

ENVIRONMENTAL IMPACT STATEMENT

Proposed Candelaria Rolling Mill Project
Brgy. Malabanban Sur, Candelaria, Quezon



CANDELARIA  STEEL

Prepared by:



Mediatrix Business Consultancy

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EXECUTIVE SUMMARY

I. PROJECT FACT SHEET

Project Name	Proposed Candelaria Rolling Mill Project
Project Location	Barangay Malabanban Sur, Candelaria, Quezon
Project Area	326,687 sq.m.
Project Type	Iron and steel mill; Steel Manufacturing
Project Capacity	600,000 MTPY
Project Description	<p>The proposed project is a rebar and wire-rod mill. This will produce rebars and wire rods which are inputs to countless uses, such as building and construction of houses, infrastructure and different concreted works. CSI will use "state of the art" technologies for this project because in the long run it will provide the lowest operating cost.</p>
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>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. The following are the major rationale for the project:</p> <ul style="list-style-type: none"> • Supply the increasing demand of rebars, particularly the upcoming infrastructure growth in South Luzon region. • Support housing construction in the region. • Support construction of power plants, BPO, office spaces and tourism projects. • Support the Visayas reconstruction projects <p>The proposed project will also provide support to the following infrastructure projects:</p> <ul style="list-style-type: none"> • SLEX Toll Road 4 Expressway • Laguna Lake Highway • PNR South Commuter and South Long-Haul Project • Quezon-Bicol Expressway (QuBex) • Cavite-Laguna Expressway (CALAX) • Cavite Industrial Area Flood Risk Management Project (CIA-FRMP) • Camarines Sur Expressway
Project Components	<p>Following are the components of the project:</p> <p>A. Main equipment:</p> <ol style="list-style-type: none"> 1. Reheating furnace 2. Rolling train 3. Cooling bed 4. Bundling <p>B. Ancillary facilities:</p> <ol style="list-style-type: none"> 1. Water treatment plant

	2. Pumping Station and water pipes 3. Rainwater collection reservoir 4. Rainwater collection reservoir 5. Power substation 6. QA laboratory 7. Machine shop
Manpower	<p>During Construction, an estimated manpower of 500 workers for the project will be required where three (3) will be directly hired by Candelaria Steel, Inc. while 497 will be employed by the Contractor.</p> <p>During Rolling Mill operations, 500 workers will be required which will be directly hired by Candelaria Steel in coordination with the Public Employment Service Office (PESO) of Candelaria.</p> <p>Skills training will be conducted before construction for workers in the host community to qualify with the skills requirements of the Plant.</p>
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 5,000,000,000.00.
Proponent Profile	
Name of Proponent	Candelaria Steel, Inc. – a subsidiary of SteelAsia Manufacturing Corporation.
Address	B2 Bldg., Bonifacio High Street, BGC, Taguig, Metro Manila
Authorized Signatory/ Representative	Mr. Roberto Cola Vice President
Contact Details	Landline number: (632) 856-6888 Mobile No.: +639178675921 Email address: RMCola@steelasia.com
Profile of the Preparer	
EIA Preparer	Mediatrix Business Consultancy
Consultant's Address	L29 Joy-Nostalg Center, 17 ADB Ave., Ortigas Center, Pasig City
Contact Person	Matilde R. Jimenez-Fernando General Manager
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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 Candelaria Steel, Inc. (CSI). The composition of the EIA Team is presented in **Table ES-1**.

Table ES-1: EIA Team Composition

EIA Team	Areas of Expertise	EIA Registration No.
Mediatrix Business Consultancy		
Matilde J. Fernando	Team Leader, Socio-Economics and Legal Framework	IPCO-035
Reynaldo S. Tejada	Air Module	IPCO-036
Hernani Bayani	Geology Module	IPCO-058
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

Mediatrix, together with the CSI, 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 Public Scoping was conducted on August 11, 2016 while the Technical Scoping was conducted on June 14, 2017. EIA baseline studies and impact assessment were conducted in May 2018 and the Environmental Impact Statement (EIS) Report was completed in June 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
EIA Planning, Project and Stakeholder Profiling	April 2016
Preliminary IEC and consultation with the officials of Candelaria	May 2016
Public Scoping	August 11, 2016
Technical Scoping	June 14, 2017
EIS Report Preparation	
• Air	August 13, 2016
• Water	August 13, 2016
• Terrestrial	July 1 to 3, 2017
• People	August 26, 2016
• Soil	Sept. 7, 2018
Official acceptance of EIS by EMB	January 17, 2019
1 st Review	January 25, 2019
Public Hearing	
Final Review	

EIA Methodology

Pursuant to the Department Administrative Order (DAO) No. 30 Series of 2003 of the Revised Procedural Manual of the Philippine EIS System (PEISS) and EMB Memorandum Circular 005 dated July 7, 2014, the proposed project is classified under Category A - 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 June 14, 2017.

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

Table ES-3: EIA Methodology

EIA Study Module	Parameters/Scope	Baseline Sampling and Methodology
Land		
Geology/Geomorphology, Pedology,	Reconnaissance, land use, land classification assessment, slope,	Review of secondary data, soil sampling and testing, review of

EIA Study Module	Parameters/Scope	Baseline Sampling and Methodology
Land Use and Classification	soil types and classification, erosion	geological reports and maps, soil site assessment
Terrestrial Biology – Wildlife and Vegetation	Flora and fauna species inventory, species endemism and conservation status, species abundance, frequency and distribution	Use of secondary data and inventory
Water		
Hydrology/Hydrogeology	Regional hydrogeology, catchment and drainage system	Spring and well inventory, flow measurements, use of secondary data, water balance analysis, flow duration and water flow analysis and groundwater recharge and production analysis, interviews
Water Quality	Physico-chemical and bacteriological characteristics of rivers, wells, springs, and river water	Water sampling and laboratory analysis
Freshwater Ecology	Full accounting of all existing benthic habitats, species, composition, density, and diversity of associated macro benthic algae in front of the project site, commercially-important macro invertebrates in the inter-tidal areas, plankton community	Use of primary and secondary data and interviews
Air		
Meteorology/Climatology	Monthly average rainfall, climatological normal and extremes, wind rose diagrams, and frequency of tropical cyclones	Use and review of secondary data
Air Quality and Noise Level	Ambient air quality and noise levels	Ambient air quality and noise sampling and laboratory analysis
Air Dispersion Modeling	Worst case scenario identification, use of meteorological data	Use of Screen 3 and AERMOD Models
Temperature and Rainfall Change	Seasonal Temperature (in °C) and Rainfall (in %) Change in 2020 and 2050 under medium range emission scenario in Quezon Monthly Average Temperature and Rainfall without Climate Change Monthly Average Temperature and Rainfall with Climate Change (2006-2035) Monthly Average Temperature and Rainfall with Climate Change (2006-2065)	Assessment of effects of Temperature and Rainfall Change
Greenhouse as Assessment	GHG Emissions based on IPCC 2006 Guidelines and USEPA Procedure	Assessment of Bunker oil consumption vs GHG emissions
People		
Public health and	Morbidity and mortality trends,	Interviews with key elected officials

EIA Study Module	Parameters/Scope	Baseline Sampling and Methodology
Demography	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	of the barangays (from barangay captains to councilors and the social welfare barangay officers/ barangay health workers); analysis of secondary health data; Use of secondary data from RHU and PSA; Interviews with the locals; household-level survey
Socio-economics	Socioeconomic data: Main sources of Income, Employment rate/ profile, sources of livelihood, Poverty incidence, commercial establishments and activities, banking and financial institutions	Perception surveys, Interviews with municipal and barangay officials; analysis of secondary data; analysis of survey results, Traffic assessment
Environmental Risk Assessment		
Risk Assessment	Safety risks and physical risks	Consequence and Frequency analyses to be undertaken 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, CSI has conducted a series of public participation activities through pre-scoping Information, Education and Communication (IEC) via FGD/KII, perception survey, public public scoping and informal discussions with the Municipal and Barangay Officials of Candelaria and Malabanban Sur from March 2016 regarding the proposed project.

Focus Group Discussion/Key Informant Interviews

FGD/KII are frequently used as a qualitative approach to gain an in-depth understanding of social issues. The method aims to obtain data from a purposely selected group of individuals rather than from a statistically representative sample of a broader population.

FGDs/KIIs were conducted on Oct. 14, 2015 and Dec. 16, 2015 in Candelaria and Malabanban Sur.

Perception Survey

The perception survey was conducted on August 28 to 30, 2016. A total of 383 households were randomly interviewed and surveyed. The Malabanban Sur population of 9,123 as of 2015 was used.

Public Scoping

The Public Scoping was conducted on August 11, 2016, 10:00 a.m. in Brgy. Malabanban Sur Candelaria, Quezon. Registration started as early as 9:30 am while the Program started at 10:00 am. A total of 225 attendees joined the Scoping activity.

III. EIA SUMMARY

Summary of Alternatives

Siting

The following site locations were considered for the proposed project:

- Barangay Salong, Calaca, Quezon

- Barangay Camastilisan, Calaca, Quezon
- Barangays Malabanban Sur, Quezon

However, based on the following criteria, the project site in Barangay Malabanban Sur, Candelaria, Quezon 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.** CSI'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. About 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 the most modern rolling mill equipment. The basis for technology selection is the efficiency of the technology to produce the target production rate at the equipment's rated capacity.

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-5** presents the summary of key environmental impacts of the proposed project and the corresponding management plan and mitigating measures.

Table ES-5: Summary of Key Environmental Impacts and Management Plan

Major Activities Description/ Key Environmental Aspects	Potential Impact	Impact Mitigation, Built-In Management Measures and Facilities Planned	Residual Effect
Preconstruction Phase			

Major Activities Description/ Key Environmental Aspects	Potential Impact	Impact Mitigation, Built-In Management Measures and Facilities Planned	Residual Effect
Land	Restriction on the land use classification of Project site	The land use is classified as industrial. Provided in Annex 2-1 is the Zoning Certification of Candelaria.	NA
Construction Phase			
Demolition of existing concrete structures	Generation of dust and demolition debris	Good housekeeping and proper construction management; dust management through water sprinkling of dusty areas	None.
Generation of domestic wastewater	Contamination of water quality	Provision of septic tanks and implementation of septage management; implementation of zero effluent	None.
Solid waste generation	Accumulation of solid wastes	Provision of Material Recovery Facility (MRF) and regular hauling of garbage	None.
Chemicals and hazardous wastes generation	Contamination of land and water	<ul style="list-style-type: none"> • Securing of Hazardous Waste Generation ID • Provision of hazardous waste storage area • Treatment and disposal with Certificate of Treatment by DENR-accredited third party treaters 	None.
Use of domestic water	Water resource use of competition	<ul style="list-style-type: none"> • Provision of water from water utility • No extraction of groundwater 	None.
Construction of the steel mill complex	Air emission (TSP, PM10, PM2.5, SO _x , NO _x) and noise pollution from equipment and vehicles.	<ul style="list-style-type: none"> • Training on power equipment and vehicle use and speed • Proper maintenance, designation of no idling zone • Good house keeping • Water sprays, use of enclosures, barriers and buffer zones • Implementation of Reforestation and Carbon-Sink Program: tree planting within the perimeter 	None. Maximum ground level concentration still within the limits of the Clean Air Act.
	Potential health and safety hazards for construction workers	<ul style="list-style-type: none"> • Health and safety policies • Employee safety inspections and toolbox meetings • Regular APE and use of PPEs • First aid training 	None.
Operations Phase			
Rebar operation	Effect on public health due to dust and emissions brought about by the project	<ul style="list-style-type: none"> • Dust management through regular water sprinkling to dusty areas • Coordinate with Rural Health Office for the implementation of programs related to community health. 	None.
	Water pollution	<ul style="list-style-type: none"> • Zero effluent • Provision of Rain catchment reservoir • Provision of Water Treatment Facility for process water 	None.
	Air emission and noise pollution	<ul style="list-style-type: none"> • Training on power equipment and vehicle use and speed • Water sprays, use of enclosures, barriers, and buffer zones. • Proper maintenance, designation of no idling zone • 65 meters stack height • Routine plant maintenance and good house keeping 	None.

Major Activities Description/ Key Environmental Aspects	Potential Impact	Impact Mitigation, Built-In Management Measures and Facilities Planned	Residual Effect
		<ul style="list-style-type: none"> Use of low sulfur fuel (LSFO or mixing with Diesel) Training on proper equipment use and speed 	
	Employment generation	Preference will be given to qualified residents of Barangays Malabanban Sur and in the municipality of Candelaria as a whole.	None.
	Increase in economic opportunities through associated incomes and taxes	These are predominantly positive effects, no mitigation measures necessary.	None.
Solid waste generation	Accumulation of solid wastes	Provision of Material Recovery Facility (MRF)	None.
Chemicals and hazardous wastes generation	Contamination of land and water	<ul style="list-style-type: none"> Securing of Hazardous Waste Generation ID Provision of Hazmat Storage Facility Treatment and disposal with Certificate of Treatment by DENR-accredited third party treaters 	None.
Storage, handling and transport of rebars	Health and safety hazards (e.g. heat and hot liquids)	<ul style="list-style-type: none"> Health and safety policies Installation of proper ventilation Implementation of safety buffer zones to separate areas where hot materials are handles and stored. Employee safety inspections and toolbox meetings. Regular APE for employees Use of PPEs First aid training Provision of 24-Hour Clinic Provision of Ambulance Spills containment of fuel 	None.
	Traffic and road accidents	<ul style="list-style-type: none"> Implementation of Traffic Management Plan Provision of proper road signages. Designation of marshalling/holding area offsite Observe traffic rules and load limit requirement 	None.
	CO ₂ emissions	<ul style="list-style-type: none"> Utilize thermally-efficient heating process equipment Explore the viability of using inline Electric Induction heating process after the reheating furnace Engage in carbon sequestration projects such as tree planting and use of electricity from renewable energy sources such as geothermal, etc. 	None.
	Noise	<ul style="list-style-type: none"> AC motors Enclosed facility Tree buffer zone Insulate structures 	None.
	Water collection and operational treatment	<ul style="list-style-type: none"> Zero water discharge Water is recycled and re-circulated within the Water Treatment Facility, which consists of grease/oil skimming, scale inhibitors plus 	None.

Major Activities Description/ Key Environmental Aspects	Potential Impact	Impact Mitigation, Built-In Management Measures and Facilities Planned	Residual Effect
		filtering and bio/algaecide	
Abandonment Phase			
<ul style="list-style-type: none"> • Removal of wastes and oil spills if any • Removal of all equipment, • Actual Rehabilitation 	<ul style="list-style-type: none"> • Change in land use • Loss of jobs and community programs 	<ul style="list-style-type: none"> • Turnover of the facilities which can still be used by the new project especially drainage system and rain collection • Adaptation to the industrial land use of the new project • Grading and drainage stabilization work including leveling of sediment trap and settling ponds • Soil conditioning • Planting or reforestation of endemic species • Retrenchment package • Labor support programs 	None.

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 CSI's mother company, the Candelaria SteelAsia Group of Companies has been in the business for more than 50 years now.

CHAPTER I: PROJECT DESCRIPTION

Candelaria Steel, Inc. (CSI) was established in April 2016 for the purpose of building and operating a steel rolling mill that produces wire-rod and other coiled bar products. Candelaria Steel Inc. is a wholly owned subsidiary of SteelAsia Manufacturing Corporation and part of the SteelAsia Group.

CSI's office is located at B2 Bldg., Bonifacio High Street, BGC, Taguig, Metro Manila. CSI is registered with the Securities and Exchange Commission (SEC) with an attached in **Annex 1-1**. CSI with SteelAsia will 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

The SteelAsia Group is comprised of steel bar manufacturing companies. From 1966 to present, it has built and operated rolling mills across the archipelago. Currently, six 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.

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, CSI proposed to construct a new Rolling Mill. The proposed project is a rebar and wire-rod mill.

1.1 PROJECT LOCATION AND AREA

1.1.1 Description of the Project Area

The proposed project site is located at 326,687 sq.m. lot in Barangay Malabanban Sur, Candelaria, Quezon. The project site is privately owned by CSI and covered by the Contract to Sell and Transfer Certificate of Title (TCT) as presented in **Annex 1-2**.

There are three major highways that pass throughout the municipality and the town proper. The [South Luzon Expressway](#) Toll Road 4 (TR4) stretching from Sto. Tomas, Batangas to Lucena City will pass in the northern part of the municipality, planned to be finished in 2016. The new expressway will occupy portions of Barangays Bukal Norte, Masalukot II, Masalukot I, Mayabobo, and Mangilag Norte. However, these matters are only speculations at present and not yet confirmed.

- A. The [Pan Philippine Highway](#) (also known as Maharlika Highway or National Highway), passes through the municipality west-east from Kilometer 102 in Barangay Bukal Sur (opposite Tiaong, Quezon) to Kilometer 111 in Barangay Mangilag Sur (opposite Sariaya). It connects the municipality to its neighboring towns of Tiaong and Sariaya, and cities like San Pablo City in Laguna and Lucena City, the provincial capital.
- B. The [Candelaria-Bolboc Road](#) (also known as Candelaria-San Juan Road) is a 16 kilometres (9.9 mi) two-lane highway that starts at the Pan Philippine Highway junction in Barangay Malabanban Norte going straight south to the municipality of San Juan, Batangas. This is an alternative road for commuters from Metro Manila via Batangas. It ends at Barangay Santa Catalina Sur (opposite Bantilan, Sariaya, Quezon).
- C. The [Candelaria Bypass Road](#) (also known as Candelaria Diversion Road) is a two-lane bypass road that serves as an alternative road for commuters from Metro Manila to Batangas and Bicol Region. Inaugurated in 2012, this 7.8 kilometres (4.8 mi) road starts at Barangay

Bukal Sur turning south to Barangays Masin Sur, Pahinga Norte, Malabanban Sur and Mangilag Sur. It intersects the Candelaria-Bolboc Road at Barangay Malabanban Sur and crosses the Philippine National Railway in Mangilag Sur. It ends at the eastern portion of Maharlika Highway right after United Candelaria Doctors Hospital.

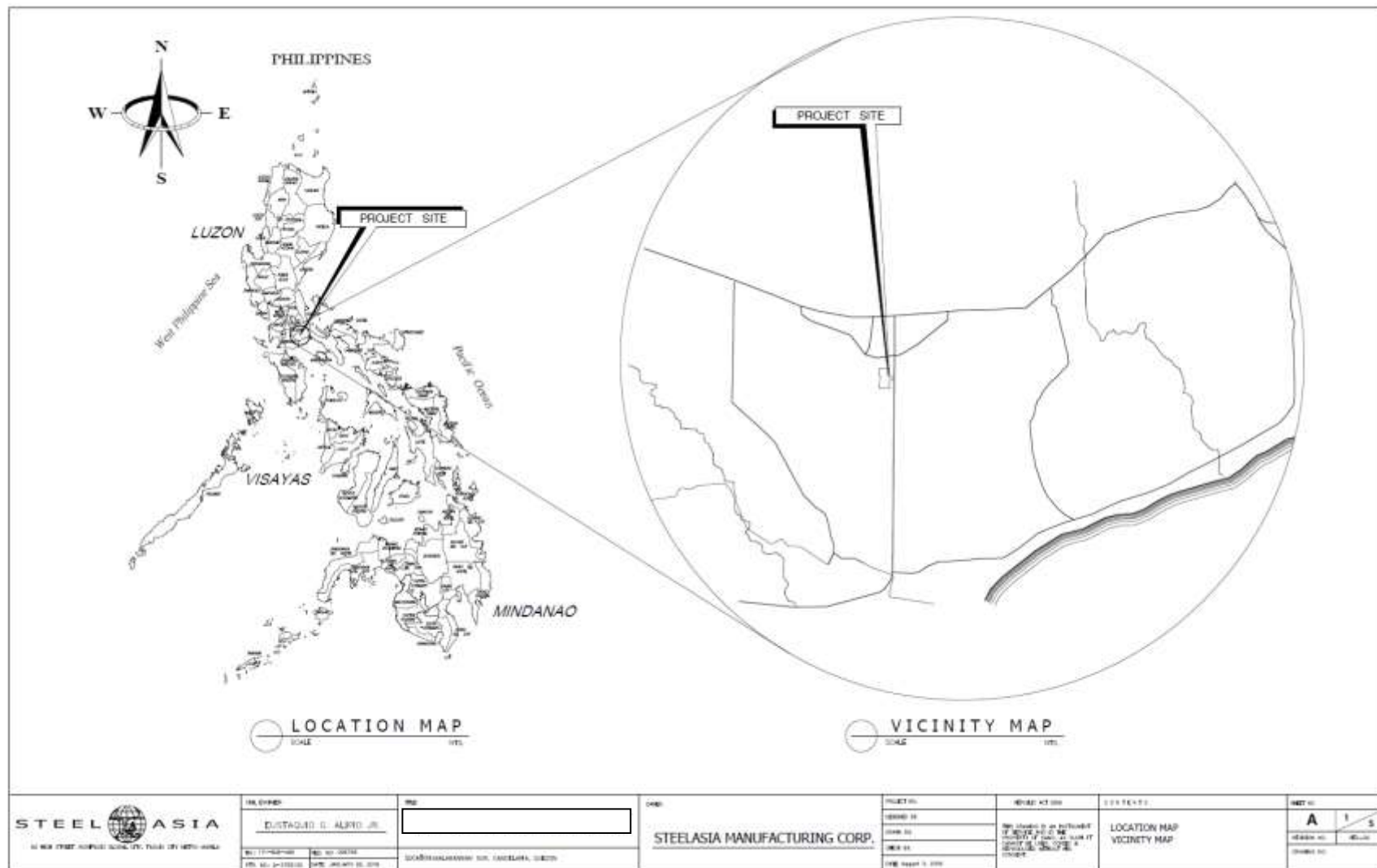
There are also major roads within the municipality as follows:

- **Rizal Avenue** is the two-lane main road located in Barangay Poblacion. It connects Barangay Masin Norte and Sur in the west and Malabanban Norte in the east. Some landmarks located here are the Municipal Hall, Catholic Church, and Plaza Narra.
- **Cabunag Street** also in Barangay Poblacion is the municipality's main business district. Most of business establishments such as hardwares like Licup Builders the oldest hardware in town, RTWs, pharmacies, footwear, general merchandise, and restaurants are located here. It also serves as a thoroughfare for local commuters going to nearby barangays such as Pahinga Norte and Masalukot I.
- **Ramos Street-Masalukot Barangay Road** is a road that starts at Maharlika Highway in Barangay Poblacion and ends at Barangay Masalukot III. This is also an access road to most of subdivisions located in Barangay Masalukot I such as School View Park Subdivision, Village of St. Jude (VSJ), Maria Cristina Village, St. Anthony Subdivision, Villa Macaria Country Homes, Clarisse Subdivision, FaustinFloraville, and others. There are also schools located along the road, such as Grabsum School Inc. and Dr. Panfilo Castro National High School Annex.
- **Tibanglan Road** is a dirt road that serves as a main access to Barangay Mayabobo from Maharlika Highway in Barangay Malabanban Norte, in front of Iglesiani Cristo Church.
- **Pahinga-Kinatihan Road** is a barangay road that starts at Cabunag Street down south to Barangay Kinatihan II. It serves as an access road to [Candelaria Bypass Road](#) from the town proper. Some landmarks located along the road are Peter Paul Philippine Corporation, Pahinga Norte Elementary School, Cocoma, and Villa Katrina Subdivision. A junction located in Barangay Pahinga Norte right after the spillway across Quiapo River connects it towards Barangay Santa Catalina Norte.
- **Mangilag-Concepcion Road** is a barangay road that starts at Maharlika Highway in Mangilag Sur and an access road to Barangays Mayabobo and Concepcion Banahawin [Sariaya, Quezon](#). Some landmarks found here are Dr. Panfilo Castro National High School, Mangilag Norte Elementary School, and Mount Mayabobo.

Table 1.1.1 present the geographic coordinates of the project site. **Figure 1.1.1** shows the location and vicinity map of the project site.

Table 1.1.1: Coordinates of the Project Site

Point	Coordinates	
	Latitude	Longitude
1	13.908707°	120.862554°
2	13.910848°	120.867157°
3	13.910147°	120.870227°
4	13.912550°	120.874490°
5	13.904750°	120.866039°
6	13.907875°	120.869144°
7	13.904694°	120.872605°
8	13.905278°	120.875792°



Source: CSI

Figure 1.1.1: Project Location Map Superimposing the Project Site

1.1.2 Impact Areas

Determination of impact area

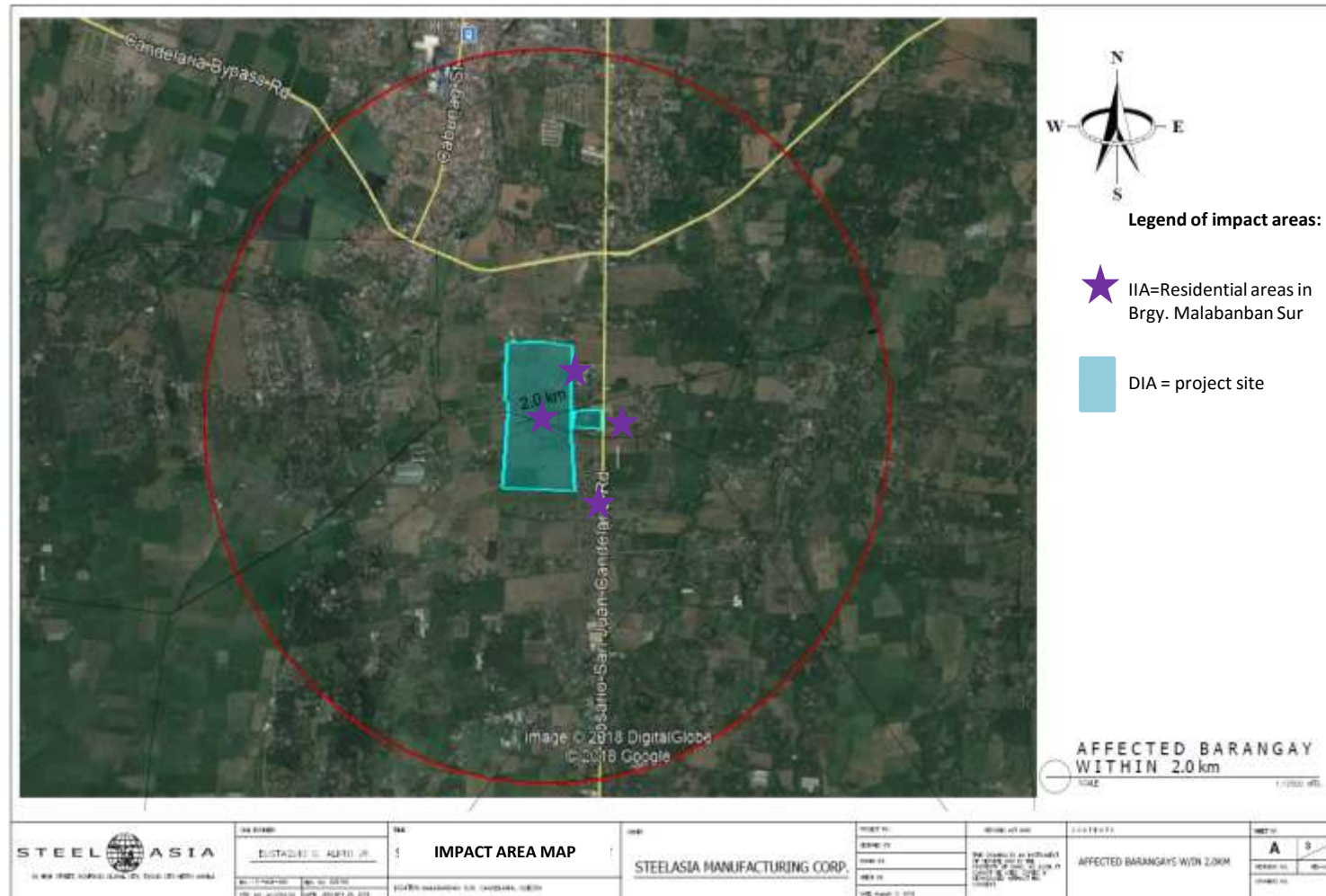
The criteria used in determining the direct impact area (DIA) and the indirect impact area (IIA) are the guidelines provided under DAO 2003-30 and supplemented by DAO 2017-15.

Annex 2-2 of the Revised Procedural Manual (RPM) of DAO 2003-30 initially defined the Direct Impact Area (DIA) at the pre-EIA stage as the area where all "*project facilities are proposed to be constructed/situated and where all operations are proposed to be undertaken*". However, this was revised by DAO 2017-15 to include the following:

- A. The DIA shall be delineated based on the results of the assessment of the Project's impact on air, water, land and people.
- B. The IIA on the other hand, shall be delineated for impacts on people and shall include those in the vicinity of the DIA who will either benefit or be affected indirectly by the Project

The result of the air dispersion modeling, noise modeling, ambient air and noise and water quality sampling were used to determine the areas directly affected by the emissions from the establishment. With this, the direct impact area (DIA) covers only the 326,687 sq.m. project site because based on the results of the air dispersion and noise modeling and air and water quality sampling, all of the GLCs and results generated were well within the standards of the Clean Air Act, DENR Standards on Noise and water quality. Though such is the case, possible air receptor areas within one (1) to two (2) kms due to the expected air emissions from the proposed project was also plotted 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 stage and of billets and finished products during operations and the community at the periphery of the project site.

The map of the Impact Areas is shown in **Figure 1.1.2**. Kindly note that in the map, 2k radius of impact area was presented naming all barangays within the radius. Same barangays were also identified as air sensitive receptors in the air dispersion modeling but results were all within the allowable limits. Mangrove area and residential areas surrounding the project site were identified as indirect impact area.



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 proponent is investing for the establishment of a steel manufacturing facility in Candelaria, Quezon. 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.

Moreover, the Project targets to provide quality steel to the following projects in the Region:

- SLEX Toll Road 4 Expressway
- Laguna Lake Highway
- PNR South Commuter and South Long Haul Project
- Quezon-Bicol Expressway (QuBex)
- Cavite-Laguna Expressway (CALAX)
- Cavite Industrial Area Flood Risk Management Project (CIA-FRMP)
- Camarines Sur Expressway

Specifically, the Project will provide employment opportunities as follows:

- The project will create more than 3,000 internal and external jobs in the nearby communities
- More than 80% of which will be available for vocational level and below.
- During construction, up to 1,000 personnel will be hired
- Steel Asia trains members of the community to upgrade skill levels (including TESDA accredited training) for FREE.
- Qualify them for vacancies in the Candelaria mill and other Steel Asia sites.
- Once operational, the job provides employee skills and technology familiarization that qualifies for overseas employment opportunities.

The Candelaria mill will create new business opportunities for the community as Steel Asia's other mills have in their own respective communities.

- Trucking
- Food and beverage services and suppliers
- Hardware supplies
- Transportation services
- Vehicle mechanics, auto-supply, servicing
- Building repair contractor services
- Machining services
- Plumbing services and supply
- Signage, painting, printing
- Many more

1.3 PROJECT ALTERNATIVES

1.3.1 Siting

The following site locations were considered for the proposed project:

- Barangay Salong, Calaca, Quezon
- Barangay Camastilisan, Calaca, Quezon

However, based on the following criteria, the project site in Barangay Malabanban Sur, Candelaria, Quezon 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.** CSI'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.

1.3.2 Technology/Operation Process

This will use the most modern rolling mill technology to produce the target production rate at the equipment's rated capacity. This is the principle being used in other rolling mills of SteelAsia Group being the most modern in Southeast Asia.

1.3.3 Resources

In terms of water source, the best option to consider is rainwater collection since the climate at the proposed Project site falls under the category of Type 1 climate which is characterized by two (2) pronounced seasons, dry from November to April and wet from May to October with maximum period from June to September. Areas under this type of climate are generally exposed to the southwest monsoon during rainy season and get a fair share of rainfall as brought about by the tropical cyclones occurring during the maximum rainy period. Rainfall ranges from 17.4 to 429.4 mm, with an annual total of 2,026.8 mm. Least number of rainy days per month occurs in February to April; while the highest number or rainy days per month occurs from December to March.

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 Candelaria, particularly in Barangay Malabanban Sur, 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.

Also, flooding may be continuously be experienced from the open project area because there are no mitigating measures installed unlike if the project will be implemented, proper drainage system will be installed so as not to affect the neighboring communities.

1.4 PROJECT COMPONENTS

1.4.1 Map showing the location and boundaries of project area, location and footprint of main and support facilities and proposed buffers

Provided in Figure 1.4.1 is the map showing the location and boundaries of project area, location and footprint of the project area. It may be seen from the Figure below that the project site's perimeter is surrounded by greeneries as its buffer zone.

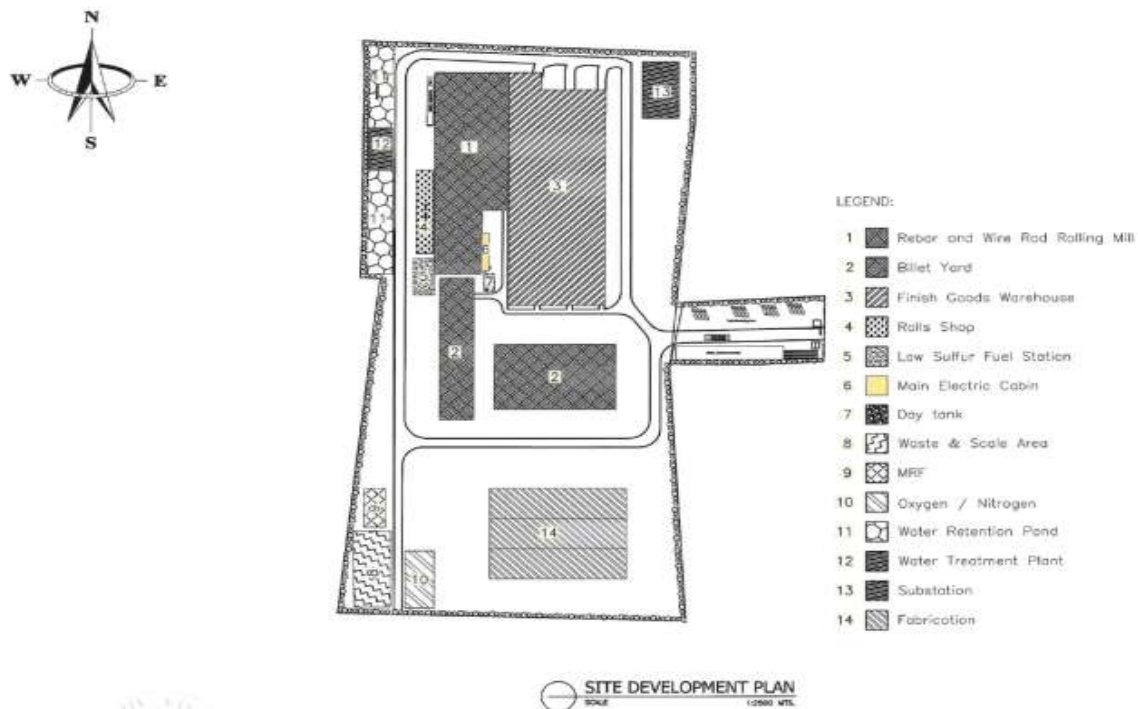


Figure 1.4.1: General Layout of Facilities

1.4.2 General lay-out of facilities

Shown in Figure 1.4.2 is the Site Development Plan while Figure 1.4.3 is the Drainage Plan.

1.4.3 Major Components

The project will have the following major components:

- A. Main equipment:
1. Billet yard
 2. Reheating furnace
 3. Finishing Stands
 4. Water Quenching Line / Tempcore
 5. Heavy Duty Dividing shear
 6. Braking Pinch Roll
 7. Cooling Bed
 8. Hydraulic Bundling Machine
 9. Inspection Table

Shown in Plates 1 to 8 are photographs of each component with description.



The first process of Rolling Mill Department is done on **BILLET YARD**. Billets are prepared and charged as per grade to be produced by Rolling Mill Production (G230, G275, G415, G520).

Plate 1: Billet yard



Billets are all reheated through **FURNACE**, to achieve rollable temperature of 1020°C to 1080°C, and measured through billet temperature profiler.



Plate 2: Reheating Furnace

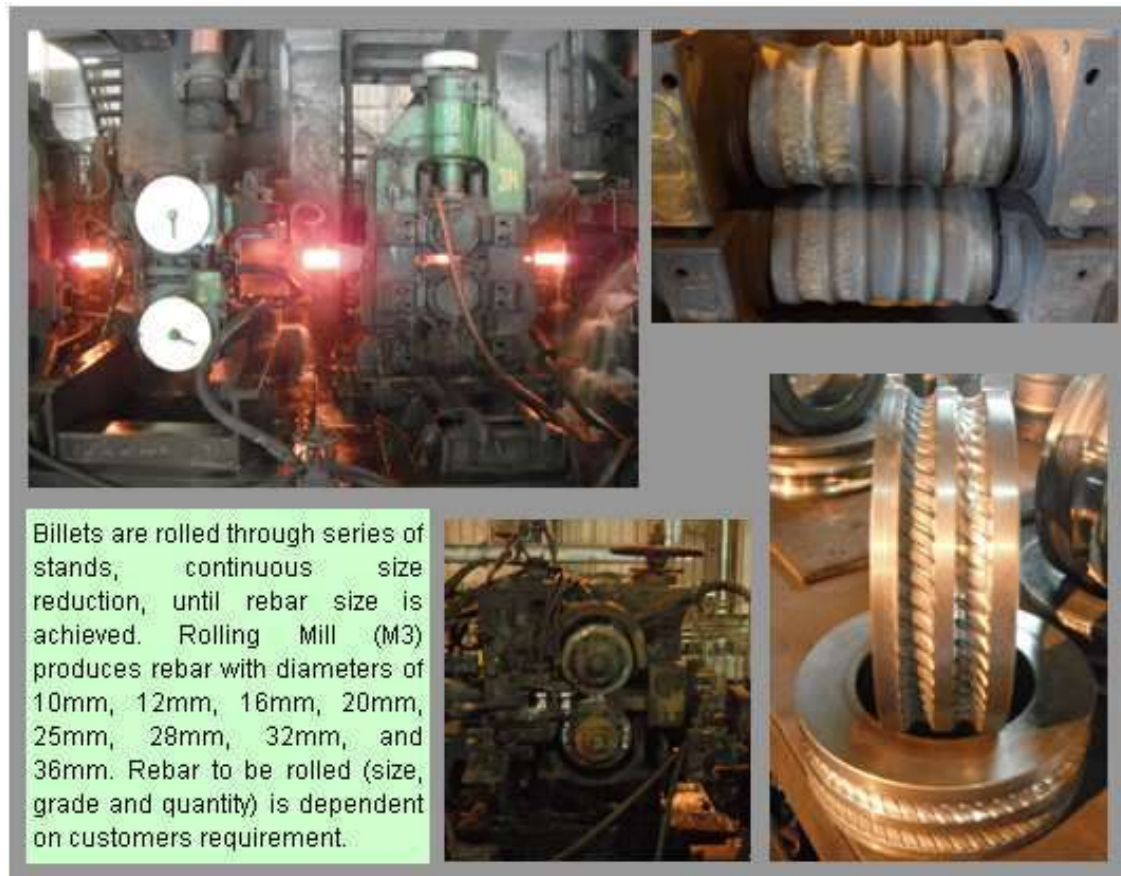


Plate 3: Finishing stands for resizing



Plate 4: Water Quenching Line / Use of Tempcore



Plate 5: Heavy Duty Dividing Shear

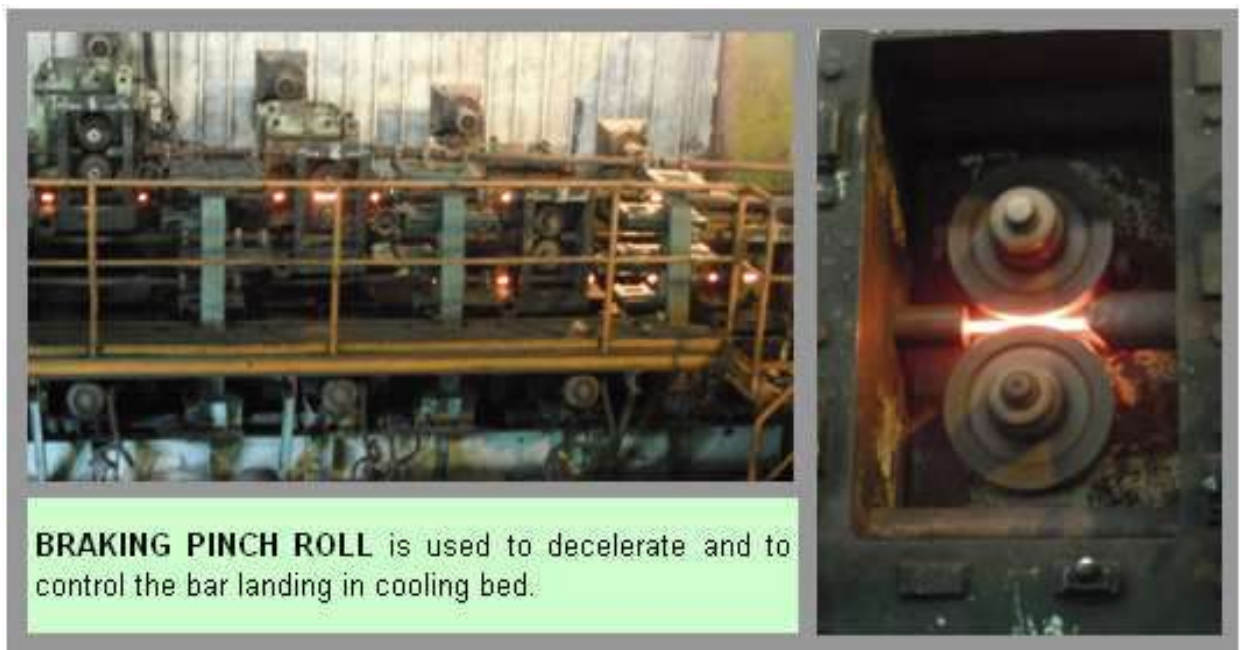


Plate 6: Braking Pinch Roll

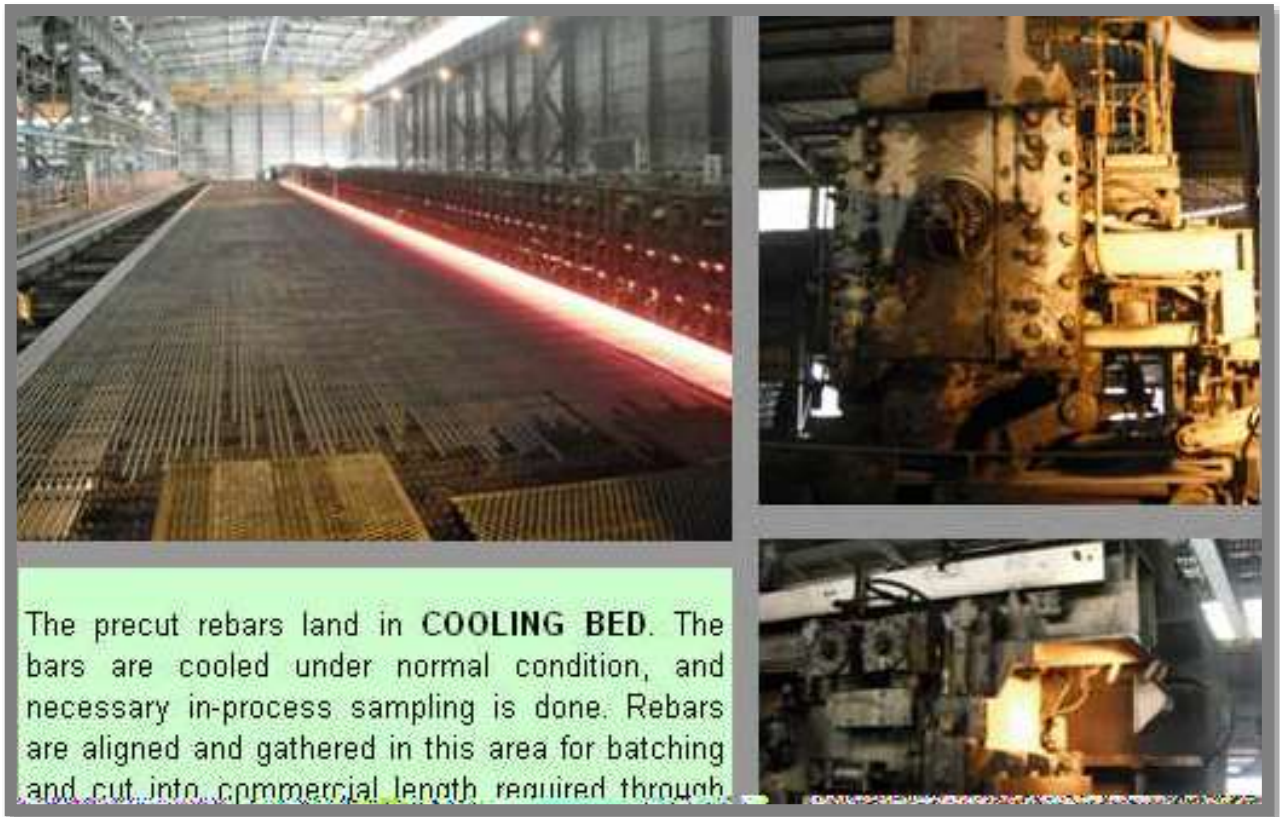


Plate 7: Cooling Bed



Plate 8: Inspection Table

1.4.4 Ancillary facilities:

The following components are ancillary facilities for the Project:

- **Circulating Water Treatment plant**

Circulating Water Treatment Plant contains four parts namely Indirect Cooling System, Direct Cooling System, Emergency Water Supply System and Sludge Treatment System. Process is shown in Figure 1.4.4.1.

The Indirect Cooling Water System's main users are furnace, roughing equipment, finishing equipment, BGV area, hydraulic units, air conditioner, compressed air station, camera housing. The indirect water system does not directly contact with the equipment. During the indirect heat exchange, only the water temperature rises but the water quality doesn't change. After cooling down, water will be pumped to the user and then recycled. There are sets of cooling tower adopted in this system and separate group of pumps for traditional equipment and furnace. In order to ensure uninterrupted water supply for furnace, the furnace circulating pump has two power sources including one emergency power.

The Direct Cooling System's main users are furnace exit area, roughing mill area, finishing mill area, quenching and flushing. The direct water system has a direct contact with the equipment. During the heat exchange, not only the temperature rises but also the water quality is changed and there isn't residual pressure. The return water flow to the underground scale pit by gravity with flushing pipes to push the scales and residuals to the scale pit. The water from the pit will then be pumped to the sedimentation basin to remove suspended solids and grease, then flow to a water pool, then pump to sand filters. Backwashing style is air and water alternately. Air is supplied by a blower and backwash water is supplied by pump. Mud produced from sedimentation and filter system will flow in the sludge water pit.

The furnace needs an emergency water supply for a duration of 8 hours upon loss of power. The emergency water is supplied by a diesel pump which will come to work automatically in case of traditional power off in order to ensure uninterrupted water supply in the furnace.

The main process of the Sludge Treatment System is a backwash waste of filters, mud/scales from sedimentation basin that will flow in the sludge water pit and then pumped into the sludge thickener. The sludge from the thickener will then be discharged to a drying bed where it will be dried naturally and then a grab bucket will transfer it to the sludge disposal truck.

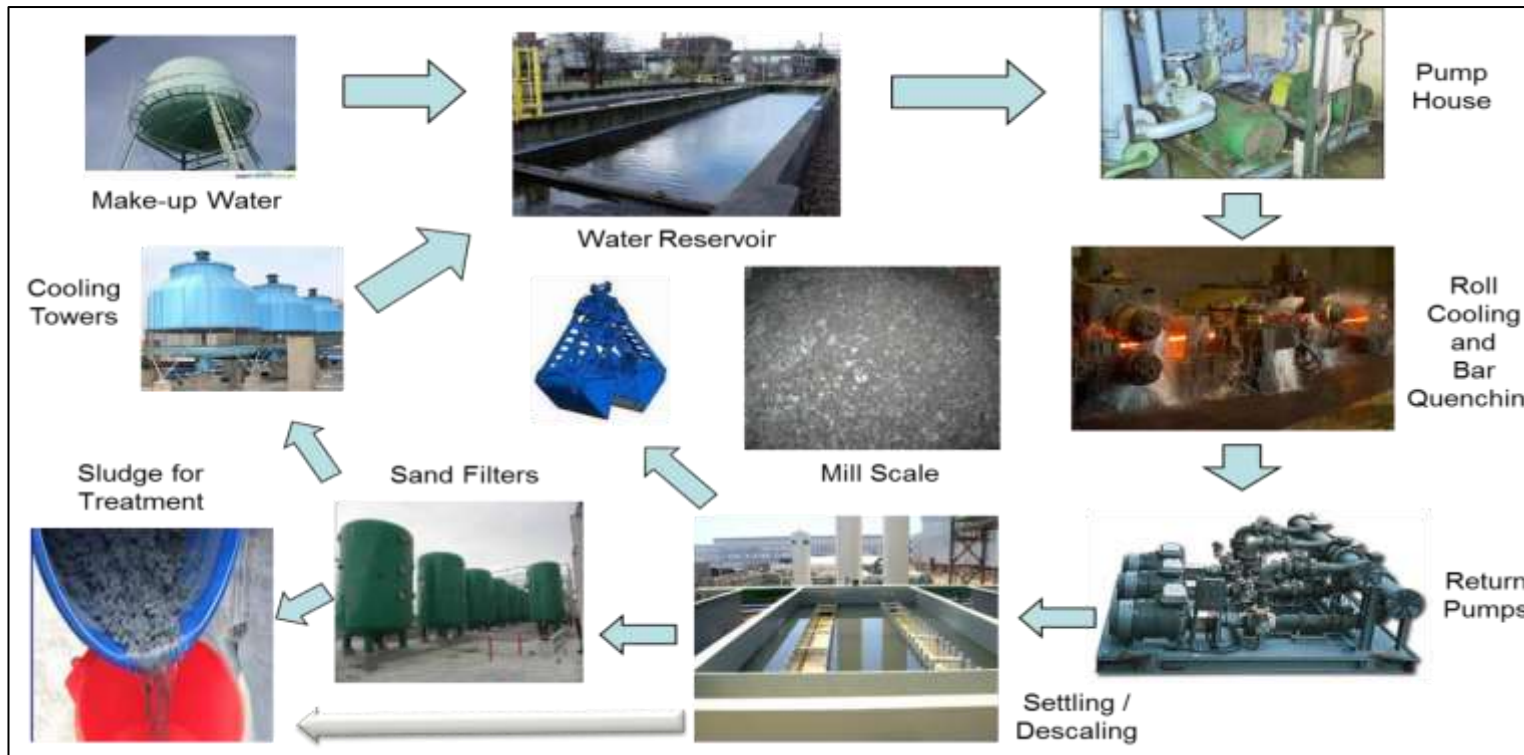


Figure 1.4.4.1: Water Treatment Process Flow

- Rainwater collection reservoir**

The main water source of our WTP plant is rainwater. The storm drainage system will be connected to the Water Catchment Pond to accumulate an amount of water to serve as make-up water to the WTP. There are 3 collecting pond to mitigate the use of water. These collecting ponds has a volume of 30,000 cu.m, 3,400 cu.m, 26,600 cu.m respectively and are interconnected with each other and in the WTP. Its main purpose is to provide make-up water for the evaporation process that takes place in the rolling mill area.

- Power substation**

The plant capacity is requiring one package of 69 KV substation to be built in a 2000 square meter area which will consist of a 31.5 MVA power transformer will be installed as the power supply of Rolling Mill and plant auxiliaries. Harmonic filters will also be installed for the rolling mill to be compliant with the Philippine grid code on the system power quality such voltage and frequency variations, flicker severity and harmonic distortions. Electric utility company will provide the power requirement of the mill, they will also provide the tapping point and the distribution line going to the rolling mill's electric substation.

- Generator Set/Emergency Power System**

This will serve as an emergency power of the rolling mill if there is power outage. This plant requires a closed type mobile generator set with a diesel engine and a capacity of 1MVA/800kW standby power to supply all key equipment and facilities such as lighting and power for safety purposes and cranes to ensure all deliveries are in time to make customer satisfied. The generator set is also set with compatible cooling system, noise reduction system, intake and exhaust system, and electronic control system.

- Compressed Air Station**

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. Capacity 5,710 m3/hr at 8 Bars.

- **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 25Tons 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.

- **Fuel Storage**

Storage area for Low Sulfur Fuel Oil (LSFO) as among the mitigating measures for air pollution

- **Smoke Stack**

- **Pumping Station and water pipes**

- **QA laboratory**

- **Machine shop**

- **FireProtectionSystem**

A fire protection system according to the National Fire Protection Association (NFPA) requirement will be provided for the entire plant. The system will provide indepth capability for early detection, alarm, containment and suppression of fires. The extent of the system will vary with the magnitude of combustibles present in an area and the magnitude of possible loss from fire. The system will consist of:

- 1 FireWaterSupplySystemfor:
 - 1.1 Outsidehydrantsystemoftheplant
 - 1.2 Standpipesystemforallbuildings
 - 1.3 Delugesprinklersystemforoilfilledtransformers
 - 1.4 Wetpipesprinklersystemforturbineoilareaandlubricantstorageareainwarehouse.
- 2 Foamtypeprotectionsystemforfueloiltanks
- 3 HalonProtectionSystemforswitchgear,MCC,batteryandbatterychargerandcontrolrooms
- 4 Portablefireextinguishersinvariousbuildings; and
- 5 FireDetectionandAlarmSystem

1.4.5 Pollution Control Devices and Corresponding Facilities Being Served or Connected

The project will use the following pollution control facilities:

- a. Water Treatment System
- b. Solid Waste Management System
- c. Hazardous Waste Mangement System

Process Wastewater Treatment Plant (WTP)

The water treatment system is designed to handle both the direct and indirect cooling water from the rolling mill operations. Direct cooling water is the water which is in direct contact with the product, specifically the water used to cool the rolls in the bar mill line. Indirect cooling water on the other hand is the water that does not touch the products and stays inside the pipes and ducts. The WTP is designed to cool and recycle 1950 m3/hr of direct cooling water and 2001 m3/hr of indirect cooling water. The recycled water allows the mill to significantly reduce the amount of fresh water required. The equipment used in this WTP are three cooling towers, sedimentation basins, several filters and pumps (Figure 1.5).

Solid Waste Management

Domestic solid waste as well as wrongly-sized rebars will be generated. Material Recovery Facility (MRF) will be provided for domestic solid waste while scrap bars will be hauled to be used as raw material for other plant's meltshop. Solid Wastes will be properly segregated and to be disposed in the Material Recovery Facility of Candelaria. Domestic Waste will be treated through the proposed Sewerage Treatment Plant.

Scales are formed on the outer surfaces of plates, sheets or profiles when they are being produced by rolling red hot iron or 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 1 mm thick and initially adheres to the steel surface and protects it from atmospheric corrosion. Scales will be collected in containers and will be for recycling in SteelAsia Melt shop plants.

Hazardous and Toxic Waste management

For hazardous wastes that will be generated such as busted bulbs and lamps, LED lamps, used oil and used batteries, disposal will be done thru 3rd party DENR-accredited Treaters. Used oil will be collected and put inside sealed drums, stored in a company designated Material Recovery Facility (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 sufficient 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.

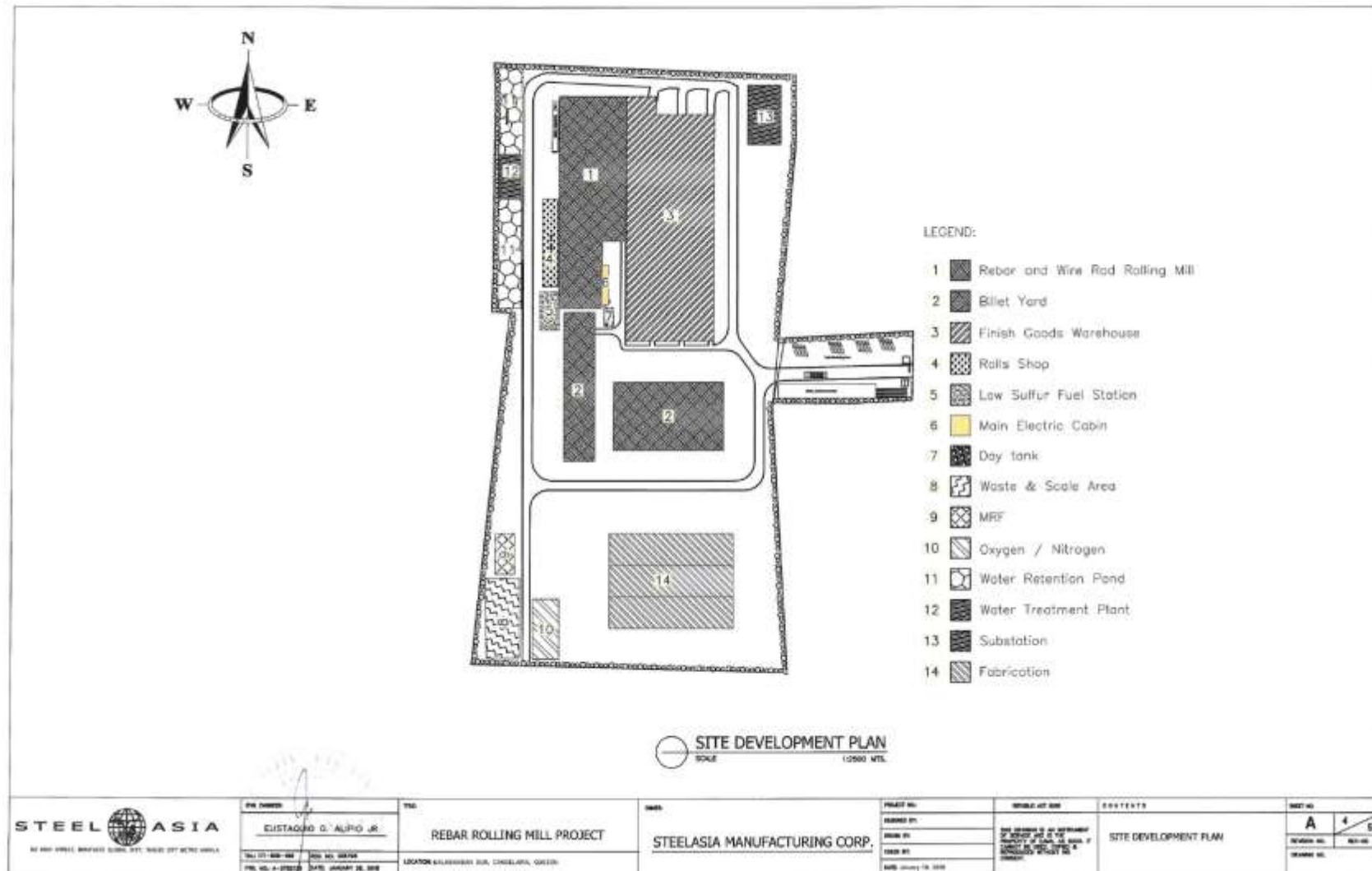
Used automotive batteries will be traded-in to designated suppliers.

In summary, following are the project's components:

Table 1.4: Summary of Project Components

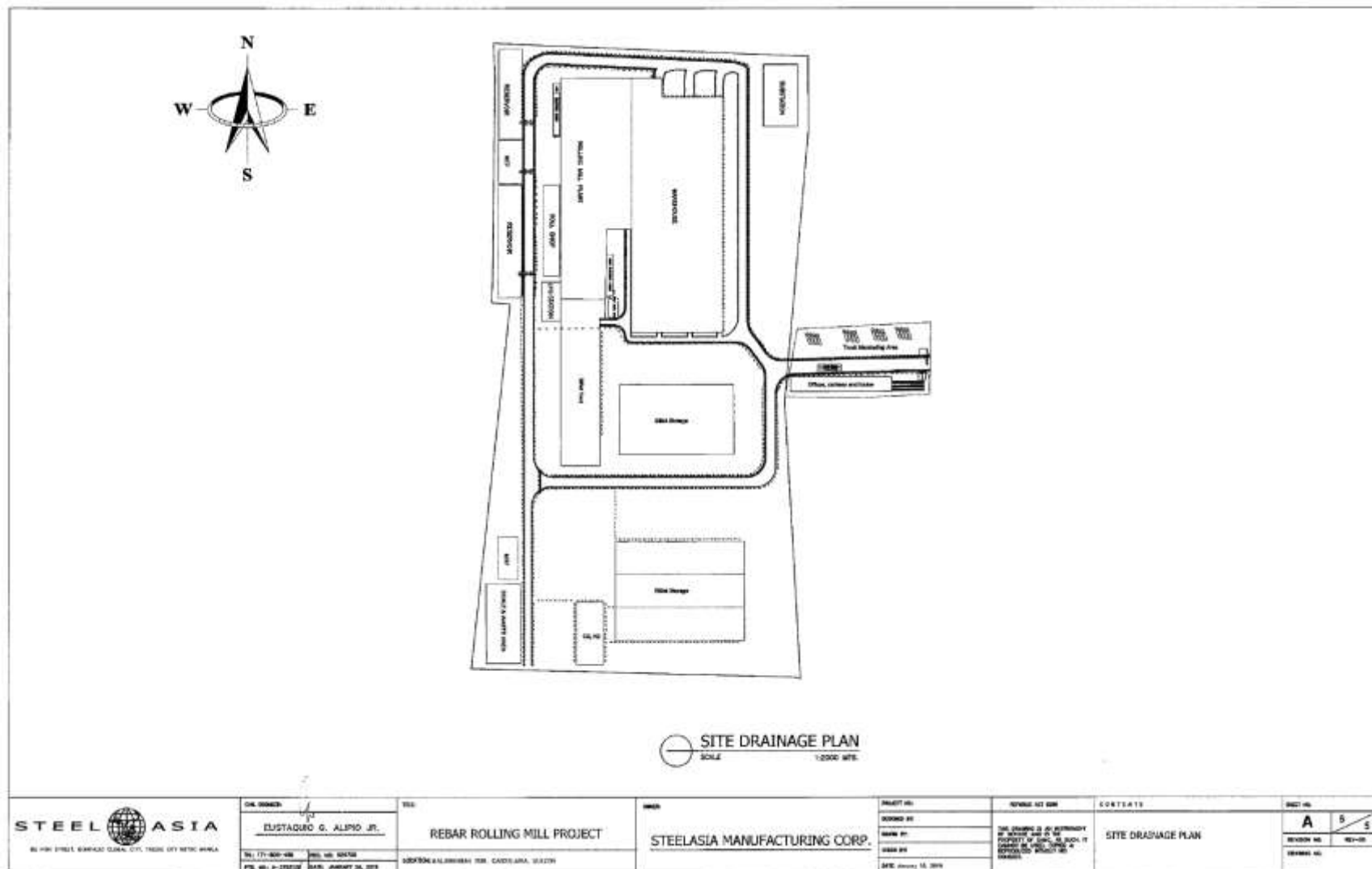
Components	Description / Capacity
1. Major	
a. Rolling Mill	
• REHEATING FURNACE	Low thermal losses and recovery of energy by combustion thru air recuperator to guarantee low fuel consumption, low mechanical maintenance and highlevel technological automation resulting to lowest emission.
• ROLLING MILL	Consists of roughing, intermediate and finishing stands, is composed of 14 rolling stands. It has 2 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.
• TWIN FINISHING BLOCKS	Twin 6-stand tungsten carbide monoblock that enables high speed manufacturing of PNS 211 and 49 rebars with high strength and high precision.
• WATER QUENCHING LINE	This is a twin tempcore quenching system wherein the two-line steel bar passes where it is rapidly cooled by a high pressure spray of water. This process increases the yield and tensile strength of the rebar.
• COOLING BED	A "start-stop walking beam" type cooling collecting and cooling the bars in multiples coming from the dividing shear. It is fitted with variable speed driving group and multi-groove lining-up rollers
• HEAVY DUTY STATIONARY SHEAR	This is the bar cutter which can cut up to 7 different commercial lengths of rebar, i.e. 6m, 7.5m, 9m, 10.5m, 12m, 13.5m and 15m.
• HYDRAULIC BUNDLING MACHINES	These are rebars bundlers using standard count for easy storage and handling.
2. Ancillary Facilities	
a. Substation	1.
b. Circulating Water Treatment Plant	3000 m3/h and covers an area of about 5900 sqm

c. Rainwater collection reservoir	3 collecting ponds with a volume of 30,000 cu.m, 3,400 cu.m, 26,600 or a total of 60,000 cu.m.
d. Generator Set/Emergency power system	Closed type mobile generator set with a diesel engine and a capacity of 1MVA/800kW standby power
e. Compressed Air Station	Capacity 5,710 m ³ /hr 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.
f. Cranes: Overhead Cranes and Semi-Gantry Cranes with Overhead cranes	Capacity ranging from 10 tons to 25Tons and 6 to 20 tons under magnet
g. Fuel Storage	The proposed project has 1 Fuel Tank System for storing Low Sulfur Fuel Oil (LSFO). The system consists of the LPG/LNG tank, unloading device, gasification unit, piping with supports, fire protection system and control system, etc.
h. Smoke / Flue Stack	The proposed project has 1 Flue Stack with a height of more than 50 meters and with sampling points according to the regulations of the government to ensure air emission quality.
i. Pumping Station and water pipes	The length is approximately 5 KMs
j. QA laboratory	Quality assurance will be tested here based on the PNS standards.
k. Machine shop	
l. Fire Protection System	The firefighting system will take place at the rolling mill area wherein series of firehoses 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.
2. Pollution Control System	
a. Wastewater Treatment System	The proposed project has a Sludge Treatment System. 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.
b. Solid Waste Management System	The proposed project has 2 Material Recovery Facilities (MRF) as temporary storage of solid and hazardous wastes.
c. Hazardous Waste Management System	



Source: CSI 2018

Figure 1.4.1: Site Development Plan



Source: CSI 2018

Figure 1.4.2: Site Drainage Plan

1.5 PROCESS /TECHNOLOGY

1.5.1 Processing/Manufacturing Technology

The Project's processes is tabulated in **Table 1.5.1** and **Figure 1.5.1**.

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	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	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 makes 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.

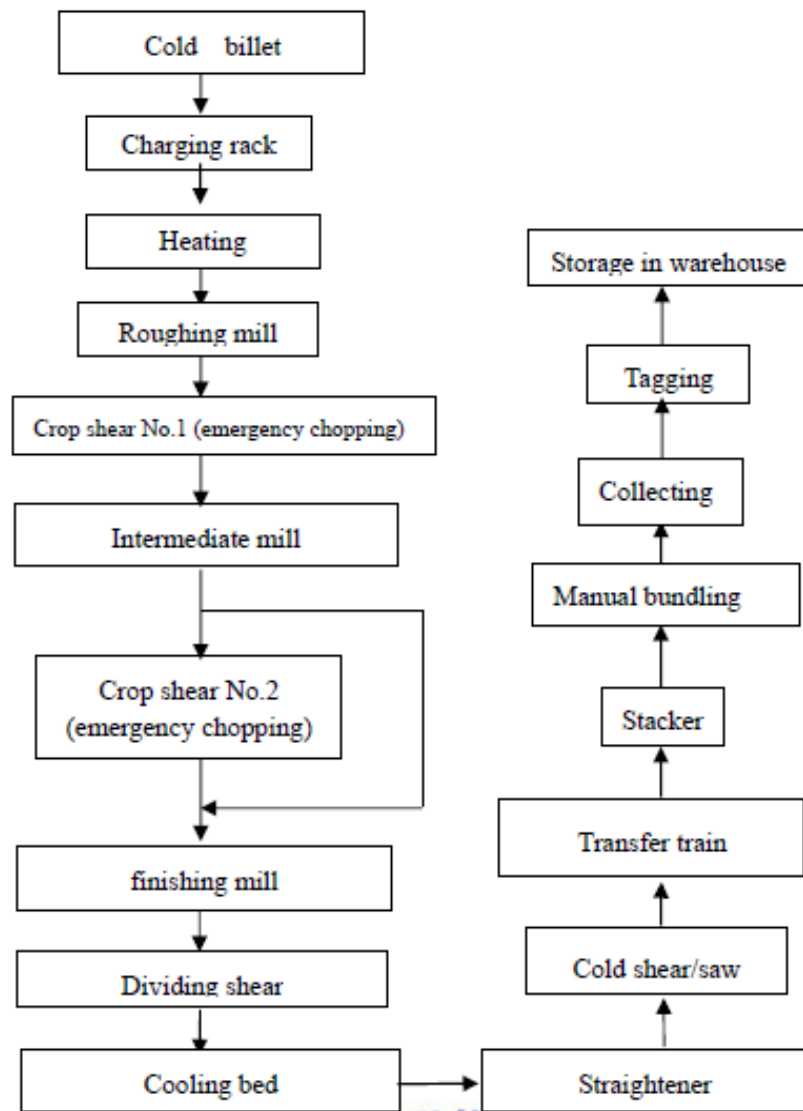


Figure 1.5.1: s Process Flow

Figure 1.5.2 shows the process flow sheet showing material balance of the Mill at 600,000 MTPY capacity.

Provided below is the Material Balance for the Rolling Mill Operation.

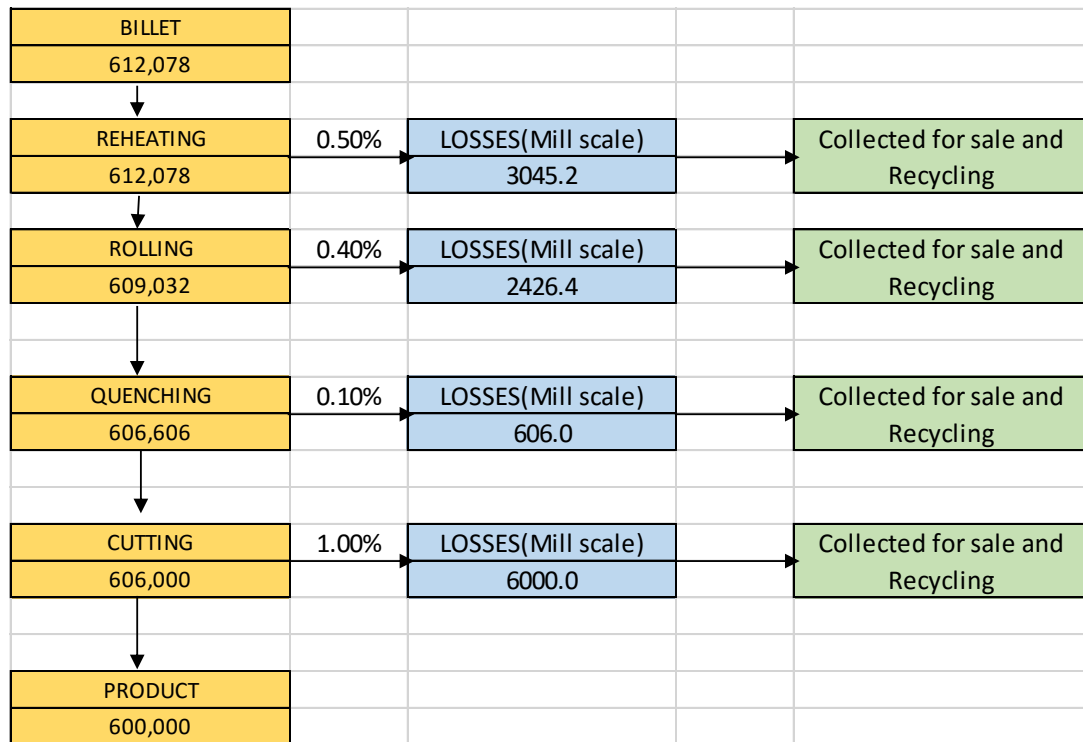


Figure 1.5.2: Material Balance for Rolling Mill Operation

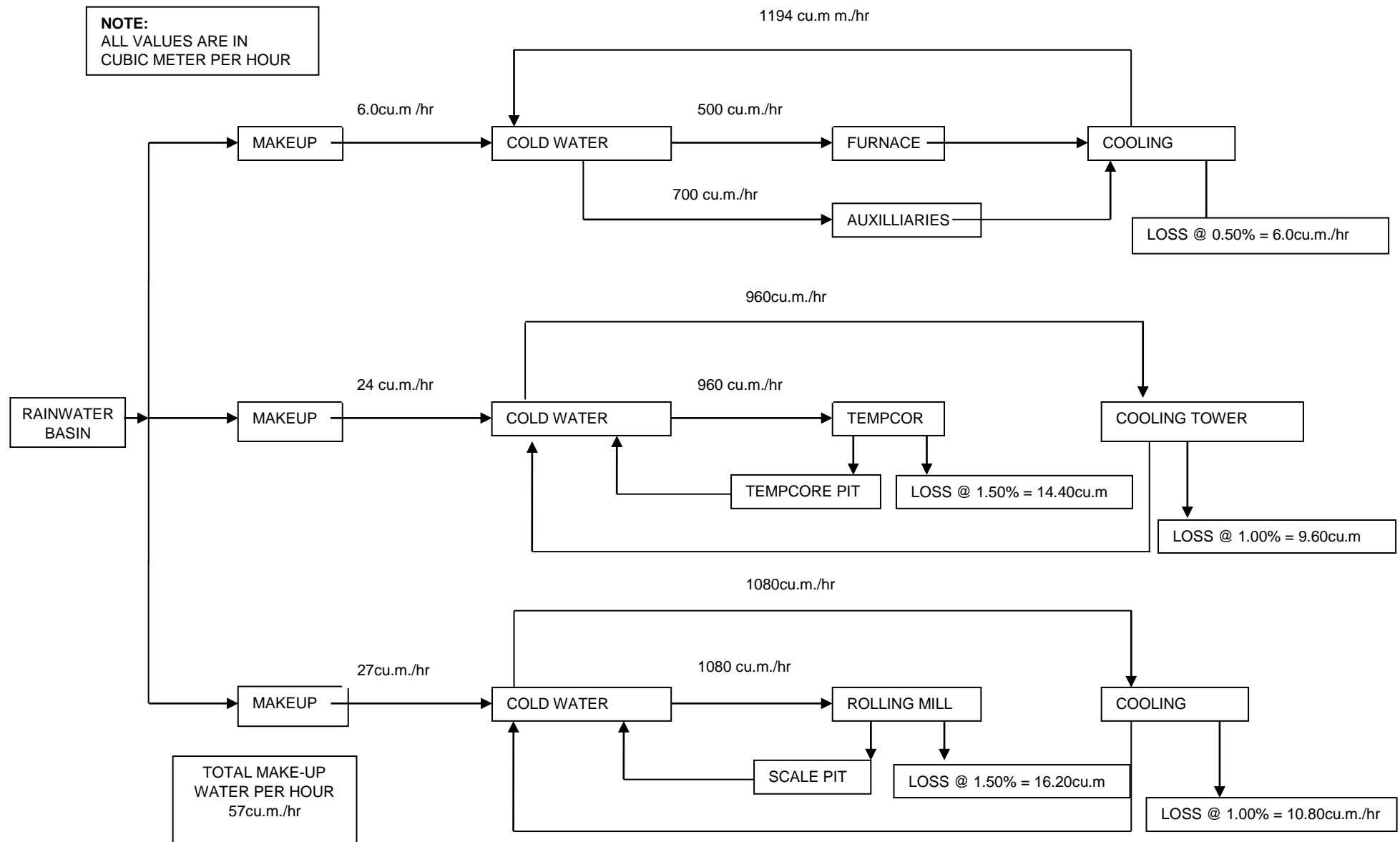


Figure 1.5.3: Water Balance

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 before being trucked out of the plant.

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 1.5.10**.

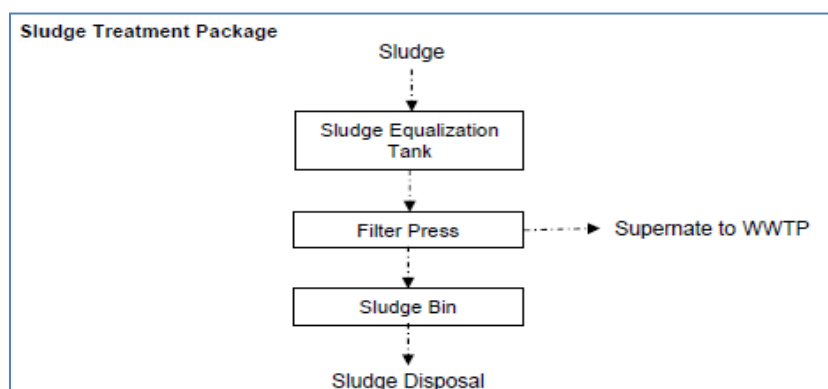


Figure 1.5.4: Sludge Treatment Process Flow

1.5.2 Operations and Maintenance of Facility

Provided **Tables 1.5.2** are the operations and maintenance of the Mill.

Table 1.5.2: Operations and Maintenance

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
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	2 Years

Equipment	Maintenance Activities	Frequency
	years, no need to dismantle. Base on monitoring)	
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	2 Years

Equipment	Maintenance Activities	Frequency
	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)	
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

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
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, Storage 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
	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
Roller Table (Run out)	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
	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
Straightening machine	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
	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,	2 Years

Equipment	Maintenance Activities	Frequency
	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)	
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
	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
	Monitoring of bearing housing temperature, lubrication, gear coupling temperature, rollers, noise, and vibration.	Daily
	Monitoring and lubricating of plumber block.	Daily
Run out Roller Table for Transfer and Saws	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	2 Years

Equipment	Maintenance Activities	Frequency
	years, no need to dismantle. Base on monitoring)	
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
	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

Equipment	Maintenance Activities	Frequency
	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.	12,000 running hours
	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
	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

Equipment	Maintenance Activities	Frequency
	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

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.

1.5.3 Utility Requirements

1.5.3.3 Power Supply

Candelaria Steel will install a substation with a demand capacity of 30 MW. It will supply the Plant's requirements. The construction of the substation conforms to the national electrical codes, to ensure safety and proper functioning of the electrical system. The main transformer output is 6.6kV, 3-phase, 60Hz for internal distribution. One 6.6kV MV power distribution room will be located in the main building. The MV Step-down Transformers will be 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.

1.5.3.4 Water Supply

The source for makeup water is from water reservoir and river water in case water reservoirs water is short.

1.5.4 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 sufficient 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.
- **Solid Wastes** will be properly segregated and to be disposed in the MRF of Candelaria
- **Domestic Waste** will be treated through the proposed Sewerage Treatment Plant.
- **Industrial waste water:** this water treatment system guarantees zero discharge of industrial waste water.

1.6 PROJECT SIZE

1.6.1 Project Capacity

The proposed project has a total annual production capacity of 600,000 MTPY of rebars and wire rods.

1.6.2 Project Area

The proposed project site has a total area of 326,687 sq.m. located in Brgy. Malabanban Sur, Candelaria, Quezon. This entire property has been acquired by Candelaria Steel, Inc. as evidenced by the Deed of Absolute Sale (DOAS) provided in Annex 1-2. The transfer of the TCTs from the previous owners to CandelariaSteel, Inc. is now on process.

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: Project Schedule

Activities ¹	FIRST 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								

1.7.1.1 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 is set by CSI. During construction, all contractors are required to have their safety officer on site. The DOLE standards (DOLE DAO 1998-13) shall be complied with by CSI and all of the contractors to ensure the protection and welfare of workers employed in the construction, to ensure protection and welfare of the general public within and around the immediate vicinity of any construction worksite as well as the promotion of harmonious employer-employee relationships and to take into consideration industry practices and applicable government requirements.

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 is a rolling mill for rebar and wire rod at an annual capacity of 600,000 MTPY.

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

The formulation of the detailed decommissioning plan will be done by CSI 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 CSI 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. CSI 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.

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.

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.

Temporary facilities will be established during construction such as toilet facilities, office, stock room and quarters. The associated environmental aspect/impact and risks of the activities from temporary facilities were thoroughly discussed under impact analysis and risk assessment.

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 500 workers where the three (3) will be directly hired by CSI while 497 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 1,000 personnel. A total of 500 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 CSI.

Skills training will be conducted before construction for workers in the host community to qualify with the skills requirements of the Plant.

CSI 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 payslips. 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, CSI 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, CSI 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. CSI 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. Manpower requirements 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 CSI. 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	25
Scaffolders Helper	Trained / Experienced Scaffolder	Outsourced	20
Steel man / Fabricator	Engineering Undergrad / Experienced Fabricator	Outsourced	41
Steel man/Fabricator Helper	Experience Fabricator	Outsourced	45
Carpenter	High School Graduate / Experienced Carpenter	Outsourced	50
Mason		Outsourced	35
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	20
Electrical Foreman	Electrical Engineer	Outsourced	25
Master Electrician	Certified Master Electrician	Outsourced	15
Electrical Helper	Undergrad Electrical Technician	Outsourced	35
Total Manpower			500
Operation Phase			
Section : Human Resources			
Staff 1 Supervisor	Degree in BS/BA Psychology or any related course	Plantilla Position	50
Section : Plant Administration			
Assistant Supervisor	Degree in BS/BA Psychology or any related course	Plantilla Position	75

Labor Type	Skill / Designation	Employee Type	No. of Personnel
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	175
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	50
Store Keeper			
Department : Information Technology			
Systems Technician	Degree in BS Information Technology or any related course	Plantilla Position	90
Department : Mechanical Maintenance			
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	100
Manager			
Planner			
Total Manpower			500
Abandonment Phase			
During decommissioning, work will be outsourced to contractors supervised by the PCO, the Resident Manager and Plant Manager of CSI.			

1.9 INDICATIVE PROJECT INVESTMENT COST

The indicative project cost is PhP 5,000,000,000.00.

CHAPTER II: ASSESSMENT OF ENVIRONMENTAL IMPACTS

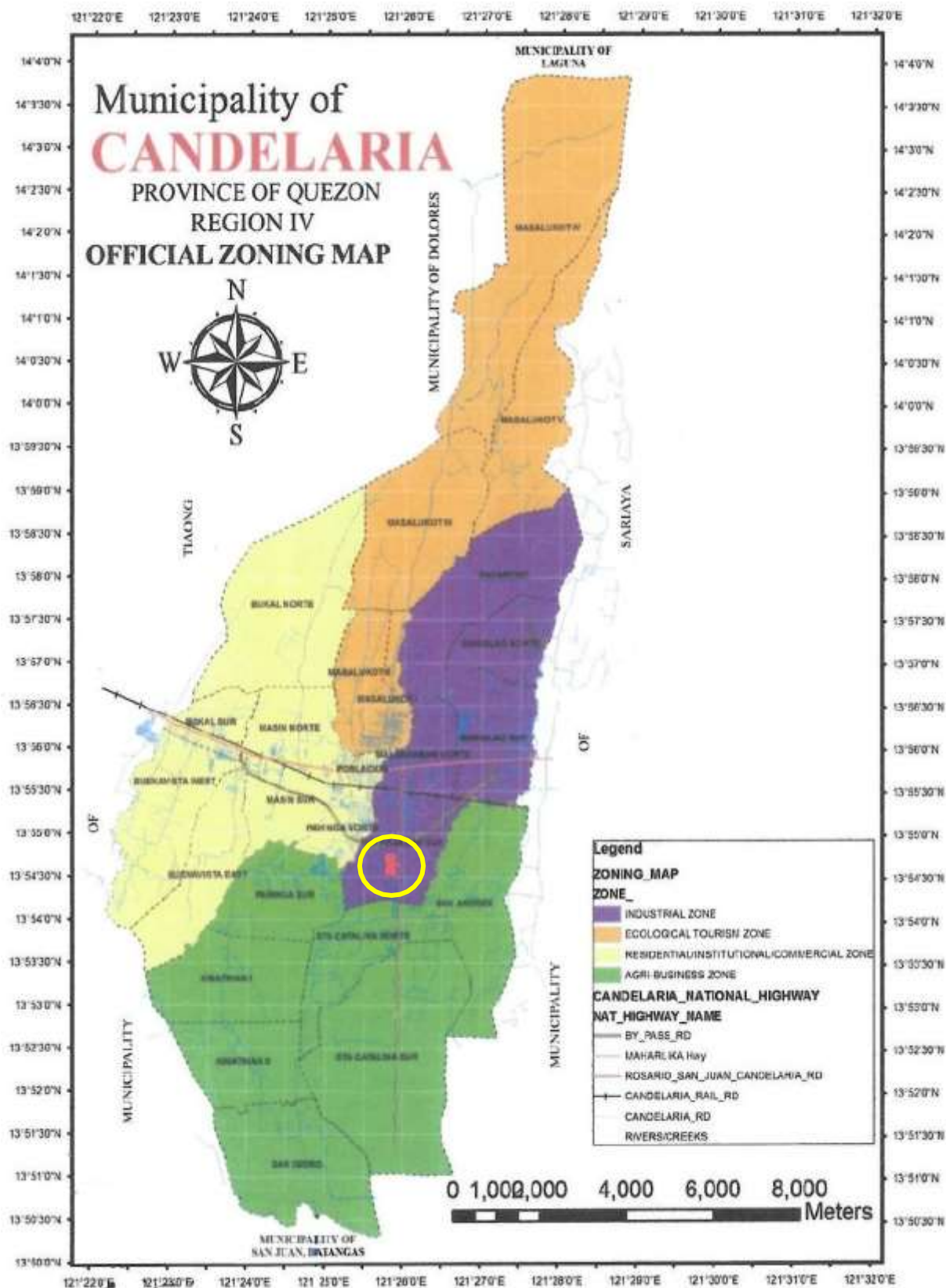
2.1 LAND

2.1.1 Land Use and Classification

2.1.1.1 Existing Land Use

Candelaria is composed of agricultural area, forest, residential area, commercial area, industrial area, tourism, mangrove area, etc. Majority of the land in Candelaria are used for agriculture. Based on the Land Use Map of Candelaria presented in **Figure 2.1.1** and in the Zoning Certificate issued by the Municipal Planning and Development Office (MPDO) of Candelaria (**Annex 2-1**), the proposed project site is designated as an industrial area. Based on the land classification map of Candelaria (**Figure 2.1.2**), the land is classified as alienable and disposable while the land cover map (**Figure 2.1.3**) provides that the project site is an open forest.

The nature of the project and its operations as far as SteelAsia Group's operations are concerned in its other existing plants, they do not pose negative impact to agricultural lands. Similarly, the same can be expected from Candelaria Steel, Inc.'s operations because this will be a more modern Rolling Mill Plant.



Source: MPDO of Candelaria

Figure 2.1.1: Land Use Map of the Municipality of Candelaria

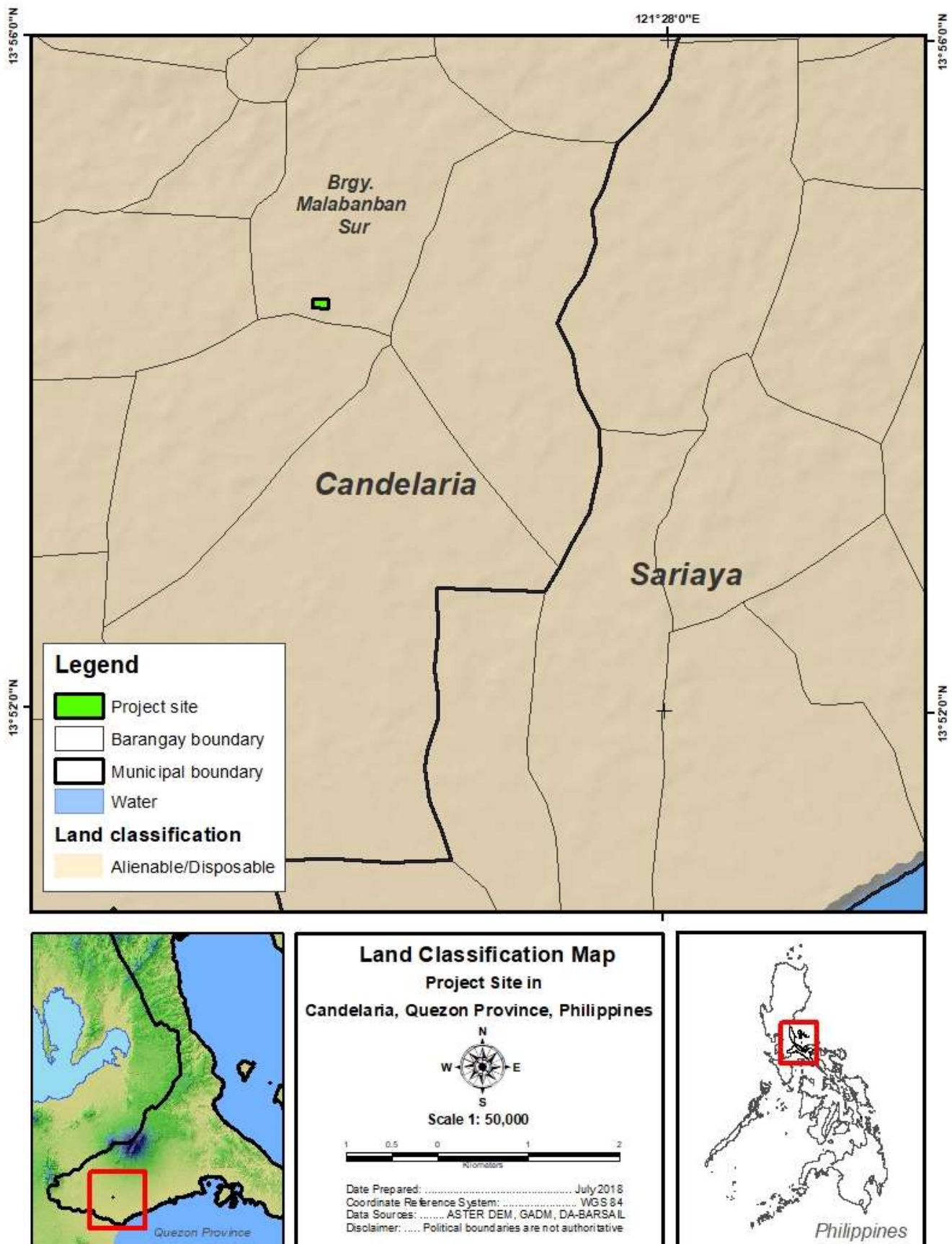


Figure 2.1.2: Land Classification Map of Candelaria (NAMRIA 2018)

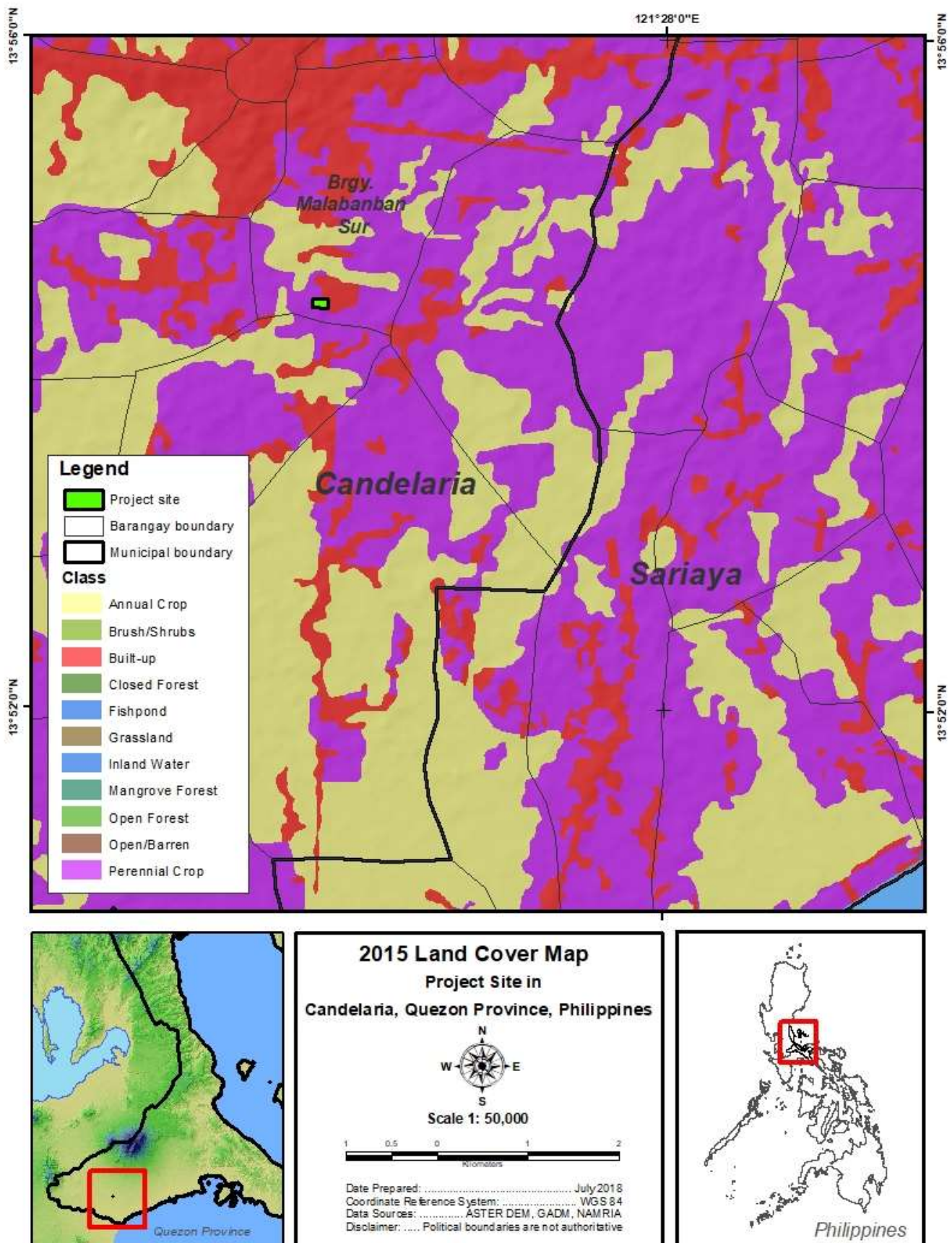


Figure 2.1.3: Land Cover Map of Candelaria (NAMRIA 2018)

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 located almost 30kms away from Mount banahaw and San Cristobal Landscape
2.	Areas set asides as aesthetic potential tourist spots	Based on the Land Use Map of Candelaria, the proposed project site is very far from tourism area.
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 is visited by at least two (2) typhoons per year based on the Typhoon Frequency Map.
7.	Areas with critical slopes	The proposed project site is flat.
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	
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.	
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.	

Source: Presidential Proclamation No. 2146 (1981)

Based on these ECA classification, the Project is not in an ECA.

2.1.1.3 Impact on Compatibility with Existing Land Use

The proposed project site is designated as an industrial area; therefore, there is no issue in terms of compatibility with the existing land use.

2.1.1.4 Impact on Compatibility with Classification as an ECA

Even if the proposed project site is not considered as ECA, CSI is committed to regularly monitor the water quality of the nearest water body.

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 CSI.

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, CSI will coordinate with the LGU of Candelaria 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 CSI 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

3.2 Geology/Geomorphology

3.2.1 General Geology

3.2.1.1 Tectonic Setting

The study area is found within a tectonically active region known as the Luzon Arc. In Luzon Island, Luzon Arc is bounded by two 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 Luzon Arc (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 Luzon Arc 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 Luzon Arc 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 kilometers, 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 Quezon including the project is geologically situated on the southern part of Luzon Island. It is tectonically bordered by the Manila Trench on the west and by the Philippine Trench on the east. Philippine Fault System that has a general trend of north to northwest transected the region. The proposed project located at Barangay Malabanban, Candelaria, Quezon is approximately 31.00 kilometers southwest of an Unnamed Fault traversing the Municipality of Mauban, Sampaloc and Pagbilao, 47.00 kilometers north of Lubang Verde Fault (Phivolcs Certification), and 37.00 kilometers west-southwest of Philippine Fault (Figure 3.2.1.1).

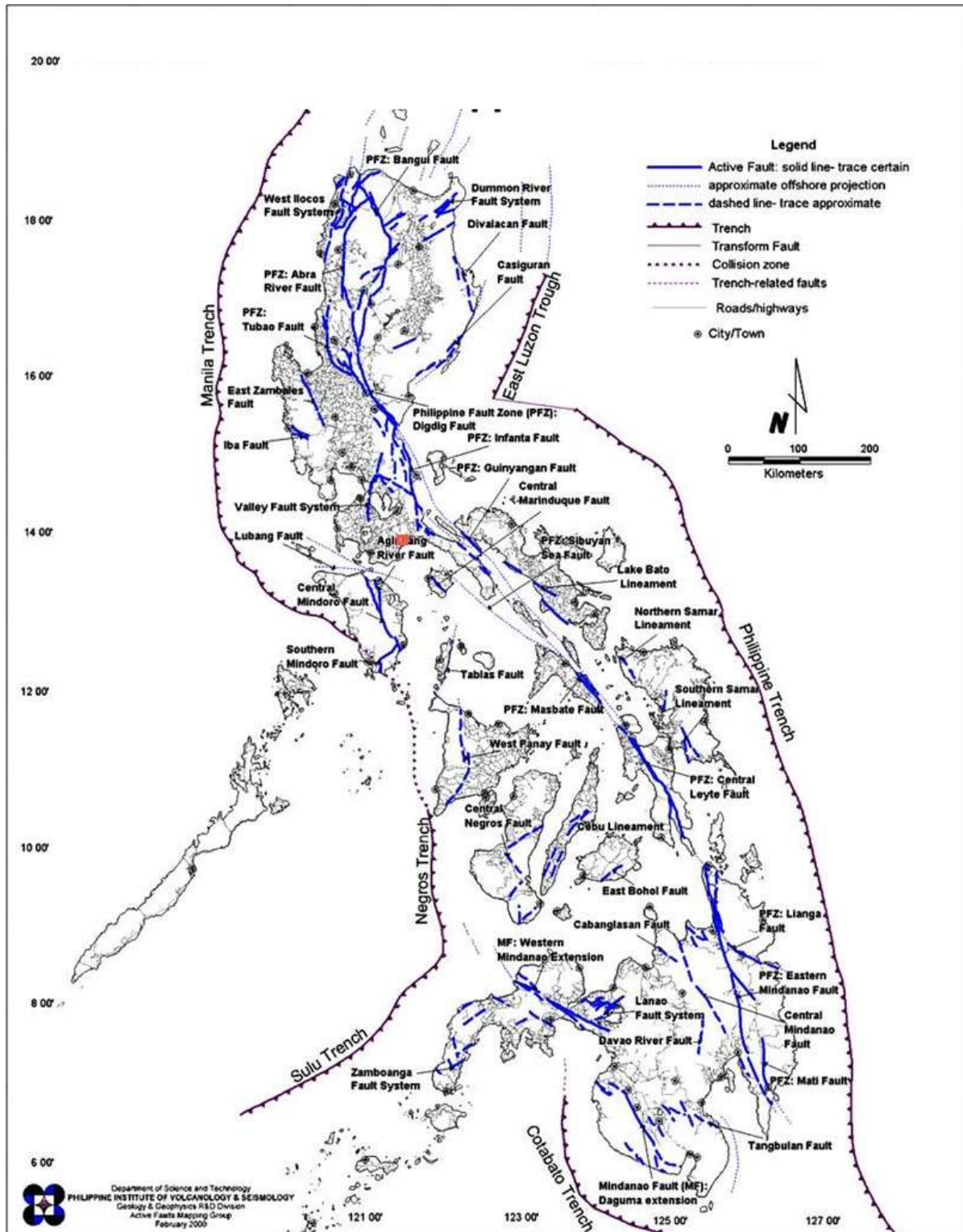


Figure 3.2.1.1. Tectonic Map of the Philippines (Aurelio 2000)

3.2.1.2 Stratigraphy

Tiaong Quadrangle including Candelaria, Quezon where the project site is located are generally underlain by four Formations namely Quaternary Alluvium, Quaternary Volcanic Plug, Taal Tuff Formation, and Talahib Formation. Quaternary Alluvium (QAI), generally found near shores and consists of unconsolidated to poorly consolidated gravel, sand, silt and clay.

Taal Tuff are mainly andesite flows interbedded with thin layers of pyroclastics and bedded tuff. The project is generally underlain by this formation (Figure 3.2.1.2).

Talahib Andesite are mainly andesite flows interbedded with thin layer of pyroclastics and bedded tuff.

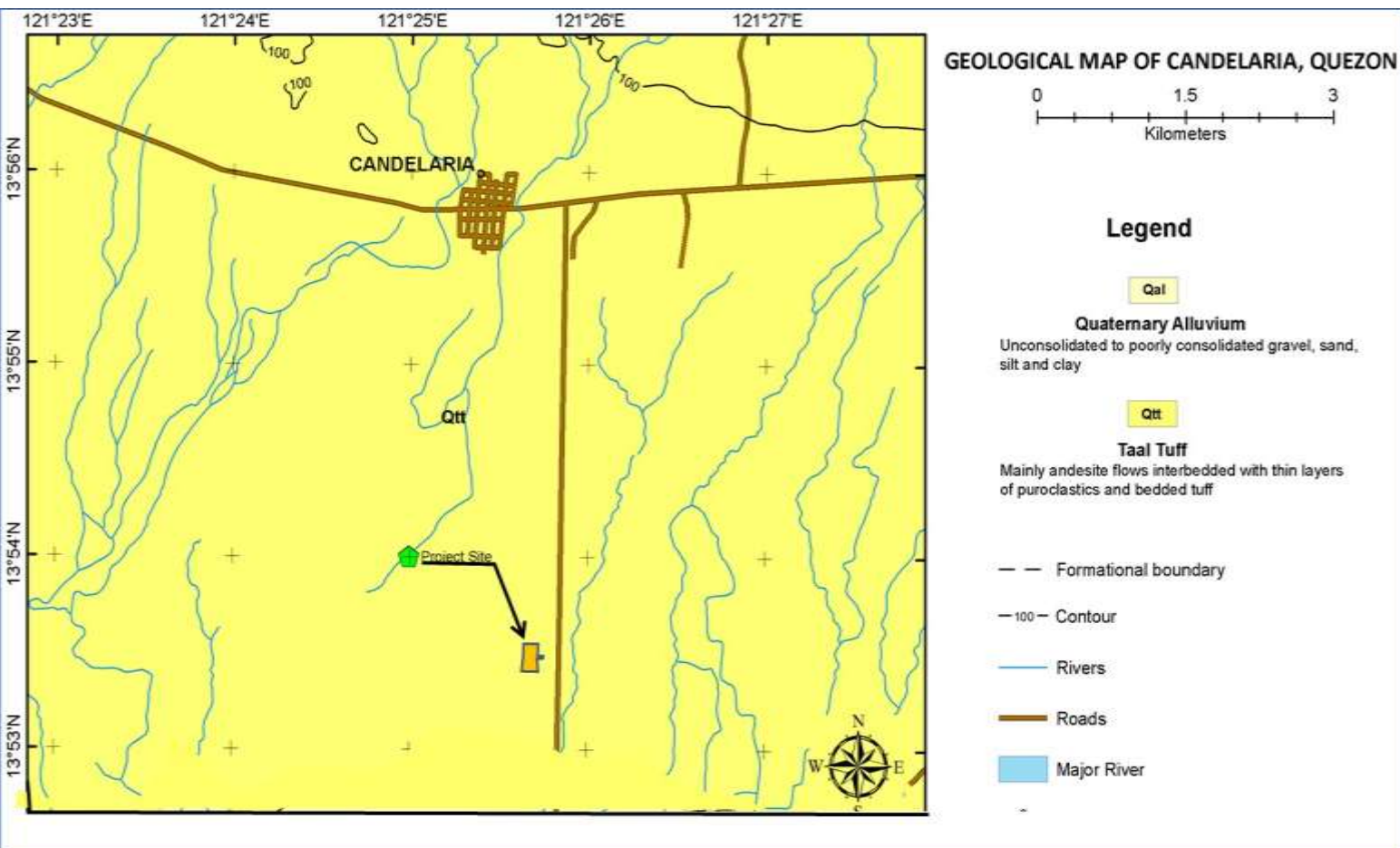


Figure 3.2.1.2. General Geology of Candelaria, Quezon (MGB 1986)

3.2.1.2a Surficial Deposit and Engineering Characteristics

There were no borehole and test pits conducted in the area, however as observed during mapping, a tuffaceous sandstone is exposed at the surface of the property. This type of rock is a good founding material. A geotechnical study is however, be undertaken to determine the engineering properties of the underlying rock.

3.2.1.3 Geologic Structure

The most prominent geologic structure in the region nearest to the project area is an Unnamed Fault (Phivolcs Certification) traversing the Municipality of Mauban, Sampaloc, and Pagbilao located 31.00 kilometers northeast of the site. Other active major faults in the region proximal to the project site include the Lubang Verde Fault, Philippine Fault, and Aglubang Fault.

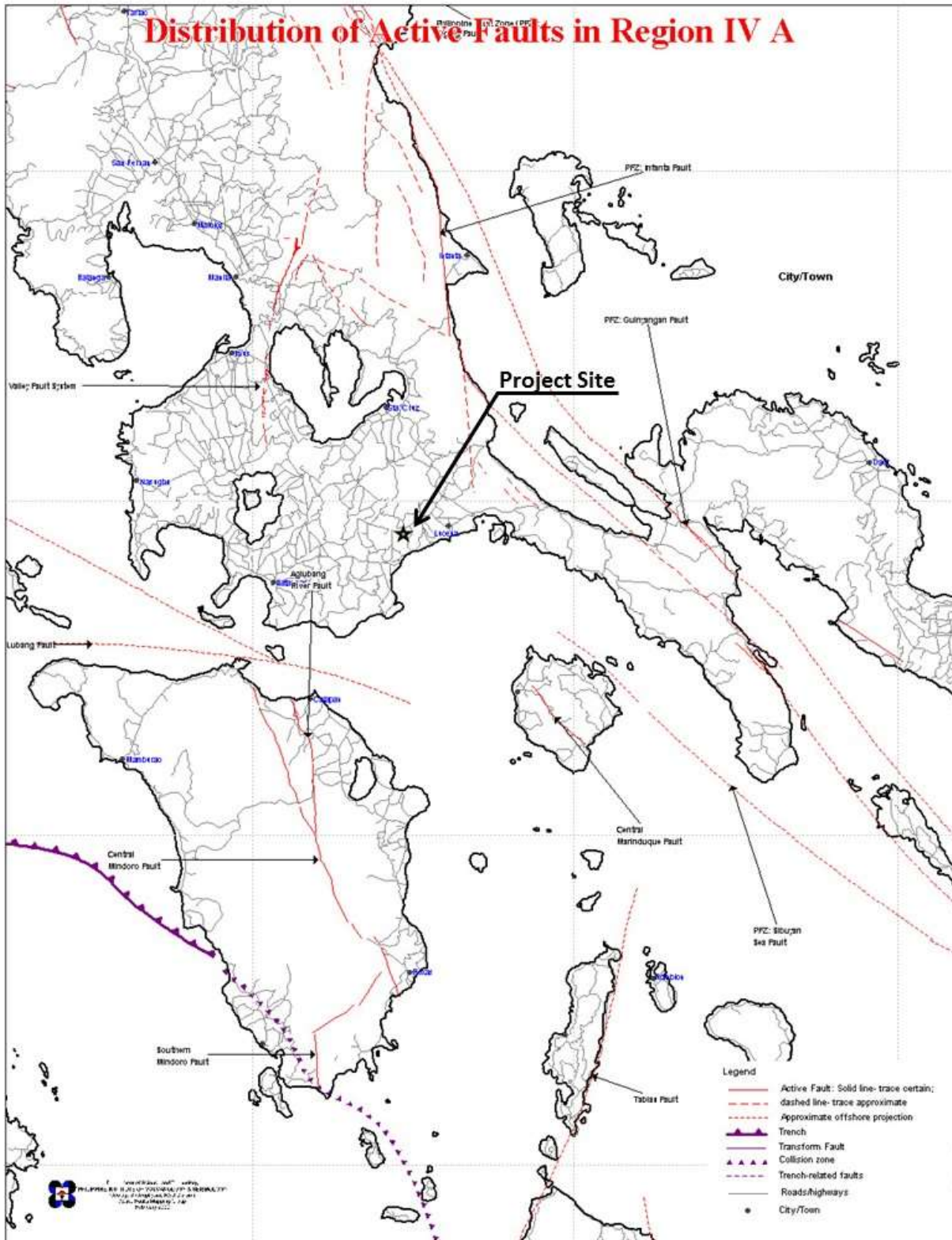


Figure 3.2.1.3. Active Faults and Trenches of Luzon Province (Phivolcs 2000)

3.2.1.4 Change in surface landform/ topography/ terrain/slope

The project area is characterized by generally flat terrain. There will be no change in surface land form as the project will only involve construction of structures for the rolling mill plant.

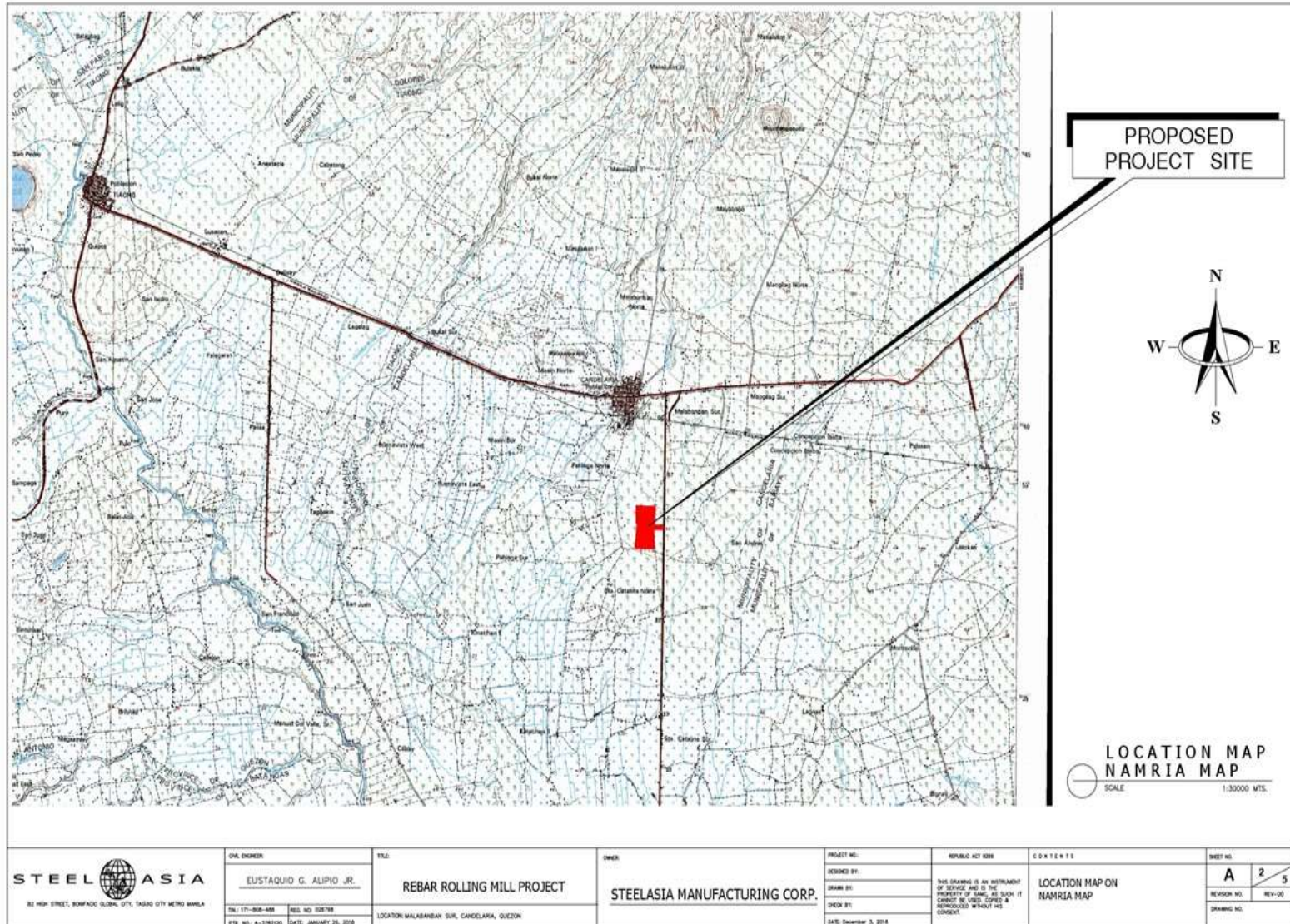


Figure 3.2.1.4. Topographic Map of the Project Site (NAMRIA 1983)

3.2.1.5 Hazard Maps and Discussions of Impacts/Effects of Natural Hazards on the Project

“Hazard is a potentially damaging physical event, phenomenon or human activity, which may cause the loss of life or injury, property damage, social and economic disruption or environmental degradation. It can include latent conditions that may represent future threats and can have origins, natural (geological, hydrometeorological and biological) and/or induced by human processes (environmental degradation and technological hazards)”

“Natural Hazards” are the natural processes or phenomena occurring in the biosphere that may constitute a damaging event. It can be classified by origin: geological, hydrometeorological or biological.

3.2.1.5.1 Geologic Hazard

3.2.1.5.1.1 Volcanic Hazard

The area studied is near the Mount Banahao, however base on the debris avalanche zonation map, the project falls outside the high-risk zone. (Figure 3.2.1.5.1.1).

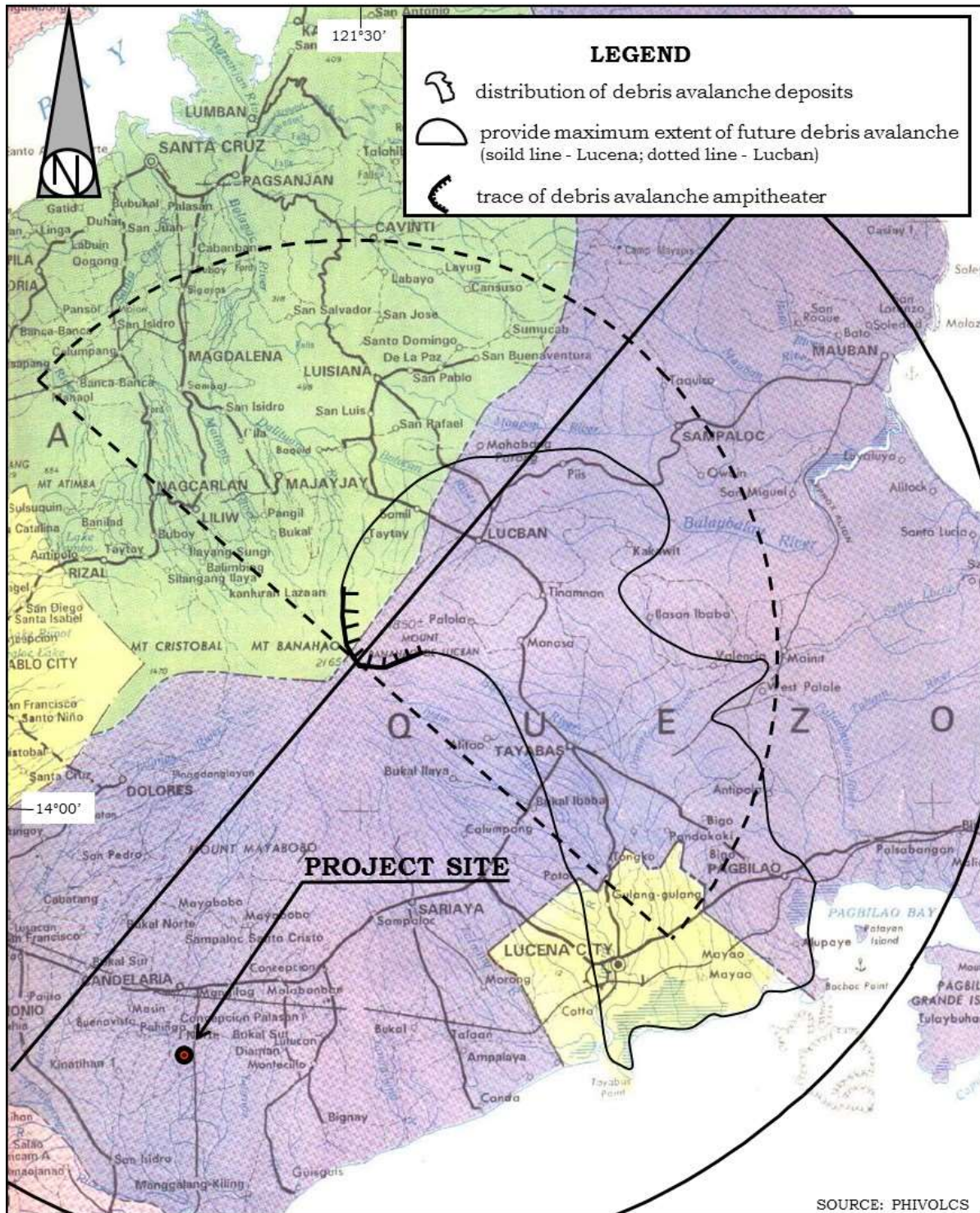


Figure 3.2.1.5.1.1 Debris Avalanche Zonation Map of Mount Banahao

3.2.1.5.1.2 Earthquake Hazards

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 3.2.1.5.1.2**).

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 Infanta Fault Extension, Lubang/Verde Passage Fault, Aglubang Fault and the Philippine Fault (Punongbayan, 1989). The site has experienced Intensity VI during the July 1990 Luzon Earthquake (**Figure 3.2.1.5.1.2b**).

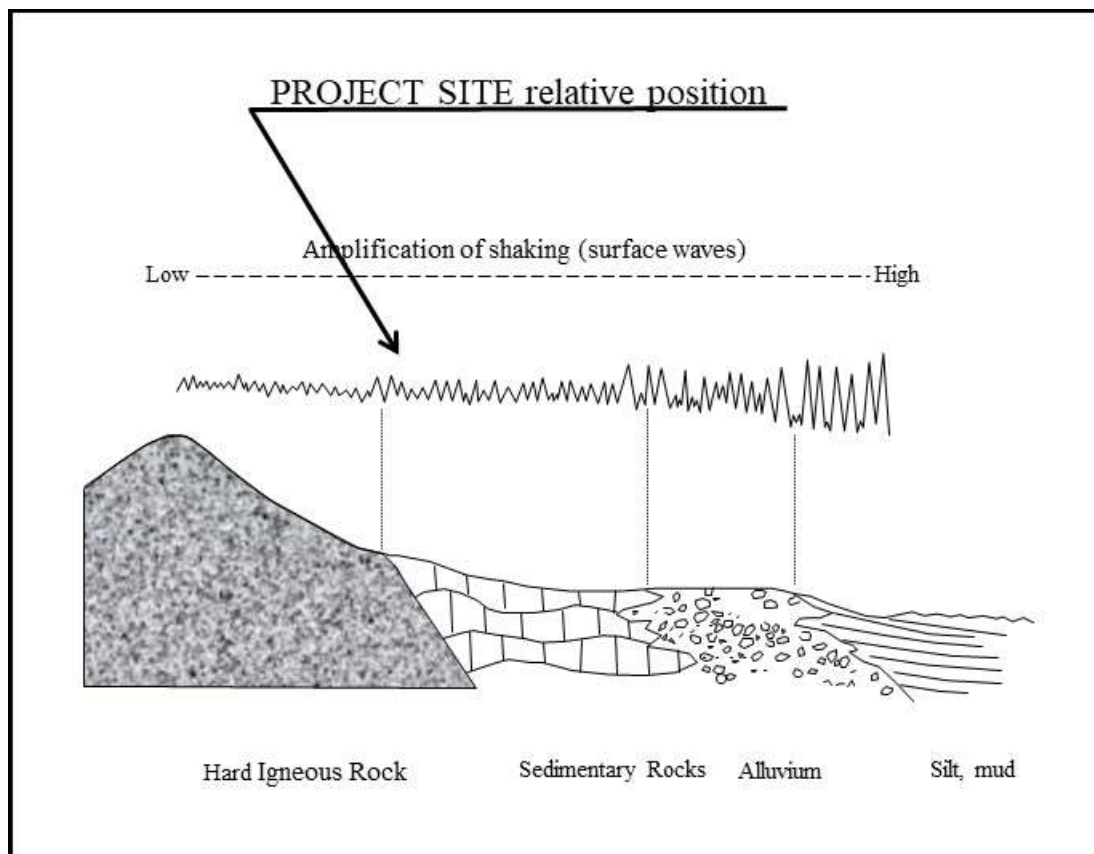


Figure 3.2.1.5.1.2 Generalized Relationship Between Near Surface Earth Material and Amplification of Shaking During a Seismic Event (Keller E. A. 1985)

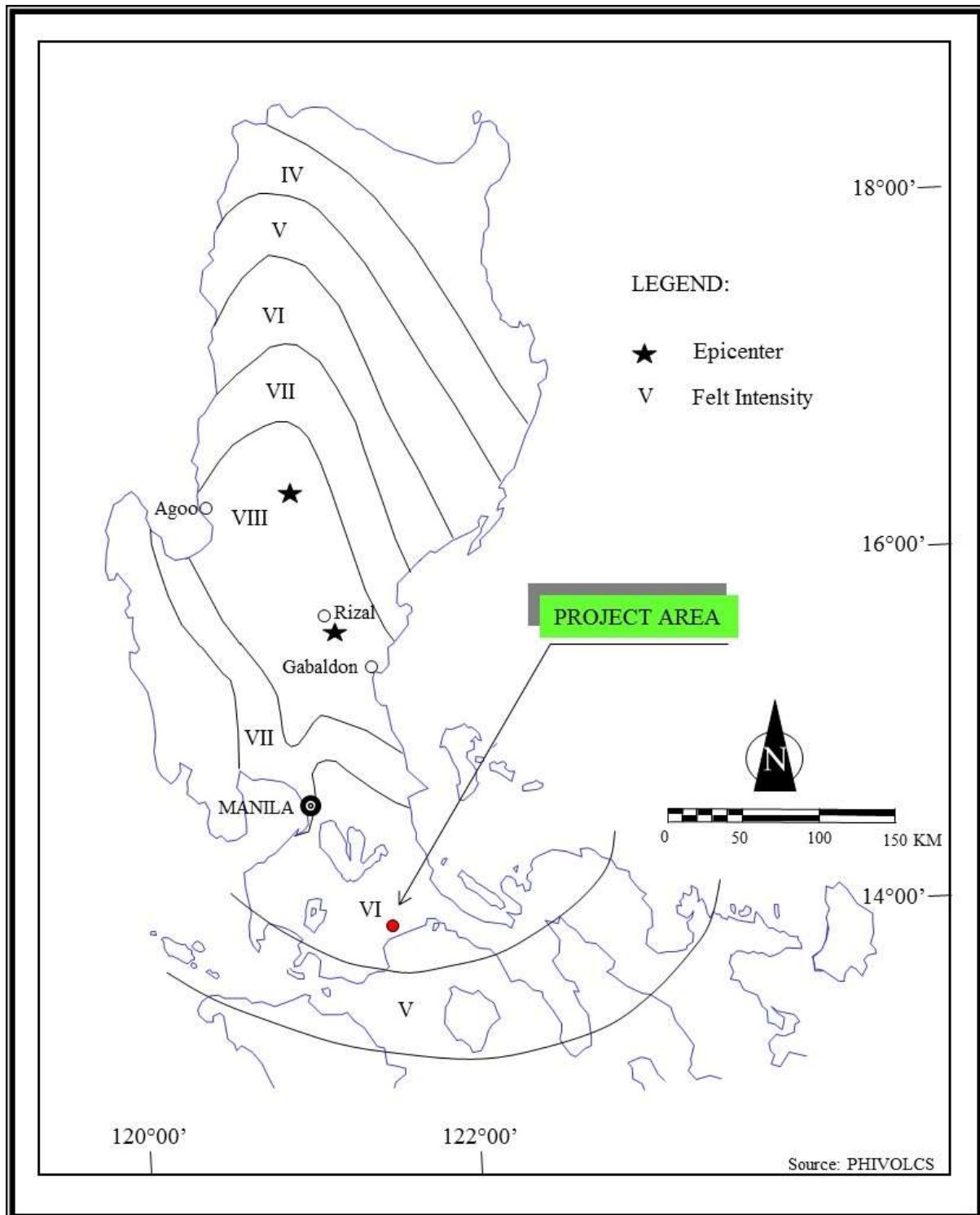


Figure 3.2.1.5.1.2b. Intensity Map of 16 July 1990 Luzon Earthquake (Phivolcs 1992)

3.2.1.5.1.2.1 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, a tectonically active place with noted active faults that are usually the source of major earthquakes is the reason why the Philippine Institute of Volcanology and Seismology (PHIVOLCS) and the United States Geological Survey (USGS) conduct ground motion hazard mapping in terms 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 tuffaceous sandstone covered by thin soil deposits and fall under the 0.39g for Medium Soil (Figure 3.2.1.5.1.2.1).

Using the deterministic method of Tanaka and Fukushima with the following attenuation relation:

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

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

and considering an earthquake magnitude of 7.2 and distance of the site of 31.00 kilometers from an Unnamed Fault, the following peak ground acceleration (PGA) values of 0.144g, 0.208g, and 0.333g for bedrock, medium soil and soft soil, respectively. The project falls on the medium soil condition.

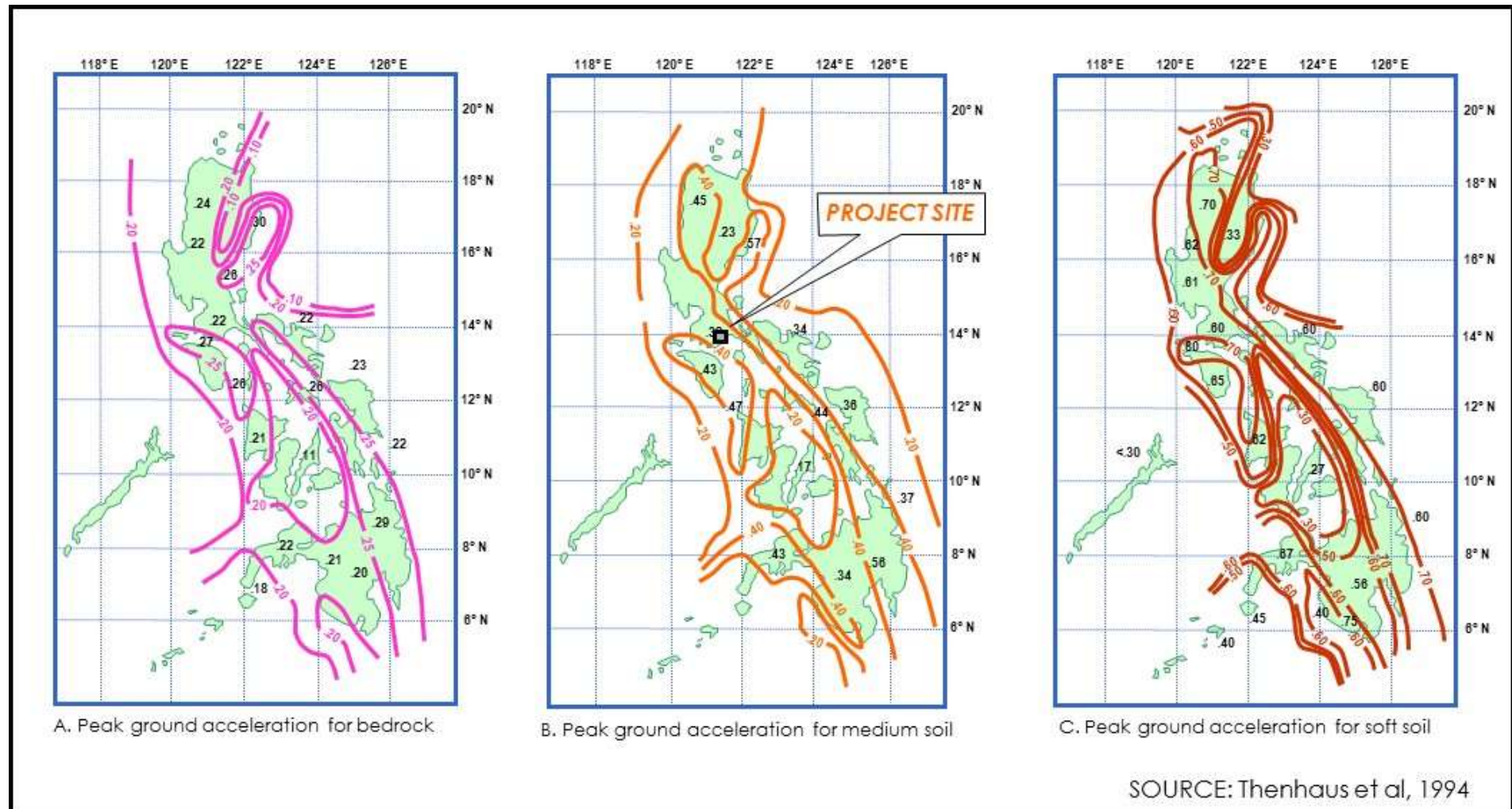


Figure 3.2.1.5.1.2.1. Maps Showing Peak Horizontal Acceleration Amplitude on Bedrock, Medium Soil and Soft Soil for the Philippine Region (Thenhaus et al, 1994)

3.2.1.5.1.2.3 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 5 meters 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 Unnamed Fault is found about 31.00 kilometers northeast of the project site.

3.2.1.5.2 Hydrologic Hazard

3.2.1.5.2.1 Landslide Hazard

Mass movement involves the bulk transfer of earth masses under the influence of gravity. Common downslope hazards include landslide, slumping, and increased erosion, which commonly occur along steep slope, escarpments, steep terrain, underlain by highly weathered, fractured and loose material. This is usually triggered by heavy precipitation and prolonged rains during monsoon rains, ground shaking, and in some cases, man-made slope excavations.

Based from the Landslide Susceptibility Mapping of Tiaong Quadrangle conducted by the Mines and Geosciences Bureau, Region 4A, the proposed project site with generally flat terrain falls outside the delineated landslide prone areas (Figure 3.2.1.5.2.1).

3.2.1.5.2.2 Flood Hazard

The proposed project site, which is generally flat and with elevation of about 45 meters above sea level is considered prone to localized flooding. During heavy continuous rain and the presence of several drainage systems makes the project susceptible to localized flooding.

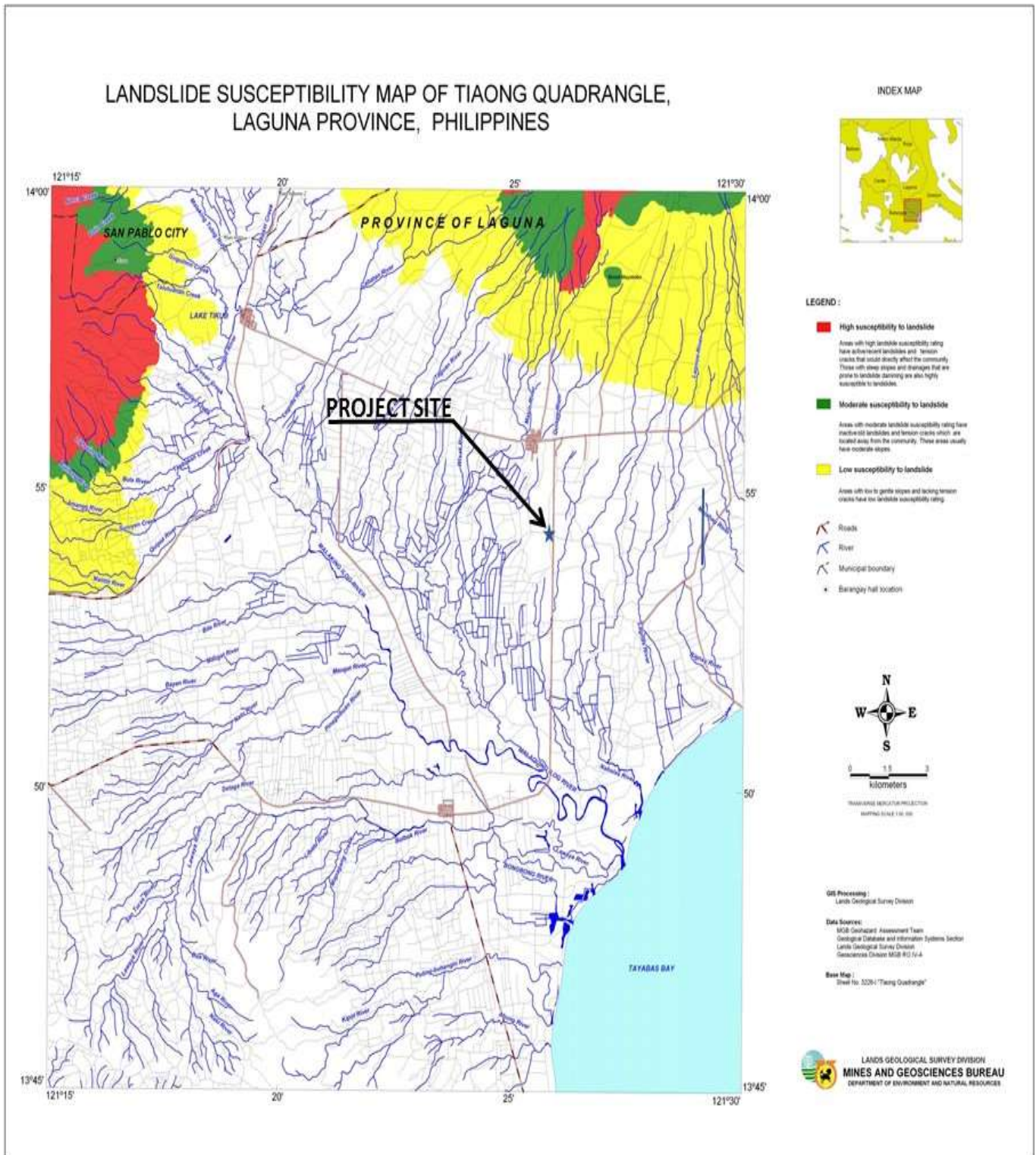


Figure 3.2.1.5.2.1. Landslide Susceptibility Map of Tiaong Quadrangle, Quezon (MGB 2007)

3.2.1.5.2.3 Typhoons

The relevance of typhoons to the project/project site is reckoned from the following hazards:

Rain-induced localized floodings
Risks to personnel

Figure 3.2.1.5.2.3 below shows the tropical cyclone frequency map where the project falls within the delineated 3 cyclones in 2 years. Figure 3.2.1.5.2.3b shows the normal path of typhoons. From these maps is seen that the project site falls outside the typhoon path.

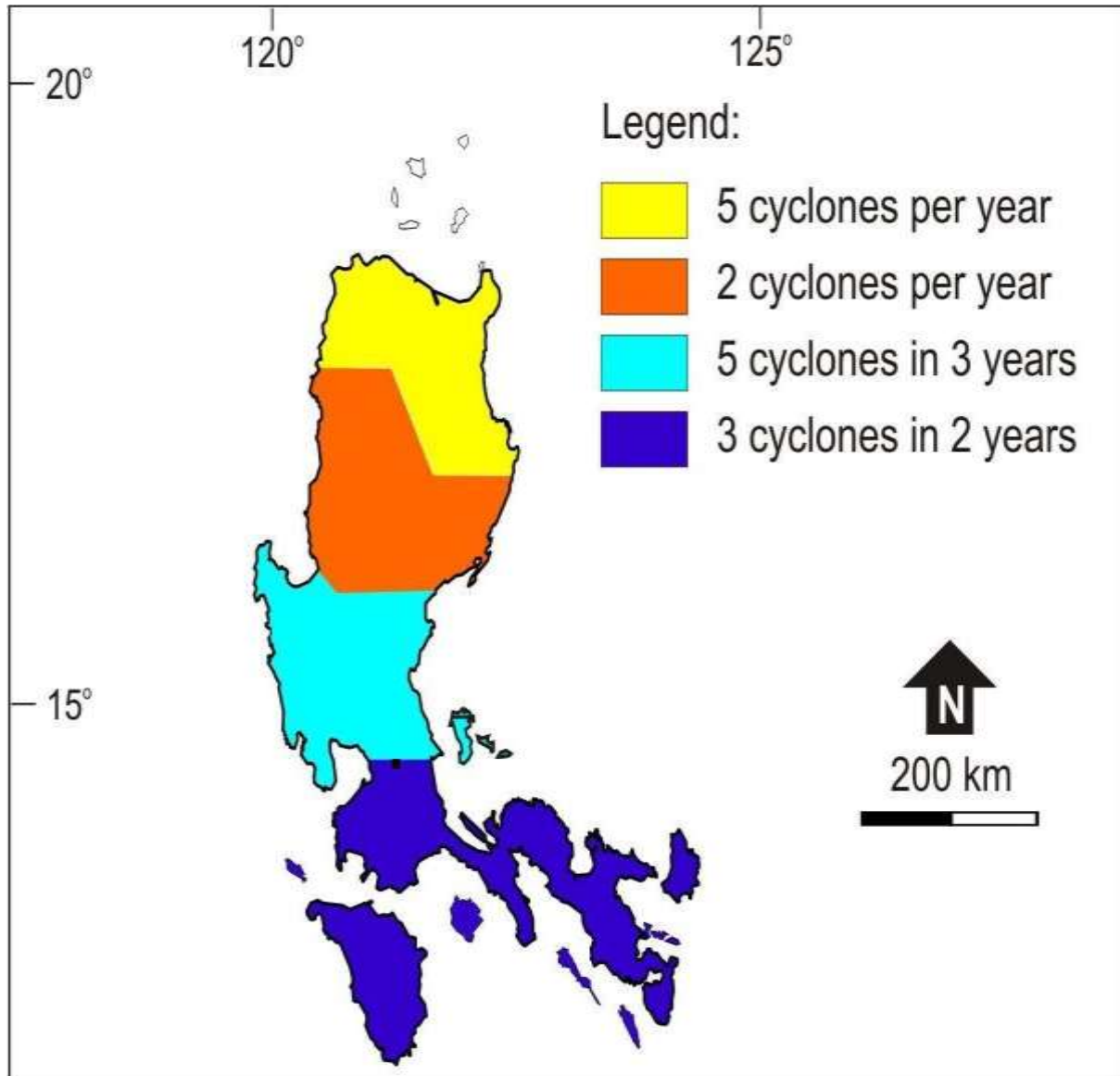
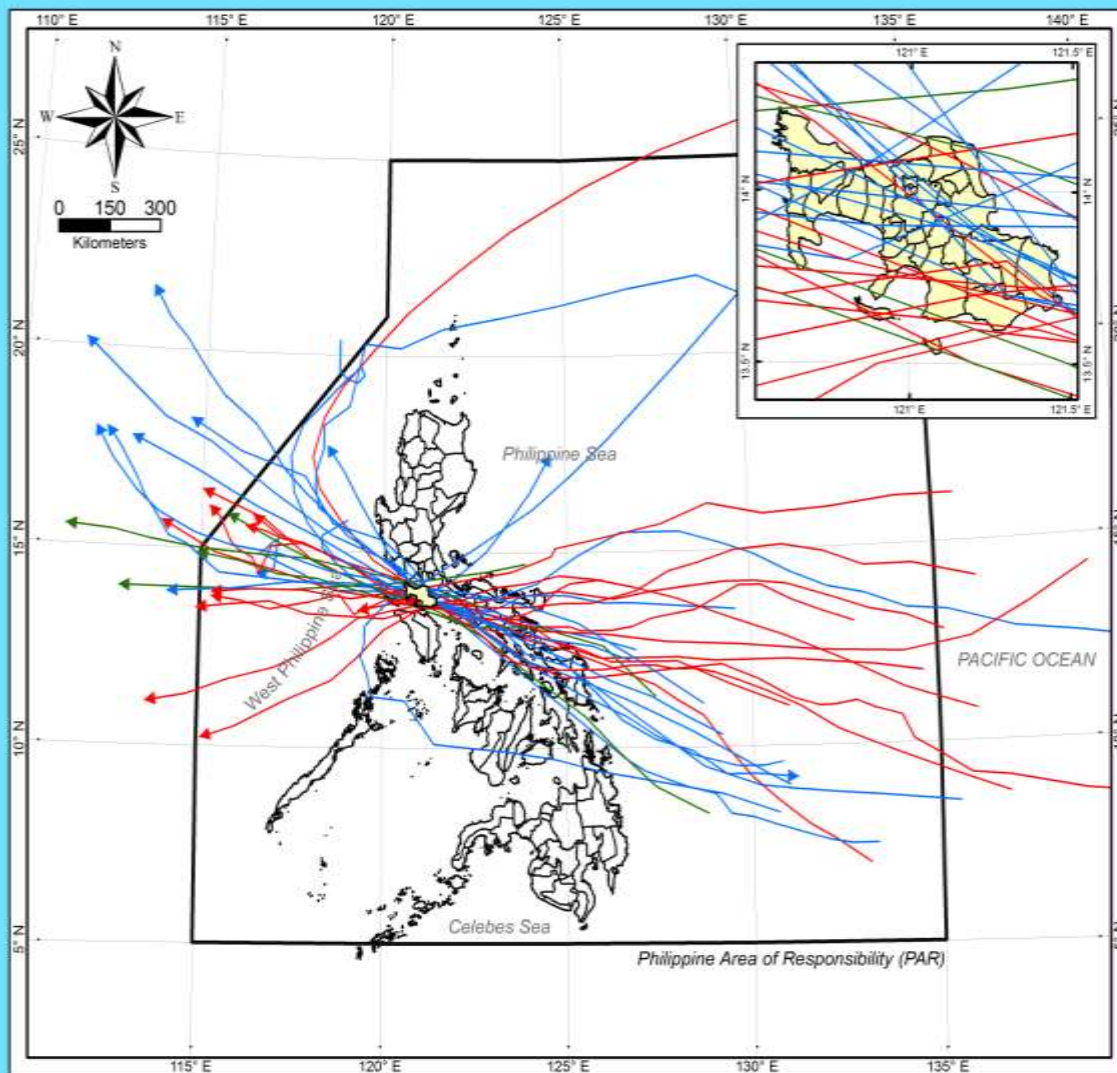


Figure 3.2.1.5.2.3. Typhoon Frequency Map

Overall, PAGASA had tracked 29 tropical cyclones that crossed in the Province of Quezon from 1948-2016 is shown in **Figure 2.1.4** while **Figure 2.1.4b** is the monthly distribution of tropical cyclone.

More detailed discussion is provided in Section 2.3.1.2 on Cyclone Frequency.

TRACKS OF TROPICAL CYCLONES WHICH CROSSED THE PROVINCE OF BATANGAS FROM 1948 TO 2016



Philippine Atmospheric,
Geophysical and
Astronomical Services
Administration (PAGASA)

LEGEND:

-  Tropical Depression
-  Tropical Storm
-  Severe Tropical Storm
-  Typhoon
-  Super Typhoon
-  Batangas

Month	No of TC
January	1
February	0
March	0
April	1
May	5
June	1
July	4
August	0
September	6
October	5
November	2
December	4
TOTAL	29

TC TYPE	No of TC
Tropical Depression	4
Tropical Storm	13
Severe Tropical Storm	0
Typhoon	12
Super Typhoon	0
TOTAL	29

Projection:
UTM Zone 51N

PREPARED BY:
Climate and Agromet Data
Section (CADS)

Figure 2.1.4: Track of Tropical Cyclone in Quezon

From this map, it is shown that the Project site is vulnerable to tropical storms where a tropical cyclone with maximum wind speed of 62 to 88 kph or 34 - 47 knots will be experienced.

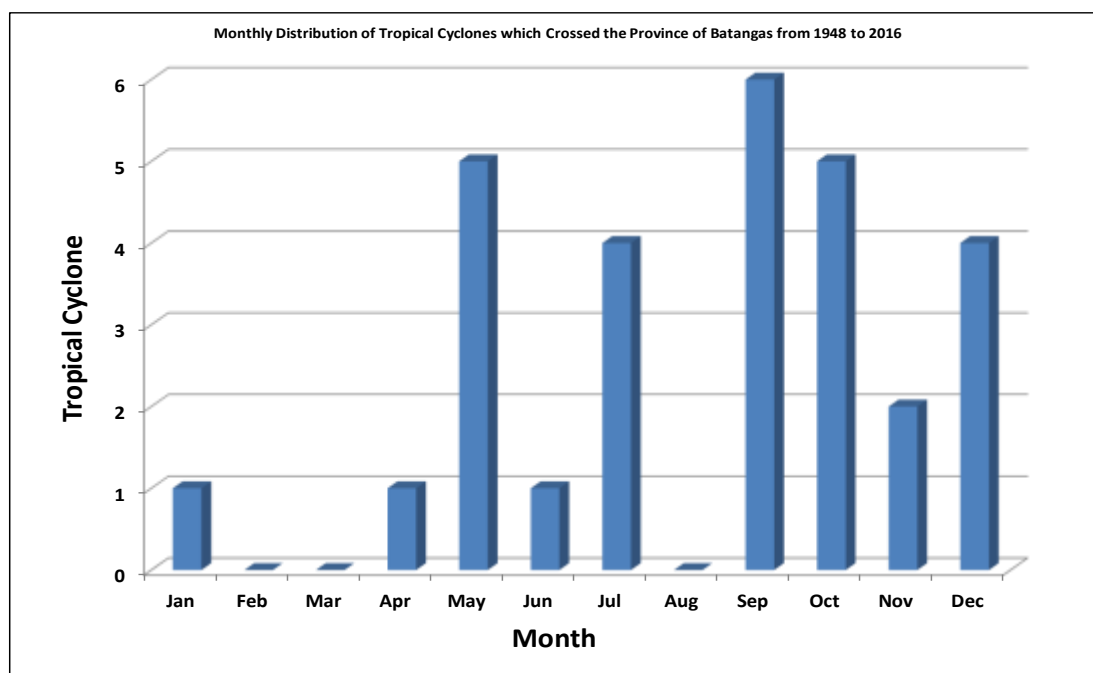


Figure 2.1.4b: Monthly Distribution of Tropical Cyclone in Quezon (source: PAG-ASA)

Table 2.1.4: List of Tropical Cyclones which crossed the Philippines in 2017

LIST OF TROPICAL CYCLONES WHICH CROSSED THE PHILIPPINES
FOR THE YEAR 2017

YEAR	MONTH	TYPE	TC NAME	PAR BEG	PAR END
2017	1	TD	AURING	1/7/2017	1/8/2017
2017	2	TD	BISING	2/3/2017	2/6/2017
2017	4	TD	CRISING	4/14/2017	4/15/2017
2017	4	TS	DANTE	4/26/2017	4/27/2017
2017	7	TS	EMONG	7/1/2017	7/2/2017
2017	7	TD	FABIAN	7/21/2017	7/22/2017
2017	7	TY	GORIO	7/25/2017	7/29/2017
2017	7	TS	HUANING	7/29/2017	7/30/2017
2017	8	TS	ISANG	8/20/2017	8/22/2017
2017	8	TS	JOLINA	8/24/2017	8/26/2017
2017	9	TS	KIKO	9/4/2017	9/6/2017
2017	9	TY	LANNIE	9/11/2017	9/13/2017
2017	9	TS	MARING	9/11/2017	9/13/2017
2017	9	TD	NANDO	9/23/2017	9/23/2017
2017	10	TS	ODETTE	10/11/2017	10/14/2017
2017	10	TY	PAOLO	10/16/2017	10/21/2017
2017	10	TS	QUEDAN	10/25/2017	10/28/2017
2017	10	STS	RAMIL	10/31/2017	11/2/2017
2017	11	TS	SALOME	11/8/2017	11/10/2017
2017	11	TS	TINO	11/17/2017	11/18/2017
2017	12	TS	URDUJA	12/13/2017	12/19/2017
2017	12	TY	VINTA	12/20/2017	12/24/2017

NOTE :

** means Tropical Cyclones with multiple entry in PAR

PREPARED BY: CADS/CAD/PAGASA

3.2.1.5.2.4 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. Factors that affect the vulnerability of an area to flooding are surface geology, topography, amount and duration of rainfall, vegetation and land cover.

Figure 3.2-2 presents the Flood Susceptibility Map of Candelaria Quezon prepared by the Mines and Geosciences Bureau (MGB) which classifies susceptibility to flooding as follows:

Areas with Low Susceptibility to Flooding experience floods with heights of less than or equal to 0.5 meter. Areas with Moderate Susceptibility to Flooding attain flood heights from 0.5 to one (1) meter. This condition is attained during prolonged and extensive heavy rainfall or extreme weather occurrences.

Areas with High Susceptibility to Flooding attain flood heights which exceed one (1) meter. These areas are usually flooded for several hours during heavy rains. These include topographic lows such as active river channels, abandoned river channels and areas along river banks.

DETAILED LANDSLIDE AND FLOOD HAZARD MAP OF
CANDELARIA, QUEZON, PHILIPPINES
3228-I-9 MALABANBAN SUR QUADRANGLE

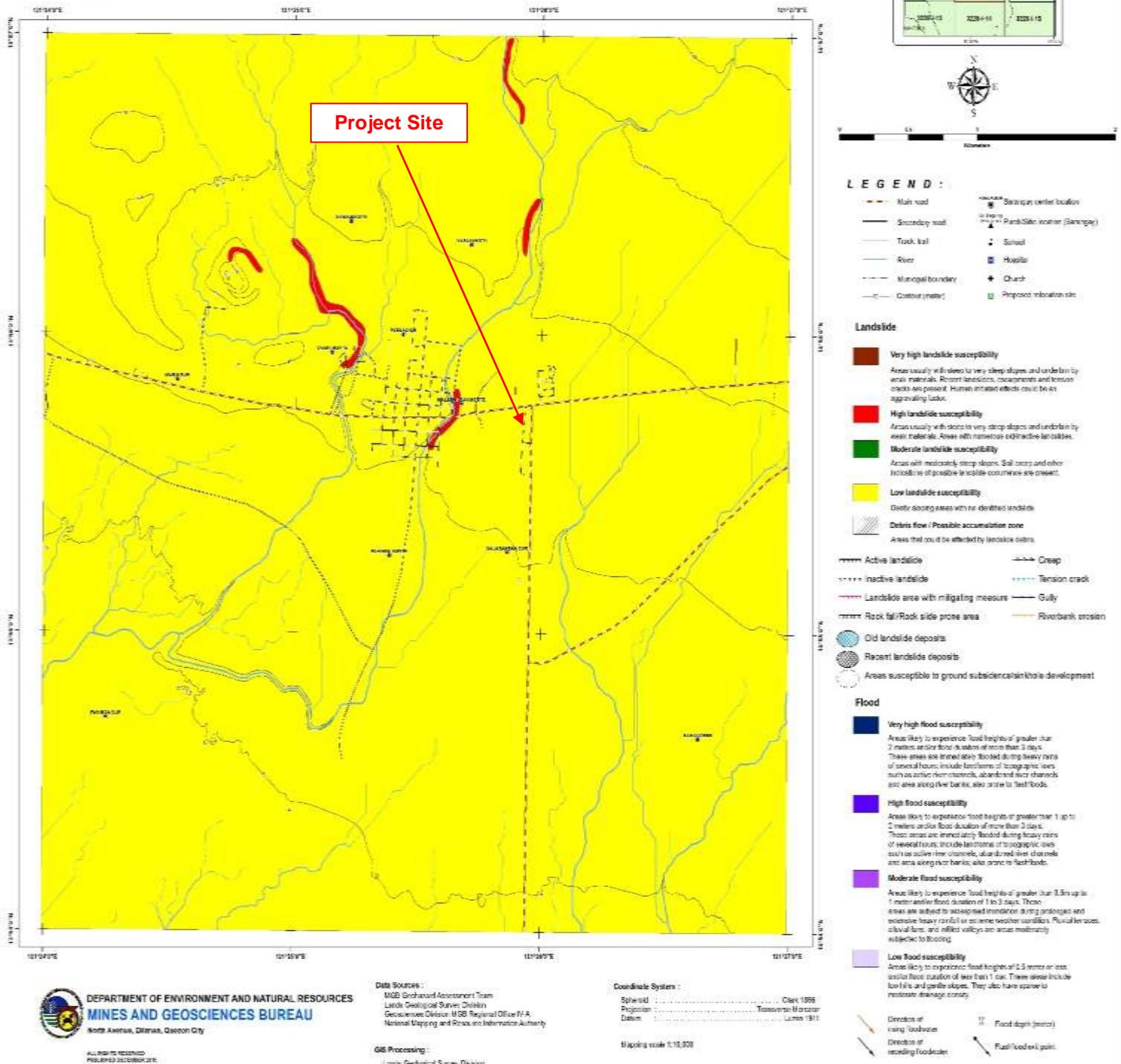


Figure 3.2.1.5.2.4: Flood Susceptibility Map (MGB 2-15)

The proposed project site is not susceptible to flooding and landslide based on the map shown in the figure above. However, the Project will install drainage systems in accordance to the comprehensive hydrological study to address flooding. Also, the Project installed a well-designed drainage system to accommodate the highest peak of rainfall based on PAGASA projections.

2.1.3 Pedology

In general, Candelaria has a rolling terrain with slope ranging 0 to above 18%. The topography of the town shows that the total land area, 26.8% belong to the slope 0 to 3%, 20.7% to 3.8%, 17.5% have slopes 8-18% while the rest which is above 18% constitute 35.0%. The overall terrain is suitable for pasture, tree crops and other agriculture development

2.1.3.1 Soil Type

There are four (4) different types of soil in Candelaria, each with specific characteristics: Guadalupe, Ibaan, Lipa, and Mountain (see Table 2.1.3.1.1).

The most common type is the Guadalupe soil series, which is the most widely distributed and most important to agriculture. Guadalupe soil can be found in nearly level to gently sloping and well-drained deep soils of the upland areas located in the northwestern section of the town proper, the southern portion, the area adjacent to the forested area, and the area near the center of the municipality. It has two (2) subtypes: the first one, Guadalupe loam, can be found in Barangay San Isidro; while the other one, Guadalupe clay loam, can be found in all barangays except San Isidro, Kinatihan, and Mayabobo. Its recommended land use is for the cultivation of following crops, accompanied with soil erosion control practices: lowland and upland rice, corn, root crops, coconut, vegetable, banana, beans, cacao, citrus, coffee, and locally adopted fruit trees.

The Ibaan soil type, developed from weathered volcanic rocks, also has two (2) subtypes: the Ibaan loam, found only in Barangay Mayabobo, is suitable for planting coconut, as well as lowland rice, but irrigation is needed for the latter; and the Ibaan silty clay loam, found only in Barangay Kinatihan, is used for growing coconuts and upland rice.

The third soil type, the Lipa series, is also developed from volcanic rocks; however, unlike the Ibaan series, it has a very deep solum, and the relief is usually nearly level to strong rolling. Found only in Quezon, the Lipa loam comprises most of the agricultural areas; and it is planted with coconut, upland rice, corn, banana, monggo, sweet potato, star apple, mango, avocado, and santol.

Lastly, the Mountain type, found near the slopes of Mount Banahaw, covers a large portion of the Quezon province; however, these areas presently have no agricultural value.

Table 2.1.3.1.1: Soil Types in Candelaria		
Type of Soil	Crops Found	Barangays With Soil Type
Guadalupe	Lowland and upland rice, corn, root crops, coconut, vegetable, banana, beans, cacao, citrus, coffee, locally adopted fruit trees	Loam: San Isidro
		Clay loam: all barangays except San Isidro, Kinatihan, Mayabobo
Ibaan	Coconut, lowland rice	Mayabobo, Kinatihan
Lipa	Coconut, upland rice, corn, banana, monggo, sweet potato, star apple, mango, avocado, santol	Malabanban Norte, Malabanban Sur, San Andres, Sta. Catalina Norte, Sta. Catalina Sur, San Isidro
Mountain	No agricultural value	Masalukot I, Masalukot II, Masin Norte, Masin Sur, Buenavista East, Pahinga Norte, Pahinga Sur, Kinatihan I, Kinatihan II

Soil test results are provided below.

Table 2.1.1.3.2: Swedish EPA Generic Guideline Value for Soil (2009)

Type of Metals Analyzed	Sensitive Land Use	Less Sensitive Land Use	Results
-------------------------	--------------------	-------------------------	---------

Total Mercury	0,25	2,5	ND
Total Arsenic	10	25	4.6
Total Cadmium	0,8	12	1
Total Lead	50	400	12
Hexavalent Chromium	2	10	ND
Potassium	No standards	No standards	2,210
Total Phosphorus	No standards	No standards	591
Total Organic Matter	No standards	No standards	2.45
pH** Lab (@ 25.0 degrees centigrade)	No standards	No standards	8.0
Total Nitrogen	No standards	No standards	1,170

^Reporting Limit/s

**PAB approved parameter/s

MDL = Method Detection Limit/s

IDL = Instrument Detection Limit/s

Teledyne, HYDRALIAA Mercury Analyzer

ND = Not Detected (Below Reporting Limit)

Results for Metals are reported as "dry basis"

Shimadzu Analytical Methods, Atomic Absorption Spectrophotometry (AAS)

Standard Methods for the Examination of Water and Wastewater, APHA, AWWA, WEF, 23rd Edition.

Velp Scientifica Operating Manual (20.24), Referenced from Methods of Solid Analysis - Chemical and Microbiological Properties, 2nd Edition.

Soil and Plant Analysis Laboratory Manual by International Center for Agricultural Research in the Dry Areas (ICARDA), 2001

Test Methods for Evaluating Solid Wastes, Vol 1A, USEPA, Third Edition

Provided in Figure 2.1.13 is the Soil Sampling Map showing the location of the sampling stations.

2.1.3.4 Soil Erosion/Loss of Topsoil/Overburden

There will be no soil erosion or loss of topsoil/overburden involved in this project because the project involves rebar and wire rod manufacturing and not mining. However, during construction, since backfilling will be undertaken, proper construction methods and procedures will be implemented to avoid soil erosion on site.

To mitigate such impacts, the following additional mitigation measures are recommended:

- Implement best engineering practices such as suitable backfilling material, proper slope, grading and contouring to minimize possibility of subsidence or
- differential settling; and
- Progressive ground preparation and clearing to minimize total area of land that will be disturbed at any one time, where practical.

2.1.3.5 Change in Soil Quality/Fertility

There will be no change in soil quality/fertility because the project will not involve use of chemicals to be directly in contact with the soil. The project will merely involve construction of structures for the rolling mill.



Figure 2.1.13: Soil Sampling Map

2.1.4 Terrestrial Ecology

The assessment of terrestrial flora and fauna were conducted in July 01 to 3, 2017 located at Barangay Malabanban Sur, Candelaria, Quezon Province. Preliminary assessment of the area using Google Earth Pro Map, NAMRIA map (with a scale of 1:50,000), and photos from Project Description for Scoping Report (PDS) revealed that terrain/ topography is generally flat covering a total of 32 hectares (more or less) with elevations ranging from 45 to 60 meters above sea level (masl). The existing landuse can be classified as an agricultural area which have been left uncultivated for more than 10 years according to residents nearby. **Figure 1** shows the land cover (landuse) map of the proposed project.

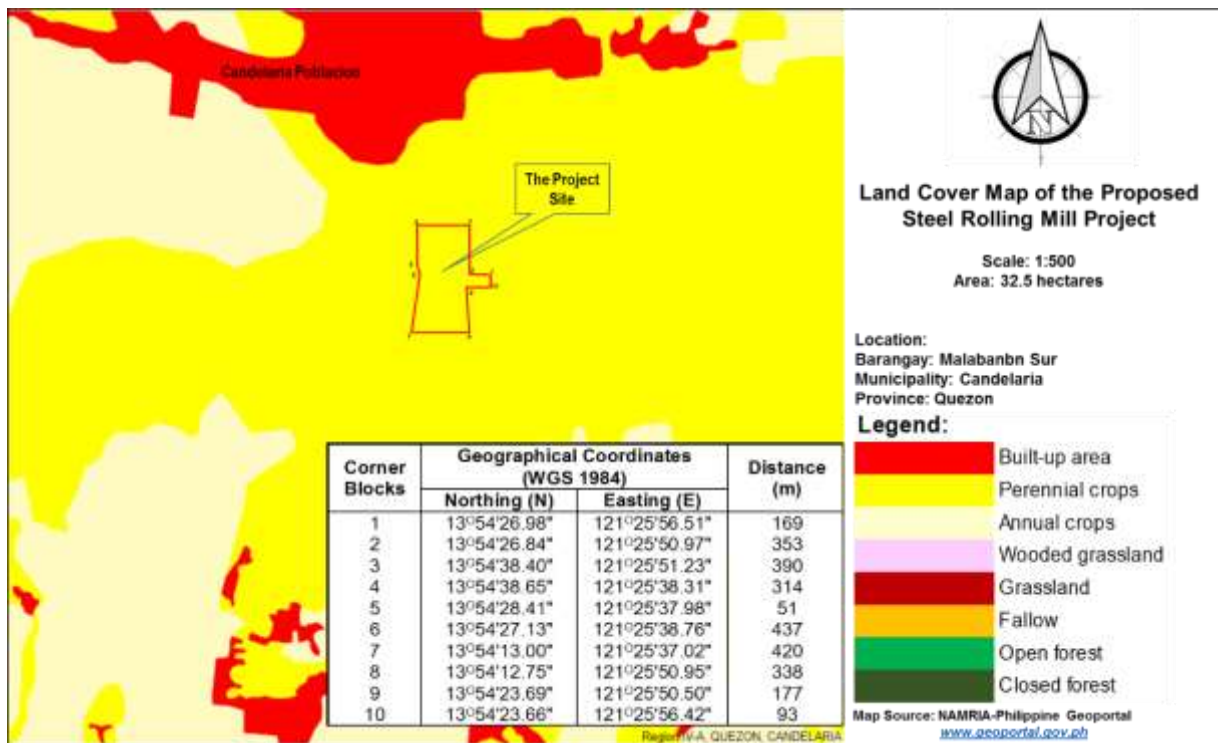


Figure 1. Map showing the land cover of the proposed Steel Rolling Mill Project situated at Barangay Malabanban Sur, Candelaria, Quezon

A. Terrestrial Flora

1. Methodology

a. Data Gathering

Secondary data/ information such as Project Description for Scoping (PDS) prepared by Mediatrix, the EIA Preparer, land cover (landuse) map from NAMRIA's Philippine Geoportal (www.geoportal.gov.ph), and Google Earth map were collected 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 serves as a guide map and was instrumental in the determination and selection of appropriate actions/ methods to be employed for primary data gathering. Other secondary information was obtained from the websites, specifically DENR and relevant institutions/ organization with database on floral taxonomy, endemcity/ 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 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/line¹ 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. In all, floral assessment was conducted in 6

¹Transect walk is a "walk through" sampling technique which starts out as a hike or walk through the area following the access roads or pathways (trails) inside the impact area.

sampling plots with an aggregate area of 2,400m² as presented in **Figure 2** and **Plates 1 to 6** for the sampling locations and habitat/ ecosystem description.

Figure 2. Terrestrial flora sampling plots and transect walk map on Google Earth Pro
(Source: Google Earth Pro, 2017)





Plate 1. View of sampling plot 1 (tree plantation)



Plate 2. View of sampling plot 2 (shrubland area)



Plate 3. View of sampling plot 3 (agricultural area)



Plate 4. View of sampling plot 4 (open area)



Plate 5. View of sampling plot 5 (shrubland area)



Plate 6. View of sampling plot 6 (agricultural area)

b. 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, 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) was 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 (Curtis and McIntosh, 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)* = $\sum(RD + RF + RDom)$

c. 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 is 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 is 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;

$J' = H/H_{max} = \sum (pi)(\ln pi)/\ln S$, where
 S is the number of species in a community;
 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

Computed values for H' and J' were then referred to the Fernando Biodiversity Scale in **Table 3** to qualify the sampled areas in terms of biodiversity and evenness levels.

Table 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

d. 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 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**. 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. Definition of Conservation Status and/or Categories

Conservation Status/ Categories	International Union for the Conservation of Nature (IUCN)	DENR Administrative Order 2007-01
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 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	Species or subspecies that is not critically endangered but whose survival in the wild is unlikely of the causal

Conservation Status/ Categories	International Union for the Conservation of Nature (IUCN)	DENR Administrative Order 2007-01
	extinction in the wild in the near future.	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.

e. 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 are used by researchers and enthusiasts 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. Results and Discussions

2.1 Summary of Floral Species and Morphological Composition

A total of 69 morpho-species composed of 1,632 individuals belonging to 65 genera composed of 36 families of seed plants (angiosperm) that include monocots and dicots were identified and recorded within the proposed project site as shown in **Table 3**. On species composition, the most speciosae (having several species) in terms of taxonomic classification belongs to families Euphorbiaceae, Leguminosae, Moraceae, and Poaceae, each with 5 representative species followed by Asteraceae and Lamiaceae with 4 representative species. Presence of other families represented by species such as *Mangifera indica*, *Artocarpus heterophyllus*, *Musa sapientum*, *Gmelina arborea*, *Leucaena leucocephala*, *Moringa oleifera*, *Lantana camara*, *Datura metel*, and *Chromolaena odorata* and other agricultural/ horticultural crop species are indicators of disturbed/ fragmented ecosystems due to loss of original vegetative cover in favor of other form of landuse that changes the overall landscape of the area.

Table 3. Floral species taxonomic classification of the proposed project site

Taxa	Number
Family	36
Genera	65
Species	69
Number of Individuals	1,632

In terms of morphological composition (plant growth/ habit), the project site recorded 6 different growths or plant habit either trees, shrubs, vines, ferns, grasses, and herbs. The most number of species observed belongs to trees with 26 representative species or 37.68% with a total of 250 individuals; herbs with 21 representative species or 30.43% composed of 672 individuals; shrubs with 5 species or 7.25% having 116 individuals; vines with 8 representative species or 11.59% composed of 266 individuals; fern with 3 species or 4.35% with 66 individuals, and grasses with 6 species or 5.66% consisting of 262 individuals (**Table 4**).

Table 4. Morphological characteristics of the proposed project site

Plant Form/ Habit	No. of Species	Percent (%)	No. of Individuals
Trees	26	37.68	250
Herbs	21	30.43	672
Shrubs	5	7.25	116
Vines	8	11.59	266
Grasses	6	8.70	262
Fern	3	4.35	66
TOTAL	69	100.00	1632

2.2 Summary of Species Richness and Importance Value Indices

Species Richness

Of the total 1,632 individuals with species richness of 69 species belonging to 36 families in 6 sampling plots (SP), the most number of species were recorded in SP6 having 53 species and 224 individuals; SP4 with 48 species and 737 individuals; SP1 and SP5 each with 47 species having 150 and 42 species with 159 individuals, respectively. Sampling plot 3 has 41 species with 259 individuals while SP2 recorded 30 species with 103 individuals (**Figure 3**).

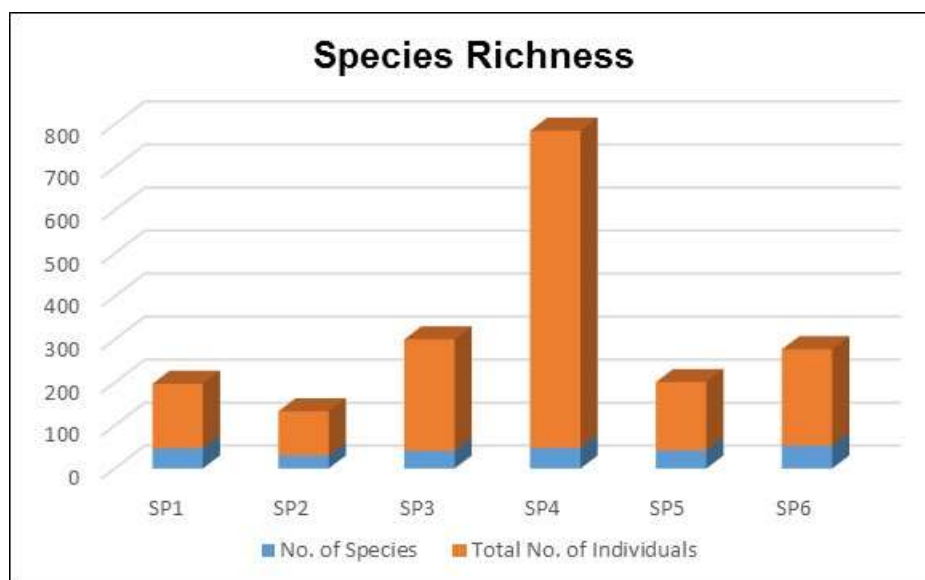


Figure 3. Species Richness of the Project Site

Importance Value (IV)

The IVs of selected species are listed in **Table 5**. The IVs of species does not necessarily indicate the ecological importance of the species but merely summarizes the density, frequency, and dominance that can be used to profile and compare plant communities. In the resulting IVIs, *Nephelium lappaceum* (Sapindaceae) recorded the highest IVI with 47.05 due to numerous individuals having the most dominant in term of basal area compared to other species. The species, being cultivated for its economic value, have dominated the other species in terms of basal area or crown/ vegetative cover with 44.35% and a relative density of 1.20%. This was followed by *Broussonetia luzonica* (Moraceae) with 40.35. The basal area and numerous individual trees commonly grown in open spaces and/or abandoned agricultural land could be the responsible for the higher values. Species with low IVI indicates the small chance of finding such species considering few number of individuals growing within the project area. Given favorable agronomic conditions, such species may have the tendency to dominate the area and their contribution to biodiversity may manifest influence to the overall species composition in the future. The other species with higher IVIs are *Macaranga tanarius* (Moraceae) with 30.84, *Gliricidia sepium* (Leguminosae) with 25.39; *Dysoxylum gaudichaudianum* (Meliaceae) with 23.90; *Wrightia pubescens* (Apocynaceae) with 22.11; *Leucaena leucocephala* (Leguminosae) with 20.03; *Vitex negundo* (Lamiaceae) with 16.81; *Chromolaena odorata* (Asteraceae) with 16.24; and *Gmelina arborea* (Lamiaceae) with 14.56. The IVIs of all species are listed in **Table 6**.

Table 5. Floral species having the highest IVIs

Species No.	Scientific Name	Common/ Local Names	Family Name	Plant Habit/ Form	TOTAL No. of Individuals	Relative Density (%)	Relative Frequency (%)	Relative Dominance (%)	IVI
9	<i>Broussonetia luzonica</i> (Blanco) Bur.	Himbabao	Moraceae	Tree	12	1.4406	2.9851	35.9268	40.35
16	<i>Chromolaena odorata</i> (L.) R.M. King & H. Rob.	Hagonoy	Asteraceae	Herb	98	11.7647	4.4776	-	16.24
21	<i>Dysoxylum gaudichaudianum</i> (A. Juss.) Miq.	Igyo	Meliaceae	Tree	10	1.2005	2.9851	19.7129	23.90
30	<i>Gliricidia sepium</i> (Jacq.) Kunth ex Walp.	Kakawate	Leguminosae	Tree	10	1.2005	4.4776	19.7129	25.39
37	<i>Gmelina arborea</i> Roxb.	Gmelina	Lamiaceae	Tree	7	0.8403	1.4925	12.2251	14.56
41	<i>Leucaena leucocephala</i> Lam.	Ipil-ipil	Leguminosae	Tree	9	1.0804	2.9851	15.9675	20.03
48	<i>Macaranga tanarius</i> (L.) Muell.-Arg.	Binunga	Euphorbiaceae	Tree	18	2.1609	3.7313	24.9492	30.84
55	<i>Nephelium lappaceum</i> L.	Rambutan	Sapindaceae	Tree	10	1.2005	1.4925	44.3541	47.05
68	<i>Vitex negundo</i> L.	Lagundi	Lamiaceae	Tree	13	1.5606	2.2388	13.0136	16.81
69	<i>Wrightia pubescens</i> R. Br. subsp. laniti (Blanco) Ngan	Lanete	Apocynaceae	Tree	15	1.8007	2.9851	17.3258	22.11

Table 6. IVs of all species covering the project area

Species No.	Scientific Name	Common/ Local Names	Family Name	Plant Habit/ Form	TOTAL No. of Individuals	Relative Density (%)	Relative Frequency (%)	Relative Dominance (%)	IVI
1	<i>Achyranthes aspera</i> (Linn.)	Prickly chaff flower/ Hangod	Amaranthaceae	Grass	49	5.8824	2.9851	-	8.87
2	<i>Acrostichum aureum</i> L.	Lagolo	Pteridaceae	Fern	19	2.2809	3.7313	-	6.01
3	<i>Adiantum philippense</i> L.	Kaikai	Pteridaceae	Fern	24	2.8812	3.7313	-	6.61
4	<i>Alpinia elegans</i> (Presl.) K. Schum.	Tagbak	Zingiberaceae	Herb	7	0.8403	2.9851	-	3.83
5	<i>Amorphophallus paeoniifolius</i> (Denntedt) Nicolson	Pongapong	Araceae	Herb	18	2.1609	4.4776	-	6.64
6	<i>Annona muricata</i> L.	Guyabano	Annonaceae	Tree	13	1.5606	2.2388	-	3.80
7	<i>Artocarpus heterophyllus</i> Lam.	Nangka/ Jackfruit	Moraceae	Tree	2	0.2401	0.7463	1.4908	2.48
8	<i>Bidens pilosa</i> (L.)	Beggar ticks/ Dadayem	Asteraceae	Herb	8	0.9604	2.2388	-	3.20
9	<i>Broussonetia luzonica</i> (Blanco) Bur.	Himbabao	Moraceae	Tree	12	1.4406	2.9851	35.9268	40.35
10	<i>Canarium asperum</i> Benth.	Pagsahingin	Burseraceae	Tree	10	1.2005	2.2388	-	3.44
11	<i>Carica papaya</i> L.	Papaya	Caricaceae	Herb	9	1.0804	2.2388	-	3.32
12	<i>Casearia fuliginosa</i> (Blanco) Blanco	Talitan	Salicaceae	Tree	4	0.4802	1.4925	-	1.97
13	<i>Celosia argentea</i> L.	Common cockscomb/ Kadayohan	Amaranthaceae	Herb	5	0.6002	2.2388	-	2.84
14	<i>Centella asiatica</i> (L.) Urb.	Penny worth/ Takip-kuhol	Apiaceae	Herb	38	4.5618	2.9851	-	7.55
15	<i>Centrosema pubescens</i> Benth.	Dilang butiki	Leguminosae	Vine	67	8.0432	4.4776	-	12.52
16	<i>Chromolaena odorata</i> (L.) R.M. King & H. Rob.	Hagonoy	Asteraceae	Herb	98	11.7647	4.4776	-	16.24
17	<i>Costus speciosus</i> (Koenig) Smith	Tubang-usa	Costaceae	Herb	7	0.8403	2.9851	-	3.83
18	<i>Dactyloctenium aegyptium</i> Linn. Richt.	Egyptian grass/ Damung-balang	Poaceae	Grass	37	4.4418	1.4925	-	5.93
19	<i>Datura metel</i> L.	Talong-punay	Solanaceae	Herb	9	1.0804	4.4776	-	5.56
20	<i>Dracaena fragrans</i> Ker-Gawl.	Fortune plant	Ruscaceae	Herb	4	0.4802	0.7463	-	1.23
21	<i>Dysoxylum gaudichaudianum</i> (A. Juss.) Miq.	Igyo	Meliaceae	Tree	10	1.2005	2.9851	19.7129	23.90
22	<i>Eclipta alba</i> (Linn.) Hassk.	False Daisy/ Tinta-tintahan	Asteraceae	Herb	27	3.2413	1.4925	-	4.73
23	<i>Eleusine indica</i> (Linn.) Gaertn	Paragis/ wire-grass	Poaceae	Grass	23	2.7611	1.4925	-	4.25
24	<i>Emilia sonchifolia</i> (Linn.) D.C.	Lilac Tassleflower/ Tagulinaw	Asteraceae	Vine	36	4.3217	2.2388	-	6.56
25	<i>Euphorbia hirta</i> (Linn.)	Asthma weed/ Tawa-tawa	Euphorbiaceae	Herb	42	5.0420	3.7313	-	8.77
26	<i>Evolvulus alsinoides</i> (Linn.)	Dwarf morning-glory	Convolvulaceae	Herb	25	3.0012	2.2388	-	5.24
27	<i>Ficus pseudopalma</i> Blanco	Niog-niogon	Moraceae	Tree	10	1.2005	3.7313	7.7004	12.63
28	<i>Ficus septica</i> Burm. f.	Hauili	Moraceae	Tree	4	0.4802	1.4925	3.1541	5.13
29	<i>Ficus ulmifolia</i> Lamk	Is-is	Moraceae	Tree	1	0.1200	0.7463	0.0770	0.94
30	<i>Gliricidia sepium</i> (Jacq.) Kunth ex Walp.	Kakawate	Leguminosae	Tree	10	1.2005	4.4776	19.7129	25.39
31	<i>Gmelina arborea</i> Roxb.	Gmelina	Lamiaceae	Tree	7	0.8403	1.4925	12.2251	14.56
32	<i>Hyptis capitata</i> Jacq.	Knobweed/ Butonesan	Lamiaceae	Herb	51	6.1224	2.9851	-	9.11
33	<i>Imperata cylindrica</i> (L.) Beauv.	Cogon	Poaceae	Grass	25	3.0012	3.7313	-	6.73
34	<i>Ipomea pes-tigridis</i> (Linn.)	Tiger foot/ Malasandia	Convolvulaceae	Vine	32	3.8415	2.9851	-	6.83
35	<i>Lantana camara</i> L.	Coronitas	Verbenaceae	Herb	68	8.1633	4.4776	-	12.64
36	<i>Laportea interrupta</i> (L.) Chew	Lipang-aso	Urticaceae	Herb	22	2.6411	3.7313	-	6.37

Species No.	Scientific Name	Common/ Local Names	Family Name	Plant Habit/ Form	TOTAL No. of	Relative Density (%)	Relative Frequency	Relative Dominance	IVI
37	<i>Leucaena leucocephala</i> Lam.	Ipil-ipil	Leguminosae	Tree	9	1.0804	2.9851	15.9675	20.03
38	<i>Litsea glutinosa</i> (Lour.) C.B. Rob.	Sablot	Lauraceae	Tree	7	0.8403	2.9851	3.7732	7.60
39	<i>Lygodium flexuosum</i> (L.) Sw.	Nito	Lygodiaceae	Vine	9	1.0804	2.2388	-	3.32
40	<i>Macaranga grandifolia</i> (Blanco) Merr.	Takip-asin	Euphorbiaceae	Tree	14	1.6807	2.9851	9.6593	14.33
41	<i>Macamga tanarius</i> (L.) Muell.-Arg.	Binunga	Euphorbiaceae	Tree	18	2.1609	3.7313	24.9492	30.84
42	<i>Mangifera indica</i> L.	Mango	Anacardiaceae	Tree	6	0.7203	2.2388	3.9919	6.95
43	<i>Melanolepis multiglandulosa</i> (Reinw. Ex Blume) Reichb. f. & Zoll.	Alim	Euphorbiaceae	Tree	7	0.8403	2.9851	7.3954	11.22
44	<i>Mimosa pudica</i> L.	Makahiya	Leguminosae	Herb	25	3.0012	4.4776	-	7.48
45	<i>Mitrephora lanotan</i> (Blanco) Merr.	Indian Lanutan	Annonaceae	Tree	10	1.2005	2.2388	7.7004	11.14
46	<i>Moringa oleifera</i> Lamk	Malunggay	Moringaceae	Tree	4	0.4802	1.4925	3.9919	5.96
47	<i>Musa sapientum</i> L.	Banana	Musaceae	Herb	13	1.5606	1.4925	-	3.05
48	<i>Nephelium lappaceum</i> L.	Rambutan	Sapindaceae	Tree	10	1.2005	1.4925	44.3541	47.05
49	<i>Orthosiphon aristatus</i> (Blume) Miq.	Kabling-gubat	Lamiaceae	Shrub	24	2.8812	2.2388	-	5.12
50	<i>Paspalum conjugatum</i> (Berg.)	Carabao grass	Poaceae	Grass	76	9.1236	4.4776	-	13.60
51	<i>Paspalum scrobiculatum</i> (L.)	Bias-biasan	Poaceae	Grass	52	6.2425	2.9851	-	9.23
52	<i>Passiflora foetida</i> (Linn.)	Stinking passion flower/ Pasionaryang-mabaho	Passifloraceae	Vine	43	5.1621	2.9851	-	8.15
53	<i>Persea gratissima</i> Gaertn.	Avocado	Lauraceae	Tree	5	0.6002	1.4925	1.9251	4.02
54	<i>Piper interruptum</i> Opiz var. <i>loheri</i> (C.DC.) Quis.	Litlit	Piperaceae	Vine	20	2.4010	3.7313	-	6.13
55	<i>Pipturus arboreescens</i> (Link) C.B. Rob.	Dalunot	Urticaceae	Tree	40	4.8019	3.7313	123.2058	131.74
56	<i>Pseudoelephantopus spicatus</i> Juss (Ex Aubl.)	Dilang-aso	Compositae	Herb	68	8.1633	2.9851	-	11.15
57	<i>Ricinus communis</i> L.	Tangan-tangan/ Castor plant	Euphorbiaceae	Shrub	41	4.9220	2.9851	-	7.91
58	<i>Selaginella plana</i> Hieron	Kamariang-gubat	Selaginellaceae	Fern	23	2.7611	2.9851	-	5.75
59	<i>Senna alata</i> (L.) Roxb.	Akapulko	Leguminosae	Shrub	6	0.7203	2.2388	-	2.96
60	<i>Stachytarpheta jamaicensis</i> (L.) Vahl.	Kandi-kandilaan	Verbenaceae	Shrub	24	2.8812	1.4925	-	4.37
61	<i>Swietenia macrophylla</i> King	Mahogany	Meliaceae	Tree	3	0.3601	1.4925	0.9980	2.85
62	<i>Syngonium podophyllum</i> Schott	Kamay-kastila	Araceae	Vine	23	2.7611	2.9851	-	5.75
63	<i>Tabernaemontana pandacaqui</i> Poir.	Pandakaki	Apocynaceae	Shrub	21	2.5210	4.4776	-	7.00
64	<i>Tetrastigma loheri</i> Gagnep.	Loher's ayo	Vitaceae	Vine	36	4.3217	4.4776	-	8.80
65	<i>Trema orientalis</i> (L.) Blume	Anabiong	Cannabaceae	Tree	6	0.7203	1.4925	7.0967	9.31
66	<i>Triumfetta rhombiodes</i> Jacq.	Kulot-kulotan	Malvaceae	Herb	67	8.0432	4.4776	-	12.52
67	<i>Urena lobata</i> L.	Kollo-kollot	Malvaceae	Herb	61	7.3229	4.4776	-	11.80
68	<i>Vitex negundo</i> L.	Lagundi	Lamiaceae	Tree	13	1.5606	2.2388	13.0136	16.81
69	<i>Wrightia pubescens</i> R. Br. subsp. <i>laniti</i> (Blanco) Ngan	Lanete	Apocynaceae	Tree	15	1.8007	2.9851	17.3258	22.11
TOTAL					1632	100.0000	100.0000	100.0000	300.0000

2.3 Grassland Community Indices

Species Richness

A total of 34 morphological grass species was recorded consists of 883 grass individuals covering a total of 64% of the project area. The highest grass density was observed in SP4 with 70% or having 619 individuals belonging to 30 species followed by SP3 with 21% or 187 individuals represented by 31 species. SP2 has the least percent coverage recorded at 9% with only 77 individuals from 17 different species. Table 7 provides the species composition of grassland community in the project site with their corresponding relative density and frequency.

Table 7. List of species found in the grassland community with computed relative density and frequency

Species No.	Scientific Name	Common/ Local Names	Distribution	Family Name	Plant Habit/ Form	Sampling Plots			TOTAL No. of Individuals	Density	Relative Density (%)	Frequency	Relative Frequency (%)
						SP2	SP3	SP4					
1	<i>Achyranthes aspera</i> (Linn.)	Prickly chaff flower/ Hangod	Introduced	Amaranthaceae	Grass		12	20	32	0.0267	5.7554	0.6667	3.8462
2	<i>Alpinia elegans</i> (Presl.) K. Schum.	Tagbak	Endemic	Zingiberaceae	Herb	1	2		3	0.0025	0.5396	0.6667	3.8462
3	<i>Amorphophallus paeoniifolius</i> (Dennted) Nicolson	Pongapong	Introduced	Araceae	Herb	3	2	2	7	0.0058	1.2590	1.0000	5.7692
4	<i>Bidens pilosa</i> (L.)	Beggar ticks/ Dadayem	Endemic	Asteraceae	Herb		3	4	7	0.0058	1.2590	0.6667	3.8462
5	<i>Carica papaya</i> L.	Papaya	Introduced	Caricaceae	Herb		6		6	0.0050	1.0791	0.3333	1.9231
6	<i>Celosia argentea</i> L.	Common cockscomb/ Kadayohan	Introduced	Amaranthaceae	Herb	1	2	2	5	0.0042	0.8993	1.0000	5.7692
7	<i>Centella asiatica</i> (L.) Urb.	Penny worth/ Takip-kuhol	Introduced	Apiaceae	Herb	10	2	23	35	0.0292	6.2950	1.0000	5.7692
8	<i>Centrosema pubescens</i> Benth.	Dilang butiki	Introduced	Leguminosae	Vine	14	6	30	50	0.0417	8.9928	1.0000	5.7692
9	<i>Chromolaena odorata</i> (L.) R.M. King & H. Rob.	Hagonoy	Introduced	Asteraceae	Herb	13	15	32	60	0.0500	10.7914	1.0000	5.7692
10	<i>Costus speciosus</i> (Koenig) Smith	Tubang-usa	Endemic	Costaceae	Herb		2	1	3	0.0025	0.5396	0.6667	3.8462
11	<i>Dactyloctenium aegyptium</i> Linn. Richt.	Egyptian grass/ Damung-balang	Introduced	Poaceae	Grass		2	35	37	0.0308	6.6547	0.6667	3.8462
12	<i>Datura metel</i> L.	Talong-punay	Endemic	Solanaceae	Herb	1	1	2	4	0.0033	0.7194	1.0000	5.7692
13	<i>Eclipta alba</i> (Linn.) Hassk.	False Daisy/ Tinta-tintahan	Introduced	Asteraceae	Herb		5	22	27	0.0225	4.8561	0.6667	3.8462
14	<i>Eleusine indica</i> (Linn.) Gaertn	Paragis/ wire-grass	Introduced	Poaceae	Grass		2	21	23	0.0192	4.1367	0.6667	3.8462
15	<i>Emilia sonchifolia</i> (Linn.) D.C.	Lilac Tassleflower/ Tagulinaw	Introduced	Asteraceae	Vine		2	33	35	0.0292	6.2950	0.6667	3.8462
16	<i>Euphorbia hirta</i> (Linn.)	Asthma weed/ Tawa-tawa	Introduced	Euphorbiaceae	Herb		5	30	35	0.0292	6.2950	0.6667	3.8462
17	<i>Evolvulus alsinoides</i> (Linn.)	Dwarf morning-glory	Introduced	Convolvulaceae	Herb		6	18	24	0.0200	4.3165	0.6667	3.8462
18	<i>Hyptis capitata</i> Jacq.	Knobweed/ Butonesan	Introduced	Lamiaceae	Herb		5	43	48	0.0400	8.6331	0.6667	3.8462
19	<i>Imperata cylindrica</i> (L.) Beauv.	Cogon	Endemic	Poaceae	Grass	2	2	10	14	0.0117	2.5180	1.0000	5.7692
20	<i>Ipomea pes-tigridis</i> (Linn.)	Tiger foot/ Malasandia	Introduced	Convolvulaceae	Vine		11	14	25	0.0208	4.4964	0.6667	3.8462
21	<i>Lantana camara</i> L.	Coronitas	Introduced	Verbenaceae	Herb	6	9	43	58	0.0483	10.4317	1.0000	5.7692
22	<i>Laportea interrupta</i> (L.) Chew	Lipang-aso	Endemic	Urticaceae	Herb		2	14	18	0.0150	3.2374	1.0000	5.7692
23	<i>Lygodium flexuosum</i> (L.) Sw.	Nito	Endemic	Lygodiaceae	Vine			6	6	0.0050	1.0791	0.3333	1.9231
24	<i>Mimosa pudica</i> L.	Makahiya	Introduced	Leguminosae	Herb	2	2	15	19	0.0158	3.4173	1.0000	5.7692
25	<i>Musa sapientum</i> L.	Banana	Introduced	Musaceae	Herb		6		6	0.0050	1.0791	0.3333	1.9231
26	<i>Paspalum conjugatum</i> (Berg.)	Carabao grass	Introduced	Poaceae	Grass	2	8	28	38	0.0317	6.8345	1.0000	5.7692
27	<i>Paspalum scrobiculatum</i> (L.)	Bias-biasan	Introduced	Poaceae	Grass		12	34	46	0.0383	8.2734	0.6667	3.8462
28	<i>Passiflora foetida</i> (Linn.)	Stinking passion flower/ Pasionaryang-mabaho	Introduced	Passifloraceae	Vine		9	27	36	0.0300	6.4748	0.6667	3.8462
29	<i>Piper interruptum</i> Opiz var. <i>loheri</i> (C.DC.) Quis.	Lilit	Introduced	Piperaceae	Vine	2		6	8	0.0067	1.4388	0.6667	3.8462
30	<i>Pseudoelephantopus spicatus</i> Juss (Ex Aubl.)	Dilang-aso	Introduced	Compositae	Herb			25	50	0.0417	8.9928	0.6667	3.8462
31	<i>Syngonium podophyllum</i> Schott	Kamay-kastila	Introduced	Araceae	Vine	2			2	0.0017	0.3597	0.3333	1.9231
32	<i>Tetragium loheri</i> Gagnep.	Loher's ayo	Introduced	Vitaceae	Vine	5	2	8	15	0.0125	2.6978	1.0000	5.7692
33	<i>Triumfetta rhombioides</i> Jacq.	Kulot-kulotan	Introduced	Malvaceae	Herb	5	9	40	54	0.0450	9.7122	1.0000	5.7692
34	<i>Urena lobata</i> L.	Kollo-kolot	Introduced	Malvaceae	Herb	6	10	31	47	0.0392	8.4532	1.0000	5.7692
TOTAL						77	187	619	883	0.46333	100.0000	17.3333	100.0000
Percent Coverage						0.09	0.21	0.70					
Number of species per sampling plot						17	31	30					

2.4 Summary of 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. Using the, 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 7 and Figure 4** shows the diversity and evenness indices of plant species within the project area.

Table 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	47	1.10	0.28
SP2	30	0.55	0.16
SP3	41	0.91	0.25
SP4	48	0.98	0.25
SP5	42	0.98	0.23
SP6	53	1.19	0.28

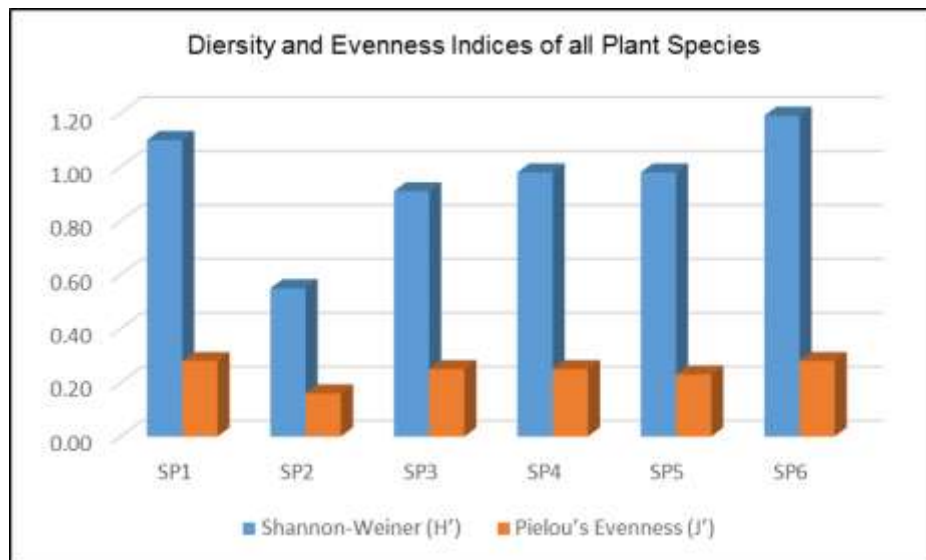


Figure 4. Diversity and evenness indices of all plant species in the project area

2.5 Summary of Species Conservation Status, Endemicity/ Geographic Distribution

Conservation Status

The Philippines is considered as one of the megadiverse country 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 (Source: Conservation International, 2007 Biodiversity Hotspots – Philippines. Accessed from www.biodiversityhotspots.org).

Of all species recorded, there are five (5) species cited by the International Union for the Conservation of Nature (IUCN) Red List of Threatened Species as either Endangered (EN), Vulnerable (VU), or Data Deficient (DD). These species are *Diospyros philippinensis* (Ebenaceae) – Endangered; *Pterocarpus indicus* (Leguminosae) – Endangered; *Swietenia macrophylla* (Meliaceae) – Vulnerable; *Ficus ulmifolia* (Moraceae) – Vulnerable; and *Mangifera indica* (Anacardiaceae) – Data Deficient. On the other hand, the list under DENR Administrative Order 2007-01 classified on two (2) species *Pterocarpus indicus* (Critically Endangered) and *Diospyros philippinensis* (Endangered). **Table 8** provides the list of species cited by the IUCN and DENR AO 2007-01 while **Figure 5** shows the location of Critically Endangered and Endangered species.

Their classification as Threatened Species were mainly attributed to overexploitation and loss of habitat as a result of rampant extraction activities and shifting cultivation that have led to considerable decline in population. Meanwhile, *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.

Table 8. Conservation Status of Species cited in IUCN and DENR AO 2007-01

Species	Scientific Name	Conservation Status	
		IUCN	DENR-AO 2007-01
Is-is	<i>Ficus ulmifolia</i> Lamk	Vulnerable	Not cited
Mahogany	<i>Swietenia macrophylla</i> King	Vulnerable	Not cited
Narra	<i>Pterocarpus indicus</i> Willd.	Vulnerable	Critically Endangered
Mango	<i>Mangifera indica</i> L.	Data Deficient	Not cited
Kamagong	<i>Diospyros philippinensis</i> A.DC.	Endangered	Endangered



Figure 5. Location of critically endangered and endangered plant species recorded in the project site

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. Such species include: *Dysoxylum gaudichaudianum* (Meliaceae), *Alpinia elagans* (Zingiberaceae), *Macaranga bicolor* (Euphorbiaceae), *Adiantum philippense* (Pteridaceae), *Ficus septica* (Moraceae), and the likes. **Table 9** presents the list of all species to include endemicity, geographical range/ distribution, uses and importance.

Table 9. 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 2007-01		
	<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>Acrostichum aureum</i> L.	Lagolo	Pteridaceae	Fern	This fern thrives along, and in shallow brackish swamps and occasionally near hot springs, a habitat not normally associated with the favorable growth and development of ferns.	Endemic	Not cited	Not cited	The tender young parts are edible (Merrill 1905). The rhizomes are useful in healing wounds, and are specially used in healing invertebrate ulcers. The leaves used in topical are emollient (Guerrero 1921). Often used as ornamental.	No threats to this species
	<i>Adiantum philippense</i> L.	Kaikai	Pteridaceae	Fern	On wet and damp banks or cliffs and in damp thickets, especially in the rainy season; common throughout the Philippines; generally distributed in the tropics.	Endemic	Not cited	Not cited	Fronds, either in decoction or syrup, utilized as <i>Adiantum capillus-veneris</i> ; In the Philippines, administered to women in childbirth as <i>Aristolochia</i> species; Roots used for strangury and for fever due to elephantiasis; Used for febrile affections in children; Used for cough, leprosy, hair falling.	No threats to this species
	<i>Alpinia elegans</i> (Presl.) K. Schum.	Tagbak	Zingiberaceae	Herb	Found in lowland thickets along streams at low and medium elevations throughout the Philippines.	Endemic	Not cited	Not cited	Medicine: decoction of rhizomes used to treat hemoptysis; pounded leaves, mized with little salt rubbed on paralyzed extremities; juice from macerated young stems used in urticarial; Food: fruits are edible, a little woody in texture; Services: cover crop; ornamental	No threats to this species
	<i>Alstonia scholaris</i> (L.) R. Br.	Dita	Apocynaceae	Tree	Found in secondary and primary forest at low to medium elevations throughout the Philippines. Occurs in Australia, China, India, SE Asia, and Solomon Is.	Endemic	Not cited	Not cited	The bark is used in homoeopathy for its tonic bitter and astringent properties; it is particularly useful for chronic diarrhea and dysentery; used as timber, poles for construction; sap is used for latex	No threats to this species
	<i>Amorphophallus paeoniifolius</i> (Denntedt) Nicolson	Pongapong	Araceae	Herb	Common in most or all, provinces of Luzon and in Mindoro, in thickets and secondary forests, along roads, trails, etc., at low and medium altitudes in settled areas; occurs in India through Malaya to Polynesia.	Introduced	Not cited	Not cited	Leaves and roots - rhizomes preferably cooked, acid when raw. May cause perioral burning and itching; petioles of young unexpanded leaves are edible when thoroughly cooked; in time of scarcity, corms are sometimes eaten; corms provides about 1,000 calories per kilo comparable in food value to kalabasa, superior to singkamas; Folkloric – poultices of corm are antirheumatic; also used for hemorrhoids; plants used for cough; roots are used for boils and hemorrhoids.	No threats to this species

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							IUCN	DENR AO 2007-01		
	<i>Annona muricata</i> L.	Guyabano	Annonaceae	Tree	Prevalent in the rainforests of Africa, South America, and Southeast Asia. Common in the Philippines, in all provinces at low to medium elevations; backyard and plantations	Introduced	Not cited	Not cited	Fruits are edible and are eaten raw; wood is used for fuelwood	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.	Endemic	Not cited	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 cicatrizant	No threats to this species
	<i>Bidens pilosa</i> (L.)	Beggar ticks/ Dadayem	Asteraceae	Herb	In waste places, chiefly at medium altitudes, ascending to 2,200 meters from Batanes and Babuyan Islands and Northern Luzon to Mindanao.	Endemic	Not cited	Not cited	Used as preventive for influenza or cold, used for treatment of swelling pain at the throat, fever among infants, fear of cold weather. For sore eyes, pounded leaves are applied over the eyelids. Used for poisonous insects and snake bite.	No threats to this species
	<i>Broussonetia luzonica</i> (Blanco) Bur.	Himbabao	Moraceae	Tree	Occurs in secondary and primary forest of low to medium elevations throughout the Philippines. Native to Philippines and other SE Asia	Endemic	Least concern	Not cited	Flower is used as ingredients in food preparation; wood is best for paneling, furniture, and cabinet; fuelwood or charcoal; as musical instrument; butcher's blocks; and boat planking.	No threats to this species
	<i>Canarium asperum</i> Benth.	Pagsahingin	Burseraceae	Tree	Found in disturbed primary forest and secondary forests, solitary in dry grassland areas, moist, and dry thickets at low to medium elevations of dry thickets to wet areas. Native to Brunei, Malaysia, Indonesia, Philippines, Papua New Guinea, and Solomon Islands.	Endemic	Least concern	Not cited	Wood is used for light to medium interior works such as veneer, plywood, pulpwood, agricultural and musical implements; tapped resin sold as Manila elemi for manufacturing of paints, varnish, and pharmaceutical/ cosmetic products; as medicine, oleoresin is used to treat arthritis, rheumatism, boils, abscess, furuncles, burns, sores; the bark is used for fever and chills and as anti-lice.	No threats to this species
	<i>Carica papaya</i> L.	Papaya	Caricaceae	Herb	Found throughout the Philippines, in cultivation or semi-cultivation, in many regions; thoroughly naturalized, at low and medium altitudes. Native to tropical America.	Introduced	Not cited	Not cited	Food: contains many biologically active compounds-chymopapain and papain, believed to aid digestion; Medicine: bruised leaves are used as poultice for rheumatism, decoction of the center of the roots are used as digestive and tonic, used to cure dyspepsia	No threats to this species
	<i>Casearia fuliginosa</i> (Blanco) Blanco	Talitan	Salicaceae	Tree	Common in thickets, secondary forests, and deserted clearings at low and medium altitudes throughout the Philippines. Occurs in India to tropical Africa and to	Endemic	Not cited	Not cited	Timber is used for light construction	No threats to this species

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							IUCN	DENR AO 2007-01		
					Malaya.					
	<i>Celosia argentea</i> L.	Common cockscomb/ Kadayohan	Amaranthaceae	Herb	In settled areas throughout the Philippines at low and medium altitudes. Introduced; pantropic.	Introduced	Not cited	Not cited	In the Philippines, eaten as vegetable, but not given to women during menstruation. Folkloric, seeds, finely powdered or in decoction, used for diarrhea or as an aphrodisiac. For redness and swelling of the eyes, photophobia, and frequent lacrimation with intense headache,	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.	Endemic	Not cited	Not cited	The name derives from its cultivation and used as a hedge or fence (bakod); used to produce jatrophamethyl ester for biodiesel; used as medicine	No threats to this species
	<i>Dactyloctenium aegyptium</i> Linn. Richt.	Egyptian grass/ Damung-balang	Poaceae	Grass	A common weed throughout the Philippines in settled areas at low and medium altitudes. Pantropic in distribution.	Introduced	Not cited	Not cited	Decoction of plant, in fresh or in dry state, used internally for dysentery and acute hemoptysis.	No threats to this species
	<i>Datura metel</i> L.	Talong-punay	Solanaceae	Herb	In open, waste places in and about settlements, throughout the Philippines. Native of tropical Asia	Endemic	Not cited	Not cited	Cultivated also for ornamental purposes.	No threats to this species

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	<i>Diospyros philippinensis</i> A.DC.	Kamagong	Ebeneceae	Tree	A timber species occurring in primary lowland forest up to 200 m. Records of Philippine ebony are often from forest fragments smaller than 50 km ² .	Endemic	Endangered		Timber. Fruit is edible	Overexploitation
	<i>Dracaena fragrans</i> Ker-Gawl.	Fortune plant	Ruscaceae	Herb	Widely cultivated for ornamental purposes. Probably originated from Malaya. Now pantropic in cultivation.	Introduced	Not cited	Not cited	In Java, young tender leaf shoots are eaten as vegetable. Roots may be boiled and baked into food, sweet candy or a fermented drink.	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.	Endemic	Least concern	Not cited	Timber for light to medium construction; ornamental	No threats to this species
	<i>Eclipta alba</i> (Linn.) Hassk.	False Daisy/ Tinta-tintahan	Asteraceae	Herb	Ubiquitous weed in settled areas, in gardens, in open waste places, ditches, rice fields and low damp lands.	Introduced	Not cited	Not cited	In the Philippines, the leaves and tops brewed in decoction are used in cases of hepatitis. Pounded, they are employed for healing wounds.	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>Ficus benjamina</i> L.	Salisi	Moraceae	Tree	From northern Luzon to Mindanao islands and provinces, in primary forests at low and medium altitudes;	Endemic	Least concern	Not cited	Ornamentals;	No threats to this species

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							IUCN	DENR AO 2007-01		
					occurs in India to southern China, Malaya, northern Australia, and the islands of the South Pacific.					
	<i>Ficus pseudopalma</i> Blanco	Niog-niogon	Moraceae	Tree	Found in secondary forests and in thickets at low to medium elevation. Native to the Philippines	Endemic	Least concern	Not cited	Edible fruits; Leaves are cooked and eaten as vegetable; leaves used as food wrap; fodder for livestock; firewood	No threats to this species
	<i>Ficus septica</i> Burm. f.	Hauili	Moraceae	Tree	Occurs in lowland and montane forests or secondary growth often along riverbanks or creeks up to 1800 masl. Distributed in India, China, Taiwan, Malenesia, Australia, and Vanuatu.	Endemic	Least concern	Not cited	Best for riverbank stabilization; water conserver species	No threats to this species
	<i>Ficus ulmifolia</i> Lamk	Is-is	Moraceae	Tree	Widely distributed in thickets and second growth forests at low to medium elevation throughout the Philippines.	Endemic	Vulnerable	Not cited	Water conserver species; bark is used for its strong bast fibers in making ropes; as scouring, leaves with its one-sided roughness, used for scouring pots and pans.	Overexploitation
	<i>Gliricidia sepium</i> (Jacq.) Kunth ex Walp.	Kakawate	Leguminosae	Tree	Occurs in agricultural areas, coastland, natural forests, planted forests, range/grasslands, riparian zones, ruderal/disturbed, scrub/shrublands, and urban areas throughout the Philippines. Native to Mexico and Central America.	Introduced	Least concern	Not cited	Wood is used for light construction; used as feedstock for biomass energy for its high calorific content; reforestation species for fire/fuelwood; leaves contain nutritional value as forage and feed supplement for domesticated animals; seeds are often used as coffee substitute.	No threats to this species
	<i>Gmelina arborea</i> Roxb.	Gmelina	Lamiaceae	Tree	Widely distributed in the Philippines. It also occurs naturally in Myanmar, Thailand, Laos, Cambodia, Vietnam, and in southern provinces of China. Extensively planted in Sierra Leone, Nigeria, Malaysia, and Philippines	Introduced	Least concern	Not cited	Timber is reasonably strong for its weight; it is used in construction purposes; furniture, carriages, sports, musical instruments and artificial limbs.	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	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

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					Africa and Asia through Malaya to Polynesia.					
	<i>Lantana camara</i> L.	Coronitas	Verbenaceae	Herb	A gregarious weed in the Philippines, in settled areas in thickets and waste places at low and medium altitudes. Native of tropical America.	Introduced	Not cited	Not cited	Decoction of fresh roots used as gargle for toothaches, and a decoction of the leaves and fruits to clean wounds; decoction or syrup of roots (in sugared water) used for asthma;	No threats to this species
	<i>Laportea interrupta</i> (L.) Chew	Lipang-aso	Urticaceae	Herb	Native of Mexico and Americas. Common in agricultural areas, thickets, and ruderal areas.	Endemic	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>Litsea glutinosa</i> (Lour.) C.B. Rob.	Sablot	Lauraceae	Tree	It is widely distributed in the Philippines at low altitudes and in the Indo-Malayan Region.	Endemic	Least concern	Not cited	Used in tanning industry. Textiles, and construction materials	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	Endemic	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 grandifolia</i> (Blanco) Merr.	Takip-asin	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

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	<i>Macamga 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 throughout Malaysia to Papua New Guinea (Bismarck Archipelago).	Endemic	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
	<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>Mitrephora lanotan</i> (Blanco) Merr.	Indian Lanutan	Annonaceae	Tree	Cultivated in the Philippines for ornamental purposes.	Endemic	Not cited	Not cited	Ornamental	No threats to this species
	<i>Moringa oleifera</i> Lamk	Malunggay	Moringaceae	Tree	Planted throughout the Philippines in settled areas at low and medium altitudes. Introduced from Malaya or some other part of tropical Asia in prehistoric times.	Introduced	Not cited	Not cited	Used as backyard fence; leaves and fruits are edible when cooked; used also as medicine	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>Nephelium lappaceum</i> L.	Rambutan	Sapindaceae	Tree	N. lappaceum thrives in humid tropical lowlands within about 17 degrees from the equator. The trees	Introduced	Least concern	Not cited	Food, timber, lipids, tannins, wax, ornamental, plantation forest	No threats to this species

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					occur in the lower or middle storey in different types of primary and secondary forest ranging from dryland to swamp.					
	<i>Orthosiphon aristatus</i> (Blume) Miq.	Kabling-gubat	Lamiaceae	Shrub		Endemic	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		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, especially in Laguna, Rizal and Quezon provinces. 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>Persea gratissima</i> Gaertn.	Avocado	Lauraceae	Tree	Widely cultivated in the Philippines. Native to Antigua and Barbuda, Barbados, Cuba, Dominica, Dominican Republic, Grenada, Guatemala, Honduras, Jamaica, Puerto Rico, St Lucia, St Vincent and the Grenadines, Trinidad and Tobago, US, Virgin Islands (US)	Introduced	Least concern	Not cited	Fruit: the tree is grown for its nutritious value and has long been important in the diets of the people. Surplus/ excess fruit is an important food source for pigs and other livestock; Apiculture: Bees, important for pollination and honey production; Timber: wood is used for house construction especially for posts, light construction, furniture, cabinet making, agricultural implements, carvings, sculptures, musical instruments, paddles, small articles like pens and brush folders, and other novelty items. It also yields a good quality veneer and plywood; Lipids: the pulp and the seeds contain fatty acids such as oleic, lanolic, palmitic, stearic, linoleic, capric, and meristic acid which constitutes 80% of the fruits fatty contents. The oil is used by the cosmetic industry in soaps and skin moisturizer products; Medicine: recently anti-cancerous activity has been reported in extracts of leaves and fresh shoots of avocado. Oil extracted from the seeds has astringent properties, and an oral infusion of	No threats to this species

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									the leaves is used to treat dysentery. The skin of the fruit has anti-helminthic properties. The avocado is also said to have spasmolytic and abortive properties. The seed is ground and made into an ointment used to treat various skin afflictions such as scabies purulent wounds, lesions of the scalp and dandruff; Essential Oil: watery extracts of the avocado	
	<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.	Endemic	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 America. Introduced from Mexico. Also occurs in the Marianne Islands, Taiwan, southern China, Taiwan, and Java.	Introduced	Not cited	Not cited	In Central Luzon, leaves used as topical for eczema. Leaves used as vulnerary.	No threats to this species
	<i>Pterocarpus indicus</i> Willd. forma <i>indicus</i>	Narra	Leguminosae	Tree	Occurs mainly in closed canopy forest of secondary and primary forest at low to medium elevations. Native to SE Asia	Endemic	Vulnerable	Critically Endangered	Used as timber for various construction purposes, furniture and handicraft; poles, piles, and pulp and paper production	Overexploitation
	<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>Sandoricum koetjape</i> (Burm. f.) Merr.	Santol	Meliaceae	Tree	Found scattered in primary or sometimes secondary forests. It also occurs in lowland dipterocarp	Endemic	Least concern	Not cited	Food: fruit is edible, being eaten fresh or processed into jam or chutney; fruit is peeled, quartered and cooked in syrup to make delicious	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 2007-01		
					forests, in thickets and rural settlement areas.				preserves; Timber: yields a lightweight to medium-weight hardwood with a density of 290-590 kg/m ³ at 15% moisture content; heartwood is pale red, yellowish-red or yellow-brown with a pink tinge, indistinct or distinguishable from the pale white or pinkish sapwood; grain straight or slightly wavy.	
	<i>Selaginella plana</i> Hieron	Kamariang-gubat	Selaginellaceae	Fern	Generally cultivated throughout the Philippines but is not a native of the Archipelago.	Endemic	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>Sterculia foetida</i> L.	Kalumpang	Malvaceae	Tree	Originally from East Africa to north Australia, <i>S. foetida</i> grows freely in Myanmar and Sri Lanka.	Endemic	Least concern	Not cited	Food, fodder, fiber, timber, gums or resins	No threats to this species
	<i>Swietenia macrophylla</i> King	Mahogany	Meliaceae	Tree	A very large timber tree which has an extensive distribution in the Philippines. Native to North America	Introduced	Vulnerable	Not cited	Used as timber for various construction purposes, furniture and handicraft; poles, piles, and pulp and paper production	Overexploitation
	<i>Synгонium 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 pandacaqui</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	Endemic	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

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 2007-01		
					Guinea, Australia, and Pacific.					
	<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 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.	Endemic	Not cited	Not cited	Juice obtained from macerating the soft wood is used for poulticing swelling; used as fuelwood and charcoal production	No threats to this species
	<i>Triumfetta rhombiodes</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,	Endemic	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;	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 2007-01		
					and India to Japan, and southward through Malaya to western Polynesia.				leaves used in aromatic baths; also as insectifuge; vapor bath prepared with the plant used for treatment of febrile, catarrhal, and rheumatic affections	
	<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.	Endemic	Least concern	Not cited	Decoction of roots and bark used as abortifacient. Leaves applied as head covering for headaches.	No threats to this species

B. Terrestrial Fauna

1. Methodology

a. Data Gathering

Survey on fauna was undertaken in three consecutive days on July 1 to 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 sampling, 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.

b. 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 the table below.

Table 1. 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

c. 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.

d. Conservation Categories and description

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

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

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

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

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

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

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



Figure 1. Google image showing the assessed area and established sampling sites

2. Results and Discussions

2.1 Selected 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 (shown in figure 1). Sampling sites are distributed on shrubland habitat and along grass land habitat, map shown in **Figure 1**.

Summarized hereunder are the corresponding habitat types and geographical coordinates of the six (6) sampling sites, presented in **Table 2**.

Table 2. 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, Igyo, Alim and other shrub species.

2.2 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 3**).

Table 3. Species abundance and family composition of evaluated sites

Sampling no.	No. of Species	TotalNo. 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.
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.

2.3 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 (*Gallirallus 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 4** illustrate the summary of wildlife species in the proposed project site, their conservation status and corresponding geographical range (Source: <http://www.iucnredlist.org/>).

Table 4. 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 5** shows the conservation status of listed terrestrial fauna species.

Table 4. Summary list of faunal species, conservation status and geographic distribution

Species No.	Common Name	Scientific Name	Family Name	Conservation Status	Distribution/ Endemicity	Geographic Range
AVES						
1	Barred Rail	<i>Gallirallus torquatus</i>	Rallidae	LC	Endemic	Philippines
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
3	Brahminy Kite	<i>Haliastur indus</i>	Accipitridae	LC	Non-endemic	Australia; Bangladesh; Brunei Darussalam; Cambodia; China; India; Indonesia; Lao People's Democratic Republic; Macao; Malaysia; Myanmar; Nepal; Pakistan; Papua New Guinea; Philippines; Singapore; Solomon Islands; Sri Lanka; Taiwan, Province of China; Thailand; Timor-Leste; Viet Nam; Vagrant in Bhutan; Hong Kong; Maldives; Palau; Vanuatu
4	Cattle Egret	<i>Bubulcus ibis</i>	Ardeidae	LC	Non-endemic	SE Asian countries
5	Chesnut Munia	<i>Lonchura malacca</i>	Estrildidae	LC	Non-endemic	Bangladesh; Brunei Darussalam; Cambodia; China; India; Indonesia; Lao People's Democratic Republic; Malaysia; Myanmar; Nepal; Philippines; Taiwan, Province of China; Thailand; Viet Nam
6	Crested Myna	<i>Acridotheres cristatellus</i>	Sturnidae	LC	Non-endemic	China; Lao People's Democratic Republic; Myanmar; Taiwan, Province of China; Viet Nam Argentina; Brunei Darussalam; Japan; Malaysia; Philippines; Singapore
7	Eurasian Tree Sparrow	<i>Passer montanus</i>	Passeridae	LC	Introduced	Eurasia, China, Taiwan, Ryukus, SE Asia, Sumatra and Java, introduced lesser Sunda to Australia, including Mollucas, Sulawesi, Borneo and the Philippines- Batan, Biliran, Bongao, Calauit, Camotes, Carabao, Catanduanes, Leyte, Luzon, Mindanao, Mindoro, Negros, Olango, Palawan, Panay, Sabtang,

Species No.	Common Name	Scientific Name	Family Name	Conservation Status	Distribution/ Endemicity	Geographic Range
						SangaSanga, Sibuyan, Sicogon, Siquijor, and Tawi-Tawi.
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
14	Orange-Bellied flower Pecker	<i>Dicaeum trigonostigma</i>	Dicaeidae	LC	Non-endemic	Bangladesh; Brunei Darussalam; India; Indonesia; Malaysia; Myanmar; Philippines; Singapore; Thailand
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
17	Pygmy Flower Pecker	<i>Dicaeum pygmaeum</i>	Dicaeidae	LC	Endemic	Balabac, Calauit, Culion and Palawan; <i>fugaensis</i> Calayan and Fuga; <i>salomonseni</i> northwest Luzon; <i>pygmaeum</i> Bohol, Boracay, Calag-an, Cebu, Corregidor, Gigantes, Guimaras, Leyte, Lubang, Central and Southern Luzon, Maestre de Campo, Marinduque, Masbate, Mindoro, Negros, Polillo, Romblon, Samar, Semirara, Sibay, Sibuyan, Sicogon, Siquijor, and Ticao; <i>Davao</i> , Camiguin Sur and Mindanao.
18	Reddish Cuckoo-Dove	<i>Macropygia phasianella</i>	Columbidae	NE	Non-endemic	Sumatra, Java, Lesser Sundas, Eastern Australia, Borneo and the Philippines- Batan, Itbayat, Sabtang, Calayan, Balabac, Basilan, Biliran, Bohol, Bongao, Busuanga, Cabo, Camiguin Sur, Catanduanes, Culion, east Bolod, Jolo, Leyte, Loran, Luzon, Malamaui,

Species No.	Common Name	Scientific Name	Family Name	Conservation Status	Distribution/ Endemicity	Geographic Range
						ManukManka, Marinduque, Masbate, Mindanao, Mindoro, Negros, Palawan, Panay, Polillo, Romblon, Samar, Sibutu, Sibuyan, Siquijor, and Tawi-Tawi.
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
20	Spotted Button Quail	<i>Butorides striatus</i>	Turnicidae	LC	Endemic	All of India up to about 2500 m in the Himalayas; Sri Lanka; Bangladesh; Burma; Indonesia and most of Southeast Asia, Philippines.
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
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
24	White-Breasted Wood Swallow	<i>Artamus leucorhynchus</i>	Motacillidae	LC	Non-endemic	Sumatra, Java, Lesser Sundas to New Guinea, Australia and southwest Pacific, Including, Mollucas, Sulawesi, Borneo and Philippines.
25	White-Eared Brown Dove	<i>Phapitreron leucotis</i>	Columbidae	LC	Endemic	A Philippine native. A generally common resident on all main islands except Palawan
26	Yellow Vented Bulbul	<i>Pycnonotus goiavier</i>	Pycnonotidae	LC	Non-endemic	Southeast Asia; common in the Philippines, Singapore and Brunei; Native in Brunei Darussalam; Cambodia; Indonesia; Lao People's Democratic Republic; Malaysia; Myanmar; Philippines; Singapore; Thailand; Viet Nam
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 Sibul), Myanmar (= Burma), New Guinea, Philippines (Negros,

Species No.	Common Name	Scientific Name	Family Name	Conservation Status	Distribution/ Endemicity	Geographic Range
						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.
3	Monitor Lizard	<i>Varanus sp.</i>	Varanidae	LC (IUCN 2015.2), VU (CITES app.2)	Non-endemic	This species is extremely widespread throughout southern and Southeast Asia (Gaulke and Horn 2004). Bangladesh; Cambodia; China (Guangxi, Hainan, Yunnan); Hong Kong; India (Andaman Is., Nicobar Is.); Indonesia (Bali, Jawa, Kalimantan, Sulawesi, Sumatera); Lao People's Democratic Republic; Malaysia (Peninsular Malaysia); Myanmar; Singapore; Sri Lanka; Thailand; Viet Nam
Amphibian						
1	Marine Toad	<i>Bufo marinus</i>	Bufoidea	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,

2.4 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 5**) has a computed value of 2.262 with species evenness value of .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 5. 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

Sampling site no.	Shannon-Wiener Biodiversity index (H')	Pielou's Index (J') species Evenness	Fernando's Biodiversity Scale (1998)
			evenness

2.5 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 6 shows the species abundance and distribution.

Table 6. Species abundance and relative frequency

Species			Abundance	No. of times intercepted	Rel freq. (%)
Common name	Scientific name	Family			
Barred Rail	<i>Gallirallus torquatus</i>	Rallidae	1	1	1.41
Blue Tailed Bee Eater	<i>Merops philippinus</i>	Meropidae	30	4	5.63
Brahminy Kite	<i>Haliastur indus</i>	Accipitridae	1	1	1.41
Cattle Egret	<i>bubulcus ibis</i>	Ardeidae	4	2	2.82
Chesnut Munia	<i>Lonchura malacca</i>	Estrildidae	42	3	4.23
Crested Myna	<i>Acridotheres cristatellus</i>	Sturnidae	6	3	4.23
Eurasian Tree Sparrow	<i>Passer montanus</i>	Passeridae	39	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
Orange-Bellied flower Pecker	<i>Dicaeum trigonostigma</i>	Dicaeidae	3	2	2.82
Pied Bush chat	<i>Saxicola Caprata</i>	Muscicapidae	2	2	2.82
Pied Fantail	<i>Rhipidura javanica</i>	Rhipiduridae	10	3	4.23
Pygmy Flower Pecker	<i>Dicaeum pygmaeum</i>	Dicaeidae	27	3	4.23
Reddish Cuckoo-Dove	<i>Macropygia phasianella</i>	Columbidae	4	1	1.41
Scaly Breasted Munia	<i>Lonchura punctulata</i>	Estrildidae	17	2	2.82
Spotted Button Quail	<i>Butorides striatus</i>	Turnicidae	4	4	5.63
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-Breasted Wood Swallow	<i>Artamus leucorhynchus</i>	Motacillidae	2	1	1.41
White-Eared Brown Dove	<i>Phapitreron leucotis</i>	Columbidae	2	1	1.41
Yellow Vented Bulbul	<i>Pycnonotus goiavier</i>	Pycnonotidae	50	6	8.45
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			232	71	100.00

C. Key environmental impacts and recommended mitigating/enhancement measures**1. Vegetation Removal/ 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. 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.

2. 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.

3. 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 agohe or ornamental plants like bougainvillea may also be used to mitigate fugitive dust emission.

4. 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.

5. 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.

6. Tree Cutting Permit

Prior to land clearing operation, it is recommended that proponent should conduct tree inventory prior to application for tree cutting and/or tree relocation permit for those trees that will be affected by the construction.

7. Replacement of trees/ vegetation affected due to land clearing

To compensate the loss vegetation, the proponent should replace the number of trees loss during land clearing operation and plant them to nearby areas or within the buffer zone or periphery of the power plant and its associated facilities particularly in ash pond site, coal yard, freshwater tank and fuel storage, limestone stockpile, and relocation area. It is recommended that buffer zone should 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 should be measured at 7 to 10ft high. Augmentation or enrichment planting using propagated seedlings (nursery grown) or wildlings should also be conducted off-site for Carbon Sink program. The number of seedlings for replacement should 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 construction and operationalization of nursery area is highly recommended, preferably near or within the project site) for the production of seedlings, both for forest trees (native/ endemic species) are highly recommended 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 should be coordinated with concerned DENR Field Office to be credited as part of the Company's contribution to National Greening Program (NGP) as should be part of the Company's implementation of Reforestation and Carbon Sink Program.

There is no area selected yet for the replacement planting of trees. The Company will coordinate with concerned DENR field office for the proper identification and selection of the area under the National Greening Program (NGP) and under the existing Memorandum of Agreement (MOA) between DENR and SteelAsia on sustainable development programs where tree planting and reforestation is included. The area to be identified shall be part of the Company's contribution to NGP, realization of its commitment to the MOA and also part of its compliance to the ECC condition to establish and maintain Reforestation and Carbon Sink Program.

8. 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.

9. 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.

10. Establishment of natural perimeter along the perimeter fence as land mark using fruit bearing trees

To consider in the planning the establishment of natural perimeter land mark within the project site using fruit bearing trees. This method could also help provide a natural abode to some wildlife as well as source of food.

3.2 The Water

3.2.1 Hydrology/Hydrogeology

3.2.1.1 Drainage Morphology/Inducement of Flooding/Reduction in Stream

Drainage Morphology

Candelaria is drained by three major rivers: Masin, Quiapo and Taguan, where several small creeks branch out. These rivers also serve as the natural boundaries of the barangays within the municipality and also the neighboring municipalities².

River systems within the municipality originate from Mount Banahaw and flow down to the Malaquingllog River at the southern boundary of the municipality, which eventually flows out to the Tayabas Bay. Other rivers include Pansol, Guhit, Palos, Mamala, Mangilag Sur, Bacong, Tiaong, Madre Estaquia, Tilarog and Mangalang. In Barangay MasalukotIV, there is an intermittent river that dries up during the dry, hot summer months of March to May. Other rivers in the municipality are Langalanga, Pritil, Anito, Mataknil, EdesBulusan, Yamot, Mantika, Bukol, Bonabohar, Timtimon, Sipit, and Bega. Springs and falls are also present in Candelaria, such as Adarna, Pansol and Mabitin springs and the Guhit and Poles falls.

Streamflow

There is no comprehensive measurement of discharges of the rivers in Candelaria.

3.2.1.1 Hydrogeology

Based on the 1997 Groundwater Availability Map of the Philippines, the Project Site falls under fairly extensive and productive aquifers which is shown in Figure 3.2-1. This classification is attributed to a extreme and highly productive aquifer. There are several wells observed within the project site. The groundwater occurs under unconfined conditions within the interstices of consolidated pyroclastics and tuffaceous sedimentary rocks. The thickness of the aquifer is not known. The aquifer in these segments is tapped by shallow wells which are pumped manually or with the aid of low capacity centrifugal pumps.

² Environment Sector, Municipality of Candelaria

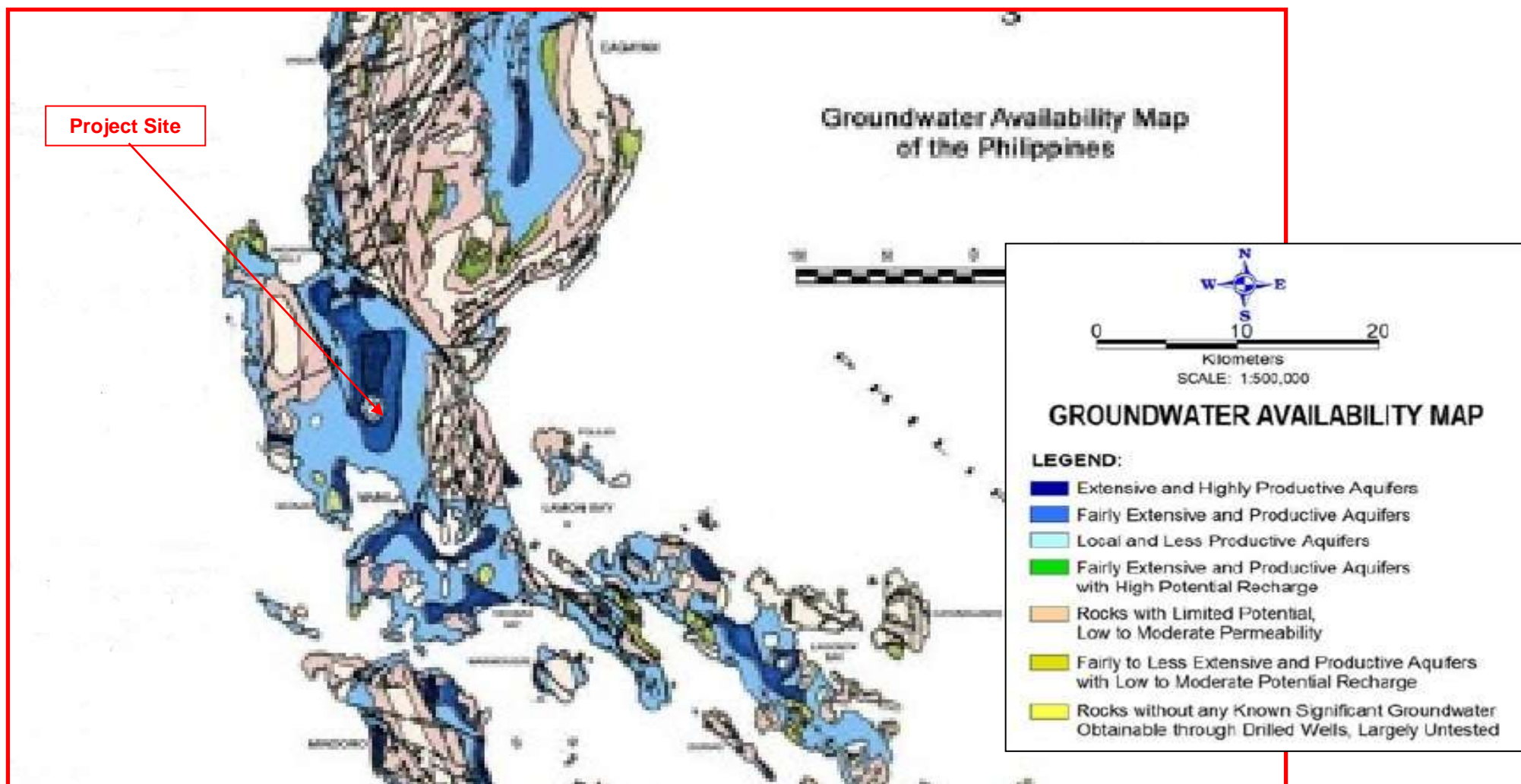


Figure 3.2-1 Groundwater Availability Map

3.2.1.2 Impact Identification, Prediction and Assessment, and Mitigation

Pre-Construction and Construction Phase

Change in Drainage Morphology/Inducement of Flooding

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. A proper temporary drainage system shall be installed in order to address the issue of flooding. Minimizing the removal of vegetation during construction will alleviate flooding.

The Project will ensure that appropriate measures are in put place and strictly complied with. Aside from the installation of the proper drainage systems, the proponent will prepare and implement Waste Management Plan that includes contractor's commitment the proper disposal of demolition debris, construction spoils and solid wastes.

Change in Stream and Lake Water Depth

The proposed project is not expected to affect the depth of the nearby river and streams because of its zero effluent discharge.

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.

Operation Phase

Change in Drainage Morphology/Inducement of Flooding

The frequency of typhoons as well as the slope and drainage characteristics of the areas where the proposed project is to be located is not susceptible to flooding and inundation. This will affect the operation activities due to drainage overflows, surface run-off and siltation. This will be eliminated with the proper drainage design though the detailed engineering design study for the project. However, 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. It is significant that the project will regularly monitor weather bulletins issued by PAGASA and get their advice on necessary actions.

Change in Stream and Lake Water Depth

The proposed project will not bring about a change in the depth of the nearby river and streams.

Depletion of Water Resources/Competition in Water Use

Domestic water is the main uses of water in the project area and its vicinity. Domestic water supply in Candelaria Quezon is provided by Candelaria Water District. As of December 31, 2017, the District was serving a total of 8,000 active concessionaires classified as residential and domestic areas.

Project Water Usage and Water Source. 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 50 to 90 meters 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.

Project Circulating Wastewater Treatment Plant. The project will invest extensively in the water treatment system that aims to recirculate all process water. Zero wastewater discharge is envisaged.

Project Water Catchment Pond. A water catchment pond will be constructed by the project to collect rain water 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.

Steel Asia 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.

3.2.2 Water Quality

3.2.2.1 Water Sample Collection

Primary data gathering was conducted to assess the baseline water quality of the water bodies within the project site. Samples were collected in each sampling station for freshwater water quality and groundwater sampling monitoring. The collected samples were subjected to physical, chemical, microbiological, nutrient and heavy metal analyses. Water samples were preserved in iced boxes prior to transport to the laboratory facility for analysis.

Table 3.2-2. Water Quality Parameters and Corresponding Methods of Analysis

Parameters	Method of Analysis
pH	Electrometric
Total Suspended Solids (TSS)	Gravimetric
Oil & Grease	Liquid Partition/Gravimetric
Biochemical Oxygen Demand (BOD ₅)	Azide Modification (Dilution Technique)
Chemical Oxygen Demand (COD)	Open reflux method; Close reflux titrimetric method, Close reflux colorimetric method
Dissolved Oxygen (DO)	Iodometric Methods; Membrane electrode method
Total Coliform	Multiple tube Fermentation technique – standard total coliform fermentation technique; enzyme substrate test

Source: MC 2016-012, Approved Methods of Analysis

Water Quality Sampling Stations

Groundwater and freshwater sampling were conducted on August 13, 2016 to assess the physico-chemical property of the water around the project site. Four (4) groundwater and two (2) freshwater sampling stations were established to characterized water quality in the area.

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 for analysis.

The station identification, description and geographical coordinates of the sampling site is provided in the table below. Figure 3.2-3 is the water quality sampling map.

Table 3.2-3. Location of Groundwater and Freshwater Sampling Station

Station	Description	UTM Coordinates	
		Easting, (m)	Northing, (m)
GW-1	Hand pump tube well	329834.68	1537989.39
GW-2	Hand pump tube well	330666.83	1538305.98
GW-3	Hand pump tube well	330530.18	1536607.69
GW-4	Hand pump tube well in Barangay	329056.70	1537019.71
FW-1	Surface Water Quiapo River	329688.56	1538909.86
FW-2	Surface Water Quiapo	329283.71	1538339.08

Source: Mediatrix, 2016

Applied Standard

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 while DAO 2016-08 Water Quality Guidelines (WQG) waters will be used for water sample collected. The river where freshwater sample is collected are not yet classified, therefore standard use is for Class C water.

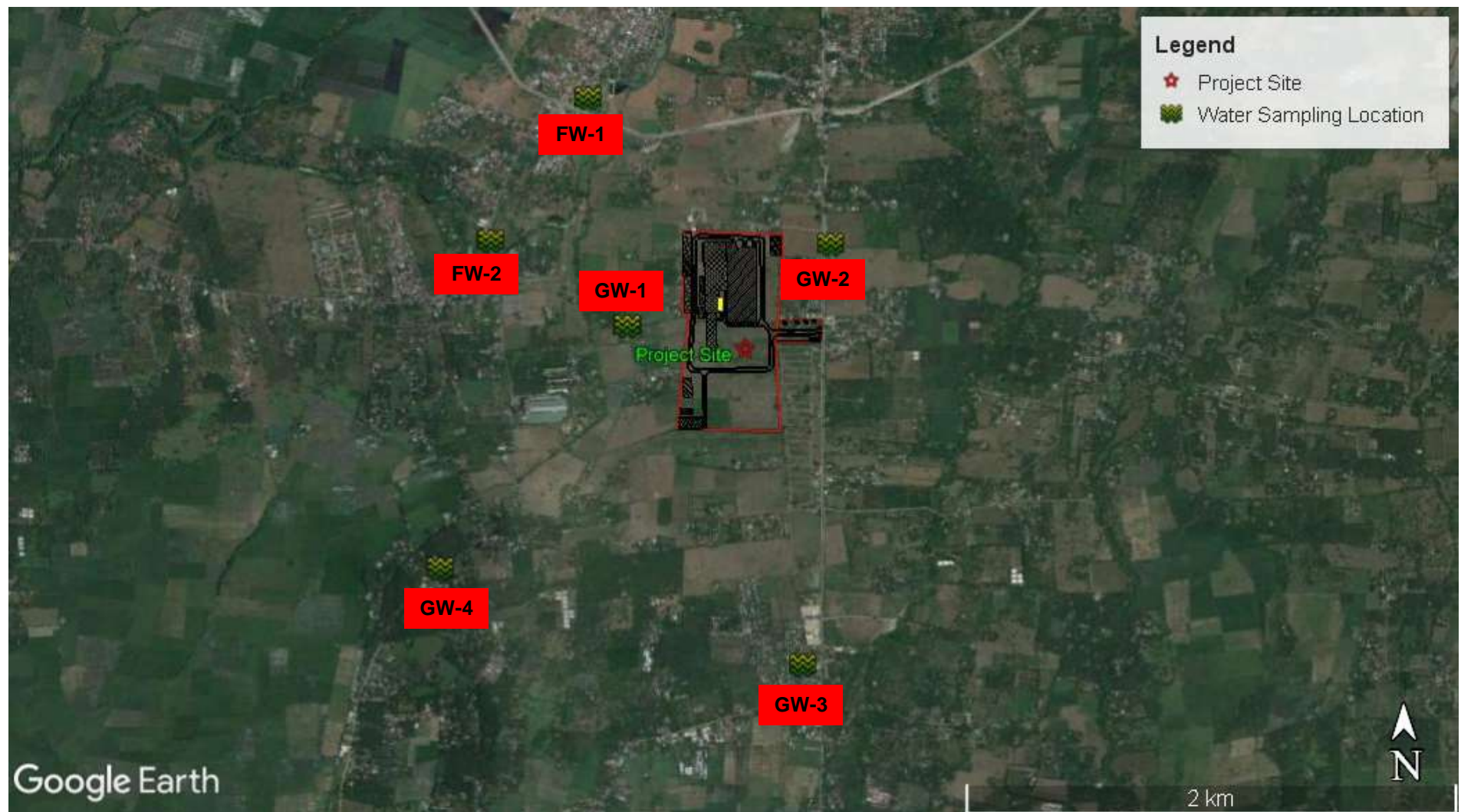


Figure 3.2-3 Location of Water Quality Monitoring Station

Water Sampling Results and Analysis

The depth of the well's ranges from 7m to 31m. The structures were built as early as 1960 to recent 2017. The usage varies from community drinking water supply and use for cooking, bathing, and watering in residential and commercial garden. As such, drinking water generally comes from the commercial "mineral" water or from the local water utility.

Collectively, there is a fair conformance (48%) of the six (6) sampling sites with 8 parameters measured and compared to the PNSDW and the DENR Class C guidelines. Out of 23 measurements, 12 or 52% cases of varying non-conformance by water sample are attributed to organics. A summary of the results is presented in Table 3.2-4 for groundwater and Table 3.2-5 for fresh water.

Table 3.2-4 Result of Groundwater Sampling Analysis

Parameters/ Station	GW-1	GW-2	GW-3	GW-4	PNSDW 2017
Date and Time of Sampling	August 13, 2016/ 0730H	August 13, 2016/ 0800H	August 13, 2016/ 0830H	August 13, 2016/ 0900H	
pH	7.04	7.04	7.01	7.04	6.5-8.5
Color (Apparent)	30	30	30	40	10
TSS, mg/L	26	26	27	27	-
Oil and Grease, mg/L	0.70	0.70	0.52	0.71	-
BOD, mg/L	2	2	2	4	-
COD, mg/L	10	10	30	30	-
Settleable Solids, ml/L	<0.1	<0.1	0.1	<0.1	-
Total Coliform, MPN/100 ml	<1.1	<1.1	<1.1	<1.1	<1.1

Note: Red color are the results that exceeded the limit. This may be caused by the discoloration of the well pumps/tubes being used which deteriorated overtime.

Table 3.2-5 Result of Fresh Water Sampling Analysis

Parameters/ Station	FW-1	FW-2	DENR Standard for Class C Waters
Date and Time of Sampling	August 13, 2016/ 0930H	August 13, 2016/ 0950H	
pH	6.98	6.99	6.5-8.5
Color (Apparent), PCU	50	55	75
TSS, mg/L	40	47	<30 mg/L increase
Oil & Grease, mg/L	3.8	2.76	2
BOD, mg/L	52	44	7
COD, mg/L	198	198	-
Settleable Solids, ml/L	0.1	0.2	-
Total Coliform, MPN/100 ml	35,000	24,000	3,000

Note: Red color are the results that exceeded the limit. These may be caused by the presence of garbage observed in the river.

3.2.2.2 Impact Identification, Prediction, Assessment and Mitigation

3.2.2.2.1 Pre-Construction and Construction Phase

Degradation of Water Quality

Wastewater generated during construction and operational phase which include domestic wastewater which may enter groundwater through seepage or through freshwater bodies as surface runoff. This

wastewater may degrade water quality in these areas and may increase fecal contamination, levels of heavy metals, turbidity and TSS.

During operations, the Project will provide wastewater treatment and management plan and shall be strictly implemented. The Plant will also employ the system of zero effluent/zero discharge. Although such is the case, quarterly monitoring of quality of groundwater and fresh water should be conducted.

Storm runoff will be directed through the siltation pond system prior to discharge to the channel. Contaminated rainwater in the maintenance area will be directed to the oil and water separator before discharged to the drainage system.

Freshwater Ecology

During construction, waste water 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. 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. A surface water and effluent quality monitoring will be conducted during construction.

3.2.2.2 Operation Phase

Degradation of Water Quality

The significant impact on groundwater quality during operation is a long-term overland discharge of untreated wastewaters from the proposed project. Wastewater would typically contain wash water and used oil. As a mitigation measure, the use of 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.

Prevention of Oil and Grease Spill

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.

2.2.4 Freshwater Ecology

Two River systems - Quiapo River and Maasin River are the main freshwater bodies that traverses Candelaria municipality. The Maasin River lies in the western side of the municipality across the entire Poblacion; its closest riparian point relative to the project site is about two (2) kilometres away, in the northwest. The Quiapo River, which emanates from the southern slopes of Mt. Banahaw Protected Landscape, meanders through Barangay Masalukot and Pahinga Norte thence entering the Poblacion through the Candelaria Bypass Road about 1 km northwest of the project site. Its closest point relative to the center of the proposed steel mill is about 700 meters away, in a tributary of the river located in the boundary of Malabanban Sur and Bgy Pahinga Norte. The Quiapo and Maasin Rivers merges some three (3) kilometres west of the project site, enters San Juan municipality where it finally flows out into Tayabas Bay.

Apart from the Quiapo River, at least two small streams pass through the vicinity of the project site – the Madre Eustaquia creek and Latian tributary. The streams emanate from natural springs in Barangay Malabanban Sur and dissipate in nearby corn fields. The streams, even as they are minor, are within the impact area of the proposed project.

Characterization of the Wawa River was conducted during aquatic ecology survey. The coordinates of the river profiling stations are listed in **Table 2.2.8** and locations are presented in **Figure 2.2.5**.



Plate 1: The Quiapo River in Candelaria, Quezon

Objectives and Methodology

River ecology assessment was conducted in seven stations along the Quiapo River and its tributaries, as well as in the Madre Eustaquia Creek in Barangay Malabanban Sur and Pahinga Norte from July 9-10, 2017. The objective of the freshwater ecology baseline study is to determine the presence of important aquatic biota in the Quiapo River and several streams that run through potential impact areas of the Steel Asia Project in Candelaria, Quezon. The assessment was focused on determining plankton community structure, presence of fish biota, macro-invertebrates, macro-benthos and fisheries resources and practices that can be susceptible to the operation of the steel mill.

Specimen collection was supplemented by actual observation of fishing operation in one station where a lone fisher was encountered during the time of the survey in one of the streams. Where it is viable, identification of freshwater fish species was generally conducted in the same sampling sites for plankton and macro-benthos. However, the Quiapo River and its tributaries, as well as the streams investigated around the project site, were too shallow, rocky and narrow, rendering the operation of net fishing gear inapplicable. Similarly, transect swims for fish identification was not viable due to shallow river depth and extreme polluted condition of the Quiapo River and the creeks. In this case, key informants were interviewed to identify species of fish in the river systems surveyed.

For plankton communities, seven stations were subjected to biotic sampling that included phytoplankton, zooplankton, and epibenthic benthos. All samples were labeled with the sampling site codes, type of sample, analysis required, and date of collection. For fish biota, presence of fish and crustacean species, as well as macro-invertebrates of significant value for food, were identified *in-situ* through opportunistic observation in the same seven stations with at least one station subjected to actual fishing operation. The test fishing operation involved electro-fishing as the use of a cast net was not feasible.

Phytoplankton and zooplankton were collected at the sampling sites by filtering 1 liter samples into a composite sample. Phytoplankton samples were filtered through a 20 µm mesh sieve; zooplankton were filtered through a 33 µm mesh sieve. Phytoplankton samples were then fixed using Lugol's solution; zooplankton samples were fixed with 10% buffered formalin. Samples were then sent to the UP MSI laboratory for counting and identification. Counting and identification of organisms were conducted using a Sedgwick-Rafter plate. For phytoplankton, a compound light microscope was used, while for zooplankton, a dissecting microscope. 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. Benthic macrobenthos were collected employing the standard kick net (see Plate 1). The net is thrust into productive habitats and substrates (e.g., riffle areas, flooded vegetation, submerged root mats and other woody debris) to collect specimens. Macro-benthos were identified up to species level.

Survey Results and Discussion

1. River Ecology Station Profiles

Basic river attributes in seven stations were investigated, the locations of which are indicated in Table 1. Four of the stations were located in the upstream and downstream sections of the Quiapo River relative to the project site, one in the Latian Creek, and two in the downstream and upstream sections of the Madre Eustaquia creek.

Table 1: *Coordinates of river parameter sampling stations investigated in the Quiapo River and Nearby Streams, Candelaria Quezon; 09-10 July 2017.*

WP Code	LATITUDE	LONGITUDE	Remarks
RVR1	N 13.915083°	E 121.423972°	Beneath Quiapo Bridge @ Bgy Malabanban Sur; extremely polluted with garbage. Stream flow @ 0.0055 meters/s (5.5mm/s)
RVR2	N 13.910000°	E 121.419917°	Culvert across Quiapo River @ Sitio Pagasa, Bgy Pahinga Norte, heavily polluted but most of the garbage are on the banks. Streamflow @ 0.0056 meters/s (5.6mm/s)
RVR3	N 13.908972°	E 121.423222°	Boundary of Bgy Malabanban Sur & Bgy Pahinga Norte, slightly polluted from visible garbage but water is "bluish". Stream flow @ 0.51 meters/s
RVR4	N 13.901611°	E 121.420778°	Boundary of Bgy Sta Catalina & Bgy Pahinga Norte, lightly polluted from visible garbage but water is light gray (suspected from desiccated coconut processing). Stream flow @ 0.47 meters/s
RVR5	N 13.914361°	E 121.426250°	Latian creek in Bgy Malabanban Sur beneath highway culvert, slightly polluted with dark brown water used to catch fish by means of electric current. Stream flow @ @ 0.0055 meters/s (5.5mm/s)
RVR6	N 13.900222°	E 121.436778°	Boundary of Bgy San Andres & Bgy Sta Catalina downstream of Madre Eustaquia spring source, apparently unpolluted from visible garbage but water is gray (suspected from commercial fertilizers). Stream flow @ 0.47 meters/s
RVR7	N 13.917944°	E 121.436667°	Spring source at Bgy Malabanban Sur midstream connecting to Madre Eustaquia spring source, unpolluted with little garbage and water is clear. Stream flow @ 0.40 meters/s

Stations 1 and 2 are located in the main body of the Quiapo River while stations 3 and 4 are tributaries downstream. Station 5 is located in Latian Creek, station 6 and 7 are in Madre Eustaquia creek. River stations 1, 3 and 5 are the closest to the project site, with the former about 820 meters northwest of the boundary of the steel plant and the stations 3 and 5 more than 800 meters away. Station 3 and 4 are located downstream of Quiapo River directly west of the project site. Station 5 (Latian Creek) is a tributary of the Quiapo River.

The location of the river parameter sampling stations is displayed in Figures 1 and 2.



Figure 1: Location of river parameter sampling stations; Steel Asia project site in Candelaria, Quezon.



Figure 2: Location of river parameter sampling stations; Steel Asia project site in Candelaria, Quezon.

1.1 Station 1 – Upstream Quiapo River

Station 1 is located beneath the Candelaria By-Pass bridge in Bgy Malabanban Sur and is the main body of the Quiapo River passing through the poblacion of Candelaria (Figure 1 and Plate 1). The section of the river in the sampling station is extremely polluted with almost stagnant conditions due to very slow movement. Garbage is strewn across the river. Extensive soil accretions have accumulated on both banks, making the river narrow with no canopy. The depth is very shallow, at 30 cm; with most sections strewn with boulders and rocks interspersed with coarse pebbles occurring extensively. River water color is dark gray, indicating extremely polluted conditions and bottom sediment is comprised of dark silt and mud. The riparian widths did not exceed 3 meters and riverbanks have been invaded by extensive grassy vegetation. Boulders and gravel in all sections within the station are embedded by silt in their lower margins. There is a marked absence of riparian natural vegetation. Stream flow was measured at 0.0055 meters/second, indicating torpid movement. According to Barangay officials, upland erosion and pollution from both domestic and industrial wastes has contributed immensely to the deterioration of river water quality and deforestation in the slopes of Mt. Banahaw where the river's headwaters emanate has allegedly caused extreme reduction in water discharge. There are five coconut processing plants in Candelaria. At present, Barangay officials claim that the river is no longer being tapped for irrigation, bathing and other domestic uses.



Plate 1: Station 1 in the Quiapo River.

1.2 Station 2 – Downstream of Quiapo River

Station 2 is located in a culvert outlet across Quiapo River at Sitio Pagasa, Bgy Pahinga Norte west of the northern boundary of the project site. The river is southwest of station 1, downstream of the Quiapo River, flowing southwest. The riparian width is narrow, not more than 3 meters in its widest portions seen from the sampling station, with very slow moving current at 0.0056 meters/s (5.6mm/s). Depth was estimated at 30 to 40 cm; with the riverbed characterized by rocks and boulders. As is station 1, the river is heavily polluted with garbage and domestic wastewaters. The natural riparian banks have been overcome by accretion, and are colonized extensively with grassy vegetation and aquatic plants. At the time of the survey, the water in Station 2 was extremely turbid with mud and murky sediments throughout the entire length of the vicinity of the sampling area (Plate 2). No fish species were encountered in several attempts of scoop net. The river is not being tapped for any domestic purpose, including fisheries.



Plate 2: Station 2 – tributary downstream of the main Quiapo River with culvert (right frame).

1.3 Station 3 – Quiapo River Tributary

Station 3, in the boundary of Bgy Malabanban Sur & Bgy Pahinga Norte, flows on the western section of the project site and is one of the closest to the project area. The narrow stream is a tributary of the Quiapo River that dissipates after about 1 km in rice and corn fields. The riparian width is no greater than 2 meters on its widest breadth. Similar to stations 1 and 2, the river is heavily polluted with domestic and industrial wastewaters, but lesser garbage. The color of the stream water is “light bluish”. Key informants attribute this to alleged disposal of coconut water discharges from coconut processing plants in Candelaria. Stream flow was measured at 0.51 meters/second. There is no significant canopy vegetation and both banks are extensively colonized by grasses. Depth was measured at 30 to 40 cm. In spite of its ‘unusual’ color, stream waters are used for irrigation of corn fields. Scoop netting for aquatic animals yielded no fish species although nearby residents claim that native “Dalag” (*Channidae*) and “Hito” (*Clariidae*) inhabit the area, albeit in very small distribution. Bottom sediments was composed of silt (Plate 3).



Plate 3- River ecology Station 3, tributary west of the projects site.

1.4 – Station 4: tributary of the Quiapo River southwest of project site

Station 4 is a tributary of the Quiapo River located in the boundary of Bgy Sta Catalina and Bgy Pahinga Norte southwest of the southern boundary of the project site. It is less than 1 kilometer from the project boundary. Similar to station 3, the river is lightly polluted from visible garbage but water is light gray to light bluish (Plate 4). Key informants claim that the color of stream water is a result of industrial wastewater pollution, allegedly from desiccated coconut processing. The width of the river is narrow (1.5 meters), with intermittent concrete revetments on both banks. River substrate is comprised of silt and mud. The riprap has caused faster stream flow, measured at 0.47 meters/sec. Grass and shrubs, as well as banana trees tended by residents, line the riparian contour which is about 30 cm high from stream water. Stream depth ranges from 10 to 20 cm in largely open canopy. Key informants claim that traditional Philippine freshwater species of fish i.e., 'dalag' 'biya' and hito' are still thriving in the water although no capture fisheries is practiced. The stream is being used for irrigation and is largely consumed in nearby corn and rice fields.



Plate 4: Station 4 - tributary of the Quiapo River southwest of project site

1.5 Station 5: Latian Creek

Located in Bgy Malabanban Sur beneath highway culvert, the Latian Creek is the closest station to the northern boundary of the project site. Strewed with trash and slightly polluted with dark brown water, the creek measures 2 meters on most sections, with 'kangkong' (*Ipomoea aquatic*), water nymphs (*Nymphaeaceae*) densely inhabit the edges, while papaya and banana trees have been planted on the riverbanks. Stream flow was measured at 0.0055 meters/sec (5.5mm/s). The river bank elevation is low and stumpy, while depth was estimated at 30 cm.

At the time of the survey, a lone fisher using "electro-fishing" was encountered. This fishing method is prohibited in Candelaria and officials of Malabanban Sur claim that the fisher is not a resident of the Barangay. The catch comprised of a single snakehead (Dalag) and two Tilapia. Opportunistic survey using scoop net also yielded fry of dalag and goby (Plate 5).



Plate 5: River ecology station 5 (Latian Creek) with fisher using electro-fishing, fry of goby and 'dalag' and muddy sediment collected from riverbed.

1.6 River ecology station 6: downstream of Madre Eustaquia Creek

The station is located in the downstream section of the Madre Eustaquia creek in the boundary of Bgy San Andres & Bgy Sta Catalina southeast of the project site. It is the only water body occurring in the eastern region of the project site's border. The Madre Eustaquia creek is fed by spring water from upstream sources and although it is claimed to be perennial, residents alleged that stream width and flow becomes very small during the dry season. At the time of sampling, the stream width was approximately 2 meters, with tree canopy occupying about 25% of stream crown, and stream flow at 0.47 meters/s. Riverbank vegetation consists of water nymphs (*Nymphaeaceae*), gabi (*Colocasia esculenta*), banana and ferns. Unlike in other stations, the Madre Eustaquia creek is only lightly polluted of visible garbage but water is gray (suspected from commercial fertilizers). The riverbed sediment consists of sand and mud, strewn with rocks. Scoop net fishing yielded a juvenile Goby (*Glossogobius sp*), indicating that there are still some invertebrates and small fish available as food for the carnivorous gobiid species. Key informants claim that Tilapia, freshwater prawn, and catfish are present in the stream although fishing for these species is not being practiced. In addition, Barangay officials declared that re-seeding of Tilapia has been undertaken in the creek.



Plate 6: Turbid waters in station 6, sandy-muddy substrate and the Asian freshwater clam (*Carbicula sp*)

1.7 Station 7: Upper Madre Eustaquia Creek, Bgy Malabanban Sur

Station 7 is the clearest and cleanest stream surveyed amongst seven river stations. It is located in the main body of the Madre Eustaquia Creek almost 1.5 kilometres north-northeast of the project site, in

Bgy Malabanban Sur midstream. The Madre Eustaquia Creek is fed by various perennial natural springs, one of which is located only half a kilometer from the Barangay Hall (Plate 7). The waters of the creek are relatively clean and are essentially being used for bathing, laundry, irrigation and other domestic uses. A resort upstream of the station surveyed draws water from the creek. Amongst the stations surveyed, station 7 was the only water system where few fishes, crustacean a bivalve and a gastropod were encountered. Fish biota included Tilapia, Goby, Gourami and Snakhead (Dalag), while crustacean species was represented solely by juveniles of the giant freshwater prawn *Macrobrachium rosenbergii*. The depth at the sampling site ranged from 10 to 20 cm; stream flow was measured at 0.40 meters/sec. Riparian vegetation is dense, mostly represented by water nymphs, ferns, grasses and few trees. The Madre Eustaquia Creek ends in the cornfields of Barangay Malabanban Sur and Pahinga Norte where it is fanned out into various irrigation canals and households.



Plate 7: The Madre Eustaquia Creek (left) and spring water sources (middle and right).

2. Plankton

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 of the bivalves in riverine and estuarine systems are also edible invertebrates collected for food and sustenance trade.

Plankton community sampling was conducted in seven stations in the Quiapo River, Latian Creek and Madre Eustaquia Creek (Figure 3) on 09 July 2017 in order to assess the composition diversity, abundance of plankton community. Plankton stations 3 and 5 are nearest to the project site.

In this survey, a total of 22 plankton genera/groups were documented belonging to Bacillariophytes (diatoms) with nine (9) genera, Cyanophytes (Blue-green algae) with two (2) genera, Chlorophytes (green algae) with two (2), Euglenophyte with three (3) species and zooplankton with six (6) groups (Table 1). Overall, euglenophyte were the most dominant group accounting for 55% of the plankton abundance and followed by cyanobacteria with 34%. However, the most speciose group was diatom with nine (9) genera observed. The chlorophyte and zooplankton group only constituted less than 1% of the plankton community. The mean plankton density was low, ranging from 103 to 26,207 cells/liter.

Among the plankters, the euglenophyte belonging to genus *Leponcincilis* had the highest overall abundance accounting for 55% and followed by the blue-green algae *Oscillatoria* with 34%. *Oscillatoria* was most frequently occurring phytoplankton genera where it was observed in all sampling stations. Among the zooplankton, ciliates were the most abundant group. The pollution tolerant genera observed in this survey include *Leponcincilis*, *Scendesmus* and *Oscillatoria*. Other important phytoplankton genera include *Synedra*, and *Fragillaria*. Blooms of these genera have been recorded to block canals and clog filters especially in water treatment facilities. Photomicrographs of dominant and common phytoplankton are shown in Figure 6.

Generally, the stations sampled in three elevations of Quiapo River and Madre Eustaquia were poor in plankton with only 3 to 11 genera/group observed. Between the two rivers, Madre Eustaquia was slightly better in terms of species richness with 10-11 plankters compared to 3-9 observed in Quiapo River (Figure 4). The tributary of Quiapo River has also a slightly higher in terms of species richness with 9 compared to main Quiapo River waterways. Regardless of elevation (upstream, midstream and downstream, tributaries), *plankton community in Quiapo River was still poor.*

This was supported by low diversity and evenness values where Shannon Diversity measurement in Quiapo River ranges from 0.04 to 1.04 while the Pielou Index of Evenness ranges from 0.17 to 0.64. A slightly higher diversity and evenness measurement was computed in Madre Eustaquia where Shannon Diversity measurement ranges from 1.58 to 2.04 while the Pielou Index of Evenness ranges from 0.66 to 0.89. In terms of abundance, stations in Quiapo river and its tributary has higher plankton density compared to stations sampled in Madre Eustaquia. This was however attributed to high number of a blue green algae, *Oscillatoria* sp in Quiapo river and a euglenoid, *Leponcincilis* sp. in the tributaries. This species are known to proliferate in highly polluted water. The plankton community in Madre Eustaquia were low in abundance but host a more or less stable diversity and evenness measurement indicating a slightly better water quality.

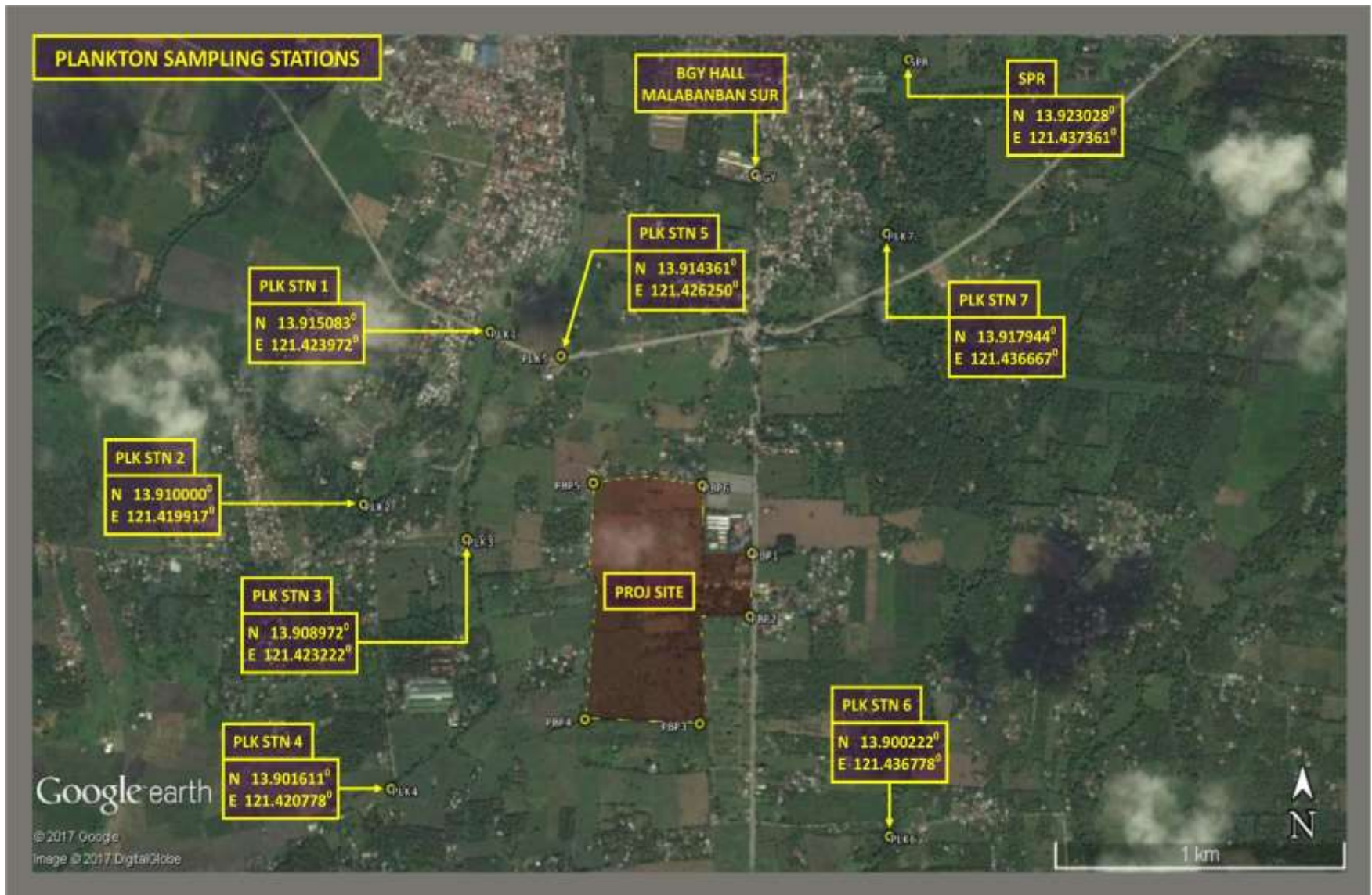


Figure 3: Location of plankton community sampling stations

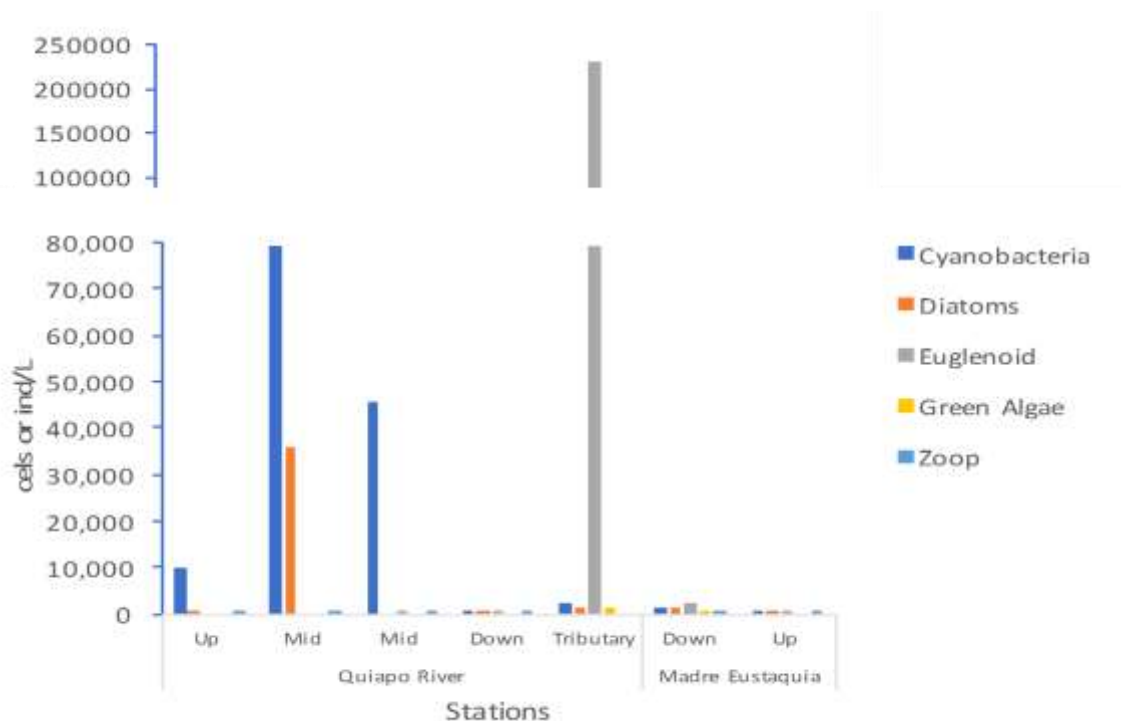


Figure 4. Total phytoplankton count in two rivers of Candelaria, Quezon during the July 9, 2017 sampling.

In terms of species composition, Quiapo River was dominated by cyanophytes accounting for 79% and followed by bacillariophytes with 21%. The tributary sampled in Quiapo River was dominated by Euglenophyte accounting for 99% of the plankton community. The Madre Eustaquia on the other hand was dominated by euglenophytes with 49%, followed by diatoms with 29% and cyanobacteria with 19% (Figure 5). In Quiapo River, plankton distribution was not even because of the high density of *Oscillatoria* observed in upstream midstream and downstream stations compared to other genera.

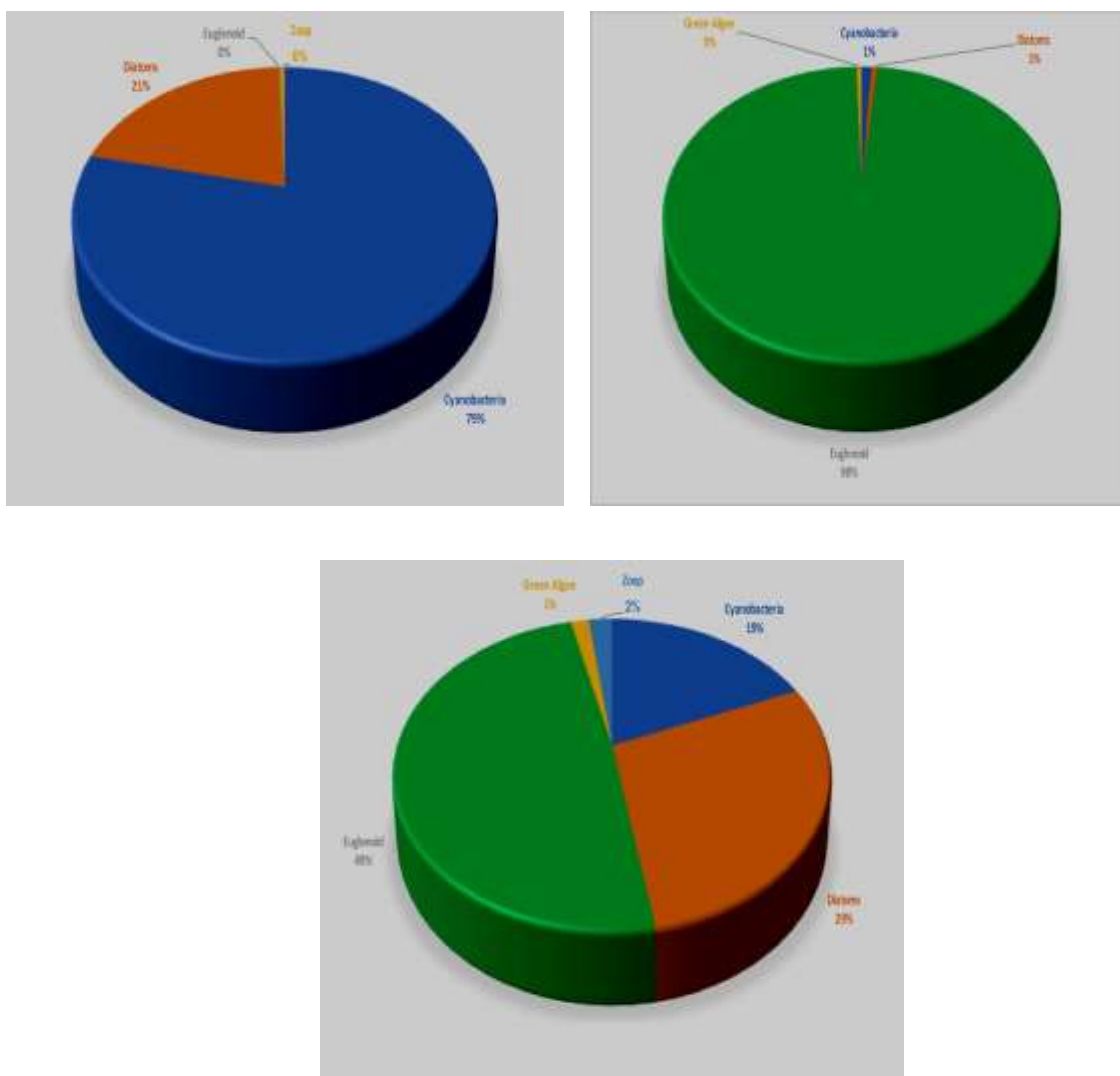


Figure 5. Percentage composition of major phytoplankton groups in (A) Quiapo River (B) tributary of Quiapo River and (C) Madre Eustaquia during the July 9, 2017 plankton community sampling.

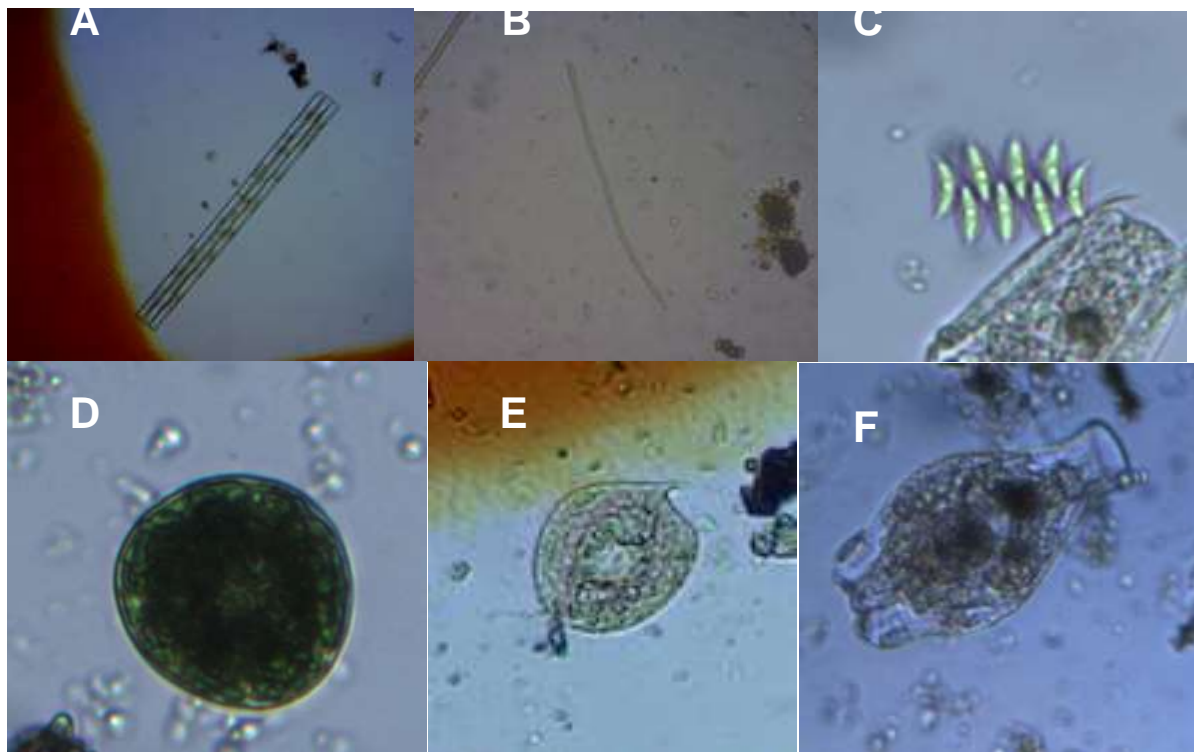


Figure 6. Photomicrograph of common and abundant phytoplankton in two rivers of Candelaria, Quezon during the July 9, 2017 sampling. (A) *Oscillatoria* (B) *Scenedesmus* (C) *Fragillaria* (D) *Leponcincilis* (E) *Phacus* (F) *Bdelloid rotifer*.

In summary, Quiapo river has very poor biodiversity and species richness with presence of pollution tolerant genera like *Oscillatoria* indicates a highly polluted river. On a positive note, although a low number of plankton were observed in Madre Eustaquia river, the biodiversity and evenness measure were slightly better with no single genera/group proliferating and dominating the plankton community indicating better water quality. In this regard, continued monitoring is still recommended to safeguard the risk of elevated organic pollutants in Madre Eustaquia inasmuch as this river system is being utilized for various domestic purposes unlike the Quiapo River system which is completely not utilized except as a conduit and receptacle for various waste streams. Since the project will be established near the Quiapo River, there is no significant threat to the plankton community in this river system since based on this assessment, the plankton biodiversity and richness is relatively poor with only the presence of highly pollution-tolerant species.

3. Macroinvertebrates

A total sixty-eight (68) individuals belonging to eleven (11) families or order were recorded during the July 9, 2017 survey in two rivers and tributary (i.e., Quiapo River and Madre Eustaquia) in Candelaria Quezon. The macro-invertebrates recorded in this survey belongs to four major phyla i.e. Chordata, Arthropoda, Annelida and Mollusca. Among these, the phylum Mollusca accounted for 76% of the total macro-invertebrates community, followed by Chordata with 9% and Annelida with 3%. Among the mollusks, the family Thiaridae constitutes for 71 % of the total macroinvertebrates count (Figure 7). The most family rich phyla were Arthropoda and Mollusca with four (4) families each recorded in all sampling sites. Among the arthropods, the family Coenagrionidae contributed significantly to overall count both with 4.4%. Images of common macroinvertebrates observed in waterways in Candelaria Quezon is shown in Figure 9.

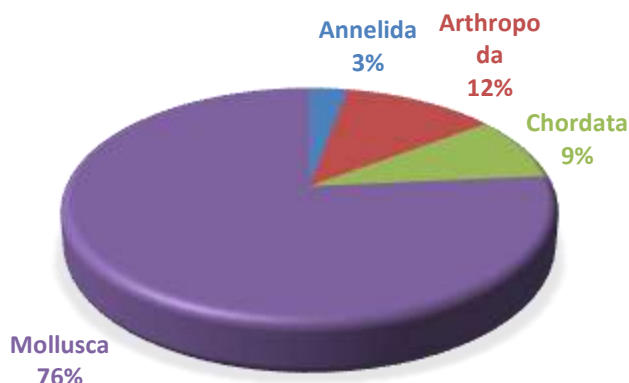


Figure 7. Percent composition of macrobenthos collected in waterways near Candelaria, Quezon during the July 9, 2017 sampling.

Macro-invertebrates, as indicator of ecosystem health, can be categorized based on their tolerance to pollution conditions (IOWATER, 2012). Group 1 (sensitive) are organisms that cannot survive under polluted conditions thus their presence indicates good water quality. Group 2 (facultative) are organisms that can exist under a wide range of water quality conditions than sensitive organisms can. Group 3 (tolerant) are organisms that are tolerant of pollution; in large amounts, they point to poor water quality conditions but can also be present in good and fair water quality (IOWATER, 2012). In this survey, most of the macroinvertebrates fit in these groupings. Vertebrates like cichlidae and gobiidae were still recorded and categorized among the three categories since they are bio-indicators of freshwater ecosystem (Figure 8). Overall, there were six taxa that belongs to category 3, four for category 2 and two for category 1. *The upstream and downstream area of the Quiapo river is severely polluted than even category 3 taxa was absent in the site.* In midstream area however, a category 3 macro-invertebrate specifically *Melanoides* sp. was still recorded but this is still an indication of heavy pollution since they are just tolerant of highly polluted areas. The upstream portion of Madre Eustaquia river recorded the highest number of Category 1 macro-invertebrates like amphipod indicating a relatively better quality of water. Amphipods are considered as sensitive group to pollution. The downstream portion of Madre Eustaquia, however also harbors a high number of category 3 macro-invertebrates primarily the mollusks that belong to family Thiariidae (Table 2). These are the most pollution tolerant species that thrives in higher dissolved oxygen, unstable pH and warmer water. The presence of category 2 macroinvertebrates in downstream portion of Madre Eustaquia still shows that it has better water quality than Quiapo river. The juvenile form of a freshwater fish belonging to family Gobiidae and Cichlidae were only found in the tributary of Quiapo river. This family of fish has considerable tolerance to environmental stressors, organic and inorganic contaminants. However, presence of these organisms alone does not indicate that the water is either clean or polluted (<http://rock.geo.csuohio.edu/norp/bmi2.htm>) but data must be integrated with the physicochemical parameters to have a holistic view of the ecosystem health.

Table 2. List of macrobenthos collected in waterways near Candelaria, Quezon during July 9, 2017

Phylum	Class/Subclass	Order	Family	Genus	Category
Annelida	Oligochaeta	Unknown	Oligochaeta (family)	Unknown	3
Arthropoda	Malacostraca	Amphipoda	Gammaridea	Amphipod	1
		Decapoda	Atyidae	Freshwater shrimp	1
	Insecta	Odonata	Coenagrionidae	<i>Pericnemis sp.</i>	2
			Libellulidae	<i>Libellula sp.</i>	2
Chordata	Actinopterygii	Perciformis	Cichlidae	<i>Oreochromis niloticus</i>	3
			Gobiidae	Unknown	2
Mollusca	Gastropoda	Architaenioglossa	Ampullariidae	<i>Pomacea sp.</i>	3
		Caenogastropoda	Thiaridae	<i>Melanoidea sp.</i>	3
				<i>Tarebia granifera</i>	3
	Bivalvia	Hygrophila	Planorbidae	<i>Planorbis sp.</i>	3
		Veneroida	Sphaeriidae	<i>Pisidium sp.</i>	2

Category 1 – pollution sensitive organisms; found in good water quality

Category 2 – can exist in wide range of water quality conditions; generally found in moderate water quality

Category 3 – can exist in wide range of water quality; highly tolerant to poor water

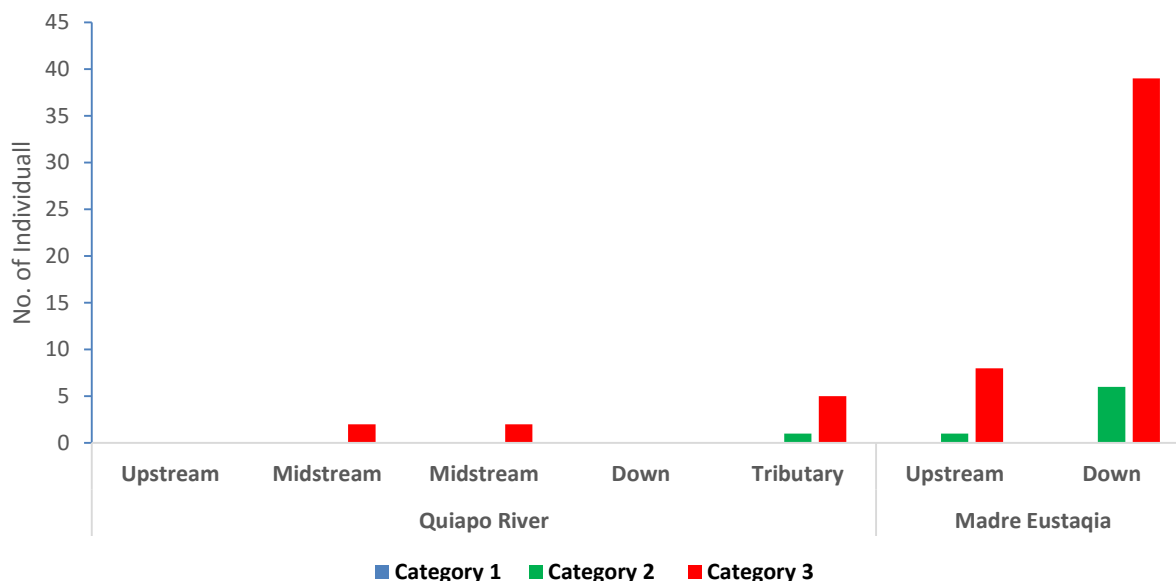


Figure 8. Occurrence of three categories of macro-invertebrates in all elevations in waterways near Candelaria, Quezon during plankton community sampling on July 9, 2017.

The Biological Monitoring Working party (BMWP) were determined for the collected macroinvertebrates in Quiapo River and Madre Eustaquia river (Table 3). The computed BMWP score for Madre Eustaquia river was 18 which is relatively higher than Quiapo River with BMWP score of 1. Quiapo river is categorized as heavily polluted while Madre Eustaquia is categorized as poor or impacted area (Table 4). Anecdotal accounts from the locals said that Madre Eustaquia river has been heavily utilized over the years due to

increased in population. However, it is important to note that the number of macro-invertebrates observed is relatively low and a monitoring system needs to be established to have a more conclusive statement.

Table 3. Table of BMWP score categories based on (National Water Council, 1981)

BMWP Score	Category	Interpretation
0-10	Very poor	Heavily polluted
11-40	Poor	Polluted or impacted
41-70	Moderate	Moderately impacted
71-100	Good	Clean but slightly impacted
>100	very Good	Unpolluted/unimpacted

Table 4. Water quality indices of macro-invertebrates in waterways near Candelaria, Quezon during the July 9, 2017 sampling.

Macroinvertebrates	Quiapo River	Madre Eustaquia
Ampullariidae <i>Pomacea sp.</i>	-	-
Atyidae Freshwater shrimp	-	-
Cichlidae <i>Oreochromis niloticus</i>	-	-
Coenagrionidae <i>Pericnemis sp.</i>	0	6
Gammaridea Amphipod	-	-
Libellulidae <i>Libellula</i>	0	8
Planorbiidae <i>Planorbis</i>	0	4
Sphaeriidae <i>Pisidium</i>	-	-
Thiaridae <i>Melanoides sp.</i> <i>Tarebia granifera</i> <i>Thiara sp.</i>	-	-
Gobiidae		
Oligochaeta (family)	1	-
BMWP Score	1	18

The three biodiversity indices - richness index, diversity index and evenness index gave better information about the environmental conditions under which the organisms lived (Yap et al., 2003) than a consideration of the individual taxa alone. Taxa richness is the total number of distinct taxa in a sample. It reflects the health of the community through measurement of the variety of taxa present which generally increases with increasing water quality (Plafkin et al., 1989). In terms of richness, the highest recorded number of species was found in the downstream and upstream station of Madre Eustaquia River while no taxa has been observed in upstream and downstream station of Quiapo River. Taxa distribution in tributary of Quiapo river and upstream station of Madre Eustaquia river was relatively even with values of 0.72 and 0.77 respectively (Table 5). The downstream station of Madre Eustaquia river however showed the dominance of a particular taxa (*Melanoides sp.*), resulting a low evenness value 0.39. Evenness and diversity values in Quiapo River was zero since there was an

absence of any taxa or only 1 taxa was recorded. The downstream area revealed the lowest diversity measurement with 0.63 primarily because of the dominance of a gastropod belonging to family Thiariidae particularly the species *Melanooides* sp. The highest diversity measurement was observed in the upstream station of Madre Eustaquia River. It has been known that the type of substrata and pollution levels are important factors that determine the distribution of macrobenthic invertebrates found (Yap et al., 2003). In this survey, the pollution level as indicated by previous indices showed that Quiapo River is severely polluted while Madre Eustaquia River has relatively better condition but still impacted. Shannon – Weiner Index (H') accounts for both abundance and evenness of the taxa present in a community. It is expected to decrease with increasing disturbances (Plafkin et al, 1989). The resulting value is generally between 1.5 – 3.5 and exceeds 4.5 very rarely. The values above 3.0 indicate that the habitat structure is stable and balanced while values lower than 1.0 indicates pollution and degradation of habitat structure (Goncalves and Menezes, 2011).

Table 5. Diversity indices and importance values in waterways near Candelaria, Quezon during July 9, 2017 sampling

TAXA	Quiapo River					Madre Eustaquia		Grand	Imp
	Up	Mid	Mid	Down	Trib	Up	Down	Total	Values
Annelida		2						2	2.94
Oligochaeta		2						2	2.94
Arthropoda						3	5	8	11.76
Atyidae						2		2	2.94
Coenagrionidae							3	3	4.41
Gammaridea						1		1	1.47
Libellulidae							2	2	2.94
Chordata					6			6	8.82
Cichlidae					5			5	7.35
Gobiidae					1			1	1.47
Mollusca			2		1	9	40	52	76.47
Ampullariidae						1		1	1.47
Planorbidae							1	1	1.47
Sphaeriidae						1	1	2	2.94
Thiariidae			2		1	7	38	48	70.59
Grand Total	0	2	2	0	7	12	45	68	100
Richness	0	1	1	0	3	5	5		
Evenness	0	0	0	0	0.72	0.77	0.39		
Diversity	0	0	0	0	0.8	1.23	0.63		



Figure 9. Common macrobenthos found in waterways near Candelaria, Quezon during July 9, 2017 sampling. (A) Thiariidae (B) Sphaeriidae (C) Cichlidae (D) Atyidae (F) Oligochaete (G) Gammaridae



Figure 10: Plankton dominance distribution in seven sampling station in the Quiapo, Latian and Madre Eustaquia Rivers in Candelaria, Quezon; July 2017

4. Fish and Fisheries

The presence of species of fish was detected in only two stations where species richness and abundance was extremely low. A lone fisher along Latian tributary /Station 5; Figure 11), using an illegal 'electro-fishing' method was documented. The practice of fishing employing probes with electrical charges is strictly prohibited in the Fisheries Code of the Philippines and, in the case of Candelaria, is supported by the municipal fishery laws. The catch consisted of two native species – two specimens of "dalag" and a juvenile Tilapia over a fishing effort of more than two hours.

Neither fish nor fishers were encountered in all of the Quiapo river system and its tributary and Barangay officials confirmed that there are no fisheries practices – or goods and services in the Quiapo River due to its polluted nature. The absence of fish in a freshwater system like the Quiapo River is unusual as species of the *Channidae* and *Clariidae* families (native Dalag and Hito) are normally tolerant of spoiled conditions in muddy substrate. The absence of fish and crustacean species only confirm findings in the plankton study that the Quiapo River is heavily polluted that even hardy fish species are absent.

In spite of the absence of fisheries uses, key informants declare that some fish species still exist in the Madre Eustaquia and Latian Creeks (Table 6).



Figure 11: Location of actual fishing station in the Madre Eustaquia Creek in Candelaria, Quezon; 09 July 2017.

Table 5: Diversity of finfish and crustaceans existing in the Madre Eustaquia Creek near the northern boundary of the Steel Asia project site.

Family	Species Name	Local Name	Common Name
1. Gobiidae	<i>Glossogobius sp</i>	Biya	Goby
2. Anabantidae	<i>Anabas testudineus</i>	Puyo/Bakang	Gourami
3. Channidae	<i>Channa icropeltes</i>	Dalag	Snakehead
4. Palaemonidae	<i>Macrobrachium rosenbergii</i>	Ulang	Freshwater giant prawn
5. Tilapia	<i>Oreochromis sp</i>	Tilapia	Tilapia



Plate 8: Only two major species of fish (*Tilapia* and *Dalag*) were seen in the Madre Eustaquia Creek during the river ecology survey on 09-10 July 2017.

5. Commercially important macro-invertebrates in the Quiapo River

No species of macro-invertebrates of commercial importance for food or trade was catalogued in six of the seven stations where opportunistic surveys for macro-invertebrates were undertaken, specifically in the Quiapo River and its tributary. The findings support similar conclusions in the plankton community sampling where very poor, pollution-tolerant species of organisms were catalogued. Similarly, the macrobenthos sampling catalogued only isolated occurrence of a gastropod (Thiaridae) and a bivalve (Sphaeridae) in the Madre Eustaquia Creek and none in the Quiapo River system.

6. Threat to existence and/or loss of important local species and habitat

Summary of endemicity/conservation status

The absence of significant plankton, foodfish and macro-invertebrate diversity in all of the river systems investigated signify a highly deteriorated biological environment and any further threats to the integrity of the said bodies of water is insignificant as there are minimal populations of fish and shellfish whose growth, reproduction and recruitment can be threatened. Prevention of further degradation should be emphasized in the Madre Eustaquia Creek as this is the only freshwater body in the project area that is still in relatively good condition and is being used for various domestic purposes, including bathing and drinking. The freshwater prawn documented in the sampling site in this creek is of high conservation value, although they are not reported as endemic, threatened and endangered. If propagated to a viable population, this species is of important commercial value for food and trade. Endemic mudfishes and catfishes were not reported to occur in the river system.

Abundance of ecologically and economically important species (fishes, benthos, planktons)

The *Tilapia* and *Dalag*, as well as to species of macro-invertebrate shellfish existing in the Madre Eustaquia creek are valuable food fishes but most are of juvenile sizes, indicating growth overfishing most probably caused by extensive use of electro-fishing in previous years and current pollution loads. The low species density and abundance is indicative of a deteriorating habitat condition. The extremely polluted nature of the Quiapo River has caused the absence of standing stocks of fish of any species. Similarly, the low number of plankton species and taxa identified in the plankton surveys is indicative of low diversity and unfavorable environmental conditions.

7. Presence of pollution indicators species

There are no species of fish and shellfish that can be employed as bio-indicators of biotoxin pollution.

On the other hand, plankton blooms are used as indicators of hyper-organic nutrient loading and extreme pollution leading to episodes of oxygen depletion and fish kills. The pollution tolerant genera observed in this survey include *Leponcinclis*, *Scendesmus* and *Oscillatoria*. Blooms of these genera have been recorded to block canals and clog filters especially in water treatment facilities and small riparian systems. However, the present plankton survey did not reveal the presence of any of the HAB-causing species in excessive densities and plankton abundance was catalogued as 'poor'. Drawing from overall diversity, richness and total abundance, the Quiapo river has very poor biodiversity and species richness with presence of pollution tolerant genera like *Oscillatoria* indicating a highly polluted river. The diatom *Fragillaria*, on the other hand, forms an important component of the food chain, especially in the production of primary organic material. Excessive diatom blooms, however, are known to cause eutrophic conditions and the current condition of the Quiapo River can trigger such blooms. Similarly, it is important to note that zooplankton community in seven sampling stations revealed only six taxa, indicating low abundance and diversity. The potential threat/impacts of additional anthropogenic pollution would be insignificant.

Epibenthic fauna (macroinvertebrates 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. Macro-invertebrates are good integrators of environmental conditions over time and can be used as indicators of heavy metal pollution, especially sessile, filter-feeding macro-invertebrates. However, no significant population of bivalves have been observed in the Madre Eustaquia River and were completely absent in the Quiapo River and its tributary.

8. Overall impacts of the project on the freshwater ecology

Degradation of freshwater quality of the Madre Eustaquia Creek.

In situ water ecological data obtained from the survey of the seven stations at the vicinity of the project site suggest that except for the Madre Eustaquia creek, the major river systems around the project site are already unsuitable for survival of aquatic biota.

Along this line it is important that protection of the integrity, and in fact promotion of improvement and maintenance of its water quality, be pursued.

Sediments carried down from soil erosion and earth moving due to construction-related activities such as land clearing activities and stock piles may end up as runoff to nearby sections of Madre Eustaquia creek, especially during storm and heavy rains. This may adversely cause water turbidity and stream flow obstruction and affect plankton and the remaining macrobenthos fauna. Sediment erosion in freshwater bodies can cause localized mortality of aquatic larval forms of bivalves and gastropods, as well as impair nesting grounds of Tilapia. Siltation may increase water turbidity, resulting in decreased light penetration and a decrease in photosynthetic function of primary producers such as phytoplankton and benthic algae.

Degradation of Water Quality from Wastes

Poorly-managed waste disposal and dust accumulation can lead to contaminants infiltration of various waste streams generated during construction, as well as domestic wastes generated in all phases of project development. This may adversely affect water and sediment quality in the Madre Eustaquia creek and exacerbate an already sluggish stream flow in the Quiapo River. Further water quality degradation may affect abundance and survival of zooplankton, macrobenthos and fish.

9. Mitigating measures

To minimize or prevent degradation of the Madre Eustaquia Creek, the following measures will be adopted:

- 9.1 Engineered drainage systems which will include siltation ponds, stabilization of gullies and construction of run-off weirs at desirable distances along and within the existing gullies will be instituted in order to prevent sediment streams from reaching any freshwater river systems;
- 9.2 No part of the river or creek will be blocked and the project will ensure fluid discharge along the intake point;
- 9.3 Construction stockpiles shall be covered and rigidly bundled;
- 9.4 Vehicles carrying construction materials shall be covered and speed limits will be imposed.
- 9.5 Drainage canals shall be engineered to trap and prevent sediment from being washed into nearby freshwater bodies of water, especially the Madre Eustaquia creek;
- 9.6 A sound wastewater and solid waste management plan will be implemented and strictly enforced as mitigation to potential waste disturbances.
- 9.7 Regular *in-situ* monitoring of water quality and aquatic fauna will be conducted.

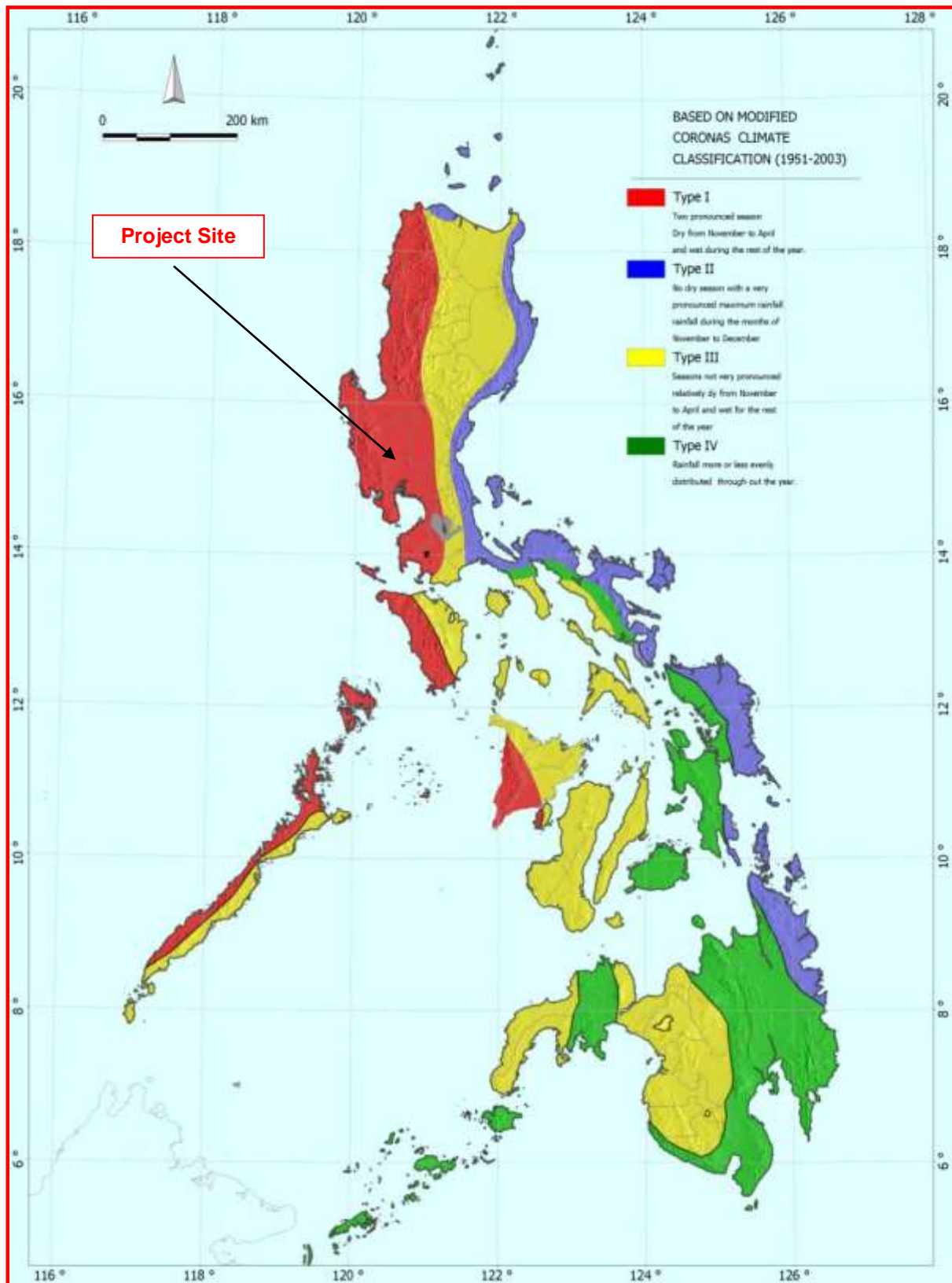
2.3 The Air

2.3.1 Climatology and Meteorology

Local Climate

The climate of the Philippines is influenced by the complex interaction of various factors such as: geography and topography; ocean currents; principal air stream; linear systems as intertropical convergence zone; and tropical cyclones which are classified as tropical depression, tropical storm or typhoon.

Based on the Modified Coronas Climate Classification of Philippine Climate (Figure 2.3-1), the climate at the proposed project falls under Type III where seasons not very pronounced relatively dry from November to April and wet for the rest of the year.



Source: PAGASA

Figure 2.3-1. Philippine Climate Map

Meteorology

The meteorological considerations at the Project site were described using the meteorological data from PAGASA Tayabas Synoptic Station located in Tayabas City, Quezon Province at coordinates 14°00'53.11" N; 121°36'7.59" E; which is approximately 22 aerial kilometer northeast of the project site.

Meteorological data recorded in Tayabas 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, g) vapor pressure, h) relative humidity, i) barometric pressure, j) cloud cover, and k) number of days with thunderstorm and lighting.

Impacts to the local climate at the proposed site were done by analyzing trends of relevant parameters like temperature, rainfall, and relative humidity. Table below shows the recorded meteorological data in Tayabas Station.

Table 2.3-1. Meteorological Data Recorded at Tayabas 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	163	18	27.7	21.9	24.8	24.2	22.5	21.8	86	N	2
February	111.4	13	28.5	22	25.3	24.6	22.7	21.9	85	NE	2
March	111.4	10	30	22.8	26.4	25.7	23.6	22.8	84	NE	2
April	109.5	9	31.8	23.8	27.8	27.2	24.6	23.7	81	NE	1
May	161.2	10	32.4	24.2	28.3	27.6	25.1	24.2	82	NE	1
June	225.5	15	31.7	24	27.9	27.3	25.1	24.3	84	S	1
July	273.8	18	31	23.6	27.3	26.8	24.8	24.1	85	SW	1
August	185.1	17	31.1	23.6	27.4	26.7	24.7	24	85	SW	1
September	274.2	18	30.9	23.3	27.1	26.5	24.6	23.9	86	SW	1
October	494.1	22	30.2	23.4	26.8	26.2	24.4	23.7	86	N	1
November	529.7	23	29.3	23.3	26.3	25.7	24	23.4	87	N	2
December	421	22	27.9	22.4	25.1	24.5	22.9	22.2	87	N	2
Annual	3055.8	198	30.2	23.2	26.7	26.1	24.1	23.3	85	N	1

Source: PAGASA Tayabas Station Climatological Normals 1981-2010

Rainfall

The project area receives an annual mean rainfall of 3055.8 mm with 198 rainy days for the period 1981-2010 (Table 2.3-1) as shown in the table above. The heaviest precipitation occurred in the month of November with an average of 529.7 mm while February and March are the driest months with 111.4 mm.

The typhoon season normally occurs between May to November and usually coincides with the onset of the southwest monsoon rains. The rainfall in Quezon has a very distinct monthly pattern (Figure 2.3-2) based from the 30-year record in PAGASA Tayabas Station. Heavy rain has been known to occur, usually between May to December with maximum period from July to December causing flooding in low lying areas.

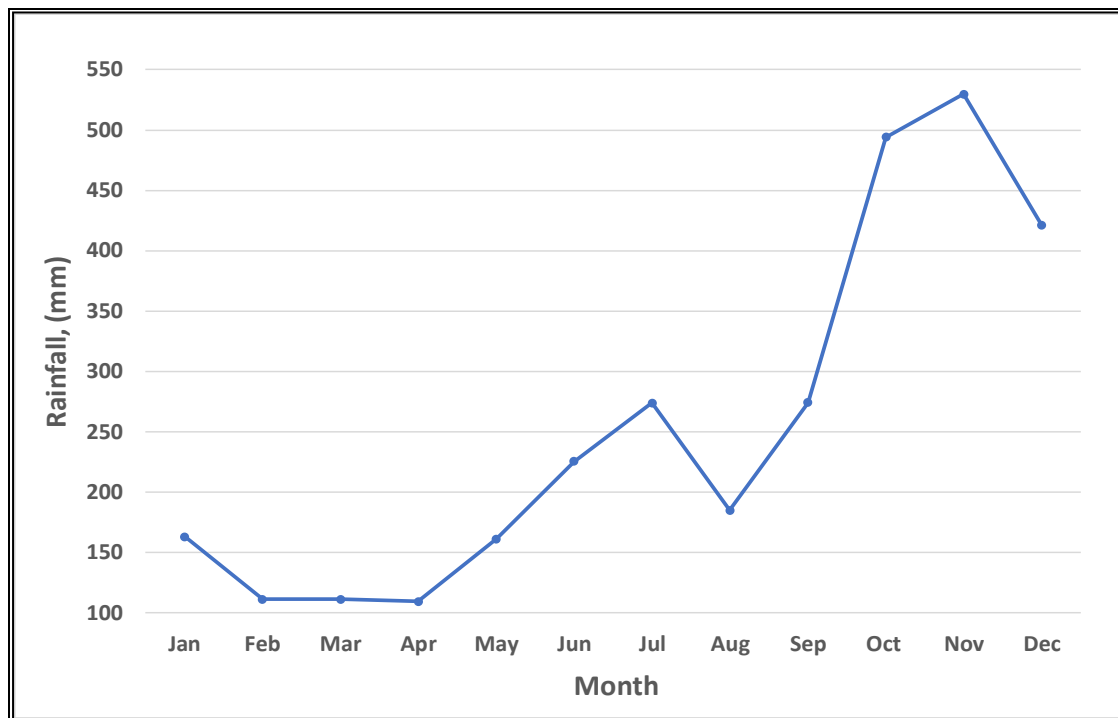


Figure 2.3-2. Monthly Rainfall PAGASA Tayabas Station

Temperature

The average monthly temperature of Quezon tends to decrease during wet season based on the data from Tayabas Station (Table 2.3-1). January being the coldest month having a mean temperature of 24.8°C while the month of May is the warmest with a mean temperature of 28.3°C. The mean annual average temperature is 26.7°C.

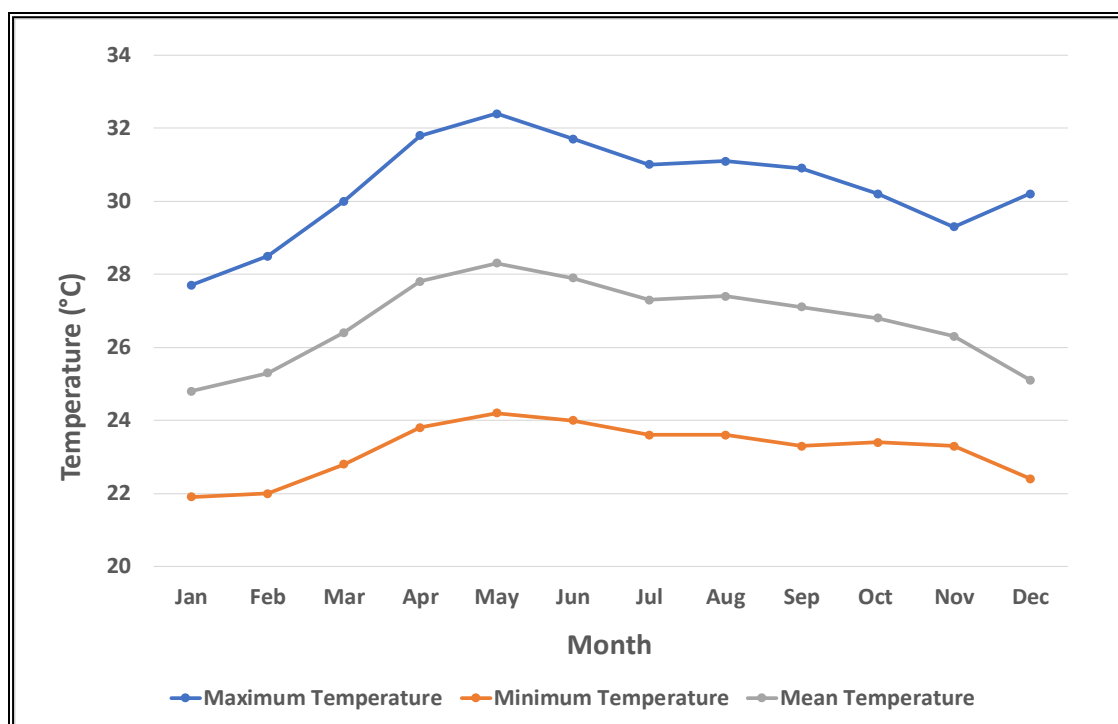


Figure 2.3-3. Monthly Temperature Tayabas Station
Relative Humidity

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 Tayabas Station are 26.1°C and 24.1°C, respectively. This translate to annual average relative humidity of 85% with November and December are the most humid months having an average relative humidity of 87% while the month of April is the least humid at 81% (Table 2.3-1).

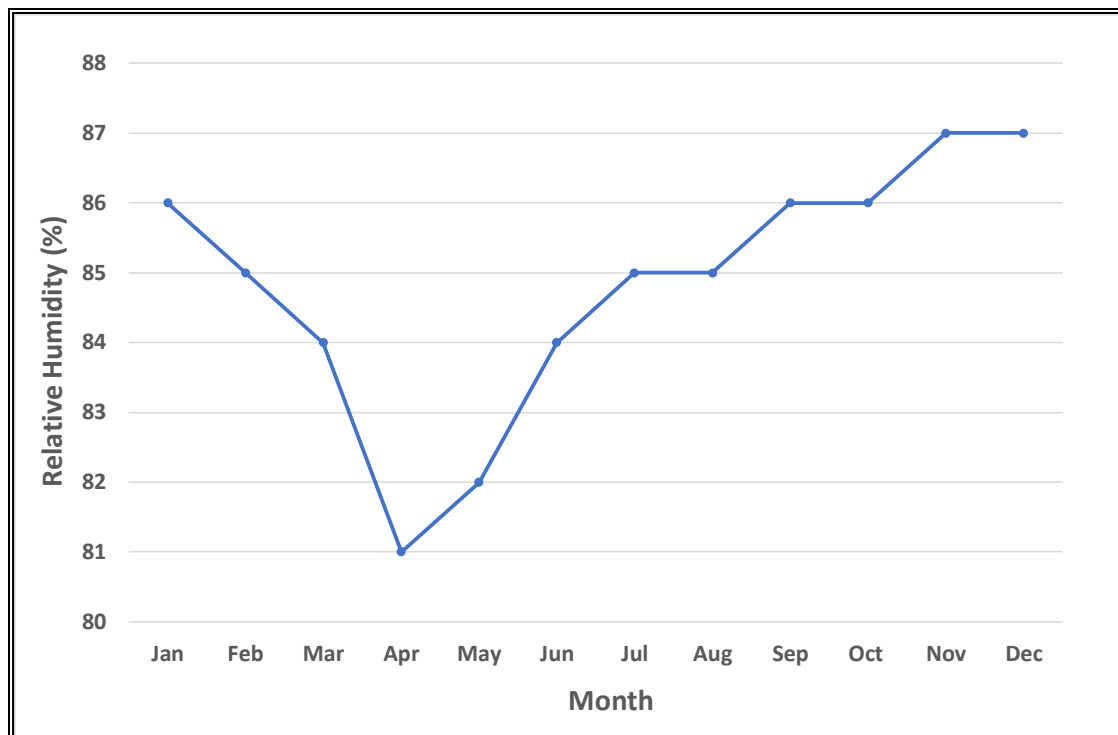


Figure 2.3-4. Monthly Relative Humidity PAGASA Tayabas Station

Wind Regime

The annual wind rose for Tayabas Station from January 1 – December 31, 2017 is provided in the figure below (Figure 2.3-5). The wind roses indicate that there is a prevailing wind direction from northeast and lighter winds from southwest. The average windspeed is 2.73 m/s while calm condition is 0.0%.

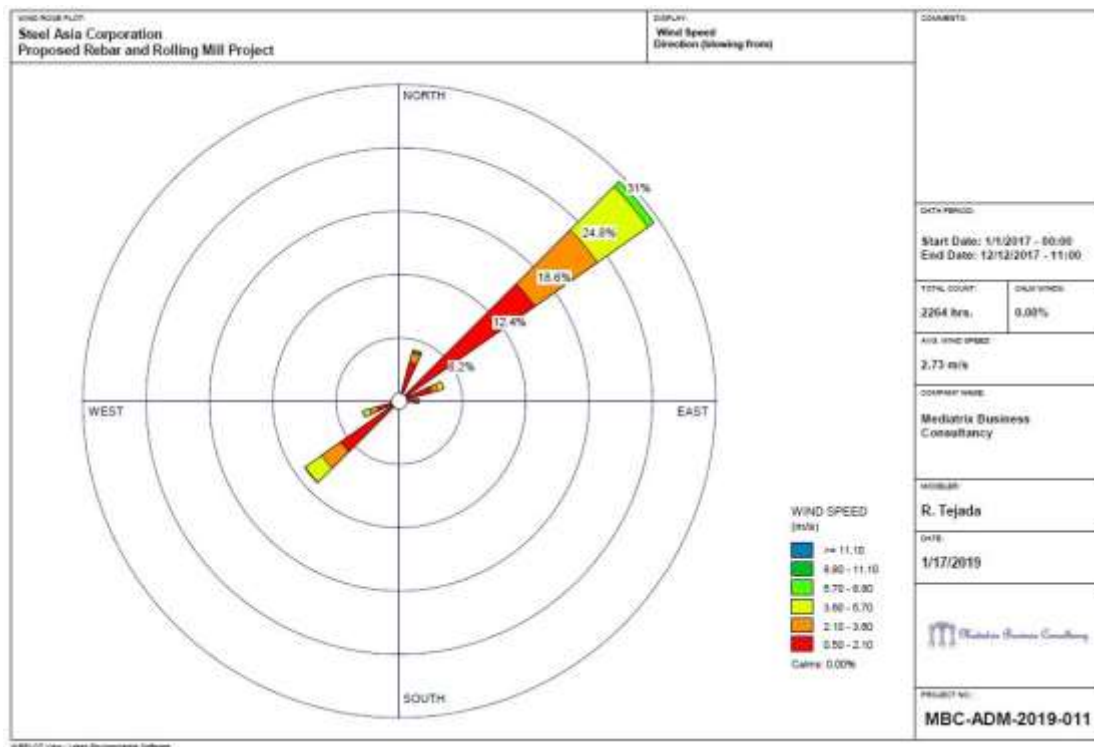


Figure 2.3-5. Windrose Diagram PAGASA Tayabas Station

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 occur 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 tropical depressions (TD), with wind speeds up to 63 kph; tropical storm (TS) with wind speeds from 64-117 kph, and tropical typhoon (TY), with wind speeds over 117 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 30-60 kph are expected within the next 36 hours
- PSWS No. 2 – tropical cyclone winds of 61-120 kph are expected within the next 24 hours
- PSWS No.3 – tropical cyclone winds of 121-170 kph are expected within the next 18 hours
- PSWS No. 4 – tropical cyclone winds of 171-220 kph are expected within the next 12 hours
- PSWS No. 5 – tropical cyclone winds of more than 220 kph are expected within 12 hours

The PAGASA had tracked 94 tropical cyclones that crossed in the province of Quezon from 1948-2016 which gives an average of 1-2 tropical cyclones per year. There was no recorded severe tropical storm and super typhoon that enter in the province of Quezon. Figure 2.3-6 is the track of tropical cyclone that crossed the province of Quezon while Figure 2.3-7 is the monthly distribution of tropical cyclone.

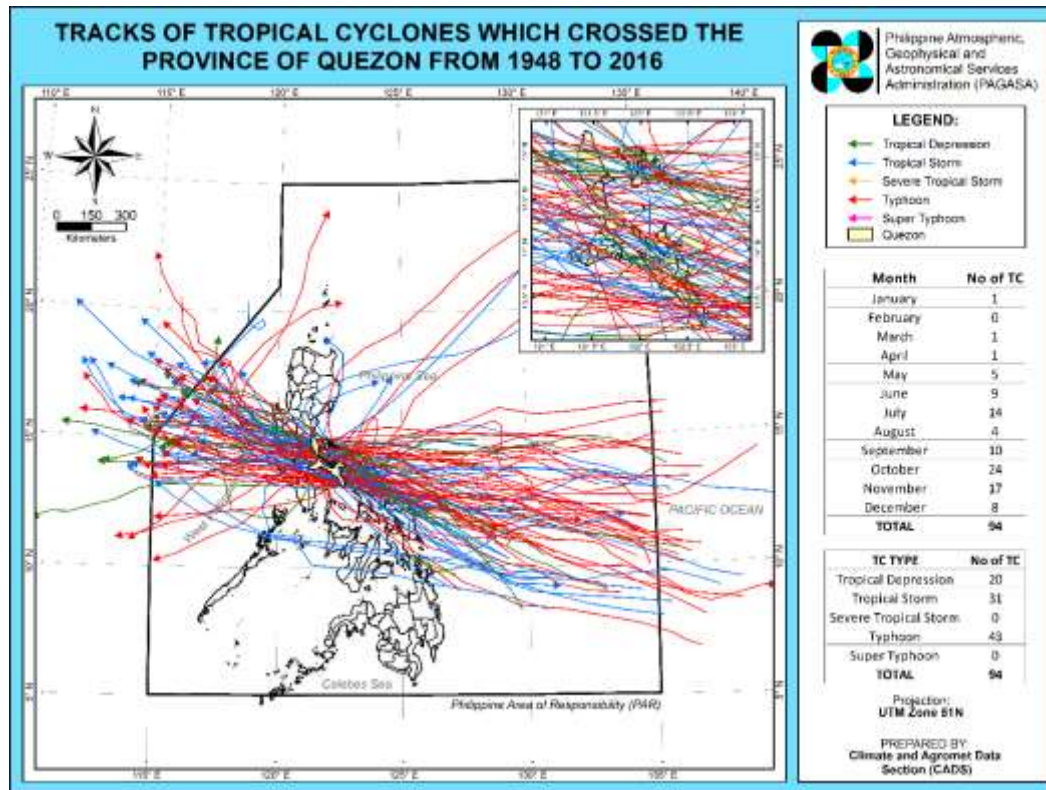


Figure 2.3-6. Track of Tropical Cyclone in Quezon

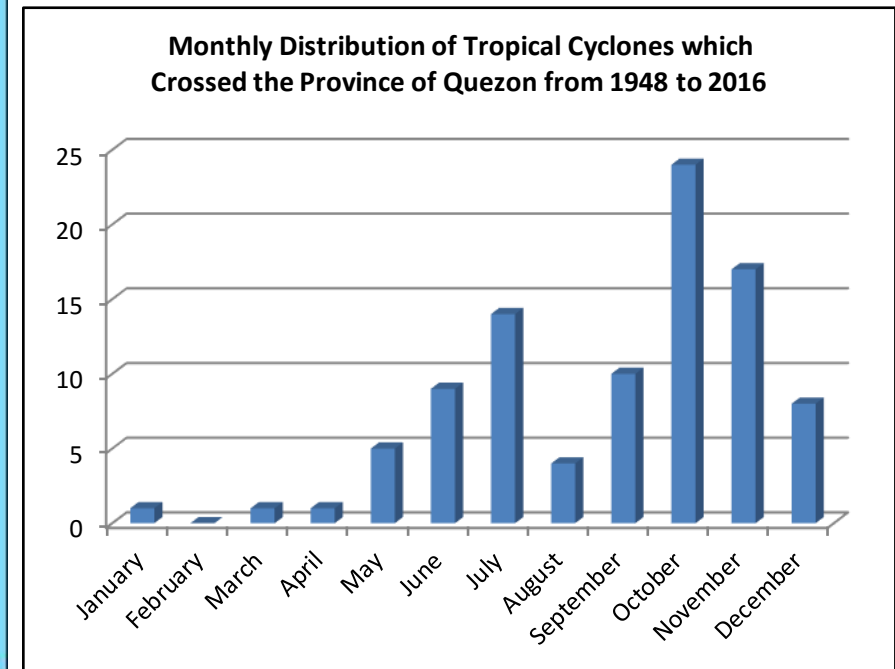


Figure 2.3-7. Monthly Distribution of Tropical Cyclone in Quezon

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 recorded annual extreme high temperature is 36.0°C occurred in April 12, 1990 and May 14, 1987 while extreme low temperature is 16.8°C occurred in February 2, 1982. The amount of annual average extreme greatest rainfall is 557.7 mm occurred in May 21, 1976 while the annual average extreme highest wind is 40 meters per second northerly direction occurred in May 5, 1993.

Table 2.3-2. Climatological Extreme Recorded at Tayabas Station as of 2016

Month	Temperature (°C)				Greatest Daily RF (mm)		Strongest Winds (m/s)		
	High	Date	Low	Date	Amount	Date	Speed	Dir	Date
Jan	32.0	01-22-1988	17.5	01-20-1976	78.3	01-11-2013	17	NE	01-13-2000
	32.0	01-23-2016							
Feb	32.5	02-25-2005	16.8	02-02-1982	137.2	02-21-2013	21	N	02-22-1977
Mar	33.5	03-31-1983	17.9	03-05-1972	138.9	03-24-1980	15	NE	03-27-1994
Apr	36.0	04-12-1990	18.3	04-14-1971	196.0	04-29-2009	13	NE	04-21-1976
May	36.0	05-14-1987	20.6	05-26-1971	557.7	05-21-1976	23	SE	05-26-1971
Jun	35.5	06-06-1993	21.0	06-23-2012	182.4	06-29-2013	30	N	06-21-2008
Jul	34.6	07-24-2007	18.9	07-27-1971	254.0	07-14-1983	36	W	07-14-1983
Aug	35.6	08-27-1983	19.3	08-11-1971	126.5	08-12-1987	19	WS	08-20-2015
	35.6	08-11-2014							
Sep	35.0	09-16-2006	19.4	09-12-1971	209.3	09-30-1995	35	S	09-28-2006
	35.0	09-03-2016							
Oct	35.0	10-16-1976	19.4	10-01-1976	306.2	10-13-1970	26	NW	10-26-1978
Nov	33.2	11-03-2003	18.6	11-22-1975	359.7	11-06-1981	30	SW	11-03-1995
Dec	32.4	12-01-2005	18.7	12-15-1981	289.1	12-05-2005	40	N	12-05-1993
Annual	36.0	04-12-1990	16.8	02-02-1982	557.7	05-21-1976	40	N	12-05-1993
	36.0	05-14-1987							

Source: PAGASA Tayabas Station Climatological Extremes as of 2016

2.3.1.1 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.

Methodology

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**

Results and Analysis

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	1. Mobile combustion Emissions from fuel use of contracted vehicles (e.g. service vans)

	purchased construction materials/ construction wastes using contracted vehicles (e.g. trucks, pickup)	
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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 kilometres 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 the table below 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 15,000 km distance travelled;
 50-units Truck with 20,000 km distance travelled;
 20-units Pick-up with 25,000 km distance travelled; and
 20-units Service Van with 30,000 km distance travelled.

The total CO₂ emissions during construction are estimated at 60.03 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	15,000	4,740	2.7	12.80
30-tonner Truck	50	Diesel	20.9	20,000	4,180	2.7	11.29
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							60.03

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

b – Emission Factors for Greenhouse Gas Inventories USEPA

CO₂ Emissions during Construction and Plant Operation from Electricity Purchased

The indirect CO₂ emission during construction and plant operation is calculated under Scope 2 emissions which is electricity consumed through purchased. The electricity consumption during project construction and plant operation was estimated at 2 MWh/mo. And 16,000 MWh/mo., respectively. The assumption is based on the daily power requirements of construction equipment and operational electricity requirements. 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 96,455.73 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
Operation	192,000	96,455.73
Total CO ₂ Emission		96,456.94

(c) 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 2.3-6 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 2.3-6. 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 Philippines Second National Communication (SNC) on Climate Change has projected 100,402,000 MT of CO₂ for 2020. Using the projection of SNC, the Project is expected to contribute approximately 0.000061% during the construction phase and approximately 0.131% during the operation phase. The 0.000061% of the CO₂ emission is equivalent to 37MT/year during construction phase and 78,600 MT/year during the operation phase at a rate of 600,000MT/year production capacity.

With the calculated CO₂ emissions of the Project, it can still be considered to be on the low-end greenhouse gas emitters.

2.3.1.2 Climate Risk/Climate Change

(1) Change in Local Climate

The PAGASA stated that future climate changes in the Philippines are likely in terms of trends in seasonal values of temperature, rainfall and extreme events.

(a) Temperature Change

The Province of Quezon 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 0.9°C to 1.1°C in the average temperature baseline data in 2020 and an increase of 1.8°C to 2.1°C in 2050.

Table 2.3-7 and Table 2.3-8 show the seasonal temperature increase and projected seasonal mean temperature in 2020 and 2050 under medium range emission scenario in the Province of Quezon. Figure 2.3-8 and Figure 2.3-9 show the graphical presentation of the monthly average temperature change from 2006 to 2035 and from 2036-2050, respectively.

Table 2.3-7. Seasonal Temperature Increase (in °C) in 2020 and 2050 under Medium Range Emission Scenario in the Province of Quezon

Provinc	Observed	Baseline	Change in 2020 (2006-	Change in 2050 (2036-
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e	(1971-2000)				2035)				2065)			
	DJF	MA M	JJA	SO N	DJ F	MA M	JJ A	SO N	DJ F	MA M	JJ A	SO N
Quezon	25.1	27.2	27.6	26.7	0.9	1.1	1.0	0.9	1.8	2.1	2.0	1.8

Based on the calculated temperature projections, the project site may experience temperature rise up to 28.6°C covering the period of 2006-2035 and 29.6°C covering the period of 2036-2065 (Table 2.3-8). This temperature increase may affect the plant operation by decreasing power output due to the heat transfer efficiency of the air-cooling system. The Project considers the temperature increase for 2020 and 2050 in their plant design. The selection of design temperature reflects an optimization, operational and capital costs based on historical conditions.

Table 2.3-8. Projected Seasonal Mean Temperature in 2020 and 2050 under Medium Range Emission Scenario in the Province of Quezon

Quarter	DJF	MAM	JJA	SON
Observed Baseline (1971-2000)				
Mean	25.1	27.2	27.6	26.7
With Climate Change Scenario (2006-2035)				
Mean	26.0	28.3	28.6	27.6
With Climate Change Scenario (2036-2065)				
Mean	26.9	29.3	29.6	28.5

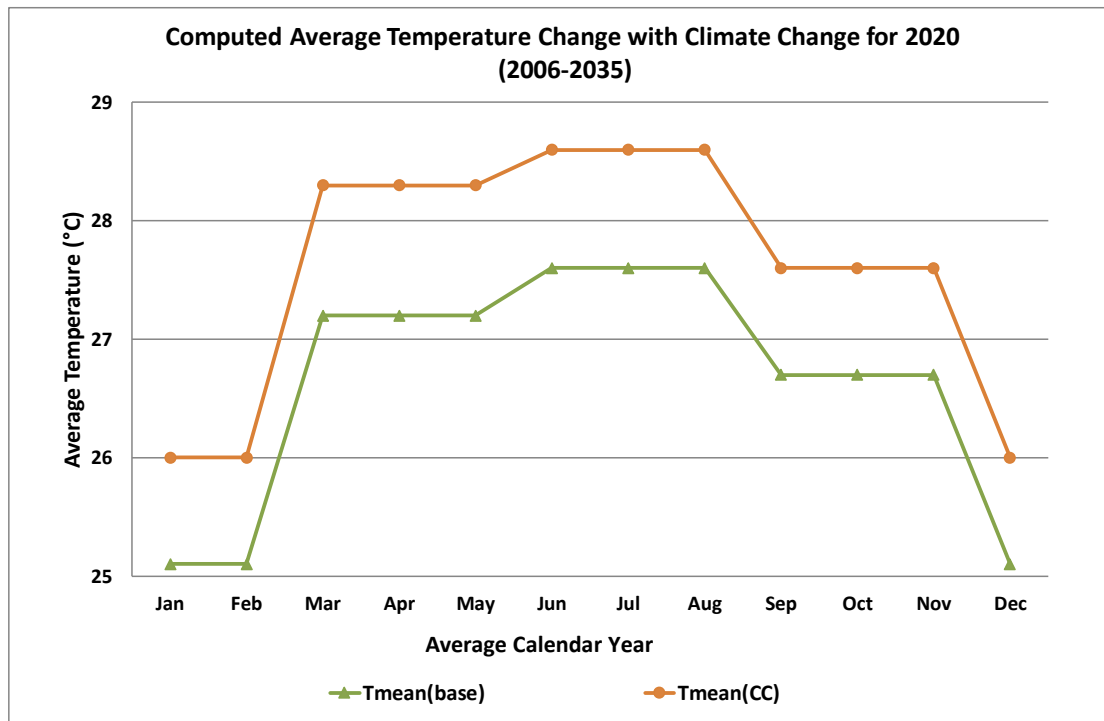


Figure 2.3-8. Change in Monthly Average Temperature for the Period 2006-2035

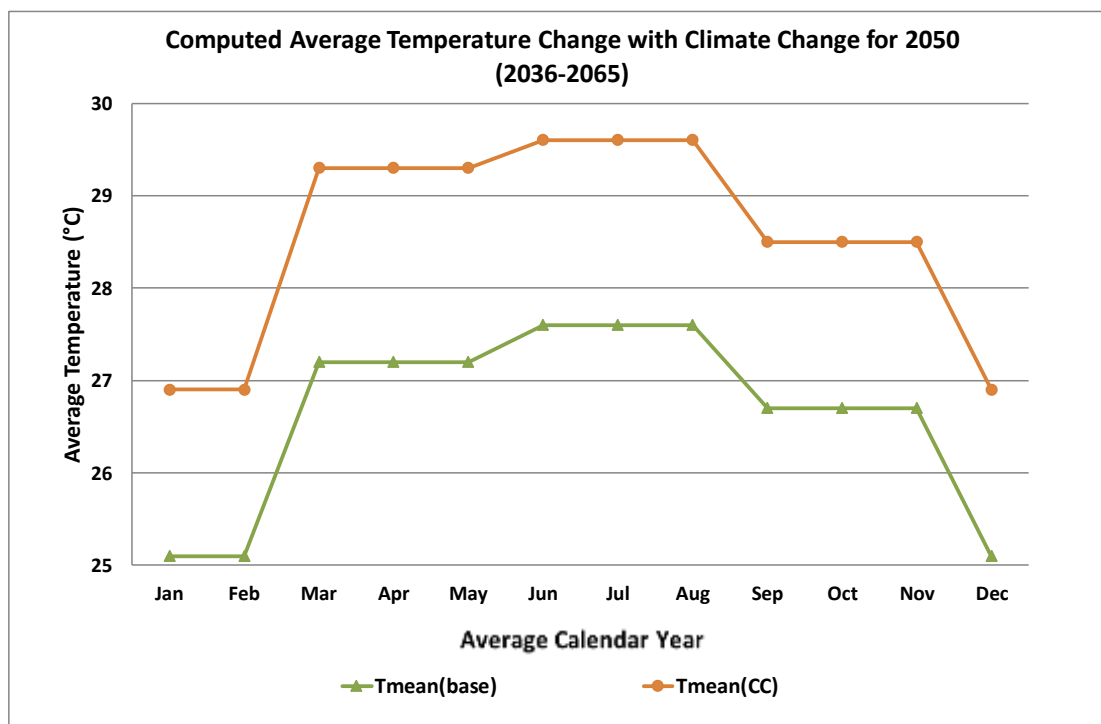


Figure 2.3-9. Change in Monthly Average Temperature for the Period 2036-2065

(b) Rainfall Change

The seasonal rainfall change under medium range scenario showed a decrease and increase in 2020 and 2050 in the Province of Quezon presented in Table 2.3-9.

Table 2.3-9. Seasonal Rainfall Change (in %) in 2020 and 2050 under Medium Range Emission Scenario in the Province of Quezon

Province	Observed Baseline (1971-2000)				Change in 2020 (2006-2035)				Change in 2050 (2036-2065)			
	DJF	MA M	JJA	SON	DJ F	MA M	JJ A	SO N	DJ F	MA M	JJ A	SO N
Quezon	827.7	382.7	670.0	1229.3	-6.5	-18.6	2.9	5.2	6.6	-20.6	6.5	0.9

The months of December to February and March to May has a projected rainfall decrease of 6.5% and 18.6%, respectively while a 2.9% increase for the months of July to August and 5.2% increase for the months of September to November in 2020. Similarly, the 2050 projection has an increase of 6.6% for the months of December to February; 6.5% for the months of July to August; and 0.9% for the months of September to November while a decrease of 20.6% for the months of March to May. With these projections, the project site may experience a rainfall increase in the months of July to November and a rainfall decrease in the months of December to May. These changes in the rainfall pattern will be included in the design criteria of the Project. Design improvement of the internal drainage system will be

considered to accommodate storm water run-off that will be collected in water harvesting facility of the plant based on the PAGASA projection.

Table 2.3-10. Projected Seasonal Mean Rainfall in 2020 and 2050 under Medium Range Emission Scenario in the Province of Quezon

Quarter	DJF	MAM	JJA	SON
Observed Baseline (1971-2000)				
Mean	827.7	382.7	670.0	1229.3
With Climate Change Scenario (2006-2035)				
Mean	773.9	311.5	689.4	1293.2
With Climate Change Scenario (2036-2065)				
Mean	882.3	303.9	713.6	1240.4

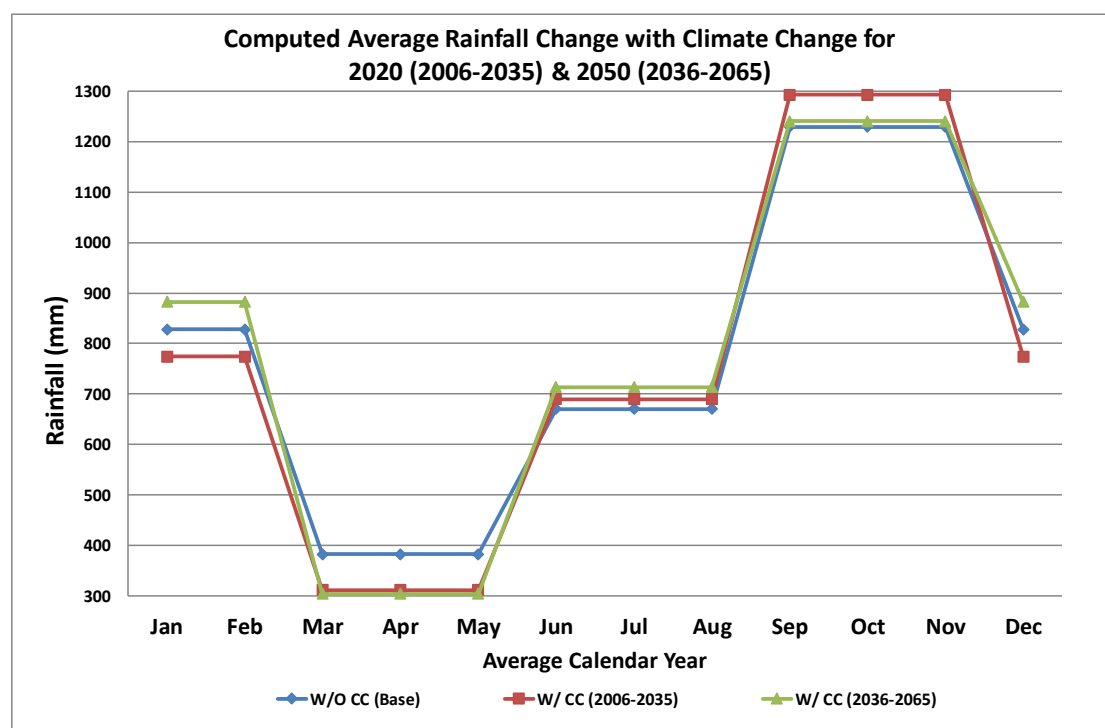


Figure 2.3-10. Projected Seasonal Mean Rainfall Change in 2020 and 2050

(2) Frequency of Extreme Weather Events

Table below shows the projected occurrences of extreme weather events in Tayabas Quezon under the medium-range scenario. Tayabs will have 791 and 1434 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 both 2020 and 2050. The number of days with daily rainfall greater than 200 mm is also decrease in 2020 and 2050 by 53% and 71%, respectively.

Table 2.3-11. Frequency of Extreme Events in 2020 and 2050 under Medium Range Emission Scenario in the Province of Quezon

Province	Station	No. of days w/ Tmax >35°C	No. of Dry Days	No. of Days w/ Rainfall >200mm
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		OBS (1971- 2000)	2020	2050	OBS	2020	2050	OBS	2020	2050
Quezon	Tayabas	22	791	1434	6771	4717	4668	17	9	12

2.3.1.3 Impact Identification, Prediction and Assessment, and Mitigation

(1) Pre-Construction and Construction Phase

(a) Change in Local Climate

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.

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.

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.

(b) Contribution in Terms of Greenhouse Gas Emissions

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.

(2) Operation Phase

(a) Change in Local Climate

The Project will consider the temperature increase for 2020 and 2050 in their plant design. The selection of the design temperature reflects an optimization of plant productivity, operational and capital costs based on historical conditions.

The changes in the rainfall pattern will be included in the design criteria of the Project. Design improvement of the internal drainage system will be considered to accommodate storm water run-off that will be collected in water harvesting facility of the plant based on the PAGASA projection.

(b) Contribution in Terms of Greenhouse Gas Emissions

Project 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.

2.3.2 Air Quality and Noise

2.3.2.1 Ambient Air Quality

(1) Field Survey

An ambient air quality monitoring was conducted to in six (6) sampling locations within the project site and its vicinity. Two (2) monitoring stations were identified for 24-hour averaging period while four (4) stations for 1-hour averaging period. These stations are located in the downwind and upwind of the prevailing wind direction of the project site. The locations of the monitoring stations are described in Table 2.3-12 and shown in Figure 2.3-11.

The ambient air quality monitoring was conducted on April 1-3, 2018. 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 are TSP, PM₁₀, PM_{2.5}, 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 1-hour and 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 Greentech Laboratory to analysed TSP gravimetrically. The concentrations of TSP 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.

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 analysed 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 midget 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 2.3-12. Ambient Air Quality Monitoring Stations, Description, Coordinates, Date and Time of Sampling

Sampling Station	Description	Coordinates	
		Easting (m)	Northing (m)
AAQ-1	At the compound of Malabanban Sur Barangay Hall, Candelaria	330632.02	1539402.42
AAQ-2	Beside the house of Kagawad Dennis Zamora, Purok 3, Brgy. Malabanban Sur Candelaria	329839.18	1537989.67
AAQ-3	Beside San Andres Elementary School, approximately 50 meters from the main gate	331875.17	1538307.89
AAQ-4	Beside the house of Wilfredo Milano, Brgy. Sta. Catalina Sur Candelaria	331313.65	1536407.71
AAQ-5	Beside the house of Josefina Lenator at Sitio Lanzonesan, Sta Catalina Norte Candelaria	328995.88	1536992.45
AAQ-6	Beside the house of Efren Pitargue, Bukayo St., Pahinga 1, Candelaria	329555.51	1538900.30



Figure 2.3-11. Map of Ambient Air Quality Monitoring Station

(2) Criteria Assessment of Ambient Air Quality

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 2.3-13. 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	-

(3) Results and Analysis

Table 2.3-14 and Table 2.3-15 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, PM₁₀, & PM_{2.5}), 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 2.3-14 Results of 24-hour Ambient Air Quality Monitoring

Items Sampling Station Date of Sampling Time of Sampling	Description/Values		
	AAQ-1 August 9-10, 2016 1330H-1330H	AAQ-2 August 10-11, 2016 1620H-1620H	CAA Limit (µg/Ncm)
TSP, (µg/Ncm)	22	20	230
PM ₁₀ , (µg/Ncm)	13	11	150
PM _{2.5} , (µg/Ncm)	6	5	50
SO ₂ , (µg/Ncm)	9	8	180
NO ₂ , (µg/Ncm)	5	5	150

Table 2.3-15 Results of hourly Ambient Air Quality Monitoring

Items Sampling Station Date of Sampling Time of Sampling	Description/Values				
	AAQ-3 August 12, 2016 0915H- 1015H	AAQ-4 August 12, 2016 1115H- 1150H	AAQ-5 August 12, 2016 1500H- 1600H	AAQ-6 August 12, 2016 1725H- 1825H	CAA Limit (µg/Ncm)
TSP, (µg/Ncm)	26	23	29	32	300
PM ₁₀ , (µg/Ncm)	15	12	17	17	200
PM _{2.5} , (µg/Ncm)	11	11	12	14	-
SO ₂ , (µg/Ncm)	10	11	11	13	340
NO ₂ , (µg/Ncm)	6	6	8	8	260

Results per Parameters

Results of analysis for each parameter were graphed (Figures 12-16) showing its relative concentration levels at the six (6) sampling stations. Brief discussions were made comparing the results across the sampling stations and against relevant CAA limit.

Total Suspended Particulates (TSP)

Figure 2.3-11 shows the graphical presentation of the concentration levels of TSP in six (6) sampling stations. As shown, the highest concentration of TSP is 29 µg/Ncm recorded at Station 5, while the lowest concentration is 20 µg/Ncm recorded at Station 2. None in the monitoring stations exceeded the CAA limit for TSP.

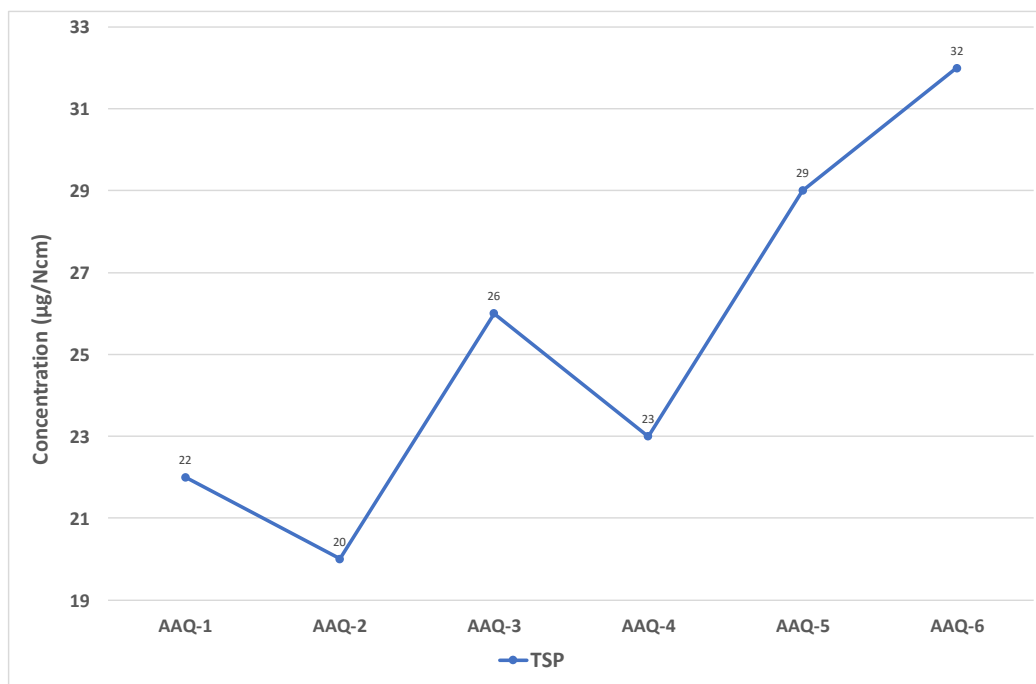


Figure 2.3-12. TSP Concentration at Six (6) Sampling Stations

Particulate Matter less than 10-microns (PM₁₀)

Figure 2.3-12 shows the graphical presentation of the concentration levels of PM₁₀ in six (6) sampling stations. As shown, the highest concentration of PM₁₀ is 17 µg/Ncm recorded at Stations 5 & 6 while the lowest concentration is 11 µg/Ncm recorded at Station 2. None in the monitoring stations exceeded the CAA limit for PM₁₀.

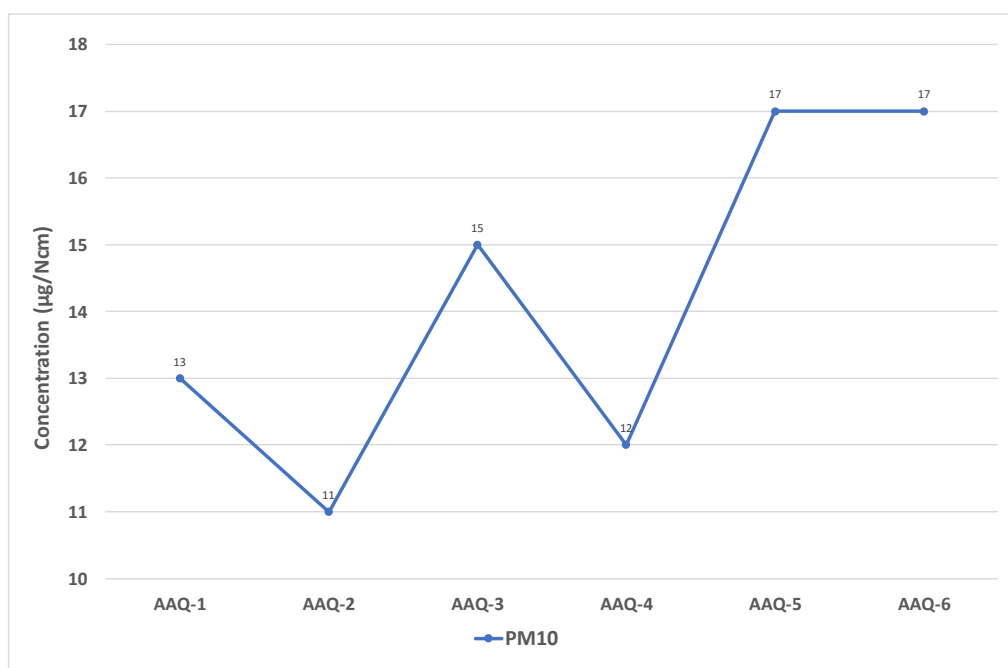


Figure 2.3-13. PM₁₀ Concentration at Six (6) Sampling Stations

Particulate Matter less than 2.5-microns (PM_{2.5})

Figure 2.3-12 shows the graphical presentation of the concentration levels of PM_{2.5} in six (6) sampling stations. As shown, the highest concentration of PM_{2.5} is 14 µg/Ncm recorded at Station 6 while the lowest concentration is 5 µg/Ncm recorded at Station 2. None in the monitoring stations exceeded the CAA limit for PM₁₀.

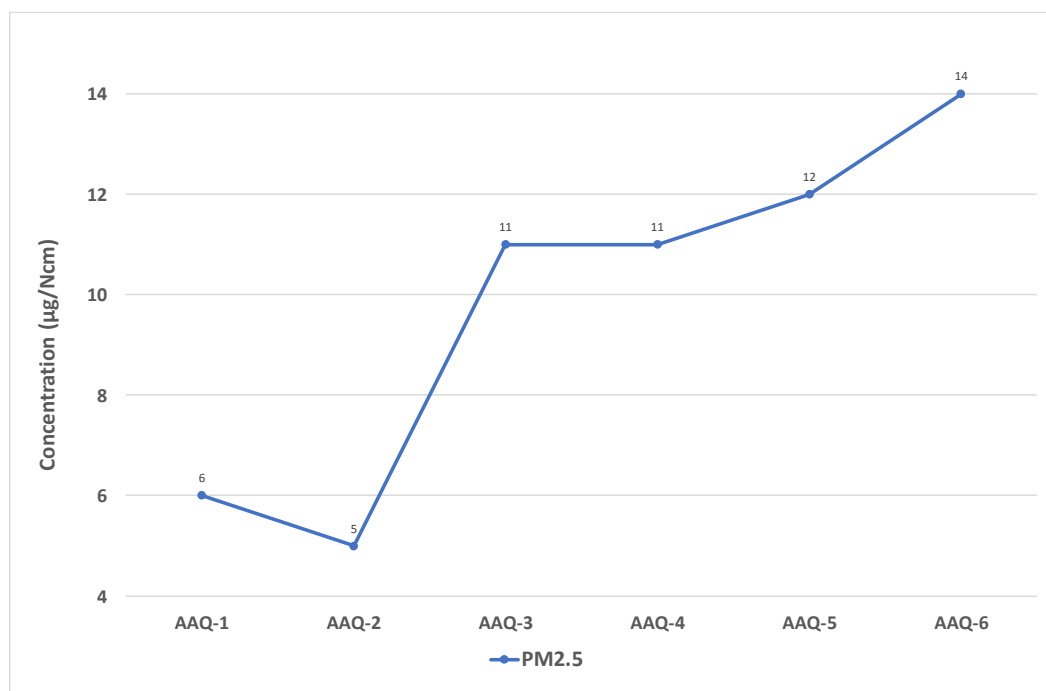


Figure 2.3-14. PM_{2.5} Concentration at Six (6) Sampling Stations

Sulfur Dioxide (SO₂)

Figure 2.3-13 shows the graphical presentation of the concentration levels of SO₂ in six (6) sampling stations. As shown, the highest concentration of SO₂ is 13 µg/Ncm recorded at Station 6 while the lowest concentration is 8 µg/Ncm recorded at Station 2. None in the monitoring stations exceeded the CAA limit for SO₂.

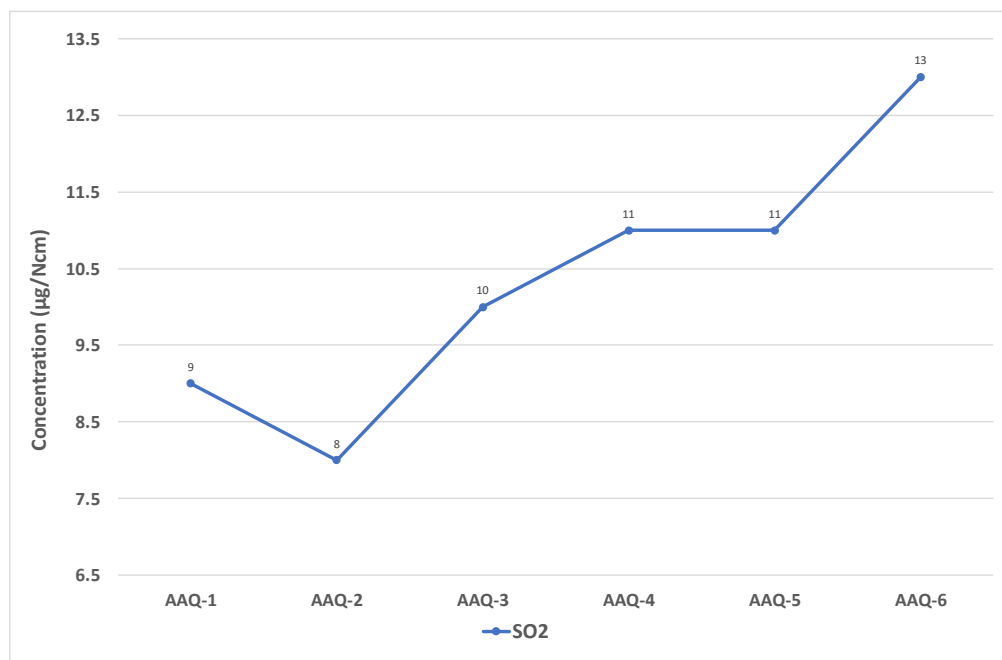


Figure 2.3-15. SO₂ Concentration at Six (6) Sampling Stations

Nitrogen Dioxide (NO₂)

Figure 2.3-14 shows the graphical presentation of the concentration levels of NO₂ in six (6) sampling stations. As shown, the highest concentration of NO₂, the highest concentration is 8 µg/Ncm recorded at Stations 5 & 6 while the lowest is 5 µg/Ncm recorded at Station 1 & 2. None in the monitoring stations exceeded the CAA limit for NO₂.

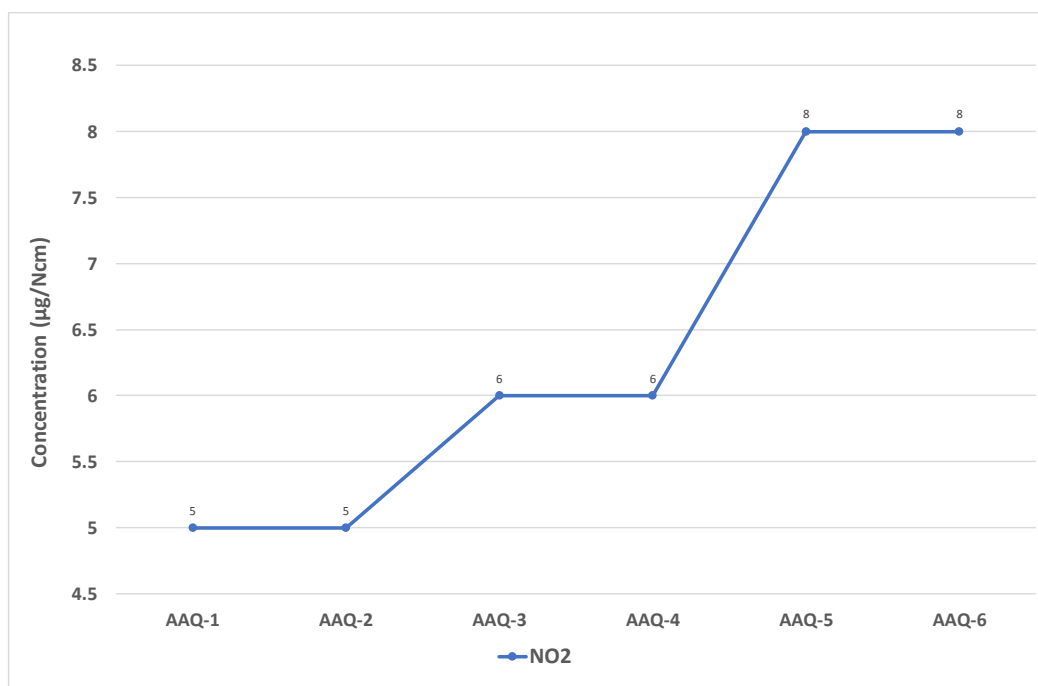


Figure 2.3-16. NO₂ Concentration at Six (6) Sampling Stations

2.3.2.2 Impact Identification, Prediction and Assessment, and Mitigation

2.3.2.2.1 Pre-construction and Construction Phase

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 <10kph;
- 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) including 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.

2.3.2.2.2 Operation Phase

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), particulate matter less than 10-microns (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.

Emission Assessment of Criteria Pollutants through Air Dispersion Modeling

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 Version 9.6.5 software was used to assess and determine air quality impact due to the emissions of criteria pollutants from the project operation. AERMOD is an approved software under TIER 4 of MC-2003-003. AERMOD requires two types of hourly meteorological data files, a file containing surface parameters and vertical profiles. These two files are produced by AERMET meteorological preprocessor program. The AERMET-Ready (surface and upper air) meteorological data (January 1 to December 31, 2017) generated by Weather Research and Forecasting (WRF) and USEPA Mesoscale Model Interface Program (MMIF) is used for this project purchased at Lakes Environmental. The WRF is the next generation mesoscale numerical weather prediction system designed for both atmospheric research and operational forecasting applications.

Modeling analysis with AERMOD is performed using the regulatory default option. Dispersion modeling domain is maximized to 10km x 10km with a grid interval of 500 meters. A cartesian and nested grid is included with interval of 50 meter up to the extent of 2km x 2km; 100 meters up to the extent of 4km x 4km; and 200 meters up to the extent of 6km x 6km from the point sources. Figure 2.3-17 show the modeling domain; Figure 2.3-18 is the cartesian and nested grid in the modeling domain.



Figure 2.3-17. Modeling Domain (10km x 10km)



Figure 2.3-18. Cartesian and Nested Grid within the Modeling Domain

Plot Plan

The sources subject for this modeling is the proposed section mill reheating furnace flue stack that release particulates (TSP & PM₁₀), sulfur oxides (SO_x), nitrogen oxides (NO_x), and carbon monoxide (CO). Figure 2.3-19 is the general plant lay-out of the facility showing the location of the emission source.



Figure 2.3-19. General Plant Layout

Air Sensitive Receptors (ASRs)

An air sensitive receptor was identified within the modeling domain. The description, distance from the source, and geographical coordinates of these receptors are listed in the table below. Figure 2.3-20 shows the relative location of the area sensitive receptors.

Table 2.3-16. Description, Distance, Direction, and Coordinates of the ASRs

Station	Description	Distance from the source (m)	Direction from the source	Coordinates	
				Easting (m)	Northing (m)
ASR-1	Buenavista East Elem School, Brgy. Buenavista East Candelaria	4,448	W	325725.55	1538325.73
ASR-2	Bukal Sur National High School, Brgy. Bukal Sur Candelaria	5,484	WNW	325262.75	1540464.81
ASR-3	Bukal Sur Elementary School, Brgy. Bukal Sur Candelaria	5,317	NW	325889.04	1541188.93
ASR-4	Millionaires Village, Brgy. Masin Sur Candelaria	3,635	NW	327456.48	1540507.64
ASR-5	Candelaria Municipal Hall, Brgy. Poblacion Candelaria	2,322	NNW	329794.83	1540333.18
ASR-6	Residential Area, Brgy. Masalukot I Candelaria	3,309	N	330463.48	1541325.47
ASR-7	Panpilo National High School, Brgy. Masalukot 1 Candelaria	4,303	N	330398.66	1542323.62
ASR-8	Mayabobo Elementary School, Brgy. Malabanban Norte Candelaria	4,981	NNE	331225.10	1542930.58
ASR-9	Residential area, Brgy. Mangilag Norte Candelaria	6,133	NE	334671.99	1542205.66
ASR-10	Mangilag Sur Elem School, Brgy. Mangilag Sur Candelaria	3,600	NE	332605.84	1540678.72
ASR-11	United Candelaria Doctors Hospital, Brgy. Mangilag Sur Candelaria	3,513	NE	332730.32	1540537.03
ASR-12	Concepcion Ibaba Elementary School, Brgy. Mangilag Sur Candelaria	4,271	ENE	334048.74	1539855.11
ASR-13	Eastern Spring Subdivision, Brgy. Malabanban Sur Candelaria	1,680	NNE	330844.10	1539600.57
ASR-14	Residential Area, Brgy. Masin Sur Candelaria	1,473	NNW	329659.98	1539460.07
ASR-15	Pahinga Norte Elementary School, Brgy. Pahinga Norte Candelaria	1,159	NE	329525.11	1539050.95
ASR-16	Malabanban Sur Elementary School, Brgy. Malabanban Sur Candelaria	1,021	NNE	330467.49	1539019.99
ASR-17	Manuel Macasaet National High School Brgy. Pahinga	1,593	W	328614.03	1538356.75

Station	Description	Distance from the source (m)	Direction from the source	Coordinates	
				Easting (m)	Northing (m)
	Sur Candelaria				
ASR-18	San Andres Elementary School, Brgy. San Andres Candelaria	1,746	E	331913.95	1538227.43
ASR-19	Residential area, Brgy. Concepcion Palasan Candelaria	4,938	ESE	334710.36	1536184.11
ASR-20	Manggalang 1 Elementary School, Brgy. Manggalang 1 Candelaria	5,081	SW	333908.91	1534699.08
ASR-21	Residential area, Brgy. Sta Catalina Sur Candelaria	1,486	SSE	330456.02	1536635.47
ASR-22	Sta Catalina Elementary and National High School, Brgy. Sta Catalina Sur Candelaria	3,658	S	330498.71	1534428.07
ASR-23	Residential area, Brgy. Sta Catalina Norte Candelaria	2,636	SW	328994.47	1535758.87
ASR-24	Residential area, Brgy. Kinatihan 1 Candelaria	3,830	WSW	326785.97	1536360.60
AAQ-1	At the compound of Malabanban Sur Barangay Hall, Candelaria	1,243	NNE	330632.02	1539402.42
AAQ-2	Kagawad Dennis Zamora, Purok 3, Brgy. Malabanban Sur Candelaria	404	SW	329839.18	1537989.67
AAQ-3	Beside San Andres Elementary School, approximately 50 meters from the main gate	1,755	E	331875.17	1538307.89
AAQ-4	Beside the house of Wilfredo Milano, Brgy. Sta. Catalina Sur Candelaria	1,207	SE	331313.65	1536407.71
AAQ-5	Josefina Lenator at Sitio Lanzonesan, Sta Catalina Norte Candelaria	1.685	SW	328995.88	1536992.45
AAQ-6	Beside the house of Efren Pitargue, Bukayo St., Pahinga 1, Candelaria	858	NW	329555.51	1538900.30

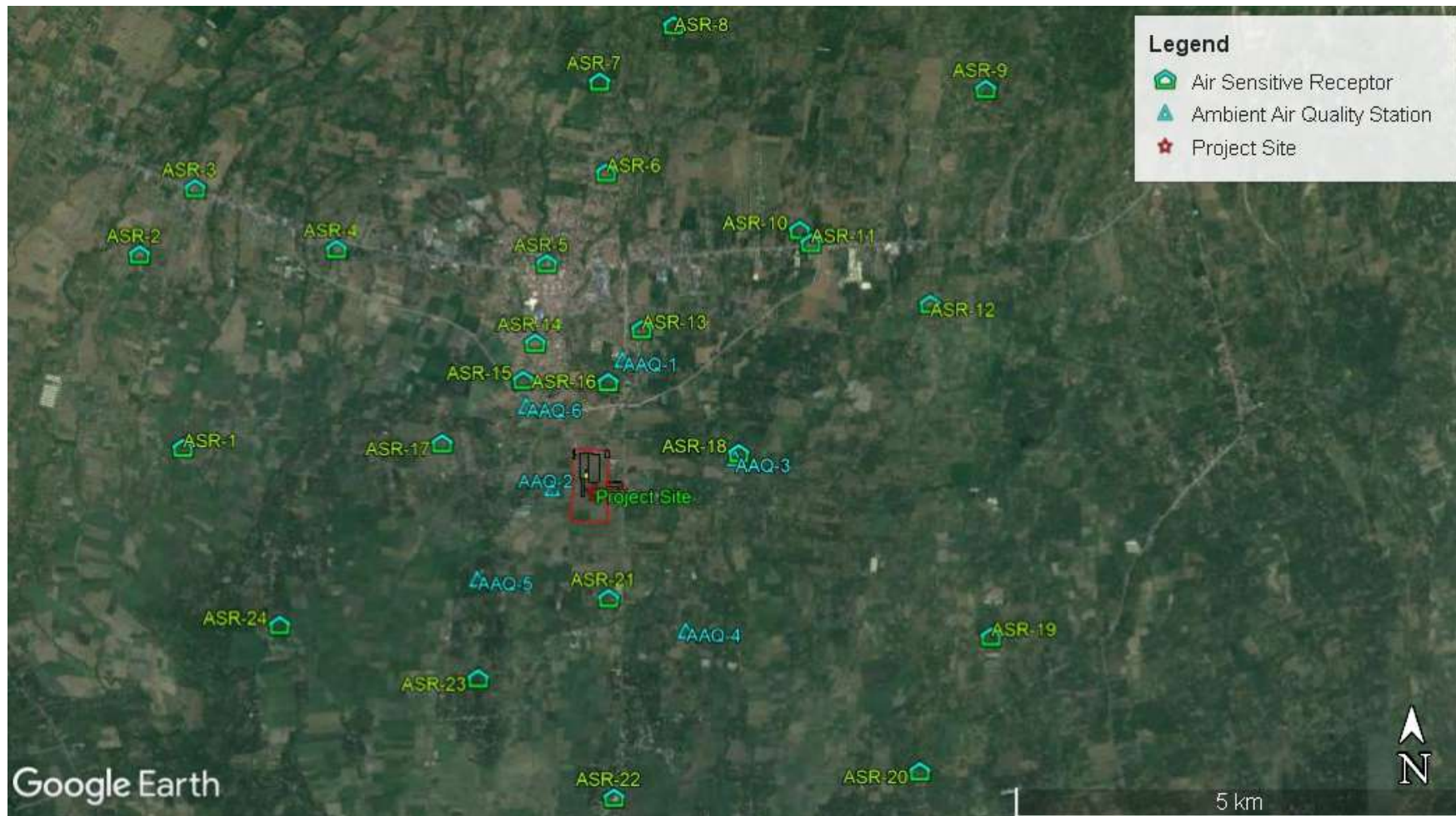


Figure 2.3-11. Plant Site and the Location of Air Sensitive Receptors

Emission Sources and Rates

The source subject for this modeling is the particulate and gaseous emissions from the proposed 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 the table below. 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). The succeeding tables 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 Steel Asia Calaca Plant conducted by Ostrea Mineral Laboratory on October 16, 2016.

Table 2.3-17 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 2.3-18. Summary of Source Parameters

Parameter	Unit	Proposed Furnace Flue Stack
Coordinates		
Easting (x)	m	330143.59
Northing (y)	m	1538260.02
Elevation (z)	m	48.60
Fuel consumption	gal/yr	3,863,106
Operating hours	h/yr	8220

Parameter	Unit	Proposed Furnace Flue Stack
Flue gas velocity	m/s	7.8
Flue gas exit temperature	°C	348.8
Stack height above the ground	m	75
Stack exit diameter	m	2
Pollutant Emission Rate		
SO ₂	g/s	33.19
NO ₂	g/s	7.75
CO	g/s	0.705
PM	g/s	1.41
PM ₁₀ ^a	g/s	1.21

Source: Steel Asia Corporation

Note: a - PM₁₀ assumed to be 86% of PM: Source: Atmospheric

Environment;

Relationship between size segregated mass concentration,

January 1999

Modeling Results

The maximum predicted ground level concentrations from the normal operation of the Proposed Rebar and Rolling Project is shown in the table below (Table 2.3-19) using WRF-MIFF meteorological data from the period January 1 – December 31, 2017. The contour plots showing the spatial distributions of the maximum predicted concentrations are also provided in the succeeding figures. The results of the modeling per averaging period are discussed in succeeding section.

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.

The selected input and output files of the model runs are attached in the Annexes,

Table 2.3-19. Summary of Modeling Results

Receptor ID	Maximum Predicted Ground Level Concentration ($\mu\text{g}/\text{m}^3$)									
	CO ^a		NO ₂		SO ₂		TSP		PM ₁₀	
	1hr	8hr	1hr	24hr	1hr	24hr	1hr	24hr	1hr	24hr
Domain Maximum	0.00234	0.00110	25.75845	9.37058	110.31264	40.13027	4.68638	1.70484	4.02164	1.46302
ASR-1	0.00097	0.00032	10.70506	1.64462	45.84530	7.04320	1.94763	0.29921	1.67137	0.25677
ASR-2	0.00109	0.00028	11.99796	1.48125	51.38222	6.34357	2.18285	0.26949	1.87323	0.23127
ASR-3	0.00108	0.00030	11.82210	1.40024	50.62912	5.99666	2.15086	0.25475	1.84577	0.21862
ASR-4	0.00105	0.00029	11.55284	1.85774	49.47598	7.95590	2.10187	0.33799	1.80373	0.29005
ASR-5	0.00174	0.00047	19.15953	3.26304	82.05221	13.97423	3.48580	0.59366	2.99136	0.50946
ASR-6	0.00119	0.00046	13.10160	2.94141	56.10867	12.59680	2.38365	0.53515	2.04554	0.45924
ASR-7	0.00111	0.00043	12.15527	2.22730	52.05594	9.53858	2.21148	0.40522	1.89779	0.34775
ASR-8	0.00093	0.00032	10.18954	1.89107	43.63754	8.09867	1.85384	0.34405	1.59088	0.29525
ASR-9	0.00080	0.00022	8.80875	0.99907	37.72417	4.27861	1.60262	0.18177	1.37530	0.15598
ASR-10	0.00115	0.00034	12.60841	1.48086	53.99653	6.34190	2.29392	0.26942	1.96854	0.23121
ASR-11	0.00118	0.00028	12.96476	1.35260	55.52263	5.79263	2.35875	0.24609	2.02418	0.21118
ASR-12	0.00095	0.00025	10.39427	1.12139	44.51429	4.80245	1.89109	0.20402	1.62285	0.17508
ASR-13	0.00166	0.00043	18.20916	3.29663	77.98219	14.11809	3.31289	0.59977	2.84298	0.51470
ASR-14	0.00132	0.00051	14.54594	1.89498	62.29418	8.11540	2.64642	0.34476	2.27104	0.29586
ASR-15	0.00135	0.00035	14.83794	1.42601	63.54466	6.10702	2.69955	0.25944	2.31663	0.22264
ASR-16	0.00172	0.00046	18.92873	1.96916	81.06380	8.43311	3.44381	0.35826	2.95532	0.30744
ASR-17	0.00110	0.00015	12.12624	0.78440	51.93159	3.35924	2.20619	0.14271	1.89326	0.12247
ASR-18	0.00097	0.00051	10.67326	2.79578	45.70910	11.97314	1.94185	0.50865	1.66641	0.43650
ASR-19	0.00107	0.00014	11.75478	0.55635	50.34078	2.38261	2.13861	0.10122	1.83526	0.08686
ASR-20	0.00104	0.00013	11.42923	0.53050	48.94660	2.27191	2.07938	0.09652	1.78443	0.08283
ASR-21	0.00084	0.00041	9.28389	2.33995	39.75901	10.02105	1.68907	0.42572	1.44948	0.36533
ASR-22	0.00084	0.00021	9.26094	1.41915	39.66071	6.07763	1.68489	0.25819	1.44590	0.22157
ASR-23	0.00109	0.00067	11.98166	5.11591	51.31241	21.90929	2.17989	0.93077	1.87068	0.79874
ASR-24	0.00110	0.00055	12.11878	3.38103	51.89967	14.47953	2.20484	0.61513	1.89209	0.52788
AAQ-1	0.00179	0.00046	19.73220	3.19972	84.50475	13.70306	3.58999	0.58214	3.08077	0.49957
AAQ-2	0.00058	0.00015	6.38347	0.60720	27.33772	2.60038	1.16138	0.11047	0.99664	0.09480
AAQ-3	0.00099	0.00047	10.86898	2.86559	46.54730	12.27214	1.97745	0.52135	1.69696	0.44740
AAQ-4	0.00135	0.00017	14.88487	0.88058	63.74567	3.77117	2.70809	0.16021	2.32396	0.13748
AAQ-5	0.00145	0.00083	15.98737	7.77420	68.46720	33.29362	2.90867	1.41440	2.49609	1.21378
AAQ-6	0.00152	0.00029	16.70659	1.30513	71.54733	5.58934	3.03952	0.23745	2.60838	0.20377
NAAQGV:	35	10	-	150	-	180	-	230	-	150
NAAQSSAP	-	-	260	-	340	-	300	-	200	-

Note: ^a – mg/m³

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 $1.0 \mu\text{g}/\text{m}^3$ and $0.50 \mu\text{g}/\text{m}^3$, respectively while the 1-hour averaging period for NO_2 , SO_2 , TSP and PM_{10} are less than $10.0 \mu\text{g}/\text{m}^3$; $50.0 \mu\text{g}/\text{m}^3$; $3.0 \mu\text{g}/\text{m}^3$; and $3.0 \mu\text{g}/\text{m}^3$, respectively.

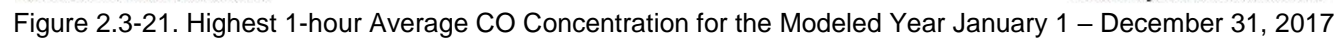
The results of the modeling may be summarized as follows:

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 (SO_2 , NO_2 , CO, TSP, & PM_{10}) in the whole modeling domain and in any of the 24 air sensitive receptors for 1-hour and 8-hour averaging period (Table 2.3-19).

The highest predicted concentration of CO for 1-hour and 8-hour averaging period is $2.34 \mu\text{g}/\text{m}^3$ and $1.099 \mu\text{g}/\text{m}^3$, respectively. The highest predicted concentration of NO_2 , SO_2 , TSP, & PM_{10} for 1-hour averaging period is $25.76 \mu\text{g}/\text{m}^3$; $110.31 \mu\text{g}/\text{m}^3$; $4.69 \mu\text{g}/\text{m}^3$; and $4.02 \mu\text{g}/\text{m}^3$, respectively and is located at coordinates 330943.59 m E. 1537610.02 m N. at approximately 1.36km southeast of the proposed smokestack.

The most affected sensitive receptors for all pollutants based on the modeling isopleth are some communities and residential areas of Barangay Sta Catalina Sur at approximately 0.6km extending to 1.7km southeast of the smokestack. The isopleth also shows an impact in Barangays Sta Catalina Norte; Masin Sur; Pahinga Norte; and Malabanban Sur.

The contour figures (Figures 2.3-21 to 2.3-26) generally show that impacts on all pollutants from the operation of the Project is greatest in the southeast; north-northwest; north; and north-northeast of the Project site.



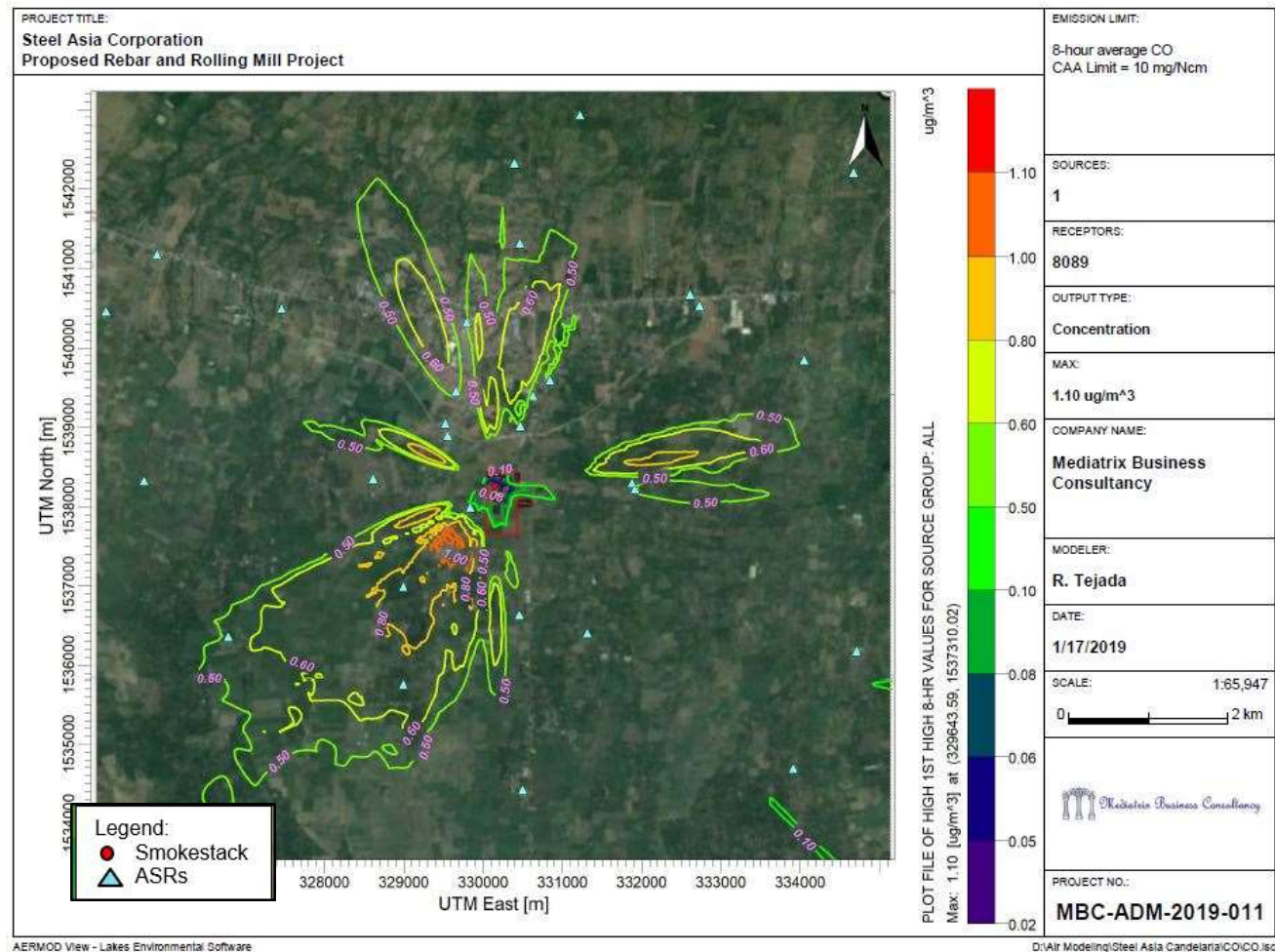


Figure 2.3-22. Highest 8-hour Average CO Concentration for the Modeled Year January 1 – December 31, 2017

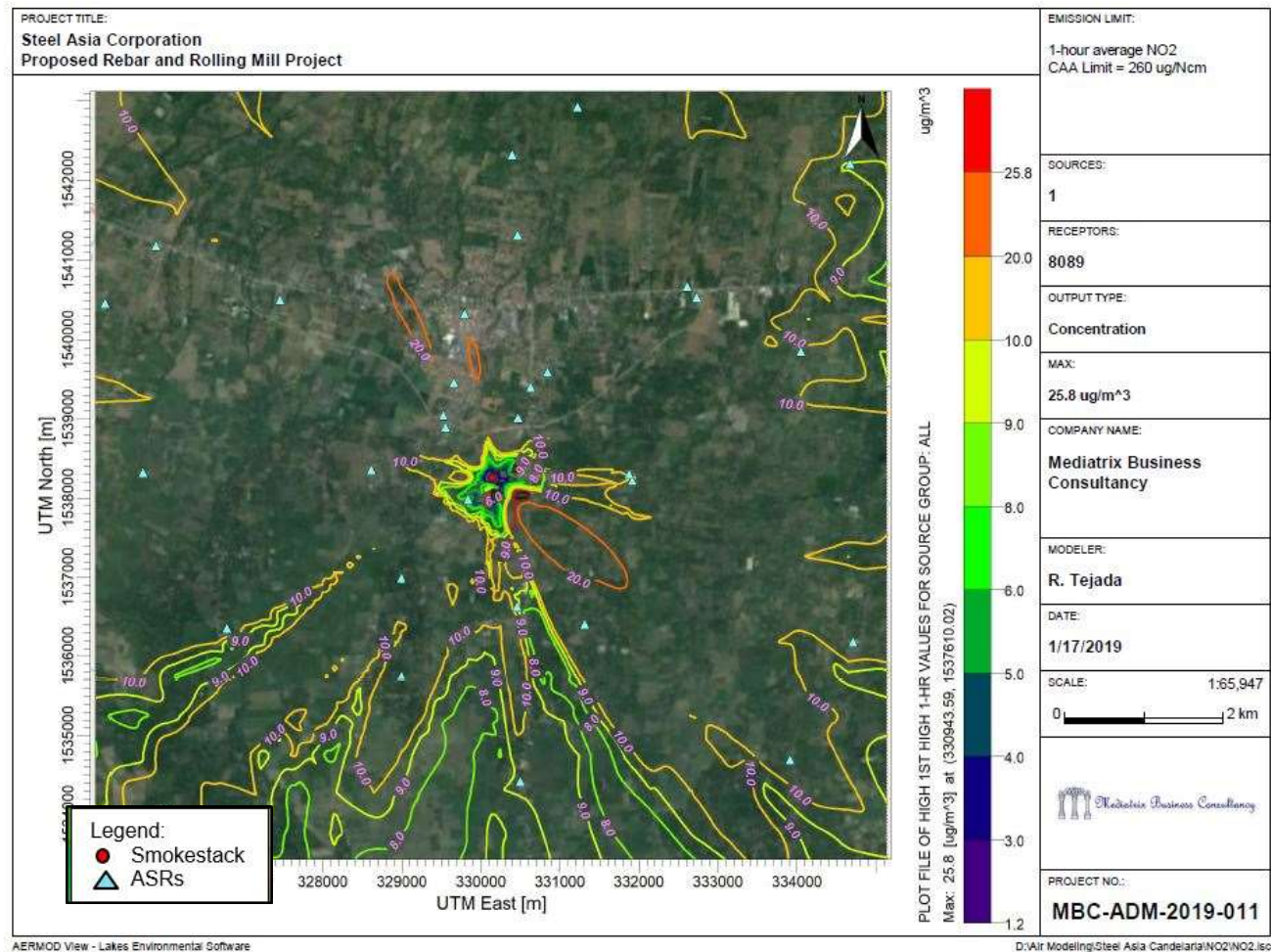


Figure 2.3-23. Highest 1-hour Average NO₂ Concentration for the Modeled Year January 1 – December 31, 2017

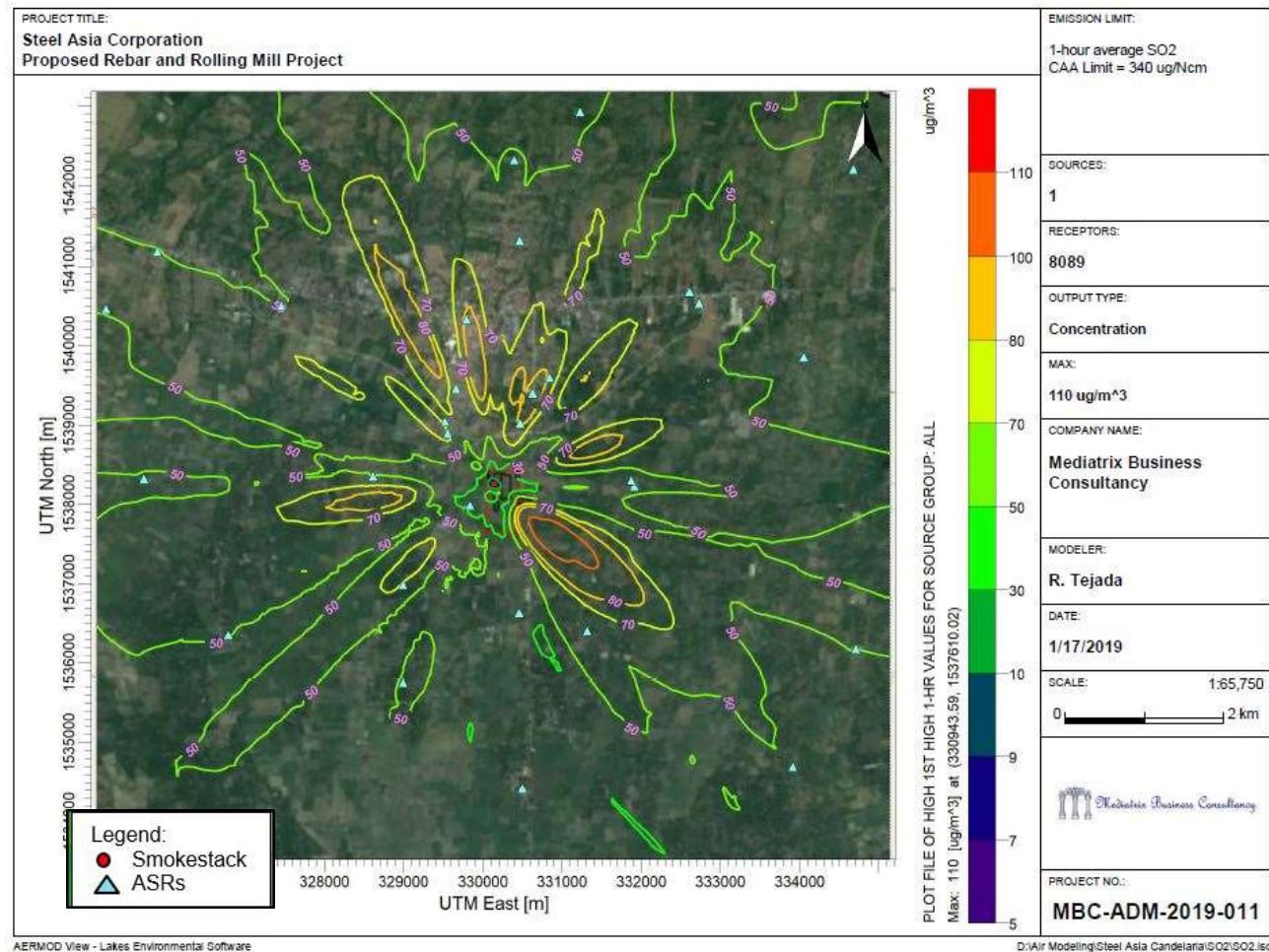


Figure 2.3-24. Highest 1-hour Average SO₂ Concentration for the Modeled Year January 1 – December 31, 2017

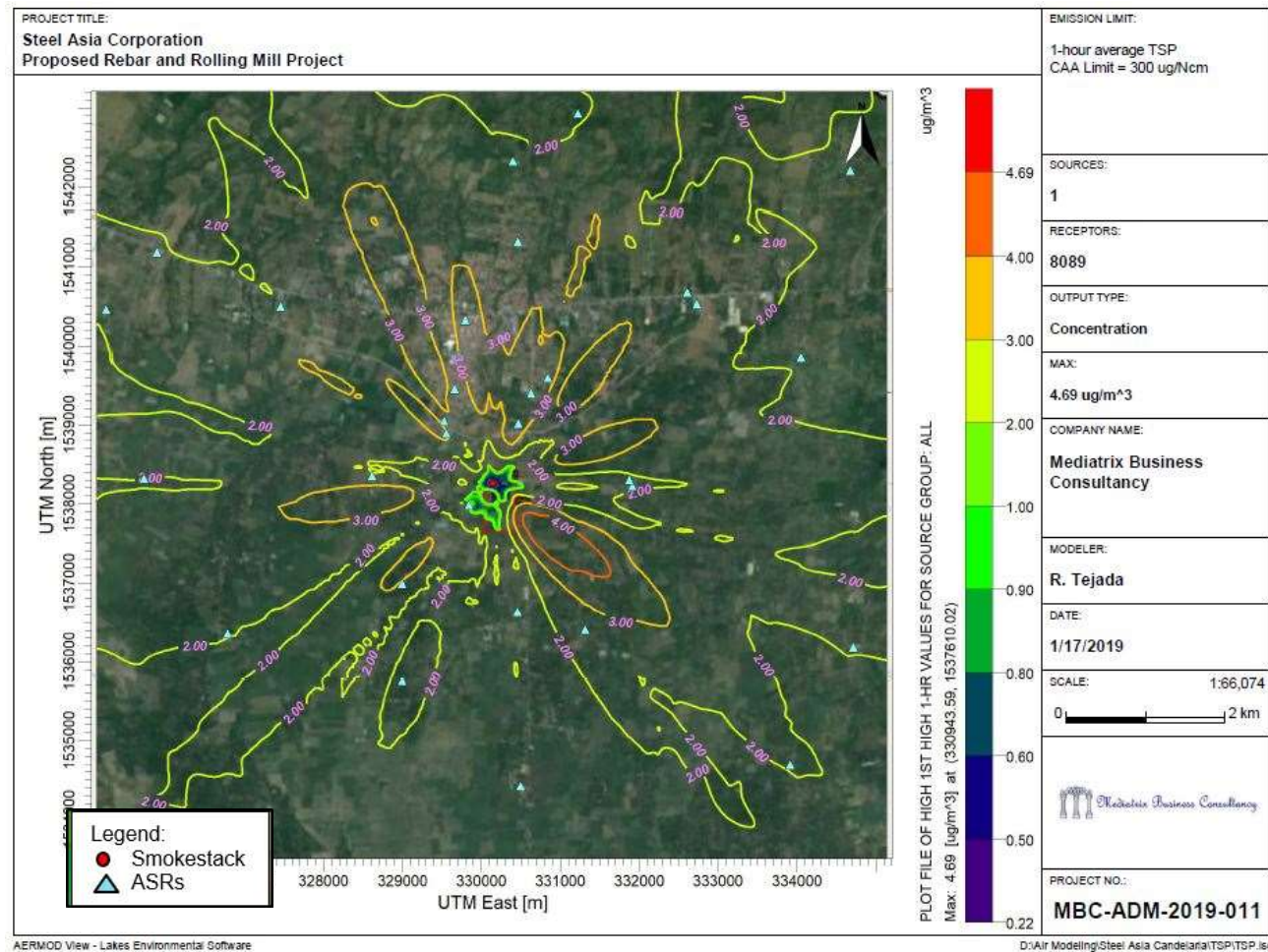


Figure 2.3-25. Highest 1-hour Average TSP Concentration for the Modeled Year January 1 – December 31, 2017

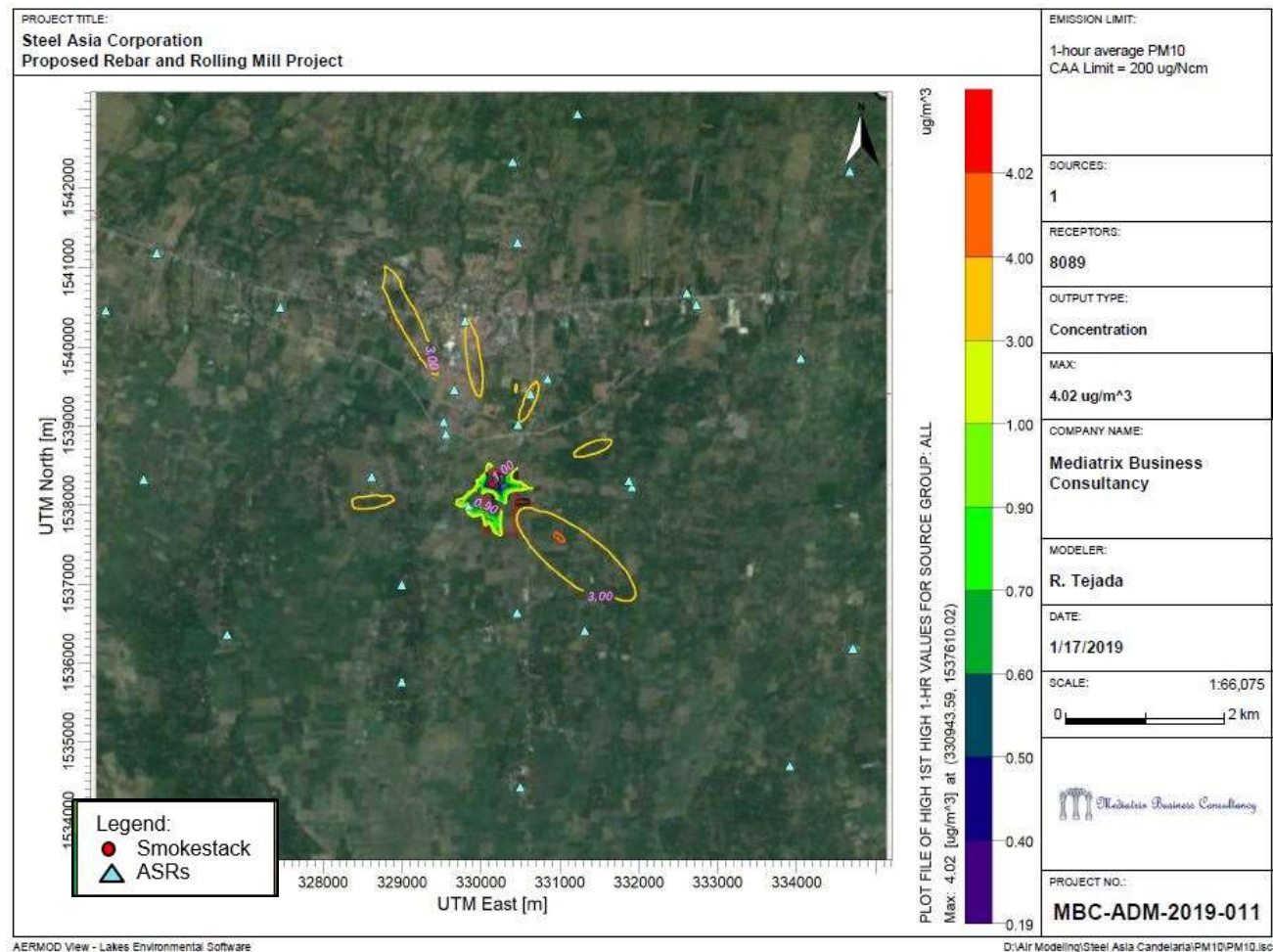


Figure 2.3-26. Highest 1-hour Average PM₁₀ Concentration for the Modeled Year January 1 – December 31, 2017

(b) 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 4.0 µg/m³; 8.0 µg/m³; 0.50 µg/m³; and 0.30 µg/m³; respectively.

The results of the modeling may be summarized as follows:

No exceedances of the relevant NAAQGV values are predicted by the modeling for the four (4) modeled parameters (NO₂, SO₂, TSP & PM₁₀) in the whole modeling domain and in any of the 24 air sensitive receptors for 24-hour averaging period (Table 2.3-19).

The highest predicted concentrations of NO₂, SO₂, TSP and PM₁₀ for 24-hour averaging period is 9.37 µg/m³; 40.13 µg/m³; 1.70 µg/m³; and 1.46 µg/m³, respectively and is located at coordinates 329443.59 m E. 1537010.02 m N. at approximately 1.4km south-southwest of the proposed smokestack.

The most affected sensitive receptors for all pollutants based on the modeling isopleth are some communities and residential area of Barangay Sta Catalina Sur at approximately 1.0km extending to 2.7km south-southwest of the proposed smokestack.

The contour figures (Figures 2.3-27 to 2.3-30) generally show that impacts on all pollutants from the operation of the Project is greatest in the elevated terrain region north of the Project site.

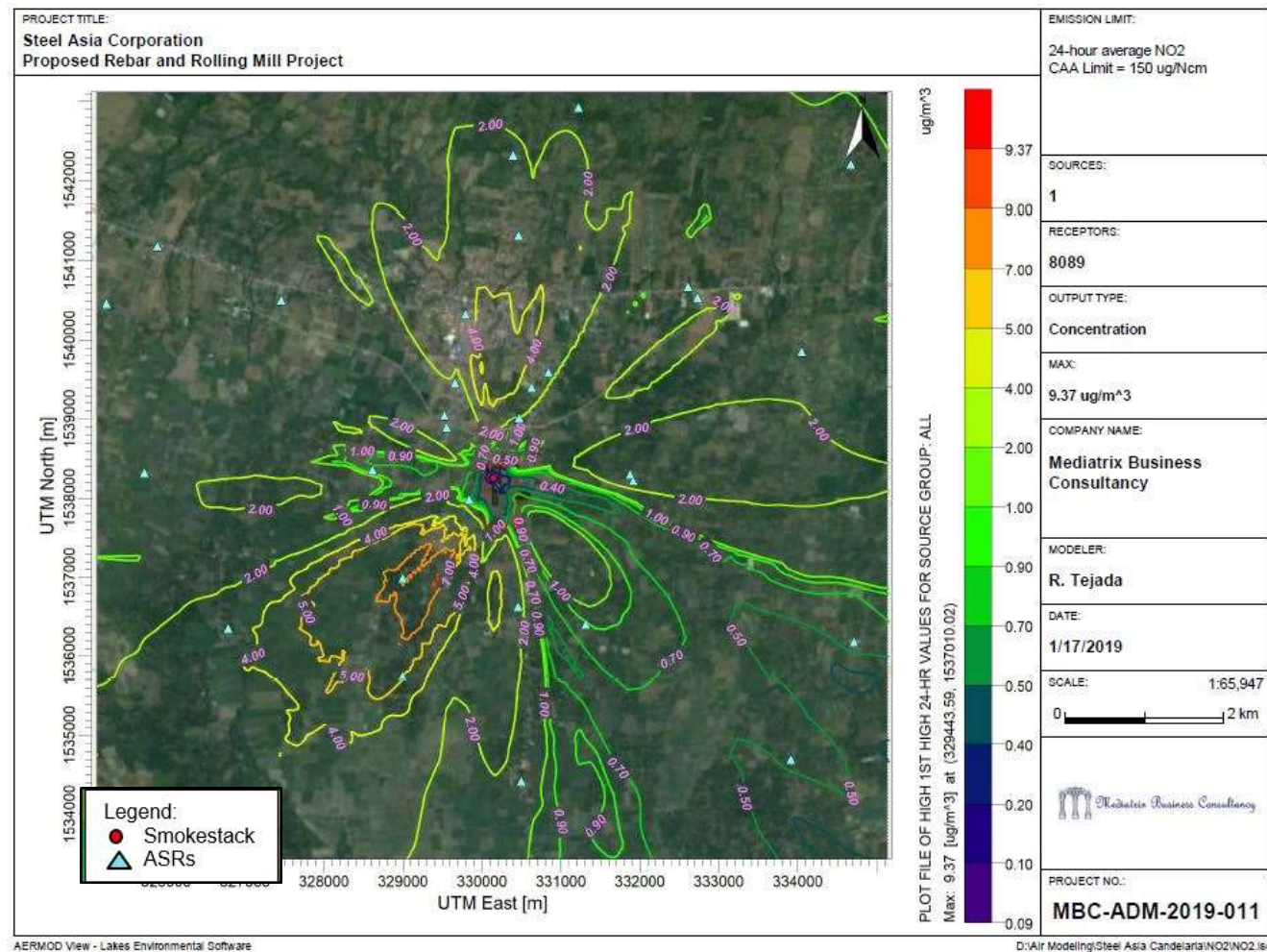


Figure 2.3-27. Highest 24-hour Average NO₂ Concentration for the Modeled Year January 1 – December 31, 2017

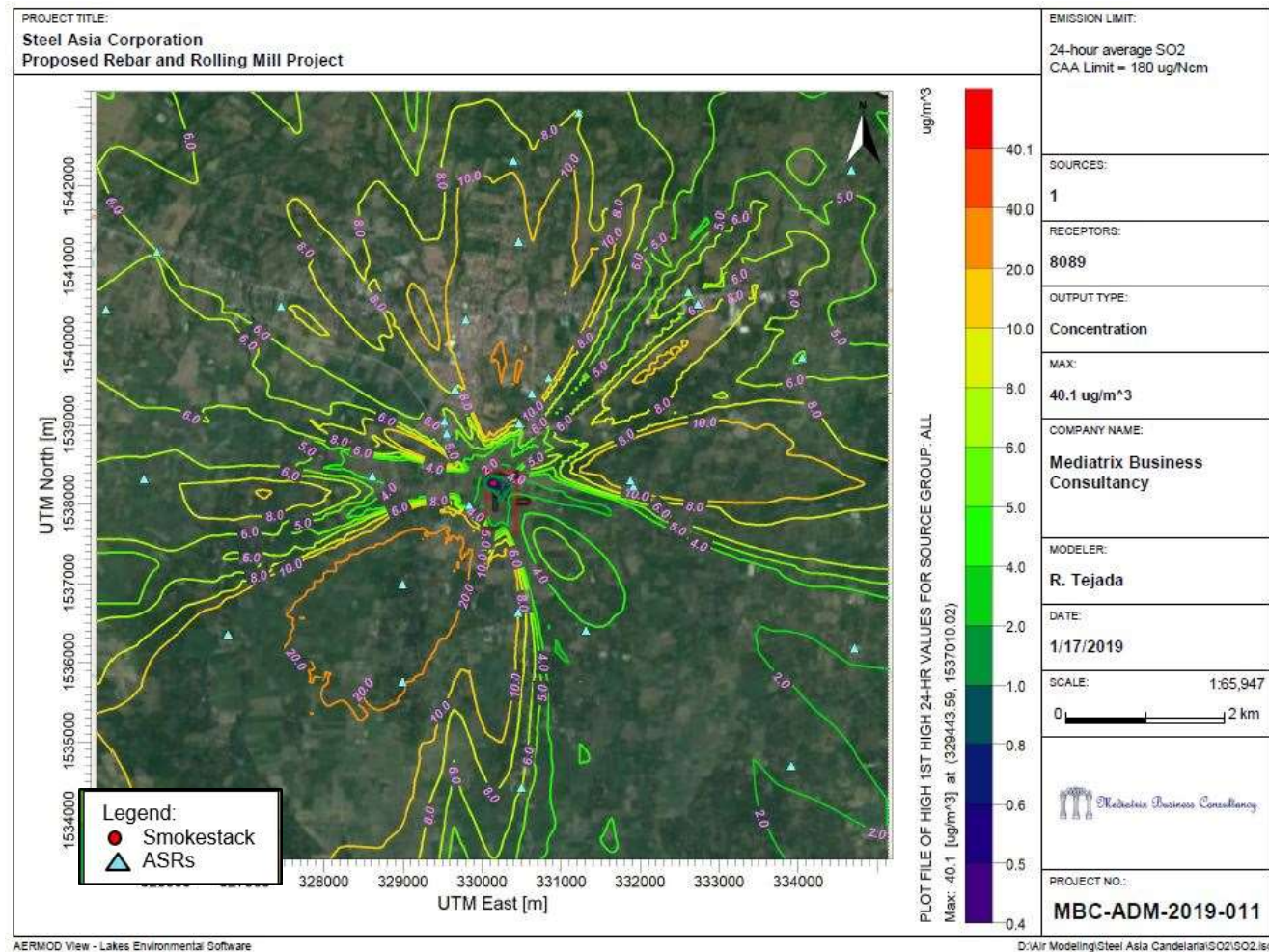


Figure 2.3-28. Highest 24-hour Average SO₂ Concentration for the Modeled Year January 1 – December 31, 2017

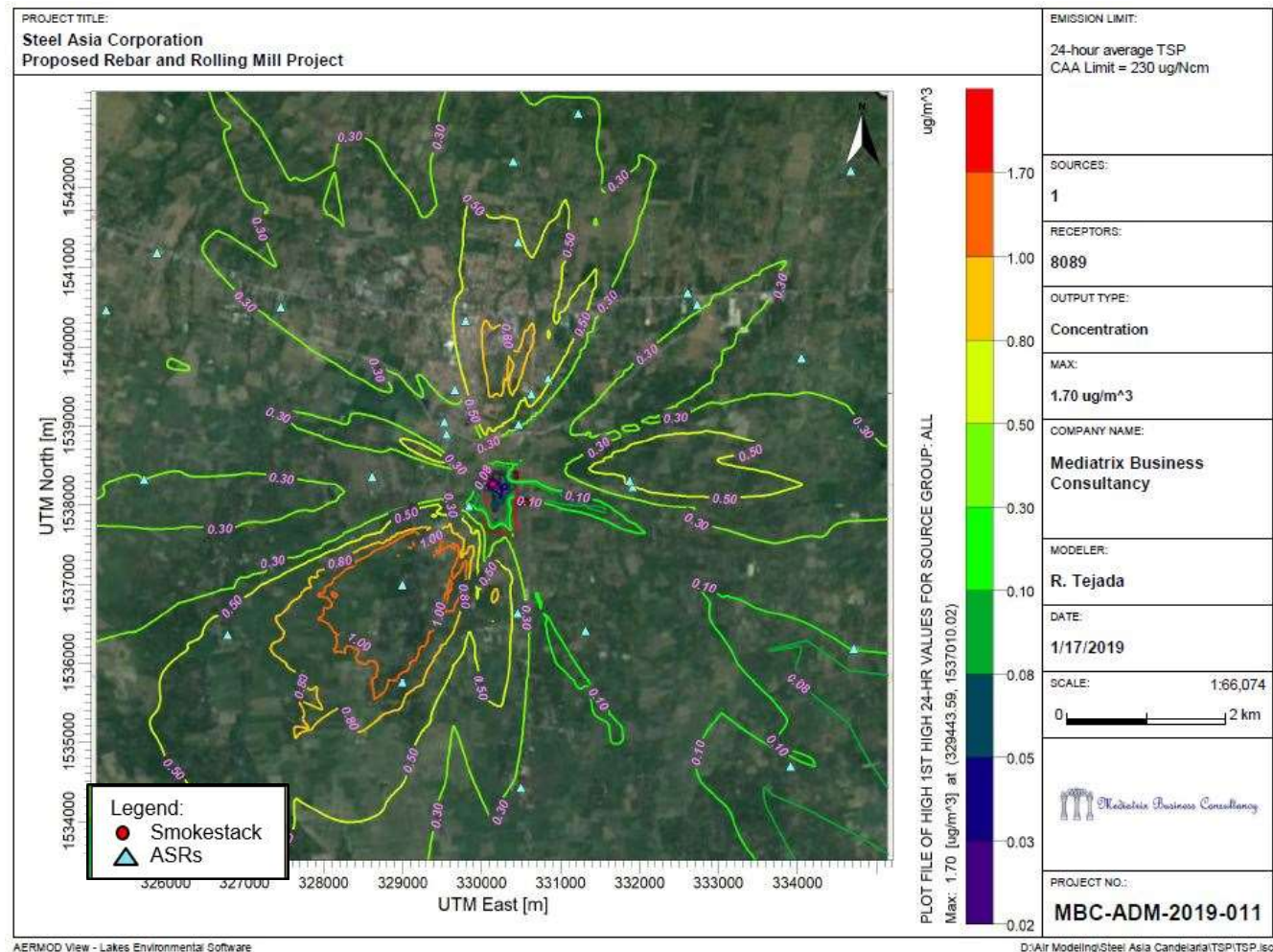


Figure 2.3-29. Highest 24-hour Average TSP Concentration for the Modeled Year January 1 – December 31, 2017

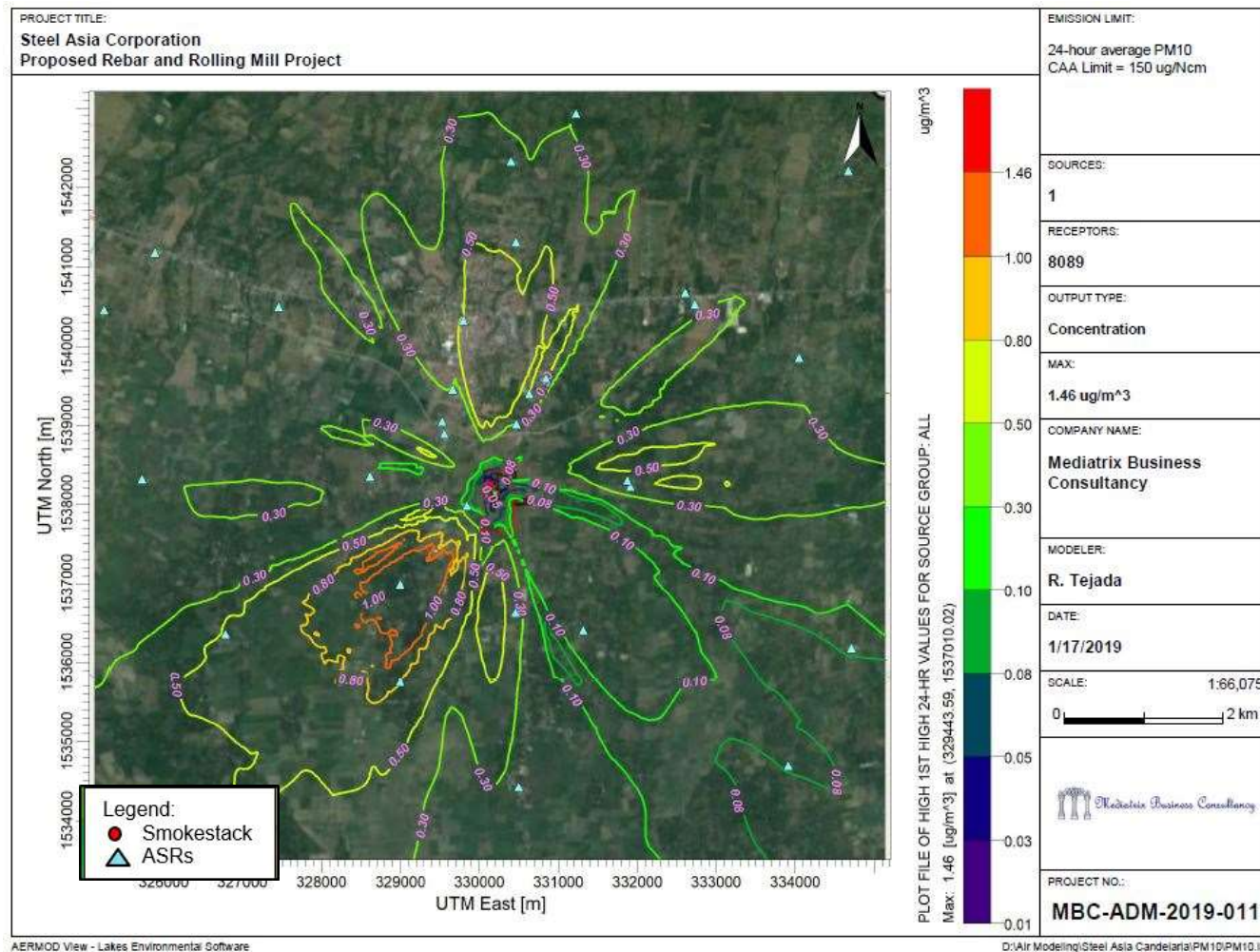


Figure 2.3-30. Highest 24-hour Average PM₁₀ Concentration for the Modeled Year January 1 – December 31, 2017

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.

2.3.2.3 Noise Quality

2.3.2.3.1 Ambient Noise Level

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.

Field Survey

Noise level measurement was conducted in six (6) sampling locations within the project site and its vicinity. The measured noise level from the established stations is used to represent the baseline data of the project. The noise monitoring station is the same as the ambient air

station. Refer to Table 2.3-16 and Figure 2.3-11 which shows the station identification and the geographical position.

Criteria Assessment for Noise Quality

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 the table below.

Table 2.3-20. 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

Noise Level Measurement Results

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 2.3-21 Results of Noise Levels Measurement

Station	Period	Date	Time	Median dB(A)	SPL	DENR Noise Standard dB(A)
STN-1	Morning	August 10, 2016	0700H-0715H	44.5		50
	Daytime	August 9, 2016	1500H-1515H	42.9		55
	Evening	August 9, 2016	1920H-1935H	39.1		50
	Nighttime	August 10, 2016	0030H-0045H	29.4		45
STN-2	Morning	August 11, 2016	0820H-0835H	35.3		50
	Daytime	August 10, 2016	1400H-1415H	36.5		55
	Evening	August 10, 2016	2000H-2015H	30.7		50

Station	Period	Date	Time	Median dB(A)	SPL	DENR Noise Standard dB(A)
	Nighttime	August 11, 2016	0020H-0035H	28.9		45
STN-3	Daytime	August 12, 2016	0900H-0915H	41.5		50
STN-4	Daytime	August 12, 2016	1100H-1115H	45.3		50
STN-5	Daytime	August 12, 2016	1445H-1500H	35.5		50

2.3.2.2.1 Impact Assessment and Mitigation

2.3.2.2.1.1 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 2.3-22. 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 2.3-22. 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

Power Mechanical Equipment	PWL, dB(A)
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
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.

Noise Modeling Methodology

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 the figure below:

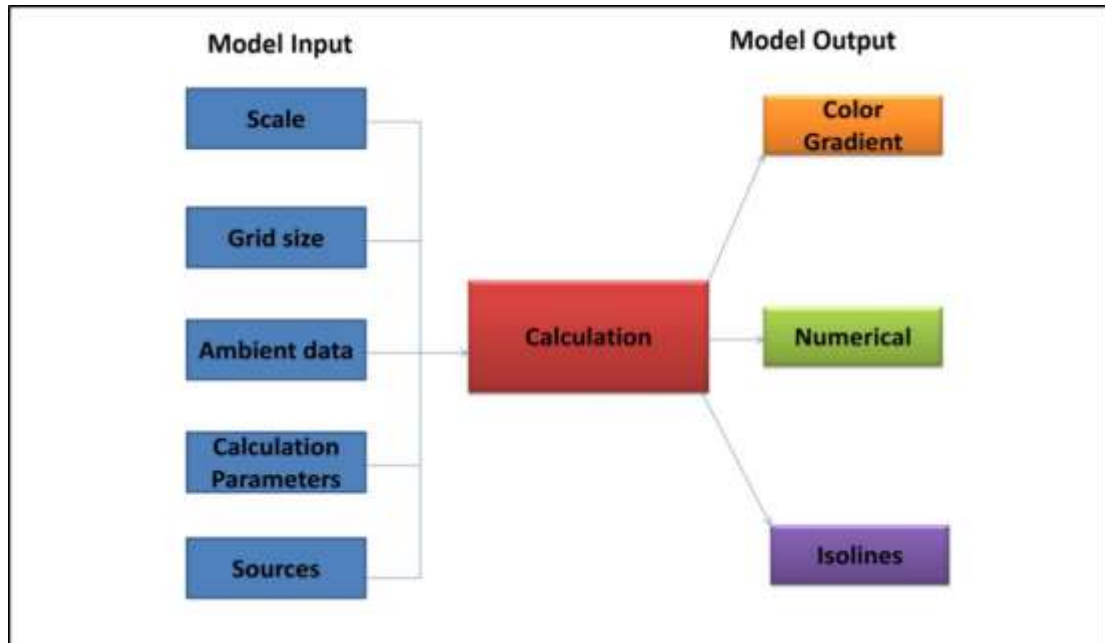


Figure 2.3-31. CUSTIC Screenshot of Input and Output

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 identified noise receiver which is the same as the ASR.

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 2,000 m x 2,000 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 2.3-22 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 2.3-23 are all below the noise condition during daytime, morning/evening and night time. The highest concentration is 51.68 dBA at approximately 300 meters

southeast 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 2.3-32.

Table 2.3-23. Predicted Noise Level at the Noise Sensitive Receiver during Construction

Station No	Description/ Identification	Predicted Noise Level (SPL), dB(A)	Allowable Noise Level, dB(A)		
			Daytime	Morning/ Evening	Nighttime
NSR-1	Buenavista East Elem School, Brgy. Buenavista East Candelaria	0.00	50	45	40
NSR-2	Bukal Sur National High School, Brgy. Bukal Sur Candelaria	0.00	50	45	40
NSR-3	Bukal Sur Elementary School, Brgy. Bukal Sur Candelaria	0.00	50	45	40
NSR-4	Millionaires Village, Brgy. Masin Sur Candelaria	0.00	55	50	45
NSR-5	Candelaria Municipal Hall, Brgy. Poblacion Candelaria	13.61	50	45	40
NSR-6	Residential Area, Brgy. Masalukot I Candelaria	0.18	55	50	45
NSR-7	Panpilo National High School, Brgy. Masalukot 1 Candelaria	0.00	50	45	40
NSR-8	Mayabobo Elementary School, Brgy. Malabanban Norte Candelaria	0.00	50	45	40
NSR-9	Residential area, Brgy. Mangilag Norte Candelaria	0.00	55	50	45
NSR-10	Mangilag Sur Elem School, Brgy. Mangilag Sur Candelaria	0.00	50	45	40
NSR-11	United Candelaria Doctors Hospital, Brgy. Mangilag Sur Candelaria	0.00	50	45	40
NSR-12	Concepcion Ibaba Elementary School, Brgy. Mangilag Sur Candelaria	0.00	50	45	40
NSR-13	Eastern Spring Subdivision, Brgy. Malabanban Sur Candelaria	21.86	55	50	45
NSR-14	Residential Area, Brgy. Masin Sur Candelaria	22.40	55	50	45
NSR-15	Pahinga Norte Elementary School, Brgy. Pahinga Norte Candelaria	29.24	50	45	40
NSR-16	Malabanban Sur Elementary School, Brgy. Malabanban Sur Candelaria	31.15	50	45	40
NSR-17	Manuel Macasaet National High School Brgy. Pahinga Sur Candelaria	23.34	50	45	40
NSR-18	San Andres Elementary	22.97	50	45	40

Station No	Description/ Identification	Predicted Noise Level (SPL), dB(A)	Allowable Noise Level, dB(A)		
			Daytime	Morning/ Evening	Nighttime
	School, Brgy. San Andres Candelaria				
NSR-19	Residential area, Brgy. Concepcion Palasan Candelaria	0.00	55	50	45
NSR-20	Manggalang 1 Elementary School, Brgy. Manggalang 1 Candelaria	0.00	50	45	40
NSR-21	Residential area, Brgy. Sta Catalina Sur Candelaria	27.43	55	50	45
NSR-22	Sta Catalina Elementary and National High School, Brgy. Sta Catalina Sur	0.18	50	45	40
NSR-23	Residential area, Brgy. Sta Catalina Norte Candelaria	13.25	55	50	45
NSR-24	Residential area, Brgy. Kinatihan 1 Candelaria	0.00	55	50	45

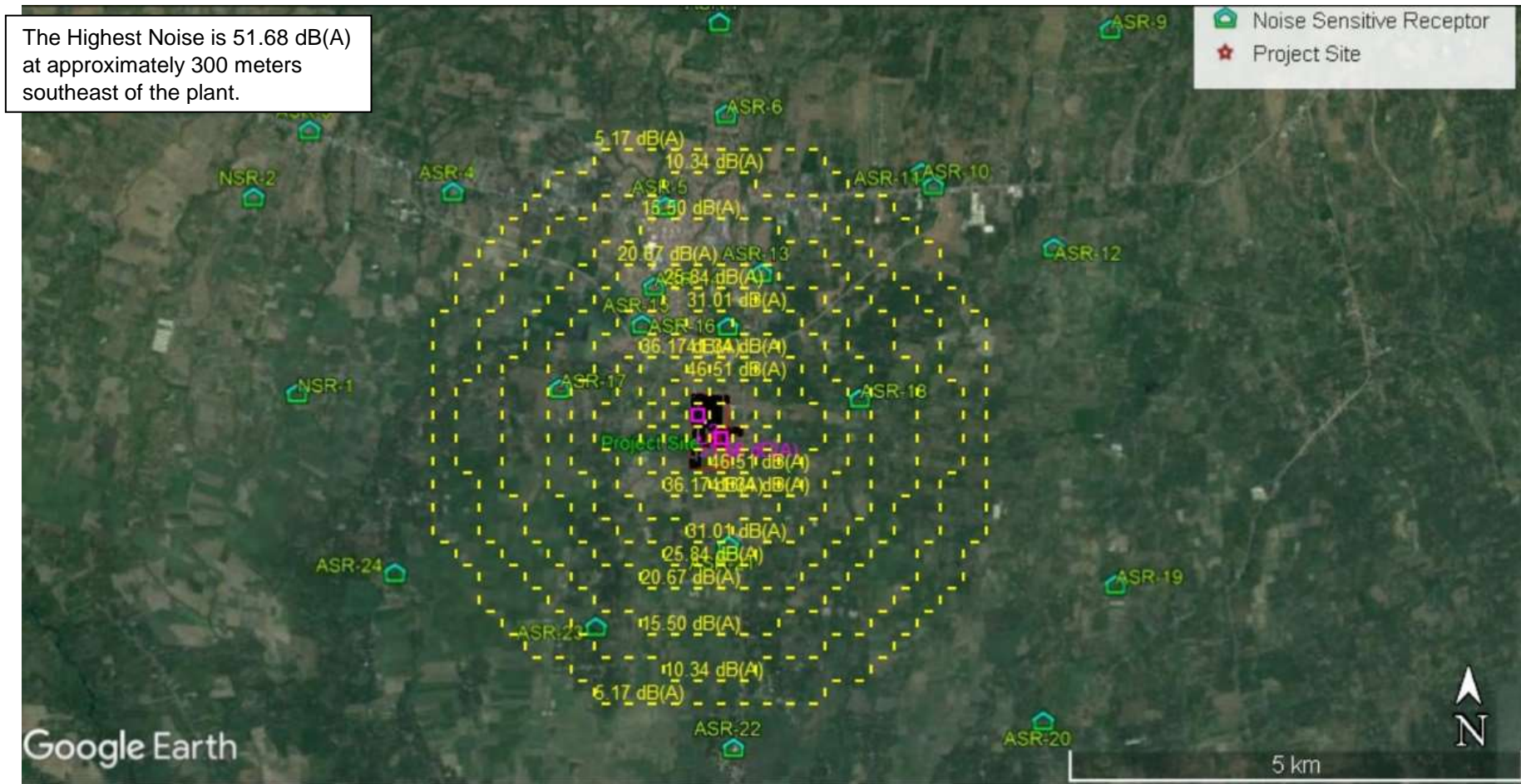


Figure 2.3-32. Plot of Noise Isolines for Construction

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.

2.3.2.2.1.2 Operation Phase

Quantitative Analysis

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 2.3-24. However, it is advised that the detailed design should be updated to reflect equipment data whenever the design changes.

Table 2.3-24. Equivalent PWL of Power Mechanical Equipment for Operation Phase

Power Mechanical Equipment	PWL, dB(A)
Reheating Furnace	90
Rolling Mill	90
Twin Finishing Blocks	95

Source: EIS of Del Pilar Steel, 2014

The total estimated sound power level for the operational equipment is 96 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 2,000 m x 2,000 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 96 dB(A) from the table above (Table 2.3-24).

Noise Modeling Results

The predicted noise levels in all sensitive receivers for the operation of the steel rolling mill as exhibited in Table 2.3-25 are all below the noise condition during daytime, morning/evening and night time. The highest concentration is 39.88 dBA at approximately 200 meters northeast 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 2.3-33.

Table 2.3-25. Predicted Noise Level at Nearest Sensitive Receiver for Operation

Station No	Description/ Identification	Predicted Noise Level (SPL), dB(A)	Allowable Noise Level, dB(A)		
			Daytime	Morning/ Evening	Nighttime
NSR-1	Buenavista East Elem School, Brgy. Buenavista East Candelaria	0.00	50	45	40
NSR-2	Bukal Sur National High School, Brgy. Bukal Sur Candelaria	0.00	50	45	40
NSR-3	Bukal Sur Elementary School, Brgy. Bukal Sur Candelaria	0.00	50	45	40
NSR-4	Millionaires Village, Brgy. Masin Sur Candelaria	0.00	55	50	45

Station No	Description/ Identification	Predicted Noise Level (SPL), dB(A)	Allowable Noise Level, dB(A)		
			Daytime	Morning/ Evening	Nighttime
NSR-5	Candelaria Municipal Hall, Brgy. Poblacion Candelaria	0.21	50	45	40
NSR-6	Residential Area, Brgy. Masalukot I Candelaria	0.00	55	50	45
NSR-7	Panpilo National High School, Brgy. Masalukot 1 Candelaria	0.00	50	45	40
NSR-8	Mayabobo Elementary School, Brgy. Malabanban Norte Candelaria	0.00	50	45	40
NSR-9	Residential area, Brgy. Mangilag Norte Candelaria	0.00	55	50	45
NSR-10	Mangilag Sur Elem School, Brgy. Mangilag Sur Candelaria	0.00	50	45	40
NSR-11	United Candelaria Doctors Hospital, Brgy. Mangilag Sur Candelaria	0.00	50	45	40
NSR-12	Concepcion Ibaba Elementary School, Brgy. Mangilag Sur Candelaria	0.00	50	45	40
NSR-13	Eastern Spring Subdivision, Brgy. Malabanban Sur Candelaria	10.06	55	50	45
NSR-14	Residential Area, Brgy. Masin Sur Candelaria	10.60	55	50	45
NSR-15	Pahinga Norte Elementary School, Brgy. Pahinga Norte Candelaria	17.44	50	45	40
NSR-16	Malabanban Sur Elementary School, Brgy. Malabanban Sur Candelaria	19.35	50	45	40
NSR-17	Manuel Macasaet National High School Brgy. Pahinga Sur Candelaria	11.54	50	45	40
NSR-18	San Andres Elementary School, Brgy. San Andres Candelaria	11.17	50	45	40
NSR-19	Residential area, Brgy. Concepcion Palasan Candelaria	0.00	55	50	45
NSR-20	Manggalang 1 Elementary School, Brgy. Manggalang 1 Candelaria	0.00	50	45	40
NSR-21	Residential area, Brgy. Sta Catalina Sur Candelaria	15.63	55	50	45
NSR-22	Sta Catalina Elementary and National High School, Brgy. Sta Catalina Sur	0.00	50	45	40
NSR-23	Residential area, Brgy. Sta Catalina Norte Candelaria	0.00	55	50	45
NSR-24	Residential area, Brgy. Kinatihan 1 Candelaria	0.00	55	50	45

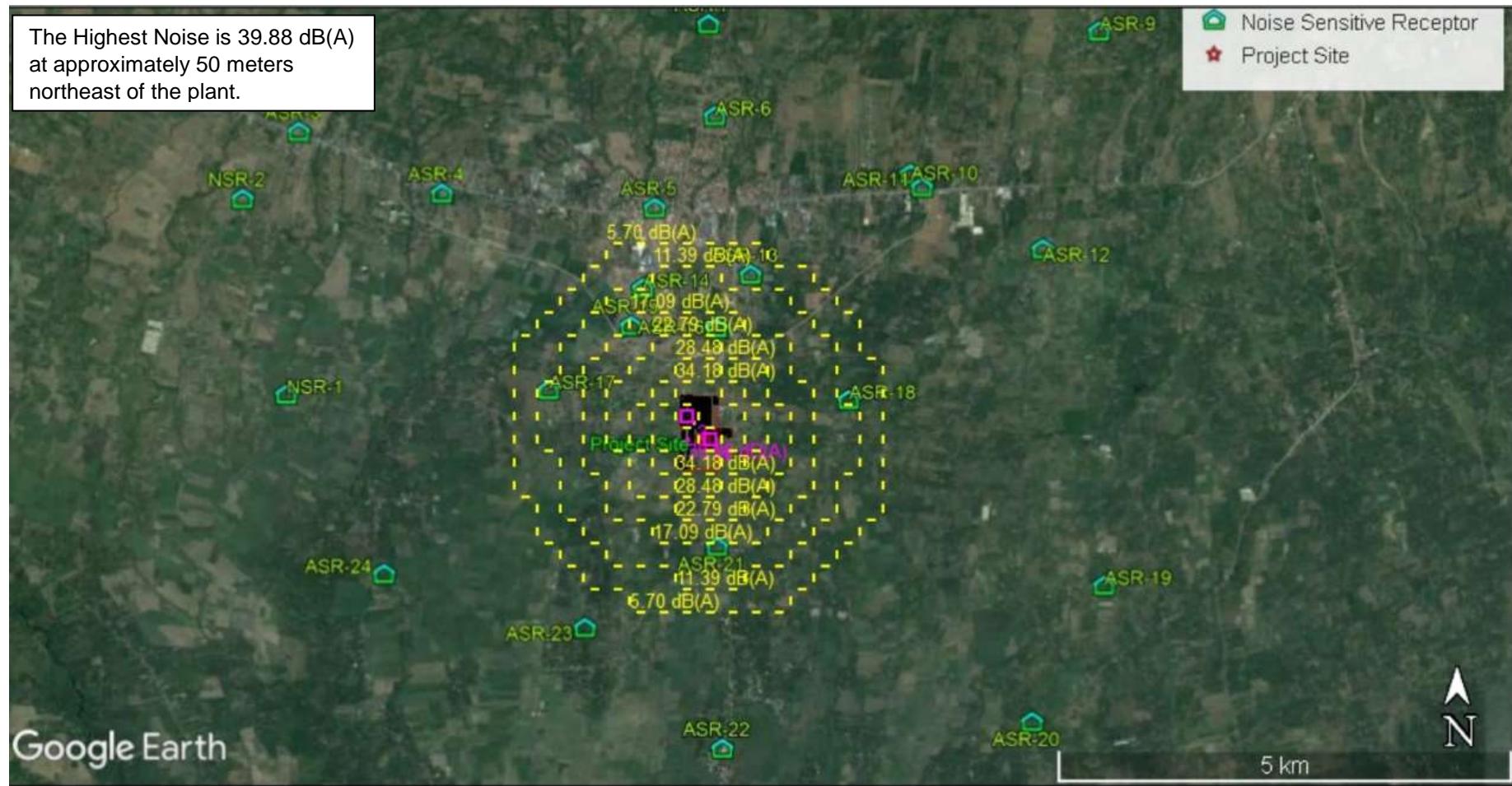


Figure 2.3-33. Plot of Noise Isolines for Operation

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; it is recommended that 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

Candelaria

Historical population

The population of Candelaria grew from 29,928 in 1960 to 117,434 in 2015, an increase of 87,506 people. The latest census figures in 2015 denote a positive growth rate of 1.15%, or an increase of 6,864 people, from the previous population of 110,570 in 2010.

Table 2.4.1.1.1: Population Growth Rate

Census date	Population	Growth rate
1960 Feb 15	29,928	—
1970 May 6	44,031	3.85%
1975 May 1	49,384	2.33%
1980 May 1	54,629	2.04%
1990 May 1	69,969	2.51%
1995 Sep 1	80,733	2.72%
2000 May 1	92,429	2.94%
2007 Aug 1	105,997	1.91%
2010 May 1	110,570	1.55%
2015 Aug 1	117,434	1.15%

Source: www.philAtlas.com

Table 2.4.1.1.2: Population per Barangay

Barangay	Population percentage(2015)	Population (2015)	Population (2010)	Change (2010-2015)	Annual Population Growth Rate (2010-2015)
Buenavista East	2.04%	2,397	2,206	8.66%	1.59%
Buenavista West	3.06%	3,589	3,340	7.46%	1.38%
Bukal Norte	2.19%	2,569	2,358	8.95%	1.65%
Bukal Sur	6.10%	7,166	6,573	9.02%	1.66%
Kinatihan I	1.47%	1,732	1,671	3.65%	0.69%
Kinatihan II	1.44%	1,688	1,659	1.75%	0.33%
Malabanban Norte	9.94%	11,673	11,446	1.98%	0.37%
Malabanban Sur	7.77%	9,123	7,290	25.14%	4.36%

Barangay	Population percentage(2015)	Population (2015)	Population (2010)	Change (2010-2015)	Annual Population Growth Rate (2010-2015)
Mangilag Norte	1.91%	2,245	2,114	6.20%	1.15%
Mangilag Sur	5.26%	6,176	5,881	5.02%	0.94%
Masalukot I	4.90%	5,760	6,025	-4.40%	-0.85%
Masalukot II	2.09%	2,450	2,273	7.79%	1.44%
Masalukot III	0.87%	1,020	1,026	-0.58%	-0.11%
Masalukot IV	0.59%	695	603	15.26%	2.74%
Masalukot V	0.54%	632	572	10.49%	1.92%
Masin Norte	5.69%	6,684	6,357	5.14%	0.96%
Masin Sur	4.54%	5,333	5,165	3.25%	0.61%
Mayabobo	1.63%	1,913	1,814	5.46%	1.02%
Pahinga Norte	11.52%	13,530	12,378	9.31%	1.71%
Pahinga Sur	2.46%	2,890	2,517	14.82%	2.67%
Poblacion	4.95%	5,809	6,040	-3.82%	-0.74%
San Andres	4.30%	5,048	4,587	10.05%	1.84%
San Isidro	3.60%	4,222	4,158	1.54%	0.29%
Santa Catalina Norte	5.22%	6,132	6,135	-0.05%	-0.01%
Santa Catalina Sur	5.93%	6,958	6,382	9.03%	1.66%
Candelaria Total		117,434	110,570	6.21%	1.15%

Malabanban Sur

Historical Background

Houses of the early settlers in Malabanban were located on the edge or sides of the Quiapo River. Then, it was just a shallow river; no large water flowed due to many small branches that draw waters from the slope of Mount Banahaw. As time went by, cutting off trees and “kaingin” started to exist resulted to deforestation which exposes direct sunlight to smaller plants and shrubs. Flooded also started to occur during that time this deepened and widened the rivers of Quiapo and Masin. Quiapo was read and spelled as Kuyapo in tagalog.

Before, the houses are built paralleled to each other, clean water flows being drawnand fetchedby residents for drinking and they are hunting “bagutbot” fish, big cat and mud fishes.

After a storm which poured a lot of rainfall, the Quiapo River will overflow and flood the community especially those at the riverside.

Brgy. Malabanban Sur is one of the seven (7) pioneering barangays of Candelaria. However, the origin of Malabanban as a name remained unknown.

Other details of Brg. Malabanban Sur:

• Population	-	7,290 (2010 Census)
• Number of Households	-	1,476
• Average Household Size	-	4 - 5
• Number of Families	-	equals to (=) or greater than (>) 1,476
• Employed	-	2,075
• Land Area	-	663.58 hectares (3.79% to total)
• Population Density	-	average of 14 people per hectare
• Urbanity	-	Urban
• Number of Puroks / Sitios	-	7
• Name of Puroks / Sitios	-	PUROK 1,2,3,4,5,6 AT 7
• General Description	-	Plains / Flat Terrain
• Boundaries	-	Malabanban Norte (North), Mangilag Sur & San Andres (East), Pahinga Norte (West) & Sta. Catalina Norte & Sur (South)
• Distance from Brgy. Pob.	-	1.5 – 2 kilometers
• Average travel time	-	10 mins
• Major Source of Livelihood	-	Agriculture, Commercial,
• Commercial Areas	-	Crossing Candelaria By-Pass Road & San Juan Provincial Road
• Number of Roads	-	9 (5.50 km in total length)
• Number of Bridges	-	1 (Spillway)
• Water Source	-	Candelaria Water District, Barangay Water System, Communal Faucets, Deep Well, Commercialized Bottled Water
• Electricity	-	MERALCO
• Info-Com	-	GTSi, PLDT, Globe, Sun Cellular, Smart
• Health Services	-	Barangay Health Center,
• Social Welfare Services	-	Day Care Services, Counseling & Rehabilitation,
• Supplemental Feeding	-	
• Education	-	Malabanban Sur ES,
• Infrastructure	-	Barangay Hall, Farm to Market Roads,

Provided below is the household map of Brgy. Malabanban Sur.

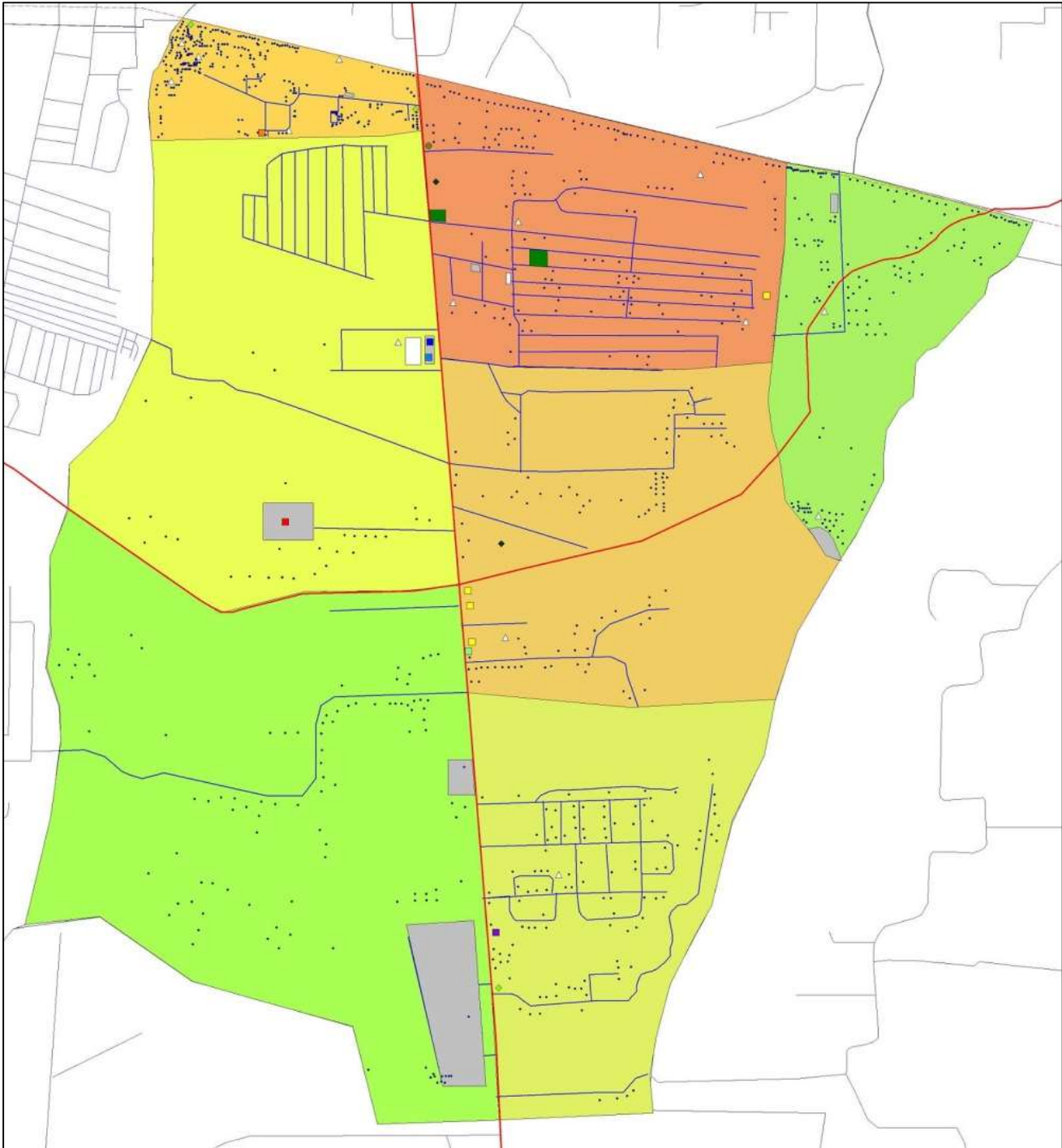


Figure 2.4.1: Household Map of Brgy. Malabanban Sur

2.4.1.2 Land Area

The municipality of Candelaria is a landlocked municipality of Quezon. It has a land area of 129.10 square kilometers or 49.85 square miles which constitutes 1.44% of Quezon's total area. Its population as determined by the 2015 Census was 117,434. This represented 6.33% of the total population of Quezon province, or 0.81% of the overall population of the CALABARZON region. Based on these figures, the population density is computed at 910 inhabitants per square kilometer or 2,356 inhabitants per square mile.

2.4.1.3 Sex and Age Profile

Population by age group

According to the 2015 Census, the age group with the highest population in Candelaria is *10 to 14*, with 12,604 individuals. Conversely, the age group with the lowest population is *75 to 79*, with 900 individuals.

Table 2.4.1.3.1: Population by Age Group

Age group	Population (2015)
Under 1	2,427
1 to 4	9,411
5 to 9	12,374
10 to 14	12,604
15 to 19	11,453
20 to 24	10,732
25 to 29	9,453
30 to 34	8,679
35 to 39	8,330
40 to 44	7,141
45 to 49	6,250
50 to 54	5,420
55 to 59	4,591
60 to 64	3,506
65 to 69	1,964
70 to 74	1,272
75 to 79	900
80 and over	927
Total	117,434

2.4.1.4 Literacy Rate and Educational Attainment

Public Education

Much like most public schools in the country, there is a lack of educational resources in terms of teachers and facilities in Candelaria. Although school administrators are effective, teachers are competent and the school receives sufficient support from the government, the municipality is still not conducive to quality public education, as there are crimes being committed on school premises (i.e., robbery and vandalism) and students have unsupportive parents, resulting in the high dropout rate and increase in out-of-school youth. Complaints from the Central Office of the Department of Education, DText, and the radio are aired concerning them.

Suggestions made in improving matters included the further training of teachers, as well as the installation of internet connection for connectivity.

Private Education

On the contrary, private schools are not acknowledged and supported less, and there is a declining trend in enrollment. It is from private schools that competent teachers in public schools come from; and they transfer from the latter because they are provided better compensation. It is suggested to the Department of Education that a request for clearance be made by a teacher two (2) years before transferring to a public school.

Despite the number of students willing to study, students also transfer from private schools to public schools because the latter is a less expensive option. Also, the weak implementation of the truancy law and the attractiveness of computer shop promos lead students to cease going to school.

2.4.2 Migration Profile

2.4.3 Indigenous People

There is no recorded settlement or presence of IPs in Candelaria and in Brgy. Malabanban Sur.

2.4.4 Historical and Cultural Heritage

An array of potential tourist destinations in Candelaria can be developed in various sites of the town such as historical landmarks, natural springs and waterfalls, resorts and parks. With the additional scenery of its natural environment (Mt. Banahaw) and resources like the different agricultural crops, and vegetables, it is possible that it can be a haven for tourism. The top two (2) potential tourist attractions in Candelaria can be found within the protected areas, the Adarna Waterfalls in Masalukot IV and the beautiful landscapes at the slopes of Mt. Banahaw in Masalukot V. These tourist destinations may be further explored including the upgrading of the present facilities of some attractions in order to compete with other tourist spots nearby. There are at least 11 tourism establishments in Candelaria that could be further developed into natural and historical attractions

Table 2.4.4.1: Different Attractions in Candelaria

NAME	TYPE OF ATTRACTION	FACILITIES	OWNERSHIP	MEANS OF TRANSPORTATION	ACCESS ROAD	
					TYPE	CONDITION
Ancestral Houses	Historical	Antiques	Private Sector	Land	Paved	Good
Del Valle Mansion	Historical	Antiques	Private Sector	Land	Paved	Good
San Pedro Parish Church	Historical	Antiques	Private Sector	Land	Unpaved	Good
Plaza Narra	Man-Made	Concrete Stage & Ground	Private Sector	Land	Paved	Good
Peter Paul Phils. Corp	Man-Made	Desiccated Coconut Factory	Private Sector	Land	Unpaved	Good
Tilarog Springs	Natural	River Water Pool, Sight Seeing	Private Sector	Land	Unpaved	Good
Adarna Waterfalls	Natural	Beautiful Scenery	Protected Area	Land	Unpaved	Good
Foot of Mt. Banahaw	Natural	Beautiful Scenery	Protected Area	Land	Unpaved	Good
Mayabobo Hills	Natural	Beautiful Scenery	Protected Area	Land	Unpaved	Good
Belen Camp Site	Natural	Beautiful Scenery	Protected Area	Land	Unpaved	Good
Malaseña Hills	Natural	Beautiful Scenery	Protected Area	Land	Unpaved	Good

Source: Tourism Office, 2008

2.4.5 Existing Social Infrastructure and Services

2.4.5.1 Power and Water Supply

Power Supply

The sole distributor of electricity in Candelaria is the Manila Electric, Railroad and Light Company (MERALCO), energizing the majority of households and establishments in the municipality. MERALCO buys its electricity from generating companies, which distribute it through transmission lines currently owned by the Philippine National Grid Corporation. Electricity bought from generating companies are of higher voltage than what is usable by standard electric sockets, so it is then distributed to individual transformers which lower the voltage of the electricity purchased to be suitable for residential and business use. Power for the province is produced by the Quezon Power Philippines Limited (QPPL), using a coal-fired power plant located in Mauban, Quezon.

Water supply

The three primary rivers of Candelaria are Masin River, Quiapo River, and Taguan River which passes through the boundaries of some barangays of Candelaria. These areas have access to fresh, potable water, from natural springs namely, Adarna Spring, Ayusan Spring, Pansol Spring, Palos Spring, and the Yamot Spring. Residents benefit from the year-round water supply, but the seasonal variations and conditions have caused a visible shortage of free-flowing water, evident in the intermittent streams and creeks, which experience short-lived droughts during the dry season.

The Candelaria Water District (CWD) is a newly established office located in the Municipal Hall of Candelaria. It is responsible for the distribution and administration of water in Barangay Poblacion and neighboring Barangays. In 2012, the Municipality of Candelaria was granted a 7-Million Peso water source project by the National Government which aims to provide the Municipal Public Market a source of clean potable water. In partnership with the CWD future plans for the overhaul of pipes and a new system of water distribution in the municipality are underway.

The barangay located in the northernmost parts of Candelaria, Masalukot IV, receives fresh water from a nearby spring, which has the capacity to supply the whole barangay with fresh water. Although during the dry season, not all of the Barangay can be accommodated from the source of water. Because the locals of the immediate Barangay have this source of water, they take it upon themselves to create their own system of pipes to distribute water within the barangay and also to the neighboring areas. This system is known as the "Barangay Water System" which is followed by most of the barangays in the municipality. The Barangay Water Systems are responsible for collection and distribution of water to the households and other structures in their vicinity. The other Barangays that are located far from natural sources of water are served by the Local Water System wherein water is distributed by private water providers, these are Barangays Poblacion, Masalukot I, II, III, Mayabobo, Bukal Norte, Mangilag Norte, Malabanban Norte and MasinNorte.

2.4.5.2 Communication

Telephone Service

The primary telephone service provider in the municipality is Digitel, showing the growing presence of PLDT in the area. Digitel is under the PLDT group of companies. The telecom company serves mainly the Poblacion area, due to the lack of demand from the other barangays.

Mobile Phone Service

Smart communications, Globe Telecom, and Sun cellular are the major mobile service providers in the Philippines, and their coverage reaches Candelaria and most of its barangays with the exception of some areas in the uplands going toward Mt. Banahaw. Each of the providers have put up their cell sites in different areas of the municipality. Their mobile network capability which the companies are able to provide utilizes 2G and 3G Technology, wherein the 2G capability can handle the voice and message delivery while the 3G network capability adds the extra service of high-speed internet.

Internet Service

Internet Service providers such as Smart Communications, Globe Telecom, Sun Cellular can provide wireless Internet Service to the Municipality of Candelaria utilizing 2G and 3G networks. PLDT and Globe have set-up wired transmissions which cater to the municipality but are limited only to the Poblacion area due to lack or low demand in other barangays. Both deliver data transmissions through copper cables. The nearest network service center of PLDT is located in the city of Lucena, while DIGITEL has its main network center in Barangay Masalukot I.

TV and Cable Service

Cable Television is provided by three companies namely, Candelaria Cable Television with its office located in Barangay Poblacion, Lucky Seven Cable TV located in Malabanban Norte, and Dreams Broadcasting Network in Masalukot I. They all utilize the Analog Cable distribution. Digital Satellite cable providers have started to boom in the municipality, with companies like Signal HD and Dream Satellite showing promise as an alternative to wired cable television. Digital Satellite cable providers supply its customers with a Satellite dish and a "digibox" which picks up wireless data and interprets it into watchable channels.

Radio Station

Located at the second floor of the South Emerald building, is the studio of the station 103.1 "The Edge - Spirit of the South" radio station, managed at present by Raymond Gonzales under the stage name "DJ Mon". The station uses the broadcasting tower located in Barangay Masin Norte. It utilizes a 1000Watt Exciter with a 30Watt Transmitter IVR. The licensing of the station allocates broadcasting to most of the provinces in CALABARZON by the National Telecommunications Company.

Postal Service

Both public and private postal services are available in Barangay Poblacion. The postal office of Candelaria is located inside the Municipal Hall in Barangay Poblacion. The office caters to the residents of the municipality serving as a branch of the National Post Office. The operation of the office is handled by the Local Government Unit. The private postal companies like LBC and JRS Express also have branches in the municipality and cater to the needs of the community.

2.4.5.3 Education

Candelaria has one (1) private college and one (1) state university for the tertiary level and serve students not only from Candelaria but from other municipalities as well. For the elementary and secondary education, the facilities and services of 25 public and 11 private elementary schools, four (4) public and three (3) private junior high schools, and one (1) public and three (3) private senior high schools can be availed.

2.4.6 Health and Safety Profile

2.4.6.1 Public Health Services

Health services are one of the basic services that are well provided in Candelaria. There are three (3) hospitals that cater to the medical needs of the residents. The Candelaria Municipal Hospital, commonly known as the Nursery Hospital, located at Barangay Masin Norte; Peter Paul Medical Center, situated at Barangay Poblacion and the newly-established United Candelaria Doctors Hospital in Barangay Mangilag Sur, all provide medical services for treatment of a wide range of illnesses or diseases.

Specifically, the Rural Health Unit renders the following programs:

Family Health Cluster

- Maternal and Child Health Care
- EPI (Expand Program on Immunization)
- Newborn Screening
- Family Planning Program
- Dental Health Program

- Nutrition Program

Non-Communicable Disease Cluster

- Cancer Control Program
- Cardiovascular Prevention and Control Program
- Renal Disease Control Program
- Chronic Obstructive Pulmonary disease
- Diabetes
- Person with Disabilities Program
- Healthy lifestyle Program
- Smoking Cessation Program
- Cessation Program
- Drug Abuse Prevention Program

Infection Disease Cluster

- Tuberculosis Control Program
- Control of Diarrheal Disease
- Malaria Control Program
- Dengue Control Program
- Rabies Control Program
- Control of Acute Respiratory Infection
- Sexually Transmitted Disease Control Program/HIV
- Leprosy Control Program

Health Situation, Environmental Awareness and Utilities

The top ten (10) leading causes of Morbidity and Mortality in Candelaria in 2012 are presented in Table 2.4.6.1.1 and Table 2.4.6.1.2 below.

Ten Leading Causes of Mortality

The the leading causes of mortality for 2012 as per records of the RHU were cardio-vascular disease/hypertension, cancer, renal failure, ischemic heart disease, gunshot wound, pneumonia, withdrawal syndrome/old age/ malnutrition, chronic obstructive pulmonary disease, vehicular accident and diabetes mellitus. In 2010, the number one cause of death was acute myocardial infarction. In 2011 and 2012, cardio-vascular disease or hypertension was the number one cause of mortality while cancer was the number two cause of mortality in 2010, 2011 and 2013 (see Table 2.4.6.1.1).

Table 2.4.6.1.1: Ten Leading Causes of Mortality, 2010-2012					
2010		2011		2012	
CAUSES	NO	CAUSES	NO	CAUSES	NO
Acute Myocardial Infarction	88	Cardio-vascular Disease/ Hypertension	106	Cardio-vascular Disease/ Hypertension	82
Cancer	78	Cancer (All Types)	75	Cancer (All Types)	60
CVA Hemorrhagic	64	Myocardial Infarction	46	Renal Failure	49
Renal Failure	48	Renal Failure	45	Ischemic Heart Disease	48
Withdrawal Syndrome	37	Withdrawal Syndrome	44	Gunshot Wound	39
COPD	35	Ischemic Heart Disease	36	Pneumonia	38
Pneumonia	28	Gunshot Wound	29	Withdrawal Syndrome	33
Gunshot Wound	25	Chronic Obstructive Pulmonary Disease	27	Chronic Obstructive Pulmonary Disease	20
Diabetes Mellitus	17	Pneumonia	23	Pneumonia	19
CVD	16	Diabetes Mellitus	22	Diabetes Mellitus	13
Source: RHU/ Hospital Records/ Local Civil Registrar					

Morbidity

Morbidity is the incidence of illness or sickness. According to the RHU, the leading causes of morbidity for 2012 were acute respiratory infection, systemic viral infection (fever), diarrhea, hypertension, urinary tract infection, asthma, dog bite, pneumonia, scabies and peptic ulcer (see Table 2.4.6.1.2).

Table 2.4.6.1.2: Ten Leading Causes of Morbidity, 2010-2012					
2010		2011		2012	
CAUSES	NO.	CAUSES	NO.	CAUSES	NO.
Acute Upper Respiratory Tract Infection	1,925	Cough and Colds	2,522	Acute Upper Respiratory Tract Infection	11,656
		Fever	1,661	Systemic Viral Infection	3,338
Systemic Viral Infection	1,706	Diarrhea	425	Diarrhea	817
Pneumonia	455	Pneumonia	359	Hypertension	518
Diarrhea	425	Wounds	312	UTI	491
Wounds	408	UTI	220	Asthma	457
Hypertension	392	Skin Disease	217	Dog Bite	447
Asthma	238	Asthma	199	Pneumonia	438
Skin Disease	219	Sore Throat	184	Scabies	161
Urinary Tract Infection	213	Hypertension	161	Acute Peptic Ulcer Disease	132

Source: RHU/ Hospital Records/ Local Civil Registrar

Births

One of the most important health indicators is the Crude Birth Rate which is defined as the ratio between the number of live births and number of individuals in a specified time period often expressed as the number of live births per 1,000 population in a given year (see Table 2.4.6.1.3). A total of 2,309 live births were recorded by the RHU resulting to a crude birth rate of 18.36%.

According to the RHU, the crude death rate for 2012 was 3.8 (see Table 2.4.6.1.4). From the total of 486 deaths, 16 (3.2%) were infant deaths, 2 (0.41%) were maternal deaths, 2 (0.41%) were neonatal deaths and 318 (65%) were deaths of people aged 50 years and over.

The recorded infant mortality rate of the municipality for 2012 according to the RHU was while the maternal mortality rate was 0.8 (see Table 2.4.6.1.5).

Table 2.4.6.1.3: General Health Situation of Candelaria, 2007-2012						
HEALTH INDICATOR	2007	2008	2009	2010	2011	2012
Crude Birth Rate (BCR)	23.04	15.09	28.54	19.63	17.67	18.36
Crude Death Rate (CDR)	5.14	4.16	3.8	2.26	4.51	3.87
Infant Mortality Rate (IMR)	2.8	8.1	3.8	6.3	4.2	6.9
Maternal Mortality Rate (MMR)	0.5	0	0	0.9	0	0.8

Crudes Rates are per 1,000 population.

Infant Mortality and Maternal Mortality Rates are per 1,000 live births. Source: Rural Health Unit (Brgy. Poblacion Candelaria, Quezon)

Among the total live births, 46.86% were delivered by doctors, 40.84% by midwives, 8.53% by trained *hilots* and 3.77% by nurses (see Table 2.4.6.1.4). More than half of the total live births, 53.49% were delivered at hospitals. As for the remaining live births, 21.09% were delivered at home and 25.42% were delivered at lying-in clinics (see Table 2.4.6.1.5).

Table 2.4.6.1.4: Births by Attending Personnel, 2007-2012

HEALTH ATTENDANT	2007	2008	2009	2010	2011	2012
Physicians	907	511	683	850	1,226	1,082
Nurses	51	71	13	29	10	87
Midwives	725	564	1,826	902	702	943
Trained Hilots	405	454	620	421	198	197
Untrained Hilots	21	0	0	0	0	0
Others	2	0	0	0	0	0
TOTAL	2,111	1,600	3,142	2,202	2,136	2,309
Source: RHU (Brgy. Poblacion Candelaria, Quezon)						

Table 2.4.6.1.5: Births by Place of Delivery, 2007-2012						
HEALTH ATTENDANT	2007	2008	2009	2010	2011	2012
Home	1,022	949	1,908	485	727	487
Hospital	1,082	651	992	1,089	1,215	1,235
Others	7	0	242	628	194	587
TOTAL	2,111	1,600	3,142	2,202	2,136	2,309
Source: RHU (Brgy. Poblacion Candelaria, Quezon)						

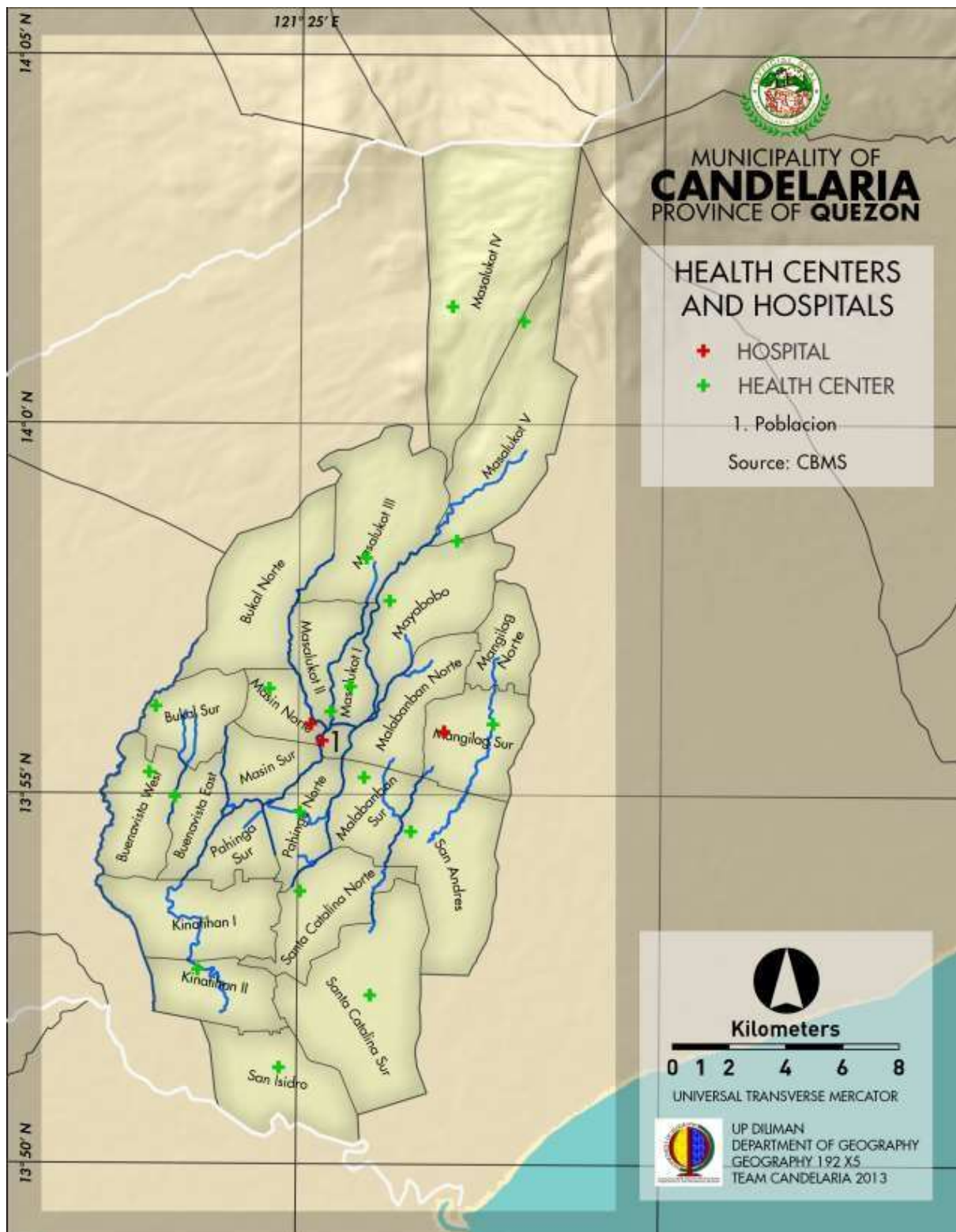


Figure 2.4.6.1: Health Centers and Hospitals in Candelaria

2.4.6.3 Diseases Due to Climate Change

According to Dr. Fely Marilyn Lorenzo of the Commission on Higher Education (CHED), climate change exacerbates the conditions that make it more favourable for diseases to set in. For example, in dengue, the vectors can multiply faster and become fiercer. However, even if there are a lot of mosquitoes, if there is no source of infection, there will be very few cases.

The Philippines has been a dengue hotspot in recent years. Dengue cases in 2015 saw a 64.8 percent increase from the previous year, with a DOH official attributing it to climate change. While the nationwide tally for the first half of 2017 has decreased by 36.8 percent from the year prior, Metro Manila experienced a 24.9 percent increase in dengue victims. This spike is linked to the high population density of areas which is ideal for transmitting diseases. This is especially evident in poor communities, which suffer from poor hygiene and stagnant water occasionally brought by flooding episodes.

Climate-related health issues become more critical in rural areas, which lack infrastructures and services common in urban areas such as water distribution systems. For instance, the spread of cholera and typhoid fever can be worsened by poor water quality, lack of electricity access, and improper sanitation. In shoreline areas, the storm surge due to typhoons may lead to saltwater infiltration of groundwater resource, exposing its inhabitants to water-borne diseases afterwards.

2.4.7 Socio Economic Profile

2.4.7.1 Local Economy

Candelaria, a land-locked municipality, is primarily agricultural where locals depend on crop farming, livestock and poultry, as well as on manufacturing industries. The local economy of Candelaria has been self-sufficient as shown by the growth in its revenues in the last 5 years.

Industrial Sector

Manufacturing corporations and establishments in Candelaria engage in coconut oil production and exportation of desiccated coconuts. Several top manufacturing business entities and corporations are in the municipality and most of them cater to both local and export markets.

The listed establishments are located within the one kilometer radius of the Poblacion area. Most of them are found in Barangays Malabanban Norte and Sur, Mangilag Sur and Pahinga Norte, probably because of access to the main road for easier transportation of goods. These industrial establishments constantly provide an increase in revenue and employment to the locality (see *Table 3.11*). Peter Paul Philippines Corporation is considered the largest private manufacturing business entity that contributes to the revenues of Candelaria with regard to its gross sales, greatly helping the municipality in their income. Thus, more people are engaged in the manufacture of coconut oil and desiccated products due to the increasing demand for such products.

Table 2.4.7.1: Industrial Establishment, Process and Raw Materials

NAME OF INDUSTRIAL ESTABLISHMENT	PROCESS	RAW MATERIAL		PRODUCTION			PRODUCT MARKET	
		MATERIAL	SOURCE	PRODUCT	VOLUME	VALUE	LOCAL	EXPORT
Tongsan Industrial Development Corp.	Food Processing / Extracting, Milling	Coconut	Locally-Produced	Copra Cake, Oil, Crude and Refined Oil	*	*	✓	✓
Pacific Royal Basic Foods Inc.	Food Processing / Extracting	Coconut / Copra	Locally-Produced	Desiccated Products / Soap	*	*	✓	✓
Peter Paul Phil Corp	Food Processing / Packing	Coconut / Copra	Locally-Produced	Desiccated Products / Virgin Coconut Oil / Coco Water	*	*	✓	✓
Primex Coco Products Inc.	Food Processing	Coconut / Copra	Locally-Produced	Desiccated Products	*	*	✓	✓
Superstar Coconut Products Co. Inc. / Licup Oil Mill	Food Processing / Extracting	Coconut / Copra	Locally-Produced	Desiccated Products, Crude Oil, Coco Water	*	*	✓	✓
N.E.P. Co. Inc.	Drying / Extracting	Coconut	Locally-Produced	Dried Coconut Husks	*	*	✓	✓
*No Data Source: Municipal Planning and Development Office, Primary Survey, 2010								

Commerce and Trade

Candelaria has numerous wholesale and retail businesses especially that the locality is rapidly urbanizing. This is evident along the main streets of Poblacion where commercial establishments are proliferating. Most of them are restaurants, bakeries, grocery stores, hardware, hotels and other real estate businesses. Also in other barangays there are a lot of small sari-sari stores that offer a wide range of grocery products like canned goods, hygienic products and many more. At present, there is a total inventory of 812 registered commercial establishments (see Table 3.12). Most prominent of these are wholesale, retail trade, and real estate leasing.

Brgy. Poblacion is considered the most urbanized and where the central business district of Candelaria is found. Sari-sari stores, general merchandisers, leaseholders, manufacturers, money changers, lending and other establishments make the main streets busy. There are four main commercial areas that are located in the municipality, serving as the center of commerce and other services (see Table 3.13). Commerce and trading in the municipality are largely centered along the strip of Maharlika Highway and other municipal roads that cater to the local market.

Table 2.4.7.1: No. of Establishments per Economic Activity and Generated Employment

ECONOMIC ACTIVITIES	2008		2009		2010	
	NO. OF ESTABLISHMENTS	NO. OF EMPLOYMENT	NO. OF ESTABLISHMENTS	NO. OF EMPLOYMENT	NO. OF ESTABLISHMENTS	NO. OF EMPLOYMENT
Wholesale and Retail Trade	422	857	409	1,010	416	800
Hotel & Restaurants, Transport & Storage	76	330	60	298	88	207
Communication	23	78	12	61	6	51
Financial Intermediation	53	212	50	221	75	284
Real Estate Leasing and Business Activities	71	195	70	147	114	1,107
Public Administration and Defense	27	127	27	271	27	339
Education	11	231	14	218	15	151
Health & Social Work	17	33	14	109	15	117
Other Community, Social and Personal Service Activities	133	871	109	1,148	56	98
Private Household with Employed Persons	*	*	*	*	*	*
Extra Territorial Organizations and Bodies	*	*	*	*	*	*
TOTAL	833	2,934	765	3,483	812	3,154
*No Data Source: LGU Business Permits Department / Primary Survey						

2.4.7.2 Social Welfare

The Office of the Municipal Social Welfare and Development Officer (OMSWDO) of Candelaria, Quezon is located at the Local Government Unit Municipal Building in Barangay Poblacion. The office provides different types of services that cater to the disadvantaged sectors of the society. These services include the care of children, the aged, the disabled and the mentally ill, among others.

The types of clientele served by the OMSWO are defined by the NSCB as follows:

- Disadvantaged Children are those aged 0-6 years old who are malnourished, orphaned, homeless, victims of armed conflicts or from poor families.
- Disadvantaged Youth are individuals from 7-17 years of age who, due to poor parents, are out of school, sickly, alcohol/drug addicts, youth offenders or victims of sexual abuse or exploitation.
- Disadvantaged Women are classified under this group if they are 18-59 years old who have been deprived of literacy opportunities, victims of abuse, exploitation, involuntary prostitution or illegal recruitment.
- Disadvantaged Families are those who belong to the bottom 30% of the income strata.
- Disadvantaged Communities are those that have inadequate resources, facilities or utilities such as roads, water system, electricity and absence of natural resources.
- Distressed Individuals/Families/Groups include needy evacuees, squatters, cultural minorities or refugees, and other persons who are victims of social conflicts or other upheavals and disasters/calamities that are both natural and man-made.

Social Case Study Reports

Social case studies are conducted by the OMSWDO to evaluate potential recipients of social welfare and development services. The potential recipients are evaluated primarily based on their economic capacities.

The results of the social case studies, the Social Case Study Reports (SCSR) help determine who among the potential recipients will be given assistance from the OMSWDO through their various

programs and services. Depending on their needs, the beneficiaries may also be referred by the OMSWDO to other agencies such as the Philippine Charity Sweepstakes Office (PCSO), the Philippine General Hospital (PGH), the Children's Hospital and the National Center for Mental Health.

Since 2007, there has been a continuous increase in the total number of social case study reports per year. In 2012, the OMSWDO conducted a total of 653 social case studies (see Table 2.4.7.2.1). The majority of those social case studies (82.70%) were conducted in the urban barangays (see Table 2.4.7.2.1). This has been the case every year since 2007.

Table 2.4.7.2.1: Social Case Studies Conducted in Urban and Rural Barangays, 2007-2012						
Barangay	2007	2008	2009	2010	2011	2012
Urban	242	226	152	385	435	540
Rural	37	50	39	84	68	113
TOTAL	279	276	191	469	503	653

Source: MSWDO

Basic Social Services

Basic social services of the municipality aim to provide opportunities for the social and economic growth of individuals or groups that belong to the disadvantaged sectors of the society. The basic social services offered by the government through the OMSWDO include Day Care Services, Supplemental Feeding, Self-employment Assistance, Pre-marriage Counseling, Small Town Lottery and Social Pension among others (see Table 2.4.7.2.2)

Table 2.4.7.2.2: Recipients of Basic Services, 2007-2012						
PROGRAM/SERVICE	2007	2008	2009	2010	2011	2012
Aid to individuals in Crisis situations	243	301	323	275	248	559
Day Care Services & Supplemental Feeding	1,057	1,268	962	1,058	1,024	1,164
Pre-marriage Counseling	64	58	92	96	76	60
Small Town Lottery	492	621	990	1,080	1,117	1,030
Social Pension	*	*	*	*	62	27

*No Data

Source: MSWDO

Aid to Individuals in Crisis Situations (AICS)

One of the basic services offered by the OMSWDO is financial assistance to the disadvantaged, also termed as Aid to Individuals in Crisis Situations (AICS). Through this program, individuals who are most in need receive financial assistance for expenses such as hospital fees, medicine costs, and burial expenses. According to the OMSWDO, the annual budget allocation for this service from the Internal Revenue Allotment (IRA) is 1.5 million pesos.

An increase in the number of recipients of the AICS program has been observed every year since 2007. In 2012, there were a total of 559 recipients of the AICS program (see Table 2.4.7.2.3). Most of the recipients in 2012 (74.60%) came from urban barangays.

Table 2.4.7.2.3: AICS Recipients from Urban and Rural Barangays, 2007-2012						
Barangay	2007	2008	2009	2010	2011	2012
Urban	193	254	257	217	169	417
Rural	50	47	66	58	69	142
TOTAL	243	301	323	275	248	559

Source: MSWDO

Day Care Services

A Day Care Service is defined by the NSCB as a type of arrangement where substitute mothering is provided to disadvantaged pre-school children and street children during the part of the day when mothers cannot attend to them.

Among the 25 barangays in Candelaria, 21 barangays have day care centers with 11 having more than one center. Only four barangays do not have a day care center. These barangays are Buenavista West, Bukal Norte, Masalukot III and Masalukot IV.

In calendar year 2012-2013, there were a total 33 day care centers, 33 day care workers and 1,754 day care center students in Candelaria.

Supplemental Feeding

The Supplemental Feeding Program provides underweight or malnourished children with food assistance in order to improve their nutritional status. The OMSWDO incorporates this into the Day Care Service program. Hence, the beneficiaries of the Supplemental Feeding Program are also the day care students.

The nutritional status of the day care center students are closely monitored by the OMSWDO. The children's weights are taken before and after the program to check whether there are improvements in their body mass indices.

Upon the entry of the 1,174 children to the Day Care and Supplementary Feeding program in November 2012, 36 children (3.07%) were severely underweight, 256 children (21.81%) were underweight, 754 children (64.22%) were normal and 128 children (10.90%) were overweight. Three months later, on February 2013, a second weighing was conducted to track the improvements in the children's nutritional status. The results of the second weighing showed that only 1 child (0.09%) was severely underweight, 124 children (10.56%) were underweight, 840 children (71.55%) were normal and 62 (5.28%) children were overweight. Weight records of 147 children (12.52%) were not available because they might have been absent during the second weighing.

Senior Citizen

In accordance with the Expanded Senior Citizens Act of 2003 (R.A. 9257), the LGU provides support for the welfare of its senior citizens through various programs and services from OMSWDO. The OMSWD also issues the senior citizen ID. Upon availing of a senior citizen ID, an elderly is entitled to a 20% discount on medicines and 5% discount on grocery items and agricultural products. In 2012, a total of 1,209 senior citizens applied for their senior citizen ID (*see Table 2.4.7.2.4*).

Table 2.4.7.2.4: Social Pension Recipients	
YEAR	SOCIAL PENSION RECIPIENTS
2011	62
2012	27
2013 (as of April)	20
Source: MSWDO	

Self-Employment Assistance- Kaunlaran (SEA-K)

The Self-Employment Assistance-Kaunlaran (SEA-K) is a capability program of the Department of Social Welfare and Development (DSWD) in coordination with the local government units. Through the SEA-K, small scale entrepreneurs are granted loans for start-ups of small businesses and enterprises. These loans are payable within ten months to one year with zero percent interest.

Training and Workshop

The OMSWDO also holds various Practical Skills Development Trainings and Livelihood Workshops with the help of different NGOs. Various workshops have already been spearheaded by the

OMSWDO where the participants are taught how to make products such as bags from tetra packs and coasters and other export-quality products from paper.

Support for Women and Children

The OMSWDO, in cooperation with the Philippine National Police (PNP), actively takes part in the implementation of laws concerning the rights of women and children. The OMSWDO is also concerned with issues of child custody and the welfare of children in conflict with the law (see Table 2.4.7.2.5). The Municipality of Candelaria has also issued an Executive Order for the protection of both Women and children's rights.

Table 2.4.7.2.5: Reported Cases to the OMSWDO Concerned with Women and Children, 2007-2012

CASE	2007	2008	2009	2010	2011	2012
Child Abuse	2	10	5	9	32	14
Violence Against Women and Childen	7	10	8	13	11	20
Child Custody	4	4	7	12	12	5
Children in Conflict with the Law	10	26	27	35	36	46

Source: MSWDO

Special Services

Government Internship Program (GIP)

The DSWD and their OMSWDO offer internships for out-of-school-youth, for college graduates who are not yet employed and for students who wish to earn during the summer vacation. Those who wish to enter the internship program undergo an application process. The applicants are evaluated by the regional offices. As of April 2013, there are 13 interns under the GIP.

2.4.8 Public Access

2.4.8.1 Transportation and Road Networks

In 2008, Candelaria had an inventory of 10 bridges and spillways distributed around the municipality, all of which were in good condition. All of the 10 structures were constructed from concrete materials (see Table 4). They serve to direct and regulate the flow of water. Some spillways also act as bridges, allowing passage to people and vehicles when water flow is still passable. The more recent 2010 CBMS data, shows that a total of 25 Bridges (including 6 Hanging Bridges) and 22 Spillways were constructed in themunicipality.

National Roads

The Pan-Philippine Highway is a road that stretches from Laoag City all the way to Sorsogon with continuing routes passing through Visayas and Mindanao. The highway is known as the "Maharlika Highway". The segment of Maharlika Highway which runs south is known as the Manila South Road (MSR). The MSR passes through the municipality of Candelaria through Barangays Bukal Sur – Masin Norte/ Masin Sur – Poblacion – Malabanban Norte – Mangilag Sur. The Highway was constructed from asphalt and stretches about 9km through Tiaong, Candelaria, and Sariaya. Standard slab thickness of the Maharlika Highway is 230mm. The number of lanes for vehicles varies with the stretch of the road.

Table 2.4.8.1.1: Inventory of Bridges by Location, Type, Capacity and Condition, 2008

BRIDGE NAME	LOCATION	TYPE	PHYSICAL CONDITION
MUNICIPAL BRIDGES			
1. Quiapo Bridge	Barangay Poblacion & Malabanban Norte	Concrete / 60 lineal meters	Good
2. Masin Bridge	Barangay Poblacion & Masin	Concrete / 90 lineal meters	Good
3. Taguan Bridge	Barangay Bukal Sur	Concrete / 60 lineal meters	Good
BARANGAY BRIDGES			
1. Spillway	Barangay Pahinga Norte	Concrete / 80 lineal meters	Good
2. Spillway	Barangay Malabanban Sur	Concrete / 30 lineal meters	Good

3. Spillway	Barangay Mayabobo	Concrete / 80 lineal meters	Good
4. Sabang (Spillway)	Barangay Masalukot I	Concrete / 60 lineal meters	Good
5. Overflow	Barangay Kinatihan I	Concrete / 20 lineal meters	Good
6. Spillway	Barangay Masin Sur	Concrete / 40 lineal meters	Good
7. Hanging Bridge	Barangay San Isidro	Steel / 70 lineal meters	Good
8. Hanging Bridge	Barangay Kinatihan II	Bailey / 12 lineal meters	Good
9. Spillway	Barangay Masin Norte (Nursery)	Concrete / 50 lineal meters	Good
10. Foot Bridge	Barangay Buenavista West	Concrete / 10 lineal meters	Good

Source: DPWH / PEO/ LGU/ MEO

Barangay Roads

Candelaria has a total of 150 Barangay Roads which span 193.428 kilometers (see Table 4.1). The most number of roads in a barangay is 15 in Poblacion and the least number of roads is 3 in Masalukot V, Pahinga Sur, and Malabanban Norte.

Table 2.4.8.1.2: Inventory of Existing Roads in Candelaria, by Barangay		
BARANGAY	NO. OF ROADS	LENGTH (km)
Poblacion	15	8.550
Buenavista East	7	9.5
Buenavista West	6	7.05
Bukal Norte	4	10.91
Bukal Sur	4	2.45
Kinatihan I	4	5.45
Kinathan II	10	4.49
Malabanban Norte	3	5.65
Malabanban Sur	9	5.5
Mangilag Norte	4	7
Mangilag Sur	6	8.45
Masalukot I	8	4.408
Masalukot II	5	15.2
Masalukot III	4	8.05
Masalukot IV	5	5.95
Masin Norte	8	9.75
Masin Sur	4	9.9
Mayabobo	5	14.7
Pahinga Norte	4	8.45
Pahinga Sur	3	4.22
San Andres	4	2.62
San Isidro	7	12.12
Santa Catalina Norte	11	10.16
Santa Catalina Sur	7	7.4
Masalukot V	3	5.5
Total	150	193.428

Source: Department of Public Works and Highways (DPWH)

Land Transport Terminals

The presence of jeepneys and buses is predominant in the Municipality; however tricycles still serve as the primary mode of transport within the area. Tricycle terminals blanket much of the municipality, offering transportation to any place in their designated routes. Many of these tricycle terminals are found around key areas in Barangay Poblacion, the center of the municipality. Other tricycle terminals are also scattered around other barangays like Malabanban Norte, Mangilag Sur, Masalukot I, Masin Norte, Masin Sur, Pahinga Norte, and Pahinga Sur.

Jeepney terminals have two stations in Barangay Poblacion and have routes that go to and from San Pablo City, Lucena City, Tiaong, Sariaya, San Juan and Candelaria. For passengers commuting to San Pablo City, the terminal is located in Rizal Avenue corner Del Valle St., for commuters bound for Lucena City, the terminal is in Rizal Ave and for commuters bound for San Juan, the terminal is at Gonzales St. Corner Maharlika Highway.

Buses from Manila going to the Bicol region, the Visayas and Mindanao pass through the municipality of Candelaria via the Maharlika Highway. Some bus companies that have routes passing through Candelaria are DLTBCO, JAC Liner, JAM Liner, and Lucena Lines. The buses have designated stops in Barangay Poblacion.

Philippine National Railways Terminal (PNR)

The PNR is a government-owned Railway System operating in Luzon. The railways cater to commuters travelling from Metro Manila to the Bicol region. The South Main Line which runs from Metro Manila to Sorsogon has a terminal in the Municipality of Candelaria. Located near the municipal public market, the stock cars pass through and pick up passengers at this terminal. The PNR provides Candelaria a link to the different parts of the country and allows for easy transport of goods and commuters to neighboring provinces.

Trolley

Some locals have created a makeshift “trolley” which utilizes the train tracks and serves as a means of transport. The trolleys are detachable from the rails in cases wherein there are incoming trains. They are made from scrap plywood and metal wheels mounted on the bottom of a wooden platform. It is man-powered and moves by gliding through the rails and kicking back to thrust forward. The trolley moves not only people but in some cases goods and products such as vegetables, building equipment, coconut husks, etc.

2.4.9 Public Participation Activities conducted for the Project

In compliance with DAO 2017-15 or the Guidelines on Public Participation under the Philippine Environmental Impact Statement System, Focus Group Discussion (FGD)/Key Informant Interviews (KII), Perception Survey and Public Scoping were conducted as part of the requirements for the Public Participation.

2.4.9.1 Perception Survey

The perception survey was conducted on Augst 28 to 30, 2016. A total of 383 households were randomly interviewed and surveyed. The Maabanban Sur population of 9,123 as of 2015 was used.

Sample Size Breakdown

Sample size calculator Raosoft in <http://www.raosoft.com/samplesize.html> was used in determining sample size. With a population of 9123, the sample size calculator came up with 369 as sample size with a 5% margin of error and 95% confidence level.

Even if the sample size calculator provided the smaller sample size, we presented the actual surveyed population which is 383 representing an additional 18% to the sample size.

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 | | |

- Length of stay in the area
- Source of Drinking Water
- Garbage Disposal

2.4.9.2 Key Informant Interviews (KII) and Focus Group Discussion (FGD)

Key informant interviews are qualitative in-depth interviews with people who know what is going on in the community. The purpose of key informant interviews is to collect information from a wide range of people—including community leaders, professionals, or residents—who have first hand knowledge about the community. These community experts, with their knowledge and understanding, can provide insight on the nature of problems and give recommendations for solutions. KII, the same with FGD is frequently used as a qualitative approach to gain an in- depth understanding of social issues. The method aims to obtain data from a purposely selected group of individuals rather than from a statistically representative sample of a broader population.

KIIs/FGDs were conducted on November 3, 2017 and January 30, 2018 in Barangays Malabanban Sur, the impact Barangays. These Barangays will host the proposed project although for Brgy. Balanga, the only a small area will be covered, the road within the project site. The participants of the FGDs were the barangay LGU officials and sectoral representatives. The number of participants was 15 for Malabanban Sur and 12 for Balanga, totaling to 27 overall. The EIA Preparer conducted the FGD together with 5 representatives from the Proponent.

2.4.9.3 Public Scoping

The Public Scoping was conducted on August 11, 2016, 10:00 a.m. in Brgy. Malabanban Sur, Candelaria, Quezon. Registration started as early as 9:30 am while the Program started at 10:00 am. A total of 225 attendees joined the Scoping activity.

2.4.2 Results

In compliance with DAO 2017-15 or the Guidelines on Public Participation under the Philippine Environmental Impact Statement System, Focus Group Discussion (FGD), Initial Perception Survey were conducted as part of the requirements for the Public Scoping. The following table summarizes the results of the FGD/KII, Perception Survey and Public Scoping.

2.4.2.1 Perception Survey

The perception survey was conducted on August 28 to 30, 2016. A total of 383 households were randomly interviewed and surveyed. The Malabanban Sur population of 9,123 as of 2015 was used.

Demographic Characteristics:

Among the respondents 155 (40%) are males and the majority (60%) is females. Most (33%) are unemployed, 18% of the respondents are self-employed, 13% are laborers/skilled, 11% are drivers, 5% are Barangay officials, 4% are Government/Private employees and another 4% of the respondents are farmers/farm workers while the remaining 11% have profession not mentioned in the survey.

85 (22.19%) respondents are between ages 41 to 50 years old, 82 (21.41%) respondents are 31 to 40 years old, 75 (19.58%) respondents fall into 21 to 30 age range, 71 (18.54%) are 51 to 60 years old, 44 (11.49%) respondents are between ages 61 to 70 years old, 9 respondents (2.35%) are 15 to 20 years old while the remaining 17 (4.44%) respondents are 71 years old and above.

Most (32%) of the respondents earn between Php 1,000-5,000 monthly, 25% of the respondents' monthly salary range between Php 5,000-10,000, 10% of the respondents earn Php 10,000 and above while the remaining 33% have no monthly income.

Majority (90.86%) of the respondents are Catholic while 7.05% are Iglesia ni Cristo. 177 respondents reached high school level, 94 respondents finished elementary, 38 respondents attained a vocational education, 60 respondents accomplished college level while 14 respondents have no educational background.

194 respondents are married, 76 are single, 44 respondents are widowed, 51 are living together (live-in) while 18 are separated. 65.27% of the respondents have 2 to 5 family members, 31.07% have 6 to 10 family members in their household while 3.55% of the respondents have 11 to 15 family members. 286 (74.67%) of the respondents are from Candelaria while 97 (25.33%) are from other places.

248 respondents get water from wells while the remaining 135 respondents acquire water from Manila Water/Nawasa. 45.69% of the respondents' own motorcycle and 1 respondent own a bicycle while the majority (54.05%) do not own any means of transportation. All the respondents' households are equipped with water closet (with or without flush).

289 of the respondents said that calamities occurred within the past ten years while 94 respondents stated that there are no calamities within the past ten years.

PERCEPTION ABOUT THE PROJECT

265 respondents are aware about the proposed rolling mill project of SteelAsia Manufacturing Corporation while 118 respondents are not aware. 149 respondents were informed through surveys while 234 respondents were notified through seminars. 210 respondents agreed that the proposed project can help their community and barangay while 22 respondents believe that the proposed project will not bring any aid or benefits to their barangay, 151 respondents are not sure if the proposed project will bring help to their community.

215 respondents believe that the proposed project will give job opportunities to the people in their community while 168 respondents mentioned other possible good effects from the proposed project. In terms of negative effects, 36 respondents stated that there is a possibility of air and water pollution, 132 respondents said other possible negative effects while 215 respondents stated that they are uncertain to the possible negative effects of the proposed project.

259 respondents agreed to the proposed project, 24 respondents disagreed while the remaining 100 respondents are still uncertain.

2.4.2.2 KII/FGD

FGD sessions prepared and conducted on November 3, 2017 and January 30, 2018 were for the local government officials of Barangays Malabanban Sur. The number of participants was 15 for Malabanban Sur and 12 for Balanga, totaling to 27 overall. The EIA Preparer conducted the FGD together with 5 representatives from the Proponent.

On the questions posted to the participants, the EIA Preparer gathered the following results:

- Both the municipality and Barangay Malabanban Sur have known the project through their municipal LGU, through their co-barangay officials and through SteelAsia
- Most of them believed that the project will provide them a big chunk of revenue that will help them provide the basic services and infrastructure to their constituents
- Some fear pollution to the environment that may be brought about by the project such as air and water pollution
- Some officials suggested that they be given ambulance and livelihood projects especially for women
- The Barangay Chairman requested for prioritization of employment and hiring of their barangayonce Candelaria Steel starts the process of recruitment
- Generally, most of them will feel happy if the project will proceed its implementation.

2.4.2.4 Public Scoping

Table 2.4.2.1B: Summary of Results of Public Scoping

Issues/Concerns	Nagbigay ng Tanong	Proponent's Response
Gaano kaligtas ang mga lupang sakahan sa paligid ng planta	Ariel Geronimo	Tugon ng Candelaria Steel, Inc: Ligat ang mga lupang sakahan sa paligid ng planta dahil sa mga sumusunod na dahilan: 1. Hindi gagamit ng tubig na ginagamit ng mga magsasaka ang planta 2. Tutulong ang kumpanya sa problema ng mga magsasaka sa tubig 3. Walang kemikal na ginagamit ang planta na maring tumapon or maka-epekto sa mga sakahan

		4. Nirerecycle ng planta ang lahat ng tubig na gagamitin at ginagamit nito
Petisyon sa Plaridel ng 7,000 mamamayan		Tugon ng Candelaria Steel, Inc.: ang mga isyu na ibinabato ng mga tumututol sa proyekto sa Plaridel ay nasagot ng lahat sa mga ginawang public consultations at mga meetings sa EIA Review Committee ng EMB-DENR.
Bakit ang bayan ng Candelaria at Brgy. Malabanban Sur ang napili ng Project?	Written questions	<p>The project was chosen because of the following reasons:</p> <ul style="list-style-type: none"> • Infrastructure growth in Southern Luzon seen in the coming years • New infrastructure will spur additional growth in housing, retail, tourism and industrial construction • New construction will require more steel products, best supplied by a local/community steel mill. • Supply of products for industrial use. • NEDA Report on Region 4A <ul style="list-style-type: none"> ○ The region is the 2nd highest in population with over 13 million. ○ The region is the 2nd highest contributor to the GDP at 17.4% compared to NCR at 36.3%. ○ The region has the highest OFW workforce and accounts for 15% of total OFWs. • Industry (including manufacturing) accounts for 61% of the region's GDP. • Manufacturing • Electricity, Gas and Water • Construction • More than 50% of the country's PEZA revenue is from Region 4A • Calabarzon is No. 1 in value output among regions and 2nd in number of firms and Employment. • Calabarzon has a comprehensive development plan. • Calabarzon Development Agenda 2010 to 2020 • Harmonization of regional development objectives and environmental protection • Enhancing Calabarzon's competitiveness as a global business hub • Adoption of knowledge-based industries and information exchange • Reduction of socio-economic disparity • Tying up human resource development, industry, research and development priorities & concerns • Sustaining capacities in local governance • Infrastructure Projects –Completed • Daang Hari–SLEX Link or Muntinlupa-Cavite Expressway to San Juan Port • Infrastructure Projects –Ongoing • LRT Line 2 East Extension Project • LRT Line 1 Cavite Extension Project • Southern Luzon Expressway Toll Road 4 • STAR Tollway Stage II

		<ul style="list-style-type: none"> • Quezon Eco-Tourism Road Phase 3 • Calatagan Port • Infrastructure Projects –Pipeline <ul style="list-style-type: none"> ○ Laguna Lake Expressway Dikey Project ○ Cavite-Laguna Expressway Project ○ North-South Rail Project (South Line) ○ Batangas flyover from Batangas Port to Star Toll ○ Rizal Expressway Dikey ○ Pililla (Rizal) Wind Farm Power Project -67.5 MW ○ Pagbilao Energy Corp. 420-MW Pagbilao3 coal-fired power project in Quezon province ○ South Luzon Thermal Energy Corp., 135-MW coal-fired unit Calaca, Batangas
Ano ang magiging epekto nito sa kalusugan ng bawat mamamayan na nakapaligid dito		Possible air pollution due to dust is the primary potential impact that may be generated by the project during construction. Proper dust management system and installation of air pollution control devices will be implemented. During operation, no significant impact is projected because the project is steel rolling mill only. Insignificant impact on noise may be experienced which will also be properly mitigated.
Can the skills requirements: welding, machining and training by Candelaria Steel, Inc. be conducted before construction?	Ma. Luningning Predilla	The Proponent responded that these skills training will be conducted before construction so as to equip and/or enhance skills of possible workers on site.
Working age limit sa planta		No age limit but employment will depend on capacity to work
Air emission	Aris Baon	The air emission of the plant is expected to be well within the standards mandated by law as experienced in other Plants of SAMC
Wala sanang epekto sa ilog		The nearest river is about 2 km away and the Plant will not discharge water because of recycling and zero effluent system. A water reservoir will also be constructed, and rainfall pattern will be studied to forecast and ascertain the requirement for make-up water.
Gaano kahanda sa sunog	Sta. Catalina National High School	The proponent responded that the least problem or risks in steel mills like Candelaria Steel is fire because the commodity is steel which is not fire hazard.
Kailan mag uumpisa at saan at kailan pwede mag apply	Carlos Andal	The target schedule is after 1 year in undergoing the permitting process; then construction for 22 months; hiring commences during construction
Avoidance of further contamination of Candelaria River - Wastewater treatment = what will be the management plan of the solid (scales and grease)	Ryan De Luna, MENRO of Candelaria	This concern was duly noted. The scales are sold to 3 rd party because scales are still raw materials for other industries.
EMB-PENRO to suggest/endorse similar technology of SteelAsia if proven to be effective and efficient	MENRO	This was noted.
Did the Plant experienced shortage of water		Yes but on other projects and not under SAMC group. If this will be experienced at the worst case scenario, then the Plant will shut down.
Community just beside the Plant site's concern is where will the water go if the Plant will fence the project area.	Kagawad Dinglasan	A canal / drainage will be constructed; adopt a river program to clean the present contaminated river will also be conducted.
Submersible pump during dry season		This was duly noted for consideration under the

		CSR of the company.
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Details of the Public Participation Documentation are provided in Annex ES-4.

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.

To control the entry of informal settlers as attracted by the project benefits, the property is fully guarded to monitor the perimeter of the project site to control and prohibit the entry of informal settlers.

2.4.11 In-Migration

The Project will contribute to the in-migration because people will be encouraged to apply for work because of the possible benefits that the project may offer. With this, the existing demographic data will be affected, specifically with respect to the following:

- Increased population of host barangays
- increased economic activity in the area

However, influx of migrants may be expected to be confined to locals from different barangays only within the Candelaria area or the whole Quezon province in general because preference will be given to the host community, i.e. host barangays and municipality of Candelaria as a whole. Only if there are expertise lacking in the manpower that are provided by the locality will the Proponent look for other workers from other areas. In case these migrants will be competing with the local services available to the locals of the area, CSI will assist in the provision of basic services through its SDP. To avoid this, CSI will also ensure that qualified residents of the host barangay and of the municipality in general will be given priority in hiring and employment.

2.4.12 Cultural/Lifestyle Change

Candelaria is also known for its various festivities celebrated between the months of January to August. One of its famous festivals is the Candle Festival, which is a five-day celebration from January 29 to February 2. The people reflect on their devotion to "Nuestra Señora de Candelaria" also known as the Candlemas Virgin. The celebration is done through a candle float parade and procession along the streets of the town featuring street dancing by the youth in the community. Also, featured during this festival is a parade of floats representing each of the 25 barangays of Candelaria.

2.4.13 Impacts on Physical/Cultural Resources

With the implementation of the proposed project, the cultural practices and traditions especially in Candelaria will not be affected as these will continue to be celebrated and CSI 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. Their kind of lifestyle of preparing for celebrations will be enhanced as they will be able to earn more income for celebrations. 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. CSI shall encourage modest lifestyle and simple living standards in accordance with its philosophy. On the contrary, the CSI will encourage families to participate in livelihood projects that will be sponsored by the company.

2.4.14 Threats to Delivery of Basic Services/Increase in Demand for Resources

While the LGU of Candelaria with support from the National Government was able to provide basic services to its people such as social services, livelihood, medical and health programs, Candelaria Steel through its Social Development Plan (SDP) and Corporate Responsibility (CSR) Programs will augment these services through a Needs Assessment Study to determine what are the actual needs of the stakeholders concerned, Brgy. Malabanban Sur in particular.

With this, 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. CSI will even be a partner to deliver and improve the delivery of these basic services for the people the social

development component which includes assistance to infrastructure, livelihood and education, among others.

2.4.15 Threats to Public Health and Safety

Health services are one of the basic services that are well provided in Candelaria. There are three (3) hospitals that cater to the medical needs of the residents. The Candelaria Municipal Hospital, commonly known as the Nursery Hospital, located at Barangay Masin Norte; Peter Paul Medical Center, situated at Barangay Poblacion and the newly-established United Candelaria Doctors Hospital in Barangay Mangilag Sur, all provide medical services for treatment of a wide range of illnesses or diseases.

The proposed project will not pose threat to public health because as experienced in other SteelAsia Group's operating Plants, public health especially worker's health were not affected. Also, all management and mitigating measures will be implemented. Occupational Health is among CSI'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 CSI which is a component of its ISO Certification.

The proposed project will not pose threat to public and workers' safety because CSI shall be responsible for the regular check-ups of workers and immediate treatment of any work-related sickness incurred by any worker. The CSI, as it does in all of its plants, will cover employees and its dependents with an HMO plan. Moreover, the CSI will have medical and dental missions and other health assistance projects for the community.

Following are the responsibilities that CSI 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 CSI, 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 CSI
- Report all safety related incidents to CSI
- Ensure the adequate supervision of any accompanying children
- Do not enter any restricted area without authorisation or escort
- Do not bring or consume alcohol or illegal drugs at workplaces
- Do not wilfully 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 CSI Plants which will also be adopted for this Project.

Table 2.4.6: Health and Safety Programs of CSI

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 Physica/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 conjunctivits (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

Specifically, provided in **Table 2.4.7** are potential health hazards during construction and project operations and the appropriate mitigating measures that will be implemented.

Table 2.4.7: Health Hazards during Construction 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 Inducing fresh air to work rooms/stations
			Skin dryness, cracking, redness, and blisters	
			Local health effect	
			Central nervous system damage	
			Systemic health effect	
	Fumes	Welding and flame cutting	Respiratory illnesses; asphixiation	Proper ventilations and exhausts; Inducing fresh air to work rooms/stations; Use of air purifying mask, Eye and face protections
		Using internal combustion engines and LPG burners	Skin irritations	
		Burning of waste materials		
		Painting - particularly paint spraying using adhesive and thinners		
	Gases	Oxygen – used for welding and cutting	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
		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		

Category	Types	Possible Sources	Health Effects	Mitigation
		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. Lead dust - arise from handling materials containing lead or its compounds, such as removal of leaded paint and handling of metallic lead	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
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
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,	Sickness; Infections	Information campaign; Good housekeeping practices; Personal

Category	Types	Possible Sources	Health Effects	Mitigation
		or contact with infected persons or contaminated object.		hygiene

As provided in the OSH Standards of 2017, each employer covered by the provisions of this Standards shall:

- furnish his workers a place of employment free from hazardous conditions that are causing or are likely to cause death, illness or physical harm to his workers;
- give complete job safety instructions to all his workers, especially to those entering the job for the first time, including those relating to the familiarization with their work environment, hazards to which the workers are exposed to and steps taken in case of emergency;
- comply with the requirements of this Standards; and
- use only approved devices and equipment in his workplace.
- Establishes and adopts in writing administrative policies on safety in conformity with the provisions of this Standards outlining therein his responsibility and authority delegated.
- Reports to the enforcing authority in two (2) copies of the policies adopted and the health and safety organization established to carry out the program on safety and health within one month after the organization or reorganization of the health and safety committee.
- Reports to the enforcing authority having jurisdiction at least once in every three (3) months, counting from January, the health and safety program of the organization outlining the activities undertaken including its safety performance, health and safety committee meetings and its recommendations and measures taken to implement such recommendations.
- Acts on recommended measures by the health and safety committee by adopting the elements of the health and safety program in the production process or workplace and in case of non-adoption of the Health and Safety Committee's recommendation, to inform the committee of his reasons.

Candelaria Steel is committed to implement the Occupational Health and Safety Standards and compliance to health facility and personnel as specified in the OHSAS of DOLE.

2.4.16 Generation of Local Benefits

With the Project, generally, additional income will be brought in to Candelaria including the following local benefits:

- Enhancement of Employment and Livelihood Opportunities
- Increased Business Opportunities and Associated Economic Activities
- Increased Revenue of LGUs

Specifically, the Project will provide employment opportunities as follows:

- The project will create more than 3,000 internal and external jobs in the nearby communities
- More than 80% of which will be available for vocational level and below.
- During construction, up to 1,000 personnel will be hired
- SteelAsia trains members of the community to upgrade skill levels (including TESDA accredited training) for FREE.
- Qualify them for vacancies in the Candelaria mill and other SteelAsia sites.
- Once operational the job provides employees skills and technology familiarization that qualifies for overseas employment opportunities.

The Candelaria mill will create new business opportunities for the community as SteelAsia's other mills have in their own respective communities.

- Trucking
- Food and beverage services and suppliers
- Hardware supplies
- Transportation services
- Vehicle mechanics, auto-supply, servicing
- Building repair contractor services
- Machining services
- Plumbing services and supply
- Signage, painting, printing
- Many more

2.4.17 Traffic Congestion

Candelaria is part of the **Quezon Eco-Tourism Road** is a 29.7-kilometer (18.5 mi), scenic road in the province of Quezon, Philippines. The entire road is a component of the **National Route 422 (N422)** of the Philippine highway network. Previously, the road was originally unnumbered as a national tertiary road at the time of the road completion.

Route description

Opened to traffic in March 2016, the road bypasses within the town proper of Candelaria and Sariaya. It starts from Rosario–San Juan–Candelaria Road in the west and ends at the Maharlika Highway in Lucena. Travelers from Batangas shortens the travel time as an alternate route to the Bicol region. Along the roadway, it is a scenic road—where it passes the agricultural land and plantations in the Quezon province.

Intersections

The entire route is located in Quezon. Intersections are numbered by kilometer post, with Rizal Park in Manila designated as kilometer 0.

During construction, if the estimated filling materials needed is around 60,000 cubic meters, it is projected that the truck hauling per day will be 60,000 cm/20 cm/120 days or 25 trucks per day or 50 trucks per day (multiplied by 2 to consider both in and out traffic). The estimated truck hauling time is 24 hours depending on availability of filling materials and traffic permitting. Thus, the hauling trucks will add an approximate 50 trucks per day or an average of 2 trucks per hour (in and out).

During operations, the proposed project will produce finished goods of 1,200,000 tons per year. Likewise, it will consume scraps of 1,383,120 tons per year for a total of 2,583,120 tons of steel materials per year. A truck can load up to 30 tons per trip. With this, the truck hauling per year is $2,583,120 / 30 = 86,104$ trucks; which $86,104 / 360 \text{ days} = 239.18$ trucks per day is equivalent to $239.18 / 24 \text{ hours} = 9.97$ trucks per hour. While, trucks hauling consumables such as fuel, oil and lubricants are estimated to be at 4 trucks per day or 0.2 trucks per hour. There will be an average of 10.17 trucks per hour or approximately 1 truck coming in or out per 5.9 minutes interval.

In consideration of all above factors, the Project will have an impact in the traffic situation of the locality. Since the road is an existing route, 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, CSI 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 CSlin coordination with and authorization of the LGU of Candelaria. Nevertheless, during all project phases, the following mitigating and management measures will be implemented:

1. Proper scheduling of hauling of construction materials in relation to existing truck ban ordinances;
2. No trucks and/or any kind of vehicles, i.e.: cars, motorcycles will be allowed to park outside the mill compound;
3. Assign traffic marshals or officers to control the vehicular movements at the entrance / exit of the Project Site;

4. Coordinate with LGU Candelaria in crafting new and better routing scheme within the affected impact zone area;
5. Posting of the project's own traffic officer to assist and coordinate with Candelaria LGU's Traffic Bureau for orderly flow of vehicle and pedestrian traffic within the identified route of trucks;
6. 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;
7. Assign sufficient number of owned traffic enforcers during rush hours;
8. Comply with the DPWH load limit requirements of 13.5 metric tons/axle and the speed limit on roads;
9. Comply with existing road traffic and smoke belching laws, and;
10. Conduct free trainings/seminars on Discipline and Traffic Rules and Regulations for all LGU traffic

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: Environmental 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
I- PRE CONSTRUCTION PHASE						
NA	Nil	Nil	Sourcing of equipment and contractors; Securing of ECC	CSI	Part of Project Cost	
II- CONSTRUCTION PHASE						
Environmental Aspect # 1: Land clearing	A. The Land:	Generation of solid wastes such as scraps and Construction debris Soil erosion	<ul style="list-style-type: none"> • Metal scraps (if any) will be segregated for inclusion in the scraps that will be used as raw material in scrap recycling operations of other SteelAsia Plants • Good housekeeping • Provision of MRF • Water spraying for dust management • Proper construction methods and procedures and implementation of slope protection 	CSI	10,000 Part of contract	Agreement with contractor
Presence of temporary facilities such as: 1. Site Offices 2. Security Office 3. Bunkhouses 4. Warehouse 5. Fabrication Yard 6. Canteen & Mess Hall 7. Motorpool/Equipment yard 8. Materials laydown area	A. The Land	Generation of solid wastes such as scraps and Construction debris Soil erosion	<ul style="list-style-type: none"> • Metal scraps (if any) will be segregated for inclusion in the scraps that will be used as raw material in scrap recycling operations of other SteelAsia Plants • Good housekeeping • Provision of MRF • Water spraying for dust management • Proper construction methods and procedures and implementation of slope protection 	CSI	10,000 Part of contract	Agreement with contractor
		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 Area with proper labeling, segregation and storage of wastes • Transport, treatment and disposal by DENR accredited third party contractors 	CSI	No cost because this is being bought by DENR accredited third party contractors	ECC Conditions TSD Permit conditions
	B. The Water	Water contamination from domestic waste discharges	Use of Portable toilets	CSI	5,000 depending on septage disposal cost	Agreement with contractor

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
					- Part of contract	
	C. The Air	Generation of Dust	<ul style="list-style-type: none">• Road water sprinkling• Tree nursery and tree planting	CSI	Part of Contract	ECC Conditions
		Generation of Noise	<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.	CSI	Part of contract	ECC Conditions and DENR Standards on noise
Environmental Aspect # 3: Land clearing	C. The Air	Generation of Dust	<ul style="list-style-type: none">• Road water sprinkling• Tree nursery and tree planting	CSI	Part of Contract	ECC Conditions
		Generation of Noise	<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.	CSI	Part of contract	ECC Conditions and DENR Standards on noise
Environmental Aspect # 4: transport of construction materials	D. People	Safety issues	<ul style="list-style-type: none">• Strict implementation of DOLE DO 13-98• Health and safety policies• Employee safety inspections and toolbox meetings• Regular APE and use of PPEs• First aid training• Provision of ambulance and Clinic• Provision of Fire Fighting System	CSI	Part of Contract	Contract provisions
		Employment and livelihood opportunities for local people and entrepreneurs	Employment generation	CSI	Part of contract	Agreement with Contractor
		Traffic congestion	<ul style="list-style-type: none">• Implementation of Traffic management plan• Coordination with local traffic bureau (barangays and municipality)	CSI	Part of contract	
II- OPERATION PHASE						
Environmental Aspect # 1: Solid waste accumulation	A. The Land	Solid waste pollution due to garbage	<ul style="list-style-type: none">• Good housekeeping• Operation of MRF	CSI	10,000.00	RA 9003, ECC conditions and EIS

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"> Recycle Sell recyclables Reuse Septic Vaults Disposal thru DENR-accredited 3rd party 			commitments
		Generation of sludge from septage	Septic tank management by desludging	CSI	10,000.00	RA 9275
		Contamination and improper management of hazardous waste materials	<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. Transport, treatment and disposal of DENR accredited third party contractors 	CSI	15,000.00	RA 6969
		Generation of slags	<ul style="list-style-type: none"> Proper stockpiling/storage Will be used as raw material for other uses 	CSI	No cost	RA 9003
Environmental Aspect # 2: Operation of rolling mill facility	B. Water	Water pollution from run-off and domestic wastes	<ul style="list-style-type: none"> Construction of rain water 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 	CSI	Part of Project Cost	ECC conditions and EIS Commitments
		Resource use competition for use of river water for make up water	Address resource use competition; secure water permit	CSI	Part of Project cost	Water Permit from NWRB, ECC conditions and EIS Commitments
		Water pollution due to inadvertent spill of domestic wastewater	<ul style="list-style-type: none"> Establishment of WTP Use of 3-chamber septic tanks in all project facilities; Construction of wastewater canal to divert fugitive liquid waste streams into a 	CSI		EIS commitments and 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
			containment and treatment area; • Adoption of clean practices by all project operating units and personnel; • Efficient waste retrieval system; • Greening of project's compound.			
		Pollution and blockage of portions of river due to solid wastes	• Implement a rigid solid waste collection and disposal system; • Collaboration with LGU on waste management and recovery.	CSI		EIS commitments and ECC conditions
		Leachate of steel mill debris and spoils	• Steel litter recovery and recycling • Install weirs to efficiently collect steel mill debris.	CSI		EIS commitments and ECC conditions
	C. Air	Air pollution from fugitive dusts, equipment and vehicles	• 65 meters stack height • Training on power equipment and vehicle use and speed • Proper maintenance, designation of no idling zone • Routine plant maintenance and good house keeping • Use of low sulfur fuel (LSFO or mixing with Diesel) • use of enclosures, barriers and buffer zones • Implementation of reforestation and Carbon-sink Program • Insulate structures • Installation of dust collectors	CSI	Part of Project cost	N.A.
		GHG emission	Implementation of a reforestation and carbon-sink/GHG reduction program	CSI	Part of Project cost	ECC conditions
	D. The People	Noise from equipment and vehicles	• Buffer zone and tree planting • Enclosed facility	CSI	Part of Project cost	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
			<ul style="list-style-type: none">• Provision of AC motors• Scheduling certain high noise emitting works to more acceptable times of day;• Enclosures for sources of noise• Provide high fence within the plant's perimeter• Provide a buffer zone on the adjoining boundaries• Planting of trees on the buffer zone and plant's perimeter that will serve as noise barrier• It is advisable that electrically-powered equipment 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 replaced;• All employees working on site will be provided with PPE			
		Health and safety hazards	<ul style="list-style-type: none">• Health and safety policies• Employee safety inspections and toolbox meetings• Regular APE and use of PPEs• First aid training• Provision of ambulance and Clinic• Provision of Fire Fighting System	CSI		
II- ABANDONMENT PHASE						
Environmental aspect #1: Demolition of structures	A. The Land	Solid waste pollution/ contamination brought about by scraps and debris from demolished structures	<ul style="list-style-type: none">• Good housekeeping• Planting of endemic species or reforestation	CSI		

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
		Oil spill	Conduct of ESA prior to abandonment	CSI		
	B. Water	Water pollution/ contamination	Conduct of ESA prior to abandonment	CSI		
	C. Air	Air pollution because of dusts from demolished structures	Sprinkling of water	CSI		
		Noise pollution from structures being demolished	No population center at construction sites	CSI		
Environment aspect #2: plant closure or operation stoppage	D. The People	Loss of Jobs	<ul style="list-style-type: none"> • Payment of legal social benefits • Retrenchment package • Labor support programs 	CSI		
		Health data of employees and communities	Recording based on annual physical checkup of employees and data from Rural Health Units for the community	CSI		
				CSI		

CHAPTER IV: ENVIRONMENTAL RISK ASSESSMENT AND EMERGENCY RESPONSE POLICY AND GUIDELINES

CSI 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 Barangays Malabanban Sur and Municipality of Candelaria.

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 provides the guidelines on the degree of ERA requirements and preparation as provided below:

- Level 1: Preparation of an Emergency/Contingency Plan
- Level 2: Preparation of an Emergency/Contingency Plan and ERA Report

4.1. Methodology

As provided in the general guidelines and outline for an Environmental Risk Assessment (ERA) preparation as prescribed in Annex 2-7e of DAO 2003-03, the ERA details for this section will only be limited to the information provided in the succeeding section. These information will also provide the basis for further quantitative risk assessment in case will be required in the post EIA stage/process.

- a) Presentation of the different type of safety associated risk relative to the project's operation;
- b) Presentation of the different type of physical risk associated to the project's operation; and
- c) Risk or Hazards Management measures or the general emergency procedures during the worst-case scenario.

Major environmental risks identified were the manufacturing methods that involve chemical storage, processing, and use. Although this is applicable for the proposed Project, this shall only form part of the overall ERA.

1.1.2 Risk Screening Level

A risk screening level exercise refers to specific facilities or the use of certain processes that has the potential to pose significant risks to people and its surrounding environment. The Plant is covered by the risk screening level exercise, as indicated in **Table 4-1**.

Table 4-1: Risk Screening Matrix

Activities Requiring Risk Screening Exercise ¹	ERA Applicability to the Project
1) Facilities for the production or processing of organic/inorganic chemicals using: Alkylation Esterification Polymerization Distillation Amination Halogenation Sulphonation Extraction Carbonylation Hydrogenation Desulphurization Solvation Condensation Hydrolysis Nitration Pesticides & Dehydrogenation Oxidation Phosphorus prod. pharmaceutical prod.	Not Applicable
2) Installations for distillation, refining, and other processing of petroleum products	Not Applicable
3) Installations for total or partial disposal of solid or liquid substances by incineration or chemical decomposition	Not Applicable
4) Installations for the production or processing of energy gases (e.g., LPG, LNG, SNG.)	Not Applicable
5) Installations for the dry distillation of coal or lignite	Not Applicable
6) Installations for the production of metals and non-metals by wet process or electrical energy	Not Applicable
7) Installations for the loading and unloading of hazardous materials defined by RA 6969 (or DAO 29)	Not Applicable
CONCLUSION	Risk screening level exercise <input type="checkbox"/> not applicable

4.1.2.1 Risk Identification and Analysis

The proposed Project entails risks that are natural, man-made, or a combination of both. Natural risks are hazards caused by phenomena such as earthquakes, geological instability and typhoons. Meanwhile, man-made risks are caused by accidents such as fires, structural/equipment failure, chemical spillages, and human error. Man-made risks could also be aggravated as a direct consequence of natural risks.

4.2 Hazard Analysis

4.2.1 Safety Risks

4.2.1.1 Fire

Probable major fires may not occur at the Plant. As an emergency measure, firefighting facilities, principally fire water lines, fire extinguishers and water hose stations and hoses will be installed at the Plant premises. Alarms will also be installed.

4.2.1.2 Explosion

The elements for explosion which are the extraordinary/release of energy accompanied by rapid increase in volume of explosive materials are not present in the proposed project.

The possible accident scenarios and the affected population are related to the operation of the major plant equipment and auxiliaries which are not present in the proposed project.

The instrumentation system of the plant is provided with control, measurements, recording and response mechanism to prevent equipment failures that may result in accidents. Pressure relief

valves are installed in sensitive points to cause release of gases away from personnel. Unit or equipment shutdowns are automatically built in the instrumentation system.

4.2.1.3 Movement of Personnel to High Structures

Plant operators and maintenance personnel may necessarily climb to high structures as routine part of their functions. Thus, the potential for falling off from these structures exist.

4.2.1.4 Movement of Vehicles

Delivery trucks for materials will necessarily enter the plant premises. Only accredited vehicles and drivers may be allowed to enter the plant, Road signages will be posted conspicuously at strategic places.

4.2.1.5 Release of Toxic Substances

There are no toxic substances associated with the proposed project. Even if such is the case, CSI will implement health hazard control programs on different levels as follows:

- A. Engineering Controls
- B. Administrative Controls
 1. Workplace and community level monitoring for noise, dust and smoke emissions;
 2. Information, education and training strategies for workers
 3. Dialogue, information and education of community members on health hazards of concern;
 4. Provision of adequate housing and sanitary facilities for workers;
 5. Personal hygiene facilities for workers; and
 6. Immunization and/or medical prophylaxis for areas where endemic diseases are present.
- C. Personal Protective Equipment (PPE):
 1. Dust mask and other respiratory protection or workers;
 2. Ear protectors (either muffs or plugs) for workers; and
 3. Hard hats and other safety ppe for workers.
- D. Proper storage of hazardous waste

Storage is the holding of waste for a temporary period of time prior to the waste being treated, disposed, or stored elsewhere. Hazardous waste is commonly stored prior to treatment or disposal, and must be stored in containers, tanks, containment buildings, drip pads, waste piles, or surface impoundments that comply with DENR regulations.

Busted lamps and bulbs and used automotive batteries are among the hazardous wastes that may be generated. These may be stored in containers or any portable device in which a hazardous waste is stored, transported, treated, disposed, or otherwise handled.
- E. Disaster management prevention and minimization:
 1. Provision of a medical clinic at the plant site;
 2. Implementation of first aid and emergency plan for plant accidents which needs trained people and detailed steps to include transport facilities and communication with the referral hospitals; and
 3. Implementation of Disaster Plan in case of excessive emissions of pollution.

4.2.1.6 Toxic Metals in Air

Under the Philippine Clean Air Act, the emission limits for stationary sources (new facilities) for mercury and lead are: 5 mg/NcM and 10 mg/NcM respectively.

Under the Toxic and Hazardous Wastes Law (R.A. 6969) following are the limits for metallic elements:

Table 4.2: Limits for metallic elements under the Toxic and Hazardous Wastes Law (R.A. 6969)

Elements	Maximum Concentration
Mercury and mercury compound. Also include organ mercury compounds	Includes all wastes with a total Hg concentration > 0.2 mg/l
Lead compounds	Includes all wastes with a total Pb concentration > 5 mg/l

Below are the lists of the identified hazardous substances within the plant and its physical and chemical properties:

Table 4.3: List of the identified hazardous substances within the plant and its physical and chemical properties

Nature of Hazardous Wastes	Source/Generator	Inventory (Initial estimate only)
Accidental Oil Spills	Vehicles and Plant Equipment	Variable but small in quantities
Spent Lighting Bulbs	Offices and Plant premises	To be determined but small in quantity
Spent computer parts	Office computers	Small in quantity for office use only
Oil Sludges	Storage Tanks	Generated only during tank cleaning which is undertaken after several years of operation, thus minimal volumes

4.2.1.8 Safety and Occupational Hazards

Occupational hazards affect workers' physical and mental well-being and soundness. Work-related hazards were identified and evaluated based on: (1) careful examination of the workers' working environment while on-the job (in the plant, offices and in the field); (2) data gathered from similar conditions and projects; and (3) the project EIA. A list of possible occupational of work-related hazards was compiled and each item was assessed considering the proposed facilities and activities of the cement plant. The assessment resulted in the identification of hazards relating to occupational health and safety, which are discussed in the succeeding sub-section.

Dust

Workers and residents in the surrounding communities may be exposed to dust coming from the plant facilities.

Road dust, particularly abundant during dry months, can cause common colds to asthmatic symptoms among workers. Rock dust is released into the air from plant operations such as loading, haulage, shoveling and so on. Dirt roads get dusty when frequently used by heavy equipment.

Noise

Workers at the plant are exposed to high noise levels from heavy equipment at the plant. Continuous exposure to high noise intensity can cause hearing impairment which is irreversible.

Falling Objects

Workers are exposed to materials falling from elevated places or conveyors at the plant and ancillary facilities. Such accidents may result in cut/contusion injuries. Workers not using hard hats are susceptible to this hazard. Defective equipment can also cause parts to fall on other moving equipment.

Fall from Elevated Positions

The design of the plant requires people and equipment to operate at different levels separated only by walkways and machinery. Rock fragments, parts of equipment, and even people can fall from one level to the next. Workers, as well as equipment are exposed to this hazard. Lack of railings, guards, or other protective structures within the plant facility can cause workers to fall from high elevations. Equipment, which is not properly supported when undergoing repairs, can fall on equipment beneath.

Heat Stress

Workers can be exposed to this heat stress hazard when conditions exceed deep body temperature of 38°C. Exposure may result in heat exhaustion, heat cramps, and disorders including electrolyte imbalance, dehydration, skin rashes, heat edema, and loss of physical and mental capacity.

Electric Shock

Workers can be exposed to live conductors when working on electrical equipment that have been inadvertently exposed or energized. Voltages as high as 4,160 to 220 are used in the plant.

Accidental Injury

While working on or repairing equipment, workers' hands/fingers/body parts or items of clothing can be caught in moving parts of equipment. Workers could suffer serious injuries resulting from grinds, squeezing or crushing.

Overexertion

Workers handling heavy materials are exposed to overexertion when they unload or move these for delivery. Musculoskeletal disorders (MSDS) could result from manual lifting and load-on-shoulder movements. Physical stress, beyond the body's capabilities may be damaging to the workers' health.

High Temperature Burns

Rolling Mill operations require the use of hot equipment, and elevated temperatures as high as 700°C at fired furnaces as well as hot streams at the mill. Contact with high temperatures can result in third degree burns.

4.2.2 Physical Risks

4.2.2.1 On-site or Off-Site Contamination of Oil or Any Hazardous Waste during Operation

In case of on-site or off-site contamination of oil/lubricants or any hazardous waste during plant operation, management procedure or plan for the rehabilitation or corrective measures such as the following will be undertaken:

1. For hazardous wastes that will be generated such as busted bulbs and lamps, LED lamps, used oil and used batteries, disposal will be done thru 3rd party DENR-accredited Treaters. 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.
2. Busted Fluorescent Bulbs will be put in a container, stored inside the plant MRF in accumulation until there are sufficient inventory for proper disposal through a DENR accredited TSD facility.
3. 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.
4. Used automotive batteries will be traded-in to designated suppliers.
5. Remedial measures will be undertaken for soil contamination.

4.2.2.2 Breakdown or Failure of Equipment and Facilities

Temperature Extremes as Precursor to Accidents

At worst case scenario, extreme temperature rise is predicted at 2.4°C for a short term period of June/July/August in 2050. At the peak ambient temperature at this time of 29.3°C the effect on operations and maintenance personnel is unlikely.

Indirect adverse effects even if unlikely have to be factored in the design of equipment and safety system, noting that process design take into consideration ambient conditions, (e.g., temperature, failure of systems or instrumentation) may in theory trigger accidents.

Rainfall Extremes as Precursor to Accidents

Aberrations in predicted rainfalls are seen from the above table. Certain months exhibit decrease in rainfalls while in other periods increase is predicted. These predicted increases, however, are not expected to trigger accidents in the operation of the plant. Potential effects of heavy rainfalls are flooding. The plant, however, will be designed for appropriate drainage system.

4.3 NATURAL HAZARD

Hazards are potentially damaging physical events, phenomenon or human activities, which may cause the loss of life or injury, property damage, social and economic disruption or environmental degradation. It can include latent conditions that may represent future threats and can have origins, natural (geological, hydrometeorological). On the other hand, Natural Hazards are the natural processes or phenomena occurring in the biosphere that may constitute a damaging event. It can be classified by origin: geological, hydrometeorological or biological.

4.3.1 Earthquake

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.

The area investigated is prone to ground shaking hazards being underlain by unconsolidated soil and sediments and due to the presence of several earthquake generators in the region (Punongbayan, 1989). These possible seismogenic structures include the active Valley Fault, Lubang Verde Fault, Unnamed Fault and the main Philippine Fault. The site has recorded and experience intensity VI during the July 16, 1990 Luzon Earthquake

4.3.2 Volcanic Hazard

The danger posed by volcanic eruption depends upon the magnitude of its explosion. The types of hazards resulting from volcano eruption are classified as base surge, airfall, lava flow and poisonous gas. The area studied falls under a high risk zone for tephra and ballistic fall wherein it could receive at least 10 centimeters thick ash from Taal Volcano.

4.3.3 Flooding

The proposed project site located in a basin with elevation of about 1 to 6 meters is prone to flooding. It falls under the delineated high susceptibility to flooding by Mines and Geosciences Bureau.

4.3.4 Tsunami

Tsunamis are giant sea waves generated by under the sea earthquakes and volcanic eruptions. This is not applicable to the project site because it is not located near a coastal area.

The project site falls under the delineated potentially high historical tsunami.

4.4 SOCIAL

In terms of Social aspect, following are the concerns during abandonment phase:

- Loss of jobs thru loss of income
- Loss of taxes paid to the government
- Loss of independent economy dependent on the project
- Loss of projects by contractors

4.5 CONCLUSION

Provide below is the matrix of risks and hazards (environmental, safety and natural/physical) that are likely to occur during construction and operations phases of the project.

are likely to occur during construction and operations phases of the project.

RISKS	CONSTRUCTION		OPERATIONS		OPERATIONAL CONTROL
	Likely	Unlikely	Likely	Unlikely	
Environment					
Rainfall extremes	✓		✓		Proper drainage system will be designed to avoid localized flooding
Safety					
Fire		✓		✓	Firefighting facilities, principally fire water lines, fire extinguishers and water hose stations and hoses will be installed at the Plant premises. Alarms will also be installed.
Explosion		✓		✓	The instrumentation system of the plant is provided with control, measurements, recording and response mechanism to prevent equipment failures that may result in accidents. Pressure relief valves are installed in sensitive points to cause release of gases away from personnel. Unit or equipment shutdowns are automatically built in the instrumentation system.
Release of Toxic Substances		✓	✓		<ul style="list-style-type: none">• Disposal of toxic substance shall be done thru 3rd party DENR-accredited Treaters.• 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.
On-site or Off-Site Contamination of Oil or Any Hazardous Waste	✓		✓		
Movement of Personnel to High Structures	✓		✓		Wearing of proper PPE and support will be provided to concerned workers
Movement of Vehicles	✓		✓		<ul style="list-style-type: none">• Only accredited vehicles and drivers may be allowed to enter the plant• Road signages will be posted conspicuously at strategic places.
Natural					
Flooding	✓		✓		<ul style="list-style-type: none">• Proper drainage design must be implemented.• Drainage must be maintained and cleared;• Proper design of seawall structure to minimize effect of storm surge
Earthquake	✓		✓		
Volcanic hazard	✓		✓		Cleaning of ash accumulated to avoid destruction of structure Design of structure must use a

					minimum of 0.40g as per building code or higher
Tsunami	✓		✓		Residents must be fully aware and prepared before and during the presence of tsunami and must evacuate themselves and proceed to higher ground. In addition, communities must learn to recognize the following signs 1) presence of strong ground shaking, 2) unusual rise and fall of sea level, and 3) strong and unusual sound coming from the sea.
Physical					
Breakdown or Failure of Equipment and Facilities	✓		✓		Engineering controls will be provided
Social – During Abandonment Phase Only					
Loss of jobs thru loss of income					Proper payment of separation package under the Labor laws
Loss of taxes paid to the government					Proper payment of taxes as per the National Internal Revenue Code
Loss of independent economy dependent on the project					Sustainable social development programs will help the local economy continue the programs initiated with the help of the Proponent
Loss of projects by contractors					Proper payment of fees as per the contract executed

4.5 EMERGENCY PREPARENESS AND RESPONSE PLAN

On top of all of these measures, CSI has formulated its Emergency Preparedness and Response Plan (EPRP) provided below:

4.5.1 Introduction

An Emergency Situation is defined as any situation or occurrence of serious nature which may develop suddenly and unexpectedly, posing threat to life, property or even the environment that demand immediate action, including, but not limited to accidents, fire, explosions, acts of terrorism and sabotage.

The EPRP is a consolidated compendium of guidance for management of emergencies in all phases of the project cycle starting from the construction stage to the abandonment phase. This plan reflects the Management System that is applied to ensure compliance with CSI's standards and other applicable Philippine legal requirements pertaining to rolling mill operations.

The scope of this EPRP is to set the minimum standards required and identifies the persons responsible for applying safe working conditions, procedures and practices including emergency situations potentially arising from plant operations. Whether natural or man-made the accidents or consequences of hazards will not be societal in scope but most confined to the plant personnel.

The success of this plan depends upon the cooperation of everybody at the site of an emergency and adherence to safety precautions and directives of this plan. The prime concern is everybody's safety which requires unwavering discipline and preparedness.

Notwithstanding that there are preventive measures to be undertaken, e.g. in the design and construction of major equipment, in the storage of diesel oil, it is prudent for operating companies

to develop their internal response plans. The response and procedure will depend on the nature of the emergency and will include the following generic guidelines:

- Establishment of official detailed responses per type of emergency; Thus each plan would be relevant to emergency situations such as fire, earthquake, and even from attacks of criminal elements.
- Contact of necessary and important agencies and offices outside of the plant and facility for assistance depending on the type of emergency;
- Sought after or obtaining the assistance of the Disaster Reduction and Management Coordinating Council;
- Conduct of emergency drills with emergency evacuation as an integral part of the drill;
- Installation or securing of necessary emergency response facilities/equipment, e.g. firefighting system, oil spill containment boom (in an event of accidental oil spill at the jetty), vehicles for use in emergency cases, situations and disasters; and
- Setting up of communication lines, e.g. with barangay, fire department, police department, clinics or hospitals.

During Actual Emergencies

- Designation of on-site emergency marshal;
The on-site team leader should be pre-determined. Night shift supervisors are the logical leaders during night time emergencies.
In case of more serious situations, the on-site team leader may have to call assistance from his supervisor who may be outside the plant premises.
- Communicating with outside parties for help when necessary:
Contact numbers and means of communications should be well-established and be posted in conspicuous places in the plant premises and buildings.
- Execution of emergency procedure; and
As a basic first step, emergency alarm signals should be set on. The alarms may be coded depending on the type and seriousness of an emergency.
- Evacuation of personnel: Evacuation routes should be well defined and known to the plant personnel.

After Emergency

- Audit or investigation of cause of emergency, if man-made such as fire
- Assistance to injured people

4.5.2 Purpose

The EPRP will serve the following general and important purposes:

- Guide and assist the proponent including all its employees, construction contractors' management, and other service provider/suppliers to handle emergency situation;
- Pre-identify responsible parties including their roles and responsibilities in handling emergency situations and cases;
- Achieve Zero Loss Time Injury, Occupational Illness and minimize the rate of incidents
- Comply with the Philippine legal requirement and international standards for handling emergency, health and safety practices and measures; and
- In case of emergency situations/cases and abnormal conditions, prevent contamination to groundwater, surface ground stability, destruction of flora and fauna and if they occur take measures to manage them in timely, safely and environmental friendly manner.

4.5.3 Emergency Action Team

The Emergency Action Team (EAT) shall be responsible for execution of the ERP. The Team is composed of:

- Chief Marshall – Construction/Project Manager,
- Members – LGUs including the Police Department, Fire Department, National Risk Reduction Committee members and the Health Department..

During the Construction Work

Under the general supervision of the Plant Manager, the EAT will be responsible for providing direction, guidance, and taking appropriate measures in safeguarding life and property. The EAT will also maintain close liaison with the Project Proponent and affected communities/people.

During the Operations Phase

For serious accidents or emergencies the EAT shall be headed by the most senior personnel of the Proponent who would be at the site of the emergency.

4.5.4 Emergency Action Officer

Emergency Response Procedures shall be under constant close supervision of the Emergency Action Officer (EAO). The EAO shall maintain central control of the execution of the plans. All incidents under emergency situations shall be reported to him. The EAO shall command, coordinate, communicate and direct necessary actions and measures. The mandate of EAO is to establish command and control. However, this does not preclude abstinence of others, especially supervisory employees, from emergency tasks requirements.

In addition to the emergency duties, the EAT shall provide training and/or arrange drills around the year so as to train employees on handling emergency situations.

4.5.5 Threat/Emergency Analysis

When there is an emergency incident e.g. fire or any type of threat or emergency as mentioned below, the first person who sees, hears or recognizes danger should immediately inform the EAO.

4.5.6 Designation of Safe Haven

Safe Haven is a place of safety, shelter, refuge or rest where there is no danger to life. Based on the type of incident, the safe haven shall be determined and designated where the people affected by an emergency situation shall proceed. In case of fire or explosion, the Safe Haven shall be the open space distant from the fire site.

By nature of the project the site is an open area; the safe haven should be pre-identified and well informed to all the personnel.

4.5.7 Evacuation Policy

In the event of any emergency, an alarm or siren or alternately a sound generating devise shall be blown / activated. The alarm may be coded to signify the intensity and nature of the emergency situation. The EAO shall direct and provide guidance to all persons affected. All affected persons shall be enjoined to strictly follow as instructed. The evacuation route/roads will be clearly delineated.

4.5.8 Standard Operating Procedures

4.5.8.1 Fire

All persons near the fire site shall be evacuated. Firefighting shall be handled by the EAO in the beginning until assistance from the LGU shall have been obtained.

4.5.8.2 Acts of Sabotage

Act of sabotage may cause fire, explosion, or damage to life and property. If a threat of sabotage is identified, the Emergency Action Team shall analyze and assess the impact of such sabotage and will determine course(s) of action. The EAO shall maintain liaison with the concerned government agency (ies) e.g. Bureau of Fire Protection, Police Department, etc. Should a fire or explosion happen due to sabotage, the corresponding procedure specific to the situation shall be followed.

4.5.8.3 Terrorist Attacks or Kidnappings

The EAT shall analyze, assess and maintain constant but safe contact with the attackers, review all incoming and outgoing communications, designate or task others for action. The EAO shall ensure compliance of the planned strategy and psychological tactics to counter terrorism and provide guidance for dealing with these incidents. An officer shall be designated to maintain direct or indirect contact with the kidnappers, maintain liaison with the Client and other pertinent Government Agencies, principally the police or the military.

4.5.8.4 Natural Disasters

Natural disasters such as landslides and earthquakes are beyond human control with respect to occurrences. The EAT shall analyze the situation and take appropriate measures. In the event of earthquake, construction workers shall come out of their workplaces, wear hard hats, and assemble at Safe Haven. Search and Rescue Team shall start search and rescue operations when needed.

As a matter of complete guidelines natural disasters are included although the occurrence of such are deemed remote.

4.5.8.5 Severe Weather Disturbances

Extreme rainfall and strong typhoon events shall be prepared for. The most effective measure is precautionary action. Constant communications with the PAGASA and the NDRMC shall be made. Warnings which are posted at the websites shall be constantly referred to. Work stoppage may be mandated by management when severe weather disturbances may be forthcoming. The movements of vehicles shall be regulated on account of dangers slippery roads.

4.5.9 Search and Rescue Team

This team shall work in close cooperation with the LGUs. The primary function of this team is to handle the smooth evacuation of personnel, supplies and personal belongings during the emergency. It is also the duty of this team to rescue personnel trapped or injured in any of the rooms of the building.

4.5.10 Coordination and Communication

One of the most important aspects in any EPRP is efficiency of immediate communications with the parties which will manage an emergency situation. In an event of fire, explosion or an act of terrorism and sabotage, the EAO shall maintain constant coordination and communication with other senior officers at site or the department heads to locate employees trapped in a work area and take appropriate measures to evacuate them.

4.5.11 Transportation

The EAO shall plan ground transportation of personnel or evacuees for transport to the city, hospital, medical professionals, etc.

4.5.12 Funds and Expenditures

Under the direct supervision of the Project Manager, the EAO shall manage funds for meeting emergency expenditures. This includes, but is not limited to, transportation, medication, expenditures arising out of emergency treatment, hospital and medical expenses, etc. During the operations phase, CSI shall ensure that the emergency response plans are properly supported by funds and resources, the latter involving people and equipment.

4.5.13 Emergency Numbers/Contact Persons

The emergency numbers/contact persons shall be posted in conspicuous places especially in the construction work temporary offices and in the toll booths, the latter during the operations phase. A list of the emergency contact information is provided in **Table 4.5.1**.

Table 4.5.1: Proforma List of Emergency Contact Numbers

Agency	Contact Detail	
	Telephone/ Mobile No.	Email Address
LGU	(043)7400157; 7402618	lma_Candelaria@yahoo.com
DRRM	0915-676-1424/726-3223	mdrrmo.Candelaria@gmail.com/mdrrmo.Candelaria@yahoo.com
Rescue	09156761424/740-0157/ 0905-485-4388	
Plant		

4.5.14 Emergency Drills

A protocol will be developed for the conduct of emergency drills at regular schedules. Administration of first aid especially involving vehicular accidents is among the important drills/training that will be imparted to the EAO for the operations phase.

4.5.15 Trainings and Seminars

CSI shall organize and conduct regular trainings and seminars to be conducted by professionals in safety and emergency management. Attendance to these on the part of the personnel shall be compulsory. Members of the LGUs as well as heads of community sectors/sitios/tribes shall be invited as well for their own education.

Among the topics to be discussed during these training programmes are: proper use of PPE, First Aid, Basic Life Support such as Cardiopulmonary Resuscitation; training in the handling of injured persons; training in search and rescue operation and fire-fighting. The assistance of NDRRMC at least from the municipal level in conducting drills or training for earthquake situations should be explored.

4.5.16 Institutional Set Up

The Plant Team will constitute themselves as the Emergency Response Team. Inasmuch as by its nature the occurrences of emergency situation cannot be reasonably anticipated the most senior personnel at the scene of an emergency situation will be designated as On Site Emergency Marshall. The supporting personnel will be dependent on the nature/extent of the emergency and the number of persons who may be exposed.

Provided in **Annex 4-1** is the detailed ERA and EPRP of CSI which are components of its ISO Certification.

CHAPTER V: SOCIAL DEVELOPMENT PLAN AND IEC FRAMEWORK

5.1 SOCIAL DEVELOPMENT PLAN

CSI 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	Indicative Budget in PhP
Livelihood / Employment (Men, Women, Youth and elderly) 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 & Elderly	<ul style="list-style-type: none"> • Barangay Council • City Council • TESDA 	Community Relations Officer	<ul style="list-style-type: none"> • Construction • Operation 	CSI	150,000.00
Education <ul style="list-style-type: none"> • Scholarships • Assistance to schools • Immersion Program for K12 • Skills training 	Barangay Kagawad for Education	DepEd	Community Relations Officer	<ul style="list-style-type: none"> • Construction • Operation 	CSI	50,000.00
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 • Adoption of Mangrove area beside the project site 	Barangay Kagawad for Environment	<ul style="list-style-type: none"> • CENRO • CHO 	Community Relations Officer	<ul style="list-style-type: none"> • Construction • Operation 	CSI	300,000.00
Water supply <ul style="list-style-type: none"> • Submersible pump for farmers' use especially during dry season 	Project Affected Community	Brgy. Malabanban SUR	Community Relations Officer	<ul style="list-style-type: none"> • Construction • Operation 	CSI	100,000.00
Peace and order <ul style="list-style-type: none"> • Assistance to barangay police/tanods like provision of necessary supplies and capability building/training 	Barangay Kagawad for Peace and order	<ul style="list-style-type: none"> • LGU • PNP 	Chief Security Officer	<ul style="list-style-type: none"> • Construction • Operation 	LGU – IRA/ CSI	25,000.00

Concern	Responsible Community Member / Beneficiary	Government/Non-Government Agencies and Services	Proponent	Indicative Timeline	Source of fund	Indicative Budget in PhP
Climate Change Adaptation and Disaster Risk Reduction and Management (CCA-DRRM) <ul style="list-style-type: none"> Regular drills with the Barangay DRRM 	Barangay and Municipal DRRM Council	LGU NDRRMC	Safety Officer	<ul style="list-style-type: none"> Construction Operation 	LGU – IRA/ CSI	15,000.00

5.2 IEC FRAMEWORK

The IEC was started as early as 2017 when CSI started series of dialogues with the LGU and land owners. This IEC will be a continuing process through the life of the project. 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 Barangays Malabanban Sur	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 barangays		Group methods	<ul style="list-style-type: none"> Educational Tour with the elementary schools of the host barangays 	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. CSI 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 CSI's budget for employees

5.3 GRIEVANCE REDRESS MECHANISM

During Construction Phase, the following grievance redress mechanism will be implemented:

- Grievance hotline centered at the Project Manager's Office to report any concern
- Provision of Bulletin Boards at the construction site
- Reporting to LGU on any issue or concern to the barangay and/or to the LGU of the Municipal Government of Candelaria

- Dedicated Project Manager who also acts as Community Relations Officer during Construction Phase

During operations, in order to avoid conflict and misunderstanding among employees and the community, CSI implements the following

- Grievance hotline in different Departments to report any suspected violation in the Code of Ethics or any concerns
- Regular coordination with barangays thru meetings
- Provision of Bulletin Boards at the Plant site and in the Barangays
- Reporting to LGU on any issue or concern to the barangay and/or to the LGU of the Municipal Government of Candelaria
- Dedicated Resident Manager who also acts as Community Relations Officer

For reporting complaints, the following may be contacted at the following contact details:

Name	RACQUEL S. BENITEZ, Resident Manager, Calaca Plant
Address	Phoenix Petroterminal & Industrial Park, Calaca Quezon, Region 4A (Southern Luzon)
Contact Details	Mobile No.: +63915616745 * Telephone: +63(043)4240228 Email: rsbenitez@steelasia.com

The Resident Manager is the contact person because she also acts as the focal person in implementing social development programs and serves as community relations officer at the same time.

The contact person and number may change once the new Resident Manager or Comrel Officer will be assigned for CSI Plant.

The current Barangay Captain of Malabanban Sur welcomes the idea of directing any resident's concern to him before the others.

CHAPTER VI: ENVIRONMENTAL COMPLIANCE MONITORING

6.1 SELF-MONITORING PLAN

CSI 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	Increased sediment deposition	Silts in drainage system	Desilting of canals	Quarterly	Constructi on site	CSI	10,000	Visual observati on of silt deposition	Immediat e clean-up	Total clean-up	Presence ofComplain ts	IEC	Regular coordinatio n with stakeholders thru regular IEC
Environmental Aspect # 1: The Land – solid wastes/garbage accumulation	Soil contamination / pollution	Scraps and debris	Observation	Quarterly	Working areas	CSI	10,000	Uncollect ed garbage	Coordinat e with the garbage hauler immediat e collection of garbage	Ensure regular garbage collectio n	Presence of Complaints	IEC	IEC
	Water quality (ground water and surface water)	BOD ₅	Azide Modification- Dilution Technique (USEPA method 3010)	Quarterly / Per DAO 2003 - 07	Downstream Monitoring wells near deepwell Effluents From Centralized Waste Water Treatment Unit	Project Proponen t	7,000	5	6	7	Review performanc e	Check WWTF	Regular maintenna ce of WWTF
		Total	Multiple tube	Quarterly	Existing	Project	10,000	3000	4000	5000	Review	Check	Regular

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
		Coliform	Fermentation – Method 9221B&E		stations	Proponen t	10,000				performanc e	WWTF	maintenna ce of WWTF
		Fecal Coliform	Multiple tube Fermentation – Method 9221B&E	Quarterly	Existing stations	Project Proponen t		100	150	200	Review performanc e	Check WWTF	Regular maintenna ce of WWTF
		Total Suspended Solids (TSS)	Gravimetric (Dried at 103-105° C) (USEPA method 3010)	Quarterly	Existing stations	Project Proponen t		100	120	150	Review performan ce	Check WWTF	Regular maintenna ce of WWTF
		pH	pH probe (USEPA method 3010) By electrode	Quarterly	Existing stations	Project Proponen t		4.0	5.0	6.0-8.5	Review performan ce	Check WWTF	Regular maintenna ce 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				Investigate source of contamination and implement corrective measures	Investigate and strengthen implementation of measures	Review and implement changes to further mitigation of hazwaste management
Environmental Aspect # 1: The Land	Generation scales	Heavy metals	TCLP/AAS	Annually	Scales storage	PCO		Silt deposition in roadways	silts in run-off	Silts in drainage	Presence of Complaints	IEC	Regular housekeeping
Environmental Aspect # 2: The Water - Use, Operation and Maintenance of	Water pollution from used oil	BOD ₅	Azide Modification-Dilution	Quarterly / Per DAO 2003 - 07	Hand pump tube well in	CSI	7,000	5	6	7 as per DAO	Review performance	Check oil and water separator.	Increase frequency of

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
Equipment			Technique (USEPA method 3010)		Barangays Malabanban Sur					2016-08		regular maintenance	maintenance schedule
	Water quality (ground water and surface water)	BOD ₅	Azide Modification-Dilution Technique (USEPA method 3010)	Quarterly / Per DAO 2003 - 07	Downstream Monitoring wells near deepwell Effluents From Centralized Waste Water Treatment Unit	Project Proponent	10,000	5	6	7	Review performance	Check WWTF	Regular maintenance of WWTF
		Total Coliform	Multiple tube Fermentation – Method 9221B&E	Quarterly	Existing stations	Project Proponent	10,000	3000	4000	5000	Review performance	Check WWTF	Regular maintenance of WWTF
		Fecal Coliform	Multiple tube Fermentation – Method 9221B&E	Quarterly	Existing stations	Project Proponent		100	150	200	Review performance	Check WWTF	Regular maintenance of WWTF
		Total Suspended Solids (TSS)	Gravimetric (Dried at 103-105° C) (USEPA method 3010)	Quarterly	Existing stations	Project Proponent	10,000	100	120	150	Review performance	Check WWTF	Regular maintenance of WWTF
		pH	pH probe (USEPA)	Quarterly	Existing stations	Project Proponent		4.0	5.0	6.0-8.5	Review performance	Check WWTF	Regular maintenance

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
			method 3010) By electrode								ce		ce 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		CSI 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 Chemiluminescence Method	Quarterly			Part of Operating Cost	105	120	150			
		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	Implementation of Reforestation			Proponent	Part of Operating Cost	Unattended reforestation	80% reforestation	60% reforestation	Immediate planting of trees and	Review reforestation and	Further study or revision of

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
		based on IPCC 2006 Guidelines and USEPA Procedure	and Carbon-Sink / GHG reduction program					commitment			revegetation	carbon sink program	the program
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		Proponent	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	Daily	Access Road	Project Proponent	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
			Traffic Impact Assessment										
	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	Proponen t	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			Propone nt thru PCO; MMT	To be determined	Based on ESA recommendations					
Environmental Aspect # 4: The People	Employment	No. of employees	Quarterly	Brgy. Malabanban Sur	Comrel	150,000.00	70% implementation of employment program	60% implementation of employment program	100% implementation of employment program	Review programs	Revise programs	Enhance program implementation	Employment
	Environmental Aspect # 1: The Land: oil spill	Soil contamination	Contaminated soil TPH (C6-C36) USEPA priority pollutant	USEPA 8260C USEPA 8015C	Once before decommissioning	Hazardous Waste Storage Area	PCO	50,000	80 0.8	90 0.9	100 1.0	Investigate source of contamination and implement	Investigate and strengthen implementation of measures

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
			metals (Sb, As, Be, Cd, Cr, Cu, Pb, Hg, Ni, Se, Ag, Ti, Zn) VOCs SVOCs	USEPA 7470A USEPA 6020A USEPA 8260 USEPA 8270					1.6 40	1.8 45	2.0 50	corrective measures	
	Livelihood opportunities for local people and entrepreneurs	No. of Programs implemented	Survey / FGD	Quarterly	Candelaria	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	Candelaria	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 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. Further, DAO 2018-18 requires that DENR-PENRO and CENRO shall participate in MMT. Provided in **Table 6.2.1** are the recommended MMT members for the proposed project.

Table 6.2.1. MMT Composition

Stakeholder-Members
DENR PENRO and CENRO
LGU Representatives
<ul style="list-style-type: none"> • Municipality of Candelaria / MENRO • Rural Health Office Chief • Barangay Chairman of Malabanban Sur
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

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 Region 4A 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, CSI 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 CSI based on a pro-forma to be provided by EMB shall be executed with conformity of members of the MMT. The MOA signed by CSI 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 the project proponent.

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

CSI commits to establish an Environmental Monitoring Fund (EMF) and Environmental Guarantee Fund (EGF). The EMF will be exclusively utilized to cover all costs needed for the operation of the MMT. Whereas, the 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. **Table 6-2** shows the EMF and EGF for the proposed Project.

Table 6.3.1: EMF and EGF for the Proposed Project

Type of Fund	Amount (PhP)
EMF based on the activities and programs of the Multi-partite Monitoring Team (MMT), is around PhP300,000.00 The EMF can be replenished once the amount of PhP300,000.00 is less than 50%.	300,000.00
EGF (Trust Fund)	1,500,000.00
EGF (Cash Fund)	1,500,000.00

The establishment of the appropriate EMF and EGF schemes will be in accordance with the prescribed guidelines and procedures of DENR Administrative Order No. 2017-15. The amount of the EGF will be based on the risk and hazards that will associated with the project's implementation and will be negotiated between CandelariaSteel, Inc. and the DENR-EMB Central office. This amount is based on similar steel mill projects of SteelAsia group.

The proposed funds are 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 and will also be subject to regular replenishments as needed.

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 Environmental Site Assessment (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 Proponent 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 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 from construction phase up to 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 SET UP

During Construction Phase, the Project Manager supported by the Assistant Project Manager heads the Team.

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.

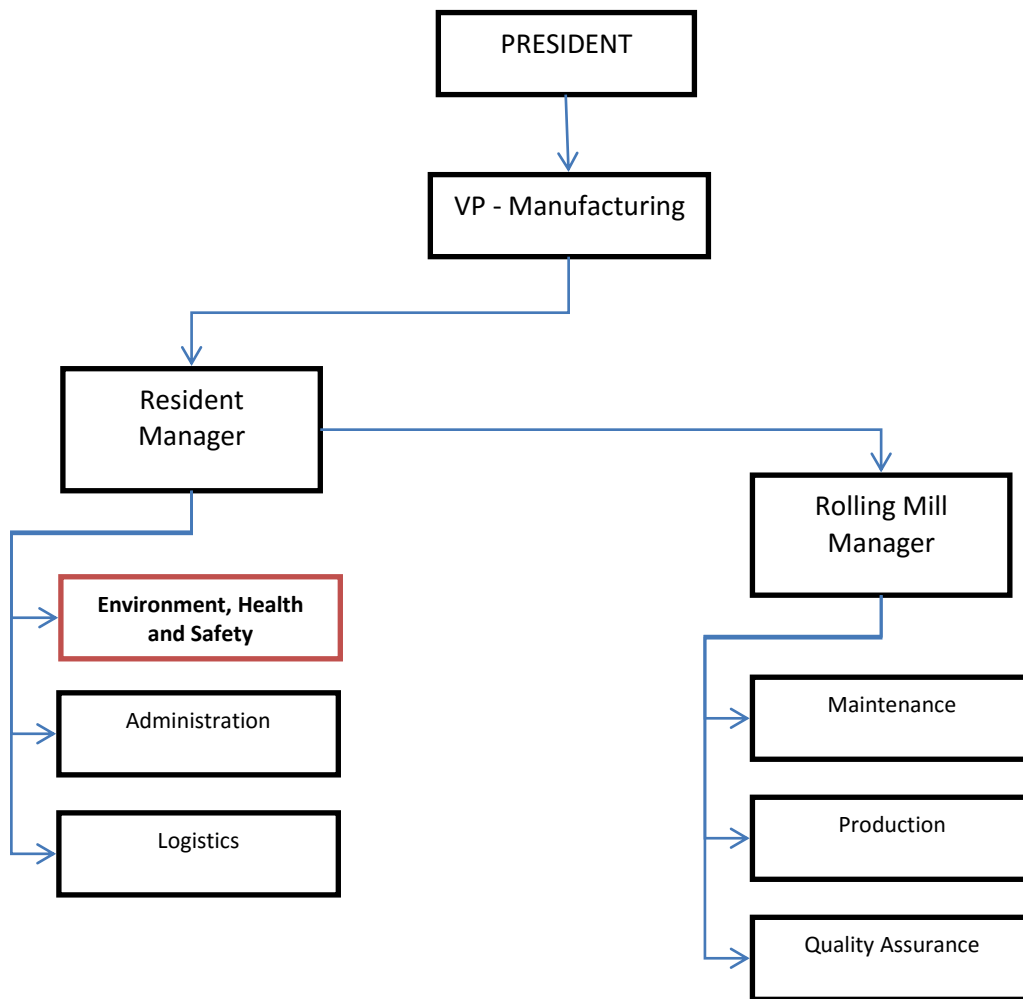


Figure 8.3.1: Initial Organizational Chart/Institutional Plan for EMP Implementation

8.4 ROLES AND RESPONSIBILITIES

During construction phase, following are the responsibilities of the Project Manager and Assistant Project Manager:

- Implementation of company policies especially for safety during construction
- Economical and safe operations and maintenance of the equipment
- Environmental compliance and sustainability;
- Promotion and enhancement of the social acceptability of the project.
- Implement the Grievance Redress Mechanism to avoid conflict and misunderstanding among employees and the community as follows:
 - Grievance hotline in different Departments to report any suspected violation in the Code of Ethics or any concerns
 - Regular coordination with barangays thru meetings
 - Provision of Bulletin Boards at the Plant site and in the Barangays
 - Reporting to LGU on any issue or concern to the barangay and/or to the LGU of the Municipal Government of Candelaria

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	<p>This department is in charge for the schedule and regular inspection, maintenance and repair of equipment</p>
Engineering Support	<p>This Department is in charge of the automation control, optimization, safety and testing of necessary support needed by the plant.</p>
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	<p>Compliance to environmental regulations and standards; maintenance of reports that are submitted to internal and external agencies</p>
Safety Engineer	<p>Responsible for implementation of emergency response procedures, handling of hazardous materials and environmental management systems and requirements of DOLE on occupational safety and health</p>
CSR and SDP personnel	<p>Community relations, grievance redress mechanisms, design, training and implementation of CSR and SDP programmes</p>
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 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

The implementation of the Environmental Management Plan (EMP) provided in this document will be specifically handled by the Environmental, Health and Safety Department. The proponent, through the said department, is committed to comply with the conditions that will be stipulated in the ECC and other related environmental laws.

The proponent will also establish a partnership with relevant government agencies, various stakeholders and local host communities in relation to the project. This partnership is necessary to maintain a transparent and positive relationship for the project and its stakeholders, as well as to ensure compliance with environmental protection and enhancement measures.

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CHAPTER X: ANNEXES

ANNEX ES-1: Accountability Statement of the Proponent and Preparers

ANNEX ES-2: EIA Scoping and Screening Form

ANNEX ES-4: Public Participation Documentation

1. Perception Survey
2. KII/FGD
3. Public Scoping

ANNEX 1-1: SEC Registration of Candelaria Steel, Inc.

ANNEX 1-2 Deed of Absolute Sale and Transfer Certificates of Title

ANNEX 2-1: Zoning Certificate

ANNEX 2-3: Selected Air Dispersion Modeling Input and Output Files

ANNEX 4-1: Detailed ERA and EPRP of CSI

ANNEX 6-1: PEMAPS Questionnaire