ENVIRONMENTAL IMPACT STATEMENT REPORT

Proposed Modular Diesel Power Plant Ancillary Project

Barangay Libertad, Isabel, Leyte

Submitted to:

ENVIRONMENTAL MANAGEMENT BUREAU
Department of Environment and Natural Resources
DENR Compound, Visayas Avenue, Quezon City, Metro Manila

Submitted by:

Isabel Ancillary Services Co. Ltd.

Lot 2-A-1-B and Lot 2-A-1-D, Leyte Industrial Development Estate, Libertad, Isabel, Leyte

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List of Acronyms

CLUP	Comprehensive Land Use Plan
DAO	Department Administrative Order
ECC	Environmental Compliance Certificate
ECP	Environmentally Critical Project
EISR	Environmental Impact Statement Report
EMB	Environmental Management Bureau
EMP	Environmental Management Plan
EMoP	Environmental Monitoring Plan
GEOSPHERE	GEOSPHERE Technologies, Inc.
IASCL	Isabel Ancillary Services Co. Ltd.
IEC	Information, Education and Communication
LGU	Local Government Unit
MGB	Mines and Geosciences Bureau
NAMRIA	National Mapping and Resource Information Authority
NDC	National Development Corporation
PAGASA	Philippine Atmospheric, Geophysical and Astronomical Services
PEISS	Procedural Manual of the Philippine EIS System
PHIVOLCS	Philippine Institute of Volcanology and Seismology

EXECUTIVE SUMMARY

A. PROJECT FACT SHEET

Project Name	Proposed Modular Diesel Power Plant Ancillary Project
Project Location	Leyte Industrial Development Estate, Barangay Libertad, Isabel, Leyte
Project Type	Modular Diesel Power Plant
Project Area	1.934 hectares
Project Capacity	• 40MW regulating reserve with an initial dispatch of 20MW at the start of the interval hour or based on system requirement and/or NGCP's dispatch instruction. Such output will then change if there will be fluctuations of system frequency in the Visayas Grid. • 30MW contingency reserve with an initial dispatch of 1.5MW at the start of he interval hour or based on system requirement and/or NGCP's dispatch instruction. Such output will then change if there will be an outage of a large generator or a loss of transmission line in the system. • In summary, 70MW plant capacity is available to the grid in cases of emergencies.
Project Technology	High Speed Diesel Engines that use Automotive Fuel Oil
Project Components	Modular Diesel Generator Air Intake System Exhaust Gas System Fuel Supply System Lubrication System Cooling System Service Water System Instrumentation and Control System Substation Administration Building and other Site Facilities Fire Protection System Smoke Stack Oily Wastewater Treatment System
Project/Investment Cost	PhP1,750,000,000.
Profile of the Proponent	
Name of Proponent	Isabel Ancillary Services Co. Ltd.
Proponent's Address	Lot 2-A-1-B and Lot 2-A-1-D, Leyte Industrial Development Estate, Libertad, Isabel, Leyte
Authorized Signatory/ Representative	Gen Takahashi Vice President
Contact Details	Landline No.: (632) 552 8009 Mobile No.: +63 9285511072 Fax No.: (632) 553 5716 E-mail: gen.takahashi@teamenergy.ph
Profile of the Preparer	
EIA Preparer	GEOSPHERE Technologies, Inc.
Consultant's Address	19D Eisenhower Tower, Eisenhower St., Greenhills, San Juan City, Metro Manila
Contact Person	Engr. Ledicia T. dela Cruz Managing Director
Contact Details	Landline: (+632) 724-5665; 724-5667 Fax Number: (+632) 723-4250 Email Address: gti0722@geospheretech.com

B. EIA PROCESS DOCUMENTATION

EIA Team

The EIA Study was conducted by a multidisciplinary team of specialists and consultants of the GEOSPHERE Technologies, Inc. (**GEOSPHERE**), who have strong background in environmental assessments. The composition of the EIA Team are listed in **Table ES-1**.

Table ES-1 EIA Team Composition

Team Member	Environmental Component/Task	Reg. No.
Ledicia T. dela Cruz	Team Lead	IPCO-287
Marmelou Popes	Geology and Geohazard	-
Enrico Replan	Terrestrial Ecology	-
Reynaldo S. Tejada	Meteorology and Air Quality	IPCO-036
Fritzie Jane Salido	Water Quality and Environmental Risk Assessment	IPCO-114
Felixberto H. Roquia, Jr.	Socio-Cultural	IPCO-028

From Isabel Ancillary Services Co. Ltd. (**IASCL**), the project management was spearheader by Mr. Gen Takahashi, Vice President, Engr. Gerald Mascardo, Manager of Project Development and Engr. Rodolfo Bernardo, Assistant Vice President of Power Department.

The Accountability Statements of IASCL and GEOSPHERE are presented in **Annex ES-1**.

EIA Schedule

The major activities undertaken to complete the EIA were listed in **Table ES-2**.

Table ES-2 EIA Study Schedule

Activity	Date
Information, Education and Communication (**IEC**) Activities	September 12 and 19, 2017
Public Scoping	November 7, 2017
Technical Scoping	December 13, 2017
Primary and Secondary Data Gathering	
Pedology	January 14-16, 2018 – Collection of Soil Samples
Terrestrial Ecology	January 14-16, 2018 – Terrestrial Flora Survey
Water Quality	November 20, 2017
Air Quality and Noise	November 6-7, 2017 – Ambient Air Quality and Noise Sampling
Socio-economic, Health and Perception Survey	November 7-21, 2017
Preparation of EISR	January – July 2018

EIA Study Area

The EIA Study area for the proposed Project covers the area within Leyte Industrial Development Estate (**LIDE**), Municipality of Isabel and Barangays Libertad and Matlang.

EIA Methodologies

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 A-1 Category of Environmentally Critical Projects (**ECPs**) which requires an Environmental Impact Statement Report (**EISR**) for an Environmental Compliance Certificate (**ECC**) application.

The EIA for the proposed Project conforms to DAO 2003-30 and DAO 2017-15 in the conduct of the following activities, to wit: (i) IEC and Scoping, (ii) collection of primary and secondary data, (iii) identification/prediction/assessment of environmental impacts, (iv) formulation of Environmental Management Plan (**EMP**) and the (v) development of an Environmental Monitoring Plan (**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, which was finalized during the Technical Scoping Meeting, which was conducted at the Environmental Management Bureau of the Department of Environmental and Natural Resources (**EMB-DENR**) Central Office, DENR Compound, Visayas Avenue, Diliman, Quezon City on December 13, 2017. The technical scoping was attended by the EMB Case Handlers, EIA Review Committee (**EIARC**), Isabel Ancillary Services Co. Ltd. (**IASCL**) and GEOSPHERE. The approved EIA Scoping and Screening Form and the attendance sheets during technical scoping are presented in **Annex ES-2**.

Data collected were processed, analyzed and evaluated for impact assessment and formulation of EMP and EmoP. The data and information were written into an EISR and the final version of the EISR was then submitted to the EMB-Central Office for ECC application.

Table ES-3 shows the pertinent data, sources and methodology used for the proposed Project.

Table ES-3 The EIA Methodology

Environmental Components	Methodology
LAND	
Land Use and Classification	• Review of Comprehensive Land Use Plan (**CLUP**) of Isabel Municipality
Geology	• Review of available reports, geologic literature and information from Mines and Geosciences Bureau (**MGB**), Environmental Management Bureau (**EMB**), Philippine Institute of Volcanology and Seismology (**PHIVOLCS**), Philippine Atmospheric, Geophysical and Astronomical Services (**PAGASA**), and National Mapping and Resource Information Authority (**NAMRIA**)
Pedology	• Review of existing literature and maps of the project area. • Collection and analysis of soil samples
Terrestrial Ecology	• Conduct field surveys at the proposed Project site.
WATER	
Hydrology	• Review of CLUP and other secondary data from existing literature and maps of the project area from MGB, EMB and NAMRIA.
Water Quality	• Review of water quality data from EMB Region 8 • Review of marine ecology from PASAR EPRMP
AIR	
Meteorology and Climatology	• Collection and review of existing literature and maps of the project area from PAGASA Tacloban Airport Station
Air Quality and Noise Level	• Conduct of ambient air quality monitoring at six (6) established sampling stations to measure the ground level concentrations (GLCs) of NO_2, SO_2, TSP, PM_{10} and Heavy metals in the project area and its vicinity. • Conduct of Noise level measurement during morning, daytime, evening,

Environmental Components	Methodology
	and night time using Extech Noise Data Logger at the six (6) established sampling stations. • Use of AERMOD version 15181 software to assess and determine air quality impact of TSP, PM_{10}, SO_x, NO_x, and CO emissions from the operation of the proposed Ancillary Plant Project. • Noise prediction for construction and operation activities of the proposed Project using CUSTIC 2.0 modeling software.
PEOPLE	
Socioeconomic and Public Health	• Conduct of IEC for the Barangay and Municipal LGUs • Conduct of Public Scoping • Conduct of Socio-economic, Public Health and Perception Survey at Barangay Libertad • Review of the CLUP of Isabel Municipality • Review of available secondary data, relevant studies and other information from Philippine Statistics Authority (**PSA**).

Public Participation Activities

An extensive and comprehensive IEC Activity about the proposed Project and the EIS System was conducted to ensure a meaningful and active participation of well-informed stakeholders – host communities, LGUs, relevant agencies, EMB and the local DENR in the EIA process.

Information, Education and Communication

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

Table ES-4 IEC Conducted for the EIA Study of the Proposed Project of IASCL Barangay Libertad Isabel, Leyte

Session	Date/Time	Venue
Municipal Mayor	September 12, 2017, 9:00 AM	Mayor's Office, Municipal Hall, Isabel, Leyte
Barangay Officials and Sectoral Leaders	September 12, 2017, 11:00 AM	Barangay Hall, Barangay Libertad, Isabel, Leyte
Sangguniang Bayan	September 19, 2017, 9:30 AM	SB Session Hall, Municipal Hall, Isabel, Leyte

Public Scoping

The Public Scoping was conducted on November 7, 2017, 9:30 A.M. at the Multi-Purpose Covered Court of Barangay Libertad, Isabel, Leyte to present the EIA Process, the proposed Project and its potential associated impacts and benefits to the public to collect site-specific concerns/inputs and suggestions to be incorporated in the EIA Study. The issues/concerns raised, copy of the received invitation letters, attendance sheets and photos taken during Public Scoping are presented in **Annex ES-4**.

C. EIA SUMMARY

Summary of Alternatives

Siting

There is no other alternative site considered for the proposed Project, except for the 1.934 hectares lot within the LIDE in Barangay Libertad, Isabel, Leyte. Considering that the proposed Project is to be located inside the industrial estate, there will be no sensitive areas such as protected areas, forest, mangroves, critical habitats and endangered species that will be affected. The source of fuel supply is also located approximately two (2) kilometers from the Project site also inside LIDE, which will ease the delivery of fuel to the Project site. Moreover, IASCL identified the 138kV transmission system of NGCP located just above the Project site as the best tapping point.

Technology

IASCL will utilize a high-speed modular diesel power plant which is a location-independent complete system with perfectly matched components. In a modular power plant, all the modules are preconfigured for quick installation and are delivered to the installation site prefabricated. This facilitates the installation of the modular power plant on site and shortens set-up times, allowing precision assembly even in locations with limited infrastructure. Other reasons which aid IASCL in choosing a modular diesel power plant are as follows:

- Has simple design and layout of plant
- Occupies less space and is compact
- Can be constructed and operated quickly
- Requires less water for cooling
- No ash handling problem
- Requires Less operating and supervising work

Impact Assessment and Environmental Management Plan

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 Environmental Management Plan for the Proposed Project

Environmental Component Likely to be Affected	Potential Impact	Prevention/Mitigation/ Enhancement Measures	Residual Effects
CONSTRUCTION PHASE			
LAND			
Land use and Classification	• Change/ Inconsistency in Land Use	• The Project site is an industrial area and consistent with the general land use of Isabel Municipality and therefore there is no issue with the change in land use.	None
Geology/ Geomorphology	• Change in surface landform/terrain/ slope • Change in sub-surface underground geomorphology	• Strict conformance to the recommendations of the geotechnical study • Since the area is already developed, the possibility of experiencing landslides and/or mud/debris flow is nil.	None

Environmental Component Likely to be Affected	Potential Impact	Prevention/Mitigation/ Enhancement Measures	Residual Effects
	• Inducement of subsidence, liquefaction, landslides, mud/debris flow		
Pedology	• Soil erosion	• When necessary, construction of soil erosion control measures either by engineering structure or planting of grasses/trees. • Placement of excavated soil materials in appropriate stockpile areas with avoidance of stockpiling along drainage ways/creeks. • The soil stockpiles will be covered with plastic sheets/geotextile, or planted with grasses/ small shrubs for erosion control.	None
Terrestrial Ecology	• Vegetation removal and loss of habitat	• Since the site is already developed, the construction of the proposed Project will not cause significant loss of habitat.	None
AIR			
Air Quality and Noise	• Degradation of Air Quality	• Every main haul road shall be paved with concrete, bituminous materials; keep the road clear of dusty materials; spray the road with water so as to maintain the entire road surface wet; and immediately before leaving a construction site, every vehicle shall be washed to remove any dusty materials from its body and wheels; • Truck loaded with dusty construction materials shall be covered entirely by clean impervious sheeting to ensure that the dusty materials do not leak; • Periodic watering of aggregates storage piles or covering or enclosure if material is especially dusty. • Ambient air (TSP) monitoring	Minimal degradation of air quality, confined only to construction site and away from sensitive receptors

Environmental Component Likely to be Affected	Potential Impact	Prevention/Mitigation/ Enhancement Measures	Residual Effects
	• Increase in ambient noise level	• 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 • Proper instruction and supervision of staff • Defective equipment/parts with abnormal noise and/or vibration will be either repaired replaced • All employees working on site will be provided with proper ear protectors • Conduct noise level monitoring	Minimal increase in ambient noise levels, confined only to construction site and away from sensitive receptors
PEOPLE			
Local residents	• Increase in local employment	• Priority employment for qualified local residents without discrimination to gender and age	Increased income of the local residents with consideration to gender equality and vulnerable group
Local community	• Improvement in infrastructures and social services	• Diligent payment of taxes/revenues	Increased income of the host LGUs
OPERATION PHASE			
LAND			
Geology	• Subsidence and Liquefaction	• Structural monitoring of buildings/facilities especially after each earthquake • Formulation of detailed Emergency Preparedness and Response Plan	None
Pedology	• Soil contamination	• Regular monitoring of possible oil spills • Implementation of Emergency Preparedness and Response Plan	None
Terrestrial Ecology	• Possible off-site impacts • Generation of power plant emissions	• IASCL shall plant native species for vegetation, as these would be expected to have good survival rate.	Increased number of trees
AIR			
Air Quality	• Degradation of Air Quality	• Use of automotive diesel oil, which is a clean fuel • Built-in smokestacks for efficient dispersion of plant's emission	Minimal degradation of air quality, since predicted GLCs of all parameters

Environmental Component Likely to be Affected	Potential Impact	Prevention/Mitigation/ Enhancement Measures	Residual Effects
		• Conduct ambient air quality monitoring and stack emissions testing	are below CAA limits and away from sensitive receptors
Noise Quality	• Increase in ambient noise level	• All generators will be enclosed; • Conduct noise level monitoring	None
PEOPLE			
People's health and safety	• Increase in local employment	• Priority employment for qualified local residents without discrimination to gender and age	Increased income of the local residents with consideration to gender equality and vulnerable group
	• Introduction of disease between migrant and local workers	• Clean bill-of-health as a condition for employment • Medical missions shall be part of the CSR program of IASCL • Provision of potable water, sanitary facilities and garbage bins for workers • Provision of a safety officer to monitor safe working conditions • Provision of Medical/First Aid kits in all work places	Accidents may still occur, but the safety and health guidelines in place will significantly lower the exposure of workers to hazards.
	• Fire hazard	• Provision of fire suppression systems, fire detections systems, fire hose stations and portable fire extinguishers	

In summary, the proposed Project has no significant adverse impact on land component, as it will be located within LIDE. For the water component, the proposed Project site is approximately 500m from the sea. Additionally, there will be no wastewater discharges into the marine environment which can cause significant adverse impact to the marine water quality and ecology.

For the air component, the air emissions are the main impact of the proposed Project. However, IASCL will use automotive diesel oil as fuel, which is cleaner. Moreover, installation of 5.6m stack per unit ensures that emissions will meet DENR air quality standards. No residual air impacts are projected based on the air dispersion modeling done.

The residents in the host barangay and municipality will be affected in a beneficial way with employment opportunities, CSR, and SDP during construction and operation phases of the proposed Project. The LGU will also be positively affected mainly with the payment of taxes and fees.
No major risks and uncertainties are identified based on the findings of the EIA.

1.0 PROJECT DESCRIPTION

The Isabel Ancillary Services Co. Ltd. (**IASCL**) proposed to install and operate an ancillary power plant with a total installed capacity of 70MW, named as Modular Diesel Power Plant Ancillary Project, which will be located inside Leyte Industrial Development Estate (**LIDE**) in Barangay Libertad, Isabel, Leyte. The ancillary power plant is proposed to provide support services necessary to sustain transmission capacity and energy essential in maintaining grid power quality, reliability, and security which is consistent to the Ancillary Services Procurement Plan under Energy Regulatory Commission (**ERC**) Case No. 2005-253.

The proposed ancillary power plant of IASCL shall provide two types of Ancillary Services, Regulating Reserve and Contingency Reserve. The Regulating Reserve is the capacity necessary to adjust total system generation over short periods of time to match system load changes. The maximum response time for the change in the generating unit's power output shall be twenty-five (25) seconds and which shall be sustainable for at least 30 minutes. The Contingency Reserve, on the other hand, is intended to take care of sudden and unexpected loss of the large synchronized generating unit or the power import from a single grid interconnection. These plants are quick enough to maintain system reliability and restore the system to generation/load balance and the system frequency. Contingency Reserve Service shall be sustainable for a period of at least 30 minutes. Continued supply service in excess of 30 minutes shall be provided under the terms of Dispatchable Reserve Service to be sourced from other AS providers. For Generators providing Regulating Reserve operating at Automatic Generation Control mode, the maximum response time is 25 seconds and should be sustainable for at least 30 minutes. For generators on Free-governor mode of operation, the maximum response time is 5 seconds and should be sustainable for 25 seconds.

The proposed ancillary power project of IASCL will have an installed capacity of 70MW allocated as follows: 40MW as regulating reserve and 30MW as contingency reserve. The regulating reserve will be dispatched and have an initial loading of 20MW or 50% of the 40 MW installed capacity at the start of the interval hour or based on system requirement and/or NGCP's dispatch instruction. Such output will then change if there will be fluctuations of system frequency in the Visayas Grid. The contingency reserve will initially require five (5) modular engines to be operated at 300 kW each or a total of 1.5MW initial loading at the start of the interval hour or based on system requirement and/or NGCP's dispatch instruction. Such output will then change if there will be an outage of a large generator or a loss of transmission line in the system. Therefore, the IASCL has committed to the National Grid Corporation of the Philippines (**NGCP**) that the 70MW plant capacity is available to the grid in cases of emergencies.

The proposed Ancillary Power Project of IASCL is classified under A-1 Category of Environmentally Critical Projects (**ECPs**) pursuant to Memorandum Circular 2014-005, the Revised Guidelines for Coverage Screening and Standardized Requirements under the Philippine Environmental Impact Statement System (**PEISS**) of the Department of Environment and Natural Resources (**DENR**) which requires an Environmental Impact Statement Report (**EISR**) for application of an Environmental Compliance Certificate (**ECC**) at the Central Office of the Environmental Management Bureau (**EMB**) of the DENR.

Brief Information about the Proponent

ISABEL ANCILLARY SERVICES CO. LTD. (**ASCL**) is a special project company of Marubeni Corporation duly registered with the Securities and Exchange Commission (**SEC**) on May 17, 2018 (**Annex 1-1**). IASCL's office is located at Lot-2-A-1-B and Lot 2-1A-1-D, Leyte Industrial Development Estate, Libertad, Isabel.

The proposed Modular Diesel Power Plant Ancillary Project has already been issued an Environmental Compliance Certificate (**ECC**) by the DENR-EMB Region 8 (ECC Reference Code: ECC R08-1840-0016 dated April 30, 2018) under its normal operating capacity of 21.5 MW for providing Regulating and Contingency reserves (**Annex 1-2**)**.** However, based on IASCL's commitment to have the total 70MW plant capacity available to the grid in cases of grid disturbances

and/or emergencies, the plant capacity in the ECC has to be upgraded. Thus, this application for an ECC of a 70 MW ancillary plant of IASCL is submitted to DENR - EMB Central Office.

1.1 PROJECT LOCATION AND AREA

1.1.1 Description of the Project Area

The proposed ancillary power project of IASCL will cover an area of about 1.934 hectares (ha) within the Leyte Industrial Development Estate (**LIDE**) in Barangay Libertad, Isabel, Leyte. Pursuant to the Certification from the National Development Corporation (**NDC**) presented in **Annex 1-3**, NDC has reserved the 1.934 ha Lot 2-A-1-B and Lot 2-A-1 of TCT No. TP 10260 for the proposed Project of IASCL.

The proposed Project site is within an industrial zone and has been stipulated in the approved Comprehensive Land Use Plan (**CLUP**) of the Municipality of Isabel.

Barangay Libertad is approximately 145 km from Tacloban City following the Tacloban-Ormoc-Isabel route. **Table 1-1** and **Figure 1-1** present the technical description and the geographical location of the proposed Project, respectively. **Figure 1-2** presents the location of the proposed Project within LIDE.

Table 1-1 Geographical Coordinates of the Proposed Project Site

Points	Latitude	Longitude
1	10°53'52.58"N	124°26'35.87"E
2	10°53'52.54"N	124°26'38.48"E
3	10°53'51.36"N	124°26'38.38"E
4	10°53'50.72"N	124°26'38.67"E
5	10°53'50.26"N	124°26'39.26"E
6	10°53'49.21"N	124°26'40.97"E
7	10°53'48.66"N	124°26'41.61"E
8	10°53'47.83"N	124°26'41.96"E
9	10°53'45.38"N	124°26'42.54"E
10	10°53'45.35"N	124°26'35.47"E

Source: IASCL

Source: IASCL, modified by GEOSPHERE, 2018

Figure 1-1 Geographical Location of the Proposed Modular Diesel Power Plant Project

Source: Google Earth, modified by GEOSPHERE, 2018

Figure 1-2 Location Map of the Proposed Modular Diesel Power Plant Project

1.1.2 Impact Areas

The direct impact areas (**DIA**) cover the areas where the proposed ancillay power plant facilities will be sited, green areas/buffer zone, and other areas around the project site which may be exposed to ground level concentrations (**GLCs**) of potential pollutants as well as other parameters above the criteria set by the DENR. In terms of socio economic benefits, the DIA areas include the host local government units (**LGUs**): Barangay Libertad, Isabel Municipality, Province of Leyte and Region 8 which are project beneficiaries for employment, business opportunities, taxes and benefits from Department of Energy (**DOE**) Energy Regulations (**ER**) 1-94 of the Electric Power Industry Reform Act (**EPIRA**) Law as well as reliable power supply that contributes to the economic stability of the Region.

The indirect impact areas (**IIA**) include the receptors of the plant's air emissions that comply with the standards based on the air dispersion modeling. The IIA in terms of socio economic benefits will cover the Visayas Area, which will benefit from the stable and reliable power supply which can contribute further to the economic stability of the country.

The DIA and IIA of the proposed Project are presented in **Table 1-2** and **Figure 1-3**.

Table 1-2 Impact Areas of the Proposed Project

Impact Area	Description
Direct Impact Areas:	
Land	
Areas where the proposed Project Facilities will be Sited	• 1.934 ha lot area including green areas/buffer zone
Access Road	• Access road within LIDE
Air and Noise	
Project Site including buffer zone	• 1.934 ha lot area
Socio-Economic	
Host Barangay, Municipality, Province and Region	• Barangay Libertad • Municipality of Isabel • Province of Leyte • Region 8
Indirect Areas:	
Receptors of plant's air emissions with concentrations less than the criteria set by the DENR	• Barangay Poblacion • Barangay Matlang

Source: NAMRIA, modified by GEOSPHERE 2018

Figure 1-3 Impact Areas of the Proposed Modular Diesel Power Plant Project

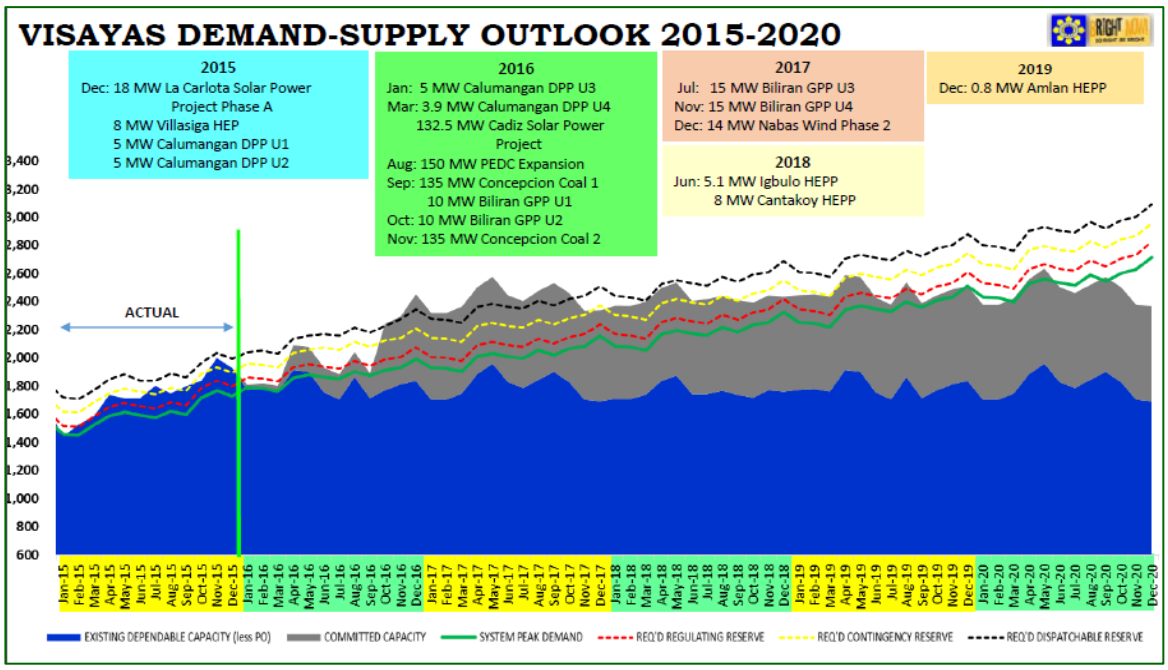
1.2 PROJECT RATIONALE

1.2.1 Shortage of Power Supply and Ancillary Services in the Visayas

The DOE Power and Supply-Demand Outlook for 2015-2020 as presented in **Figure 1-4**, shows an increasing power demand in Visayas Grid at an average annual growth rate (AAGR) of 4-5%. Due to growing demand and increasing number of new consumers, the DOE determined the shortfall not only on the baseload power but also on the ancillary or reserve power by 2018. Hence, the IASCL decided to develop the proposed Project to help reinforce the ancillary power capacity of the grid to sustain the power supply reliability and to avoid expensive results of brownouts to industries social inconvenience to the public.

The proposed Project aims to provide ancillary services to the Visayas grid to help sustain the transmission capacity and energy that are essential in maintaining the power quality, reliability, and security of the grid. It will also address both frequency and voltage fluctuations brought about by the intermittent operation of the variable renewable energy power plants such as solar and wind power plants.

The proposed Project will also serve as Back-up Power Plant, which will provide power during times that LIDE and/or Isabel Municipality becomes isolated from the Leyte sub-grid.



Source: DOE PDP, 2015-2020

Figure 1-4. DOE Supply-Demand Outlook in Visayas, 2015-2020

1.2.2 Socio-Economic Benefits

DOE ER 1-94 Fund

One centavo for every 1 kWh of electricity sold will go to a fund to be managed by the DOE. The fund will be used for local projects that meet the following categories and respective budget shares:

- Electrification fund (50%),
- Development and livelihood fund (25%), and
- Reforestation, Watershed Management, Health and/or Environmental Enhancement Fund (25%).

Increase in Internal Revenue Allocation

The taxes collected from the proposed Project, which include property tax, remittance, and corporate income tax, would be an additional income for Barangay Libertad, Isabel Municipality and Leyte Province through the increased Internal Revenue Allocation (**IRA**). Additionally, there will be incomes from fees for different permits and clearances that the IASCL is required to secure from LGUs. IASCL will also purchase construction supplies and materials from local suppliers in the area.

Employment Opportunity

The proposed Project will generate additional jobs as it will require manpower during site preparation, project construction and operation phases. IASCL will prioritize hiring of qualified residents of Barangay Libertad and other barangays in Isabel Municipality during project implementation. It is expected that the project will need about 120 workers during construction and 46 personnel during operation excluding security and janitorial personnel. IASCL shall closely coordinate with the Public Employment Services Office (**PESO**) of Isabel Municipality in hiring local personnel for the proposed Project.

Corporate Social Responsibility

The Isabel Municipality will benefit from the Corporate Social Responsibility (**CSR**) Programs of IASCL, which include programs on community development such as the following:

Community Development

- **Tree Planting Program**

  IASCL acknowledges the importance of environmental aspect and caring for trees is the social responsibility of every individual. The tree planting program of the municipality in partnership with the local government aims to promote the climate change mitigation strategy as it seeks to enhance the country's forest stock to absorb carbon dioxide, which is largely blamed for global warming. IASCL will join in tree planting program of the Isabel Municipality and/or will donate seedlings for tree planting activities.

- **Relief Assistance and Medical Mission**

  Medical Missions will be brought to various areas in Isabel Municipality. Services provided will be free medical consultation, medicine, and basic medical services to the host communities.

1.3 PROJECT ALTERNATIVES

1.3.1 Site Selection

The site selected for the proposed Project was a result of careful and thorough search to meet all the technical, environmental and land use requirements of the project. Considering that the proposed Project is to be located inside the industrial estate, there will be no sensitive environmental locations such as protected areas, forest, mangroves, critical habitats and endangered species that will be affected.

The source of fuel supply is also located approximately two (2) kilometers from the Project site, which will ease the delivery of fuel to the Project site. Moreover, IASCL identified the 138kV transmission system of NGCP located just above the Project site as the best tapping point.

1.3.2 Technology Selection

IASCL will utilize a high-speed modular diesel power plant which is a location-independent complete system with perfectly matched components. In a modular power plant, all the modules are preconfigured for quick installation and are delivered to the installation site prefabricated. This

facilitates the installation of the modular power plant on site and shortens set-up times, allowing precision assembly even in locations with limited infrastructure. Other reasons which aid IASCL in choosing a modular diesel power plant are as follows:

- Has simple design and layout of plant
- Occupies less space and is compact
- Can be constructed and operated quickly
- Requires less water for cooling
- No ash handling problem
- Requires Less operating and supervising work

1.3.3 Resources

For ancillary service purposes, power reserves from solar and wind coupled with high power reserve batteries are expensive to develop while gas (LNG) for gas turbines is still out of sight, the selection of diesel fuel is preferred because it is much cleaner, affordable and suitable for the required quick response mode for both regulating reserve and contingency reserve capacities at a maximum response time for power output of twenty-five (25) seconds.

1.3.4 No Project Alternatives

The proposed modular diesel power plant ancillary project of IASCL is in consistent to the requirements of the Ancillary Services Procurement Plan under Energy Regulatory Commission (**ERC**) Case No. 2005-253. Based on this, the No Project Alternative is not an option. Without the proposed Project, it could result to a worst-case scenario comprising of rotating brownouts and total blackouts, loss of new investments and expansion of industries, work stoppages, increased pollution resulting from the use of small generators with no appropriate pollution controls, reduced economic growth, increased poverty and social inconvenience by 2018. Without the project, opportunity for additional 120 jobs during construction, about 46 permanent jobs during operation and indirect jobs and business opportunities that would be created by the proposed Project would be lost. The substantial increase in local taxes and revenues including the direct and indirect local benefits that are expected to receive would also be foregone.

1.4 PROJECT COMPONENTS

Table 1-3 presents the major component, support facilities, pollution control devices and temporary facilities for the proposed Project of IASCL.

Table 1-3 Project Components and Specification

Component	Specification/Description
Modular Diesel Generator	Combination of a diesel engine with an electric generator (often an alternator) to generate electrical energy.
Air Intake System	Supplies the correct amount of air needed to increase the combustion and the efficiency of an engine
Exhaust Gas System	The exhaust system consists of the exhaust ducting, exhaust silencer complete with spark arrestor and rain cap assembly. The exhaust gas exits the engine and passes through the exhaust ducting and exhaust out the top of the container through the rain cap assembly. Insulation and heat shields are fitted to the exhaust ducting to prevent operators contact with high temperature surface
Fuel Supply System	The proposed Project will have 10x40,000 litres and 4x20,000 litres fuel tank installed on a bunded plinth. Fuel delivery to the generator sets will be pressurized at 2 bar pressure through 3” main fuel lines and 2” branch line using 2xFuel Pump/Filtration container.

Component	Specification/Description
	The engine fuel system consist of an internal fuel tank, Racor filters, fine fuel filter, fuel pump, injection pump and nozzles. Fuel is pump through the Racor filters to the fine fuel filters and then passed to the injectors and then to the injection nozzles.
Lubrication System	The engine oil lubrication system includes pump, strainer and sump all fitted internally within the engine block. Total oil capacity is 177 litres.
Cooling System	Aggreko engine cooling system uses cooling fluid where flow to the radiator is controlled by thermostat.
Service Water System	The proposed Project will have a service water system for site facilities containers and washing the equipment at site. Water supply line for equipment washing will be installed in line with the fuel pipeline using PVC pipe material.
Instrumentation and Control System	The proposed Project will be connected to a central PLC and SCADA system that will automate all equipment controls and protections for plant start/stop, load management, and operations required for meeting regulating and contingency mode protocols. The SCADA will provide trending and data recording functions, as well as user HMO for the PLC and metering, fuel consumption information. The communication platform is Modbus.
Substation	138kV Gas Insulated Switchgear, 2x60MVA Transformer
Administration Building and other Site Facilities	Administration building and other site facilities are all modular in design such as control rooms (HV/EHV), office container, security/first aid container, kitchen/dinner container, toilet/locker container, workshop container & consumables containers.
Fire Protection System	The proposed Project will be provided with manually operated DCP & CO_2 fire extinguishers that will be located on strategic location around the site.
Smoke Stack	The proposed Project will have 70 smoke stacks with a height of 5.6 m from the ground and with a circumference of 40.6cm. Each smoke stack can be access through generator built in ladder and Bi-Line system (fall arrester).
Oily Wastewater Treatment System	The system will separate oily wastewater generated during the process of equipment maintenance/washing and preventing the entry of unacceptable level of contamination to the site drainage system.

1.4.1 Main Plant Components

1.4.1.1 Modular Diesel Generator

The proposed Project will consist of 80 units of 1MW modular diesel generator sets with a maximum output of 70MW. IASCL will utilize the 16-cylinder diesel engine as the prime mover where the fuel burned inside the combustion chambers produces mechanical energy, which is converted in electrical energy as it drives directly couples alternator. The modular diesel generator specifications are provided in **Table 1-4**.

Table 1-4 Modular Diesel Generator Specifications

Parameters	Specifications
Engine Model	Cummins KTA50 G12 CPL3947
Model and Type	4 Stroke; 60° Vee; 16-Cylinder Diesel
Speed	1500rpm
No. of Cylinders	V16
Bore and Stroke	159mm,159mm
Total Power Output	60Hz/1097kW/1470HP
Fuel Consumption (max feed rate)	254 Li/h
Compression ratio	13.9:1
Piston Speed	7.9 m/sec
Cylinder Block	16-cylinder,direct injection, 4-cycle diesel engine

1.4.1.2 Air Intake System

The Air Intake System supplies sufficient air to the engine for an effective internal combustion. It consists of pipes for the supply of fresh air to the engine intake manifold. Filters are provided to remove dust particles from air, which are abrasive to the engine cylinders. The intake air is turbocharged and cooled by charge air cooler for best results.

1.4.1.3 Exhaust Gas System

The exhaust system consists of the exhaust ducting, exhaust silencer complete with spark arrestor and rain cap assembly. The exhaust gas exits the engine and passes through the exhaust ducting and exhaust out the top of the container through the rain cap assembly. Insulation and heat shields are fitted to the exhaust ducting to prevent operators contact with high temperature surface. A silencer is incorporated in the system to reduce the noise level to within the acceptable limits.

1.4.1.4 Fuel Supply System

Diesel oil will be delivered from the depot located approximately two (2) kilometer away from the Project site and will be stored in the 10x40,000 litres and 4x20,000 litres fuel tanks installed on a bunded plinth. Fuel delivery to the generator sets will be pressurized at 2 bar pressure through 3" main fuel lines and 2" branch line using 2xFuel Pump/Filtration container.

The engine fuel system consist of an internal fuel tank, Racor filters, fine fuel filter, fuel pump, injection pump and nozzles. Fuel is pump through the Racor filters to the fine fuel filters and then passed to the injectors and then to the injection nozzles.

The diesel oil should meet the minimum specifications as required by law, acceptable to the engine requirement specifications, as presented in **Table 1-5**.

Table 1-5. Parameter Limits of Diesel Oil

Parameter	Limit(s)
Specific gravity @ 60/60ºF (ASTM D1298)	0.8654 max.
ºAPI @ 60 ºF (ASTM D 1298)	32.00 – 40.00
Density @ 15.5ºC (ASTM D 1298)	0.8650 kg/L max.
Water Content, Vol.% (ASTM D95)	0.20% max.
Heating Value (ASTM D240)	19,200 Btu/lb min.
Sulfur Content, Wt. % (ASTM 129)	1.00% max.

1.4.1.5 Engine Oil Lubrication System

The lubrication system with a capacity of 177 liters includes lubricating oil tank, oil pump, strainer and sump all fitted internally within the engine block. Lubricating system aims to reduce the wear of the engine moving parts such as piston, shaft, and valves. It also cools the engine.

In the lubrication system, the oil is pumped from the lubricating oil tank through the oil cooler where the oil is cooled by the cold water entering the engine. The hot oil after cooling the moving parts will be pumped to the lubricating oil tank.

1.4.1.6 Cooling System

Aggreko engine cooling system uses cooling fluid where flow to the radiator is controlled by thermostat.

1.4.2 Support Facilities

1.4.2.1 Service Water System

The proposed Project will have a service water system for site facilities containers and washing the equipment at site. Water supply line for equipment washing will be installed in line with the fuel pipeline using PVC pipe material. This water requirement of the proposed Project will be supplied by the LMC.

1.4.2.2 Instrumentation and Control System

The proposed Project will be connected to a central PLC and SCADA system that will automate all equipment controls and protections for plant start/stop, load management, and operations required for meeting regulating and contingency mode protocols. The SCADA will provide trending and data recording functions, as well as user HMO for the PLC and metering, fuel consumption information. The communication platform is Modbus.

1.4.2.3 Substation

A switching and metering station (switchyard) will be installed to provide all the necessary technical requirements for interconnection of the switchyard to the grid.

1.4.2.4 Administration Building and Other Site Facilities (Containerized)

Administration building and site facilities are all modular in design and specifically built based on purpose. The proposed Project will include control rooms (HV/EHV), office container, security/first aid container, kitchen/dinner container, toilet/locker container, workshop container and consumables containers.

1.4.2.5 Fire Protection System

To protect the facility in the event of fire or fire risks such as excessive heat or smoke, a fire protection system will be installed, composed of the following components: (i) CO2 fire extinguisher systems; (ii) heat and smoke detector system; (iii) fire hydrants with hose stations; (iv) fire and general services pumps and (v) portable fire extinguishers.

1.4.3 Pollution Control Devices

1.4.3.1 Air Pollution Control Facilities

1.4.3.1.1Exhaust Stack

The proposed Project will have 80 smoke stacks for adequate dispersion of emissions. Each smoke stack can be access through generator built in ladder and Bi-Line system (fall arrester). Exhaust stack has a height of 5.6 m from the ground with a circumference of 40.6cm.

1.4.3.2 Water Pollution Control System

1.4.3.2.1 Oily Wastewater Treatment System

The oily wastewater from the fuel and lube oil centrifuging unit and leakages from lube oil, fuel and water system are collected to the oily wastewater tank, then pumped into the Oil-Water Separator Treatment Plant. The bottom sludge of the oil-water separator will be discharged periodically by the operator for disposal through an accredited treater by the DENR. Oil spill kits will be maintained also on-site in case of emergency oil spill.

1.4.3.3 Solid Waste Management System

Waste material generated will be classified as hazardous and non-hazardous wastes. Separate receptacles and storage areas will be established for each type of waste identified at the Project site. Non-hazardous solid waste will be classified as compostable, recyclable, and residual. These will then be properly disposed of, based on their classification. IASCL shall comply with disposal regulations stipulated in the Ecological Solid Waste Management Act of 2000 or Republic Act 9003. Hazardous waste will be classified based on Republic Act 6969 or the Toxic Substances and Nuclear Wastes Control Act 1990. It will be handled, stored and transported according to Philippine standards and treated through DENR-accredited hazardous waste treaters. The following are the solid wastes generated from the proposed Project:

- Domestic waste consisting of compostable waste materials from food and recyclable or residual materials such as plastics, wrappers, crates or boxes for food supply of workers and/or employees.
- Debris and other materials removed from construction activities such as spoils or excavated materials
- Industrial solid wastes, such as damaged vehicle and equipment parts, etc.
- Hazardous wastes such as fuel/lube oil sludge, and bulbs.

A Solid Waste Management Plan for the Project will also be developed.

1.4.4 Temporary Facilities

Construction Offices

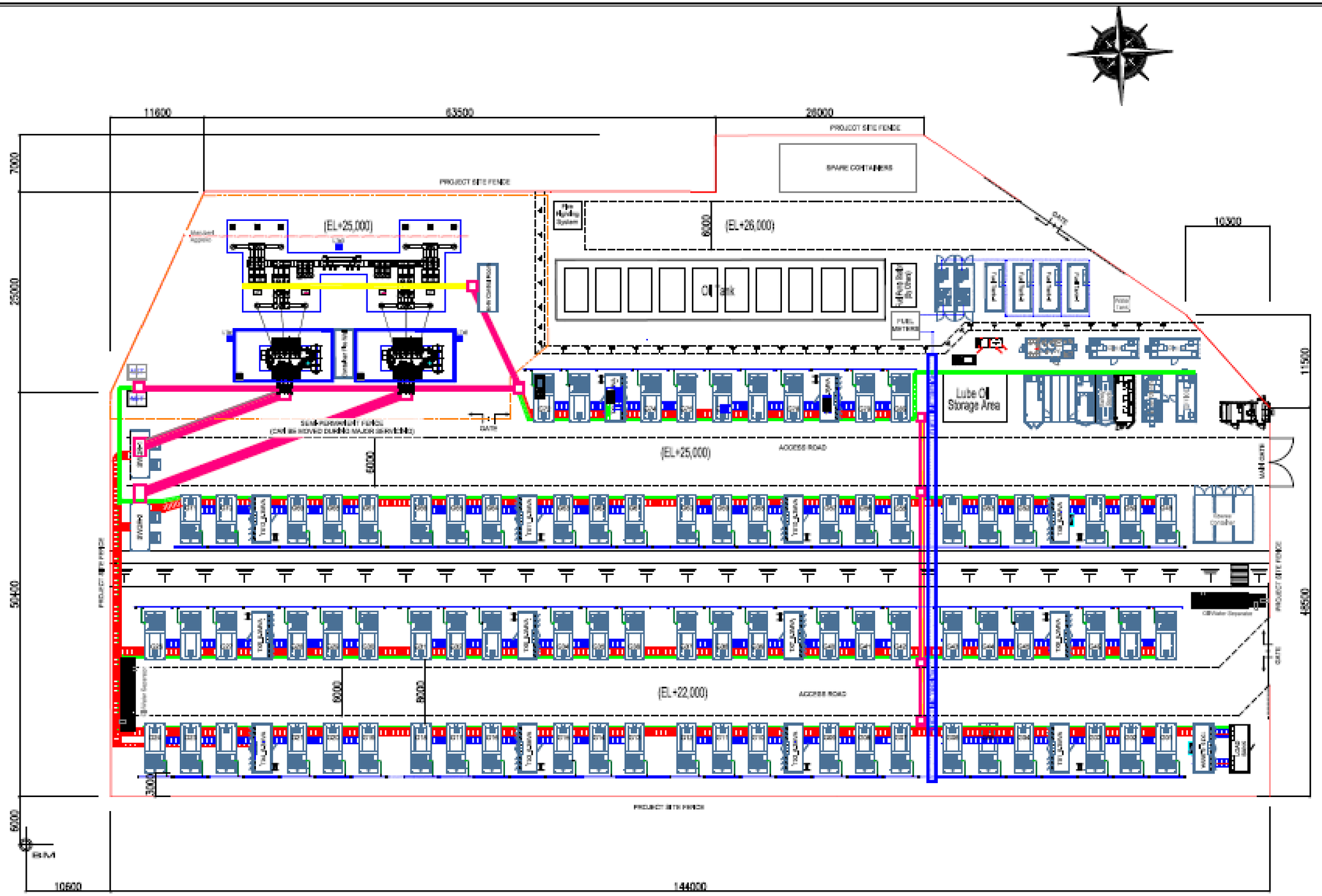
Temporary facilities shall be constructed to house the offices of IASCL, contractor and its subcontractor. The offices shall be equipped with appropriate utilities such as power supply, water supply, sanitary facilities, communication/internet connection and road network.

1.4.5 General Layout Facilities

Table 1-6 shows the major components and the corresponding estimated footprints of the proposed Project. The Site Development Map of the proposed Project is shown in **Figure 1-5**.

Table 1-6 Estimated Footprint of the Proposed Project

Components	Area (m^2)
Power Plant Modular Diesel Generator, Air Intake System, Exhaust Gas System, Cooling System, Smoke Stack, Fire Protection System, Instrumentation and Control System	2,679
Fuel Supply System	516
Lubrication System	72
Substation	1,415
Administration Building and other Site Facilities	270
Service Water System	36
Oily Wastewater Treatment System	
Open space, access road and buffer zones	14,352
Total	**19,340**



Source: IASCL

Figure 1-5 Layout and Site Development Plan of the Proposed Modular Diesel Power Plant Ancillary Project

1.5 PROCESS/TECHNOLOGY

IASCL will utilize a modular diesel power plant, which is a location-independent complete system with perfectly matched components. All the modules are preconfigured for quick installation and are delivered to the installation site prefabricated. This facilitates the installation of the modular cogeneration power plant on site and shortens set-up times, allowing precision assembly even in locations with limited infrastructure. **Figure 1-6** shows an illustrative sample of a modular diesel power plant.

IASCL will utilize a modular High Speed Diesel Engines that use Automotive Fuel Oil, a 4-stroke diesel engine technology. These four (4) strokes are the intake, compression, power and exhaust (**Figure 1-7**). During the intake, fresh air is sucked in or forced into the power cylinder. The compression stroke compresses the air to produce hot gas. As fuel is introduced and burnt with the hot gas, the power stroke happens. The last stroke is to eject the burnt gas to the atmosphere where exhaust stroke happens. The process diagram is described in **Figure 1-8**.

Figure 1-6. Modular Diesel Power Plant

Figure 1-7. 4-Stroke Diesel Engine Technology

The proposed Project will be designed mainly to provide ancillary services, regulating reserve and contingency reserve to the NGCP. The ancillary services is support services necessary to sustain the transmission capacity an energy that are essential in maintaining the power quality, reliability and security of the grid. It also addresses both frequency and voltage fluctuations brought about by intermittent operation of variable renewable energy power plants. The 70MW capacity shall be subdivided based on the two (2) types of ancillary services. The 40MW capacity shall be allocated for Regulating Reserve and the remaining 30MW capacity shall be for Contingency Reserve. This contractual arrangement is consistent to the rules, terms and condition of the Ancillary Services Procurement Plan under Energy Regulatory Commission (**ERC**) Case No. 2005-253.

The Regulating Reserve is the capacity necessary to adjust total system generation over short periods of time to match system load changes. The maximum response time for the change in the generating unit's power output shall be twenty-five (25) seconds and which shall be sustainable for at least 30 minutes. The Contingency Reserve, on the other hand, is intended to take care of sudden and unexpected loss of the large synchronized generating unit or the power import from a single grid interconnection. These plants are quick enough to maintain system reliability and restore the system to generation/load balance and the system frequency. Contingency Reserve Service shall be sustainable for a period of at least 30 minutes. Continued supply service in excess of 30 minutes shall be provided under the terms of Dispatchable Reserve Service to be sourced from other AS providers.

The regulating reserve will be dispatched and have an initial loading of 20MW or 50% of the 40MW installed capacity at the start of the interval hour or based on system requirement and/or NGCP's dispatch instruction. Such output will then change if there will be fluctuations of system frequency in the Visayas Grid. The contingency reserve will initially require five (5) modular diesel engines to be operated at 300kW each or a total of 1.5MW initial loading at the start of the interval hour or based on system requirement and/or NGCP's dispatch instruction. Such output will then change if there will be an outage of a large generator or a loss of transmission line in the system. Therefore, the IASCL has committed to the National Grid Corporation of the Philippines (**NGCP**) that the 70MW plant capacity is available to the grid in cases of emergencies.

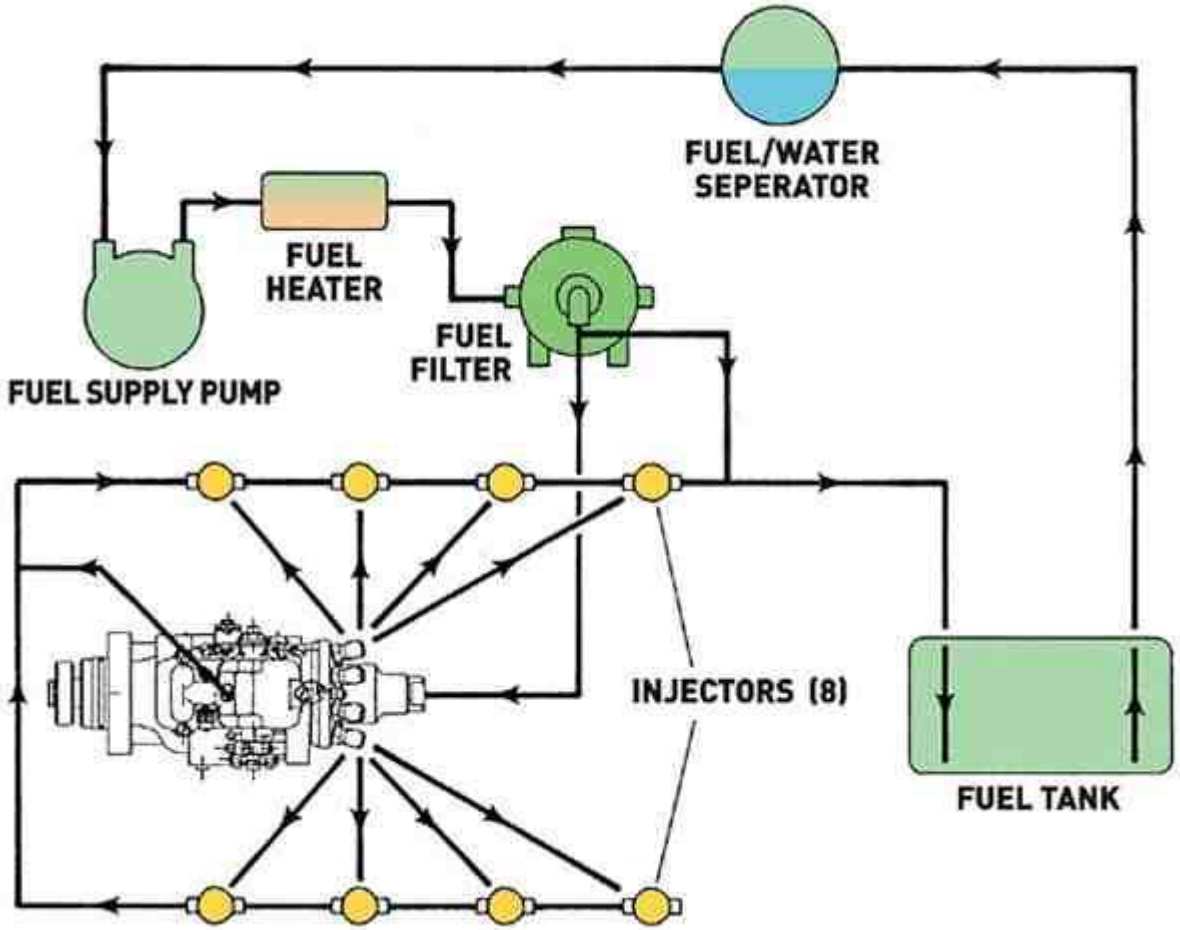


Figure 1-8. Proposed Project Process

1.5.1 Utility Requirements

1.5.1.1 Automotive Diesel Oil

The proposed Project will require about 150,000 liters/day of Automotive Diesel Oil. The Automotive Diesel Oil will be sourced from the existing Petron depot located approximately 2km from the proposed Project site via dedicated fuel delivery trucks for the proposed Project owned by Petron. **Table 1-7** presents the specifications of the automotive diesel oil to be used for the proposed Project.

Table 1-7 Automotive Diesel Oil Specifications

Properties	Specification
Specific Gravity,	
Density	0.816-0.876 kg/L
Kinetic Viscosity	1.3 – 4.5 mm2/s
Sulfur, % wt	Max 0.5
Calorific Value (HHV)	Min 19,600
Calorific Value (LHV)	Min 18,400

1.5.1.2 Water Use

The proposed Project will be using water for the operation and maintenance of the proposed power plant which will be sourced from the potable water supply system of LMC. The water requirement will be primarily used as process water, make-up water, service water, potable water, and other necessary water consumptions. Around 50 m^3/month will be allocated for the domestic use at the plant facilities and administrative building.

1.5.1.3 Electricity

During its operation, the plant's generator will produce 440 volts AC. A step-up transformer will increase the voltage to 12,000 volts or 12 kV before it is supplied to the Visayas Grid via the 138kV substation. The parasitic load per unit of the proposed Project is less than 1 MW. These will come from their generated power.

1.5.2 Waste Generation and Built-in Management Measures

1.5.2.1 Air Emissions

Fuel oil combustion will generate SO_x and NO_x emissions. Based on the fuel consumption and specifications, the proposed Project is expected to produce the emission characteristics, which will meet or better the standards set by the Philippine Government. The proposed power plant will have an anticipated emission rates well below the DENR standards of 700 mg/Ncm for SO_x, and 2000mg/Ncm for NO_x. The maximum predicted ground level concentration resulting from the modeling for one hour and twenty four-hour concentrations did not exceed the DENR standard for SO_x, and NO_x.

These emissions will be directed to 70 smoke stacks with a height of 5.6 m from the ground and with a circumference of 40.6cm. The exhaust stack will provide an elevated point of discharge of flue gas emissions to promote air dispersion.

1.5.2.2 Noise

The generators for the proposed Project will be designed and arranged as such to prevent resonant vibration and will comply with the noise standards set by DENR for industrial areas. At the plant's property line, the noise standards are 75 dB(A) during daytime, 70 dB(A) during morning and evening, and 65 dB(A) during nighttime.

The green areas surrounding the proposed Project will be enhanced and will also serve as a control measures to decrease the noise that may reach the Nearest Sensitive Receptor (**NSR**).

1.5.2.3 Wastewater

Operation of the proposed Project requires less volume of water. Oily water from the equipment area drains and the secondary containment areas of the transformers and fuel oil tanks will be treated in the Oily Water Treatment System. IASCL shall ensure that wastewater is properly treated to meet DENR effluent standards prior to discharge to the receiving body of water.

1.5.2.4 Spill Containment

Spill containment provisions will also be incorporated which will meet all national, provincial and local regulations and requirements. Spill containment will be provided for potential risk of leak/spill in the area. The fuel oil storage tanks will be furnished with a bund with plinths to house the fuel storage tanks. The bund shall be constructed of reinforced concrete and capable of containing a spill of at least 10,000 gallons (US), plus 10% of the aggregate storage capacity of the remaining

1.5.2.5 Solid Wastes

1.5.2.5.1 Industrial Solid Wastes

The industrial solid wastes include ash, slag, wasted conveyor belts and barrels, oily sludge from vehicles, equipment and oil and water separators, spent lubricants and other chemicals. Utmost concern will be focused on ash production, handling and disposal.

1.5.2.5.2 Domestic Solid Wastes

The amount of domestic solid waste will not be significant. Waste per capita, calculated on an average income basis, in a developing country is 0.5 kg/day. With an estimated workforce of 120 during construction, the domestic waste will amount to 60 kg/day. With a workforce of 46 during operation, the domestic waste generated amounts to 23 kg/day/shift. Domestic solid waste will include paper, cartons, plastic, bottles, tin cans, rubber, food left-over, etc. These will be temporarily collected and stored in waste bins properly sorted out into recyclables and non-recyclables before collection and disposal by the local government. Some hazardous solid waste will include busted fluorescent lamps, spent industrial and car batteries, spent chemical cartridges and containers and expired chemicals. Within six (6) months from generation, these hazardous wastes will be removed, transported and disposed according to acceptable practices. IASCL will ensure that the hazardous waste will be properly treated and disposed of, by the DENR accredited transporter and treater.

1.5.3 Operations and Maintenance of Facilities

The proposed Project will operate 24 hours a day, 7 days a week and 52 weeks a year. The maintenance is conducted per diesel engine. As such, there is no maintenance outage to be considered.

1.6 PROJECT SIZE

1.6.1 Plant Capacity

The proposed Project has a net capacity of 70 MW. It will have a projected output of up to 188,340,000 kilowatt-hours of electricity annually for a period of at least five (5) years.

1.6.2 Project Area

The total land area allocated for the proposed Project, which includes major components, support facilities, access road and green areas is 1.934 ha.

1.7 DEVELOPMENT PLAN, DESCRIPTION OF PROJECT PHASES AND CORRESPONDING TIMEFRAMES

1.7.1 Project Phases

1.7.1.1 Pre-Construction Phase

Permit Acquisition. During the Pre-Construction Phase, the design and detailed engineering of the project components will be prepared and finalized. Preparatory works involves the procurement of the supplies and equipment planning for setting-up the physical characteristics, permit acquisition, and resource requirements allocation and provision.

1.7.1.2 Construction Phase

Site Clearing. The area where the project components will be installed shall be cleared of all structures and obstructions. All trees, shrubs, vegetation and other landscape features designated for preservation shall be carefully protected from damage during site preparation and equipment installation. Holes remaining after removal of all obstruction, objectionable materials, trees, stumps, shall be backfilled with approved material, compacted and restored to approximately its original contours by bulldozing or by other method.

Site Grading. This shall cover the removal of top soil, cutting, grading, filling, rough contouring and compacting materials as required to established 1-2 % slope sub-grade elevation of the site. Removal of top soil will depend on the extent available or required as directed by a Civil Engineer. When the natural grade of the proposed site is essentially flat, it may be necessary to bring fill material to improve the drainage condition of the lay down area. The fill material shall consist of a satisfactory soil free from sods, stump, roots, large rocks or other perishable matters. The amount of fill material shall vary from 300mm to 600mm thickness or as necessary to meet the desired sub-grade elevation. Adequate compaction during placement of the fill is necessary to develop the required soil bearing capacity. All fill areas shall be compacted in 200mm (8 inch) layers to 95 percent Maximum Dry Density.

Gravel Layer Finish. Prior on applying gravel layer finish, it is ideal that all equipment is already in place to provide a level and stable positioning of plastic block platforms and container stands. Gravel surfacing material shall be of 20mm to 25mm grade sprinkled evenly over the entire yard and extending 1 meter beyond perimeter fence. Layer thickness shall not be less than 75mm.

Site Drainage System. Site drainage system shall be surface runoff type whereby ground elevation gently sloping 1% to 2% gradient to the edge of the yard or shallow ditches within the yard. Site slope elevation shall be coordinated with the location of the cable trenches and roads within the site. Careful consideration of the quantity, quality, and particularly the location of the discharge water from the yard has to be emphasized prior to site preparation. Small interceptor ditches strategically located within the site will prevent erosion of slopes or embankments.

Mobilization of Construction Equipment and Materials. Construction equipment and raw construction materials will be transported to the dedicated temporary laydown area. Machineries, equipment, and construction materials shall be transported by truck or by boat to the Project site. The existing jetty within the LIDE will be used to transport large and heavy components.

Hiring of Workers. Approximately 120 workers will be employed during the construction period. The majority of the workers will be coming from the host and nearby barangays of Isabel while the highly skilled workers who will be coming from outside of the Isabel will be billeted in the surrounding communities in order to enhance the economic activity of these areas.

Installation of Modular Diesel Generators and Facilities. The construction activities will commence starting from the access and internal roads, installation of permanent drainage systems and installation of project components. The construction period is approximately three (3) months.

1.7.1.3 Post Construction Phase

During the Post-Construction phase, all temporary structures/facilities will be demolished and construction debris will be removed. Construction machinery and equipment will be decommissioned and removed from the site. Clean-up activities will be undertaken.

Construction/demolition wastes will be segregated into recyclable and non-recyclable wastes. Where recyclable and reusable items are available and desired by the communities near the site, the IASCL will be willing to make these available to them. Open spaces and buffer zones will be revegetated/landscaped with appropriate indigenous species. In all aspects, IASCL will endeavor to minimize the visual impact of the site consistent with its purpose as an industrial facility.

1.7.1.4 Operation Phase

Electricity Generation. The proposed Project will operate 24 hours a day, 7 days a week and 52 weeks a year to provide Regulating Reserve and Contingency Reserve. The 40MW capacity shall be allocated for Regulating Reserve and the remaining 30MW capacity shall be for Contingency Reserve. This contractual arrangement is consistent to the rules, terms and condition of the Ancillary Services Procurement Plan under Energy Regulatory Commission (**ERC**) Case No. 2005-253. Based on the required operation of NGCP for provision of ancillary services, only half of the 40MW capacity for Regulating Reserve shall be initially dispatched. This means that only 40 modular diesel engines will operate at 50% loading, having a total of 20MW output capacity. Such output capacity will then change if there will be fluctuations of system frequency in the Visayas grid.

On the other hand, for the provision of 30MW Contingency Reserve, NGCP initially will requires five (5) modular diesel engines to be operated at 300kW each, a total of 1.5MW. The remaining 25 modular diesel engines will serve as standby units and shall only be dispatched by NGCP should there be an outage of a large generator or loss of transmission line in the system which has caused the system frequency to drop below 59.85Hz. Such frequency drop shall trigger the modular diesel engines to start automatically and produce the full 30MW output in less 10 minutes. Once the system frequency comes back to its nominal value of 60Hz, then the modular diesel engines shuts down automatically as well.

Environmental Pollution Control and Monitoring. Part of the operations of the proposed Project is to ensure that all pollution control devices will be installed and properly working in order to assure compliance with the DENR standards.

1.7.1.5 Abandonment Phase

The contract lifespan of IASCL with NGCP for the proposed Project is five (5) years. However, if the plant is still needed, it may extended as agreed upon by both parties. In the unlikely event that the operation of the project is no longer deemed feasible to operate and maintain, a decommissioning or abandonment plan will be prepared by the proponent. The abandonment plan will specify the proposed studies to be conducted (e.g., site assessment) and what equipment can be recovered, relocated, or sold, and the area will be developed based on the next industrial use of the site. If soil contamination is present, the subject area will be decontaminated through the appropriate measures. The green buffer zone will have to be retained.

1.7.2 Project Schedule

The proposed Project is targeted to begin construction in September 2018 and completion in February 2019. Following the accreditation test conducted by NGCP, it is expected to commercially operate in May 2019.

1.8 MANPOWER

The manpower requirements during construction of the proposed Project will be composed of local skilled workers to be hired based on formal qualifications, experience and good moral character. Priority employment will be afforded to the local residents in the host barangay, surrounding

barangays and Isabel Municipality, provided they possess the necessary qualifications. Furthermore, IASCL will comply with the relevant provisions of the DOE Act (RA 7368) regarding local employment. The proposed Project is expected to employ approximately 120 workers during the construction period. During the operation phase, it is estimated that 46 professional, technical and non-technical workers will operate and maintain the plant facility.

1.9 INDICATIVE PROJECT INVESTMENT COST

The proposed Project and its components are estimated to cost at **One Billion Seven Hundred Fifty Million (PhP 1,750,000,000) Pesos** only.

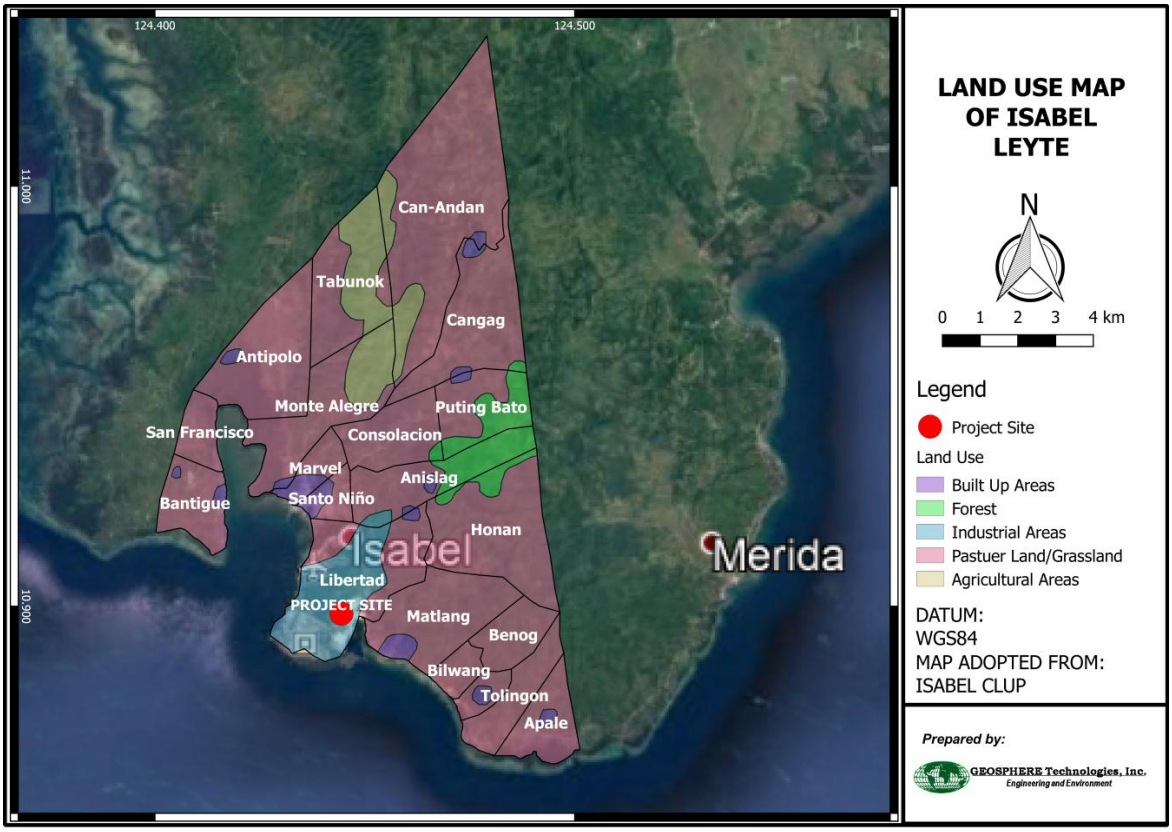
2.0 ANALYSIS OF KEY ENVIRONMENTAL IMPACTS

2.1 LAND

2.1.1 Land Use Classification

2.1.1.1 Impact in Terms of Compatibility with the Existing Land Use

Isabel Municipality is composed of built-up areas, forest, industrial areas, pastuer land/grass land and agricultural areas. Majority of the land in Isabel are grassland. The land use of the area where the proposed Project is located is designated as an industrial area as this is located inside LIDE (**Figure 2-1**). Therefore, there is no issue in terms of compatibility with the existing land use.



Source: CLUP of Isabel Municipality, modified by GEOSPHERE 2018

Figure 2-1. General Land Use Map of Isabel, Leyte

2.1.1.2 Impact on Compatibility with Classification as an Environmentally Critical Areas

Environmentally Critical Areas (**ECAs**) are environmentally sensitive areas declared under Presidential Proclamation No. 2146 of 1982 where significant environmental impacts are expected if certain types/thresholds of proposed Project are located, developed or implemented in it. Since the proposed Project is to be located inside the LIDE, which is and industrial area, there will be no encroachment of ECAs.

2.1.1.3 Impact in Existing Land Tenure Issue/s

The proposed Project site is to be located inside the LIDE, which is an industrial area. No areas within the proposed Project site is under CARP or with CADC/CADT/ CALC. Thus, there is no possible tenurial or land issue within the proposed Project site.

2.1.1.4 Impairment of Visual Aesthetics

There are no identified significant landforms or structures within the proposed Project site. Project Area is inside the LIDE, which is an industrial site which houses two of the country's major industries, the Philippine Associated Smelting and Refining Corporation (**PASAR**), and the Philippine Phosphate Fertilizer Corporation **(PhilPhos**).

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

Generation of waste and improper waste disposal may affect the soil quality in the area. The proposed Project will generate 60 kg/day of domestic wastes during construction phase and 23 kg/day/shift of domestic waste during operation phase. Domestic solid waste will include paper, cartons, plastic, bottles, tin cans, rubber, food leftover, etc. Some hazardous solid waste that will be generated by the proposed Project include busted fluorescent lamps and spent industrial and car batteries.

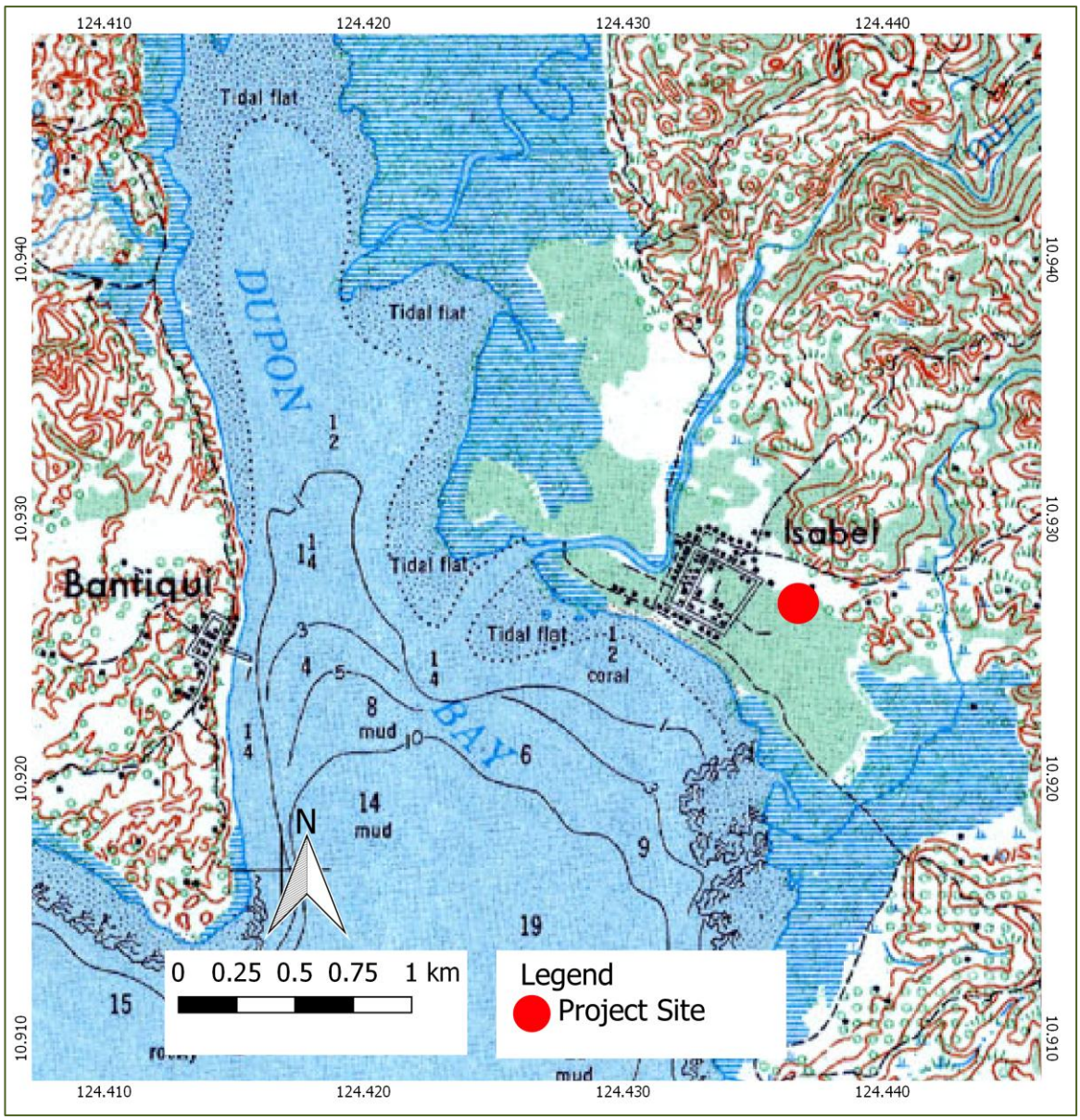
A Solid Waste Management Plan will be implemented in the power plant facility, which includes minimization of waste generation and segregation. All domestic wastes will be temporarily collected and stored in waste bins properly sorted out into recyclables and non-recyclables before collection and disposal by the local government. Within six (6) months from generation, the hazardous wastes will be removed, transported and disposed according to acceptable practices. IASCL shall ensure that the hazardous waste will be properly treated and disposed of, by the DENR accredited transporter and treater.

2.1.2 Geology/Geomorphology

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

The general terrain morphology of Isabel, Leyte is generally moderately sloping as most of the land area has a slope of greater than 10%. Barangay Libertad has a slope of greater than 10% (**Figure 2-2**).

It is expected that the alteration of the terrain and slope of the proposed Project site will be less significant for the site is already an existing industrial estate. However, the permanent alteration due to cut and fill activities to achieve the planned grade level is unavoidable, but may be lessened by proper planning of earthwork with respect to the proposed design. The strength of the fill materials shall be taken into account as well for the computation of the stable slope.

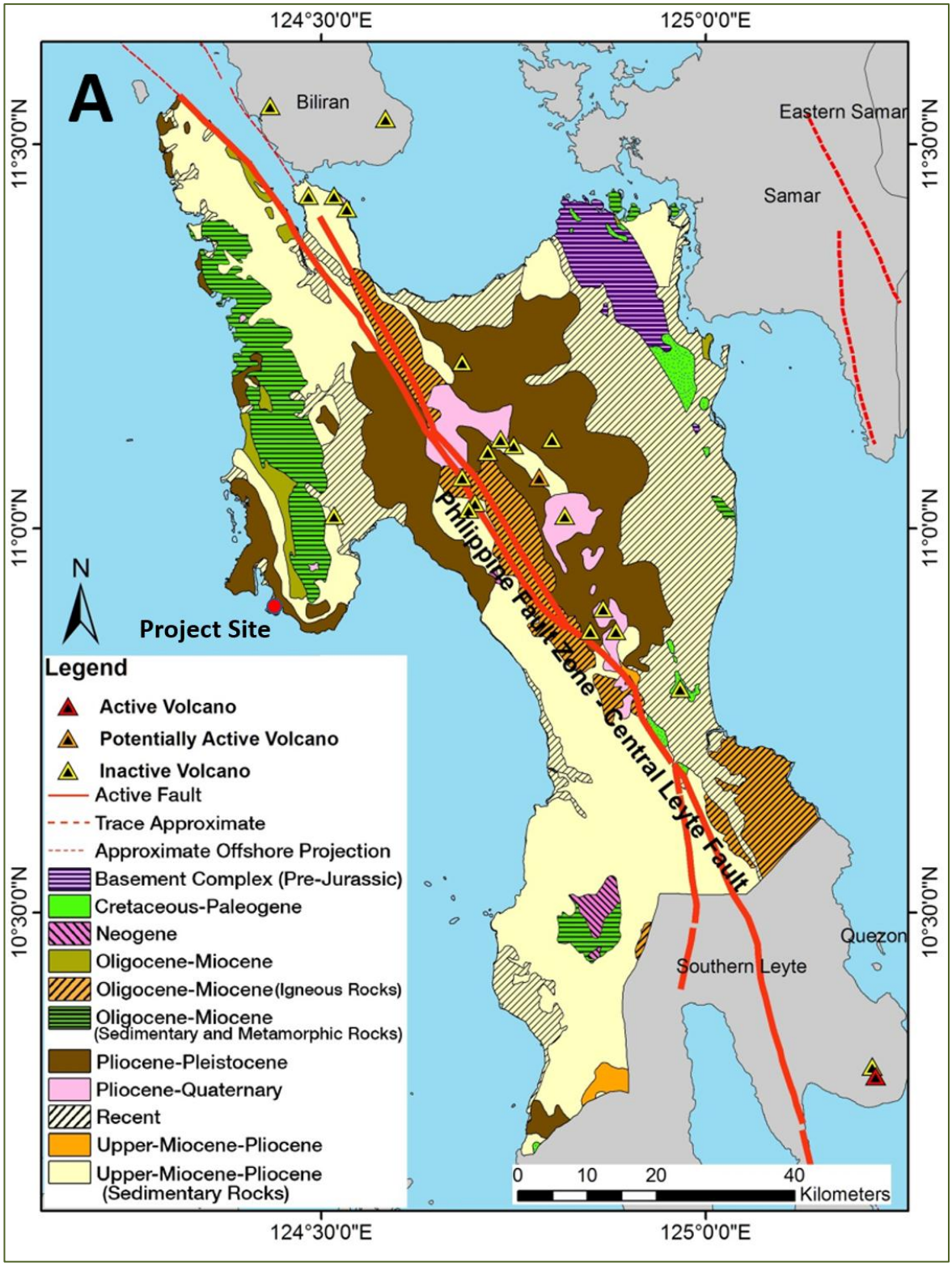


Source: NAMRIA

Figure 2-2. Topographic Map of the Project Area

2.1.2.2 Change in Sub-surface Geology/Underground Condition

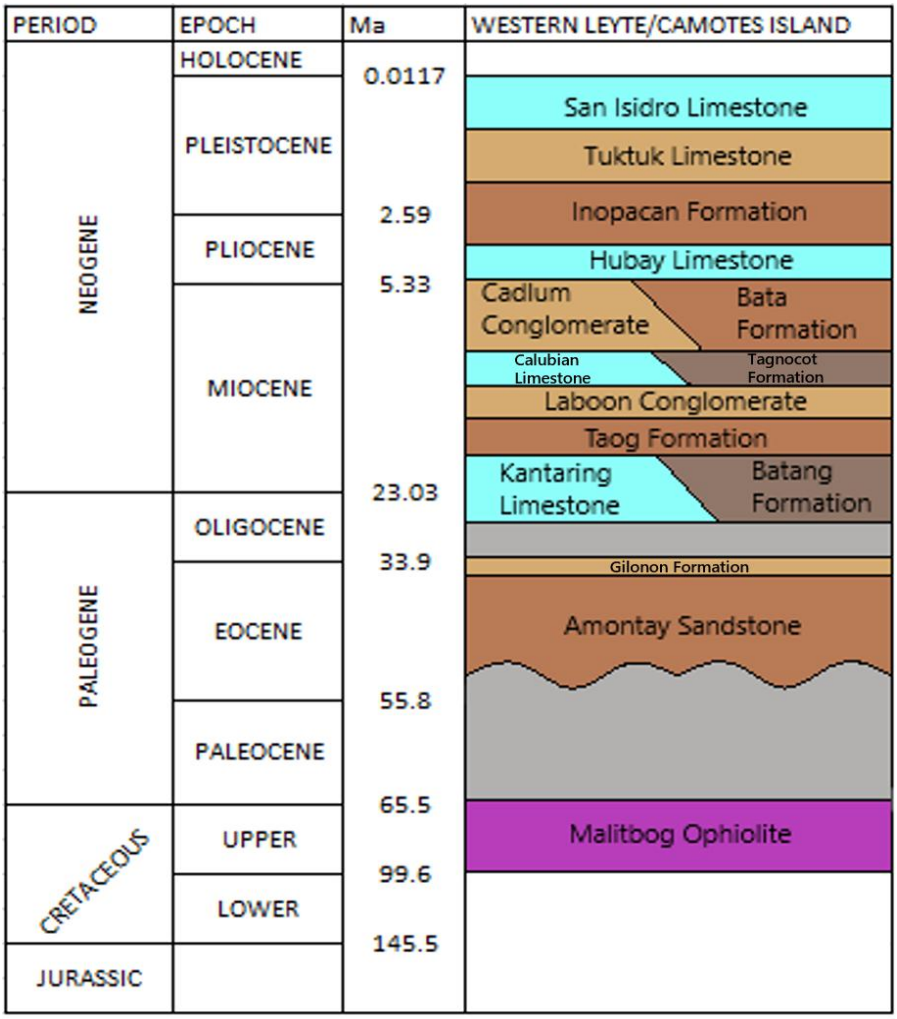
Bedrock Lithology and Subsurface Geomorphology. The geology of the mainland area is relatively young and ranges in age between Tertiary and Quarternary (**Figure 2-3**). The area is predominantly underlain by coralline limestone and calcarenites with varying thickness of everburden. The mainland of Isabel is predominantly composed of alluvium and Hubay formation. The northern portion of Isabel is underlain by quarternary alluvium that is composed of lenticular clayey, sandy, gravelly, river sheet talus and coastal and partly unconsolidated coral deposits. Clayey deposits dominate over valleys underlain by the sedimentary rocks. The Hubay formation is very evident at the western side of Dupon Bay and the eastern sides of both bays, characterized as Pliocene to Pleistocene coralline limestone underlain by minor sandstone, shale and conglomerate. Since the area is predominantly covered with the Hubay Limestone, the underlying geology of the area might be karst. Possible speleogenesis might be present in the area.



Source: Eco et al. in 2014

Figure 2-3. Geologic Map of Leyte

Stratigraphy. The basement of Western Leyte is made up of the Malitbog Ophiolite, while the youngest lithologic units that can be found on this portion of Leyte is the San Isidro Limestone which is dated to Middle to Late Pleistocene (**Figure 2-4**).



Source: Peña (2010)

Figure 2-4. Stratigraphic Column for Western Leyte/Camotes Island

There will be no significant disturbance of the subsurface/underground geomorphology of the proposed Project site. Although, excavations shall cause permanent impact, the level of disturbance is considered low. The area of disturbance would include the footprint of the proposed Project facilities, which includes its appurtenant facilities.

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

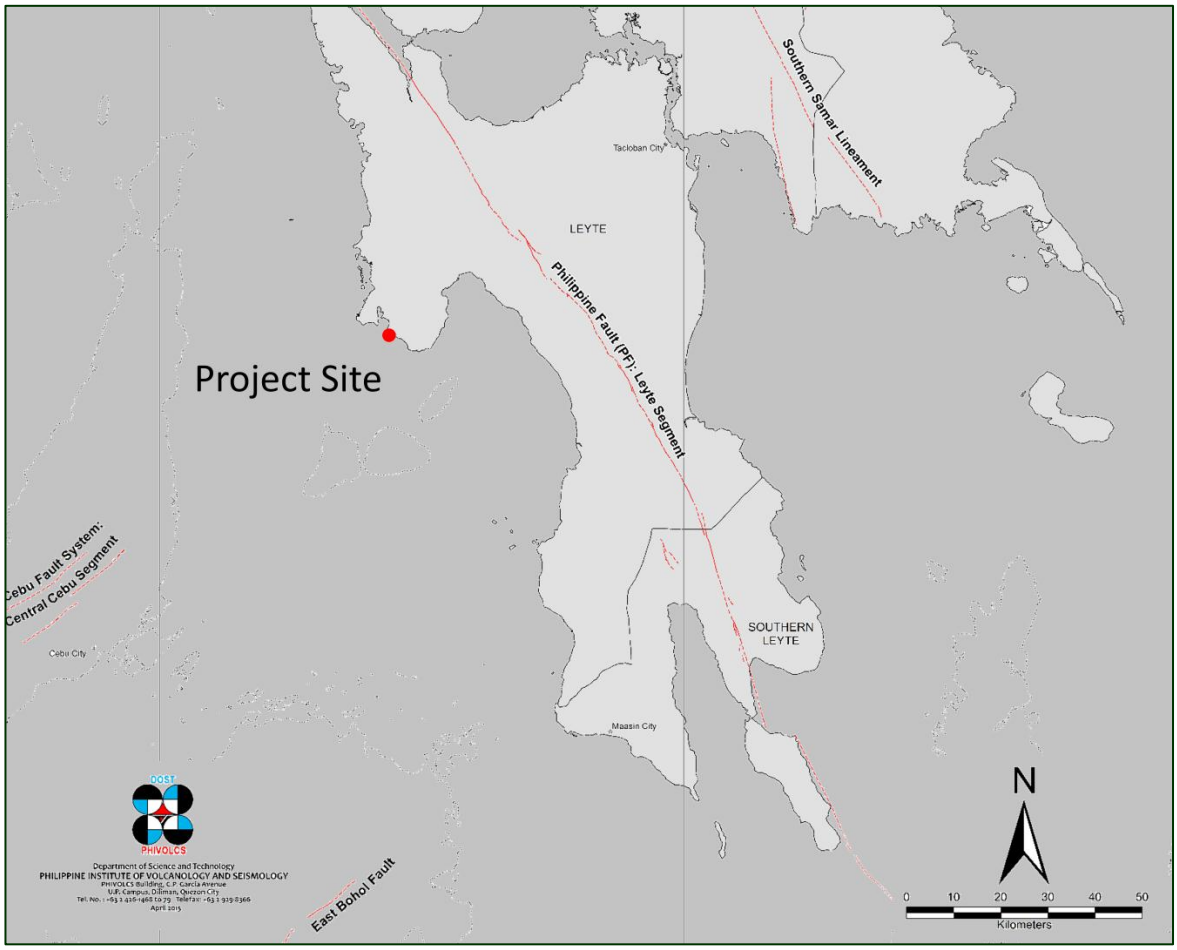
Seismic Hazards. The main hazard associated with earthquakes is intense ground shaking accompanied with ground rupture, tsunami and landslides occur as collateral hazards. The degree and extent by which the area is affected by these seismic hazards will depend on the magniture of the earthquake, proximity to the earthquake source and the site's geological conditions.

The are no major faults present near the project site for at least 30km from the project area as indicated by **Figure 2-5**. The nearest major fault present near the site is the main branch of the Philippine Fault that traverses Leyte Island striking Northwest to Southeast. The presence of the Philippine Fault in the areas produces numerous earthquake events in the island (**Figure 2-6**). Other earthquake generating structures that can affect the area are the Philippine Trench, Cebu Fault System: Central Segment and East Bohol Fault.

The Philippine Trench is produced by the subducting Philippine Plate to the Philippine Mobile Belt. It is deeply subducting in the northern portions and shallows towards the south. This structure has

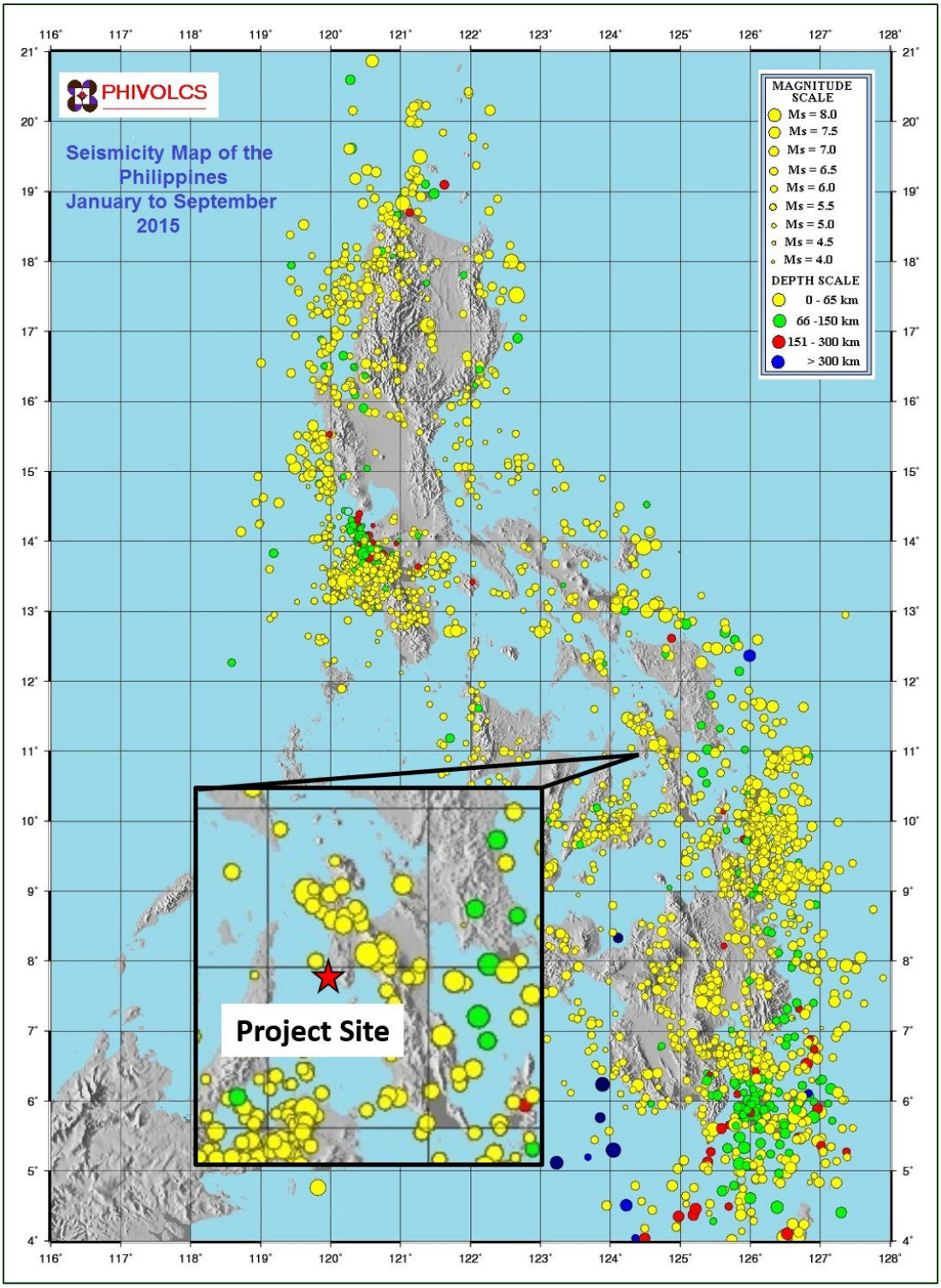
produced many earthquakes on the eastern margins of the Philippine Archipelago. The Cebu Fault System together with the East and North Bohol Faults are major faults that have contributed to the majority of the earthquake events in Central Visayas.

Although these structures can affect the area due to their distance from the project site, their overall impact to the seismic hazard in the project site is quite minimal.



Source: PHIVOLCS

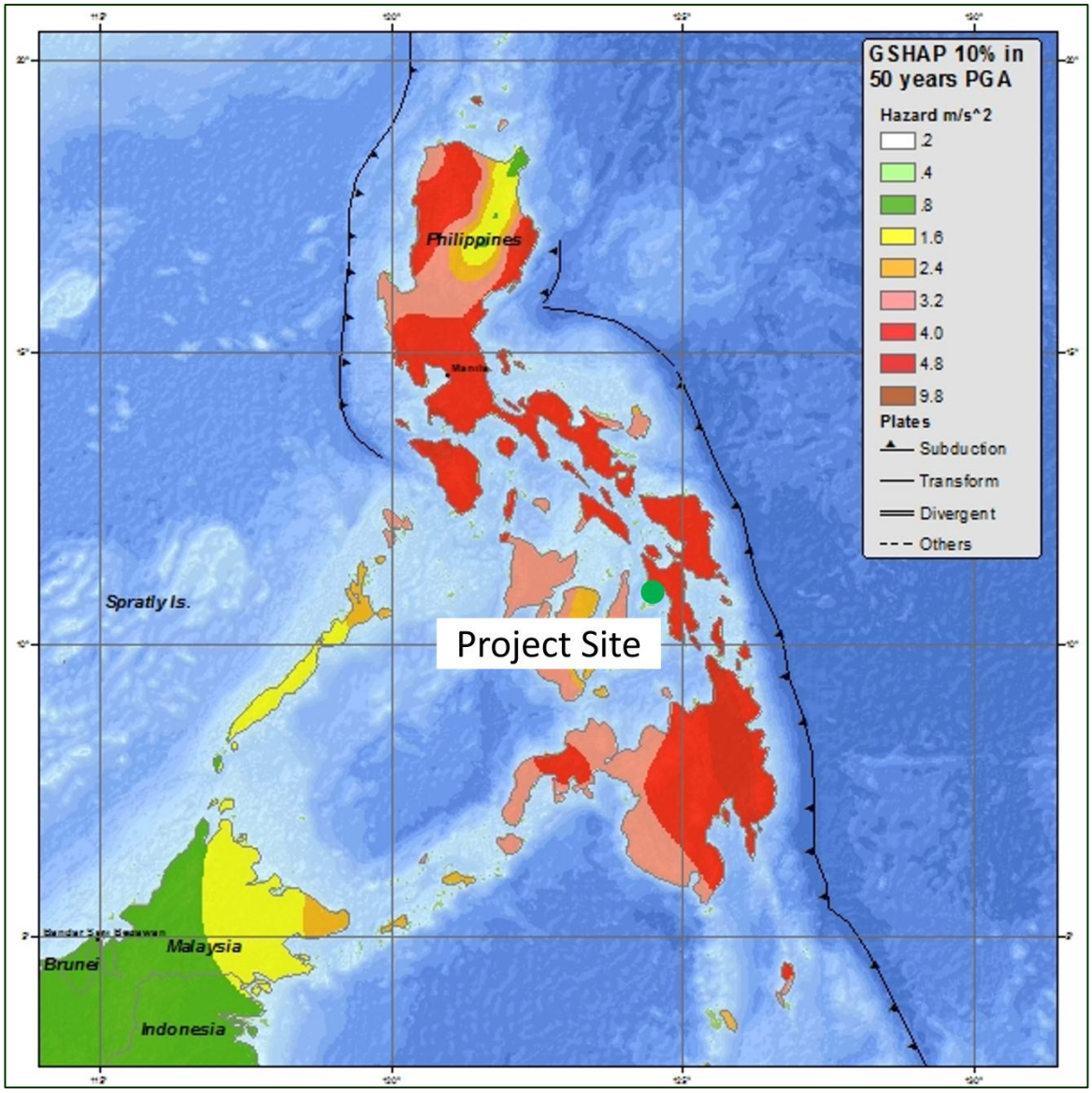
Figure 2-5. Fault Map of the Project Site showing the Philippine Fault, Cebu Fault System, and the East Bohol Fault



Source: PHIVOLCS

Figure 2-6. Earthquake Map of the Philippines for the Year 2015

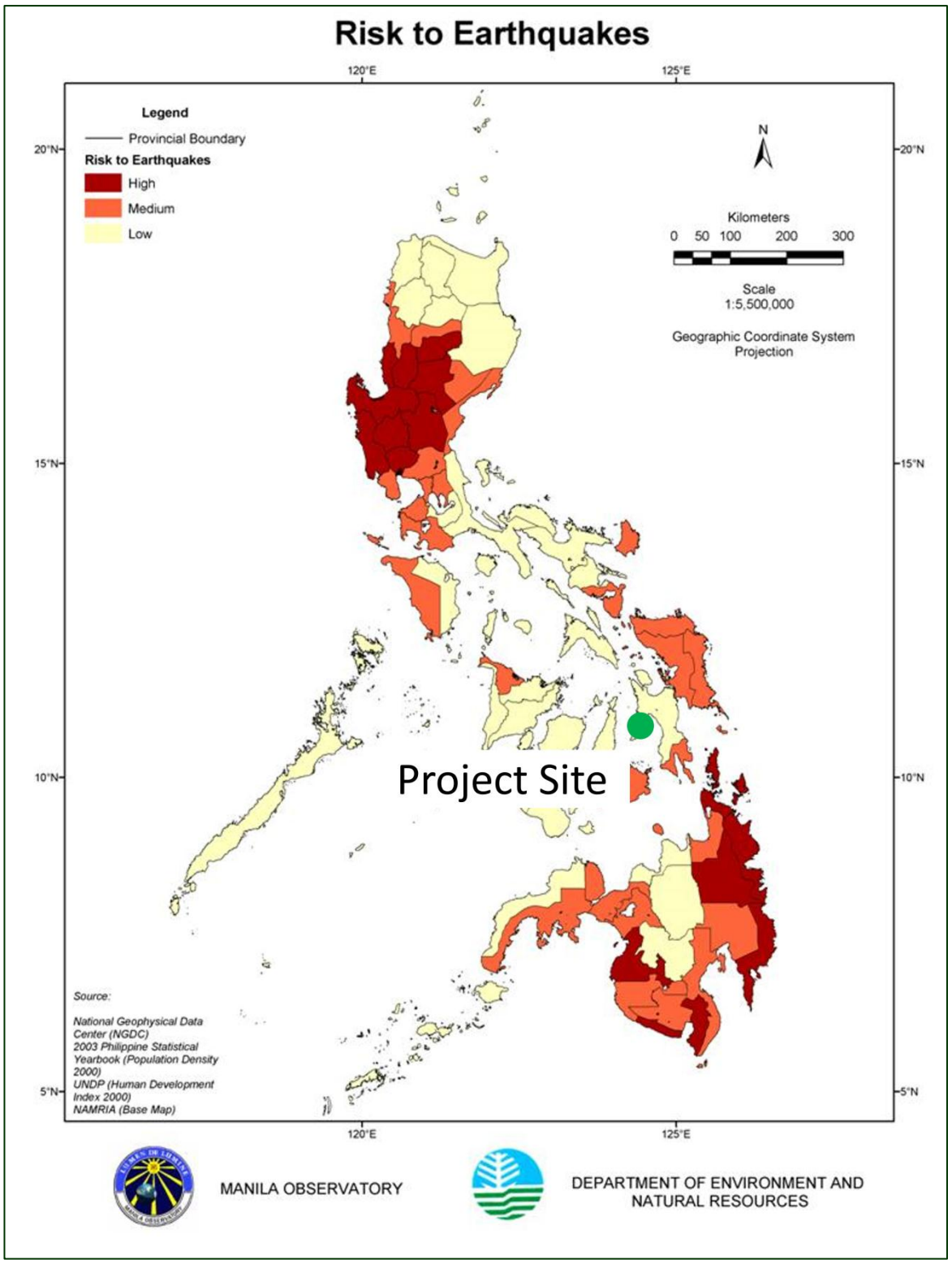
Ground Acceleration. Ground shaking is a well-recognized geologic hazard in the Philippines considering that the country is located in a tectonically active region where seismic activities such as earthquakes normally occur. The Peak Gound Acceleration values for the project site are high as presented in **Figure 2-7**. This is due to the fact that the main branch of the Philippine Fault directly traverses the island of Leyte.



Source: USGS

Figure 2-7. Peak Gound Acceleration Map

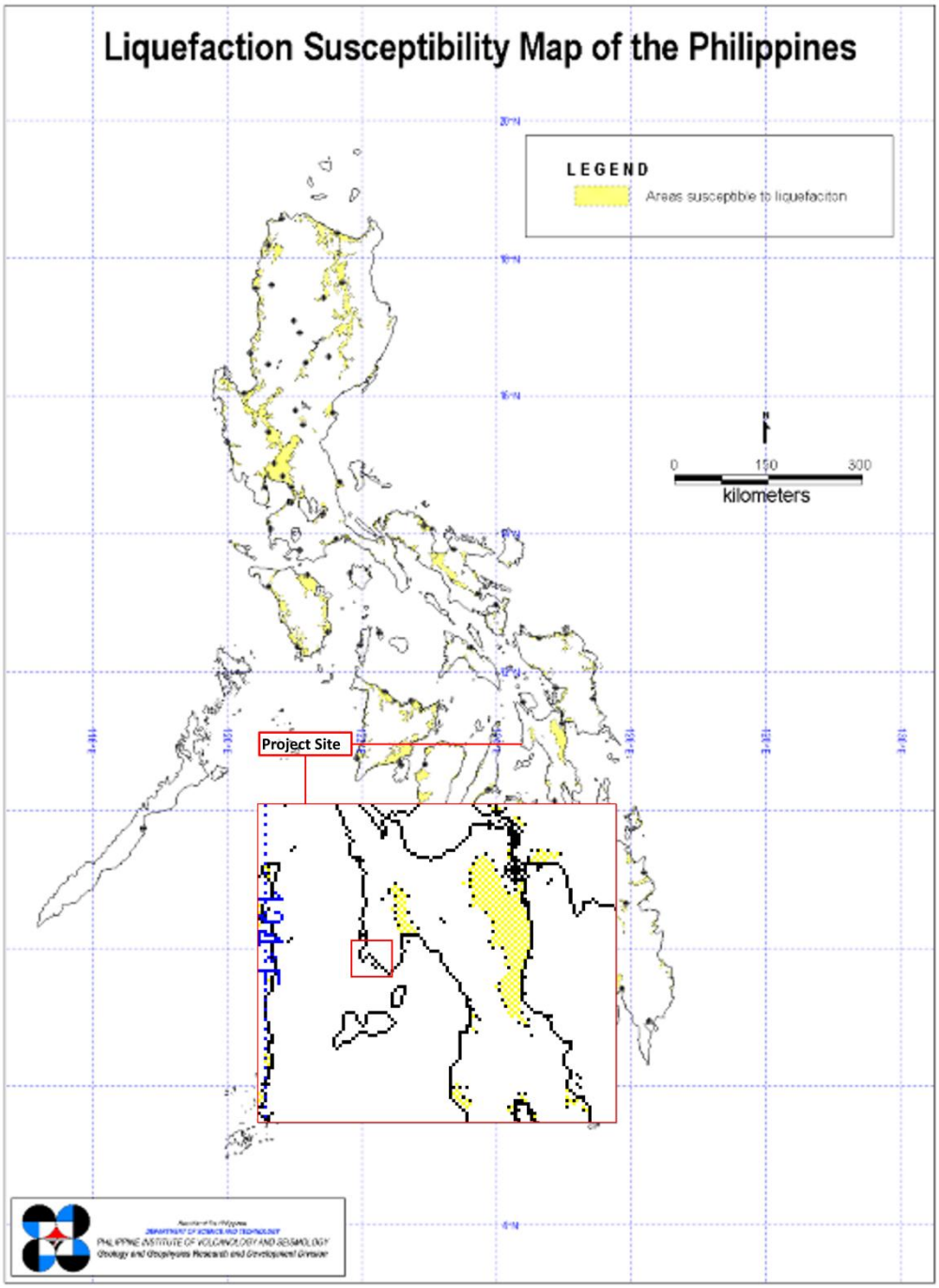
Although the island of Leyte experiences a lot of earthquakes, the risk induced by earthquakes in the project site is low (**Figure 2-8**). This is might be due to the underlying lithology in the areas and the fact that the project site is far from the main branch of the Philippine Fault. The portion of the Philippine Fault where the project is located is part of the creeping segment which produces low energy but frequent earthquakes.



Source: DENR and Manila Observatory

Figure 2-8. Risk to Earthquakes Map of the Philippines

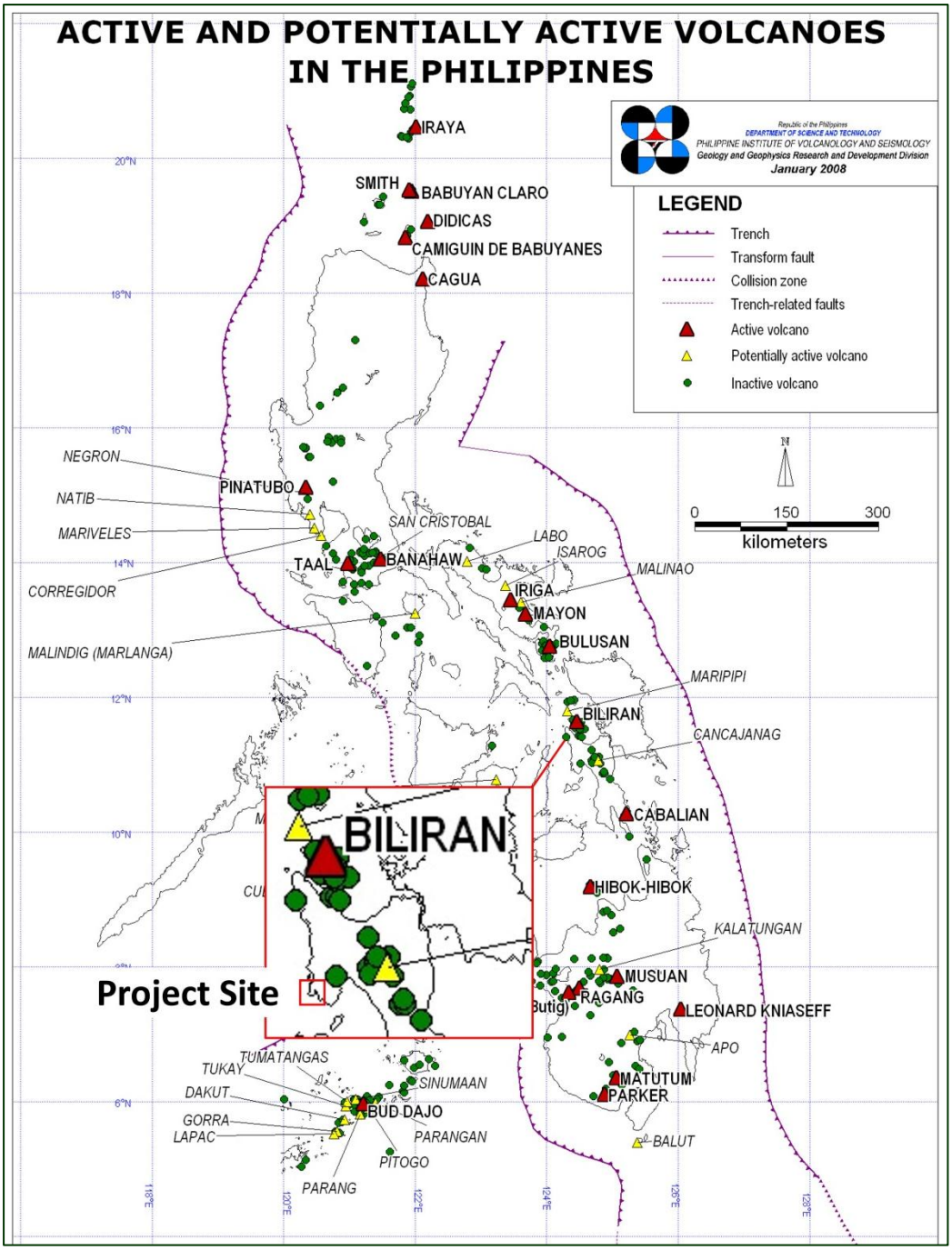
Liquefaction. Since Leyte is tectonically active because of the presence of the main branch on the Philippine Fault traversing the island, parts of the island may be subjected to liquefaction during earth movement. **Figure 2-9** shows that Project area is not susceptible to liquefaction.



Source: PHIVOLCS, modified by GEOSPHERE

Figure 2-9. Liquefaction Susceptibility Map of the Philippines

Volcanic Hazards. Leyte being host to a huge geothermal area in the Philippines is also hosts to few active and potentially active volcanoes (**Figure 2-10**). Mt. Biliran is a stratovolcano that is basaltic to andesitic in nature. It can erupt both lava and ash. However, the project site is far from Mt. Biliran to be directly affected by lava flow or pyroclastic flow. Tephra or ashfall may reach the project site especially during large volcanic eruptions. The size of the materials expected to reach the site will not exceed a few millimeters in diameter. The worst treat for the project site is the ashfall which can be readily mobilized by the subsequent rainfall.



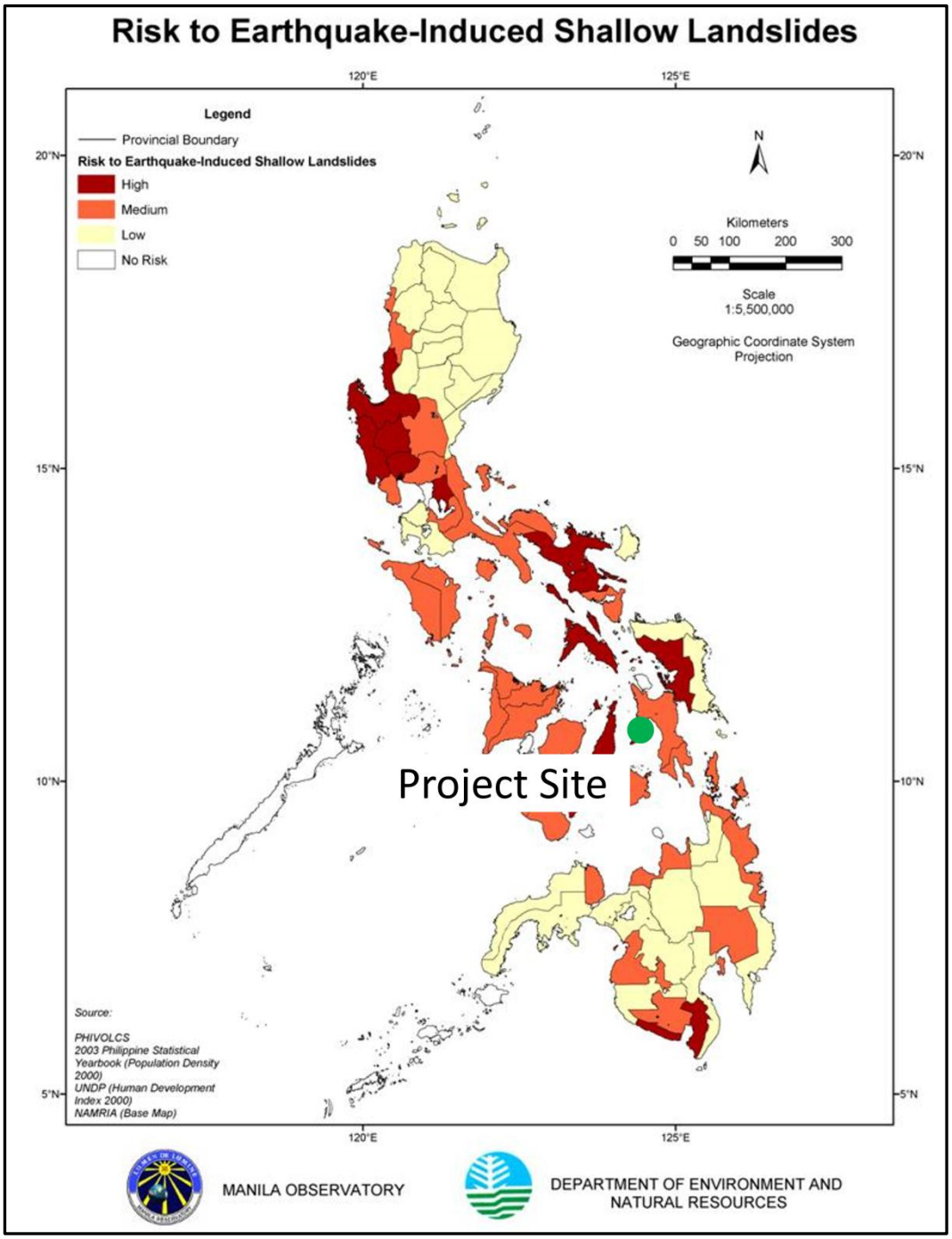
Source: PHIVOLCS

Figure 2-10 Distribution of Volcanoes in the Philippines

Land Subsidence. Land subsidence is the lowering of ground in elevation. There are many factors that can affect the subsidence of ground. It can be that the area experienced earthquake, presence of psuedokarst, or other reasons. Since the project site is predominantly overlain by limestone as bedrock, it is possible that the area has numerous sinkholes. This sinkholes will then contribute to the hazard of land subsidence for the area. It is recommended that a geotechnical survey of the project site must be conducted in order to check for the presence of sinkholes in the area.

Moreover, since the project site is located inside the LIDE, the ground where the power plant will erect would have been already compacted and other possible causes of land subsidence would have been eliminated already.

Landslide. Considering the earthquake induced shallow-landslides, the project site is moderately at risk (**Figure 2-11**). Since the project site is dominantly covered by limestone, the weathering of the underlying geology is much faster compared to volcanic rocks. Considering that limestone is also a brittle rock, the risk to earthquake-induced landslides can be common.



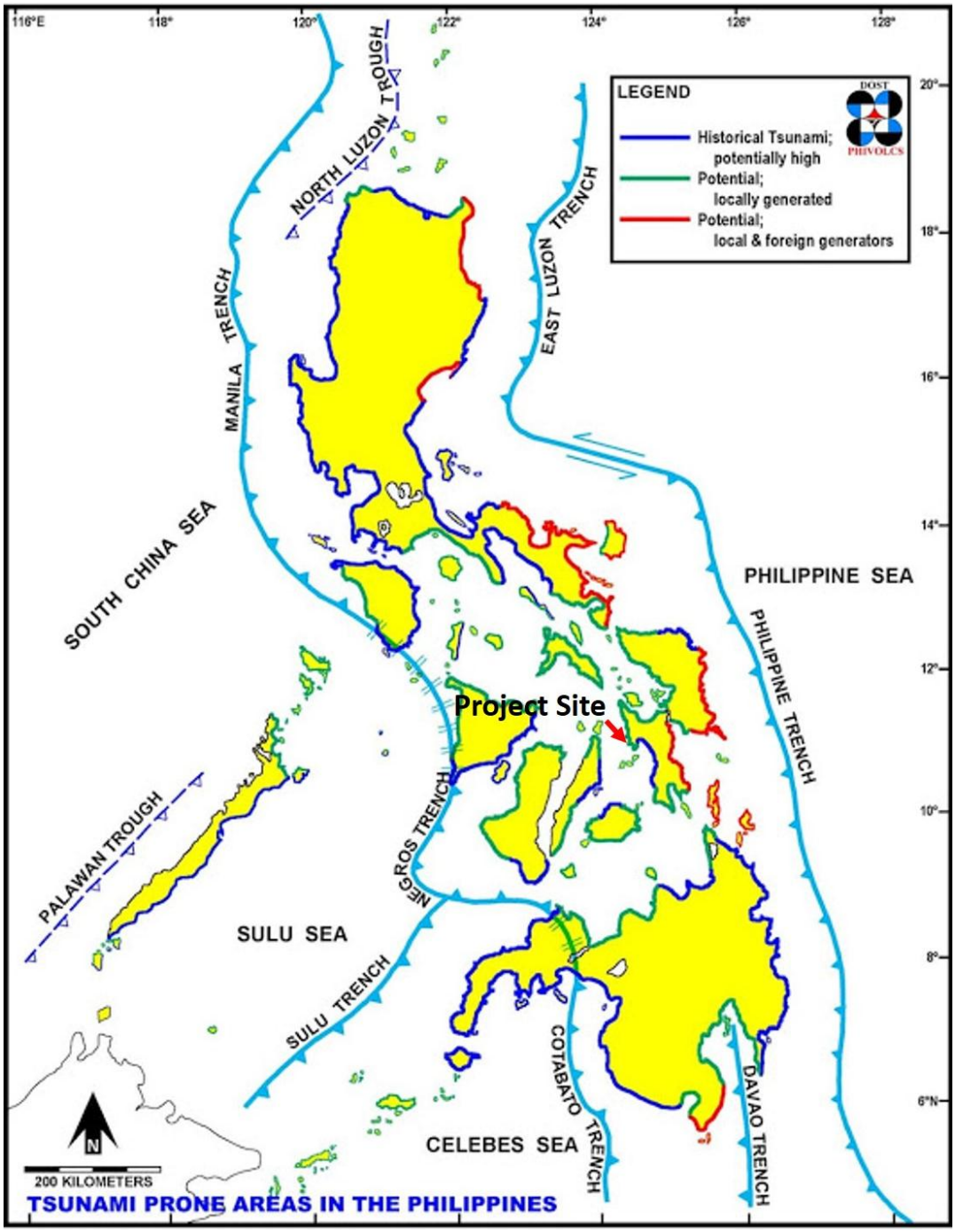
Source: DENR and Manila Observatory

Figure 2-11. Risk to Earthquake-Induced Shallow Landslides Map of the Philippines

Tsunami and Storm Surge. Tsunamis are high amplitude ocean waves generated by earthquakes, volcanic eruptions or other underwater explosions. Sudden displacements in the ocean floor caused by fault movements generate these large waves, which can travel over long distances.

Tsunami and storm surge are among the coastal hazards in the Philippines. Tsunamis are giant sea waves that are produced by a massive displacement of land under water, usually due to vertical displacement during dip slip faulting. Coastal zones are particularly vulnerable to tsunami and storm surge.

Most of the histrorically prone areas of tsunami in the Philippines are near high-energy earthquake producers. As shown in in **Figure 2-12**, the project site is considered to be an area where locally generated earthquakes can affect the area and produce tsunami. It is considered as such because lines the margins of the island. However, there are no historical accounts on occurences of previous tsunamis in the area.



Source: PHIVOLCS

Figure 2-12. Tsunami Prone Areas in the Philippines

Attention shall be directed to designing the proposed Project to withstand repetitive shaking over long period of time. The stability of the foundation of the project facilities shall also be considered. If soft soil materials are encountered in areas where heavy structures will be constructed or where heavy equipment will be installed, the soft materials shall be excavated and replaced by engineered fill. The founding level of all structures must be on competent soil or rock, depending on the results of the soil investigation.

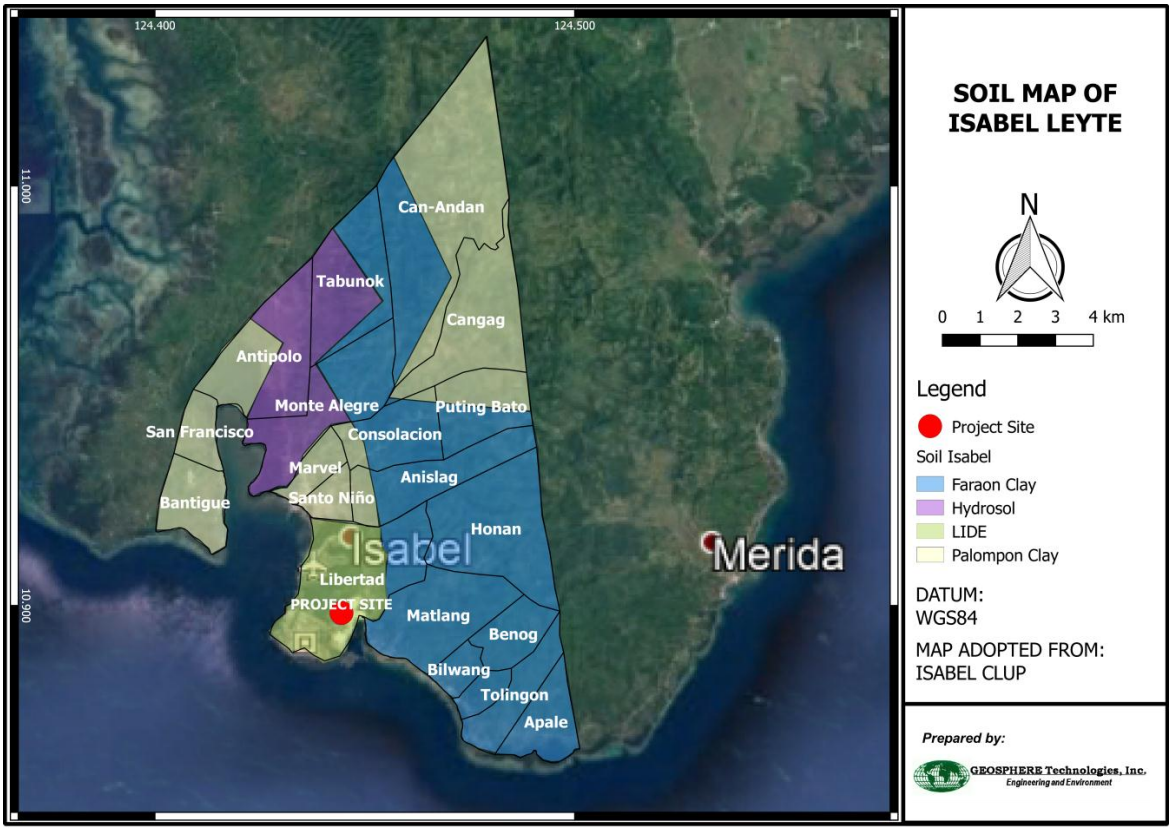
Moreover, IASCL shall prepare an Emergency Preparedness and Response Plan, which includes evacuation point, alternative transport routes and communication lines, to ensure preparedness of the personnel in the event of natural hazards such as typhoon, earthquake, etc.

2.1.3 Pedology

2.1.3.1 Soil Erosion/Loss of Topsoil/Overburden

The soils in Isabel Municipality is mostly clay which ranges from Hydrosol Clay to Faraon Clay to Palompon Clay. Significant part of the total area which is 64% is the Faraon Clay. It is faily granular clay that becomes sticky when wet and hard upon drying. The Palompon Clay comprises 33% of the total area. This kind of clay has a light to brown clay, with good granular structure and slightly sticky when wet but friable when dry.

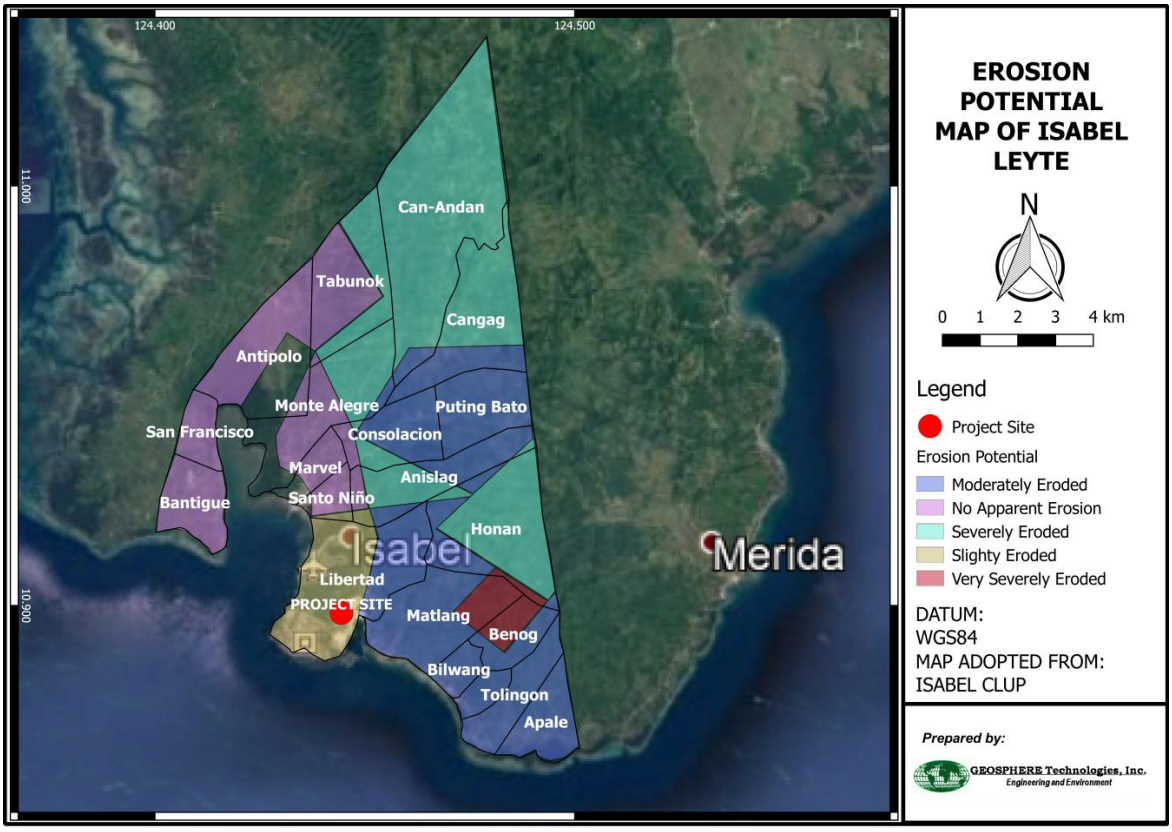
Only 3% of the total area is Hydrosol Clay, which is a poorly drained flat lowland, located near the coastal and swampy areas. Depending upon the tide, these areas are covered with seawater or saturated with brackish water throughout the year. **Figure 2-13** presents the soil map of Isabel Municipality.



Source: CLUP of Isabel Municipality

Figure 2-13. Soil Map of Isabel Municipality

Based on the Soil Erosion Map presented in **Figure 2-14**, about 19.2% of the total land area is very severly eroded; significant 36.6% is severely eroded; 28.1% is moderately eroded and 2.4% is slightly eroded. Only 13.7% of the total areas has no erosion potential. The proposed Project is located at the area which is slighty eroded.



Source: CLUP of Isabel Municipality

Figure 2-14 Erosion Susceptibility Map of the Proposed Project Site

Earthworks during construction phase will disturb the soil and may lead to soil erosion. Cut and fill activities can generate significant volume of sediments that may be carried off by surface runoff. Soil erosion and sedimentation could be considerable during rainfall events, especially during the wet season but could be minimal during the dry season. However, erosion, downslope processes and siltation are expected to return to their natural rates as soon as excavation activities stop when construction phase ended. Operation-related impacts of the proposed Project on soil would be of minor magnitude, short-term duration, and small extent, and have a possible likelihood of occurring. Soils are anticipated to be completely stabilized upon commencement of plant operations.

To avoid considerable soil erosion during rainfall events, an erosion protection program will be implemented. This program shall contain specific engineering, protective construction and planting rules, as well as requirements in the terms of reference of construction companies.

Earthworks during the construction phase shall be scheduled during dry season. Soil erosion control measures sush as engineering structures, silt traps and vegetative cover shall be installed prior to grading of the site. Areas which are most vulnerable to soil erosion by water will be covered with geo-textile liners.

The ground surface on which fill is to be laid will be prepared by removing some of the vegetation, non-complying fill, topsoil, and other unsuitable materials. The exposed material will be scarified to provide bond with the new fill. It is absolutely necessary that the fill slopes be keyed in into the natural sub-grade to prevent the formation of a weak interface which could trigger a block slide particularly when the interface is saturated with water. Detrimental amounts of organic materials will not be permitted on fills. All fills will be compacted to a minimum 95% of maximum dry density based on ASTM D-698 using an adequate size compactor. Irreducible material with a maximum dimension of greater than 300 mm will not be buried or placed on fills. The quality and adequacy of the compaction works will be verified using ASTM D-1556 Procedures. Vibratory rollers such as tamper

foot of smooth drum are suited for granular materials. Such vibratory rollers will have a minimum static weight of ten (10) metric tons and vibrating frequency of 30 cps and will have a maximum travel speed of two (2) KPH when compacting granular materials. For soils exhibiting cohesiveness or plasticity, a smooth drum static roller or sheep foot roller will become necessary. Earthworks contractor will perform compaction trials to determine the most suitable compaction procedure.

2.1.3.2 Change in Soil Quality and Fertility

Soil testing was conducted at three (3) established sampling stations on January 14-16, 2018 (**Table 2-1** and **Figure 2-15**) to determine the physico-chemical properties of the soils with the proposed Project site and its vicinity.

Table 2-1. Sampling Stations for Soil Quality Testing

Station	Coordinates	Vegetation Profile	Photos
S1	N 10°53'49.96" E124°26'37.27"	Upper portion of the project site, with dense stand of Ipil-Ipil (*Leucaena leucocephala*) and mixed understorey layer species of Ganoi (C. odorata) and Kulot (*Triumfetta rhomboidea*). Mixed species of banana and herbaceous layer.	
S2	N 10°53’47.50" E124°26'41.30"	Tree species of Ipil-Ipil (*Leucaena leucocephala*) and mixed understorey layer of Sablot (*Listea glutinosa*) and *Leea philippinensis*, *Mucuna pruriens*, *Mimosa pudica* L., and *Callicarpa formosana* Rolfe. Thin litter layer.	
S3	N 10°53'44.38" E124°26'36.53"	Near a small creek with small patch of dense tree and shrub vegetation. Tree species: *Ficus variegata, Trema orientalis* (L.) Blume, *Macaranga tanarius* (L.) Muell.-Arg. *Morinda citrifolia* L., *Ficus septica* Burm. f	

Source: Google Earth, modified by GEOSPHERE, 2018

Source: Google Earth, Modified by GEOSPHERE, 2018

Figure 2-15 Location Map of Soil Quality Sampling Stations

As presented in **Table 2-2**, the level of pH in Station S1 is favorable, however the soil reactions in Stations S2 and S3 are highly basic. Nitrogen range is high from 1,200mg/kg to 1,600 mg/kg. Organic matter is very low. The levels of Phosphorous in all sampling stations are adequate. The levels of Potassium in all sampling stations are also high.

Table 2-2. Results of Surface Soil Analysis Pertaining to Soil Fertility Rating, January 14-16, 2018

Parameters	Sampling Stations			Soil Fertility Rating Guidelines[a]		
	S1	S2	S3	Adequate (Favorable)	Moderate (Moderately Unfavorable)	Deficient (Unfavorable)
pH	6.4	9.2	9.3	5.5-8.5	5.0-5.5	<5.0/>8.5
Total Kjeldahl Nitrogen, mg/kg	1,500	1,200	1,600	-	-	-
Phosphorus, mg/kg	5,801	112	878	>10	6-10	<6
Potassium, mg/kg	1,655	2,717	1,982	-	-	-
Organic Matter, %	1.36	0.94	0.94	>3	2-3	<2

The limits used for assessment of heavy metals are the Target and Intervention Values of Dutch Standards. USEPA 2010 Standard and Leeper, 1978 were used as reference for the assessment of parameters that are not found in the Dutch Standards. The Dutch Standards are environmental pollutant reference values used in environmental remediation, investigation and clean-up.

Table 2-3 shows that the levels of Chromium Hexavalent in all samplings stations are below the detectable limits of the analysis. The levels of Zinc and Arsenic in all sampling stations exceeds the the Intervention Value of the Dutch Standard except in Station S3 for Arsenic and in Station 1 for Zinc which are below the Intervention Value but exceeds the Target Value of the Dutch Standard. The levels of Cadmium, Lead and Mercury in all sampling stations exceeds the Target Value but way below the Intervention Value of the Dutch Standard. The levels of Copper in all sampling stations exceed the Intervention Value of the Dutch Standard. The levels of Fe in all sampling stations exceed the standard range (3,000-10,000mg/kg) of Fe in soil. Manganese and Oil and grease are also present in all sampling stations.

Table 2-3. Results of Surface Soil Analysis for Heavy Metals, January 14-16, 2018

Parameters	Sampling Stations			Dutch Standard	
	S1	S2	S3	Target Value	Intervention Value
Copper, mg/kg	1,165	4,192	6,996	36	190
Manganese, mg/kg	558	162	89.4	-	-
Lead, mg/kg	97.3	106	59.9	85	530
Zinc, mg/kg	1,127	2,363	547	140	720
Mercury, mg/kg	0.58	0.4	0.5	0.3	10
Iron, mg/kg	20,635	560,234	430,100	3,000 – 10,000 (Leeper)	
Cadmium, mg/kg	9.04	5.94	5.16	0.8	12
Arsenic, mg/kg	46.60	163	172	29	55
Chromium Hexavalent, mg/kg	<0.2	<0.2	<0.2	-	2 (USEPA)
Oil and Grease, mg/kg	425	104	112	-	-

Note: Target Values of Dutch Standard (2000) – indicates the level at which there is a sustainable soil quality; Intervention Values of Dutch Standard (2000) – representative of the level of contamination above which there is a serious case of soil contamination;
Range of Iron in Soil = 3,000 – 10,000 mg/kg (Leeper, 1978);
Chromium hexavalent = 2mg/kg (USEPA, 2010)

Construction of the proposed Project involves the use of heavy equipment, which has risk of an accidental fuel or chemical spill and potential contamination of soils. The operation of the proposed Project could hypothetically result in localized contaminant loading into the soil due fuel leakage and spill and improper disposal of wastes. Accidental fuel and oil spill may occur in storage area, and tank truck unloading area.

The following procedures for the handling and storage of fuel shall be implemented to reduce the potential soil contamination within the vicinity of the proposed Project:

(i) Fueling and lubrication of equipment shall be in designated and approved locations.
(ii) Washing, servicing and fueling of mobile equipment shall not be allowed within thirty (30) meters of drainage
(iii) Storage of waste oils and lubricants shall be in a tank or closed container
(iv) Storage of greasy or oily rags or materials shall be in an appropriate and approved designated area that are not prone to spontaneous combustion
(v) Prohibition on dumping of any contaminating material product to the environment, including waste oils
(vi) Formulation of Spill Prevention Procedures and a Spill Contingency Plan, a detailed response system to deal with accidents such as the release of petroleum, oils, or lubricants. Make available on-site all equipment and materials necessary to execute a clean-up
(vii) Collection and storage of all wastes recovered during clean-up operations in labeled and secured containers for subsequent disposal by an accredited treatment facility
(viii) Training and awareness programs shall be conducted for all personnel

During operation phase, the fuel storage area will be provided with a secondary containment in the form of a bund containment wall. The bund containment wall will surround the fuel storage tank and will be sized to accommodate the volume for a full capacity spillage of the tank.

The tank truck unloading area shall be installed with a berm, sized with sufficient capacity to contain 110% of the largest tank truck capacity and the volume displaced by the truck in the unloading area. The fuel oil spill containment area will be provided with a level transmitter for level monitoring and alarm in the digital control system.

All routine handling or transfer of chemicals will take place within bermed areas to ensure that spills or leaks will be contained. Chemical feed skids, pot feeders, portable storage tanks, or drums will

be installed or staged in bermed areas. Bermed areas for storing at least one spare portable tank or drum for each in service will be provided.
Possibility of soil contamination will be assessed through a soil-testing program, especially in the vicinity of storage areas. If positive for contamination, then the area will be subjected to remediation or decontamination. Any toxic or hazardous materials remaining in the site will be collected along with the contaminated soil for appropriate disposal. An accredited treater/ transporter will be contracted to undertake the required treatment and proper disposal.

2.1.4 Terrestrial Ecology

2.1.4.1 Vegetation Removal and Loss of Habitat

The terrestrial flora survey was conducted at ten (10) sampling plots within the proposed Project site and its vicinity on January 14-16, 2018. Nested quadrat method using 20m x 20m ($400m^2$) plots was used to assess and characterize the structure and species composition of the different plant communities within the sampling plots (**Figure 2-16**). Individual trees inside the quadrat, with a diameter at breast height (**DBH**) of ≥10 cm, were geo-tagged and the merchantable height (**MH**), and total height (**TH**) were measured. The diameter of trees was measured at 1.3m above ground or 10 cm above the tallest buttress/prop roots if taller than 1.3m. For tree forks below 1.3 m from the ground, all stems with ≥ 5 cm DBH were measured separately.

Associated species of trees < 10 cm and other plant forms such as palm, vine, shrubs, weeds, lianas, ferns, bamboos, and grasses identified were recorded. Frequency of shrubs, poles, and saplings inside the 5m x 5m quadrat was counted to account for the intermediate species, while percentage cover of understorey species such as grasses and other plants below 1m in height inside the 1m x 1m quadrat was determined. Opportunistic sampling survey was also conducted in other sections of the study area particularly in the peripheral sections near roads and excavation area. This was done to account other plant species and vegetation extent of the area using a more comprehensive and systematic approach.

Identification of all species inside the transect plots was made. Specimens that were not identified in the field were collected and voucher specimens were prepared for later identification. Species and family names followed the latest Angiosperm Phylogeny Group classification (APG 3, version 13) while the common names adapted that of Rojo (2001). Local names provided by the community guides were also incorporated.

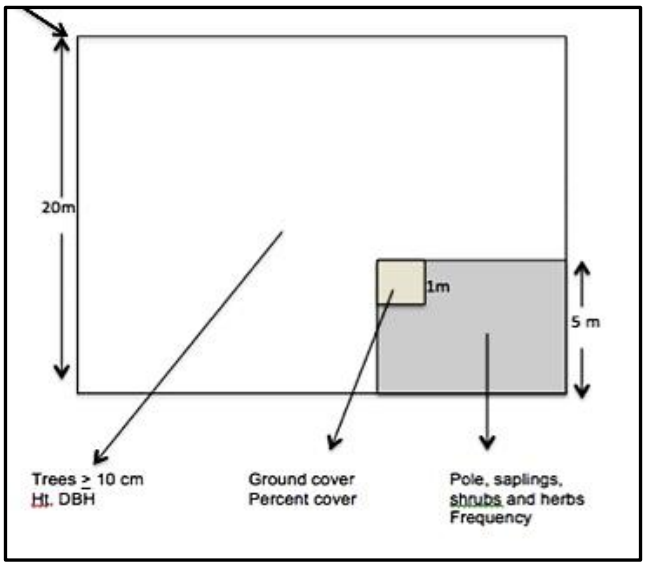


Figure 2-16. The nested plot technique employed in the plant diversity survey.

The ecological or biodiversity value of an area is always measured in terms of species richness and in the number of endemic and threatened species present. In addition, the presence of indigenous and endemic species are also contributing factors to the total biodiversity of the area.

Important Values

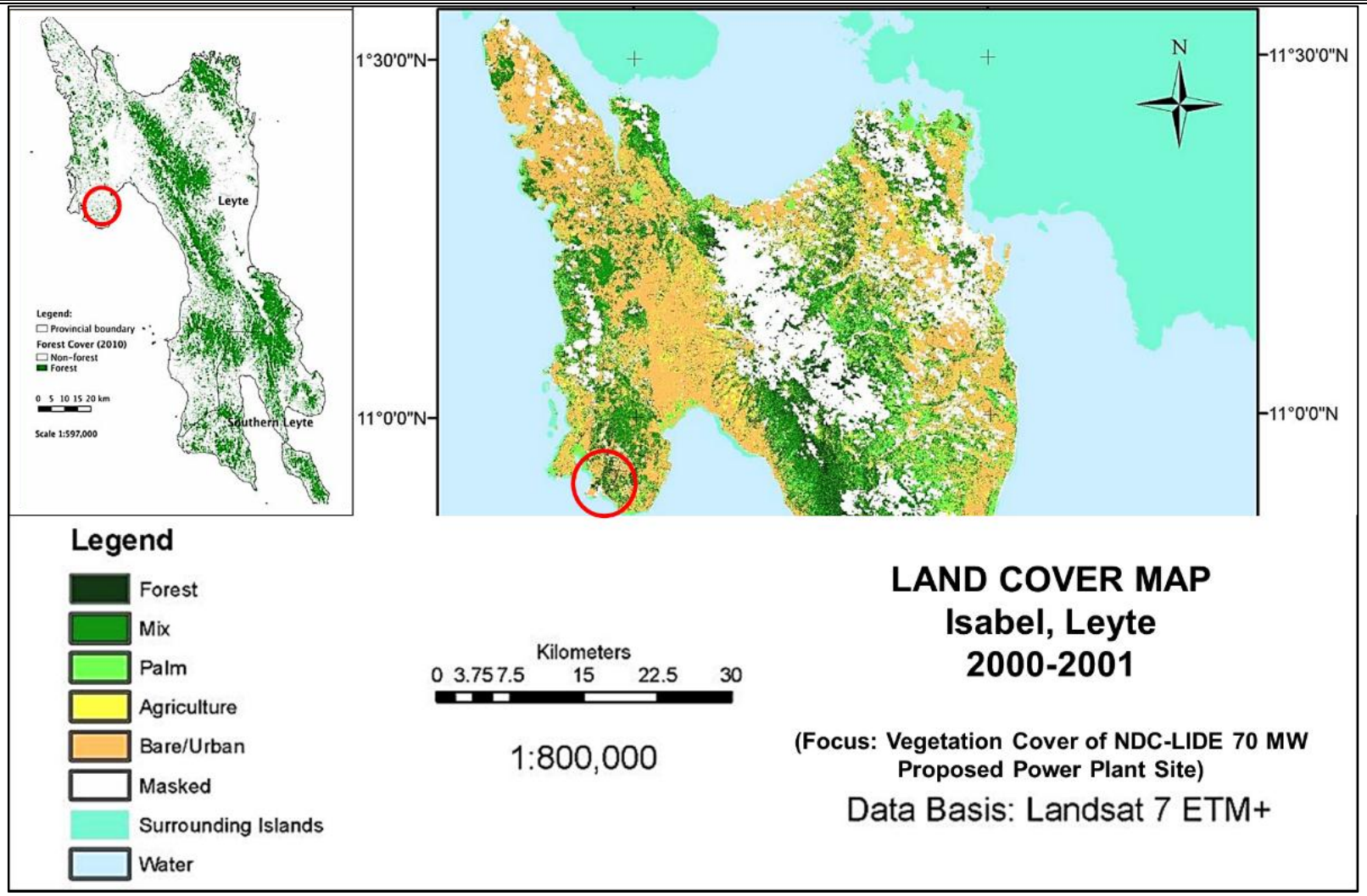
The relative density, relative dominance and relative frequency values for each plant and tree species in all the monitoring plots were determined to obtain their Importance Value (IV), a standard measure in ecology that determines the rank relationships of species. High Importance values of species indicate a composite score for high relative species dominance, density and frequency. IV is often correlated with both ecological and economic importance. Species importance value (SIV) as a parameter, covers all of these parameters together for the determination of distribution and frequency patterns of species as well as judgments about ecological conditions that have more significance

Conservation Status

The consevartion status of species is based on the most recent recommendations of the Philippine Plant Conservation Committee (PPCC) officially issued as as DENR Administrative Order No. 2007-01 better known as ‘‘The National List of Threatened Philippine Plants and their Categories’. The listing of protected species of CITES and threatened species of the IUCN red list were also used as reference. Based from these listings, a number of conservation categories were describe pertaining to the threatened ecological community (TEC), which is found to fit into one of the following categories; Critically Endangered (CR), Endangered (EN) or Vulnerable (VU). Possible threatened ecological communities that do not meet survey criteria are added to ‘Other threatened species’ (OTS). Lists under Priorities 1, 2 and 3 (referred to as P1, P2, P3). Ecological Communities that are adequately known, are rare but not threatened, or meet criteria for Near Threatened, or that have been recently removed from the threatened list, are placed in Priority 4 (P4). These ecological communities require regular monitoring.

Based from the land cover map with focus on the different land uses in the Island of Leyte in 2000-2001, the Municipality of Isabel was categorized as having mixed-land use involving forestry and agricultural uses such as pasture areas, firewood production, etc.

Figure 2-17 shows the 2002-2001 land use map.



Source: NAMRIA, 2002

Figure 2-17 Land Use Map of Leyte

The vegetation inside the about 2-ha proposed power plant site is generally a brush land and remnant of mixed-land use vegetation where in pioneer tree species dominates the area after a long history series of agricultural activities such as pasture, firewood production and etc. as shown in **Figure 2-18.**

Figure 2-18 Satellite image of the proposed project site which is currently being temporarily utilized by the contractor of the adjacent facility

Based from the reconnaissance survey, the upper portion of the proposed site was dominated by a dense stand of Ipil-Ipil (Leucaena leucocephala). However, there are few unique individual tree species such as Bayok (Pterospermum diversifolium) and Bogo (Garuga floribunda) located in the upper portion of the area that is fortunately quite far from the proposed project site. Furthermore, some of the tree and plant species were confined and growing well in sites where soil are stacked for a long period of time. These species are represented by either exotic or native species in various plant forms such as shrubs, woody vines and trees. Exposed areas are smothered by opportunistic and shade tolerant species such as the exotic species Gonoi (Chromalaena odorata) and Coronitas (Lantana camara). These species are regarded as illegal recruits since they grow in many kinds of soils and can be easily adapted to extreme environments and conditions. They are observable all throughout the proposed plant site and even in adjacent areas.

Associated Vegetation/Landscape

Associated vegetation or landscapes are important in assessing terrestrial ecology since these areas can serve as either viable alternative shelter or entrance site for new plant or animal species recruits in the main ecosystems or an area affected by any development or disturbance.

During the survey, it was observed that the study area has no associated vegetation as it was already surrounded by heavy industrial facilities and infrastructures. Aside from the remaining dense vegetation with some tall trees and shaded portions, there could still be some areas that can serve as viable habitat for birds and other wildlife species in the area. These areas includes the upper portion of the site near transmission tower and vegetated sections with native tree species**.**

Figure 2-19 presents the photos during floral survey.

Note: a) Dense vegetation of Ipil-Ipil, Alim, Binunga, and some individuals of Molave in the upper portions near Transmission tower; (b) East sections of the project site along the stretch of the road going to the existing plant nursery

Figure 2-19 Site Photos during Floral Survey

On the other parts within the middle section of the project site, the vegetation actually includes some remaining patches of grasses transition to the dense vegetation in the upper section. These includes species of Hakati (Paspalum sp.), Talahib (Saccharum spontaneum) and Cogon (Imperata cylindrica), etc. Other documented species present in the area are Gonoi (Chromolaena odorata), Kamot-kabag (Caesalpinia latisiliquum), and species of clumping grasses such as Cogon (Imperata cylindrica) and a leguminous species Alysicarpus sp. The vegetation in the area supports immediate cover which also became shelter for some bird species in the area.

At the inner portion, large diameter trees such as Bogo (Garuga floribunda), Gmelina (Gmelina arborea) and Alim (M. multiglandulosa) dominate the area. These trees are typically pioneer species that tend to dominate open areas and are light tolerant species. The remaining patch of vegetation is very significant in terms of cover in the area as these would serve as buffer zone to nearby facilities that don't operate heavily (e.g. in the case of a power plant) and as well as to adjacent communities near the proposed project site. There is an existing plant nursery in the area, though located outside the project site. The nursery is actually located in the upper portion of the site where in a large area of gypsum by-products (black sand) are being piled. Remnants of agricultural activities can also be observed in the area such that these areas are planted with Banana (Musa sp.), Mangga (Mangifera indica) and Avocado (Persea americana). Other species that can be observed in the area are Bangkoro (Morinda citrifolia), Malakalumpang (Sterculia ceramica), mixed with forest tree species were the wildlings/trees of the following species are present, namely, Binunga (Macaranga tanarius), Alim (Melanolepis multiglandulosa), Rain tree (Samanea saman), Hauili (Ficus septica) and Niyog-niyogan (Ficus pseudopalma).

Aside from the tree vegetation in the proposed power plant site, there are other vegetation with notable tree species that can be observed from other parts of the whole study area. These sites should be covered as monitoring zones or conserved area such as the forest vegetation in the upper elevations near the gypsum pile/stock area. A rapid listing and enumeration of plant and tree species were also done to account other species that are present in these areas.

Table 2-4 and **Figure 2-20** present the location and general vegetation condition of the different plots from the 10 sampling plots established in the site.

Table 2-4. Description of the Terrestrial Flora Sampling Stations

Plot No.	Coordinates	Elevation (masl)	Profile/Dominant Species**
1	N 10°53'50.29" E124°26'32.86"	41	**Shrub species**: *Lantana camara* L., *Urena lobata*, *Chromolaena odorata* and *Pipturus arborescens*. **Tree species**: *Leucaena leucocephala*, *Trema orientalis* (L.) Blume, *Macaranga tanarius* (L.) Muell.-Arg. *Morinda citrifolia* L., *Ficus septica* Burm. f. *Melanolepis multiglandulosa*, **Herbaceous layer**: *Mimosa pudica* L., *Stachytarpeta jamaicensis, Mikania cordata* (Burm. f.) B.L. Rob., *Caesalpinia latisiliquum, Tridax procumbens*
2	N 10°53'50.51" E124°26'34.26"	43	**Herbaceous layer**: *Xanthosoma violaceum, Stachytarpeta jamaicensis, Mikania cordata* (Burm. f.) B.L. Rob., *Caesalpinia latisiliquum, Musa acuminata* **Shrub species**: *Tristellateia australasiae* A. Rich., *Callicarpa formosana* Rolfe*, Lantana camara* L. **Tree species**: *Artocarpus blancoi*, *Trema orientalis* (L.) Blume, *Macaranga tanarius* (L.) Muell.-Arg. *Garuga floribunda*, *Ficus septica* Burm. f., *Gmelina arborea*, *Litsea glutinosa*
3	N 10°53'50.59" E124°26'35.68"	43	**Shrub species**: *Lantana camara* L., *Tristellateia australasiae* A. Rich. *Mimosa pudica* L., **Tree species**: *Leucaena leucocephala, Garuga floribunda, Trema orientalis* (L.) Blume, *Macaranga tanarius* (L.) Muell.-Arg. *Morinda citrifolia* L., *Ficus septica* Burm. f., *M. multiglandulosa, Munitigia calabura, Artocarpus blancoi* **Herbaceous layer**: *Alysicarpus sp., Mimosa pudica* L., *Stachytarpeta jamaicensis, Mikania cordata* (Burm. f.) B.L. Rob., *Caesalpinia latisiliquum, Tridax procumbens, Imperata cylindrica.*
4	N 10°53'49.96" E124°26'37.27"	40	**Shrub species**: *Lantana camara* L., *Tristellateia australasiae* A. Rich., *Triumfetta rhomboidea*, *Callicarpa formosana* Rolfe, *Leea philippinensis* **Tree species**: *Leucaena leucocephala, Garuga floribunda*, *Trema orientalis* (L.) Blume, *Macaranga tanarius* (L.) Muell.-Arg. *Morinda citrifolia* L., Molave (*Vitex parviflora* Juss)., *Melanolepis multiglandulosa* **Herbaceous layer**: *Xanthosoma violaceum, Caesalpinia latisiliquum, Stachytarpeta jamaicensis, Mikania cordata* (Burm. f.) B.L. Rob., *Mimosa pudica, Centrosema pubescens, Imperata cylindrica.*

Plot No.	Coordinates	Elevation (masl)	Profile/Dominant Species**
5	N 10°53'47.50" E124°26'41.30"	25	**Shrub species**: *Leea philippinensis*., *Solanum torvum*., *Cocos nucifera* L., *Mimosa pudica* L., *Callicarpa formosana* Rolfe **Tree species**: *Leucaena leucocephala, Samanea saman*, *Artocarpus blancoi*, *Trema orientalis* (L.) Blume, *Macaranga tanarius* (L.) Muell.-Arg. *Garuga floribunda*, *Ficus septica* Burm. f., Gmelina arborea, Sterculia ceramica, *Litsea glutinosa* **Herbaceous layer**: *Centrosema pubescens*, *Alysicarpus sp., Mimosa pudica* L., *Phyllanthus debilis, Mikania cordata* (Burm. f.) B.L. Rob., *Caesalpinia latisiliquum, Tridax procumbens*
6	N 10°53'45.60" E124°26'41.11"	17	**Shrub species**: *Solanum torvum*., *Cocos nucifera* L., *Callicarpa formosana* Rolfe **Tree species**: *Gmelina arborea*, *Trema orientalis* (L.) Blume, *Macaranga tanarius* (L.) Muell.-Arg. *Morinda citrifolia* L., *Ficus septica* Burm. f. *Melanolepis multiglandulosa* **Herbaceous layer**: *Centrosema pubescens*, *Alysicarpus sp., Mimosa pudica* L., *Imperata cylindrica, Mikania cordata* (Burm. f.) B.L. Rob., *Caesalpinia latisiliquum, Tridax procumbens*
7	N 10° 53'45.82" E124°26'38.65"	20	**Shrub species**: *Leea philippinensis*., *Solanum torvum*., *Cocos nucifera* L., *Mimosa pudica* L., *Callicarpa formosana* Rolfe **Tree species**: *Sweitenia macrophylla*, *Trema orientalis* (L.) Blume, *Macaranga tanarius* (L.) Muell.-Arg. *Morinda citrifolia* L., *Ficus septica* Burm. f. Some planted seedlings of Molave (*Vitex parviflora* Juss). **Herbaceous layer**: *Centrosema pubescens*, *Alysicarpus sp., Mimosa pudica* L., *Phyllanthus debilis, Mikania cordata* (Burm. f.) B.L. Rob., *Caesalpinia latisiliquum, Tridax procumbens*
8	N 10°53'44.38" E124°26'36.53"	15	**Shrub species**: *Leea philippinensis*., *Solanum torvum*., *Cocos nucifera* L., *Mimosa pudica* L., *Callicarpa formosana* Rolfe **Tree species**: *Sweitenia macrophylla*, *Trema orientalis* (L.) Blume, *Macaranga tanarius* (L.) Muell.-Arg. *Morinda citrifolia* L., *Ficus septica* Burm. f. Some planted seedlings of Molave (*Vitex parviflora* Juss). **Herbaceous layer**: *Centrosema pubescens*, *Alysicarpus sp., Mimosa pudica* L., *Phyllanthus debilis,*

Plot No.	Coordinates	Elevation (masl)	Profile/Dominant Species**
			Mikania cordata (Burm. f.) B.L. Rob., *Caesalpinia latisiliquum, Tridax procumbens*
9	N 10°53'46.13" E124°26'34.78"	22	**Shrub species**: *Leea philippinensis*., *Solanum torvum*., *Cocos nucifera* L., *Mimosa pudica* L., *Callicarpa formosana* Rolfe **Tree species**: *Sweitenia macrophylla*, *Trema orientalis* (L.) Blume, *Macaranga tanarius* (L.) Muell.-Arg. *Morinda citrifolia* L., *Ficus septica* Burm. f. Some planted seedlings of Molave (*Vitex parviflora* Juss). **Herbaceous layer**: *Centrosema pubescens*, *Alysicarpus sp., Mimosa pudica* L., *Phyllanthus debilis, Mikania cordata* (Burm. f.) B.L. Rob., *Caesalpinia latisiliquum, Tridax procumbens*
10	N 10°53'47.03" E124°26'32.73"	26	**Shrub species**: *Leea philippinensis*., *Solanum torvum*., *Cocos nucifera* L., *Mimosa pudica* L., *Callicarpa formosana* Rolf **Tree species**: *Sweitenia macrophylla*, *Trema orientalis* (L.) Blume, *Macaranga tanarius* (L.) Muell.-Arg. *Morinda citrifolia* L., *Ficus septica* Burm. f. Some planted seedlings of Molave (*Vitex parviflora* Juss). **Herbaceous layer**: *Centrosema pubescens*, *Alysicarpus sp., Mimosa pudica* L., *Phyllanthus debilis, Mikania cordata* (Burm. f.) B.L. Rob., *Caesalpinia latisiliquum, Tridax procumbens*

*** Profile/Information regarding the plant/vegetation composition of each plots.*

Figure 2-20. Location of different sampling plots for the plant diversity assessment

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

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

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

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

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

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

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

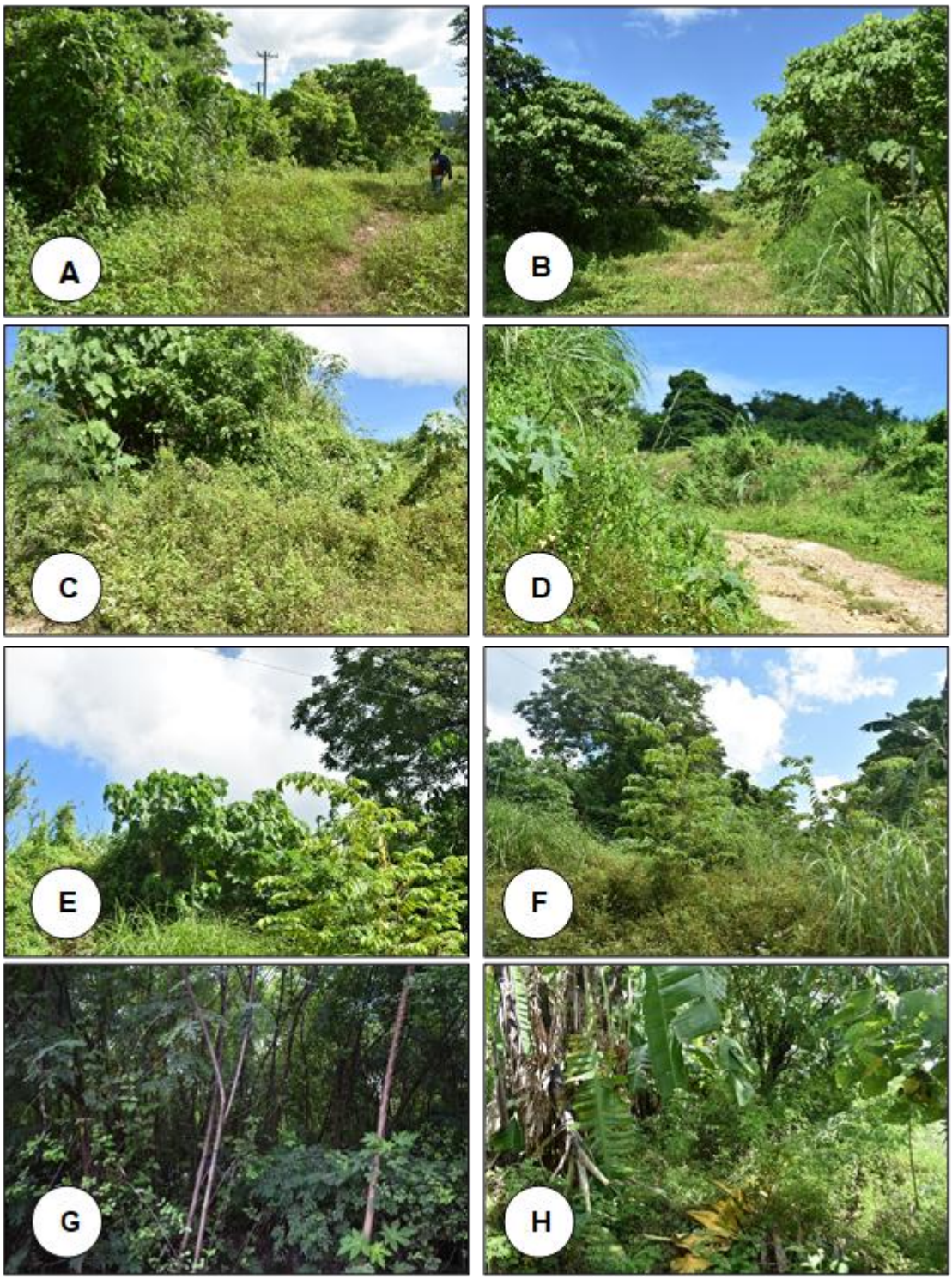
$$\text{Importance Value} = \text{Relative Density} + \text{Relative Frequency} + \text{Relative Dominance}$$

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

The proposed Project site is generally a remnant of secondary growth vegetation. It comprises a dense vegetation from small patch of grassland to tree and shrub vegetation representing different stages of recovery from the previous and present human disturbances. Moreover, some sections of the area is predominantly a second growth vegetation with a less proportion (5%) being a forest while the remaining vegetation are man-made from a long history of reforestation activities.

The vegetation area in the proposed Project site can be classified as distributed brush land vegetation. There are no significant residual secondary forest growths in the area, although several tree species (both naturally grown and planted) proliferate throughout. The dense vegetation inside the proposed Project site were actually dominated by the species of Ipil-Ipil (*L. leucocephala*) which is small fast-growing mimosoid tree native to southern Mexico and northern Central America (Belize and Guatemala) and is now naturalized throughout the tropics. Vegetation on the site is generally low in species richness and plant cover because of the dominance of Ipil-Ipil as dense tree cover in almost all sections in the area. However, in terms of understorey species, the area is covered with many colonizers and invasive species such as shrubs, creeping leguminous vines and herbaceous plants from the family Fabaceae, Asteraceae, Verbenaceae, Urticaceae and Poaceae (**Plate 2-1**). Many of these species are early colonizers which begin soil stabilization. Seed production is typically high as the majority of these species are dispersed by prolific seeds, rhizomes or stolons. Though undocumented, seed dispersal is primarily by wind and soil transport (piling and stacking due to earthwork activities).

In terms of ground cover, majority of the species are represented by the family of Asteraceae such as *Tridax procumbens*, *Mikania cordata*, *Chromolaena odorata* and some individuals of *Wedelia trilobata*. Other leguminous ground cover species include *Caesalpinia latisiliquum, Mimosa pudica, Centrosema pubescens* and *Mucuna pruriens.* Ground cover is dense in open areas especially in areas where soil are piled due to excavation and left undisturbed for a long period of time.



Note: (a) Plot 5 with dominant species *Euphorbia atoto* and *Mimosa pudica* for ground cover; (b) Vegetation near the entrance of the site; (c) Dense vegetation of *C. odorata*; (d) *Ricinus communis* shrub species along roadside; (e) Dominant trees of Anabiong (*T. orientalis*) in P4; (f) Talahib (*Sacharrum spontaenum*) dominated (P6); (g) Dense stand of young saplings of Ipil-Ipil (*L. leucocephala*); (h) *Musa sp.* dominated plot 3 in the upper section of the site.

Plate 2-1. Dense Vegetation Inside the Proposed Project Site

A total of 71 morpho-species from 64 genera belonging to 31 families were recorded from the ten (10) sampling plots (including the opportunistic sampling) surveyed. The study area was dominated by Fabaceae, Malvaceae, Cannabaceae, Asteraceae, Burseraceae, Lamiaceae and Euphorbiaceae. The most frequently occurring species were *Leucaena leucocephala*, *Macaranga tanarius*, *Melanolepis multiglandulosa*, *Gmelina arborea*, *Garuga floribunda* and *Trema orientalis*. The aforementioned species were present in all transects except for the *Sterculia ceramica* R.Br. from the family Malvaceae and Molave (*Vitex parviflora* Juss) of the family Lamiaceae.

Plate 2-2 Photos of the Proposed Project Site Showing the Dense Stands of Ipil-Ipil, Anabiong and Binunga Tree and Grass Patches.

The dominance of pioneer tree species in the area is due to the degradation and exposure of the environment to extreme sunlight. These triggers opportunistic and light demanding species to grow faster than neighboring plant species. The high presence of these pioneer species is a bit unexpected but can be explained by the high environmental heterogeneity of the site compared in other sections of the study area in early successional stages. Some individual trees of Gmelina (*G. arborea*) sprouts from mature trunks, while strong disturbances (like clearing and site preparation) allow light demanding pioneer species to recruit and establish, thus increasing the number of species as observed in the area. With ongoing succession, some of the original vegetation remnants are disappearing, in part due to environmental stress and to losing out in light competition with early succession species, which causes a decline in species diversity. At the same time, the light demanding pioneer species are already establishing cover in disturbed sections of the study area.

Other plant and tree species documented in the area are closed from young to mature stage and been able to regenerate quickly after disturbance, by maximizing the coexistence of fast growing pioneers and more competitive ground cover species. However, the disturbance intensity of site preparation in relation to habitat fragmentation and loss use may be too high for fast regeneration dynamics. The re-establishment of the vegetation species is a slow process, which demands longer time periods.

The construction of the proposed Project will not cause more biodiversity losses as these have already been developed.
However, unavoidable impacts on the surrounding flora and fauna due to dust generation will be expected during preconstruction and construction phase of the proposed Project. Dust will be generated as delivery vehicles transport the construction materials into the site. The dust will cover the leaves of vegetation and may stress the plants thus, affecting the photosynthetic activity of the plants.

In order to minimize the generation of dust during construction phase, delivery trucks carrying loose materials such as sand and gravel as well as filling materials will be covered. The speed of vehicles shall be reduced and watering of road network during dry periods shall be undertaken.

IASCL is also committed to establish a buffer zone to reduce air pollution that may be emitted within the Project site. In line with the National Greening Program of DENR and to partially offset carbon emission, IASCL shall carry out a reforestation program in coordination with the LGUs. Additionally, native species shall be used for revegetation, as these would be expected to have good survival rate.

2.1.4.2 Threat to Existence and/or Loss of Important Local Species

Only five (5) Philippine endemic plant species were found in the proposed Project site (**Table 2-5**). Eighty four percent (84%) of the total number of species are indigenous to the Philippines and exhibit different economic and ecological importance. These species are represented by different general plant forms such as trees, vines, herbs and shrubs.

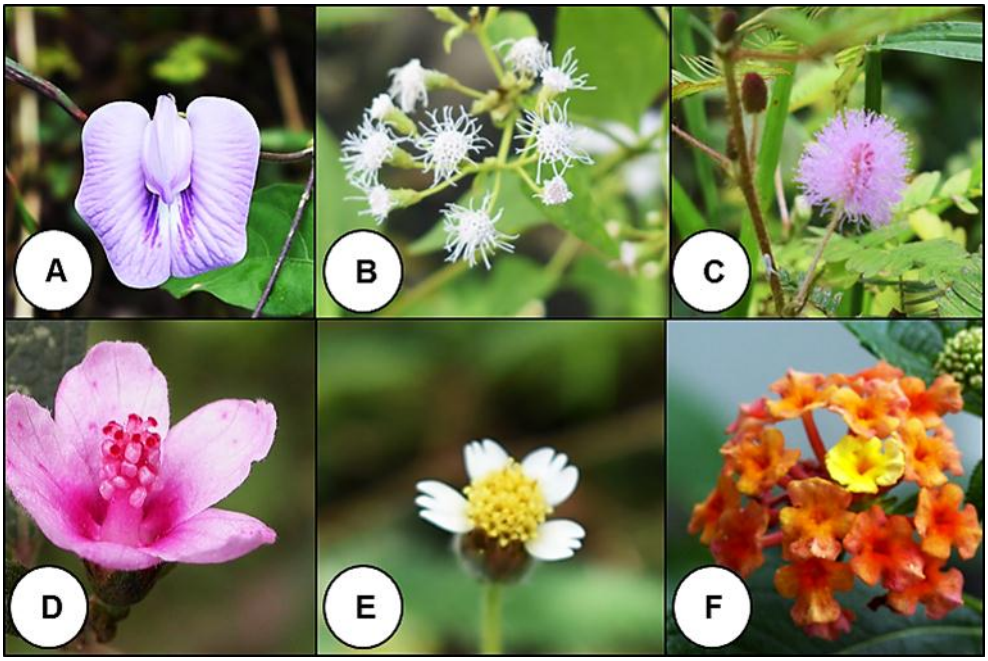
There were 12 exotic/alien invasive species that were observed in the proposed Project site. These species have negative effects in terms of maintaining local biodiversity in the area as they can grow invidually in clump or as dense thickets, crowding out more desirable species. Coronitas (*L. camara*) and Gonoi (*C. odorata*) have allelopathic qualities that can reduce vigor of nearby plant species and reduce their productivity (GISD, 2006). **Plate 2-3** presents the photos of some exotic species observed in the proposed Project site.

Table 2-5. List of Flora Species and Endemicity

Family Name	Species	Local Name	Endemicity/ Indigenous/ Exotic
1. ANACARDIACEAE	1. *Buchanania arborescens* (Blume) Blume	Balinghasai	Indigenous
	2. **Mangifera indica* L.	Mangga	Exotic
	3. *Semecarpus cuneiformis* Blanco	Ligas	Indigenous
2. APOCYNACEAE	4. *Voacanga globosa* (Blanco) Merr.	Bayag Usa	Indigenous
3. ARACEAE	5. *Rhapidophora pinnata* (L.) Schott	Tibatib	Indigenous
	6. *Xanthosoma violaceum* Schott	Yautia	Indigenous
4. ARECACEAE	7. *Caryota rumphiana* Mart. var. *philippinensis* Becc.	Takipan	Indigenous/ Endemic
	8. *Cocos nucifera L.*	Niyog	
5. ASTERACEAE	9. **Chromolaena odorata* (L.) R.M. King & H. Rob.	Gonoi/ Hagonoy	Exotic
	10. *Mikania cordata* (Burm. f.) B.L. Rob.	Uoko	
	11. *Tridax procumbens*		
6. BURSERACEAE	12. *Canarium ovatum* Engl.	Pili	Indigenous/ Endemic
	13. *Garuga floribunda* Decne	Bogo	Indigenous
7. CANNABACEAE	14. *Trema orientalis* (L.) Blume	Anabiong	Indigenous
8. CARICACEAE	15. *Carica papaya*	Papaya	

Family Name	Species	Local Name	Endemicity/ Indigenous/ Exotic
9. CONVOLVULACEAE	16. *Merremia vitifolia* (Burm. f.) Hall. f.	Kalalaknit	Indigenous
10. CORNACEAE	17. *Alangium javanicum* (Blume) Wangerin	Putian	Indigenous
11. CUCURBITACEAE	18. *Momordica sp.*	Ampalayang ligaw	
12. DIOSCOREACEAE	19. *Dioscorea sp.*		
13. EUPHORBIACEAE	20. *Melanolepis multiglandulosa* (Reinw. Ex Blume) Reichb. f. & Zoll.	Alim	Indigenous
	21. *Euphorbia atoto* G. Forst.	Lamingo	Indigenous
	22. *Euphorbia heterophylla* (L.)	Pintado	Indigenous
	23. *Euphorbia hirta*	Tawa-Tawa	
	24. *Macaranga tanarius* (L.) Muell.-Arg.	Binunga	Indigenous
	25. *Ricinus communis*	Tangan-tangan	Indigenous
	26. *Mallotus philippensis* (Lamk) Muell.-Arg.	Banato	Indigenous
14. FABACEAE	27. *Alysicarpus sp.*		
	28. *Caesalpinia latisiliquum* (Cav.) Hattink	Kamot-kabag	Indigenous
	29. *Caesalpinia nuga* (L.) Ait.	Sapinit	Indigenous
	30. * *Centrosema pubescens* Benth.	Dilang butiki	Exotic
	31. **Gliricidia sepium* (Jacq.) Kunth ex Walp	Kakaute	Exotic
	32. **Mimosa pudica* L.	Makahiya	Exotic
	33. *Mucuna pruriens* (L.) DC	Anipay	Indigenous
	34. *Leucaena leucocephala* (Lam.) de Wit	Ipil-Ipil	Indigenous
	35. **Samanea saman* (Jacq.) Merr.	Rain tree	Exotic
15. FLAGELLARIACEAE	36. *Flagellaria indica L.*	Baling-uai	Indigenous
16. LAMIACEAE	37. *Callicarpa formosana* Rolfe	Tambabasi	Indigenous
	38. **Gmelina arborea* Roxb.	Gmelina	Exotic
	39. *Vitex parviflora* Juss.	Molave	Indigenous
17. LAURACEAE	40. *Litsea glutinosa* (Lour.)C.B. Rob.	Sablot	Indigenous
	41. **Persea gratissima Gaertn.*	Avocado	Exotic
18. LOMARIOPSIDACEAE	42. *Nephrolepis biserrata* (Sw.) Schott	Pakong Kalabaw	Indigenous
19. MALVACEAE	43. *Abutilon theophrasti Medik.*		
	44. *Hibiscus spp.*		
	45. *Pterospermum diversifolium* Blume	Bayok	Indigenous
	46. *Sterculia ceramica* R.Br.	Malakalumpang	Indigenous
	47. *Triumfetta rhombiodea* Jacq.	Kulot-kulotan	
	48. *Urena lobata* L.	Kulot-Kulot	
20. MELIACEAE	49. *Dysoxylum gaudichaudianum* (A. Juss.) Miq.	Igyo	Indigenous
	50. *Sandoricum koetjape* (Burm. f.) Merr.	Santol	Indigenous
21. MORACEAE	51. *Artocarpus blancoi* (Elmer) Merr.	Antipolo	Indigenous/ Endemic
	52. *Ficus ampelas* Burm. f.	Upling gubat	Indigenous

Family Name	Species	Local Name	Endemicity/ Indigenous/ Exotic
	53. *Ficus pseudopalma* Blanco	Niyog-Niyogan	Indigenous/ Endemic
	54. *Ficus septica* Burm. f.	Hauili	Indigenous
	55. *Ficus variegata* Blume	Tangisang-bayawak	Indigenous
	56. *Ficus subcordata* Blume	Marabotum	Indigenous
22. MUNTIGIACEAE	57. * *Muntigia calabura L.*	Datiles	Exotic
23. MUSACEAE	58. *Musa acuminata* Colla	Saging matsing	Indigenous
24. MYRTACEAE	59. *Psidium guajava L*	Guava	Exotic
25. PASSIFLORACEAE	60. *Passiflora foetida L.*	Karunggut	Exotic
26. PHYLLANTACEAE	61. *Breynia vitis-idaea*	Matanghipon	Indigenous
	62. *Phyllanthus debilis* Klein ex Willd	Sampa-sampalukan	Indigenous
27. POACEAE	63. *Bambusa vulgaris* Schrad.	Kawayan kiling	Indigenous
	64. *Imperata cylindrica (L.) Beauv.*	Cogon	
28. RUBIACEAE	65. *Morinda citrifolia* L.	Bangkoro	Indigenous
29. RUTACEAE	66. *Micromelum minutum* (J.G. Forster) Wight & Arn	Tulibas tilos	Indigenous
30. SOLANACEAE	67. *Solanum torvum Sw.*	Talong-talungan	
31. URTICACEAE	68. *Pipturus arborescens* (Link) C.B. Rob.	Dalunot	Indigenous
32. VERBENACEAE	69. *Lantana camara L.*	Coronitas	Exotic
	70. *Stachytarpeta jamaicensis*	Kandilaan	
33. VITACEAE	71. *Leea philippinensis* Merr.	Kaliantan	Indigenous/ Endemic



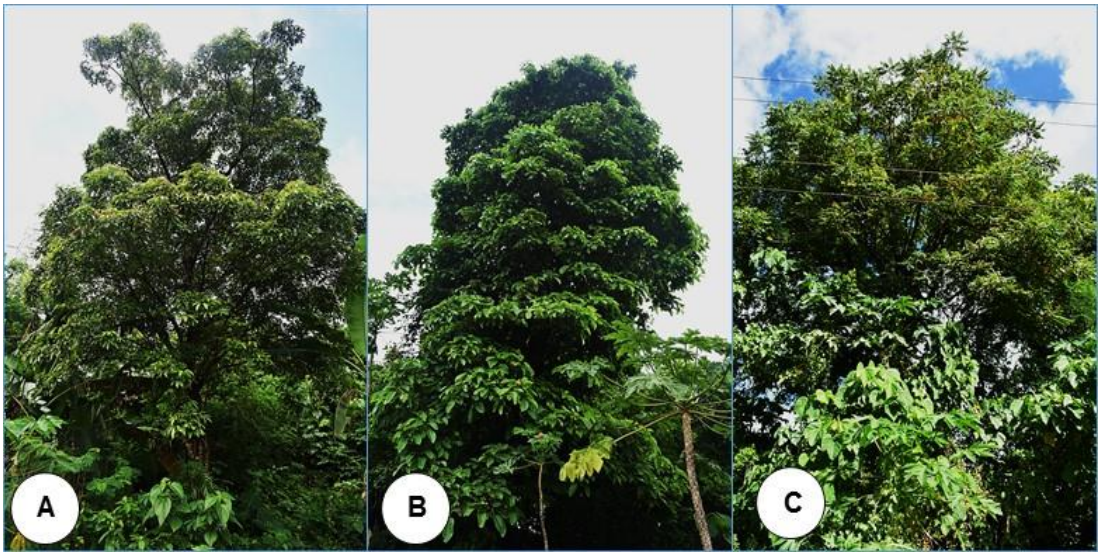
Note: a) Dilang butiki (*Centrosema pubescens* Benth); (b) Hagonoy (*Chromolaena odorata* (L.) R.M. King & H. Rob.); (c) Makahiya (*Mimosa pudica* L.); (d) Kulot-Kulot (*Urena lobata* L.); (e) *Tridax procumbens*; (f) Coronitas (*Lantana camara* L.)

Plate 2-3. Photographs of Some Exotic Species at the Proposed Project Site

Among the species recorded at the proposed Project site, Molave is the only species listed as Endangered Species (**EN**) under IUCN Red List of Threatened Species (IUCN 2015-3) and as Vulnerable Species (**VU**) under DAO 2007-01, The National List of Threatened Philippine Plants and their Categories.

2.1.4.3 Threat to Abundance, Frequency and Distribution of Important Species

A total of 23 tree species with 178 individuals were recorded to have a dbh of more than 10 cm (**Plate 2-4**). The average number of trees per quadrat (20m x 20m) is about six (6) individuals or an average density of 0.015 tree/m^2 (1 tree for every 100 m^2). This is very low than the normal average stocking density of a second growth vegetation which is .05 tree/m^2 (5 tree for every 100m^2). The lower tree density of the quadrats can be attributed to the disturbance and land use of the area. Most sections surveyed are in the early advanced stage of vegetation succession characterized by the dominance of medium-sized trees. The trees with the largest diameter are Rain tree (*Samanea saman*), Molave (*Vitex parvilfora*), Gmelina (*Gmelina arborea*), Bogo (*Garuga floribunda)*, Alim (*Melanolepis multiglandulosa*), Ipil-Ipil (*Leucaena leucocephala*), Binunga (*Macaranga tanarius*), and Anabiong (*Trema orientalis*).



Note: (a) Molave (*Vitex parviflora* Juss) LAMIACEAE; (b) Malakalumpang (*Sterculia ceramica* R.Br.) MALVACEAE; (c) Bogo (*Garuga floribunda* Decne) BURSERACEAE

Plate 2-4. Some of the Notable and Important Tree Species Recorded at the Study Area

The average diameter size of all tree species with greater than 10 cm is 17.06 cm which indicates that the area is in the early stage of vegetation succession. These trees are located along constructed roads and within the dense vegetation inside the study area. Some trees were observed to be coppicing such as Gmelina (*Gmelina arborea*) and Datiles (*Muntigia calabura*) as a result of partial cutting due to road construction and other site preparation activities.

The relative density, relative dominance and relative frequency values for each tree species in all the quadrats were determined to obtain their Importance Value (IV), a standard measure in ecology that determines the rank relationships of species. High Importance values of species indicate a composite score for high relative species dominance, density and frequency. Based on the computed IV (Table 2), the three most important species (with the highest IV) are Bogo (52.312), Gmelina (20.136), and Molave (18.509). It is interesting to note that one of the tree species such as Molave is listed as threatened species yet it is one of the dominating native tree species in the project site. This imply a conservation value of the tree species as well as other notable tree species in the study area.

Table 2-6. Top 10 Species with the Highest Importance Value

Scientific Name	Common Name	Family Name	IV
Garuga floribunda Decne	Bogo	BURSERACEAE	52.312
Gmelina arborea Roxb.	Gmelina	LAMIACEAE	20.136
Vitex parviflora Juss.	Molave	LAMIACEAE	18.509
Trema orientalis (L.) Blume	Anabiong	CANNABACEAE	11.322
Melanolepis multiglandulosa (Reinw. Ex Blume) Reichb. f. & Zoll.	Alim	EUPHORBIACEAE	7.959
Leucaena leucocephala (Lam.) de Wit	Ipil-Ipil	FABACEAE	7.214
Macaranga tanarius (L.) Muell.-Arg.	Binunga	EUPHORBIACEAE	6.049
Samanea saman (Jacq.) Merr.	Rain tree	FABACEAE	6.000
Artocarpus blancoi (Elmer) Merr.	Antipolo	MORACEAE	5.176
Muntigia calabura L.	Datiles	MUNTINGIACEAE	5.121

**Note: RF – Relative frequency; RDen – Relative density; RDom – Relative dominance
* IV – Importance Value

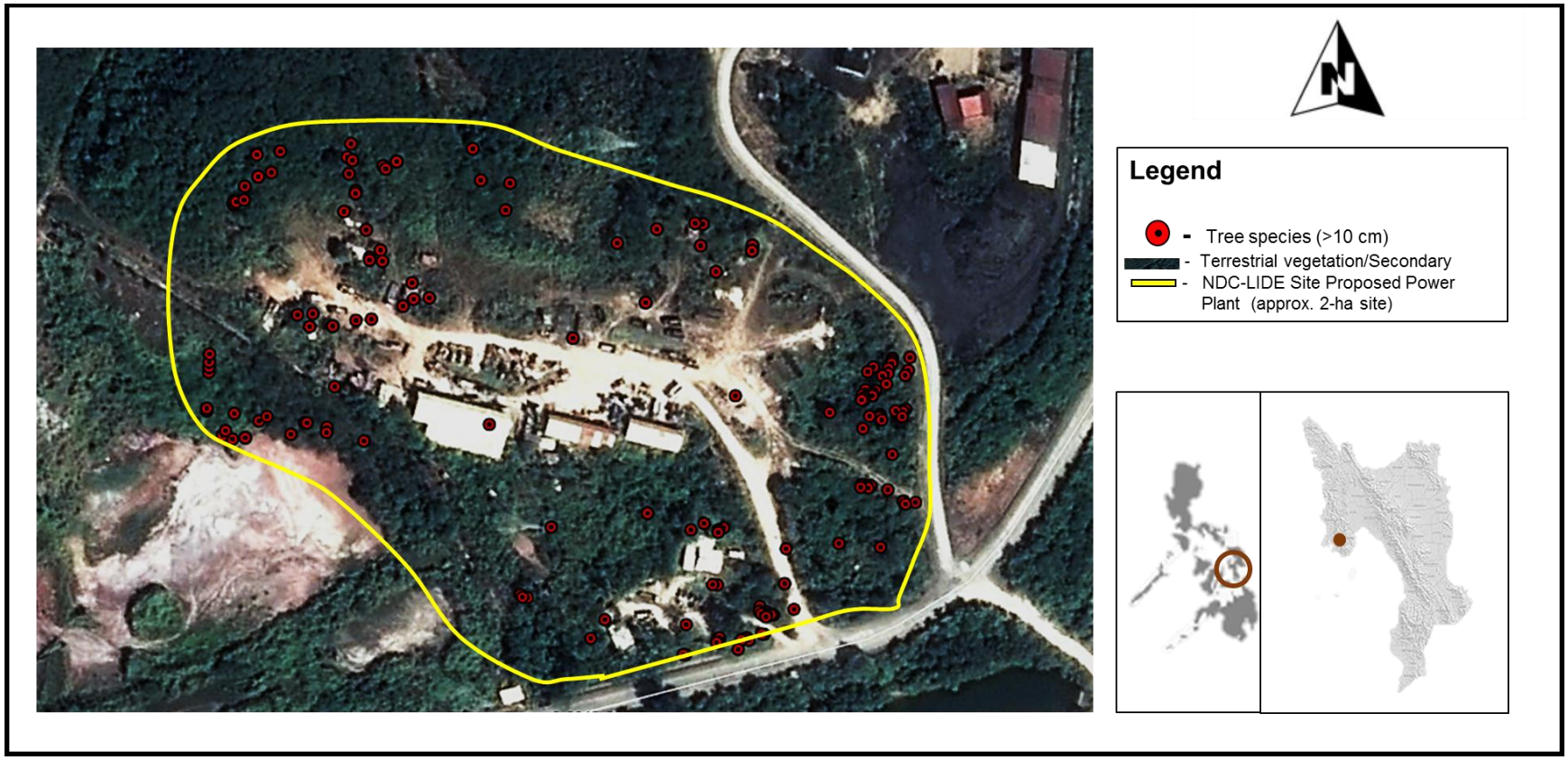


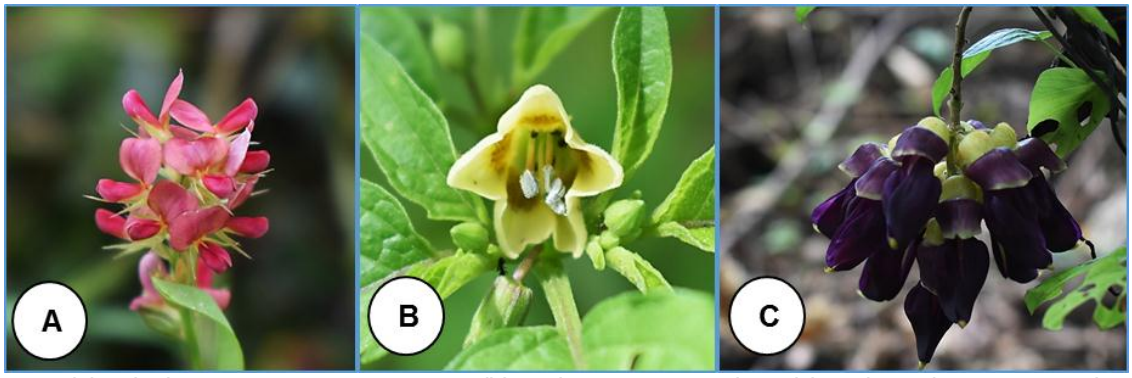
Figure 2-21. Map of the geo-tagged trees with dbh > 10 cm in the proposed Project

A total of 542 individuals belonging to 34 species were recorded for intermediate and understorey species. The average density is slightly higher than that of trees, at 0.72 individual/m^2 or equivalent to 72 individuals for every 100m^2. The two most abundant understorey species are Ipil-Ipil (*L. leucocephala*) with 41 individuals and Binunga (*Macaranga tanarius*) with 34. Both species are native species which confirm attention for conservation of trees in the area for ecosystem services. Table 3 shows the top understorey species in terms of abundance.

Table 2-7. Top 10 most abundant understorey species

Scientific Name	Common Name	Family Name	Total Count
Leucaena leucocephala (Lam.) de Wit	Ipil-Ipil	FABACEAE	41
Macaranga tanarius (L.) Muell.-Arg.	Binunga	EUPHORBIACEAE	34
Pipturus arborescens (Link) C.B. Rob.	Dalunot	URTICACEAE	22
Lantana camara L.	Coronitas	VERBENACEAE	14
Gmelina arborea Roxb.	Gmelina	LAMIACEAE	13
Melanolepis multiglandulosa (Reinw. Ex Blume) Reichb. f. & Zoll.	Alim	EUPHORBIACEAE	13
Litsea glutinosa (Lour.)C.B. Rob.	Sablot	LAURACEAE	11
Muntigia calabura L.	Datiles	MUNTIGIACEAE	11
Semecarpus cuneiformis Blanco	Ligas	ANACARDIACEAE	11
Breynia vitis-idaea	Matang-hipon	PHYLLANTACEAE	10

There are 10 ground cover species recorded from the thirty 1m x 1m quadrats. It must be noted that the ground cover species referred in this survey are all species (crawling or erect) inside the 1m x 1m quadrat with height of less than 1 meter. Hence, seedlings of different tree species are included as ground cover. This treatment gives us better understanding of the stand structure of the vegetation from the ground to the canopy. Based on the survey, forest litter occupies less than 32% of the vegetation floor leaving more growing spaces for the ground cover species, hence, low species diversity. The most dominant species that occupy the highest relative cover are Dilang butiki (*Centrosema pubescens*) (24.12%), Hagonoi (*Chromolaena odorata*) (23.25%), *Alysicarpus sp*.(23.22%) , Kamot-kabag (*Caesalpinia latisiliquum*) (23.21%), Ipil-Ipil (*Leucaena leucocephala*) (15.47%), and Lamingo (*Euphorbia atoto*) (4.86%).



Note: (a) *Alysicarpus sp.,* FABACEAE; (b) Solanaceae species; (c) Anipay (*Mucuna pruriens*) FABACEAE, with flowers in bloom.

Plate 2-5. Other notable ground cover species present in the area with few individuals.

All ground cover species were identified into species level except for 1 species of Fabaceae which is identified to genus level (*Alysicarpus sp*.). Ground cover species are dominated with the families of Fabaceae, Verbenaceae, Poaceae and Asteraceae. These families are typical for ground cover plants that inhabit certain open spaces and degraded conditions. They are most favorable and can survive in dry areas. Dilang butiki (*Centrosema pubescens* Benth.), Hagonoy (*Chromolaena odorata*

(L.) R.M. King & H. Rob.) and Kamot kabag (*Caesalpinia latisiliquum* (Cav.) Hattink) are some of the dominant ground cover species in the project site. They are present in the whole study area especially in exposed soils along road sides and grass covered area.

Table 2-8. Top 10 most dominant ground cover species.

Scientific Name	Common Name	Family Name	Relative % Cover
Centrosema pubescens Benth.	Dilang butiki	FABACEAE	24.12
Chromolaena odorata (L.) R.M. King & H. Rob.	Hagonoy/ Gonoi	ASTERACEAE	23.25
Alysicarpus sp.		FABACEAE	23.22
Caesalpinia latisiliquum (Cav.) Hattink	Kamot-kabag	FABACEAE	23.21
Leucaena leucocephala (Lam.) de Wit	Ipil-Ipil	FABACEAE	15.47
Euphorbia atoto G. Forst.	Lamingo	EUPHORBIACEAE	14.86
Tridax procumbens		ASTERACEAE	13.65
Lantana camara L.	Coronitas	VERBENACEAE	3.65
Imperata cylindrica (L.) Beauv.	Cogon	POACEAE	3.34
Mucuna pruriens	Anipay	FABACEAE	2.73

The diversity index of the area ranged from low to moderately low, while evenness indices varied from very low to low. Diversity indices were highest in the understorey and herbaceous layer. The vegetation in some of the sampling plots plots (P2, P3, P5) is considered as young secondary growth/early succession/pioneer vegetation where trees are not that dominant, which provides a more favorable environment for the growth of the intermediate and understorey layers including opportunistic species. Evenness index was low in the tree layer.

Table 2-9 shows the species diversity per plot established in the whole project area which suggest introduction, disturbance and invasion. Consequently, the number of species per plot recorded in the survey coincide with the general trend that the disturbed areas are dominated with more understorey and ground cover species which are mostly opportunistic and light tolerant species.

Table 2-9. Species diversity, dominant families and abundance per sampling plot

Sampling Plot	Number of Species (S)	Number of Individuals (N)	Dominant Plant Families
P1	9	64	Asteraceae, Fabaceae, Verbenaceae, Lamiaceae, Malvaceae, Euphorbiaceae, Meliaceae, Moraceae, Cannabaceae
P2	9	66	Poaceae, Fabaceae, Verbenaceae, Lamiaceae, Malvaceae, Euphorbiaceae, Meliaceae, Moraceae, Cannabaceae
P3	7	82	Moraceae, Verbenaceae, Lamiaceae, Euphorbiaceae, Muntigiaceae, Asteraceae, Cannabaceae
P4	8	56	Fabaceae, Verbenaceae, Lamiaceae, Malvaceae, Euphorbiaceae, Meliaceae, Arecaceae, Poaceae, Asteraceae
P5	10	72	Euphorbiaceae, Asteraceae, Fabaceae, Verbenaceae, Lamiaceae, Malvaceae, Burseraceae, Cannabaceae, Arecaceae
*P6	7	55	Euphorbiaceae, Muntigiaceae, Moraceae, Fabaceae, Lamiaceae, Araceae, Musaceae, Asteraceae, Cannabaceae

Sampling Plot	Number of Species (S)	Number of Individuals (N)	Dominant Plant Families
*P7	7	56	Euphorbiaceae, Muntigiaceae, Moraceae, Lamiaceae, Araceae, Musaceae, Asteraceae, Cannabaceae
*P8	3	61	Muntigiaceae, Moraceae, Fabaceae, Lamiaceae, Araceae, Musaceae, Asteraceae, Cannabaceae, Euphorbiaceae
*P9	2	57	Fabaceae, Moraceae, Verbenaceae, Lamiaceae, Euphorbiaceae, Muntigiaceae, Asteraceae, Cannabaceae
*P10	9	59	Fabaceae, Poaceae, Cannabaceae, Euphorbiaceae and Lamiaceae
Total	**71**	**628**	

*** Inner and Outer areas of the project site*

Based on the diversity classification range developed by Fernando *et al*. (1996), most of the sampling plots has low diversity (**Table 2-10**). The low diversity for a 20m x 20m quadrat is expected in any disturbed environment or vegetation per se due to disruption of the biological as well as physical environment such as exposed soils, extreme heat and land use conversion. Sampling plot 1, 2, 3 and 4 are considered to be low in diversity. Transect plot 5 obtained the highest value (0.579) while plot 8 and 9 with a single species got the lowest Shannon index of zero (0). The number of species present in each quadrat was primarily the reason for very low/low value of Shannon index.

Ten (10) species were recorded in plot 5 and only three (3) species was recorded in plot 8. Similarly, plot 9 had the lowest value of Simpson index. Transect plot 8 and 9, a dense vegetation of Ipil-ipil and Datiles along with other plant and tree species composed of *M. multiglandulosa* obtained the second lowest value of Shannon and Simpson index. Plot 5 obtained the highest value of Simpson index instead of plot 1. The over dominance of *M. tanarius* and *L. leucocephala* in plot 2 and 1 lowered its Simpson index. In terms of Evenness index, plot 5 had the highest value of 1.00 understandably because it contains a relatively more species.

Table 2-10. Diversity indices and number of species and individuals for each plot

Sampling Plot No.	No. of species	No. of Individuals	Diversity Indices		
			H'	D'	J'
1	9	64	0.323	0.680	0.890
2	9	66	0.304	0.130	0.432
3	7	82	0.197	0.670	0.645
4	8	56	0.344	0.671	0.832
5	10	72	0.579	0.010	1.001
6	7	55	0.196	0.361	0.543
7	7	56	0.159	0.456	0.623
8	3	61	0.091	0.332	0.734
9	2	57	0.128	0.609	0.532
10	9	59	0.120	0.504	0.322

Note: H' – *Shannon index*; D = *Simpson's index*; J – *Evenness index*
Diversity Index: vh – very high (3.50 above), h – high (3.00 – 3.49), m – moderate (2.50 – 2.99), l – low (2.00 – 2.49), vl – very low (1.99 – below); Evenness Index: vh – very high (0.75 – 1.00), h – high (0.50 – 0.74), m – moderate (0.25 – 0.49), l – low (0.15 – 0.24), vl – very low (0.05 – 0.14).

The dense vegetation of *L. leucocephala* in general are represented by young saplings in the area. Such species has a diameter of less than 5 cm and with height of 3-4 meters which can be regarded as young stands. Figure 14 shows the dense young vegetation of Ipi-Ipil (*Leucaena leucocephala*).

Plate 2-6. Dense vegetation of young Ipil-Ipil (*L. leucocephala*) stands in the upper section of the project site all throughout going to the nursery

Based on the computed IV (**Table 2-11**), the three most important species (with the highest IV) are Bogo (*Garuga floribunda*), Anabiong (*Trema orientalis*), and Gmelina (*Gmelina arborea*). *G. floribunda* obtained more than 30% of the total importance values for all the species. It is number one in all the 3 values – relative frequency, relative density, and relative dominance.

Table 2-11. Importance value of plant and tree species surveyed in the whole project area.

Species	RF	RD	RDom	IV
Garuga floribunda Decne	11.966	18.980	30.881	61.827
Trema orientalis (L.) Blume	7.692	12.606	17.307	37.606
Gmelina arborea Roxb.	8.547	7.365	12.897	28.809
Vitex parviflora Juss.	8.547	9.632	6.081	24.259
Leucaena leucocephala (Lam.) de Wit	6.838	6.374	11.037	24.249
Melanolepis multiglandulosa (Reinw. Ex Blume) Reichb. f. & Zoll.	9.402	6.374	5.770	21.545
Artocarpus blancoi (Elmer) Merr.	6.838	5.949	7.211	19.998
Muntigia calabura L.	8.547	5.099	0.780	14.427
Chromolaena odorata (L.) R.M. King & H. Rob.	2.564	6.374	4.350	13.288
Pipturus arborescens (Link) C.B. Rob.	5.128	4.533	0.982	10.643
Centrosema pubescens Benth.	4.274	3.966	0.817	9.056
Caesalpinia latisiliquum (Cav.) Hattink	4.274	2.550	0.323	7.146
Imperata cylindrica (L.) Beauv.	0.855	0.142	0.001	0.997

Note: RF – Relative frequency, RD – Relative density, RDom – Relative dominance

2.1.4.4 Hindrance to Wildlife Access

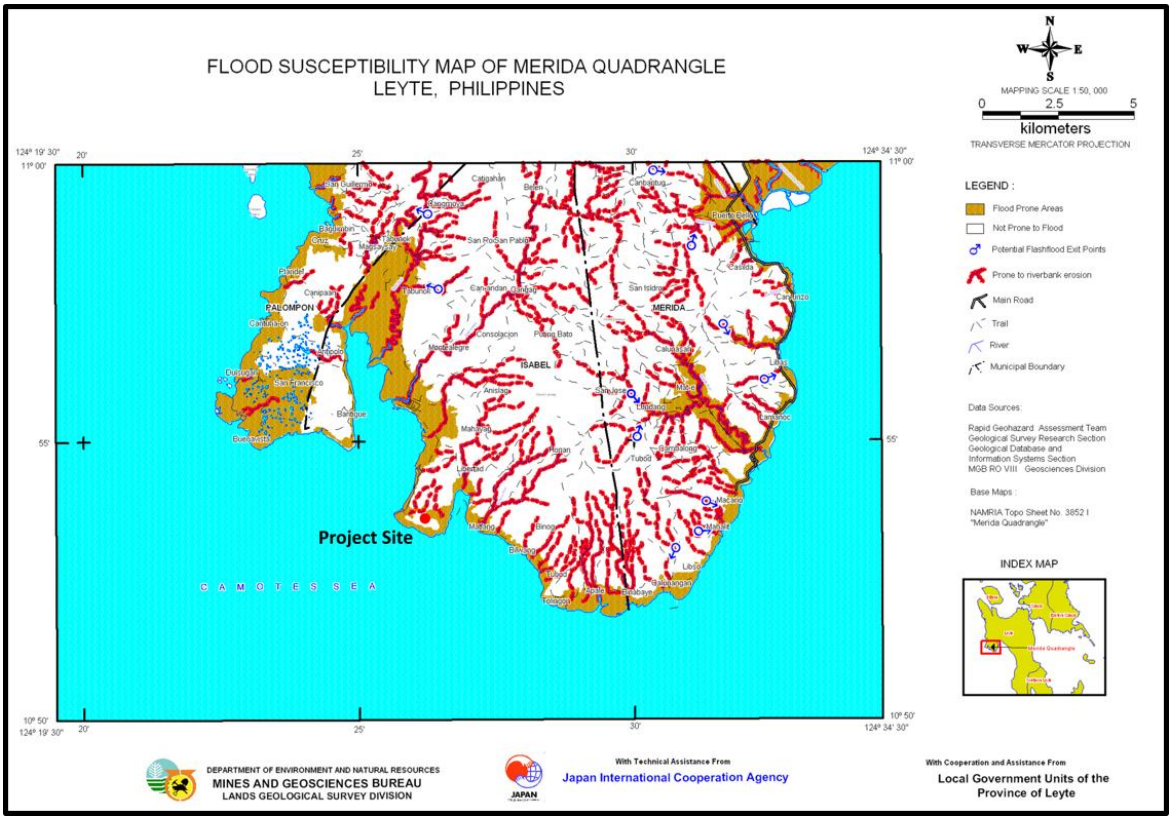
There are no significant wildlife habitats or endangered species within the project site, except for some common domestic animals. The only natural habitat that could be considered significant to fauna is the brush land at the back of the study area.

2.2 WATER

2.2.1 Hydrology/Hydrogeology

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

The Project Area is elevated and there are no rivers and creeks within its vicinity. Rainwater runoff from the proposed Project site drain into the sea. Thus, the project will not cause or contribute to flooding to neighboring areas. Moreover, the Flood Susceptibilty Map of MGB shows that the project site is not prone to flooding (**Figure 2-22**).



Source: MGB

Figure 2-22. Flood Susceptibilty Map of the Merida Quadrangle

2.2.1.2 Change in Stream/Lake/Water Depth

The Project Area is elevated and there are no streams and lakes within its vicinity.

2.2.1.3 Depletion of Water Resources/Competition in Water Use

Based on the 1997 Groundwater Availability Map of the Philippines presented in **Figure 2-23**, the area where the proposed Project is to be located fall under the classification “Fairly to Less Extensive and Productive Aquifers with Low to Moderate Potential Recharge”.

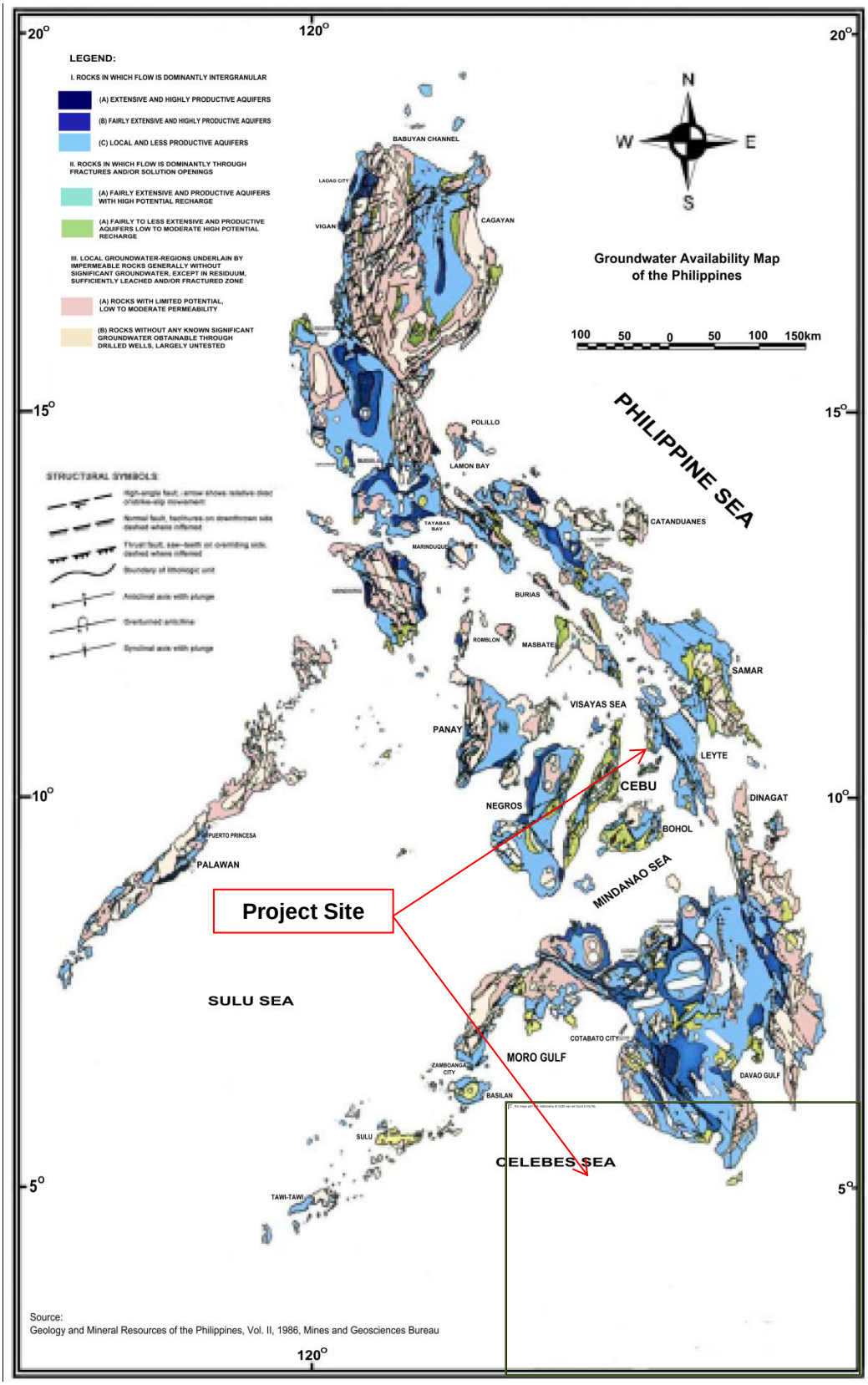


Figure 2-23. Groundwater Availability Map of the Philippines

There will be no extraction of groundwater at the proposed Project site. The water requirement for the proposed Project will be sourced from the LMC Pumping Station located in Barangay Salvacion, Ormoc City. The facility consists of eight (8) deep well pumps with a capacity of 5,600m^3/day per pump. There are two (2) back-up pumping stations at Tabunok and Matlang with a capavity of 4,300 m^3/day and 3,700 m^3/day, respectively. These pumping stations are reserved sources in case the Ormoc pumping station is not operational. LIDE has a 15,000m^3 storage tank capacity which is kept full for emergency purposes. IASCL shall implement necessary measures to conserve water and reduce water usage.

2.2.2 Water Quality

2.2.2.1 Degradation of Coastal/Marine Water Quality

LIDE is bounded by the Dupon Bay at the west and Matlang Bay at the east. These two (2) bays form a peninsula with the Camotes Sea. Based on the DENR Memorandum Circular dated January 2013, the surrounding body of water has been reclassified from Class SD to Class SC.

The marine water quality at the LIDE was described using the monitoring data from EMB-Region 8. The EMB-Region 8 monitored the marine water quality at ten (10) sampling stations presented in **Figure 2-24**.

Station	Coordinates	
	Latitude	Longitude
MW1	10°55'21.00"N	124°25'52.00"E
MW2	10°55'16.00"N	124°26'5.00"E
MW 3	10°54'35.00"N	124°26'2.00"E
MW 4	10°54'1.00"N	124°25'52.00"E
MW 5	10°54'4.00"N	124°25'52.00"E
MW 6	10°53'11.00"N	124°26'4.00"E
MW 7	10°53'18.00"N	124°26'46.00"E
MW 8	10°53'42.00"N	124°26'58.00"E
MW 9	10°53'8.00"N	124°27'27.00"E
MW 10	10°52'55.00"N	124°27'52.00"E

Note: MW – Marine Water
Source: Google Earth modified by Geosphere, 2016

Figure 2-24. Marine Water Quality Monitoring Stations

The results of the analyses of marine water samples were described with reference to the standards for Class SC Waters set in DAO No. 2016-08. **Tables 2-12** to **2-17** show that the levels of Temperature, pH, and Dissoved Oxygen (**DO**) recorded in all sampling stations fall within the DENR Standards for Class SC Waters. The levels of Arsenic, Cadmium, Chromium Hexavalent, Copper, Lead and Mercury in all sampling stations also fall within the DENR Standard except for the level of Arsenic in Station MW6. The levels of Total Suspended Substance (**TSS**) in all sampling sampling stations monitored in May and June 2017 are all within the DENR Standard except in Station MW1 during June 2017. Only Stations MW4, MW5 and MW6 have the levels of Fecal Coliform that are below the DENR Standard for the whole monitoring period.

Due to the distance of the project site to the sea, the proposed Project is not expected to cause adverse impact the marine water.

Table 2-12. Results of Temperature Monitoring by EMB Region 8 for Marine Water Quality

Station	Temperature (°C)						
	February	March	April	May	June	August	September
MW1	28.67	28.08	26.95	31.10	31.2	31.0	30.3
MW2	28.75	27.47	27.14	30.80	31.4	31.1	30.5
MW3	28.86	27.23	26.48	30.40	31.2	30.8	30.5
MW4	28.62	27.48	27.05	30.50	31.3	30.5	30.5
MW5	29.67	27.47	28.17	31.00	31.5	31.4	30.5
MW6	33.37	27.52	27.43	31.0	32.4	30.7	30.6
MW7	28.30	27.81	28.54	31.40	31.7	30.7	30.9
MW8	27.14	27.79	27.49	31.60	30.8	30.7	31.1
MW9	28.33	27.79	27.25	30.70	31.1	30.9	30.8
MW10	28.08	27.73	26.96	31.30	30.6	31.1	30.7
DENR Standard (Class SC)	**25-31**						

Source: EMB Region 8

Table 2-13. Results of pH Monitoring by EMB Region 8 for Marine Water Quality

Station	pH						
	February	March	April	May	June	August	September
MW1	7.66	8.26	7.96	8.03	8.09	8.25	8.26
MW2	7.67	8.12	7.99	8.03	8.09	8.30	8.26
MW3	7.69	8.13	7.86	8.05	8.09	8.33	8.34
MW4	7.70	8.25	7.98	8.05	8.10	8.34	8.33
MW5	7.72	8.26	8.01	8.05	8.09	8.36	8.38
MW6	7.68	8.26	8.02	8.05	8.05	8.37	8.39
MW7	7.72	8.16	7.00	8.06	7.59	7.76	8.38
MW8	7.23	8.18	7.82	8.04	8.02	7.89	8.34
MW9	7.58	8.16	7.89	8.04	8.06	8.27	8.37
MW10	7.71	8.12	7.98	7.98	8.02	8.35	8.39
DENR Standard (Class SC)	**6.5-8.5**						

Source: EMB Region 8

Table 2-14. Results of DO Monitoring by EMB Region 8 for Marine Water Quality

Station	DO (mg/L)						
	February	March	April	May	June	August	September
MW1	9.10	7.82	11.22	10.32	9.49	5.07	5.8
MW2	11.87	7.72	10.58	8.65	9.3	5.88	5.55
MW3	12.04	8.43	9.48	8.29	8.93	6.4	5.76
MW4	10.26	7.08	9.01	9.05	9.08	8.34	5.73
MW5	6.56	7.85	10.33	8.87	9.65	5.73	5.94
MW6	6.34	6.34	9.55	8.65	8.73	6.28	5.47
MW7	9.30	7.49	8.11	9.24	7.96	5.5	5.54
MW8	6.32	9.17	7.89	8.92	8.5	5.63	5.29
MW9	5.18	8.58	8.01	8.84	8.17	5.85	5.87
MW10	5.22	8.96	8.18	10.81	8.14	5.97	5.45
DENR Standard (Class SC)	**5**						

Source: EMB Region 8

Table 2-15. Results of TSS Monitoring by EMB Region 8 for Marine Water Quality

Station	TSS (mg/L)						
	February	March	April	May	June	August	September
MW1	70	121	14	32	86	106	92
MW2	83	102	113	10	23	104	111
MW3	99	91	17	35	37	104	119
MW4	104	95	41	60	21	107	118
MW5	82	97	103	45	48	140	124
MW6	88	95	121	33	47	130	140
MW7	109	103	118	46	54	137	143
MW8	81	94	95	51	57	136	136
MW9	67	148	90	37	52	132	153
MW10	127	113	106	44	32	137	134
DENR Standards (Class SC)	**80**						

Source: EMB Region 8

Table 2-16. Results of Fecal Coliform Monitoring by EMB Region 8 for Marine Water Quality

Station	Fecal Coliform (mg/L)						
	February	March	April	May	June	August	September
MW1	2600	130	4900	39	2	17	4900
MW2	1300	9.3	330	39	<1.8	1.8	70
MW3	<1.8	130	790	27	<1.8	<1.8	7.8
MW4	7	4.5	49	32	<1.8	<1.8	2
MW5	4.5	<1.8	<1.8	39	<1.8	<1.8	1.8
MW6	23	<1.8	70	34	<1.8	<1.8	1.8
MW7	490	2	790	33	330	460	2100
MW8	7900	7.8	1300	39	7900	1700	2
MW9	79	2	7900	70	490	3100	330
MW10	1100	2	1100	46	7900	7.8	4
DENR Standard (Class SC)	**200**						

Source: EMB Region 8

Table 2-17. Results of Heavy Metals Monitoring by EMB Region 8 for Marine Water Quality

Station	First Semester 2017					
	Arsenic	Cadmium	Chromium Hexavalent	Copper	Lead	Mercury
MW1	0.0013	<0.002	<0.01	<0.01	<0.01	<0.0001
MW2	0.0019	<0.002	<0.01	<0.01	<0.01	<0.0001
MW3	0.0017	<0.002	<0.01	<0.01	<0.01	<0.0001
MW4	0.0027	<0.002	<0.01	<0.01	<0.01	<0.0001
MW5	0.0197	<0.002	<0.01	<0.01	<0.01	<0.0001
MW6	0.0221	<0.002	<0.01	<0.01	<0.01	<0.0001
MW7	<0.0001	<0.002	<0.01	<0.01	<0.01	<0.0001
MW8	<0.0001	<0.002	<0.01	<0.01	<0.01	<0.0001
MW9	0.0005	<0.002	<0.01	<0.01	<0.01	<0.0001
MW10	<0.0001	<0.002	<0.01	<0.01	<0.01	<0.0001
DENR Standards (Class SC)	**0.02**	**0.005**	**0.05**	**-**	**0.05**	**0.002**

Source: EMB Region 8

2.2.3 Marine Ecology

The marine ecology near the vicinity of the proposed Project was described using the data from PASAR Corporation. The marine ecology survey was conducted by PASAR Corporation through the Visayas State University Marine Biologist on August 17 and 24, 2013. The survey was conducted at four (4) monitoring stations established within the vicinity of PARAR Corporation, as described in **Table 2-18** and **Figure 2-25**.

Table 2-18. Monitoring Stations of PASAR Corporation for Marine Ecology Survey

Station	Description	Coordinates	
		Latitude	Longitude
Station 1	Fronting the mangroves along the Old Filipino-Japanese Bunkhouse	10°53.22'N	124°26.428'E
Station 2	Near the outfall of Settling Pond	10°53.19'N	124°26.182'E
Station 3	Inside the Fish Sanctuary	10°53.41'N	124°25.259'E
Station 4	Near the Sludge Out-Loading Facility	10°53.57'N	124°25.693'E

Source: EPRMP, PASAR Corporation

Figure 2-25. Marine Ecology Monitoring Stations of PASAR Corporation

2.2.3.1 Seagrass/Seaweeds

There were no seagrasses nor seaweeds found in the four (4) monitoring stations. During the survey, the substrate were observed to be sandy-rocky which were heavily covered with silts. The silts made the water coulumn very turbid that could inhibit the growth of the macro-flora and macro-algae. Associated marine invertebrates were also rarely found in the sites being surveyed.

2.2.3.2 Coral Reefs

The different lifeforms of microbenthic organisms, inclusive of corals and abiotic substrate components encountered along the transect line, were identified and their corresponding transition cover was recorded (**Table 2-19**). The percent cover of the different lifeforms and substrate were computed for the quantitative description of the community structure of the reef.

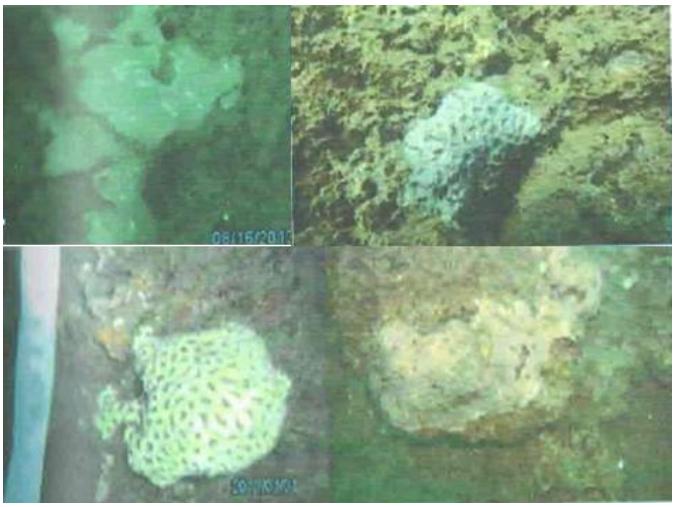
The coral reef was dominantly rock (72%) and sand (21%). Presence of dead corals (6%) indicate that live corals in the area was once growing. Live coral cover comprise 0.73% which indicate poor

coral reef condition. Most of the living corals were juveniles (10cm) which indicate poor the potential restoration of corals.

Table 2-19. Percent Cover of Corals and Other Resources in the Reefs

Station	Dead Coral	Live Coral	Sand	Rock	Mud
Station 1	350	70	1,730	2,850	-
Station 2	415	28	995	2,760	-
Station 3	-	-	110	4,090	20
Station 4	-	-	40	10	-
Total	**765**	**98**	**2,875**	**9,710**	**20**
% Cover	**5.68**	**0.73**	**21.35**	**72.10**	**0.15**

Source: EPRMP, PASAR Corporation



Source: EPRMP, PASAR Corporation

Plate 2-7. Juveniles (10cm) of Massive (Porites) and Encrusting Growth Forms

2.2.3.3 Fisheries

A total of 15 fish species belonging to eight families were found in which Labridae and Pomacentridae were the most abundant. Ninety-seven percent (97%) of all the species found in the area were non-target species (*i.e.,* not commercially important). The target species recorded include *Scolopsis ciliatus, Epinephelus* sp., and *Gymnothorax thyrsoideus.* Based on the study, PASAR coastal waters has an estimated average of 865 fishes per hectare. **Table 2-20** present the fish species found in the vicinity of the Pasar marine waters.

Table 2-20. Fish Species Found in the Vicinity of the PASAR Marine Waters

Family	Species	Local Name	Station			
			1	2	3	4
Apogonidae	*Apogon sp. 1*	moong	4	0	0	0
	Apogon sp. 2	moong	20	0	0	0
Blenniidae	*Blenniidae sp. 1*	-	0	1	0	0
Labridae	*Halichoeres pictus*	labayan	5	8	0	0
	Halichoeres sp.	labayan	4	26	2	0
	Labridae sp. 1	labayan	0	1	3	0
	Labroides dimidiatus	labayan	1	2	3	0

Family	Species	Local Name	Station			
			1	2	3	4
	Thalassoma lunare	labayan	6	12	18	0
Muraenidae	Gymnothorax thyrsoideus	ubod	0	0	1	0
Nemipteridae	Scolopsis ciliates	silay	0	2	0	0
Pinguipedidae	Parapercis clathrate	-	0	1	0	0
Labridae	Halichoeres pictus	labayan	5	8	0	0
Labridae	Halichoeres sp.*	labayan	4	26	2	0
Labridae	Labridae sp. 1	labayan	0	1	3	0
Labridae	Labroides dimidiatus*	labayan	1	2	3	0
Labridae	Thasalloma lunare*	labayan	6	12	18	0
Muraenidae	Gymnothorax thyrsoideus	ubod	0	0	1	0
Nemipteridae	Scolopsis ciliates	ubod	0	0	1	0
Pinguipedidae	Parapercis clathrata	-	0	1	0	0
Pomacentridae	Abudadefduf saxitilis*	pata	1	6	2	0
Pomacentridae	Chrysiptera parasema	“pata”	0	4	2	0
Pomacentridae	Neoglyphidodon oxyodon*	“pata”	20	10	6	0
Serranidae	Epinephelus sp.	“lapu-lapu”	0	0	2	0
Total Counts			**61**	**73**	**39**	**0**
Total No. of Species			**8**	**11**	**9**	**0**

Source: EPRMP, PASAR Corporation

Of the eight families, Labridae and Pomacentridae were the most abundant. Species from these families also dominated in each sampling station. Five (5) species occurred in all stations (i.e., Stations 1 to 3): *Thasalloma lunare, Halichoeres sp., Labroides dimidiatus* (Labridae)*; Abudefduf saxitilis and Neoglyphidodon oxyodon* (Pomacentridae). There were no fish found in the SOF area. Ninety-seven (97%) of all the species found in the area were non-target species (i.e., not commercially important). Target species found were *Scolopsis ciliatus*, *Epinephelus sp., and Gymnothorax thyrsoideus*. From the present study, there is an estimated average of 865 fishes-ha (fish per hectare) in the PASAR coastal waters is presented in **Table 2-21.**

Table 2-21. Estimated fish abundance in the PASAR Coastal Area

Family	Station 1	Station 2	Station 3	Station 4	Average
Apogonidae	480	0	0	0	120
Blennidae	0	20	0	0	5
Labridae	320	980	520	0	455
Muraenidae	0	0	20	0	5
Nemipteridae	0	40	0	0	10
Pinguipedidae	0	20	0	0	5
Serranidae	0	0	40	0	10
Total	**1220**	**1460**	**780**	**0**	**865**

Note: values are in fish per hectare
Source: EPRMP, PASAR Corporation

Twenty (20) major taxa of meiofauna were identified at the four sampling stations. Most of the meiofauna were found in Station 2. Foramonifera had the highest mean density among the meiofaunal groups. It is known to tolerate a wide range of unfavorable conditions, and its sensitivity are useful indicators of environmental changes. Nematodes, copepods, and ostracods were also abundant in all stations. These serve also as indicators to environmental stressors based on their density. Generally, the abundance of meiofauna in the coastal area was very low (0-10 individuals per cm^3; safe concentration should be a little more than 100 individuals per cm^3. Their density depends on the nutrient input from the land.

Nitzschia longgisima, a phytoplankton, was abundant in Stations 2, 3, and 4. It is known to produce neurotoxin called domoic acid, a toxin which is responsible for the human illness called amnesic

shellfish poisoning. It is very sensitive to nutrient inputs which cause algal bloom when nutrient input from the land is abundant.
Generally, the coastal area has poor biological resources. However, the presence of juvenile corals indicates that the reef has improved better compared to the last survey (BFAR 2006) wherein no live corals were found. Mangrove and associated organisms are growing well which can be enhanced by reducing the iron granulated slag that settles at the mangrove area and transplanting of mangrove seedlings.

2.2.3.4 Threat to abundance, frequency and distribution

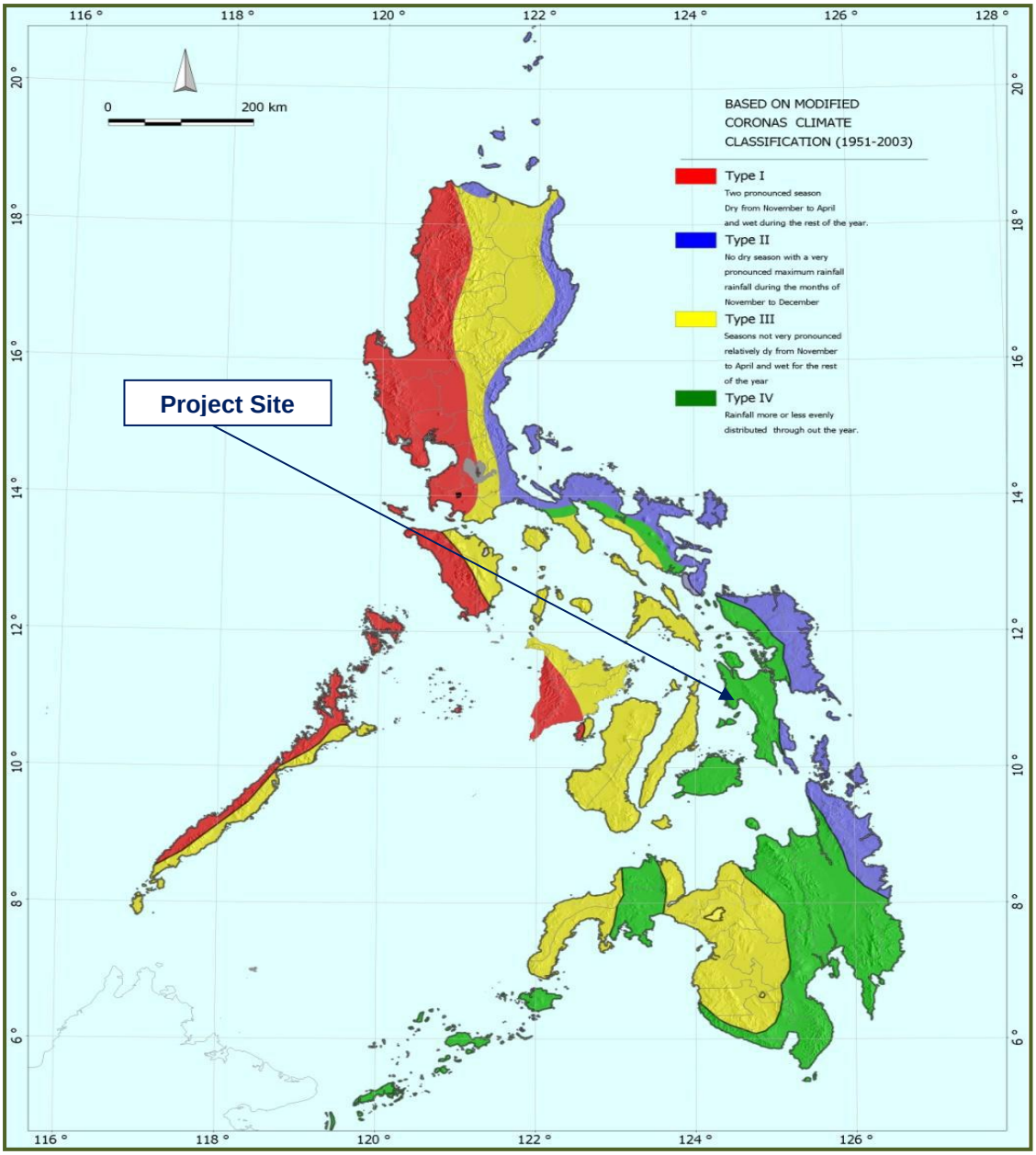
Due to the distance of the project site to the sea and there will be no wastewater discharges into the sea, the proposed IASCL ancillary project is not expected to cause threat to abundance, frequency and distribution of the marine community.

2.3 AIR

2.3.1 Climatology and Meteorology

2.3.1.1 Climate Type

The climate at the proposed Project site falls under Type IV category based on the Modified Coronas Climate Classification of Philippine Climate (**Figure 2-26**). Type IV climate is characterized by having a rainfall of more or less evenly distributed throughout the year.

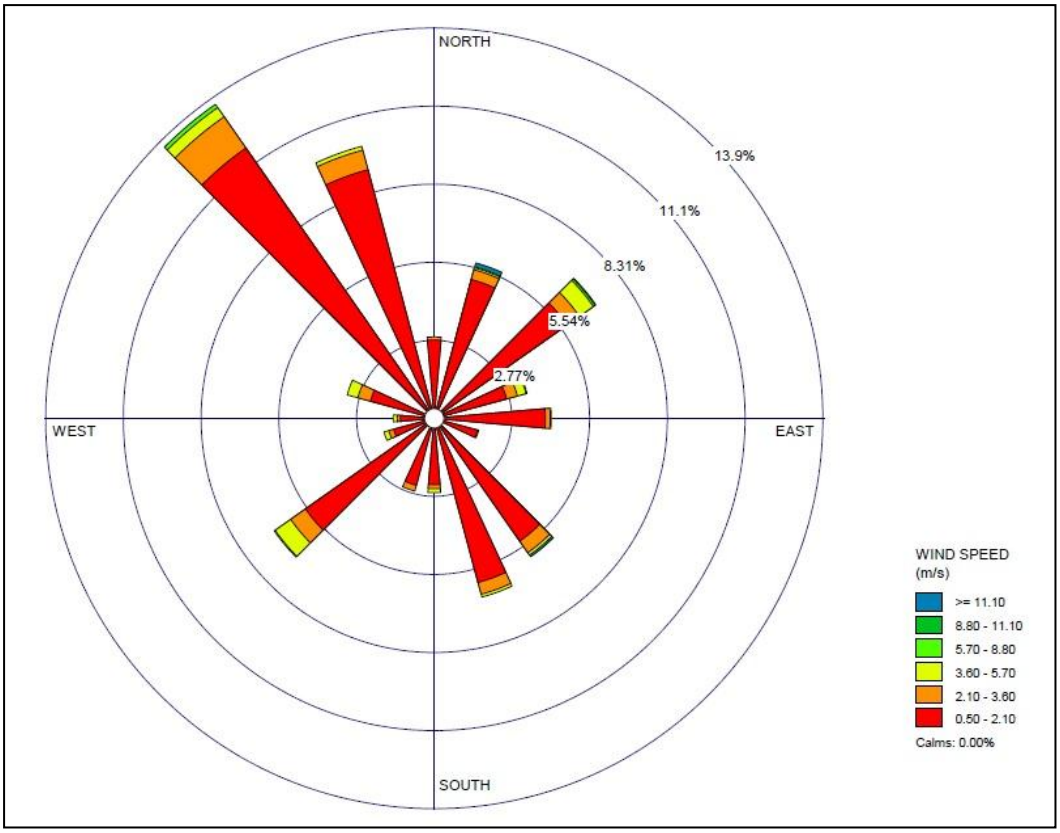


Source: PAGASA, modified by GEOSPHERE 2018

Figure 2-26. The Philippine Climate Map

2.3.1.2 Wind Regime

The nearest meteorological station of the Philippine Atmospheric Geophysical and Astronomical Services Administration (PAGASA) to the proposed Project site is the Tacloban Airport Station. The meteorological data of Tacloban Station from January 1 to December 31, 2012 was plotted and the windrose diagram is shown **Figure 2-27**. Prevailing winds were from northwest which comprised of about 13.5% over the site followed by north-northwest covering 10% over the site. The average wind speed was 1.78 meters per second, few winds exceeded 11.1 meters per second and winds of less than 2.10 meter per second occurred from all directions. Calm conditions were 0.0% of the time. Strongest wind came from north-northeast followed by northeast which occupied about 0.2% of the time.

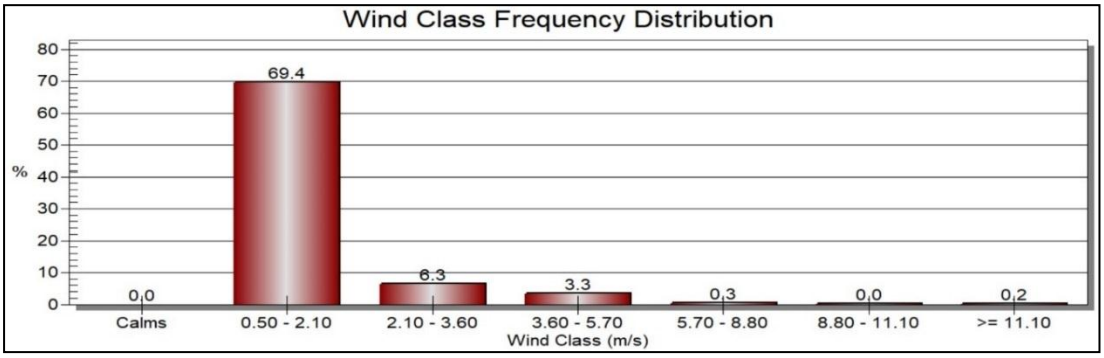


Source: AERMET View Version 9.5.0 Lakes Environmental; weather underground

Figure 2-27. Windrose Diagram for Tacloban Station of PAGASA from January 1 to December 31, 2012

The tropical condition can be attributed to the location of the project which is between 10 to 11 degrees north of equator. The monsoonal condition, on the other hand, refers to two seasonal wind regimes, the northeasterly winds and the southwesterly winds. From September to March the wind blows on a northwesterly direction with an average wind speed of 1.84 meters per second. From April to August the southwesterly winds prevail with an average wind speed of 1.64 meters per second.

Majority of wind speeds in the Project site occupying 69.4% of the total wind is 0.50 to 2.10 mps, as shown in **Figure 2-28**.



Source: AERMET View Version 9.5.0; weather underground

Figure 2-28. Wind Class Frequency Distributions for the Tacloban Station January 1 to December 31, 2012

2.3.1.3 Climatological Normals and Extremes

The annual mean average temperature is 28°C with January being the coldest month having an average temperature of 26.3°C while the month of May is the warmest with an average temperature of 28.8°C (**Table 2-22**).

The highest and lowest temperatures occurred in the months of May and March, respectively. The mean maximum and minimum temperatures range from 28 to 28.8°C and 23.4 to 26.6°C, respectively.

Rainfall ranges from 115.2 to 386 mm, with an annual total of 2,659.3 mm. Least number of rainy days per month occurred in February to April; while the highest number or rainy days per month occurred in December to March.

The mean annual relative humidity recorded at PAGASA Tacloban Station was 85% with seasonal variation (i.e. mean monthly relative humidity range of 82% to 88% based from 1981 - 2010 meteorological data). The months of November to January were the most humid months of the year. 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 vapor possible at a given temperature. When the temperature of the air falls below the dew point, some of the water vapors contained in the air condense, clouds form, and precipitation can result in the form of rain.

Table 2-22. Climatological Normals Recorded at PAGASA Tacloban Station (1981-2010)

Month	Rainfall		Temperature (°C)						RH (%)	No. of Days with	
	Amount (mm)	No. of RD	Max	Min	Mean	Dry Bulb	Wet Bulb	Dew Point		Thunder	Lightning
January	323.9	22	29.2	23.4	26.3	25.7	24	23.4	87	2	1
February	238.4	17	29.9	23.4	26.6	26	24	23.2	85	1	0
March	184.4	17	30.7	23.8	27.3	25.7	24.5	23.7	83	3	1
April	115.2	14	31.8	24.7	28.3	27.9	25.5	24.7	82	7	4
May	144.1	10	32.3	25.3	28.8	28.4	26	25.2	83	15	12
June	184.6	17	32	25.2	28.6	28.1	25.9	25.2	84	16	14
July	186	17	31.6	24.8	28.2	27.7	25.5	24.7	84	17	15
August	160.9	15	32	24.9	28.4	27.9	25.6	24.8	83	15	13
September	173.7	16	31.8	24.7	28.2	27.6	25.5	24.8	84	18	16
October	243.9	20	31.4	24.6	28	27.3	25.4	24.7	86	18	15
November	318.2	22	30.7	24.4	27.5	26.9	25.1	24.5	86	12	8
December	386	23	29.7	23.9	26.8	26.1	24.5	23.9	88	5	3
Annual	**2659.3**	**214**	**31.1**	**24.4**	**27.8**	**27.2**	**25.1**	**24.4**	**85**	**129**	**102**

Source: PAGASA

Climatological extreme values from the 30-year monthly and annual summaries of temperature, rainfall, and wind speed are presented in **Table 2-23**. The recorded annual extreme high temperature was 38.0°C which occurred on April 6, 1924 and August 18, 1924, while the extreme low was 17.5°C which was recorded on December 3, 1904. The amount of annual average extreme greatest rainfall was 325.9 mm which occurred on May 2, 1959 while the annual average extreme highest wind of 62 meters per second southwesterly direction occurred on November 23, 1968.

Table 2-23. Climatological Extreme Recorded at Tacloban Station as of 2016

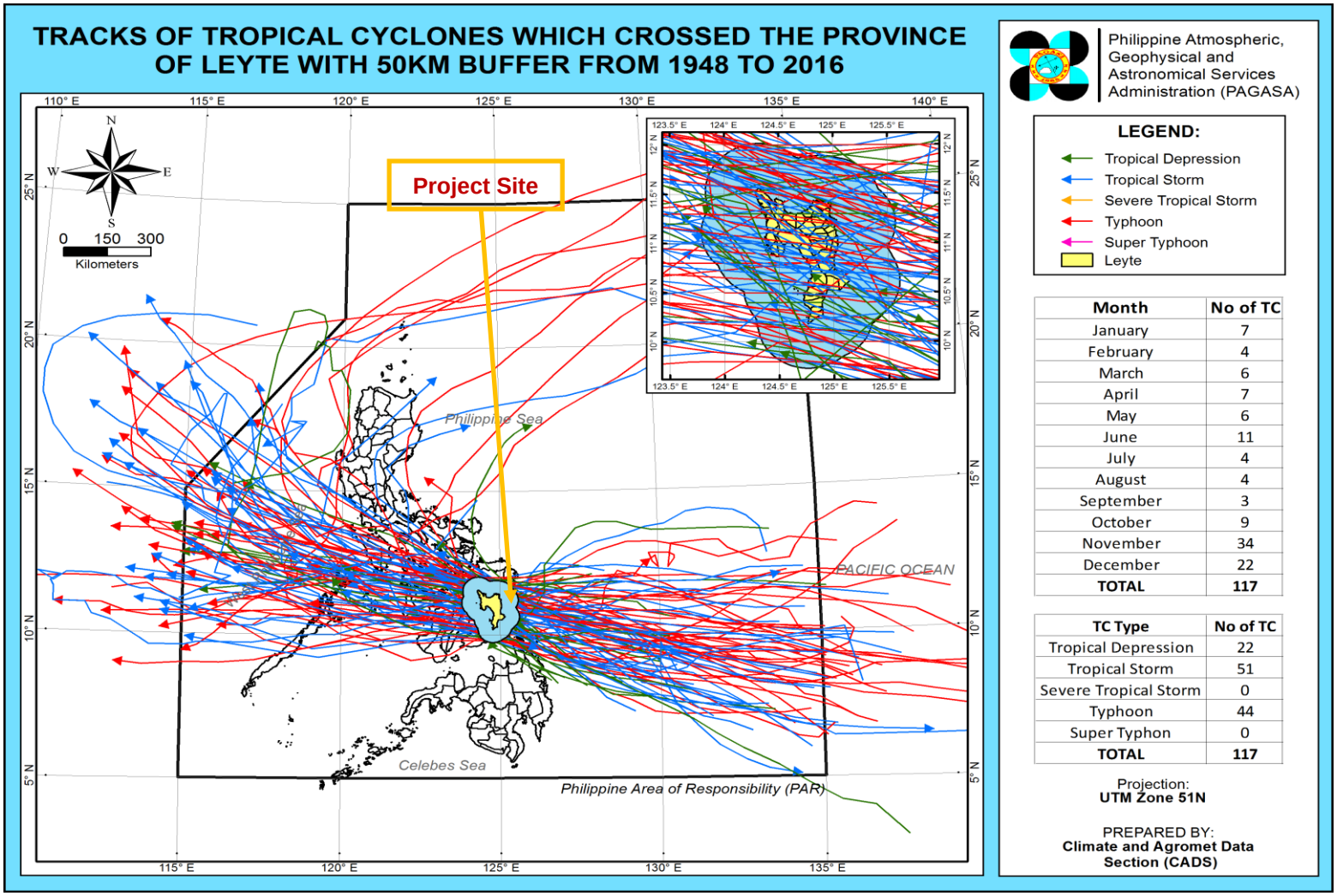
Month	Temperature (°C)				Greatest Daily RF (mm)		Strongest Winds (m/s)		
	High	Date	Low	Date	Amount	Date	Speed	Dir	Date
Jan	34.7	01-28-1924	18.8	01-30-1905	246.7	01-14-1916	29	NNW	01-07-1972
Feb	34.8	02-22-1998	17.6	02-24-1905	160.3	02-17-2001	20	SE	02-18-2001
Mar	35.9	03-31-1924	18.0	03-04-1905	397.4	03-16-2011	27	NW	03-16-2006
Apr	38.0	04-06-1924	20.2	04-23-1911	135.4	04-20-1978	53	NNW	04-15-1979
May	37.9	05-02-1924	20.5	05-01-1985	325.9	05-02-1959	55	SW	05-15-1966
Jun	36.5	06-03-1987	20.9	06-23-1975	244.0	06-02-1923	35	W	06-20-2008
Jul	37.8	07-24-1920	21.0	07-10-1991	244.3	07-14-1913	30	WSW	07-14-1971
Aug	38.0	08-18-1924	20.6	08-01-1920	118.0	08-12-2008	22	WSW	08-08-1968
Sep	37.2	09-10-1924	21.0	09-14-1982	156.4	09-29-1995	20	NNW	09-04-1999
Oct	36.0	10-08-1947	19.8	10-30-1920	167.9	10-23-1988	32	W	10-26-1952
Nov	35.2	11-01-1924	19.4	11-17-1968	206.5	11-11-1928	62	WSW	11-04-1984
Dec	35.0	12-02-1998	17.5	12-03-1904	314.8	12-29-2014	42	ESE	12-21-1994
Annual	**38.0**	**04-06-1924**	**17.5**	**12-03-1904**	**325.9**	**05-02-1959**	**62**	**SW**	**11-23-1968**
	38.0	**08-18-1924**							
Period of Record	**1903-2016**				**1903-2016**		**1951-2016**		

Source: PAGASA Climatological Extremes as of 2016

2.3.1.4 Cyclone Frequency

The most number of tropical cyclones that crossed Leyte is during the months November and December. These tropical cyclones are associated with the occurrence of low pressure areas (**LPA**) normally originating from the North Western Pacific Ocean 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.

From 1948-2016 (period of 68 years) PAGASA determined an annual average of 20 tropical cyclones in the PAR with nine of these passing through the Philippine landmasses. Overall, PAGASA had tracked 117 tropical cyclones that crossed in the province of Leyte as shown in **Figure 2-29**. Moreover, in **Figure 2-30,** the map shows that the project site is under medium typhoon risk.



Month	No of TC
January	7
February	4
March	6
April	7
May	6
June	11
July	4
August	4
September	3
October	9
November	34
December	22
TOTAL	**117**

TC Type	No of TC
Tropical Depression	22
Tropical Storm	51
Severe Tropical Storm	0
Typhoon	44
Super Typhon	0
TOTAL	**117**

Source: PAGASA

Figure 2-29. Tracks of Tropical Cyclones that Crossed the Province of Leyte, 1948-2016

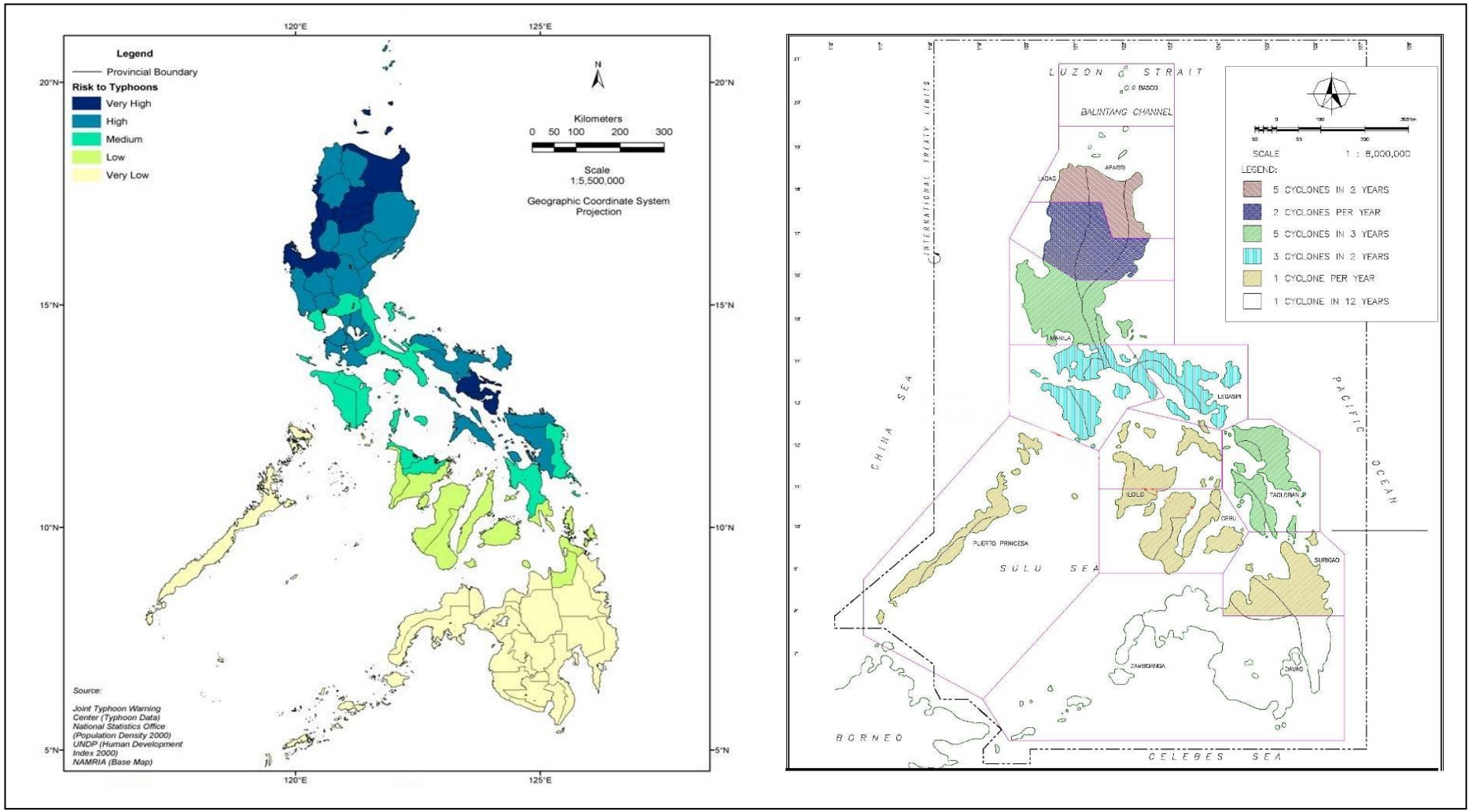


Figure 2-30. Philippine Typhoon Map

2.3.1.5 Change in the Local Micro-Climate

Temperature Change

The historic average annual ambient air temperature of Leyte is 27.8°C. The data indicate that there is little monthly or seasonal variation in the average temperatures. On a daily time-step, temperatures can vary by 5°C to 8°C on the average during a day, peaking above 30s and dropping to the low 20s overnight.

The climate change scenario for the Philippines as published by PAGASA in February 2011 indicates that the province of Leyte will have an increased temperature (**Table 2-24**).

Table 2-24. Seasonal Temperature Increase (in ºC) in 2020 and 2050 under Medium Range Emission Scenario in Leyte

Observed baseline (1971-2000)				Change in 2020 (2006-2035)				Change in 2050 (2036-2065)			
DJF	MAM	JJA	SON	DJF	MAM	JJA	SON	DJF	MAM	JJA	SON
26.4	27.8	28	27.7	0.9	1.2	1.1	1.0	1.8	2.3	2.2	1.9

Source: Climate Change in the Philippines, 2011 PAGASA

The PAGASA projection revealed that the average monthly temperature over the period of 2006–2035 will increase by 0.9°C to 1.2°C while temperatures for the period of 2036-2065 will increase by 1.8°C to 2.3°C**.** The annual average temperature covering the period of 2006-2035 will rise to 29°C while 2036-2065 will rise to 30.1°C. **Table 2-21**, **Figures 2-31** and **2-32** present the projected monthly average temperature with climate change (**T_{ave} CC**) and without climate change (**T_{ave} base**).

Table 2-25. Projected Monthly Average Temperature

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Baseline/Without Climate Change Scenario (1981-2010)												
Max	29.2	29.9	30.7	31.8	32.3	32	31.6	32	31.8	31.4	30.7	29.7
Min	23.4	23.4	23.8	24.7	25.3	25.2	24.8	24.9	24.7	24.6	24.4	23.9
Ave	26.3	26.6	27.3	28.3	28.8	28.6	28.2	28.4	28.2	28	27.5	26.8
With Climate Change Scenario (2006-2035)												
Max	30.1	30.8	31.9	33	33.5	33.1	32.7	33.1	32.8	32.4	31.7	30.6
Min	24.3	24.3	25	25.9	26.5	26.3	25.9	26	25.7	25.6	25.4	24.8
Ave	27.2	27.5	28.5	29.5	30	29.7	29.3	29.5	29.2	29	28.5	27.7
With Climate Change Scenario (2006-2065)												
Max	31	31.7	33	34.1	34.6	34.2	33.8	34.2	33.7	33.3	32.6	31.5
Min	25.2	25.2	26.1	27	27.6	27.4	27	27.1	26.6	26.5	26.3	25.7
Ave	28.1	28.4	29.6	30.6	31.1	30.8	30.4	30.6	30.1	29.9	29.4	28.6

Source: PAGASA
Note: Calculated based on the PAGASA Climate Change in the Philippines, 2011

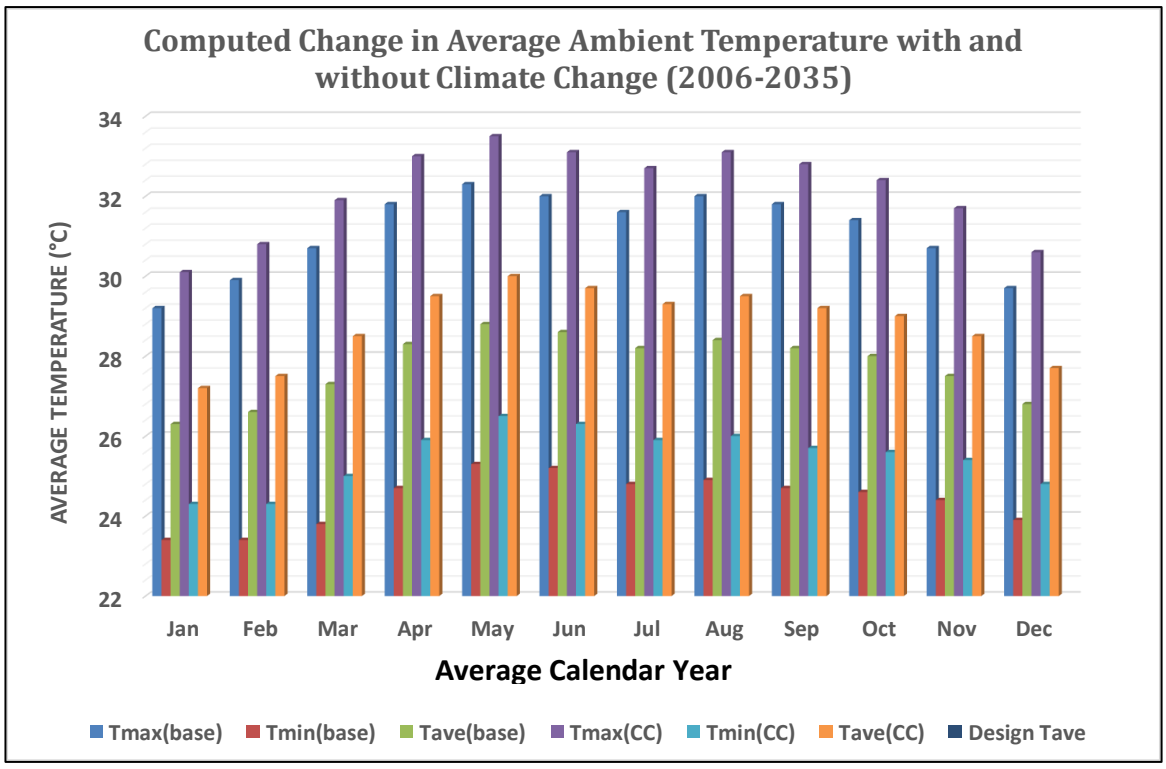


Figure 2-31 Change in Monthly Average Temperature for the Period of 2006-2035

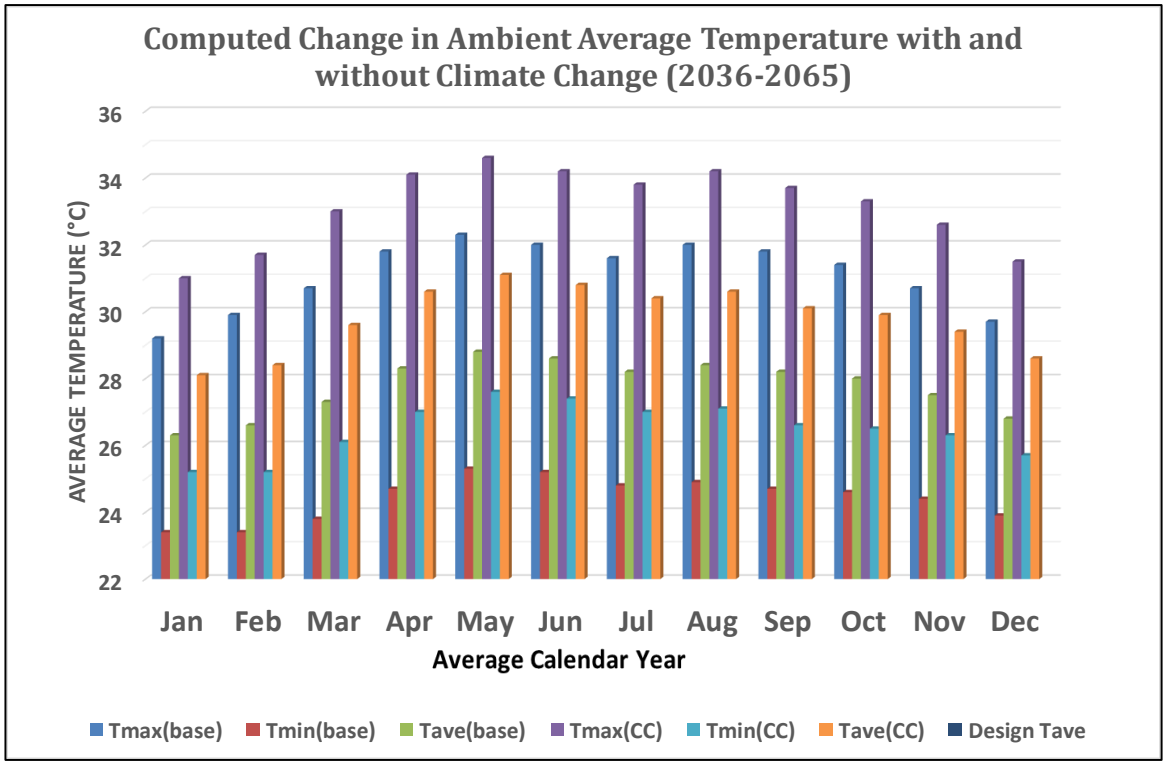


Figure 2-32 Change in Monthly Average Temperature for the Period of 2036-2065

The typical effect of temperature increases in the plant operation is the decrease of power output leading to energy inefficiency. This is because an increase in air temperature reduces air density and the mass flow of air intake to the compressor, and creates a similar reduction in heat transfer efficiency of the air cooling system.

For plant operations, the variability in daily temperatures together with the longer-term monthly averages defines the design air temperature. IASCL considers 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.

Rainfall Change

The historic average annual rainfall of Leyte is 2,659.3 mm. Based from the climate change scenario for the Philippines as published by PAGASA in February 2011, the province of Leyte will have an increased and decreased rainfall in 2020 and 2050 (**Table 2-26**).

Table 2-26. Seasonal Rainfall Change (in %) in 2020 and 2050 under Medium Range Emission Scenario in Leyte

Observed baseline (1971-2000)				Change in 2020 (2006-2035)				Change in 2050 (2036-2065)			
DJF	MAM	JJA	SON	DJF	MAM	JJA	SON	DJF	MAM	JJA	SON
43.4	265.4	1193.5	644.3	3.0	-8.9	9.5	7.4	9.4	-18.9	19.6	19.5

Source: Climate Change in the Philippines, 2011 PAGASA

The PAGASA projection reveal that the average monthly rainfall over the period of 2006–2035 will increase by 3 to 9.5% from July to February and it will decrease by 8.9% between March to May; while the rainfall for the period of 2036-2065 will increase by 9.4 to 19.6% from June to February and will decrease by 18.9% between March to May**.** The annual average rainfall covering the period of 2006-2035 will rise to 23.55 mm in November and will decrease to 16.4mm in March; while the rainfall for the period of 2036-2065 will rise to 36.3mm in December and will decrease to 34.9mm in March. **Table 2-27** and **Figure 2-33** present the projected monthly average rainfall with climate change scenario for 2006-2035; and the monthly average rainfall with climate change scenario for 2036-2065.

Table 2-27. Projected Monthly Average Rainfall

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Baseline/Without Climate Change Scenario (1981-2010)												
Ave	323.9	238.4	184.4	115.2	144.1	184.6	186	160.9	173.7	243.9	318.2	386
With Climate Change Scenario (2006-2035)												
Ave	333.6	245.6	168	104.9	131.3	202.1	203.7	176.2	186.6	261.9	341.7	397.6
With Climate Change Scenario (2036-2065)												
Ave	354.3	260.8	149.5	93.4	116.9	220.8	222.5	192.4	207.6	291.5	380.2	422.3

Source: PAGASA
Note: Calculated based on the PAGASA Climate Change in the Philippines, 2011

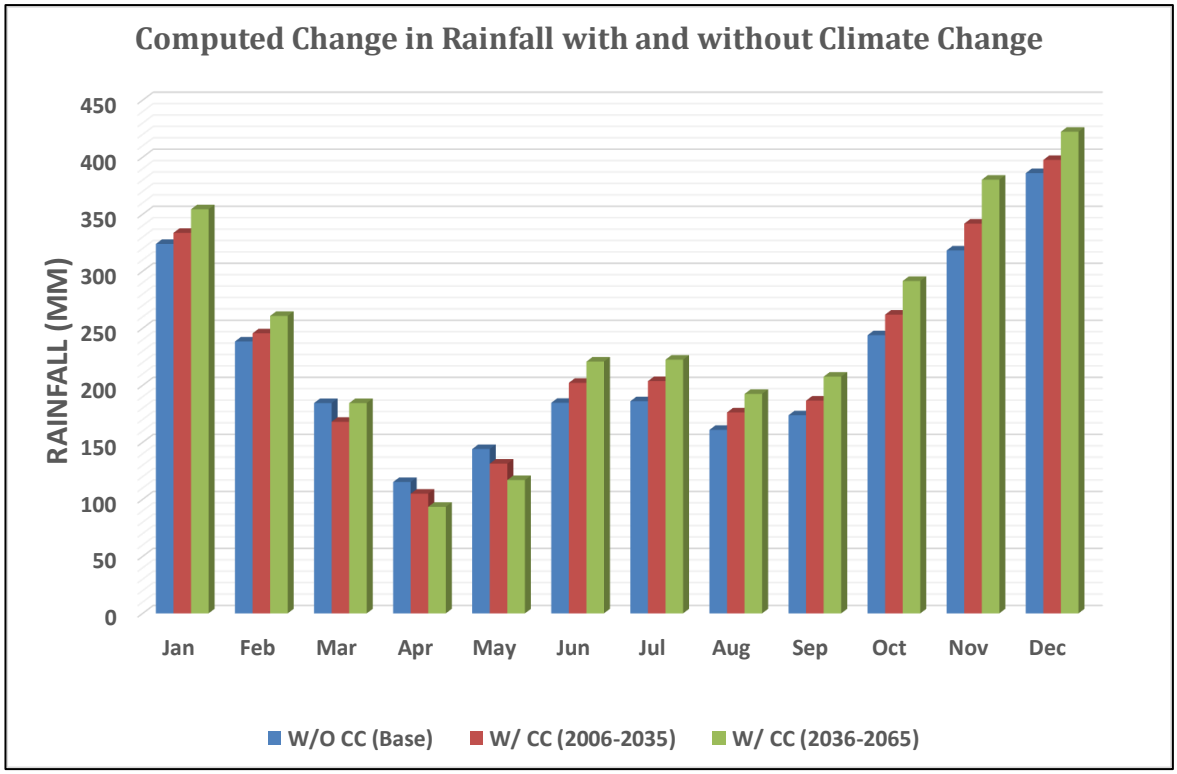


Figure 2-33 Computed Average Rainfall With and Without Climate Change Scenarios

Frequency of Extreme Events

Based from the climate change scenario for the Philippines as published by PAGASA in February 2011, the province of Leyte will have 1,398 days with maximum temperature of >35°C during the 2006-2035 period and 2,495 days during the 2036-2050 period; 5,199 dry days during the 2006-2035 period and 5,475 dry days during the 2036-2050 period; and 10 days with rainfall >200mm during the 2006-2035 period and 15 days during the 2036-2050 period, as presented in **Table 2-28**.

Table 2-28 Frequency of Extreme Events in 2020 and 2050 under Medium Range Emission Scenario in Leyte

No. of Days w/ T_{max} >35ºC			No. of Dry Days			No. of Days w/ Rainfall >200mm		
OBS (1971-2000)	2020	2050	OBS	2020	2050	OBS	2020	2050
52	1398	2495	6874	5199	5475	1	10	15

Note: Based from the Frequency of Extreme Events in 2020 and 2050 under Medium Range Emission Scenario in the province of Leyte
Source: Climate Change in the Philippines, 2011 PAGASA

2.3.1.6 Contribution in Terms of Greenhouse Gas Emissions (or GHG Mitigation Potential)

The Greenhouse Gas (**GHG**) emissions from the proposed Project include carbon dioxide, methane and nitrous oxides. Calculation of these GHG gases employs the Tier 1 Approach of the Intergovernmental Panel on Climate Change (**IPCC**) 2006 Guidelines using the following equation:

Equation 1:

$$\textbf{Emissions}_{GHG,fuel} = \textbf{fuel consumption}_{fuel} \times \textbf{emission factor}_{GHG,fuel}$$

Where:

$Emissions_{GHG,fule}$ = emissions of a given GHG by type of fuel (kg GHG)
$Fuel\ consumption_{fuel}$ = amount of fuel combusted (TJ)
$Emission\ factor_{GHG,fuel}$ = default emission factor of a given GHG by type of fuel (kg gas/TJ). For CO_2, it includes carbon oxidation factor, assumed to be 1.

Table 2-29 shows the summary of the GHG emissions from the Project. The default emission factor of residual oil no. 6 from Table 2.2 of the IPCC 2006 Guidelines is 74,100 kg of CO_2/TJ; 3 kg of CH_4/TJ for methane; and 0.6 kg of N_2O/TJ for nitrous oxides.

Table 2-29. Summary of GHG Emissions of the Proposed Project

Emission Sources	Fuel Consumption (L/hr)	Fuel Heating Value (kcal/kg)	CO_2 Emission (MT/year)	CH_4 Emission (MT/year)	N_2O Emission (MT/year)
Proposed Generator Set Stacks	254	10,755.3	121,679	5	1

The total estimated CO_2 emission from the operation of the furnace based on IPCC 2006 is 121,685 MT/yr. The Philippines Second National Communication (SNC) on Climate Change has projected 100,402,000 MT of CO_2 for 2020. Using the projection of SNC, the Project operation is expected to contribute an approximately 0.12% of the total CO_2 emission. Moreover, AISCL will establish a "green buffer zone" to mitigate some of the potential effects of emissions of its proposed Power Plant Project.

2.3.2 Air Quality and Noise Level

An ambient air quality monitoring programme was conducted in six (6) sampling locations within the project site and vicinity. The collected ambient air and noise data from the established stations will be used to represent the baseline data of the project. Station identification and geographical location are presented in **Table 2-30**, while **Figure 2-34** shows the location of the stations.

The ambient TSP, PM_{10}, SO_2, and NO_2 concentrations were measured at the identified sampling points. The selection of the sampling stations was based on the locations of receptors, source, and prevalent wind direction. Methods for sampling and analysis conformed to the methods prescribed in Sec. 1(b) Rule VII Part II of the Clean Air Act IRR. The resulting ambient air concentrations were compared with the National Ambient Air Quality Guidelines Values (NAAQGV), Rule VII, Part II and the National Ambient Air Quality Standards for Source Specific Air Pollutants (NAAQSSSAP) from Industrial Sources/Operations Section 1 Rule XXVI Part VII of the Clean Air Act IRR.

Table 2-30. Description of Established Sampling Stations for Ambient Air Quality & Noise Level Monitoring for the Proposed Project

Station	Description	Coordinates		Averaging Period
		Easting, m	Northing, m	
STN-1	Inside of the Proposed Project Site, Brgy. Libertad, Isabel	657784.53	1204913.88	24-hour
STN-2	Inside the Clubhouse parking lot of LIDE Staff House, Brgy. Mahayag, Isabel	657523.53	1206277.22	24-hour
STN-3	About 40 meters away from the shore of Kinatumyan Beach, Brgy. San Roque, Isabel	656802.84	1205859.03	1-hour

Station	Description	Coordinates		Averaging Period
		Easting, m	Northing, m	
STN-4	About 26 meters away from PHILPHOS Gate No. 2, Brgy. San Roque, Isabel	656706.03	1205142.71	1-hour
STN-5	Inside the compound of Isabel Roro Port, Brgy. Matlang, Isabel	658517.12	1204868.68	1-hour
STN-6	About 53 meters away from the main gate of LIDE, Brgy. Libertad, Isabel	658530.77	1205824.25	1-hour

Figure 2-34. Established Stations for Ambient Air Quality and Noise Level Monitoring for the Proposed Project

2.3.2.1 Ambient Air Quality

Tables 2-31 and 2-32 present the results of air quality monitoring for 24-hour and hourly averaging periods conducted on November 5-7, 2017 at the Project site and its vicinity located in Isabel Leyte. The results showed that the concentrations of particulates (TSP & PM_{10}), SO_2, and NO_2 for 24-hour averaging period were all below the CAA limit of 230 µg/Ncm for TSP; 150 µg/Ncm for PM_{10}; 150 µg/Ncm for NO_2; and 180 µg/Ncm for SO_2. 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 PM_{10}, 260 µg/Ncm for NO_2, and 340 µg/Ncm for SO_2.

The highest concentration of TSP was 79.42 µg/Ncm recorded at Station 4, while the lowest concentration is 22.26 µg/Ncm recorded at Station 2. For PM_{10}, the highest concentration is 27.56 µg/Ncm recorded at Station 6 while the lowest concentration is 12.25 µg/Ncm recorded at Station 5. The highest concentration of SO_2 is 83.25 µg/Ncm recorded at Station 5 while the lowest concentration is 47.11 µg/Ncm recorded at Station 2. For NO_2, the highest concentration is 1.17 µg/Ncm recorded at Station 6 while the lowest is 0.26 µg/Ncm recorded at Station 2.

Table 2-31. Results of 24-hour Ambient Air Quality Monitoring

Items Sampling Station Date of Sampling Time of Sampling	Description/Values		
	STN-1 Nov. 5-6, 2017 1300H-1300H	STN-2 Nov. 6-7, 2017 1345H-1345H	CAA Limit
TSP, (µg/Ncm)	54.95	22.66	230
PM_{10}, (µg/Ncm)	23.56	13.51	150
SO_2, (µg/Ncm)	47.54	47.11	180
NO_2, (µg/Ncm)	0.66	0.26	150

Table 2-32. Results of hourly Ambient Air Quality Monitoring

Items Sampling Station Date of Sampling Time of Sampling	Description/Values				
	STN-3 Nov. 7, 2017 1500H-1600H	STN-4 Nov. 7, 2017 16300H-1730H	STN-5 Nov. 7, 2017 1819H-1919H	STN-6 Nov. 7, 2017 2000H-2100H	CAA Limit
TSP, (µg/Ncm)	44.71	79.42	25.06	51.74	300
PM_{10}, (µg/Ncm)	19.99	31.18	12.25	27.56	200
SO_2, (µg/Ncm)	57.01	63.04	47.77	83.25	340
NO_2, (µg/Ncm)	1.01	1.01	1	1.17	260

2.3.2.2 Degradation of Air Quality during Pre-Construction and Construction Phases

Construction activities are the significant sources of dust emissions that may have a substantial temporary impact on local air quality. The expected air quality impacts during construction would be mainly from a) fugitive emissions from site clearing and site grading, and b) vehicular emissions from construction equipment and other vehicles. Dust emissions can vary substantially from day to day, depending on the level of activity, the specific operations, and the prevailing meteorological conditions but these emissions are short-term, local, and minor.

A dust particle is a potential environmental impact during construction activities such as removal of the surface layers of the soil. The generated dust particles will increase the concentration of TSP and PM_{10} that will lead to health hazard for workers. All construction related emissions would be temporary and vary from day to day depending on the type of work being done.

The following measures shall be considered to minimize fugitive dust emission from construction activities:

Access Road

Every main haul road (i.e. any course inside a construction site having a vehicle passing rate of higher than four (4) in any 30 minutes should be paved with concrete, bituminous materials, hardcores or metal plates, and kept clear of dusty materials; or sprayed with water or a dust suppression chemical so as to maintain the entire road surface wet; and

The portion of any road leading only to a construction site that is within 30 m of a discernible or designated vehicle entrance or exit should be kept clear of dusty materials.

Use of Vehicle

Immediately before leaving a construction site, every vehicle should be washed to remove any dusty materials from its body and wheels; and

Trucks loaded with dusty construction dusty materials shall be covered entirely by clean impervious sheeting to ensure that the dusty materials do not leak.

Site Clearing and Site Grading

The working area of any site clearing and site grading shall be sprayed with water immediately before, during and immediately after the acitivities so as to maintain the entire surface wet.

Stockpiling of Dusty Materials

Any stockpile of dusty material should be either covered entirely by impervious sheeting; placed in an area sheltered on the top and the three (3) sides; or sprayed with water or a dust suppression chemical so as to maintain the entire surface wet.

2.3.2.3 Degradation of Air Quality during Operation Phase

The proposed Project will utilize automotive diesel oil as fuel. This will be burned in the generator set in turn releases air pollutants which will cause significant impact on the environment. Emissions from oil combustion depend on the fuel composition, size and type, firing conditions, load, type of control technologies, and level of equipment maintenance. The major pollutants of concern from oil combustions are particulate matter (PM & PM_{10}), nitrogen oxides (NO_x), and sulfur dioxide (SO_2). Some unburned combustibles, including carbon monoxide (CO) and other organic compounds are generally emitted even under proper operating conditions.

Air Dispersion Modeling Methodology

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

Air quality models use mathematical and numerical techniques to simulate physical and chemical processes that affect air pollutants as they disperse and reach the atmosphere. Several factors impact the fate and transport of pollutants in the atmosphere including meteorological conditions, site configuration, emission release characteristics, surrounding terrain, among others.

American Meteorological Society/Environmental Protection Agency Regulatory Model (**AERMOD**) model (Version 9.5.0) was used in this modeling report to assess and determine air quality impact due to the emissions of TSP, PM_{10}, SO_x, NO_x, and CO in the operation of the proposed project. The meteorological data set used is from Clark International Airport Station. The model utilized assessment to determine the level of the proposed development impacts on the surrounding environment, including terrain effects on the discharged plumes for one hour, 8-hours (for CO), 24-hour and annual averaging times, without the need for the use of conversion factors.

The MC 2008-003 under Tier 4 adopted the use of AERMOD. AERMOD was developed to replace the Industrial Source Complex Short-Term Version 3 (ISCST3) model. It includes a state-of-the science downwash algorithm and utilizes AERMET, a meteorological data processor that utilizes current planetary boundary layer theory to calculate the dispersion coefficients (σy and σz).

The modeling with AERMOD was performed using the regulatory default option, which includes stack height adjusted for stack-tip downwash.

Plot Plan

The source subject for this modeling are the generator sets flue` stack from the proposed project. **Figure 2-35** is the general plant lay-out of the facility showing the location of the emission sources and **Figure 2-36** is the 3-D view of emission sources.

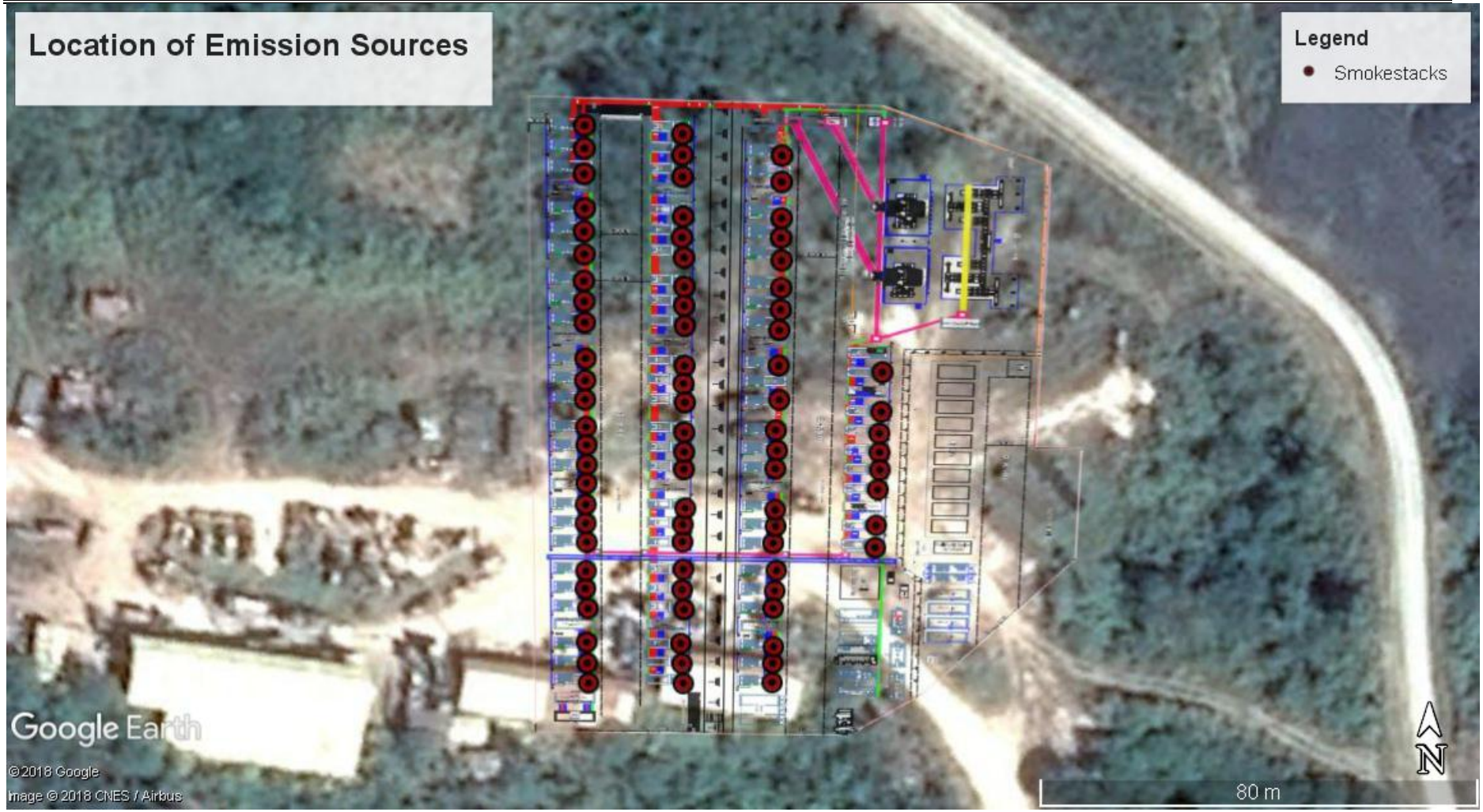


Figure 2-35. Location of Emission Sources

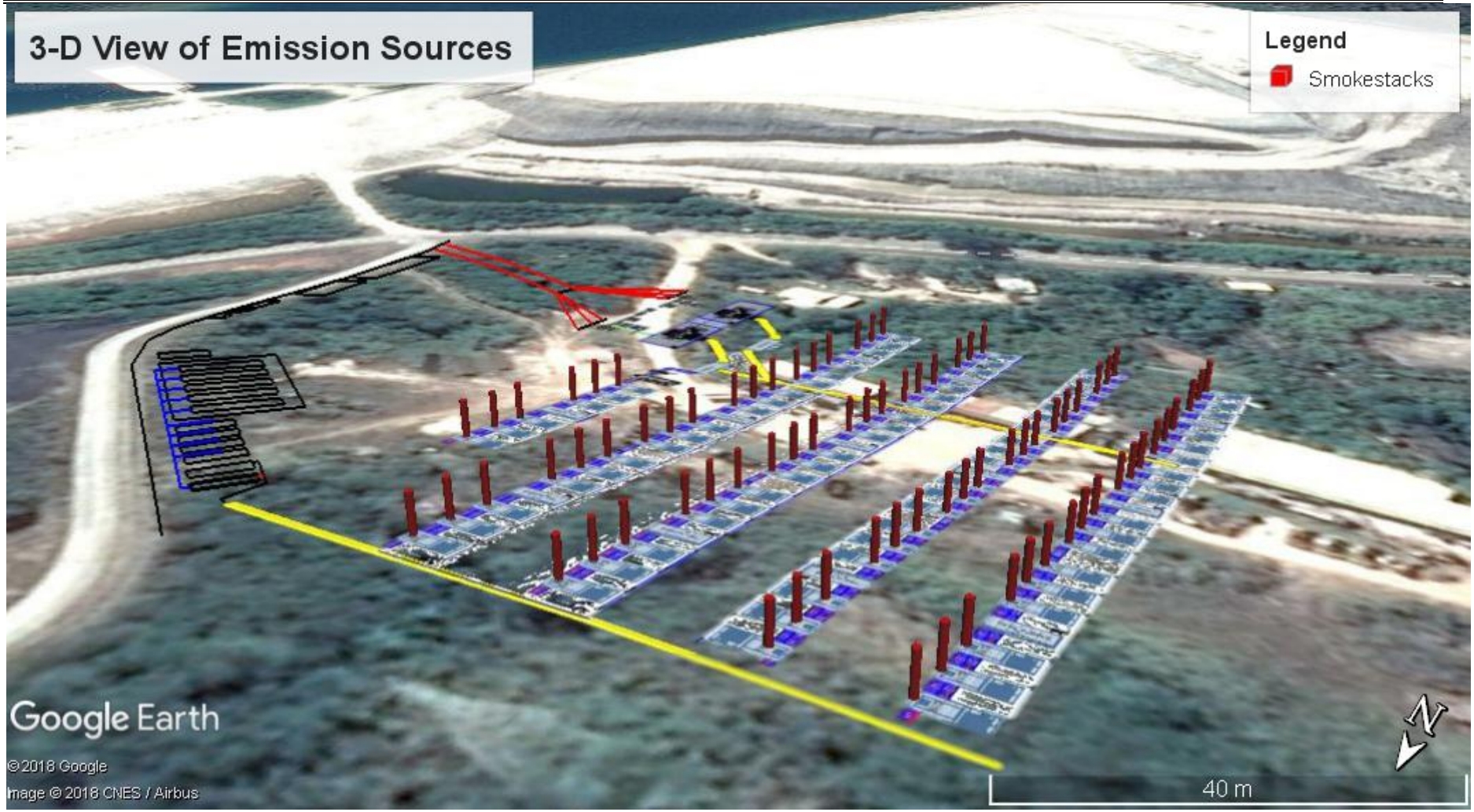


Figure 2-36. 3-D View of Emission Sources

Area Sensitive Receptors (ASRs)

There are 11 area sensitive receptors identified within the modeling domain. The description, distance from the source, and geographical coordinates of these receptors are listed in **Table 2-33**. **Figure 2-37** shows the relative location of the area sensitive receptors.

Table 2-33. Description, Distance, Direction, and Coordinates of the ASRs

Station	Description	Distance from the source	Direction	Coordinates	
				Easting (m)	Northing (m)
ASR-1	LIDE Staff Housing Compound, Brgy. Mahayag, Isabel	1,463	N	657513.37	1206355.56
ASR-2	Central School of Isabel, Brgy. Marvel, Isabel	3,620	N	657002.04	1208428.12
ASR-3	Isabel Adventist Elementary Schoolm Brgy. Santo Nino, Isabel	3,058	N	657124.45	1207888.09
ASR-4	Residential Area, Brgy. Santo Nino, Isabel	3,160	N	657521.75	1208041.40
ASR-5	Residential Area, Brgy. Anislag, Isabel	2,352	NNE	658650.30	1207122.57
ASR-6	Libertad Elementary School, Brgy. Libertad, Isabel	1,554	NE	658713.86	1206192.82
ASR-7	Residential Area, Brgy. Matlang, Isabel	867	E	658672.70	1204803.10
ASR-8	Matlang National High School, Brgy. Matlang, Isabel	1,627	ESE	659302.94	1204279.05
ASR-9	Bilwang Central School, Brgy. Bilwang, Isabel	2,675	SE	660136.98	1203626.42
ASR-10	Relocation Site, Brgy. Binog, Isabel	3,297	SE	660904.44	1203711.99
ASR-11	Residential Area, Brgy. Tubod, Isabel	3,908	SE	661139.59	1202870.23

Figure 2-37. Location of Area Sensitive Receptors

Modeling Meteorological Data

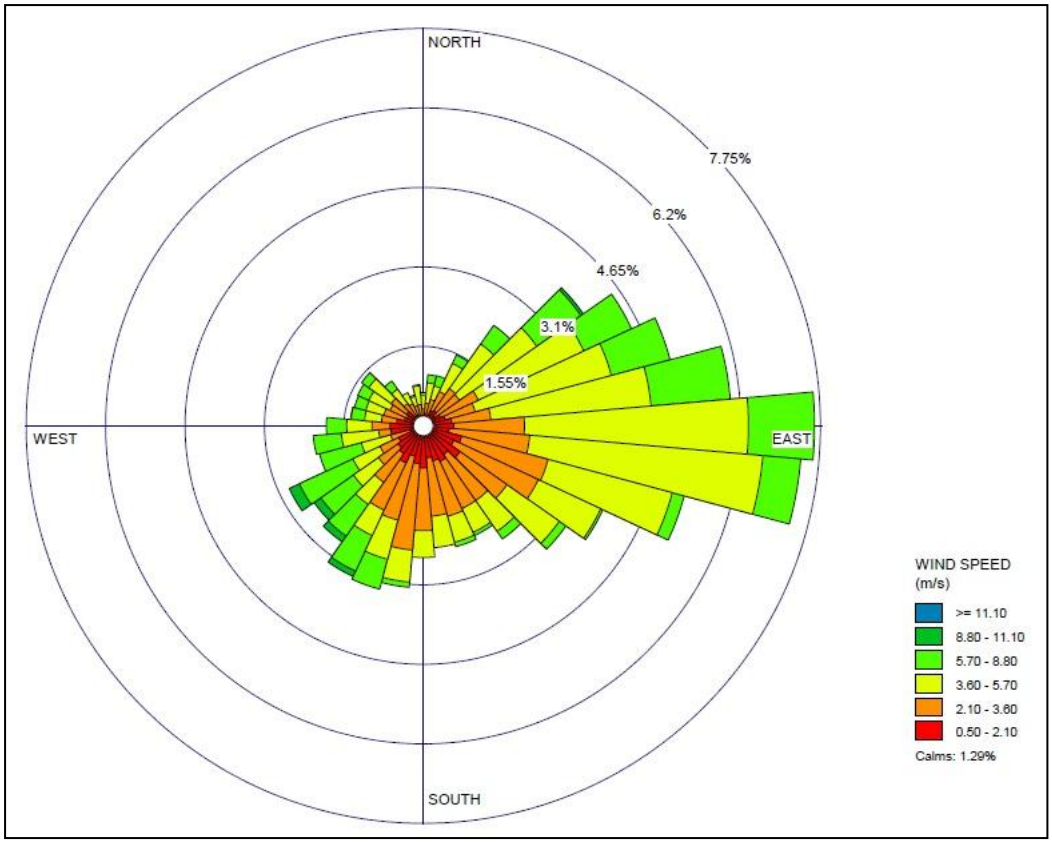
The nearest meteorological station of the Philippine Atmospheric Geophysical and Astronomical Services Administration (**PAGASA**) to the proposed Project site is the Tacloban Airport Station. However, said station is too far to the Project site to use in the modeling, therefore the meteorological data set to be used is from The Fifth-Generation Penn State University / National Center for Atmospheric Research mesoscale model (commonly referred to as MM5) purchased at Lakes Environmental. The table below shows the details of the purchased Surface & Upper Air Met Data for AERMET preprocessed from MM5.

Met Number	MET1711208
Met Data Type:	AERMET-Ready (Surface & Upper Air Data
Start-End Date:	January 1 to December 31, 2016
Latitude:	10.896561 N
Longitude:	124.443547 E
Datum:	WGS 84
Site Time Zone:	UTC/GMT UTC + 8 hour(s)
Anemometer Height:	15 m
Station Base Elevation:	2 m
Upper Air Adjustment:	-8 hour(s)
Closest City:	Ormoc City
Country:	Philippines

The format of the Hourly Surface Met Data is SAMSON (surface met data for preprocessing by AERMET (*.sam)) while the format for upper air data is TD-6201 – Fixed Length (upper air met data for preprocessing by AEMET (*.ua)).

The MM5 is a frequently-used global meteorological model for historical episodes. It is a limited-area, non-hydrostatic, terrain-following sigma-coordinate model designed to simulate or predict mesoscale and regional-scale atmospheric circulations.

The annual wind rose from the 2016 MM5-AERMET derived meteorological data for the Project site is provided in **Figure 2-38**. Prevailing winds are coming from the east and east-southeast occupying an approximately 8.88% percent of the time. There are lighter winds from the south (sea breeze) while the strongest wind is from the southwest occupying approximately 0.7% of the time. The average wind speed is 3.81 m/s and calm condition is 1.293% of the time.



Source: AERMET View Version 9.5.0 Lakes Environmental

Figure 2-38. Windrose Diagram for the MM5-AERMET Derived Meteorological Data

Emission Load of Each Sources

IASCL proposes to install 80 units power generator sets with 1MW capacity each with a maximum output of 70 MW (10 units will serve as a spare unit) and designed mainly to provide ancillary services to the NGCP. The 70MW capacity shall be subdivided based on the two (2) types of ancillary services: the 40MW shall be for Regulating Reserve; and the 30MW shall be Contingency Reserve.

Accordingly, based on the required operation of NGCP for provisional of Ancillary Services, only half of the 40MW capacity for Regulating Reserve shall be initially dispatched. This means that only 40 modular diesel engines will operate at 50% loading, having a total initial dispatch of 20MW. Such output will then change if there will be fluctuations of system frequency in the Visayas Grid.

On the other hand, for the provision of 30MW Contingency Reserve, NGCP initially will require five (5) modular diesel engines to be operated at 300KW each, a total initial dispatch of 1.5MW. The remaining 25 modular diesel engines will serve as standby units and shall only be dispatched should there be an outage of a large generator loss of transmission line in the system.

The modeling scenarios considered in this study are the worst-case condition wherein the emission sources are modeled at its maximum output. The sources subject for this air modeling are the 40MW Regulating Reserve and the 30MW Contingency Reserve. The modeling scenario considered are the following:

- Scenario 1: Normal operating condition (Regulating Reserve); consisting of 40 operating modular diesel engines; and

- Scenario 2: Maximum operating condition (Regulating + Contingency Reserves); consisting of 70 operating modular diesel engines.

Emission data used in the modeling are from the source emission testing report of the 1.3MW Generator Set of DMCI Masbate Power Corporation conducted by GEOSPHERE Technologies, Inc.

The average of the results for PM, SO_2, NO_2, and CO together with the source parameters of the stacks, such as stack height, stack inside diameter; flue gas exit velocity and temperature are summarized in Tables 2-13 to 2-19.

Tables 2-34 to **2-40** summarize the source input parameters.

Table 2-34. Summary of Source Parameters

Parameter	Unit	Generator Set #1	Generator Set #2	Generator Set #3	Generator Set #4	Generator Set #5	Generator Set #6	Generator Set #7	Generator Set #8	Generator Set #9	Generator Set #10
Coordinates											
Easting	m	657753.83	657753.65	657753.53	657753.37	657753.56	657753.45	657753.30	657753.48	657753.66	657753.74
Northing	m	1204989.06	1204983.00	1204976.91	1204964.25	1204958.45	1204952.08	1204943.16	1204936.98	1204930.78	1204918.27
Rated Capacity	MW	1	1	1	1	1	1	1	1	1	1
Operating hours	hrs/yr	8,760	8,760	8,760	8,760	8,760	8,760	8,760	8,760	8,760	8,760
Flue gas velocity	m/s	34.8	34.8	34.8	34.8	34.8	34.8	34.8	34.8	34.8	34.8
Flue gas exit temperature	°C	341.19	341.19	341.19	341.19	341.19	341.19	341.19	341.19	341.19	341.19
Stack height above the ground	m	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6
Stack exit diameter	m	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41
Emission rate											
CO	g/s	0.00812	0.00812	0.00812	0.00812	0.00812	0.00812	0.00812	0.00812	0.00812	0.00812
SO_2	g/s	0.00561	0.00561	0.00561	0.00561	0.00561	0.00561	0.00561	0.00561	0.00561	0.00561
NO_2	g/s	0.00896	0.00896	0.00896	0.00896	0.00896	0.00896	0.00896	0.00896	0.00896	0.00896
PM	g/s	0.01736	0.01736	0.01736	0.01736	0.01736	0.01736	0.01736	0.01736	0.01736	0.01736
PM_{10}	g/s	0.01493	0.01493	0.01493	0.01493	0.01493	0.01493	0.01493	0.01493	0.01493	0.01493

Note: 1. Emission data are extracted from the Source Emission Testing Report of the 1.23MW Generator Set of DMCI Masbate Power Corporation conducted by GEOSPHERE Technologies, Inc. dated July 12-14, 2017.

2. The Report has no PM_{10} result; therefore, PM_{10} is assumed to be 80% of PM.

Table 2-35. Summary of Source Parameters

Parameter	Unit	Generator Set #11	Generator Set #12	Generator Set #13	Generator Set #14	Generator Set #15	Generator Set #16	Generator Set #17	Generator Set #18	Generator Set #19	Generator Set #20
Coordinates											
Easting	m	657753.63	657753.81	657753.68	657753.69	657753.69	657753.65	657753.62	657753.60	657769.68	657769.40
Northing	m	1204911.97	1204905.64	1204897.23	1204890.56	1204884.76	1204872.80	1204866.08	1204859.93	1204860.20	1204866.36
Rated Capacity	MW	1	1	1	1	1	1	1	1	1	1
Operating hours	hrs/yr	8,760	8,760	8,760	8,760	8,760	8,760	8,760	8,760	8,760	8,760
Flue gas velocity	m/s	34.8	34.8	34.8	34.8	34.8	34.8	34.8	34.8	34.8	34.8
Flue gas exit temperature	°C	341.19	341.19	341.19	341.19	341.19	341.19	341.19	341.19	341.19	341.19
Stack height above the ground	m	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6
Stack exit diameter	m	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41
Emission rate											
CO	g/s	0.00812	0.00812	0.00812	0.00812	0.00812	0.00812	0.00812	0.00812	0.00812	0.00812
SO_2	g/s	0.00561	0.00561	0.00561	0.00561	0.00561	0.00561	0.00561	0.00561	0.00561	0.00561
NO_2	g/s	0.00896	0.00896	0.00896	0.00896	0.00896	0.00896	0.00896	0.00896	0.00896	0.00896
PM	g/s	0.01736	0.01736	0.01736	0.01736	0.01736	0.01736	0.01736	0.01736	0.01736	0.01736
PM_{10}	g/s	0.01493	0.01493	0.01493	0.01493	0.01493	0.01493	0.01493	0.01493	0.01493	0.01493

Note: 1. Emission data are extracted from the Source Emission Testing Report of the 1.23MW Generator Set of DMCI Masbate Power Corporation conducted by GEOSPHERE Technologies, Inc. dated July 12-14, 2017.

2. The Report has no PM_{10} result; therefore, PM_{10} is assumed to be 80% of PM.

Table 2-36. Summary of Source Parameters

Parameter	Unit	Generator Set #21	Generator Set #22	Generator Set #23	Generator Set #24	Generator Set #25	Generator Set #26	Generator Set #27	Generator Set #28	Generator Set #29	Generator Set #30
Coordinates											
Easting	m	657769.41	657769.42	657769.43	657769.43	657769.52	657769.29	657769.35	657769.48	657769.26	657769.04
Northing	m	1204872.52	1204884.79	1204891.20	1204896.72	1204906.29	1204912.34	1204918.36	1204930.89	1204936.82	1204943.28
Rated Capacity	MW	1	1	1	1	1	1	1	1	1	1
Operating hours	hrs/yr	8,760	8,760	8,760	8,760	8,760	8,760	8,760	8,760	8,760	8,760
Flue gas velocity	m/s	34.8	34.8	34.8	34.8	34.8	34.8	34.8	34.8	34.8	34.8
Flue gas exit temperature	°C	341.19	341.19	341.19	341.19	341.19	341.19	341.19	341.19	341.19	341.19
Stack height above the ground	m	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6
Stack exit diameter	m	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41
Emission rate											
CO	g/s	0.00812	0.00812	0.00812	0.00812	0.00812	0.00812	0.00812	0.00812	0.00812	0.00812
SO_2	g/s	0.00561	0.00561	0.00561	0.00561	0.00561	0.00561	0.00561	0.00561	0.00561	0.00561
NO_2	g/s	0.00896	0.00896	0.00896	0.00896	0.00896	0.00896	0.00896	0.00896	0.00896	0.00896
PM	g/s	0.01736	0.01736	0.01736	0.01736	0.01736	0.01736	0.01736	0.01736	0.01736	0.01736
PM_{10}	g/s	0.01493	0.01493	0.01493	0.01493	0.01493	0.01493	0.01493	0.01493	0.01493	0.01493

Note: 1. Emission data are extracted from the Source Emission Testing Report of the 1.23MW Generator Set of DMCI Masbate Power Corporation conducted by GEOSPHERE Technologies, Inc. dated July 12-14, 2017.
2. The Report has no PM_{10} result; therefore, PM_{10} is assumed to be 80% of PM.

Table 2-37. Summary of Source Parameters

Parameter	Unit	Generator Set #31	Generator Set #32	Generator Set #33	Generator Set #34	Generator Set #35	Generator Set #36	Generator Set #37	Generator Set #38	Generator Set #39	Generator Set #40
Coordinates											
Easting	m	657769.42	657769.48	657769.27	657769.28	657769.27	657768.98	657794.41	657794.46	657794.51	657794.33
Northing	m	1204951.94	1204958.32	1204964.38	1204976.46	1204982.80	1204988.85	1204988.92	1204982.89	1204976.84	1204964.71
Rated Capacity	MW	1	1	1	1	1	1	1	1	1	1
Operating hours	hrs/yr	8,760	8,760	8,760	8,760	8,760	8,760	8,760	8,760	8,760	8,760
Flue gas velocity	m/s	34.8	34.8	34.8	34.8	34.8	34.8	34.8	34.8	34.8	34.8
Flue gas exit temperature	°C	341.19	341.19	341.19	341.19	341.19	341.19	341.19	341.19	341.19	341.19
Stack height above the ground	m	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6
Stack exit diameter	m	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41
Emission rate											
CO	g/s	0.00812	0.00812	0.00812	0.00812	0.00812	0.00812	0.00812	0.00812	0.00812	0.00812
SO_2	g/s	0.00561	0.00561	0.00561	0.00561	0.00561	0.00561	0.00561	0.00561	0.00561	0.00561
NO_2	g/s	0.00896	0.00896	0.00896	0.00896	0.00896	0.00896	0.00896	0.00896	0.00896	0.00896
PM	g/s	0.01736	0.01736	0.01736	0.01736	0.01736	0.01736	0.01736	0.01736	0.01736	0.01736
PM_{10}	g/s	0.01493	0.01493	0.01493	0.01493	0.01493	0.01493	0.01493	0.01493	0.01493	0.01493

Note: 1. Emission data are extracted from the Source Emission Testing Report of the 1.23MW Generator Set of DMCI Masbate Power Corporation conducted by GEOSPHERE Technologies, Inc. dated July 12-14, 2017.

2. The Report has no PM_{10} result; therefore, PM_{10} is assumed to be 80% of PM.

Table 2-38. Summary of Source Parameters

Parameter	Unit	Generator Set #41	Generator Set #42	Generator Set #43	Generator Set #44	Generator Set #45	Generator Set #46	Generator Set #47	Generator Set #48	Generator Set #49	Generator Set #50
Coordinates											
Easting	m	657794.68	657794.45	657794.53	657794.59	657794.65	657794.76	657794.81	657794.86	657794.94	657794.98
Northing	m	1204958.61	1204952.20	1204943.22	1204936.73	1204930.77	1204918.76	1204912.43	1204906.64	1204897.34	1204891.51
Rated Capacity	MW	1	1	1	1	1	1	1	1	1	1
Operating hours	hrs/yr	8,760	8,760	8,760	8,760	8,760	8,760	8,760	8,760	8,760	8,760
Flue gas velocity	m/s	34.8	34.8	34.8	34.8	34.8	34.8	34.8	34.8	34.8	34.8
Flue gas exit temperature	°C	341.19	341.19	341.19	341.19	341.19	341.19	341.19	341.19	341.19	341.19
Stack height above the ground	m	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6
Stack exit diameter	m	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41
Emission rate											
CO	g/s	0.00812	0.00812	0.00812	0.00812	0.00812	0.00812	0.00812	0.00812	0.00812	0.00812
SO_2	g/s	0.00561	0.00561	0.00561	0.00561	0.00561	0.00561	0.00561	0.00561	0.00561	0.00561
NO_2	g/s	0.00896	0.00896	0.00896	0.00896	0.00896	0.00896	0.00896	0.00896	0.00896	0.00896
PM	g/s	0.01736	0.01736	0.01736	0.01736	0.01736	0.01736	0.01736	0.01736	0.01736	0.01736
PM_{10}	g/s	0.01493	0.01493	0.01493	0.01493	0.01493	0.01493	0.01493	0.01493	0.01493	0.01493

Note: 1. Emission data are extracted from the Source Emission Testing Report of the 1.23MW Generator Set of DMCI Masbate Power Corporation conducted by GEOSPHERE Technologies, Inc. dated July 12-14, 2017.

2. The Report has no PM_{10} result; therefore, PM_{10} is assumed to be 80% of PM.

Table 2-39. Summary of Source Parameters

Parameter	Unit	Generator Set #51	Generator Set #52	Generator Set #53	Generator Set #54	Generator Set #55	Generator Set #56	Generator Set #57	Generator Set #58	Generator Set #59	Generator Set #60
Coordinates											
Easting	m	657794.73	657795.10	657795.14	657794.89	657815.87	657815.52	657815.47	657815.35	657815.29	657815.53
Northing	m	1204885.09	1204872.80	1204866.63	1204860.46	1204860.48	1204866.36	1204872.82	1204885.14	1204891.28	1204897.12
Rated Capacity	MW	1	1	1	1	1	1	1	1	1	1
Operating hours	hrs/yr	8,760	8,760	8,760	8,760	8,760	8,760	8,760	8,760	8,760	8,760
Flue gas velocity	m/s	34.8	34.8	34.8	34.8	34.8	34.8	34.8	34.8	34.8	34.8
Flue gas exit temperature	°C	341.19	341.19	341.19	341.19	341.19	341.19	341.19	341.19	341.19	341.19
Stack height above the ground	m	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6
Stack exit diameter	m	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41
Emission rate											
CO	g/s	0.00812	0.00812	0.00812	0.00812	0.00812	0.00812	0.00812	0.00812	0.00812	0.00812
SO_2	g/s	0.00561	0.00561	0.00561	0.00561	0.00561	0.00561	0.00561	0.00561	0.00561	0.00561
NO_2	g/s	0.00896	0.00896	0.00896	0.00896	0.00896	0.00896	0.00896	0.00896	0.00896	0.00896
PM	g/s	0.01736	0.01736	0.01736	0.01736	0.01736	0.01736	0.01736	0.01736	0.01736	0.01736
PM_{10}	g/s	0.01493	0.01493	0.01493	0.01493	0.01493	0.01493	0.01493	0.01493	0.01493	0.01493

Note: 1. Emission data are extracted from the Source Emission Testing Report of the 1.23MW Generator Set of DMCI Masbate Power Corporation conducted by GEOSPHERE Technologies, Inc. dated July 12-14, 2017.

2. The Report has no PM_{10} result; therefore, PM_{10} is assumed to be 80% of PM.

Table 2-40. Summary of Source Parameters

Parameter	Unit	Generator Set #61	Generator Set #62	Generator Set #63	Generator Set #64	Generator Set #65	Generator Set #66	Generator Set #67	Generator Set #68	Generator Set #69	Generator Set #70
Coordinates											
Easting	m	657815.38	657815.28	657815.18	657815.28	657815.17	657815.36	657815.21	657815.10	657814.99	657815.07
Northing	m	1204906.15	1204912.53	1204918.59	1204930.92	1204937.18	1204943.42	1204952.43	1204958.58	1204964.70	1204976.87
Rated Capacity	MW	1	1	1	1	1	1	1	1	1	1
Operating hours	hrs/yr	8,760	8,760	8,760	8,760	8,760	8,760	8,760	8,760	8,760	8,760
Flue gas velocity	m/s	34.8	34.8	34.8	34.8	34.8	34.8	34.8	34.8	34.8	34.8
Flue gas exit temperature	°C	341.19	341.19	341.19	341.19	341.19	341.19	341.19	341.19	341.19	341.19
Stack height above the ground	m	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6
Stack exit diameter	m	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41
Emission rate											
CO	g/s	0.00812	0.00812	0.00812	0.00812	0.00812	0.00812	0.00812	0.00812	0.00812	0.00812
SO_2	g/s	0.00561	0.00561	0.00561	0.00561	0.00561	0.00561	0.00561	0.00561	0.00561	0.00561
NO_2	g/s	0.00896	0.00896	0.00896	0.00896	0.00896	0.00896	0.00896	0.00896	0.00896	0.00896
PM	g/s	0.01736	0.01736	0.01736	0.01736	0.01736	0.01736	0.01736	0.01736	0.01736	0.01736
PM_{10}	g/s	0.01493	0.01493	0.01493	0.01493	0.01493	0.01493	0.01493	0.01493	0.01493	0.01493

Note: 1. Emission data are extracted from the Source Emission Testing Report of the 1.23MW Generator Set of DMCI Masbate Power Corporation conducted by GEOSPHERE Technologies, Inc. dated July 12-14, 2017.
2. The Report has no PM_{10} result; therefore, PM_{10} is assumed to be 80% of PM.

Modeling Results

Tables 2-41 and **2-42** give an overall summary of the predicted concentrations, i.e. maximum modeled concentrations for Scenarios 1 and 2, respectively. The predicted peak 1-hour and 24-hour emissions of TSP, PM_{10}, SO_2, NO_2, and CO are within the CAA limit for the whole modeling domain and at any air sensitive receptors. The highest ground level concentrations of modeled parameters in the whole modeling domain occurred in an uninhabited area of Barangay Libertad, Isabel extending from a distance 50 to 300 meters north-northwest of the Project site boundary. The highest ground level concentrations predicted were for particulates followed by SO_2 and NO_2 of the proposed sources.

In the succeeding figures are the isophlets of each modeled parameter corresponds to its averaging periods.

Table 2-41. Summary of Predicted Maximum Concentration under Scenario 1

Receptor ID	Maximum Predicted Ground Level Concentration (µg/m^3)									
	CO[a]		NO_2		SO_2		TSP		PM_{10}	
	1hr	8hr	1hr	24hr	1hr	24hr	1hr	24hr	1hr	24hr
Domain Maximum	0.6580	0.2586	72.61	16.49	91.26	19.58	140.69	31.96	121.0	27.48
ASR-1	0.0319	0.0047	3.52	0.232	4.17	0.279	6.83	0.449	5.87	0.386
ASR-2	0.0153	0.0020	1.69	0.101	2.16	0.124	3.28	0.196	2.82	0.169
ASR-3	0.0170	0.0024	1.88	0.119	2.27	0.146	3.64	0.231	3.13	0.199
ASR-4	0.0213	0.0028	2.35	0.116	2.99	0.147	4.56	0.225	3.92	0.194
ASR-5	0.2248	0.0350	24.81	1.35	29.74	1.638	48.07	2.61	41.34	2.25
ASR-6	0.0430	0.0195	4.75	0.943	5.98	1.174	9.20	1.83	7.91	1.57
ASR-7	0.0323	0.0200	3.57	1.50	4.46	1.878	6.91	2.91	5.94	2.50
ASR-8	0.0217	0.0114	2.39	0.588	2.98	0.739	4.64	1.14	3.99	0.979
ASR-9	0.0164	0.0069	1.81	0.406	2.26	0.509	3.51	0.787	3.02	0.677
ASR-10	0.1318	0.0166	14.54	0.616	18.01	0.763	28.18	1.19	24.23	1.03
ASR-11	0.0158	0.0045	1.74	0.241	2.18	0.301	3.37	0.467	2.90	0.402
NAAQGV:	**35**	**10**	**-**	**150**	**-**	**180**	**-**	**230**	**-**	**150**
NAAQSSAP	**-**	**-**	**260**	**-**	**340**	**-**	**300**	**-**	**200**	**-**

Note: a - mg/m^3:

Table 2-42. Summary of Predicted Maximum Concentration under Scenario 2

Receptor ID	Maximum Predicted Ground Level Concentration (µg/m^3)									
	CO[a]		NO_2		SO_2		TSP		PM_{10}	
	1hr	8hr	1hr	24hr	1hr	24hr	1hr	24hr	1hr	24hr
Domain Maximum	1.69	0.711	168.92	26.96	95.03	14.39	218.19	34.82	187.65	29.95
ASR-1	0.071	0.011	7.07	0.570	7.06	0.42	9.14	0.737	7.86	0.634
ASR-2	0.048	0.0061	4.82	0.239	3.97	0.21	6.23	0.309	5.36	0.266
ASR-3	0.045	0.0060	4.53	0.278	4.14	0.18	5.85	0.360	5.03	0.310
ASR-4	0.066	0.0087	6.61	0.323	4.57	0.25	8.54	0.417	7.34	0.359
ASR-5	0.617	0.106	61.65	3.79	28.86	1.47	79.63	4.90	68.48	4.21
ASR-6	0.122	0.056	12.20	2.38	7.82	1.39	15.76	3.07	13.56	2.64
ASR-7	0.099	0.061	9.91	4.12	5.79	2.11	12.80	5.33	11.01	4.58
ASR-8	0.064	0.034	6.40	1.59	4.08	0.79	8.27	2.05	7.11	1.77
ASR-9	0.048	0.020	4.83	1.09	3.05	0.52	6.23	1.41	5.36	1.21
ASR-10	0.380	0.048	38.03	1.61	13.88	0.59	49.12	2.08	42.25	1.79
ASR-11	0.047	0.013	4.69	0.642	2.76	0.29	6.05	0.829	5.21	0.713
NAAQGV:	**35**	**10**	**-**	**150**	**-**	**180**	**-**	**230**	**-**	**150**
NAAQSSAP	**-**	**-**	**260**	**-**	**340**	**-**	**300**	**-**	**200**	**-**

Note: a - mg/m^3:

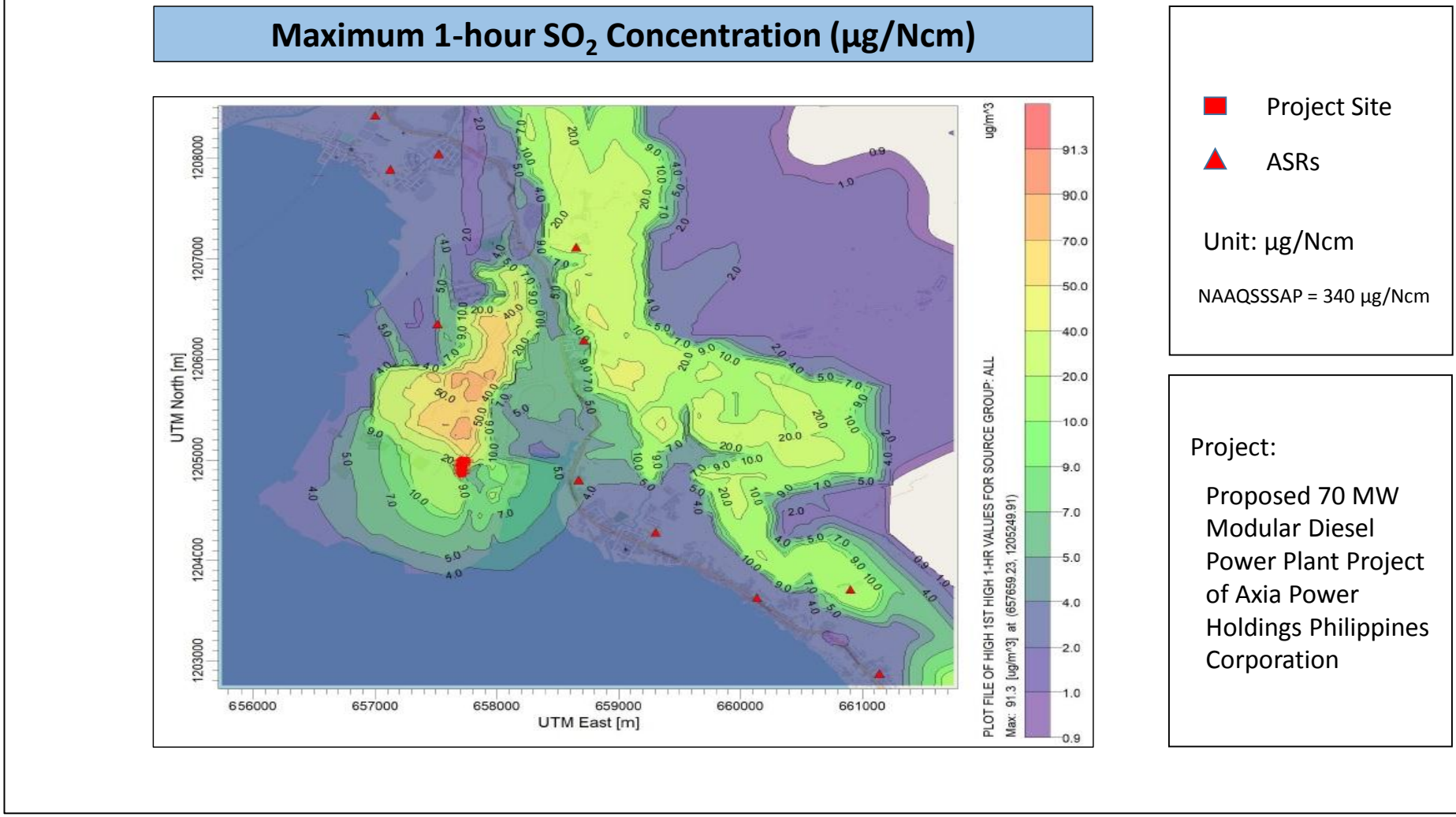
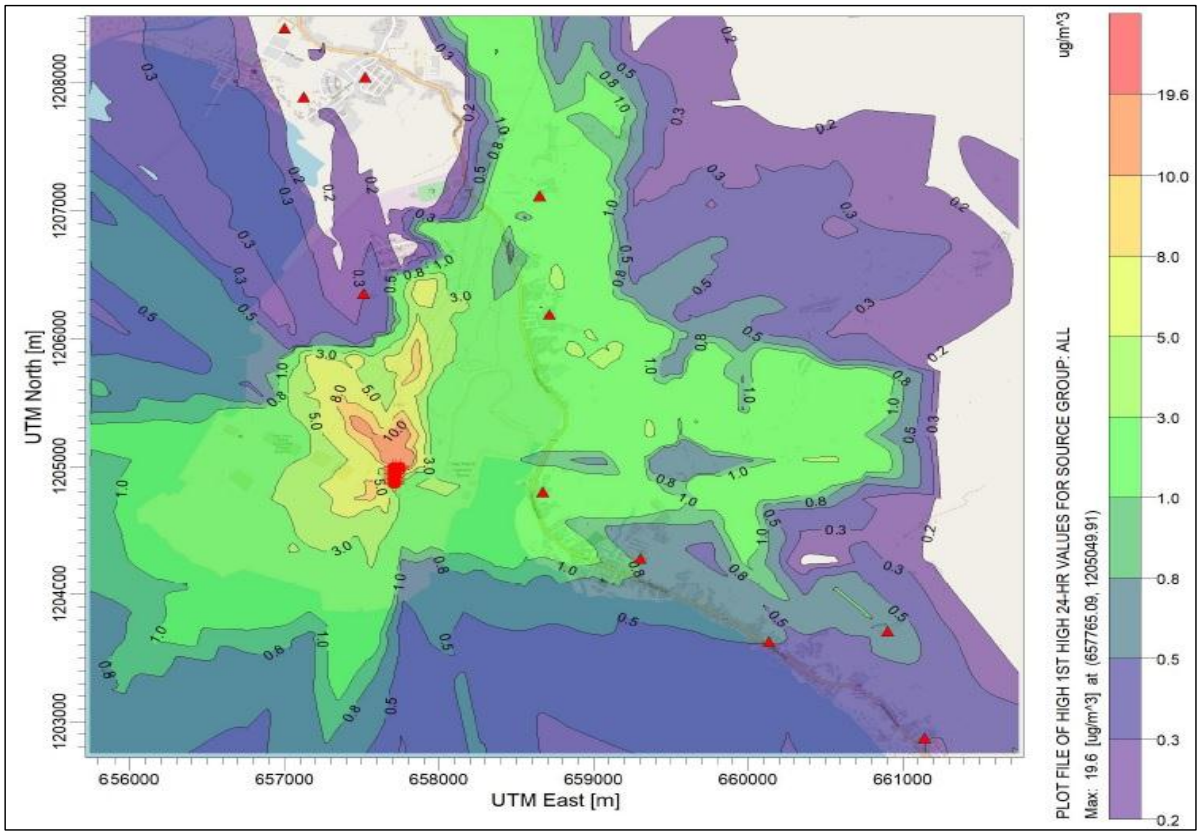


Figure 2-39. Isopleth of SO_2 Concentration 1-hour averaging period Scenario 1

Maximum 24-hour SO_2 Concentration (µg/Ncm)



Project Site

ASRs

Unit: µg/Ncm

NAAQGV = 180 µg/Ncm

Project:

Proposed 70 MW Modular Diesel Power Plant Project of Axia Power Holdings Philippines Corporation

Figure 2-40. Isopleth of SO_2 Concentration 24-hour averaging period Scenario 1

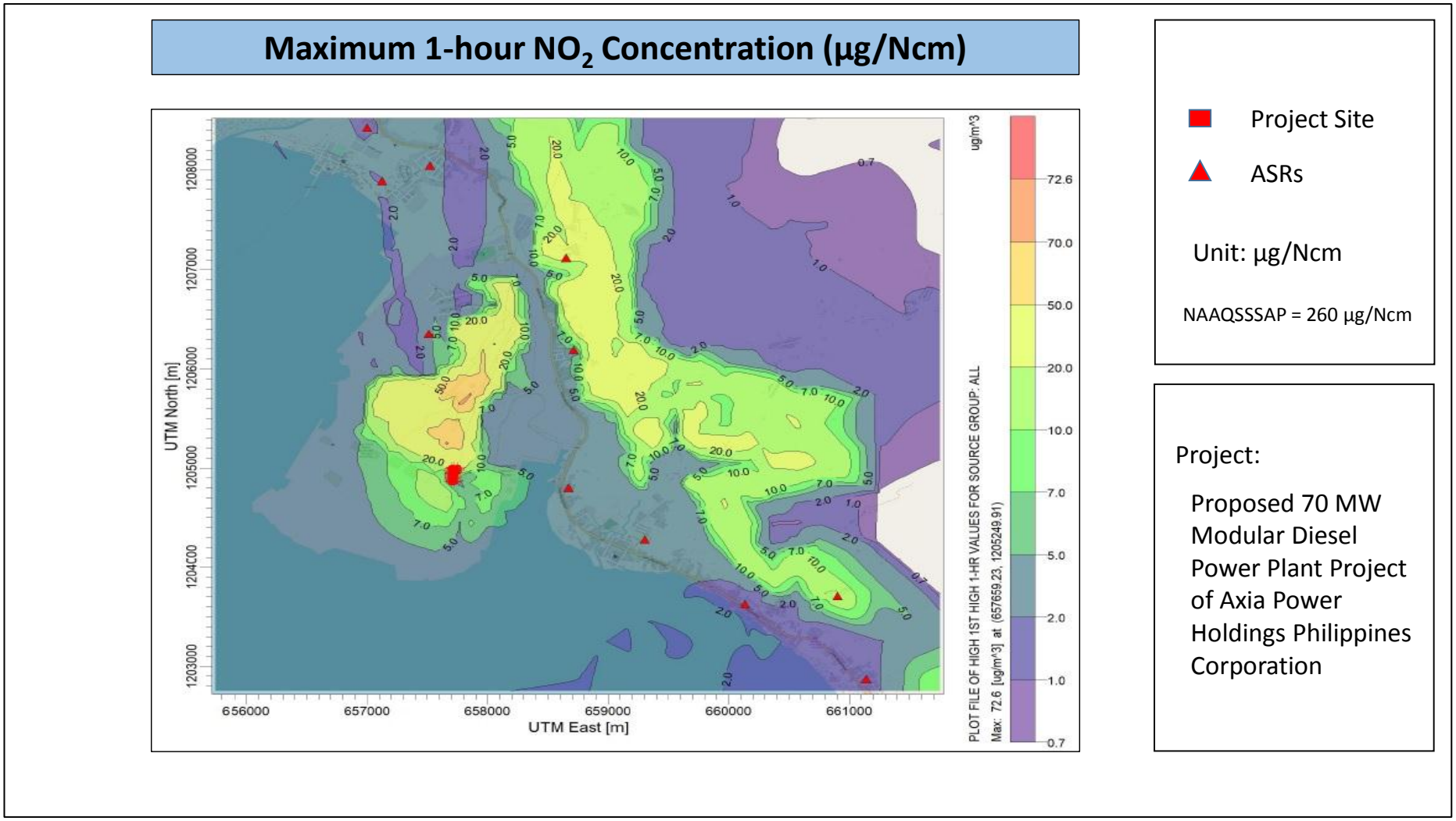


Figure 2-41. Isopleth of NO2 Concentration 1-hour averaging period Scenario 1

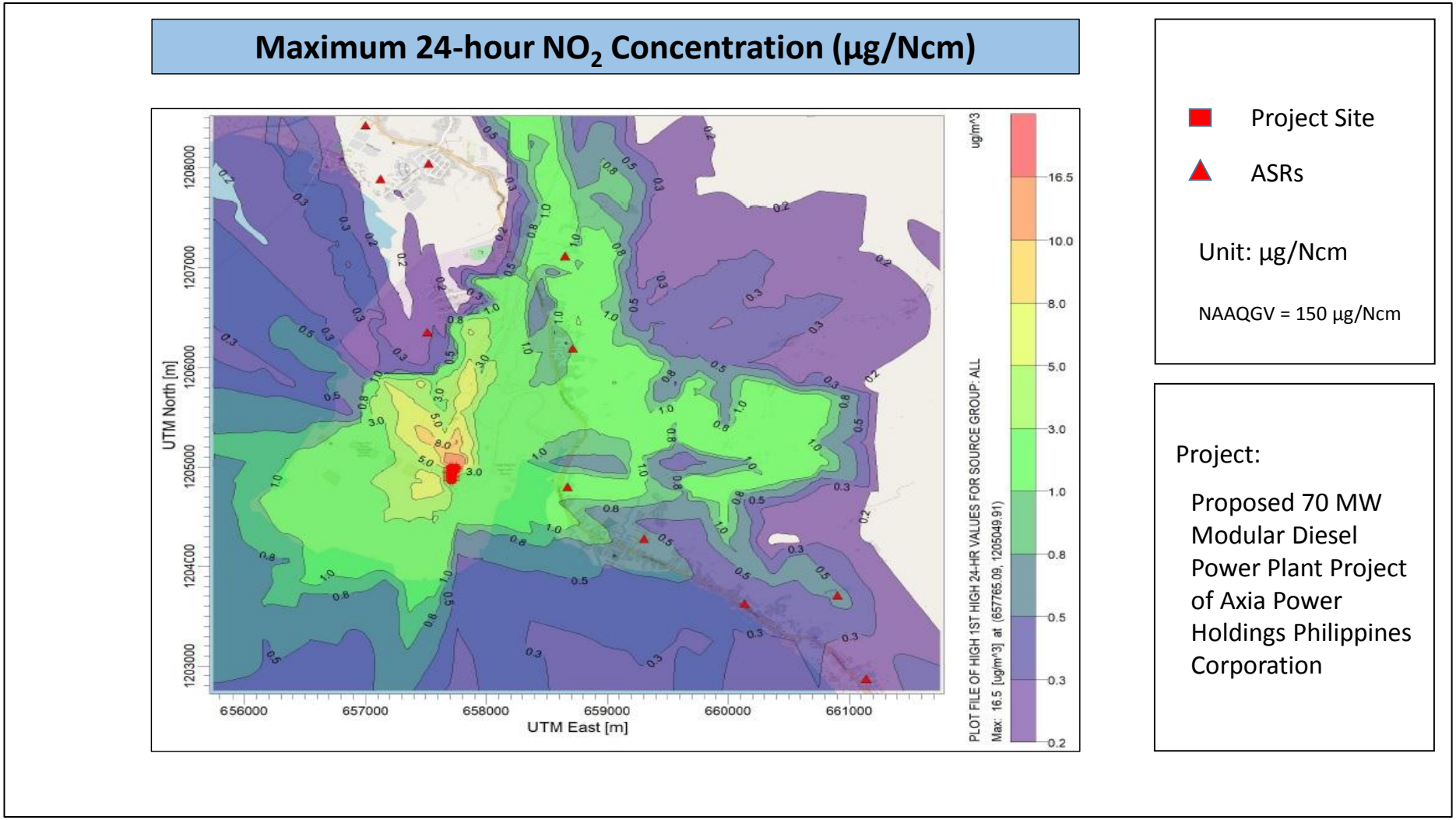
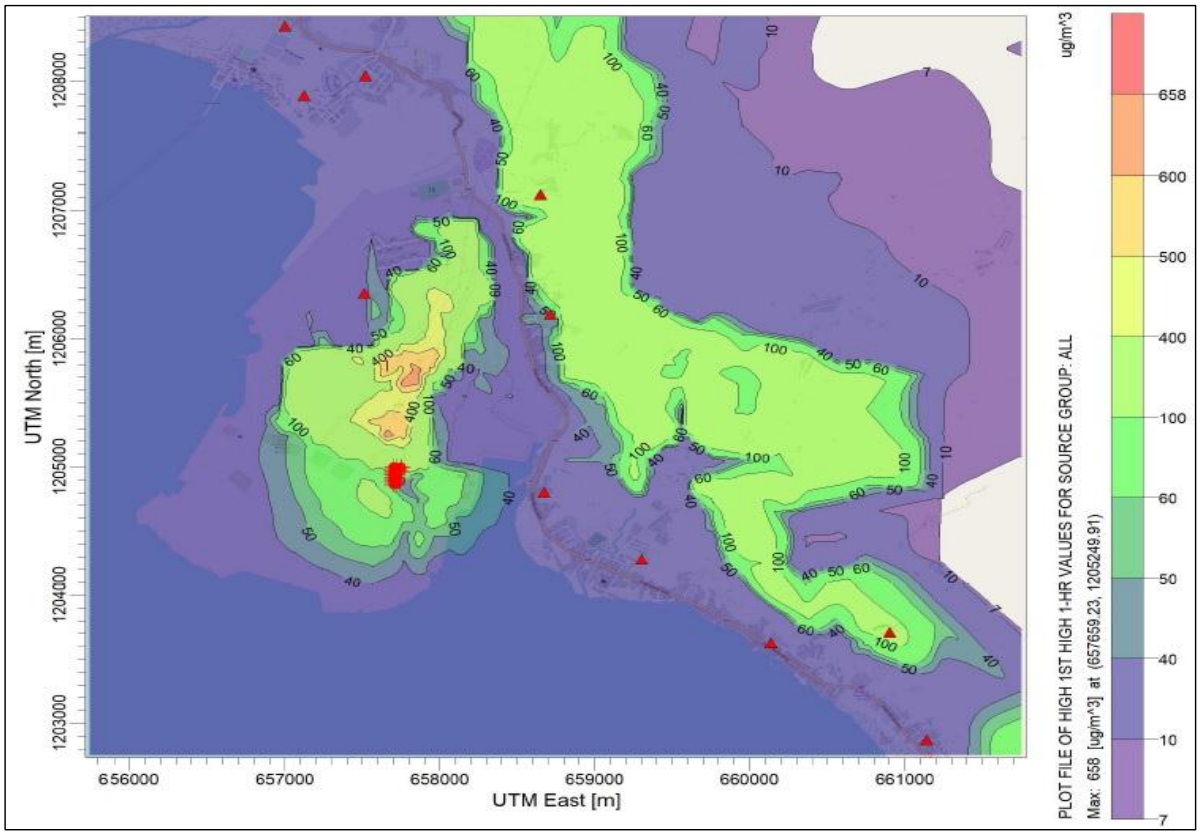


Figure 2-42. Isopleth of NO_2 Concentration 24-hour averaging period Scenario 1

Maximum 1-hour CO Concentration (µg/Ncm)



Project Site

ASRs

Unit: µg/Ncm

NAAQGV = 30,000 µg/Ncm

Project:

Proposed 70 MW Modular Diesel Power Plant Project of Axia Power Holdings Philippines Corporation

Figure 2-43. Isopleth of CO Concentration 1-hour averaging period Scenario 1

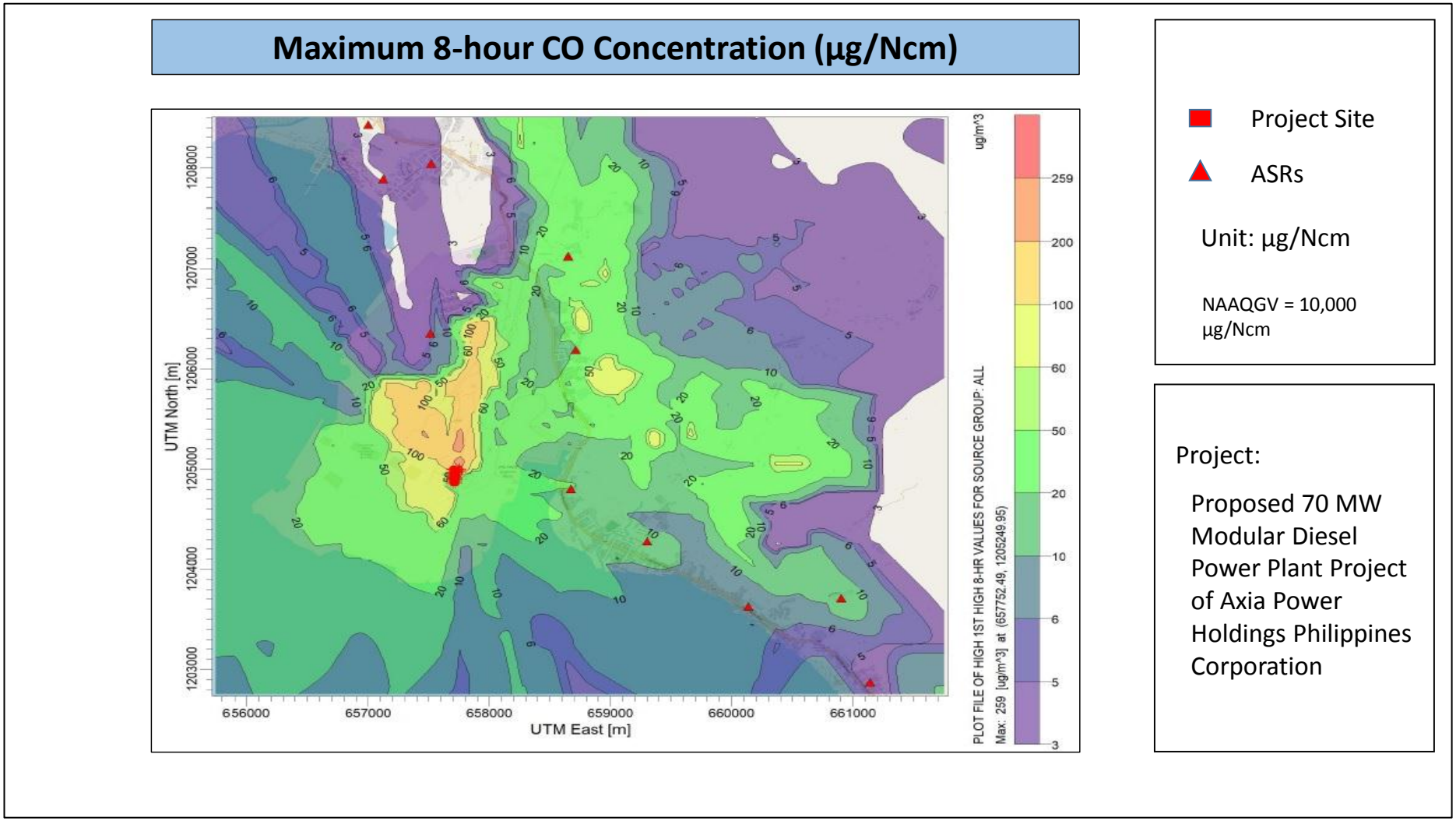


Figure 2-44. Isopleth of CO Concentration 8-hour averaging period Scenario 1

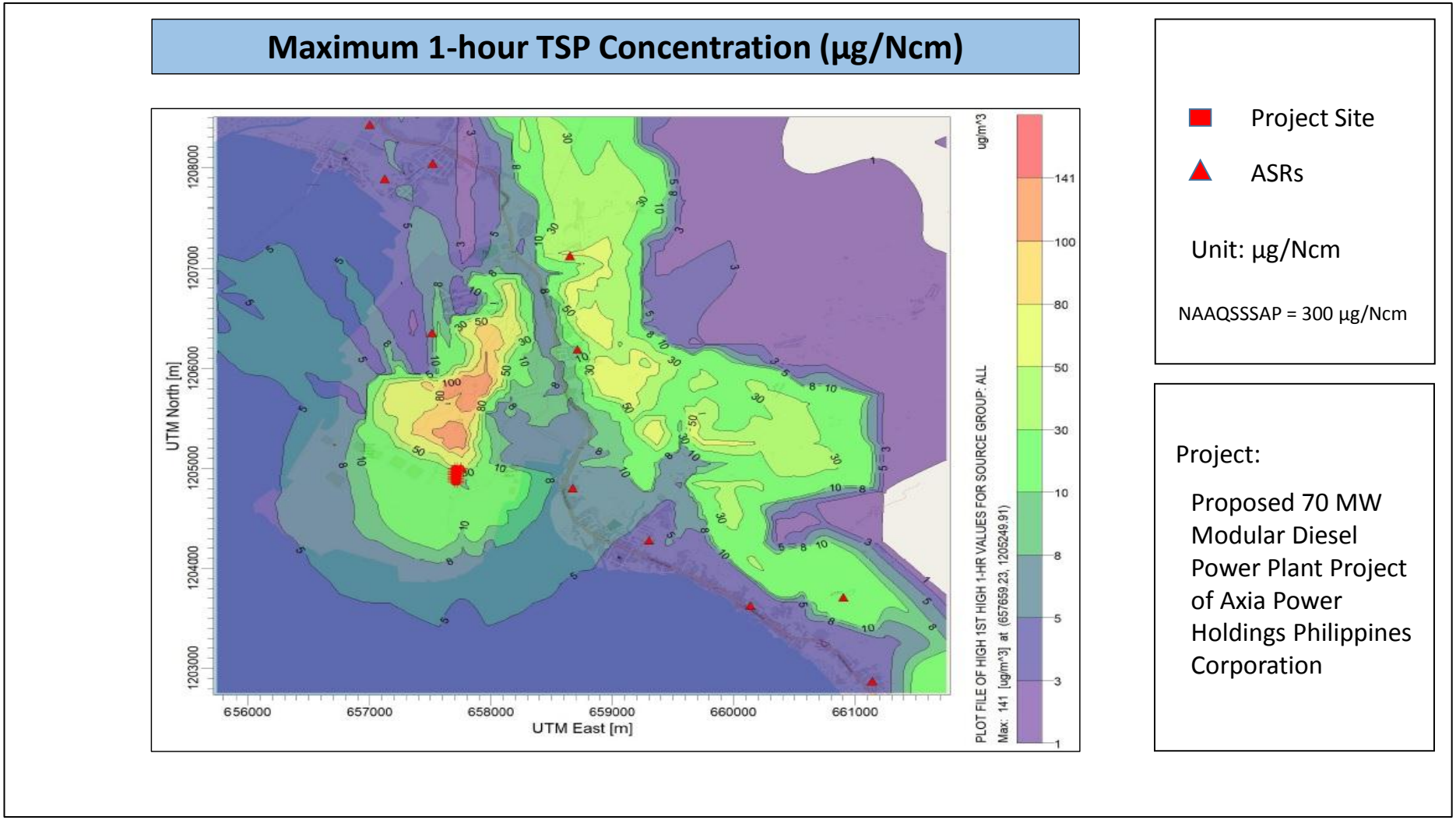


Figure 2-45. Isopleth of TSP Concentration 1-hour averaging period Scenario 1

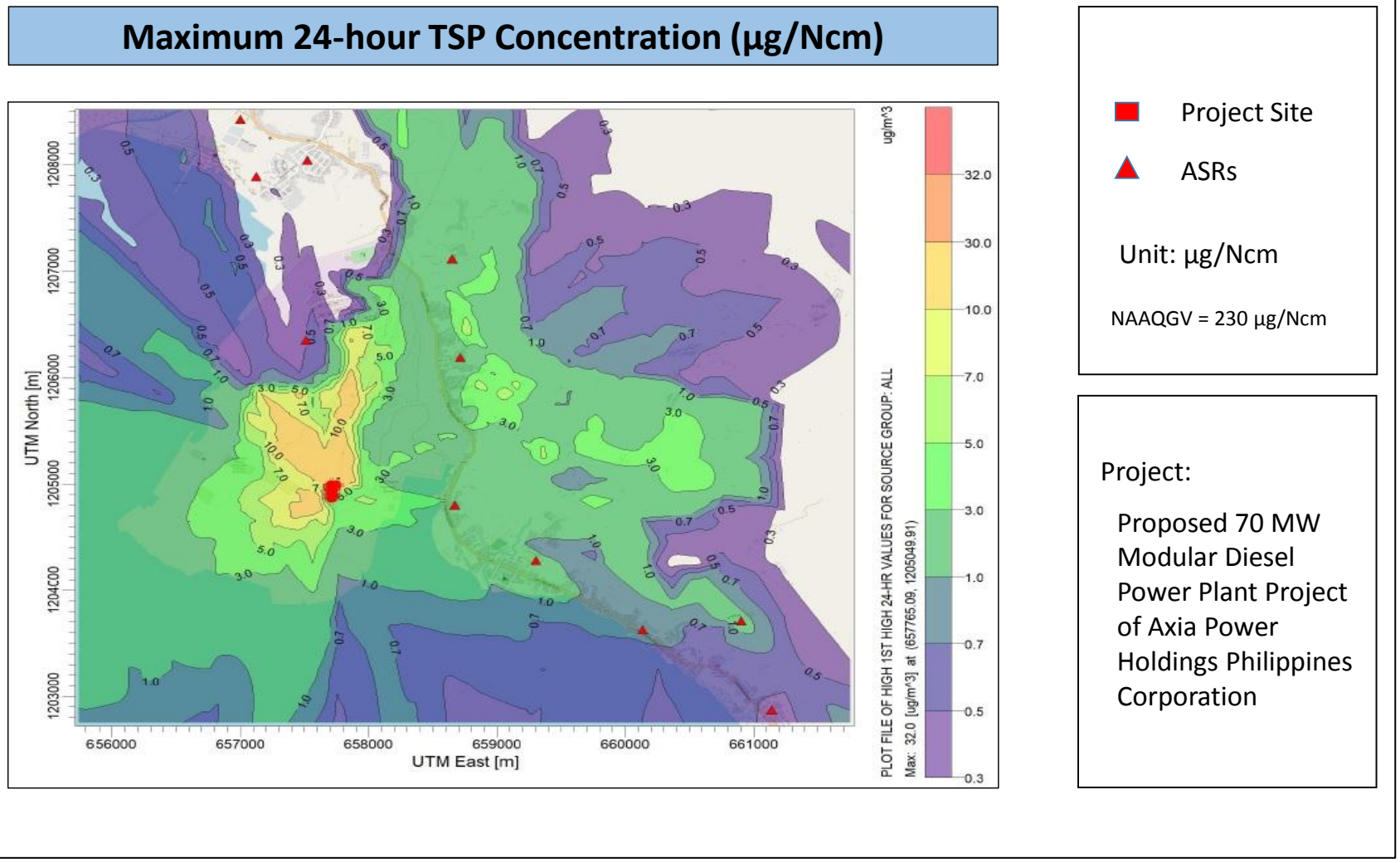


Figure 2-46. Isopleth of TSP Concentration 24-hour averaging period Scenario 1

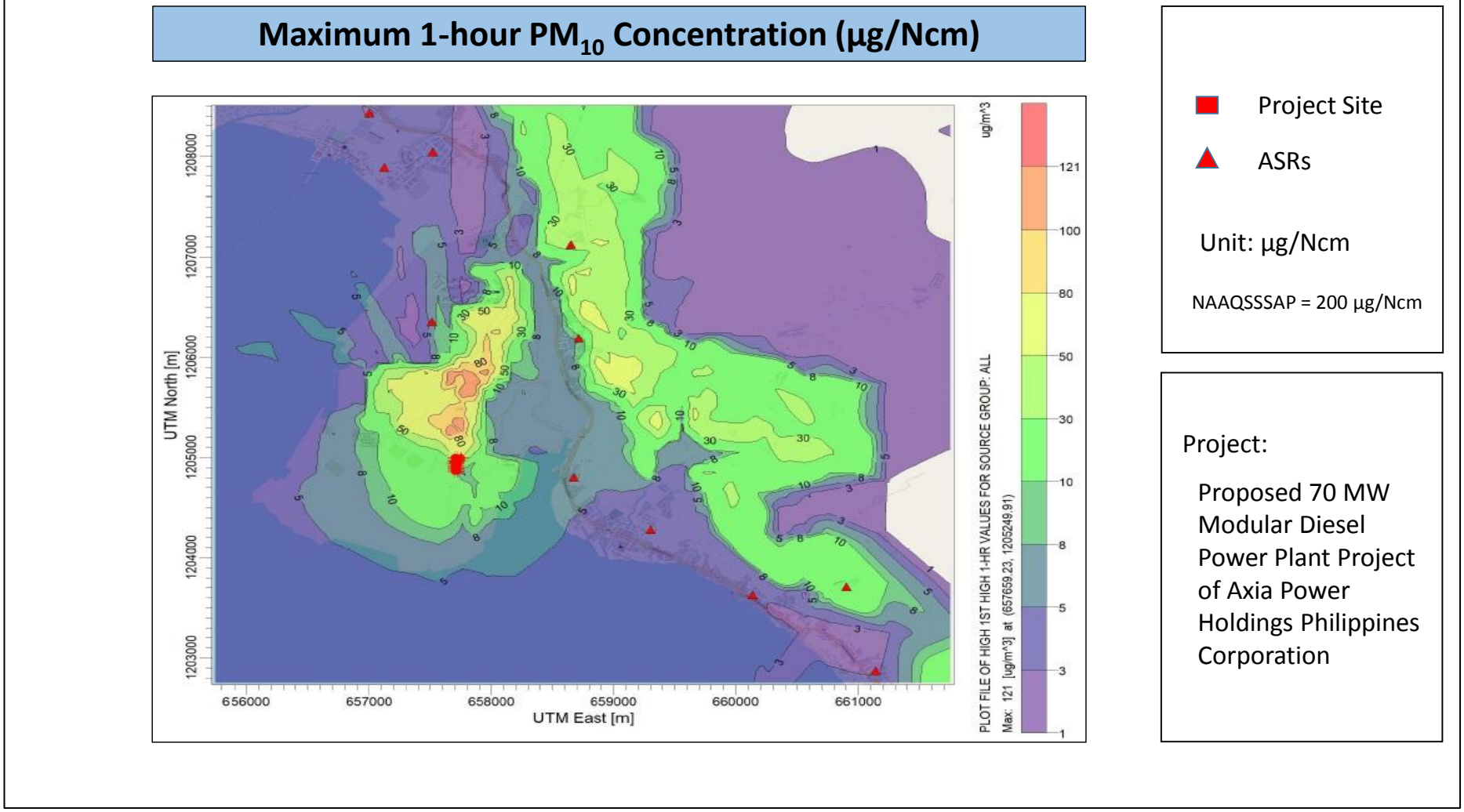


Figure 2-47. Isopleth of PM_{10} Concentration 1-hour averaging period Scenario 1

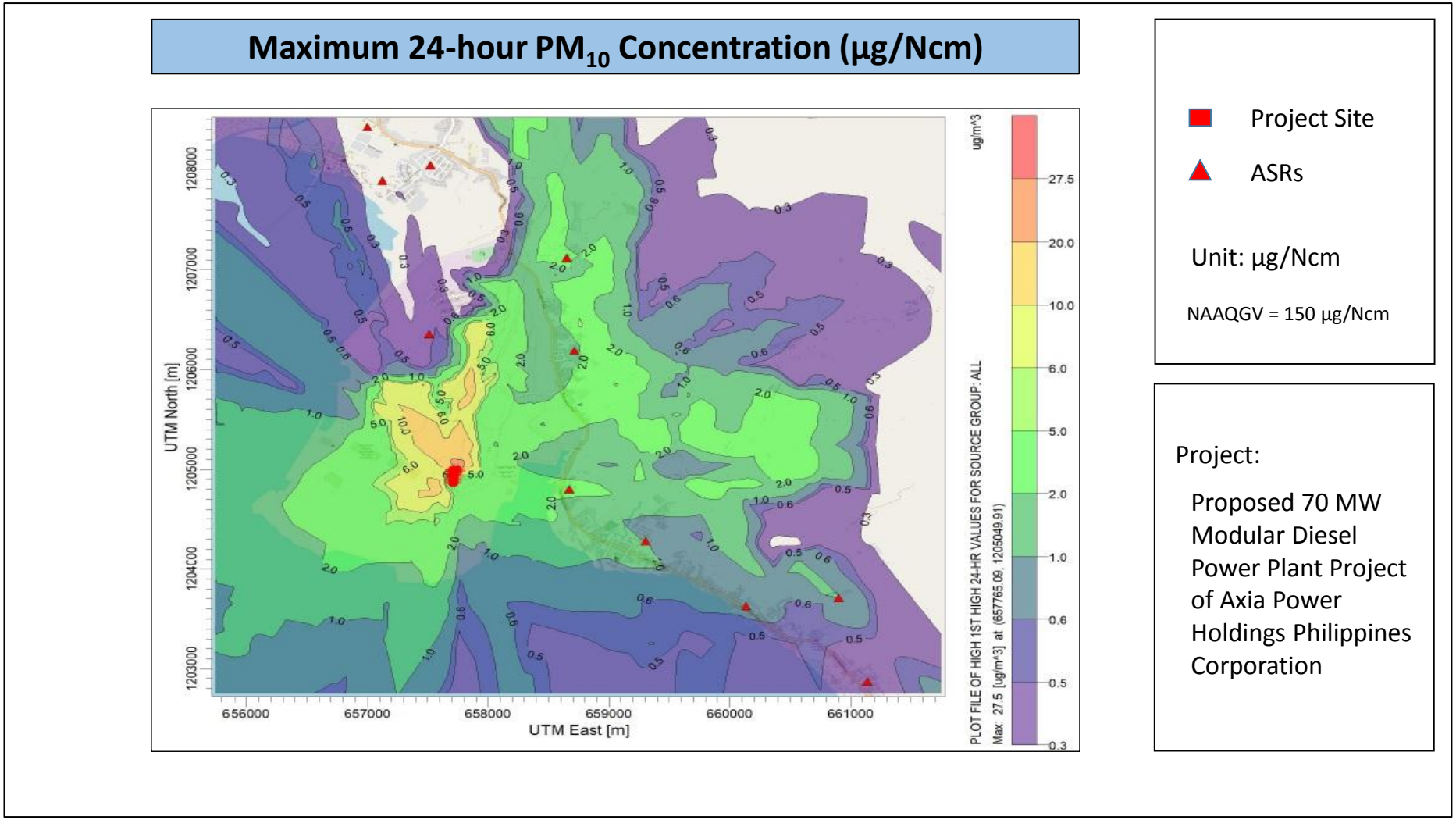


Figure 2-48. Isopleth of PM_{10} Concentration 24-hour averaging period Scenario 1

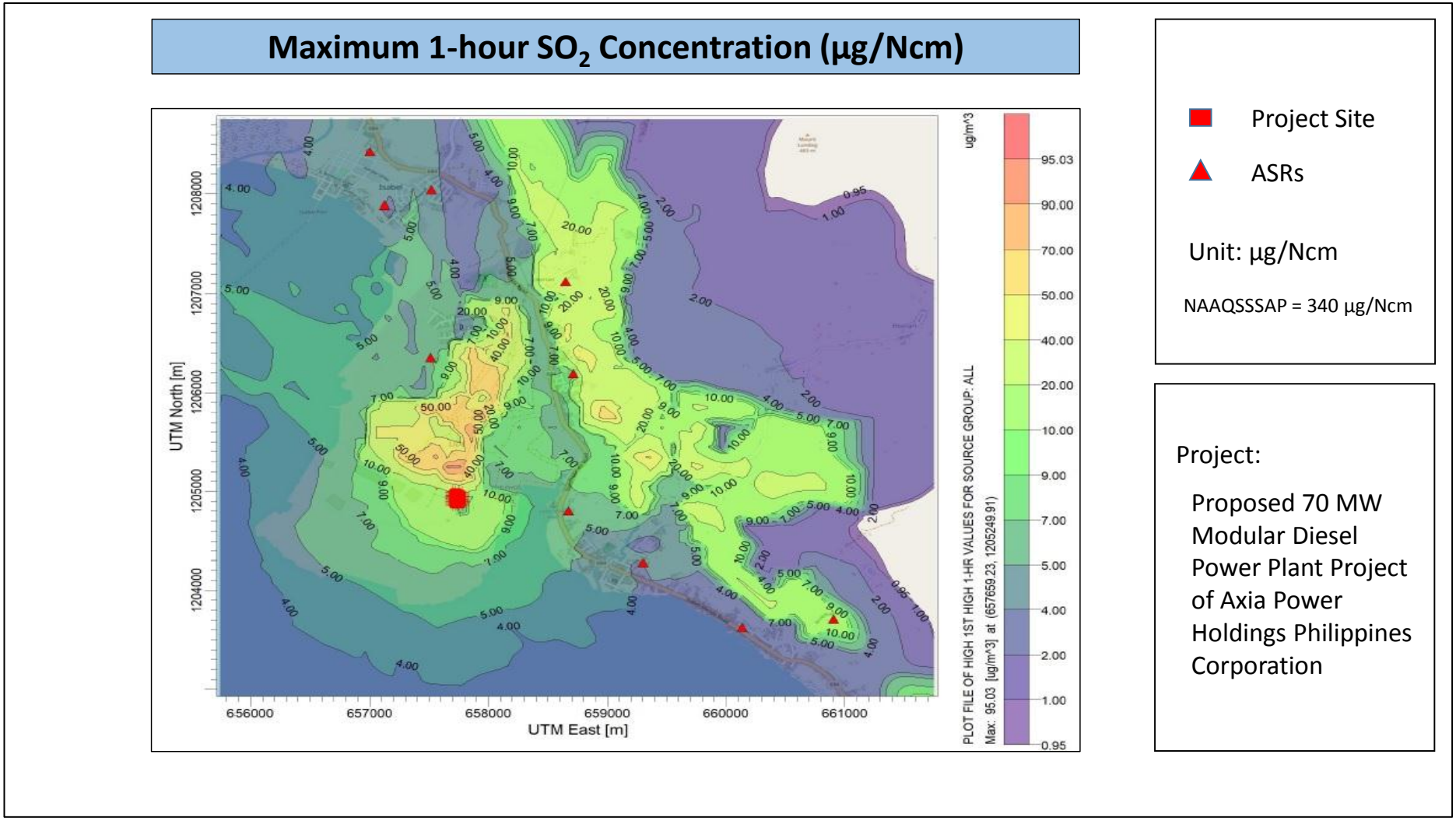


Figure 2-49. Isopleth of SO_2 Concentration 1-hour averaging period Scenario 2

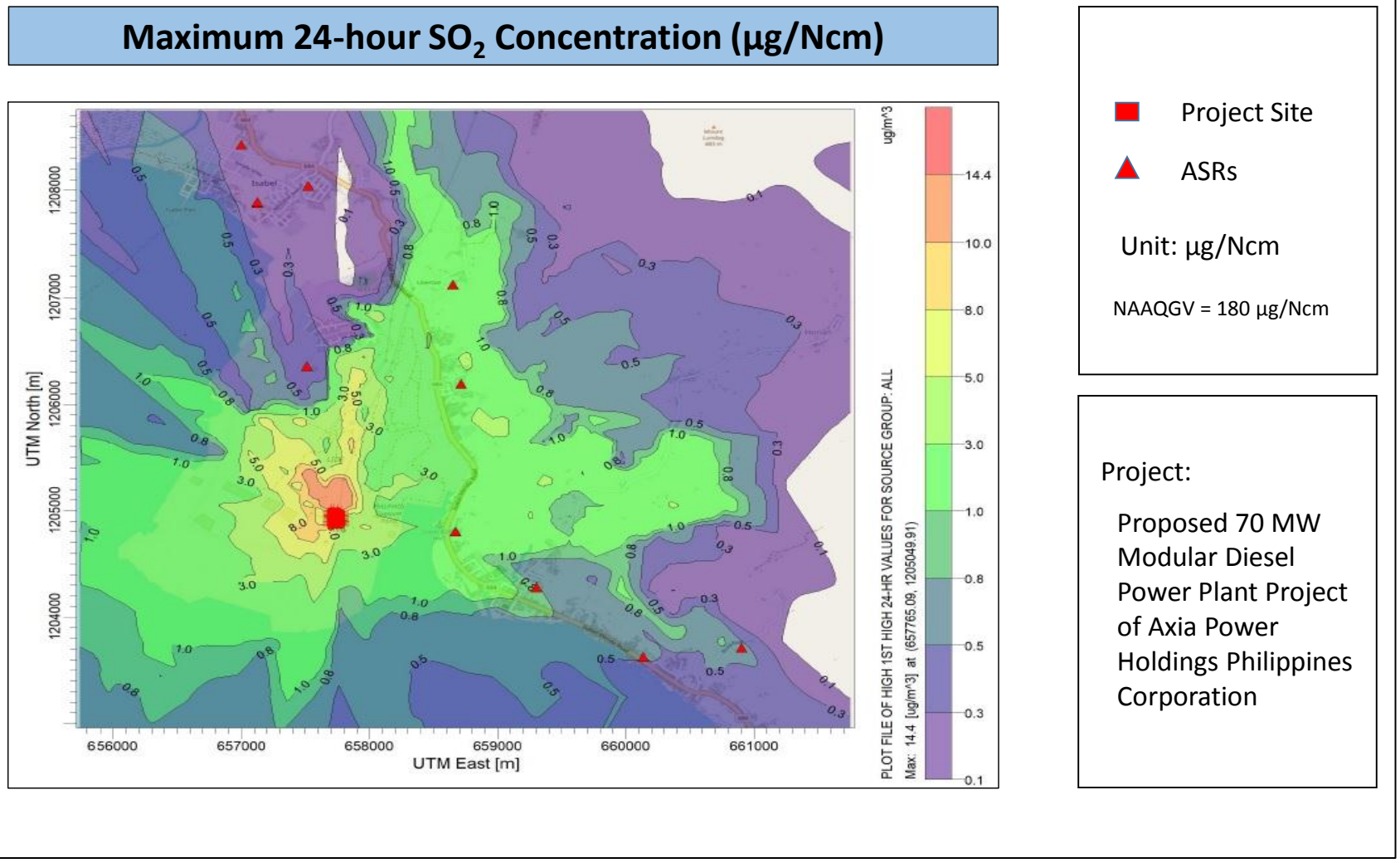


Figure 2-50. Isopleth of SO_2 Concentration 24-hour averaging period Scenario 2

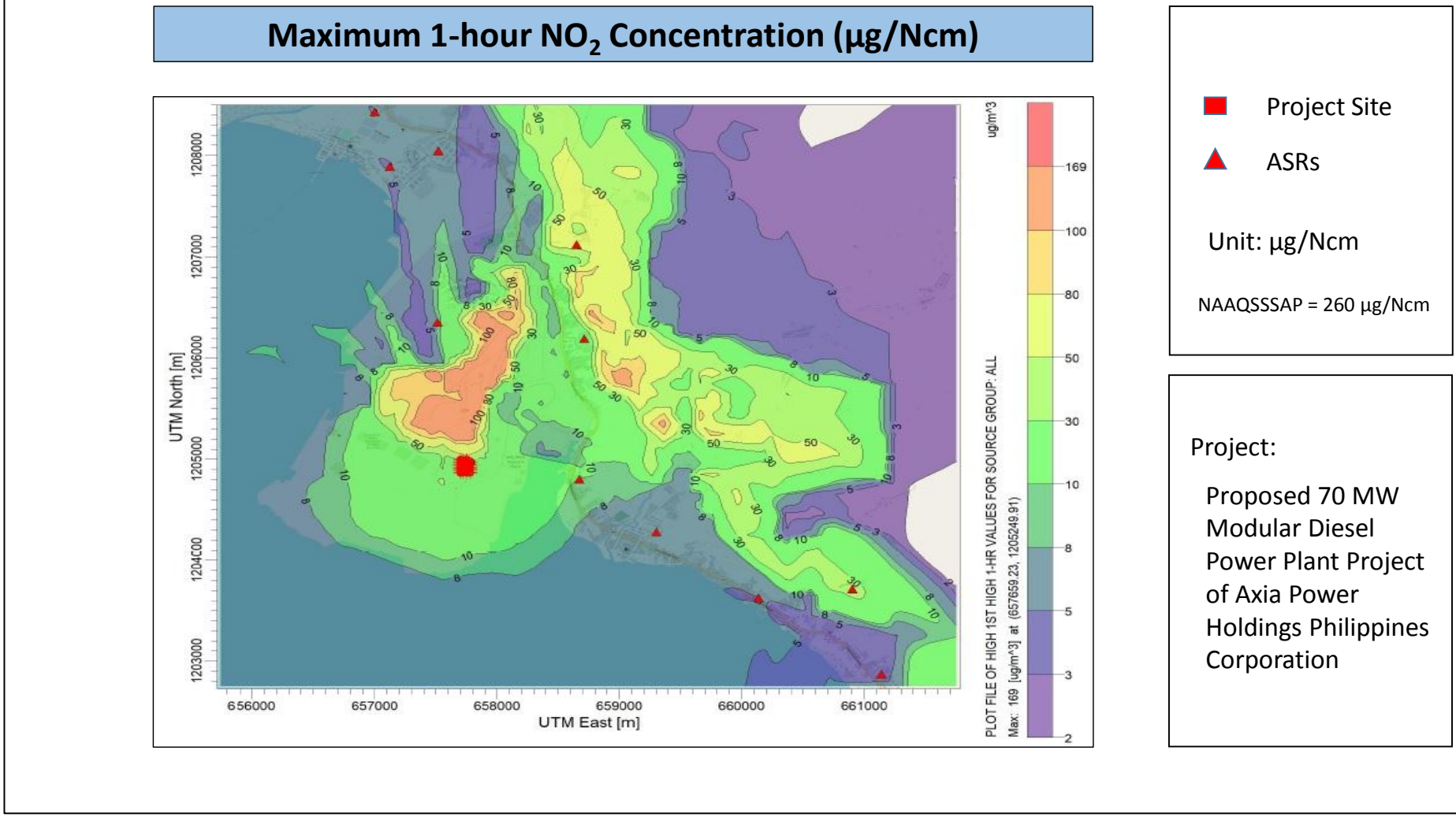


Figure 2-51. Isopleth of NO2 Concentration 1-hour averaging period Scenario 2

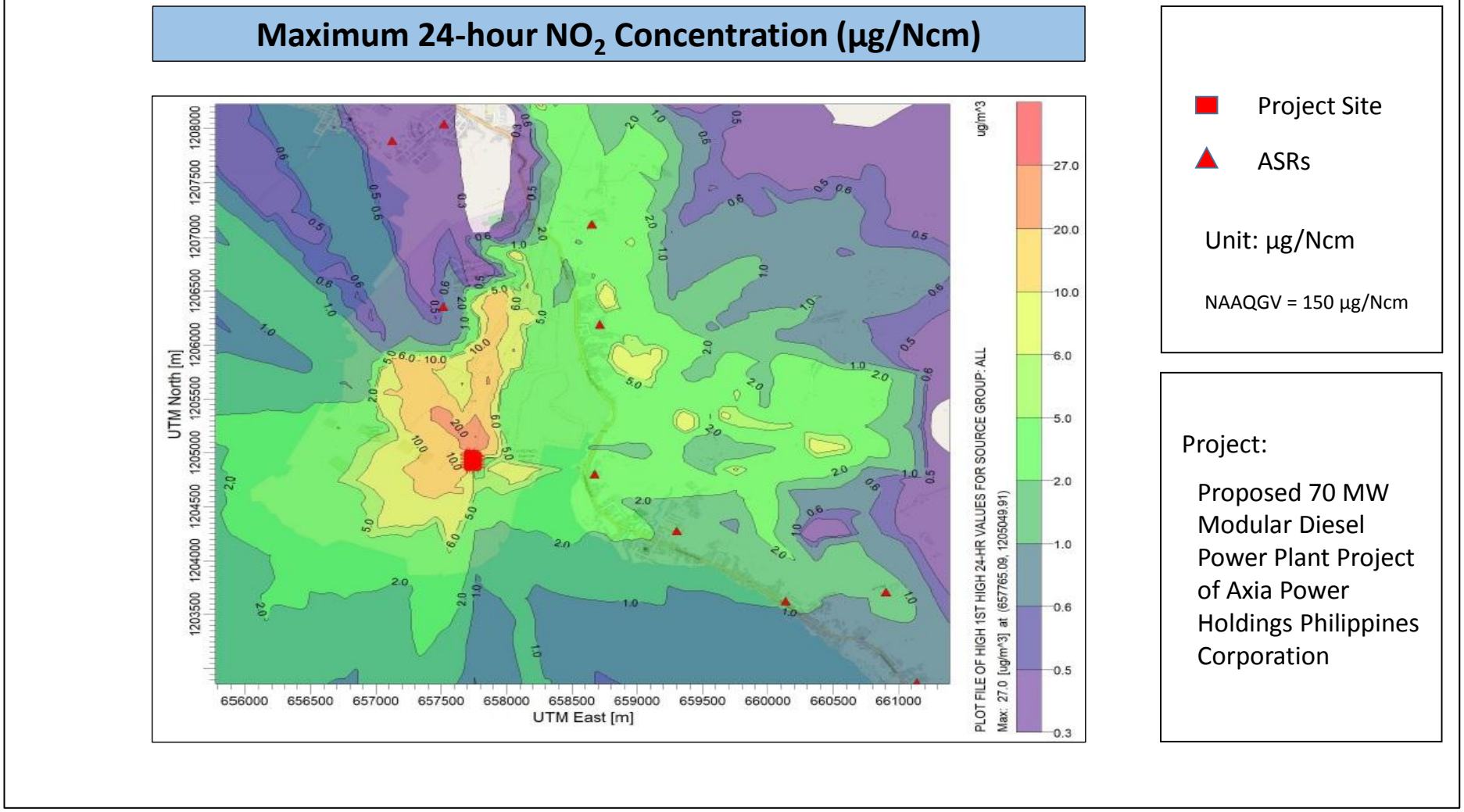


Figure 2-52. Isopleth of NO_2 Concentration 24-hour averaging period Scenario 2

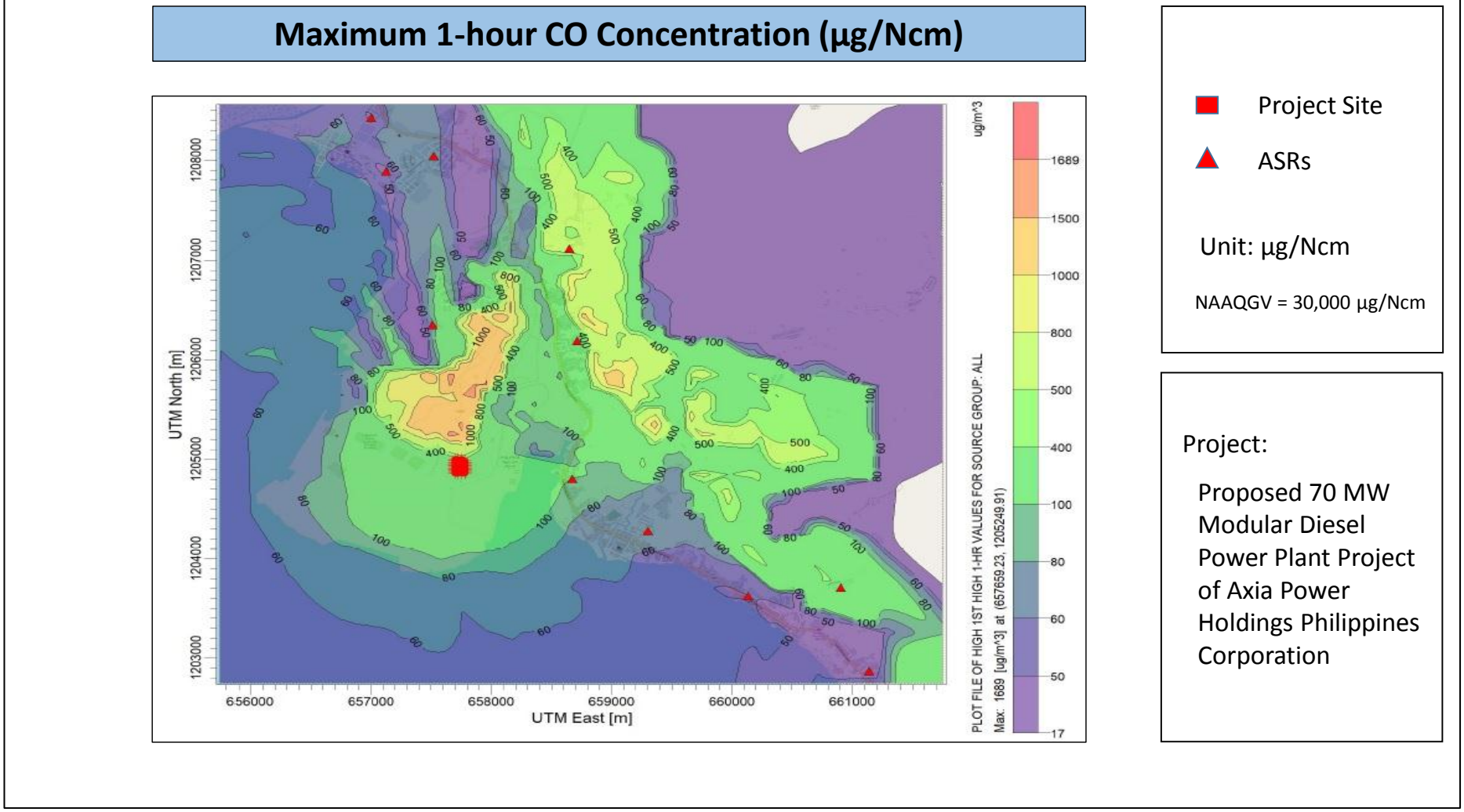


Figure 2-53. Isopleth of CO Concentration 1-hour averaging period Scenario 2

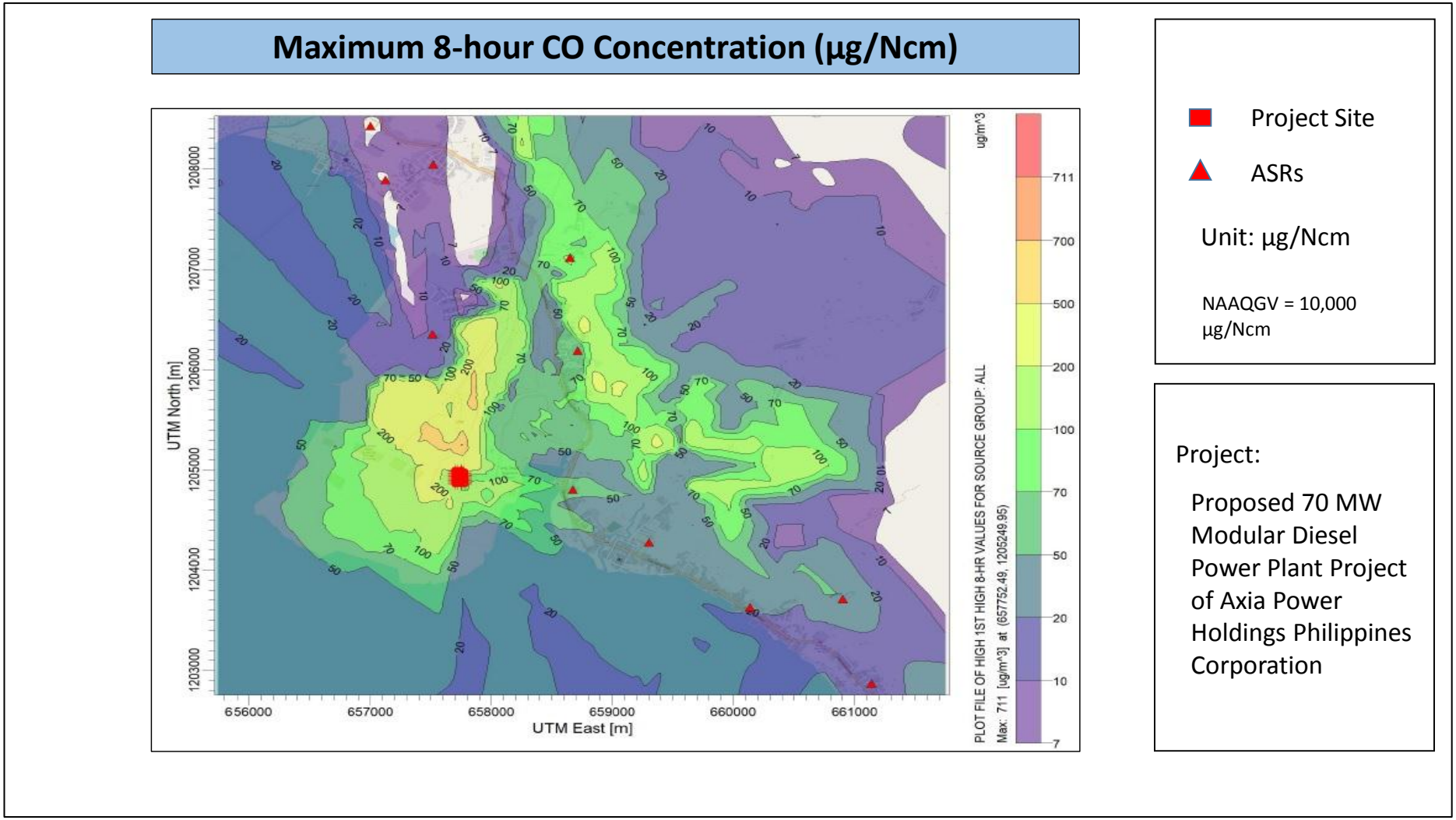


Figure 2-54. Isopleth of CO Concentration 8-hour averaging period Scenario 2

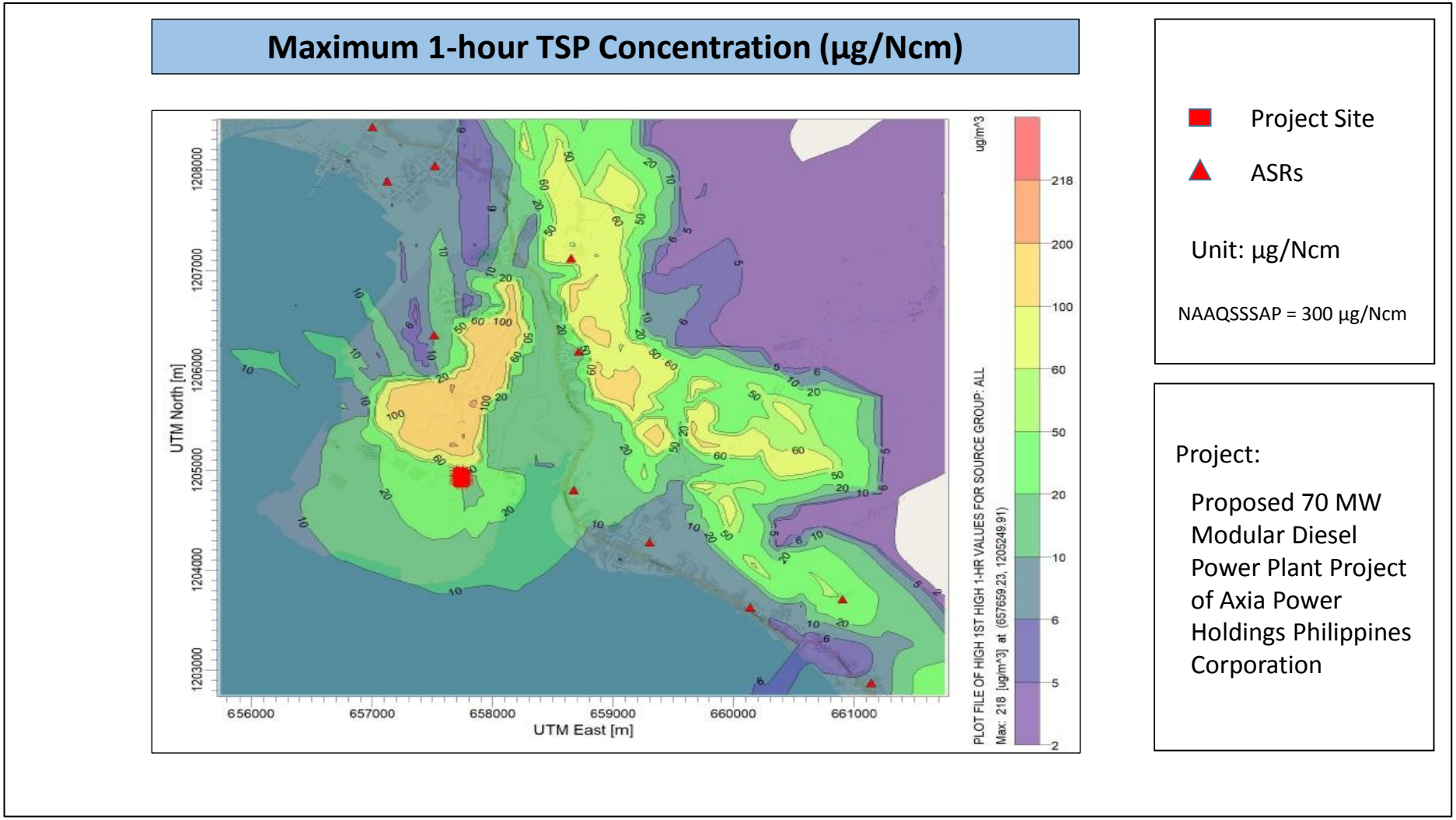


Figure 2-55. Isopleth of TSP Concentration 1-hour averaging period Scenario 2

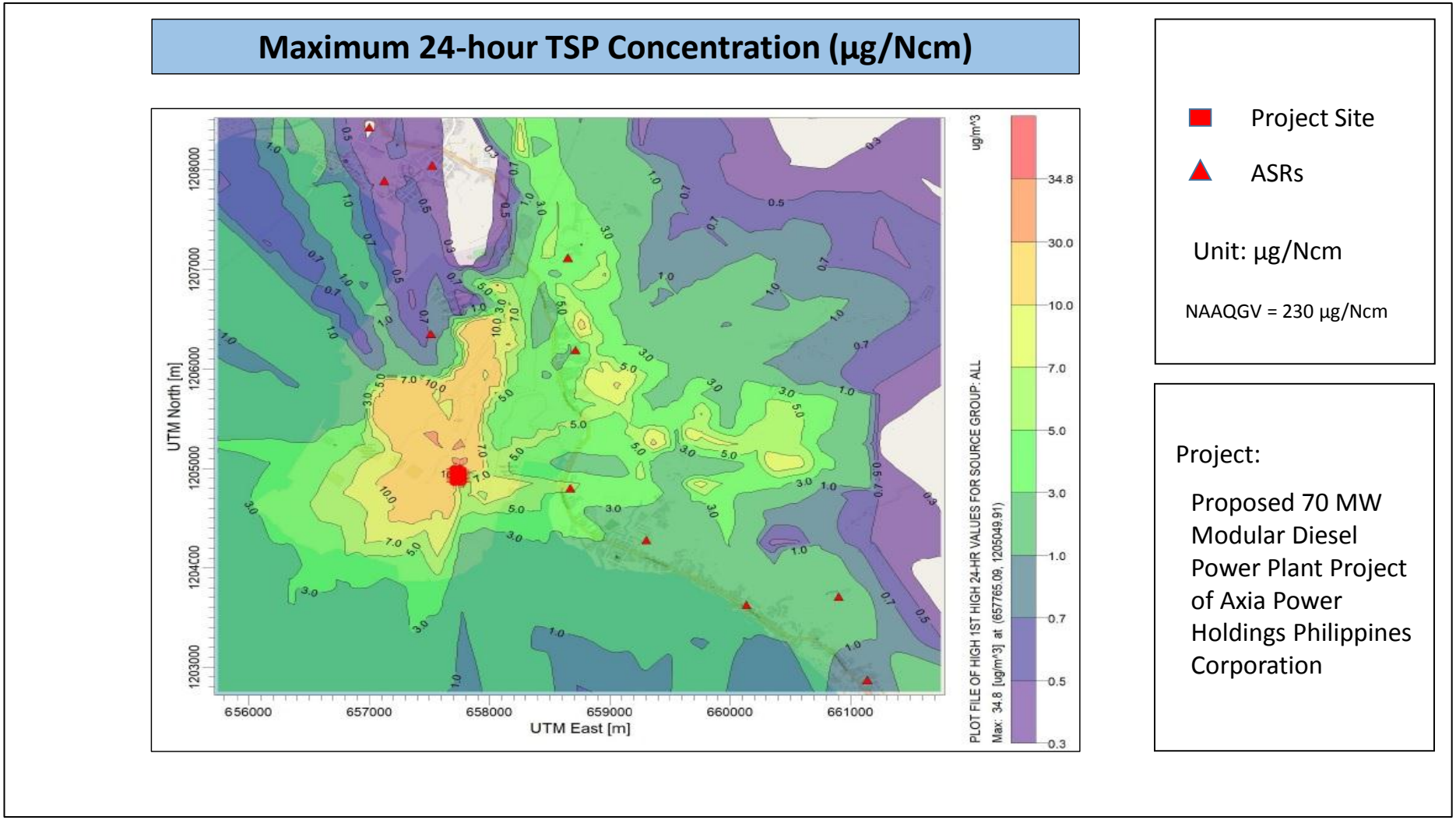


Figure 2-56. Isopleth of TSP Concentration 24-hour averaging period Scenario 2

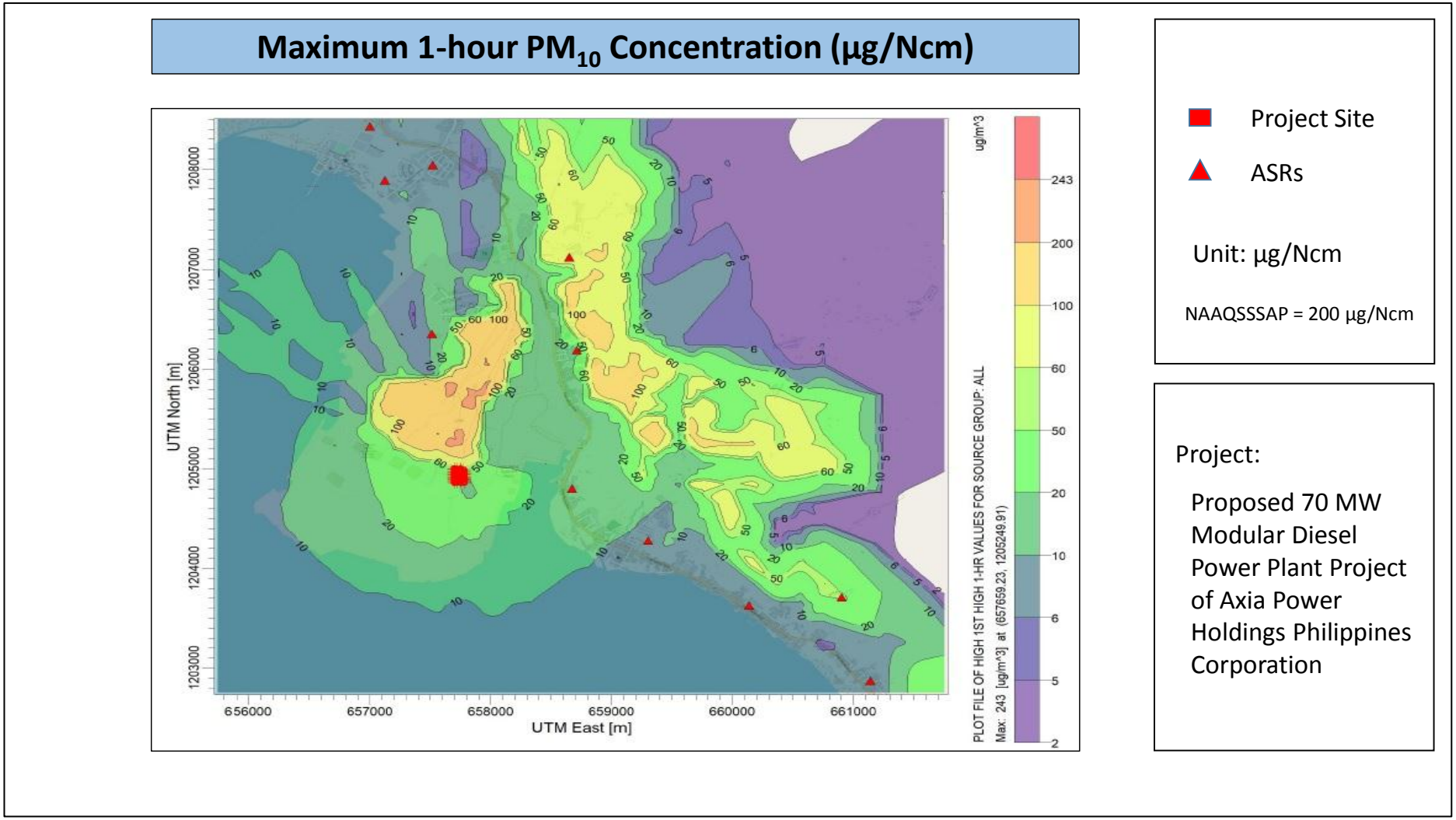


Figure 2-57. Isopleth of PM_{10} Concentration 1-hour averaging period Scenario 2

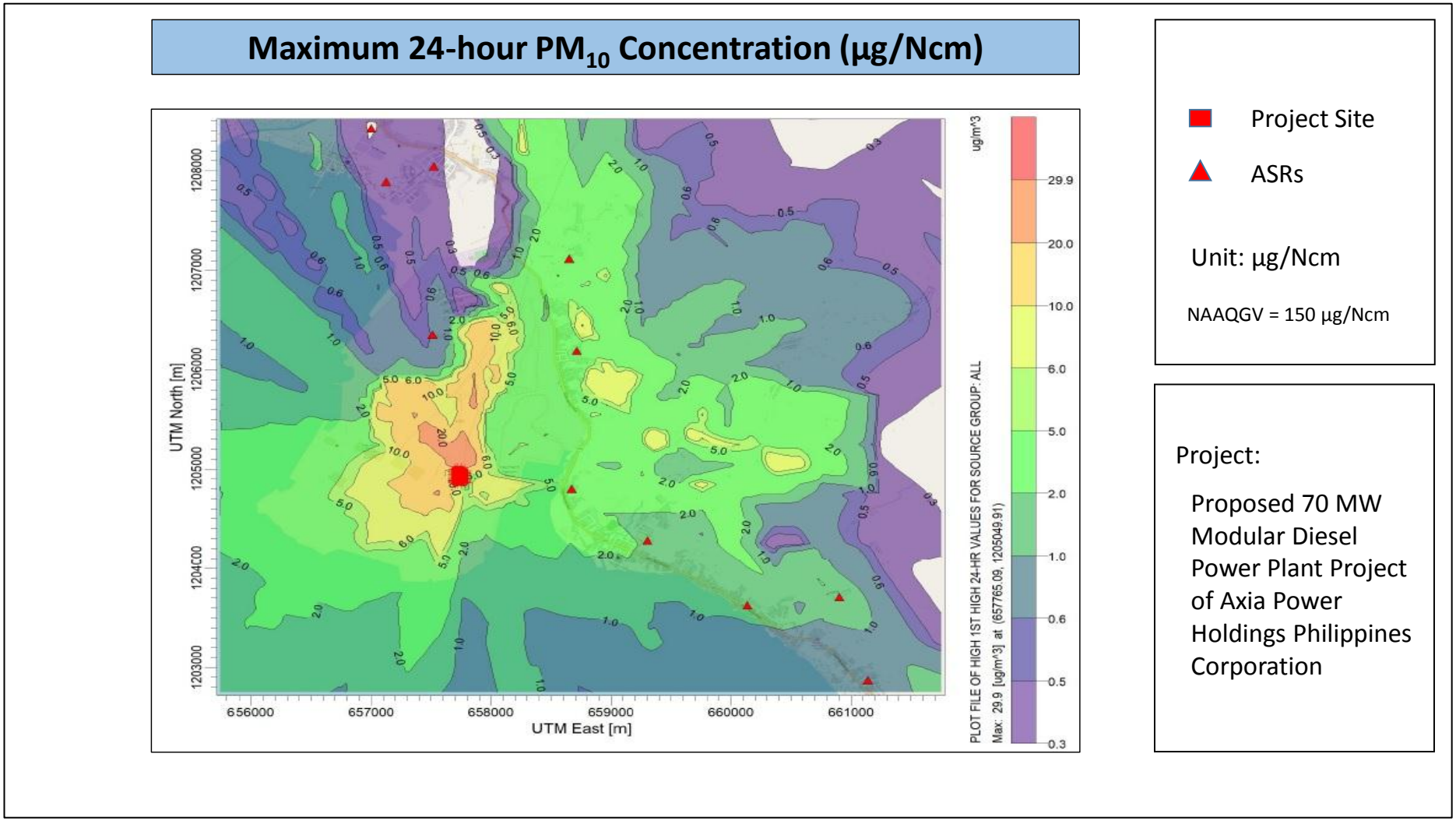


Figure 2-58. Isopleth of PM_{10} Concentration 24-hour averaging period Scenario 2

To lessen, control and prevent emission of NO_x (as NO_2) into the receiving environment, Low NOx Burners (**LNB**) shall be installed. LNB limit NOx 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 NOx formation; (ii) a reduced flame temperature that limits thermal NOx formation; and/or (iii) a reduced residence time at peak temperature which also limits thermal NOx formation.

2.3.2.4 Noise Quality

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

Noise level measurement was conducted in 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. **Table 2-43** presents the results of noise level monitoring conducted from November 5-7, 2017 at the ambient air quality monitoring stations. As shown in **Table 2-43**, the median noise level in all stations were below the allowable noise standards in Section 78, Table 1 of the 1978 NPCC Rules and Regulations, Environmental Quality Standard for Noise in general areas except for STN-2 Daytime. The location of STN-2 is in the parking area of LIDE Clubhouse where noise is expected because the site is full of recreational facilities such as basketball court, swimming pool, gym, etc.

Significant noise was contributed by vehicles plying near the stations which were situated in populated communities, with houses close to each other. Motorcycles and tricycles were main modes of transportation although there were few cars that pass along these roads.

During sampling, there were also activities that contribute to the noise levels measured, like youths playing basketball games, karaoke singing, etc. Activities like these are part of the community culture and so they were considered valid for inclusion in the measurement of baseline noise data.

Table 2-43. Results of Noise Levels Measurement

Station	Period	Date	Time	Median SPL dB(A)	DENR Noise Standard dB(A)
STN-1	Morning	Nov. 6, 2017	0642H-0652H	46.7	70
	Daytime	Nov. 5, 2017	1732H-1742H	56.0	75
	Evening	Nov. 5, 2017	2019H-2029H	51.1	70
	Nighttime	Nov. 5, 2017	2234H-2244H	51.2	65
STN-2	Morning	Nov. 7, 2017	0533H-0543H	47.8	50
	Daytime	Nov. 6, 2017	1703H-1713H	56.8	55
	Evening	Nov. 6, 2017	1943H-1953H	53.5	50
	Nighttime	Nov. 6, 2017	2251H-2301H	47.3	45
STN-3	Daytime	Nov. 7, 2017	1518H-1528H	50.4	65
STN-4	Daytime	Nov. 7, 2017	1645H-1655H	55.4	75
STN-5	Evening	Nov. 7, 2017	1829H-1839H	53.4	60
STN-6	Evening	Nov. 7, 2017	2024H-2034H	54.6	70

2.3.2.4 Impact in Noise Quality during Construction Phase

Quantitative Analysis

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. 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 2-44**. The equipment listed in the table are 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.

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

Table 2-44. Equivalent PWL of Power Mechanical Equipment during Construction Phase

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

The modeling guidelines used is the Technical Memorandum on Noise of Hongkong Environmental Protection Department, Noise Control Authority. Noise levels should be summed in a pairwise

fashion and the final total rounded to the nearest whole dB(A), with values of 0.5 or more being rounded up.[1]

Table 2-45 shows the summation of noise levels. The summed noise assumed to be at the centre of the Project site.

Table 2-45. Summation of Noise Levels

Difference in dB(A) Between Two Noise Levels Being Summed	Amount in dB(A) to Add to the Higher Noise Level
0 to 0.5	3.0
1.0 to 1.5	2.5
2.0 to 3.0	2.0
3.5 to 4.5	1.5
5.0 to 7.0	1.0
7.5 to 12.0	0.5
More than 12.0	0

Source: Technical Memorandum on Noise, Hongkong Environmental Protection Department

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. Construction activities are predicted to be its worst-case scenario where 24-hour operation is expected. Noise generated from blasting (if there's any) is not included in this modeling because blasting operation is on case to case basis only. CUSTIC software predict a continuous operation, if blasting is included, it simulated continuously for 24- hours.

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.

Noise Sensitive Receivers

Noise sensitive receiver can be defining as those locations or areas where dwelling units or other fixed, developed sites frequent human use occur (**FHWA**). The identified NSRs are the same as ASRs in the air dispersion modeling. Noise is simulated to determine the noise impact at the NSRs from the proposed Project.

Noise Modeling Input Data

The following input data were used to execute the noise simulation for Construction Phase:

- External source: External means a noise source placed out of a building (for example, a vehicle engine).
- 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 20,000 m x 20,000 m which is a scale view of CUSTIC 2.0. The following assumptions were made to execute the model:

- Ambient Temperature - 25°C

[1] Technical Memorandum on Noise, Hongkong Environmental Protection Department, Noise Control Authority, January 1996

- Relative Humidity – 80%
- Frequency – 500 Hz

Noise Modeling Results

Presented in **Table 2-46** is the predicted noise level at the plant boundary wall. The modeling result shows that the allowable noise level is within the standard, therefore noise emission from the construction of the proposed Project is not expected to cause significant impacts to the surrounding environment. The simulation is on 24-hours continuous operation. The predicted noise contour is presented in **Figure 2-59**.

Table 2-46. Predicted Noise Level at NSRs during Construction

Station No	Description	Predicted Noise Level (SPL), dB(A)	Allowable Noise Level, dB(A)		
			Daytime	Morning/ Evening	Nighttime
NSR-1	LIDE Staff Housing Compound, Brgy. Mahayag, Isabel	21.93	55	50	45
NSR-2	Central School of Isabel, Brgy. Marvel, Isabel	0.0	55	50	45
NSR-3	Isabel Adventist Elementary Schoolm Brgy. Santo Nino, Isabel	2.09	55	50	45
NSR-4	Residential Area, Brgy. Santo Nino, Isabel	3.04	55	50	45
NSR-5	Residential Area, Brgy. Anislag, Isabel	10.66	55	50	45
NSR-6	Libertad Elementary School, Brgy. Libertad, Isabel	22.84	55	50	45
NSR-7	Residential Area, Brgy. Matlang, Isabel	33.96	55	50	45
NSR-8	Matlang National High School, Brgy. Matlang, Isabel	19.72	55	50	45
NSR-9	Bilwang Central School, Brgy. Bilwang, Isabel	8.20	55	50	45
NSR-10	Relocation Site, Brgy. Binog, Isabel	0.29	55	50	45
NSR-11	Residential Area, Brgy. Tubod, Isabel	0.0	55	50	45

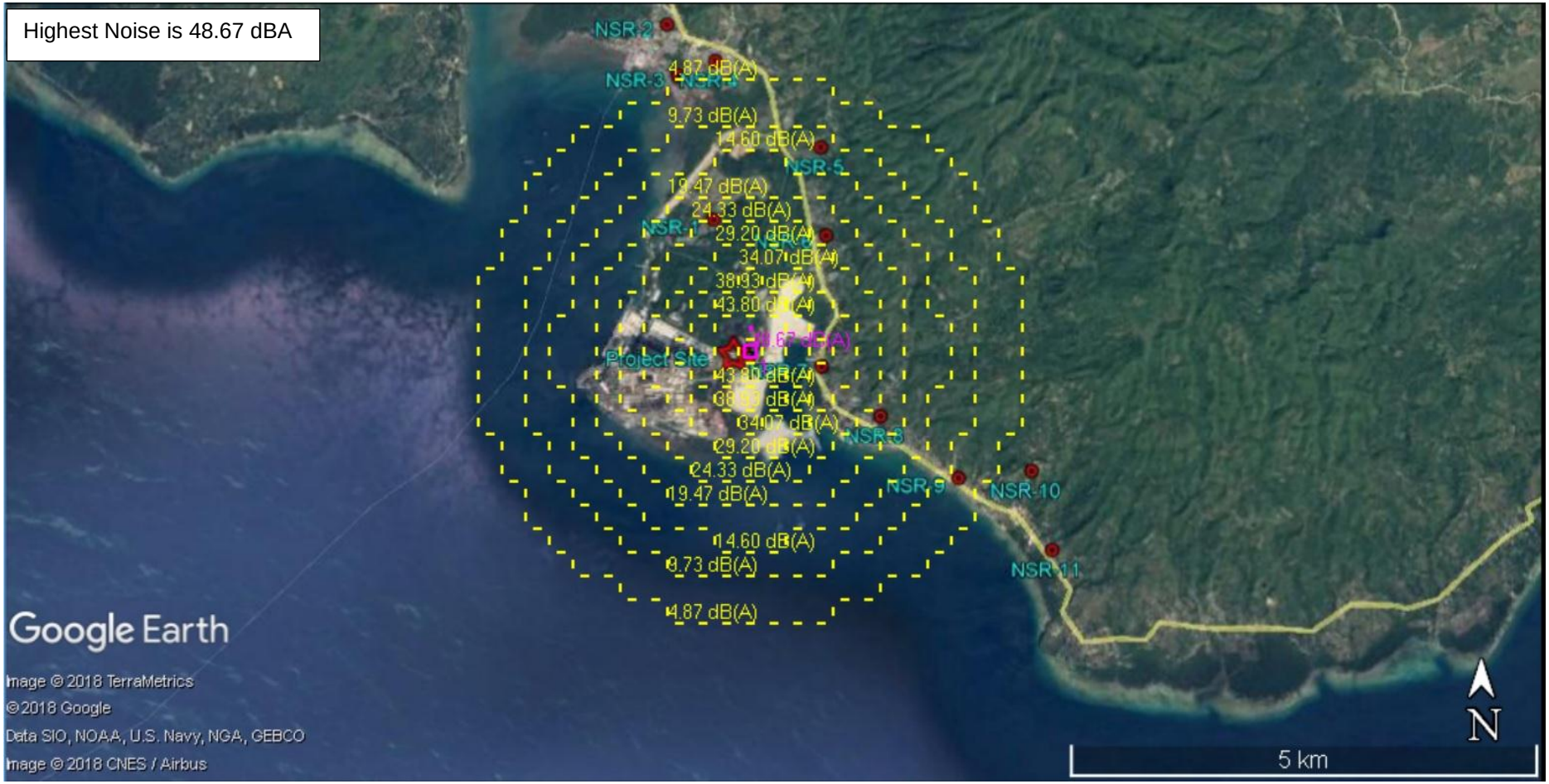


Figure 2-59. Predicted Noise Contour during Construction

The following measures shall 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 shall 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 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.

2.3.2.5 Impact in Noise Quality during Construction 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 power plant were based on the given equipment noise data, sizes, and dimensions. The list of power mechanical equipment during operation is presented in **Table 2-47**. However, it is advised that the detailed design should be updated to reflect equipment data whenever the design changes.

Table 2-47. Equivalent PWL of Power Mechanical Equipment for Operation Phase

Power Mechanical Equipment	PWL, dB(A)
Engine	121
Engine exhaust	120
Cooling Fan	105
Alternator	90
Induction	90

Source: Technical Information from Cummins Power Generation, 2007

From the table above, the total estimated sound power level for the operational equipment is 123 dB(A).

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

Modeling Input Data

The following input data were used to execute the Noise Simulation for the operation of the power plant:

- Internal source such as generator, 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 20,000 m x 20,000 m grid which is a scale view of CUSTIC 2.0. The following assumptions were made to execute the model:

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

Noise Modeling Results

The predicted noise levels at the plant boundary for the operation of the proposed Project as exhibited in **Table 2-48** are all below the noise condition during daytime, morning/evening and night time. Therefore, 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 2-60**.

Table 2-48. Predicted Noise Level at the Boundary of the Proposed Plant during Operation

Station No	Description	Predicted Noise Level (SPL), dB(A)	Allowable Noise Level, dB(A)		
			Daytime	Morning/ Evening	Nighttime
NSR-1	LIDE Staff Housing Compound, Brgy. Mahayag, Isabel	34.26	55	50	45
NSR-2	Central School of Isabel, Brgy. Marvel, Isabel	9.78	55	50	45
NSR-3	Isabel Adventist Elementary Schoolm Brgy. Santo Nino, Isabel	15.29	55	50	45
NSR-4	Residential Area, Brgy. Santo Nino, Isabel	16.24	55	50	45
NSR-5	Residential Area, Brgy. Anislag, Isabel	23.86	55	50	45
NSR-6	Libertad Elementary School, Brgy. Libertad, Isabel	36.04	55	50	45
NSR-7	Residential Area, Brgy. Matlang, Isabel	43.16	55	50	45
NSR-8	Matlang National High School, Brgy. Matlang, Isabel	36.04	55	50	45
NSR-9	Bilwang Central School, Brgy. Bilwang, Isabel	21.40	55	50	45
NSR-10	Relocation Site, Brgy. Binog, Isabel	13.49	55	50	45
NSR-11	Residential Area, Brgy. Tubod, Isabel	7.17	55	50	45

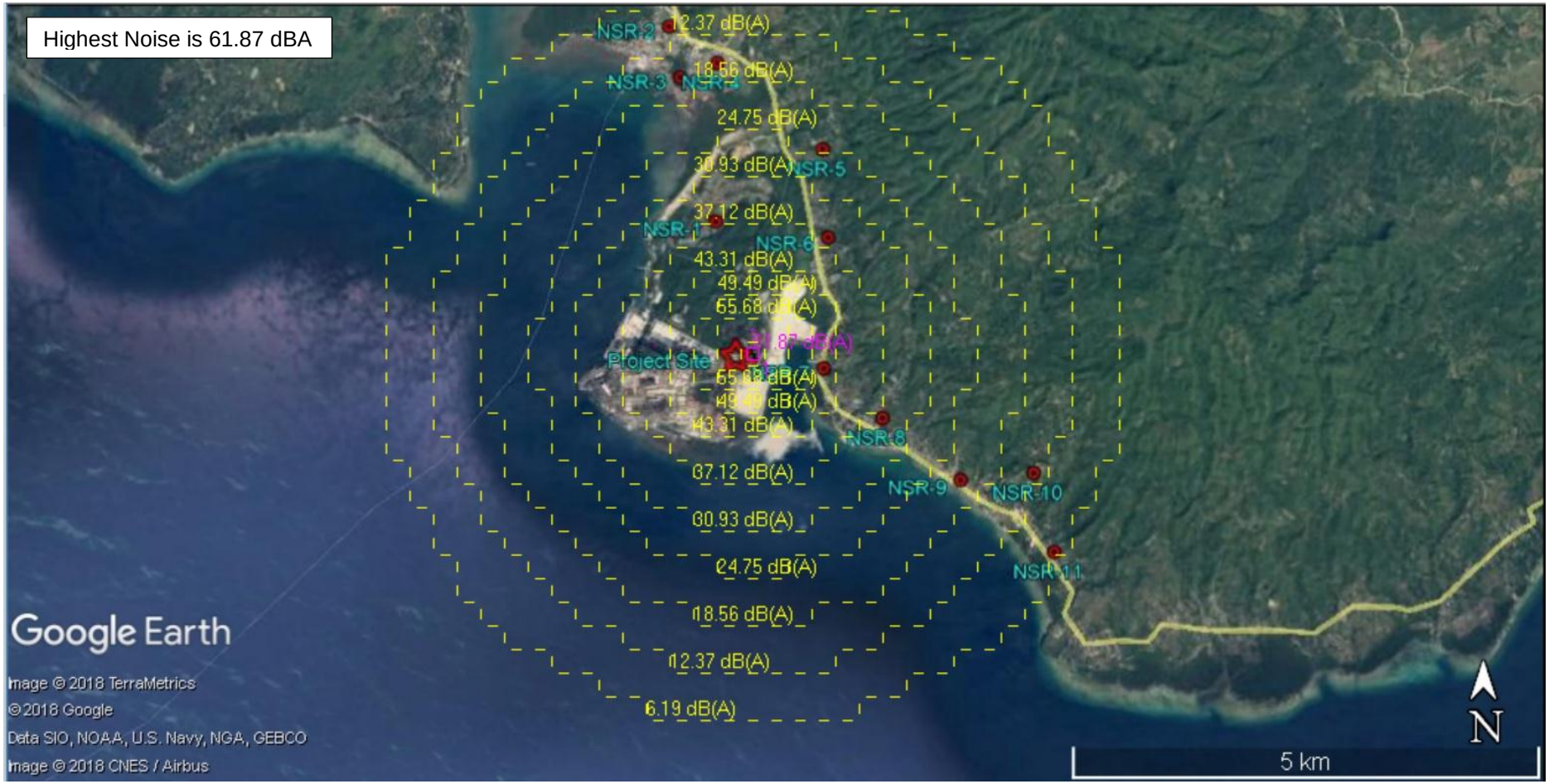


Figure 2-60 Predicted Noise Contour during Operation

It is clearly important to limit the noise emission of all major noise sources in the plant 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 power plant 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 plant 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 inside the plant.

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 areas 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 machines operators from the harmful consequences of excessive noise;
- 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; and
- Defective equipment/parts with abnormal noise and/or vibration will be either repaired or replaced.

2.4 PEOPLE

2.4.1 Displacement of Settlers

The proposed project will not cause displacement of settlers and properties for it will be located within an existing industrial estate in Isabel, Leyte.

Isabel, Leyte is a first class municipality located in the north east coast of Leyte Island about 150 kilometers from Tacloban City. It is bounded by the municipalities of Palompon in the North and Merida in the East and Camotes Sea in the South and West. It can be reached by any mode of land transportation through highway passing through Ormoc City or Palompong Leyte. It can also be accessed by seacrafts from Danao City, Cebu and Camotes, Cebu. Isabel, Leyte has a seaport as well in Barangay Libertad (Pingag).

Land Area, Population, Population Density and Growth Rate. Isabel Municipality has a total of 24 barangays covering an area of 5,717.92 ha. Barangay Libertad, the host barangay of the proposed Project, covers 190.13 hectares or 3.33% of the municipality's total land area. The August 2015 population census conducted by the Philippine Statistics Authority (**PSA**) had recorded 46,915 persons in Isabel Municipality. The five (5) most populous barangays are Matlang, Libertad, Santo Niño, Marvel (Pob.) and Bilwang. **Table 2-49** presents the land area and 2015 population per barangay of Isabel.

Table 2-49. Land Area and Population per Barangay of Isabel

Barangay	Land Area		Population			
	Area (ha)	Classification	Number, 2010	Density	Number, 2015	Density
Anislag	218.10	Rural	562	2	738	3
Antipolo	85.39	Rural	550	6	611	7
Apale	220.88	Rural	1,697	7	1,836	8
Bantigue	244.94	Rural	2,085	8	2,339	10
Benog	304.66	Rural	607	1	664	2
Bilwang	107.19	Rural	2,878	26	3,062	29
Can-andan	141.18	Rural	373	2	410	3
Cangag	450.55	Rural	601	1	674	1
Consolacion	295.21	Rural	443	1	566	2
Honan	443.67	Rural	1,053	2	1,096	2
Libertad	**190.13**	Rural	**4,870**	**25**	**5,332**	**28**
Mahayag	194.89	Rural	1,959	10	2,269	12
Marvel (Pob.)	174.58	Urban	3,568	20	4,093	23
Matlang	441.63	Rural	5,841	13	5,972	14
Monte Alegre	281.07	Rural	649	2	799	3
Putting Bato	844.75	Rural	659	0.78	779	1
San Francisco	143.97	Rural	859	5	973	7
San Roque	6.61	Urban	1,614	244	1,625	246
Santa Cruz	5.77	Urban	1,680	321	1,687	292
Santo Niño	264.36	Urban	5,151	19	5,293	20
Santo Rosario	3.05	Urban	839	275	962	315
Tabunok	312.61	Rural	1,912	6	1,885	6
Tolingon	225.87	Rural	1,723	7	1,829	8
Tubod	116.86	Rural	1,340	11	1,421	12
Total Isabel	**5,717.92**		**43,593**	**8**	**46,915**	**9**

Note: Urban-rural barangay classification - barangay should have at least 1,000 inhabitants, the occupation is predominantly non-farming or fishing and/or meet the following: population density of at least 500 persons/sq.km or regardless of population with street pattern or network of streets, at least 6 establishments, at least 3 of the following: town hall, church, public plaza, park or cemetery, market place, school hospital or health center

Source: 2015 Census and Housing Population; 2015 Philippine Statistics Authority, Total Population by Province, City, Municipality and Barangay as of August 1, 2015

The population of Isabel, Leyte has increased by 1.56% from 43,513 in 2010 to 46,915 in 2015. On the other hand, the population of the host Barangay Libertad increased by 1.90% from 4,870 in 2010 to 5,332 in 2015. **Table 2-50** presents the population history and annual growth rate per barangay of Isabel from 2010-2015.

Table 2-50. Annual Growth Rates per Barangay of Isabel Municipality

Barangay	Total Population		Annual Growth Rate (%)
	2010	2015	
Anislag	562	738	6.26
Antipolo	550	611	2.22

Barangay	Total Population		Annual Growth Rate (%)
	2010	2015	
Apale	1,697	1,836	1.64
Bantigue	2,085	2,339	2.44
Benog	607	664	1.88
Bilwang	2,878	3,062	1.28
Can-andan	373	410	1.98
Cangag	601	674	2.43
Consolacion	443	566	5.55
Honan	1,053	1,096	0.82
Libertad	**4,870**	**5,332**	**1.90**
Mahayag	1,959	2,269	3.16
Marvel (Pob.)	3,568	4,093	2.94
Matlang	5,841	5,972	0.45
Monte Alegre	649	799	4.62
Putting Bato	659	779	3.64
San Francisco	859	973	2.65
San Roque	1,614	1,625	0.14
Santa Cruz	1,680	1,687	0.08
Santo Niño	5,151	5,293	0.55
Santo Rosario	839	962	2.93
Tabunok	1,912	1,885	-0.28
Tolingon	1,723	1,829	1.23
Tubod	1,340	1,421	1.21
Total Isabel	**43,513**	**46,915**	**1.56**

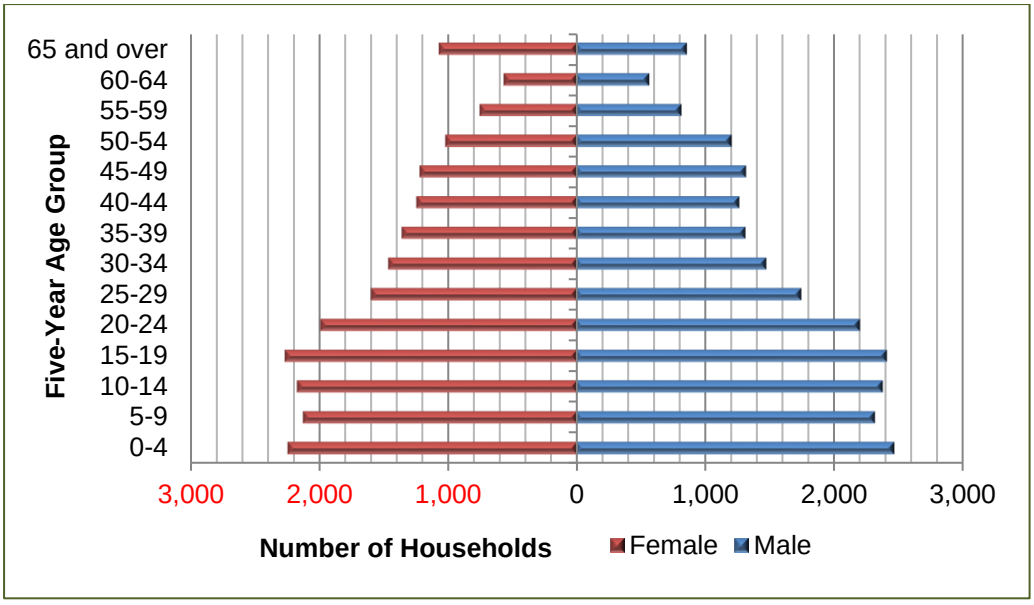
Source: PSA

Household Size and Gender and Age Profile. In 2010, PSA had recorded a total of 43,524 households in Isabel. The recorded data also shows that Isabel had more males than females. The proportion of the population aged 0 to 14 was 31.52%. The productive aged 15 to 64 years comprised 64.03% of the total population while only 4.45% of the populations were 65 years old and above. **Table 2-51** and **Figure 2-61** present the Percent Distribution of Household Population by Age and Sex of Isabel.

Table 2-51. Total Household Population on Isabel by Five-Year Age Group, Sex, 2010

Five-Year Age Group	Number of Household		
	Total	Male	Female
0-4	4,717	2,467	2,250
5-9	4,448	2,318	2,130
10-14	4,555	2,377	2,178
15-19	4,682	2,410	2,272
20-24	4,197	2,201	1,996
25-29	3,352	1,749	1,603
30-34	2,944	1,477	1,467
35-39	2,679	1,315	1,364
40-44	2,518	1,269	1,249
45-49	2,544	1,321	1,223
50-54	2,232	1,207	1,025
55-59	1,578	819	759
60-64	1,141	570	571
65 and over	1,937	863	1,074
Total	**43,524**	**22,363**	**21,161**

Note: Figures are based on 20% sample households.
Details may not add up to total due to rounding off.
Source: 2010 Census of Population and Housing, PSA



Source: 2010 Census of Population and Housing, PSA

Figure 2-61. Age-Sex Distribution Pyramid

There will be no settlers and properties that will be displaced, land ownership transfer, right-of-way conflict and land use conversion for the proposed Project will be cited in the LIDE of LMC.

2.4.2 In-migration

Migration. Most of the households (99.45%) in Isabel are non-movers, as presented in **Table 2-52**.

Table 2-52. Households Reporting Intention to Reside in Isabel of Residence Five Years from 2010

Total Number of Households	Residence Five Years from 2010				
	Same Province/ Municipality (Non-movers)	Same Province Different Municipality (Domestic Short Distance Movers)	Different Province (Domestic Long Distance Movers)	Foreign Country (Immigrants)	Not Reported
10,075	10,020	20	15	10	10

Note: Figures are based on 20% sample households. Details may not add up to total due to rounding off.
Source: 2010 Census of Population and Housing, PSA

Influx of migrant workers during the construction and operation phases of the proposed Project will intensify the competition for jobs of locals. Locals who are qualified shall be given the opportunities and priority to seek employment from the proposed Project. IASCL and its Contractors shall maximize the use of local labor as possible.

2.4.3 Cultural/Lifestyle Change

There are no ethnic groups or cultural minorities known to exist in Isabel Municipality. Semi-urban lifestyle prevails in the municipality. The population is predominantly Roman Catholic. However, surge of various religious affiliations recently has been very noticeable.

In terms of lifestyle, there is not much change projected since there is already an existing industries within the LIDE. Migrant workers may bring in cultures and views not acceptable to the locals.

Sometimes, the presence of foreign labor in the area is associated with increased crime rate and other social ills.

Locals who are qualified shall be given the opportunities and priority to seek employment from the proposed Project. Some residents may have to increase the pace of their lifestyle to keep up with the increased demands of employment and livelihood opportunities.

2.4.4 Impacts on Physical Cultural Resources

The Isabel Municipality has some tourist spots such as the Candonicot Cave in Barangay Bantigue, the Bentoraray Cave in Barangay Tolingon, Hombayon Spring in Barangay Tabunok and Apale Falls in Barangay Apale. Candonicot Cave is 8km away from Poblacion. Bentoraray Cave is 20 min ride from Poblacion and is located along the coast of Barangay Tolingon. Honbayon Spring can be reach by means of tricycle or multi-cabs within 10 min. Apale falls is about 4km walk from Barangay Apale proper. These places are still in their pristine state and tourist can enjoy their natural beauty.

The proposed Project site is to be located within LIDE and is classified industrial area. Moreover, there will be no direct impact on the identified tourist spots and other physical cultural resources and landscapes that have historical or cultural significance since they are relatively distant from the project site.

Since the Project involves earthmoving activities, possible unearthing of artifacts and archeological remains is inevitable. In the event that an archaeological asset is discovered during the course of construction period, the following procedure shall be implemented:

1. IASCL must preserve the potential archaeological finds and report it immediately to the National Museum.
2. Closely coordinate with the National Museum on the appropriate course of action in protecting the archaeological finds.
3. Cease immediately all construction activities in the vicinity of the find/feature/site;
4. Hire an archaeological professional, recognized by the National Museum, to ensure the following are carried out:

    - Delineate the discovered find/feature/site;
    - Record the coordinates of the find location, and all remains are to be left in place;
    - Secure the area to prevent any damage or loss of removable objects;
    - Assess, record and photograph the find/feature/site;
    - Undertake the inspection process in accordance with all project health and safety protocols under direction of the Health and Safety Officer;
    - Conduct all investigation of archaeological soils by hand;
    - Keep all finds, osteological remains and samples and submit to the National Museum as required;
    - In the event that any artefacts need to be conserved, secure approval from the National Museum;
    - Provide an on-site office and finds storage area to allow storage of any artefacts or other archaeological material recovered during the monitoring process;
    - In the case of human remains, in addition to the above, contact the National Museum and adhere to the guidelines for the treatment of human remains; and
    - If skeletal remains are identified, tap an osteo-archaeological to examine the remains

5. Implement the following process for conservation:

    - Hire a conservator, if required
    - The consulting archaeologist completes a report on the findings and submits to the National Museum
    - National Museum reviews the report and informs when works can resume

2.4.5 Threat to Delivery of Basic Services/Resource Competition

In view of the entry of migrant workers and increase of economic activities due to the proposed Project, there could be overburdening of public social services in the area and possible resource competition in terms of food, water supply, electricity and medical supply.

To prevent competition for public basic services, the IASCL will provide temporary housing/ construction camp for non-resident workers. The water requirement for the proposed Project will be sourced from the LMC Pumping Station located in Barangay Salvacion, Ormoc City. The facility consists of eight (8) deep well pumps with a capacity of 5,600m^3/day per pump. There are two (2) back-up pumping stations at Tabunok and Matlang with a capavity of 4,300 m^3/day and 3,700 m^3/day, respectively. These pumping stations are reserved sources in case the Ormoc pumping station is not operational. LIDE has a 15,000m^3 storage tank capacity which is kept full for emergency purposes. IASCL shall implement necessary measures to conserve water and reduce water usage. Power supply will be source from the power plant itself.

2.4.6 Threat to Public Health and Safety

The health service in Isabel Municipality is being delivered by the Department of Health (**DOH**) through its Rural Health Unit (**RHU**). The RHU is composed of a municipal health officer, public health nurse, rural health midwife, dentist, medical technicial and rural sanitary inspector. The RHU building is located at Simangan, Barangay Sto. Niño along the national road.

In order to be able to effectively serve the needs of the populace, there are five (5) barangay health stations (**BHS**) located in Barangays Bantigue, Matlang, Monte-alegre, Cangag and Tolingon. These stations serve adjacent barangays within a range of 3-8km. They are manned by one (1) rural health midwife each.

The RHU and BHS personnel render Maternal and Child Health care services such as Expanded Program on Immunization, Nutrition Program, Control of Diarrheal Diseases, Under Five Clinics, Maternal Care and Family Planning. They also render health education, immunization, internal medicine, eye, ear, nose, throat clinic, emergency/first aid, simple laboratory examinations (urinalysis/blood typing), dental health service, and ambulance services. They implement the National Tuberculosis Program, Sexually Transmitted Diseases Control and the National Leprosy Control Program.

Aside from the health centers, the services of private practitioners consisting of medical doctors and dentists are also available to the residents of the municipality. There is one (1) pediatrician and one (1) general medicine practitioner in the poblacion. The Canora Clinic and Laboratory in poblacion also offers medical services to the residents of Isabel. PhiliPhos and PASAR Hospital located inside the LIDE serve the medical and dental needs of its employees and dependents. They also admit patients in emergency cases. Isabel Municipality has only one private dental clinic situated in the poblacion.

The health data of Isabel from 2008 to 2012 showed that the leading caused of morbidity in the municipality is the Uppert Respiratory Tract Infection, with an average cases of 3,517 cases. **Table 2-53** presents the ten (10) leading causes of morbidity in Isabel Municipality, while **Table 2-54** presents the ten (10) leading causes of mortality.

Table 2-53. Leading Causes of Morbidity from 2008-2012

Causes	Number of Cases (Average)
1. Upper Respiratory Tract Infection	3,517
2. Bronchitis	1,549
3. Urinary Tract Infection	1,023
4. Wounds (All Kinds)	619
5. Skin Diseases (All Kinds)	525
6. Acute Gastritis	243
7. Acute Gastroenteritis	224

Causes	Number of Cases (Average)
8. Musculo-Eskeletal Diseases	193
9. Vitamin Deficiency	181
10. Asthma	100

Source: RHU of Isabel Municipality, PASAR EPRMP

Table 2-54. Leading Causes of Mortality from 2008-2012

Causes	Number of Cases (Average)
1. Cardio Vascular Disease	84
2. Cancer (All Forms)	31
3. Pneumonia	12
4. Renal Diseases	9
5. Diabetes Mellitus	8
6. Bleeding Peptic Ulcer Disease	7
7. Status Ashmaticus	6
8. Chronic Obstructive Lung	4
9. Liver Cirrhosis	4
10. Hemorrhage Sec. to Stab/Gunshot Wound	3

Source: RHU of Isabel Municipality, PASAR EPRMP

Isabel Municipality has a dump site located at Sition Can-esco, Barangay Tabunok, with an area of 1ha. A total of 984 households or 11.85% of the total number of households availed the services of the garbage truck. About 33.01% of the households dumped their garbage in individual pits; 3.5% resorted to burning their garbage and 12.37% used the compost method which is to be used later on as fertilizer.

The potential air pollutants generated during the various phases of the project may have adverse impacts on the health of operation workers and residents of nearby communities, specifically those along the property boundaries. This impact to the health of the residents may be worsen by increased temperature and frequent rainfall events brought about by climate change.

Workers, particularly those on field, may be exposed to ergonometric stress and increased levels of noise, dust and heat. They may also be exposed to physical hazards associated with heavy lifting, moving heavy equipment, etc.

Infectious diseases among workers caused by viruses and bacteria (i.e. fungus and parasites) may spread to the residents if the workers live and mingle with the community.

An IEC plan shall be formulated and implemented to inform the local communities of the project, the project activities, the duration, the person/company responsible for the operation and the management of the project. It shall also contain information on safety aspects like portions of operation areas and equipment that shall be avoided.

Medical check-up will be part of the CSR Program of IASCL to monitor the occurrence of unusual health problems that can be associated with the proposed Project. IASCL shall coordinate with the barangay health unit to create a barangay health database from the medical check-ups. Vaccines shall be provided to protect workers from different kinds of infectious and non-infectious diseases.

IASCL will provide safe working environment for workers. Workers shall be given orientation on occupational health and safety. Appropriate personal protection equipment (**PPEs**) shall be provided to each worker. Ample potable water and clean toilet shall be provided in the plant site. Medical clinic shall be provided and a safety officer shall be designated to monitor safe working conditions. Medical/First Aid kits shall be available at all times in all work places that can be used in case of emergency especially in areas, which are of distance to the medical clinic.

All workers shall undergo medical examinations, and be certified to be physically fit by a licensed physician prior to hiring. IASCL shall implement a continuous annual health examination of workers. All occupational injuries and diseases shall be recorded, analyzed and submitted to DOLE annually.

2.4.7 Generation of Local Benefits from the Project

Literacy Rate/Profile of Educational Attainment. The municipality has one (1) tertiary school, seven (7) secondary schools and 26 elementary schools. There are also five (5) private pre-elementary schools. In 2010, majority (98.27%) of the population over ten (10) years old in Isabel are literate.

Table 2-55. Literacy Rate of Population 5 years Old and Over by Sex, 2010

	Male		Female		Both Sexes	
	No.	%	No.	%	No.	%
Population 10 years old over	17,578	51.16	16,781	48.84	34,359	100.00
Literate	17,246	51.08	16,520	48.92	33,766	98.27
Illiterate	332	72.85	161	27.15	593	1.73

Note: Figures are based on 20% sample households. Details may not add up to total due to rounding off.
Source: 2010 Census of Population and Housing, PSA

Peace and Order/Crime. The 2007 Philippine National Police data recorded ten (10) crimes against persons and three (3) crimes against property in Isabel Municipality. The crime rate against persons is 2.5 per 10,000 population, while the crime rate against property is 0.8 per 10,000 population.

Industries, Commercial Establishments and Activities. The 435-hectare LIDE houses two heavy industries, namely PASAR and PhilPhos. PASAR produces over 172,000 metric tons of copper cathodes every year. These are being shipped to international and domestic markets together with its by-products namely: dore metal, sulfuric acid and selenium powder. Among its major importers are Japan, Taiwan, South Korea, China and Southeast Asia. PhilPhos, on the other hand, produces phosphatic fertilizers which are also exported to countries like Vietnam and Southeast Asia. It also produces, as by-product 600 to 900 metric tons of gypsum per year. LIDE still offers 80 hectares for other investors.

LIDE maintains one of the most modern ports in the country having a total berth length of 670 meters and a handling capacity of 3.4 million tons of cargo per year.

LIDE has spurred economic activities in Isabel. In 2001, the municipality registered a total of 553 commercial establishments. The bulk or 77.6% were engaged in retail trading, 20.8% in business, recreational and personal services, and 1.6% in finance and other industries. Also, with the influx of workers coming from the different parts of the country, the municipality now has three subdivision sites as follows: Pleasantville Subdivision located in Brgy. Tolingon; Don Ciriaco Sotero Subdivision in Brgy. Bilwang; and Isabel Development and Realty Corporation Subdivision situated at Sitio Alipasa, Mahayag.

With the big income derived from these two industries, Isabel is now classified as first class municipality. In 1988, the municipality belonged to fourth class municipalities.

Employment Profile. In 2010, Isabel has 606,971 gainful workers where in most (33.79%) of workers are involve in trade and related works (**Table 2-56**).

Table 2-56. Gainful Workers in Isabel Municipality, 2010

Major Occupation Group	Gainful Workers, 15 Years Old and Over	Age Group										
		15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65 and over
Government Officials and Special Interest Organizations, Corporate Executives, Managers, Managing Proprietors, and Supervisors	47,742	441	1,575	3,587	4,836	5,407	6,045	6,139	5,737	4,333	3,822	5,819
Professionals	24,818	11	2,755	4,400	3,922	3,365	2,756	2,559	2,152	1,666	994	238
Technicians and Associate Professionals	13,343	167	1,437	1,884	1,895	1,635	1,756	1,403	1,328	829	441	568
Clerks	24,372	528	3,588	4,626	3,778	2,654	2,395	2,498	2,084	1,400	530	291
Services Workers and Shop and Market Sales Workers	51,464	4,022	8,877	8,280	7,153	6,242	4,909	4,294	3,058	2,244	1,181	1,205
Farmers, Forestry Workers and Fishermen	144,297	3,122	7,701	11,839	13,659	15,238	16,105	16,388	15,951	13,822	11,056	19,417
Trade and Related Workers	46,219	1,303	3,619	4,926	5,875	6,490	5,871	5,304	4,446	3,292	2,296	2,798
Plant and Machine Operators and Assemblers	42,545	701	3,741	6,310	7,505	6,754	6,096	4,458	3,344	2,035	1,008	594
Laborers and Unskilled Workers	205,096	23,622	28,533	26,105	23,948	21,417	20,448	18,146	14,786	11,267	7,402	9,421
Armed Forces	114	-	5	20	10	25	15	20	10	-	10	-
Other Occupation	10	-	5	-	-	5	-	-	-	-	-	-
Not Reported	6,952	45	359	962	1,023	811	945	900	816	600	308	183
Total	**606,971**	**33,961**	**62,195**	**72,939**	**73,603**	**70,043**	**67,340**	**62,110**	**53,710**	**41,488**	**29,049**	**40,534**

Note: Figures are based on 20% sample households. Details may not add up to total due to rounding off.
Source: 2010 Census of Population and Housing, PSA

The direct benefits resulting from this Project include the creation of employment for local residents and non-local manpower in the area. During construction of the proposed Project, IASCL would provide temporary about 120 employment to local residents. During operation, 46 new positions will be required. Potential positive effects of the manpower influx will include demand for retail and other services, which may increase economic activities and benefits for some local businesses, including food suppliers and other retailers. It is expected also to increase business opportunities in terms of the project needs for construction materials, supplies, concrete aggregates and social services.

Aside from the generation of job opportunities for the direct and indirect impact barangays, opportunities for business establishments is also expected to be created by the proposed Project. Another benefit is under DOE ER 1-94 which provides a percentage share to LGUs for every kW-hr sale of electricity. The fund that will be accessed by the concerned LGUs from the DOE will be used for electrification, development and livelihood fund and reforestation/watershed management. Another benefit is the generation of revenues from taxes, permits and other dues for the local government units**.**

To enhance the employment opportunities brought by the proposed Project, IASCL shall regularly coordinate with the LGU of Isabel, specifically at the barangay level regarding the hiring of temporary workers during construction phase and regular workers during operation phase to ensure that the workers being considered are legitimate residents in the area. Moreover, by hiring local residents, some of the social conflicts associated with uncontrolled in-migration can be minimized.

The respective contractor shall be responsible to provide accommodation for their workers and equipped with the necessary social infrastructure. Workers and professional personnel from outside the area will stay in temporary accommodation. Increased traffic in the project area during construction will be controlled on and off site to minimize traffic hazards to road users.

2.4.8 Traffic Congestion

Leyte can be accessed by air through the only one (1) commercial airport located in Tacloban City. Isabel Municipality, which is 145km from Tacloban City can be reach by any transportation within 2.5h to 3.5h.

Isabel Municipality can also be reach by inter-island transport. Philtranco, which has a bus stop in Tacloban and Ormoc, operates a route from Manila-Maharlika highway, passing through Allen, Northern Samar in Samar Island from Matnog, Sorsogon in Bicol region.

Major ports are also located in Ormoc City in the south and Tacloban City in the north. Small ports are also located in Palompon, Hilongos, Isabel, and Baybay City.

Isabel Municipality has a total road length of approximately 57.5 kilometers, which is broken down into national roads (33.7km), municipal streets (4.8km) and barangay roads (19 km). About 34.18km or 59.45% of the total road length are concrete, 14.4km are gravel filled and 8.92km are earth road. All municipal streets are concrete/paved. The national road traverses Barangays Sto. Niño, Marvel, Mahayag, Libertad, Matlang, Bilwag, Tubod, Tulingon, Apale, Tabunok, the Consolacion–Putingbato and the Sto. Niño–Consolacion sections. The municipal streets are traverses Poblacion which is composed of Barangays Marvel and Sto. Niño. The barangay roads are situated in the rural areas.

The national roads and municipal streets are six (6) meters wide except the national road at Barangay Tabunok which is only four (4) meters wide. The width of the barangay roads vary from 1.5m to 6m with the narrowest at the Barangay Bilwang Road which is only an earth road. Some portion of Barangay Bilwang Road and the Matlang-Honan Road are 3m width and the Antipolo-San Francisco Road and the Mahayag-Anislag Road have 4m width. The rest are 5-6m wide.

The national roads and municipal street are in good condition. The barangay roads which are either gravel-filled or earth roads are also passable.
An increase in vehicular traffic will be expected during construction phase of the proposed project due to the movement of construction equipment; the delivery of construction materials by haulers and trucks; and the additional commuters—the construction workforce during rush hours in the

morning and the afternoon. The entry and exit of the construction equipment and vehicles into and out of the project site will increase the volume of vehicles passing the access roads.

Employee traffic is anticipated during rush hours in the morning and late in the afternoon. Additional traffic can also be expected at the beginning and end of weekly work cycles, when migrant workers report for work on a Monday and go home for the weekend.

Management measures to alleviate overland traffic impacts during construction are the following:

(i) Delivery of construction materials during off peak hours;
(ii) Detailed truck scheduling;
(iii) Formulation of an overland traffic management scheme in coordination with the host Barangay Libertad and Isabel Municipality,;
(iv) Provision of adequate parking areas; and
(v) Posting of appropriate traffic sign and warning.

IASCL shall prepare a traffic management system, which will minimize possible traffic volume in the area.

2.4.9 Socio-Economic, Perception and Health Survey

The perception survey was conducted to the host Barangay Libertad. The survey covers the demographic characteristics, the source of income, the knowledge about the new structures and their attitude towards the proposed Project. **Table 2-57** presents the number of respondents surveyed in Barangay Libertad.

Table 2-57. Number of Respondents of Socio-Economic and Perception Survey

Male	Female	Total Number of Respondents
27	48	75

Demographic Characteristic

Majority (63%) of the respondents are women while only 36% are men. Most (55%) of the respondents were born in the Barangay. Majority (91%) of the respondents are Ceburano and some are Waray. Majority (54%) of the respondents are within the bracket of 46-65 year old. Most (42%) had finished college, 25% had finished high school, 21% had finished elementary and 11% had finished vocational school. Most (80%) of the respondents are married having 1-3 male (55%) and female (64%) children. Majority (91%) of the respondents are Catholics by religious affiliation.

Migration/Settlement History

Most of the respondents (54%) have stayed in the Barangay for 21-40 years and 33% of the respondents have stayed in the Barangay for 51-60 years. If they were given a chance to live in other places, 93% of them would still chose to live in their Barangay.

Income and Employment

The husband (64%) is contributing a major portion of income in the family of the respondents. About 52% have an earning of PhP1,000 to PhP9,999 per month and 16% have an earning of less than PhP1,000 per month. Majority (75) of the respondents source their income from the salary. Though, the Barangay is near the sea, only 8% of the respondent are fishermen.

Community & Land Resource

Most of the respondents (87%) indicated that livelihood or source of income is the main problem in their community followed by solid waste and water conservation. Majority (82%) do not own any land.

Perception

Majority (84%) of the respondents knew about the proposed Project of IASCL, learning about it from the IEC and Public Scoping (58%). Some (33%) of them knew the proposed Project from the Barangay Officials. About 87% of the respondents are in favor of the proposed Project. They considered it to have a positive effect, such as provision of job opportunities (64%); source of livelihood (45%); and additional income to the barangay (33%). On the other hand, degradation of air quality is the main negative impact raised by the respondents.

Smoking and Drinking Habits

Twenty percent (12%) of the respondents smoke cigarites and 33% drink liquors. Majority of the smokers smoke for more than 31 years. Chronic obstructive pulmonary disorder (**COPD**) is the disease predisposed by smoking one pack of cigarette for ten years and above. It is manifested by chronic cough, wheezing and progressive difficulty of breathing in the 50-year old smoker. Moreover, excessive and prolonged liquor drinking can result to alcoholic hepatitis and cirrhosis. Majority of the respondents who drinks liquor are drinking only during occasions.

Site of Medical Consultation

The respondents consult the private clinic (30%) and the Municipal Health Unit (22%) for their health problems. Some of them consult the Barangay Health Unit, Hospital and herbalist.

Causes of Diseases

The most common causes of diseases encountered by the respondents are cough, hypertension and diabetes (**Table 2-58**).

Table 2-58. Causes of Diseases

Diseases	Respondents
Cough	9%
Hypertension	7%
Diabetes	7%
Fever	5%
Asthma	5%
UTI	4%
Arthritis	4%

Source: GEOSPHERE 2017

Medicines Taken by Respondents

The medicines usually taken by the respondents are the medicine for for fever (Paracetamol). The list of medicine ussualy taken by the respondents are listed in **Table 2-59**.

Table 2-59. Medicines Taken by the Respondents

Medicine	Respondents
Paracetamol	30%
Aspirin	8%
Neozep	5%
Salbutamol	5%

Medicine	Respondents
Antibiotic	4%

Source: GEOSPHERE 2017

Sources of Medicines

Most of the respondents source their medicines from the pharmacy and Hospital, as shown in **Table 2-60.**

Table 2-60. Sources of Medicines

Source	Respondents
Pharmacy	71%
Hospital	4%
MHU/RHU	3%
BHU	4%

Source: GEOSPHERE 2017

Toilet Facility

Majority (71%) of the respondents have water sealed toilet at home, while 20% of the respondent are using flash toilet.

Water Sources

Majority (80%) of the respondents source their water supply from water system. Some sources their water from sping and deep well.

3.0 ENVIRONMENTAL MANAGEMENT PLAN

The IASCL is committed to minimize any adverse impacts, which could arise from the construction, operation and abandonment of the proposed Project. It will do so by formulating an Environmental Management Program (**EMP**) to manage the Project's impacts, adopt the best available proven control technologies and procedures, undergo a continuing process of review and positive action in the light of available monitoring results and continuing consultation with the local communities.

Basically, the EMP will aim to achieve an exemplary environmental performance in the construction and operation of a power plant. In order to meet this goal, the following activities/measures/programs will have to be implemented:

- Environmental Policy;
- Application of Mitigation/Management Measures;
- Environmental Monitoring Program;
- Social Development Program;
- Emergency and Contingency Plan;
- Information, Education and Communication Plan;
- Reforestation Program for Buffer Zone;
- Construction Contractor's Program; and
- Institutional Plan and Hiring of an Environmental/Safety Officer.

3.1 ENVIRONMENTAL POLICY

The Environmental Policy of the IASCL can be summarized in three (3) statements, as follows:

- To produce electricity using high-efficiency, state-of-the-art technology and practices with the minimum possible impact on the environment and surrounding community;
- To design and operate the plant safely and in an environmentally-responsible manner according to world class standards and in full compliance with all applicable laws and regulations; and
- To conduct continuous dialogue with the affected community as well as all stakeholders to ensure protection and enhancement of the quality of the environment and to contribute to the sustainable development of the country.

To carry out this Environmental Policy, the IASCL commits to regularly evaluate the environmental impacts of the proposed Project, its facilities and jetty operations all throughout the construction and operation phases; and maintain good communication/relations with the local communities.

Furthermore, the IASCL Management shall issue work instructions/controls for defining the manner of conducting an activity and inspection procedure to ensure application of the mitigation measures. Documentation of the supervision and monitoring results for the Project shall be done to test the effectiveness of mitigation measures and impact controls.

The IASCL Management will inform the community and the local government about its environmental policies and program through its IEC Program.

3.2 MANAGEMENT AND MITIGATION

The main emphasis of environmental management of the proposed Project will be on air quality and safety factor of the plant.

The mitigation measures are formulated to reduce the adverse environmental impacts that have been identified and enhance the beneficial impacts as a result of the proposed Project. The mitigation measures have been discussed in **Chapter 2** of this EISR after the assessment of each

impact. The EMP outlines the predicted impacts of the proposed Project as well as its prevention/mitigation and enhancement measures.

3.3 ENVIRONMENTAL MANAGEMENT PROGRAMS

The following are the EMPs that will be implemented for the proposed Project:

- **Solid Wastes Management System.** The proposed Project operation mainly generates industrial solid wastes which include ash, slag, wasted conveyor belts and barrels, oily sludge from vehicles, equipment and oil and water separators, spent lubricants and other chemicals. Utmost concern will be focused on ash production, handling and disposal.

- **Stormwater Management and Drainage Plan.** IASCL shall install a storm drainage system especially along the access/maintenance roads and stormwater detention/retention pond.

- **Emergency Preparedness and Response Plan.** Emergency response/procedures will be developed for accidents due to equipment/machinery failure or malfunction; and calamity from a major seismic event or earthquake. Evacuation maps shall be posted at different areas of the Project site. Evacuation drills shall be conducted to assess the applicability of the plan.

- **Fire Protection system.** A comprehensive fire detection, alarm system and fire protection system is designed for the facility to provide a high degree of protection for plant buildings and other auxiliary facilities. The Fire Protection System shall consist of fire suppression systems, independent fire detection systems, standpipe, fire hose stations, fire loop system, and portable fire extinguishers to protect the asset, buildings and facilities. Fire drill shall be undertaken regularly to ensure preparedness of the personnel in the event of fire or fire risks.

- **Social Development and IEC Program.** The indicative sustainable social development plan that was formulated is based on the government requirement R.A 7279/DAO 2003-30 revised and the mandated corporate responsibility of IASCL aligning the programs to the mandated development programs as required by the Department of Interior and Local Government (**DILG**) in the Internal Revenue Allotments (**IRA**).

- **Health and Safety Plan.** The Health and Safety Plan for the community especially the directly affected/impact area involves the following: a) A Medical and Dental Program; and b) Emergency Disaster Health Program.

- **Reforestation Program for Buffer Zones.** The need for a buffer zone is clearly stressed in the light of neutralizing the noise level at the property line, creating a habitat for displaced vegetation, and improving the aesthetics of the Project site.

- **Construction Contractors Program.** The contract between IASCL and the respective contractors shall incorporate rules, regulations and conditions to ensure that the mitigating, management and enhancement measures in the EISR and the conditions stipulated in the ECC are strictly followed.

Table 3-1 Impact Management Plan for the Proposed Project

Environmental Aspect	Environmental Component Likely to be Affected	Potential Impact	Prevention/Mitigation/Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement
PRE-CONSTRUCTION PHASE						
Pre-construction phase covers activities like planning, feasibility study, drawing of plans and permit procurement.						
CONSTRUCTION PHASE						
	LAND					
Cut and fill activities Construction of the proposed Project	Land use and Classification	• Change/Inconsistency in Land Use	• The Project site is an industrial land and consistent with the general land use of Isabel Municipality and therefore there is no issue with the change in land use.	IASCL and Contractor	NA	NA
		• Encroachment to ECA	• The Project site has not encroached in an ECA.	IASCL and Contractor	NA	NA
	Geology/ Geomorphology	• Change in surface landform/terrain/slope	• Strict conformance to the recommendations of the geotechnical study • Since the area is already developed, the possibility of experiencing landslides and/or mud/debris flow is nil.	IASCL and Contractor		Part of EPC contract cost
		• Change in sub-surface underground geomorphology				
		• Inducement of subsidence, liquefaction, landslides, mud/debris flow				
Site Preparation, and Earthwork	Pedology	• Soil erosion	• When necessary, construction of soil erosion control measures either by engineering structure or planting of grasses/trees. • Placement of excavated soil materials in appropriate stockpile areas with avoidance of stockpiling along drainage ways/creeks.	IASCL and Contractor	150,000.00	Part of EPC contract cost

Environmental Aspect	Environmental Component Likely to be Affected	Potential Impact	Prevention/Mitigation/Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement
			• The soil stockpiles will be covered with plastic sheets/geotextile, or planted with grasses/ small shrubs for erosion control.			
	Terrestrial Ecology	• Vegetation removal and loss of habitat	• Since the site is already developed, the construction of the proposed Project will not cause significant loss of habitat.	IASCL and Contractor	NA	NA
		• Threat to existence and/or loss of important local species	• Not applicable since there will be no significant flora and fauna that will be affected in the project site	IASCL and Contractor		NA
		• Threat to abundance, frequency and distribution of important species				
		• Hindrance to wildlife access	• There are no ecologically sensitive habitats such as mangroves, etc. in the Project area and its vicinity that will be affected by the proposed Project.			
	AIR					
	Meteorology/ climatology	• Change in local climate and local temperature	• IASCL shall plant native tree species for vegetation, as these would be expected to have good survival rate.			
Mobilization of Construction Equipment and Materials	Air Quality and Noise	• Degradation of Air Quality	• Every main haul road shall be paved with concrete, bituminous materials; keep the road clear of dusty materials; spray the road with water so as to maintain the entire road surface wet; and immediately before leaving a construction site, every vehicle	IASCL and Contractor		Part of EPC contract cost

Environmental Aspect	Environmental Component Likely to be Affected	Potential Impact	Prevention/Mitigation/Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement
			shall be washed to remove any dusty materials from its body and wheels; • Truck loaded with dusty construction materials shall be covered entirely by clean impervious sheeting to ensure that the dusty materials do not leak; • Periodic watering of aggregates storage piles or covering or enclosure if material is especially dusty. • Ambient air (TSP) monitoring			
		• Increase in ambient noise level	• 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 • Proper instruction and supervision of staff • Defective equipment/parts with abnormal noise and/or vibration will be either repaired replaced • All employees working on site will be provided with proper ear protectors • Conduct noise level monitoring			
	PEOPLE					
Implementation of livelihood projects	Local residents	• Increase income for residents	• Positive Impact	IASCL	100,000.00	Part of EPC contract cost

Environmental Aspect	Environmental Component Likely to be Affected	Potential Impact	Prevention/Mitigation/Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement
Hiring of workers	Local residents	• Increase in local employment	• Priority employment for qualified local residents without discrimination to gender and age	IASCL, Contractor in coordination with host barangay		Part of EPC contract cost
Increase in taxes and revenues	Local community	• Improvement in infrastructures and social services	• Diligent payment of taxes/revenues	IASCL		Part of EPC contact cost
Accidents	Local residents	• Construction-related hazards	• Environment, health and safety training prior to construction	IASCL, Contractor		Part of EPC contract cost
OPERATION PHASE						
	LAND					
Foundation Stability	Geology	• Subsidence and Liquefaction	• Structural monitoring of buildings/facilities especially after each earthquake • Formulation of detailed Emergency Preparedness and Response Plan	IASCL, EMB	200,000.00	Part of Operation cost
Operation of the power plant	Pedology	• Soil contamination	• Regular monitoring of possible oil spills	IASCL, EMB	60,000.00	Part of Operation cost
	Terrestrial Ecology	• Possible off-site impacts • Generation of power plant emissions	• IASCL shall plant native species for vegetation, as these would be expected to have good survival rate.	IASCL	100,000.00	Part of Operation cost
	AIR					
Operation of the power plant	Air Quality	• Degradation of Air Quality	• Built-in smokestacks for efficient dispersion of plant's emission • Conduct ambient air quality monitoring and stack emissions testing	IASCL, EMB	1,000,000.00	Part of Operation cost

Environmental Aspect	Environmental Component Likely to be Affected	Potential Impact	Prevention/Mitigation/Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement
	Noise Quality	• Increase in ambient noise level	• All generators will be enclosed; • Conduct noise level monitoring	IASCL	150,000.00	Part of Operation cost
	PEOPLE					
	Waste Management	• Generation of sewage/solid waste	• Provision, portalets and latrines, no litter signs, waste bins • Applying the hierarchy of measures: Reduce, Segregate, Re-use, Recycle and Dispose • Proper disposal of non-recyclable wastes through an accredited contractor	IASCL	100,000.00	Part of Operation cost
Hiring of workers	Population	• Change in population (size, distribution) • In-migration	• Priority hiring of qualified local residents in coordination with the Municipal Gov't and host barangay	IASCL, LGU	300,000.00	Part of Operation cost
	Social services	• Overburdening of public social services	• Priority hiring of qualified local residents • On-site safety officer/first aider	IASCL	300,000.00	Part of Operation cost
	Health	• Introduction of disease between migrant and local workers	• Clean bill-of-health as a condition for employment • Medical missions shall be part of the CSR program of IASCL • Provision of potable water, sanitary facilities and garbage bins for workers • Provision of a safety officer to monitor safe working conditions • Provision of Medical/First Aid kits in all work places	IASCL	200,000.00	Part of Operation cost
Operation of the power plant	Local residents	• Increased social and economic financial activity	• Positive impact, no mitigation required	IASCL	NA	NA

Environmental Aspect	Environmental Component Likely to be Affected	Potential Impact	Prevention/Mitigation/Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement
	Local properties	• Fire hazard	• Provision of fire suppression systems, fire detections systems, fire hose stations and portable fire extinguishers	IASCL	100,000.00	Part of Operation cost
ABANDONMENT PHASE						
	LAND					
Decommissioning	Pedology	• Soil contamination with heavy metals	• The Abandonment Rehabilitation Plan shall be followed strictly with emphasis on the strategy of sustaining erosion/ sedimentation control within and adjacent vicinity of the power plant and rendering the Project area free of soil contamination from oil spills	IASCL, EMB	50,000.00	Part of Abandonment cost
	Terrestrial Ecology	• Increase biodiversity due to retention of planted native trees	• Positive impact, no mitigation needed	IASCL	NA	NA
	AIR					
	Air Quality and Noise	• Generation of noise, • Generation of dusts which affects workers and vegetation	• Watering during dismantling to minimize dusts • Proper maintenance of vehicles • Use of noise suppressors/mufflers • Limiting noisy activities during daytime • Conduct noise level monitoring	IASCL, EMB	50,000.00	Part of Abandonment cost
	PEOPLE					
Hiring of workers for demolition and abandonment activities	Local residents	• Increase in local employment during abandonment • New skills developed for decommissioning	• Priority for qualified local residents	IASCL	NA	NA

Environmental Aspect	Environmental Component Likely to be Affected	Potential Impact	Prevention/Mitigation/Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement
		may be marketable elsewhere				
Loss of jobs/ employment		• Reduction in employment opportunities to include the staff of local contractors with long-standing service contracts with the project, for example, maintenance services, site transport services and franchised catering companies.	• Six (6)-month notice prior to termination of contract to give ample time to look for next employment • Effective management via consultation, planning and communications with affected workers • Financial support within a human resources plan	IASCL	NA	NA
	Demographic	• Out migration of affected project personnel to seek work elsewhere				

4.0 ENVIRONMENTAL RISK ASSESSMENT (ERA) & EMERGENCY RESPONSE POLICY AND GUIDELINES

The Environmental Risk Assessment (**ERA**) was conducted as part of the EIA Study requirement for the proposed Project in Barangay Libertad, Isabel, Leyte. This ERA report is in accordance with the prescribed format stipulated in the RPM of DAO 2003-30, Implementing Rules and Regulations of PD 1586, establishing the PEISS. The primary objective of this ERA is to perform a preliminary qualitative risk assessment/ screening to identify, describe and evaluate the possible impacts arising from the development and operation of the proposed Project on the communities and the environment. The general objective of this report shall be as follows:

- To identify and characterize the hazardous substances that will be handled, used, and stored at the proposed Project;
- To identify the requirements or the degree of ERA preparation based on the results of the inventory as compared with Threshold levels prescribed in Annex 2-7e of the RPM DAO 2003-30.
- To present the physical and chemical properties of these substances;
- Discussion of the hazards associated with the use and storage of these substances; and
- To establish mitigation measures to prevent harmful consequences to human health and possible damage to the environment.

4.1 HAZARD IDENTIFICATION

IASCL will store and utilize diesel fuel oil for the operation of the proposed Project. The categorization of diesel fuel oil shall be mainly based on the nature and the quantity that will be stored on-site. If diesel fuel oil falls in any category definitions of Annex 2-7e, it is considered hazardous and will be included in this study. The results are summarized in **Table 4-1**.

Table 4-1 Categorization of Hazardous Substances

Category	Applicable Criteria	Evaluation	Criteria Met?
Diesel Fuel Oil			
Explosives	Substances or preparations which create risk of an explosion by shock, friction, fire, or other sources of ignition.	Not explosive in normal form (liquid).	No
Flammable Substance	Substances and preparations having a flash point range of 21°C to 55°C and capable of supporting combustion.	Flash point 50°C.	Yes
Oxidizing Substances	Substances which give rise to highly exothermic reaction when in contact with other substances, particularly flammable substances.	Diesel oil belongs to aliphatic saturated hydrocarbons which are mostly unreactive. They are not affected by aqueous solutions of acids, alkalis, most oxidizing agents, and most reducing agents. (http://cameochemicals.noaa.gov/chemical/11452#section2)	No
Toxic Substances	Low, medium, high, very high and extreme toxicity of substances or preparations.	Value of *a* based on LC_{50} = 6 Value of *b* based on Vapor Pressure = 1 Toxicity Class (*a* + *b*) = 7 (Medium Toxicity based on Table 1 in Annex 2-7e of RPM)	Yes
Unclassified Substances	Substances or preparations that react violently with water (Type A), and substances or	Insoluble in water. No known hazardous reaction. (http://cameochemicals.noaa.gov/r	No

Category	Applicable Criteria	Evaluation	Criteria Met?
	preparations which release or liberate toxic gas in contact with water (Type B).	eactivity/documentation/RG29-RG100)	
Lube Oil			
Explosives	Substances or preparations which create risk of an explosion by shock, friction, fire, or other sources of ignition.	Not explosive in normal form (liquid).	No
Flammable Substance	Substances and preparations having a flash point range of 21°C to 55°C and capable of supporting combustion.	Flash point 230°C.	No
Oxidizing Substances	Substances which give rise to highly exothermic reaction when in contact with other substances, particularly flammable substances.	Lube oil belongs to aliphatic saturated hydrocarbons which are mostly unreactive. They may be incompatible with stong oxidizing agents like nitric acid. Not affected by aqueous solutions of acids,alkalis, most oxidizing agents and most reducing agents. https://cameochemicals.noaa.gov/chemical/12193	No
Toxic Substances	Low, medium, high, very high and extreme toxicity of substances or preparations.	Value of *a* based on LC_{50} = 6 Value of *b* based on Vapor Pressure = 1 Toxicity Class (*a* + *b*) = 7 (Medium Toxicity based on Table 1 in Annex 2-7e of RPM)	Yes
Unclassified Substances	Substances or preparations that react violently with water (Type A), and substances or preparations which release or liberate toxic gas in contact with water (Type B).	Insoluble in water. https://cameochemicals.noaa.gov/chemical/12193	No

Using the data in T**able 4-1**, the result of the categorization and classification of the quantity of substance to be stored on site shows that diesel fuel oil falls within the Level 1 category (**Table 4-2**). Therefore, IASCL is required to prepare an Emergency/Contingency Plan.

Table 4-2 Threshold Inventory Level for Hazardous Substances Identified

Hazardous Substance	Total Storage Capacity	Category	Threshold Inventory		Remarks
			Level 1	Level 2	
Automotive Diesel Oil	480 tons	Flammable Substance	5,000	50,000	Level 1
Lube Oil	14	Toxic Substances	50	200	Level 1

Risk screening however was done in lieu of a QRA at this time because (1) the required data and information for a QRA will be only available after the detailed engineering design phase; and (2) the proponent may submit the QRA prior to operation. In lieu of the QRA, Hazard Operability (**HAZOP**) study will be prepared by IASCL and will be completed upon project operation.

4.2 EMERGENCY RESPONSE POLICY AND GENERIC GUIDELINES

IASCL shall have necessary emergency preparedness and response plan (**EPRP**) in case of emergency while doing the proper monitoring and preventive maintenance to avoid any cases of fire.

Earthquake and strong typhoons are natural calamities that may affect the environment and safety of the people although these are quite remote to occur. The proposed Project will be built in accordance with the prescribed processes, mechanical, electrical, and civil structural engineering designs, with each phase featuring the necessary safety requirements.

Moreover, IASCL shall establish an EPRP to define response protocol for any possible crisis/disaster that the proposed Project may encounter in the future such as Fire, Earthquakes, Typhoon, Flood, Enemy Attack, Bomb Threat and Oil Spill. The EPRP shall be consistent with the relevant government agencies' guidelines, specially procedures and protocols followed by Isabel Municipality and LMC.

4.2.1 General Requirements

4.2.1.1 Facilities, Equipment and Supplies

IASCL shall ensure that the proposed Project has complete facilities, equipment and supplies for communication, firefighting, medical and security. The following equipment shall be made readily available at or near the office:

- Siren System
- Walkie-talkies (if available)
- Portable Loud Speakers
- Portable Fire Extinguishers
- First Aid Kit
- Stretchers
- Van and Driver

A manually activated emergency siren will be situated at one or more locations to allow full coverage of the project and shall be loud enough to be distinguished above other noise.

Fire protection system shall be in place throughout the plant as per the recommendation of Bureau of Fire Protection (**BFP**) according to the Fire Code of the Philippines, Safety Regulations set forth by Department of Labor and Employment (**DOLE**) and National Fire Protection Association (**NFPA**). The Fire Protection System shall consist of the following equipment:

- Fire suppression systems;
- Independent fire detection systems;
- Standpipe and fire hose stations;
- Fire loop system; and
- Portable fire extinguishers.

Fire protection equipment shall be installed in strategic areas in the event of fire or fire risks such as excessive heat or smoke. Portable fire extinguishers shall be provided at all fire hose stations in addition to other key locations to ensure that adequate fire protection is distributed strategically. Fire alarm signals shall be installed from various facility areas of the power plant.

4.2.1.2 Emergency Communication System

An emergency communication system shall be established between the person(s) that discovers the emergency, HSE Office, Project Manager, Employer's Emergency Control Center, LMC, fire station, hospital, etc. Notification of this emergency communication system shall be posted in prominent locations at project site.

The Plant Communications System shall facilitate communication among personnel at the facility. The Plant Communications System shall consist of a multichannel party line and one page line system, with page or party line selection being available from all handsets located throughout the facility. Paging speakers will be located throughout the facility such that pages can be heard from any locations. Consideration shall be given to the environment where handsets and speakers are located. Where possible, handsets and speakers shall be located in non-hazardous areas. Handsets and speakers located outdoors or in hazardous areas will have intrinsic ratings suitable for the area in which the device is located.

The Plant Paging System will consist of cable, raceway, handsets, and speakers. Handsets, amplifiers or speakers shall be finalized during detail design to achieve adequate coverage for the entire finished facility.

4.2.1.3 Emergency Evacuation Muster Areas

The position of muster areas shall be defined as the Project develops. Muster areas on site will normally located outside of the operation and office areas. HSE Officers will be responsible for the assembly area locations as well as signages. The evacuation routes and assembly location, and emergency communication network shall be prominently displayed at key points around the project site and main office and gates.

4.2.1.4 Emergency Response Training and Drills

Emergency Response Training and Drills for Fire Fighting, Rescue and Evacuation shall be conducted at least twice a year for all personnel in the project site.

4.2.2 Response Procedures

4.2.2.1 Fire and Explosion Emergency Response Procedure

- At the first sign of fire or explosion, sound the fire alarm located at the nearest site of the fire or explosion. A fire alarm shall be characterized by continuous sound.

- This alarm will trigger the security guard to call the following:

    - Fire Department
    - Plant Manager

- The main power supply to the affected area (if possible) shall be switched off by the designated power cut-off personnel if it can be done safely. Always put into consideration the power supply to the man lift as somebody might be trapped. The fire pump tender shall start the fire pump at the pump house.

- The nozzle man with the assistance of the hose man shall attempt to extinguish the fire if applicable. If the fire is too big to handle, they shall abandon their posts and assemble at the Emergency Evacuation Muster Areas.

- All the remaining personnel shall congregate at the muster areas and do the following:

    - The Office Coordinator/Sweeper shall ensure that all staffs, visitors and office personnel are evacuated to the assembly area.
    - The Sweeper shall scout their respective areas and guide other personnel into the muster areas.
    - The First Aid Coordinator shall provide emergency first aid to any injured personnel.
    - The Point Man shall advise the Head Count Personnel in charge of his presence and immediately go to the main gate and wait for the fireman's arrival. Upon their arrival, he will inform him the details regarding the fire/explosion and inform them of the hydrant's connection point.

- The Head Count Personnel shall see to it that all personnel are accounted for including those that has asked permission and performed their other functions.
- The Security Officer shall advise the Head Count Personnel of his presence and then advise the driver to proceed to the parking area.
- Fire Pump Tender shall advise the head count of his presence, then proceed to the pump-house and start the operation of the fire pumps.
- The Power Cut-Off personnel shall advise the head count of his presence and proceed to cut-off the main power supply.

- Upon arrival of the emergency responding unit, Point Man shall be the one who will assist the group towards the fire scene and give them the details. The fire officials shall have the jurisdiction over all emergency operations.

- All communications with the media personnel shall be handled by the Media Representative.

4.2.2.2 Bomb Threat/Suspected Bomb Package Emergency Procedure

- At the first sign of a bomb threat or whenever somebody discovers an unidentified package or box inside the facility, advice the Plant Supervisor. Either one of them shall call the Police Department and give them the following information:

  For Bomb Threat

  - Caller name
  - Time call was made
  - Location of the bomb
  - Any other information related to the threat

  For Suspected Bomb Package

  - Description of the box
  - Location of box
  - Other information related to the box

- The Plant Supervisor shall advise the following personnel to evacuate outside of the plant to the muster area.

  - The Office Coordinator shall ensure that all staffs, visitors and office personnel are evacuated to the assembly area. The Sweeper shall scour the plant area and guide other personnel into the assembly area.
  - The First Aid Coordinator shall provide emergency first aid to any injured personnel.
  - The Point Man shall advise the Head Count Personnel in charge of his presence and immediately go to the main gate for the rescue unit's arrival. Upon their arrival, he will inform him of the details regarding the threat.
  - The Security Officer shall see to it that all personnel are accounted for including those that seek his permission and performed their other functions.
  - The Security Officer shall advise the driver to proceed to the muster area. The driver shall stay on the cars and wait for instructions.

- Upon arrival of the bomb disposal unit, the Point Man shall assist the police and fire officials of the location of the box and shall have jurisdiction over all emergency operations.

- All communication with the media personnel shall be handled by the Plant Manager only (media representative).

- All telephone calls shall be handled at the guardhouse.

- Back to work order shall be cleared by the bomb disposal unit officials with the approval of the Plant Manager.

4.2.2.3 Storm and Flood Emergency Response Procedure

- In the absence of any announcement from the government or as the need arises, the Plant Manager shall be responsible for any announcement regarding the operation of the plant.

- Operators shall shutdown their equipment in the normal procedure.

- All personnel shall congregate in the following areas:

    - The Office Coordinator shall advise all staffs, visitors and office personnel to congregate at the assembly area for any special instructions. They shall get a hand held radio for better communication.
    - The Security Officer shall advise the drivers and helpers to stay put at the parking area and wait for any special instruction. All other personnel shall proceed inside the plant warehouse premises and wait for instructions. Being the Security-In-Charge, inform the Plant Manager of any other abnormal condition within the plant.
    - The Head Count Personnel shall assemble plant personnel at the assembly area and ensure the head count for all production and other personnel (Admin/Country Office, contractors, visitors) are complete.

- The Head Count Personnel, with coordination with the Plant Manager, shall relay either of the following information to the plant personnel and also the Office Coordinator:

    - Order to go Home- if personnel feel safer in the comfort of their homes or they may stay within the plant if they feel unsafe to travel.
    - Order to stay- if floodwater has already elevated to an unsafe level. If ever anybody insists on going home, he may be allowed to leave at his own risk. In addition, plant personnel might be requested to stay and secure the plant.

Additional Reminders:

- Home sketches must be available especially for those living in lower lying areas, in case they need to be evacuated to the plant.
- Employee communication (e.g. cell phone numbers) must be done to ensure all employees are accounted for.
- Floaters must be available (e.g. empty plastic drums, banana husk) for use mini-boats in case of floods.
- Advanced notification must be communicated to employees as to “go home”, “stay at the plant”, or “do not report” advice (for those who are still at home or on the way to work).
- Put electronic appliances (e.g. computers, servers) to higher areas to prevent them from being washed away by floodwaters.

4.2.2.4 Earthquake Emergency Response Procedure

- In the event that an earthquake is detected, the detecting personnel shall advise the Central Control Room Operator to activate the Earthquake alarm). Listed below are the steps to be followed in this emergency:

    - During the earthquake, do not panic. Stay under a rigid table to prevent falling objects from hitting you if the earthquake is too strong.
    - Carefully move out of the building after the earthquake. The Plant Supervisor or the Plant Manager at day shall advise personnel to evacuate and congregate at the Gazeebo.
    - The Power Cut-Off Personnel shall cut all source of energy like electricity, and close all source of fuel.
    - The Office Coordinator shall ensure that all staffs, visitors and other office personnel are evacuated to the assembly area.

- The Sweeper shall scout plant area and guide other personnel into the assembly area. He shall confirm that nobody is trapped or left.
- The Head Count Personnel shall ensure the headcount for all production and other personnel (administration office, staffs and visitors) are complete.
- The First Aid Coordinator shall provide emergency first aid to any injured personnel.

- After the earthquake, the plant manager shall check if the condition is already safe for the personnel to move back to work or instruct them to go home if necessary.

4.2.2.5 Liquid Spill/Fuel Oil/Lubricating Oil Spill Control Procedures

- In case of oil spillage, the detecting personnel shall immediately notify his supervisor. In turn, the Plant Supervisor shall notify the Plant Manager all the information and the steps to clean up the spill.

- The Supervisor shall immediately instruct the following:

  - The Mechanic shall immediately isolate the affected tank enclosure valves.
  - The Plant Technician, with the assistance of plant personnel, shall layout the spill blanket (if applicable) and prepare for clean-up.

- The Plant Supervisor shall directly supervise the clean-up
- The Plant Supervisor shall prepare the Spill Reporting Plan.

4.2.2.6 Physical Injury or Illness Emergency Response Procedure

- Notify the Plant Manager or Plant Supervisor in case of personal emergency:

- In case of extreme emergency (life threatening) the supervisors shall do the following:

  - Advise plant management of the situation as soon as possible so that they can notify the victim's relatives.
  - Daytime – the Plant Supervisor shall drive the victim to the hospital and accompany the patient until he is stabilized.
  - Nightshift- the Plant Supervisor shall drive the victim to the hospital and accompany the patient until he is stabilized.

- In case of minor injury or immovable injuries (orthopedic cases), the Plant Supervisor shall do the following:

  - Call the hospital for assistance and stay on the phone until all information is relayed.
  - Assign at least one person to stay with the victim and to assure him that help is on the way.
  - If applicable, basic first aid will be administered as necessary by qualified personnel.
  - Assign personnel who will guide the emergency crew to the victim
  - Notify the victim's relatives.

NOTE: There must be an available vehicle and a qualify driver all the time

5.0 SOCIAL DEVELOPMENT PLAN/FRAMEWORK AND IEC FRAMEWORK

5.1 Social Development Plan/Framework

The Social Development Plan (**SDP**) was prepared based on the data/information collected from the CLUP of Isabel Municipality. The results of perception survey were also incorporated in the SDP to address the perceived fears of environmental degradation due to pollution on land, water, air and health risks.

The SDP aims to enhance the identified programs and design the appropriate development programs that would be the basis for the preparation of the DOE required five-year Social Development and Management Plan (**SDMP**) upon the continued operation of the proposed Project. Various programs identified are in the areas of health and safety; education; peace and order; environment and sanitation; and spiritual. Multi-sectoral representatives are the Inter-agency Government Offices (MSWD, MAO, MPDO/ENRO, MHO, PNP) from the youth, senior citizens, church/religious organizations and the LGUs. The recommended SDP will be presented to the Inter-agency representatives in consideration of their mandate to deliver services in coordination with the LGU and IASCL. This includes the municipality and barangay IRAs to maximize the resources with IASCL's socio-economic commitments as mandated by law. For sustainability, the Social Development Technical Working Group sits as Ad hoc Committee in coordination with IASCL CSR Team to oversee the implementation of the SDMP.

IASCL has indicated its commitment to support the SDP in partnership with the LGUs, NGOs, POs and other concerned government agencies. It is expected that in the long term, the economic benefits from tax revenues, the funds from the mandated services of the inter-agencies and the socio-economic benefits from DOE ER No. 1-94 will be the contributing sources of funds together with the IRA of the host barangay to sustain the implementation of the SDP.

Table 5-1 presents the SDP for the proposed Project of IASCL.

5.2 Information, Education and Communication

Information materials such as brochures, videos, slide, pamphlets and posters will be prepared and distributed by IASCL. These materials will provide information about the project details such as benefits and risks that will result from its implementation. As well, focus group discussions and community open forum will be carried out to disseminate important information to affected residents. The IEC program will be implemented in close coordination with concerned LGUs, NGOs, and stakeholders. **Table 5-2** presents the proposed IEC Framework.

Table 5-1 Indicative SDP for the Proposed Project

Concern	Responsible Community Member/Beneficiary	Government Agency/ Non-government Agency and Services	PROPONENT	Indicative Timeline	Source of fund
Gender Responsive Livelihood/and Credit Facilities (Men, Women, Youth, Elderly and PWD)	• Barangay Chairman • Barangay Chair for Women • Qualified Project Affected Men, Women, Youth, Elderly and PWD	**LGU, Municipal Planning Office** **MSWD, TESDA, DA** • Development Community Micro-finance Facilities • Product and Marketing Information System Development: • Cooperative Development **TESDA/TLRC** • Technician/electrician/mechanics/driving	**IASCL Community Relations Officer (ComRel)** • Create opportunities for the barangay to address their most basic asset in growth and development – land and resources. • Equity among the men and women in the access and control of economic opportunities.	Construction Operation	LGU–IRA, ER 1-94, IASCL CSR

Health and Safety
 	
• Climate Change
• Environment Health Risk from the construction and operation of the proposed Project
• Contagious Diseases
• Malnourished Babies and Children
• Problems of Potable Water and Sanitation
• Lack of Health Facilities and Development Program
• Expensive quality drugs
• Proliferation of unhealthy lifestyle
	• Barangay Kagawad for Health
	• Barangay Kagawad for Senior Citizen
	• Barangay Health Workers
	• Barangay Nutrition Scholars
	• Barangay Disaster Risk Reduction Coordinating Council
		MHO/MSWD/MDRRMC
		• Community Health Awareness Project
		• Upgrading of Facilities and Equipment
		• Supply and Medicines
		
		Regular Programs
		• Nutrition and Food for Growth Program
		  ○ Malnutrition
		  ○ Supplemental feeding
		• Health Facilities Development Program
		• Water and Sanitation Program
		• Provide potable water system
		• Improvement of Access to Low Cost Quality Drugs through the Botika ng Barangay
		• Advocacy on Healthy Lifestyle
		• Provide assistance to Senior Citizens and Persons with Disability
		• Barangay Disaster Management Training
			IASCL ComRel
			• Organize medical missions and provision of medicines to the host barangay
				Construction Operation	LGU–IRA, ER 1-94, IASCL CSR

Concern	Responsible Community Member/Beneficiary	Government Agency/ Non-government Agency and Services	PROPONENT	Indicative Timeline	Source of fund
• Neglect of Senior Citizen and PWD • Enhancement of Senior Citizen's benefits					
Education and Recreation • Community/School children lack training for disaster preparedness • Lack of knowledge about the construction and operation of a modular diesel power plant • Lack of school rooms • Lack of teachers • Scholarship for qualified students • Alternative education for adults who lack literacy and numeracy skills • Maintenance of Culture and Sports school activities	• Barangay Kagawad for Education • Barangay School Head Teacher/Principal	**DepEd/MHO/ME/MDRRC** • Production of IEC Materials including Climate Change & Disaster Management in relation to the operation of the proposed Project • Include in the school curriculum the operation of a modular diesel power plant • Disaster Preparedness and Response Program • Construction/Rehabilitation of additional School Buildings • Provision/Hiring of additional teachers • Construction of school fences • Upgrading of parks & playground • Teachers orientation & skills training • Basic Literacy and Numeracy/*Sulong Dunong* Program • Technical Education and Skills Development Program • Setting-up of scholarship program for qualified students • Literacy Programs & Alternative Education • Opening of Technical/Vocational Courses **Sports** • Purchase of Sports Equipment • Establishment of Sports Program (i.e. scholarship, etc.)	**IASCL ComRel** • Proviosion of Technical Education Scholarship ○ Skills training based on the technical needs of the proposed Project ○ Includes TESDA training fee and meal allowance	Construction Operation	LGU–IRA, ER 1-94, IASCL CSR

Concern	Responsible Community Member/Beneficiary	Government Agency/ Non-government Agency and Services	PROPONENT	Indicative Timeline	Source of fund
Environment and Sanitation • Indiscriminate disposal of waste • No proper toilets and sewage system	• Barangay Kagawad for Environment	**MPDO/MENRO/MHO/BFAR (Climate Change Programs)** • Enforcement/Implementation of Ecological Solid Waste Management Ordinance and Integrated Solid Waste Management Plan • Establishment of Recycling Industry • Establishment of Garbage Collection and Transport System • Provide water sealed toilets • Monitor water quality for consumption • Development of MRF and Solid Waste Management System • Prevention/Control of Land, Water, Air and Noise Pollution • Control of Soil Erosion and Siltation • Construction of STP	**IASCL ComRel** • Training and capcity building	Construction Operation	LGU–IRA, ER 1-94, IASCL CSR
Infrastructure • Improvement and rehabilitation of barangay roads	• Barangay Chairman • Barangay Kagawad for Infrastructure	**MPDO/ME/ DPWH** • Road Rehabilitation	**IASCL ComRel**	Construction Operation	LGU–IRA, ER 1-94, IASCL CSR
Peace and order • Maintenance of peace & order	• Barangay Kagawad for Peace and Order • Barangay Tanod	**LGU/PNP** • Capacitate and Strengthen Barangay Tanods in peace keeping	**IASCL Chief Security Officer**	Construction Operation	LGU–IRA, ER 1-94, IASCL CSR
Spiritual	• Barangay Assigned Catholic Priest • Pastor of different denomination	**Parish Priest/Pastor**	**IASCL ComRel**	Construction Operation	LGU–IRA, ER 1-94, IASCL CSR

Table 5-2 Proposed IEC Framework

Needs	Implementation	Community Implementation Plan (Strategies)	Government/ Non-Government Agency Services	Proponent	Cost Estimate (PhP)
• Province of Leyte • Municipality of Isabel • Barangay Libertad: Full Information about: ❑ The EIA process ❑ The nature and operation of the modular diesel power plant ❑ The consequential impacts on the residents of the community and their mitigation measures ❑ The benefits of the Project on their Socio-cultural/ economic and bio-physical environment of the affected residents as they address the major issues of air pollution using IEC	Before project implementation During project operations	**1. Primer/Brochure (print media)** This strategy is effective in explaining in detail the subject matter, done in a simplified manner and in the language of the people. This strategy, likewise, uses illustrations to further clarify the processes that are to be done. It is a good vehicle for IEC to provide updates and relevant issues of the proposed Project during construction and operation. A. The EIA process must be illustrated and simplified in the language of the affected community written in English & Tagalog/Visayan. B. The Modular Diesel Power Plant This shall contain: - the project description, project time frame, project facilities, management of social and environmental impacts, potential project benefits, graphic illustration about the process and operation of modular diesel power plant, process of EIA, roles and responsibilities of the stakeholders - Philippine Clean Water Act of 2004 - R.A. No. 8749 (Philippine Clean Air Act of 1999); - R.A. 9003 Ecological Solid Waste Management	1. Municipality & Barangay Information Officers 2. Elementary and High School Students 3. Barangay Committee on Education and Culture 4. Barangay Gabay sa Mamamayan Action Center	• **IASCL** ComRel	50,000.00

Needs	Implementation	Community Implementation Plan (Strategies)	Government/ Non-Government Agency Services	Proponent	Cost Estimate (PhP)
❑ Full information on the decommissioning plan of the project.		C. Benefits ❑ The Social Development and Management Plan - Gender Responsive Livelihood and Credit Facilities - Education and Recreation - Health and Safety - Environment and Sanitation R.A.9003 - Peace and order - Spiritual D. Grievance On the residents who will be affected by the proposed Project activities showing their right to complain for violations of ECC conditions **2. Consultations** These are face to face encounters where participants and facilitators of knowledge and skills develop strategies to respond to the needs of the communities in the context of what is appropriate for their capabilities and resources ❑ Using the interpersonal approach, the Community Relations Officer shall maintain regular consultations with the barangay for an open dialogue on the issues, problems and concerns related to the implementation and sustainability of the project. ❑ Group discussion of the sectoral groups which will be affected in the project activities, the legal processes with the application of priority job placement, and other benefits ❑ Workshops on Solid Waste Management and Preparation of IEC materials ❑ Workshop on community Disaster and Risk Management			

Needs	Implementation	Community Implementation Plan (Strategies)	Government/ Non-Government Agency Services	Proponent	Cost Estimate (PhP)
		3. Posters and Wall Comics ❑ A graphic illustration of information on "What is a Modular Diesel Power Plant?" and the rationale of the project in the context of their life-ways based on DOE ER 1-94. ❑ Community-Based Solid Waste Management and information about R.A.9003 and DAO 2004-1 ❑ Community-Based Climate Change Management/ Disaster Risk Management. **4. Cell phone Patch Consultation** ❑ Using the Cell Phone feed-back mechanism through the Barangay Counsel in project affected barangay. **5. Barangay Forum and Phone Patch Up** ❑ This strategy enables the IASCL to discuss the progress of the proposed Project with key-persons of the company/resource persons weekly. This also encourages multi-sectoral interest groups to ask questions through phone patches.			

6.0 ENVIRONMENTAL COMPLIANCE MONITORING

The Environmental Compliance Monitoring presents the IASCL's commitment to conduct a self-monitoring activity wherein various measures are proposed in order to ensure that the impacts which will be caused by the proposed project are minimized and properly managed.

6.1 SELF-MONITORING PLAN

IASCL 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**) is presented in **Table 6-1**. This EMoP follows Annex 2-20 of the DAO 2003-30. The plan is largely indicative and will be refined during project implementation.

Environmental monitoring involves all project phases; namely, construction, commissioning, operations and abandonment to determine and find explanation on any changes in the baseline data. This includes inventory of opened up areas, removal of structures and vegetation, volume of spoils, spaces opened up, built up structures, influx of workers, water consumption, jetty operations, waste generation, disposal of hazardous wastes, operating and maintenance of equipment, fuel and chemical storage and dismantling and removal of facilities and removal and disposal of demolition wastes.

Table 6-1 Environmental Monitoring Plan for the Proposed Project

Key Environmental Aspects	Environmental Component	Potential Impacts	Sampling & Measurement Plan				Lead Entity	Estimated Cost (PhP)	EQPL Management Scheme					
									EQPL Range			Management Measures		
			Parameter	Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
CONSTRUCTION PHASE														
	LAND													
• Mobilization of construction equipment and materials • Construction of power plant and other support facilities • Generation of domestic waste	Pedology	Soil contamination due to fuel spills/ leakage	Volume of leak	Visual inspection	Upon report, stoppage of spills		IASCL, Contractor EMB	NA	Spill Vol.: <1L Visible oil spill in the site.	Spill Vol.: 1L to <100L Visible oil spill in the site.	Spill Vol.: >100L Visible oil spill in the site.	Conduct investigation regarding the reason of the leak. Visual check of the oil tanks.	Conduct of leak test in the tank. Inspection of the tanks for the area where leakage occur.	Conduct of leak test. Do not use the tank unless the damage is fixed. Report the incident to the EMB Region 8.
CONSTRUCTION PHASE														
	AIR													
• Mobilization of construction equipment and materials • Construction of power plant and other support facilities • Generation of domestic waste	Air Quality	Degradation of ambient air quality	TSP, µg/Ncm			**1-Hour Averaging Time:** Station 3 Station 4 Station 5 Station 6			240	270	300	Check weather condition during sampling and if location is downwind of the area. Check possible sources of pollution including external factors.	Check weather condition during sampling and if location is downwind of the area. Conduct site visit at said sampling stations and hire a 3rd party DENR accredited sampling firm to confirm. If the source is not from the Project, coordinate it with LGUand EMB for	Hire a 3rd party DENR accredited sampling firm to confirm results and conduct investigation. Temporarily stop certain aspects of the activities unless the problem has been resolved. If the source is not from the Project, coordinate it with LGU and EMB for appropriate action.
			PM_{10}, µg/Ncm						160	180	200			
			NO_2, µg/Ncm						208	234	260			
			SO_2, µg/Ncm						272	306	340			

Key Environmental Aspects	Environmental Component	Potential Impacts	Sampling & Measurement Plan				Lead Entity	Estimated Cost (PhP)	EQPL Management Scheme					
									EQPL Range			Management Measures		
			Parameter	Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
													appropriate action.	
	Noise level	Increase in noise level	Noise Level (dBA)	Portable Noise Level Meter	Once a month (morning, daytime, evening and nighttime) Quarterly Reporting to DENR	Stations 1 to 5 (ClassD)	IASCL, Contractor & EMB		Daytime-65 Morning/ Evening-60 Nighttime-55	Daytime-70 Morning/Evening-65 Nighttime-60	Daytime-75 Morning/ Evening-70 Nighttime-65	Conduct survey at sampling stations to verify complaints. Check the sound level using sound meter. Determine possible causes.	Conduct retesting to validate the complaint/ If source of noise is from the Project, inform the Unit head in-charge to provide noise mitigation measures. Conduct noise monitoring to verify the limits are already within limits. If source of noise is not from the Project, inform the EMB regarding possible source of noise for the group's investigation and coordination with LGU.	Conduct noise sampling with the presence of the DENR or a 3rd party environmental firm. Inform the operations or the area owner to stop activity unless noise mitigation measures have been installed or the source of noise has been corrected. Upon installation of noise mitigation measures, conduct noise monitoring to verify if the noise level is already within limits.
						Staion 6 (Class B)			Daytime-55 Morning/Evening-50 Nighttime-45	Daytime-60 Morning/Evening-55 Nighttime-50	Daytime-65 Morning/ Evening-60 Nighttime-55			
CONSTRUCTION PHASE														
	PEOPLE													
Hiring of workers	Local residents	Increase in local employment Increase income for residents	Composition of workforce		Semi-annually	NA	IASCL, Contractor, LGU, EMB	NA	50% of the employees are local residents (based on the skills and capacity)	55% of the employees are local residents (based on the skills and	60 % of the employees are local residents (based on the skills	Increase employability of local residents by undertaking construction skills training prior to job hiring	Investigation of the reasons for not meeting the % local resident employment	Review employment memos, etc.

Key Environmental Aspects	Environmental Component	Potential Impacts	Sampling & Measurement Plan				Lead Entity	Estimated Cost (PhP)	EQPL Management Scheme					
									EQPL Range			Management Measures		
			Parameter	Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
										capacity)	and capacity)			
OPERATION PHASE														
	LAND													
• Operation of power plant and other support facilities • Generation of domestic waste	Pedology	Soil Contamination due to fuel spills/ leakage	Volume of leak	Visual inspection	Upon report, stoppage of spills	Project site and off-site	IASCL Contractor EMB	NA	Spill Vol.: <1L Visible oil spill in the site.	Spill Vol.: 1L to <100L Visible oil spill in the site.	Spill Vol.: >100L Visible oil spill in the site.	Conduct investigation regarding the reason of the leak. Visual check of the oil tanks.	Conduct of leak test in the tank. Inspection of the tanks for the area where leakage occur.	Conduct of leak test. Do not use the tank unless the damage is fixed. Report the incident to EMB Region 8.
OPERATION PHASE														
	AIR													
• Operation of power plant	Air Quality	Decrease in Ambient air quality	TSP, µg/Ncm PM_{10}, µg/Ncm NO_2, µg/Ncm SO_2, µg/Ncm	Using High volume-gravimetric method of analysis	Quarterl	**1-Hour Averaging Time:** Stations1-6	IASCL, Contractor EMB		240 160 208 272	270 180 234 306	300 200 260 340	Check weather condition during sampling and if location is downwind of the area. Check possible sources of pollution including external factors. Check status of generators for any upset or off-operating parameters and have it adjusted accordingly as needed.	Check weather condition during sampling and if location is downwind of the area. Conduct site visit at said sampling stations and hire a 3rd party DENR accredited sampling firm to confirm. Check emission of smoke stacks using CEMS. Conduct adjustments of the unit's operation as per operating manual.	Hire a 3rd party DENR accredited sampling firm to confirm and conduct investigation. Check emission of smoke stacks using CEMS. Conduct adjustments of the unit's operation as per operating manual. Temporarily stop certain aspects of the operations unless the problem has been resolved. If the source is not from the Project,

Key Environmental Aspects	Environmental Component	Potential Impacts	Sampling & Measurement Plan				Lead Entity	Estimated Cost (PhP)	EQPL Management Scheme					
									EQPL Range			Management Measures		
			Parameter	Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
													If the source is not from the proposed Project, coordinate it with LGU, DENR and the EMB for appropriate action.	coordinate it with LGU, DENR and the EMB for appropriate action.
		Decrease in air quality due to source emissions	PM, mg/Ncm	Using USEPA Methods 1 to 5	Continuous with manual stack testing Twice a year	Stack	IASCL Contractor EMB		120	135	150	Coordinate with operations and verify the status of generator for any upset or off operating parameters and have it adjusted accordingly as needed.	Hire a 3rd party DENR accredited sampling firm to confirm and conduct investigation. Check emission of smoke stacks using CEMS. Conduct adjustments of the unit's operation as per operating manual.	Hire a 3rd party DENR accredited sampling firm to confirm and conduct investigation. Check emission of smoke stacks using CEMS. Conduct adjustments of the unit's operation as per operating manual. Temporarily stop certain aspects of the operations unless the problem has been resolved.
			SO_x, mg/Ncm	Using USEPA Methods 1 to 4 and 6 or 8 as appropriate					500	600	700			
			NO_x, mg/Ncm	Using USEPA Methods 1 to 4 and Method 7					700	850	1000			
			CO, mg/Ncm						300	400	500			
Operation of the power plant	Noise level	Increase in noise level	Noise Level (dBA)	Portable Noise Level Meter	Quarterly	Stations 1 to 5 (ClassD)	IASCL, Contractor & EMB		Daytime-65 Morning/ Evening-60 Nighttime-55	Daytime-70 Morning/Evening-65 Nighttime-60	Daytime-75 Morning/ Evening-70 Nighttime-65	Conduct survey at sampling stations to verify complaints as per IASCL Guideline on Noise Level Monitoring and Measurement Procedure.	If source of noise is from the proposed Project, inform the Plant Manager to provide noise mitigation measures. Conduct noise monitoring to	Conduct noise sampling in the presence of the DENR or a 3rd party environmental firm. Inform the Operations or the area owner to stop activity unless noise mitigation
						Staion 6			Daytime-55	Daytime-60	Daytime-65			

Key Environmental Aspects	Environmental Component	Potential Impacts	Sampling & Measurement Plan				Lead Entity	Estimated Cost (PhP)	EQPL Management Scheme					
									EQPL Range			Management Measures		
			Parameter	Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
						(Class B)			Morning/Evening-50 Nighttime-45	Morning/Evening-55 Nighttime-50	Morning/Evening-60 Nighttime-55	Check the sound level using sound meter. Determine possible causes.	verify if the level is already within limits. If source of noise is not from the Project, inform the EMB regarding possible source of noise for the group's investigation and coordination with LGU.	measures have been installed or the source of noise has been corrected. Upon installation of noise mitigation measures, conduct noise monitoring to verify if the noise level is already within limits.
OPERATION PHASE														
	PEOPLE													
	Local residents	Increase in local employment	Composition of workforce		Semi-annual	NA	IASCL	NA	50% of the employees are local residents (based on the skills and capacity)	55% of the employees are local residents (based on the skills and capacity)	60 % of the employees are local residents (based on the skills and capacity)	Increase employability of local residents by undertaking construction skills training prior to job hiring	Investigation of the reasons for not meeting the % local resident employment	Review employment memos, etc.
		Develop Local residents' Skills Training	Progress of skills training of local residents		Semi-annual	NA	IASCL	NA	50% of invited did not attend the skills training	60% of invites did not attend the skills training	70% of invites did not attend the skills training	Conduct investigation regarding the turn out of the training activity	Conduct perception survey and do research of what is the preferred skills training of the stakeholders	Hire 3rd party experts to conduct investigation and do some assessment regarding the effective skills training for a certain group of people. Intensify the IEC.
		Health risks and safety of workers	Safe person-hours, injury, near miss and other safety performance indices Health statistics	Medical Check-up	Regular	Project Site	IASCL, EMB	NA	No safety training of workforce	No sustained training for workforce	Zero accident	Conduct safety training for workers	Sustained safety training for workers Implement wearing of PPE among workers	Implement Phil. OSH Std./NIOSH Std.
				Incident reporting, surveys, included in the Health and	Monthly report				Zero accident			Conduct re-training of the workers on health safety rules and regulation Conduct investigation. Inspect the area wherein most accidents happen. Conduct monitoring.		

Key Environmental Aspects	Environmental Component	Potential Impacts	Sampling & Measurement Plan				Lead Entity	Estimated Cost (PhP)	EQPL Management Scheme					
									EQPL Range			Management Measures		
			Parameter	Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
				Safety Plan of IASCL								Hire a 3rd party safety practitioner to conduct safety audit in the plant site. Strictly adhere to occupational health and safety standards		
		Increased social acceptability for the proposed Project	Question on approval/ disapproval for the proposed Project and reason	Follow-up survey	Annually for 5 years	Municipality & affected barangay	IASCL, EMB	P60,000	50% says that project is unacceptable/degrading the environment.	60% says that project is unacceptable/degrading the environment.	70% says that project is unacceptable/degrading the environment.	Talk with the local stakeholders to check their stand on the issues to properly address it.	Intensify IEC and community relations.	Hire a 3rd party firm to conduct investigation in the area.
			Project Related complaints	Listing of valid complaints	Monthly	Municipality and affected barangay	IASCL, EMB	NA	One (1) valid complaint in a month	Three (3) valid complaint in a month	Five (5) valid complaint in a month	Talk with the complainant Conduct investigation	Talk with complainants and conduct immediate investigation Intensify monitoring of usual complaints of stakeholders	Participation of EMB in the resolution of complints
ABANDONMENT PHASE														
	LAND													
• Mobilization of Decommissioning equipment • Decommissioning of the power plant and other support facilities • Generation of domestic waste	Pedology	Soil Contamination due to fuel spills/ leakage	Volume of leak	Visual inspection	Upon report, stoppage of spills	Project site and off-site	IASCL Contractor EMB	NA	Spill Vol.: <1L Visible oil spill in the site.	Spill Vol.: 1L to <100L Visible oil spill in the site.	Spill Vol.: >100L Visible oil spill in the site.	Conduct investigation regarding the reason of the leak. Visual check of the oil tanks.	Conduct of leak test in the tank. Inspection of the tanks for the area where leakage occur.	Conduct of leak test. Do not use the tank unless the damage is fixed. Report the incident to EMB Region 8.
ABANDONMENT PHASE														
	AIR													
• Mobilization of Decommissioning equipment	Air Quality	Decrease in Ambient Air Quality	TSP, µg/Ncm PM_{10},	Using High volume sampling-gravimetric	Quarterly	**1-Hour Averaging Time:**	IASCL Contractor EMB		240 160	270 180	300 200	Check whether the area wherein exceedances occur is upwind or	Conduct retesting of the parameters to validate results.	Hire a 3rd party DENR accredited firm to check

Key Environmental Aspects	Environmental Component	Potential Impacts	Sampling & Measurement Plan				Lead Entity	Estimated Cost (PhP)	EQPL Management Scheme					
									EQPL Range			Management Measures		
			Parameter	Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
• Decommissioning of the power plant and other support facilities			µg/Ncm	method of analysis		Stations 1-6						downwind of the Project site. Conduct investigation regarding the source of the pollutants in the area including external sources.	Inspect the area where the possible source of pollution is. Report the incident to the DENR Region 8.	validate results in the area. Inspect the site together with any DENR Representative.
			NO_2, µg/Ncm						208	234	260			
			SO_2, µg/Ncm						272	306	340			
• Mobilization of Decommissioning equipment • Decommissioning of the power plant and other support facilities	Noise level	Increase in noise level	Noise Level (dBA)	Portable Noise Level Meter	Once a month (morning, daytime, evening and nighttime) Quarterly Reporting to DENR	Stations 1 to 5 (ClassD)	IASCL Contractor EMB		Daytime-65 Morning/ Evening-60 Nighttime-55	Daytime-70 Morning/Evening-65 Nighttime-60	Daytime-75 Morning/ Evening-70 Nighttime-65	Conduct survey at sampling stations to verify complaints as per IASCL Guideline on Noise Level Monitoring and Measurement Procedure. Check the sound level using sound meter. Determine possible causes.	If source of noise is from IASCL, inform the Plant Manager to provide noise mitigation measures. Conduct noise monitoring to verify if the level is already within limits. If source of noise is not from the Project, inform the EMB regarding possible source of noise for the group's investigation and coordination with LGU.	Conduct noise sampling in the presence of the DENR or a 3rd party environmental firm. Inform the Operations or the area owner to stop activity unless noise mitigation measures have been installed or the source of noise has been corrected. Upon installation of noise mitigation measures, conduct noise monitoring to verify if the noise level is already within limits.
						Staion 6 (Class B)			Daytime-55 Morning/Evening-50 Nighttime-45	Daytime-60 Morning/Evening-55 Nighttime-50	Daytime-65 Morning/ Evening-60 Nighttime-55			

6.2 IMPLEMENTATION OF THE EGF COMMITMENTS

The IASCL commits to establish an Environmental Guarantee Fund (**EGF**). The EGF shall be used exclusively for the following purposes:

- Immediate rehabilitation of areas affected by damages to the environment 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;
- Conduct of scientific or research studies related to the proposed Project that will aid in the prevention or rehabilitation of accidents and/or environmental damages; and
- For contingency and clean-up activities, environmental enhancement measures, damage prevention programs and social equity measures including the necessary IEC and capability building activities related to the 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 EGF Trust Fund and EGF Cash Fund for the proposed Project.

Table 6-2 EGF Trust Fund and EGF Cash Fund for the Proposed Project

Type of Fund	Amount (PhP)
EGF Trust Fund (PhP)	250,000.00
EGF Cash Fund (PhP)	250,000.00

7.0 ABANDONMENT/DECOMMISSIONING/REHABILITATION POLICIES AND GENERIC GUIDELINES

In the unlikely event that the proposed Project becomes uneconomically viable or if by *force majeure* or acts of God, the Project will have to be terminated. A detailed abandonment plan shall be developed prior to the closure of the facilities and within the timeframe that will be specified in the ECC. The Abandonment and Decommissioning Plan will be prepared in accordance to DENR requirements and shall address the following:

- Proposed abandonment/decommissioning measures for the power plant and all auxiliary facilities constructed as part of the project.
- Removal of the existing hazardous and non-hazardous waste, if any
- Site restoration
- Cost associated with the proposed abandonment/decommissioning activities and source of funds for the implementation of the activities
- Conformance to the requirements of the company, the local government, the DENR and other relevant agencies.

The plan will be submitted to the DENR for review and approval prior to the commencement of abandonment/decommissioning activities. IASCL Staff/Workers will be informed six (6) months prior to abandonment of the Project.

8.0 INSTITUTIONAL PLAN FOR EMP IMPLEMENTATION

The different divisions/units of the proposed Project Management who are responsible for the implementation of the EMP, EMoP, SDP and the ECC Conditions are presented in **Figure 8-1**.

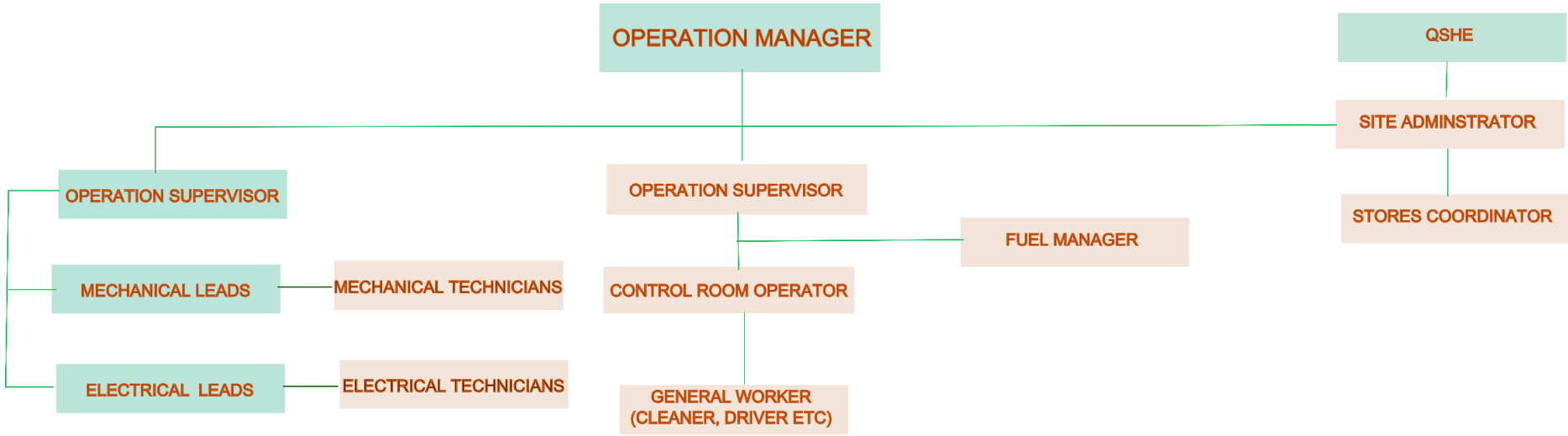


Figure 8-1 Organizational Structure for the Proposed Project

9.0 REFERENCES

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5 Long and Giri (2011) Assessment of Philippine Mangrove Forest Cover. GIS Applications and Mapping. Published at Sensors. Retrieved at December 11, 2017.
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7 Merrill, E.D. 1923-1926. An Enumeration of Philippine Flowering Plants. Vol. I-IV. Bureau of Printing, Manila, Philippines.
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9 Environmental Performance Report and Management Plan of PASAR
10 RPM (DAO 2003-13)
11 DENR Administrative Order No. 2016-08. Water