	Lubricate the bearings	
	General Overhaul and change impeller	Every 5 years
	Manual greasing motor bearings	Every 3000 operating hours
Cooling Tower	Monitor Temperature	Daily
	Monitor Pressure	Daily
	Lubrication	Every 3000 operating hours
	Check the tightening of the bolts.	Every 6 Months
	Check the fan blades to ensure their structural integrity	
	Cleaning of blades	
Sand Filter	Sedimentation	Every 72 operating hours
	Air Removal	
	Drain	
	Backwash	Every 24 operating hours
	Air and Water Backwash	
	Filling	
Lubrication Unit	Monitoring of oil (pressure, temperature, level, and color), cooling temperature, filter, pump temperature, noise, and vibration.	Daily
	Inspection of pump, filter, hose, and pipe/tube.	Weekly
	Replacement of filter.	2 months
	Replacement of pump, and valves. (Based also on the condition of pump and valve)	3 Years
	Change oil. (Based also on the monitoring)	3 Years
Hydraulic	Monitoring of oil (pressure, temperature, level, and color), cooling temperature, filter, pump temperature, noise, and vibration.	Daily
	Inspection of pump, filter, hose, and pipe/tube.	Weekly
	Replacement of filter.	2 months
	Replacement of pump, and valves. (Based also on the condition of pump and valve)	3 Years
	Change oil. (Based also on the monitoring)	3 Years
Hydraulic Valve Stand	Cleaning and servicing (stop leaks).	Weekly
Cylinder, Solenoid Valve, Flow Control	Replacement (Recondition - cleaning and replacement of seal)	Yearly
Air Tank Receiver	Inspection and cleaning of tank and valves.	Yearly

Table 1.5.3: Operations and Maintenance of the Melt Shops

Equipment	Maintenance Activities	Frequency
Main Section		
Scrap charging system	Monitoring of hydraulic cylinder, solenoid valve, hose, and tube/pipe.	Daily
	Monitoring of bearings.	
	Monitoring of lubricating of all rotating joints.	Weekly
	Replacement of hydraulic cylinder, and solenoid valve, bearing.	Based also on the condition used
Auxiliary material charging system -Belt conveyor	Monitoring of belt	Daily
	Monitoring of bearings.	
	Monitoring of lubricating of all rotating joints.	Weekly

Equipment	Maintenance Activities	Frequency
	Replacement of belt, bearing.	Based also on the condition used
Auxiliary material charging system -Vibrating feeder	Monitoring of springs.	Daily
	Replacement of springs.	Based also on the condition used
EAF and LF	Monitoring of hydraulic cylinder, solenoid valve, and hose.	Daily
	Monitoring of bearings.	
	Monitoring of lubricating of all rotating joints.	Weekly
	Monitoring of refractory.	Daily
	Monitoring of water cooling cable.	
	Water Cooling piping	
	Replacement of refractory	Based also on the condition used
	Replacement of water cooling cable and pipe.	
	Replacement of hydraulic cylinder, and solenoid valve, bearing.	
	Replacement of hydraulic cylinder, and solenoid valve, bearing.	
Bloom CCM -Mold oscillating device	Monitoring of bearing housing temperature, lubrication, noise.	Daily
	Monitoring of lubricating of all rotating joints.	Weekly
	Replacement of bearing and sealing.	Based also on the condition used
Bloom CCM -Straightening machine -Roller Table - Cooling bed	Monitoring of bearing housing temperature, lubrication, gear coupling temperature, rollers, noise, and vibration.	Daily
	Monitoring of bearings and gear box.	Daily
	Monitoring of lubricating of all rotating joints.	Weekly
	Replacement of hydraulic cylinder, and solenoid valve, bearing.	Based also on the condition used
Bloom CCM - Secondary cooling chamber	Monitoring of hydraulic cylinder, solenoid valve, hose, and tube/pipe.	Daily
	Monitoring of bearings and gear box.	Daily
	Monitoring of lubricating of all rotating joints.	Weekly
	Replacement of hydraulic cylinder, and solenoid valve, bearing.	Based also on the condition used
Bloom CCM - Cutting torch	Monitoring of nozzle and control valve.	Daily
	Monitoring of bearings.	Daily
	Monitoring of lubricating of all rotating joints.	Weekly
	Replacement of hydraulic cylinder, and solenoid valve, bearing.	Based also on the condition used
Auxiliary process equipment -Ladle -Tannish	Monitoring of refractory.	Daily
	Replacement of refractory	Based also on the condition used
Auxiliary process equipment -Ladle preheater	Monitoring of nozzle and control valve.	Daily
	Monitoring of lubricating of all rotating joints.	Weekly
	Replacement of solenoid valve, bearing.	Based also on the condition used
Dedusting system - Pulse bag filter	Monitoring of pneumatic cylinder, solenoid valve, hose, and tube/pipe.	Daily
	Lubricating of all rotating joints.	Weekly
	Replacement of solenoid valve, bearing.	Based also on the condition used
	Replacement of filter.	
Dedusting system -Fan	Monitoring of bearings.	Daily
	Lubricating of rotating.	Daily
	Replacement of solenoid valve, bearing.	1 year
Dedusting system -Water-cooled sleeve flue -Combustion settling chamber -Water-cooled flue	Replacement of refractory	Based also on the condition used or two (2) years

Equipment	Maintenance Activities	Frequency
Dedusting system -Dust conveying facilities	Monitoring of belt	Daily
	Monitoring of bearings.	Daily
	Monitoring of lubricating of all rotating joints.	Weekly
	Replacement of belt, bearing.	Based also on the condition used
Utilities Section		
Air Compressor and Dryer	Change Oil.	6,000 running hours
	Replacement of oil filter.	
	Replacement of oil separator.	
	Replacement of air filter.	3,000 running hours
	Inspection of belt/coupling.	
	Inspection of valve.	12,000 running hours
Crane		
Wire Rope	Checking by sight for any deformation, wear kinks and element disconnection. Measurement of wire rope diameter. Greasing.	Monthly
Rope Drum	Checking by sight for any deformation, wear, crack and looseness. Measurement of groove.	
Wheel and bearing	Checking of any deformation, abnormal noise. Measurement of wheel dimension (diameter, width, lip thickness).	
	Greasing of bearing.	Weekly
Frame	Check for cracks on the running saddle and girder. Inspection of hook using crack detection dye. Tightening of bolt.	Monthly
Bottom block and pulley	Greasing of bearing. Inspection of pulley groove.	
Crane Hoist	Overhauling. Pull out the hoist and inspect all parts. Replace all wheel, hoist and gearbox bearings.	2 Years
Water Treatment Plant		
Pumps	Monitor Temperature	Daily
	Visually inspect the lifting chain/rope	Every 4,000 operating hours
	Change the lubricant	Every 10,000 operating hours
	Check the mechanical seal leakage	
	Lubricate the bearings	
	General Over Haul	Every 5 years
Hoist	General inspection	Daily
	Operating checks	
	Inspection of ropes and hooks	
	Greasing	Every 3 Months
	Check the condition of the main power line	Every Year
	Check pulleys for wear	
	Change Gear Oil	Every 4 Years
Bucket for Scale Removal	Replacement oil filter cartridge	Every 400 operating hours
	Replacing the hydraulic oil and clean the tank	Every 3000 operating hours
	Pins with lubrication pump in possession of such a connection point	Every 65 operating hours
	Filling the tank automatic centralized lubrication.	Every 600 operating hours
	Manual greasing motor bearings	Every 3000 operating hours
Cooling Towers	Monitor Temperature	Daily
	Monitor Pressure	Daily
	Lubrication	Every 3000 operating hours
	Check the tightening of the bolts.	Every 6 Months

Equipment	Maintenance Activities	Frequency
Sand Filter	Check the blades to ensure their structural	Every 6 Months
	Cleaning of blades	Every 6 Months
	Sedimentation	Every 72 operating hours
	Air Removal	
	Drain	
	Air Backwash	
	Air and Water Backwash	
	Filling	
Lubrication and Hydraulic Units	Monitoring of oil (pressure, temperature, level, and color), cooling temperature, filter, pump temperature, noise, and vibration.	Daily
	Inspection of pump, filter, hose, and pipe/tube.	Weekly
	Replacement of filter.	2 months
	Replacement of pump, and valves. (Based also on the condition of pump and valve.)	3 Years
	Change oil. (Based also on the monitoring.)	
Hydraulic Valve Stand	Cleaning and servicing (leak removal).	Weekly
Cylinder, Solenoid Valve, Flow Control, FRL	Replacement (Recondition - cleaning and replacement of seal)	Yearly

During these maintenance activities for equipment/machine, there will be insignificant increase in waste generation because of contaminated rags with used oil and lubricants and wastewater contaminated with oil that may be generated. Since these are hazardous wastes, these wastes will be disposed to DENR-accredited third party treaters. There will be slight increase in water consumption because water will be used during maintenance activities.

1.5.4 Utility Requirements

1.5.4.1 Raw Materials

Oxygen

The proposed project will require an approximately 38Nm³/tonne of Oxygen for the steelmaking process. The main Oxygen pipe will be from supplier's station.

Nitrogen

The proposed project will require an approximately 9Nm³/tonne of Nitrogen for the steelmaking process. The main Nitrogen pipe will be from supplier's station.

1.5.4.2 Power Supply

Power to the melt shop is supplied by overhead lines at high voltage 138kV from the power company. The required power need for the melt shop is estimated at 80MVA.

1.5.4.3 Water Supply

The source for Melt Shops makeup water is underground water.

1.5.5 Waste Generation and Built-in Management Measures

Disposal procedures of hazardous, solid and domestic wastes are as follows:

- **Scales** is formed on the outer surfaces of plates, sheets or profiles when they are being produced by rolling red hot steel billets in rolling mills. Mill scale is composed of iron oxides mostly ferric and is bluish black in color. It is usually less than 1mm thick and initially adheres to the steel surface and retards further oxidation. Scales will be collected in containers and will be for sale abroad for recycling in sinter plants.
- **Used oil** will be collected and put inside sealed drums, stored in a company designated MRF inside the plant. It will be transported and treated by a DENR accredited TSD facility.
- **Busted Fluorescent Bulbs** will be put in a container, stored inside the plant MRF in accumulation until there are enough inventory for proper disposal through a DENR accredited TSD facility.
- **Contaminated rags and gloves** will also be put in bags, stored inside the plant MRF in Accumulation until there is sufficient inventory for proper disposal through a DENR accredited TSD facility.
- **Used automotive batteries** will be traded-in to designated suppliers. It will be stored inside the plant MRF for hazwaste.
- **Domestic Solid Waste** will be stored inside the plant MRF and to be disposed in the MRF of Villanueva while **Domestic Liquid Waste** will be treated through the proposed Sewerage Treatment Plant.
- **Industrial Wastewater Treatment System:** this water treatment system guarantees zero discharge of industrial wastewater.

1.6 PROJECT SIZE

1.6.1 Project Capacity

The proposed project has a total annual production capacity of 500,000 MTPY Rebar and 500,000 MTPY Scrap Recycling.

1.6.1 Project Area

The proposed project site has a total area of 248,035m².

1.7 DEVELOPMENT PLAN, DESCRIPTION OF PROJECT PHASES AND CORRESPONDING TIMEFRAMES

1.7.1 Project Phases

Provided below is the general timeline in the project's implementation. As soon as all clearances and permits are secured, land clearing will commence.

Table 1.7.1: Project Schedule

Activities	1 st YEAR				2 ND YEAR			
	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q
Land clearing								
Site and road development								
Construction of warehouses and other facilities								
Installation of equipment								
Full commercial operations of the Plant								

1.7.1 Pre-Construction

Prior to the implementation of the project, conduct of significant studies will be done. These include preliminary design, detailed engineering study, impact study to include geohazard identification and environmental impacts assessments. All the necessary information, plans and designs will be gathered and prepared relative to the requirements and in compliance with the existing laws and regulations applicable to the project. Jurisdiction over the project site, clearances, permits and all other administrative requirements of concerned agencies will also be completed.

1.7.1.2 Construction

Construction phase is comprised mostly of civil works construction. The major activities during construction phase are as follows:

- land/site clearing
- land development
- provision of services for the workforce such as temporary housing and toilet facilities
- transport of materials
- mobilization of personnel and equipment
- finishing
- equipment installation

An established guideline for contractors will be set by SAMC. During construction, all contractors are required to have their safety officer on site. The DOLE standard for construction (DO 13-98) shall be complied with by SAMC and all of the contractors.

1.7.1.3 Operation

The proposed project will operate 360 days per year for 24 hours, with maintenance shutdown of 5 days per year.

The proposed facility will produce 500,000 MTPY Rebar and 500,000 MTPY Scrap Recycling.

In order to produce rebars, billets shall be reheated then shall undergo the size reduction in a series of mill stands through rolling process. Each stand contains a pair of rolls that shall be set-up in accordance with the desired bar diameter. The rolls need to be reset each time a new bar diameter is desired. Larger size rebars shall require less number of passes through the stands while smaller ones shall require more passes. Hence, smaller diameter rebars takes longer time to be produced.

After passing through the rolling stands they passed through a quenching water box to impart the target mechanical properties and temporarily stored in the cooling bed. Bars are air-cooled while on cooling bed. Chains carry the bars and transport them to the conveyor. Slow speed of chains allows sufficient time for bars to cool down. The cooled rolled bars shall then be cut to the desired lengths. The ends of the bars are sheared off by a shearing machine. Ends are sheared because they are often bent or cracked. The finished product shall then be sorted, bundled and stocked prior to delivery.

1.7.1.4 Abandonment

Considering that the project has a lifespan of at least 40 years, continuous maintenance, enhancement and upgrading will be done to ensure high production efficiency, environmentally compliant and safe facility. Structures and plant equipment will be assessed regularly for the project to continue its operation beyond its lifespan.

The formulation of the detailed decommissioning plan will be done by SAMC within the specified timeframe as part of the post-ECC requirement. It will be submitted for approval to the LGU and concerned government agencies on the activities such as Environmental Site Assessment (ESA) to determine contaminants left by the operation, method and equipment to be used for dismantling of structures, clean-up plan and demobilization scheme before proceeding.

Demobilization during post construction will be conducted by the SAMC with the contractors as per EMB requirements which include all activities and costs for transport of all construction equipment used, all excess materials, disassembly and transport of temporary facilities (office, stock room, quarters, etc.) used during construction, removal and disposal of all construction debris and general clean-up of construction site. SAMC will also require its contractor to post performance bond together with the 10% retention to take care of any defects and damages left behind after demobilization.

The projected future use of the project area will still be industrial as the zoning classification of the land use is industrial. However, in case the zoning is revised or amended, the future use will be in accordance with the land use classification when that tie comes.

1.7.2 Project Schedule

It is estimated that the construction of all the necessary structures will be finished in approximately one and a half year. The proposed project is targeted to begin the construction in 2019 and will be completed in 2021. Target start of the operation will be in 2021 provided all the necessary permits will be secured.

1.8 MANPOWER

Pre-construction manpower will be dedicated to the miscellaneous activities associated with project development, planning and the securing of various governmental permits. Construction requirements for manpower will largely depend on the schedule of workers that will be put up by the Contractor(s) which at this time is identified to be at least 1,500 workers where the three (3) will be directly hired by SAMC while 1497 will be employed by the Contractor. Depending on the construction tasks/jobs that will be undertaken at a given time, the peak manpower complement could reach up to 2,000 personnel. A total of 1500 personnel will be hired to fill in the regular job positions for the plant operation. During decommissioning, workers will be outsourced to contractors supervised by the PCO and Plant Manager of SAMC.

SAMC will comply with the equal opportunity principle in hiring persons with disability (PWD) as well as women. A qualified employee, whether a woman or with disability is subject to the same terms and conditions of employment and the same compensation, privileges, benefits, incentives and allowances with other qualified employee.

For plantilla-based/regular employees, monthly salaries or wages for services rendered by an employee are timely paid twice a month via bank transfer. For transparency, the said payments are duly acknowledged by the employees through electronic and/or manual pay slips. Thirteenth month pay is likewise paid to all qualified employees in compliance with the relevant laws, rules and regulations. Qualified employees also enjoy various benefits such as vacation leaves, sick leaves, overtime pay, health insurance, health plan, separation pay, retirement plan and allowances, as well as safety provisions like Personal Protective Equipment (PPE) and personal emergency kits, contributions and remittances for SSS, Philhealth and PAG-IBIG fund and other welfare benefits. Employees who have queries on the salaries or benefits they receive or are entitled to may bring their concerns with the Human Resources Department.

For contractors or manpower agencies who engage contractuels, SAMC will undertake an accreditation process wherein contractors are required to submit documents to establish that they are duly registered with the SEC or Department of Trade and Industry and with the Bureau of Internal Revenue and that they have substantial capital and/or investments to ensure that they can perform the work to be done and are compliant with relevant laws and regulations, specifically on the prohibition against labor-only contracting. Without this accreditation, SAMC will not engage the services of the contractor and ensure compliance by the contractors with all the rights and benefits under labor laws, rules and regulations. SAMC will strictly enforce such contractual provisions in order to ensure that the contractor's employees are paid all statutory benefits and that the contractor comply with all the requirements as provided by law.

Provided in **Table 1.8.1** is the tabulation of manpower requirements which do not discriminate against sex and age as long as the worker is qualified and fit to work. For all of these manpower requirements, applicants from the host community are given priority subject to the qualifications of the applicant to the position. Job vacancies/openings are posted in the barangay and municipal bulletin boards for qualified locals to have an opportunity to work for SAMC. Local officials sometimes provide recommendations for qualified workers.

Table 1.8.1: Manpower Requirements

Labor Type	Skill / Designation	Employee Type	No. of Personnel
Construction Phase			
Safety	Safety Officer / Engineer	Plantilla Position	3
Project Management	Project Manager / Engineer	Plantilla Position	1
Civil/Structural Foreman	Civil Engineer	Outsourced	15
Scaffolder	Certified Scaffolder	Outsourced	175
Scaffolders Helper	Trained / Experienced Scaffolder	Outsourced	90
Steel man / Fabricator	Engineering Undergrad / Experienced Fabricator	Outsourced	241
Steel man/Fabricator Helper	Experience Fabricator	Outsourced	195
Carpenter	High School Graduate / Experienced Carpenter	Outsourced	150
Mason		Outsourced	265
Crane Operator	Certified Crane Operator	Outsourced	15
Rigger	Certified Crane Rigger	Outsourced	35
Mechanical Foreman	Mechanical Engineer	Outsourced	20
Mechanical Fitter	Engineering Undergrad / Experience Mechanical Fitter	Outsourced	35
Welder	Certified Welder	Outsourced	65
Mechanical Helper	High School Graduate / Experience Mechanical Fitter	Outsourced	120
Electrical Foreman	Electrical Engineer	Outsourced	25
Master Electrician	Certified Master Electrician	Outsourced	15
Electrical Helper	Undergrad Electrical Technician	Outsourced	35
Total Manpower			1500
Operation Phase			
Section : Human Resources			
Staff 1	Degree in BS/BA Psychology or any related course	Plantilla Position	200
Supervisor			
Section : Plant Administration			
Assistant Supervisor	Degree in BS/BA Psychology or any related course	Plantilla Position	375
Driver 1	Must have a five (5) years' experience in driving; with Professional Driver's License	Plantilla Position	
Health and Safety Officer	College Level	Plantilla Position	
Building and Grounds Maintenance			
Building and Facility Engineer	BS Engineering or at least Technical course graduate	Plantilla Position	375
Building and Grounds Maintenance Personnel			
Department : Plant Accounting			
Staff	Degree in BS in Accountancy	Plantilla Position	60
Department : Materials, Planning and Control			
Staff	Degree in BS Accountancy	Plantilla Position	250
Store Keeper			
Department : Information Technology			
Systems Technician	Degree in BS Information Technology or any related course	Plantilla Position	90
Department : Mechanical Maintenance			

Labor Type	Skill / Designation	Employee Type	No. of Personnel
Assistant Supervisor	BS Electrical / Electronic Engineering or BS Mechanical Engineering	Plantilla Position	
AutoCAD Operator			
Maintenance Project Specialist			
Mechanic	At least vocational course on Mechanical Technology	Plantilla Position	
Senior Supervisor	BS Electrical / Electronic Engineering or BS Mechanical Engineering	Plantilla Position	
Technician	2-year vocational course on Industrial Electronics or Industrial Electricity	Plantilla Position	
Department : Electrical Maintenance			
Assistant Supervisor	BSME Graduate or Any Related Technical Course.	Plantilla Position	250
Manager			
Planner			
Total Manpower			1500
Abandonment Phase			
During decommissioning, work will be outsourced to contractors supervised by the PCO, the Resident Manager and Plant Manager of SAMC.			

1.9 INDICATIVE PROJECT INVESTMENT COST

The indicative project cost is PhP 10,000,000,000.00.

CHAPTER II: ASSESSMENT OF ENVIRONMENTAL IMPACTS

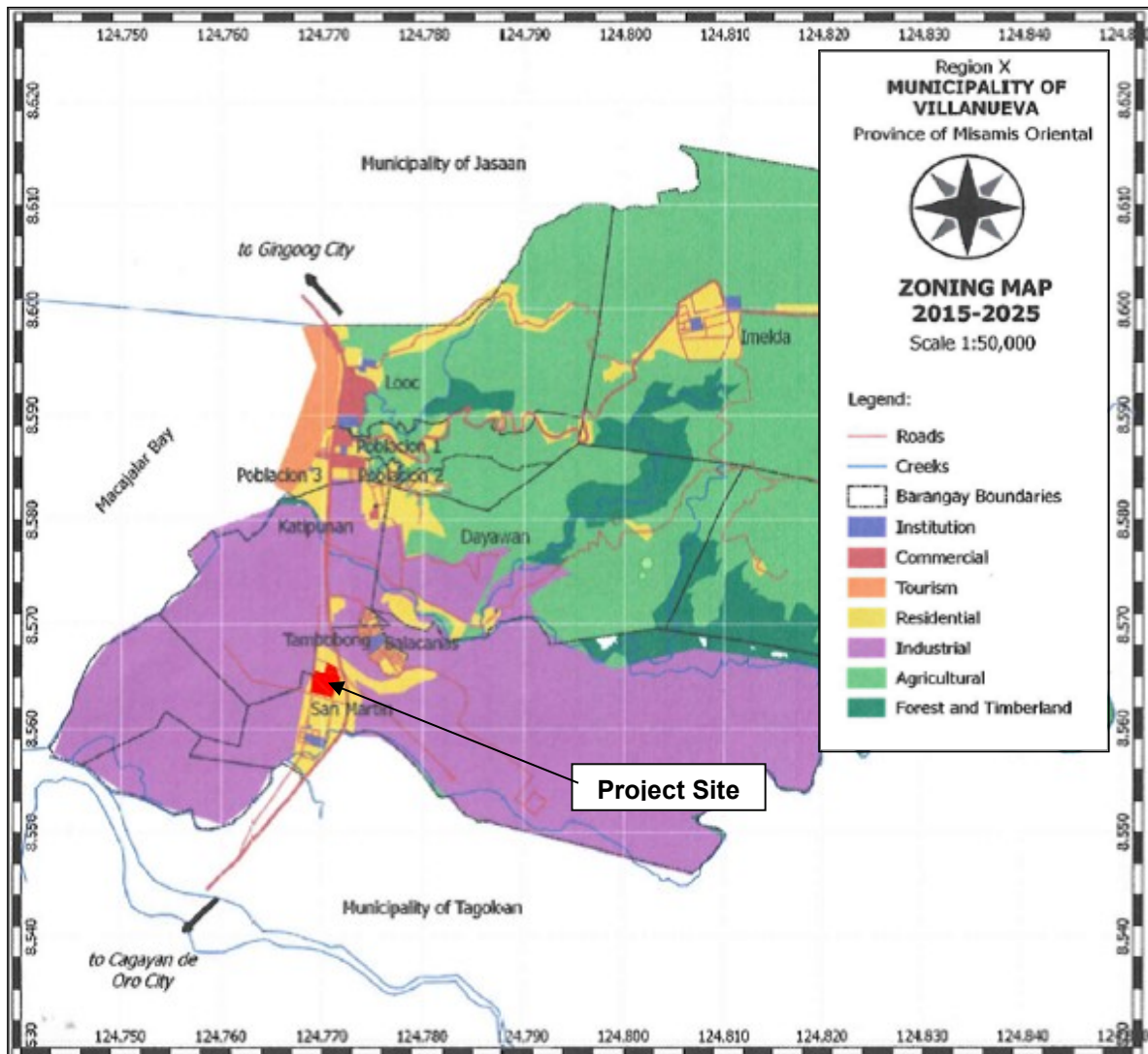
2.1 LAND

2.1.1 Land Use and Classification

2.1.1.1 Existing Land Use

Villanueva is composed of open/cultivated lands covering 2,665.83 ha or 51% of the total land area; brushlands/shrubs occupying 1,308.11 ha or 25%; forest area covering 395.49 ha or 7.6%; open/grassland covering 343.42 ha or 6.6%; plantation area covering 261.07 ha or 5%; and built-up/settlements area covering 248.58 ha or 4.8% of the total municipal area. Approximately 1,790 hectares or 34.27 percent of this total land area is within the jurisdiction of the Philippine Veterans Development Corporation (PHIVIDEC) or the PHIVIDEC Industrial Authority.

Based on the Zoning Map of Villanueva presented in **Figure 2.1.1** and in the Zoning Certificate issued by the Municipal Planning and Development Office (MPDO) (**Annex 2-1**), the proposed project site is designated as an industrial area.



Source: MPDO of Villanueva

Figure 2.1.1: Land Use Map of the Municipality of Villanueva superimposing the Project Site

2.1.1.2 Environmentally Critical Areas

Environmentally Critical Areas (ECA) are environmentally sensitive areas declared under Presidential Proclamation No. 2146 of 1981 where significant environmental impacts are expected if certain types/thresholds of proposed project are located, developed or implemented in it. **Table 2.1.1** presents the list of ECA and their relevance to the proposed project site.

Table 2.1.1: List of ECA and Relevance to the Proposed Project Site

No.	Environmentally Critical Areas	Relevance to the Proposed Project Site
1.	All areas declared by law as national parks, watershed reserves, wildlife preserves, sanctuaries	The proposed project site is designated as industrial area based on the Zoning Map of Villanueva and on the Zoning Certificate issued by the MPDO.
2.	Areas set asides as aesthetic potential tourist spots	
3.	Areas which constitute the habitat of any endangered or threatened species of Philippines wildlife (flora and fauna)	There are no endangered or threatened species present in the proposed project site.
4.	Areas of unique historic, archaeological, or scientific interests	There are no unique historic and archaeological area within the project site.
5.	Areas which are traditionally occupied by cultural communities or tribes	There is no ancestral domain area within the project site.
6.	Areas frequently visited and/or hard-hit by natural calamities (geologic hazards floods, typhoons, volcanic activity, etc.)	The project area located on a flat terrain has an elevation ranging from 0 to 10 meters above sea level (masl) and falls on low to moderate susceptibility to flooding as delineated by MGB. Misamis oriental falls under Very Low Risk to Typhoon with a frequency of one (1) cyclone per year.
7.	Areas with critical slopes	The project area located on a flat terrain has an elevation ranging from 0 to 10 masl.
8.	Areas classified as prime agriculture lands	The proposed project site is designated as industrial area.
9.	Recharged areas of aquifers	Based on the 1997 Groundwater Availability Map of the Philippines, the proposed project site falls under fairly extensive and productive aquifers
10.	Water bodies 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	This type of ECA is not relevant for the proposed project. The proposed project site is approximately 1.5km far from Tagoloan River and 4km far from Macajalar Bay.
11.	Mangrove areas characterized by one or any combination of the following conditions: with primary pristine and dense young growth, adjoining mouth of major river systems: near or adjacent to traditional productive fry or fishing grounds; areas which act as natural buffers against shore erosion, strong wind and storm floods; areas on which people are dependent for their livelihood.	This type of ECA is not relevant for the proposed project. There is no Mangrove area within or near the proposed project site.
12.	Coral reefs characterized by one or any combination of the following conditions: With 50% and above live coral cover; Spawning and nursery grounds for fish; act as natural breakwater of coastlines.	This type of ECA is not relevant for the proposed project. The proposed project site is approximately more than 5km far from Macajalar Bay at its nearest point as shown in Figure 2.1.1.2.1 below.

Source: Presidential Proclamation No. 2146 (1981)



Figure 2.1.2: Distance of the Project Site to the Nearest ECA

2.1.1.3 Impact on Compatibility with Existing Land Use

There is no issue in terms of compatibility with the existing land use because the proposed project site is designated as an industrial area based on the Land Use Map of Villanueva and on the Certificate issued by the MPDO.

2.1.1.4 Impact on Compatibility with Classification as an ECA

SAMC is committed to address the impacts of the natural and geologic hazards. Typhoon impacts may be mitigated through regular coordination with PAGASA and adjustment of construction schedules in relation to bulletins issued by the said weather agency. SAMC will not discharge to any water body as the project is zero effluent. Drainage systems will be constructed to address flooding. The project will be designed in compliance with the National Building and Structural Codes of the Philippines, and internationally accepted guideline. Moreover, Emergency Preparedness and Response Plan will be prepared and implemented.

2.1.1.5 Impact on Existing Land Tenure Issue/s

There are no possible land issues since the area of the project site privately owned by SAMC.

2.1.1.6 Impairment of Visual Aesthetics

There will be no impairment of visual aesthetics because the proposed project is to be located in an area classified as industrial and will be designed to suit the aesthetic perspective. Moreover, SAMC will coordinate with the LGU of Villanueva if there will be plans and programs with respect of the LGU's Tourism Plan.

2.1.1.7 Devaluation of Land Value as a Result of Improper Solid Waste Management and other Related Impacts

The proposed project will not contribute to the devaluation of land value resulting from improper solid waste management and other related impacts because the SAMC will strictly implement the Solid Waste Management Plan which will include the operation of MRF and Hazardous Waste Storage Area for used oil and batteries and busted bulbs.

2.1.2 Geology/Geomorphology

2.1.2.1 Surface Landform/ Topography/ Terrain/Slope

San Martin, Villanueva, Misamis Oriental, where the proposed project site is located, is characterized by generally flat terrain. It has an elevation ranging from 0-10 masl and is drained by Pugaan River and Tagoloan River (**Figure 2.1.3**).

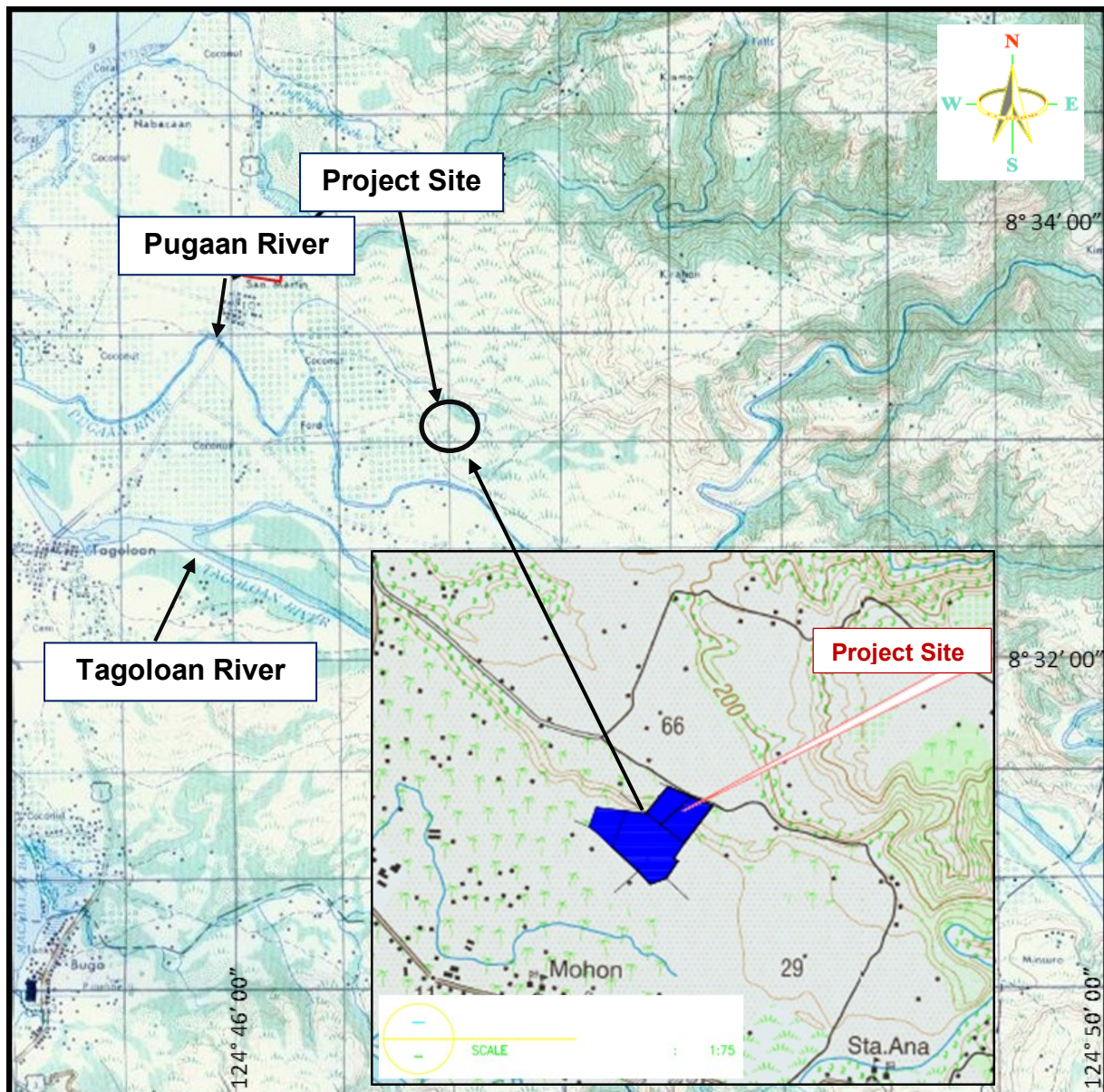
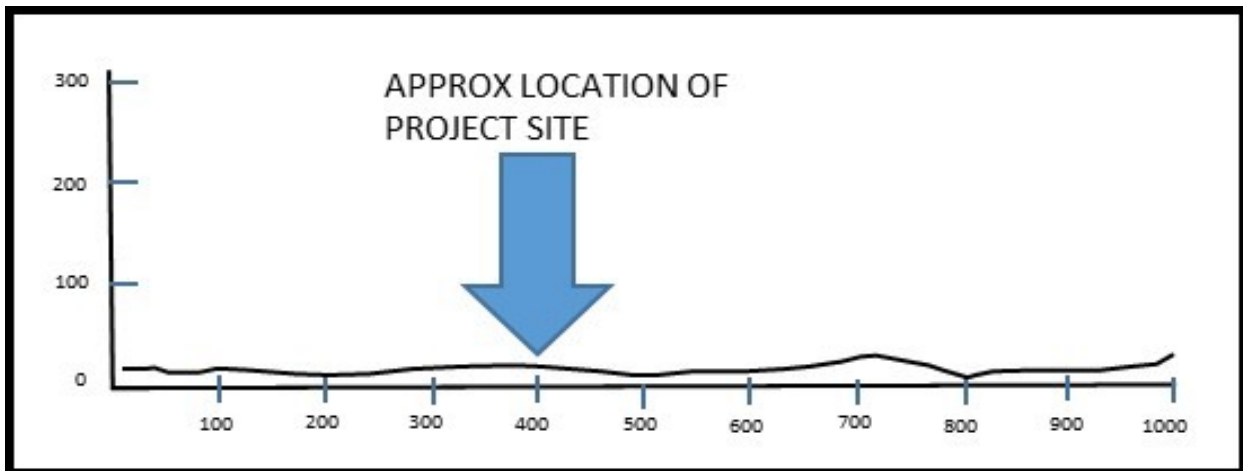


Figure 2.1.3: Topographic Map of the Project Site



Source: NAMRIA 1983

Figure 2.1.4: Project Site' slope and elevation based on the topo map

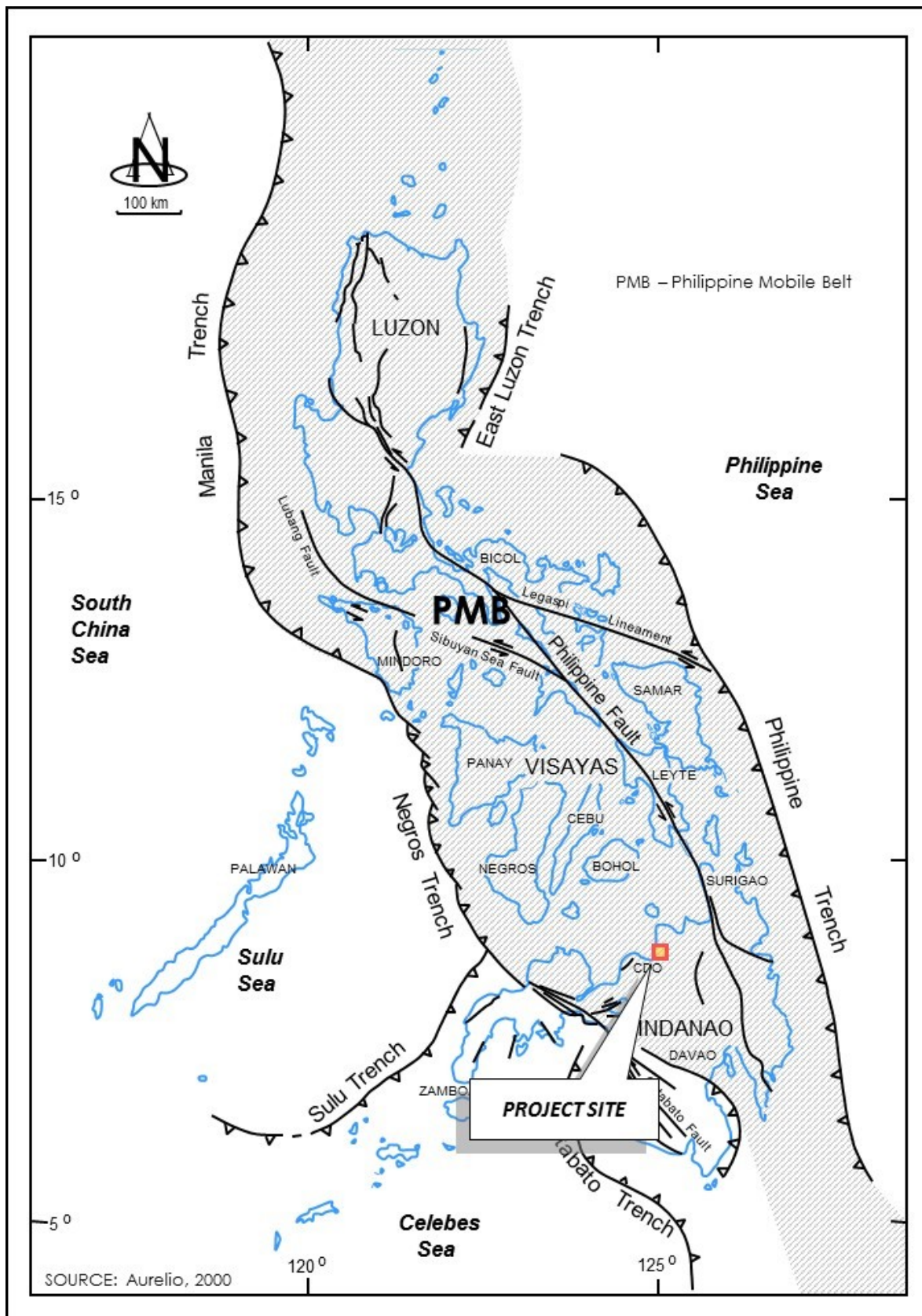
2.1.2.2 Subsurface Geology/Underground Condition

2.1.2.2.1 Tectonic Setting

The study area is found within a tectonically active region known as the Philippine Mobile Belt (PMB). In Luzon Island, PMB is bounded by two (2) oppositely dipping subduction zones; namely, the Manila Trench on the west and the Philippine Trench-East Luzon Trough on the east. The Manila Trench is the morphological expression of the eastward subduction of the South China Sea marginal basin lithosphere beneath the Philippine Mobile Belt (Barrier et al, 1991). The Philippine Trench-East Luzon Trough, on the other hand, represents the westward oblique subduction of Eocene Philippine Sea Plate (Cardwell *et al.*, 1980; Fitch, 1972 and Hamburger et al., 1983 in Aurelio; Sajona et al., 1993). Convergence of the Philippine Mobile Belt and the surrounding blocks is associated with seismicity and formation of volcanic chains in the region (Barrier et al, 1991; Daligdig and Besana, 1993).

The deformation of the Philippine Mobile Belt is further influenced by movement along the Philippine Fault Zone. This fault system, the movement of which is generally considered to be left-lateral, extends more than 1,200 km, transecting the Philippine archipelago from Luzon to Eastern Mindanao (Aurelio, 1996). Its age of initiation is still controversial, although extensive studies (e.g. Barrier et al, 1988 and Aurelio et al, 1990 and Barrier et al., 1991) of the fault in Luzon and Visayas indicate that fault activity began during the Pliocene. The trace of the Philippine fault is defined by young geomorphic features including fault scarps, sinistral stream offsets, fault parallel ridges and narrow, elongated troughs (Barrier et al, 1991).

The province of Misamis Oriental including the project is geologically situated on the northern part of Mindanao Island west of the so-called Philippine Mobile Belt (PMB), a highly seismic belt that transects the archipelago. The proposed project located at Barangay San Martin of Villanueva, Misamis Oriental is approximately two (2) kilometers west of the Tagoloan Fault, 16 km southwest of Cabanglasan Fault, 42 km southwest of Central Mindanao Fault and 126 km northeast of Mindanao Fault-Western Mindanao Extension (**Figure 2.1.5**).



Source: Aurelio 2000

Figure 2.1.5: Tectonic Map of the Philippines

2.1.2.2.2 Stratigraphy

The stratigraphic relationship of various geologic formation occurring around the project site, together with their corresponding ages and description are shown in **Figure 2.1.6** and described below:

Quaternary Alluvium (R). This composed of alluvial deposit that accumulates in low areas most specially along mouth of major drainages and outwash plains near the coast and beach deposits fringing the coastline.

Cretaceous-Paleocene Rocks (Kpg). This rock formation is composed mainly of metamorphosed volcanic and sedimentary rocks, consisting of phyllite, greywacke, meta-conglomerate, mylonite, metavolcanics and meta-dabase. Its occurrences are in the southwest of Brgy. Dansolihon, west of Iponan River, high ranges east of Naawan, west of Brgy. Alae and the Mt. Tagiptip.

Cretaceous-Paleogene Rocks (UC). This formation is represented by ultramafic and mafic plutonic rocks composed of dunite, pyroxenite-peridotite, serpentinite and gabbro which are in the form of dikes. It covers the whole Caraballo Mountain Range; occurs on a northeast trending belt southeast of Opol and on an east-west belt between Biga-an and Agusan River. Isolated bodies were also noted in the region.

Plio-Pleistocene Rocks (N3 + Q1). This rock member is composed of limestone, intercalated pyroclastics and clastic rocks and pure clastics such as conglomerate, shale, sandstone and tuffaceous sandstone, agglomerate and conglomerate. The limestone member known as Indahag Limestone (Pacis, 1962) fringes the coastline of the western part of the region while scattered exposures capped the older formation. The intercalated pyroclastic and clastic members is part of the Bukidnon Formation occupying the eastern side of the region. It covers the whole area east of Cagayan River except those underlain by older rock.

Pliocene-Quaternary Rocks (QV). These are represented by porphyritic andesite which overlies the cone of Mt. Lumot and Mt. Balasocan located in the northeastern portion of the province.

Pliocene-Quaternary (QVP). This formation is mainly pyroclastic and volcanic rocks that occupy the gently sloping hills and plateau of the region especially on the eastern part of the province.

Upper Miocene-Pliocene Rocks (N2). This formation is composed of sedimentary and pyroclastic rocks which is widespread in the western half of the region. This include interbeds of conglomerate, pebbly sandstone, agglomerate tuffaceous sandstone and tuff. These rocks are well bedded and slightly folded.

Oligocene-Miocene Rocks (N1). This rock formation is made up of sequence of sedimentary rocks and intercalated volcanics and sedimentary rocks. The well bedded sedimentary sequence consists of conglomerate, well indurated sandstone with lenses of limestone and siltstone, thin coal beds and carbonaceous shale. Basalt breccias, indurated sandstone and tuffaceous materials represent the member of intercalated volcanics and sedimentaries. The largest exposed outcrop underlies the high ridges on the western flank of the region.

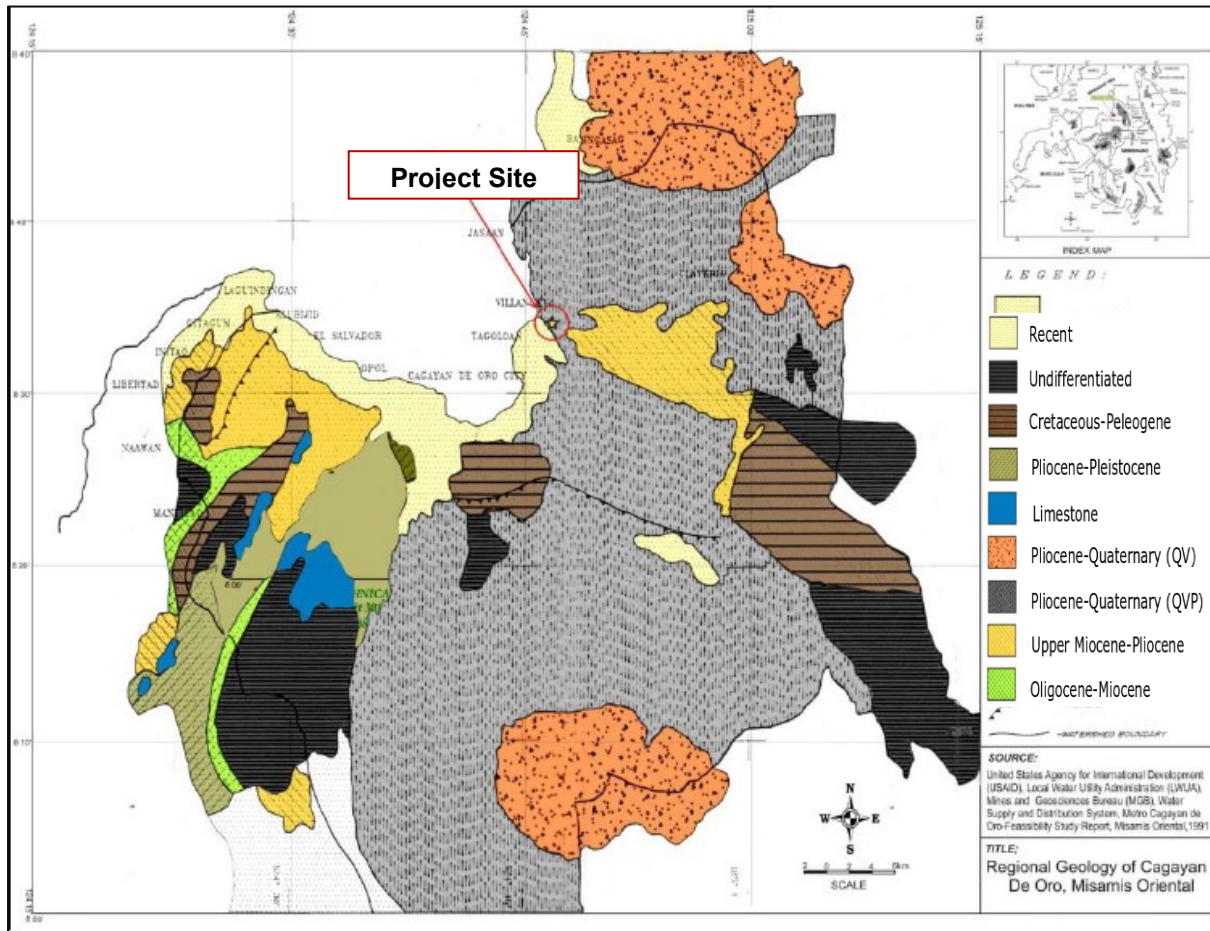
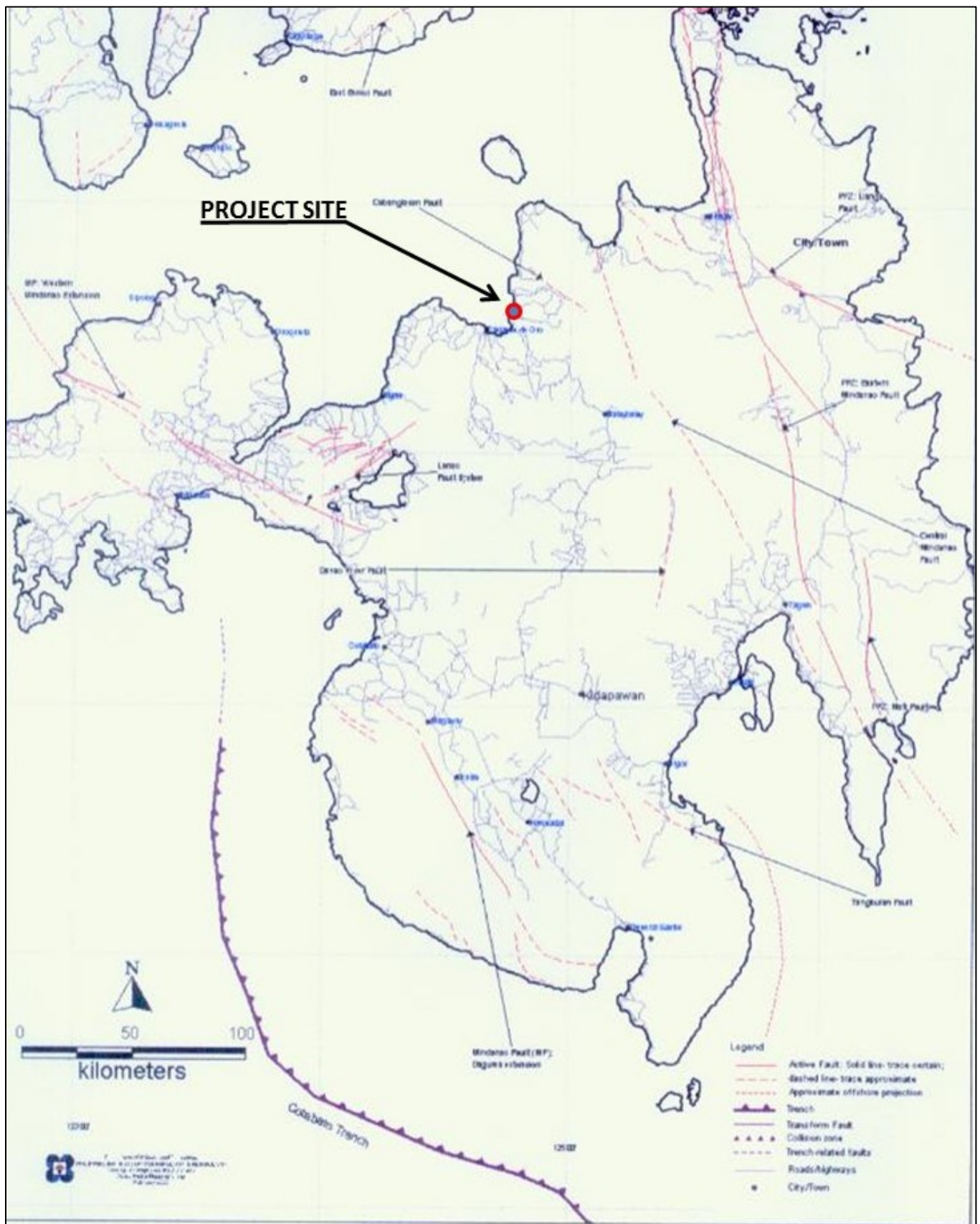


Figure 2.1.6: Regional Geology of Cagayan de Oro and Vicinity of Misamis Oriental

2.1.2.2.4 Geologic Structure

The most prominent geologic structure in the region nearest to the project area is the northwest trending Tagoloan Fault approximately located 2km west of the site (**Figure 2.1.7**). Other active major faults in the region proximal to the project site include the Cabanglasan Fault, Central Mindanao Fault and Mindanao-Western Mindanao Extension Fault.



Source: PHIVOLCS, 2000

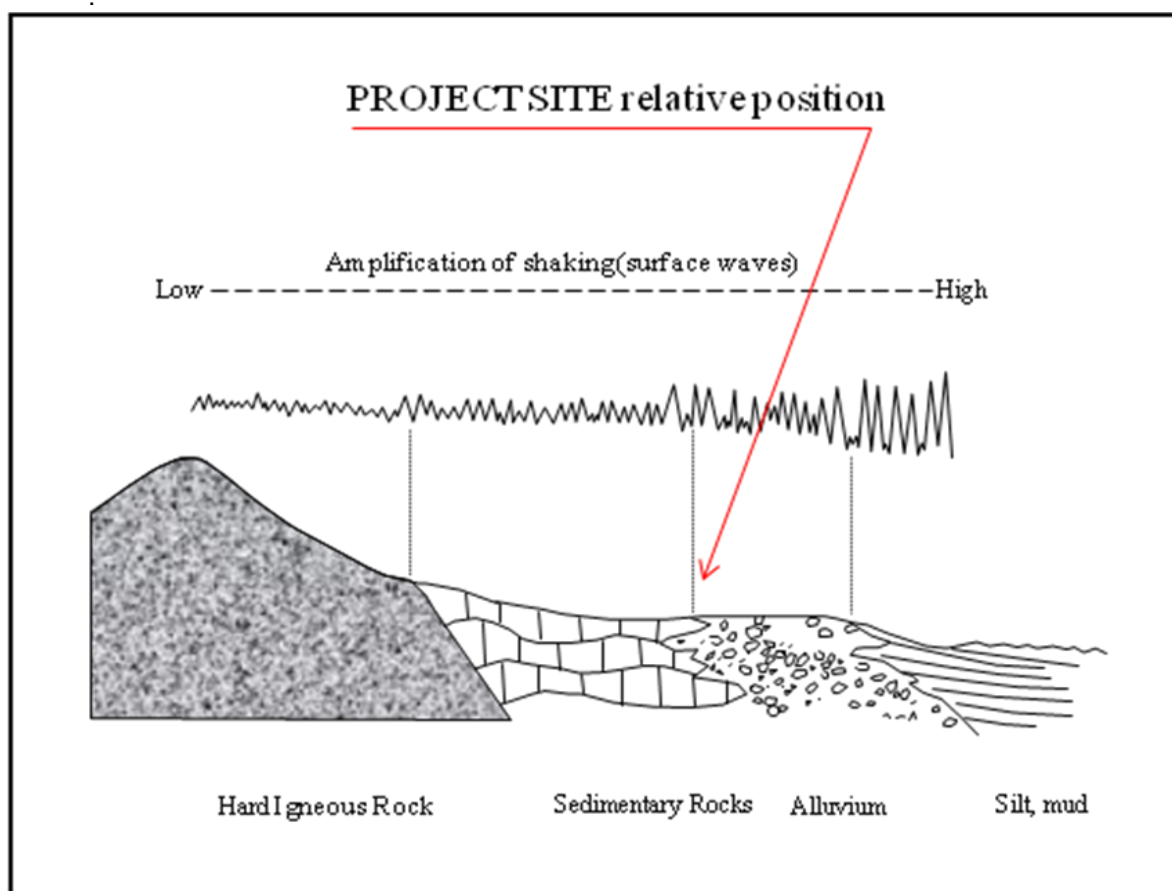
Figure 2.1.7: Active Faults and Trenches in Region X

2.1.2.3 Geologic and other Natural Hazard

2.1.2.3.1 Seismicity

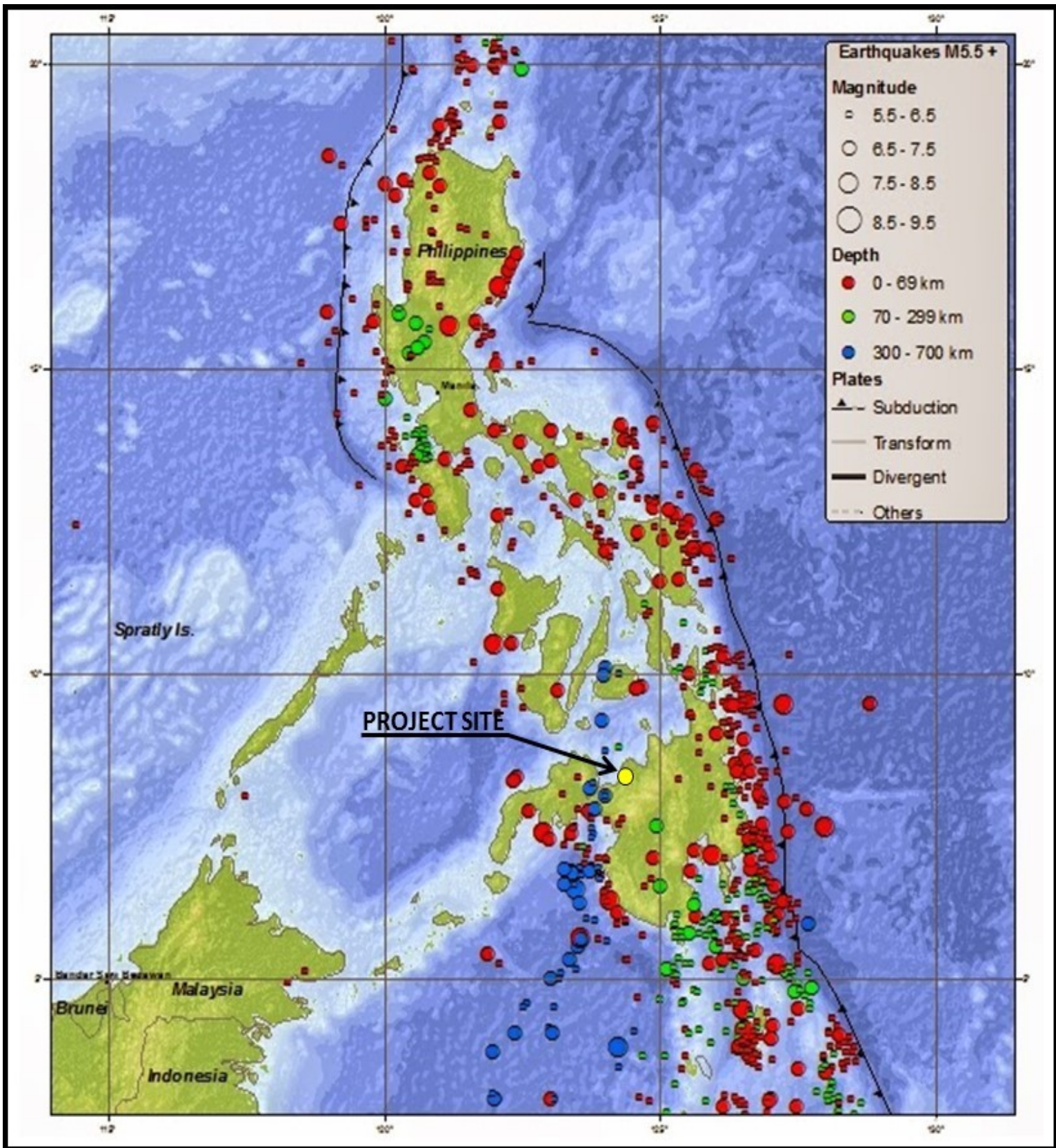
Earthquake is the perceptible trembling to violent shaking of ground caused by either tectonic movements or volcanic activity. The Philippines is located near or along the so called “earthquake belt” and is prone to seismic hazards. Areas that are susceptible to this seismic hazard are those underlain by unconsolidated soils and sediments deposited on the low-lying areas (**Figure 2.1.8**).

The area investigated is prone to ground shaking hazards due to the presence of several earthquake generators in and near the region. These possible seismogenic structures include the active Tagoloan Fault, Central Mindanao Fault, Cabanglasan Fault, and the Mindanao Fault-Western Mindanao Extension. **Figure 2.1.9** shows that the project falls near the location where earthquake magnitude of 6.5 -7.5 and with depth of 300 – 700 km where recorded.



Source: Keller E. A. 1985

Figure 2.1.8: Generalized Relationship Between Near Surface Earth Material and Amplification of Shaking During a Seismic Event



Source: PHIVOLCS

Figure 2.1.9: Map showing Earthquakes in the Philippines, its Recorded Magnitude and Corresponding Depth

2.1.2.3.2 Ground Acceleration

Ground acceleration caused by earthquakes may result to great damage and destruction to property and infrastructure accompanied by loss of life. Factors that influence the intensity of ground shaking include the magnitude of the earthquake, distance of the site in relation to the earthquake generator, characteristics of the underlying rocks, and the soundness of the building. The Philippines is a tectonically active place with noted active faults that are usually the source of major earthquakes. This is the reason why the Philippine Institute of Volcanology and Seismology (PHIVOLCS) and the United States Geological Survey (USGS) conduct ground motion hazard mapping, which is useful to engineering design, using modern probabilistic methodology. In the study, the peak horizontal ground accelerations that have a 10 % probability of being exceeded in 50 years have been uniformly estimated for rock, hard soil, medium soil, and soft soil site condition. Result of the study shows an estimate on rock ranging from a low of 0.11g in Visayas to a high of 0.30g in the vicinity of Casiguran fault zone in eastern Luzon (Thenhaus et al, 1994). Estimates for soft soil conditions are considerably higher and range between 0.27g for Visayas and 0.80g along the Casiguran fault zone.

The project site is underlain mainly by alluvial deposits mostly sandy silt associated with pebble to gravel size material being located near Macajalar Bay and fall under the 0.30g and 0.20g for Soft Soil and Medium Soil condition, respectively (**Figure 2.1.10**).

Using the deterministic method of Tanaka and Fukushima with the following attenuation relation and considering an earthquake magnitude of 7.2 and distance of the site of 2km from the Tagoloan Fault (**Figure 2.1.11**), the following peak ground acceleration (PGA) values of 0.351g, 0.509g, and 0.813g for bedrock, medium soil and soft soil, respectively. The project falls on the soft soil condition.

$$\text{Log}_{10}A=0.41M-\text{log}_{10}(R + 0.032 \times 10^{0.41M}) - 0.0034R = 1.30$$

Where: A= mean of the peak acceleration from two horizontal components at each site (cm/sec²)
R= shortest distance between site and fault rupture (km)
M= surface-wave magnitude

2.1.2.3.3 Ground Rupture

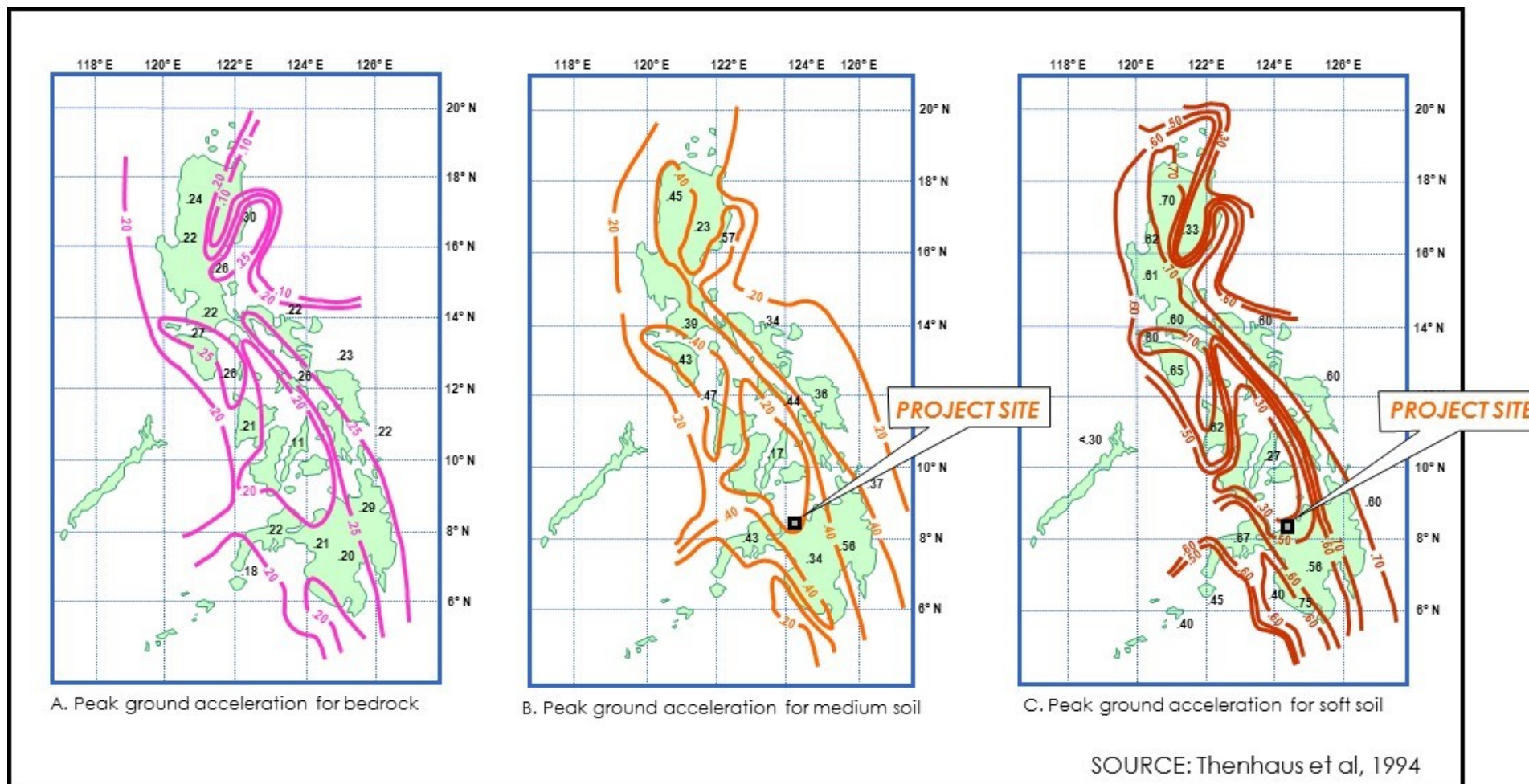
Ground rupture occurs when a new rupture is created or when renewed movement of old fractures takes place (Punongbayan, 1994). PHIVOLCS is recommending a buffer zone of at least 5m on both sides of a fault trace or from the edge of deformation zone. This hazard is seemingly absent in the project area since the nearest active Tagoloan Fault is found about 2km west of the project site (**Figure 2.1.9**).

2.1.2.3.4 Liquefaction

Liquefaction occurs when a water-saturated cohesionless soil loses its strength and liquefies when subjected to intense and prolonged ground shaking. Reyes et al, of UP-Engineering Research and Development Foundation, Inc., in their soil study of areas that liquefy during the 16th July 1990 Luzon earthquake came out with the following soil conditions for the potential liquefiable layers:


- loose soil classification;
- upper layers of the surveyed areas;
- water table near the ground surface;
- N-value of less than 30 using the American Association of State Highway and Transportation Officials (AASHTO) method and less than 35 using the Japan Society of Civil Engineers (JSCE) method; and
- 50% passing (D50) of approximately 0.001-1.8mm.

Based on the field observation, the proposed project site is underlain by alluvial deposits and fall under the delineated liquefaction prone areas (**Figure 2.1.12**).




Source: Thenhaus et al, 1994


Figure 2.1.10: Maps Showing Peak Horizontal Acceleration Amplitude on Bedrock, Medium Soil and Soft Soil for the Philippine Region



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Department of Science and Technology
PHILIPPINE INSTITUTE OF VOLCANOLOGY AND SEISMOLOGY



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HASS-EQ-04

HAS-Mar-18-439

DATE
FOR
REPRESENTED BY
PURPOSE

21 March 2018
SAN MARTIN STEEL, INC.
HERNANI I. BAYANI
MGB requirement


EARTHQUAKE HAZARD ASSESSMENT

LOT DESCRIPTION, PROJECT NAME, LOCATION	GROUND RUPTURE			
Lots 1, 296, 280-A, 2713-A, 2712-AI, Pls-923; Lot 1, Swo-10-0000174-B1; Lot 1, Swo-10-000174-AI; Steel Rolling Mill Expansion Project; Brgy. San Martin, Villanueva, Misamis Oriental	Safe; Approximately 2 kilometers west of the Tagoloan River Fault			

EXPLANATION AND RECOMMENDATION


- ✓ All hazard assessments are based on the latest available hazard maps and on the location indicated in the vicinity map provided.
- ✓ Ground rupture hazard assessment is the distance to the nearest known active fault. The recommended buffer zone, or Zone of Avoidance, against ground rupture hazard is at least 5 meters on both sides of the active fault or from its zone of deformation.
- ✓ All sites may be affected by strong ground shaking.
- ✓ Ground shaking hazard can be mitigated by following the provisions of the National Building Code and the Structural Code of the Philippines.
- ✓ This hazard assessment supersedes previous assessment made by this office regarding the site.

Assessed by Kimberley M. Vitto
Verified by Abigail C. Pidlaoan


RENATO U. SOLIDUM, JR.

Officer-of-the-Day
Science Research Specialist II

Approved by


RENATO U. SOLIDUM, JR.

Undersecretary for DRR and CC, DOST
and
Officer-in-Charge, PHIVOLCS

V2-2017-05-19

kmv\jdb\TJFF\Volume_2\01 SERVICES_DATABASE\03 DRAFTS\Hazard Assessment Services\2018\March\HAS-Mar-18-439_San Martin Steel, Inc.-Villanueva, Misamis Oriental

PHIVOLCS Building, C.P. Garcia Avenue, U.P. Campus, Diliman, Quezon City 1101 Philippines
Tel. Nos.: (+632) 426-1468 to 79; (+632) 926-2611 | Fax Nos. (+632) 929-8366; (+632) 928-3757
Website: www.phivolcs.dost.gov.ph

Figure 2.1.11: PHIVOLCS Fault Certification

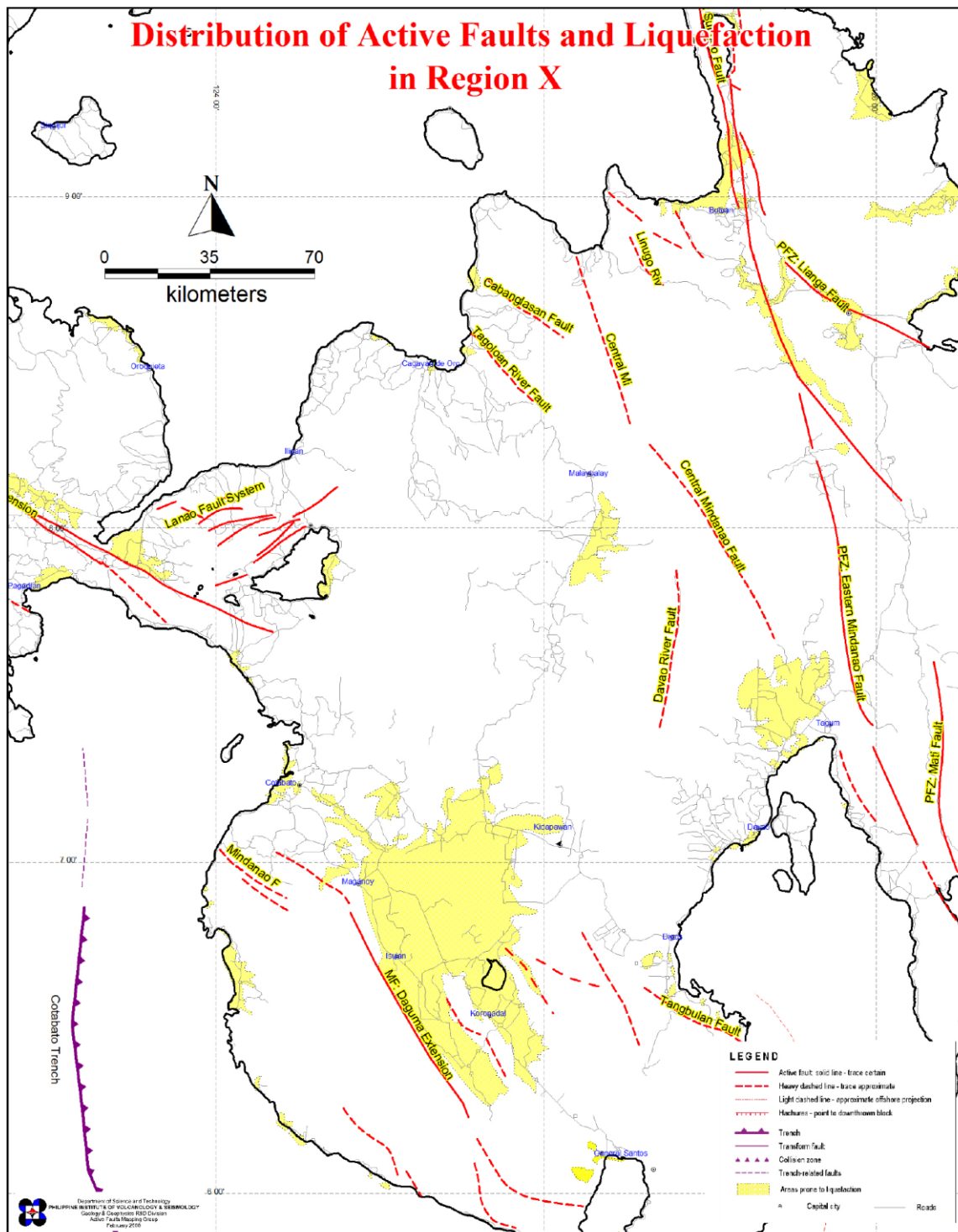
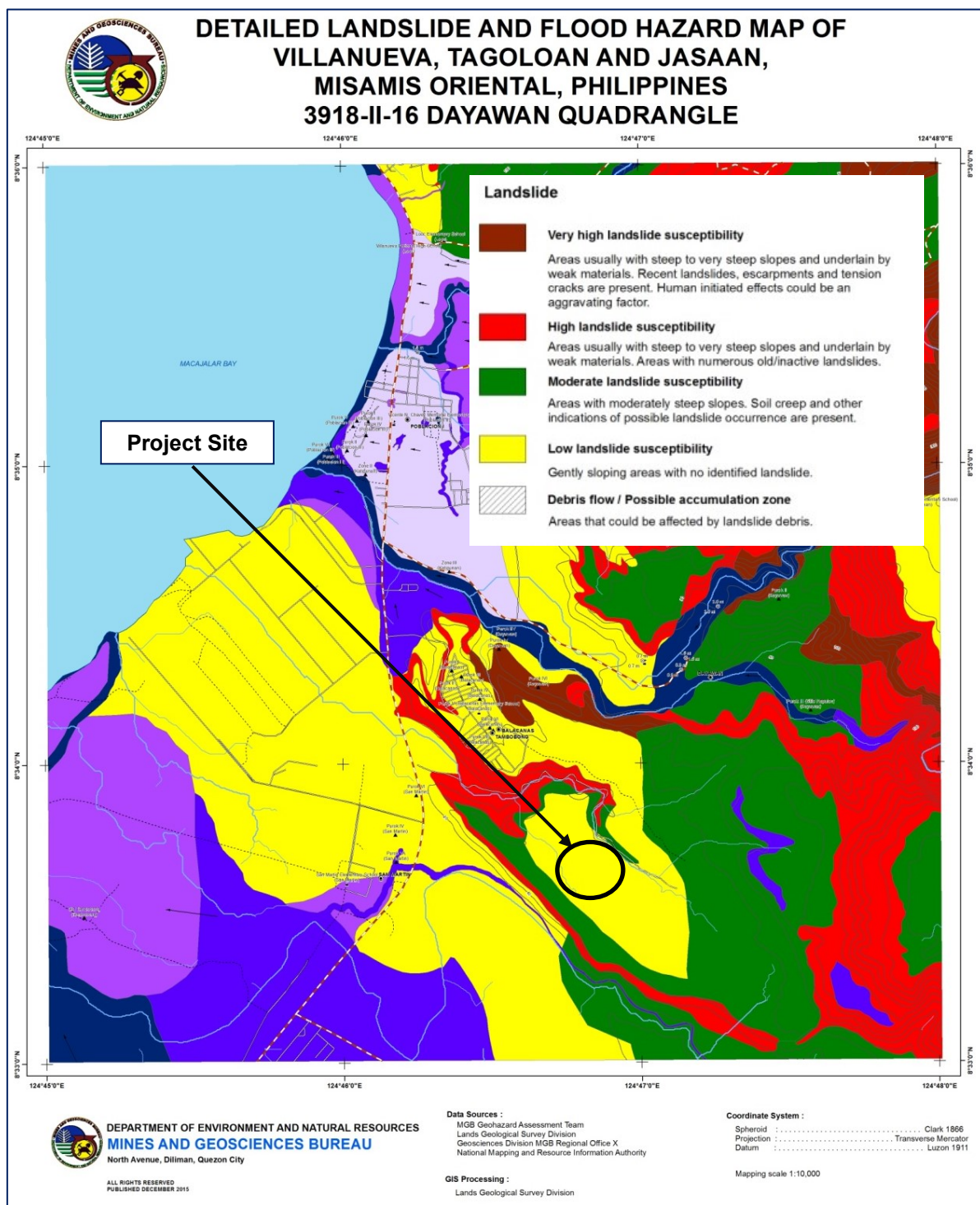


Figure 2.1.12: Active Faults and Liquefaction Susceptibility Map of Region X

2.1.2.3.5 Landslide

Based on the Landslide Map of the MGB, the proposed project site has a low susceptibility to landslide (Figure 2.1.13).



Source: MGB

Figure 2.1.13: Landslide Map

2.1.2.3.6 Tsunamis

Tsunamis are giant sea waves generated by under the sea earthquakes and volcanic eruptions. All coastal areas in the region are susceptible to tsunami. **Figure 2.1.14** shows that the project site is essentially vulnerable to potential locally generated tsunami.

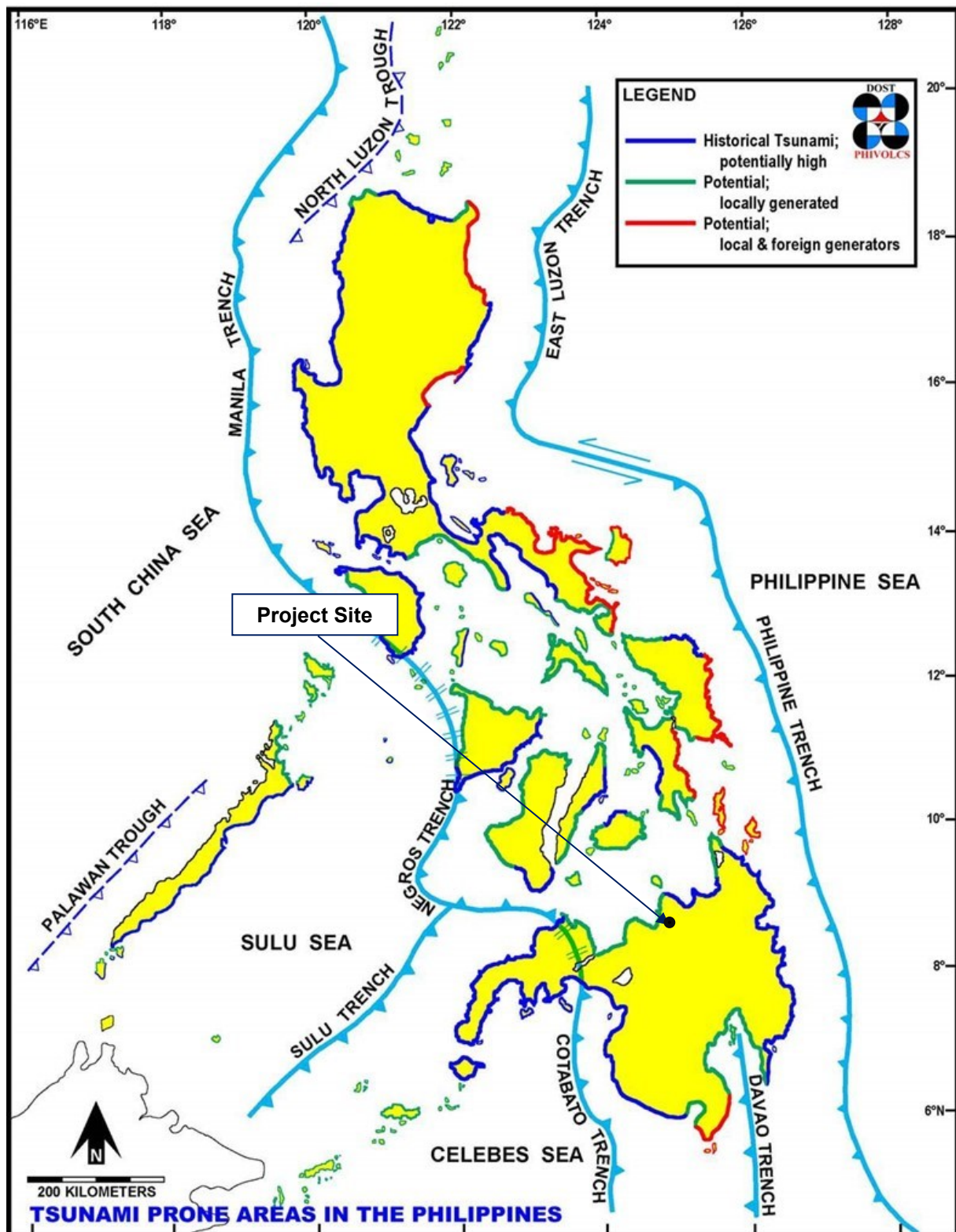
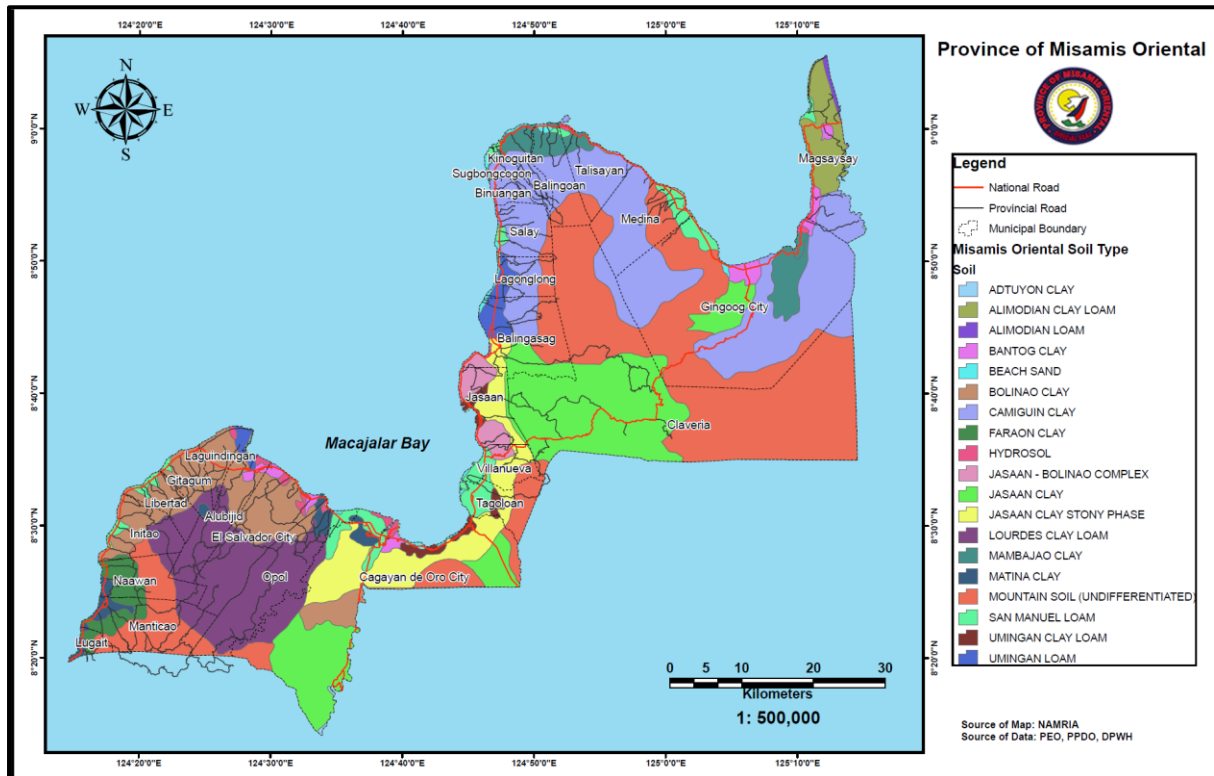


Figure 2.1.14: Tsunami Prone Areas and Occurrences Map

2.1.3 Pedology

2.1.3.1 Soil Type

The Municipality of Villanueva has four (4) types of soil cover. The San Manuel Loam, which favors agricultural activities, is found dominating the area around the Poblacion, Barangay San Martin and Katipunan. The Jasaan Clay is found in Dayawan while Mountain Soils cover Kimaya. The rest being coastal barangays are covered with Beach Sand. Based on the Soil Map presented in **Figure 2.1.15**, the soil in the proposed project site belongs to San Manuel Loam.



Source: MPDO of Villanueva

Figure 2.1.15: Soil Map of the Municipality of Villanueva

Two (2) test pits were also excavated to check the underlying subsoil of the project. Exposed in the 0.50 meter test pits are mostly pebble to gravel size andesitic to cherty rock associated with silty material. **Plate 2.1.1** shows the subsoil profile of the test pits.



Plate 2.1.1: Subsoil Profile of the Test Pits

The subsoil profile shows that the soil/land can accommodate the proposed development with minimal soil erosion and loss of topsoil/overburden because the project only involved construction of Plant structures and its facilities.

2.1.3.2 Soil Quality/Fertility

The western part of the municipality has probably the most productive soil parent materials considering its flat landform and other factors concerning productions. However, most of these areas are already used for built up areas especially with the implementation of PD 538 creating the PHIVIDEDEC Industrial Estate.

The remaining half towards the eastern side have soils development from a parent materials that is generally deep to very deep, a pH thread of acid to strongly acid. Plant growth in this soil is good. Some of these areas are cultivated for agricultural production, some still have forest cover.

Soil sampling was conducted at the project site in 17 October 2018. Soil sampling was conducted to investigate the elements, particularly heavy metals, which are present in the soil matrix within the project site. Heavy metals are a special concern since these substances are hazardous, even in small amounts and have a potential to contaminate the surrounding environment. Also, the aspects of soil erosion/soil quality/fertility were taken into consideration as there are some farming activities ongoing at the project site. Soil quality test was conducted at the quarry area using Dutch Target and Intervention Values (2013), as there are no standards under Philippine law.

Heavy metals such as mercury, arsenic, cadmium, chromium and lead were tested. Results of soil sampling were compared with Dutch Target and Intervention Values (2013), which was established to

determine whether soil require urgent remediation due to unmitigated contamination. Although all of the parameters were detected in the Project area, they are all below the Dutch target values. This shows that the operation has minimal effect on pedology in terms of heavy metal contamination. Although the present DENR-EMB guideline does not have a definitive acceptable standard or limits on the presence of heavy metals on soils, SAMC conducted the sampling to establish a baseline on soil quality which was compared with Dutch Target and Intervention Values (2013).

The results on current soil baseline information will not be affected with the project implementation because the project will not use chemicals which may contaminate the soil.

Table 2.1.2: Soil Quality Sampling Results

Type of Heavy Metals Analyzed	Results (mg/kg)	Dutch 2013 Target Values (mg/kg)
Total Mercury	ND	40
Total Arsenic	ND	76
Total Cadmium	ND	13
Total Chromium		258
Total Lead	7.2	530
Potassium	186	-
Total Organic Matter	2.16	-
Hexavalent Chromium	ND	-
pH Lab @25 degrees Centigrade	6.9	-
Total Nitrogen	1,050	-
Total Phosphorus	226	-

2.1.4 Terrestrial Ecology

The assessment of terrestrial flora and fauna was conducted in April 03, 2018 at the project site in Sitio Kirahon, Barangay San Martin, Villanueva, Misamis Oriental. Preliminary assessment of the area using Google Earth Pro Map, NAMRIA Map (with a scale of 1:50,000), and photos of the project site revealed that terrain/ topography is generally flat covering a total of 24 hectares (more or less). The existing landuse is industrial. **Figure 2.1.16** shows the land cover (landuse) map of the proposed project where the area falls under the classification of grassland.

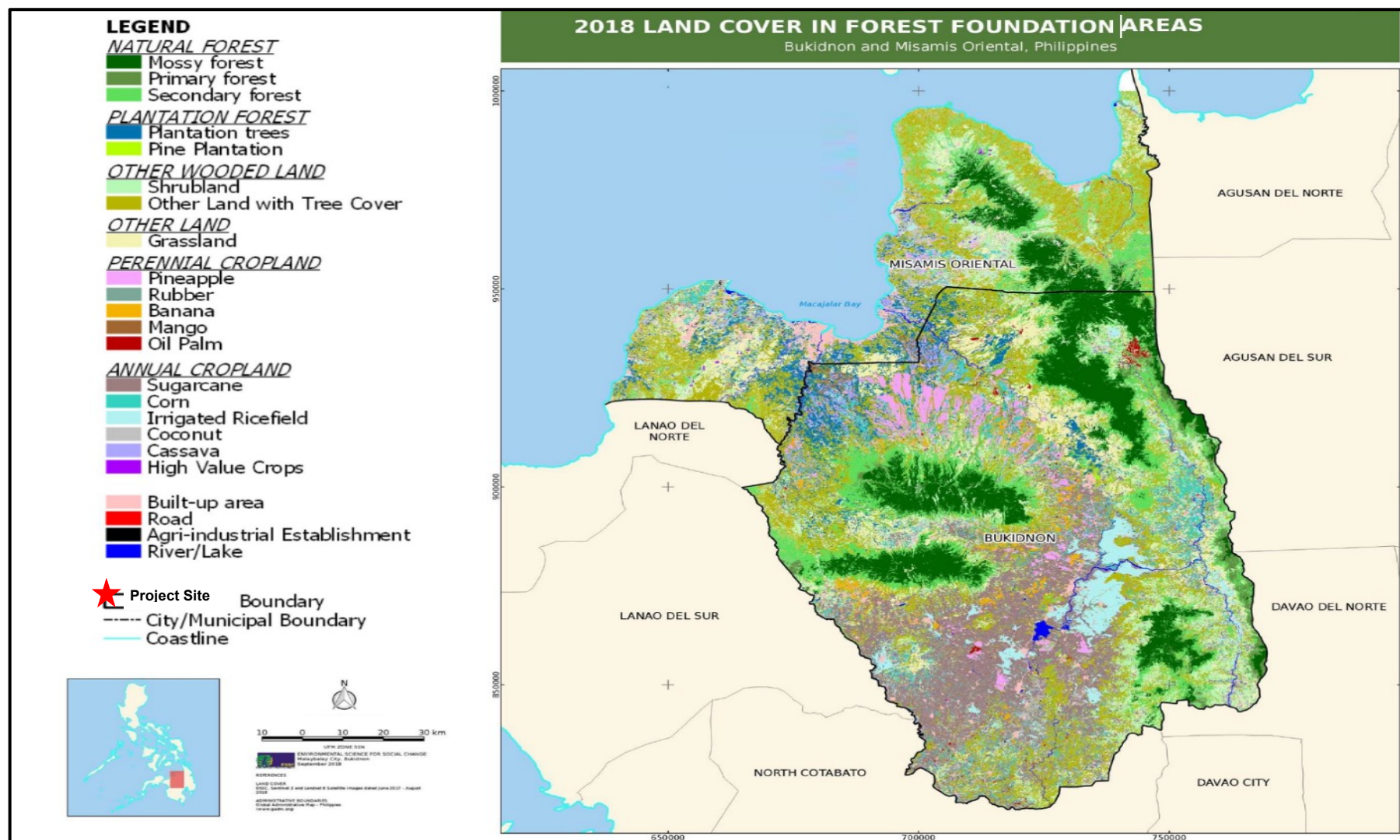


Figure 2.1.16: Land cover (landuse) map of the proposed project

2.1.4.1 Terrestrial Flora

2.1.4.1.1 Methodology

Data Gathering

Secondary data/ information such as Project Description for Scoping (PDS), land cover (landuse) map from NAMRIA's Philippine Geoportal (www.geoportal.gov.ph), and Google Earth map were used to generate reference maps showing various land cover, types of ecosystems, topography, slope, elevations, access roads/ trails, tributaries, and residential/ built-up areas. These reference maps were served as guide maps and were used to determine and select appropriate actions/ methods to be employed for primary data gathering. Other secondary information were obtained from the websites, specifically DENR and relevant institutions/ organization with database on floral taxonomy, endemism/ geographical distribution, known conservation status, and uses/ importance. Reconnaissance survey prior to conduct of actual assessment was conducted to gather initial impression of the project site with respect to types of ecosystems, floral assemblages, and composition.

Primary data gathering for assessing the floral composition of the two MPSAs follows Patch Sampling Technique (Oshawa, 1991; Rice and Lambshed, 1994) based on land cover or landuse. The approach uses the selection of patches as a landscape element to determine the floral composition of the study area, specifically in areas with dense vegetative cover. Nested sampling plots using Quadrat Sampling Method (QSM) measured at 20m x 20m (400m²) dimensions were established within the vegetative cover along transect walk/line with roads and foot trails as access point. The location of each sampling plots were recorded using handheld GeoCam application for android mobile phones and tablets with build-in World Geodetic Systems 1984 (WGS 84) geographical datum/reference commonly used in geo-tagging and locational survey. Sampling plots are presented in **Figure 2.1.17**.

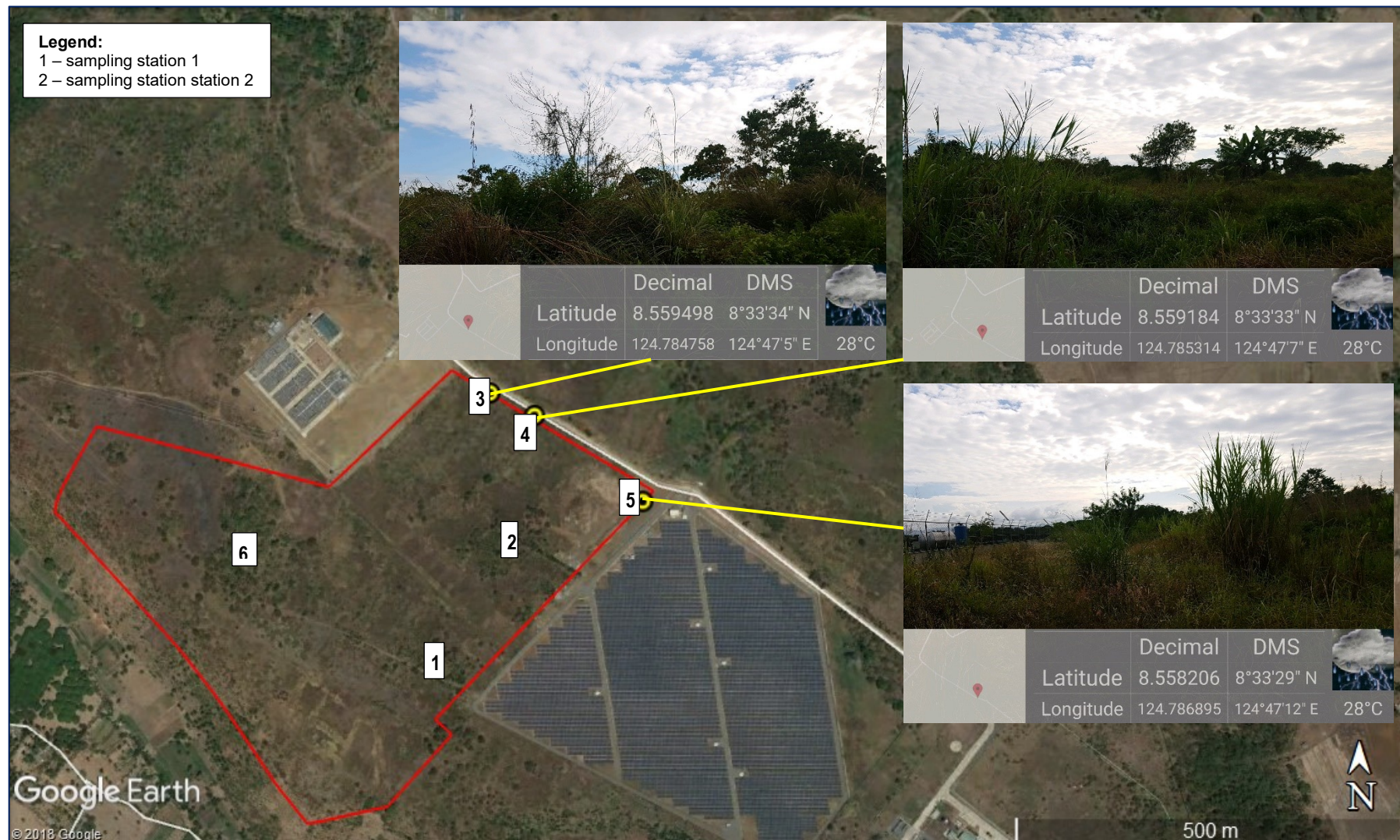


Figure 2.1.17: Sampling Map site map showing the existing vegetation at the proposed project site

Estimation of Relative Indices/ Importance Value (IV)

Terrestrial flora assessment involves complete enumeration and documentation of plant species encountered in each sampling plots and recorded in-situ following acceptable scientific and standard taxonomic nomenclatural classification systems. The assessment involves characterization of plant community in relation to species composition, taxonomic classification or group, plant form and habit, geographical distribution, relative indices of each species (density, frequency, dominance), importance value (IV), biodiversity measurement and evenness index, endemism and conservation status as per DAO 2017-11, and importance/uses. The importance values would determine the ranks of the species within the sampled ecosystem and would identify which of them would be exerting more influence to the ecosystem in terms of nutrient cycling, energy transfer, and micro-climatic effects.

For the determination of importance value indices (IVs), measures of absolute and relative abundances of each species (density, frequency, and dominance) were used to describe the floral composition of each sampling plots with trees while density and frequency measures for determining the relative indices for grassland community. Below are the formulas used in determining the relative indices for each species (Curtes and Mc Intosh, 1950), to wit;

- a) *Relative Density (RD)* = $\frac{\text{Number of Species } A}{\text{Total Area Sampled}} \times 100\%$;
- b) *Relative Frequency (RF)* = $\frac{\text{Number of Samples in which Species Occur}}{\text{Total Number of Sampling Plots}} \times 100\%$;
- c) *Relative Dominance (RDom)* = $\frac{\text{Total Basal Area of Species}}{\text{Total Area Samples}} \times 100\%$;
- d) *Importance Value Index (IVI)* = $\sum(RD + RF + RDom)$

Biodiversity and Evenness Measurement

Shannon-Weiner Index or H' was used in computing the biodiversity measurement for comparing plant communities. It is a measure of the average degree of "uncertainty" in predicting to what an individual species chosen at random from a collection of S species and N individuals will belong (Magurran, 1988). Shannon-Weiner information theoretic index is one of the most popular methods for expressing diversity and important in determining the quality of every ecosystem. It is also being used as an indicator of biodiversity loss or gain when applied to monitoring. The computed index may result in diversity values H' ranging from zero (0) indicating low community complexity to 3.5 and above which implies a very high complexity of plant community. The index was computed using the relative densities of species ($pi = ni/N$), where ni are the abundance values for each i species and N is the total abundance for the data set. The maximum likelihood estimator of $pi = ni/N$, where ni are the observed abundances for each species i and N is the total abundance observed from the sample. Below is the formula for Shannon-Weiner Biodiversity Index:

$$H' = -\sum_{i=1}^S [(pi) \ln(pi)], \text{ where;}$$

H' , represents the symbol for the amount of diversity in ecosystem;

pi , represents the proportion or relative abundance of each individual species to the total (measured from 0 to 1); and

$\ln pi$, represents the natural logarithm of pi

On the other hand, Pielou's Evenness Index or J' denotes the maximum possible species diversity H_{max} for a community were **evenly distributed** among all S species. It expresses H' relative to the maximum value that H' can obtain when all of the species in the sample are perfectly even with one individual per species (Magurran, 1988). It also expresses the condition of maximum evenness of species in a plant community. Species evenness was calculated as the proportion of species diversity of a particular plant community H' by the maximum possible diversity for the community denoted by $J' = H/H_{max}$ when H/H_{max} the community has reached its maximum diversity. The value of J' will approach zero (0) as the community becomes dominated by a single species indicating decreasing diversity. Below is the equation for computing evenness index;

$$J' = H/H_{max} = \sum(pi)(\ln pi)/\ln S, \text{ where}$$

S , is the number of species in a community;

p_i , represents the proportion or relative abundance of each individual species to the total (measured from 0 to 1); and

$\ln p_i$, represents the natural logarithm of p_i

Computed values for H' and J' were then referred to the Fernando Biodiversity Scale in **Table 2.1.3** to qualify the sampled areas in terms of biodiversity and evenness levels.

Table 2.1.3: The Fernando Biodiversity and Evenness Indices (1988)

Relative Values	Shannon Biodiversity (H') Index	Pielou (J') Evenness Index
Very High	3.5 and above	0.75-1.00
High	3.0 – 3.49	0.50-0.74
Moderate	2.5 – 2.99	0.25-0.49
Low	2.0 – 2.49	0.15-0.24
Very Low	1.9 and below	0.05-0.14

Species Conservation Status, Endemicity/ Geographic Distribution

On determining conservation status and endemicity of each species, the International Union for the Conservation and Nature (IUCN) Red List of Threatened Species and DENR-AO 2007-01 “Establishing the National List of Threatened Philippine Plant and Their Categories, and the List of Other Wildlife Species as well as DAO 2017-11 were employed. The IUCN Red List is the world’s largest and most comprehensive inventory of the global conservation of biological species. The Red List is set upon precise criteria to evaluate the extinction of thousands of species and subspecies. The aim of the Red List is to convey the urgency of conservation issues to the public and policy-makers, as well as help the international community to try to reduce species extinction. It is aimed to provide scientifically based information on the status of the species and subspecies at a global level; draw attention to the magnitude and importance of threatened biodiversity; influence national and international policy and decision-making; and provide information to guide actions to conserve biological diversity (Source: Convention on International Trade of Wild Flora and Fauna, Joint Meeting of the Animals and Plants Committee, Shepherdstown, USA., December 2000, retrieved November 2012). Plants and animal assessed for the IUCN Red List are the bearers of genetically and the building blocks of ecosystems, and information on their conservation status and distribution provides the foundation of making informed decisions about conserving extinction and the main purpose of the Red List is to catalogue and highlight those plants and animals that are facing higher risk of extinction either those listed in **Table 2.1.4**. In addition, the DENR AO 2007-01 was also used pursuant to Section 22 of Republic Act 9147, otherwise known as the Wildlife Conservation and Protection Act of 2001.

Table 2.1.4: Definition of Conservation Status and/or Categories

Conservation Status/ Categories	International Union for the Conservation of Nature (IUCN)	DENR Administrative Order 2017-11
EXTINCT (EX)	A taxon is Extinct when there is no reasonable doubt that the last individual has died.	Not defined.
EXTINCT IN THE WILD (EW)	A taxon is Extinct in the wild when it is known only to survive in cultivation, in captivity or as a naturalized population (or populations) well outside the past range. A taxon is presumed extinct in the wild when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), and throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.	Not defined.
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.	Species or subspecies facing extremely high risk of extinction in the wild in the immediate future. This shall include

Conservation Status/ Categories	International Union for the Conservation of Nature (IUCN)	DENR Administrative Order 2017-11
		varieties, formae, or other infraspecific categories;
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.	Species or subspecies that is not critically endangered but whose survival in the wild is unlikely of the causal factors continue operating. This shall include varieties, formae, or other infraspecific categories.
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.	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.
LOWER RISK (LR)	A taxon is Lower Risk when it has been evaluated, does not satisfy the criteria for any of the categories Critically Endangered, Endangered or Vulnerable. Taxa included in the Lower Risk category can be separated into three subcategories:	Not defined.
	a. Conservation Dependent (CD). Taxa which are the focus of a continuing taxon-specific or habitat-specific conservation programme targeted towards the taxon in question, the cessation of which would result in the taxon qualifying for one of the threatened categories above within a period of five years.	Not defined.
	b. Near Threatened (NT). Taxa which do not qualify for Conservation Dependent, but which are close to qualifying for Vulnerable.	Not defined.
	c. Least Concern (LC). Taxa which do not qualify for Conservation Dependent or Near Threatened.	Not defined.
DATA DEFICIENT (DD)	A taxon is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. A taxon in this category may be well studied, and its biology is well known, but appropriate data on abundance and/or distribution is lacking. Data Deficient is therefore not a category of threat or Lower Risk. Listing of taxa in this category indicates that more information is required and acknowledges the possibility that future research will show that threatened classification is appropriate. If the range of a taxon is suspected to be relatively circumscribed, if a considerable period of time has elapsed since the last record of the taxon, threatened status may well be justified.	Not defined.
NOT EVALUATED (NE)	A taxon is Not Evaluated when it has not yet been assessed against the criteria.	Not defined.

Source: (1) International Union for the Conservation of Nature Red List of Threatened Species (www.iucn.org)

(2) DENR Administrative Order 2007-01 "Establishing the National List of Threatened Philippine Plants and Their Categories, and the List of Other Wildlife Species". January 22, 2007.

Uses/ Importance

Plants play a key role in maintaining ecological balance and ecosystems stability. It provides ecological goods and services for various purposes such as clean air and water, soil anchorage and slope stabilization, herbal or alternative medicines as remedy for various ailments of folkloric and traditional beliefs, sources of food and as shelter/ habitat for wildlife species, dyes/ tannins as coloring pigments, fuelwood and firewood, pulp and paper production, essential oils for cosmetic purposes, building and construction materials, aesthetic and recreational values, musical instruments and farm implements, shelterbelts and windbreaks, and many other applications. Some species were used as keystone or indicator species for identifying quality of ecosystems. Uses and importance of each plant species were documented through the use of technical researches/ studies conducted and or compiled by various institutions. Uses of plant species found within the community were documented through observations and interviews with local residents during the period of field assessment.

2.1.4.1.2 Floral Species and Morphological Composition

In terms of morphological composition (plant growth/ habit), six (6) different growths or plant habit either trees, shrubs, vines, ferns, grasses, and herbs were recorded at the sampling sites. The most number of species observed belongs to trees with 13 representative species composed of 194 individuals; shrubs with 3 species having 54 individuals; vines with 4 representative species of 99 individuals; fern with 3 species with 22 individuals, and grasses with 3 species consisting of 88 individuals (**Table 2.1.5**).

Table 2.1.5: Morphological characteristics of the floral species on the proposed project site

Plant Form/ Habit	No. of Species	No. of Individuals
Trees	13	194
Herbs	11	54
Shrubs	3	20
Vines	4	99
Grasses	3	88
Fern	2	22
TOTAL	36	477

2.1.4.1.3 Species Richness and Importance Value Indices

Of the 477 individuals with species richness of 36 species, the most number of species were recorded in SP1 having 13 species and 123 individuals; SP3 with 11 species and 111 individuals; SP6 and SP5 each with 4 species having 87 individuals and 4 species with 69 individuals, respectively. SP4 has 2 species with 19 individuals while 2 species with 23 individuals were recorded in SP2. **Table 2.1.6** shows the list of all floral species assessed on the plots and observed on the area.

Table 2.1.6: Details of Tree Species Recorded

Species No.	Scientific Name	Common/ Local Names	Family Name	Plant Habit/ Form	Total No. of Individuals
1	<i>Artocarpus heterophyllus</i> Lam.	Nangka/ Jackfruit	Moraceae	Tree	7
2	<i>Gmelina arborea</i> Roxb.	Gmelina	Lamiaceae	Tree	61
3	<i>Leucaena leucocephala</i> Lam.	Ipil-ipil	Leguminosae	Tree	63
4	<i>Macaranga tanarius</i> (L.) Muell.-Arg.	Binunga	Euphorbiaceae	Tree	10
5	<i>Mangifera indica</i> L.	Mango	Anacardiaceae	Tree	3
6	<i>Swietenia macrophylla</i> King	Mahogany	Meliaceae	Tree	1
7	<i>Sandoricum koetjape</i>	Santol	Meliaceae	Tree	3
8	<i>Terminalia catappa</i>	Talisay	Combretaceae	Tree	1
9	<i>Chrysophyllum caimito</i>	Caimito / star apple	Sapotaceae	Tree	2
10	<i>Cocos nucifera</i>	Coconut	Arecaceae	Tree	2

Species No.	Scientific Name	Common/ Local Names	Family Name	Plant Habit/ Form	Total No. of Individuals
11	<i>Melanolepis multiglandulosa</i>	Alom	Euphorbiaceae	Tree	39
12	<i>Artocarpus odoratissimus</i>	Marang	Moraceae	Tree	1
13	<i>Acacia concinna</i>	Acacia	Fabaceae	Tree	1
14	<i>Achyranthes aspera</i> (Linn.)	Prickly chaff flower	Amaranthaceae	Grass	48
15	<i>Acrostichum aureum</i> L.	Lagolo	Pteridaceae	Fern	19
16	<i>Adiantum philippense</i> L.	Kaikai	Pteridaceae	Fern	24
17	<i>Dactyloctenium aegyptium</i> Linn.	Egyptian grass/ Damung-balang	Poaceae	Grass	27
18	<i>Eleusine indica</i> (Linn.) Gaertn	Paragis/ wire grass	Poaceae	Grass	13
19	<i>Alpinia elegans</i> (Presl.) K. Schum.	Tagbak	Zingiberaceae	Herb	5
20	<i>Amorphophallus paeoniifolius</i> (Denntedt) Nicolson	Pongapong	Araceae	Herb	5
21	<i>Bidens pilosa</i> (L.)	Beggar ticks/ Dadayem	Asteraceae	Herb	3
22	<i>Carica papaya</i> L.	Papaya	Caricaceae	Herb	7
23	<i>Celosia argentea</i> L.	Kadayohan	Amaranthaceae	Herb	4
24	<i>Centella asiatica</i> (L.) Urb.	Penny worth/ Takip-kuhol	Apiaceae	Herb	11
25	<i>Chromolaena odorata</i> (L.) R.M. King & H. Rob.	Hagonoy	Asteraceae	Herb	7
26	<i>Costus speciosus</i> (Koenig) Smith	Tubang-usa	Costaceae	Herb	2
27	<i>Datura metel</i> L.	Talong-punay	Solanaceae	Herb	3
28	<i>Dracaena fragrans</i> Ker-Gawl.	Fortune plant	Ruscaceae	Herb	2
29	<i>Eclipta alba</i> (Linn.) Hassk.	False Daisy/ Tinta-tintahan	Asteraceae	Herb	5
30	<i>Centrosema pubescens</i> Benth.	Dilang butiki	Leguminosae	Vine	12
31	<i>Emilia sonchifolia</i> (Linn.) D.C.	Lilac Tasseflower/ Tagulinaw	Asteraceae	Vine	25
32	<i>Ipomea pes-tigridis</i> (Linn.)	Tiger foot/ Malasandia	Convolvulaceae	Vine	32
33	<i>Orthosiphon aristatus</i> (Blume) Miq.	Kabling-gubat	Lamiaceae	Shrub	8
34	<i>Ricinus communis</i> L.	Tangan-tangan/ Castor plant	Euphorbiaceae	Shrub	5
35	<i>Tabernaemontana pandacaqui</i> Poir.	Pandakaki	Apocynaceae	Shrub	7
36	<i>Tetragium loheri</i> Gagnep.	Loher's ayo	Vitaceae	Vine	30
TOTAL					477

2.1.4.1.4 Species Diversity and Evenness

Biodiversity or biological diversity refers to variety or variability among living organisms and the ecological complexes in which they occur, and encompasses ecosystem, species, and genetic diversity (D.B. Jensen, M. Torn, and J. Harte., 1990). Having a variety of livings in an area is important in the health of the environment or biological systems. In general, the higher or the more diversity of life in the environment, the better the environment is. On the other hand, species richness occurring within a specific area or community measures a unique level of ecological organization which reflects the biological structure of a community. A community with high species richness and diversity will likely have a complex network of trophic pathways. In contrast, a community with low species richness and diversity likely have a fewer species and trophic interactions. Interactions among species within the food web of communities with high species diversity are theoretically more complex and varied than in communities of low species diversity. Indices of species richness and species diversity are often used in a comparative manner, that is, to compare communities growing under different environmental conditions or to contrast stages of succession.

Measurement of biodiversity is important given the obvious declines on habitat quality in almost every ecological system. For this purpose, the Shannon's Biodiversity Index, the most practical and popular biodiversity measurement were used to examine the overall community characteristics and quality of

two or more distinct habitats and to describe the degree of uncertainty of predicting the species of an individual picked at random from the community. The uncertainty of occurrence increases both as the number of species increases and the individuals are evenly distributed among all species in a given community. Shannon's Biodiversity Index may result in diversity value (H') ranging from zero indicating low community complexity to 3.5 and above which indicates very high community complexity. This is the condition where maximum possible species diversity composing the community is evenly distributed among all species. It is also a condition where biodiversity is high and have reached its maximum evenness while a community composed of single species or being dominated by a single species will have low biodiversity as its evenness reaches zero.

The overall floral diversity and evenness index of the project area range from $H' = 0.55$ to $H' = 1.19$ indicating a very low biodiversity level and $J' = 0.16$ to $J' = 0.28$ indicating a very low to moderate evenness index. This can be explained due to habitat type of the sampling plots. The area is generally characterized as an agricultural area wherein there are less plant species and the dominant species are mostly composed of Poaceae, Asteraceae, and low stature species (pioneer species) belonging to Moraceae, Lamiaceae, and Euphorbiaceae. Further, there are very few solitary trees scattered in the area and live fence composed of shrubs and low stature trees. Likewise, majority of the project area has been left uncultivated for more than 10 years paving the growth of other species for succession such as grasses, herbs, vines, and shrubs. The highest computed Shannon Biodiversity Index can be found in SP6 with $H' = 1.19$ indicating a very low biodiversity which is attributed to low species richness/ composition and an evenness index at $J' = 0.28$ indicating a moderate succession of pioneering species. This was followed SP1 with $H' = 1.10$ and $J' = 0.28$; SP4 and SP5 each with $H' = 0.98$ and $J' = 0.25$ and $J' = 0.23$, respectively. SP2 has the second lowest biodiversity index at $H' = 0.91$ and an evenness index at $J' = 0.25$ while SP2 has the lowest biodiversity at $H' = 0.55$ and evenness index at $J' = 0.16$. **Table 2.1.7** shows the diversity and evenness indices of plant species within the project area.

Table 2.1.7: Diversity and evenness indices of all plant species in the project area

Sampling Plots	No. of Species	Shannon-Weiner (H')	Pielou's Evenness (J')
SP1	13	1.10	0.28
SP2	2	0.55	0.16
SP3	11	0.91	0.25
SP4	2	0.98	0.25
SP5	4	0.98	0.23
SP6	4	1.19	0.28

2.1.4.1.5 Species Conservation Status, Endemicity/ Geographic Distribution

Conservation Status

The Philippines is considered as one of the megadiverse countries in the world. The 7,100 islands comprising the Philippines possesses high level of endemicity of marine/aquatic and terrestrial flora and fauna species, regarded as one of the biodiversity hotspots in the world, Philippines is one of the world's biologically richest nation and has the most threatened and fragile ecosystems. Many endemic species are confined to forest fragments that cover 7% of the original extent of the hotspots. The 93% of the original forest have been cleared due to logging and extractive activities for agricultural/farming expansions and other developments to accommodate the needs of the growing population. And with this, the Philippines have been placed as one of the most endangered areas at the same time remains as one of the most diverse area on the planet. At the very least, one-third of more than 9,250 vascular plant species are endemic to the Philippines as per Conservation International, 2007 Biodiversity Hotspots – Philippines.

Of all species recorded, there are no species cited by the International Union for the Conservation of Nature (IUCN) Red List of Threatened Species as either Endangered (EN) or Vulnerable (VU).

Mangifera indica L. (Anacardiaceae) was classified as Data Deficient (DD) by the IUCN. *M. indica* L. have been cultivated for thousands of years and become pantropic in distribution. IUCN cited that wild

populations can be found in Assam, India and Myanmar (Assam-Chittagong Hills). However, appropriate data on abundance and/or distribution is lacking, hence more information/ data on the species in the wild is required to approximate its status whether it is threatened or not. The species is said to be restricted (native) to India and an introduced species in Bangladesh, China, Indonesia, Malaysia, Myanmar, Philippines, Sri Lanka, Thailand, and Vietnam.

It must be noted that Mahogany (*S. macrophylla*) is considered as vulnerable worldwide, but introduced local population has a tendency to disrupt growth of other species in the area. This entails careful planning of using mahogany in plantation establishment or reforestation so as not to disrupt the local biodiversity.

Endemicity/ Geographic Distribution of all Species/ Uses and Importance

Endemicity of species are those which are only confined to a certain land mass, region, or country and not anywhere else in the world. Therefore, these species are of conservation concern since they are only found within a specific location. Of the total number of species found the project area, 41% were found to be endemic to the country. Some of these species include: *Dysoxylum gaudichaudianum* (Meliaceae), *Alpinia elagans* (Zingiberaceae), *Macaranga bicolor* (Euphorbiaceae), *Adiantum philippense* (Pteridaceae), *Ficus septica* (Moraceae), and the likes. **Table 2.1.8** presents the list of all species to include endemicity, geographical range/ distribution, uses and importance.

Table 2.1.8: List of all species to include geographical range/ habitat, endemism, conservation status, uses and importance, and threats

Species No.	Scientific Name	Local/ Common Name	Family Name	Plant Form/ Habit	Geographical Range/ Distribution/ Habitat	Endemism	Conservation Status		Uses/ Importance	Threats/ Remarks
							IUCN	DENR AO 2017-11		
	<i>Achyranthes aspera</i> (Linn.)	Prickly chaff flower/ Hangod	Amaranthaceae	Grass	It is found as a weed throughout the Philippines at low and medium altitudes in open, waste places. It is a pantropic weed	Introduced	Not cited	Not cited	Medicine: A decoction of the leaves and roots of this plant is used locally as a diuretic. The sap is said to be useful in dissipating the spacity of the cornea. The plant is used as a stomachic and laxative. It is also used, in piles, for the inflammation of the internal organs, and enlarged cervical glands.	No threats to this species
	<i>Artocarpus heterophyllus</i> Lam.	Nangka/ Jackfruit	Moraceae	Tree	Cultivated throughout the Philippines at low and medium altitudes. Occurs in India to Malaya, and is now cultivated in most tropical countries; Prehistoric introduction from Malaya or tropical Asia.	Indigenous	LC	Not cited	Fruits are edible; seed contains starch; pulp or flesh (lamukot) is rich in vitamin C, eaten fresh or cooked or preserved; the unripe fruit can be pickled; wood is best for musical instrument as sounding board for guitar; as medicine, treats skin diseases, ulcers and wounds: ash of burnt leaves applied on wounds and ulcers as cicatrizing	No threats to this species
	<i>Centella asiatica</i> (L.) Urb.	Penny worth/ Takip-kuhol	Apiaceae	Herb	Found in gardens, thickets, and open, damp grasslands, on rice paddy banks and streams throughout the Philippines. Pantropic.	Introduced	Not cited	Not cited	Eaten as a salad or vegetable dish. In Malaysia and Indonesia, common eaten as fresh vegetable (ulam and salad), eaten raw or cooked as soup ingredient. Mild bitterness is countered by the addition of coconut milk and/or shredded coconut. Used as health tonic and processed into cordial drinks or blended to make juice drink. (28). Used in the preparation of juices and other food products. Folkloric, in the Philippines, sap of leaves used as curative for sclerotic wounds. Decoction of leaves used as diuretic and considered useful for gonorrhea.	No threats to this species
	<i>Centrosema pubescens</i> Benth.	Dilang butiki	Leguminosae	Vine	Occurs in open areas and closed canopy forests at low to medium elevations. Native to America and Mexico	Introduced	Not cited	Not cited	Grazed pastures in mixture with a grass, legume - only protein bank, cut-and-carry; potential also as soil cover.	No threats to this species
	<i>Chromolaena odorata</i> (L.) R.M. King & H. Rob.	Hagonoy	Asteraceae	Herb	Occurs gregariously in newly opened areas/ cultivated lands throughout the Philippines. Native to North America, from Florida and Texas to Mexico and the Caribbean, and has been introduced to tropical Asia, Africa, and parts of Australia.	Introduced	Not cited	Not cited	Forms dense stands preventing establishment of other species, both due to competition and allelopathic effects; can be used as soil cover; an insect repellent.	No threats to this species
	<i>Costus speciosus</i> (Koenig) Smith	Tubang-usa	Costaceae	Herb	Very common in and about towns, in thickets and hedges along roadsides throughout the Philippines. Introduced at an early date in colonial history from Mexico.	Introduced	Not cited	Not cited	The name derives from its cultivation and used as a hedge or fence (bakod); used to produced jatroph methyl ester for biodiesel; used as medicine	No threats to this species

Species No.	Scientific Name	Local/ Common Name	Family Name	Plant Form/Habit	Geographical Range/ Distribution/ Habitat	Endemism	Conservation Status		Uses/ Importance	Threats/ Remarks
							IUCN	DENR AO 2017-11		
	<i>Datura metel</i> L.	Talong-punay	Solanaceae	Herb	In open, waste places in and about settlements, throughout the Philippines. Native of tropical Asia	Indigenous	Not cited	Not cited	Cultivated also for ornamental purposes.	No threats to this species
	<i>Dysoxylum gaudichaudianum</i> (A. Juss.) Miq.	Igyo	Meliaceae	Tree	In thickets and forests at low altitudes from Cagayan to Sorsogon in Luzon, and in Mindoro, Palawan, Masbate, Leyte, Negros, Mindanao, and Basilan. Also occurs in Java to New Guinea.	Native	Least concern	Not cited	Timber for light to medium construction; ornamental	No threats to this species
	<i>Eleusine indica</i> (Linn.) Gaertn	Paragis/ wire-grass	Poaceae	Grass	An abundant weed in waste places and along river banks, roads, and settled areas throughout the Philippines. Strictly xerophytic. Also found throughout warm countries.	Introduced	Not cited	Not cited	Roots and seeds are edible. Roots eaten raw, young seedling raw or cooked. Grain is a famine food in India and parts of Africa. Folkloric: Decoction of fresh leaves used as anthelmintic. Decoction of the fresh plant used as a diuretic and for dysentery.	No threats to this species
	<i>Emilia sonchifolia</i> (Linn.) D.C.	Lilac Tasseflower/ Tagulinaw	Asteraceae	Vine	In open places, wastelands, cultivated lands, gardens, etc., in and about towns and settlements at low and medium altitudes throughout the Philippines. Pantropic weed of Old World origin.	Introduced	Not cited	Not cited	Plant is edible. At a later stage the stem-leaves can be eaten, but best when cooked.	No threats to this species
	<i>Euphorbia hirta</i> (Linn.)	Asthma weed/ Tawa-tawa	Euphorbiaceae	Herb	Abundant throughout the Philippines, in waste places, open grasslands, etc. Pantropic.	Introduced	Not cited	Not cited	Called gatas-gatas because of the healing property of the milky juice. In the Philippines, leaves are mixed with <i>Datura metel</i> leaves and flowers in the preparation of "asthma-cigarettes."	No threats to this species
	<i>Evolvulus alsinoides</i> (Linn.)	Dwarf morning-glory	Convolvulaceae	Herb	Locally abundant, from northern Luzon to Mindanao, in open grasslands at low and medium altitudes. Pantropic.	Introduced	Not cited	Not cited	Infusion of entire plant used to cure irregularities of the bowels. Also used as vermifuge and febrifuge. In the Goa territory, whole plant used extensively as tonic and febrifuge. In decoction or infusion, used as alterative, febrifuge, anthelmintic and antiphlogistic.	No threats to this species
	<i>Hyptis capitata</i> Jacq.	Knobweed/ Butonesan	Lamiaceae	Herb	From northern Luzon (Cagayan) to Mindanao, In all or most islands and provinces, as a weed in settled areas, occurring in open, waste places, fallow rice paddies, etc. Introduced from Mexico. Now also established in the Marianne and Caroline Islands in Taiwan, in Java, and in Amboina.	Introduced	Not cited	Not cited	In the Philippines, decoction of leaves used to clean wounds. Decoction of roots used for amenorrhea. Used by the Maranaos for dry cough and tooth aches; gas pains in infants and convulsions in children.	No threats to this species
	<i>Ipomea pes-tigridis</i> (Linn.)	Tiger foot/ Malasandia	Convolvulaceae	Vine	In all or most parts of the Philippines in open grasslands and waste places at low and medium altitudes. Also occurs in tropical Africa and Asia through Malaya to Polynesia.	Introduced	Not cited	Not cited	Poultices of leaves used as resolvent for pimples, boils, carbuncles, etc. In Java, leaves used for poulticing sores, boils, pimples.	No threats to this species
	<i>Lantana camara</i> L.	Coronitas	Verbenaceae	Herb	A gregarious weed in the Philippines, in settled areas in thickets and waste places	Introduced	Not cited	Not cited	Decoction of fresh roots used as gargle for toothaches, and a decoction of the leaves and fruits	No threats to this species

Species No.	Scientific Name	Local/ Common Name	Family Name	Plant Form/ Habit	Geographical Range/ Distribution/ Habitat	Endemism	Conservation Status		Uses/ Importance	Threats/ Remarks
							IUCN	DENR AO 2017-11		
					at low and medium altitudes. Native of tropical America.				to clean wounds; decoction or syrup of roots (in sugared water) used for asthma;	
	<i>Laportea interrupta</i> (L.) Chew	Lipang-aso	Urticaceae	Herb	Native of Mexico and Americas. Common in agricultural areas, thickets, and ruderal areas.	Introduced	Not cited	Not cited	Poison: hairs can cause contact dermatitis; Medicine: leaves applied locally for carbuncles; decoction of root used as diuretic.	No threats to this species
	<i>Leucaena leucocephala</i> Lam.	Ipil-ipil	Leguminosae	Tree	Widely distributed throughout the Philippines; in agricultural areas, coastal land, natural forests, planted forests, rangeland/ grassland/ brushlands, riparian zones, and urban areas. Native to Mexico and Central America	Introduced	Not cited	Not cited	Fuelwood: used as feedstock for biomass energy production due to its high calorific content and low ash content; Timber: wood is used for light construction; Food: leaves used as forage to domesticated animals; seeds are often used as substitute for coffee;	No threats to this species
	<i>Lygodium flexuosum</i> (L.) Sw.	Nito	Lygodiaceae	Vine	Pantropical in distribution and occurs in thickets, wastelands, secondary and primary forest of low to high elevations; native to Angola, Bangladesh, Benin, Bhutan, Burkina Faso, Cambodia, Cameroon, Africa; China, Congo, Ethiopia, Guinea, India, Indonesia, Lao, Liberia, Madagascar, Malaysia, Maldives, Mauritius, Myanmar, Nepal, Pakistan, Philippines, Singapore, Sri Lanka, Thailand, and Vietnam	Indigenous	Not cited	Not cited	Wiry rachises are used for plaiting and weaving (handicrafts); also used to tie rice sheaths in the fields.	No threats to this species
	<i>Macaranga tanarius</i> (L.) Muell.-Arg.	Binunga	Euphorbiaceae	Tree	Common in thickets and secondary forests at low and medium altitudes throughout the Philippines. Native to the Andaman Islands and Malay Peninsula to southern China and Taiwan southward to northeastern Australia.	Endemic	Least concern	Not cited	Fruits are added to palm juice when it is boiled down into crystals, improving the quality of the sugar; as fuel, good as firewood; fiber yields high quality pulp and produces high-quality particleboard; used as timber for light construction; gums/ resins are tapped from the bark for glue, particularly for joining parts of musical instruments; tannin/ dyestuff is used for toughening fishing nets; bark and leaves are widely used in the preparation of a fermented drink called 'basi' made from sugarcane.	No threats to this species
	<i>Mangifera indica</i> L.	Mango	Anacardiaceae	Tree	Cultivated throughout the Philippines	Introduced	Data Deficient	Not cited	Food: taste has slightly similarity to peaches; canned with syrup, dried and candied, jammed. Unripe mangoes are chutneyed, or pickled in brine; young, fresh leaves are used in native dishes; decoction of root is considered diuretic.	No threats to this species
	<i>Melanolepis multiglandulosa</i> (Reinw. Ex Blume) Reichb. f. & Zoll.	Alim	Euphorbiaceae	Tree	Common in thickets and secondary growth forests at low to medium elevations. Widespread over Taiwan, Ryukyu Islands, Marianas, and from Southern Thailand	Indigenous	Least concern	Not cited	Used as fuelwood/ charcoal; as medicine, heated bark and leaves are applied to the skin to increase sweating and as poultice for scaly skin; used to expel intestinal worms; fruits are used in treating wounds and has abortive capacity	No threats to this species

Species No.	Scientific Name	Local/ Common Name	Family Name	Plant Form/Habit	Geographical Range/ Distribution/ Habitat	Endemism	Conservation Status		Uses/ Importance	Threats/ Remarks
							IUCN	DENR AO 2017-11		
					throughout Malaysia to Papua New Guinea (Bismarck Archipelago).					
	<i>Mimosa pudica</i> L.	Makahiya	Leguminosae	Herb	Common weed widely distributed in the Philippines in open, moist, waste places, open grasslands and open thickets, at low and medium altitudes in settled areas. Introduced from tropical America.	Introduced	Not cited	Not cited	In the Philippines, roots used as diuretic; also used for dysentery and dysmenorrhea; roots considered aphrodisiac, and used for bladder gravel and similar urinary complaints; decoction or infusion of leaves used in asthma; expectorant; used for hypertension, glandular swelling, sore throat and hoarseness.	No threats to this species
	<i>Musa sapientum</i> L.	Banana	Musaceae	Herb	Cultivated in many parts of the Philippines and in many parts of the world.	Introduced	Not cited	Not cited	Used as food, medicine, and handicraft weaving	No threats to this species
	<i>Orthosiphon aristatus</i> (Blume) Miq.	Kabling-gubat	Lamiaceae	Shrub	Found mainly throughout southern China, the Indian Subcontinent, South East Asia and tropical Queensland	Indigenous	Not cited	Not cited		No threats to this species
	<i>Paspalum conjugatum</i> (Berg.)	Carabao grass	Poaceae	Grass	Found abundance in open waste places and settlement areas throughout the Philippines; considered weed but sometimes planted as a coarse ground cover grass; native of tropical America and now a pantropic.	Introduced	Not cited	Not cited	Used as fodder for livestock and soil cover; landscaping	No threats to this species
	<i>Paspalum scrobiculatum</i> (L.)	Bias-biasan	Poaceae	Grass	Grown primarily in India, and also in the Philippines, Indonesia, Vietnam, Thailand, and in West Africa from where it originated	Introduced	Not cited	Not cited		No threats to this species
	<i>Passiflora foetida</i> (Linn.)	Stinking passion flower/ Pasionaryang-mabaho	Passifloraceae	Vine	In waste places at low altitudes. Introduced from tropical America. Now pantropic.	Introduced	Not cited	Not cited	Medicinal/culinary purposes (Randall, 2003); infusion of leaves and roots used for hysteria; decoction of fruit used for asthma and biliousness; leaves and roots as emmenagogue; fruit used as emetic.	No threats to this species
	<i>Piper interruptum</i> Opiz var. <i>loheri</i> (C.DC.) Quis.	Litlit	Piperaceae	Vine	Southeast Asia - Taiwan, Indo-China, Indonesia, Philippines, New Guinea to northeast Australia and possible also to the Pacific Islands. Rainforest at elevations from near sea level to 750 metres in northeast Australia	Introduced	Not cited	Not cited	The stem is used as a flavouring. It is very spicy, with peppery and chilli tones, and leaves a lingering aftertaste. It is used especially in Northern Laos and northern Thailand food, and has a slightly numbing effect on the tongue	No threats to this species
	<i>Pipturus arborescens</i> (Link) C.B. Rob.	Dalunot	Urticaceae	Tree	Very common and wide distributed species. In thickets and secondary forests at low and medium altitudes. Also occurs in Borneo, Riqueys, and Taiwan.	Indigenous	Not cited	Not cited	Food: fruits are reportedly edible; Medicine: in the Philippines, bark scrapping is used externally as cataplasm for boils; leaves used for treating herpes, simplex and skin diseases; Mansaka people of Mindanao apply scrapped and pounded bark or pulp on wounds to enhance healing.	No threats to this species
	<i>Pseudoelephantopus spicatus</i> Juss (Ex Aubl.)	Dilang-aso	Compositae	Herb	Common in waste places in settled areas generally, from the Batan Islands and northern Luzon to Mindanao, in most islands and provinces. Native to tropical	Introduced	Not cited	Not cited	In Central Luzon, leaves used as topical for eczema. Leaves used as vulnerary.	No threats to this species

Species No.	Scientific Name	Local/ Common Name	Family Name	Plant Form/Habit	Geographical Range/ Distribution/ Habitat	Endemism	Conservation Status		Uses/ Importance	Threats/ Remarks
							IUCN	DENR AO 2017-11		
					America. Introduced from Mexico. Also occurs in the Marianne Islands, Taiwan, southern China, Taiwan, and Java.					
	<i>Ricinus communis</i> L.	Tangan-tangan/ Castor plant	Euphorbiaceae	Shrub	In open waste places near settled areas throughout the Philippines. Prehistoric introduction. Native of the Old World. Pantropic in distribution.	Introduced	Not cited	Not cited	Entire fresh leaves are used externally for headache. Cooked with milk, leaves are used as poultices for certain kinds of ulcers.	No threats to this species
	<i>Selaginella plana</i> Hieron	Kamariang-gubat	Selaginellaceae	Fern	Generally cultivated throughout the Philippines but is not a native of the Archipelago.	Indigenous	Not cited	Not cited	Prized for its large corms or underground stems, used as staple food in many localities. Fresh edible leaves and petioles are a rich source of protein, ascorbic acid, dietary fiber, and some important minerals. Used to treat asthma, arthritis, diarrhea, internal hemorrhage, skin disorders.	No threats to this species
	<i>Senna alata</i> (L.) Roxb.	Akapulko	Leguminosae	Shrub	Abundant throughout the Philippines in settled areas at low and medium altitudes. Occasionally planted as ornamental or for its medicinal properties. Introduced from tropical America; now pantropic.	Introduced	Not cited	Not cited	The seeds used for intestinal parasitism. Tincture from leaves reported to be purgative. Decoction of leaves and flowers for cough and as expectorant in bronchitis and asthma. Also used as astringent.	No threats to this species
	<i>Stachytarpheta jamaicensis</i> (L.) Vahl.	Kandi-kandilaan	Verbenaceae	Shrub	Common weed in open and waste places at low and medium altitudes in settled areas throughout the Philippines. Native of tropical America. Now pantropic.	Introduced	Not cited	Not cited	Decoction or roots are abortive. Decoction of leaves are vermifuge to children. In the Antilles, juice of fresh leaves is emetocathartic. Decoction of leaves in enemas used to expel intestinal worms; also used as purging vehicle for other vermifuges.	No threats to this species
	<i>Syngonium podophyllum</i> Schott	Kamay-kastila	Araceae	Vine	Common weed in open and waste places at low and medium altitudes in settled areas throughout the Philippines. Native of tropical America. Now pantropic.	Introduced	Not cited	Not cited	Medicine.	No threats to this species
	<i>Tabernaemontana pandacqui</i> Poir.	Pandakaki	Apocynaceae	Shrub	Common in lowland thickets or brushland or scrubland areas and along trails of abandoned/ waste lots. Also found in Thailand, Taiwan, Borneo, Sulawesi, Java, New Guinea, Australia, and Pacific.	Indigenous	Not cited	Not cited	Decoction of roots and bark used to treat stomach and intestinal ailments; white sap of the stem is applied to thorn injuries; boiled leaves (decoction) is known to cure erectile dysfunction or known as "herbal viagra."	No threats to this species
	<i>Tetrastigma loheri</i> Gagnep.	Loher's ayo	Vitaceae	Vine	Occurs in Luzon (Ilocos Norte to Sorsogon including Rizal, Mindoro, Palawan, and Mindanao. In low and medium elevation thickets and forests, ascending up to 1,400 meters above sea level	Introduced	Not cited	Not cited	Handicraft: used for weaving, basketry, and rope albeit poor quality; Food: pulp of the fruit is green, sour but edible; suitable for making preserves; leaves are cooked with other foods for flavoring; Medicine: decoction of the plant used as powerful diuretic; externally, lotion made from plant used for scabies	No threats to this species
	<i>Trema orientalis</i> (L.) Blume	Anabiong	Cannabaceae	Tree	In deserted clearings, thickets, and second-growth forests, often abundant, and found throughout the Philippines, at	Indigenous	Not cited	Not cited	Juice obtained from macerating the soft wood is used for policing swelling; used as fuelwood and charcoal production	No threats to this species

Species No.	Scientific Name	Local/ Common Name	Family Name	Plant Form/Habit	Geographical Range/ Distribution/Habitat	Endemism	Conservation Status		Uses/ Importance	Threats/ Remarks
							IUCN	DENR AO 2017-11		
					low and medium altitudes, in some places ascending to 2,000 meters. Also occurs in India to southern China and southward to northeastern Australia and Polynesia.					
	<i>Triumfetta rhombioides</i> Jacq.	Kulot-kulotan	Malvaceae	Herb	Common and widespread in the Philippines, in open grassland and ruderal areas, settlement, and scrubland. Native to Africa. Occurs in open waste places throughout the Philippines.	Introduced	Not cited	Not cited	Medicine: pounded or decoction of roots used to cure intestinal ulcers; decoction of leaves, flowers, and roots used in gonorrhea and leprosy; Food: used also as fodder for livestock	No threats to this species
	<i>Urena lobata</i> L.	Kollo-kollot	Malvaceae	Herb	Pantropic in distribution. Found in all regions, in open places, thickets, and damp areas. Native to Africa.	Introduced	Not cited	Not cited	Food: in Africa, leaves and flowers are eaten as famine food; Medicine: root decoction used to relieve colic; infusion of root used internally as emollient and refrigerant and externally for skin diseases associated with pain and inflammation; used to treat diabetes in Nigeria; in Congo, part of a herbal concoction used for abdominal inflation associated with schistosomiasis; Fiber: bast fiber of the plant is of the jute type, more easily extracted than jute; rope made from fiber is fairly strong; used as cordage material; favored fiber in the manufacture of coffee bags; makes a strong paper and said to be twice as strong as "Bank of England" note pulp	No threats to this species
	<i>Vitex negundo</i> L.	Lagundi	Lamiaceae	Tree	Widely distributed in the Philippines at low and medium altitudes, in thickets and waste places; occurs in tropical East Africa, Madagascar, and India to Japan, and southward through Malaya to western Polynesia.	Indigenous	Not cited	Not cited	Decoction of leaves used externally for cleaning ulcers and internally for flatulence; also used as a lactagogue and emmenagogue; decoction of bark, tops and leaves used as antigestralgic; leaves used in aromatic baths; also as insectifuge; vapor bath prepared with the plant used for treatment of febrile, catarrhal, and rheumatic affections	No threats to this species
	<i>Wrightia pubescens</i> R. Br. subsp. <i>laniti</i> (Blanco) Ngan	Lanete	Apocynaceae	Tree	Found in primary and secondary forests at low and medium altitudes.	Indigenous	Least concern	Not cited	Decoction of roots and bark used as abortifacient. Leaves applied as head covering for headaches.	No threats to this species

2.1.4.2 Terrestrial Fauna

2.1.4.2.1 Methodology

Data Gathering

Fauna survey was undertaken on April 1-3, 2017. The survey covers the four groups of wildlife-vertebrates which includes the avi-fauna, mammals, herpeto-fauna and amphibians. Prior to the conduct of the survey, general habitat assessment was undertaken to consider different ecosystems in the project area for the selection of areas for observation. Rapid survey method was employed in the conduct of faunal diversity assessment. Observation for fauna-aves was undertaken during morning from 6:00 am to 9:00 am and late afternoon from 3:00 pm to 6:00 pm, when birds are most active and feeding. Species not encountered during the period of assessment is generated through interview with local informants to obtain other important information on the presence of other wildlife species not encountered throughout the survey. Photo documentation of observed wildlife was also undertaken as much as possible for documentation and for further species verification.

Birds. Point area count method was used during the survey. All species observed within a circle of about 50 meters radius from the point of observation was recorded. Techniques employed during the survey includes ocular and aural observation, identification through wildlife calls, foot prints and droppings, if any. All the bird species seen and heard by the observer at the sampling site for approximately 30 minutes were recorded. As much as possible, no double counting was made.

Reptiles and Amphibians. Active search for reptiles and amphibians was done systematically within the six (6) sampling sites and in its immediate vicinity especially in areas with the presence of suitable habitats like underneath of decaying logs, uprooted trees and bamboos. Search at night time was also undertaken when some reptiles and amphibians are active. For each species observed and heard, the name of the species, number of individuals and the type of habitat where it was found were recorded. Double counting of the individuals of the same species was definitely avoided. Photos of species encountered at the sampling sites was also undertaken.

Mammals. For non-volant mammals such as rodents, cage trapping using Sherman's traps was employed on selected sites. Eight (8) cage traps with grilled coconut meat as bait was used during the survey. Used of mist nets to trap volant (flying) mammals primarily bats are installed across the potential flight ways and/or near identified feeding trees on site. Three mist nets were installed and left for two (2) consecutive nights. Mist nets installed are being checked once at night and in early morning. Trapped bats were identified and photo documented and released immediately after documentation.

Biodiversity measurement

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

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

The interpretation of the values obtained using the above formulas will be based on the Fernando Biodiversity Scale (1998) shown in **Table 2.1.9**.

Table 2.1.9: The Fernando Biodiversity Scale (1998)

Relative Values	Shannon –Wiener Biodiversity (H') Index	Pielou's (J') Evenness Index
Very High	3.5 and above	0.75-1.00
High	3.0 – 3.49	0.50-0.74
Moderate	2.5 – 2.99	0.25-0.49
Low	2.0 – 2.49	0.15-0.24
Very Low	1.9 and below	0.05-0.14

Fauna species conservation status and endemicity

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

Conservation Categories and description

Critically Endangered (CR) - A taxon is Critically Endangered when it is facing an extremely high risk of extinction in the wild in the immediate future.

Endangered (EN) - A taxon is endangered when it is not Critically Endangered but is facing a very high risk of extinction in the wild in the near future.

Vulnerable (VU) - A taxon is Vulnerable when it is not Critically Endangered or Endangered but is facing a high risk of extinction in the wild in the medium-term future.

Near threatened (NT) - Taxa which do not qualify for Conservation Dependent, but which are close to qualifying for Vulnerable.

Least Concern (LC) - Taxa which do not qualify for Conservation Dependent or Near Threatened.

Other Threatened Species (OTS)- refers to a species or subspecies that is not critically endangered, endangered nor vulnerable but is under threat from adverse factors, such as over collection, throughout its range and is likely to move to the vulnerable category in the near future.

Not Evaluated (NE) - A taxon is Not Evaluated when it is has not yet been assessed against the criteria.

2.1.4.2.2 Sampling Sites

Six (6) sampling sites were selected within the project area based on the presence of remaining habitat and possible feeding areas of remaining faunal species. Sampling sites are distributed on shrubland habitat and along grass land habitat, as shown in **Figure 2.1.17**. Establishment of the plots are based

on the difference of existing vegetation. Patches of plant covers are assessed as it may affect the movement of any observable fauna.

Summarized hereunder are the corresponding habitat types and geographical coordinates of the six (6) sampling sites, presented in **Table 2.1.10**.

Table 2.1.10: Description and geographic location of selected sampling sites

Sampling Site	Description/ Habitat	Geographic Coordinates (WGS 84)		Remarks
		Latitude	Longitude	
1	Shrubland	13°54'25.63"	121°25'55.96"	With some fruit bearing trees, adjacent the national road
2	Shrubland	13°54'24.93"	121°25'50.33"	Associations of forest trees (not fruit bearing), shrub species and varieties of grasses.
3	Shrubland	13°54'27.11"	121°25'43.60"	Associations of forest trees (not fruit bearing), shrub species and varieties of grasses.
4	Grass land	13°54'36.76"	121°25'44.63"	This area is dominated by small grasses with few livestock (cattle's) foraging.
5	In between grassland and shrubland	13°54'20.99"	121°25'45.33"	This area is adjacent a larger grass area which is utilized as forage to some livestock (cattle's).
6	Shrubland	13°54'14.75"	121°25'43.42"	This area is dominated by forest trees which is not fruit bearing such as Gmelina, Iggyo, Alim and other shrub species.

2.1.4.2.3 Fauna composition and richness

The overall result of fauna survey in the proposed project site shows the presence of 29 species of aves belonging to 23 families with a total abundance of 232 individuals accounted within the 6 sampling sites. Of the 23 families, Columbidae is the dominant family with a total species of 4 or 13.8% from the total species. With regard to species abundance, Yellow Vented Bulbul from family Pycnonotidae has the highest abundance of 50 individuals followed by Chestnut Munia and Eurasian Tree Sparrow belonging to families Estrildidae and Passeridae with a total abundance of 42 and 39 individuals, respectively (**Table 2.1.11**).

Table 2.1.11: Species abundance and family composition of evaluated sites

Sampling no.	No. of Species	Total No. of Individuals	No. of Families	Remarks
1	13	50	11	Dominant families are Dicaedidae and Sylviidae. While, most abundant species are the Yellow Vented Bulbul and Eurasian Tree Sparrow belonging to families Pycnonotidae and Passeridae, respectively.
2	15	79	12	The dominant family is Columbidae. While, most abundant species is the Chestnut Munia belonging to family Estrildidae
3	14	64	11	Dominant families are Columbidae, Dicaedidae and Estrildidae. While, abundant species is the Yellow Vented Bulbul under family Pycnonotidae.
4	14	46	13	Dominant family is Sturnidae, while most abundant species is the Scaly Breasted Munia under the family Estrildidae.

Sampling no.	No. of Species	Total No. of Individuals	No. of Families	Remarks
5	14	49	13	Dominant family is Sylviidae, while most abundant species is the Chestnut Munia under the family Estrildidae.
6	6	22	6	Species families are equally distributed, however, most abundant species are the Eurasian Tree Sparrow and Yellow Vented Bulbul belonging to families of Passeridae and Pycnonotidae, respectively.

The 6 sampling sites reveals that sampling no. 2 has the highest number of species recorded and site 6 has the least species richness. In terms of total no. of individuals observed, site 2 has the highest abundance of 79 individuals followed by site no. 3 with 64 individuals. In contrary, site 6 has the least abundance with only 22 individuals. On the other hand, species family composition shows that site nos. 4 and 5 has the highest accounted species families with the same count of 13 families.

Other fauna species found within the assessed area also includes 3 species of reptile belonging to families of Scincinidae, Gekkonidae and Varanidae and one species of amphibian. A total of 14 individuals of Marine Toad was recorded were observed at night time. Also, 5 individuals of fruit bat (*Cynopterus brachyotis*) under the mammalian group were caught on mist net traps. Note that there are only limited non-volant species observed during the survey maybe due to significant impacts of rainfall which forced most of the fauna species to stay on their sanctuaries. Other factors may be due to lack of feeding trees on site. Likewise, extent of vegetation cover of the project site influence possible existence of other wildlife species.

Observed species are noted to be common in lowland areas an in wide range of habitats including agricultural areas, shrub lands, grasslands and even in settlement areas. Likewise, most of these species could thrive even in highly disturb areas including highly urbanized areas.

2.1.4.2.4 Endemism and conservation status

In terms of species endemism only 5 species are found to be endemic in the country and the rest of the recorded species are non-endemic species. Among the endemic species are the Barred Rail (*Garillus torquatus*), Grey Hooded Sun Bird (*Aethopyga primigenius*), Pygmy Flower Pecker (*Dicaeum pygmaeum*), Spotted Button Quail (*Butorides striatus*) and the White-Eared Brown Dove (*Phapitreron leucotis*). **Table 2.1.12** illustrates the summary of wildlife species in the proposed project site, their conservation status and corresponding geographical range (Source: <http://www.iucnredlist.org/>).

Table 2.1.12: Conservation status of observed fauna species (IUCN red list 2016)

Conservation status	Aves	Mammal/s	Reptiles	Amphibians	Total
Critically endangered	-	-	-	-	0
Near Threatened	-	-	-	-	0
Vulnerable	-	-	-	-	0
Least Concern	28	1	1	1	31
Not evaluated	1	-	2	-	3
TOTAL	29	1	3	1	34

With reference to the International Union for Conservation of Nature (IUCN) (2016), conservation status of recorded species within the project site are mostly under least concern in category. Of the 34 species observed within the project site showed that 95.6% or 28/29 species of fauna-aves are under least concern category and only 1 species is not evaluated. On the other hand, the Monitor Lizard (*Varanus sp.*) is categorized as Vulnerable under Appendix II of the Convention on International Trade in Endangered Species of Fauna and Flora which is not Critically Endangered or Endangered but is facing a high risk of extinction in the wild in the medium-term future. **Table 2.1.13** shows the conservation status of listed terrestrial fauna species.

Table 2.1.13: Summary list of faunal species, conservation status and geographic distribution

Species No.	Common Name	Scientific Name	Family Name	Conservation Status (IUCN Red list)	Distribution/ Endemicity	Geographic Range
AVES						
2	Blue Tailed Bee Eater	<i>Merops philippinus</i>	Meropidae	LC	Non-endemic	Brunei Darussalam; Cambodia; China; Indonesia; Lao People's Democratic Republic; Malaysia; Singapore; Thailand; Viet Nam
8	Glossy Swiftlet	<i>Collocalia esculenta</i>	Apodidae	NE	Non-Endemic	Brunei Darussalam; Christmas Island; India; Indonesia; Malaysia; Myanmar; New Caledonia; Papua New Guinea; Philippines; Singapore; Solomon Islands; Thailand; Timor-Leste; Vanuatu; Vagrant in Australia
9	Great Eared NightJar	<i>Eurostopodus macrotis</i>	Caprimulgidae	LC	Non-endemic	Bangladesh; Cambodia; China; India; Indonesia; Lao People's Democratic Republic; Malaysia; Myanmar; Philippines; Thailand; Viet Nam
10	Greater Coucal	<i>Centropus sinensis</i>	Cuculidae	LC	Non-endemic	Bangladesh; Bhutan; Brunei Darussalam; Cambodia; China; India; Indonesia; Lao People's Democratic Republic; Malaysia; Myanmar; Nepal; Pakistan; Philippines; Singapore; Sri Lanka; Thailand; Viet Nam
11	Grey Hooded Sun Bird	<i>Aethopyga primigenius</i>	Nectariniidae	LC	Endemic	Brunei Darussalam; Cambodia; Indonesia; Lao People's Democratic Republic; Malaysia; Myanmar; Philippines; Singapore; Thailand; Viet Nam
12	Large Billed Crow	<i>Corvus macrorhynchos</i>	Corvidae	LC	Non-endemic	Oriental region. A widespread and common resident on the mainland, including Hong Kong and Singapore; the only Corvidae found throughout the Philippines. Native in Afghanistan; Bhutan; Cambodia; China; India; Indonesia; Japan; Korea, Democratic People's Republic of; Korea, Republic of; Lao People's Democratic Republic; Malaysia; Myanmar; Nepal; Pakistan; Philippines; Russian Federation; Singapore; Taiwan, Province of China; Thailand; Timor-Leste; Viet Nam
13	Long Tailed Shrike	<i>Lanius schach</i>	Laniidae	LC	Non-endemic	Afghanistan; Bangladesh; Bhutan; Cambodia; China; India; Indonesia; Kazakhstan; Kyrgyzstan; Lao People's Democratic Republic; Malaysia; Myanmar; Nepal; Oman; Pakistan; Papua New Guinea; Philippines; Singapore; Sri Lanka; Taiwan, Province of China; Tajikistan; Thailand; Timor-Leste; Turkmenistan; Viet Nam; Vagrant in Israel; Japan; Maldives; United Arab Emirates; United Kingdom
15	Pied Bushchat	<i>Saxicola Caprata</i>	Muscicapidae	LC	Non-endemic	Afghanistan; Bangladesh; Cambodia; China; India; Indonesia; Iran, Islamic Republic of; Kazakhstan; Lao People's Democratic Republic; Malaysia; Myanmar; Nepal; Pakistan; Papua New Guinea; Philippines; Sri Lanka; Tajikistan; Thailand; Timor-Leste; Turkmenistan; United Arab Emirates; Uzbekistan; Viet Nam
16	Pied Fantail	<i>Rhipidura javanica</i>	Rhipiduridae	LC	Non-endemic	Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, Thailand and Vietnam
19	Scaly Breasted Munia	<i>Lonchura punctulata</i>	Estrildidae	LC	Non-endemic	Afghanistan; Bangladesh; Bhutan; Brunei Darussalam; Cambodia; China; India; Indonesia; Lao People's Democratic Republic; Malaysia; Myanmar; Nepal; Philippines; Singapore; Sri Lanka; Taiwan, Province of China; Thailand; Timor-Leste; Viet Nam
21	Spotted Dove	<i>Streptopelia chinensis</i>	Columbidae	LC	Non-endemic	Bangladesh; Brunei Darussalam; Cambodia; China; India; Indonesia; Lao People's Democratic Republic; Malaysia; Maldives; Myanmar; Philippines; Singapore; Thailand; Timor-Leste; Viet Nam

Species No.	Common Name	Scientific Name	Family Name	Conservation Status (IUCN Red list)	Distribution/ Endemicity	Geographic Range
22	Tawny Grass Bird	<i>Megalurus timoriensis</i>	Sylviidae	LC	Non-endemic	Australia; Indonesia; Papua New Guinea; Philippines; Timor-Leste
23	White Collared King fisher	<i>Halcyon chloris</i>	Alcedinidae	LC	Non-endemic	Oriental region; Australasia; American Samoa (American Samoa); Australia; Bangladesh; Brunei Darussalam; Cambodia; Eritrea; Fiji; India; Indonesia; Lao People's Democratic Republic; Malaysia; Micronesia, Federated States of; Myanmar; Northern Mariana Islands; Oman; Palau; Papua New Guinea; Philippines; Saudi Arabia; Singapore; Solomon Islands; Thailand; Timor-Leste; Tonga; United Arab Emirates; Vanuatu; Viet Nam; Vagrant in China; Christmas Island; Hong Kong; Japan; Somalia
27	Zebra dove	<i>Geopelia striata</i>	Columbidae	LC	Non-endemic	Native in Brunei Darussalam; Cambodia; Indonesia; Malaysia; Myanmar; Philippines; Singapore; Thailand
28	Striated Grass Bird	<i>Megalurus palustris</i>	Sylviidae	LC	Non-endemic	Bangladesh, Cambodia, China, India, Indonesia, Laos, Malaysia, Myanmar, Nepal, Pakistan, Philippines, Russia, Thailand and Vietnam.
29	Asian Glossy starlings	<i>Aplonis payanensis</i>	Sturnidae	LC	Non-endemic	Bangladesh; Brunei Darussalam; India; Indonesia; Malaysia; Myanmar; Philippines; Singapore; Thailand
Mammal						
1	Common Short Nose Fruit Bat	<i>Cynopterus brachyotis</i>	Pteropodidae	LC	Non-endemic	Widespread species in SE; Native in Cambodia; China; India (Andhra Pradesh, Bihar, Goa, Karnataka, Maharashtra, Nagaland, Tamil Nadu); Indonesia (Sulawesi, Sumatera); Lao People's Democratic Republic; Malaysia; Myanmar; Singapore; Sri Lanka; Thailand; Timor-Leste; Viet Nam
Reptiles						
1	Skink/Bubuli	<i>Eutropis multifasciata</i>	Scincinidae	NE	Non-endemic	Found in Bangladesh, Cambodia, China, (Hainan, Yunnan), India (Assam), Indonesia (Borneo, Sumatra, Java, Bali), Laos, Malaysia (Peninsular, Pulau Tioman, Johor: Pulau Besar, Pulau Sibu), Myanmar (Burma), New Guinea, Philippines (Negros, Panay, Palawan: Calamian Islands, Luzon), Singapore, Taiwan, Thailand (incl. Phuket) and Vietnam
2	Gecko/Tokay	<i>Gecko gecko</i>	Gekkonidae	NE	Non-endemic	Tokay Geckoes are found from northeast India to the Indo-Australian Archipelago.
Amphibian						
1	Marine Toad	<i>Bufo marinus</i>	Bufonidae	LC	Introduced	Belize; Bolivia, Plurinational States of; Brazil; Colombia; Costa Rica; Ecuador; El Salvador; French Guiana; Guatemala; Guyana; Honduras; Mexico; Nicaragua; Panama; Peru; Suriname; Trinidad and Tobago; United States (Florida - Introduced, Hawaiian Is. - Introduced, Texas); Venezuela, Bolivarian Republic Introduced: Antigua and Barbuda; Aruba; Australia; Barbados; Dominican Republic; Grenada; Guadeloupe; Guam; Haiti; Jamaica; Japan; Martinique; Montserrat; Northern Mariana Islands; Papua New Guinea; Philippines; Puerto Rico; Saint Kitts and Nevis; Saint Lucia; Saint Vincent and the Grenadines; Solomon Islands; Taiwan, Province of China; Virgin Islands, U.S.

Note: LC- Least concern, NE -Not Evaluated

2.1.4.2.5 Computed Biodiversity index

Biodiversity indices particularly Shannon-Wiener Diversity Index (H') and Pielou's Evenness Index (J') were computed for this survey using the bird sampling data. The overall computed biodiversity index of the project site by getting the average biodiversity index of the six sampling sites (**Table 2.1.14**) has a computed value of 2.262 with species evenness value of 0.976. Interpretation of these values using the Fernando's Biodiversity Scale (1998) showed that the area has low biodiversity with very high species evenness.

Computed diversity richness of the 6 sampling sites reveals the same level of diversity scale which present a low diversity richness with a very high species evenness. By comparing the computed diversity index values of sampling sites, site no. 2 has the highest values in terms of diversity richness, while site no. 5 has the lowest diversity value. Species evenness on the other hand, showed that sampling site no. 6 has the highest evenness value dissimilar to site no. 5 which has the lowest computed species evenness, respectively.

Table 2.1.14: Computed biodiversity index of sampled sites

Sampling site no.	Shannon-Wiener Biodiversity index (H')	Pielou's Index (J') species Evenness	Fernando's Biodiversity Scale (1998)
1	2.351	0.891	Low diversity with very high species evenness
2	2.421	0.894	Low diversity with very high species evenness
3	2.198	0.833	Low diversity with very high species evenness
4	2.313	0.876	Low diversity with very high species evenness
5	2.144	0.813	Low diversity with very high species evenness
6	2.145	0.976	Low diversity with very high species evenness
Average	2.262	0.8805	Low diversity with very high species evenness

2.1.4.2.6 Species Abundance and Relative Frequency

Of the six sampling sites established in the proposed project area there are 29 species of fauna-aves were recorded with a total abundance of 232. In terms of abundance, the Yellow Vented Bulbul (*Pycnonotus goiavier*), Chesnut Munia (*Lonchura malacca*) and Eurasian Tree Sparrow (*Passer montanus*) has the highest population count of 50, 42 and 39, respectively. Population count of the three species represents about 21.6%, 18.10% and 16.8% of the total species population.

In terms of species distribution, the Yellow Vented Bulbul (*Pycnonotus goiavier*) and Zebra dove (*Geopelia striata*) are observed in all the sampling sites with the highest computed relative frequency of 8.45 %. Relative to species occurrence, it was noted that 11 (37.9 %) species out of the total species listed are only encountered in one sampling site. The rest of the species (18/29 or 62.1%) are observed more than once in the assessed area. **Table 2.1.15** shows the species abundance and distribution.

Table 2.1.15: Species Abundance and Relative Frequency

Species			Abundance	No. of times intercepted	Rel freq. (%)
Common name	Scientific name	Family			
Blue Tailed Bee Eater	<i>Merops philippinus</i>	Meropidae	30	4	5.63
Glossy Swiftlet	<i>Collocalia esculenta</i>	Apodidae	2	1	1.41
Great Eared Night Jar	<i>Eurostopodus macrotis</i>	Caprimulgidae	1	1	1.41
Greater Coucal	<i>Centropus sinensis</i>	Cuculidae	1	1	1.41
Grey Hooded Sun Bird	<i>Aethopyga primigenius</i>	Nectariniidae	2	2	2.82
Large Billed Crow	<i>Corvus macrorhynchos</i>	Corvidae	3	1	1.41
Long Tailed Shrike	<i>Lanius schach</i>	Laniidae	3	1	1.41
Pied Bush chat	<i>Saxicola Caprata</i>	Muscicapidae	2	2	2.82

Species			Abundance	No. of times intercepted	Rel freq. (%)
Common name	Scientific name	Family			
Pied Fantail	<i>Rhipidura javanica</i>	Rhipiduridae	10	3	4.23
Scaly Breasted Munia	<i>Lonchura punctulata</i>	Estrildidae	17	2	2.82
Spotted Dove	<i>Streptopelia chinensis</i>	Columbidae	2	1	1.41
Tawny Grass Bird	<i>Megalurus timoriensis</i>	Sylviidae	4	3	4.23
White Collared King fisher	<i>Halcyon chloris</i>	Alcedinidae	8	4	5.63
White-Eared Brown Dove	<i>Phapitreron leucotis</i>	Columbidae	2	1	1.41
Zebra dove	<i>Geopelia striata</i>	Columbidae	21	6	8.45
Striated Grass Bird	<i>Megalurus palustris</i>	Sylviidae	7	4	5.63
Asian Glossy starlings	<i>Aplonis payanensis</i>	Sturnidae	8	3	4.23
TOTAL			123	40	100.00

2.1.4.3 Vegetation Removal and Loss of Habitat

The project will require land clearing resulting to the removal of remaining vegetation to give way on the construction of the manufacturing facilities. This entails to further disturbance and loss of habitats in the area. Given this, the occurrence of wildlife species will decrease significantly resulting to the potential loss of biodiversity in the area. Under different construction/ development phases of the project, reptiles mammals, and amphibians will be more severely impacted due to soil excavation. Faunal community will change as a result of the modification to the landscape during the phases of the project. As the project progress, habitats will be altered and emptied.

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

Grassland dominates portions of the area. Grass conservation will be considered on the environmental program of the site. Additionally, grass species are known for their capacity to hold soil, thus preventing possible siltation or fugitive dust emissions that may be posed by any activities on the site. Species present on the site based on the assessment such as Carabao grass (*Paspalum conjugatum*) can be used.

2.1.4.4 Threat to existence and/or loss of important local species

Though, most of the faunal species are mobile in nature this situation will force them to migrate in other areas to search for new habitats. Migration of other wildlife to new territory/ies or ecosystem will pose threat to their existence since, they can be further exposed to hunting, persecution and trading. Continuous disturbance of faunal habitats will possibly threaten the remaining species population and survival in the near future. Thence, decrease of population of some species is be expected to happen while others may not incur significant change.

2.1.4.5 Threats to abundance, frequency and distribution of important species

No threats to abundance, frequency, and distribution that can be attributed to the construction of the project. The release of carbon in the form of smoke from steel milling has minimum effect on the nutrient contents and physiological process of the plants. However, the generation of dusts by passing vehicles and trucks may block-off leaf surfaces and stomates which limit the respiration, transpiration, and photosynthetic processes of the plants. This may lead to the weakening of plant parts and ultimately led to senescence of the leaves. To mitigate the impacts of the generation of dusts, buffer zones should be established so that plants outside the buffer zone would be protected. Continuous watering of unpaved roads should be done regularly for dust suppression. Planting of dust-tolerant plant species

such as Indian lanutan and agoho or ornamental plants like bougainvillea may also be used to mitigate fugitive dust emission.

2.1.4.6 Hindrance to wildlife access

No hindrance to wildlife access is perceived to occur since the structures will be constructed within the project's property area which is already cleared of vegetation, particularly trees. However, the presence of anthropogenic disturbances brought about the community may cause further fragmentation leading to decreased populations of floral species and decreased territories of faunal species.

GHG emissions and carbon sequestration program/s

In the course of the Project cycle, GHG emissions will increase due to processing and milling of steel. To compensate for the increased emissions, rehabilitation of disturbed areas should be conducted using globally threatened, indigenous and endemic species. Those species are able to sequester large amounts of carbon which they assimilate into their tissues and these may also lower the local microclimate of the area. Sources of planting materials may be obtained from accredited DENR seedlings suppliers while nurseries for growing plant species should also be established.

Greenhouse gases (GHG) are responsible for temperature increase on earth's surface. Ferrous metallurgy produces mainly carbon dioxide (CO₂). Other GHGs are part of the secondary energy sources (SER) used in steel milling and is burnt to CO₂ in metallurgical units. In this case, the 0.000061% CO₂ emission in a 600,000 MT/year production capacity is almost equivalent to 37MT/year of CO₂ emission.

Tree Cutting Permit

The proponent has already conducted tree inventory and is in the process of completing the requirements for application for tree cutting and/or tree relocation permit for those trees that will be affected by the construction.

Replacement of trees/ vegetation affected due to land clearing

To compensate the loss vegetation, SAMC shall replace the number of trees loss during land clearing operation and plant them to nearby areas, within the buffer zone, or periphery of the plant and its associated facilities. Buffer zone will be planted with broad-leaved tree species for noise and dust barriers. As much as possible, trees that will be planted in the buffer zones or periphery of the project site shall be measured at 7-10ft high. Augmentation or enrichment planting using propagated seedlings (nursery grown) or wildlings shall also be conducted off-site for Carbon Sink program. The number of seedlings for replacement shall follow the DENR Memorandum Order 2012-05 "Uniform Replacement Ratio for Cut or Relocated Trees" item 2.2 "For planted trees in private and forest lands not covered under..... tree replacement shall be 1:50 while naturally growing trees on the same area, including those affected by development projects shall have 1:100 ratio in support of the National Greening Program (NGP) and Climate Change initiatives of the Government." As such, a nursery area for the production of seedlings, both for forest trees (native/ endemic species) or outsourcing the requirements for seedlings will be considered to ensure high percentage of survival rate) which will be used as replacement or enrichment planting. Improvement of general landscape inside and outside of the project site through planting of ornamentals would add aesthetics to the overall housekeeping of the project site. Replacement planting shall be coordinated with concerned DENR Field Office to be credited as part of the Company's contribution to National Greening Program (NGP) and as part of the Company's implementation of Reforestation and Carbon Sink Program. However, if it is deemed essential for the project to fell the trees, immediate offsetting must be done.

Strict adherence to the development plan of the project site especially during land clearing

Land clearing will be confined on designated sites only based on the approved development plant. Likewise, gradual land clearing and removal of vegetation is encouraged to provide sufficient time for non-volant fauna species to transfer in the nearby habitat.

Prohibition of wildlife poaching/collection

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

Establishment of natural perimeter along the perimeter fence as landmark using fruit bearing trees

For consideration in the planning is the establishment of a natural perimeter land mark within the project site using fruit bearing trees, native or endemic species. This method could also help provide a natural abode to some wildlife as well as source of food. This perimeter mark will also serve as the buffer zone that can minimize any adverse impact for the project to the neighboring ecosystems

2.2 WATER

2.2.1 Hydrology/Hydrogeology

2.2.1.1 Drainage Morphology/Flooding/Stream Volumetric Flow

Drainage Morphology

The Project site is located in Sitio Kirahon in Barangay San Martin, Villanueva, Misamis Oriental drained by rivers and creek towards Macajalar Bay. The hydrologic feature which affects the Project is the Tagoloan River. Tagoloan River is the main drainage way of basin with generally north western flow. The Macajalar Bay serves as the discharge point of the whole basin with an annual discharge run-off of 4,106 million cubic meter (RDC, 2005).

Tagoloan River Basin is the 13th largest river basin in the Philippines with a basin estimated area of 1,704 km² (**Figure 2.2.1**). There are two (2) provinces covered by the Tagoloan River Basin: Bukidnon and Misamis Oriental. The municipalities covered by the river basin are the City of Malaybay, the municipalities of Baungon, Manolo Fortich, Sumilao, Impasug-ong, and Malitbog. The lower portion of the drainage area covers the municipalities of Claveria, Tagoloan, and Villanueva in the province of Misamis Oriental where the project is located.

The Tagoloan River is the main drainage-way of the river basin. It originates in the slopes of Mount Kibuwa and flows in a northwesterly direction before draining into Macajalar Bay. The river basin is consisting of eight (8) major tributaries; namely, Pugaan, Malitbog, Silo-o, and Amusig on the north; and Ipaon, Atugan, Calamuan, and Manolo Fortich on the south. **Table 2.2.1** shows the river system of the basin including its area and length. **Figure 2.2.2** presents the delineation of rivers and other tributaries near the project area.

Table 2.2.1: Major Tributaries of Tagoloan River Basin

River Name	Basin Area, (km ²)	River Length (km)
Pugaan	64	25
Malitbog	135	31
Silo-o	142	47
Amusig	227	53
Ipaon	89	27
Atugan	518	61
Calamuan	153	61
Manolo Fortich	151	78

Source: *The Preparatory Study for Loan on Disaster Risk Management in the Republic of the Philippines: JICA; CTI Engineering International Co., Ltd.; Nippon Koei Co., Ltd.*

Streamflow

There is no comprehensive measurement of discharges of the rivers in the Tagoloan River Basin except for the annual discharge run-off of 4,106 million cubic meter (RDC, 2005). The freshwater requirement for the operation of the plant will be fully sourced from underground and rainwater harvesting. There are no recorded streamflow measurements in the rivers draining the Project area. Since there will be no extraction of water resources or expected impounding of surface water, the Project will have no impact on the stream water depth.

Flooding

Flood is the abnormal rising and overflowing of a body of water. It usually results from high precipitation caused by excessive and continuous downpour brought about by typhoons or monsoon rains wherein the river channels are saturated with water resulting to river swelling and overflowing of floodplains. Factors that affect the vulnerability of an area to flooding are surface geology, topography, amount and duration of rainfall, vegetation and land cover.

The areas in the Municipality of Villanueva that are regularly inundated by floodwaters include Barangays Tambobong, Looc, Dayawan, Balacanas and Poblacion 3. Most of the flooding incidents experienced in these areas were due to rising water of the surrounding fluvial systems including Tagoloan River, Tag-anga Creek and Tubigan Creek. Other flooding incidents include the seasonal rise of floodwaters in Barangay Balacanas which at time reach heights of 3m and destroyed several houses as well as killed a few animals.

The project site is located on a flat terrain has an elevation ranging from 0 to 10 masl and is not susceptible to flooding, as delineated by MGB (**Figure 2.2.3**). Provided in **Figure 2.2.4** is the drainage map of the project site. The storm drainage is connected to the Water Catchment Ponds to accumulate water to serve as make-up water to the WTP. Advanced water treatment system is used to ensure that no wastewater will be discharged outside of the plant.

2.2.1.2 Hydrogeology

Based on the Map of Groundwater Distribution in Tagoloan River Basin and Vicinities from the Integrated River Basin Management and Development Master Plan for the Tagoloan River Basin (DENR; CFNR-UPLB; 2014), the proposed project site falls under fairly extensive and productive aquifers (**Figure 2.2.1**). This classification is attributed to a fair-level wells in the area. This was supported by the 1997 Groundwater Availability Map of the Philippines as shown in **Figure 2.2.5**.

A small portion of highly productive aquifer composed of alluvial deposits are found near the mouth of the river in the town of Tagoloan, Misamis Oriental. Both shallow and deep wells within this area can be expected to have high discharges. The aquifer in these segments is tapped by shallow wells which are pumped manually or with the aid of low capacity centrifugal pumps.

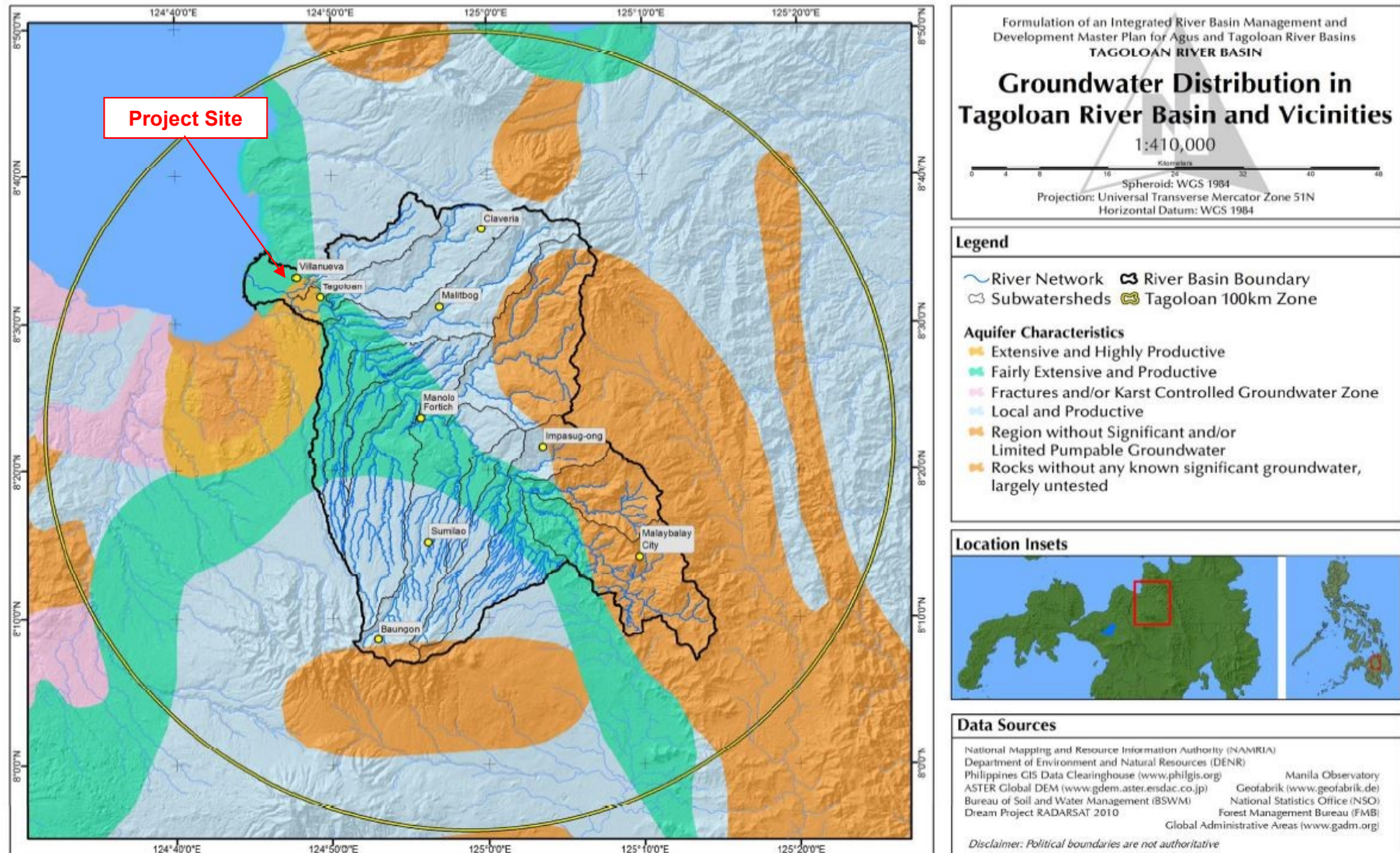
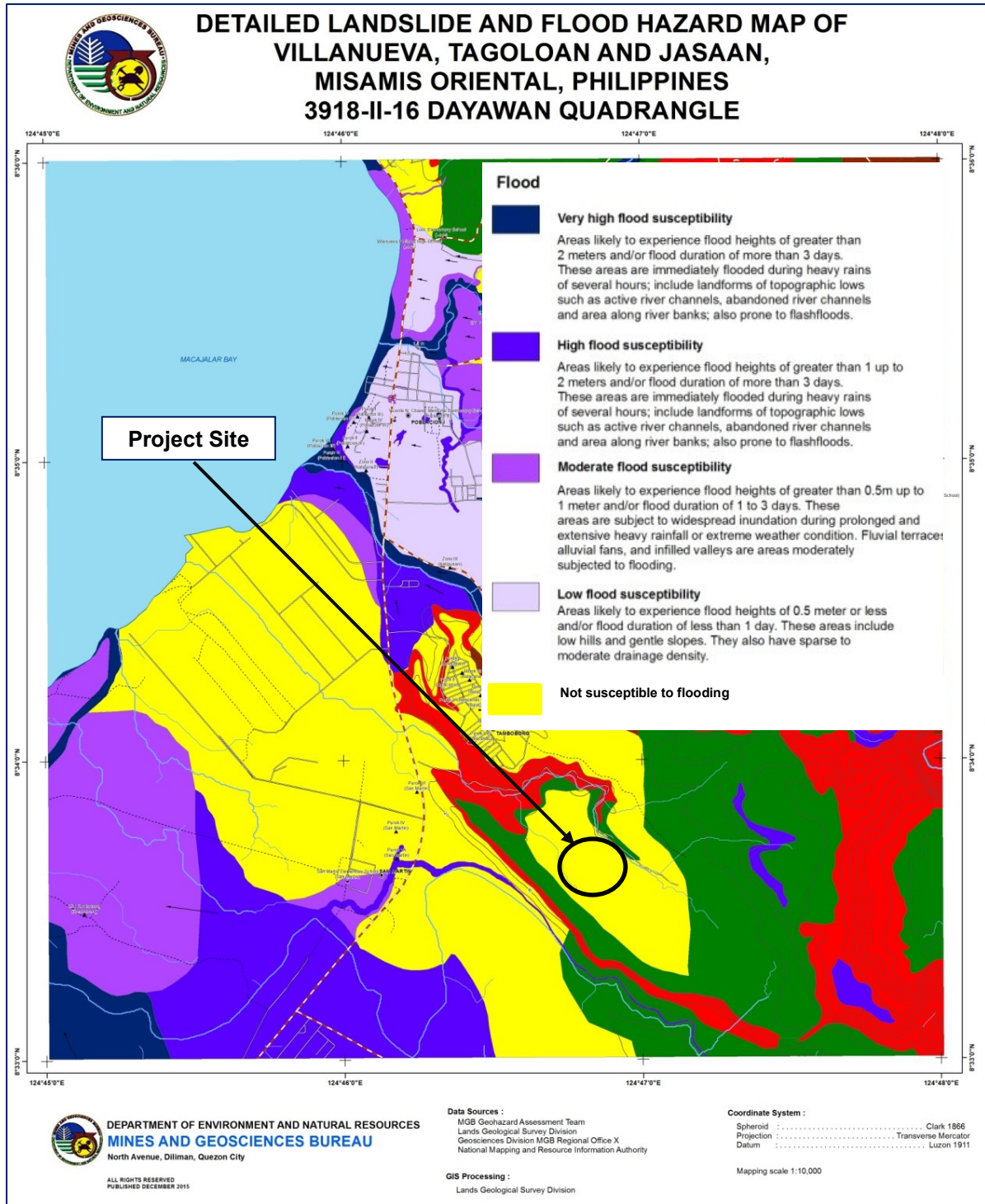


Figure 2.2.1: Groundwater Distribution in Tagoloan River Basin and Vicinities

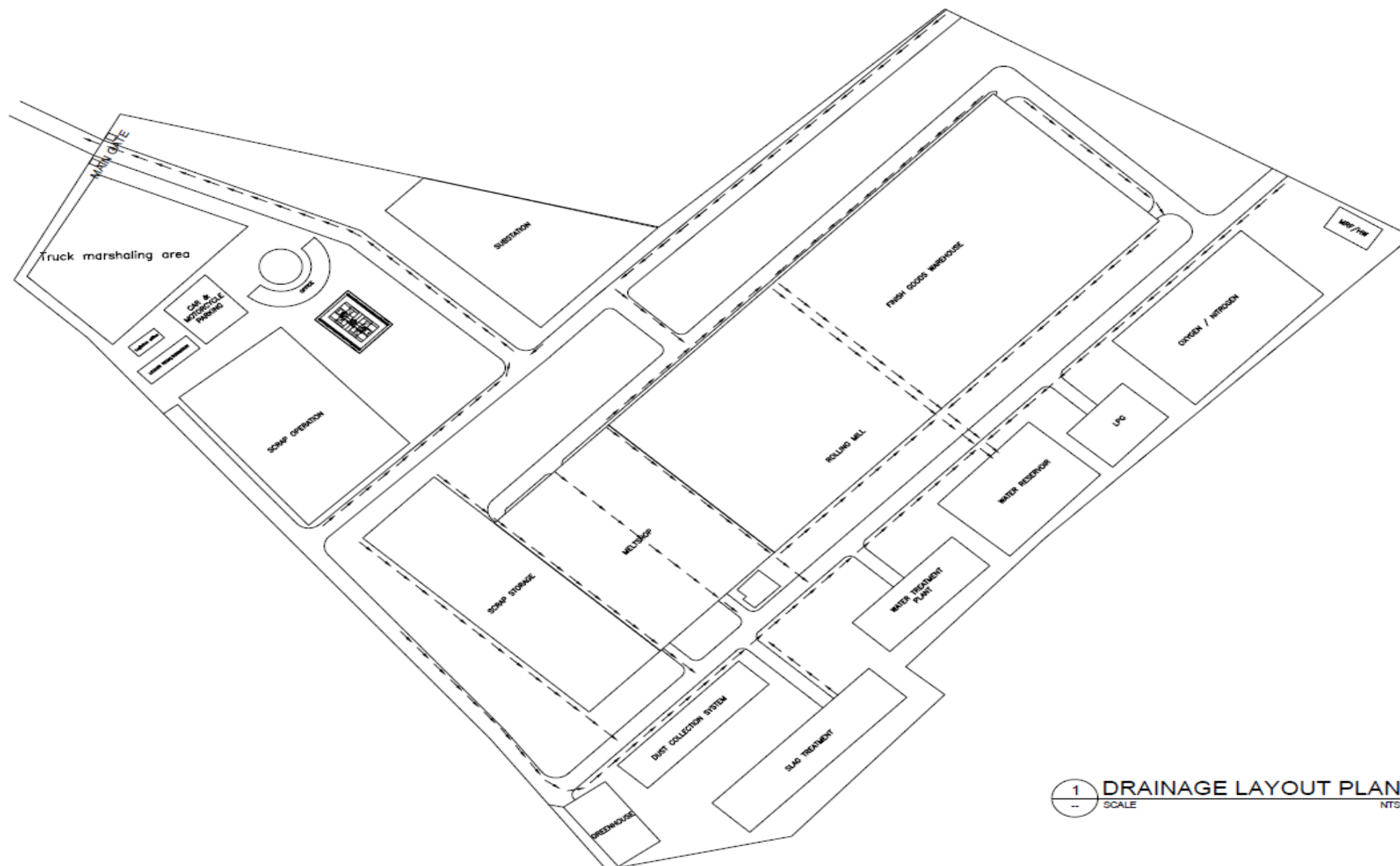


Figure 2.2.2: Delineation of Rivers and Other Tributaries near the Project Area



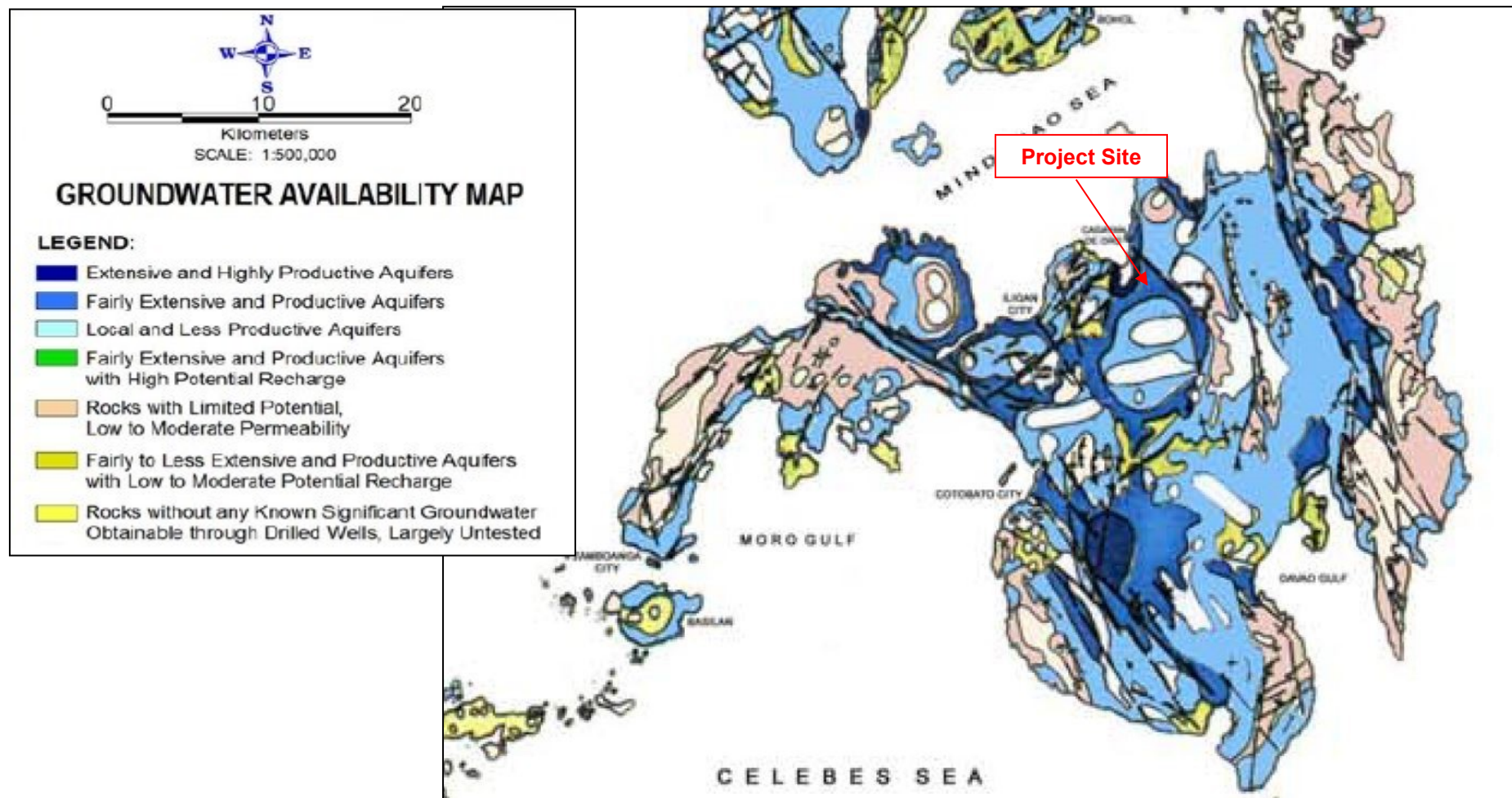
Source: MGB

Figure 2.2.3: Flood Hazard Map of Villanueva, Misamis Oriental



1 DRAINAGE LAYOUT PLAN
SCALE NTS

Figure 2.2.4: Site Drainage Plan



Source: *Geology and Mineral Resources of the Philippines Vol. II*, Mines and Geo-sciences Bureau

Figure 2.2.5: Groundwater Availability Map

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

The construction of the proposed project, specifically during site preparation, land clearing, excavation and earthworks may potentially induced flooding and cause inundation due to sediment run-off, siltation and drainage overflow. Improper handling, storage and hauling of demolition debris/ excavated materials and solid wastes, may clog drainage system. The SAMC will ensure that appropriate measures are put in place and strictly complied with. SAMC will minimize the removal of vegetation during construction to alleviate flooding. Moreover, SAMC will prepare and implement a Solid Waste Management Plan that includes contractor's commitment of proper disposal of demolition debris, construction spoils and solid wastes.

The project area is located on a flat terrain has an elevation ranging from 0 to 10 masl and falls on low to moderate susceptibility to flooding as delineated by MGB. During operation, the proposed project site however could experience "localized flooding" if the drainage systems are inadequate and not fully maintained. This will affect the operation activities due to drainage overflows, surface run-off and siltation. The SAMC will install drainage systems in accordance with the comprehensive hydrological study to accommodate the highest peak of rainfall data and to address flooding.

The plant process is dry except for the use of the cooling water for the rolling mill, thus there will be no inducement of flooding from plant water usage. The SAMC will invest extensively in the water treatment system that aims to recirculate all process water. Zero wastewater discharge is envisaged. The cooling water is to be returned to the water treatment plant for proper treatment after its use the returned back again to cool down the rolling mill.

In case of extreme events (strong typhoon, extreme flooding), operation schedules may be affected. The operation of the plant may be disrupted and cancelled. As such, necessary adjustments are to be taken. SAMC will regularly monitor the weather bulletins issued by PAGASA and get their advice on necessary actions.

2.2.1.4 Change in Stream and Lake Water Depth

There will be no surface water extraction from the Tagoloan River; therefore, no reduction in stream flow rate is expected due to the Project. The freshwater requirement for the operation of the plant will be fully sourced from the deepwell and rain harvesting. There are no recorded streamflow measurements in the rivers draining the Project area. Since there will be no extraction of water resources, the Project will have no impact on the stream water depth.

Several households are still using groundwater using hand pump tune well. Their locations were used as sampling station in the water quality testing and is provided under **Table 2.2.2**.

2.2.1.5 Depletion of Water Resources/Competition in Water Use

The major water requirement during construction is the concreting works. Concreting of buildings, roads, and other necessary structures will bring about increase in water consumption. The amount of water will depend on the size of the structure that will require concreting. However, the project concrete requirement will be provided by a batching plant contractor near the area. Therefore, water requirement of the project will be minimal as the water will only be use for cleaning the entire project site during and after concrete pouring and domestic water use for the workers.

During operation phase, the project will require about 60 m³/hr make up water system; 576 m³/hr fire protection water system; 1200 m³/hr for indirect cooling water system; and 1700 m³/hr direct cooling water system. A deep well will be drilled to a depth of 50m to 90m and designed not to extract water from the shallow aquifers that are utilized by the surrounding communities. A permit from the NWRB will be secured. SAMC will invest extensively in the water treatment system that aims to recirculate all process water. Zero wastewater discharge is envisaged. Moreover, a water catchment pond will be constructed to collect rainwater to minimize usage of potable water in the cooling system. The collecting pond has a volume of 35,000 m³. Its main purpose is to provide make up water for the evaporation

losses within the plant operation. The storm drainage is connected to the water catchment pond for storing rainwater.

SAMC is already practicing a water catchment pond system in their existing steel mill plants e.g. Davao Plant. With the use of circulating wastewater treatment plant and water catchment pond, depletion of wastewater resources and competition with its use is not expected as a result of the project.

Also, as per the household perception survey conducted in Brgy. San Martin in terms of their sources of water, out of the 1,165 households interviewed, only 2% of households get water from deepwells, 41% acquires water from artesian well, 41% use purified water and 16% obtain water from the water district.

2.2.2 Water Quality

2.2.2.1 Water Quality Sampling and Analysis

The proposed project is approximately 1.5km and 4km away from Tagoloan River and Macajalar Bay. Although there is no direct significant relevance on the quality of water in the said river because of the absence of discharges to the river from the plant, three (3) representative samples were taken on October 29, 2018 from Tagoloan River to establish the baseline data on water quality. According to a staff of the LGU which guided the survey team, there are no other major river systems running contiguous to the impact area of the proposed project. Station 1 was positioned approximately upstream of the Tagoloan River in Barangay Mojon, Tagoloan relative to the geographic position of the proposed project. Station 2 is located midstream in Barangay Sta. Cruz, while Station 3 is located in the river estuary in Brgy. Sto. Niño, Tagoloan.

Groundwater samples were also collected at the established five (5) sampling stations to assess the physico-chemical property of the groundwater near the project site. The description of the sampling station is provided in **Table 2.2.2**; while the location map is presented in **Figure 2.2.6**.

Table 2.2.2: Description of Water Quality Sampling Stations

Station	Description	UTM Coordinates	
		Easting, (m)	Northing, (m)
Groundwater			
GW-1	Hand pump tube well in Barangay Santa Cruz, Tagoloan	694568.06	945019.25
GW-2	Hand pump tube well in Barangay Katipunan Villanueva	695686.26	947976.71
GW-3	Hand pump tube well in Barangay Santa Ana Tagoloan	697754.13	944009.96
GW-4	Hand pump tube well in Barangay Baluarte Tagoloan	692372.53	944959.66
GW-5	Hand pump tube well in Barangay Poblacion Villanueva	695765.56	949253.85
Freshwater			
FW-1	Surface Water Tagoloan River Upstream in Barangay Mohon Tagoloan	696792.50	943416.15
FW-2	Surface Water Tagoloan River Midstream in Barangay Santa Cruz	694051.21	944467.43
FW-3	Surface Water Tagoloan River Downstream in Barangay Poblacion Tagoloan	692557.50	945511.55

Source: Mediatrix, 2018



Figure 2.2.6: Location Map of Water Quality Sampling Station

Samples were collected in each sampling station and were subjected to physical, chemical, microbiological, nutrient and heavy metal analyses, as presented in **Table 2.2.3**. The samples for the analysis of microbes were collected into sterilized small glass bottles and wrapped with aluminum foil. The samples for the analyses of organics were collected into amber glass bottle. The samples for the analysis of other parameters were collected into Polyethylene Terephthalate (PET) bottles. The collected samples were labeled, stored in ice-chest and submitted to AERONICS, Inc., a DENR recognized laboratory.

Table 2.2.3: Water Quality Parameters and Corresponding Methods of Analysis

Parameters	Method of Analysis
pH	Electrometric
Total Suspended Solids (TSS)	Gravimetric
Oil & Grease	Petroleum Ether Extraction
Biochemical Oxygen Demand (BOD ₅)	Azide Modification (Dilution Technique)
Chemical Oxygen Demand (COD)	5220 B. Modified Open reflux Dichromate
Dissolved Oxygen (DO)	Dissolved Oxygen Meter
Temperature	Alcohol-filled Thermometer
Lead	Flame AAS-EPA Method 7420
Mercury	Flame AAS-EPA Method 7420
Cadmium	Flame AAS-EPA Method 7130
Chromium Hexavalent	Diphenylcarbazide-SM Method 3500CrB
Copper	Flame AAS-EPA Method 7210
Arsenic	Colorimetry- SDDC SM Method 3500
Fecal Coliform	Multiple tube Fermentation – Method 9221B&E
Total Coliform	Multiple tube Fermentation – Method 9221B&E

Source: EMB-MC 2016-012, Approved Methods of Analysis

2.2.2.2 Water Quality Results

The Department of Health (DOH) Administrative Order (DAO) No. 2017-0010 otherwise known as Philippine National Standards for Drinking Water (PNSDW) of 2017 establishes the criteria for drinking water quality was applied for groundwater quality. On the other hand, the results of freshwater quality sampling were compared with the DAO 2016-08 Water Quality Guidelines (WQG) for Class B water.

The results of groundwater quality sampling showed that all parameters were conformant to the PNSDW 2017 except for Fecal Coliform and Total Coliform in all sampling stations, as described in **Table 2.2.4**. The exceedance may have been contributed by agricultural runoff, effluent from septic systems or sewage discharges from residences, infiltration of domestic or wild animal fecal matter and poor well maintenance and construction (particularly shallow dug wells) which can also increase the risk of bacteria generation.

Table 2.2.4: Results for the Physico-Chemical Analysis for Groundwater

Parameters/ Station	GW-1	GW-2	GW-3	GW-4	GW-5	PNSDW 2017
Date and Time of Sampling	Oct. 29, 2018/ 1500H	Oct. 29, 2018/ 1750H	Oct. 29, 2018/ 1520H	Oct. 29, 2018/ 1330H	Oct. 29, 2018/ 1710H	
pH	7.82	7.05	7.28	7.29	7.16	6.5-8.5
Color (Apparent)	10	10	10	10	10	10
TSS, mg/L	3	9	4	4	7	-
Oil and Grease, mg/L	4.1	4.4	2.4	2.4	1.8	-
Chlorides, mg/L	10.5	19.2	3.5	59.2	13.9	250
Nitrates, mgNO ₃ -N/L	0.93	0.56	1.02	4.08	0.26	50

Parameters/ Station	GW-1	GW-2	GW-3	GW-4	GW-5	PNSDW 2017
Date and Time of Sampling	Oct. 29, 2018/ 1500H	Oct. 29, 2018/ 1750H	Oct. 29, 2018/ 1520H	Oct. 29, 2018/ 1330H	Oct. 29, 2018/ 1710H	
Phosphate, mg/L	0.077	0.14	0.069	0.306	0.191	-
Temperature, C	24	23	24	23	24	-
Arsenic, mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	0.01
Cadmium, mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	0.003
Chromium hexavalent, mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	-
Copper, mg/L	<0.04	<0.04	<0.04	<0.04	<0.04	1
Iron, mg/L	0.0603	<0.01	0.0714	<0.01	0.138	1
Lead, mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	0.01
Mercury, mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	0.001
Fecal Coliform, MPN/100ml	4.5	<1.8	<1.8	2	170	<1
Total Coliform, MPN/100 ml	1,400	4.5	2	4.5	160,000	<1.1

Note: Red color are the results that exceed the limit.

The results of freshwater quality sampling showed that all parameters were conformant to DAO 2016-08 WQG except for TSS, Oil and Grease, BOD, and Total Coliform in all sampling stations, as described in **Table 2.2.5**. Fecal Coliform is also high in station FW-2. During sampling, dredging and sand and gravel quarrying, as well as construction of flood control structures, were being undertaken in the upstream and estuary sampling stations and the disturbance of loose soil and sand from quarrying activities were vividly evident, with sediment streams spilling out up to the estuary and into coastal waters.

Table 2.2.5: Results for Physico-Chemical Analysis of Tagoloan River

Parameters/ Station	FW-1	FW-2	FW-3	DENR Standard for Class B Waters (DAO 2016-08)
Date and Time of Sampling	Oct. 29, 2018/ 1600H	Oct. 29, 2018/1430H	Oct. 29, 2018/1550H	
pH	8.34	8.32	8.17	6.5-8.5
Color (Apparent), PCU	15	20	15	75
TSS, mg/L	51	43	57	<30 mg/L increase
Oil & Grease, mg/L	3.8	4	2.2	2
BOD, mg/L	6	8	6	5
COD, mg/L	39	39	39	-
Chlorides, mg/L	1.7	3.5	61	250
Nitrates, mgNO ₃ -N/L	0.29	0.33	0.28	7
Phosphate, mg/L	0.202	0.271	0.191	0.5
Temperature, °C	23	24	24	25-31
Arsenic, mg/L	<0.04	<0.04	<0.04	0.01
Cadmium, mg/L	<0.01	<0.01	<0.01	0.003
Chromium hexavalent, g/L	<0.01	<0.01	<0.01	0.01
Copper, mg/L	<0.04	<0.04	<0.04	0.02
Iron, mg/L	1.6471	1.7501	2.0022	1
Lead, mg/L	<0.01	<0.01	<0.01	0.01
Mercury, mg/L	<0.004	<0.004	<0.004	0.001
Fecal Coliform, MPN/100ml	11	2,200	68	200
Total Coliform, MPN/100 ml	14,000	13,000	28,000	3,000

Note: Red color are the results that exceed the limit.

2.2.2.3 Degradation of Water Quality

The proposed project is approximately 1.5km and 4km away from Tagoloan River and Macajalar Bay. Due to the distance of the project site to the sea and Tagoloan River, the proposed Project can not affect the freshwater and marine water quality and ecology. Moreover, there is no direct significant relevance on the quality of water in the said river because of the absence of discharges to the river from the plant.

Wastewater generated during construction and operational phase which include domestic wastewater may enter groundwater through seepage. This wastewater may degrade water quality in these areas.

During construction, 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 construction site. Fuel, lubricant and hydraulic oil discharges from poorly maintained construction equipment, machineries and heavy vehicles will also impact on water quality. SAMC will prepare a wastewater management plan, which will be strictly implemented. During repair of equipment and machinery, containers/drip trays will be used to collect leakage. Any spilled or spent oil will be collected and disposed by an accredited waste hauler and transporter. Scheduling of excavation activities during dry season and tide consideration whenever possible will be applied to reduce impact of soil erosion and sedimentation of waterways. Contaminated rainwater in the maintenance area will be directed to the oil and water separator before it flows to the water collection pond.

During operation phase, the significant impact on groundwater quality during operation is the long-term overland discharge of untreated wastewaters from the proposed project. Wastewater would typically contain wash water and used oil. As a mitigation measure, 3-chambered septic tanks shall be installed in all project facilities where wastewaters and other effluents are generated. Waste minimization will be practiced in all aspects of project operation. The objective is to ensure that pollution-causing effluents that can be potentially carried downstream are treated at the source. The project is envisaged for a zero-waste discharge where a circulating wastewater treatment plant and a water catchment pond will be installed. Clean practices in oil and fuel dispersal will be strictly enforced in the fuel dispensing facilities. Fuel and oil-based residues will be collected and disposed of properly. An oil and grease containment and fuel waste contingency plan will be formulated and enforced in all aspects of project operations. Moreover, regular monitoring of groundwater and effluent quality will be conducted.

2.2.3 Freshwater Ecology

Freshwater ecology assessment was conducted in three stations along the Tagoloan River in Barangays Mojon, Sta. Cruz and Sto. Niño in Tagoloan Municipality on October 29-30, 2018. Figure 2.2.7 shows the location of the Tagoloan River which is about about 3km from the southern periphery of the project site.

The objective of the aquatic ecology baseline study is to establish baseline parameters of the river system and to determine the presence of important aquatic biota that can be susceptible to anthropogenic that can arise during the establishment and operation of the project. The assessment was focused on determining plankton community structure, presence of fish biota, macro-invertebrates, macro-benthos, mangroves and river fisheries resources that can be susceptible to the operation of the steel mill. Identify and assess project's impacts in terms of threats to existence and/or loss of species, abundance frequency and distribution of species and discussion on overall impact to freshwater ecology.

The environmental assessment also covered fisheries resources and resource use practices around the general impact area in the river and the near-shore sea fronting the river estuary where pelagic fisheries by a sizeable number of local fishers provide the main source of livelihoods to small-scale fishers in Tagoloan. The survey aimed to document fishing practices in the river system through observance of actual fishing operations but no fishers were encountered during the survey as the inland portions have ceased to be a

popular fishing ground due to loss of fisheries productivity. According to key informants, both fish and freshwater bivalve fisheries are already under immense pressure from loss of habitats and dwindling stocks. However, the survey employed a cast net to conduct actual fishing in river station 1 (upstream section) in order to document catch composition during in-situ documentation of fishing effort. Moreover, key informants were interviewed to identify species of fish in the river system particularly focusing on the rare species of 'Pigok' and river snapper that allegedly were previously present in the river system. On the other hand, the river estuary is a traditional fishing ground and two (2) actual fishing operations by local fishers were documented for catch composition, species diversity and catch per unit effort (CPUE). For plankton communities, three stations were subjected to biotic sampling that included phytoplankton, zooplankton, and epibenthic benthos. Benthos community and macro-invertebrates of significant economic value for food and livelihood were also catalogued through core sampling in three (3) benthos sampling stations and an additional two (2) macro-invertebrate stations where opportunistic surveys for bivalves and gastropods were conducted in alleged gleaning areas in the estuary.



Figure 2.2.7: The Tagoloan River with Location of the Proposed Steel Asia Recycling Plant and River Ecology Survey Stations; November 2018

2.2.3.1 Methodology

2.2.3.1.1 Sampling Stations

Three (3) sampling stations were investigated during freshwater ecology baseline assessment in Tagoloan River. According to a staff of the LGU which guided the survey team, there are no other major river systems running contiguous to the impact area of the proposed steel mill in Villanueva, Misamis Oriental.

Station 1 was positioned approximately upstream of the Tagoloan River in Barangay Mojon, Tagoloan relative to the geographic position of the proposed project. Station 2 is located midstream in Barangay Sta. Cruz, while Station 3 is located in the river estuary in Brgy. Sto Niño, Tagoloan. The coordinates of the survey stations are listed in **Table 2.2.6** and depicted in **Figure 2.2.8**.

Parameters describing the basic morphology of the river in three sampling stations were documented in situ. Among others, this included riparian width, substrate composition, riverbank vegetation, depth, salinity and river flow measurement. At the time of the survey, dredging and sand and gravel quarrying, as well as construction of flood control structures, were being undertaken in the upstream and estuary sampling station and the disturbance of loose soil and sand from quarrying activities were vividly evident, with sediment streams spilling out up to the estuary and into coastal waters (**Plate 2.2.1**)

Table 2.2.6: Location of River Ecology Sampling Stations in the Tagoloan River

WP Code	LATITUDE	LONGITUDE	Remarks
RVR1	N 08.536329°	E 124.781817°	Upstream position along Tagoloan River approximately 3 km from the proposed project site. Turbid grayish water with gravel and sand Actual riverbank width at 88m (from Google Earth).
RVR2	N 08.540616°	E 124.764156°	Midstream position along Tagoloan River with flow velocity 0.22m/s ENE, Depth 46cm at sampling point. Turbid brown-colored water with sand, mud and gravel substrate. Actual riverbank width at 137m (from Google Earth).
RVR3	N 08.557807°	E 124.743384°	Estuary area of Tagoloan River flanked by Brgy. Sto. Nino (Tagoloan) and Brgy. Balacanas (Villanueva) to the east. Flow Velocity 0.173m/s and width of 370 (from Google Earth). The estuary is a favored fishing ground for small-scale fishers.



Note: Station 1 with dredging activity (upper left); Station 2 with sand quarrying (upper right); and Station 3 in the estuary of Tagoloan River (bottom pictures).

Plate 2.2.1: Freshwater Ecology Sampling Stations



Figure 2.2.8: Map Showing the Freshwater Ecology Sampling Stations in Tagoloan River, Tagoloan-Villanueva area, Misamis Oriental

2.2.3.1.2 Aquatic Biota - Plankton

Composition, abundance and density of phytoplankton communities were determined using standard methodologies, including plankton net surveys, Shannon-Weaver Diversity/Evenness Indices and bio-assessment metrics. Plankton sampling was conducted in three (3) stations (**Figure 2.2.9**) where water samples for quantitative and qualitative analysis were collected by vertical towing employing a 20 µm Plankton net (**Plate 2.2.2**). Morphological characteristics were used as the basis for the identification of the different plankton species. After fixing the samples with Lugol's solution (10mL:1L), the samples were transported to the UP MSI laboratory for counting and identification, where 1 ml aliquot samples were taken for plankton identification and enumeration under a Zeiss Axioskop II Microscope. Identification of the phytoplankton organisms using the taxonomic guide of Tomas (1997) was done up to species level whenever possible. Nanoplankton and picoplankton were not included in the phytoplankton identification. Cell counts up to 200 cells were made using a Sedgewick Rafter counter chamber. Diversity (H') and evenness (J') indices were computed according to Shannon-Weaver (1963) and Pielou (1966) considering only the identified organisms at genus and species level. Counting and identification of organisms were conducted using a Sedgwick-Rafter plate. For zooplankton, a dissecting microscope was used. Phytoplankton were counted and identified to the lowest taxonomic level (genera) possible while zooplankton were identified to major groups using available references. Phytoplankton and zooplankton densities are presented as number of cells or organisms per liter. The coordinates of the plankton sampling stations are presented in **Table 2.2.7**. Location map of sampling stations is presented in **Figure 2.2.9**.

Table 2.2.7: Sampling Stations for Plankton Community Diversity during the Freshwater Ecology Survey in Tagoloan River

WP Code	LATITUDE	LONGITUDE	Remarks
PLK1	N 08.536329°	E 124.781817°	Upstream position along Tagoloan River in Barangay Mojon about 2.2 km south of the proposed steel mill site.
PLK2	N 08.540616°	E 124.764156°	Midstream position along Tagoloan River in Barangay Sta. Cruz almost 3 km southwest of the proposed project site.
PLK3	N 08.557807°	E 124.743384°	Located in the 330m wide estuary of Tagoloan River bordered by Barangay Sto. Niño in Tagoloan and Barangay Balacanas in Villanueva.

2.2.3.1.3 Macroenthos and Macro-Invertebrates of Significant Value for Food and Trade

Core sampling of benthic and epibenthic benthos were conducted in the same stations as plankton community sampling (**Table 2.2.8**). Location of the benthos sampling stations is shown in **Figure 2.2.10**. Identification of other macro-invertebrates, particularly those with significant economic value for food and trade was supplemented through opportunistic surveys and core sampling along the riverbanks, particularly in the Tagoloan River estuary. The coordinates of stations for opportunistic surveys of macro-invertebrates of significant value for food and livelihood of local fishers are listed in **Table 2.2.9** and shown in **Figure 2.2.11**.

Table 2.2.8: Sampling stations for benthos community diversity during the freshwater ecology survey in Tagoloan River

WP Code	LATITUDE	LONGITUDE	Remarks
BNT1	N 08.536329°	E 124.781817°	Upstream position along Tagoloan River in Barangay Mojon about 2.2 km south of the proposed project site.
BNT2	N 08.540616°	E 124.764156°	Midstream position along Tagoloan River in Barangay Sta. Cruz almost 3 km southwest of the proposed project site.
BNT3	N 08.557807°	E 124.743384°	Located in the 330 m wide estuary of Tagoloan River bordered by Barangay Sto. Niño in Tagoloan and Barangay Balcanas in Villanueva.

Table 2.2.9: Sampling stations for macro-invertebrates during the freshwater ecology survey in Tagoloan River

WP Code	LATITUDE	LONGITUDE	Remarks
MAC1	N 08.535562°	E 124.778452°	About 100m downstream of station 1. Core sampling and use of scoop net was undertaken in riverbank strewn with rocks and pebbles.
MAC2	N 08.557807°	E 124.743384°	Core sampling was undertaken in wide sandy flat in the northern bank of the Tagoloan river estuary in Barangay Balacanas, Villanueva. The site is almost 4.3 km west of the proposed project site.



Plate 2.2.2: Plankton Sampling (left) and Turbidity Measurement in Tagoloan River



Figure 2.2.9: Location of plankton community sampling stations in the Tagoloan River



Figure 2.2.10: Location of benthos community sampling stations in the Tagoloan River



Figure 2.2.11: Location of survey stations for macro-invertebrates of significant commercial value to local fishers in the Tagoloan River and its estuary

2.2.3.1.4 Fish Biota

Determination of common species of fish in the Tagoloan River was undertaken through key informant interviews and actual fishing using a cast net in the upstream station in natural fish shelters along shallow and calmer portions of the river (**Plate 2.2.3**). This was supplemented by documentation of actual fishing operations of two fishers encountered in the estuary. There were no actual fishing operations in the river stations during the survey time and staff of the local government unit, as well as key informants living near the stations visited, claim that the river is no longer being popularly used for fisheries activities due to low yields. The coordinates of the actual fishing stations are listed in **Table 2.2.10** and displayed in a map in **Figure 2.2.12**.

Table 2.2.10: Sampling Stations for Freshwater Fish Biota and Diversity during the Freshwater Ecology Survey in Tagoloan

WP Code	LATITUDE	LONGITUDE	Remarks
AFE1	N 08.535600°	E 124.779214°	Upstream position along Tagoloan River in Barangay Mojon, Tagoloan; actual fishing conducted through cast net along calmer areas of river bank with sandy substrate.
AFE2	N 08.556841°	E 124.742932°	Midstream of Tagoloan river estuary; actual fishing operation of local small-scale fisher in motorized boat using multiple hook and line was documented.
AFE3	N 08.557580°	E 124.741392°	Midstream of Tagoloan river estuary; actual fishing operation of local small-scale fisher in motorized boat using multiple hook and line was documented; area is about 100 meters north of station 2.



Plate 2.2.3: Actual fishing using a cast net in upstream river station (left) and documentation of actual fishing operation in the estuary of Tagoloan River



Figure 2.2.12: Actual fishing stations for determination of catch rate and species composition in three stations in Tagoloan River

2.3.2.1.1 River Station Profiles

The Tagoloan River, the most adjacent surface water body to the impact area of the project, is the main river system in the Misamis-Bukidnon area and is the 13th largest river in the Philippines as classified by the National Water Resource Board. It has a length of 106 km emanating from Bukidnon in Northern Mindanao and a basin of covering the provinces of Misamis Oriental and Bukidnon. Its headwaters include portions of the Mount Kitanglad watershed. The river mouth is located in Tagoloan Municipality in Misamis Oriental. The Tagoloan River is included in the flood control project of the DPWH funded by the JICA in 2016 and includes dike system, drainage improvement, drainage channel, and excavation. The river bank has been eroded over time, bringing floods to about 1,300 ha around the river (*Rapler.com*; 11 July 2016).

The Tagoloan River Basin emanates from the Bukidnon plateau with a catchment area of approximately 1,700 km². The basin is located between longitudes 124° 45'E and 125° 15'E and latitudes 8° 5'N and 8° 40' (*HATCH EIS for the Mindanao Power Plant, 2001*), with the highest portion being Mt. Kitanglad in the southwestern edge of the basin. The river's estuary which lies about 4 km west of the proposed project site, measures about 300 m in breadth and exits into Macalajar Bay. There are corals in the sediment-laden coastal shelf in the estuary of the river.

Based on NAMRIA topographic maps, the Tagoloan River has nine (9) tributaries coming from the south and southwestern sector of the basin and nine (9) tributaries coming from the north and northeastern sector of the basin. All the tributaries are within the Province of Bukidnon. The largest tributaries are the Mangima River passing through Manolo Fortich, Dila River coming from Malaybalay, Calaman River through Maluko, Amusig River through Santiago, Silo-o River through Silo-o, and Malitbog River through Malitbog and Santa Inez. The Pugaan River, passing through Santa Ana, has been diverted to the Tagoloan River and is now the northernmost tributary. The Malitbog River joins the main Tagoloan River channel in the vicinity of Barangay Maribojoc at the section where the latter begins to meander and forms a delta. This delta expands westward and northward as it coalesces with similar deposits of the Pugaan River and the Tagbalitang Creek. It reaches its widest on-land base in the estuary along the coast of Macajalar in the boundary of Barangays Balacanas, Villanueva in the north and Bogo, Tagoloan in the south.

The Tagoloan River is being used extensively for both agriculture and industrial uses. Concrete dikes have been built along both banks of the river about 1km upstream of the Tagoloan - Villanueva Highway for the purpose of flood control during the wet season where stream flows have been recorded at a mean of between 81 to 92 m³/s during the rainy months from July to August. PHIVIDEC draws water from the southern bank of Tagoloan River through a pumping station located about 800m upstream of the main highway. The reported pumping rate is 152 liters per second (lps) or 2,400 gallons per minute (gpm). Along the same riverbank, two rock crushing or aggregate plants also pump water from the river for their own use. On the right bank, a diversion canal carved out of the old Mohon creek is used for irrigating adjacent rice fields. A portion of the diverted water is also used by Steniel Corporation. Moreover, aggregate quarrying companies and locators of PHIVIDEC have used the main channel and a tributary of Tagoloan River as a source of water. Quarry operators along the southern bank of Tagoloan River use river waters for washing (HATCH EIS, 2001). Various other river water users were observed in the 2018 freshwater ecology baseline assessment – including poultry and piggery farms, vegetable, banana, eggplant and moringa plantations along the fertile banks of the river. In Barangay Mojon, Tagoloan, both small-scale and large scale sand and gravel quarries are operating.

In the 2018 freshwater ecology baseline assessment, the three (3) river stations investigated for physical parameters reveal that the Tagoloan River is a wide river system, with varying from 88m in the upstream station to 370m in its estuary, a depth ranging from 1.5 to 1.8m (**Table 2.2.11**). Constant disturbance from sand and gravel quarrying as well as sediment erosion in upstream riverbanks have led to turbid waters, estimated at a mean of 44cm across three stations surveyed (**Table 2.2.11**). River substrate consisted of a mixture of rocks and pebbles, sand and mud in the downstream portions. Deposition of soil and sand have occurred in many portions of the riverbank in the upstream and midstream stations, and these accretions have been converted to vegetable plantations that include eggplant and moringa, among others. The river has largely open canopy banks, dominated by grassland and some banana trees and rain trees. In the estuary, a clump of *Nypa fruticans* is growing in the eastern river bank. River uses include small-scale and industrial sand/gravel extraction, washing, bathing, and marginal fishing at the time of the survey. There were no gleaning for commercially-important macro-invertebrates observed during the survey even as the estuary is bordered by a wide sandy accretion. Likewise, no hunting for the mangrove crab *Scylla* sp was seen during the survey and key informants alleged that the mangrove crab can no longer be seen in the estuary.

The river station profiles are shown in **Figure 2.2.13**.

Table 2.2.11: River Parameters Measured in Three (3) Survey Stations in the Tagoloan River

Station	Location	Depth	Width	Salinity	Substrate	Ref Color	Turbidity	Vector Flow Rate	Cover & Vegetation
RVR1 Upstream	Brgy. Mohon Tagoloan	1.8m	88m	0 ppt	Sand/rock /gravel	brown	36cm	0.22m/s	Open canopy with grassland and rain trees
RVR2 Midstream	Brgy. Sta. Cruz Tagoloan	1.6m	137m	0 ppt	Sand/mud /gravel	brown	48cm	0.22m/s	Open canopy with grassland and banana crops
RVR3 Estuary	Brgy. Sto. Nino Tagoloan	1.5m	370m	5 ppt	Mud/rock/ sand	green- brown	49cm	0.17m/s	Open canopy with <i>Nypa</i> sp. and rain trees



Figure 2.2.13: Summary of River Parameters Measured in Three (3) Survey Stations in the Tagoloan River

2.3.2.1.2 Freshwater fish biota

Presence and diversity of freshwater species of fish in the Tagoloan River was determined through documentation of results of actual fishing employing a cast net in the upstream station and handlines and gill net in the estuary. Key informants and staff of the Municipal Agriculture Office (MAO) of Tagoloan were also interviewed to validate the species of fish claimed by fishers to be present in the river, particularly the rare catadromous species of tapiroid therapon or *Mesopristes cancellatus* that fishers claim inhabit the Tagoloan River in previous years but has not been captured any more recently. The MAO office was also consulted to validate other large species of fish that were allegedly captured in the river early this year – including a 19kg “tilapia-like” fish as claimed by fishers. The MAO could not identify the said fish but the team identified it from pictures provided by a key informant to be the freshwater snapper *Lutjanus fuscescens* (local name - *Tadlongan*) (Plate 2.2.4). The species is not endemic in Tagoloan.



Note: The pictures were provided by key respondent. The captured snapper is considered a “super spawner”.

Plate 2.2.4: Rare 19kg freshwater snapper caught in the Tagoloan River in 2018

At present, the only major fishery stock that is found extensively in the Tagoloan River is the freshwater fish *Tilapia* (*Oreochromis* sp) which are reseeded by the MAO with 100,000 fingerlings per year. The species is caught by cast nets thrown by fishers in shallow calm waters in the upstream section of the river. However, few fishers currently operate in the upstream region as fisheries productivity in this part of the river is lesser than the fisheries in the estuary area where fish species that migrate into brackish water can still be captured, albeit in progressively decreasing yield. Key informants declared that species of the brackish water shrimp *Nematopalaemon tenuopsis* (pasayan) are still being harvested in the estuary and upstream portions of the river, albeit, in progressively decreasing quantity. Key informants further claim that Gobies, (Gobiidae), snakehead (*Channa striata*), freshwater eel (*Anguilla* sp) and mullets (*Mugil* spp) can still be captured in the river estuary.

River fishing is the main livelihood of Segundo Bakwahon, 48 years old, a resident of Brgy. Mohon. In 2.5 hours of fishing in station 1 using a cast net, the catch consisted of an estimated 2kg of assorted fishes such as tilapia, river mullet, scats/spadefish (*Scatophagus argus* or kitang) and gobies (Plate 2.2.5). The price of these species in the market is at PhP 80 to 100 per kilogram (“kuridas” –mixed species). Other fishing gear he uses are allegedly gill net that targets fish species such as tilapia, mullet, scats and ‘*aluan*’, hook and line that targets *kasile*, *pigok*, *tadlongan*, *banak*, and *subok*; and “Taklab” (fish trap) designed specifically for *dalapakan*. Moreover, the fisher claims that juveniles of *ulang* (giant freshwater prawn – *Macrobrachium rosenbergii*) are caught by scoop nets if they migrate along the river banks but fishers use poison (e.g., Decis-R) and other type of agricultural pesticide to stun the crustaceans. Species such as *kasile*, *pigok* and *dalapakan* command higher market value at PhP 150 to 200 per kilo but are rarely caught recently due to quarrying and the use of agricultural chemical in fishing.



Note: Upper photos: river mullet and tilapia; lower photos: spadefish and goby.

Plate 2.2.5: Species of Fish Caught in Actual Fishing Operation in the Upstream Station in Tagoloan River

Cornelio Markita is a 52 years old full time fisher residing in Brgy. Baluarte. He operates a 6.5 powered pump boat and uses gill net and hook and line for fishing (**Plate 2.2.6**). Average catch per day is four (4) kilograms of assorted fishes, commonly consisting of *bugaong* (convex-lined *theraponid*), *mohon*, *sapsap* (ponyfish), *talakitok* (cavalla), *torsilyo* (barracuda), and *kitang* (spadefish) priced at P80/kg (**Plate 2.2.7**). The lean catch is allegedly half a kilo of fish. During the actual fishing documentation on October 30, 2018, the fisher caught less than 1kg of assorted fishes using multiple-hook floating hand line locally known as “*margate*”. The catch composition is comprised of *torsilyo*, *talakitok* and *sapsap* over 3 hours of fishing at the river mouth. The catch per unit effort (CPUE) is extremely low at 0.33 kg/hour. The fisher claimed that in previous years, he catches *mangagat* (mangrove snapper), *matang-pusa* (seabass) and large tilapias as big as 1-3kg each but this has ended about 7 years ago when massive quarrying has started, making the waters turbid and the river bottom muddy. By this, it appears that effects of quarrying have altered benthic grazing and breeding grounds of many brackishwater species.



Plate 2.2.6: Fisher (Cornelio Markita) in the Estuary of the Tagoloan River



Note: Left to right: *Sphyræna flavicuda* (barracuda), *Secutor insidiator* (ponyfish) and juvenile *Caranx ignobilis* (cavalla)

Plate 2.2.7: Catch Composition of fisher in the Tagoloan River estuary

About 200m from the river mouth, fisher Francis Bagyo, 26 years old and a resident of Brgy. Sta Cruz was observed fishing using multiple hook handline in a 7-HP pumpboat. The volume of catch during three (3) hours fishing is estimated at 1.5kg of assorted fish species including *tulingan* (frigate tuna; *Euthynus affinis*), *hasa-hasa* (short-bodied mackerel; *Rastrelliger brachysoma*), *chabita* (moonfish; *Mene maculata*) and *tamban* (Sardinella) priced at P100/kg. Photographs of the species caught are shown in **Plate 2.2.8**.



Note: Top photos: Fisher Francis Bagyo; moonfish *Mene maculata*, mackerel *Rastrelliger brachysoma*, Bottom: bullet tuna *Euthynus affinis*, and sardine *Clupea* sp.

Plate 2.2.8: Catch Composition of Fisher Documented for CPUE and Species Diversity in the Tagoloan River Estuary

In summary, a total of twelve (12) species of fish and crustaceans were documented to occur in the Tagoloan River, belonging to eleven (11) families, shown in **Table 2.2.12**. The results of actual fishing documentation is also summarized in **Figure 2.2.14**.

Table 2.2.12: Freshwater and Brackishwater Fish and Crustacean Species Present in Tagoloan River

Family	Species Name	Local Name	Common Name	IUCN Red List Status
1. Gobiidae	<i>Glossogobiussp</i>	Biya	Goby	Not assessed
2. Cichlidae	<i>Oreochromisnilotica</i>	Tilapia	Tilapia	Least concern
3. Channidae	<i>Channastrata</i>	Dalag	Chevron snakehead	Not assessed
4. Anguillidae	<i>Anguilla marmorata</i>	Igat/Kasili	Eel	Least concern
5. Theraponidae	<i>Therapon jarbua</i>	Bugaong	Convex-lined therapon	Unknown/Not assessed
6. Leiognathidae	<i>Leiognathusequulus</i>	Sap-sap	Common slipmouth	Not assessed
7. Scatophagidae	<i>Scatophagusargus</i>	Kikilo/Kitang	Spotted scat	Not assessed
8. Mugilidae	<i>Mugilcephalos</i>	Banak	Flathead mullet	Not assessed
9. Mugilidae	<i>Valamugilcunnessius</i>	Aligasin	Long-arm mullet	Not assessed
10. Gerridae	<i>Gerresfilamentosus</i>	Malakapas	Spotted mojarras	Not assessed
11. Clariidae	<i>Clarias batrachus</i>	Hito	catfish	Least concern
12. Palaemonidae	<i>Macrobrachium rosenbergii</i>	Ulang	Giant freshwater prawn	Least concern
13. Penaeidae	<i>Nematopalaemon tenuopsis</i>	Pasayan/hipon	Endeavor shrimp	Unknown/Not assessed
14. Lutjanidae	<i>Lutjanus fuscescens</i>	Tadlongan	Freshwater snapper	Unknown
15. Theraponidae	<i>Mesopristes cancellatus</i>	Pigok/Pigek	River mullet	unknown



Figure 2.2.14: Freshwater and Brackishwater Fish Species Caught during Actual Fishing Operations in the Tagoloan River

2.3.2.1.3 Results of Mangrove Assessment

There are no significant mangrove resources in the Tagoloan River that required detailed assessment. A small patch of *Nypa fruticans* are the only mangrove-associated vegetation found within the project site. This small clump is only about 100 m² and is composed solely of the mangrove associated *Nypa fruticans* (**Plate 2.2.9**). A similar community of *Nypa* is located across the Tagaloan River, in Sitio Pulva, Brgy. Nabolod in Tagoloan. There is no marked deterioration in the dense *Nypa* growth in this area although interviews with local residents reveal that these are being used for the fabrication of nipa shingle roofing materials, broom sticks and are being lightly exploited for vinegar. This clump is composed entirely of *Nypa* and no longer required a quadrat survey. The 'nipa' plants were mixed with terrestrial trees such as talisay, bunot-bunot, narra, malabago and shrubs that were growing at the higher ground unreachable by the estuarine waters.



Plate 2.2.9: Clump of Nipa (*Nypa fruticans*), the Only Mangrove-Associated Plants Found in the Tagoloan River Estuary

2.3.2.1.4 Plankton Community

Plankton are free-drifting organisms typically found in the upper layers of the water column. They are often important components at the lower base of marine and aquatic food webs. However, planktons are not known to proliferate in fast moving lotic environs and the sampling stations chosen were areas of relatively slow current. Changes in ecological conditions in a stream often lead to changes in the community structure of planktons and benthic animals. Epibenthic fauna (macro-invertebrates or macrobenthos), on the other hand, serve a number of ecosystem roles at various levels of the food chain, ranging from consumers of plant material to prey for fish. Due to their filter-feeding nature, macro-invertebrates are good indicators of environmental conditions over time and can be used as indicators of water quality and the degradation of the aquatic environment. Benthic or bottom dwelling animals constitute a major part of the diet of many benthic and bottom dwelling fishes and crustaceans. Many species of bivalves in riverine and estuarine systems are also edible invertebrates collected for food and sustenance trade.

Phytoplankton

A total of twenty (20) phytoplankton species were identified in three water elevations (downstream, midstream, upstream) of Tagoloan river (**Table 2.2.13**). The phytoplankton community was comprised of four major groups namely diatoms, dinoflagellates, green algae and cyanobacteria. Cyanobacteria dominated the phytoplankton community which constituted for 51%, followed by diatoms with 44%, green algae with 4% and dinoflagellate with less than 1% (**Figure 2.2.15**). A total of 2.6×10^6 cells/m³ phytoplankton organisms were quantified from all the stations combined. During this survey, cyanobacteria were found in all sampling stations but most abundant in upstream station. The filamentous cyanobacteria,

Oscillatoria spp. recorded the highest cell density constituting for 51% of the total microalgal community. Other phytoplankton genera with significant relative abundance include *Fragilaria* sp. (36%), *Pinnularia* (5%), *Closterium* (2%) and *Surirella* (2%). All the remaining phytoplankton genera accounted for 4% of the total density. These species significantly contribute to the overall productivity of the river ecosystem.

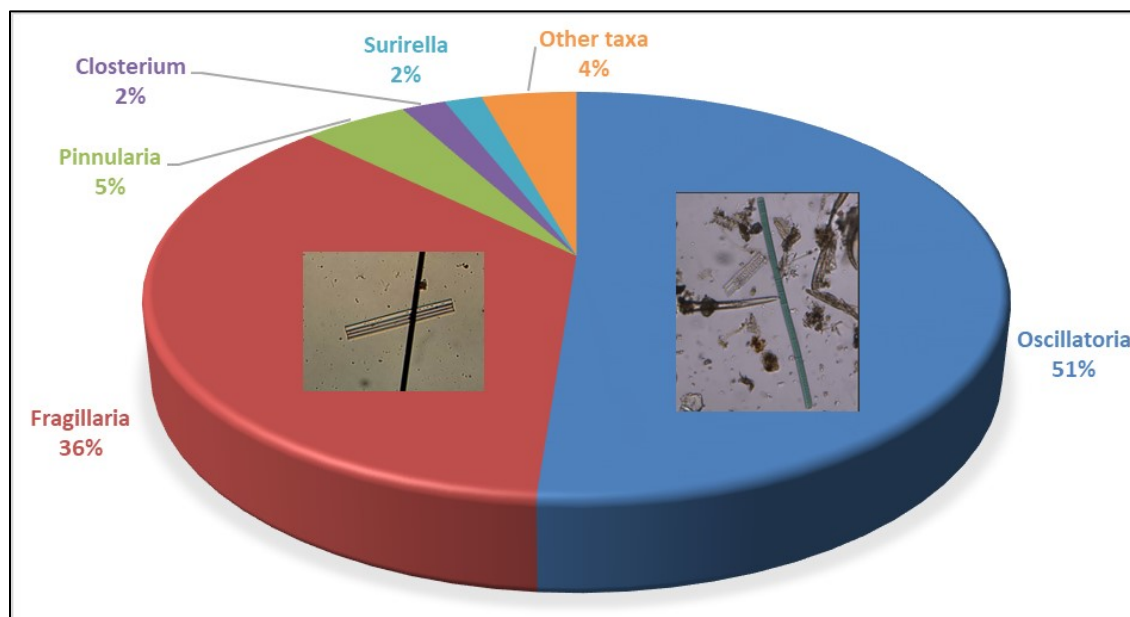


Figure 2.2.15: Percentage Composition of Top 5 major phytoplankton genera in three Sampling Stations of Tagoloan River

Table 2.2.13: Phytoplankton Composition, Distribution, Diversity and Abundance (cells/m³) in Three Sampling Stations of Tagoloan River

Taxa	Station			Grand	Rel.
	Upstream (Ph1)	Midstream (Ph2)	Downstream (Ph3)	Total	Abund.
Cyanobacteria	794,500	224,400	1,059	1,343,000	51.34
<i>Arthospira</i>	700	1,200	700	2,600	0.10
<i>Oscillatoria</i>	793,800	223,200	359	1,340,400	51.24
Diatoms	356,300	592,700	212,100	1,161,100	44.38
<i>Achnanthes</i>		600		600	0.02
<i>Aulacosiera</i>		300		300	0.01
<i>Fragilaria</i>	260,400	512,000	172,200	944,600	36.11
<i>Gomphonema</i>			2,800	2,800	0.11
<i>Gyrosigma</i>	1,050	1,500	1,050	3,600	0.14
<i>Navicula</i>	16,800	6,600	4,200	27,600	1.06
<i>Nitzschia</i>		2,100		2,100	0.08
<i>Pinnularia</i>	63,700	45,600	14,350	123,650	4.73
<i>Rhabdonema</i>	4,550		7,000	11,550	0.44
<i>Surirella</i>	9,800	24,000	10,500	44,300	1.69
Dinoflagellates		2,100		2,100	0.08
<i>Glenodinium</i>		2,100		2,100	0.08
Green Algae	55,300	36,000	18,550	109,850	4.20

Taxa	Station			Grand	Rel.
	Upstream (Ph1)	Midstream (Ph2)	Downstream (Ph3)	Total	Abund.
<i>Bulbochaete</i>	19,250			19,250	0.74
<i>Closterium</i>	20,300	19,500	11,900	51,700	1.98
<i>Cosmarium</i>	700	5,100	2,100	7,900	0.30
<i>Pediastrum</i>			700	700	0.03
<i>Spirogyra</i>	13,650	11,400	3,500	28,550	1.09
<i>Tetraedron</i>	350		350	700	0.03
<i>Tribonema</i>	1,050			1,050	0.04
Grand Total	1,206,100	855,200	554,750	2,616,050	100
Richness	15	14	13		
Evenness (I')	0.40	0.45	0.44		
Diversity (H')	1.10	1.18	1.13		

The mean phytoplankton abundance during this sampling was 872,017 cells/m³. In terms of spatial distribution, station Ph1 located at the upstream area recorded the highest phytoplankton abundance with 1.2×10^6 cells/m³ and also had the most number of phytoplankton genera with 15 (**Figure 2.2.16**). The lowest phytoplankton abundance and richness was observed in the station Ph3 located in downstream area of the river with 554,750 cells/m³ and 13 taxa. The diversity index based on Shannon Weiner was generally low (<2) with the highest computed value in the midstream station (1.18). The computed index of evenness among the three stations was not so variable ranging from 0.40 – 0.45. The Shannon diversity index of all the stations was below 2 which is categorized overall as low based on the Wilhm criteria (1975) classifying the diversity index <3.0 as low diversity and community stability.

The overall impression from results of the plankton survey in Tagoloan River is that in terms of richness, diversity and abundance of the phytoplankton community was relatively poor indicating a stressed environmental condition for the proliferation of phytoplankton community.

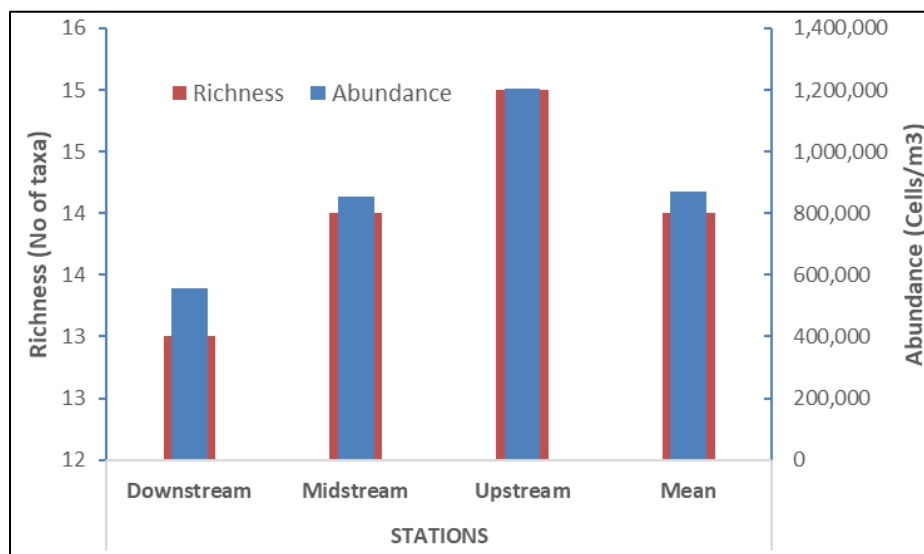


Figure 2.2.16: Total Phytoplankton Density and Richness in Three Sampling Stations of Tagoloan River

Zooplankton

Zooplankton identified during this sampling was a typical groups/type found in freshwater environment. They were composed of protozoan (*Arcella* spp.) constituting 78%, rotifer with 19%, copepod nauplius with 2% and an insect belonging to family chaoboridae (midges) at 1% (**Table 2.2.14; Figure 2.2.17**). Zooplankton communities analyzed were generally totally dominated by adult forms which comprised of around 97% while larval forms constituted nearly 9%. Adult forms are mostly represented by protozoans (*Arcella* spp.) with 78% and total density of 24,583 ind/m³. Larval forms on the other hand, were mostly dominated by a copepod nauplius accounting for 6% and total density of 650 ind/m³. The protozoan *Arcella* inhabit freshwater pools, eutrophic waters, marshes, mosses, as well as wet foliage. Few species can also be found in soils. They nourish on diatoms, unicellular green algae or animal protozoa such as flagellates and ciliates.

The total zooplankton abundance was 10,400 individuals/m³. The most taxa rich sample was collected from station ZP1 located in the upstream area with 6 zooplankton groups and also the station which recorded the highest zooplankton abundance with 5,133 ind/m³ (**Figure 2.2.18; Figure 2.2.19**). The most depauperate station was observed in the midstream station with only 4 zooplankton groups. Copepod nauplius were found in the downstream and upstream stations indicating a favorable recruitment habitat this small crustacean. No fish and decapod larvae were observed during the sampling period. Diversity was low (<2) with the highest calculated diversity index based on Shannon Weiner in the downstream station with 1.95 (**Table 2.2.14**). The computed index of evenness among the three stations was not so variable ranging from 0.92-0.97. In this survey, most of the zooplankton are common types with no endemic or rare groups encountered.

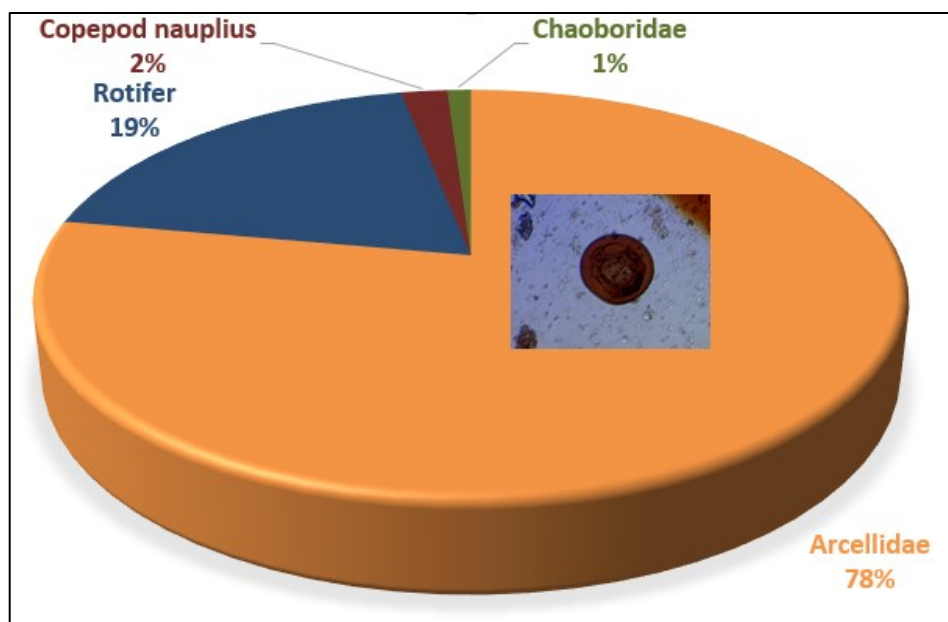


Figure 2.2.17: Percentage Composition of Major Zooplankton Taxa in Three Sampling Stations of Tagoloan River

Table 2.2.14: Zooplankton Composition, Distribution, Diversity and Abundance (Individuals/ m³) in Three Sampling Stations of Tagoloan River

Taxa	Station			Grand	Rel.
	Upstream (Zp1)	Midstream (Zp2)	Downstream (Zp3)	Total	Abund.
Adult forms	17,567	11,367	1,667	30,600	96.89
Anuraeopsis rotifera	283		333	617	1.95
Bdelloid rotifera	283	1,467	667	2,417	7.65
Ploimida rotifera	567	1,467	667	2,700	8.55
Rotifera sp2 (Brachionidae)	283			283	0.90
Arcellidae	16,150	8,433		24,583	77.84
Larval form	283	367	333	983	3.11
Chaoboridae		367		367	1.16
Copepod nauplius	283		333	616	1.95
Grand Total	17,850	11,733	2,000	31,583	100
Richness	6	4	5		
Evenness (I')	0.97	0.92	0.95		
Diversity (H')	1.73	1.27	1.52		

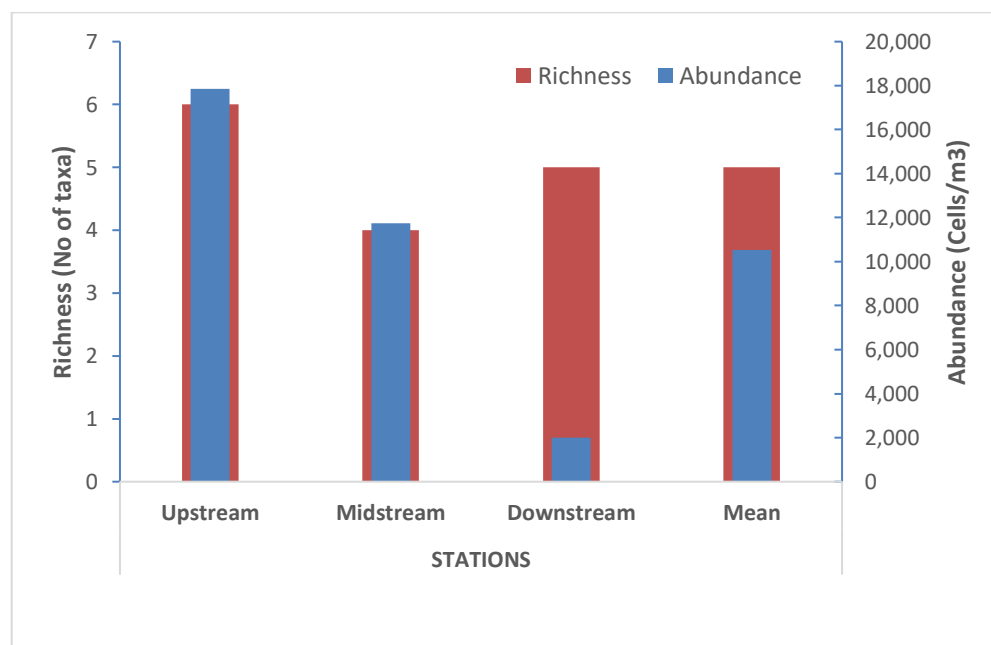


Figure 2.2.18: Total zooplankton density and taxa richness in three sampling stations of Tagoloan River



Figure 2.2.19: Diversity of Dominant Plankton Groups in the Tagoloan River

2.3.2.1.5 Freshwater Macroenthos Fauna

Macroenthos consists of organisms that live at the bottom of a water column. In some classification schemes, these organisms are larger than 1 mm; in another, the smallest dimension must be at least 0.5 mm. They live on or within sediments, rocks, logs, debris and aquatic plants during some period in their life span includes immature forms of aquatic insects, mollusks, aquatic worms and crustaceans. The benthic macro-invertebrates community contributes immensely to the functioning of the aquatic ecosystem.

Table 2.2.15 presents the species composition, density and distribution of benthic fauna in three stations collected in three water elevations (upstream, midstream, downstream) in Tagoloan River, Misamis Oriental for the proposed project. A total of nineteen (19) individuals belonging to six families were recorded during the study with different composition at the three sampling stations.

Table 2.2.15: Density and Abundance of Freshwater Macroenthos Fauna in Three Sampling Stations in Tagoloan River

Freshwater Benthos Taxa	BN1	BN2	BN1	Grand
	Upstream	Midstream	Down	Total
Phylum Mollusca				
Class Gastropoda				
Family Thiariidae	6	3		9
<i>Melanoides</i> sp.		3		3
<i>Melanoides maculata</i>	4			4
<i>Tarebia granifera</i>	2			2
Family Neritidae			2	2
<i>Nerita</i> sp.			2	2
Phylum Arthropoda				
Subphylum Hexapoda				
Class Insecta				
Order Ephemeroptera				
Family Baetidae	2	1		3
<i>Baetis</i> sp.	2	1		3
Order Diptera				
Family Chironomidae	1	1		2
<i>Chironomous</i> sp.	1	1		2
Phylum Chordata				
Class Actinopterygii				
Order Perciformes				
Family Gobiidae			4	4
<i>Gobies</i>			4	4
TOTAL	9	5	6	19
Richness	3	3	2	8

Figure 2.2.20 shows the Relative Abundance (RA) of all the macro-invertebrate families identified in the three sampling stations observed during the October 2018. RA is the ratio of individuals in a certain taxon to the total number of individuals of all taxa which is affected by various factors. A community dominated by relatively few species could indicate environment stress (Plafkin et al., 1989 in ESS Group, Inc. (2001). High percent contribution by a taxon generally indicates community imbalance (Bode, 1988).

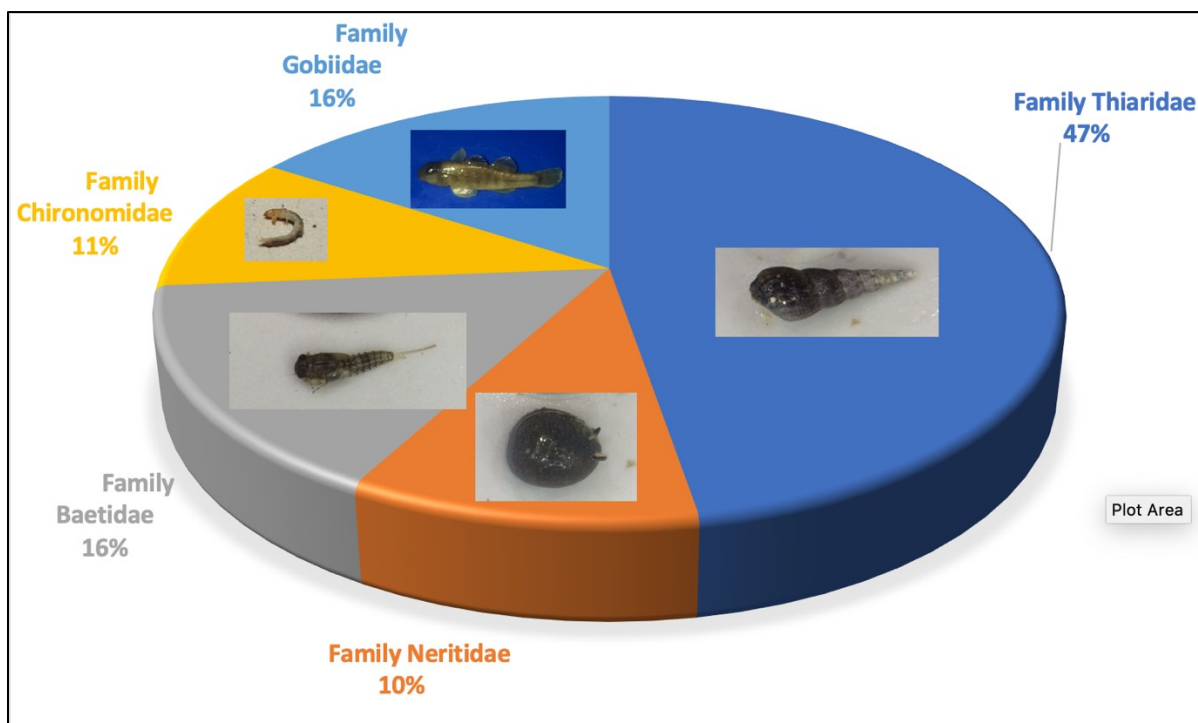


Figure 2.2.20: Percent composition Macroinvertebrates Class/Families Identified in Three Sampling Stations of Tagoloan River

Representatives from Family Thiaridae (*Melanoides* spp. and *Tarebia granifera*) with total count of nine (9) individuals or 49% relative abundance (RA) dominated the benthic fauna survey. Ranking in second was the taxa belonging to family Gobiidae (gobies) and Family Baetidae (mayflies) with total count of Three (3) individuals each or 16% RA. Representatives belonging Gobiidae (gobies), family Chiromonidae (mayflies) and family Neritidae only recorded two (2) individuals each or 11% RA. *Melanoides* is commonly eaten by molluscivorous fish, such as some cichlid species (Tilapia) and carp, but its use as a commercially interesting food source in fish farming requires confirmation. Occurrence of mayflies in upstream station is indicative of relatively good water condition because this group is sensitive to pollution. **Figure 2.2.21** shows the total density of freshwater benthic fauna observed in the three sampling stations.

In terms of spatial distribution, the highest macrobenthos count was recorded in station BN1 or upstream area with 9 while the lowest was recorded in midstream station with three (3) (**Figure 2.2.21**). The overall impression of the benthos assessment during this survey is poor as indicated by low abundance, richness and diversity. Also, no endemic taxa recorded during this survey but only common taxa found in freshwater community.

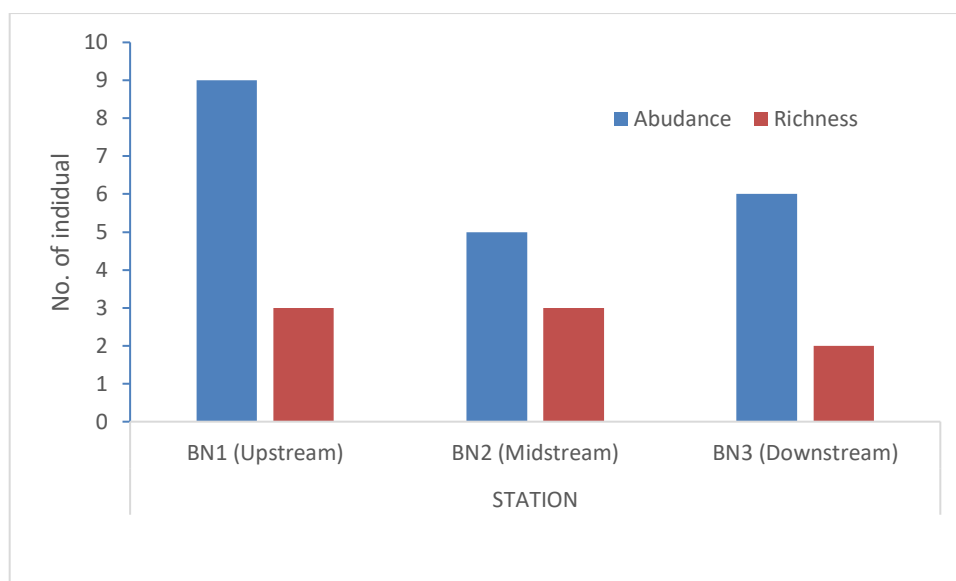


Figure 2.2.21: Total benthos abundance and richness in three sampling stations in Tagoloan River

The highlight of macrobenthos diversity catalogued in three sampling stations during freshwater ecology baseline assessment in the Tagoloan River is presented in **Figure 2.2.22**.

2.3.2.1.6 Commercially Important Macro-Invertebrates in Tagoloan River Estuary

Opportunistic survey for macro-invertebrates of commercial importance for food or trade was undertaken in the upstream and estuary station to supplement data on fish catch composition and productivity of the estuary. No macro-invertebrates were encountered in the rocky riverbank of the upstream station. In the estuary, the opportunistic survey yielded a total of eight (8) species of shellfish and one crustacean (**Table 2.2.16**; **Plate 2.2.10**; and **Figure 2.2.23**). The shellfish were comprised of three species of gastropods and four bivalves.

Based on “*FAO Species Identification Guide for Fishery Purposes*”, only four (4) species encountered were noted to have commercial importance, or are considered edible. Other macro-invertebrates species not covered by the random selection of sampling area stations could still be present as indicated by anecdotal accounts of local fishers. Apart from penaeid shrimps in the estuary, key informants claim that significantly important and lucrative macro-invertebrates will include species of ark shells, pen shells and holothurian sea cucumbers (e.g., the black holothurian *Stichopus chloronotus* - trepang or balatan).

Table 2.2.16: Macro-invertebrates catalogued in the estuary station surveyed in Tagoloan River

Species Name	Common Name	Habitat	Group
<i>Chana iostoma</i>	Talabang bato/oyster	Sandy-muddy littoral	Bivalve
<i>Nerita costata</i>	Costate nerite	Mangrove flats	Gastropod
<i>Telinna sp</i>	Telin	Sandy substrate	Bivalve
<i>Anadar antiquata</i>	Ark shell/litob	Sandy substrate	Bivalve
<i>Trachycardium orbita</i>	Orbit cockle	Sandy substrate	Bivalve
<i>Littoria scabra</i>	Perwinkle	Mangrove	Gastropod
<i>Terebralia palustris</i>	Swamp cerith	Muddy substrate	Gastropod
<i>Carcinus sp</i>	common shore crab	Muddy substrate	Crustacean



Note: left to right: costate nerith, telin and oyster

Plate 2.2.10: Some Macro-Invertebrates Collected in the Tagoloan River Estuary

Indicators of the degraded macro-invertebrate community in the river and estuary include the extremely low numbers of benthic organisms and low species variety in the stations surveyed. There were no major macro-invertebrates of commercial importance seen in the other two stations upstream. The poor shellfish diversity can be attributed to issues of sediment loading and blanketing, erosion, and river water pollution caused by domestic wastes.



Figure 2.2.22: Diversity of Macrobenthos Community Recorded in the Tagoloan River Estuary



Figure 2.2.23: Few Species of Macro-Invertebrates of Important Economic Value Recorded in Tagoloan River Estuary

2.3.2.1.7 Summary of endemism/conservation status

Of the species of freshwater aquatic biota encountered in three river sampling stations, only the tapiroid therapon (*Mesopristes cancellatus*), freshwater prawn (*Macrobrachium rosenbergii*), and the freshwater snapper (*Lutjanus fuscus*) are of high conservation value although they are listed as “least concern or unknown” in the IUCN. Although they are not reported as threatened and endangered, indications of over-harvesting and loss of habitats are posing risks to natural populations and the capture of these species has allegedly become extremely rare. None of the species catalogued are endemic. The *Pigok* is classified as threatened by the Bureau of Fisheries and Aquatic Resources (BFAR). This rare river mullet is known to enter upstream river systems where it seeks undisturbed feeding grounds and cleaner shelters. Key informants claim that the *Pigok* exists in the Tagoloan River, migrating downstream during certain times of the year to spawn in coastal waters. During these periods they become highly susceptible to fishing mortality. In the survey, there has been no sightings of the *Pigok* even as it is a highly sought after fish due to its lucrative price (P 800/kilogram) and rare status. Research undertaken by the survey team revealed that the *Pigok* is the same as the tapiroid therapon species known as *Pigek* (*Mesopristes cancellatus*) which was previously thought to be endemic in the Abra River and the Rio Grande de Mindanao. The fish is allegedly captured rarely at the present time and residents suspect that the practice of capturing spawning females as they migrate downstream to lay eggs is the main reason for the disappearance of the fish. It is evident too that the habitats of the *Mesopristes cancellatus* have already been disturbed by intense quarrying operations, sedimentation and scouring of riverbanks during heavy rains. Alteration of the river mullet’s migration pathway can also be a major reason for the failure of recruitment of the species.

2.2.3.2 Threats to existence and/or loss of important local species and habitats

The overall impression of the phytoplankton community during the survey is poor due to low number of taxa observed and relatively low phytoplankton abundance during the sampling period. Likewise, macrobenthos community, with only three families recorded, is indicative of a stressed environment resulting to biodiversity imbalance. Macrobenthic organisms, because of their contact with sediments reflect that their relative abundance, ubiquity, and sedentary nature, are considered to be suitable bio-indicators of the long-term environmental status of sediments contaminated by hydrophobic organic micropollutants. (LOUATI ET AL., 2014). The variability of macrobenthic organisms are generally affected by abiotic factors such as substrate types, salinity, water temperature, and dissolved oxygen. Moreover, the presence of pollution-tolerant and gastropod shells (F. Thiaridae) in the river should be looked upon to as it indicates that there is a factor causing the situation. Physical and habitat disturbances to the river can lead to higher natural mortality which affects the diversity of the macrobenthic community. Conversion of the habitat by mechanical and anthropogenic disturbance would cause sediment discharge and disturbance of the bottom substrate that would lead to turbidity of the water column and displacement of benthic organisms and alteration of their habitat. Other disturbances on the habitat in either anthropogenic or natural in origin, like water pollution and introduction of thick sediments may cause severe depletion on their population due to disruption of reproductive functions.

The project site is too far from the Tagoloan River. There will be no water abstraction from the river thus no disruption of river water flow is anticipated.

2.3.2.1 Threats to abundance of ecologically and economically important species

Freshwater fish species have not been utilized as pollution indicator species and the low species diversity and abundance as observed in the survey indicates relatively disturbed river ecology. In areas of high sediment load, there are no ecologically and economically important species apart from the hardy Tilapia and species of gobies. Sporadic fishing activities are being undertaken for household and not for commercial purposes. On the other hand, filter-feeding bivalves in the estuary that can be susceptible to biotoxin accumulation (e.g., oyster/litob) but the current population of this bivalve is sparse. In the river itself, the presence of the Thiaridae

species is indicative of a polluted environment although this can be localized and not in the entire river system.

Potential degradation of freshwater ecology of the Tagoloan River

Although the project site is 3 km from the Tagoloan River and sediment intrusion is unlikely. Nevertheless, potential disturbance that can emanate from the proposed project would relate to inadvertently uncontrolled streams of sediments and loose soil carried down from failed sediment ponds and poorly-maintained stockpiles. Enhanced substrate infiltration can further reduce river water quality and alter riverbed structure resulting to loss of grazing areas and habitats for bottom dwelling aquatic biota. Extreme sediment blanketing in the freshwater systems can cause localized mortality of aquatic larval forms of benthic organisms and impair the few remaining nesting grounds of fish species and the freshwater prawn. Extreme sediment loading can also disrupt fish species migration into the river.

The primary mitigation to prevent fugitive sediments and terrigenous material generated during Project establishment from being carried to the Tagoloan River is the establishment of a series of sediment mitigation structures in strategic points to ensure that silt and sediments will not wantonly pollute waterways or drain into the river. This will include installation of silt traps and screens in project areas where liquid waste and loose soil run-off can occur, and establishment of settling ponds to contain sediments before the water is reused and collected in rainwater harvesting cisterns. In heavy construction areas, loose materials shall be stockpiled in areas away from waterways and where erosion control measures can be easily applied. Construction stockpiles shall be covered and rigidly bundled. As a precautionary approach, the stabilization of areas where earthmoving and construction has occurred will be undertaken in appropriate areas through extensive vegetation cover enrichment in order to increase sediment amalgamation capacity and soil compacting.

Pollution due to liquid wastes and domestic wastewater

There are no effluent discharges to the Tagoloan River. However, during the project's construction phase, poorly-managed waste disposal system can lead to solid and liquid wastewater contamination in the river carried by various waste streams generated during construction. This may further adversely affect water quality in the Tagoloan River. Domestic wastewater pollution can lead to hyper-nutrient loading and trigger algal blooms. It is to be noted however, that because sediments serve as a sink for various nutrients, sediment-associated environmental problems is an issue that cannot be attributed to single point source alone but to a broad range of sources, in many instances, other industrial establishment, domestic wastewater from households, open latrines, fertilized croplands, and denuded watersheds.

A sound wastewater and solid waste management plan will be implemented and strictly enforced as mitigation to potential waste disturbances, which will include the setting up of a wastewater treatment facility. State-of-the art modern sanitation facilities and wastewater disposal systems will be installed. The use of 3-chambered septic tanks shall be adopted in all project facilities where wastewaters and other effluents are generated both during construction and operations phase. Drainage canals shall be fitted with sediment filters and geotextile screens before fluid wastes they can enter waterways. Regular *in-situ* monitoring of river water quality and the state of habitats and diversity of aquatic fauna will be conducted.

Spillage of steel mill wastes

Spillage of waste materials including debris and litter generated from steel milling is highly unlikely due to stringent recovery and recycling measures. However, inadvertent spillage can occur and such wastes can be discharged into waterways and reach the river system especially during the rainy season. A solid waste management system will be instituted, incorporating waste recovery and re-cycling of steel mill debris and spoils.

Oil and grease contamination

The risk of oil and grease contamination of the river can only occur if disposal of fuel-based wastes is not undertaken properly and accidental spills near waterways that drain into the river happens. From portions of the river, oily sludge, processing slurry and hazardous wastes can be inadvertently carried to coastal waters if containment, recovery and treatment systems are not efficiently established and maintained. Such fugitive wastes will have far-reaching and irreversible impacts on benthic communities in the estuary, resulting to contamination of nipa stands and depressing recruitment and growth, and loss of fish habitats.

An oil and grease containment and waste containment and recovery plan will be formulated and enforced in all aspects of project operations. Remediation will include recovery and treatment of sludge. Carpools will be located farthest from coastal influences and all vehicle oil discards will be recovered.

River water use competition

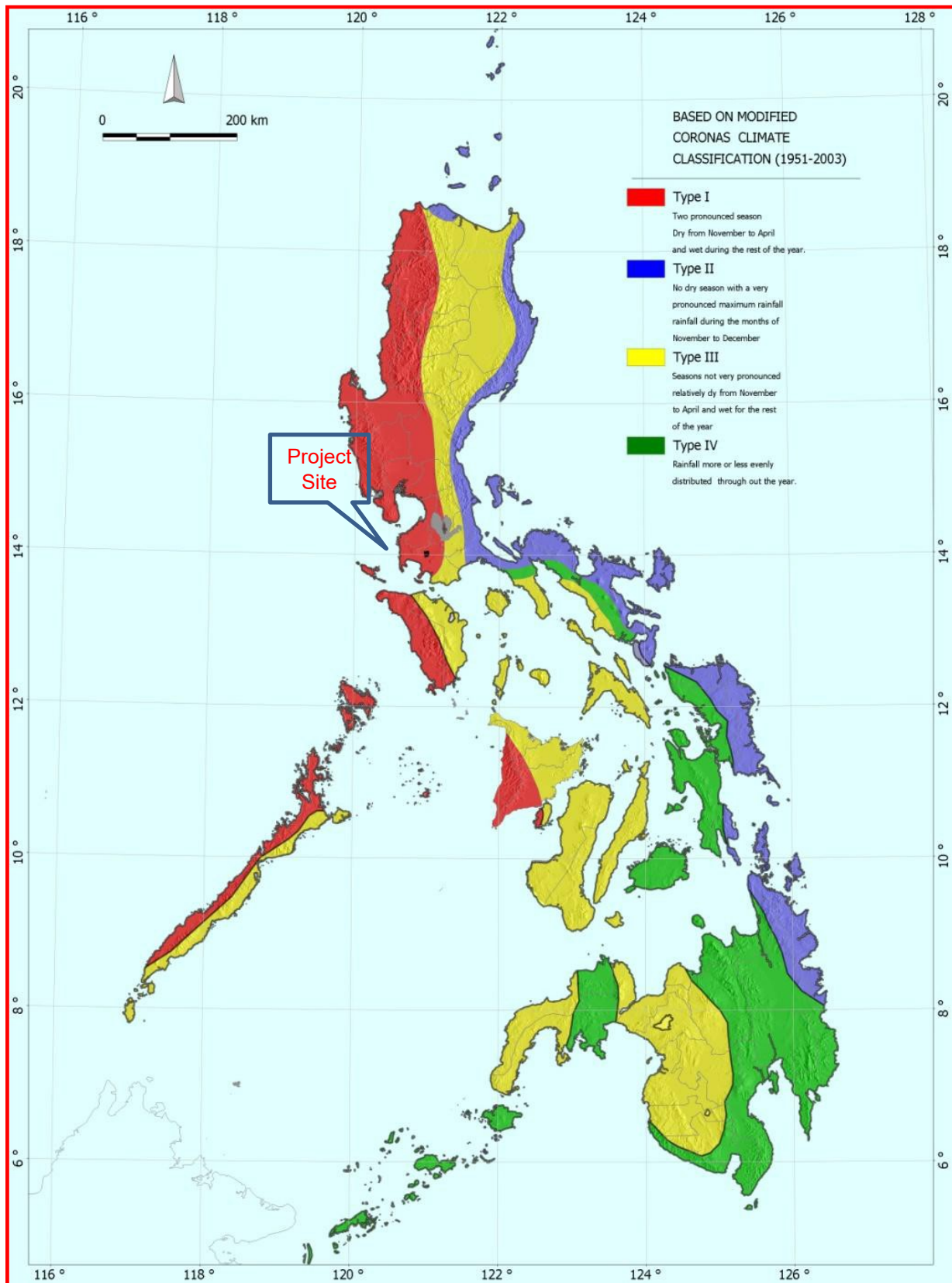
There will be no water to be extracted from Tagoloan River. Thus, the Project operations will not have any impact on the survival and distribution of fish and macro-invertebrates, nor the loss of its habitats upstream. There will be no alteration of habitats, either in the estuary or in the upstream portions away from the project site. Neither will upstream migration of fishes, especially of the rare freshwater fish – the Pigok – will be interrupted as well as there will be no barriers to impede such animal movements. Tilapia juveniles normally swim against the current and would therefore be more prominent in upstream waters where salinity is lower. It is unlikely too that fishes that are estuary dwelling, such as gobies, mullets and juvenile snappers, will not be affected because there will be no river water extraction. Moreover, molluscan veligers (settlers) have not been found to be densely occurring in the river as revealed during zooplankton investigations and are therefore too few to be affected significantly. Sustaining the population of benthic and epi-benthic macro-invertebrate communities in the Tagoloan River and its estuary will be a special concern in preventing sediment run-off. Areas of dense macro-invertebrate population will be monitored for possible disturbances from project-related issues, if any.

2.3 AIR

2.3.1 Climatology and Meteorology

2.3.1.1 Climate

The Project site located in Sitio Kirahon, Barangay San Martin, Villanueva, Misamis Oriental falls under Type I based on the modified Coronas Climate Classification of the Philippine Climate (**Figure 2.3.1**). The Type I climate has a pronounced weather to be dry from November to AOril and wet during the rest of the year.



Source: PAGASA

Figure 2.3.1: Philippine Climate Map

2.3.1.2 Meteorology

Local climate impacts to the proposed project site were done by analyzing trends of relevant meteorological parameters such as temperature, rainfall, wind speed and direction among others. Description of meteorological considerations at the proposed project site is from PAGASA Lumbia Synoptic Station located in Barangay Lumbia, Cagayan de Oro City and Molugan-El Salvador Synoptic Station located in Barangay Molugan, El Salvador City, Misamis Oriental.

Meteorological data recorded in Lumbia-El Salvador Station are from 1981-2010 with the following parameters: a) wind speed, b) wind direction, c) temperature (max, min, & mean), d) dry bulb, e) wet bulb, f) dew point, and g) relative humidity (**Table 2.3.1**).

Table 2.3.1: Meteorological Data Recorded at Lumbia-El Salvador Synoptic Station (1981-2010)

Month	Rainfall Data		Temperature						Relative Humidity (%)	Wind Direction/Speed	
	Amount (mm)	No. of Rainy Days	Max (°C)	Min (°C)	Mean (°C)	Dry Bulb (°C)	Wet Bulb (°C)	Dew Point (°C)		Wind Direction (16 pt)	Wind Speed (m/s)
January	98.9	12	29.6	21.6	25.6	25	23	22.2	84	N	2
February	68	8	30.2	21.4	25.8	25.2	22.9	22	82	N	2
March	49.8	6	31.3	21.6	26.5	25.9	23.3	22.3	80	N	2
April	52.6	5	32.5	22.4	27.5	26.9	23.8	22.6	77	N	2
May	125	10	32.9	23.2	28	27.3	24.3	23.2	78	N	2
June	212.7	17	32	22.8	27.4	26.5	24	23.1	81	S	2
July	245.6	18	31.6	22.4	27	26.1	23.8	22.9	83	S	2
August	195.8	15	32.1	22.5	27.3	26.4	23.8	22.8	80	S	2
September	219.7	16	31.8	22.3	27.1	26.1	23.7	22.8	82	S	2
October	185.9	16	31.4	22.3	26.9	26.1	23.8	22.9	83	S	2
November	136	12	30.9	22.1	26.5	25.9	23.7	22.9	83	S	2
December	113.2	11	30.1	21.8	26	25.5	23.4	22.6	84	N	2
Annual	1703.3	148	31.4	22.2	26.8	26.1	23.6	22.7	81	N	2

Source: PAGASA

2.3.1.2.1 Wind Speed and Direction

The hourly meteorological data for the year 2012 collected in the PAGASA Lumbia Synoptic Station shows that the prevailing wind at the project site is from south and north, which comprise of about 17% and 15%, respectively (**Figure 2.3.2**). A significant event produce southwest comprises of about 12% over the site. The average wind speed is 1.76 meters per second, few winds exceed 11 meters per second and winds less than 2 meters per second occur from all directions. Calm conditions were observed 0.00% of the time. Strongest winds come from north-northeast occupying 0.4% of the time.

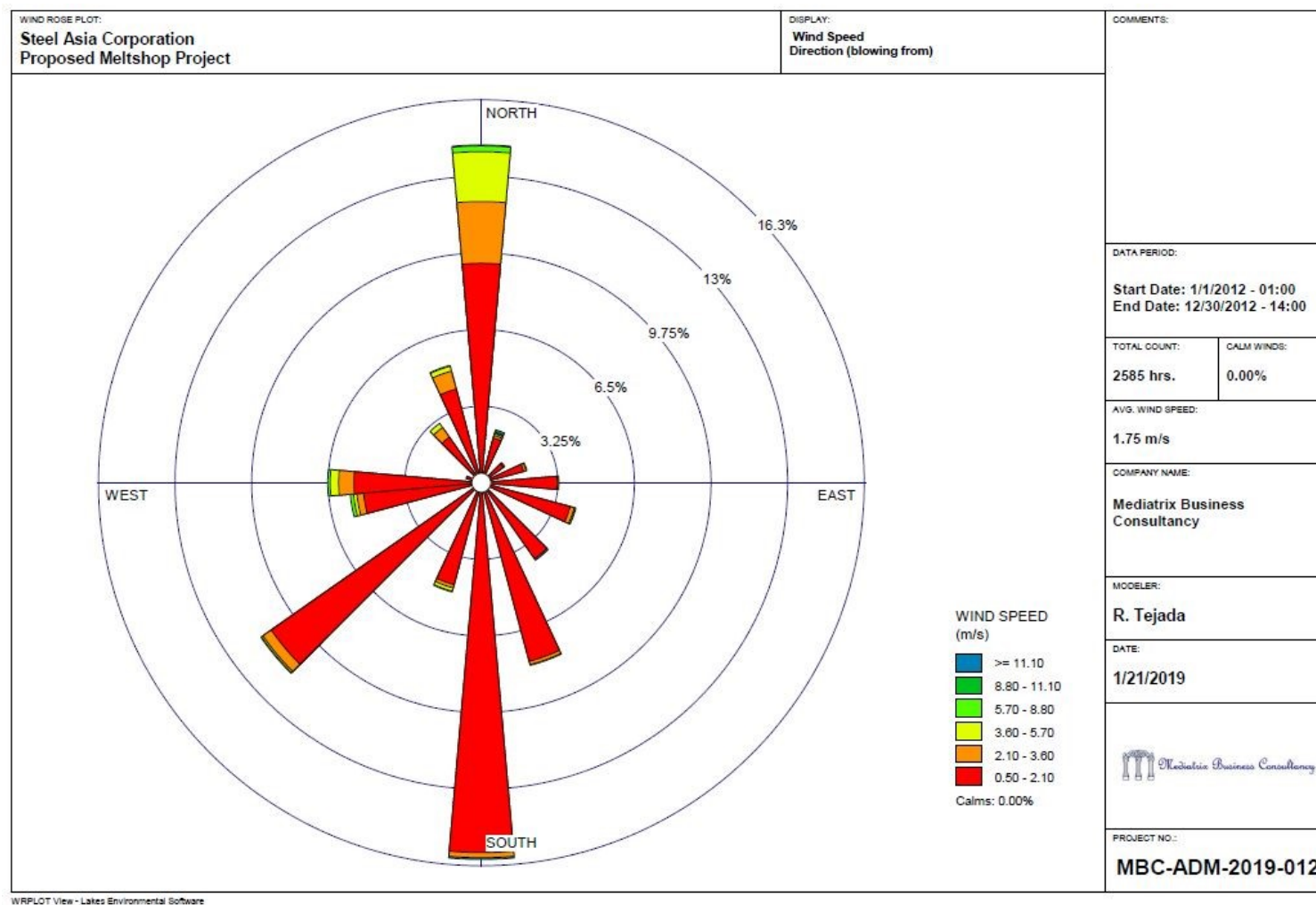


Figure 2.3.2: Windrose Diagram for Lumbia Station

2.3.1.2.2 Temperature

The average monthly temperature of Misamis Oriental tends to decrease during wet season based on the data from Lumbia Station (**Figure 2.3.3**). January being the coldest month having a mean temperature of 25.6°C while the month of May is the warmest with a mean temperature of 28°C. The mean annual average temperature is 26.8°C.

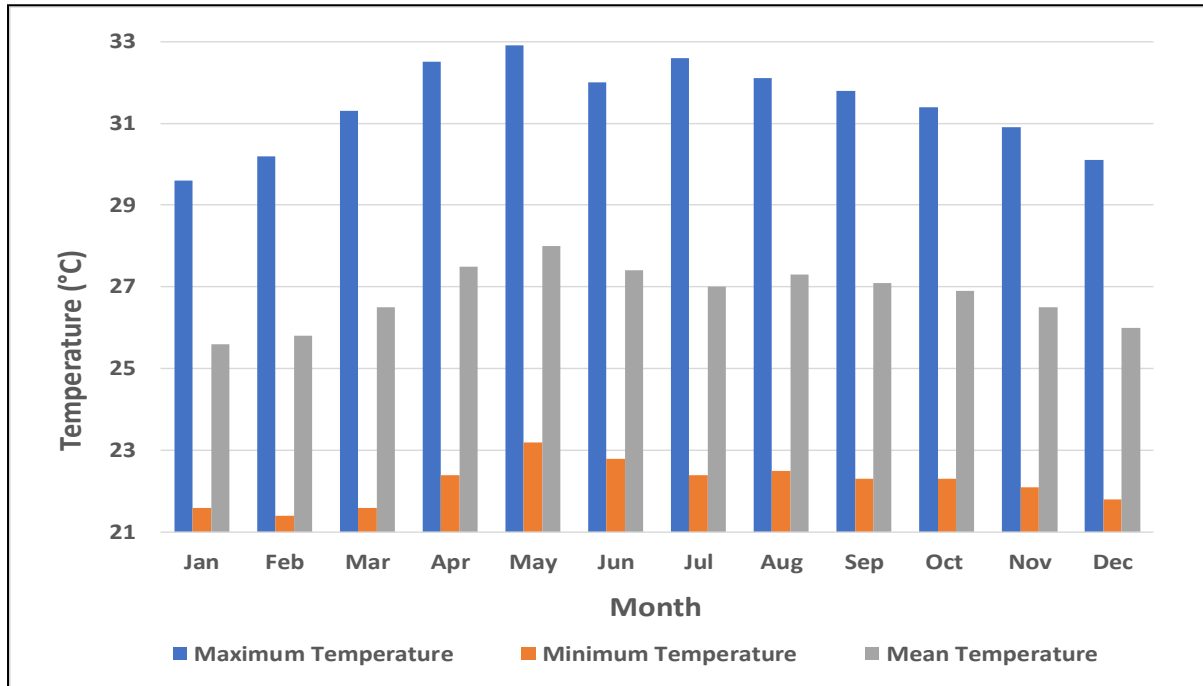


Figure 2.3.3: Monthly Temperature in Lumbia Station

2.3.1.2.3 Rainfall

The typhoon season normally occurs between May to November and usually coincides with the onset of the southwest monsoon rains. Based from the 30-year record in PAGASA Lumbia Station, the amount of rainfall starts to increase during the month of May with maximum rain period from June to October then subsides during the month of November. The total annual rainfall in Lumbia is 1703.3 mm with 148 annual average rainy days.

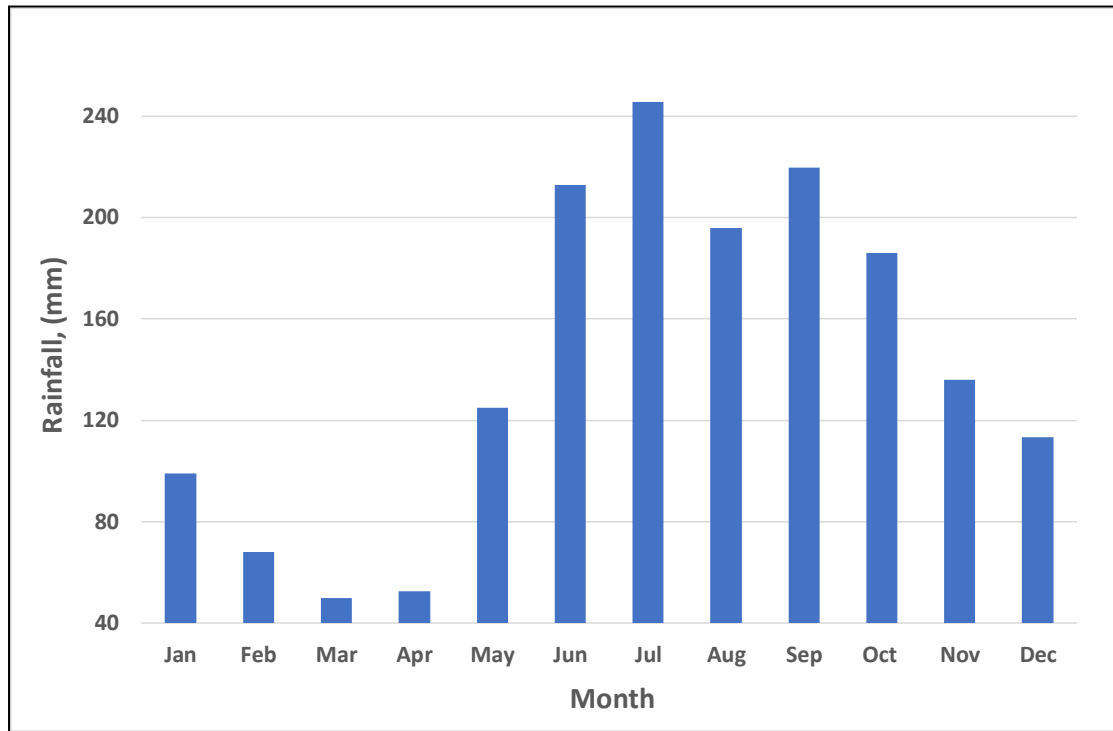


Figure 2.3.4: 30-year Monthly Rainfall in Lumbia Station

2.3.1.2.4 Relative Humidity

Factors affecting humidity are changes in temperature and atmospheric circulation. The air is said to be saturated when it contains the maximum amount of water vapour possible at a given temperature. When the temperature of the air falls below the dew point, some of the water vapour contained in the air condenses, clouds form, and precipitation can result in the form of rain.

The annual average dry and wet bulb temperature from Lumbia Station are 26.1°C and 23.6°C, respectively (**Table 2.3.1**). This translate to annual average relative humidity of 81% with December and January are the most humid months having an average relative humidity of 84% while the month of April is the least humid at 77%.

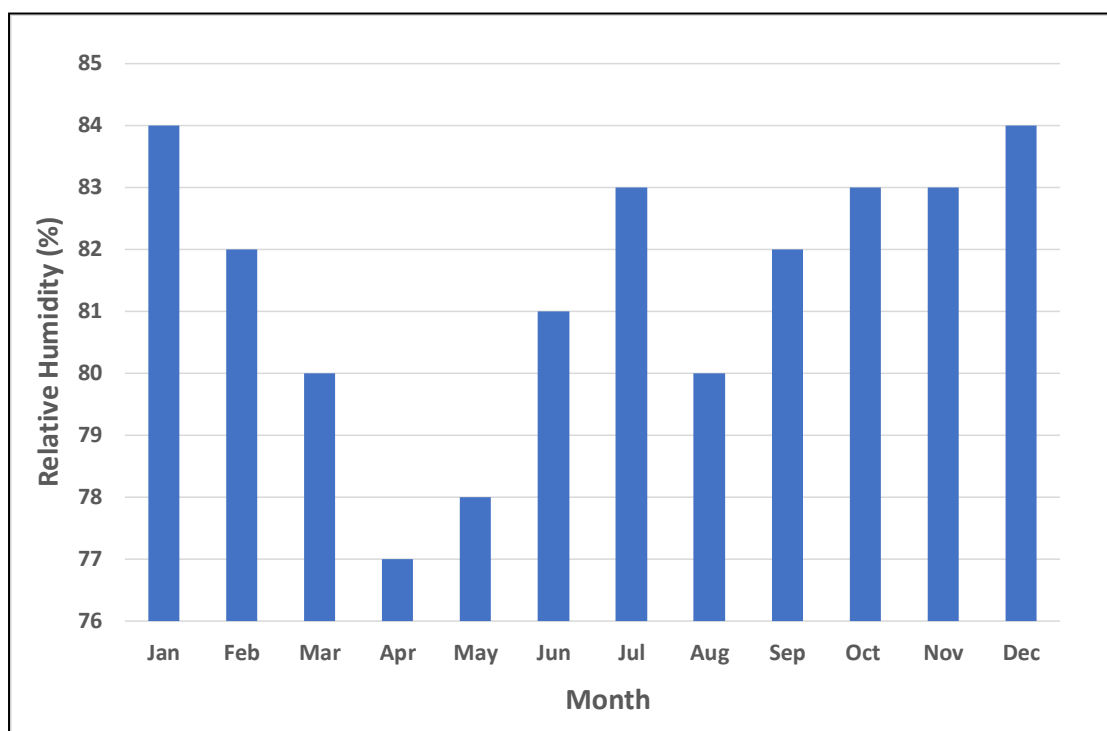


Figure 2.3.5: Monthly Relative Humidity in Lumbia Station

2.3.1.2.5 Cyclone Frequency

A tropical cyclone reaching maximum sustained winds of greater than 118 kph are called typhoons. The Philippines is located in the northwest Pacific Ocean cyclone basin and tropical cyclones. The greatest number of cyclones in the Philippines occurs during the months of June to December. These tropical cyclones are associated with the occurrence of low pressures areas (LPA) normally originating over the North Western Pacific Ocean side of the Philippine Area of Responsibility (PAR) and generally moving northwestward. PAGASA categorized these cyclones as Super Typhoon, with sustained winds equal or up to 220 kph; Typhoon with sustained winds from 118-220 kph; Severe Tropical Storm with sustained winds from 89-117 kph; Tropical Storm with sustained winds from 62-88 kph; and Tropical Depression with sustained winds less than or equal to 61 kph. For the past 10 years the Philippines experiencing number of extremely damaging tropical cyclones. In May 18, 2015, PAGASA updated the tropical cyclone classification system for the Philippines. The new public storm warning signal system are as follows:

- PSWS No. 1 – tropical cyclone winds of 30-60kph; expected within the next 36 hours
- PSWS No. 2 – tropical cyclone winds of 61-120kph; expected within the next 24 hours
- PSWS No. 3 – tropical cyclone winds of 121-170kph; expected within the next 18 hours
- PSWS No. 4 – tropical cyclone winds of 171-220kph; expected within the next 12 hours
- PSWS No. 5 – tropical cyclone winds of more than 220 kph; expected within 12 hours

The PAGASA had tracked eight (8) tropical cyclones that crossed in the province of Misamis Oriental from 1948-2017 where the month of December received the highest number of tropical cyclones. There was no recorded severe tropical storm or super typhoon that enter in the province of Misamis Oriental. **Figures 2.3.6** and **2.3.7** present the track of tropical cyclone that crossed the province of Misamis Oriental and the monthly distribution of tropical cyclone, respectively. Moreover, **Figure 2.3.8** shows that the project site is under very low typhoon risk with one (1) cyclone per year.

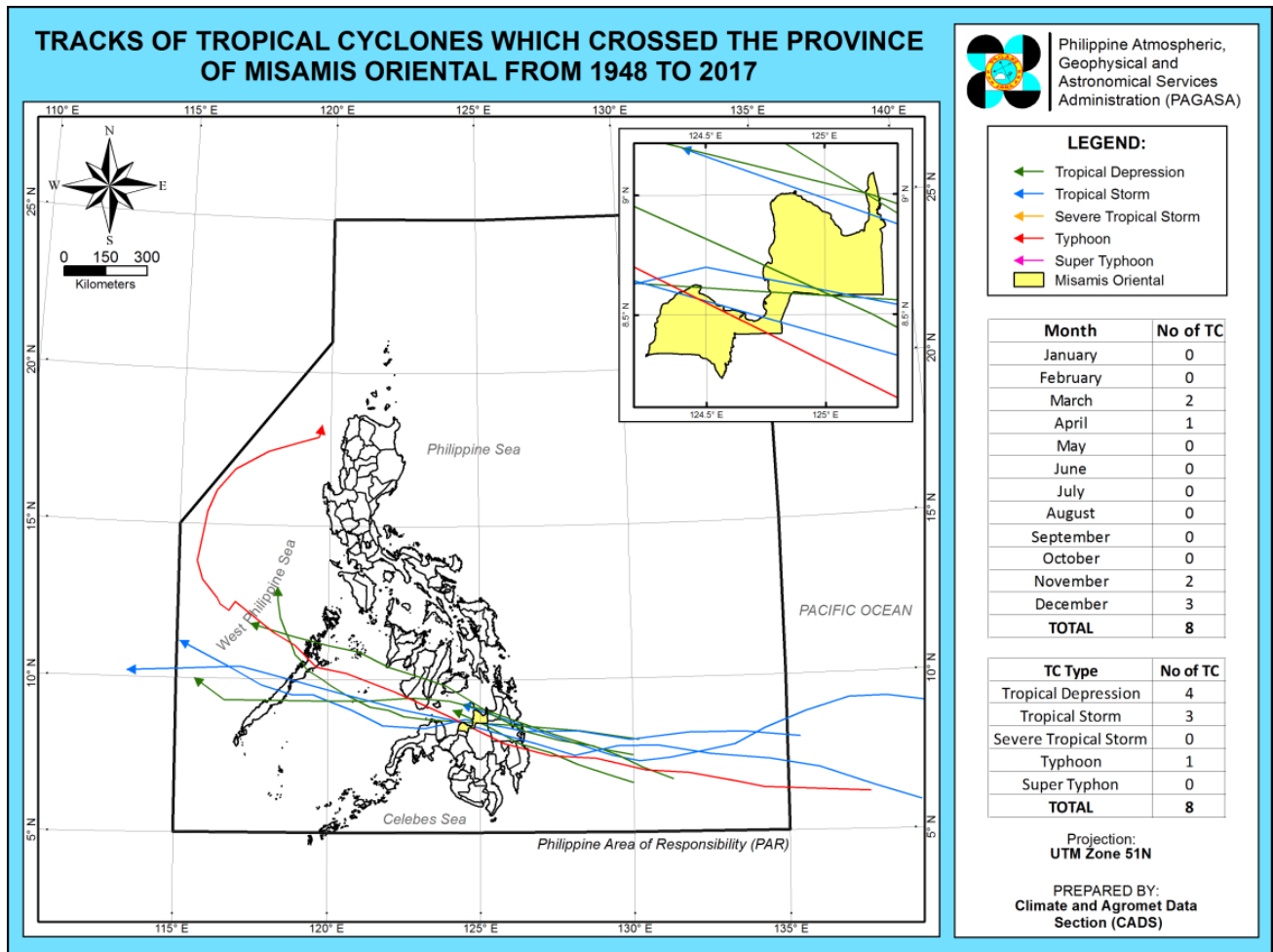


Figure 2.3.6: Track of Tropical Cyclone

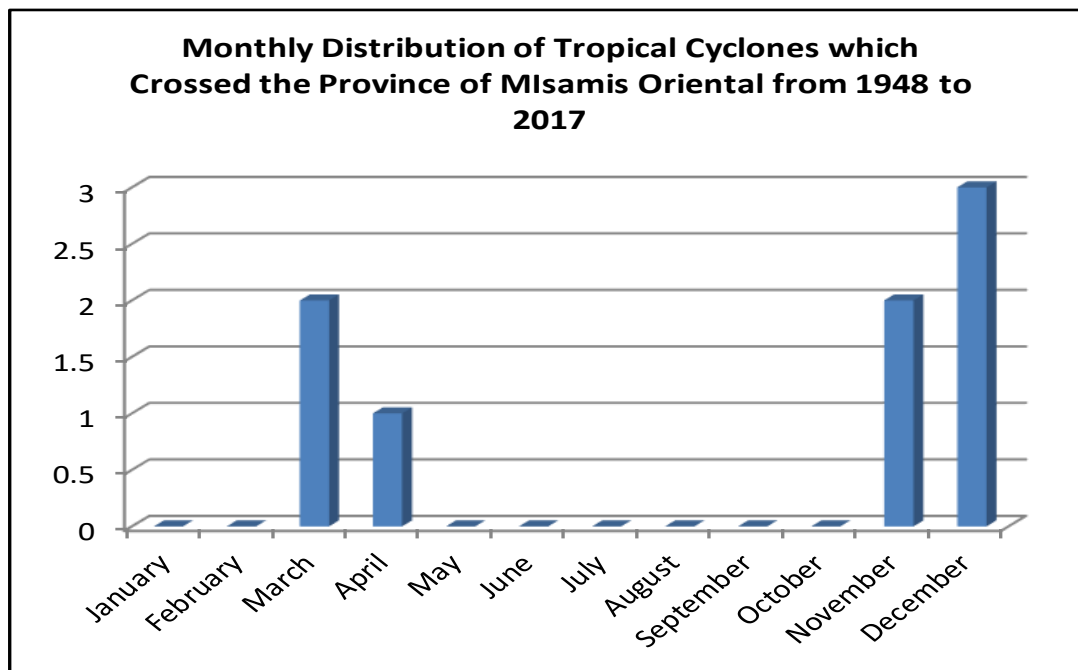


Figure 2.3.7: Monthly Distribution of Tropical Cyclone

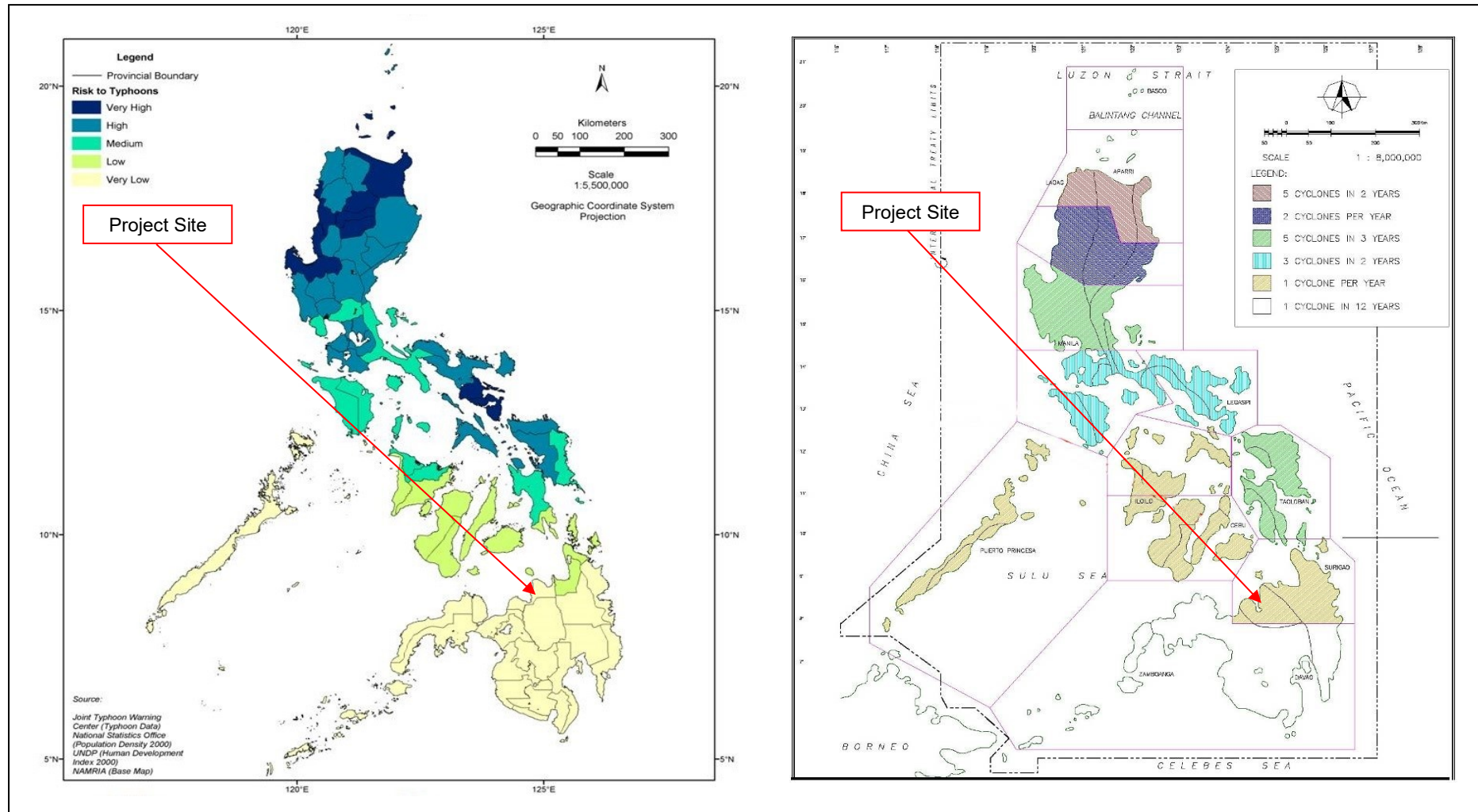


Figure 2.3.8: Philippine Typhoon Map

2.3.1.2.6 Frequency of Extreme Event

Climatological extremes values are from the 30-year monthly and annual summaries of temperature, rainfall, and wind speed in **Table 2.3.2**. The highest temperature recorded in the station is 38.4°C which occurred in June 6, 2009 while the lowest temperature is 16.1°C which occurred in January 3, 1991. The greatest daily rainfall recorded in the station is 237.1mm which occurred in November 24, 2009. The strongest wind speed in the station is 34 meters per second southerly direction occurred in December 4, 2012.

Table 2.3.2: Climatological Extreme Recorded at Lumbia Station as of 2017

Month	Temperature (°C)				Greatest Daily RF (mm)		Strongest Winds (m/s)		
	High	Date	Low	Date	Amount	Date	Speed	Dir	Date
Jan	36.2	01-08-2016	16.1	01-03-1991	104.4	01-13-2009	14	WNW	01-28-2017
	-	-	-	-	-	-	13	N	01-31-2015
Feb	36.0	02-14-2003	17.1	02-05-1980	107.8	02-05-1999	14	N	02-02-1993
	-	-	-	-	-	-	14	N	02-02-2015
	-	-	-	-	-	-	14	N	02-12-2017
Mar	37.6	03-28-1998	17.1	03-10-1992	84.2	03-19-1982	13	ENE	03-26-1984
Apr	37.0	04-11-1998	18.0	04-13-1983	88.4	04-14-2014	20	NNW	04-29-1983
May	38.2	05-07-1998	20.7	05-28-1984	94.3	05-21-1990	18	W	05-27-1998
Jun	38.4	06-06-2009	20.0	06-11-1992	124.2	06-21-2016	18	WNW	06-10-1997
Jul	36.2	07-11-2002	20.0	07-17-1994	142.0	07-13-1999	22	W	07-31-1999
	-	-	20.0	07-02-2015	-	-	-	-	-
Aug	37.8	08-28-1990	19.4	08-26-1995	129.3	08-21-1998	25	SW	08-05-1997
Sep	36.7	09-02-1992	19.0	09-23-1991	117.0	09-09-2017	24	NNW	09-23-1996
Oct	35.2	10-20-2015	19.0	10-31-1982	114.1	10-20-1980	18	SW	10-04-2014
	-	-	19.0	10-25-2015	-	-	-	-	-
Nov	34.7	11-30-2006	18.0	11-25-1992	237.1	11-24-2009	18	NW	11-20-1990
Dec	34.4	12-08-1996	17.8	12-31-1990	180.9	12-16-2011	34	S	12-04-2012
Annual	38.4	06-06-2009	16.1	01-03-1991	237.1	11-24-2009	34	S	12-04-2012

Source: PAGASA

2.3.1.3 Contribution in Terms of Greenhouse Gas Emissions

The proposed Project is expected to generate greenhouse gas (GHG) emissions from activities associated during construction (fuel/electricity uses for the operation of construction vehicles and equipment), furnace operation (electricity uses for steel melting operations), and general plant operations. These fuel combustion and electricity consumption activities releases three (3) major GHGs, namely: carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O). Of these gases, the major gas emitted is CO₂ and the bulk of the GHG emissions calculations involve determining the amount of CO₂ emissions as CH₄ and N₂O emissions have a very low share in terms of emissions. As such, this report only focused on CO₂ emissions.

The CO₂ were calculated using emission factor-based estimation method. The methodology estimates the CO₂ emissions by multiplying a level of activity data (AD) by an emission factor (EF). Activity data is a quantified measure of activity resulting in emissions during a given period of time (e.g. data on fuel consumption (liters/km) and purchased electricity (kWh reading)) while emission factor is the average emission rate of a given GHG for a given source, relative to units of activity. The general equation is shown below. This is based on 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), 2006 Intergovernmental Panel on Climate Change (IPCC) Guidelines for National GHG Inventories and 2014 IPCC Assessment Report.

Equation: GHG Emissions = AD x EF

The Project are expected to have a direct and indirect GHG emissions. The direct GHG emissions of Scope 1 are from the sources which are owned and/or controlled by the Project.

This is usually applicable during the operational phase such as the use of generator set commonly called as the point sources of emission. Moreover, the indirect emissions, on the other hand, are further categorized into Scope 2 and Scope 3. In the Scope 2, emissions are a consequence of the project's operations at sources owned and/or controlled by another entity which include purchased electricity consumption. Further, in the Scope 3, emissions are a consequence of the Project activities but to which has no direct control such as tailpipe emissions from contracted equipment/ vehicles during construction.

Table 2.3.3: Items to Consider for Each Scope

Scope	Construction	Operation
1	1. Stationary combustion Emissions from fuel use of entity-owned/ controlled stationary equipment (e.g. standby genset) 2. Mobile combustion Tailpipe emissions from entity-owned/ controlled vehicles (e.g. service van)	1. Stationary combustion Emissions from fuel use of entity-owned/ controlled stationary equipment (e.g. genset) 2. Mobile combustion Tailpipe emissions from entity-owned/ controlled vehicles (e.g. service van)
2	1. Stationary combustion Emissions from the consumption of purchased electricity for construction works	1. Stationary combustion Emissions from the use of purchased electricity during operations
3	1. Stationary combustion Emissions from fuel use of contracted construction equipment (e.g. standby genset) 2. Mobile combustion Emissions from transportation of purchased construction materials/ construction wastes using contracted vehicles (e.g. trucks, pickup)	1. Mobile combustion Emissions from fuel use of contracted vehicles (e.g. service vans)

Calculated CO₂ from Construction Equipment

During construction, CO₂ emissions are calculated using Scope 3 where sources to be considered are the construction equipment, including service vehicles in transporting of construction materials. The primary input is the fuel consumption used and kilometers travelled of each vehicle transporting construction materials. The estimated CO₂ emissions were presented in **Table 2.3.4**. These construction equipment/ vehicles are diesel-powered, the emission factor for diesel will be based from the US EPA Emission Factors for Greenhouse Gas Inventories, which was last modified on November 19, 2015. Presented in **Table 2.3.4** are the activity data, emission factor as well as the results of the computation.

Assumption used in calculating CO₂ emissions during construction are the following:

- 30-units Heavy equipment with 20,000 km distance travelled for each unit;
- 50-units Truck with 50,000 km distance travelled for each unit;
- 20-units Pick-up with 50,000 km distance travelled for each unit; and
- 20-units Service Van with 60,000 km distance travelled for each unit.

The total CO₂ emissions during construction are estimated at 81.22 MT CO₂/yr.

Table 2.3.4: Calculated CO₂ Emission from Heavy Equipment and Mobile Sources

Emission Sources	No. of Units	Fuel Type	Fuel Consumption (L/100km) ^a	Assumed distance travelled (km/yr)	Fuel Consumption (L/yr)	Emission Factor (kg CO ₂ /L) ^b	Calculated CO ₂ Emission (MT CO ₂ /yr)
Heavy Equipment	30	Diesel	31.6	20,000	6,320	2.7	17.06
30-tonner Truck	50	Diesel	20.9	50,000	10,450	2.7	28.22
Pick-up	20	Diesel	12.1	50,000	6,050	2.7	16.34
Service Van	20	Diesel	12.1	60,000	7,260	2.7	19.60
Total CO ₂ Emission							81.22

Source: a – 2017 Fuel Consumption Guide, Natural Resources Canada

b – Emission Factors for Greenhouse Gas Inventories USEPA

CO₂ Emissions during Construction from Electricity Purchased

The indirect CO₂ emission during construction is calculated under Scope 2 emissions which is electricity consumed through purchased. The electricity consumption during project construction is at 2 MWh/mo. The assumption is based on the daily power requirements of construction equipment to be consumed. GHG Protocol's Purchased Electricity Calculation Tool with emission factor from the GWP values of the 2014 IPCC Fifth Assessment Report was utilized to automatically calculate the total CO₂ emissions. Presented below (**Table 2.3.5**) are the activity data as well as the results of the computation. The total CO₂ emissions during construction and operation are estimated at 1.21 MT CO₂/yr.

Table 2.3.5: Calculated CO₂ Emission during Construction and Operation

Emission Sources	Annual Electricity Consumption (MWh/yr)	Calculated CO ₂ Emission (MT/yr)
Construction	24	1.21

CO₂ Emissions for Steel Melting Furnace and Plant Operation

The electricity consumption for melting furnace operation was estimated at 190,322.60 MWh/yr. The assumption is based on the daily power requirements for the operation of the smelting furnace at 355 kWh per ton of steel in nominal tapping capacity of 70 tons with tap-to-tap time of 45 minutes. Other plant operational power requirement is assumed to 100,000 MWh/yr. Scope 2 of the GHG Protocol's Purchased Electricity Calculation Tool with emission factor from the GWP values of the 2014 IPCC Fifth Assessment Report was utilized to automatically calculate the total CO₂ emissions of the melting furnace. Presented below are the activity data as well as the results of the computation. The total CO₂ emissions during operation are estimated at 145,867 MT CO₂/yr.

Table 2.3.6: Calculated CO₂ Emission for the Operation of the Melting Furnace

Emission Sources	Annual Electricity Consumption (MWh)	Calculated CO ₂ Emission (MT/yr)
Heavy Meltshop	190,323	95,630
Other Plant Operation power requirement	100,000	50,237
Total CO ₂		145,867

CO₂ Emissions for Steel Rolling Mill Furnace Stack

The CO₂ emission from the steel rolling mill furnace is calculated under Scope 1 emissions using the equation presented above. The fuel to be used in the rolling mill furnace is the low sulfur fuel oil. **Table 2.3.7** shows the summary of the calculated GHG emissions from the rolling mill furnace. The default emission factor of residual oil no. 6 is used from Table 2.2 of the IPCC 2006 Guidelines is 77,400 kg of CO₂/TJ; 10 kg of CH₄/TJ for methane; and 0.6 kg of N₂O/TJ for nitrous oxides.

Table 2.3.7: Summary of Calculated GHG Emissions for Rolling Mill Furnace

Emission Sources	Fuel Consumption (L/year)	Fuel Heating Value (kcal/kg)	CO ₂ Emission (MT/year)	CH ₄ Emission (MT/year)	N ₂ O Emission (MT/year)
Heavy Mill Furnace Stack	14,623,440	10,082	42,499	5.49	0.33

The total calculated CO₂ emissions for the proposed project is 188,454.25 MT/yr. This will contribute of approximately 0.18% based on the Philippines Second National Communication (SNC) on Climate Change of CO₂ for 2020. With the calculated CO₂ emissions of the Project, it can still be considered to be on the low-end greenhouse gas emitters.

The construction of the Project is expected to contribute an approximately 0.000061% of the total CO₂ emission, which is a small contribution to the total anthropogenic CO₂ load. However, in order to minimize unnecessary CO₂ generation from construction activities, the following measures will be implemented:

- Minimize vegetation removal and alteration of topography if possible;
- Implement regular inspection and preventive maintenance of heavy equipment, machineries and service vehicles to meet the DENR Emission Standard; and
- Use electric or fuel-efficient equipment, machineries and vehicles and maximize its operation if possible.

The Project operation can be considered to be on the low-end greenhouse gas emitters based on its estimated CO₂ contribution. However, necessary measures shall be enforced to further minimize its possible impact. In addition, essential enhancement shall be implemented to lessen impact of climate change to the Project.

To maintain and/or further reduce its minimal contribution, necessary measures during operation shall be enforced including tree planting, energy/water conservation program implementation as well as:

- Planting of vegetation as much as possible to open areas at the facility and in the buffer zone.
- Energy/water conservation program such as use energy efficient products (i.e. LED lights) and carbon footprint monitoring.
- Regular inspection and proper maintenance of structural facilities, equipment, and machinery.

2.3.1.4 Climate Risk/Climate Change

Temperature Change

The Province of Misamis Oriental will have an increase in temperature in 2020 and 2050 based in the climate change scenario for the Philippines published by PAGASA in 2011. The projected temperature increase is 1.0°C to 1.2°C in the average temperature baseline data in 2020 and an increase of 1.9°C to 2.0°C in 2050.

Tables 2.3.8 and **2.3.9** show the seasonal temperature increase and projected seasonal mean temperature in 2020 and 2050 under medium range emission scenario in the Province of

Misamis Oriental. **Figures 2.3.9 and 2.3.10** show the graphical presentation of the monthly average temperature change from 2006 to 2035 and from 2036-2050, respectively.

Table 2.3.8: Seasonal Temperature Increase (in °C) in 2020 and 2050 under Medium Range Emission Scenario in the Province of Misamis Oriental

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
25.4	26.8	26.9	26.5	1.0	1.2	1.2	1.0	1.9	2.3	2.4	2.0

Based on the calculated temperature projections, the project site may experience temperature rise up to 28.1°C covering the period of 2006-2035 and 29.3°C covering the period of 2036-2065 (**Table 2.3.9**). These temperature increase may affect the plant operation by decreasing power output due to the heat transfer efficiency of the air-cooling system. The Project will consider the temperature increase for 2020 and 2050 in their plant design to achieve optimum operation with less energy consumption. The selection of design temperature reflects an optimization, operational and capital costs based on historical conditions.

Table 2.3.9: Projected Seasonal Mean Temperature in 2020 and 2050 under Medium Range Emission Scenario in the Province of Misamis Oriental

Quarter	DJF	MAM	JJA	SON
Observed Baseline (1971-2000)				
Mean	25.4	26.8	26.9	26.5
With Climate Change Scenario (2006-2035)				
Mean	26.4	28.0	28.1	27.5
With Climate Change Scenario (2036-2065)				
Mean	27.3	29.1	29.3	28.5

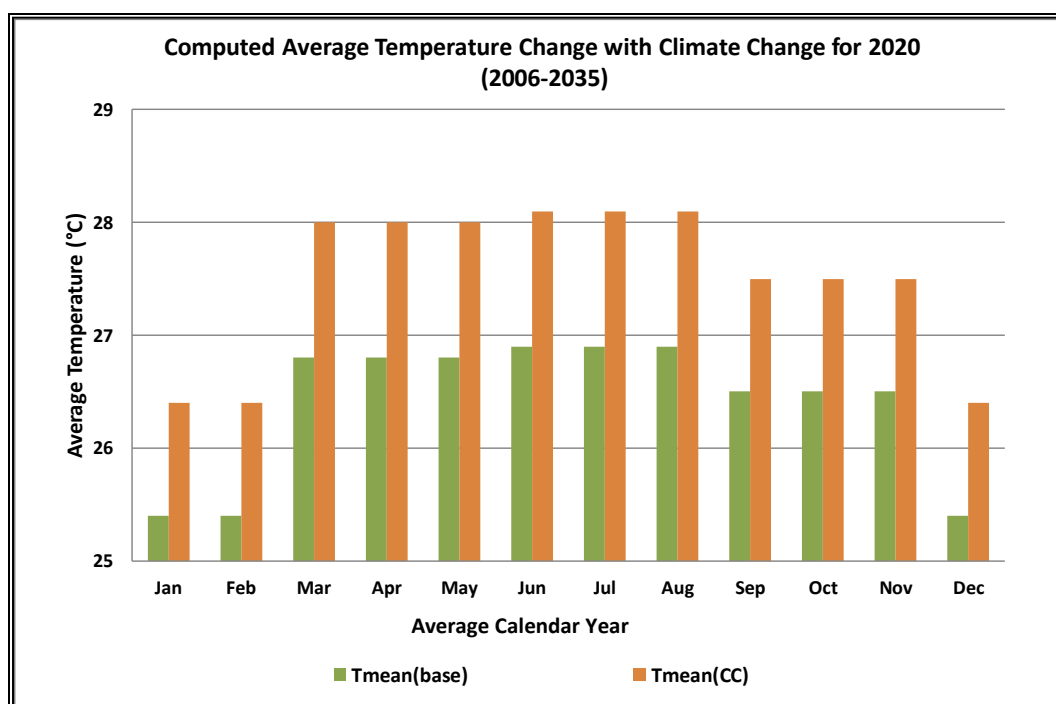


Figure 2.3.9: Change in Monthly Average Temperature for the Period 2006-2035

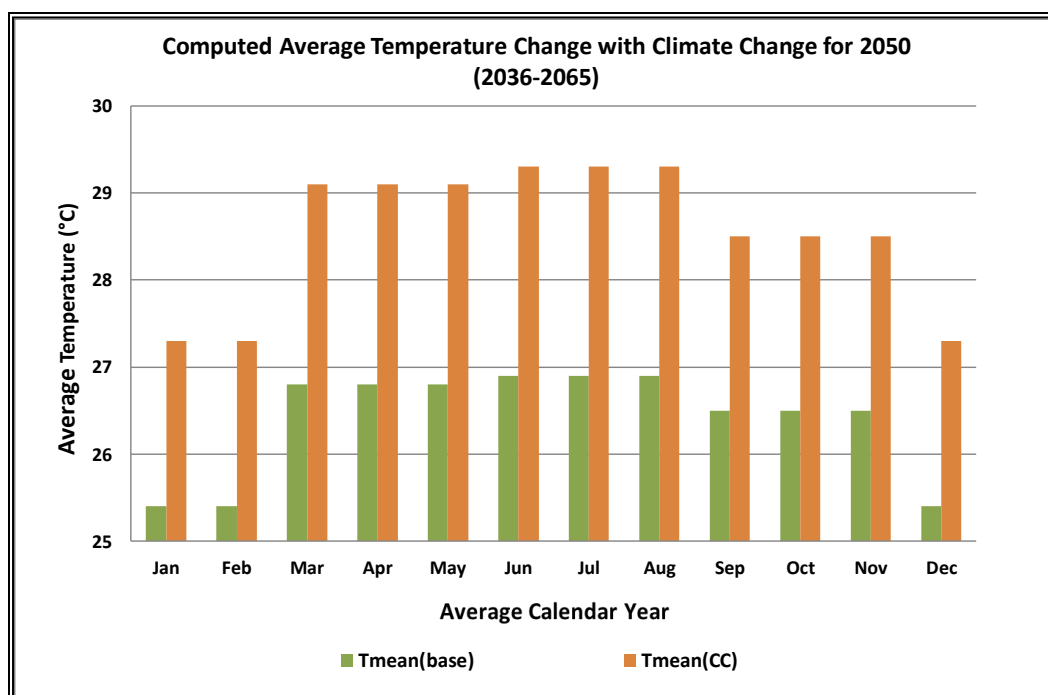


Figure 2.3.10: Change in Monthly Average Temperature for the Period 2036-2065

Rainfall Change

The seasonal rainfall change under medium range scenario showed a decrease and increase in 2020 and 2050 in the Province of Misamis Oriental presented in **Table 2.3.10**.

Table 2.3.10: Seasonal Rainfall Change (in %) in 2020 and 2050 under Medium Range Emission Scenario in the Province of Misamis Oriental

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
442.5	296.0	615.7	581.1	4.6	-10.4	-3.7	2.9	1.8	-17.8	-5.2	-0.1

The months of December to February and September to November has a projected rainfall increase of 4.6% and 2.9%, respectively while a 10.4% decrease for the months of March to May and 3.7% for the months of June to August in 2020. Similarly, the 2050 projection has an increase of 1.8% for the months of December to February, and a decrease of 17.8%, 5.25%, and 0.1% for the months of March to May, July to August; and September to November, respectively. These changes in the rainfall pattern will be included in the detailed engineering design of the Project. Design improvement of the internal drainage system will also be considered and prioritized to accommodate storm water run-off that will be collected in water harvesting facility of the plant based in the PAGASA projection.

Table 2.3.11: Projected Seasonal Mean Rainfall in 2020 and 2050 under Medium Range Emission Scenario in the Province of Misamis Oriental

Quarter	DJF	MAM	JJA	SON
Observed Baseline (1971-2000)				
Mean	442.5	296.0	615.7	581.1
With Climate Change Scenario (2006-2035)				
Mean	462.9	265.2	592.9	598.0
With Climate Change Scenario (2036-2065)				
Mean	450.5	243.3	583.7	580.5

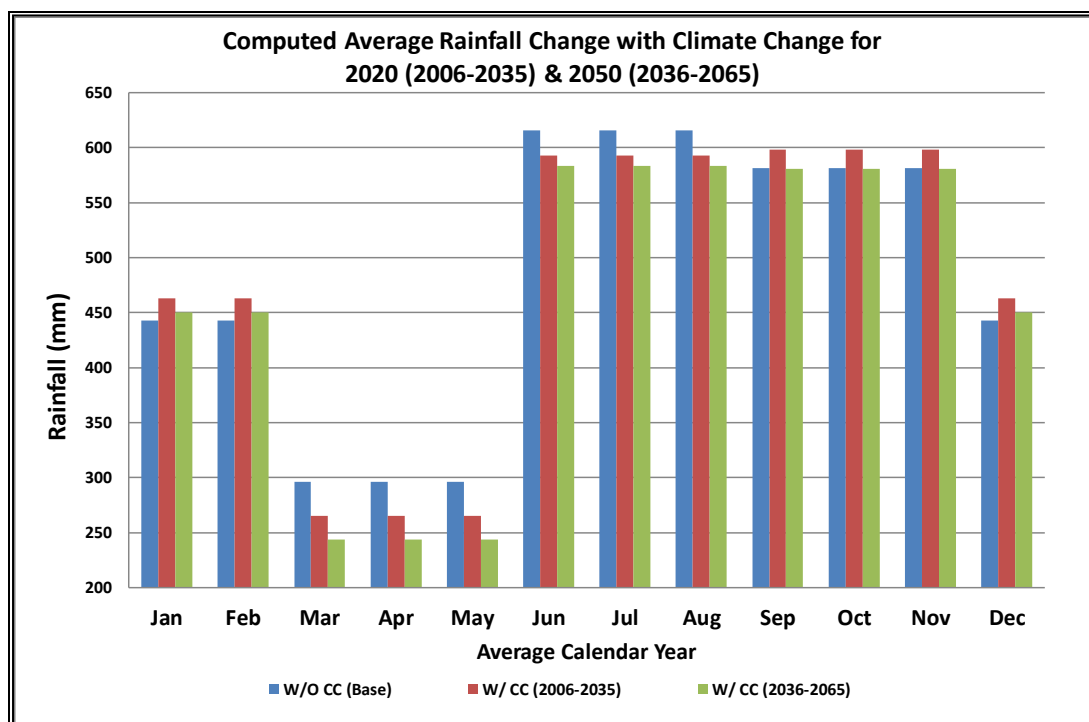


Figure 2.3.11: Projected Seasonal Mean Rainfall Change in 2020 and 2050

Frequency of Extreme Weather Events

Table 2.3.12 shows the projected occurrences of extreme weather events in Misamis Oriental under the medium-range scenario will have 2012 and 3759 days with extreme or maximum temperature greater than 35°C for 2020 and 2050, respectively while the number of dry days or days with rainfall less than 2.5 mm/day showed decreasing trend in 2020 while increasing in 2050. The number of days with daily rainfall greater than 200 mm will increase by 100% in 2020 and a decrease by 66% in 2050.

Table 2.3.12: Frequency of Extreme Events in 2020 and 2050 under Medium Range Emission Scenario in the Province of Misamis Oriental

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
Lumbia	106	2012	3759	6495	6290	6580	3	6	1

During construction, variations in climate will affect the schedule of construction works, potentially delaying the progress of construction. Consideration of effects of climate variabilities will mitigate the delays in the work schedule. 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.

The changes in the rainfall pattern and significant local temperature changes shall be included in the design criteria of the Project. Material selection 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. The selection of the

design temperature reflects an optimization of plant productivity, operational and capital costs based on historical conditions.

Design improvement of the internal drainage system will be considered to accommodate storm water run-off that will be collected in water the harvesting facility to be installed by the project based in the PAGASA projection.

2.3.2 Air Quality and Noise

2.3.2.3 Ambient Air Quality

An ambient air quality monitoring was conducted in five (5) sampling locations within the project site and its vicinity. Two (2) monitoring stations were identified for 24-hour averaging period while three (3) stations for 1-hour averaging period. These stations are located in the downwind and upwind of the prevailing wind direction of the project site. **Table 2.3.13** shows the description of the monitoring stations while the location is shown in **Figure 2.3.12**.

Although the project site is Type IV which rainfall is more or less evenly distributed throughout the year, monitoring was still conducted for wet season on July 6 to 8, 14 to 16 and 19 to 21, 2017 for wet season and on April 1-3, 2018 to represent dry season. The monitoring was conducted in accordance to the standard methods of the DENR as prescribed in its DAO No. 2000-81, the Implementing Rules and Regulations (IRR) of the Philippine Clean Act of 1999. The collected ambient air and noise data from the established stations will be used to represent the baseline data of the project. Parameters measured were TSP, PM₁₀, SO₂, and NO₂.

Ambient air samples are drawn through a glass fiber filter for TSP at a flow rate of 40 cubic feet per minute over a period of 24-hour averaging period. Calibrated high volume pumps were used to draw air sample into the sampling media to ensure collection of sufficient sample mass for analysis. The sampler flow rate and geometry of the shelter favor the collection of particles at aerodynamic diameter. Following sampling, filters were sent to AERONICS Inc. to analyze heavy metals (As, Cd, Cr, Hg, and Pb) collected at the TSP filter.

An EFRM Particulate Monitor sampler was used to collect PM₁₀ from ambient Air. The sampler is equipped with a specially shaped inlet cyclone where suspended particulate matter is inertially separated into one or more size fractions within the PM₁₀ size range. The sampler draws ambient air at constant flow rate of 16.7 L/min through a pre-weighed quartz fiber filter. Following sampling, filters were sent to Greentech Laboratory to analyze PM₁₀ gravimetrically. The concentrations of PM₁₀ in ambient air are computed as the mass of collected particles, measured gravimetrically and after moisture equilibrium divided by the total volume of air sampled, corrected to standard condition.

Air samples for sulfur dioxide and nitrogen dioxide were collected using midjet impinger trains consisting of two primary impinger tubes and one back up tube. The two primary impinger tubes, with an approximately 30 milliliter capacities were loaded by a suitable reagent reactive to the specific pollutant. Calibrated low-volume pumps (set at 0.5 liter/minute for 1-hour and 0.2 liter/minute for 24-hour sampling) were used to draw air through the impinger tubes and sample inlet nozzle is positioned at 1.5 meters above ground level. Impinger solutions were submitted to AERONICS, Inc. for analysis using Colorimetry; Pararosaniline Method for SO₂ and Griess-Saltzman Method for NO₂.

Table 2.3.13: Ambient Air Quality Monitoring Stations, Description and Coordinates of Sampling

Sampling Station	Description	Coordinates	
		Easting (m)	Northing (m)
AAQ-1	Beside the covered court of Brgy. Sta. Cruz, Tagoloan, Misamis Oriental	694636.79	944992.27 m

Sampling Station	Description	Coordinates	
		Easting (m)	Northing (m)
AAQ-2	Brgy. Dayawan Volleyball court, near Don Fernando Jacinto Elementary School	695760.12	947939.42
AAQ-3	Inside the compound of Sta. Ana National High School, 50 meters from the main gate	697659.45	943955.85
AAQ-4	Beside the house of Lolo Raldizo at Brgy. Balwarte Sto. Nino, Tagoloan, Misamis Oriental (Residential Area)	692098.31	944990.18
AAQ-5	In Front of the house of Vice Mayor of Poblacion, Villanueva, Misamis Oriental (Residential Area)	695455.41	949252.83
AAQ-6	Balacanas Elementary School, Villanueva Misamis Oriental	8°33'48.58"N	124°45'17.70"E
AAQ-7	Dense residential area of Brgy. San Martin, Villanueva Misamis Oriental	8°33'43.72"N	124°46'12.24"E
AAQ-8	Residential area in Brgy. Sta. Cruz, Tagoloan, Misamis Oriental	8°32'53.99"N	124°45'56.85"E

The monitoring results of ambient air quality monitoring were compared with the National Ambient Air Quality Standard for Source Specific Air Pollutants (NAAQSSAP) provided in the PCAA of 1999 for 1-hour averaging period. On the other hand, the 24-hour sampling results was compared with the National Ambient Air Quality Guideline Value (NAAQGV).

Table 2.3.14: Relevant Guideline Values for Ambient Air Quality

Pollutant	Averaging Period	NAAQGV ($\mu\text{g}/\text{m}^3$)	NAAQSSAP ($\mu\text{g}/\text{m}^3$)
SO ₂	1-hour	-	340
	24-hour	180	-
NO ₂	1-hour	-	260
	24-hour	150	-
TSP	1-hour	-	300
	24-hour	230	-
PM ₁₀	1-hour	-	200
	24-hour	150	-



Figure 2.3.12: Map of Ambient Air Quality Monitoring Station

Tables 2.3.15 and 2.3.16 present the results of air quality monitoring for 24-hour and hourly averaging period conducted on August 9-12, 2016 at the Project site and its vicinity. The results show the concentrations of particulates (TSP and PM₁₀), SO₂, and NO₂ for 24-hour averaging period are all below the CAA limit of 230 µg/Ncm for TSP; 150 µg/Ncm for PM₁₀; 150 µg/Ncm for NO₂; and 180 µg/Ncm for SO₂. All samples collected for hourly averaging time in all stations were also below the CAA limit of 300 µg/Ncm for TSP, 200 µg/Ncm for PM₁₀, 260 µg/Ncm for NO₂, and 340µg/Ncm for SO₂. The heavy metals concentrations are below the method detection limit in all air sampling stations.

Table 2.3.15: Results of 24-hour Ambient Air Quality Monitoring

Items	Description/Values		
	AAQ-1; Oct. 29-30, 2018 0955H-0955H	AAQ-2; Oct. 30-31, 2018 1050H-1050H	CAA Limit (µg/Ncm)
PM ₁₀ , (µg/Ncm)	43.80	35.34	150
SO ₂ , (µg/Ncm)	131	136	180
NO ₂ , (µg/Ncm)	6	16	150
As, (µg/Ncm)	<0.04	<0.04	-
Cd, (µg/Ncm)	<0.01	<0.01	-
Cr+6, (µg/Ncm)	<0.01	<0.01	-
Cu, (µg/Ncm)	<0.4	<0.4	-
Fe, (µg/Ncm)	0.4653	0.7636	-
Hg, (µg/Ncm)	0.1025	<0.004	-
Pb, (µg/Ncm)	<0.10	<0.10	-

Table 2.3.16: Results of Hourly Monitoring

Parameter	Description/Values						CAA Limit (µg/Ncm)
	AAQ-3	AAQ-4	AAQ-5	AAQ-6	AAQ-7	AAQ-8	
PM ₁₀ , (µg/Ncm)	52.16	53.58	38.16	29	27	22	200
SO ₂ , (µg/Ncm)	104	126	18	<1	<1	<1	340
NO ₂ , (µg/Ncm)	18	7	12	<0.3	<0.3	<0.3	260
CO (µg/Ncm)				<1	<1	<1	10

2.3.2.4 Degradation of Ambient Air Quality during Pre-Construction and Construction Phases

Due to the nature of construction process, emissions will not be constant and will fluctuate based on operating periods and the combination equipment to be used at any one time. Intensive construction activities will not be generally carried out at night time. 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;
- Earthworks including excavation activities;
- Site clearance including removal of topsoil at the construction site;
- Construction site's generation of dust from construction materials, waste, loose earth, and moving excavated material and transporting wastes on vehicles;
- Use of diesel-based construction machineries which may cause huge air quality impacts; and
- Loading and unloading of construction materials.

Dust Generation

Maximum construction activities have the potential to generate dust. The expansion of impacts from dust will depend on the location of construction activities and types of vehicles. Weather also plays an important factor for dust generation. Stronger winds and dry condition will increase the transfer of dust, whereas damp or wet conditions will reduce the impact.

Transportation of earth and establishment of the material will involve use of heavy machinery like compactors, rollers, water tankers, and dumpers. This activity is machinery intensive resulting in dust generation. However, this activity will only be short-term and the air pollution during construction is localized and only around the project site only.

The following are the proposed mitigating measures:

- Minimize alteration of topography and removal of vegetation to lessens earthworks;
- Conduct regular cleaning and clearing of construction access /sites and the surfaces of spoils and debris from construction equipment and vehicles and wetting of ground soil in the construction site when necessary;
- Store excavated materials at designated disposal area. Stock pile construction and trucks loaded with spoils shall be covered;
- Undertake daily cleaning of paved routes around the construction sites;
- Control vehicle movement maintaining the speed limit within the construction site to <10kp;
- Store excavated materials outside road reserve, but where there is no area, spoils shall be loaded and transported immediately; and
- Plant vegetation on bare ground as early as possible and create vegetated buffer zone where possible.

Exhaust Generation

Transportation of construction materials and excavated soil by trucks that use diesel for fuel will cause impacts on ambient air quality. Operation of construction machine will cause exhaust gas emissions. However, the air quality impacts associated with the vehicular and operational equipment emissions during construction activities will be less significant as the construction period will be short term. The proposed mitigating measures are as follows:

- Undertake regular preventive maintenance of heavy equipment, machineries and service vehicles to meet the DENR Emission Standards. Wherever possible, use electrically-powered equipment;
- Minimize vehicle transport by maximizing the use of site-generated materials.

Air quality will be monitored at identified baseline sampling point including nearby sensitive receptors (residential, school and hospital areas) and ecologically significant area/s (if any) likely to be affected by the operation and evaluate effectiveness of the air pollution reduction measures. Monitor actions on complaints, if any, based on Grievance Redress Mechanism.

2.3.2.5 Degradation of Ambient Air Quality during Operation Phase

Steel Rolling Mill

The proposed rolling mill furnace will utilize oil as its primary fuel. The fuel oil will be burned in the re-heating furnace unit in turn releases air pollutants which will cause significant impact on the environment. The criteria pollutants emitted from the furnace operation are total suspended particulates (TSP & PM₁₀), sulfur oxides (SO_x), nitrogen oxides (NO_x), and carbon monoxide (CO).

The arrangement of burners in the reheat furnace is “top and bottom fired” type. They are arranged to provide the most efficient heat transfer to the billets; with lowest possible fuel

consumption and the best temperature uniformity for the stock. By using sophisticated computer and programmable logic controllers, all billets are subject to predetermined heating profile to achieve the most optimized temperature at the discharging end of the reheat furnace. The eventual billet temperature is 1150-1250°C before being discharged for rolling. Due to sophisticated fuel/air ratio control within the system, emissions from the combustion are kept to below the national regulation limits. Low sulfur fuel oil is used to achieve lower than national limits of SO_x. The burners are designed for low NO_x emission. There is no ozone resulted from the combustion process.

Waste gases are ducted to the chimney via a heat-exchanger called recuperator. The recuperator provides additional heat salvaged from the waste gas to heat up ambient air for combustion. Typical combustion air temperature can be raised to around 300 to 350°C; enabling major energy savings as compared to traditional billet reheat furnaces presently exist in the country. The chimney will be of steel construction, lined with heat insulating refractory. The chimney height will be more than 50m high, so that emissions concentration can be kept negligible surrounding the plant.

Steel Melting Shop

The proposed light and heavy-duty melt shop will use Electric Arc Furnace (EAF) in melting scrap which is the most appropriate steelmaking route to produce quality steel. The EAF makes use of electric arcs that emit extremely high heat at 6000°C in the furnace. The intense heat is sufficient to melt any steel scrap brought into contact. The continuous striking of the arcs melts all the scrap, and the bath temperature is steadily brought to around 1600°C, ready for tapping. Structure of the EAF is shown below. High electrical power is connected to a set of 3-graphite electrodes suspended from above the furnace. The furnace is a refractory-lined vessel that holds measured quantity of scrap or molten steel. The graphite electrode mast is controlled up and down the furnace so that predetermined arc currents will flow when in contact with the scrap.

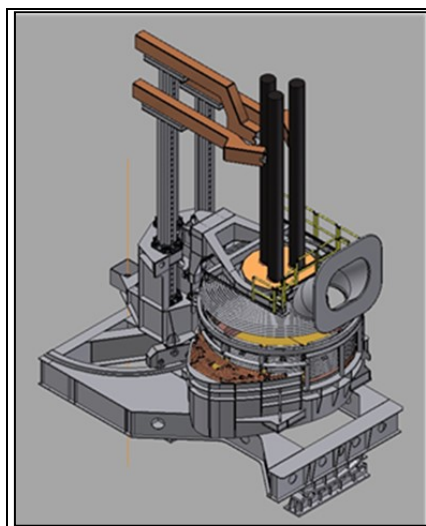


Figure 2.3.13: EAF Structure

A waste heat recovery system makes use of the waste heat to preheat the in-feeding scrap so that it attains around 500 to 600°C before being charged into the furnace. The feeding system is specially constructed to divert the hot waste gases from the EAF to heat the scrap before being ducted to the fume treatment plant (FES). Benefiting from the scrap preheating system, electrical energy consumption can be reduced to 350kW-hours per ton of liquid steel. The FES is adequately sized to provide sufficient suction and to handle the dust being collected from the process. Hot gas is drafted from the EAF through the scrap preheater at flow rate more than

300,000 Nm³/hr. Thereafter, the flue gas flows into a combustion chamber for complete oxidation of the remaining combustibles. Larger particulates are settled at this station. The gas is further drafted to a heat exchanger to cool the temperature down to below 140°C, before going into the baghouse for dust removal. In the baghouse, the gas is distributed into a series of long filter bags. Dust particles gather at one side of the filter and clean gas passes through the filter medium. Gas velocity is controlled at around 1 meter per second to allow for maximum capture. **Figure 2.3.14** is the typical dedusting using a series of filter bag house. The filter baghouse is equipped with louvers where particulates (TSP and PM₁₀) are emitted.

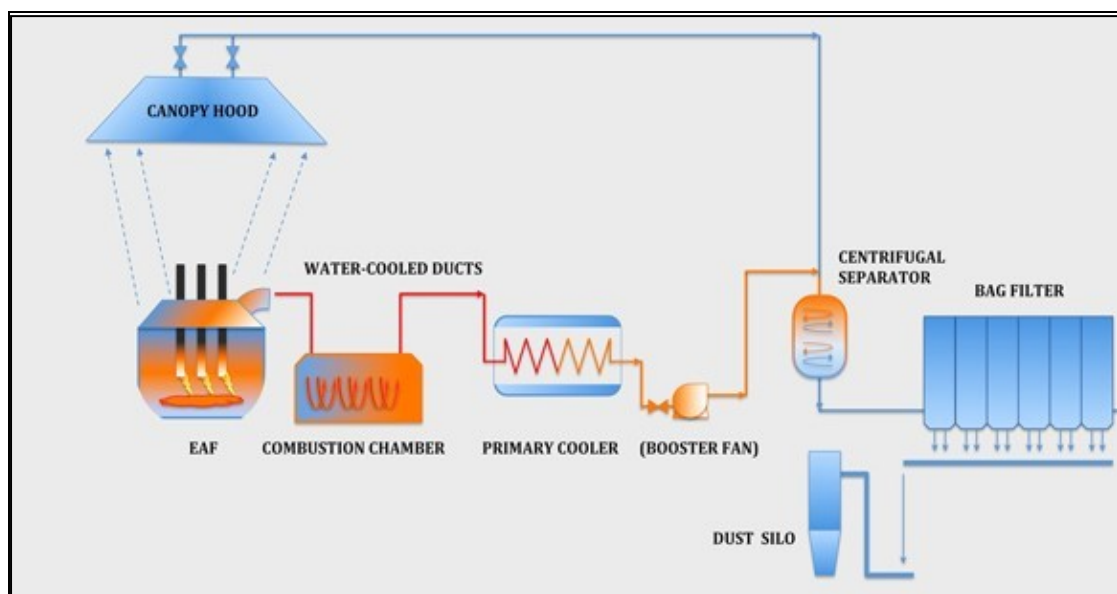


Figure 2.3.14: Typical EAF Dedusting Using a Series of Filter Baghouse

Emission Assessment of Criteria Pollutants

The Environmental Management Bureau, Memorandum Circular 2008-03 “Guidelines for Air Dispersion Modeling” uses a tiered approach in assessing air contaminants concentrations against the Clean Air Act (CAA of 1999) air quality guidelines and standard. The tiered approach follows the United States Environmental Protection Agency (USEPA) that includes:

- Screening-level dispersion modeling techniques conducted using worst-case input data rather than site-specific data; and
- Refined level dispersion modeling techniques conducted using site specific meteorological data or derived regional meteorological data.

A fundamental assumption of the tiered approach to model selection is that the simpler modeling techniques always yielded more conservative results. It is assumed that screening level models would always predict higher ground-level concentrations than refined modelling techniques, and that the refined models would predict higher impacts than the ‘best-estimate’ models.

Modeling Approach for this Study

AERMOD software was used to assess and determine air quality impact due to the emissions of criteria pollutants from the project operation. AERMOD is a steady-state Gaussian dispersion model useful for the assessment of different ambient air pollutants concentration from different emission sources (Area, line and point). This incorporates dispersion of air pollutants based on planetary boundary layer turbulence structure and scaling concepts and applicable for both simple and complex terrain. The model is composed of three domains: AERMOD Meteorological Preprocessor (AERMET), AERMOD Terrain Preprocessor (AERMAP) and

AERMOD Gaussian Plume Model with the PBL modules. The AERMET processes hourly surface and upper meteorological data. These meteorological inputs for AERMET were used to calculate boundary layer parameters, such as the Monin-Obukhov length, convective velocity scale, temperature scale, mixing height, and surface heat flux. The second module, AERMAP, is used for processing the terrain data in conjunction with a layout of receptors and emission sources to be used for the AERMOD input files

AERMOD was run using the 3-year (2016 to 2018) meteorological data from PAGASA El Salvador Station located in El Salvador City, Misamis Oriental to simulate the effects of time- and space-varying meteorological conditions on pollutant transport, transformation and removal. Dispersion modeling domain is maximized to 11km x 11km with uniform Cartesian grid of 500m interval for the whole modeling domain with a fine grid resolution of 200m extending to 6km from the center of rolling mill smokestack. The discrete Cartesian receptors were defined within the modeling domain to identify areas of maximum predicted concentrations. **Figure 2.3.15** show the modeling domain.

Plot Plan

The sources subject for this modeling is the proposed section mill reheating furnace flue stack and the melt shop filter baghouse stack that release particulates (TSP & PM₁₀). Aside from particulate emissions from reheating furnace, it also emits sulfur oxides, nitrogen oxides, and carbon monoxide which is included in this air modeling exercise. **Figure 2.3.16** is the general plant lay-out of the facility showing the location of the emission source.

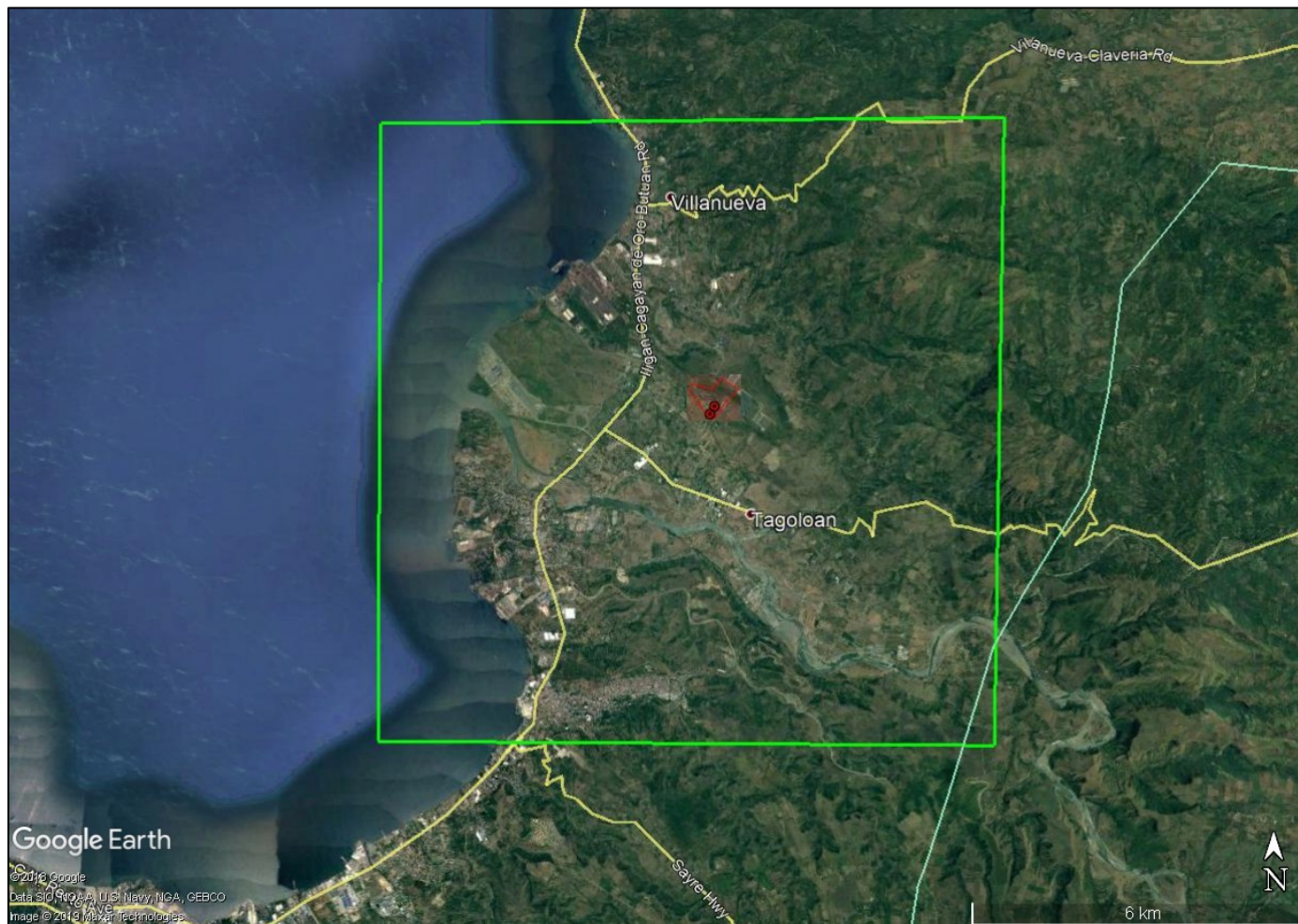


Figure 2.3.15: Modeling Domain (11km x 11km)

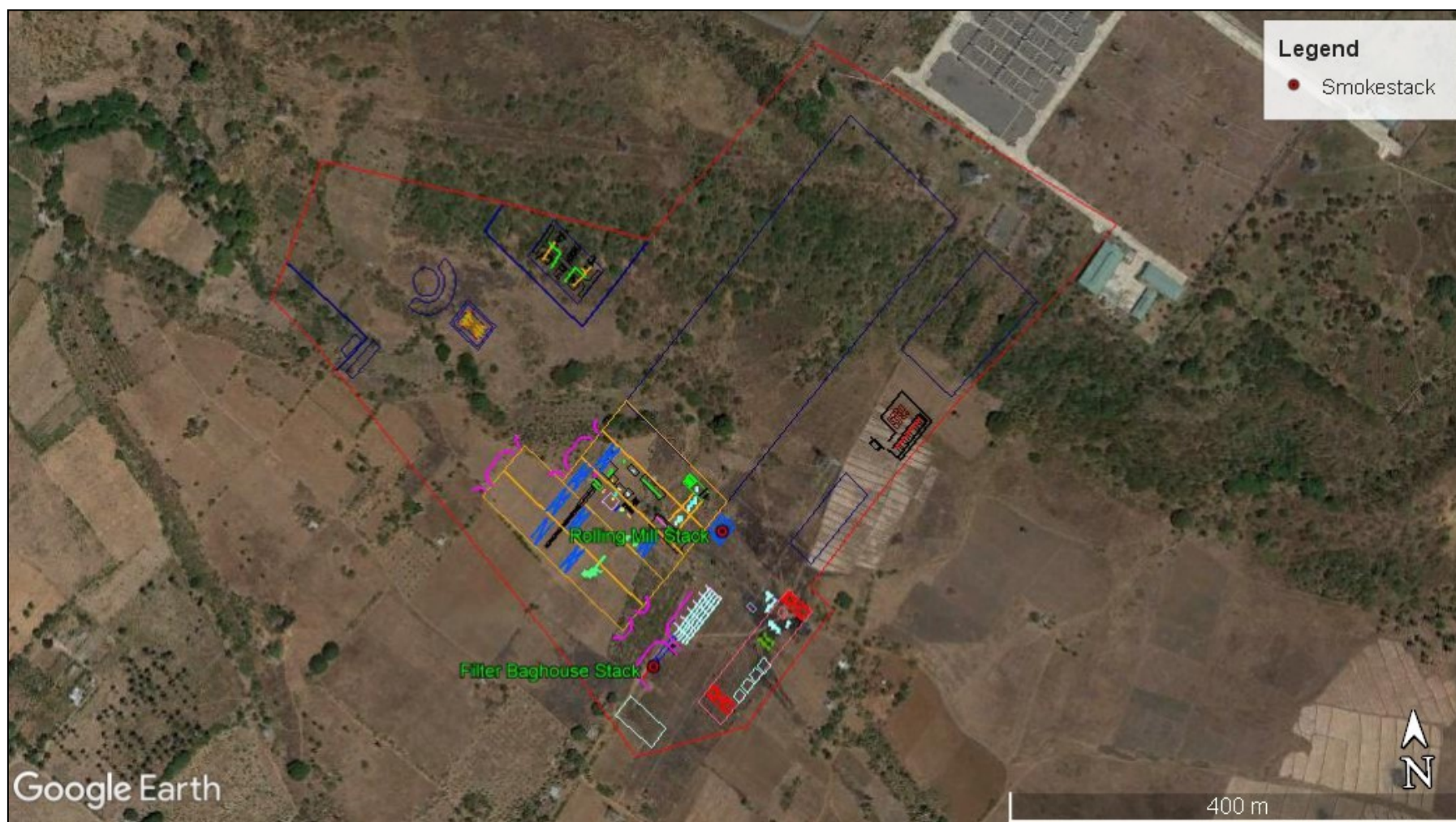


Figure 2.3.16: General Plant Layout

Air Sensitive Receptors

Air sensitive receptors (ASRs) such as residences, schools and hospitals were identified within the modeling domain. The description, distance from the source, and geographical coordinates of these receptors are presented in **Table 2.3.17**. The relative location of the ASRs is shown in **Figure 2.3.17**.

Table 2.3.17: Description of the ASRs

Station	Description	Distance from the source (m)	Direction from the source	Coordinates	
				Easting (m)	Northing (m)
ASR-1	Bugo Barangay Hall, Barangay Bugo Cagayan de Oro City	5909	SW	693171.95	940833.96
ASR-2	Bugo National High School, Barangay Bugo Cagayan de Oro City	5563	SW	693899.73	940782.55
ASR-3	Philippine Southfield School, Barangay Bugo Cagayan de Oro	4951	SSW	694822.00	940991.81
ASR-4	Suntingon Elementary School, Barangay Bugo Cagayan de Oro City	4834	SSW	695114.65	940988.85
ASR-5	Casinglot National High School, Barangay Casinglot Tagoloan	5222	SW	692976.05	941950.47
ASR-6	Villa Rosario Subdivision, Barangay Casinglot Tagoloan	4206	SW	693636.09	942733.29
ASR-7	Gracia Elementary School, Barangay Subongcogon Tagoloan	4501	SW	692957.44	943152.98
ASR-8	Subongcogon Barangay Hall, Barangay Subongcogon Tagoloan	5021	SW	692380.44	943126.47
ASR-9	Tagoloan Central School, Barangay Poblacion Tagoloan	3839	WSW	693192.24	944152.11
ASR-10	Tagoloan National High School, Barangay Poblacion Tagoloan	4427	WSW	692430.64	944489.51
ASR-11	Baluarte Elementary School, Barangay Baluarte Tagoloan	5065	WSW	691763.89	944767.28
ASR-12	TESDA 10 Regional Training Center, Barangay Sta Cruz Tagoloan	2719	WSW	694059.37	945193.71
ASR-13	Mohon Elementary School, Barangay Mohon Tagoloan	1356	SW	695841.08	944552.76
ASR-14	Santa Ana National High School, Barangay Santa Ana Tagoloan	1850	SSE	697668.35	943941.08
ASR-15	Santa Ana Elementary School, Barangay Santa Ana Tagoloan	2342	SE	698525.06	944008.23
ASR-16	Residential Area, Purok 2 Buntong, Barangay Santa Ana Tagoloan	2637	SSE	697884.06	943182.35
ASR-17	Santa Cruz Elementary School, Barangay Santa Ana Tagoloan	2131	WSW	694678.78	945118.12
ASR-18	Residential Area, Barangay Santa Cruz Tagoloan	905	WSW	695883.53	945274.53
ASR-19	Residential Area, Barangay Santa Cruz Tagoloan	2277	WNW	694723.38	946534.11
ASR-20	PNP Provincial Headquarters, Barangay San Martin Villanueva	2434	NW	695125.29	947313.55
ASR-21	Residential Area, Barangay Katipunan Villanueva	2570	NNW	695328.20	947659.07
ASR-22	San Roque Village, Barangay Katipunan Villanueva	2391	NNW	695920.61	947742.26
ASR-23	Residential Area, Barangay Dayawan Villanueva	2375	N	696627.41	947877.00
ASR-24	Residential Area Barangay Katipunan Villanueva	3183	NNW	695543.24	948475.17
ASR-25	Residential Area Barangay Poblacion 1 Villanueva	4065	NW	694746.73	949040.89
ASR-26	Vicente N. Chavez Memorial Central School Barangay Poblacion 2 Villanueva	4237	NNW	694956.85	949363.24

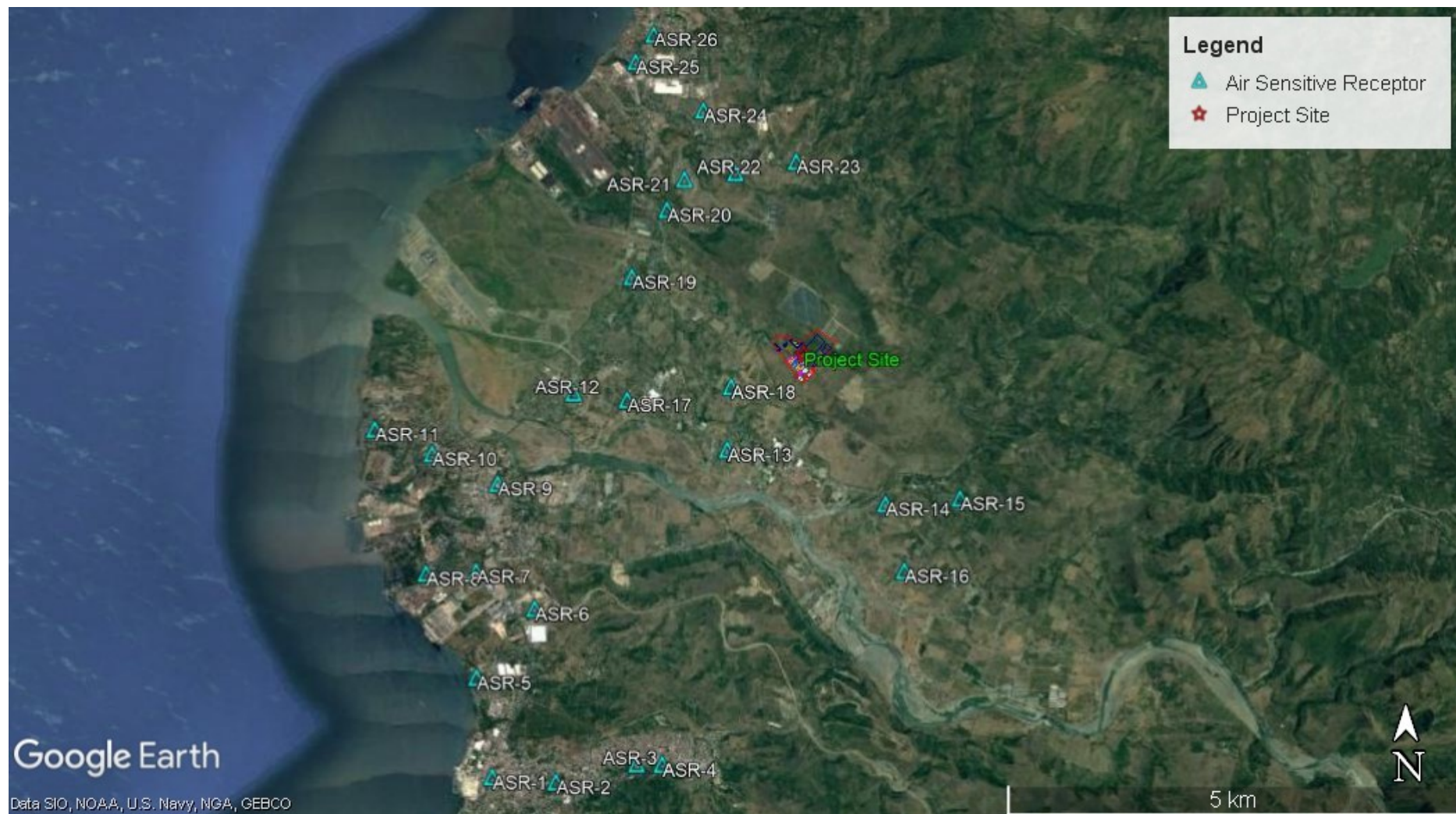


Figure 2.3.17: Location of Air Sensitive Receptors

Emission Sources and Rates

The source subject for this modeling is the particulate and gaseous emissions from the proposed melting furnace and reheating furnace flue stack. The scenario considered is under normal operating condition. The emission rates used in the modeling for each parameter are provided in **Table 2.3.18**. Emission rate for each parameters of the reheating furnace are calculated based on the United States Environmental Protection Agency (USEPA) AP-42, 12th Edition. AP-42 is a compilation of air pollutant emission factors developed by the USEPA.

Below is the general equation in calculating emissions from USEPA AP 42, 12th Edition.

$$E = A \times EF \times (1 - (ER/100))$$

Where:

E = emissions

A = activity rate

EF = emission factor

ER = overall emission reduction efficiency

The estimated fuel consumption of the reheating furnace based on the design is 34,800,000 L/yr or 9,193,189 gal/yr of heavy fuel oil (Bunker C). Presented in **Table 2.3.18** are the emission factors and the calculated emission rate of the furnace. Assumption used in the calculation is the worst-case scenario where the plant will operate for 24 hours a day, 7-day per week, and 365 days per year. Other parameters in calculating emissions such as stack temperature, stack gas velocity, and dry volumetric flow rate are extracted from the source emission testing report of San Martin Steel Plant conducted by AERONICS Inc. on April 2, 2018.

Table 2.3.18: Emission Factor (Bunker C Fuel Oil)

Parameters	Emission Factor, (lbs./10 ³ gal burned)
Particulate Matter	10
Sulfur Dioxide	33.6(S)
Nitrogen Oxide	55
Carbon Monoxide	5

Source: USEPA AP 42, 12th Edition, Criteria Pollutant Emission Factors for Fuel oil Combustion

Example calculation for PM:

$$\begin{aligned} \text{Emission} &= 9,193,189 \text{ gal/yr} \times 10 \text{ lbs/10}^3 \text{ gal of fuel burned} \\ &= 41.70 \text{ tons/yr or } 1.41 \text{ g/s} \end{aligned}$$

Table 2.3.19: Summary of Source Parameters

Parameter	Unit	Proposed (Medium Mill) Furnace Flue Stack	Proposed (Heavy Meltshop) Filter Baghouse Flue Stack
Coordinates			
Easting (x)	m	269593.46	270196.63
Northing (y)	m	1538473.44	1538529.05
Elevation (z)	m	6.7	7.13
Operating hours	h/yr	8220	8220
Flue gas velocity	m/s	6.8	1
Flue gas exit temperature	°C	330	120
Stack height above the ground	m	75	30
Stack exit diameter	m	2	3

Parameter	Unit	Proposed (Medium Mill) Furnace Flue Stack	Proposed (Heavy Meltshop) Filter Baghouse Flue Stack
Pollutant Emission Rate			
SO ₂	g/s	4.954	-
NO ₂	g/s	3.538	-
CO	g/s	3.538	-
PM	g/s	1.062	0.707
PM ₁₀ ^a	g/s	0.913	0.608

Source: Steel Asia Corporation: EIA Study for Steel Asia High Street, 2017
 Note: a - PM₁₀ assumed to be 86% of PM: Source: Atmospheric Environment;
 Relationship between sizes segregated mass concentration, January 1999

Modeling Results

The maximum predicted ground level concentrations from the normal operation of the proposed reheating and melting furnace using PAGASA El Salvador Station meteorological data from the period January 1, 2016 – December 31, 2018 is shown in **Table 2.3.20**. In this modeling analysis, the results exclude natural background levels and the contribution of other sources. The model shows that the project impacts on the short-term and long-term ambient air quality concentrations would be well within the guideline values for the protection of environment and community living within the project vicinity.

Table 2.3.20: Summary of Modeling Results

Parameters	Averaging Period	Maximum Predicted GLC, (µg/Ncm)	Location of Highest Predicted Concentration		CAA Limit, (µg/Ncm)
			X, (m)	Y, (m)	
CO ^a	1-hour	0.03107	697777.00	946212.06	35
	8-hour	0.02009	696856.11	948957.47	10
NO ₂	1-hour	31.07	696656.11	948957.47	260
	24-hour	14.13	696277.00	948957.47	150
SO ₂	1-hour	43.50	696656.11	949157.47	340
	24-hour	19.79	696277.00	951212.47	180
TSP	1-hour	16.76	696277.00	950712.06	300
	24-hour	12.42	696656.11	950712.06	230
PM ₁₀	1-hour	14.41	696277.00	950712.47	200
	24-hour	10.68	696656.11	947357.47	150

Note: a – mg/Ncm

Modeling Results for 1-hour and 8-hour Averaging Period

The spatial distribution of predicted CO concentration for 1-hour and 8-hour averaging period shows that the most common concentrations is less than 5.0 µg/Nm³ and 1.0 µg/Nm³, respectively. On the other hand, the 1-hour averaging period for NO₂, SO₂, TSP and PM₁₀ are less than 1.0 µg/Nm³; 1.0 µg/Nm³; 0.5 µg/Nm³; and 0.3 µg/Nm³; respectively.

No exceedances of the relevant National Ambient Air Quality for Source Specific Air Pollutants (NAAQSSAP) and National Ambient Air Quality Guideline Values (NAQGV) are predicted by the modeling for the five (5) modeled pollutants (SO₂, NO₂, CO, TSP, and PM₁₀) in the whole modeling domain and in any of the 26 ASRs for 1-hour and 8-hour averaging period (**Table 2.3.20**).

The highest predicted concentration of CO for 1-hour and 8-hour averaging period is 0.03107 µg/Nm³ and 0.02009 µg/Nm³, respectively. The highest predicted concentration of NO₂, SO₂, TSP, and PM₁₀ for 1-hour averaging period is 31.07 µg/Nm³; 43.50 µg/Nm³; 16.76 µg/Nm³; and 14.41 µg/Nm³, respectively and is located at approximately 2.9km north of the proposed smokestack.

The hotspot areas based on the modeling isopleth are some communities and residential areas of Barangay San Martin, Villanueva at approximately 1.5km extending to 3.0km east, east-northeast, and north-northeast of the smokestack. The isopleth also shows a minimal impact in some areas of Barangays Katipunan and Poblacion in Villanueva.

The contour in **Figures 2.3.18 to 2.3.22** show that impacts on all pollutants from the operation of the Project is greatest in the north followed by north-northeast and east of the Project site.

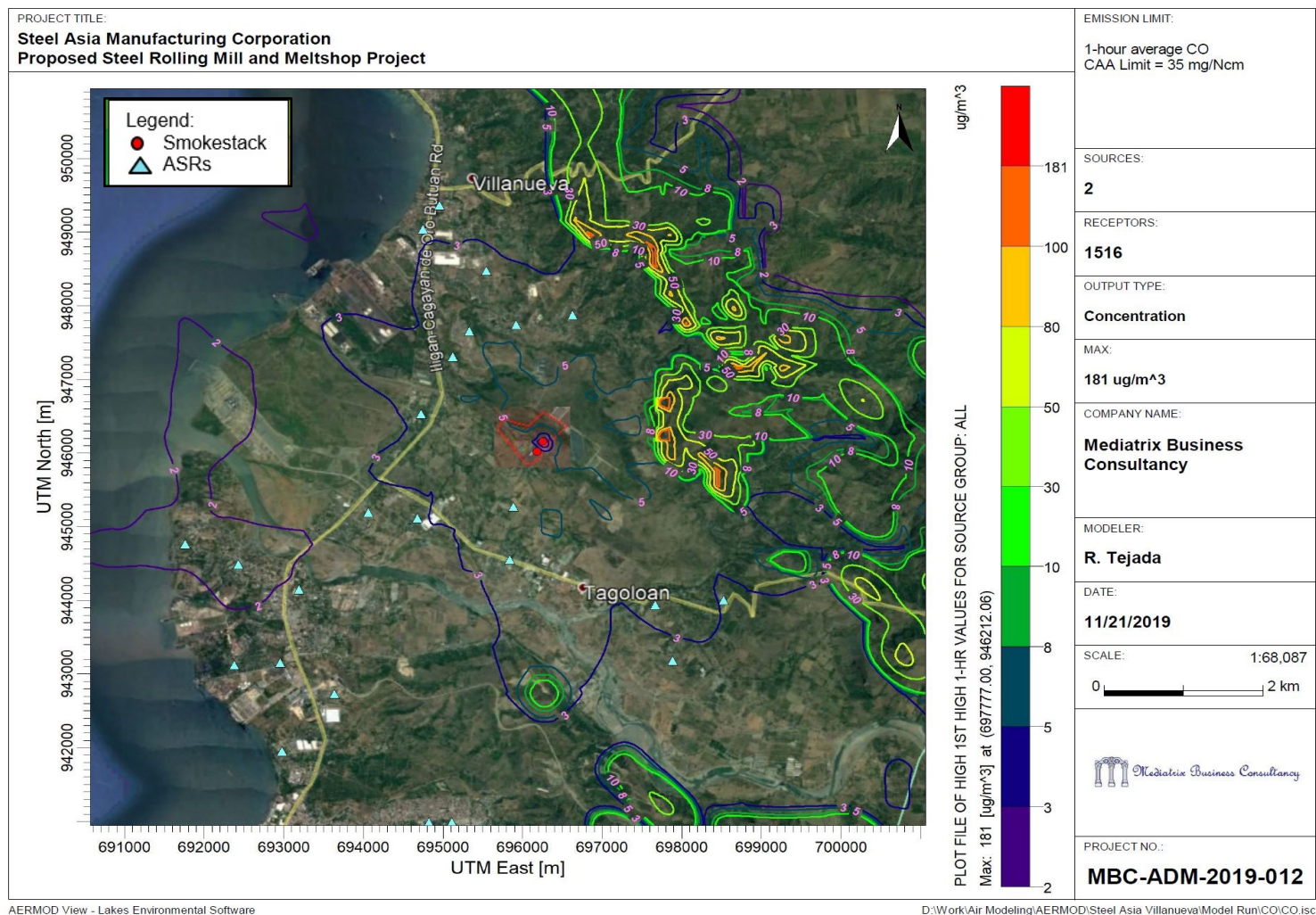


Figure 2.3.18: Highest 1-hour Average CO Concentration for the Modeled Year January 1, 2016 – December 31, 2018

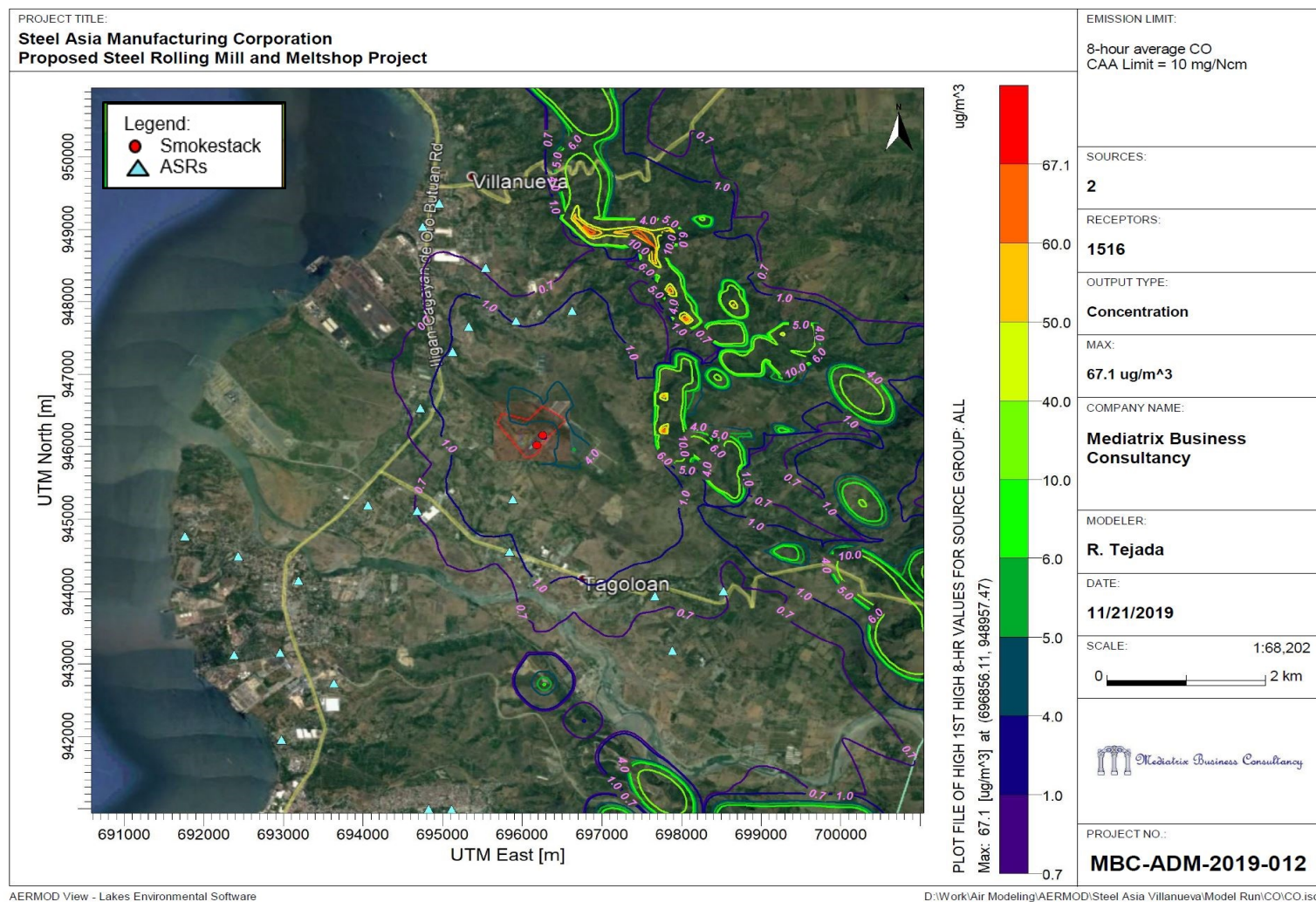


Figure 2.3.19: Highest 8-hour Average CO Concentration for the Modeled Year January 1, 2016 – December 31, 2018

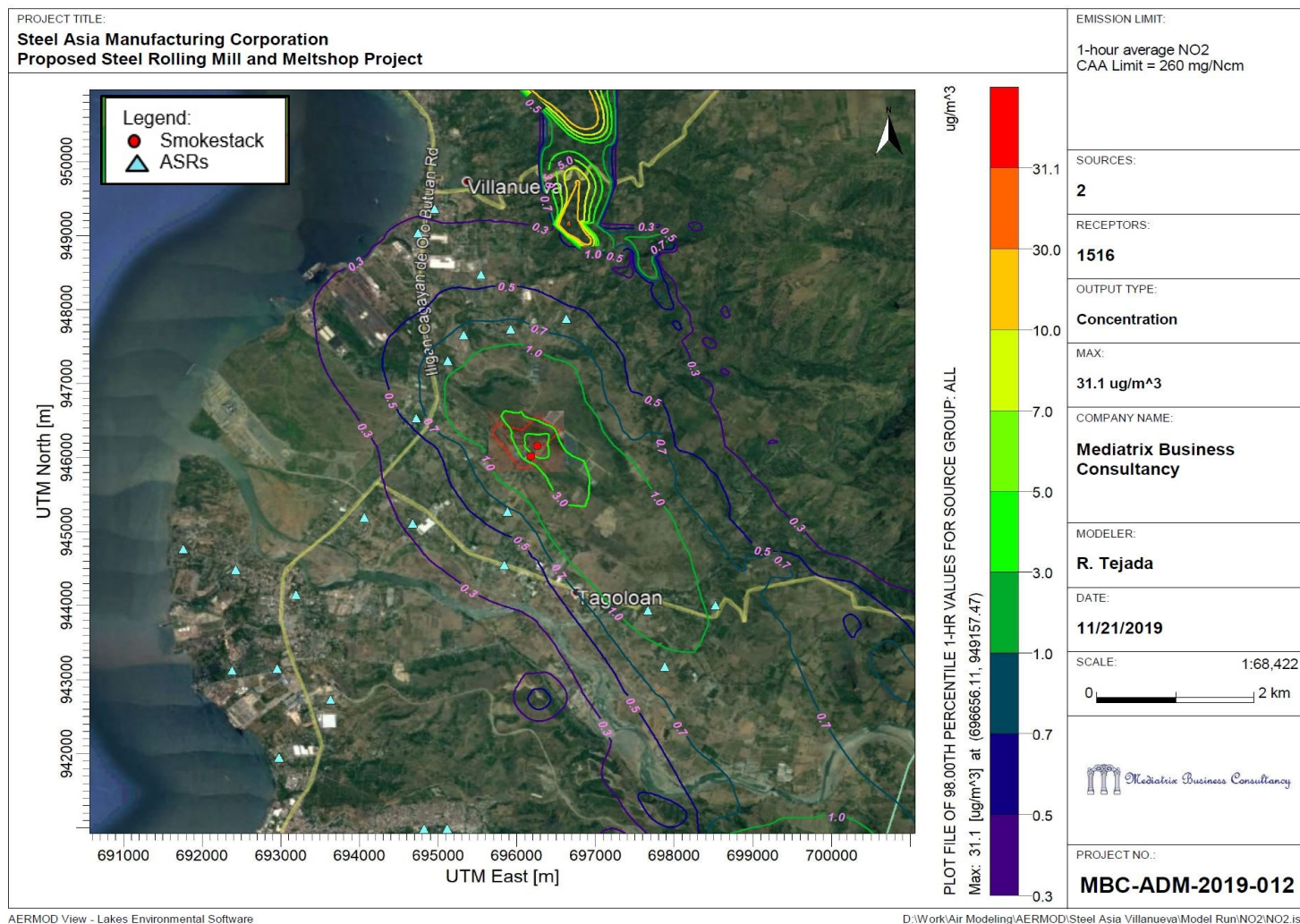


Figure 2.3.20: Highest 1-hour Average NO₂ Concentration for the Modeled Year January 1, 2016 – December 31, 2018

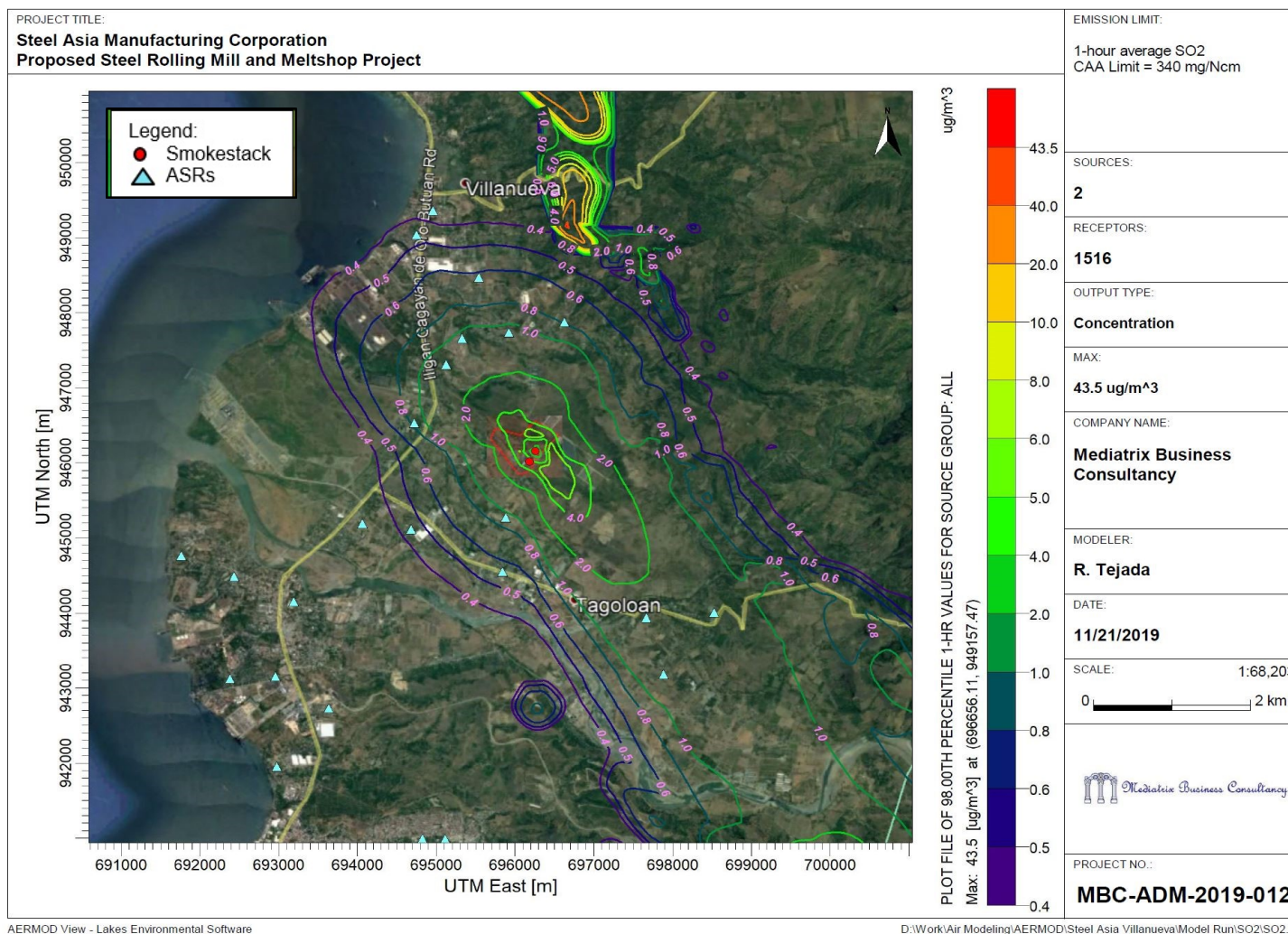


Figure 2.3.21: Highest 1-hour Average SO₂ Concentration for the Modeled Year January 1, 2016 – December 31, 2018

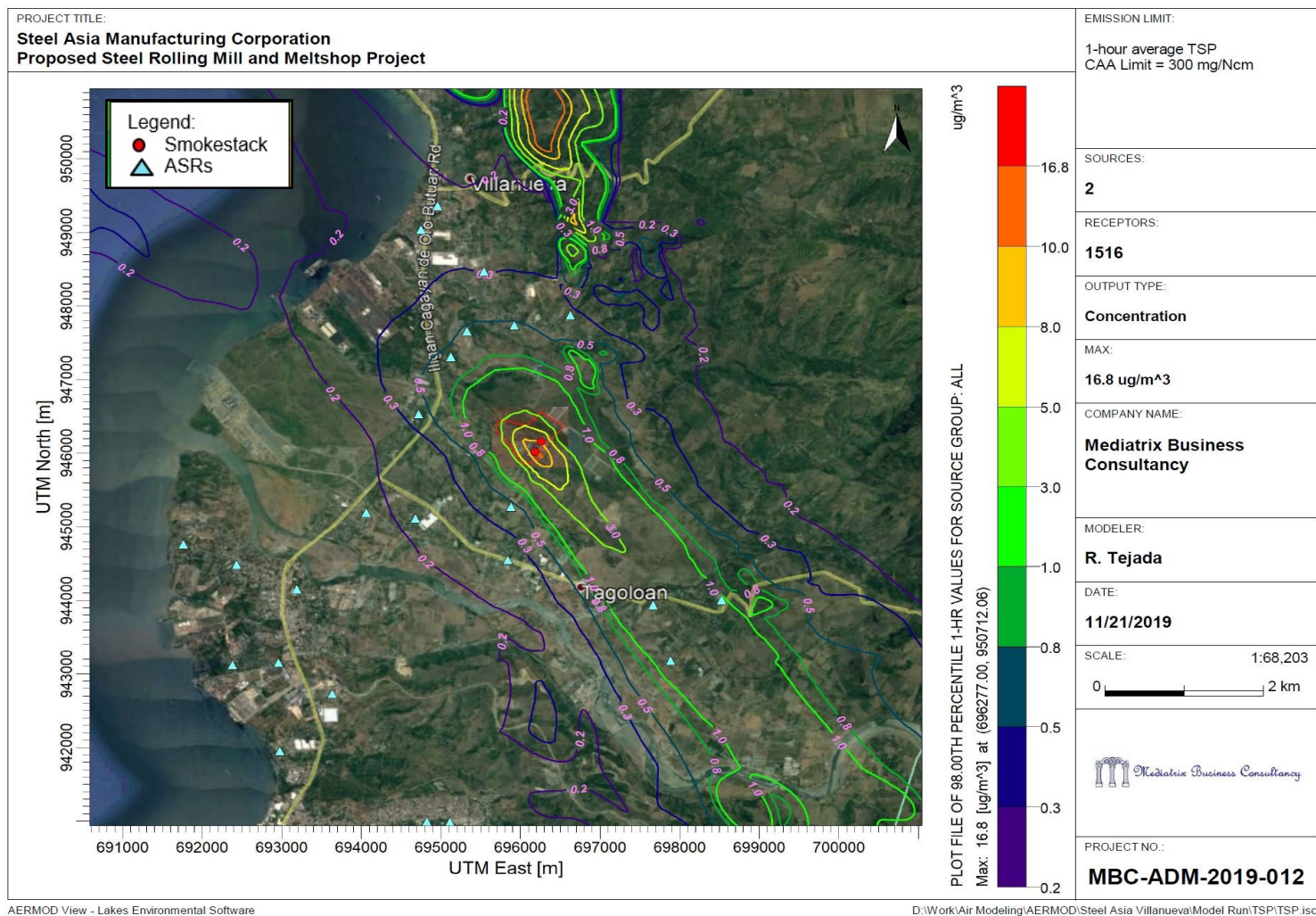


Figure 2.3.22: Highest 1-hour Average TSP Concentration for the Modeled Year January 1, 2016 – December 31, 2018

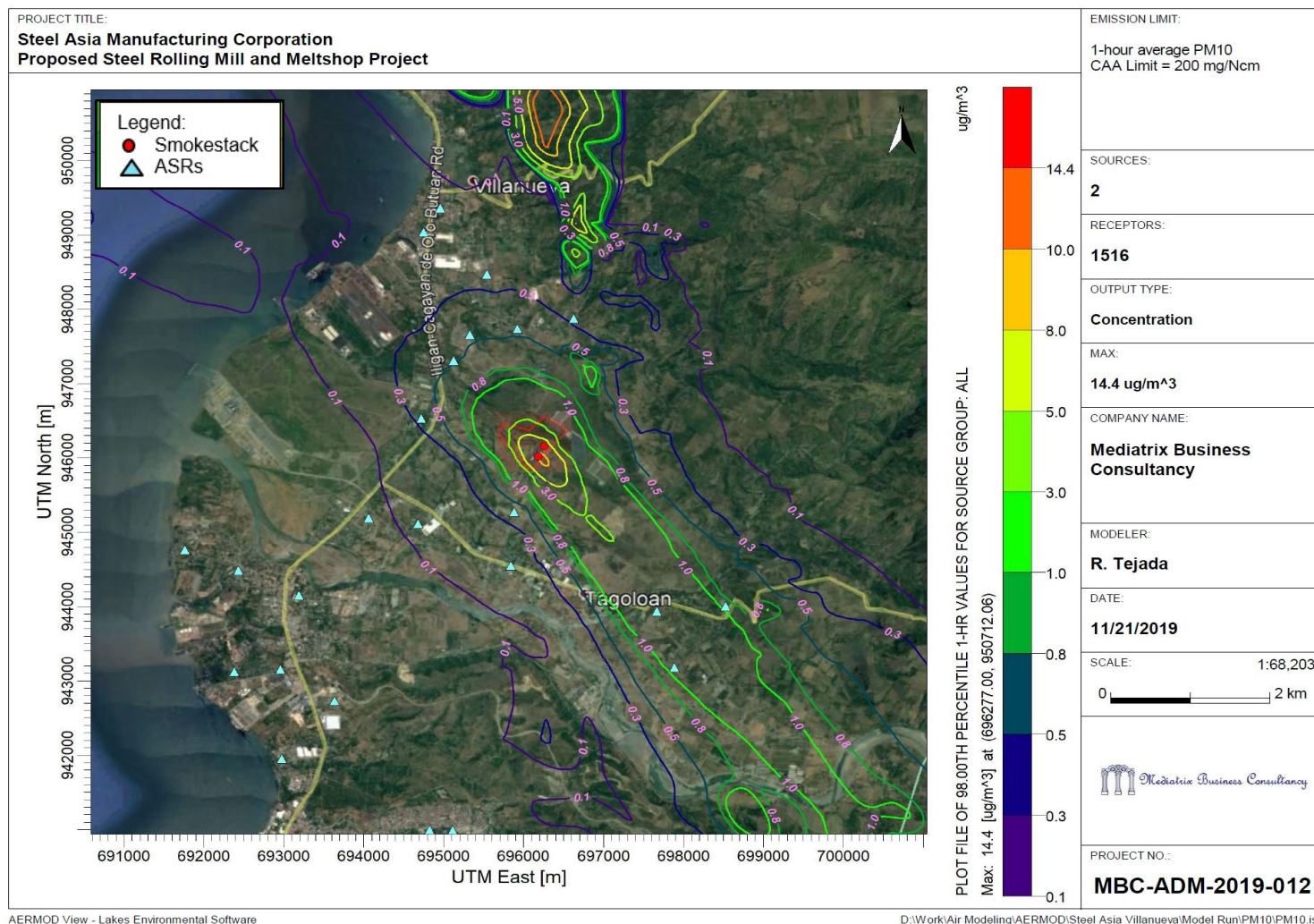


Figure 2.3.23: Highest 1-hour Average PM₁₀ Concentration for the Modeled Year January 1, 2016 – December 31, 2018

Modeling Results for 24-hour Averaging Period

The spatial distribution of predicted NO₂, SO₂, TSP and PM₁₀ concentrations for 24-hour averaging period shows that the most common concentrations are less than 0.50 µg/Nm³; 0.50 µg/Nm³; 0.30 µg/Nm³; and 0.50 µg/Nm³; respectively.

No exceedances of the relevant NAAQGV values are predicted by the modeling for the four (4) modeled parameters (NO₂, SO₂, TSP and PM₁₀) in the whole modeling domain and in any of the 26 air sensitive receptors for 24-hour averaging period (**Table 2.3.20**).

The highest predicted concentrations of NO₂, SO₂, TSP and PM₁₀ for 24-hour averaging period is 14.13 µg/Nm³; 19.75 µg/Nm³; 12.42 µg/Nm³; and 10.68 µg/Nm³, respectively and is located at approximately 4.6km north of the proposed smokestack.

The hotspot areas based on the modeling isopleth are some communities and residential area of Barangay Poblacion, Villanueva at approximately 3km extending to 3.5km north of the proposed smokestack. The isopleth also shows a minimal impact in some areas of Barangay Katipunan, Barangay San Martin, upper portion of Barangay Mohon and Barangay Sta Ana.

The contour in **Figures 2.3.24 to 2.3.27** generally show that impacts on all pollutants from the operation of the Project is greatest in the north of the Project site.

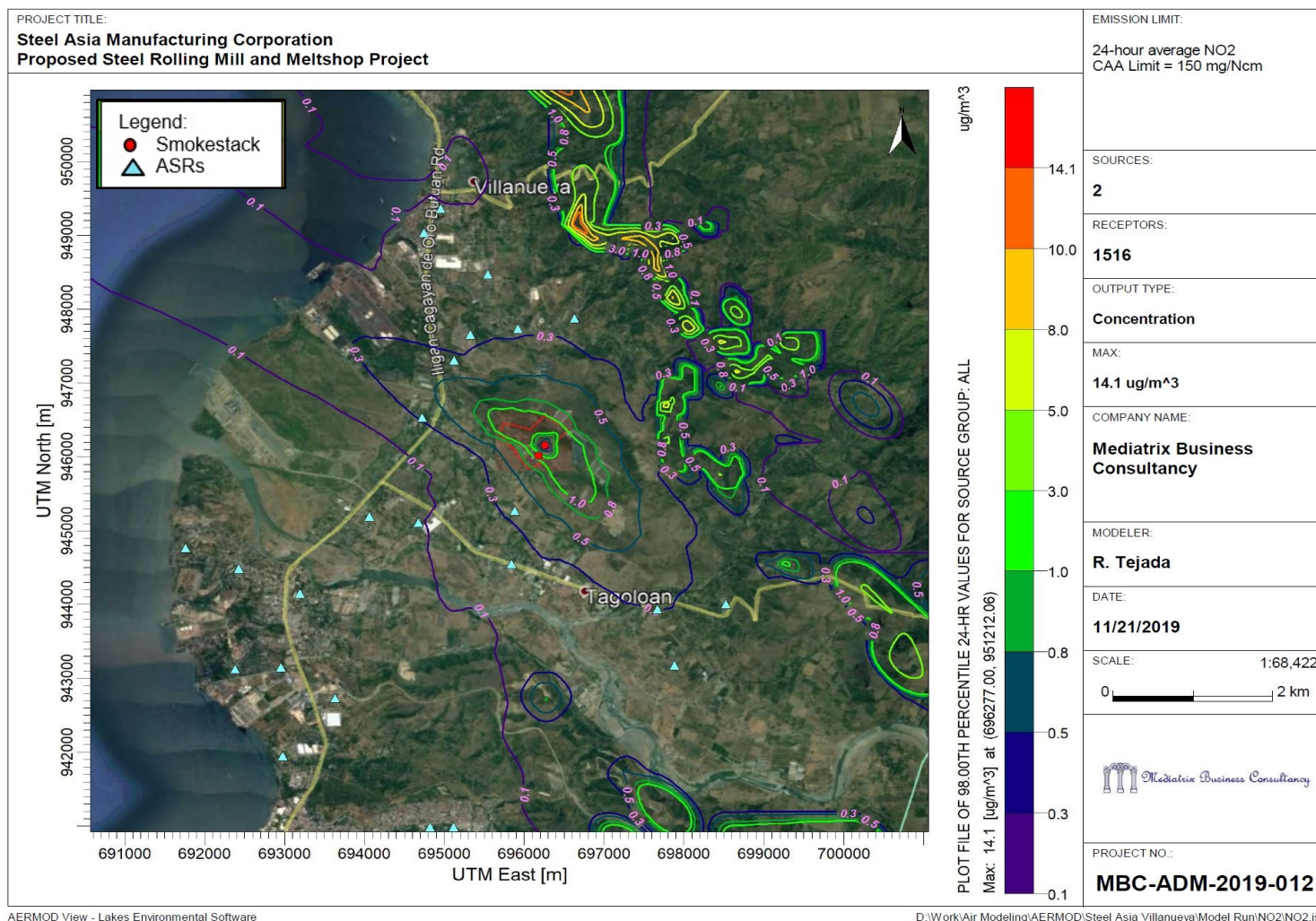


Figure 2.3.24: Highest 24-hour Average NO₂ Concentration for the Modeled Year January 1, 2016 – December 31, 2018

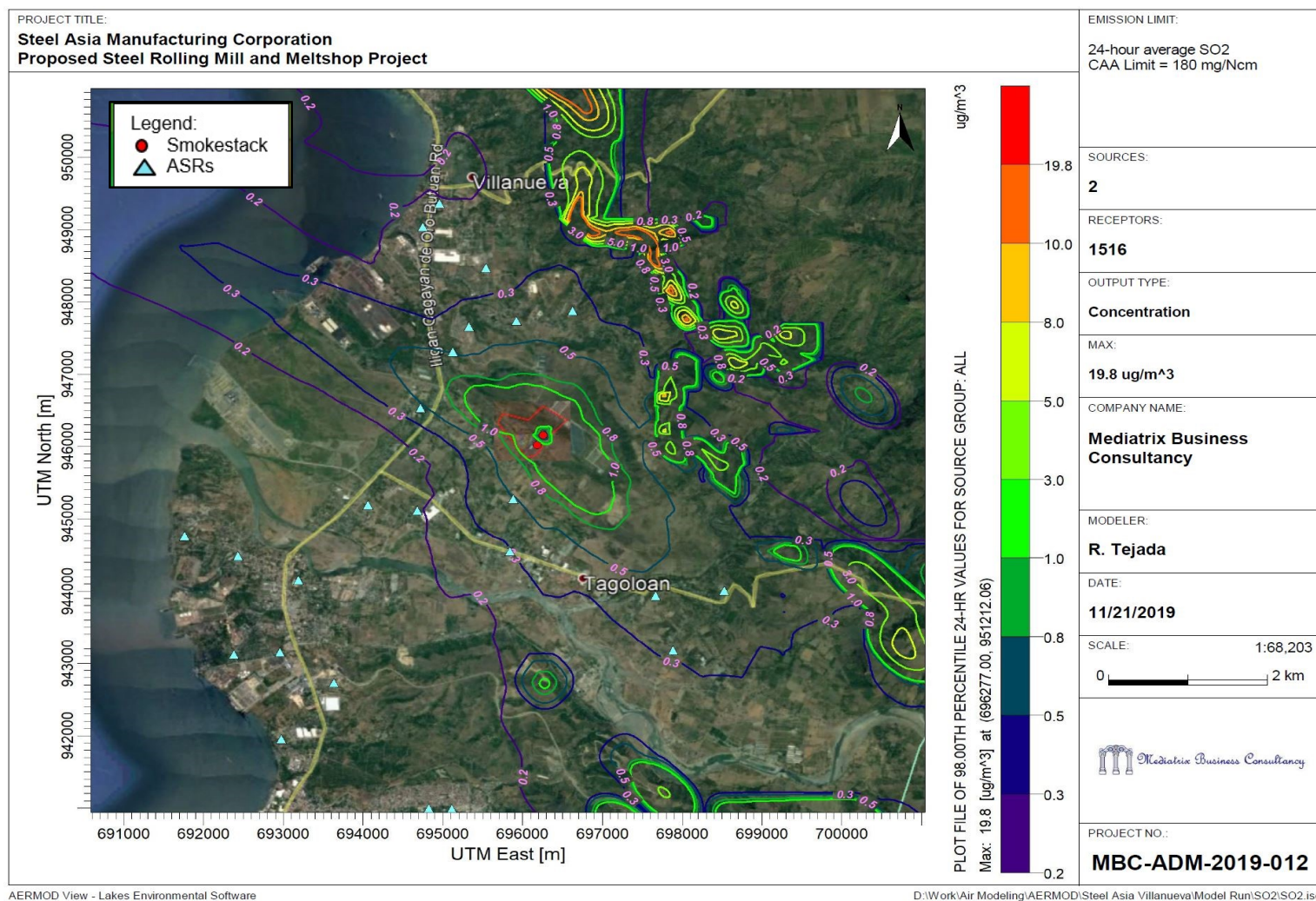


Figure 2.3.25: Highest 24-hour Average SO₂ Concentration for the Modeled Year January 1, 2016 – December 31, 2018

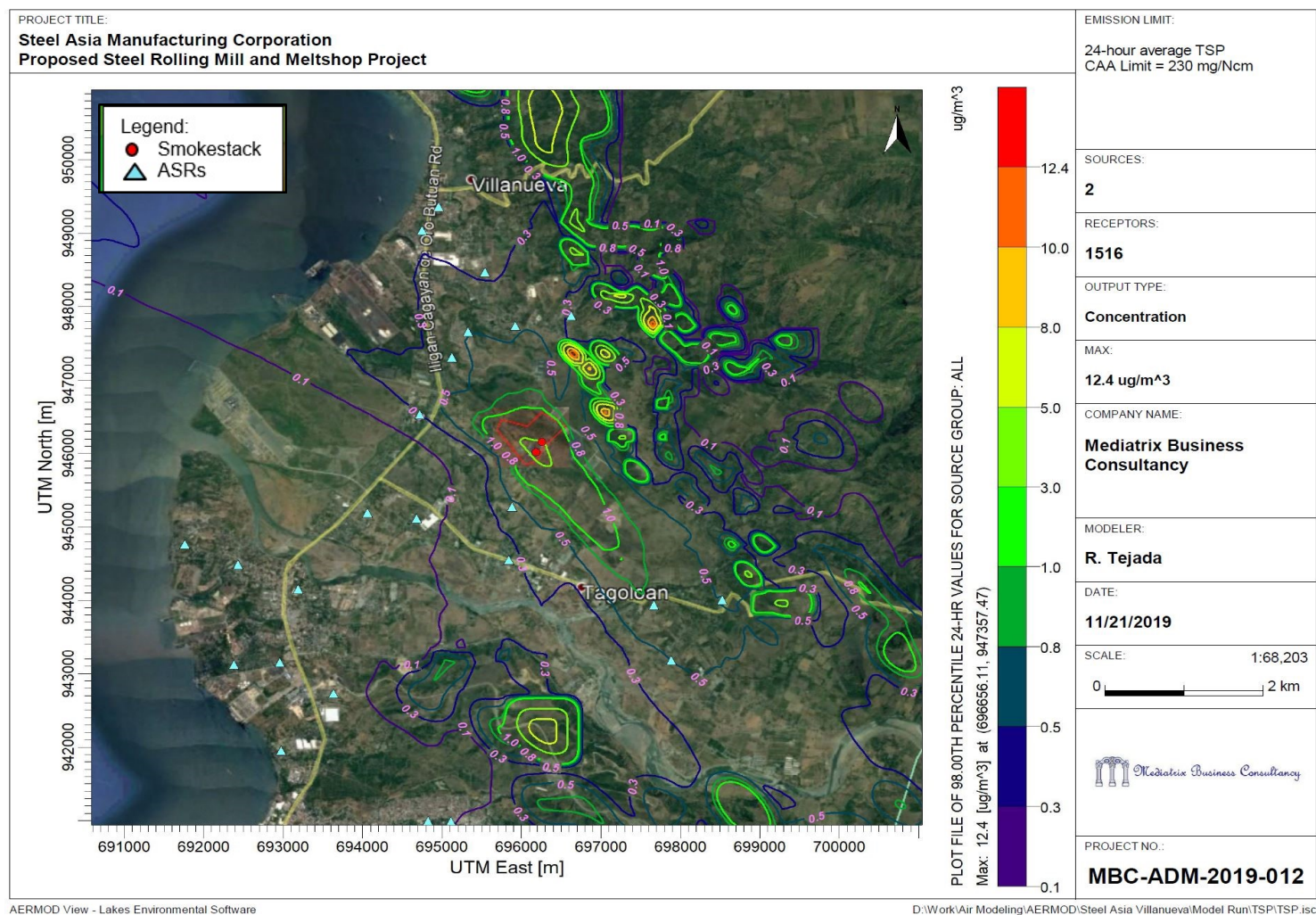


Figure 2.3.26: Highest 24-hour Average TSP Concentration for the Modeled Year January 1, 2016 – December 31, 2018

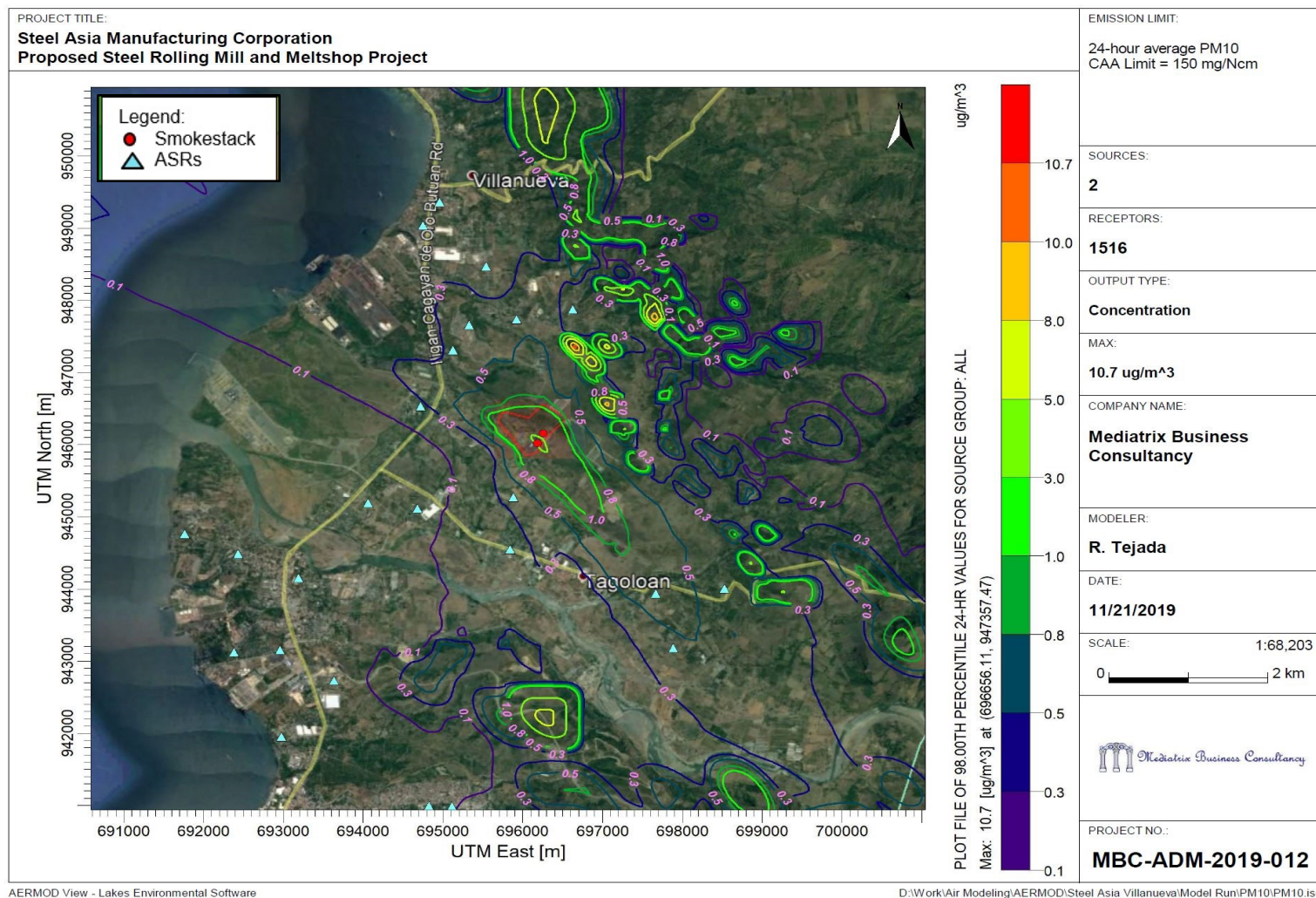


Figure 2.3.27: Highest 24-hour Average PM₁₀ Concentration for the Modeled Year January 1, 2016 – December 31, 2018

Management and Mitigation Measures

The following mitigation and control measures are presented in detail to establish the capabilities of each equipment to lessen, control and prevent emission of criteria pollutants into the receiving environment.

Low NO_x Burner

The Project will use Low NO_x Burners (LNB) in the furnace to reduce the amount of NO_x emission. LNB limit NO_x formation by controlling the stoichiometric and temperature profiles of the combustion process in each burner zone. The unique design of features of an LNB may create: (i) reduced oxygen level in the combustion zone to limit fuel NO_x formation; (ii) a reduced flame temperature that limits thermal NO_x formation; and/or (iii) a reduced residence time at peak temperature which also limits thermal NO_x formation.

Recuperator System

The Project will utilize recuperator system in the proposed furnace. A recuperator is a special purpose counter flow energy recovery heat exchanger positioned within the supply and exhaust air streams of an air handling system in order to recover the waste heat. The system needs to install because it provides benefits on energy saving, fuel and time during operation. It will also reduce emissions of gases pollutants such as CO₂, SO₂ and other gases emissions formed during the combustion of fossil fuel.

Emission Monitoring System

The furnace flue stack will be provided with a complete set of emission monitoring system. The basis for the installation of monitoring system will be the DAO 2007-22 "Guidelines on the requirements for continuous emission monitoring systems and other acceptable protocols, thereby modifying and clarifying certain provisions of Section 5, Rule X of DAO 2000-81 and other related provisions".

Section 3 of DAO 2007-22 states that a) new and modified sources with potential to emit at least 750 tons per year for each applicable pollutant listed in Section 4, Rule IX of DAO 2000-81 must install CEMS for that parameter; b) all sources with potential to emit more than 100 tons per year but less than 750 tons after the air pollution control installation may utilize a PEMS.

In this regard, the plant's utilization of emission monitoring system either CEMS or PEMS will depend on the results of actual source emission testing to be conducted once the plant is in operation. The result of the actual source testing will determine if the plant's emission rate will have exceeded the 750 tons/year of any regulated pollutants for the installation of CEMS or below the 750 tons/year but more than 100 tons/year of any regulated pollutants for the installation of PEMS.

Ambient Air Quality Monitoring

Ambient air quality during operation phase will be monitored at identified baseline sampling point including nearby sensitive receptors (residential, school and hospital areas) and ecologically significant area/s (if any) likely to be affected by the operation and evaluate effectiveness of the air pollution reduction measures.

2.3.2.6 Noise Quality

The main sources of noise and vibration will be the equipment during construction and vehicle operations. There will be a short-term noise that will be created by the operations of the construction equipment. This equipment may consist of earth moving machines such as, graders, trucks, scrapers, generators and compressors.

Noise level measurement was conducted in the same five (5) sampling locations for ambient air quality sampling as presented in **Table 2.3.12** and **Figure 2.3.12**. The measured noise level from the established stations is used to represent the baseline data of the project.

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 2.3.21**.

Table 2.3.21: Noise Standard in General Areas

Class	Maximum Allowable Noise Level, (dB)		
	Daytime	Morning/Evening	Nighttime
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

The noise monitoring results have found to be within the limit of 55 dBA for daytime; 50 dBA for morning/evening; and 45 dBA for nighttime. The results are within the standard although significant noise was contributed by vehicles plying along the road near the stations, especially those stations which were situated in populated communities, with houses close to each other. Motorcycles and tricycles were main modes of transportation particularly for communities situated in small municipalities, aside from cars, bus and trucks passing along the main highway.

Table 2.3.22: Results of Noise Levels Measurement

Station	Period	Date	Time	Median SPL dB(A)	DENR Noise Standard dB(A)
STN-1	Morning	Oct. 29, 2018	0830H-0845H	49.2	50
	Daytime	Oct. 29, 2018	1450H-1505H	53.3	55
	Evening	Oct. 29, 2018	2000H-2015H	50.2	50
	Nighttime	Oct. 30, 2018	0010H-0025H	44.8	45
STN-2	Morning	Oct. 30, 2018	0820H-0835H	49.0	50
	Daytime	Oct. 30, 2018	1500H-1515H	52.0	55
	Evening	Oct. 30, 2018	1910H-1925H	49.1	50
	Nighttime	Oct. 31, 2018	0020H-0035H	43.0	45
STN-3	Daytime	Oct. 31, 2018	1650H-1705H	41.3	45
STN-4	Daytime	Oct. 31, 2018	1320H-1335H	48.7	50
STN-5	Daytime	Oct. 31, 2018	1235H-1250H	49.7	50

2.3.2.7 Increase in Noise Level during Construction Phase

During construction phase, noise will be generated by the construction equipment and earth moving activities. Initially, vegetation in the area is graded or cut using chainsaws and mowers. Trucks are used to haul away material that cannot be stockpiled or disposed on-site and to bring in necessary construction materials. Typical construction vehicles include bucket trucks, cranes or digger derricks, backhoes, pulling machines, pole trailers, or dumpsters. Foundation structures are constructed using a standard drill rig to bore a hole to the required depth. If water is encountered, pumps will be used to move the water to either adjacent low land areas or to waiting tanker trucks for proper disposal. After the construction is completed, the project area is graded up to the desired level and cleaned up.

All of these operations produce noise that may impact adjacent communities/residential areas within the immediate vicinity of the project. However, normal work schedules usually restrict noise producing activities to daytime hours.

The power mechanical equipment and its equivalent sound power levels are presented in **Table 2.3.23**. The equipment listed in the table is the typical equipment used during construction. As a worst-case scenario for this modeling, it is assumed that all equipment listed is running at the same time during construction. The predicted noise measurement for construction activities were determined by summing logarithmically the sound power levels. Since there is no EMB published noise modeling guidelines and procedures, the computation used are based on international technical guidelines and procedures.

This assessment was carried out based upon the preliminary estimates of likely construction activities, plant selection and utilization. In the absence of reference, the noise data for individual items of construction equipment (in terms of source Sound Power Level (PWL) was taken from Hong Kong Environmental Protection Department's "Technical Memorandum on Noise from Construction Work other than Percussive Piling and Technical Memorandum of Noise from Percussive Piling."

An inventory of typical equipment items expected to be used during the construction phase and their indicative sound power levels are presented below.

Table 2.3.23: Equivalent PWL of Power Mechanical Equipment during Construction Phase

Power Mechanical Equipment	PWL, dB(A)
Jackhammer	104
Chipping gun	93
Air compressor	96
Bulldozer	89
Lejeune gun	89
Backhoe	86
Forklift	85
Hand hammer	85
Welding torch	84
Chopsaw	80
Truck	78
Heavy-duty bulldozer	99
Vibrating road roller	97
Crawler crane <35 ton Non-insulated cab	94
Laborers	90
Power shovel	88
Shop work	95
Rubber tired crane, <35 ton Insulated cab	81
Truck-mounted crane	79

Power Mechanical Equipment	PWL, dB(A)
Tower crane	74
Dozer	102
Paver	90
Front-end loader	90
Roller	98
Heavy equipment	90
Gravel plant	102
Crane	99

Source: Neitzel, R., N. Seixas, M. Yost, and J. Camp., 1998

From the above table, the total estimated sound power level for all construction equipment is 109.8 dB(A). To depict the worst-case condition, it is assumed that all construction equipment listed in the table above are working at the same time.

The total power level considers 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. Construction activities are predicted to be its worst-case scenario where 24-hour operation is expected.

Noise Prediction

Noise prediction for construction activities in the Project was derived using CUSTIC 2.0 modeling software. CUSTIC 2.0 is capable of executing predicted noise contours showing sound pressure as it moves away from the source. CUSTIC software predict a continuous operation simulated continuously for 24- hours.

The CUSTIC 2.0 software uses numerical algorithms for noise modeling which give possibility to study the noise pollution in the environment. Mathematical model the software uses provide option to model noise emissions from a wide range of sources that might be present whether industrial or urban areas. The modeling is based on estimates for dispersion of noise in free field by mean of numerical simulations which give as results approximate values for the noise levels, regardless of source type.

The CUSTIC 2.0 software accepts meteorological data records to define the conditions for sound propagation. The model estimates the noise level for each source/receptor combination and calculates user-selected averages. The model calculates attenuation due to noise source enclosures and other noise control measures, the distance from the source to the receiver, the noise source size, type and directivity, barriers and natural topographical features and sound absorption in the air.

The snap shot of the input and output data is shown in **Figure 2.3.28**.

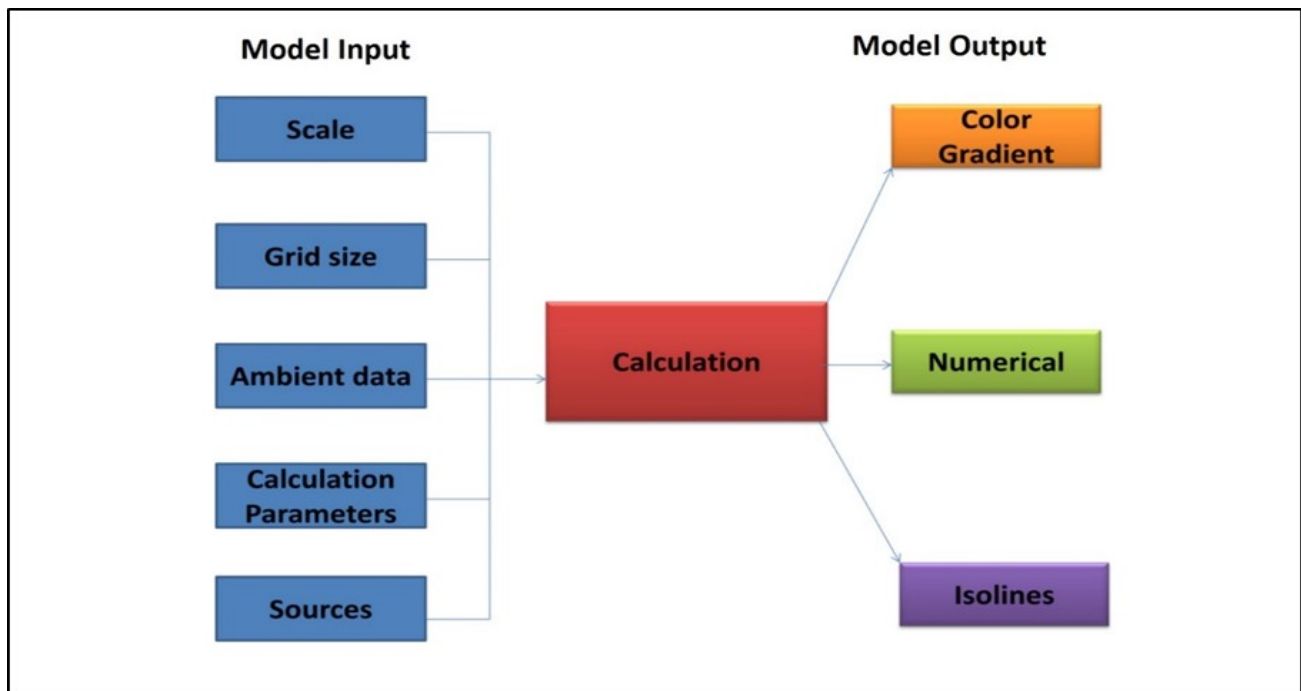


Figure 2.3.28: CUSTIC Screenshot of Input and Output

Noise Sensitive Receivers (NSRs)

Noise sensitive receiver can be defining as those locations or areas where dwelling units or other fixed, developed sites frequent human use occur (FHWA). For this project, expected noise from the project is simulated to determine the noise level at the plant perimeter fence. **Figure 2.3.29** is the map showing the boundary of the proposed project.

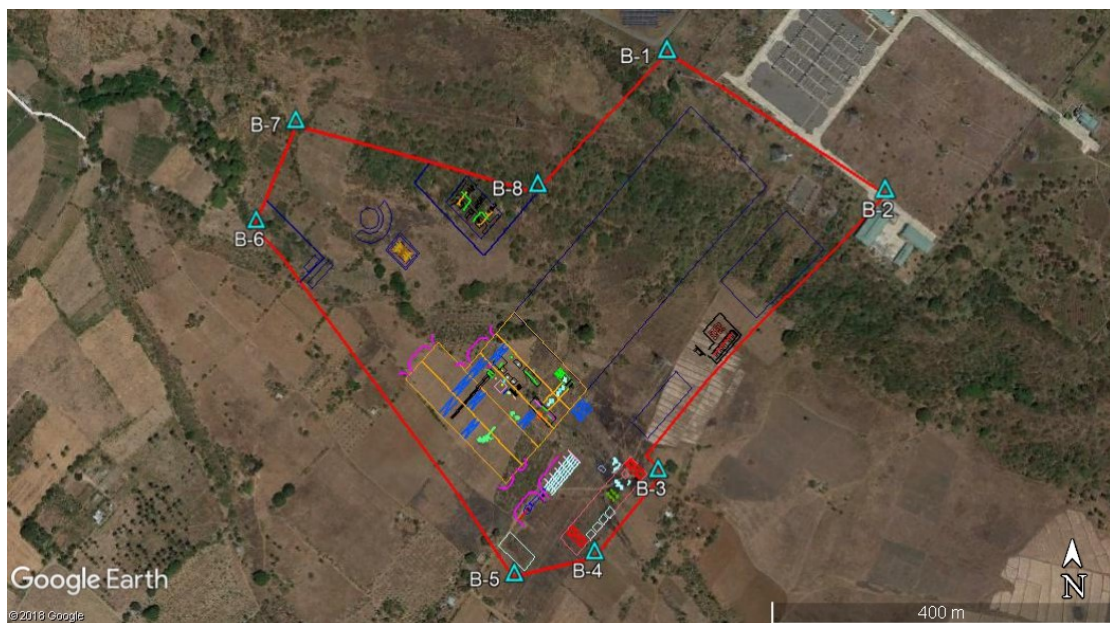


Figure 2.3.29: Noise Boundary Points at the Plants Perimeter Fence

Noise Modeling Input Data

The following input data were used to execute the noise simulation for the construction of the project:

- External source: External means a noise source placed out of a building (for example, a vehicle engine).
- Ambient Data: Ambient conditions are defined by the land and atmospheric conditions in the vicinity of the pollutant emission.
- 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 2,500 m x 2,500 m.

Modeling Assumption

The following assumptions were made to execute the model:

- Ambient Temperature - 25°C
- Relative Humidity – 80%
- Frequency – 500 Hz

The calculated noise power is 109.8 dB(A): This is the noise power at source position in decibels. It is assumed that all construction equipment listed in **Table 2.3.23** are working at the same time in 24 hours to depict the worst-case scenario.

Noise Modeling Results

The predicted noise levels in all noise sensitive receivers for the construction of the plant as exhibited in **Table 2.3.24** are all below the noise condition during daytime, morning/evening and night time. The highest concentration is 68.63 dBA at approximately 70 meters radius from the center of the Plant. The noise contribution from the construction of the Project is not expected to cause any significant noise impacts to the surrounding environment. The predicted noise contours for the operation is presented in **Figure 2.3.30**.

Table 2.3.24: Predicted Noise Level at the Noise Sensitive Receiver during Construction

Station No	Predicted Noise Level (SPL), dB(A)	Allowable Noise Level, dB(A)		
		Daytime	Morning/Evening	Nighttime
B-1	41.50	70	65	60
B-2	39.67	70	65	60
B-3	50.55	70	65	60
B-4	49.78	70	65	60
B-5	49.99	70	65	60
B-6	45.28	70	65	60
B-7	43.85	70	65	60
B-8	48.34	70	65	60

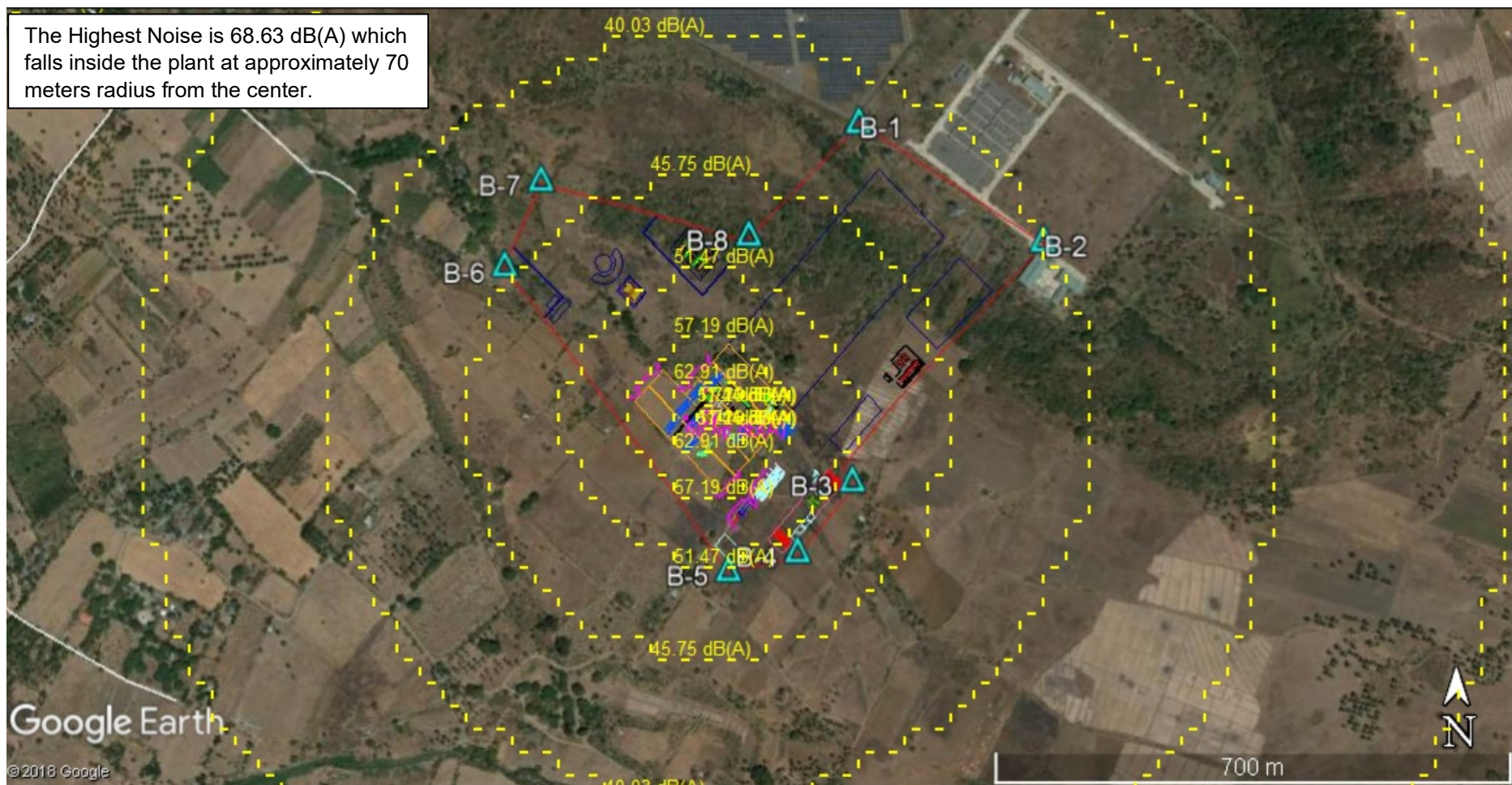


Figure 2.3.30: Plot of Noise Isolines for Construction

Management and Mitigation Measures

The need for the following measures should be considered prior to commencement of construction activities:

- Scheduling certain high noise emitting works to more acceptable times of day;
- Use of the most environmentally acceptable equipment which is properly maintained and silenced;
- Use of the least intrusive method of work;
- Proper instruction and supervision of staff; and
- Acoustic screening.

The following are the noise control measures that will be applied for the protection of employees working on site as well as the nearest sensitive receptor:

- It is advisable that electrically powered plant should be preferred, where practicable, to mechanically powered alternatives. If mechanical powered plant will be used, it should be fitted with suitable silencers and mufflers;
- Defective equipment/parts with abnormal noise and/or vibration will be either repaired or replaced;
- Schedule use of equipment/machines emitting high noise like pile driver during day time operation while, minimize use during night time operation;
- All employees working on site will be provided with proper ear protectors;
- During truck transport, along or beside the residential area, traffic transportation will be limited during night operation; and
- The Contractor shall at all times comply with all current statutory environmental legislation.

2.3.2.8 Increase in Noise Level during Operation Phase

The sound power level during operation was assumed to be at steady state base load and bypass operations and will not consider following activities:

- Commissioning phase;
- Failure conditions;
- Emergency conditions; and
- Other abnormal operating conditions.

The sound power levels derived/anticipated for each equipment item identified during the operation of the rolling mill were based on the given equipment noise data/sizes/dimensions extracted from a previous project. The list of power mechanical equipment during operation is presented in **Table 2.3.25**. However, it is advised that the detailed design should be updated to reflect equipment data whenever the design changes.

Table 2.3.25: Equivalent PWL of Power Mechanical Equipment for Operation Phase

Power Mechanical Equipment	PWL, dB(A)
Product Enclosure	89
Reheating Furnace	90
Rolling Mill	90
Cooling Bed	93
Twin Finishing Blocks	95
Melting Furnace	95
Casting	97
Ladle Furnace	107
Electric Arc Furnace	109
Furnace Enclosure	109

Source: Noise Pollution from Metal Melting Industry, October 20, 2015

The total estimated sound power level for the operational equipment is 113.5 dB(A) from the data listed above.

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. CUSTIC software predict a continuous operation where it simulated continuously for 24- hours.

Noise Modeling Input Data

The following input data were used to execute the noise simulation for the operation of rolling mill project:

- Internal source such as rolling mill, roller mill, compressors or any other noise source placed inside of a building.
- Noise power (dB): This is the noise power at source position in decibels.
- Ambient Data: Ambient conditions are defined by the land and atmospheric conditions in the vicinity of the pollutant emission.
- 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 2500 m x 2500 m.

Modeling Assumption

The following assumptions were made to execute the model:

- Ambient Temperature - 25°C
- Relative Humidity – 80%
- Frequency – 500 Hz
- The total estimated sound power level for the operational equipment is 113.5 dB(A) from the table above (**Table 2.3.25**).

Noise Modeling Results

The predicted noise levels in all sensitive receivers for the operation of the steel rolling mill as exhibited in **Table 2.3.26** are all below the noise condition during daytime, morning/evening and night time. The highest concentration is 72.33 dBA at approximately 150 meters radius from the center of the Plant. The noise contribution from the operation of the Project is not expected to cause any significant noise impacts to the surrounding environment. The predicted noise contours for the operation is presented in **Figure 2.3.31**.

Table 2.3.26: Predicted Noise Level at Nearest Sensitive Receiver for Operation

Station No	Predicted Noise Level (SPL), dB(A)	Allowable Noise Level, dB(A)		
		Daytime	Morning/ Evening	Nighttime
B-1	45.20	70	65	60
B-2	43.37	70	65	60
B-3	54.25	70	65	60
B-4	53.48	70	65	60
B-5	53.69	70	65	60
B-6	48.36	70	65	60
B-7	47.55	70	65	60
B-8	52.04	70	65	60

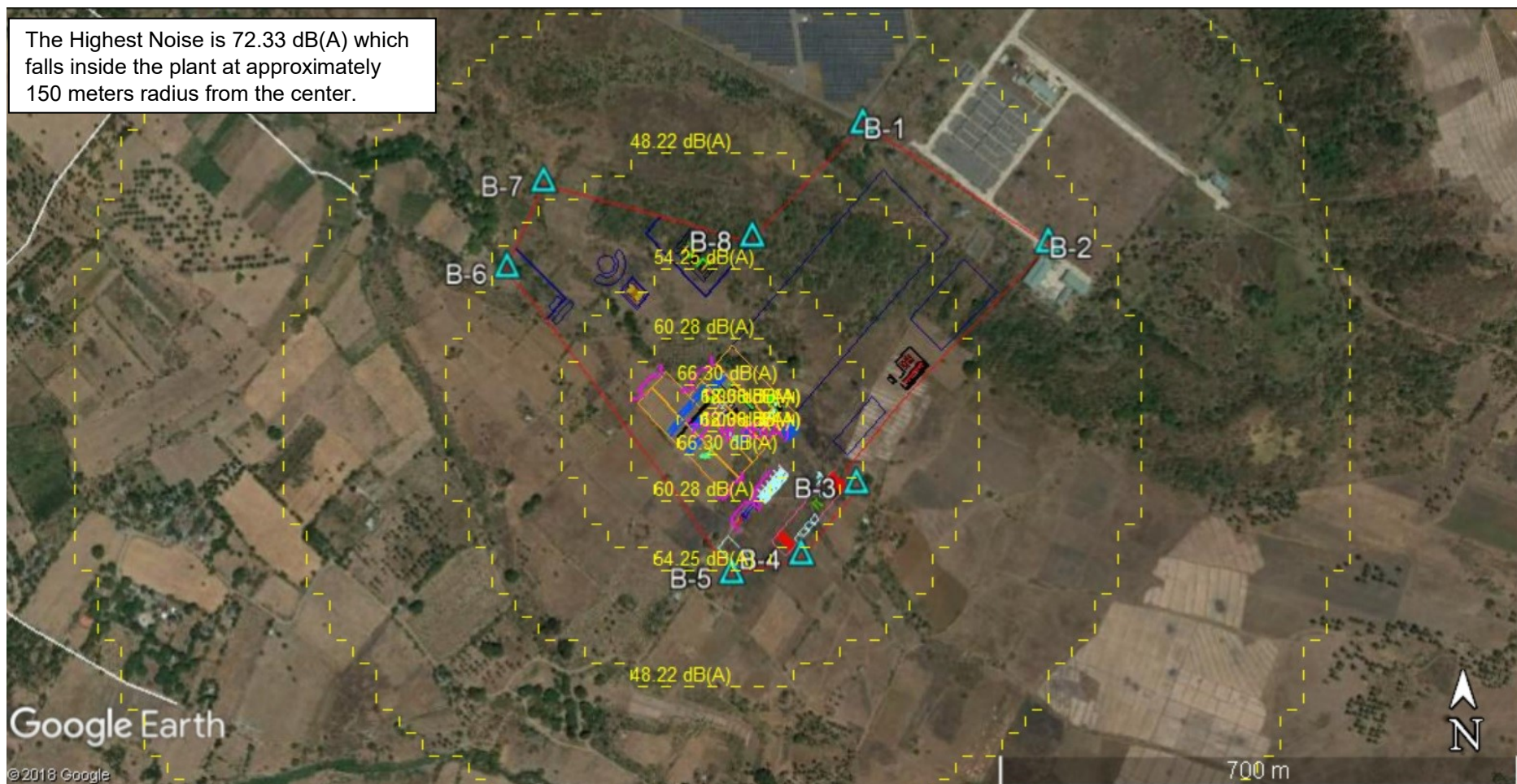


Figure 2.3.31: Plot of Noise Isolines for Operation

Management and Mitigation Measures

It is clearly important to limit the noise emission of all major noise sources in the production area for both environmental and occupational reasons. The specific noise limit to be placed on an individual item of equipment may be dictated by either the on-plant requirements or by the boundary noise limit, depending on the source size, location and elevation.

Providing the majority of the equipment complies with the relevant equipment noise specifications, noise levels on-plant should meet the 85 dBA limit and noise levels at all boundaries would then be expected to meet the DENR and DOLE requirements.

It is important therefore to ensure that appropriate noise limits are specified within the equipment tender documents and that guarantees are obtained for all major equipment. A detailed noise control study should be carried out as part of the detailed design of the rolling mill to ensure that appropriate limits and noise control measures are incorporated.

Moreover, predicted noise levels are high within the radius of the plant premises which may bring negative impact to workers because of excessive noise. Therefore; personnel protection of workers should be provided and it is necessary to carry out the planned protective measures systematically. The stated measures include (i) controlling the noise level inside the rolling mill and the surrounding inhabited areas; (ii) reducing the noise in individual plants and machines; (iii) applying acoustic protection by setting physical barriers or enclosures and applying personal protection instruments of the employees in the mine.

Protective panels, as physical barriers should be used as an additional measure for protecting the settlement from noise along with the envisaged green belt.

The effect of the panel is momentary reduction of noise emitted towards the settlement until the designed green belt has reached functional age. In terms of protection from emitted noise, the panels as movable structures follow the progression of the activities.

Protective measures for reducing the negative impacts of noise on the working and living environment include the following:

The 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 level in the surrounding settlements exceeds legally allowed values, barriers should be set – sound protection panels for the reduction of noise;

If it is practically possible and feasible, noise sources should be enclosed, which directly depends on the source nature;

It is necessary to provide the equipment for protecting the hearing of the machine's operators from the harmful consequences of excessive noise; and

Planting a green belt around the Plant, especially in the part where the level of noise in the vicinity of an inhabited place is the highest.

Defective equipment/parts with abnormal noise and/or vibration will be either repaired or replaced.

2.4 PEOPLE

2.4.1 Demography

2.4.1.1 Population, Number of Households and Household Size

The latest 2015 Census of Population undertaken by the Philippine Statistical Authority (PSA) in August 2015, reports the total population of Villanueva at 39,378 which was 31,966 in 2010 registering an increase of 7,412 in five years, an annual growth rate of 4.05%. Villanueva's population ranked Ninth among the Top Ten most populous cities (except Cagayan de Oro City)/municipalities in the province of Misamis Oriental.

In the 2015 census, of the eleven (11) barangays, Katipunan topped with the highest population of 4,897 or 13% of the total population. This was very closely followed (a difference of only 15) by Dayawan with its 4882 population, also 13% of the total.

Three other barangays with bigger population were Looc with 4,517 or 12% of the total population; San Martin with 4,496 or 11.9%; and Poblacion 3 with 4,446 or 11.8%.

With the fast-paced industrialization of the municipality, only one (1) of the eleven (11) barangays remain rural and the other ten (10) have become urban (**Table 2.4.1**). The total number of households in the municipality was 8,739 in 2015 and the first five barangays that had bigger number of households are Katipunan, 1148 (13%); Dayawan, 1145, (13%); Looc, 1059 (12%); San Martin, 1029 (11.8%); and Poblacion 3, 1042 (11.9%). The remaining six barangays had lower number of households, such as Imelda, 816 (9%); Poblacion 1, 736 (8%); Poblacion 2, 635 (7%); Balacanas, 474 (5.4%); Tambobong, 440 (5%); and finally with the lowest number of households is Kimaya with 215 households or 2.5% to the total number of households.

Table 2.4.1: Household Population by Urban and Rural Barangay

Barangay	Number of Household	Average Household Size
A. Urban		
Poblacion 1	736	4.2
Poblacion 2	635	4.3
Poblacion 3	1042	4.3
Dayawan	1145	4.3
Imelda	816	4.3
Katipunan	1148	4.3
Looc	1059	4.3
San Martin	1029	4.4
Balacanas	474	4.4
Tambobong	440	4.4
B. Rural		
Kimaya	215	4.2
Total	8739	4.3

Source: CLUP of Villanueva

2.4.1.2 Land Area

The Municipality of Villanueva occupies a total land area of 5,222.5 ha and covers eleven (11) barangays, namely: San Martin, Dayawan, Kimaya, Poblacion 1, Poblacion 2, Tambobong, Looc, Balacanas, Katipunan, Imelda and Poblacion 3. Approximately 1,790 ha or 34.27% of the total land area is within the jurisdiction of the Philippine Veterans Development Corporation (PHIVIDEC) or the Phividec Industrial Authority.

2.4.1.3 Gender and Age Profile

As reflected in **Table 2.4.2**, the household population by school age, working age, dependent age group and sex, Villanueva reflects a young population. The labor force population constitutes 62%; the working age population composes 59%; and the young dependent population constitutes 38% while old dependent population comprises only 3%.

The male population dominates in school-going population and the working age population. In the dependent age group, the males dominate among the young dependent population while the females dominate in the old dependent population.

Table 2.4.2: Gender and Age Profile

Age Group	Both Sexes	Male		Female		Sex Ratio
		No.	%	No.	%	
School going in:						
Preschool (3-6)	3950	2094	53	1856	47	114
Elementary (7-12)	5612	2469	44	3143	56	78
Secondary (13-16)	3585	1792	49.98	2013	50.05	99.9
Tertiary (17-21)	3805	2017	53	1788	47	113
Working Age (15-64)	23126	12025	52	11101	48	107
Labor Force (15 and over)	20747	10581	51	10166	49	106
Dependent Population:						
Young (0-4)	4025	2093	52	1932	48	108
Old (56-over)	1044	454	45	590	55	83

Source: CLUP of Villanueva

2.4.1.4 Literacy Rate and Educational Attainment

By highest educational attainment of population 5 years old and over (**Table 2.4.3**), a population comprising 37.44% had elementary schooling while 37% had high school education and of this number about 8.5% were college undergraduate; 5% had no grade completed, 5% were academic degree holder; 3% had pre-school education; and almost 1% had post-baccalaureate.

Table 2.4.3: Educational Attainment Profile of Villanueva, 2015

Highest Educational Attainment	Male		Female		Both Sexes	
	No.	%	No.	%	No.	%
No Grade Completed	746	5.19	557	5.19	1449	5.19
Pre – School	496	3.45	398	2.94	894	3.20
Elementary	5631	39.64	4822	35.10	10453	37.44
High School	5137	35.75	5197	38.35	10334	37.01
Post Secondary	209	1.45	214	1.58	423	1.51
College Undergraduate	1136	7.90	1238	9.13	2374	8.50
Academic Degree Holder	638	4.44	809	5.97	1447	5.18
Post Baccalaureate	11	0.08	17	0.12	28	0.09
Not Stated	266		255		521	1.86
Total	12920	99.99	12270	100	25104	99.98

Source: CLUP of Villanueva

Segregated by sex, the males dominated at the lower levels of education, i.e., at pre-school, elementary and those with no grade completed while as the grade level rises, the females predominate thus there were more females than males in high school, post-secondary, college undergraduate, academic degree holder and with post-baccalaureate studies.

Literacy rate of population 5 years old and over (**Table 2.4.4**), records a literacy rate of the population at 91.6% or at least an 8.4% of the population as illiterate. The female population reflects a higher (91.9%) literacy rate compared to the males with 91.3% literacy rate.

Table 2.4.4: Literacy Rate of Population 5 Years Old and Over, 2015

Particular	Male		Female		Both Sexes	
	No.	%	No.	%	No.	%
Population 5 Years Old Over	14399	51.5	13524	48.5	27923	100
Literate	13154		12425		25579	
Literacy Rate (%)		91.3		91.9		91.6
Illiterate	1245		1072		2344	
Illiteracy Rate (%)		8.7		8.1		8.4

Source: CLUP of Villanueva

2.4.2 Migration Profile

Immigration is likely to occur brought about by workers from the head office of SteelAsia coming in and out of San Martin because of the Project. Although the company hiring policy will give preference to qualified locals, immigration may further be increased if there are no qualified applicants from the host barangay or municipality. The company will encourage that migrant workers will participate in social activities and social development programs to interact with the community.

2.4.3 Indigenous People

There are no indigenous people or informal settlers in the on and around the project site/area.

2.4.4 Historical and Cultural Heritage

Long before the Spanish colonization, the place was originally named "Bongloy" by the natives called the Magahats, because of the three gigantic Bongloy trees that grew in the place where the Catholic Church and town plaza stands today.

In 1830, the mission of Jasaan, an adjacent town to the north, was to establish separation from Cagayan de Oro and evangelization to as far as the towns of Sumilao, Linabo and Malitbog in the province of Bukidnon. Its center of civilization and the first Church was at "Daanglungsod" which is now the Aplaya, Jasaan, where an old Kota (watchtower) still exists, thus marked the birth of Christianity in Bongloy.

Father Gregorio Parache, S.J., - (432 local historical sources of Northern Mindanao by Father Francisco Demetrio, S. J), who was the parish priest of Jasaan at that time brought a certain Captain Villanueva to Bongloy. Villanueva was a Mexican-American soldier who was one of the occupants of Balingasag Convent during the American occupation of the Philippines.

Father Parache requested Captain Villanueva to assist him in the plans and then commissioned the captain to develop a potable water and irrigation system in the Bongloy area. As the years passed, the Magahats moved eastward below the town of Claveria and began calling Bongloy as Villanueva in honor of the captain. The word Villanueva was handed down through word of mouth in the succeeding generations.

2.4.5 Existing Social Infrastructure and Services

2.4.5.1 Power and Water Supply

The LGU of Villanueva operates Level 4 local waterworks system, which has a total of 3,471 connections. Ninety seven percent (97%) of these are domestic consumers, two percent (2%) is commercial. While less than one percent (1%) is industrial consumption. These industries consume the biggest in terms of cubic meter per industry per month.

2.4.5.2 Communication

Villanueva has substantial communication system facilities such as Smart, Globe and Sun. Moreover, the LGU has its radio telecommunication, which can address to areas who doesn't have sufficient signal for the telecommunication companies. Philpost is also within the municipality.

2.4.5.3 Education

The municipality has eleven (11) elementary schools spread in the various barangays. Barangay Dayawan has three (3) elementary schools, the Don Fernando Jacinto Elementary School; Dayawan Elementary School and Lukong Elementary School. Barangay San Martin has also two, San Martin Elementary School and Kirahon Elementary School. Poblacion 2, Balacanas, and Looc have one elementary school each.

There are four (4) secondary schools, two of which are public, the Kalingagan National High School and Villanueva National High School, while the two private schools are Regina Angelurom and Liberty Christian.

2.4.5.4 Peace and Order

The municipality's police force composes 34 policemen and six (6) district jail personnel in a 200 square-meter police headquarters and a 100-square meter district jail, respectively. A total of 47 barangay tanods doing auxiliary services back the police force up through voluntary services in traffic, peace and order, disaster, and other forms of services.

While there is no fire protection force in the municipality, it has experienced at least nine (9) incidents of fire during the last five (5) years (2012-2016).

2.4.6 Public Health and Safety Profile

2.4.6.1 Public Health Services

The municipality has a Lying-in, 5-bed capacity Municipal Health Clinic (MHC) located in Poblacion 1 that provides health services for the population. There are nine (9) Barangay Health Stations (BHS) strategically situated in all other eight (8) barangays of the municipality. These health facilities are in good condition.

MHC is manned by one (1) doctor, two (2) nurses, three (3) midwives, two (2) sanitary inspectors, one (1) DOH representative, one (1) dentist, one (1) medical technologist, one (1) microscopist, one (1) physical therapist, one (1) dental aide, two (2) ambulance driver, two (2) ambulance aide and two (2) health staffs. One (1) private doctor also provides health services in the municipality.

2.4.6.2 Malnutrition, Morbidity and Mortality

In 2015, the ten leading causes of morbidity are Upper Respiratory Tract Infections, Wounds, Skin Disease, Abdominal Pain, Hypertension, Epigastric Pain, Diarrhea, UTI, Dengue and Bites (all forms).

On the other hand, the ten leading causes of mortality are Coronary Artery Disease, Hypertensive Vascular Disease, Accidents, Chronic Obstructive Pulmonary Disease, Cancer, Sepsis, Liver Cirrhosis, TB, DM, and Pneumonia.

2.4.7 Socio Economic Profile

2.4.7.1 Employment

By major occupation groups, Villanueva's Gainful Workers 15 years and over which total 20,747 in 2015, show that twenty-five percent (25%) belong to the Laborers and Unskilled Workers group, twenty-three percent (23%) were in the Farmers, Forestry Workers, and Fishermen group, and fourteen percent (14%) were in the Trade and Related Workers group. Another twelve percent (12%) were Plant and Machine Operators and Assemblers, and almost nine percent (9%) were Services Workers and Shop and Market Sales Workers occupation group.

2.4.7.2 Local Economy

Industry

The Province of Misamis Oriental is designated as the Regional Industrial Center (RIC) with the presence of the PHIVIDEC Industrial Estate, the country's oldest and largest industrial estate covering an area of approximately 3,000 ha within the portions of Tagoloan and Villanueva, which are the immediate municipalities east of Cagayan de Oro City.

The facilities dominate the landscape in these areas, the 210 MW Coal-fired Mindanao Power Plant (STEAG Power Incorporated) in Villanueva and the Mindanao Container Terminal (MCT) in Tagoloan. The power plant located adjacent to the Philippine Sinter Corporation in Villanueva was established in late 2005 to attain stable supply of electricity in the region and Mindanao, to a very potential power shortage in the short-to-medium term, with foreseen entry of more industries. Another coal-fired power plant of the FDC Utilities, Inc. (FDCUI), the Filinvest Group's re-entry into the power market is the 405MW Misamis power plant which is the biggest power project in Mindanao, is also located in Villanueva.

In 2012, commercial companies and industrial establishments totaled twenty seven (27) and of this number 9 or 33 percent were Very Large; 11 or 41 percent were Large and 7 or 26 percent were Medium. The companies/ establishments, contractors/ service providers, and general merchandisers/ enterprises/ traders/ sari-sari stores had an aggregate total of 147. About 68 or 46% were under category medium, 35 or 24% were large category, 25 or 17% were small category, and 19 or 13% under category very large.

There are four (4) banks in the municipality and these are, the following: the Cooperative Bank of Misamis Oriental; D' Asian Hills Bank; Secured Bank, Inc.; and One Network Bank. Microfinancing firms are also present in the municipality and these are the Taytay sa Kauswagan, Inc. and Aakay and MELAMDEEC Microfinance Foundation, Inc. Pawnshops such as RD Pawnshops, MLuiller Pawnshop and Palawan Pawnshop and money express are also present in the municipality.

Agriculture

The total crop area is 1,182 hectares representing 22.6 percent of the total municipal land area distributed into 710 hectares or sixty percent (60%) of the total cropland planted to prime crops, 24.1 hectares or 34% to rice and 469 hectares or 66% to corn, the crop considered to be the dominant crop in terms of area.

Manufacturing

Considering Villanueva is an Industrial Center in the Province of Misamis Oriental, several manufacturing plants are located within the municipality. Mindanao Container Corporation, which manufactures quality steel drums, is the first to establish. Steel Asia manufactures Billet steel for

construction materials, and the Coca-Cola Bottlers Phils. Inc. which commonly known for manufacturing delightful beverages and sold nationwide.

Tourism

The municipality has four (4) beach resorts situated in Barangay Looc and categorized as Large is Villa Rose Beach, two (2) resorts, Aquarius Beach and GMC Shades and Beach are categorized as Medium, while one (1) resort categorized as Small is DC South Beach.

Cultural and Tourism activities include the yearly fiesta celebration on December 12 in honor of Our Lady of Guadalupe which is celebrated in three (3) days, the Araw ng Villanueva on June 16 is another yearly celebration and celebrated in three (3) days, and the Villanueva Youth Festival which is celebrated yearly and in one week.

2.4.7.3 Social Welfare

Day Care Centers for 3-5 years old are spread over the municipality's barangays and these are: Dayawan, 6; Katipunan, 4; Kimaya, 3; Looc, 4; Balacanas, 1; Imelda, 5; Tambobong none but there's a Day Care for the elderly; Poblacion 1, 2; Poblacion 2, 2; Poblacion 3, 2; San Martin, catering to a total of 2,142 children.

Other services provided are Philippine Health Insurance for the disadvantaged families and Practical Skills Training for disadvantaged.

Other social welfare services available in the 11 barangays of the municipality include the following:

- Social Enhancement for the elderly/issuance of I.D. and booklets
- Practical Skills Training for disadvantaged women
- Financial/Medical Assistance for disadvantaged families
- Peer group service for out-of-school youth
- Educational assistance for disadvantaged youth
- Marriage Counseling for would-be couple and couple with problem in relationship
- Provision of Assistive service for persons with disabilities
- Referral for disadvantaged families
- Parent effectiveness service for disadvantaged families
- Responsible parenting movement for disadvantaged families
- Custody supervision/mediation and diversion program for children below 18 years old
- Social enhancement/rehabilitation for persons with disabilities

2.4.8 Public Access

2.4.8.1 Road Network

Villanueva is accessible via the well-paved Maharlika National Highway which cuts the western Section of the municipality running through barangays San Martin, Katipunan, Poblacion 1, Poblacion 2 and Looc. Access roads towards the interior of the barangays are conveniently connected with the transverse national highway. They are composed of a combination of cemented and graveled all-weather roads. Farther into the upland barangays, access roads degrade into rough and muddy roads which may become inaccessible during heavy rains especially during the rainy season.

Villanueva is linked by a road municipal streets and a total of 39.288km barangay roads of also 10m and 8m wide. This road network is connected by thirteen (13) bridges: six (6) concrete and seven (7) steel bridges. The two (2) concrete bridges are Tag-anga Bridge at Katipunan, and Baloc Bridge at Poblacion connecting Barangay Looc. The four (4) concrete spillways are found in upper Dayawan, SRV relocation, Kimaya and Looc. The seven (7) foot bridges are in Tuburan, Looc, Butigon, Poblacion 2, Baac Camp, Poblacion 1 and famex-Soligao in Poblacion 2. Auxillary roads

supporting this road network are 12 pedestrian crossings, a sidewalk in Poblacion, 15 waiting sheds and streetlights along the national road.

2.4.8.2 Transportation

In terms of Transportation System, there are land transportation terminals in the municipality, one at Katipunan Public Market for Jeepney and Tri-motor; a jeepney terminal in Poblacion 2 and a Motorela Terminal in Poblacion 1. There are also trisikad terminals in Poblacion 1, Poblacion 2. Katipunan and Dayawan.

2.4.9 Perception Survey

The perception survey was conducted on March 16 to 18, 2018. A total of 1,165 households were randomly interviewed and surveyed in Barangay San Martin, Villanueva, Misamis Oriental.

Questions in the survey covered the following:

- | | | |
|----------------------------------|---|--|
| • Gender | • Intention to out-migrate | • Current Environmental Conditions |
| • Age | • Material component of the dwelling unit | • Awareness on the Proposed Project |
| • Civil status | • House ownership | • Impacts of Proposed Project: Positive and Negative |
| • Religious affiliation | • Home utilities | • Perception and attitude towards the Project |
| • Educational attainment | • Causes of morbidity and mortality | |
| • Occupation | • Health services | |
| • Place of work | • Health facilities | |
| • Number of years earning income | • Type of Toilet | |
| • Monthly income | • Source of Drinking Water | |
| • Length of stay in the area | • Garbage Disposal | |

Demographic

Of the total respondents interviewed, whose household sizes are commonly comprised of 2-5 individuals (76%), 52% are female, while 48% are male. Majority of them are Catholic (82%). More than half of them are married (58%). Only 17% of them, however, have gone through college, while most of them have only completed high school (55%).

Majority of them are of productive ages, ranging from 15 to 60 years old, which comprises 89% of the respondents. Many of them are either working as laborers and skilled workers (23%) or are self-employed (16%). Most of them are earning within the income range of 1,000-5,000 pesos (38%) and 5,001-10,000 (22%), while 28% claims to have no income.

While many of the respondents claimed to have been living in Brgy. San Martin for more than 21 years (71%), almost half of them are from various parts of Bukidnon (43%).

Sanitation

According to the respondents, many of them source their drinking water from processed/bottled water refilling stations (48%), while their water for household and agricultural use are being sourced mainly from artesian/water wells (36%) with some sourcing it from the river, since water is really a very scarce commodity in the community.

In disposing human bodily wastes, many of the respondents said they are using water closets (58%), while some are using open pits (37%) and the rest simply urinate and defecate without the use of these facilities (5%).

Corporate Social Responsibility

When asked what they think the company could contribute to the betterment of the barangay and its residents, half of the respondents answered that they will be given priority in employment (52%), (20%) mentioned infrastructure projects such as road concreting, street lighting, water facilities, among others while (10%) answered scholarship/ educational sponsorship.

Perception about the Project

More than half of the respondents (56%) claimed to have prior knowledge about the project. 63% of them said that they knew about it from the barangay officials and workers, while the rest of the respondents claimed that they heard of the project from the IEC and from the words of others.

In addition, majority (70%) of the respondents perceives that the project will be beneficial for their community as it will open up opportunities for local employment and livelihood, help enhance the delivery of social services, as well as contribute to the overall development of the barangay.

2.4.10 Displacement of Settlers

There is absence of settlers in the proposed project site; therefore, there will be no displacement of settlers that will take place. However, there will be some community members who may have to immediately harvest their crops as these are planted in the area covered by the proposed project site.

2.4.11 In-Migration

In-migration is likely to occur brought about by workers from the head office of SAMC coming in and out of Villanueva because of the proposed project. Although the SAMC'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 or municipality. The SAMC will encourage that migrant workers will participate in social activities and social development programs to interact with the community.

2.4.12 Cultural/Lifestyle Change

With the implementation of the proposed project, the cultural practices in Villanueva will not be affected as these will continue to be celebrated and SAMC will support these celebrations. However, there will be change in lifestyle of the community, which will be for the better because the proposed project will contribute to improvement of the people's standard of living. This will be brought about by stable jobs and higher household incomes. As a result, the affected families will be capable of giving their children proper education and widen their opportunities. The SAMC, shall encourage modest lifestyle and simple living standards in accordance with its philosophy. On the contrary, the SAMC will encourage families to participate in livelihood projects that will be sponsored by the company.

2.4.13 Impacts on Physical/Cultural Resources

The proposed project will not affect any physical nor cultural resource in Villanueva. It will even support and assist the customs and traditions of the community and assist in the improvement of the physical resources through its social development programs.

2.4.14 Threats to Delivery of Basic Services/Increase in Demand for Resources

The proposed project will not pose threat to delivery of basic services because it will not compete with the services being provided by the local and national government especially in terms of power and water requirement.

The major water requirement during construction is the concreting works. Concreting of buildings, roads, and other necessary structures will bring about increase in water consumption. The amount of water will depend on the size of the structure that will require concreting. However, the project concrete requirement will be provided by a batching plant contractor near the area. Therefore, water requirement of the project will be minimal as the water will only be use for cleaning the entire project site during and after concrete pouring and domestic water use for the workers. During operation phase, water requirement will be fully sourced from rain harvesting and make up water from deepwell.

For power requirement, the Plant will have its own substation and will get power from the nearest power source/supplier.

The SAMC will even be a partner to deliver and improve the delivery of these basic services for the people because the proposed project will have a social development component which include assistance to infrastructure, livelihood and education, among others.

2.4.15 Threats to Public Health and Safety

The potential air and water pollutants generated during construction of the proposed project may have adverse impacts on the health and safety of the workers and residents of nearby communities. Workers may be exposed to ergonomic stress and increased levels of noise, dust, and heat, as well as physical hazards associated with heavy lifting, moving heavy equipment, etc. The workers and local residents may also expose to or spread contagious/infectious diseases due to unsanitary condition at the project area.

During operation of the plant, it will have a potential to emit dust and smoke due to the nature of operation itself, poor maintenance of air pollution control facility and failure to effectively implement internal pollution control program. During operation, the noise will be generated by the machine operation. Wastewater discharge is usually limited to surface run-off and cooling water and causes no substantial contribution to water pollution.

Table 2.4.5 presents other potential health hazards during construction and project operations and the appropriate mitigating measures that will be implemented.

Table 2.4.5: Health Hazards during Construction and Project Operation

Category	Types	Possible Sources	Health Effects	Mitigation
Chemical hazards	Vapors	When liquids are heated up to its Flash Point	Dissolve skin fats and oils	Proper ventilations and exhausts
			Skin dryness, cracking, redness, and blisters	
			Local health effect	Inducing fresh air to work rooms/stations
			Central nervous system damage	
	Fumes	Welding and flame cutting	Systemic health effect	Proper ventilations and exhausts; Inducing fresh air to work rooms/stations; Use of air purifying mask, Eye and face protections
			Respiratory illnesses; asphyxiation	
			Skin irritations	
		Using internal combustion engines and LPG burners		
		Burning of waste materials		

Category	Types	Possible Sources	Health Effects	Mitigation
	Gases	Painting - particularly paint spraying using adhesive and thinners	Cause severe skin and eye irritation and burns as well as frostbite. Breathing pure Oxygen at high pressures can cause nausea, dizziness, muscle twitching, vision loss, convulsions (fits), and loss of consciousness, Death	Proper ventilations and exhausts; Inducing fresh air to work rooms/stations; Use of air purifying mask, Eye and face protections
		Oxygen – used for welding and cutting		
		Acetylene – used for welding and cutting		
		Propane – used for heating & fuel		
		Carbon Dioxide – used as an inert gas and can be found naturally in sewers		
		Methane – the principle component of natural gas and found in earth deposits		
		Hydrogen Sulfide –break down of organic matter and can be found naturally in sewers		
		Carbon Monoxide – highly toxic and produced by the incomplete combustion of fuels		
		Welding Gases – The welding arc can produce Ozone, phosgene and carbon monoxide gases		
		Diesel Exhaust – Nitrogen Dioxide		
	Dust	Silica dust - Any process involving breaking, crushing or grinding silica containing materials will generate silica dust.	Disease of the lungs due to the breathing of dust containing crystalline silica particles. Silicosis, a disease with lung fibrosis causing difficulty in breathing; Excessive exposure may cause acute or chronic health effects	Engineering Control - Dust collector; Use of air purifying breathing apparatus/Mask
		Lead dust - arise from handling materials containing lead or its compounds, such as removal of leaded paint and handling of metallic lead		
Physical hazards	Noise	With noise damage to the ear, it may take many years for the symptoms to appear	can distract concentration, cause difficulties in speech communication; Long term exposure to excessive noise can cause permanent hearing damage	Engineering controls thru replacement of equipment or regular conduct of Preventive Maintenance; Introduce work schedule rotation; Use of ear protections
	Heat	May be aggravated if impermeable protective clothing is worn when undertaking heavy work or working in an enclosed area with a strong heat source, poor ventilation and high humidity.	Heat rashes, Heat cramps, Heat exhaustion, Heat stroke; Injuries	Avoid heavy manual work in hot environment, Providing shelter, blowing fans, adequate cool drinks to replace the water lost as sweat and sufficient rest breaks
	Vibration	Hand-Arm Vibration Syndrome (HAVS) can cause permanent damage	May cause carpal tunnel syndrome - affects the fingers and hands; In the long run, permanent damages to the nerves will result in a loss of the sense of touch and dexterity	Where possible, low vibration tools should be used; Wearing anti-vibration gloves

Category	Types	Possible Sources	Health Effects	Mitigation
Ergonomics		Poor design of equipment, workstation design, (postural) or workflow, manual handling, repetitive movement.	Body fatigue; Risk for heart diseases; Induce risk of diabetes; musculoskeletal disorders	Adopt ergonomically design apparatus and equipment;
Psychological		Shiftwork, workload, dealing subordinates, harassment, discrimination, threat of danger, constant low-level noise, stress	Affects a person's thinking, feeling or mood; may affect someone's ability to relate to others and function each day	
Biological		Infection by bacteria, virus, fungi or parasites through a cut, insect bite, or contact with infected persons or contaminated object.	Sickness; Infections	Information campaign; Good housekeeping practices; Personal hygiene

Occupational Health is among SAMC's priority as it is committed to implement structured approach to workplace health and safety in order to achieve a consistently high standard of safety performance. Occupational Health Plan is included in its Environment, Health and Safety Policies of the SAMC which is a component of its ISO Certification.

SAMC shall be responsible for the regular check-ups of workers and immediate treatment of any work-related sickness incurred by any worker. The SAMC, as it does in all of its plants, will cover employees and its dependents with an HMO plan. Moreover, the SAMC will have medical and dental missions and other health assistance projects for the community.

Following are the responsibilities that SAMC is committed to:

- Ensure the health and safety of its workers and others in its workplace
- Ensure the health and safety of other persons is not put at risk from work carried out as part of its operations
- Provide and maintain a work environment that is without risks to health and safety
- Provide and maintain safe plant and structures
- Provide and maintain safe systems of work
- Ensure the safe use, handling and storage of plant, structures and substances
- Provide adequate facilities for the welfare of workers
- Provide information, training, instruction and supervision
- Monitor the health of workers and the conditions of our workplaces.

Workers must take reasonable care for their own health and safety while they are at work, and take reasonable care that their acts or omissions do not adversely affect the health and safety of other persons. They must comply, so far as they are reasonably able, with any reasonable instruction given by the Station Manager, as well as co-operating with any reasonable policy or procedure which relates to workplace health and safety. On a day to day basis, this includes:

- To the extent of the worker's control or influence over working conditions and methods, take reasonable care to work safely
- Making sure that the work area safe when leaving it
- Make proper use of all appropriate safeguards, safety devices and personal protective equipment
- Follow agreed safe working practices and rules
- Report all known hazards, accidents and incidents as soon as possible.

It is acknowledged that, in accordance with Labor laws, a worker may cease, or refuse to carry out work if they have a reasonable concern the work would expose the worker to a serious risk to their health or safety. The workers who cease work shall notify the relevant manager that they have ceased unsafe work as soon as practicable after doing so. Workers are also required to remain available to carry out 'suitable alternative work'. This would not however require workers to remain at any place that poses a serious risk to their health or safety.

Contractors, sub-contractors and self-employed persons are required to:

- Comply with the contractual requirements with SAMC, laws, rules and regulations
- Have in place any work health and safety policies and programs required under safety legislation
- Consult with about safety matters and comply with policies
- Work safely and to include the safety of staff and visitors in their safety plans.

If any staff member believes that a contractor may be engaging in an unsafe work practice, they are required to report this issue to their manager.

Visitors and other persons' responsibilities are as follows:

- Take reasonable care for their own health and safety and for the health and safety of other persons
- Comply with, so far as they are reasonably able, all reasonable safety directions provided by SAMC
- Report all safety related incidents to SAMC
- Ensure the adequate supervision of any accompanying children
- Do not enter any restricted area without authorization or escort
- Do not bring or consume alcohol or illegal drugs at workplaces
- Do not willfully or recklessly interfere with property.

Emergency Procedures is also part of the Occupational Health Plan which is fully discussed in **Chapter IV**. Provided in **Table 2.4.6** is the Health and Safety Program being implemented in existing and operating SAMC Plants, which will also be adopted for this Project.

Table 2.4.6: Health and Safety Programs of SAMC

Health Programs	Target Date	Activities
Liver Cancer and Viral Hepatitis Awareness and Prevention Program	January	Lecture on Liver Cancer and Hepatitis.
Locker Room/Restrooms Inspection		Regular inspection of restrooms and lockers together with B&G, San Maritanzion and HR.
Potability Test of Drinking Water		Potability Test of drinking water every two months and Physical/Chemical Test of water source once a year.
STD/AIDS Awareness Program	February	STD/AIDS Awareness Seminar.
Oral Health Program		Lecture on Oral Hygiene and Care (Invite a dentist to talk about the topic).
Cardiovascular Diseases/ Hypertension Prevention Program	March	Lecture on Cardiovascular Diseases/ Hypertension Prevention.
		Case finding. Continuous Blood Pressure Monitoring of high risk employees.
Lecture on Conjunctivitis and Foreign Body in the Eyes		Lecture on conjunctivitis (Sore eyes) and Foreign Body in the eyes.
Lecture on Wound Care	April	Lecture on proper wound care and dressing.
Sports Fest - Table Tennis		Table Tennis tournament.
Smoking Cessation Program	May	Seminar on the Ill-effects of smoking.
Motorcycle Safety Program		Seminar on Motorcycle Safety.
Flu Awareness and Prevention Program	June	Flu Awareness Lecture.
		Flu vaccination in partnership with accredited clinics (Sanofi) for interested employees.
National Headache/Migraine Awareness month	June	Headache/Migraine Awareness Lecture
		Case finding / monitoring from previous SL records
Sports Fest - Billiards	June	Billiards Tournament
Dengue Awareness	July	Lecture on Dengue Disease and Prevention.
Gout Arthritis Awareness Lecture	August	Lecture on Gout/Arthritis Disease and Prevention.
Family Planning Program		Lecture on Family Planning and Responsible Parenthood.

Health Programs	Target Date	Activities
		One on one counselling to those who are interested with family planning.
Tuberculosis Awareness and Prevention Program	July	Lecture on TB Awareness and Prevention. Case finding (APE Result).
Programs on Ergonomics	September	Lecture on Ergonomics.
Food Safety and Nutrition Program	October	Lecture on Safe Food Handling.
Drug Free Workplace Program	November	Re-orientation on Drug Free Workplace Policy. Random Drug Testing.
Diabetes Awareness Lecture	December	Lecture on Diabetes

2.4.16 Generation of Local Benefits

The direct benefits resulting from the proposed project during construction and operation include the creation of employment for both local and non-local manpower. Construction requirements for manpower will largely depend on the schedule of workers that will be put up by the Contractor(s) which at this time is identified to be at least 1,500 workers where the three (3) will be directly hired by SAMC while 1497 will be employed by the Contractor. Depending on the construction tasks/jobs that will be undertaken at a given time, the peak manpower complement could reach up to 2,000 personnel. A total of 1500 personnel will be hired to fill in the regular job positions for the plant operation. During decommissioning, workers will be outsourced to contractors supervised by the PCO and Plant Manager of SAMC.

SAMC is committed to provide equal opportunities for employment of everyone, in compliance with the Labor Codes of the Philippines, Republic Act No. 10911 known as the Anti-Age Discrimination in Employment Act, and RA 7277 known as the Magna Carta for Disabled Person. SAMC will provide equal opportunities for employment of men and women, on the basis of their abilities, knowledge, skills and qualifications rather than on age or disability. The policy on hiring including the treatment of statutory benefits of the workers will be stipulated in the TORs and contracts with the local contractors to ensure compliance.

To enhance the employment opportunities brought by the proposed project, SAMC will regularly coordinate with the host LGUs and barangays regarding the hiring of temporary workers to ensure that the workers being considered are legitimate residents in the area. Moreover, by hiring local residents, some social conflicts associated with uncontrolled in-migration may be minimized.

The respective contractor will be responsible to provide accommodation for their workers and equipped with the necessary social infrastructure such as potable drinking water, portable toilets, waste bins, first aid kits, etc. The temporary accommodation will also be provided with security guards for safety and security purpose.

Potential positive effects of the manpower influx will include demand for retail and other services. This may increase economic activities, revenues, 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.

2.4.17 Traffic Congestion

The proposed Project will have an impact in the traffic situation of the locality. Traffic density within the site may become high and the volume of cargo and delivery trucks that will be used for the delivery of construction materials and finished goods may contribute to traffic problem.

With this, SAMC is committed to implement the Traffic Management Plan. The concept of the Traffic Management Plan is basically premised on the measures that will be implemented by the SAMC in coordination with and authorization of the LGU of Villanueva. Nevertheless, during construction phase, the following mitigating and management measures will be implemented:

1. The provincial road is the main ingress/egress;
2. Proper scheduling of hauling of construction materials in relation to existing truck ban ordinances;
3. No trucks and/or any kind of vehicles, i.e.: cars, motorcycles will be allowed to park outside the mill compound;
4. Assign traffic marshals or officers to control the vehicular movements at the entrance / exit of the Project Site;
5. Coordinate with the LGU Villanueva in crafting new and better routing scheme within the affected impact zone area;
6. Posting of the project's own traffic officer to assist and coordinate with the LGU's Traffic Bureau for orderly flow of vehicle and pedestrian traffic within the identified route of trucks;
7. Institution of mitigating and enhancement measures to avoid the risk of vehicular accidents (e.g. traffic accidents as a result of hauling of construction materials or construction spoils) and to promote safety like putting of safety and directional signages on the identified route of trucks;
8. Assign sufficient number of owned traffic enforcers during rush hours;
9. Comply with the DPWH load limit requirements of 13.5 metric tons/axle and the speed limit on roads ;
10. Comply with existing road traffic and smoke belching laws, and;
11. Conduct free trainings/seminars on Discipline and Traffic Rules and Regulations for all LGU traffic enforcer, Barangay officials and tanods as well as other interested motorists and pedestrians.

During project operation, the following mitigating and management measures will be implemented:

1. The provincial road is the main ingress/egress;
2. Proper scheduling of hauling of raw materials and finished products in relation to existing truck ban ordinances;
3. No trucks and/or any kind of vehicles, i.e.: cars, motorcycles will be allowed to park outside the mill compound;
4. Designate a substantial area inside the plant site for truck marshalling/holding;
5. Address the parking demands/requirements of employees and visitors through proper allocation of parking slots;
6. Assign a traffic marshals or officers to control the vehicular movements at the entrance / exit of the Project Site;
7. Coordinate with the LGU in crafting new and better routing scheme within the affected impact zone area;
8. Posting of the project's own traffic enforcers to assist and coordinate with the LGU's Traffic Bureau for orderly flow of vehicle and pedestrian traffic within the identified route of trucks;
9. Post proper and permanent directional and safety traffic signs in coordination with Villanueva Traffic Management Office;
10. Assign sufficient number of traffic enforcers during rush hours;
11. Alert concerned government agencies regarding the upkeep and maintenance of the roads.
12. Comply with DPWH load limit requirements of 13.5 metric tons/axle and the speed limit on roads;
13. Comply with existing road traffic and smoke belching laws, and;
14. Conduct free trainings/seminars on Discipline and Traffic Rules Education for all LGU traffic enforcer, Barangay Officials and tanods as well as other interested motorist and pedestrian.

CHAPTER III: 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.

With the identification of the key project activities at each phase and key impact thereof and the delineation of the important baseline conditions (Chapter 2), this Section summarizes the significant impacts and corresponding management plan/mitigating measures.

Table 3.1.1 summarizes all the potential impacts and options for prevention.

Table 3.1.1: Impact Management Plan

Project Phase / Environmental Aspect	Environmental Component Likely to be Affected	Potential Impact	Options for Prevention or Mitigation* or Enhancement	Responsible Entry	Estimated Cost in PhP	Guarantee / Financial Arrangements
CONSTRUCTION PHASE						
Site Clearing and Construction of Facilities	Land	Land contamination due to generation of construction debris such as excess fill materials from grading and excavation activities, scrap wood and metals and small concrete spills	<ul style="list-style-type: none"> Designation of temporary area near the construction site for storage and segregation of wastes Provision of Material Recovery Facility (MRF) and practice good housekeeping through segregation of wastes Provision of Hazardous Materials Facility for proper segregation and storage of hazardous waste 	SAMC	10,000 Part of contract	Agreement with contractor
		Soil erosion due to heavy rainfall	<ul style="list-style-type: none"> Scheduling of construction works during dry months to avoid heavy runoff Contouring and minimizing length of steepness of slopes in case cut and fill will be implemented Providing immediate and effective short-term measures for slope stabilization, sediment control, and subsidence control until long-term measures for the operational phase can be implemented 	SAMC	Part of contract	Agreement with contractor
	Water	Water pollution due to generation of domestic wastewater discharges	<ul style="list-style-type: none"> Provision of at least 3 units portable toilets at the construction site and will be added when necessary Provision of hygienic Septic Tanks with regular desludging by third party contractor as needed at least once a year and 1 Waste Water Treatment Facility where all the domestic liquid wastes are connected to for water recycling for reuse as process water. 	SAMC	Part of contract	Agreement with contractor
	Air	Air pollution due to dust generation due to transport of construction materials	<ul style="list-style-type: none"> Water sprinkling during wet season will be 2x a day while four (4x) times a day during dry season. Delivery trucks shall be covered with canvass materials 	SAMC	Part of Contract	ECC Conditions

Project Phase / Environmental Aspect	Environmental Component Likely to be Affected	Potential Impact	Options for Prevention or Mitigation* or Enhancement	Responsible Entry	Estimated Cost in PhP	Guarantee / Financial Arrangements
		Degradation of air quality due to SOx and NOx emissions from motor vehicles	<ul style="list-style-type: none"> Regular maintenance of heavy equipment at least once a year or as the need arises and motor vehicles at least twice a year 	SAMC	Part of Contract	ECC Conditions
		Noise and vibration due to operation of pile drivers, earth moving and excavation equipment, concrete mixers, cranes and transportation of equipment and materials	<ul style="list-style-type: none"> Proper maintenance of construction equipment and vehicles The Contractor shall at all times comply with all current statutory environmental legislation. Scheduling of activities to mitigate disturbance / potential noise generation 	SAMC	Part of contract	ECC Conditions and DENR Standards on noise
	People	Traffic and road safety and health hazards	<ul style="list-style-type: none"> Implement traffic management through proper scheduling of delivery. Installation of adequate signages approaching National Highway Provide at least 1 personnel / assigned traffic enforcer to manage or direct the vehicles going in and out of the premises. Implementation of 20kph speed limit Coordinate with the LGU 	SAMC	Part of Contract	Contract provisions
OPERATION PHASE						
Operation of Electric Arc Furnace for scrap recycling	Land	Land contamination due to mixing of low and high quality scrap metals to be melted	<ul style="list-style-type: none"> Provision of separate stockpiles for low and high quality scrap metals Provision of storage area for metals from filter dust, slag, and waste metals which will be sold to sintering plants 	SAMC	10,000.00	RA 9003, ECC conditions and EIS commitments
		Land contamination due to generation of slag	<ul style="list-style-type: none"> Proper stockpiling of slag in a landfill, sell to sintering plants or selling it as a raw material to cement plants, use it for social development / livelihood programs or corporate social responsibility. Proper disposal thru DENR-accredited TSD 	SAMC	10,000.00	RA 9003, ECC conditions and EIS commitments
Operation and maintenance of facilities		Land contamination due to solid waste generation	<ul style="list-style-type: none"> Operation and maintenance of Material Recovery Facility (MRF) Segregation or establishment segregation within the area is strictly enforced. 	SAMC	10,000.00	RA 9003, ECC conditions and EIS commitments

Project Phase / Environmental Aspect	Environmental Component Likely to be Affected	Potential Impact	Options for Prevention or Mitigation* or Enhancement	Responsible Entry	Estimated Cost in PhP	Guarantee / Financial Arrangements
			<ul style="list-style-type: none"> Coordination with the local government units for schedule of collection. 			
		Land contamination due to Generation of hazardous wastes such as used oil, used batteries, contaminated rags, busted bulbs and lamps	<ul style="list-style-type: none"> Provision of a Hazardous Waste Storage Area with proper labeling, segregation and storage of wastes Transport, treatment, and disposal by DENR accredited third-party contractors 	SAMC	15,000.00	RA 6969
		Land contamination due to formation of sludge, containing heavy metals, and oil and grease, from wastewater	<ul style="list-style-type: none"> Desludging and collection of sludge from wastewater treatment facility at least once a year for proper disposal to 3rd party TSD Facility 			
	Water	Water pollution from run-off and domestic wastes	<ul style="list-style-type: none"> Construction of rainwater cisterns and collection ponds Regular ambient and effluent water quality monitoring using DENR standards Domestic wastewater management by connecting it to the water treatment facility Zero discharge/effluent 	SAMC	Part of Project Cost	ECC conditions and EIS Commitments
		Water contamination due to generation of domestic wastewater and sludge from septage	<ul style="list-style-type: none"> Provision of hygienic septic tank and septic tank management by desludging at least once a year 	SAMC	10,000.00	RA 9275
		Possible depletion of ground water source as used by the community	Provide 2 rainwater cisterns/collection ponds as rainwater water harvesting system	SAMC	Part of Project cost	ECC conditions and EIS Commitments
		Resource use competition for use of river water for make up water and process water	Implementation of Zero Discharge thru recycling of water (at least 50%) and water recirculation	SAMC	Part of Project cost	ECC conditions and EIS Commitments
		Effluent generation from cooling and quenching, containing scales and emulsified oil	Construction of wastewater treatment plant for removal of oil and sediments in the process water	SAMC	Part of Project Cost	ECC conditions and EIS Commitments
		Contamination and improper management of hazardous waste materials, e.g. transformer oil spill	<ul style="list-style-type: none"> Provision of Hazardous Waste area with proper labeling, segregation and storage of wastes Management of transformer oil to prevent spills. Storage rooms should have concrete containment. The transformer room/ area should also be designed to prevent accidental spills to contaminate soil in the area. The storage room also for used 	SAMC		ECC conditions

Project Phase / Environmental Aspect	Environmental Component Likely to be Affected	Potential Impact	Options for Prevention or Mitigation* or Enhancement	Responsible Entry	Estimated Cost in PhP	Guarantee / Financial Arrangements
			transformer oils should have containment - this is our Hazmat Storage Facility. • Transport, treatment and disposal of DENR accredited third party contractors • Provision of secondary containment for oil drums & diesel fuel tanks • Provision of oil skimmer for mechanical clean up in case of accidental spillage • Proper labelling of oil drums & diesel tanks			
Operation of Electric Arc Furnace for scrap recycling	Air	Degradation of air quality due to generation of particulate matter during melting, oxygen injection and decarbonizing phases (primary off gas emissions), and charging/ tapping (secondary off-gas emissions) and generation of dioxins and furans	• Quick cooling of gas emissions from EAF, followed by bag filters • Ensure complete combustion by achieving temperature above 1200°C	SAMC	Part of Project cost	ECC conditions
Operation of the rolling mill facility		Possible increase in ambient concentration of PM10, CO2, CO, SOx and NOx	• Regular maintenance of equipment and making sure the recuperator system is always working • Use of low sulfur fuel (LSFO or mixing with Diesel at 60/40 proportion/ratio) • Use of enclosures for equipment and insulation for structures • Quarterly monitoring of the ambient air to ensure the project's operation is compliant with the clean air act	SAMC	Part of Project cost	ECC conditions
		Degradation of air quality due to fugitive dusts from equipment and vehicles	• Strict implementation of speed limits in vehicles • Proper maintenance of equipment • Designation of no idling zone • Strict implementation of routine plant maintenance and good house keeping • Regular wet suppression or water spraying during dry weather condition of the access road • Regular maintenance of trucks to reduce or maintain tailpipe emissions	SAMC	Part of Project cost	ECC conditions
		Generation of dioxins and furans	• Ensure complete combustion by achieving temperature above 1200°C			

Project Phase / Environmental Aspect	Environmental Component Likely to be Affected	Potential Impact	Options for Prevention or Mitigation* or Enhancement	Responsible Entry	Estimated Cost in PhP	Guarantee / Financial Arrangements
			<ul style="list-style-type: none"> Use of oxygen injection and post combustion of the EAF off-gas to ensure complete combustion 			
		Generation of Air Pollution from all sources (Point, Area, Volume, Line, generator set, reheating furnace, rolling mill)	<ul style="list-style-type: none"> Regular stack test monitoring 	SAMC	Part of Project cost	ECC conditions
Operation of the rolling mill facility	Noise	Noise from vehicles	<ul style="list-style-type: none"> The Contractor shall at all times comply with all current statutory environmental legislation especially on noise. 	SAMC	Part of Project cost	ECC conditions
		Noise due to plant operations (product handling, waste or by-product gas fans, process cooling and draft fans, dedusting systems, cutting activities, wire rod pay-off units, and transport and ventilation system)	<ul style="list-style-type: none"> Ensure enclosures of process buildings and/or insulation of structures are well maintained Maintain appropriate measures and buffer zones along the entire periphery of the industrial complex with appropriate species/dense vegetation cover to enhance the condition of the ecosystem and to serve as noise, vibration and dust buffers Defective equipment/parts with abnormal noise and/or vibration will be either repaired replaced All employees working on site will be provided with proper PPE especially ear protectors 			
Operation of the rolling mill facility	People	Health and safety hazards	<ul style="list-style-type: none"> Strict implementation of Health and Safety Policies at the Plant Regular conduct of employee safety inspections and toolbox meetings Regular APE and strict implementation on the use of PPEs Regular conduct of First Aid Training Provision of Fire Fighting System 	SAMC	Part of Project cost	ECC conditions
		Traffic due to increase in number of trucks	<ul style="list-style-type: none"> Allocation of open yards and spaces for stationing of the trucks and provide ample parking spaces Adequate signages and proper scheduled hours for the truck and vehicles coming in and out Assign traffic personnel to manage the traffic 	SAMC	Part of Project cost	ECC conditions
ABANDONMENT PHASE						
Demolition of structures	Land	Solid waste pollution/ contamination brought about by	<ul style="list-style-type: none"> Good housekeeping Planting of endemic species or reforestation 	SAMC		

Project Phase / Environmental Aspect	Environmental Component Likely to be Affected	Potential Impact	Options for Prevention or Mitigation* or Enhancement	Responsible Entry	Estimated Cost in PhP	Guarantee / Financial Arrangements
	Water	scraps and debris from demolished structures				
		Oil spill	Conduct of ESA prior to abandonment	SAMC		
		Water pollution/ contamination	Conduct of ESA prior to abandonment	SAMC		
		Air pollution because of dusts from demolished structures	Sprinkling of water	SAMC		
		Noise pollution from structures being demolished	No population center at construction sites	SAMC		
Plant closure or operation stoppage	People	Loss of Jobs	<ul style="list-style-type: none"> • Payment of legal social benefits • Retrenchment package • Labor support programs 	SAMC		
		Health data of employees and communities	Recording based on annual physical checkup of employees and data from Rural Health Units for the community	SAMC		
				SAMC		

Provided in **Figure 3.1.1** is the flow diagram of the Project's waste streams with its management system. Fugitive liquid waste streams might come from leaks from the wastewater pipeline due to pipeline system deterioration thus wastewater canals are planned to be constructed. To avoid this, there will be prediction on the condition of pipes in individual zones and optimization of the utilization of rehabilitation resources by targeting the areas with the highest leakage rates.

PROCESS										WASTE	TREATMENT / MANAGEMENT SYSTEM
				SCRAP						No waste	Solid waste management / Material Recovery Facility
				587,357.4							
				↓	90.00%						
				LIQUID STEEL TAPPING OF EAF						EAF dust / air emission / heat / slag	Dust collector/dedusting system / Slag Treatment System
				528,621.6							
				↓	100.00%						
				LIQUID STEEL IN LF						Wastewater from domestic waste	Deslugging/siphoning by accredited treatment and disposal company
				528,621.6							
				↓	99.20%				0.80%		
				LIQUIDSTEEL IN TUNDISH				REMAIN IN IADLE		Run-off	To be collected in a collection pond for water reuse as process water
				524,392.7				4,229.0			
				↓				↓			
	0.30%		0.30%	↓	98.60%			0.40%	0.40%	Mill scales	For recycling in melt shop
SCALE		CROP CUT		BILLET		CUTTING LOSSES		CAST REMAIN			
1,573.2		1,573.2		517,051.2		2,097.6		2,097.6			
		↓	0.30%	↓	99.70%					Deformed bars	
		REJECT		QUALIFIED BILLET							
		1,551.2		515,500.0							

Figure 3.1.1: Project's Waste Stream

CHAPTER IV: ENVIRONMENTAL RISK ASSESSMENT AND EMERGENCY RESPONSE POLICY AND GUIDELINES

SAMC has high regard to the environment, health, and safety and is committed to serve its consumers' and stakeholders' social and economic needs by providing livelihood projects, technical trainings and career opportunities to deserving local residents of Barangay San Martin and Municipality of Villanueva.

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.

Annex 2-7e of the RPM DAO 2003-03 provides the guide in determining the level of coverage for projects handling, storing, and using hazardous substance and mixtures. The degree of ERA preparation is provided by the following level of coverage:

- Level 1: Preparation of an Emergency/Contingency plan
- Level 2: Preparation of an Emergency/Contingency plan and ERA Report

4.1 ENVIRONMENTAL RISK ASSESSMENT

Risk Screening Study is the initial step for determining whether or not the proposed project will reach these levels. The following are steps for conducting the RSS:

- Identifications of the major substances that will be used in the project;
- Presentation of the physical and chemical properties of these substances;
- Discussion of the hazards associated with these substances during accidents;
- Categorization of the major substances used, handled, or stored at the facility; and
- Determination of the amounts of these substances if it will reach or exceed the threshold limit of Levels 1 and 2.

Table 4.1.1: Hazard Identification, Characterization and Assessment

Hazards	Exposure Pathway and Potential Receptors	Adverse Impact
Noise	Workers' exposure is experienced from equipment, machines, vehicles and human activities.	Nuisance and annoyance problem to workers/personnel and to the nearest downwind community. Transient and permanent noise- induced hearing loss to workers at site.
Dust	Community and workers exposure will be experienced during the construction phase. Exposure pathways are through inhalation and skin contact.	Nuisance and annoyance. Exacerbation of respiratory symptoms and diseases (i.e. cough and asthma).
Air pollutants (Sox, NOx and CO)	Workers and community exposure to vehicle emission and source specific emission (i.e. gen set and furnace).	Increased susceptibility to bacterial infections of lungs. This may aggravate existing respiratory and cardiovascular conditions. Irritation of the respiratory tract and may result to coughing.
Particulates (PM10 and TSP)	Workers and community exposure to minute particles from hauling and delivery trucks and source specific emissions.	Exposure may cause irritation of eyes, skin, and throat or may affect the respiratory system.
Oil and Grease	Workers involved in the repair and maintenance of vehicles, equipment, and machines will be exposed through skin contact.	Contact may cause skin irritation/ dermatitis.
Fall, slips, and other accidents	Workers are largely affected by means of physical contact with hard or heavy objects.	Fatalities Burns Injuries in any parts of the body.

The contribution of the plant to the existing environmental pollution is found on **Table 4.1.2.**

Table 4.1.2: Air pollutants

Air Pollutants	Health Effects	Exposure Limits *
NO ₂	Possible increase in upper respiratory tract infection especially among children <2 years old.	0.053 ppm (200ug/m ³) Annual arithmetic mean
SO ₂	Increase respiratory symptoms like cough, colds, difficulty of breathing, wheezing and bronchitis more common among children and the elderly.	0.03 ppm (365 ug/m ³) 24 hour averaging
PM ₁₀	Increase in respiratory symptoms like cough, colds, difficulty of breathing, wheezing and bronchitis more common among children and the elderly.	Standard for PM ₁₀ 150ug/m ³ 24 hour averaging

Source: National Ambient Air Quality Standards, 1987. US

The Proponent will implement mitigating measures to maintain the safe level of emissions, by providing anti-pollution measures and strictly follow the Environmental Management Plan through periodic monitoring of air pollutants.

4.2 EMERGENCY RESPONSE POLICY AND GUIDELINES

Purpose

The purpose of this plan and procedure is to:

- Safeguard human lives in the event of fire or/and explosion, or any oil/chemical spill that may cause injuries to person/s or/and damages to plant, equipment and environment.
- To establish a systematic and proper line of communication and responsibility towards orderly evacuation, rescue and recovery.
- Safeguard the environment against contamination of any possible spillage during storage, handling and transfer of any quantity of chemical/ oil.

Emergency Identification

It is the responsibility of the Safety Officer/Engineer and members of the Health & Safety Committee to identify and evaluate emergencies with potential risks and come up with a conclusion if a certain emergency will have high impact to Steel Asia, thus a need for a preparedness and response procedures.

When identifying potential emergency situations, consideration should be given to emergencies that may occur during both normal operations and abnormal conditions (e.g. operation start-up or shut-down, construction or demolition activities).

Identification process should consider emergencies that can be associated with specific activities, equipment or workplaces.

Following information should be considered in the identification of potential emergency situations:

History	At least one occurrence from the past in the site or in other similar site / organization
Legal Requirement	Required by applicable law to have emergency preparedness procedures
Geographical Location	If the emergency is highly potential due to the location of the site
Presence of material / equipment that can trigger or worsen the emergency	Available in the site in significant quantity
EHS risk assessment	Identified as emergency situation in at least one area and risk level is at least moderate

In combination to above considerations, the severity of the consequence should be considered as per below **Table 4.2.1**.

Table 4.2.1: Severity of Consequence

Rating	Description
5 - Severe	Can cause severe environmental damage, e.g. permanent / long-term environmental damage; multiple fatalities
4 - Major	Can cause environmental damage, but the damage is not permanent or is only medium term.; Single fatality, permanent total disability, severe occupational diseases or health concerns
3 - Moderate	Can cause environmental damage, but such damage is short term and always repairable; Temporary partial disability, permanent partial disability
2 - Minor	Can result in environmental change, but the effect of such change is easily recoverable or self-recovering, and there is no lasting impact; Minor injury e.g. cuts and bruises
1 - Insignificant Positive	None of the relevant parameters exist at a level that cannot cause environmental change, or may results in a positive environmental effect; No injury, minor discomfort or nuisance e.g. odor

Emergency risks will be assessed using Annex A: SA-IMS-FRM-010 Potential Emergency Risk Assessment in SA-IMS-CP-220.

If any of the condition listed under 4.2.4 is satisfied, rate Probability with "1". Otherwise, input "0". Risk value is equal to the product of Probability and Severity.

If the risk value is at least 3, the potential emergency becomes significant and there's a need for the establishment of a preparedness and response procedures.

Responsibilities

The emergency response team is group of people who will respond or control to all emergency situations like fire, chemical spill and other emergency situation inside the plant as identified to be have a significant risk to plant operations

Team Structure and Responsibilities

In keeping with the internal responsibility system and best practice, all workplace parties have an important role in emergency preparedness and response. These workplace parties include employers, emergency response teams, OH&S committees, workers, managers and supervisors. The development and implementation of an effective emergency management response is a team effort that requires the participation and consultation of all workplace parties. One way of ensuring best practice is to follow these roles and responsibilities of workplace parties.

Emergency Response Teams should:

- Participate in specialized emergency response training as coordinated by the OH&S committee.
- Activate and administrate the ERP in consultation with the employer.
- Report the emergency to all workers and external agencies.
- Control and take command of the situation.
- Coordinate all emergency activities.
- Order evacuation of all workers and visitors, and confirm completion of evacuation.
- Request external aid from mutual agreement partners in consultation with employer.
- Provide the list of hazardous materials to emergency responders.
- Direct equipment shut-downs.
- Initiate rescue operations, including the retrieval of specialized equipment and PPE for the internal emergency response team and workers.
- Attend to casualties.
- Issue the all-clear to workers when it is safe to return to the building.
- Coordinate property clean-up.
- Review results of emergency exercises and drills with all workers, employer emergency and OH&S committee.

Note: Safety Officer will oversee the overall duties and responsibilities of the ER Team

The Emergency Response Team composed of:

Emergency Response Commander with duties and responsibilities of:

- Activate the response team to all emergency situations.
- Direct and support the activities of the ERT and maintain an effective emergency response to reduce the loss of life and property and the cleanup operations.
- Evaluate the severity, potential impact, safety concerns and response requirement based on the information provided.
- Know the normal work location for all the members of the ERT and how to contact them at work and at home. To maintain and periodically update a directory of this information.
- Develop and maintain an Emergency Response Plan.
- Develop and periodically rehearse a plan to evacuate and/or search the building.
- Must be able to gain access to all parts of the building.
- Must know and be able to demonstrate to others the use of all emergency equipment in the plant.
- Know the location of valuable or sensitive areas in the plant and develop a plan to quickly secure those areas.
- Select and train any additional ERT Members necessary to carry out the responsibilities of the position.
- Confirm safety aspects at site, including need for Personal Protective Equipment, sources of ignition and potential need for evacuation.
- Communicate and provide incident briefing to company superiors, as appropriate
- Coordinate/complete additional internal and external notifications.

The **ERC** should always be responsible for directing the response activities and should assume the duties of all the primary positions until the duties can be delegated to other qualified personnel. The more knowledgeable individuals are of their roles and responsibilities during an emergency event, the better prepared a team can be to implement a streamlined response.

Organizational and Manning of the Plant Fire Brigade

- Fire Marshal - Shall have an over-all administrative and supervisory control of the Fire Brigade Organization, responsible for the implementation of the Fire Prevention measures within and outside the building, for maintaining an up to date records of the Fire Brigade Organization, shall conduct periodic evaluation of the equipment available and its replacement of missing and correction of inoperative equipment and call immediate attention of the establishment head, any situation likely to reduce the effectiveness of firefighting operation.
- Deputy Fire Marshal — Assists Fire marshal in enforcing instructions
- Fire Hose Crews - They are members of the fire brigade whose duty is to combat the fire using the fire hose/water from the fire hydrant. The organization and activities of each member of the Fire Hose Team shall be:
- Hydrant Man - He pulls out the hose from the hose Cabinet or stand. He sees to it that sufficient lengths of hose are laid out connected. He is the one who shall commission or decommission the line on signal or instructions from the nozzle man.
- Nozzle Man - Initially charge of the laying out of the fire hose. He is to ensure the right type of nozzle is coupled or connected to the hose line. He is the only person who can signal or give instruction to the Hydrant man to open the hydrant valve.
- Back Up To The Nozzle Man - Assist in laying out the required hose. He may be required to get additional length of hoses to ensure maneuverability of the nozzle man. He is provided all the necessary assistance to the Nozzle Man to ensure expeditious movement in attacking or withdrawing from the area of fire.
- Fire Extinguisher Crews - They are members of the firefighting team whose duty is to provide initial firefighting action using the extinguishers in the area. The first reaction to a fire emergency is to secure the right extinguisher and combat the fire. Tight after the exhausting the content of the extinguisher, they're to assist and serve as back-up to Fire Hose crews.

Spill Response Team

Individuals who are properly trained in controlling and proper clean-up of minor spill:

- Spill Response Team Leader — Evaluate the hazard (s) at the scene; advise on clean up procedure, protective clothing and emergency response equipment investigate the incident & suggest preventive methods and fully understand and be well verse in any spill operations.
- Spill Response Team Assistant Leader - Shall assist and assume all the duties and responsibilities of Spill Response Team Leader in his absence in all emergency situations.
- Spill Response Team Members - Assist the Spill Response Team Leader in all activities involving emergency spill response.

Communication Team

In normal situation, is responsible for the dissemination of information regarding the over-all plan, function and responsibilities of each individual in case of emergency. Should emergency in fire occur, in charge of immediate sounding of fire alarm system; call fire station for assistance; wait for and direct responding units to the specific location of the fire.

Security, Traffic and Crowd Control

Secure and cordon (put barrier) area where incident is in progress; Prevent looters, entry curious onlookers and other persons not involved in the operation to avoid hampering movements of ER team and other units; Secure/salvage valuables to minimized damages and losses, direct traffic emergency vehicles, and have control over assembly area, or as cleared by ERC.

Responsibilities of Assembly Area Leader

- The Assembly Area Leader in the event of an evacuation should immediately coordinate with the Evacuation Leader to obtain the head count. The Assembly Area Leader should:
- Track the number, names and department of missing employees along with the location that they were last seen.
- Track the number, names and types of injuries associated with any injured personnel reporting to the Assembly Area
- Ensure that all employees remain to their assigned Assembly Area.
- Once the building or area has been cleared for re-entry the Emergency Response Team Leader should authorize the Assembly Area Leader to inform the Evacuation Leader to direct the employees back to their respective areas.

Medical Team

Responsible for the immediate administration of all emergency medical treatments to injured persons and seeing to it that all seriously injured are stabilized and brought to the nearest medical unit or hospital for treatment. Composed of the company nurse and registered First Aiders.

Evacuation Team

- Takes charge to locate and extricate victim of endangered areas then stabilize victims and bring them to safe place; must conduct searches for employees reported missing and shall coordinate/assist officer to rescue trapped personnel
- Area Supervisor as the Evacuation Leader
- Upon initiation of an evacuation and rescue the Evacuation Leader should ensure that all work is stopped and that all employees, visitors and contractors evacuate the area or building quickly and in orderly manner using the pre-designated evacuation route.
- Evacuation leader should close the door being sure not to lock it.
- Once at the Assembly Area, take a headcount of the employees, visitors and contractors that have reported to the Assembly Area.
- Determine how many people are missing; their names and the locations that they were last seen and report the head count status to the Assembly Area Leader

- When the Emergency Response Team Leader has cleared an area for re-entry is sure to explain to the employees why an area is safe for upon re-entering the building.

Emergency Command Center

In cases of emergencies, SAMC Admin office is assigned as the command center. It is where the analysis and command will take place during an emergency while the ERT deal with the incident. The center will be equipped with the necessary communication facilities to inform, monitor and received feedback from the field, from the corporation and the external bodies concern about the emergency situation. All emergency databases will be made available at this office which includes:

- Material safety and data sheet (for toxic and hazardous materials)
- Emergency procedures
- Area maps and layout
- Personal development
- Emergency contact list
- Emergency transportation Vehicle
- Equipment data and its respective operating manuals

Emergency Response Procedure

Communication Procedure

Internal Emergency Notification

- Once an employee identifies an emergency situation the employee must report the situation to his immediate superior immediately. The immediate superior informs the ERC.
- Give the following information to the immediate superior, be as specific as possible
- Your name Work Area
- Nature of problem (fire, spill, employee injury, etc.)
- If the employee is on the phone and in a safe location stay on the telephone until the ERC indicates that you can hang up.

Implementation of Emergency Response Plan

- Upon receiving the internal notification, the ERC will activate the Emergency Response Team.
- ERC should immediately report to the Emergency Command Center (Admin Office) ready to provide assistance.
- If necessary, the Safety Officer will contact local responsible agency (Fire dept., Police Dept., Hospital) refer to Emergency Hotline.
- If deemed necessary, the ERC will announce an evacuation.

ERT Communication Procedure

- The ERC will assess the situation and implement the appropriate emergency response. And shall gather and analyze all information available to help determine the appropriate action.
- The ERC shall maintain communication at the Emergency Command Center.
- The ERC will issue clear instruction to the ERT members and other appropriate Company Personnel and be sure they are understood.
- The ERC will ensure that fire; explosions and hazardous materials releases do not occur or re-occur by implementation of preventive measures such as shutdown of operations, containment of chemicals or a shutdown of utilities.
- The ERC will ensure that ERT members entering any hazardous use the buddy system and will not allow entry into dangerous areas without communication capability.
- Once the Emergency is over, the ERC shall ensure the all emergency and production equipment is clean, decontaminated and fit for use before normal operations are resumed.
- ERC through Assembly /Evacuation Area Leader will inform and update Managers and Supervisors; this information will be disseminated to their respective subordinates.

Media Communication

- The management representative shall act as the public relations representative during the incident.
- The ERC will ensure that the public relations representative receive accurate and updated information regarding the emergency incident.
- Employees shall not engage in any dialog with any press or media representative. Company employees should refer press and media representative to the *ERC* and HRAD Manager

Evacuation Procedure

In advance, each employee shall:

- Be familiar with the building evacuation plan
- Recognize the sound of the evacuation alarm
- Know at least two ways out of the building from your regular work space.

Evacuation plan must be posted in the workplace, and made available to emergency responders when they arrive on the scene. The plan must include primary and secondary routes, location of fire extinguishers, fire alarms, fire hose cabinets, emergency exits and assemble areas

Primary and Secondary Escape Routes

Primary and Secondary Escape Routes for all areas must be determined to ensure the evacuation of all employees in a timely and orderly manner. It is important to identify assistance to those individuals who require it when leaving a building.

Emergency Exits

Emergency Exits must be clearly marked with signs and evacuation routes large enough to accommodate the numbers of evacuating people. The Evacuation Team ensure they do not expose workers to additional hazards and are clear of obstruction at all times (e.g. not being used for additional storage areas). Workplace inspections must check all emergency exits, equipment and signage to ensure they are being properly maintained.

Emergency Lighting

An emergency lighting system should be installed to keep work areas and evacuation routes well-lit when lights are unavailable in a power outage.

Assembly Area

All workers must be accounted for in each assembly area nearest to the workplace. See evacuation plan. Building may be evacuated in the event of the following:

- Fire and Explosions
- Hazardous Material Release
- Chemical Spill
- Natural Disaster
- Earthquake
- Typhoon
- Flood
- Bomb Threat
- Power Failure

Evacuation may be announced by any of the following means of communication:

- Public Address System
- Fire Alarm System

When you hear the evacuation alarm or are told to evacuate the building:

- Remain calm
- Immediately cease all operations that may become hazardous

- Leave quickly, without running
- During normal business hours the Supervisor in each area is responsible for ensuring that all employees evacuate the area. In addition, every employee should check that all others in the area are leaving as instructed.
- During other than normal business hours, quickly check nearby restrooms, copier rooms, closets, etc. for personnel as you exit.
- Accompany and assist handicapped personnel, visitors, and any coworkers who appear to need direction or assistance.
- Shut all doors behind you as you go. Closed doors can slow the spread of fire, smoke, and water.
- Proceed as quickly as possible, in an orderly manner. Do not push or shove. Hold handrails when you are walking on stairs.
- Once outside, move away from the building to the designated assembly area.
- Contact your supervisor or Evacuation Assembly Area Leader if you are not familiar with the assembly area locations(s) for your building.

Medical Emergency

The range of medical emergencies can be vast and can include heart attack, airway blockage, epileptic fits or seizures, unconsciousness, absent pulse, uncontrolled bleeding, and possibly, serious injury due to an accident. Each type of incident will present varying conditions and behaviours.

The area Supervisor or the person discovering the injury must immediately call the First Aider or member of medical Team in the area if an injury or illness occurred to conduct first aid.

If the injury requires minor First Aid Treatment minor worker is to be assisted by nominated first aid aider.

If the injured victim needs medical assistance, the ambulance service is to be called or the injured worker can be transported to the nearest medical center, hospital, etc. if the health and safety of the injured person will not be compromised.

The Nurse on duty or representative should assist the victim during transport to the nearest hospital.

Chemical/Oil Spill

Response to chemical spills is dependent on several factors: nature and type of substance, amount spilled, area in which spill occurs, number of persons affected/involved etc.

Procedures for minor spill/oil spill (<200 litres)

- Alert supervisor (if possible)
- Contain spill (if spill is observed to be spreading) with appropriate absorbent (saw dust/rugs)
- Use PPE when trying to contain spill. Avoid direct contact with oil/chemicals.
- Dispose soiled absorbents into disposal bags or empty drum and seal.
- Inform DENR — EMB for investigation and disposal. (If chemical /oil is classified as hazardous)

Procedures for major spill/oil spill (>200 litres)

- The informant should alert personnel in the vicinity by shouting and/or using the paging system
- He should, with the assistance of the personnel in the vicinity (if any) contain the spill with appropriate chemical absorbent.
- The informant should not come into direct contact with the chemicals. Use proper PPE. If not sure, evacuate immediately and inform the Safety Officer and/or ERT Leader.
- The area where chemical spill occurred should be sealed and nobody is allowed to go close without wearing the proper PPEs.

In case of accident where a person has been hit by chemical spill proper care should be given and immediately brought to the nearest hospital for treatment.

- Check immediately the area for any incompatible substances.
- Check for any possibility of spilled chemicals/substances entering any drains, and protect where possible.
- All collected spill chemical should be contained in sealed containers.
- PCO shall be involved in case of emergency.

Monitoring and Control

Area in-charge during spillage is the Spill Control Leader and in coordination with PCO and SO. Monitoring of spillage is conducted by PCO and S.O.

Natural Disaster

Earthquake

Employees should be informed about the following guidelines during an earthquake.

If you are inside the building:

- DROP to the ground; take COVER by getting under a sturdy table or other piece of furniture; and HOLD ON until the shaking stops. If there isn't a table or desk near you, cover your face and head with your arms and crouch in an inside corner of the building.
- Stay away from heavy equipment, glass and chemical storage areas. If in chemical storage area, get out, move and take then cover.
- Move to an inner wall or hallway, the inner core of the building is the strongest and least likely to collapse.
- If not under cover, place anything handy such as coat, magazine or cardboard box over your head and face as shield.
- Do not rush outside doors and stairs maybe broken. The greatest danger from falling debris is just outside doorways and close to outer walls while the ground is shaking

If you are outside the building:

- Stay there but move away from buildings, wall power pole and lamppost.
- Once in the open area, stay there until the shaking stops. The greatest danger exists directly outside buildings, at exits and near exterior walls.

If you are in a moving car:

- Stop the car as soon as possible in a safe manner.
- Do not stop under on an overpass or bridge or near tall building or walls.
- Stay in your car because it is a great shock absorber.
- Be prepared for aftershocks that may be quite strong and cause even more damage due to the already weakened

After the quake:

- Inside the Plant the ERT shall be activated to perform the following procedures:
- Note: Expect aftershocks. These secondary shockwaves are usually less violent than the main quake but can be strong enough to do additional damage to weakened structures and can occur in the first hours, days, weeks or even months after the quake.
- Check the injured personnel. Do not move the seriously injured unless they are in immediate danger.
- Evacuate and take headcount to determine that everyone is accounted for. Search for missing personnel in the area they were last seen.
- Remove debris piece, starting from the top of the pile.
- Check cabinet and chemical storage areas. Open the doors slowly and watch for falling objects spills, fires and leaks. Place an "X" on the areas that you have searched already.

- Notify Local Emergency Response Agencies in case of major fires, spills, leaks and serious injuries.
- Do not allow re-entry into the building until it has been declared safe for occupancy

Typhoon

General Procedure

- The Safety Officer shall obtain weather forecast from PAG-ASA (Phil. Atmospheric Geophysical and Astronomical Services Administration). He shall continue to monitor the incoming severe weather.
- Forty-eight hours prior to the arrival of severe weather the ERT Leader shall survey the plant to determine area that may require tie downs, shutdown of equipment and clean o material or debris.
- Maintenance Personnel shall be advised to check the building especially the roof condition and ensure that electrical outlets and wiring would not be soaked from rainwater.
- The Area Supervisor shall ensure that emergency light in his area is functional and flashlight is readily available
- The ERT shall be assembled and stationed as observers in key areas to render assistance where needed.
- In case of severe weather where employees will be advised to evaluate the plant, the HR Personnel shall provide means of transportation.
- Before and after severe weather the Safety Officer shall continually assess the situation and determine if shutdown in necessary particularly if power is disrupted.
- As soon as possible, after the weather clears, all area supervisors shall prepare a damage report for the Plant Manager.
- Maintenance Department will make repairs in order of plant priorities.

Employees Emergency Procedure

When at Work:

- Do not GO outside unless notified by the Safety Officer that it is SAFE to do so.
- Should work stoppage be declared, determine the NAME of the resource person and the TIME and DATE when work will resume.
- Resume work on specified DATE and TIME.

When going to work:

- Collect accurate information from TV, radio or other related organizations and agencies.
- Call the HRAD to confirm any information on work stoppage
- Determine the NAME of the resource person and the time when work will resume.
- Resume work on specified DATE and TIME.

Flood

Where flooding is not likely occurrence, it may still occur especially due to rupture of water lines. The following procedures shall be followed:

- Notify the ERT leader and evacuate the area immediately.
- Plant Manager shall evaluate the situation and take appropriate action. Particular precautions must take to assure that the flooded area is not electrically energized before entering.
- Maintenance Department shall be informed for equipment repairs or de- energizing.
- Safety Officer shall provide warning sign indicating the slipping hazard on floor spaces.

Civil Disturbance

Receiving the threat

Key employee like receptionist or secretary should be informed of the detailed procedures for receiving a threat.

Written Threat

If a bomb threat is received in writing it should be kept including any envelope, container or accompanying materials. Unnecessary handling must also be avoided and every effort made to preserve possible evidence such as fingerprints, handwriting, paper and postmarks.

Telephone Threat

The person receiving the call should not disconnect the caller, remain calm and try to find out the information detailed on the checklist below. If not able to fill out checklist during the call then complete the checklist as soon as possible after the threat, while details are still fresh in memory.

- Record the time and exact words of the messages with particular emphasis on the description and location of the device.
- Elicit as much information as possible from the caller such as time of explosion, location and bomb specification and why bomb is planted.
- Note the sex of the caller, an impression about his/her age, any peculiarities of voice or speech such as hoarseness, shrillness, speech impediment, accent, dialects, signs of intoxication, irrationality and any pet phrases or other mannerisms.

Responding to the threat / Plans for a response to a threat should include:

- Notify the Operation Manager, ERC, Safety Officer and Security Officer.
- Safety Officer or Security Officer shall immediately call the Local Law Enforcement to inform the situation.
- Follow the Police Department instructions closely.
- Do not hesitate to evacuate the facility if there is any reason to believe that the threat is real.
- ERC shall provide the plant lay out to the Police Respondent for their thorough search of key and critical areas.
- If an appropriate search has failed to confirm the existence of a bomb, emergency police crew and ERT should stand by until it is reasonably certain the limit of threat has passed.

Discovery of a bomb

In the event that a bomb or anything resembling a bomb is discovered follow the following action:

- Evacuate the area immediately
- Do not disarm or move the device.
- Call the Bomb Disposal Unit of the Police
- Alert the ERT to stand by.

Power Failure

- If power failure occurs remain calm.
- Wait for instructions from your Operation Leader and stay in your premises for further report of the situation.
- The electrical maintenance personnel shall switch off all facilities, machine and equipment to protect it from current surges when power returns.

Fire and Explosion

If you discover a Fire:

- Pull the nearest fire alarm
- Check to see if anyone is in immediate danger.

- If it is a very small and controllable fire, attempt to put out the fire ONLY if you have been properly trained in fire extinguisher use and only if it can be done without risk to your safety and health and to others.
- For those who have been trained in safely operating a fire extinguisher, remember to read the label on the fire extinguisher prior to discharge to ensure that the extinguishing materials is appropriate for that particular type of fire
- Do not attempt to fight the fire alone or without having at least two other escapes routes.
- If the fire is uncontrollable, evacuate the area immediately.
- Notify or call immediately the Safety Officer and/or Security Officer or the SIC

If trapped in a Room/Building:

- Stay calm. Do not panic.
- If all exits or stairways are blocked, go to the nearest room and close the door. Keep all doors and windows closed.
- Stuff objects, such as wet cloth towels, into openings to prevent smoke from entering the area.
- If the room has a window, hang a cloth or other object out of the window to signal that the room is occupied. **DO NOT LEAVE WINDOWS OPEN.**
- Wet clothing if possible. Wrap wet clothing around face to minimize smoke inhalation.
- Fill sinks and tubs with water if possible to maintain a supply of water.
- If smoke enters the room prior to the arrival of assistance, keep your head no more than 8-12 inches off the floor where the air is less toxic.
- Shout at regular intervals to alert emergency personnel of your location.
- If there is a telephone, call Emergency Hotline (See Annex B), and advise them of your location and that all exits are blocked. Remain calm, stay on the line as long as possible and wait for the arrival of assistance.

If Caught in Smoke:

- Drop to hands and knees and crawl toward exit
- Stay low, as smoke will rise to ceiling level,
- Hold your breath as much as possible.
- Breathe shallowly through nose, and use a filter such as a shirt or towel.

If forced to advance through Flames:

- Hold your breath.
- Move quickly.
- Cover your head and hair.
- Keep your head down and your eyes closed as much as possible.

If your Clothing or Hair Catches on Fire:

- Do not panic.
- Stop.
- Drop to the ground or floor; roll around until the flames are out.
- Make sure you cover your face and mouth. You will want to protect your face from

Note:

After every drill or actual emergency, generated waste will be disposed of properly in accordance with MSDS or any known legal requirements and risk assessments made prior the execution of the exercises.

Safety Officer shall review the adequacy and effectiveness of the emergency and response procedures and decide if there's a need for revision or not, using attached forms as maybe applicable.

Table 4.2.2: Emergency Drill Frequency

Identified Emergencies	Frequency
Fire & Explosion	Twice a year*
Earthquake	Twice a year*
Chemical/Oil Spill	Once a year
Medical Emergency	Once a year
Typhoon	Once every two (2) years
Flood	Once every two (2) years
Civil Disturbance	Once every two (2) years
Power Failure	Once every two (2) years

Source: PD 1185 Fire Code of the Phils.

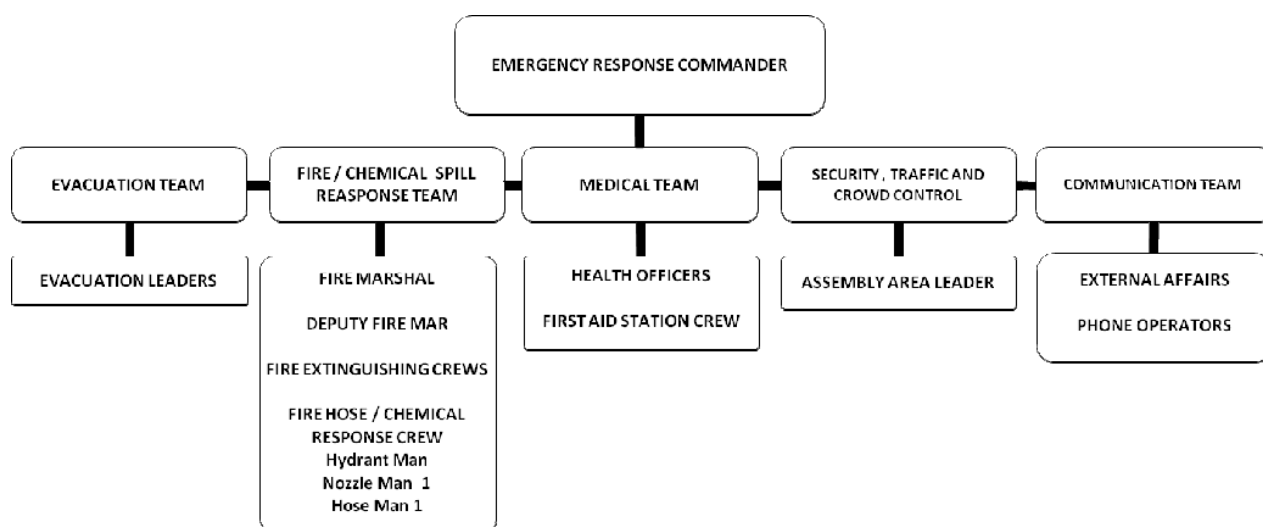


Figure 4.2.1: Emergency Response Team

Functional and procedural flow chart during an Emergency

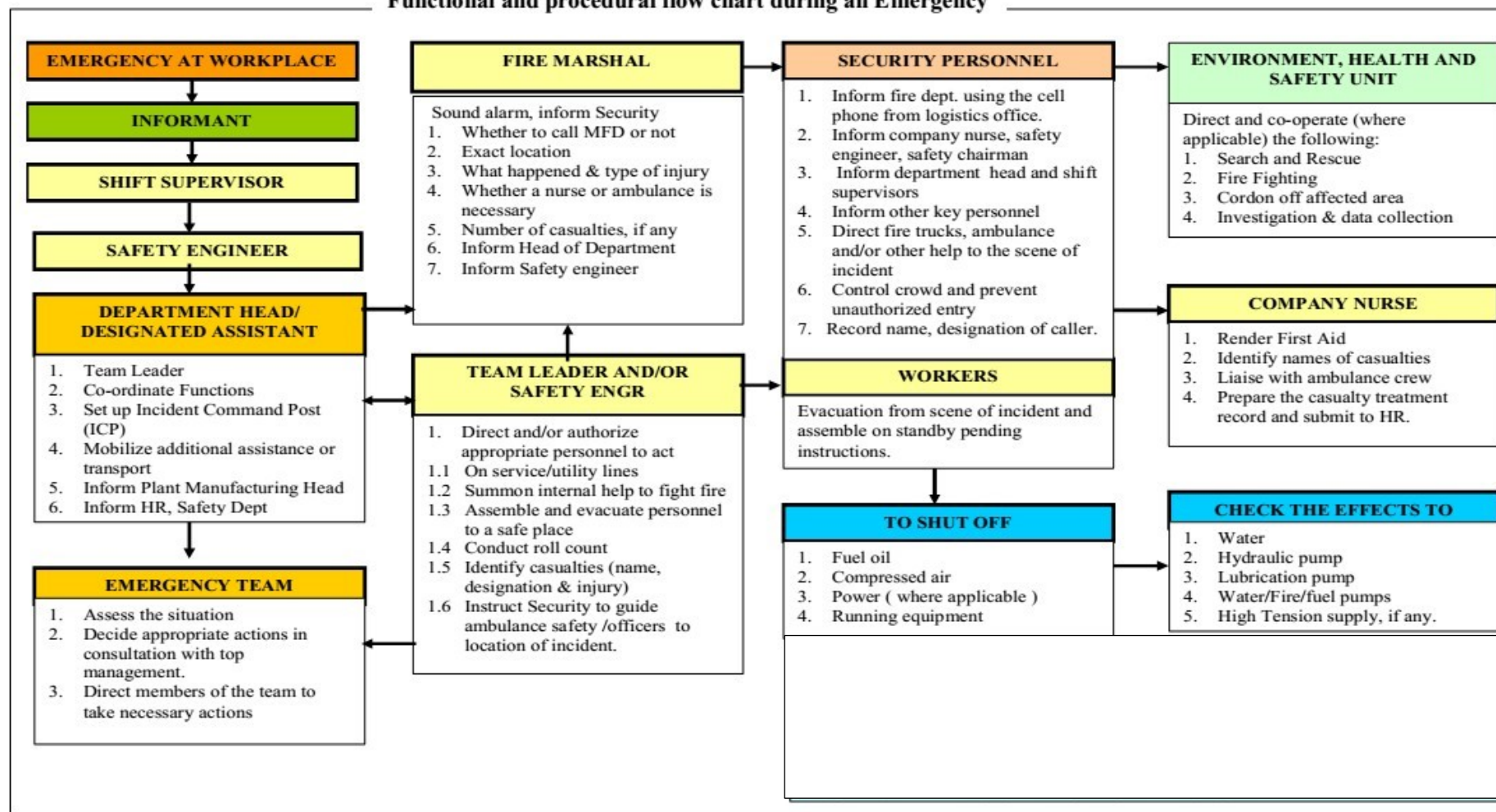


Figure 4.2.2: Functional and Procedural Flow Chart during an Emergency

CHAPTER V: SOCIAL DEVELOPMENT PLAN AND IEC FRAMEWORK

5.1 SOCIAL DEVELOPMENT PLAN

SAMC will be undertaking SDPs in consonance with its Corporate Social Responsibility (CSR) mission, which includes but not limited to the following:

- Skills training to prepare the community for employment opportunities during the construction phase of the project
- Sustainable livelihood training programs
- Environmental/Climate Mitigation Actions: Reforestation and Carbon Sink Programme

The SDP for the proposed project was derived from and aligned with the LGU's existing SDP. The project's SDP normally aims to prevent/mitigate and/or enhance a project's adverse and positive impacts, respectively, on people's livelihood, health and environment. The SDP provided in **Table 5.1.1** shows programs needed by the community based on the perception survey conducted and issues and concerns raised during the Public Scoping and Public Consultation.

Table 5.1.1: Social Development Plan/Framework

Concern	Responsible Community Member / Beneficiary	Government/Non-Government Agencies and Services	Proponent	Indicative Timeline	Source of fund
Livelihood/Employment (Men, Women, Youth and elderly) <ul style="list-style-type: none"> • Skills training to prepare the community for employment opportunities during the construction phase of the project • Sustainable livelihood training programs 	Qualified Project Affected Men, Women, Youth and Elderly	<ul style="list-style-type: none"> • Barangay Council • Municipal Council • TESDA 	Community Relations Officer	Construction Operation	SAMC
Education and Recreation	Barangay Kagawad for Education <ul style="list-style-type: none"> • Project-affected Families 	<ul style="list-style-type: none"> • DepEd 	Community Relations Officer	Construction Operation	SAMC
Environment and Sanitation <ul style="list-style-type: none"> • Reforestation and Carbon-Sink Program • Tree nursery • Climate Change and Disaster preparedness • Adoption of Rivers for clean-up • Coastal Clean-up • Adoption of Mangrove area 	Barangay Kagawad for Environment <ul style="list-style-type: none"> • Project Affected Community 	<ul style="list-style-type: none"> • MENRO • MHO 	Community Relations Officer	Construction Operation	SAMC
Peace and order	Barangay Kagawad for Peace and order <ul style="list-style-type: none"> • Project Affected Community 	<ul style="list-style-type: none"> • LGU • PNP 	Chief Security Officer	Construction Operation	SAMC
Climate Change Adaptation and Disaster Risk Reduction and Management (CCA-DRRM)	Barangay and Municipal DRRM Council	LGU NDRRMC	Safety Officer	Construction Operation	SAMC

5.2 IEC FRAMEWORK

The IEC will be a continuing process through the life of the project. The IEC necessarily involves several media and forms such as perception surveys, public consultations or Focus Group Discussions (FGDs) or print media.

The IEC Plan/Framework for the proposed project is shown in **Table 5.2.1**. This IEC Framework is generic and will be updated before project implementation through consultations with the concerned stakeholders.

Table 5.2.1: IEC Plan/Framework

Target Sector Identified as Needing Project IEC	Major Topic/s of concern in Relation to Project	IEC Scheme / Strategy Methods	Information Medium	Indicative Timeline/ Frequency	Indicative Cost
1. Residents of the host Barangay San Martin	Awareness for the people on the actual impacts and mitigating measures of the Project and concerns related to CCA-DRRM specifically capacity-building for Barangay and Municipal Disaster Risk Reduction and Management Council	Group methods Multi-media	<ul style="list-style-type: none"> Stakeholders' Consultative Planning Session / Community Projects Planning Sessions Informal discussion/ / meeting with stakeholders CCA-DRRM Seminar and workshop 	Annually Monthly	35,000.00
2. Students of elementary schools of the host barangay		Group methods	<ul style="list-style-type: none"> Educational Tour with the elementary schools of the host barangay 	Once a year	50,000.00
3. Stakeholders meeting		Group methods	<ul style="list-style-type: none"> Stakeholder's meeting 	Once a year	25,000.00
4. SAMC employees	Awareness and safety	Group methods	<ul style="list-style-type: none"> Annual Safety program Safety Inspectors Training First Aid Training Hazard Identification and Risk Assessment Training CCA-DRRM Seminar 	Once a year	Part of SAMC's budget for employees

5.3 GRIEVANCE REDRESS MECHANISM

In order to avoid conflict and misunderstanding among employees and the community, SAMC implements the following mechanism:

1. Grievance hotline in different Departments to report any suspected violation in the Code of Ethics or any concerns
2. Regular coordination with the host barangay thru meetings
3. Provision of Bulletin Boards at the Plant site and in the host barangay
4. Reporting to LGU on any issue or concern to the barangay and/or to the LGU of the Municipal Government of Villanueva
5. Dedicated Resident Manager who also acts as Community Relations Officer

CHAPTER VI: ENVIRONMENTAL COMPLIANCE MONITORING

6.1 SELF-MONITORING PLAN

SAMC will conduct a self-monitoring activity of its environmental operations, and will regularly submit its Self-Monitoring Report (SMR) to the DENR. An initial Environmental Monitoring Plan (EMoP) for the proposed project follows Annex 2-20 of RPM for DAO 2003-30. The EMoP is largely indicative and will be refined during project implementation. The Environmental Quality Performance (EQPL) Criteria/Guidelines in the EMoP are interim and could be best firmed up with the MMT prior to construction phase. **Table 6.1.1** presents the definition of EQPL.

Table 6.1.1: EQPL Definition

EQPL Level	Description
Alert or Red Flag	Early warning
Action Level	Point where management measures must be employed so as not to reach the regulated threshold or limit level, or to reduce deterioration of affected environmental component to pre-impact or optimum environmental quality
Limit Level	Regulated threshold of pollutant (standard that must not be exceeded); point where emergency response measures must be employed to reduce pollutants to lower than standard limit.

The EMoP for the proposed project is presented in **Table 6.1.2**.

Table 6.2.1: Environmental Monitoring Plan

Key Environmental Aspects per Project Phase	Potential Impacts Per Environmental Sector	Parameter to be Monitored	Method	Frequency	Location	Lead Person	Annual Estimated Cost in PhP	EQPL Management Scheme					
								EQPL Range			Management Measure		
								Alert	Action	Limit	Alert	Action	Limit
I. Pre-Construction Phase - Not Applicable													
II. Construction Phase													
Environmental Aspect # 1: The Land: Land clearing	Siltation: Increased sediment deposition	Silts in drainage system	Desilting of canals	Quarterly	Construction area	SAMC	10,000	Visual observation of silt deposition	Immediate clean-up	Total clean-up	Presence of Complaints	IEC	Regular coordination with stakeholders thru regular IEC
Environmental Aspect # 1: The Land – solid wastes/garbage accumulation	Soil contamination / pollution	Scraps and debris	Observation	Quarterly	Working areas	SAMC	10,000	Uncollected garbage	Coordinate with the garbage hauler immediate collection of garbage	Ensure regular garbage collection	Presence of Complaints	IEC	IEC
Environmental Aspect # 2: Water	Degradation of Water quality (ground water)	pH	pH probe (USEPA method 3010) By electrode	Quarterly	GW-1 Hand pump tube well in Barangay Santa Cruz, Tagoloan	SAMC	10,000.00	4.0	5.0	6.0-8.5	Review performance	Check WWTF	Regular maintenance of WWTF
		Temperature	Laboratory and field methods	Quarterly		SAMC		23	25	26-30	Review performance	Check WWTF	Regular maintenance of WWTF
		BOD ₅	Azide Modification-Dilution Technique (USEPA method 3010)	Quarterly	GW-2 Hand pump tube well in Barangay Katipunan Villanueva	SAMC	10,000	5	6	7	Review performance	Check WWTF	Regular maintenance of WWTF
		DO	Iodometric Method; Membrane Electrode Method	Quarterly		SAMC		3	4	5	Review performance	Check WWTF	Regular maintenance of WWTF
		Oil and grease	Liquid or Solid Partition Gravimetric Method	Quarterly monitoring	GW-3 Hand pump tube	SAMC		0.6	0.8	1	Review performance	Check WWTF	Regular maintenance of WWTF

Key Environmental Aspects per Project Phase	Potential Impacts Per Environmental Sector	Parameter to be Monitored	Method	Frequency	Location	Lead Person	Annual Estimated Cost in PHP	EQPL Management Scheme					
								EQPL Range			Management Measure		
								Alert	Action	Limit	Alert	Action	Limit
		TSS	Gravimetric (Dried at 103-105° C) (USEPA method 3010)		<ul style="list-style-type: none"> well in Barangay Santa Ana Tagoloan GW-4 Hand pump tube well in Barangay Baluarte Tagoloan GW-5 Hand pump tube well in Barangay Poblacion Villanueva 	SAMC		40	45	50	Review performance	Check WWTF	Regular maintenance of WWTF
III. Operations Phase													
Environmental Aspect # 1: The Land - Generation of solid waste	Soil contamination	Heavy metals	TCLP/AAS	Annually	Area near hazwaste storage	PCO	50,000				Presence of Complaints	IEC	Regular coordination with stakeholders thru regular IEC
	Generation of EAF dust	Heavy metals	TCLP/AAS	Annually		SAMC							
	Generation of slags	Heavy metals	TCLP/AAS	Annually		SAMC							
Environmental Aspect # 2: The Water - Use, Operation and Maintenance of Equipment	Water pollution from used oil	BOD ₅	Azide Modification-Dilution Technique (USEPA method 3010)	Quarterly / Per DAO 2003 - 07	<ul style="list-style-type: none"> GW-1 Hand pump tube well in Barangay Santa Cruz, Tagoloan 	SAMC	10,000	5	6	7 as per DAO 2016-08	Review performance	Check oil and water separator, regular maintenance	Increase frequency of maintenance schedule
		Ammonia		Quarterly monitoring		SAMC		0.03	0.04	0.05	Review performance	Check WWTF	Regular maintenance of WWTF
		Nitrates			<ul style="list-style-type: none"> GW-2 Hand pump tube well in Barangay 	SAMC					Review performance	Check WWTF	Regular maintenance of WWTF
		DO	Iodometric Method; Membrane Electrode Method			SAMC		3	4	5	Review performance	Check WWTF	Regular maintenance of WWTF

Key Environmental Aspects per Project Phase	Potential Impacts Per Environmental Sector	Parameter to be Monitored	Method	Frequency	Location	Lead Person	Annual Estimated Cost in PHP	EQPL Management Scheme					
								EQPL Range			Management Measure		
								Alert	Action	Limit	Alert	Action	Limit
		Oil and grease	Liquid or Solid Partition Gravimetric Method		Katipunan Villanueva	SAMC	10,000	0.6	0.8	1	Review performance	Check WWTF	Regular maintenance of WWTF
		TSS	Gravimetric (Dried at 103-105° C) (USEPA method 3010)		• GW-3 Hand pump tube well in Barangay Santa Ana Tagoloan	SAMC		40	45	50	Review performance	Check WWTF	Regular maintenance of WWTF
		Temperature	Laboratory and field methods		• GW-4 Hand pump tube well in Barangay Baluarte Tagoloan • GW-5 Hand pump tube well in Barangay Poblacion Villanueva	SAMC		23	25	26-30	Review performance	Check WWTF	Regular maintenance of WWTF
Environmental Aspect # 3: The Air – plant operation	Ambient air pollution: Increase in dust generation, Increase in exhaust or SOx and NOx emission	TSP	(S)24 hr High Volume (A)Gravimetric USEPA 40 CFR, Part 50	Quarterly		SAMC through PCO; MMT	100,000.00	400 ug/Ncm	500 ug/Ncm	600 ug/Ncm	Immediate repair, conduct regular maintenance	Replacement of parts and conduct regular maintenance	Stop operation
		SO2	(S)24 hr Gas Bubbler (A) Pararosaniline Method (West and Gaeke Method)	Quarterly			Part of Operating Cost	126	144	180			
		NO2	S)24 hr Gas Bubbler (A) Griess-Saltzman or Chemi luminescence Method	Quarterly			Part of Operating Cost	105	120	150			

Key Environmental Aspects per Project Phase	Potential Impacts Per Environmental Sector	Parameter to be Monitored	Method	Frequency	Location	Lead Person	Annual Estimated Cost in PHP	EQPL Management Scheme					
								EQPL Range			Management Measure		
								Alert	Action	Limit	Alert	Action	Limit
		PM10	Quarterly	Quarterly			Part of Operating Cost	70% of the CAA limit	80% of the CAA limit	90% of the CAA limit	Conduct adjustment of the unit's operation as per operating manual.	Check APCD	Stop operation until the problem has been resolved
Environmental Aspect # 3: The Air – Operation of Rolling Mill	GHG emission	CO ₂ , CH ₄ , and N ₂ O Emissions based on IPCC 2006 Guidelines and USEPA Procedure	Implementation of Reforestation and Carbon-Sink / GHG reduction program			SAMC	Part of Operating Cost	Unattended reforestation commitment	80% reforestation	60% reforestation	Immediate planting of trees and revegetation	Review reforestation and carbon sink program	Further study or revision of the program
Environmental Aspect # 3: The Air – Operation of Melt shop	Generation of EAF dust	Heavy metals	TCLP/AAS	Annually		SAMC					Immediate repair, conduct regular maintenance	Replacement of parts and conduct regular maintenance	Stop operation
Environmental Aspect # 3: The Air –Operation of equipment and vehicles	Increase in sound levels from operation activities	Sound levels	Sound measurements using handheld sound meter	Quarterly		SAMC	To be determined	does not exceed 71.6dB	does not exceed 76.6 dB	does not exceed 81dB	Investigate and identify source of noise	Identification of the source of noise and check buffer zones and noise attenuation measures	Assess performance of the attenuation measures, employ corrective measures and install additional measures if necessary
Environmental Aspect # 4: The People	Traffic congestion	Traffic condition / Road Accessibility	Visual: Number of vehicles per report of Receiving Clerk Representation with the LGU regarding road network and its infrastructure plans Traffic Impact Assessment	Daily	Access Road	SAMC	Part of the Proponent's responsibilities	20 minutes traffic	Half hour traffic	1 hour traffic	Deployment of traffic enforcers	Increased deployment of traffic enforcers	Review traffic management program and impact assessment and revise

Key Environmental Aspects per Project Phase	Potential Impacts Per Environmental Sector	Parameter to be Monitored	Method	Frequency	Location	Lead Person	Annual Estimated Cost in PhP	EQPL Management Scheme							
								EQPL Range			Management Measure				
								Alert	Action	Limit	Alert	Action	Limit		
	Accidents	Number and Nature	Records from Clinics Safety Records	Monthly	NA	Health and Safety	No cost	3	4	5	Evaluation of safety procedures				
IV. ABANDONMENT PHASE															
Environmental Aspect # 1: The Land: oil spill	Soil contamination	Heavy metals	TCLP/AAS		Area near hazwaste storage	SAMC	50,000	Apply remedial measures							
Environmental Aspect # 2: The Water	Water pollution/contamination	<ul style="list-style-type: none">• BOD₅• Total Coliform• Fecal Coliform• Total Suspended Solids (TSS)• pH	ESA that will be conducted prior to abandonment			SAMC	To be determined	Based on ESA recommendations							
Environmental Aspect # 4: The People	Employment	No. of employees	Hiring process	Every hiring season	Brgy. San Martin and municipality of Villanueva	HR and Personnel Department of SAMC	150,000.00	70% implementation of employment program	60% implementation of employment program	50% implementation of employment program	Review programs	Revise programs	Enhance program implementation		
	Environmental Aspect # 1: The Land: oil spill	Soil contamination	Contaminated soil TPH (C6-C36)	USEPA 8260C	Once before decommissioning	Hazardous Waste Storage Area	PCO	50,000	80	90	100	Investigate source of contamination and implement corrective measures	Investigate and strengthen implementation of measures		
			USEPA priority pollutant metals (Sb, As, Be, Cd, Cr, Cu, Pb, Hg, Ni, Se, Ag, TI,Zn	USEPA 8015C					USEPA 7470A	USEPA 6020A	0.8			0.9	1.0
			VOCs	USEPA 8260						1.6	1.8			2.0	
		SVOCs													

Key Environmental Aspects per Project Phase	Potential Impacts Per Environmental Sector	Parameter to be Monitored	Method	Frequency	Location	Lead Person	Annual Estimated Cost in PHP	EQPL Management Scheme					
								EQPL Range			Management Measure		
								Alert	Action	Limit	Alert	Action	Limit
				USEPA 8270					40	45	50		
	Livelihood opportunities for local people and entrepreneurs	No. of Programs implemented	Survey / FGD	Quarterly	Villaueva	Comrel	150,000.00	60% implementation of programs	100% implementation of programs	Review programs	Revise programs	Enhance program implementation	Livelihood opportunities for local people and entrepreneurs
	<ul style="list-style-type: none"> Total taxes paid to the national government Development of small and medium enterprises like transport, construction and utility services, food services and laundry supplies 	Total taxes paid	Real Property Tax payments	Quarterly	Villaueva	Comrel		90% availment	70% availment	60% availment services	Review availment and identify issues	Coordinate with LGU to determine if there are revisions/improvement needed	Revisit policy and implement amendments and enhancements

6.2 MULTI-SECTORAL MONITORING FRAMEWORK

Pursuant to DAO 2017-15, the law mandates that after issuance of the ECC, a Multi-Partite Monitoring Team (MMT) shall be formed for ECPs. 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 and DAO 2018-14 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. Provided in **Table 6.2.1** are the commended MMT members for the proposed project.

Table 6.2.1: MMT Composition

Stakeholder-Members
LGU Representatives
<ul style="list-style-type: none"> • Municipality of Villanueva/ MENRO • Rural Health Office Chief • Barangay Chairman of San Martin
LGU-Accredited Local NGO
Two (2) representatives from locally-recognized community leaders
Three (3) representatives from government agencies with related mandate on the type of project and impacts during operations
PENRO/CENRO

6.2.1 Functions of the MMT

As an independent entity whose membership represents the stakeholders / public, the MMT is expected to add credibility by being open and transparent in monitoring environmental impacts and compliance with the Philippine EIS System requirements.

The MMT shall have the following specific functions:

- Conduct quarterly ocular site visit to validate the proponent's compliance with the ECC conditions and the EMP and EMoP including the requirement to conduct self-monitoring and submit corresponding reports regularly. The MMT may observe sampling activities conducted by the project proponent.
- Prepare and submit its report to EMB Central Office and EMB Regional Office using EMB-prescribed format at least semi-annually not later than July 30 for the first semester report and January 30 for the 2nd semester report
- Institute and environmental emergency and complaints receiving and management mechanism, which shall include systems for transmitting recommendations for necessary regulatory action to EMB in a timely manner to prevent adverse environmental impacts.

6.2.2 MMT Formation and Operationalization

After the issuance of ECC, SAMC shall initiate the formation of the MMT based on DAO 2017-15 and relevant ECC condition. A Memorandum Agreement (MOA) between EMB Central Office and SAMC based on a pro-forma to be provided by EMB shall be executed with conformity of members of the MMT. The MOA signed by SAMC and the new members the MMT shall be submitted to EMB Central Office for final approval within the deadline specified in the ECC.

A MMT Manual of Operations (MOO) shall be formulated / updated based on the policy updates. The MOO shall guide the MMT in planning its activities.

In the conduct of its quarterly site visit, the MMTs shall implement the usual procedures including a closing meeting where the MMT findings shall be discussed with the representative of SAMC.

MMTs who do not submit the required reports, those who fail to submit its report before the deadlines or submits incomplete reports for one (1) year shall be suspended until such time that such requirements are complied with.

Individual MMT Members who violate the code of ethics shall be subject to suspension/removal/replacement/ by the chairman of MMT or any other disciplinary action as indicated in the MOO.

6.3 ENVIRONMENTAL GUARANTEE AND MONITORING FUND COMMITMENTS

SAMC commits to establish an Environmental Monitoring Fund (EMF) and Environmental Guarantee Fund (EGF). The EGF Amount will be Php1,000,000.00 and an EMF with an amount of Php300,000.00 will be established immediately after the Memorandum of Agreement (MOA) which is based on the activities and programs of the MMT. The EMF is still be subject to adjustments together with MMT members especially during the preparation of the Annual Work and Financial Plan once the MMT is established. The EMF will be replenished once the amount of Php300,000.00 is less than 50%.

Whereas, the proposed EGF amount will be Php500,000.00 Trust Fund and Php500,000.00 Cash Fund which is the current EGF baseline amount for similar steel mill projects. EGF will be used exclusively for the following purposes:

- Immediate rehabilitation of affected areas and the resulting deterioration of environmental quality as a direct consequence of the proposed Project construction, operation and abandonment;
- Just compensation of parties and communities affected by the negative impacts of the proposed project; and
- Contingency and clean-up activities, environmental enhancement measures, damage prevention programs and social equity measures including the necessary public participation and capability building activities related to the proposed project.

The EGF Trust Fund and EGF Cash Fund shall be replenished to its original amount annually or whenever the amount goes below 50% of the original amount. The EGF Trust Fund shall be renewed upon every expiration.

CHAPTER VII: DECOMMISSIONING/ ABANDONMENT/ REHABILITATION POLICY

Decommissioning refers to the permanent stoppage of the plant operations. The relevant aspects, waste generation, issues and built-in measures during this phase will be dependent on the decommissioning plan. The decommissioning / abandonment plan necessarily starts with an ESA taking note in particular of any residual toxic substances especially in the soil.

As a matter of procedure, the Decommissioning shall be subject to submittal of a plan and approval thereof by the EMB. Third party monitoring of the decommissioning activities for the check and balance may be made by the MMT and the EMB. Unless given clearance after the decommissioning works shall have been completed, the SAMC shall remain legally responsible for any residual impacts on the environmental resources.

On the basis that the economic life of the project at a minimum of forty (40) years, decommissioning may take place after this period. The protocol for the decommissioning is premature to develop at this early stage but will include among others the following aspects:

In drafting the Decommissioning/Abandonment Plan, following shall be considered:

1. Baseline environmental conditions especially air and water quality. Any plan shall be accompanied by definite action plans on how to rehabilitate the environmental resources in order to approximate its pre-project state.
2. Result of the monitoring activities.
3. Existing rehabilitation program and the cumulative accomplishments of the mitigating measures. The accomplishments will be useful in the determination of the performance gaps, which must be given more attention and funding if needed. Also, consideration of these efforts shall be given attention to have continuity and not just disregard them.
4. Issues and concerns, demands, opinions, wishes and suggestions of the local community, workers and local government, which may be extracted thru several means of public consultation. It is best to consider them they will be the ones who will be left behind after the life of the Project.
5. Inputs from MMT as an independent third party institution and interaction and relationship between EU and MMT.
6. Procedures for decommissioning of the equipment which will consider the following:
 - Potential use of the equipment to be decommissioned; i.e. equipment that can be usable by third parties needs to be decommissioned intact.
 - Transportation of equipment and other materials used
 - Alternatives for the future use of the abandoned area
 - Alternate use of the area, which may involve development into business centers including area for housing.
 - Consistency with the long-term zoning and land use development plan
 - Restoration/rehabilitation plan; and
 - Results of the ESA mentioned above.

CHAPTER VIII: INSTITUTIONAL PLAN FOR EMP IMPLEMENTATION

8.1 INTRODUCTION

This section provides the instrument required to establish a proactive institutional requirement to guarantee compliance with environmental regulations and policies and implementation of environmental safeguards and commitments. It is important to set up capable and competent unit/group with properly defined roles in the process of the monitoring and evaluation of post EIA requirements and commitments as well as with other environmental regulations. It is important to identify and provide the group that will implement said requirements for a sustainable project operation.

8.2 FUNCTION

The Environment Unit/Team is responsible for the environmental performance of the project. It ensures implementation of the environmental safeguards and controls for the project implementation (for all phases of the project) and is responsible for overseeing environmental compliance activities, environmental requirements and regulatory obligations.

Core Function of the team/unit includes the following:

- Systems and Procedures
- Environmental Safeguards and Implementation
- Government Regulatory Compliance
- Environment Health Safety Program and Awareness
- EHS Program Compliance

8.3 SETUP

In many cases, the environmental unit leads the post EIA compliance and implementation process in collaboration with the other technical team/groups to provide technical support. **Figure 8.3.1** illustrate the institutional framework for the proposed project. There are no generally applicable, rigid rules, so many variations are possible depending on the personnel capacities and structures.

The MMT is also included as part of the EMP implementation mechanism because it has the primary role of monitoring the project's implementation of the committed EMP.

STEELASIA ORGANIZATIONAL STRUCTURE
AS OF FEBRUARY 2018

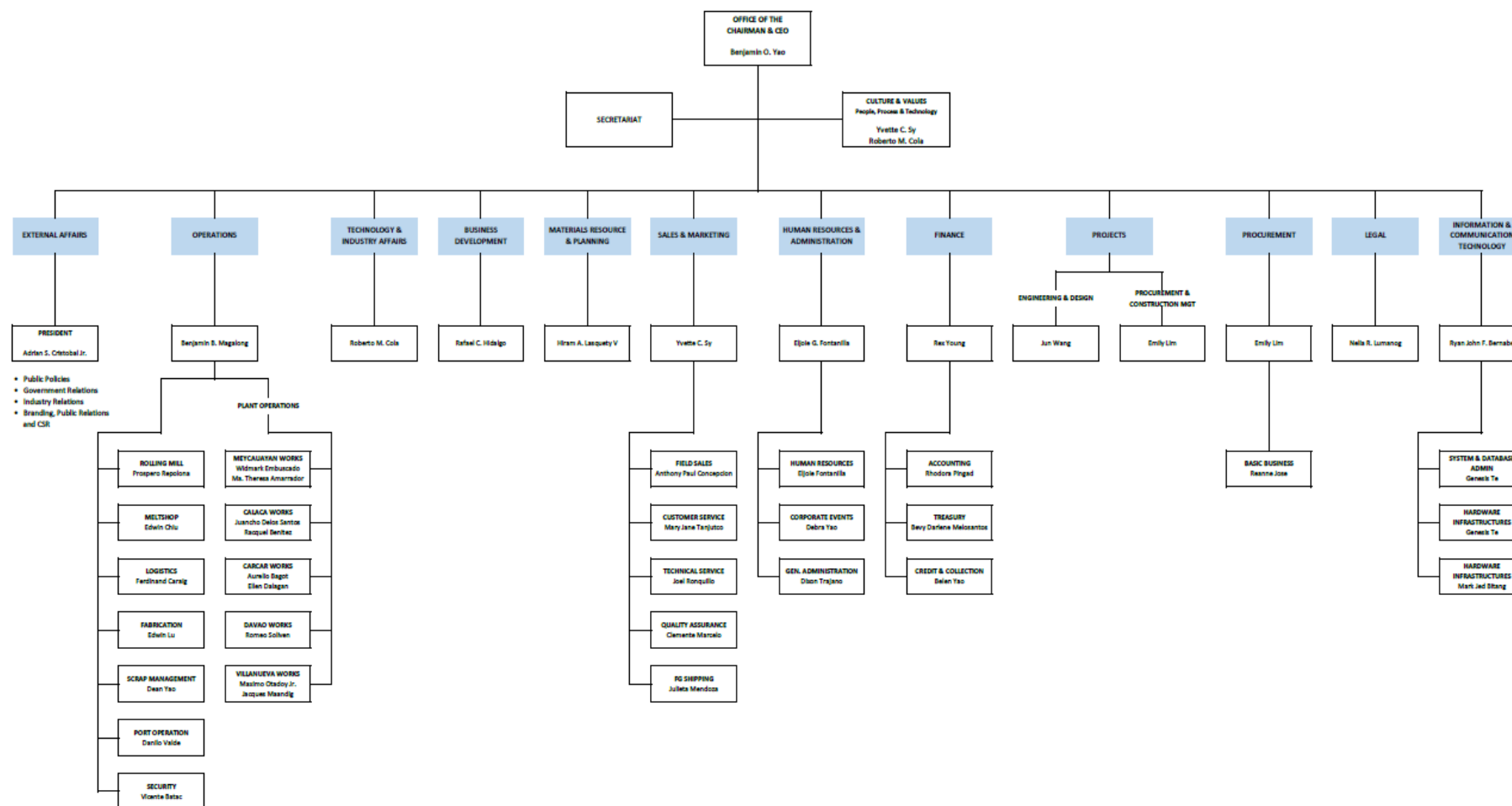


Figure 8.3.1: Initial Organizational Chart/Institutional Plan for EMP Implementation

8.4 ROLES AND RESPONSIBILITIES

Table 8.4.1 provides the brief description of the role and responsibilities of the key personnel, the technical team, and collaborating units/groups in the implementation of the EMP.

Table 8.4.1: Roles and Responsibilities of Departments and Key Personnel

Department/Key Personnel	Roles and Responsibilities
Operations	<p>The operations department is responsible for acquiring the inputs and devising the best plant operations methods so that value adding occurs in the most efficient and effective way. Thus, the role of operations management (and the operations manager) is to ensure a smooth production process that contributes to the output of goods and services of an organization. In additions, following are inherent responsibilities of the Operations Department:</p> <ul style="list-style-type: none"> • Full Plant operations • Safety and Morale of the Department • Production / Schedule attainment • Continuous Improvement • Leadership and Direction, plant wide • Customer interface • Company policy enforcement • Production start-up / launch
Maintenance	This department is in charge for the schedule and regular inspection, maintenance and repair of equipment
Engineering Support	This Department is in charge of the automation control, optimization, safety and testing of necessary support needed by the plant.
Administration and Finance	<p>Administrative and Financial Department is a unit to be assigned with various responsibilities concerning personnel, finance, publications, public relations, conferences, sale of documents and similar administrative functions; in particular:</p> <ul style="list-style-type: none"> • Personnel affairs; • Organization of training of officials and supervision of programs established to that effect; • General services including the general register of the staff and services; • Rendering consultations to other Departments on organizational matters; • Preparation of studies on the administrative organization; • Maintaining and auditing the accounts of the Company; • Supervision of storage and purchasing; • Preparation of the budget; • Organization of administrative services for conferences and meetings; • Maintaining and organization of the library and the archives as well as their use.
Pollution Control Officer/ Engineer	Compliance to environmental regulations and standards; maintenance of reports that are submitted to internal and external agencies
Safety Engineer	Responsible for implementation of emergency response procedures, handling of hazardous materials and environmental management systems and requirements of DOLE on occupational safety and health
CSR and SDP personnel	Community relations, design, training and implementation of CSR and SDP programmes
MMT	<ul style="list-style-type: none"> • Monitor project compliance with the conditions stipulated in the ECC and commitments made in the EMP using checklist form and mainly secondary technical information and primary observations; • Prepare, integrate, and disseminate simplified monitoring reports and submit recommendations to the DENR; • Monitor implementation of community IEC plan/program and SDP; • Interface with the technical third party audit group to understand and be updated on Monitoring and Evaluation results;

Department/Key Personnel	Roles and Responsibilities
	<ul style="list-style-type: none"> • Initiate popularization of Monitoring and Evaluation results for community consumption; and • Officially receive complaints/requests from the public-at large for transmittal to the proponent and EMB-DENR and be able to recommend immediate measures against the complaint.

8.5 ROLES AND RESPONSIBILITIES SKILLS AND COMPETENCY

Selection of competent and effective personnel comprising the environmental unit will be crucial in the institutional or organization building. Qualifications for the members may include the following:

- Understanding of environment management, legal regulatory framework, environmental impact assessment and reporting, and environmental compliance and audit management. Well-versed and familiar with the application of local laws and regulations on Environmental regulatory compliance.
- Experience in integrated environmental assessment
- Good relationship with the environmental regulatory authority
- Capacity to dialogue with different stakeholders from both the public and private sector, and ability to build consensus on key environmental issues
- Oral and written communication skills; people skills; project coordination; monitoring and audit; scientific research and development; project planning; policy formulation; and training and facilitation

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CHAPTER X: ANNEXES

ANNEX ES-1: Accountability Statement of the Proponent and Preparer

ANNEX ES-2: EIA Scoping and Screening Form

ANNEX ES-3: IEC Documents

ANNEX ES-4: Results of Initial Perception Survey

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ANNEX 1-1: SEC Registration of SteelAsia Manufacturing Corporation

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ANNEX 2-1: Zoning Certificate

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ANNEX 2-3: Selected Input and Output Files of the Model Runs

ANNEX 4-1: Detailed ERA and EPRP of SAMC

ANNEX 6-1: PEMAPS Questionnaire