ATN HOLDINGS, INC.

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ENVIRONMENTAL IMPACT STATEMENT

Proposed ATN Integrated Aggregates Project

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SUBMITTED TO:

THE ENVIRONMENTAL MANAGEMENT BUREAU

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SUBMITTED BY:

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EXECUTIVE SUMMARY

Project Fact Sheet

I. Basic Project Information

Project Name	:	ATN Integrated Aggregates Project
Nature of Project	:	Major Quarrying and Crushing Project
Proposed Annual Extraction Rate	:	7,000,000 DMT
Proposed Annual Crushing Rate	:	5,000,000 DMT
Commodity	:	Aggregates
Location of Quarry and Facilities	:	Brgy. Macabud, Rodriguez (formerly Montalban), Rizal
Permit	:	EP- IVA-019
Total Project Area	:	82.7092 hectares
Mining Method	:	Surface Mining – Quarrying
Mine Life	:	14 Years
Project Components	:	Quarry (includes haul and access roads, mobile crusher, stockpile and dumps) Crushing plant, batching plant and concrete hollow blocks plant Support facilities (includes office buildings, housing facilities and bunk houses, security outposts and facilities, motorpool, nursery area) Pollution control facilities (includes sedimentation ponds/settling ponds, pit drainage)

II. Proponent Profile

ATN Holdings Inc.
Embracing the FUTURE

ATN Holdings, Inc.

Address	:	9th Floor, Summit One Tower, 530 Shaw Blvd., Mandaluyong City
Authorized Representative/Contact Person	:	Paul Saria CEO
Contact Details	:	(032) 404-0239/404-2596 09178839330
Email Address	:	atnsolar.team@gmail.com atnsolar@tbgi.net.ph

III. Project Preparer

permata RESOURCES INC.

Address	:	Unit 406, FSS Bldg. II, Sct Tuason cor. Sct Castor Sts., Laging Handa, Quezon City
Authorized Representative/ Contact Person(s)	:	Mr. Edwin Ramirez Managing Director
Contact Number	:	(+63) 917-5259-192

Tenement History

ATN Holdings, Inc., through its affiliate company, is implementing an energy project in Barangay Macabud, Rodriguez (formerly Montalban), Rizal. The company also owns 256.10 hectares of land encompassed under TCT # 463732; some which lies within the aforesaid project area.

With the potential of rock aggregates resource within the said areas, ATN plans to develop the area and utilize the aggregate resources for the upcoming projects of the company. With such, ATN Holdings, Inc. was issued with an Exploration Permit denominated as EP-IVA-019 (**Annex A**) covering an area of 82.7092 hectares

Process Documentation of the Conduct of Environmental Impact Assessment

For this Environmental Impact Assessment (EIA), the terms of reference utilized were consistent with those indicated in the Revised Procedural Manual for Department of Environment and Natural Resources (DENR) Administrative Order (DAO) No. 2003-30; otherwise known as the Implementing Rules and Regulations of Presidential Decree No. 1586 “Establishing the Philippine Environmental Impact Statement System.

The established EIA Team is composed of multi-disciplinary specialists/experts who have extensive training and experience on their respective fields and in the conduct of EIA for various industry sectors.

I. EIA Team

This study is a conglomeration and integration of the various inputs and findings from the following specialists/experts in terms of technical, environmental, institutional/legal, and social aspects:

EIA Team Member	Field of Expertise	IPCO Number
Edwin D. Ramirez, EM, MSERM	Mining and Geology	076
Christopher Vir Fabio, EM	Mining	-
George P. Moreno	Geology	-
Abner M. Padrique	Geology	-
Silverio V. Magallon, Jr., Ph.D	Socio-economic	-

EIA Team Member	Field of Expertise	IPCO Number
Wilfredo Sanidad, Ph.D	Soil and Water	139
Ronald S. Pahunang	Air and Noise	173
Raul R. Bunao	Biodiversity	192
Jess M. Addawe	GIS and Environmental Impact Assessment	055

II. EIA Study Schedule and Area

Public scoping was conducted on 16 May 2019, which was participated by DENR-Environmental Management Bureau (EMB) personnel, DENR-Mines and Geosciences Bureau (MGB) personnel, ATN Holdings, Inc. and Permata Resources, Inc.

Activitiy(ies)	Date
Public Scoping	16 May 2019
Social survey/assessment	April and May 2019
Air and noise sampling	21 to 24 July 2019
Flora and fauna assessment	12 to 13 June 2019
Freshwater assessment	12 to 13 June 2019
Water sampling	24 June 2019
Soil sampling	12 to 13 June 2019

The area subjected to the EIA conducted was based on the perceived direct and indirect impact areas of the proposed ATN Integrated Aggregates Project. As stipulated in DAO 2003-30, direct impact areas, in terms of physical environment, are those where all project facilities are to be constructed/situated and the designated mine areas. On the other hand, areas not directly subjected to any activities/construction and those outside the identified mining are but are within the jurisdiction of Rodriguez (e.g. stretch of river draining the project area, communities along haul roads) are considered as indirect impact areas. For the social impacts, direct impact community are those from Barangay Macabud, while other communities not encompassed by the delineated direct impact areas constitutes the indirect impact communities.

III. EIA Methodology

Primary and secondary data were utilized for the assessment of the project impacts. Primary data were obtained from conducted on-site investigation and field sampling/surveys; while secondary data were acquired from the proponent and pertinent government agencies/institutions. Relevant and previously conducted studies were also considered.

The following were the sampling/assessment methodologies employed by the EIA team for the study:

Module		Methodology
Land	Land Use	- Gathering and review of secondary data - Site observation
	Geology and Geomorphology	- Gathering and review of secondary data

Module		Methodology
		- Site observation
	Natural Hazards	- Gathering and review of secondary data - Site observation
	Pedology	- Gathering and review of secondary data - Soil sampling - Chemical and physical analysis of soil
	Terrestrial Biology	- Gathering and review of secondary data - Site observation, transect - Quadrant sampling - Interviews
Water	Hydrology and Hydrogeology	- Gathering and review of secondary data - Drainage Area-Ratio Method - Float Method
	Water Quality	- In-situ measurements; grab sampling and laboratory analysis
	Freshwater Ecology	- Sampling: towing and Reach-wide benthos method - Gathering and review of secondary data
Air and Noise	Meteorology	- Gathering and review of secondary data
	Air and Noise Quality	- Sampling: High Volume Sampler; Dual Channel Dust Sampler; Personal Sampler - digital sound level meter for noise
People	Socio-economic Profile	- Gathering and review of secondary data - Perception survey - Focus group discussions

IV. Public Participation

The conducted site investigation, perception survey and various focus group discussions served as the venue for community participation. Through these, they were able to relay their issues, concerns, and perceptions regarding the proposed project.

<u>Summary of Baseline Characterization</u>

Module	Summary of Baseline Conditions
Geology	The project area of lies immediately 8-km northeast of Lamesa Watershed Reservation. Regionally, the project, including whole of Metro Manila, is bordered on the western and eastern sides by the Manila Trench and the Philippine

Module	Summary of Baseline Conditions
	Trench, respectively. East of the project area is the Valley Fault System (VFS) which runs all the way from south of Metro Manila including cities of Muntinlupa, Pasig, west edge of Laguna de Bay, Pasay, Marikina, Quezon City, Montalban, Rizal up to San Jose del Monte, Bulacan. The project area is also part of the Southern Sierra Madre. Generally, it is underlain by Late Cretaceous basement consisting of ophiolite/ophiolitic complex - Montalban Ophiolitic Complex that is overlain by the Kinabuan Formation. The Kinabuan Formation consists of two members: a lower clastic member and an upper limestone member. Above the Kinabuan Formation is Maybangain Formation, consisting of two members, namely, the lower Paleocene Masungi Limestone and the upper Eocene clastic-volcanic member. Sta. Ines Diorite intrudes the Kinabuan and Maybangain formations during the Early Oligocene. It occurs as a stock and also dikes and sills intruding sedimentary rocks in the area. The dominant rock type is medium to coarse grained hornblende diorite with local quartz diorite, gabbro and diabase facies. Overlying the Maybangain Formation is the Binangonan Formation. It has two members, namely lower Teresa Siltstone and an upper limestone member. The Early Miocene Angat Formation consists of a lower clastic member and an upper limestone member.
Geomorphology	It project area is hilly to mountainous, with highest elevation at 260m asl located in the northwestern part of the property. The northern part is gently sloping typified by a plateau land form then abruptly grade towards south-central portion of the permitted area, forming a depression-like formation or valley shaped morphology characterized by moderate to steep slopes. The drainage on the project area is defined by two major north-northeast trending river which drains towards Wawa river then to Marikina River basin. Its tributaries have rectangular pattern displaying right-angled banks which indicates structurally controlled system.
Pedology	The soil of the proposed project area belongs to the Antipolo series. It is a member of the fine, mixed, isohyperthermic family of Typic Tropudalfs. They are moderately deep to deep well drained soils occurring on undulating to rolling basaltic hills and ridges with localized valley.

Module	Summary of Baseline Conditions
	pH of the soil in the sampling stations are generally moderately acidic. Moreover, based on the conducted laboratory analysis, the soil has low to very high SOM; nitrogen content is low; phosphorous content is elevated; high potassium content; calcium levels are medium to high; sodium, manganese, zinc, iron and magnesium levels are high. The soils of the project area also have low to undetected levels of arsenic, mercury and hexavalent chromium
Terrestrial Biology	Generally, the forest cover of the project area varies from closed-canopy to open canopy forest and some portions of brushlands. The closed-canopy forest is a second-growth and residual forest are dominated with Fabaceae, Euphorbiacea and Moraceae family tree species. The open forest is relatively young with the highest recorded diameter at breast height (dbh) at only 34 cm; while majority of the individual species have dbh that falls between the ranges of 3 cm to 18 cm. The open portions are brushland which is dominated by ferns such as pako-pako, herbs such as kantutay and hagonoy, some shrubs and small trees. Flora. A total of two hundred twenty (120) species were recognized belonging to the seed plants, ferns and their allies from the six quadrats sampled. Out of the said species, fifteen (15) are Philippine endemics and four (4) species are included in the National Red List. Fauna. Sampling conducted reveal five different species of bats, at least 14 species of birds, 3 species of amphibians and one species of rodents.
Hydrology and Hydrogeology	The project area is underlain by volcanic formation consisting of Basalt, Andesite and volcanic breccias, which are generally impermeable and low porosity rocks as compared to sediments derived rock layers such as sandstone. This hydro-geological characteristic affirms that the project area is classified under local and less productive aquifers and rocks with limited potential, low to moderate permeability.
Water Quality	Laboratory analysis results showed that waters in the sampling stations have low BOD, oil and grease, surfactants, nitrate content, chloride content and COD; low to high TSS; high levels of ammonia; elevated levels of hexavalent chromium and copper; low lead and zinc content; and high fecal coliform content.
Freshwater Ecology	Seventeen (17) species of phytoplanktos with 31,500 cell/mL in five different division were identified from the collected specimen during the sampling. A total of nineteen (19) individual species were captured during the macroinvertebrate sampling. In three different

Module	Summary of Baseline Conditions
	stations, three (3) species of macroinvertebrates where identified which belongs to two (2) families in categorization. Downstream has the highest number of species captured with seven (7) individual species belonging to two family.
Climatology, Air Quality and Noise	The project site is in an area zoned as Type I Climate, though it appears adjacent or along the boundary between Type I and Type III climate. Rainfall amount appears to gradually increase from March to April, and abruptly increase in May and in August. It then gradually decreases in September and with about 150 mm decrease of rainfall from October to November. The hottest month is May with monthly average temperature of 29.3 °C followed by April with 29.2 °C. April is also the least humid month with 67% relative humidity. Prevailing wind directions are from the southwest during the southwest monsoon season (June to September) and from the north and northeast in October to February during the transition and the northeast monsoon season. Background levels of particulates (TSP, PM10, and PM2.5) were way below the ambient guidelines and standards set for these air pollutants. NO2 at one-hour average sampling was not detected at the four (4) locations, though remarkably, NO2 levels at 24-hour sampling at two locations (Stations AQ2 and Station AQ4) were measured at 2.1 and 3.3 µg/Nm3, respectively. SO2 (24-hour and 1-hour average concentrations) was not detected (or below detection limits) at the time of monitoring. Metals in ambient air (lead, antimony, arsenic, cadmium, and mercury) were all not-detected (less than the detection limits) at the time of monitoring Measured noise levels were generally within the ambient noise standard set for residential areas, except when vehicles passed near the monitoring location during sampling. Sources of noise were generally from residents, animals, insects, and passing vehicles.
Socio-economic	The Municipality of Rodriguez, formerly known as Montalban, has a steady growth of population with a total count of 280,904 as of 2010. Barangay Macabud has an overall population of 6,605. Rodriguez has a total land area of 36,307.31. Of said area, 27,243.87 is utilized for agriculture. Rice is the basic agricultural crop raised in Rizal Province. Other crops such as bananas, mangoes, cashew and other fruit trees covered the upland or the hilly portion to some parts of the mountainous landscape. Vegetable and other diversified crops are found generally on the nearly level river terrace where crops respond well to loamy to fine loamy soils of Agustin, San Manuel and Quingua.

Module	Summary of Baseline Conditions
	Based on the conducted survey, twenty five percent are aware of the company's proposed project. Fifteen percent believe on the perceived positive effects of mining in their community.

Summary of Key Environmental Impacts and Management and Monitoring Plan and Contingent Liability and Rehabilitation Fund, Mine Rehabilitation Fund, and Environmental Trust Fund

The Impact Management Plan for the proposed Project is as follows:

Project Activity	Environmental/ Social Component to be Affected	Potential Impacts	Options for Prevention, Mitigation or Enhancement	Residual Effects
Development/Construction Phase				
Site preparation (clearing, grubbing and stripping of topsoil) Construction of benches/mine facilities/haul roads Stockpiling of topsoil	Land	- Change in land use of areas occupied by the mine facilities - Loss of topsoil and decrease in soil quality/productivity - Soil contamination	- Planning of rehabilitation will be in accordance with the FMR/DP and in consultation with stakeholders - Removed soils will be conserved and stockpiled in a pre-determined area and will be in rehabilitation and backfilling activities - Stockpiles shall be graded to a stable relief - Progressive ground preparation/grubbing to minimize the area removed with soil cover at any one time	- Minimal inexorable topsoil loss due to transport/movement
		- Inducement of land slides	- Safe working slopes and land slide control structures will be established - Train pertinent personnel on recognition of the various slope/ground failure modes, hazard warning signs and standard operating procedures to be observed in the case of ground failure events or impending event	- None as thorough geological studies were and will continuously be implemented relative to the mine plan that will be laid out.
		- Generation of wastes	- Materials recovered from vegetation removal shall be used as: ▪ Trash lines on steep slopes to mitigate soil erosion ▪ Materials for construction and/or composted and used for the fertilization of the seedlings in the nursery, seedling	- None; implementation of an integrated solid waste management plan on the commencement of project implementation

Project Activity	Environmental/ Social Component to be Affected	Potential Impacts	Options for Prevention, Mitigation or Enhancement	Residual Effects
			outplanting and field maintenance - Proper disposal of construction debris and solid wastes - Implementation of an Integrated Solid Waste Management Plan: Reduce, reuse, recycle	
	Terrestrial Ecology	- Loss of vegetation and habitat - Increase in noise - Mortality of small, less mobile animals due to project activities - Habitat Fragmentation	- For accessibility, existing roads will be utilized and improved - For new roads to be established, heavily disturbed (e.g., grassland, scrubland, etc.) areas or trails shall be prioritized as the location - Whenever possible, tree-balling and immediate transfer of trees to open areas within the project area will be done (Applicable only to the critically endangered tree species) - Tree cutting permit shall be secured prior to any clearing and cutting - Strictly prohibit poaching of wildlife to mitigate population reduction and allow safe movement - Vegetation removal kept at minimum through planned clearings - Establishing voluntary conservation zones and biological corridors within the Project area	- Minimal unavoidable impact on some vegetation and animals (eg. grasses, small plants) due to equipment movement and stripping activities
	Surface hydrology	- Increase in surface runoff and river discharge - Decline in river carrying capacity due to siltation	- Construction of a drainage system within the project area - Proper stockpiling of excavated materials with appropriate drainage to minimize sedimentation.	- Possible siltation of water body due to onslaught of extreme weather condition on project area

Project Activity	Environmental/ Social Component to be Affected	Potential Impacts	Options for Prevention, Mitigation or Enhancement	Residual Effects
		- Increases sewage and solid wastes, including petroleum based products	- Placement of regulatory signs on proper waste disposal of construction solid wastes - Provide proper waste disposal facilities for petroleum products and solid wastes - Provide sufficient toilet facilities for workers	-
	Air and Noise	- Ambient air pollution - Occupational health effects - Increased ambient sound levels	- Regular spraying of water in active construction areas - Replacement of vegetation in non-construction areas - Compacting of exposed soil - Provision of tarpaulin cover on trucks transporting construction materials - Immediate hauling of spoils - Impose speed restrictions - Regular maintenance of heavy equipment and motor vehicles - Regular maintenance of heavy equipment mufflers (noise) - Provision of ear mufflers to workers operating noisy equipment - Proper scheduling of noisy activities during day time	- Minimal fugitive dust and noise generation
	People	- Employment and Economic Opportunities - Population Influx - Loss of income from agricultural activities due to removal of crops and use of the land for mine development and road works	- Policy on the preferential hiring of locals - Pre-employment training to community residents - Training and development of local service cooperative - Preferential hiring of locals will be announced	- None
		- Exposure to safety and Health	- Safety and Health Program for workers and	- None

Project Activity	Environmental/ Social Component to be Affected	Potential Impacts	Options for Prevention, Mitigation or Enhancement	Residual Effects
		Hazards	impact communities. - Community Health Survey - Assistance to the LGU on traffic management	
		- Proliferation of vices that affects the peace and order in the area	- Values orientation seminars to workers and community residents - Conduct of activities that promotes community cohesion - Assistance to the LGU on Peace and Order management	- None
		- Increased income of LGUs due to tax revenues	- Prompt payment of taxes to the Local and National Government	- None
		- Possible unearthing of historical artifacts and/or fossil remains	- Safeguard possible archeological site and immediately inform the National Museum in case of finds	- None
Operation Phase				
Quarry	Land	- Generation of open areas with greater potential for runoff, erosion and landslides	- Establishment of safe working slopes and installation of land slide control structures - Implementation of a suitable and appropriate slope/ground failure monitoring plan to detect instability at an early and non-critical stage (eg. drone survey) - Train pertinent personnel on recognition of the various slope/ground failure modes, hazard warning signs and standard operating procedures to be observed in the case of ground failure events or impending event; - Identification, early recognition and monitoring of warning signs of potential and impending slope stability problems - Progressive rehabilitation of disturbed areas - "Vengineering" (i.e. planting of vegetation	- None; open areas during operation phase are only those where active mining operations revolve

Project Activity	Environmental/ Social Component to be Affected	Potential Impacts	Options for Prevention, Mitigation or Enhancement	Residual Effects
			with high rainfall intercepting capacity and high transpiration rate characteristics to serve as re-evaporators/biological pumps, respectively) - Utilization of removed topsoil for backfilling low-lying areas and service roads - Formulate a topsoil management plan (TMP) to address topsoil removal, stockpiling, and archiving of topsoil inventory for the project's progressive rehabilitation activities	
	Soil Quality	- Decrease in surface soil quality due to compaction, shearing and dust deposition during quarrying and hauling activities - Improper disposal of domestic wastes - Soil Contamination due to accidental fuel and lubricant spills from vehicles and equipment	- Constant monitoring of the surface soil physico-chemical quality (i.e. Bulk density, metals, plant essential nutrient elements, pH) - Use vegetative cover (i.e. Grass and shrub species with known tolerance to acidic soil conditions; hyper/accumulator of metals to expedite and enhance soil quality - All domestic wastes will be sold to DENR accredited recyclers. Residual waste will be disposed to a designated sanitary land fill - All used oils, lubricants will be sold to recyclers. Residual waste will be disposed to a designated sanitary land fill - Contaminated soils will be removed and disposed off-site - Provision of refuse storage facility with oil and water separator to contain any accidental spill	- None
	Air and Noise	- CO_2 generation - Dust generation	- Implement regular inspection and preventive maintenance of heavy equipment,	- Minimal fugitive dust and noise generation

Project Activity	Environmental/ Social Component to be Affected	Potential Impacts	Options for Prevention, Mitigation or Enhancement	Residual Effects
		- Noise generation	machineries and service vehicles - Use electric or fuel-efficient equipment, machineries and vehicles and maximize its operation, if possible - Water spraying - Mining activities to be confined during daytime	
	Water	- Increase in surface runoff and river discharge - Decline in river carrying capacity due to siltation - Water pollution - Water resource use	- Establishment of siltation ponds and implementation of sediment and erosion control plan - Provision of drains to access roads to contain and limit sedimentation downstream of the quarry - Strengthen water monitoring system by keeping a record of daily water extraction and consumption. - Rainwater harvesting through decentralized impoundments	- Possible siltation of water body due to onslaught of extreme weather condition on project area
	Terrestrial Ecology	- Removal of ecologically and economically important species and wildlife habitat - Removal of photosynthesizing plants - Mortality of small, less mobile animals due to project activities - Accessibility of area to illegal hunters and poachers of animals	- Priority conservation for ecologically and economically important species identified in the area - Establishment of a nursery to propagate the seeds/propagules of these species, which will provide seedlings for future rehabilitation requirements - Tree plantation development using the indigenous species and assisted natural regeneration (ANR) techniques - Enhancement of Agro-forestry technologies suitable for the area - Prevention of unnecessary clearing of	- Minimal unavoidable impact on some vegetation and animals (eg. grasses, small plants) due to equipment movement and stripping activities

Project Activity	Environmental/ Social Component to be Affected	Potential Impacts	Options for Prevention, Mitigation or Enhancement	Residual Effects
			vegetation - Strictly prohibit poaching of wildlife to mitigate population reduction and allow safe movement. - Personnel, heavy equipment, other vehicles, etc. shall be confined only to pre-determined designated areas and shall not occupy other areas to avoid further disturbances - An active and continuous wildlife protection and conservation campaign will be pursued with the participation of all key stakeholders (e.g., communities, LGUs, etc.) within and around the project site.	
	People	- Safety and health risks to workers	- Provision of PPE to every personnel - Conduct of safety orientation and training	- None
Crushing, batching and CHB plant	Water	- Water pollution - Water resource use	- Strengthen water monitoring system by keeping a record of daily water extraction and consumption. - Alternative source of water such as rainwater harvesting through decentralized impoundments - Water monitoring system by keeping a record of daily water extraction and consumption.	- None
		- Water contamination from leaks and spills from vehicles and equipment, fuel and oil tanks and used oil storage	- Access roads will be provided with drains - Site water management that includes the provision of facilities that would reutilize effluent to ensure minimal effluent discharge (specially constructed tanks, pipe systems), and planting of vegetation–grassy plots, flowering shrubs, and fruit trees.	- None

Project Activity	Environmental/ Social Component to be Affected	Potential Impacts	Options for Prevention, Mitigation or Enhancement	Residual Effects
			- Training on in proper handling and implementation of good housekeeping practices.	
	Air and Noise	- CO2 generation - Dust generation - Noise generation	- Implement regular inspection and preventive maintenance of heavy equipment, machineries and service vehicles - Use electric or fuel-efficient equipment, machineries and vehicles and maximize its operation, if possible - Water spraying - Installation of dust suppression devices	- Minimal fugitive dust and noise generation
	People	- Safety and health risks to workers	- Provision of PPE to every personnel - Conduct of safety orientation and training	- None
Stockpiling of waste rock Hauling of materials	Land	- Soil erosion	- Proper and strategic siting of stockpiles - Progressive reclamation of exposed waste rocks - Stockpiling below angle of repose - Stockpiling in benches - Provision of rock facing and installation of large boulders along the toe line increase stability	- None
	Water	- Siltation of nearby water body	- Proper management of stockpile - Addition of soil amelioration and seeding of stockpiled topsoil - Provision of drainage	- Possible siltation of water body due to onslaught of extreme weather condition on project area
	Air and noise	- Ambient air pollution - Occupational health effects	- Regular spraying of water in active construction areas - Replacement of vegetation in non-construction areas - Compacting of exposed soil - Provision of tarpaulin cover on trucks	- Minimal fugitive dust and noise generation

Project Activity	Environmental/ Social Component to be Affected	Potential Impacts	Options for Prevention, Mitigation or Enhancement	Residual Effects
		- Increased ambient sound levels	transporting aggregates - Impose speed restrictions - Regular maintenance of heavy equipment and motor vehicles - Regular maintenance of heavy equipment mufflers (noise) - Provision of ear mufflers to workers operating noisy equipment - Proper scheduling of noisy activities during day time	
	People	- Safety and health risk to workers and communities near the haul roads	- Provision of PPE to every personnel - Conduct of safety orientation and training - Implementation of speed limit and other relevant safety procedures	- None
Operations of motorpool	Land	- Contamination of soil	- Provision of procedures for proper handling, storage, and transport of used oils, lubricants and chemicals - Provision of relevant pollution control devices (i.e. oil and water separator, auto shutoff valves) - Contaminated soils will be removed and disposed off-site. - Provision of Refuse storage facility with oil and water separator to contain any accidental spill.	- None
	Water	- Contamination of water		
	People	- Safety and health risks to workers	- Provision of procedures for proper handling, storage, and transport of used oils, lubricants and chemicals - Provision of PPE - Implementation of proper housekeeping	- None

Project Activity	Environmental/ Social Component to be Affected	Potential Impacts	Options for Prevention, Mitigation or Enhancement	Residual Effects
Operationalization of administrative complex	Land, water, people	- Contamination of soil and water - Health risks to workers and the community	- Implementation of proper housekeeping - Provision of proper domestic waste handling and disposal - Provision of a materials recovery facility for wastes - Implementation of segregation	- None
Abandonment Phase				
Decommissioning of equipment Rehabilitation of disturbed areas Dismantling of structures	Land	- Erosion of newly replaced soils - Difficulty in plant establishment within footprints due to soil compaction	- Establishment of newly restored areas with proper drainage and soil erosion control structures - Soil amelioration	- None
		- Permanent land use change - Generation of wastes	- Rehabilitation of the project area to the agreed and approved final land use embodied in the FMR/DP - The final perimeter and cover of the quarry area will have an undulating profile to facilitate drainage and future land use - Recyclable materials will be sold to recyclers. Residual wastes will be hand over to the municipal garbage collectors. Hazardous waste will be transported to accredited disposal companies - Decommissioning of infrastructures and rehabilitation of quarried out areas will be conducted in accordance with the project FMR/DP	- None
	Water	- Contamination of water quality due to failure of the siltation ponds	- Design impoundment structures relative to seismic and structural parameters - Monitoring of structural integrity for the duration of operation of these facilities and beyond mine closure	- Possible siltation of water body due to onslaught of extreme weather condition on project area

Project Activity	Environmental/ Social Component to be Affected	Potential Impacts	Options for Prevention, Mitigation or Enhancement	Residual Effects
			- Development of an Emergency Response Plan to handle possible siltation pond failure	
	Air and Noise	- Ambient air pollution - Occupational health effects - Increased ambient sound levels	- Regular spraying of water in active areas - Provision of tarpaulin cover on trucks transporting decommisioned materials - Impose speed restrictions - Regular maintenance of heavy equipment and motor vehicles - Regular maintenance of equipment mufflers (noise) - Provision of ear mufflers to workers operating noisy equipment - Proper scheduling of noisy activities during day time	- Minimal fugitive dust and noise generation
	People	- Termination of LGU revenues - Loss of employment/livelihood opportunities - Discontinuation of the social services offered by ATN through CSR and SDMP	- Extensive IEC prior to decommissioning - Implementation of a post-mining Social development plan	- None

For mining projects, a financial mechanism called the Contingent Liability and Rehabilitation Fund (CLRF) is established in lieu of the EMF and EGF. This CLRF is an environmental guarantee fund mechanism that ensures the just and timely compensation for damages and progressive and sustainable rehabilitation for any adverse effect a mining operation or activity may cause. This fund is further broken down as follows: Environmental Trust Fund (ETF), Mine Rehabilitation Fund (MRF), MWTF Reserve Fund (MWTFRF), and Final Mine Rehabilitation and Decommissioning Fund (FMRDF).

The MRF is established and maintained by each operating mine as a reasonable environmental deposit to ensure the availability of funds for the satisfactory compliance with the commitments and performance of the activities stipulated in the EPEP/Annual EPEP and this comes in two (2) forms: the Monitoring

Trust Fund (MTF), which covers the maintenance and other operating budget for the transportation and travel expenses, cost of laboratory analysis, and other reasonable expenses incurred by the multi-partite monitoring team in the amount of Php 150,000.00 which is replenishable every quarter; and the Rehabilitation Cash Fund (RCF), which is being used to ensure compliance with the approved rehabilitation activities and schedules for specific mining phase including research as defined in the EPEP/AEPEP in the amount equivalent to ten per cent (10%) of the total amount needed to implement the EPEP or Php 5 Million, whichever is lower.

Alternatively, the FMRDF is the cost used to implement the final mine rehabilitation and decommissioning plan which is after the life of the mine while MWTFRF are pertinent costs collected based on the amount of mine waste and tailings generated by a mining project and are used for payment of compensation for damages caused by mining pollution.

For the implementation of the Social Development and Management Program, an SDMP fund shall be established by the company. This fund should be 1.5% of the operating cost and should be utilized in this manner: 75% of the 1.5% is for the development of the host and neighboring communities (i.e. skills development/training, provision of health facilities, etc.); 10% of the 1.5% for the development of mining technologies and geosciences (i.e. expenditures for scholars on mining technology and geosciences); and 15% of 1.5% for the development and institutionalization of Information, Education, and Communication (IEC) (i.e. publication of IEC materials on social, environment, and/or other issues).

ATN Holdings, Inc. commits to establish the needed funds after approval of all the required documents.

1 PROJECT DESCRIPTION

1.1 Project Location and Area

The proposed ATN Integrated Aggregates Project (Project) of ATN Holdings, Inc. (ATN) is covered by EP-IVA-019 (**Annex A**) which encompasses a total area of 82.7092 hectares and is located at Barangay Macabud, Rodriguez, Rizal. Said tenement area is bounded by the following coordinates:

Table 1. Technical description of EP-IVA-019

Corner	Latitude	Longitude
1	14°47'00"	121°8'00"
2	14°47'30"	121°8'00"
3	14°47'30"	121°8'30"
4	14°47'00"	121°8'30"

1.2 Accessibility of Project Area

The project area is located in Barangay Macabud, Municipality of Rodriguez, Rizal Province. It is situated at the northeastern outskirts of Metro Manila and is about 50 kilometers by road and accessible to any land transportation from Manila via Cubao-Marikina-San Mateo Road or via the Commonwealth-Litex-Payatas-Montalban Road in about 2 hours

The project area can be reached through Litex, Commonwealth, Quezon City for less than an hour; passing by Payatas, the east side of Lamesa Dam until Barangay Isidro, Montalban - the entry point at the southern part of the property. Alternatively, the area could also be accessed from the north side via Tungkong Manga, San Jose Del Monte, Bulacan.

1.3 Direct and Indirect Impact Areas

The EIA was conducted based on the perceived direct and indirect impact areas of the proposed ATN Integrated Aggregates Project. Direct impact areas, in terms of physical environment, are those where all project facilities are to be constructed/situated and the designated mine areas. On the other hand, areas not directly subjected to any activities/construction and those outside the mining area but are within the jurisdiction of Rodriguez (e.g. stretch of river draining the project area, communities along haul roads) are considered as indirect impact areas. For the social impacts, direct impact community are those from Barangay Macabud, while other communities not encompassed by the delineated direct impact areas constitutes the indirect impact communities.

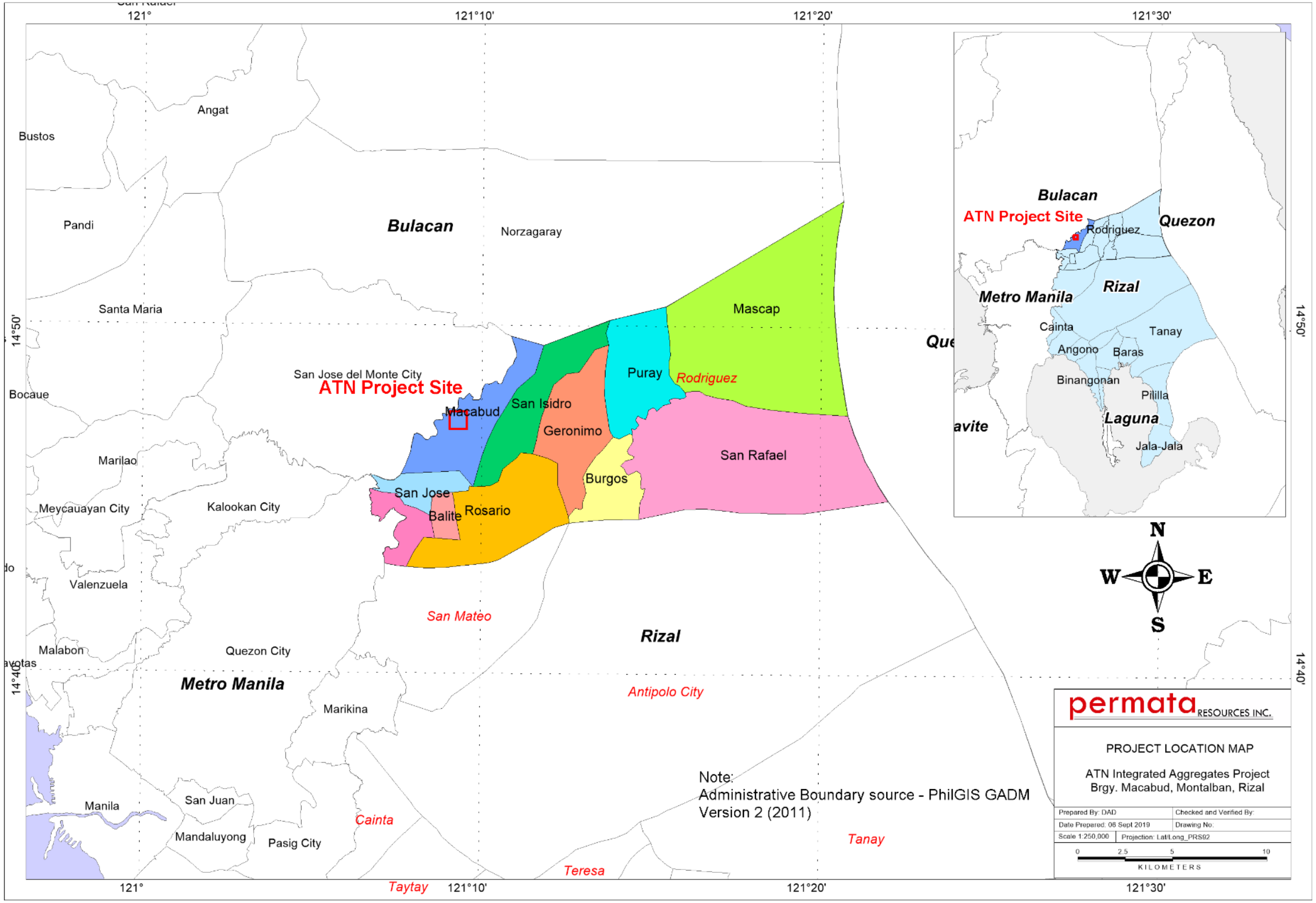
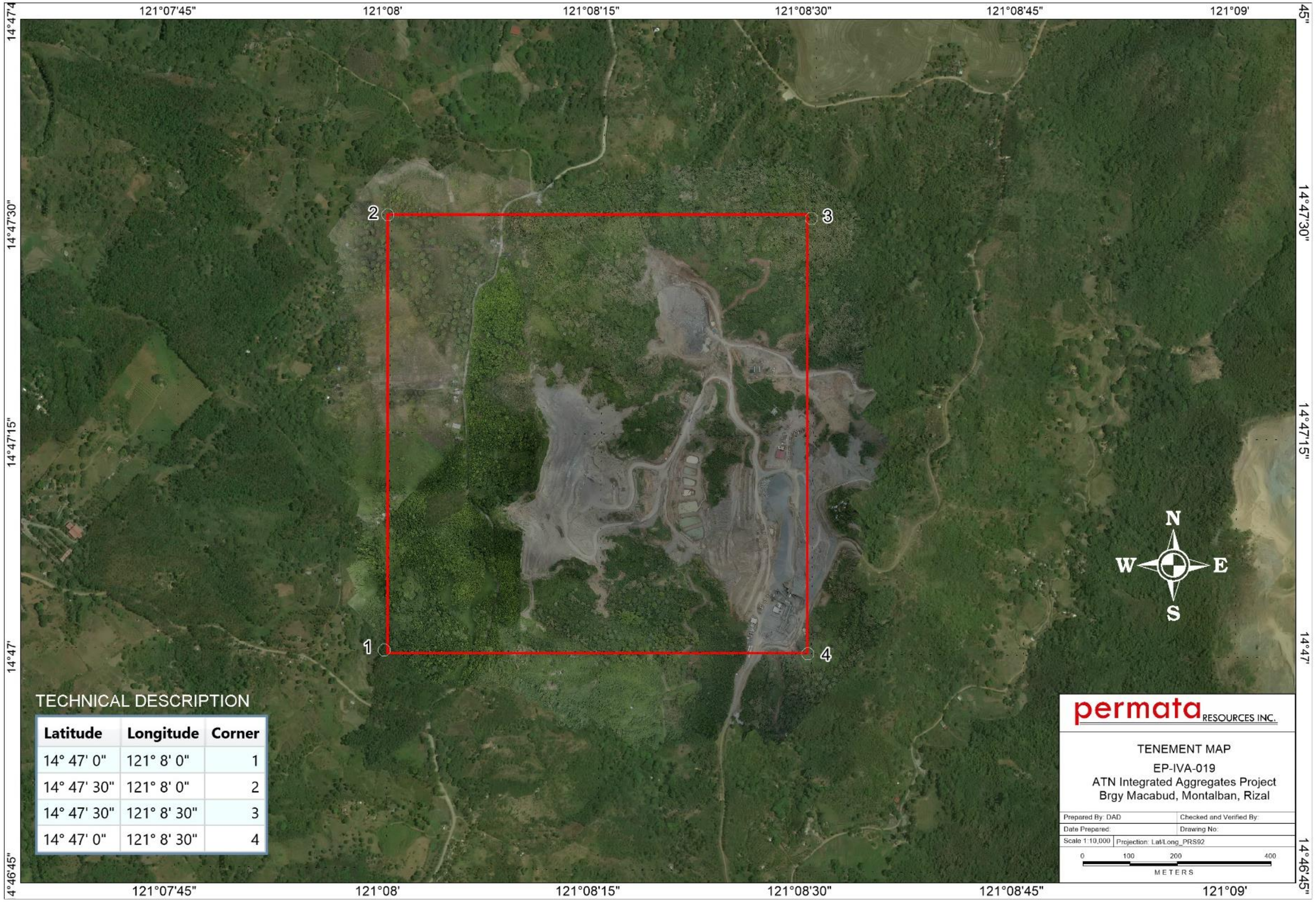


Figure 1 – Project Location



Latitude	Longitude	Corner
14° 47' 0"	121° 8' 0"	1
14° 47' 30"	121° 8' 0"	2
14° 47' 30"	121° 8' 30"	3
14° 47' 0"	121° 8' 30"	4

Figure 2 – Aerial View of Project Location

1.4 Project Rationale

With industrialization and continuous quest for development, the project is foreseen to aid in augmenting the higher demand for rock aggregates and cement raw materials by the construction industry for the infrastructure development and the government's prioritized infrastructure projects such as irrigation, mass transport, power supply, school buildings, transport terminals, concrete roads, bridges and airport and harbor facilities.

Aside from revenues generated from tax and fees, it would also provide additional jobs to the communities and promote the emergence of other income-generating activities relative to the economic activity produced by the Project. These, consequently, would result in the reduction of poverty in the area and contribute to the national wealth.

1.5 Project Alternatives

Mining projects are site specific because mineral extraction can only be undertaken where economic deposits occur. Given such, ATN Holdings, Inc. has not considered any alternative project site. For the mining method, given the nature of the deposit, result of the initial feasibility conducted, drilling/geologic results and environmental considerations, the most suitable method of extraction is by open-cut quarry method

For the quarry facilities and plants, the proposed locations of these facilities were determined by the following:

- Proximate locations of the proposed plant sites and quarry facilities would minimize impacts inherent to the transport of aggregate materials to the plant sites and limit footprint within the already disturbed areas;
- Proposed areas would allow for future expansion of the quarry area;
- The proposed area of the crushing, batching and CHB plant sites are not in a flood prone area in order to minimize and eliminate contaminated storm water runoff towards the natural waterways; and
- The proposed locations of the crushing, batching, and CHB plants were based on the prevailing strong winds in the project area to minimize the potential dust generation.

Technology Selection

a. Batching Plant

Given the suitable area/space within the project area, ATN plans to develop an off-site batching plant to produce better quality concrete through accurate and computerized control of sand aggregates and water as per mixed. The establishment of such also minimizes cement waste due to bulk handling.

The proposed batching plant has a rated output of 60m3/h and will utilize JS1000 concrete mixer. This said mixer is a twin shaft compulsory concrete mixer that can mix dry concrete, plasticity concrete, flow-ability concrete, light aggregate concrete and various mortar. It is also made up of high manganese wear-resisting cast steel lining board and mixing blades which is durable and convenient to replace. The mixer can be used for various kinds of large, medium or small prefabricated factory, construction sites, roads, bridges, airports and tunnels, etc. It has the advantages of reasonable design, compact structure, convenient operation, stable working, good mixing quality, high efficiency, low energy consumption, low noise and long-life wearing parts.

b. CHB Plant

Concrete Hollow Blocks (CHB) are one of the most extensively used walling materials in the Philippines. Some of the reasons for this are due to its relative low cost of manufacturing when compared to other materials and the speed by which it can be installed by semi-skilled workers. However, good quality CHB are hard to find as most CHB available in the market are manufactured by small to medium scale CHB manufacturers and quality control is not much of their concern.

Given such, the plant chose this instead of the other alternatives such as the Interlocking Compressed Earth Blocks (ICEB) and autoclaved aerated concrete (AAC).

1.6 Project Components

1.6.1 Major Components

1.6.1.1 Quarry

The company shall employ the surface mining method for the quarrying/extraction of basalt. The average working bench width is twenty (20) meters, with a safety berm of about 2m width - 0.5m height or half the diameter of the tire of the trucks used in the quarry operations. The bench height is between 5-10 meters. A thirty (25) m buffer zone is provided to address slope stability upon reaching the quarry limit.

Other design parameters used for the determination of the final quarry limit of the deposit are as follows:

Overburden Zone

Bench height	:	5 meters
Bench width	:	3 meters
Bench slope	:	80°
Ramp width	:	12 meters (inclusive of 2 meters safety berm with 0.5m height)
Ramp Gradient	:	10%

Basalt Zone

Bench height	:	10 meters
Bench width	:	10 meters
Bench slope	:	80°
Ramp width	:	12 meters (inclusive of 2 meters safety berm with 0.5m height)
Ramp Gradient	:	10%
Overall Quarry Slope	:	48°

The mining will be limited to the last free-drain elevation of the pit.

1.6.1.2 Crushing Plant

The proposed crushing plant has a rated capacity of 800 tons per hour. The plant site will occupy an approximate area of 7,200 m^2 and will be located adjacent to the quarry area in order to minimize impacts brought about by the transport of quarried aggregate materials to the crushing plant.

1.6.1.3 Batching Plant

The proposed batching plant has a rated output of $60m^3/h$. This translates to $1,200m^3$ per day in a 20-hour per day operations. It will occupy approximately $540m^2$.

1.6.1.4 Concrete Hollow Blocks (CHB) Plant

The CHB plant will occupy an approximate area of $2,800m^2$. The projected production output is 8,000 pieces per shift. This translates to a total of 24,000 pieces per day for a three (3) shifts per day operation.

1.6.1.5 Mine Haul Roads and Access Roads

Mine haul and access roads that will be developed in the mining areas shall follow the topographic surface contour. This shall be ballasted with crushed bedrocks extracted from mining areas. Maximum adverse road gradient is 6.0%. Road development shall precede overburden stripping.

1.6.1.6 Stockpile and dumps

The company will maintain an ore stockpile and waste dump area. Topsoil stockpiles will be designated in mined-out areas to minimize the creation of additional disturbed areas. Stockpile slope will be kept at low angle and height to minimize slumping. The proposed height of the stockpile will depend on the angle-of-repose of the material to ensure that the maximum volume of materials will be stockpiled without sacrificing safety.

1.6.2 Support Facilities

1.6.2.1 Office Building

The office building shall be the headquarters of the project managers. It will hold the offices of the Resident Manager, Quarry Planning, the MEPEO, CRO and Safety and Health, clinic, survey and geology, administrative and finance personnel.

1.6.2.2 Housing Facilities and Bunk Houses

A housing facility will be constructed to serve as shelter for quarry and plant personnel.

1.6.2.3 Security Outposts and Facilities

Security outposts shall be constructed in strategic locations to maintain security and control of ingress/egress of vehicles, materials and personnel to and from the mine site. Relative to this, guard and security facilities shall also be provided for the security personnel of the Project.

1.6.2.4 Mechanical Repair Workshop, Inventory Warehouse and Fuel Depot

A mechanical repair workshop shall be established to support repairs and maintenance of mechanical equipment. A warehouse for critical parts and fast-moving supplies shall also be erected.

1.6.2.5 Nursery

A nursery area shall be established to support the rehabilitation activities of the Project.

1.6.3 Pollution Control Facilities

1.6.3.1 Sedimentation Ponds/Settling Ponds

Settling ponds will be constructed in series. These ponds shall be appropriately designed to effectively arrest the silt coming from the mining area to meet the required water quality of the recycled water and effluent standards in case of water discharge.

Sediments shall be impounded from the first to the third pond in succession. While the second pond is utilized, the first pond shall be drained and allowed to dry and desilted. Recovered silt materials will be used to backfill mined out areas. The third pond shall act as a buffer for the first two ponds. Ponds will also be monitored and managed to ensure that sediments would not exceed 60% of the designed storage volume; and with at least two (2) feet of freeboard.

1.6.3.2 Pit drainage

Pit drainage with sufficient depth will be constructed and laid along the bench toe in order to handle storm runoff. Berms will be provided on the unprotected crest side to ensure safety.

Figure 3 presents the proposed locations of the aforesaid project components.

1.6.4 Utilities

1.6.4.1 Power Supply

Power supply for the project area, facilities, and for the plant will be sourced from MERALCO. Nevertheless, a standby generator set shall be installed and used during power outages.

1.6.4.2 Water Supply

Rizal has an existing waterworks system (Manila Water Company, Inc.). Aside from this, deep wells and springs present shall also be sourced for water in the project area.

1.6.4.3 Fuel

Major fuel distributors like Shell and Petron service the needs at Rizal. Most of these fuel distributors are accessible and would be able to cater the needs of the company’s fuel and oil requirements for its operations.

1.7 Process/Technology

1.7.1 Quarry Development

The development and production of the Project will be through the typical open-cut quarrying method, which involves the following stages:

- Access road preparation;
- Overburden/Topsoil Stripping;
- Ripping/Breaking;
- Stockpiling;
- Loading and Hauling; and
- Screening/Crushing.

Proper benching shall be employed in each quarry sites. Once overburden has been stripped, terrace-like extraction faces are cut from the topmost strata progressing downward to serve as quarry levels for positioning equipment that will conduct excavation and loading activities. The company will construct a main haulage road going in and out of the quarry and to connect the production benches. The series of production benches shall be interconnected to each other by ramps for easier access and to maximize the deposit.

Quarrying will be executed through multiple benching pattern to provide greater operation flexibility and production output. Open face extraction of benches is accompanied by a process cycle of excavation and loading; until bench design limits are reached. With repeated process cycle, bench advances are done laterally. The working bench is maintained by systematized programming of earlier extraction of upper benches. Once the bench design limit is reached, the process is transferred to another prepared working bench. Bench height will be limited by the maximum reach of the loader or excavator to be used. Bench width shall be governed by final pit slope, loading system and size of haul truck to be utilized. Drainage canals of sufficient depth to handle storm runoff will be laid along the bench toe, and berms with an average height of 0.5 meters will be provided for the unprotected crest site for added safety. On the event that the materials can’t be removed by ripping, hydraulic breakers will be used. Should hydraulic breakers not suffice, minimal blasting will also be employed.

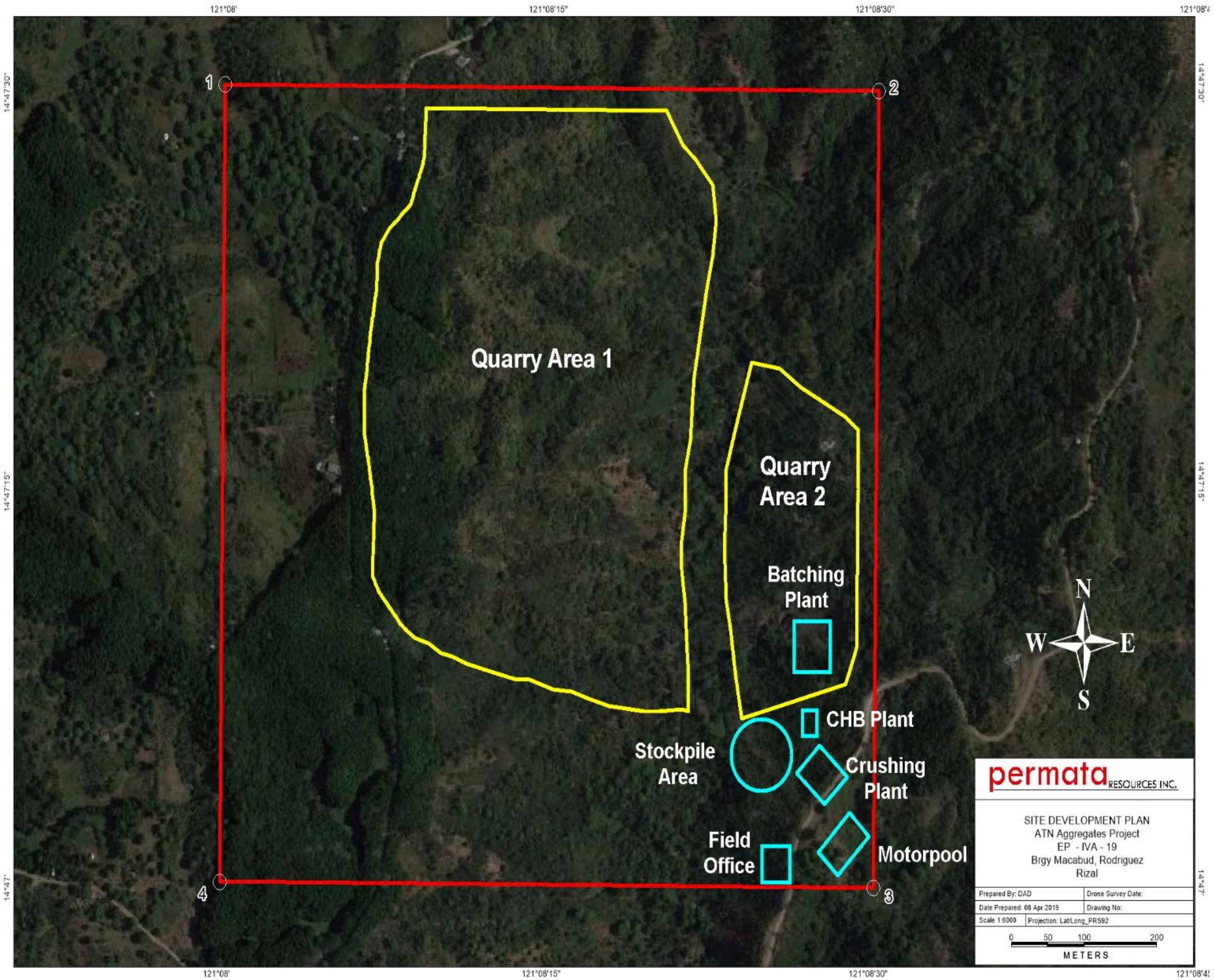


Figure 3 – Site Development Map

1.7.2 Drilling and Blasting

Blasthole drilling shall be carried out using hydraulic drilling machines. This is a combination of rotary-percussion drill equipped with dust collector to address the generation of dust during drilling. As a rule of thumb in blasting, a bench's free-face combined with good firing sequence are required to achieve optimum fragmentation.

The blast holes are drilled using a 3-inch diameter drill bit. Production holes are drilled at vertical angle (90 degrees) while the batter holes are drilled with an inclination of 80 degrees to achieve the designed bench slope angle. The burden and spacing used varies from 2.5m x 2.5m. in areas with strong and highly competent rocks while 3.0m x 3.5m are used in areas with less competent rocks or in transition zone. Drilling depth is at 10m with 0.5m to 1.0m sub-drill. This sub-drill will address the problems related to hard toes after blasting and will create a smooth floor in preparation for the next cut.

Accredited blasting contractors using the latest technologies such as in-hole-delays will be commissioned. Using non-electronic delay detonators and limited quantity of explosive fired in a given time minimizes the generation of ground vibration, fly rocks, dust and as well as noise emission. An average of 0.45 kg per cubic meter powder factor will be maintained in all formation except for highly fractured overburden where it will be lowered to 0.30 kg per cubic meter. To stabilize the slopes of the final wall, controlled blasting will also be applied to every last row of holes along the final boundary of the quarry.

1.7.2.1 Blasting Methodology

General Methodology

A. Fly-Rock, Noise, Vibration Control:

- Overlying loose materials and loose rocks shall be removed prior to drilling activity. Bench faces shall be oriented in such a way that blast throw or direction shall not be pointing directly to any structure, vital facilities and/or community;
- Blaster shall prepare the drilling layout to ensure correctness of burden, spacing, and depth of hole;
- Protective works (eg. blasting mats) shall be utilized in blast areas that are in very close proximity to vital facilities and/or community;
- Full delay system of initiation shall be used. Only non-electric down the hole detonators and truck line delay detonators shall be used. Delay time between adjacent holes shall not be less than 17ms; and
- Stemming materials that will be used are composed of rock fragments sized 5/8 of hole diameter mixed with drill cuttings that are compacted properly.

B. Safety Methodology:

A licensed blaster shall supervise the whole blasting activity. All manufacturers' safety guidelines and PNP rules and regulations shall be followed in conducting said activity. The company shall inform the nearby communities regarding the time and date of any blasting operation.

1. Explosives Transport

- All explosives and its accessories shall be transported on diesel fueled trucks;
- Vehicle transporting explosives shall not be overloaded and in no case shall boxes or packages be piled in such a position that may easily fall-off;
- A driver of explosives trucks shall be in good condition and shall not be under the influence of liquor; and
- Explosives truck shall not enter to any blast layout with loaded holes.

2. Handling and Charging

- Only the licensed blaster shall do the charging and priming;
- Primer shall only be assembled before charging;
- Stemming height shall be greater or equal to the designed burden of the layout and size shall be 5/8 of the hole diameter mixed with some fine materials and compacted using a tamping stick;
- Only non-conductive materials shall be used for charging or tamping; with tamping sticks having flat bottoms;
- Tamping of stemming materials shall be done carefully to prevent hitting the down line initiator that might cause it to misfire or initiate prematurely;
- Final connection of loaded holes shall only be done when the exact firing time has been confirmed; and
- A final inspection of the whole lay out shall be made by the blaster, prior to his declaration that the area is ready to be blasted.

3. Clearing and Traffic Control

- Clearing of blasting area shall be done by the contractor blasting crew. The Contractor shall designate blast guards to manned roadblocks and barricades;
- If possible, blasting time shall be set during breaks at work (eg. lunch or snack). No blasting will be carried out during night time;
- All possible entries towards the blasting area, at least 200 meters from the blast site, shall be barricaded and all equipment and personnel within 200 meters shall be evacuated for safety; and
- When all roadblocks are in place, the licensed blaster shall conduct final clearing of the area. Only the drilling and blasting supervisor or Project Manager shall give the clearance to fire the starter initiator after ensuring that the area is fully cleared.

4. Firing

- The licensed blaster will only install the starter initiator (OBC and Safety Fuse) once the area has been declared clear;
- Each fuse shall bear a minimum of two minutes period to allow the blaster to seek cover;

- A blasting timer shall be made by the licensed blaster as a warning shot, which will fire around five (5) seconds prior to the main blast;
- After checking all the connections, the blaster will seek the approval of the drilling and blasting supervisor to fire the shot;
- The drilling and blasting supervisor or Project Manager shall have the authority to give signal to fire the shot;
- After firing the shot, the licensed blaster shall allow 5 to 10 minutes for dust and fumes to settle before checking for possible misfires;
- In case of a misfire, the blaster shall inform his supervisor about the presence of it. All roadblocks and barricades shall not be lifted and the whole step in firing shall be repeated all over again; and
- Only the drilling and blasting supervisor or Project Manager shall declare that blasting is over and barricades can be lifted.

1.7.3 Crushing

The proposed crushing plant has a rated capacity of 800 tons per hour and will occupy an approximate area of 7,200 m^2, located adjacent to the quarry area in order to minimize impacts brought about by the transport of quarried aggregate materials to the crushing plant. Moreover, in order to minimize water consumption, dry crushing process will be utilized.

The major components of the crushing plant include; dump hoppers, vibrating feeders, jaw crusher, cone crushers, vibrating screens, and belt conveyors, product outlet and control room.

Table 2. Technical parameters of the main crushing equipment

Equipment	Quantity (Set)	Power (KW)
Vibrating Feeder (TSW1548)	2	3
Jaw Crusher (PEW1100)	1	185
Hydraulic Cone Crusher (HST250/S1)	1	220+25
Symons Cone Crusher (HPT 400)	2	185+25
Vibrating Screen (2YKN3075)	1	2x37
Vibrating Screen (2YZS2460)	1	22
Electric Control System	Total (KW)	976

Table 3. Technical parameters of belt conveyors

Equipment	Quantity (Set)	Power (KW)
No. 1 Belt Conveyor (B650x18m)	1	5.5
No. 2 Belt Conveyor (B1200x40m)	1	37
No. 3 Belt Conveyor (B1000x10m)	1	7.5
No. 4 Belt Conveyor (B1000x3m)	1	7.5
No. 5 Belt Conveyor (B1400x16m)	1	22
No. 6 Belt Conveyor ((B1400x28)	1	37
No. 7 & 8 Belt Conveyor (B1000x22m)	2	15
No. 9 Belt Conveyor (B1000x23m)	1	15
No. 10, 11 & 12 Belt Conveyor (B650x22m)	3	7.5

Equipment	Quantity (Set)	Power (KW)
Electric Control System	Total (KW)	206

Finished products will be the most commonly used aggregate sizes in the Philippine construction industry namely; G1, 3/4, 3/8 and S1.

Table 4. Aggregate sizes

Product Description	
Name	**Size**
G – 1	38 mm (3/4”-1.5”)
3 / 4	20 mm (3/8”-3/4”)
3 / 8	10 mm (1/4”-3/8”)
S – 1	5 mm (0-1/4”)
Sub-Base / Base Course	mixed

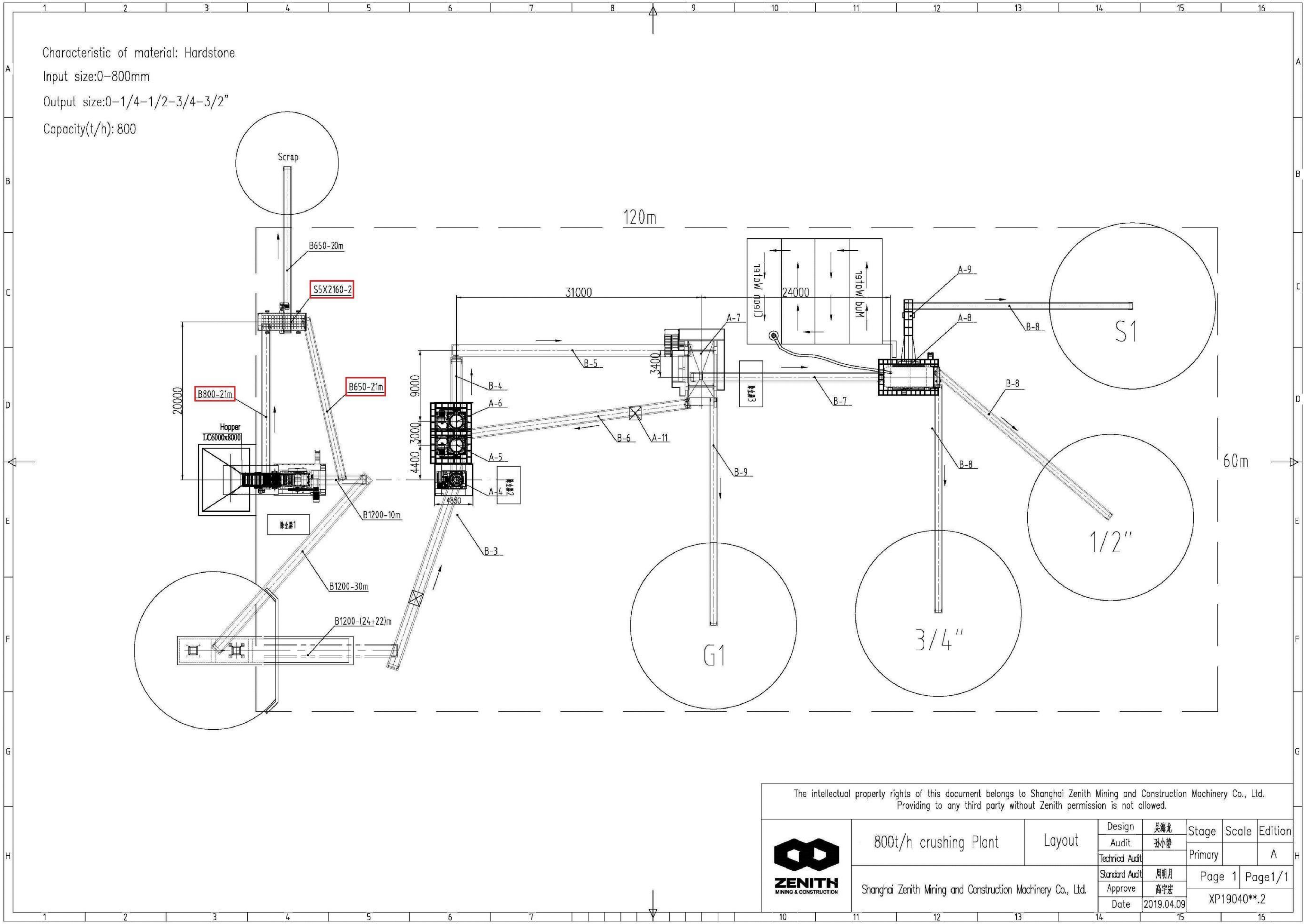


Figure 4 – Crushing Plant Layout

1.7.4 Batching

The batching plant will utilize the HZS60Q concrete mixing station with compulsory twin shaft mixer JS1000. It is manufactured by Janeoo in Shandong, China. The concrete mixing station is equipped with dust collector at the top of the powder silo and rain cover on the strap conveying machine to prevent dust blowing.

Table 5. Technical parameters of HZS60Q concrete mixing plant

Theoretical Capacity	60m3 / h
Mixer Model	JS1000
Mixing motor power	2 × 18.5 kW
Cycle	60s
Mixer nominal capacity	1000L
Powder warehouse capacity	2 × 50t
Ingredients station capacity	1600L
Aggregate storage capacity	3 × 17m^3
Aggregate types	3
Aggregate belt conveyor productivity	140 t / h
Screw conveyor for maximum productivity	110t / h
Discharge height	3.8m
Capacity	100KW
Aggregate weighing range and accuracy	(0 ~ 3000) ± 2% kg
Cement weighing range and accuracy	(0 ~ 900) ± 1% kg
Fly weighing range and accuracy	(0 ~ 900) ± 1% kg
Water weighing range and accuracy	(0 ~ 300) ± 1% kg
Additive weighing range and accuracy	(0 ~ 20) ± 1% kg
Standard reference amount	50 × 103kg

Table 6. Technical parameters of JS100 concrete mixer

Model Parameters Items		JS1000
Charge Capacity (L)		1600
Discharge Capacity (L)		1000
Productivity (m3/h)		$\geq$50
Max. Aggregate Diameter (Scree/Gravel) (mm)		80/60
Mixing Motor	Model	Y200L1-6
	Power (kw)	2*18.5
Hoist Motor	Model	YEE180M-4
	Power (kw)	18.5
Hopper Hoist Speed (m/min)		21.9-28.5
Dimension (L*W*H)		9260*3350*8332
Overall Weight (Kg)		11000
Dumping Height (mm)		3800

The process of producing ready mix concrete starts with the raw materials (crushed aggregates) delivered to the batching plant by dump trucks. The cement will be stored in elevated silos pneumatically or by bucket elevator. The sand and coarse aggregates are transferred to elevated bins by a belt conveyor. From these elevated bins, the constituents are fed by gravity or screw conveyor to weigh hoppers, which combine the proper amounts of each material. Depending on customer's specifications, the amount of water and admixtures will also be combined.

Based on several studies, the estimated water consumption per cubic meter of a ready-mix concrete is at least 180L. As for the proposed capacity of ATN's batching plant which is 1,200m^3 per day, the projected daily water consumption is least 216,000L.

Particulate matter, consisting primarily of cement dust but including some aggregate and sand dust emissions, is one of the pollutants of concern. All but one of the emission points are fugitive in nature. The only point source is the transfer of cement to the silo; which is usually vented to a fabric filter or "sock". Fugitive sources include the transfer of sand and aggregate, truck loading, mixer loading, vehicle traffic, and wind erosion from sand and aggregate storage piles. The amount of fugitive emissions generated during the transfer of sand and aggregate depends primarily on the surface moisture content of these materials.

Types of air pollution controls to be used include water sprays, enclosures, hoods, curtains, shrouds, movable and telescoping chutes, and the like. A major source of potential emissions, the movement of heavy trucks over unpaved or dusty surfaces in and around the plant, will be addressed through good maintenance and wetting of road surface.

The main sources of waste water at batching plants are contaminated storm water runoff, dust control sprinklers, agitator washout station, agitator charging station, slumping station, and cleaning and washing activities. In order to minimize contamination of surface waters and potential generation of contaminated storm water runoff, the batching plant will be established away from flood prone area and will be designed in such a way that all sources of waste water is paved and bunded. A bund is a small wall of concrete or another impervious material, similar to the curb beside a bitumen road. Bunds serve the dual purpose of ensuring all waste water is captured and excluding clean storm water runoff.

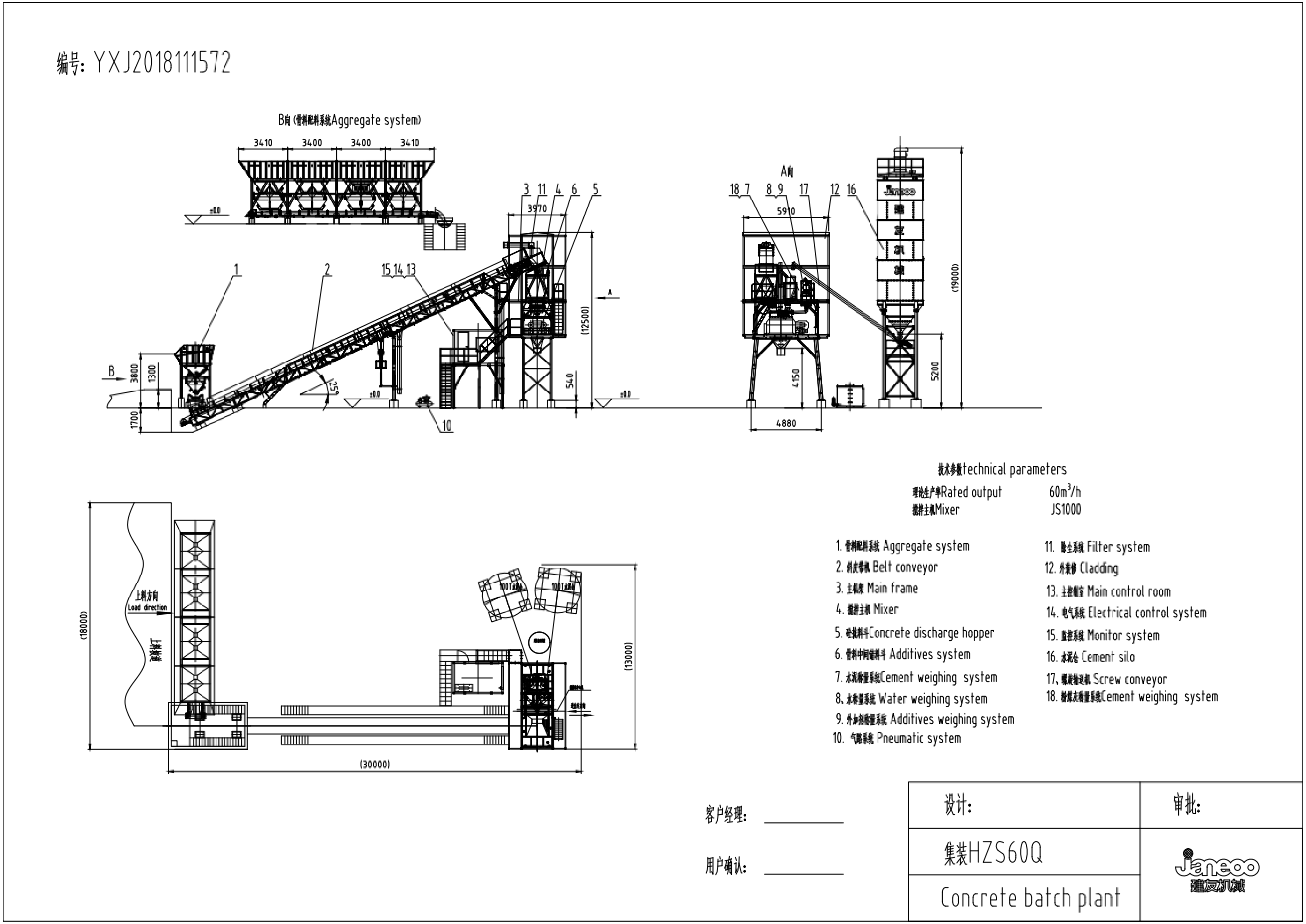


Figure 5 – Batching Plant Layout

1.7.5 CHB Manufacturing

Common CHB mix is composed of 82% sand, 12% cement, and 6% water; with the expected water consumption for a three-shift operation amounting to at least 26,400 liters.

The production of concrete blocks consists of four basic processes: mixing, molding, curing, and cubing. In the mixing process, the required amount of sand and cement are transferred by gravity or by mechanical means to a weigh batcher that measures the proper amounts of each material. After the dry materials are blended, water is added. Once the load of concrete is thoroughly mixed, it is dumped into an inclined bucket conveyor and transported to an elevated hopper. From the hopper, the concrete mix is conveyed to another hopper on top of the block machine at a measured flow rate. The concrete is then forced downwards into molds that consist of an outer mold box containing several mold liners. The liners determine the outer shape of the block and the inner shape of the block cavities. When the molds are full, the concrete is compacted by the weight of the upper mold head coming down on the mold cavities. This compaction may be supplemented by air or hydraulic pressure cylinders acting on the mold head. Most block machines also use a short burst of mechanical vibration to further aid compaction.

The compacted blocks are pushed down and out of the molds onto a flat steel pallet that are, then, eventually are pushed out of the machine and onto a chain conveyor. In some operations, the blocks pass under a rotating brush which removes loose material from the top of the blocks. The pallets of blocks are transferred and placed in curing racks by a forklift. The blocks pass through a cuber which aligns each block and then stacks them into a cube three blocks across by six blocks deep by three or four blocks high. These cubes are then carried outside with a forklift and placed in storage.

To ensure quality control, several measures will be installed along the production process flow which requires constant monitoring to produce blocks that have the required properties. Amongst these is the electronic weighing of raw materials are weighed electronically prior to its transfer to the mixer. Trapped water content in the sand and gravel could be measured with ultrasonic sensors, and the amount of water to be added to the mix is automatically adjusted to compensate. As the blocks emerge from the block machine, their height could be checked with laser beam sensors. And during curing, the temperatures and cycle times are all controlled and recorded to ensure that the blocks are cured properly to achieve their required strength.

Similar to the batching plant, the main pollutants of concern in the CHB plant will be the cement, aggregate and sand dust emissions during the process of stockpiling and transferring of these materials in the mixing equipment. This will be mitigated by installing dust collectors and regular wetting of the paved surfaces within the plant site.

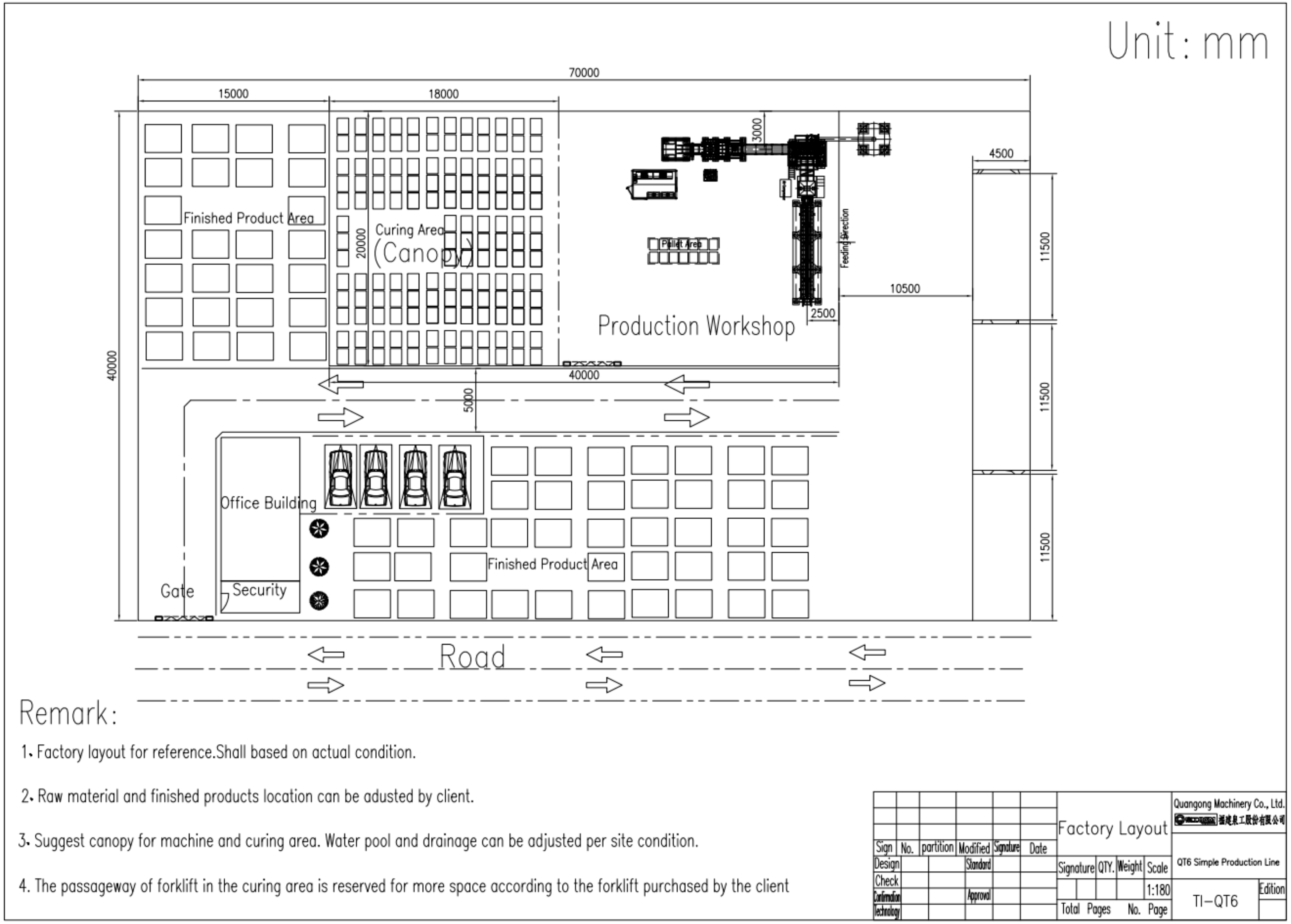


Figure 6 – CHB Plant Layout

1.8 Project Size

1.8.1 Ore Resource

Exploration activities are currently being conducted at the project site to determine the volume and extension of basalt to be extracted. Initial geological and mineral resource modelling study indicated a total mineable resource of 88.20 million metric tons at a specific gravity of 2.6.

The initial resource translates to a mine life of 14 years.

1.8.2 Production Capacity and Schedule

The proposed project aims to produce 1,500,000 MT of basalt materials during its first year of operation, gradually increasing to 4,500,000 MT on the second year and 7,000,000 MT on the third year onwards.

Table 7. Quarry production schedule

Sizes	% Distribution	Material Movement Schedule									
		1	2	3	4	5	6	7	8	9	10
Armor Rock	40	333,000	999,000	1,554,000	1,554,000	1,554,000	1,554,000	1,554,000	1,554,000	1,554,000	1,554,000
Double Head Size	20	166,500	499,500	777,000	777,000	777,000	777,000	777,000	777,000	777,000	777,000
Head Size	10	83,250	249,750	388,500	388,500	388,500	388,500	388,500	388,500	388,500	388,500
Apple Size	10	83,250	249,750	388,500	388,500	388,500	388,500	388,500	388,500	388,500	388,500
Fines	20	166,500	499,500	777,000	777,000	777,000	777,000	777,000	777,000	777,000	777,000
Total LCM		832,500	2,497,500	3,885,000	3,885,000	3,885,000	3,885,000	3,885,000	3,885,000	3,885,000	3,885,000
Total Tonnage		**1,500,000**	**4,500,000**	**7,000,000**	**7,000,000**	**7,000,000**	**7,000,000**	**7,000,000**	**7,000,000**	**7,000,000**	**7,000,000**

1.9 Development Plan, Description of Project Phases and Corresponding Timeframes

The proposed Project is projected to have a mine life of fourteen (14) years.

Four (4) phases, which were categorized according to activities, were also considered for the proposed Project; and these are as follows:

1.9.1 Pre-construction Phase

This phase involves the following activities:

- Planning of technical design and finalization of quarry plans and construction method for the installation of facilities;
- Soil investigation prior to civil works; and
- Securing of necessary permits.

1.9.2 Development/Construction Phase

The results of the detailed exploration, feasibility study, and issuance of the pertinent permits would dictate the commencement of this phase, which shall involve the following activities:

- Hiring of qualified manpower required to complement the workers in the construction works. Hiring of qualified local residents will be prioritized at this stage. Company guidelines and policies on hiring will be imposed;
- Site clearing and stripping of over burden;
- Access road development;
- Establishment of drainage line;
- Construction of plants, settling pond, office buildings, housing and other quarry buildings; and
- Preparation of loading pad and benches.

Commitments relative to environmental protection, safety, and community development stipulated in the Environmental Protection and Enhancement Program (EPEP), Environmental Management Plan (EMP), Environmental Monitoring Plan (EMoP), and Social Development and Management Program (SDMP) will also be conducted and implemented.

1.9.3 Operation Phase

It is projected that operation would commence a year after the development/construction phase. This phase covers the following activities:

- Extraction of basalt;
- Crushing, batching and CHB manufacturing; and
- Continued implementation of the EPEP, EMP, EMoP, and SDMP

1.9.3.1 Quarry Operations

The quarry operation will employ the open-cut quarry method. Access roads will initially be established to access the topmost portion of the quarry where development/stripping of overburden shall commence. As a rule of thumb, any quarry development should be from top to bottom for safety purposes and in order to achieve optimum design efficiency of the quarry. The company will construct a main haulage road going in and out of the quarry and to connect the production benches. The series of production benches shall be interconnected to each other by ramps for easier access and to maximize the deposit.

The average working bench width is twenty (20) meters, with a safety berm of about 2m width - 0.5m height or half the diameter of the tire of the trucks used in the quarry operations. The bench height is between 5-10 meters. A thirty (25) m buffer zone is provided to address slope stability upon reaching the quarry limit.

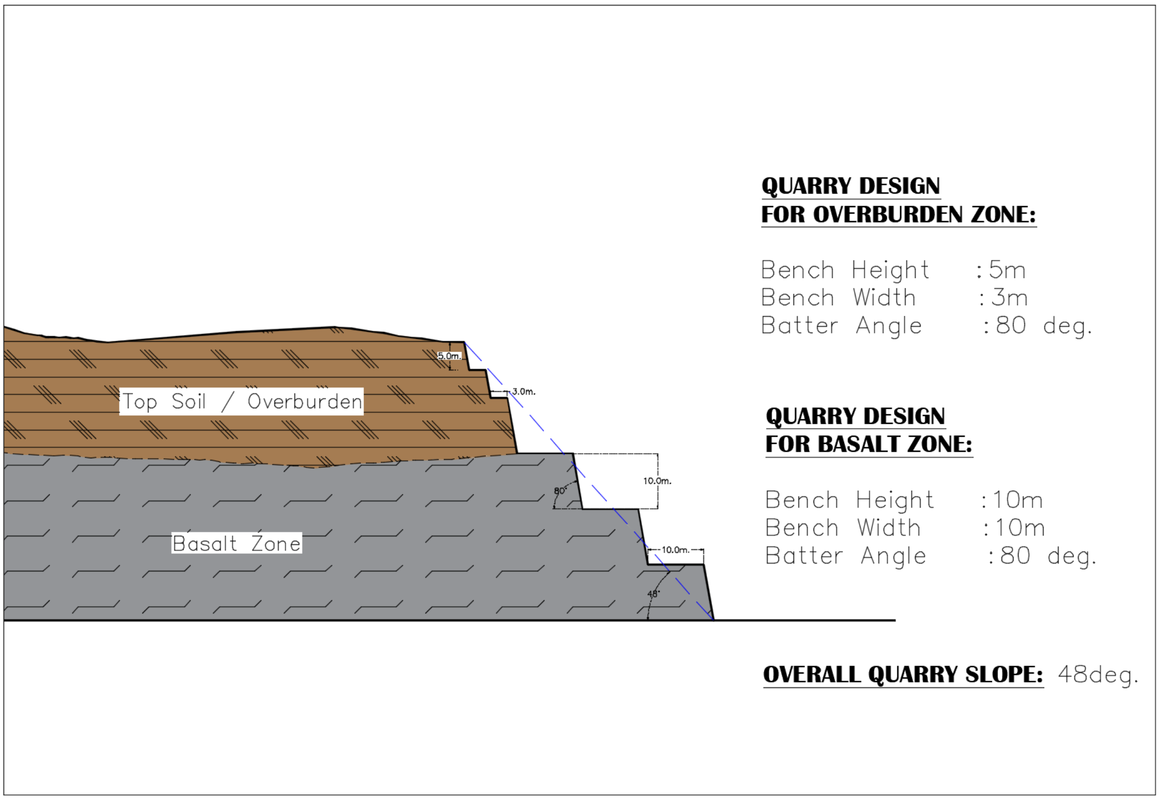


Figure 7 – Quarry Design Parameters

Topsoil and overburden materials that will be stripped off shall be temporarily transported to a designated stockpile area within the project area to be used for progressive rehabilitation. Construction is designed in 5-meter lifts due to the loose nature of topsoil and overburden materials. To minimize suspended solids in run-off during heavy rains, slopes will be protected with rock facing. Large boulders will also be placed along the toe line increase stability.

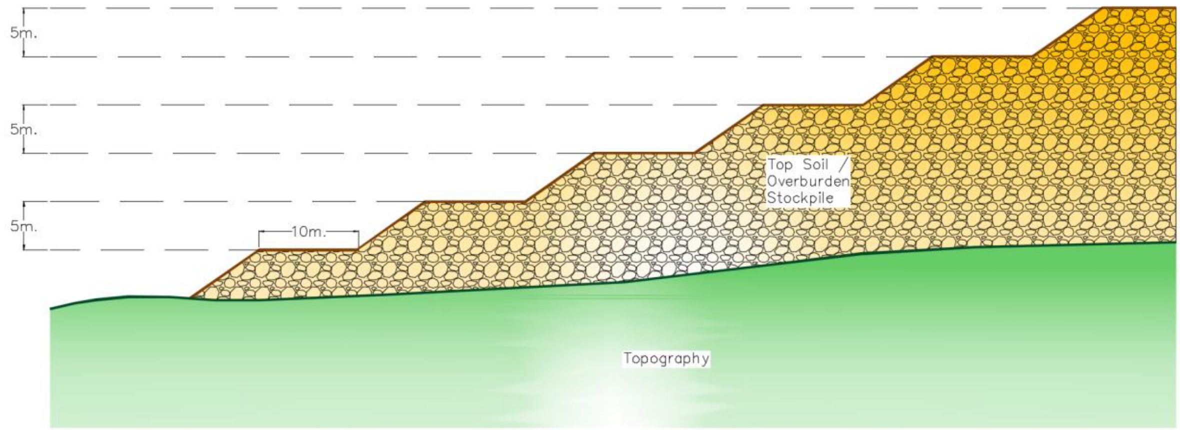


Figure 8 – Topsoil Stockpile Design

The quarry will operate a single shift a day to utilize daylight. Depending on orders, the quarry operations may be extended some 2-hours in a day or can go 30-days in a month; but on average will only be operating 22 days a month or 264 days a year. Moreover, in order to minimize the effect to the environment, only 2-3 production benches will be open for extraction at any given time. **Annex B** provides the quarry plan of the project area.

As part of operations and main control strategy, progressive rehabilitation will be carried out by the company with the intention continuously restoring, enhancing and/or preparing the disturbed areas towards the agreed upon final land use of the area. By doing partial restoration of the disturbed areas, the company would minimize the adverse impacts of the project and lessen the impairment of visual aesthetics in the project area.

Major activities for progressive rehabilitation include the following:

- Revegetation of areas that will no longer utilized by the operations or those that have reached its designed limits. Revegetation strategies include surface preparation to ensure the survival and growth of the vegetation that will be established; establishment of contour lines that would serve as planting guides; and maintenance and operation of a nursery;
- Maintenance of buffer zones; and
- Stabilization of slopes, benches and other pertinent structures to prevent possible collapse and the consequential adverse impact should such occur.

1.9.3.2 Crushing Plant Operations

Raw materials from the quarry site will be transported using dump trucks and unloaded into the primary dump hopper. Under the hopper, a vibrating Feeder (TSW1548) will feed materials to the primary Jaw Crusher (PEW1100).

Base course materials will be separated and the No. 1 Belt Conveyor will take it to the stockpile. The crushed materials will be transported to hopper by No. 2 Belt Conveyor. Underneath this hopper is another vibrating Feeder (TSW1548) which will separate the material into 0-5” and >5” (or 4”, 6” adjustment). The 0-5” materials will be fed to the first cone crusher (CSB160); while materials >5” will be fed to the hydraulic cone crusher (HST250/S1).

A wider belt conveyor below these three sets of cone crushers will send the output materials to another vibrating screen (2YK3X3075). This screen will separate the materials into 0-3/4”, 3/4”-1.5” and >1.5”. The >5” materials will then be sent to the third cone crusher (CSB160). The 3/4” - 1.5” will be the final product stockpile, while the 0-3/4” will be sent to the second screen (2YZS2460) which will separate them into 0-1/4”, 1/4”-3/8” and 3/8”-3/4” as final products and transported to the final products stockpile.

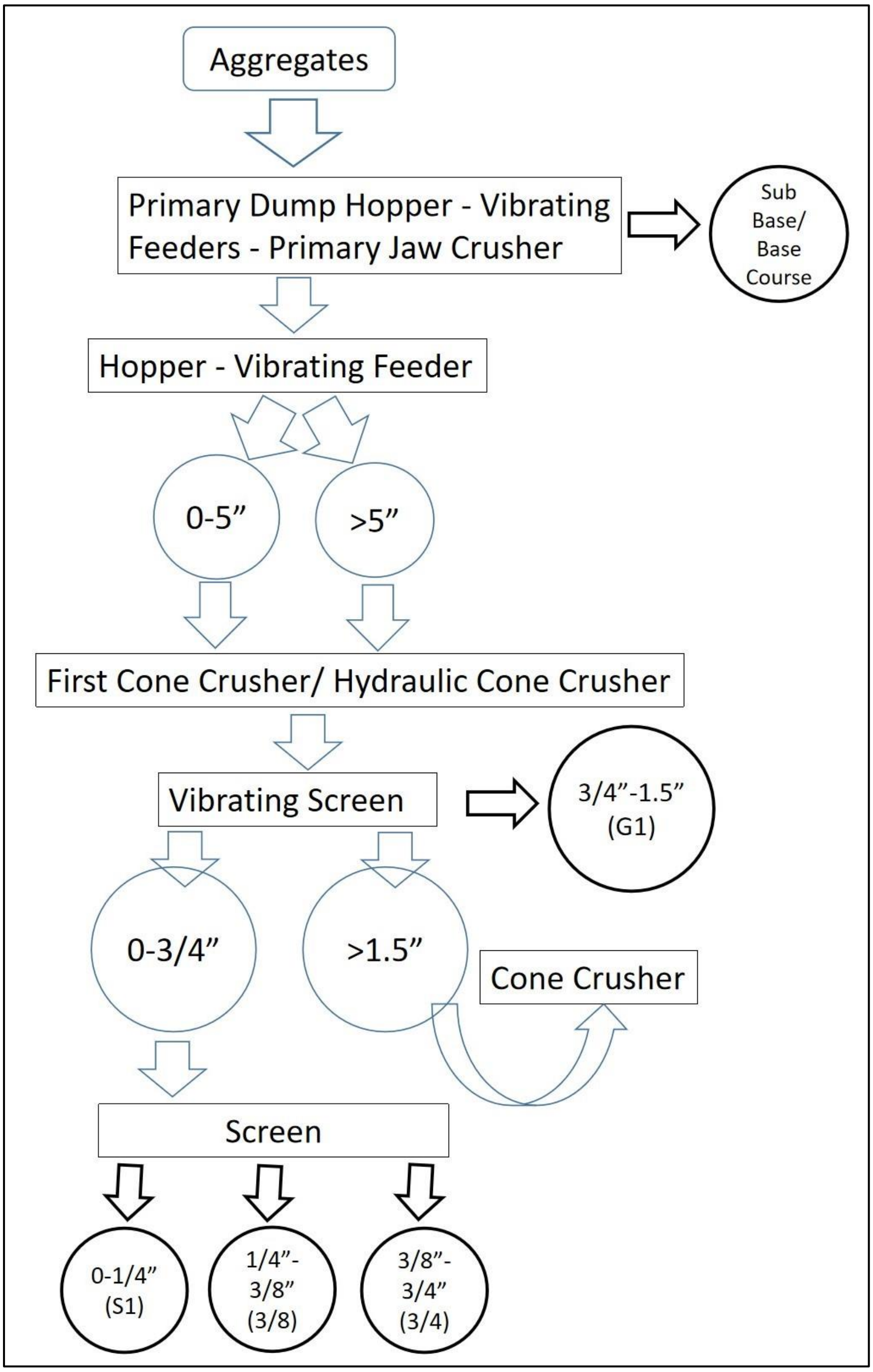


Figure 9 – Crushing Plant Process Flowchart

1.9.3.3 Batching Plant Operations

Raw materials (crushed aggregates) will be delivered to the batching plant by dump trucks. The cement will be stored in elevated silos pneumatically or by bucket elevator. The sand and coarse aggregates are transferred to elevated bins by a belt conveyor. From these elevated bins, the constituents are fed by gravity or screw conveyor to weigh hoppers, which combine the proper amounts of each material. Depending on customer's specifications, the amount of water and admixtures will also be combined.

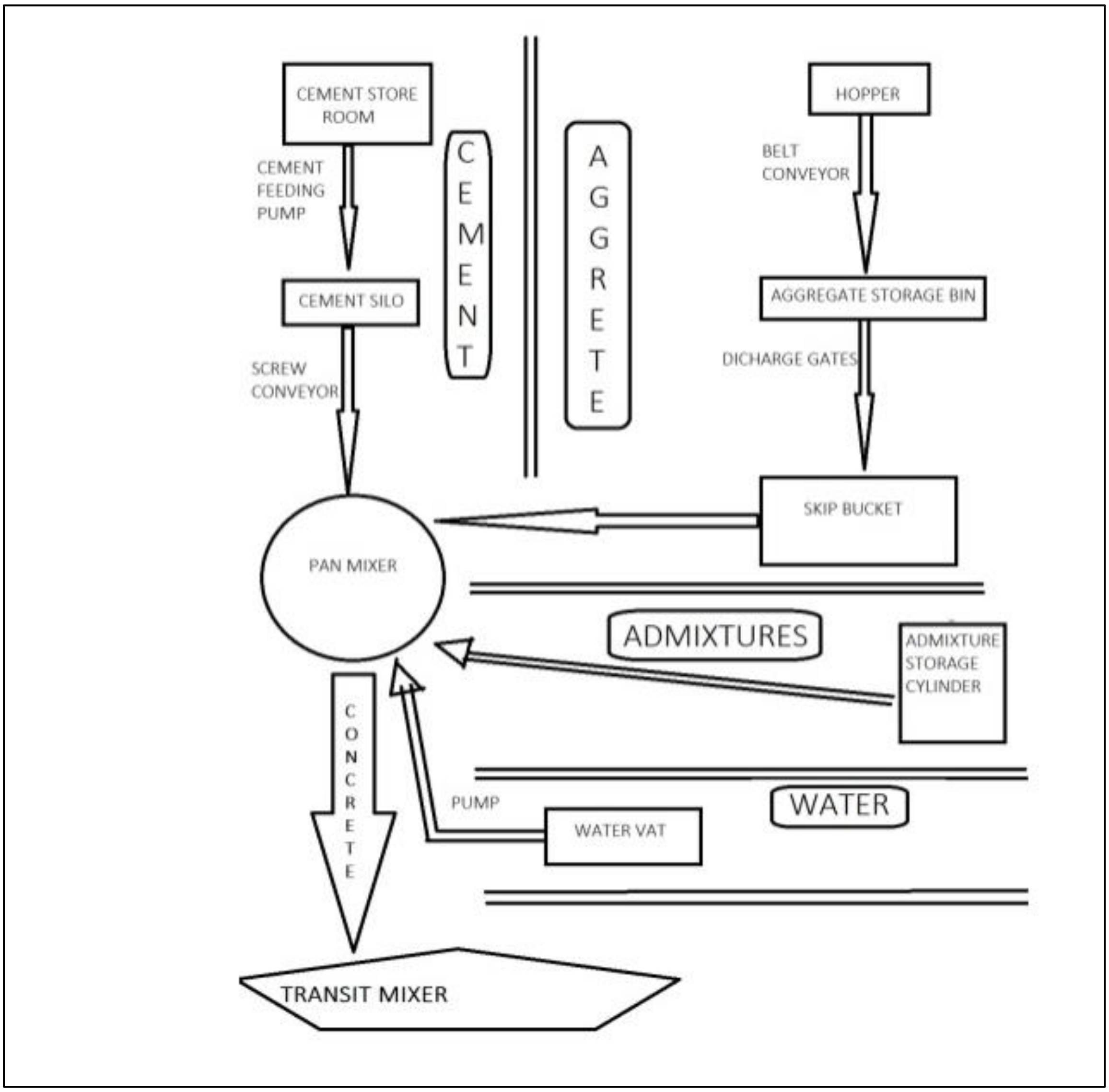


Figure 10 – Batching Plant Operation Flowchart

The heavy equipment that will be utilized in the batching plant is a front-end loader which will facilitate in the feeding the aggregates on the aggregate system. In addition, it will also be utilized in management and containment of spillage from the conveyors during the process.

1.9.3.4 CHB Plant Operations

CHBs are produced through four basic processes: mixing, molding, curing, and cubing. In the mixing process, the required amount of sand and cement are transferred by gravity or by mechanical means to a weigh batcher that measures the proper amounts of each material. After the dry materials are blended, water is added. Once the load of concrete is thoroughly mixed, it is dumped into an inclined bucket conveyor and transported to an elevated hopper where the concrete mix is conveyed to another hopper on top of the block machine at a measured flow rate. The concrete is then forced downwards into molds that consist of an outer mold box containing several mold liners. The liners determine the outer shape of the block and the inner shape of the block cavities. When the molds are full, the concrete is compacted by the weight of the upper mold head coming down on the mold cavities.

The compacted blocks are pushed down and out of the molds onto a flat steel pallet that are, then, eventually are pushed out of the machine and onto a chain conveyor. The pallets of blocks are transferred and placed in curing racks by a forklift. The blocks pass through a cuber which aligns each block and then stacks them into a cube three blocks across by six blocks deep by three or four blocks high. These cubes are then carried outside with a forklift and placed in storage.

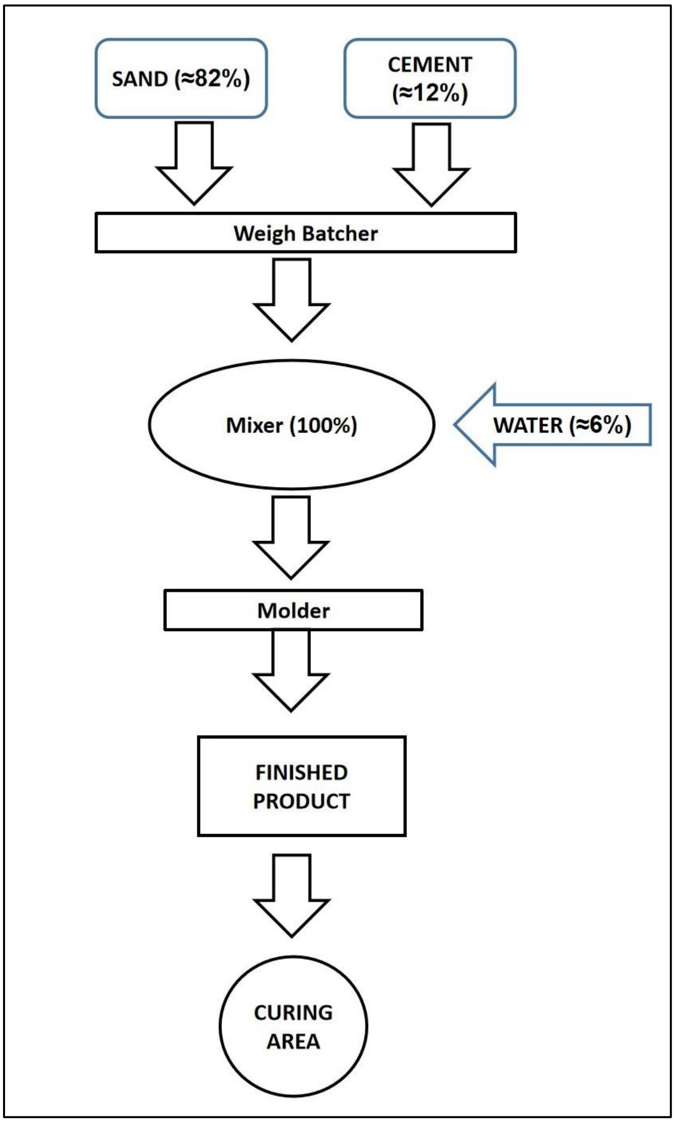


Figure 11 – CHB Process Flowchart

1.9.4 Abandonment Phase

Upon exhaustion of the reserves, quarry rehabilitation and decommissioning works shall immediately be implemented. Activities in this phase include:

- Mobilization of equipment out of the quarry area;
- Rehabilitation of remaining mined-out areas, and settling ponds in accordance to the planned land use program of the Local Government Unit (LGU);
- Decommissioning of quarry ancillary facilities;
- Decommissioning of crushing, batching and CHB plant facilities and equipment;
- Implementation of post mining social programs; and
- Transfer/donation of buildings to interested LGUs.

Detailed components of this phase will be embodied, as would be stipulated in the ECC, in the Final Mine Rehabilitation and/or Decommissioning Plan (FMR/DP). The activities in said plan shall be based on the agreed upon and approved, by the company, stakeholders, and Mines and Geosciences Bureau, final land use of the project area.

Table 9 shows the duration/schedule of the abovementioned phases.

1.10 Manpower

An estimated one hundred twenty-eight (128) personnel are needed for the project

Table 8. Manpower Requirement of the Project

Workforce Project Component	Number
General Manager (Corporate)	1
SHES /MEPEO Manager (Corporate)	1
Quarry Superintendent (Project Base)	2
SHESD Personnel (Project Base)	1
Heavy Equipment Operator (Project Base)	80
Administration	10
Crushing Plant Personnel	8
Batching Plant Personnel	5
CHB Plant Personnel	5
Maintenance/Utility Personnel	5
Guards (Project Base)	10
Total	**128**

1.11 Indicative Project Investment Cost

The estimated cost to establish the Project is Php 190,000,000.00.

Table 9. Project Schedule

Project Phases	Year																									
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
Pre-Construction - Planning of technical design and finalization of quarry plans and construction method for the installation of facilities; - Soil investigation prior to civil works; and - Securing of necessary permits																										
Construction/ Site Preparation - Hiring of qualified manpower required to complement the workers in the construction works. Hiring of qualified local residents will be prioritized at this stage. Company guidelines and policies on hiring will be imposed; - Site clearing and stripping of over burden; - Access road development; - Establishment of drainage line; - Construction of settling pond, office buildings, housing and other quarry buildings; - Establishment of crushing, batching and CHB plants; and - Preparation of loading pad and benches.																										
Operation - Quarrying of basalt - Hauling of extracted basalt - Progressive rehabilitation; - Crushing, batching and CHB manufacturing; and - Implementation of environmental, safety and health, and social development programs																										
Abandonment - Mobilization of equipment out of the quarry area; - Rehabilitation of remaining mined-out areas, and settling ponds in accordance to the																										

planned land use program of the Local Government Unit (LGU); - Decommissioning of quarry ancillary facilities; - Decommissioning of Crushing, batching and CHB plant facilities and equipment; - Implementation of post mining social programs; and - Transfer/donation of buildings to interested LGUs																										

2 ANALYSIS OF KEY ENVIRONMENTAL IMPACTS

2.1 Land

2.1.1 Land Use and Classification

Rodriguez's accessibility and proximity to the metropolis and highly urbanized towns have been affecting its land use and growth pattern through the years. As per the municipality's comprehensive land use plan (CLUP), the existing land uses are presented in the table below.

Table 10. Existing general land use classification of Rodriguez, Rizal

Land Use Category	Area (has)	% to Total
Forestland	27,243.87	75.04
Agricultural	3,381.34	9.13
Built-up Areas	1,862.76	5.13
Others	2,790.78	7.69
Agro-Industrial	45.814	0.13
Mining/Quarrying	304.13	0.84
Tourism Zone	606.49	1.67
Water	72.12	0.20
TOTAL	**36, 307.31**	**99.83**

Source: Municipality of Rodriguez' Comprehensive Land Use Plan 2012-2022

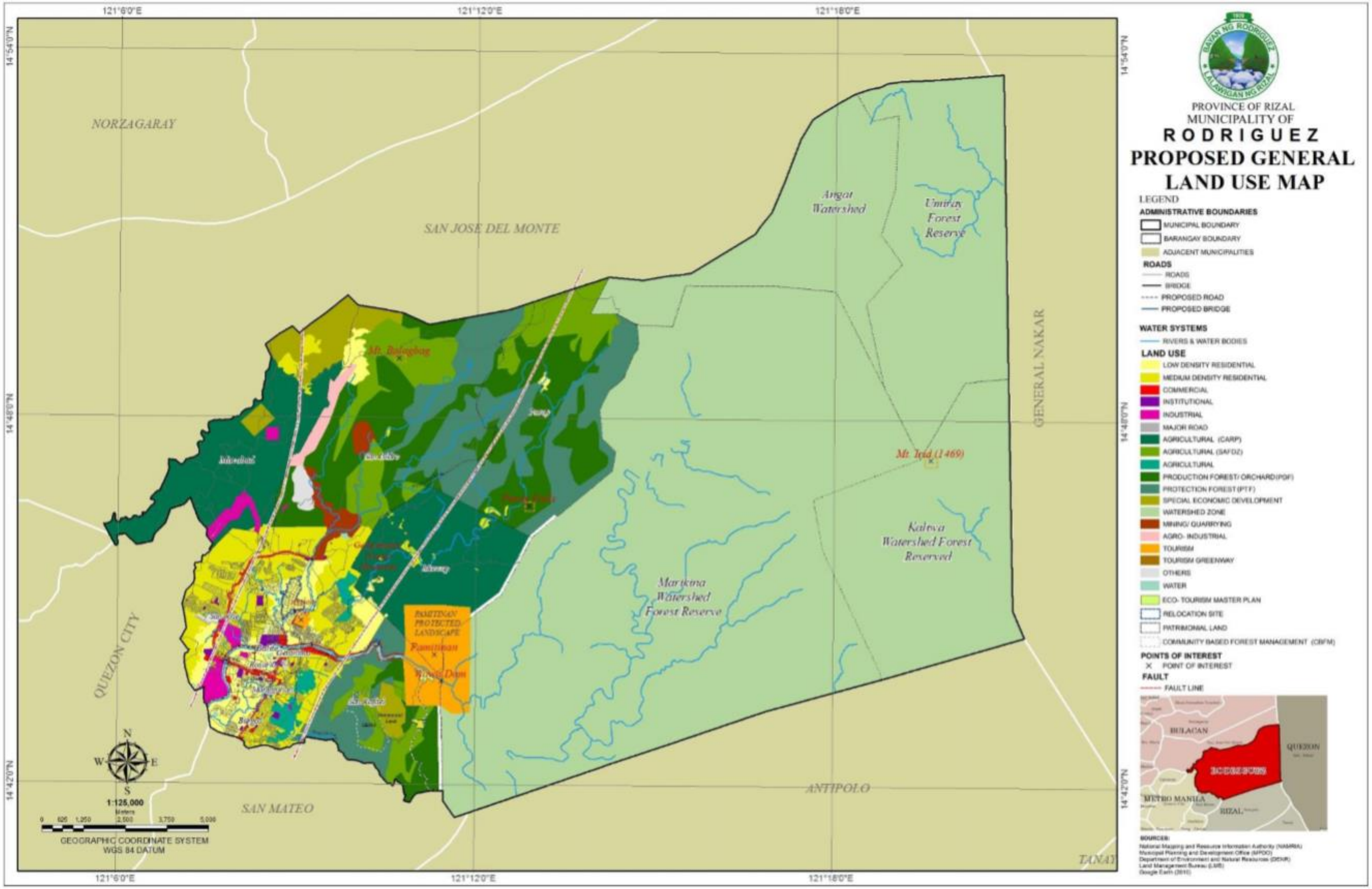
With the municipality's development vision shifting from the traditional market-based development to an environmentally sound sustainable development, the proposed land use features an overall increase in the natural and built-up areas.

Table 11. Proposed general land use classification of Rodriguez, Rizal

Land Use Category	Area (has)
Forestland	28,671.70
Agricultural	3,442.07
Built-up Areas	2,975.62
Others	178.36
Agro-Industrial	113.65
Mining/Quarrying	191.99
Tourism Zone	661.81
Water	72.12
TOTAL	**36,307.31**

Source: Municipality of Rodriguez' Comprehensive Land Use Plan 2012-2022

Based on the proposed general land use, Barangay Macabud's land uses are agricultural, industrial and residential.



Source: Municipality of Rodriguez' Comprehensive Land Use Plan 2012-2022

Figure 12 – Proposed General Land Use, Rodriguez, Rizal

2.1.1.1 Possible Tenurial/Land Issue

ATN's project area has no ancestral domain nor stewardships agreements such as CBFM, IFMA, forest co-management implemented. Some parts of the project area are also owned by the company under TCT # 463732.

IMPACTS AND MITIGATING MEASURES

Foreseen project footprints on the land surface shall be progressively rehabilitated according to the municipality's land use plan and agreed upon final land use with the community through rehabilitation/revegetation. A waste management plan shall also be established and implemented by the company throughout its operations. Color-coded waste bins will strategically be placed throughout the project area and a Materials Recovery Facility (MRF) will be established to further segregate the wastes. Income-generating wastes like metal scraps will be placed in a warehouse prior to selling; while hazardous wastes (i.e. battery) shall be placed in a temporary storage area prior to its haulage and treatment/disposal by the EMB accredited treaters.

2.1.2 Geology/Geomorphology

The assessment conducted is a compilation of combined internal studies by ATN and secondary information available from different government agencies. Data were collected and reviewed coupled with a field inspection on the project area. Publicly available data related to the project such as maps and literatures from Mines and Geosciences Bureau (MGB) and Philippine Institute of Volcanology and Seismology (PHIVOLCS) were referred to further develop the discussion.

Discussions in the succeeding sections are on the impacts of the project in relation to the changes in surface landform/topography including existing hazards; on local geomorphology and the proposed modification of the landform, its impact and the proposed mitigation. Assessment of project impacts in terms of the changes in sub-surface geology and inducement of subsidence as well as the effects of geologic hazards within and around the project area were also carried out.

2.1.2.1 Brief Project Geology Description

The project area is generally underlain by volcanics comprised of competent massive basalt, andesite and volcanic breccia which were exposed along river courses and tributaries. These rock types contain potential resource of mountain-rock quarry type deposit which exhibit good rock strength characteristics suitable for aggregates and rock armor.

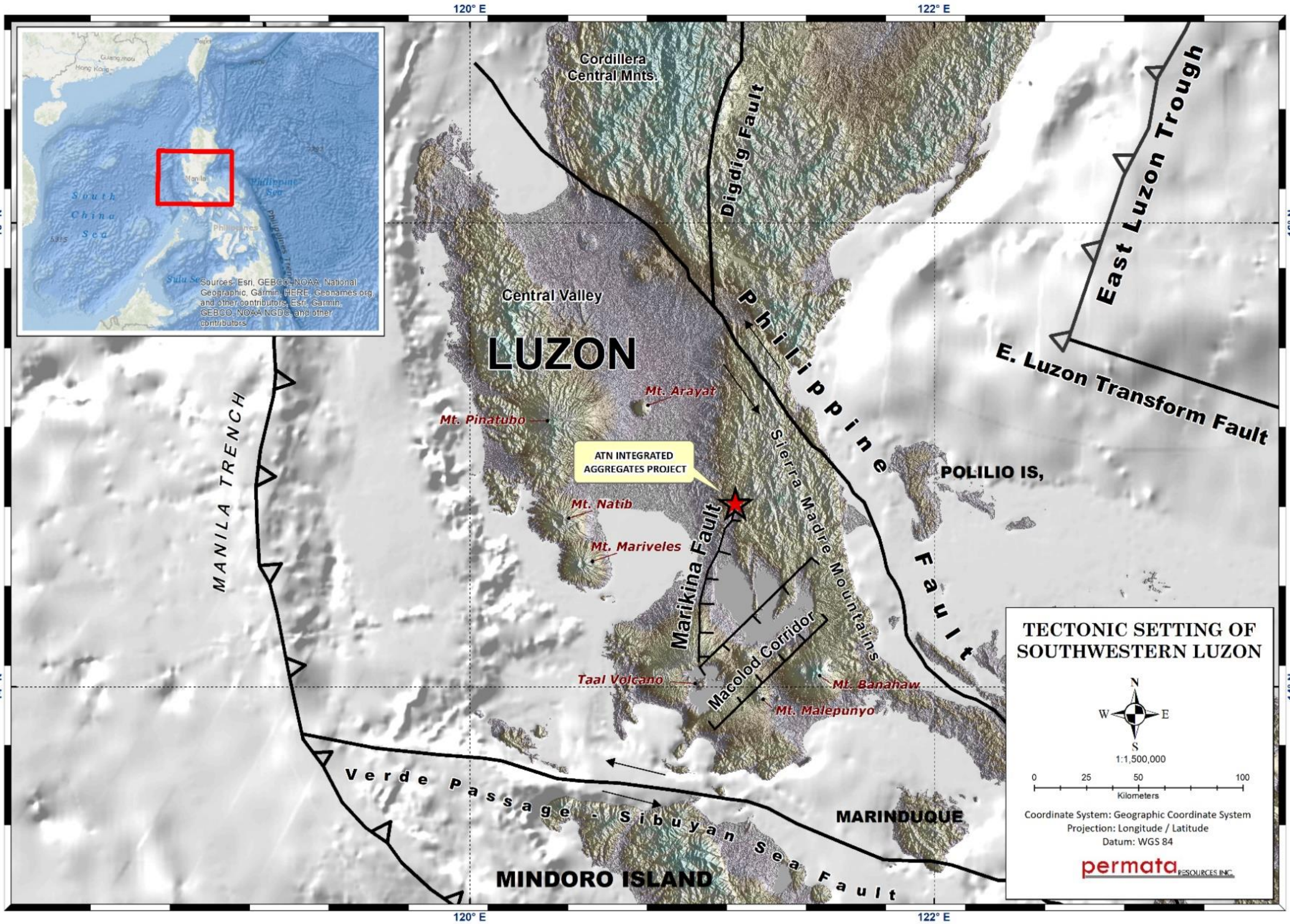
Photo 1. Outcropping massive Basalt along the river bed located north of the project area

2.1.2.2 Geologic Setting

2.1.2.2.1 Tectonic Setting

The project area of ATN lies immediately 8-km northeast of Lamesa Watershed Reservation. Regionally, the project, including whole of Metro Manila, is bordered on the western and eastern sides by the Manila Trench and the Philippine Trench, respectively (**Figure 13**). The Philippine Trench is a west dipping subduction zone of the Philippine Sea Plate subducting beneath the eastern Philippine Arc system. West of Luzon Island, the Manila Trench of the South China Sea subducting under the Luzon Arc. Stresses induced by the movement in the trenches is translated into stresses along the 1,200-km long strike-slip Philippine Fault Zone (PFZ) on the entire archipelago. This fault intersects the eastern portion of Luzon along the coastlines between Atimonan and Mauban in Quezon Province some 40 km east of Baras, Rizal.

East of the project area is the Valley Fault System (VFS) which runs all the way from south of Metro Manila; including cities of Muntinlupa, Pasig, west edge of Laguna de Bay, Pasay, Marikina, Quezon City, Montalban, Rizal up to San Jose del Monte, Bulacan. The fault is a graben structure where the contact of the downthrown block of the Marikina River valley with the upthrown block sandwiching the valley is occupied by the fault system. The said fault system consisted of two NE trending fault that bound the Marikina Valley on the west and east – the West Valley Fault (WFV) and East Valley Fault (EVF), respectively (Daligdig, et al 1997)



Source: Modified after Tectonic setting of a composite terrane: A review of the Philippine island arc system; GP Yumul Jr, et al

Figure 13 – Project Area with Respect to Philippines Tectonic Setting

2.1.2.2.2 Regional Geology and Stratigraphy

The project area is part of the Southern Sierra Madre. Generally, it is underlain by Late Cretaceous basement consisting of ophiolite/ophiolitic complex – **Montalban Ophiolitic Complex.** The ophiolitic sequence consists of layered and massive gabbro, sheeted dike complex, pillow basalts and turbiditic sedimentary rocks. The Montalban Ophiolitic Complex is overlain by the **Kinabuan Formation** that consists of two members: a lower clastic member and an upper limestone member. The lower clastic member is composed of thinly interbedded silty shale and calcareous sandstone with tuffaceous and siliceous layers capped by steeply dipping thin beds of limestone. The upper limestone member consists of light to dark gray pelagic limestone with minor calcarenite and calcisiltite and rare interbeds of calcareous shale (MGB, 2010).

Above the Kinabuan Formation is the **Maybangain Formation** consisting of two members, namely, the lower Paleocene Masungi Limestone and the upper Eocene clastic-volcanic member. The Masungi Limestone is composed of redeposited limestones, debris flows and turbiditic strata that are interbedded with calcareous and non-calcareous mudstones and minor volcaniclastic rocks. The clastic-volcanic member is composed mainly of a thick sequence of volcanic and clastic rocks.

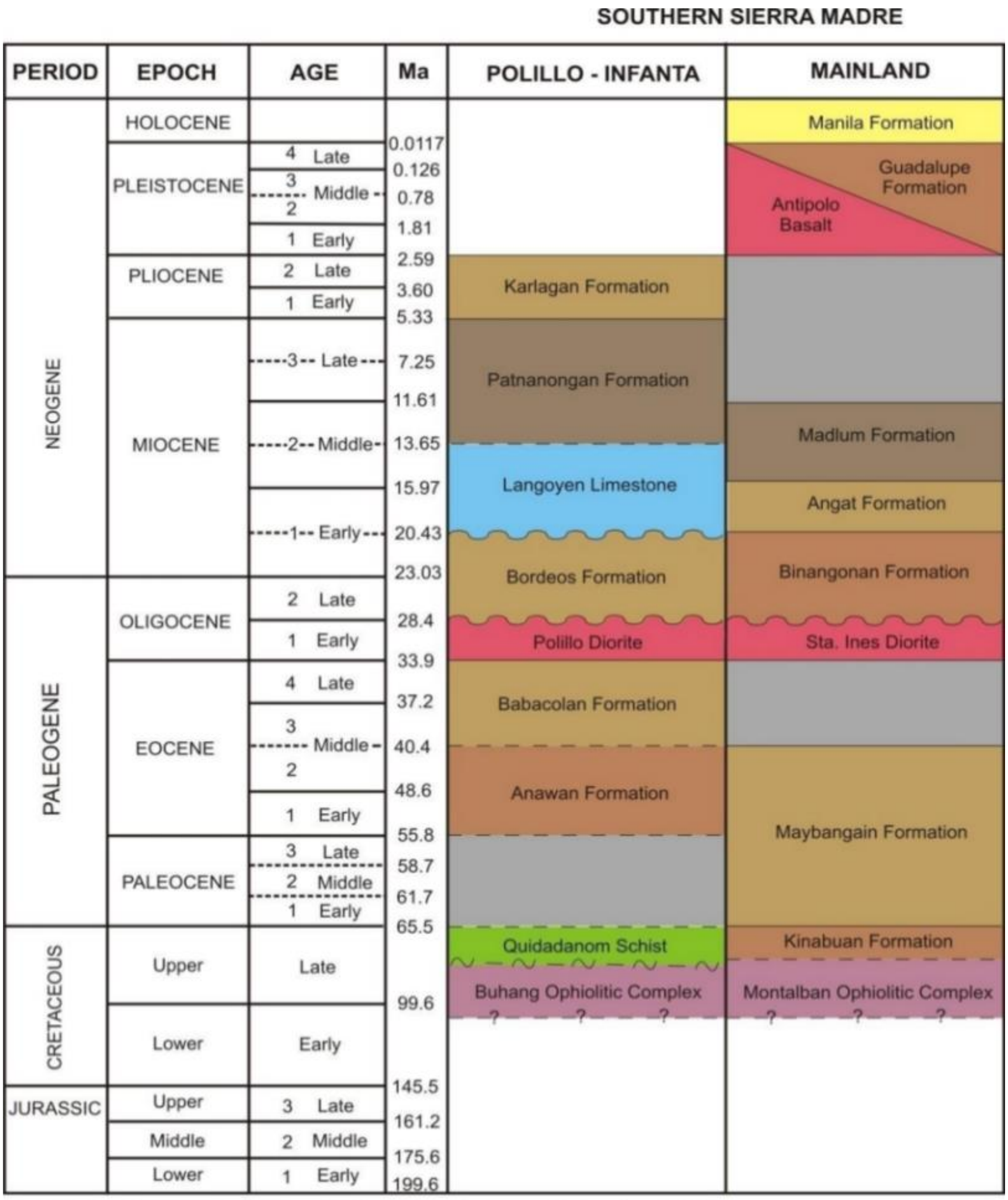
Sta. Ines Diorite intrudes the Kinabuan and Maybangain formations during the Early Oligocene. It occurs as a stock and also dikes and sills intruding sedimentary rocks in the area. The dominant rock type is medium to coarse grained hornblende diorite with local quartz diorite, gabbro and diabase facies.

Overlying the Maybangain Formation is the **Binangonan Formation.** It has two members, namely, lower Teresa Siltstone and an upper limestone member. The Teresa Siltstone is a sequence of tuffaceous calcareous siltstone and marl deposited by turbidity currents in a shallow basin while the upper limestone is massive, light cream to pink to bluish gray and fossil-rich.

The Early Miocene **Angat Formation** consists of a lower clastic member and an upper limestone member. The lower member, constituting a minor part of the formation, is mainly made up of calcareous shale and clayey sandstone with occasional lenses of limestone. It contains mollusks and coral stems that suggest shallow marine deposition. The upper limestone member consists of a lower bedded reef flank deposit and an upper biothermal mass.

Resting conformably above the Angat Formation is the Middle Miocene **Madlum Formation**, which is subdivided into three members, namely, lower clastic member, Alagao Volcanics and Buenacop Limestone.

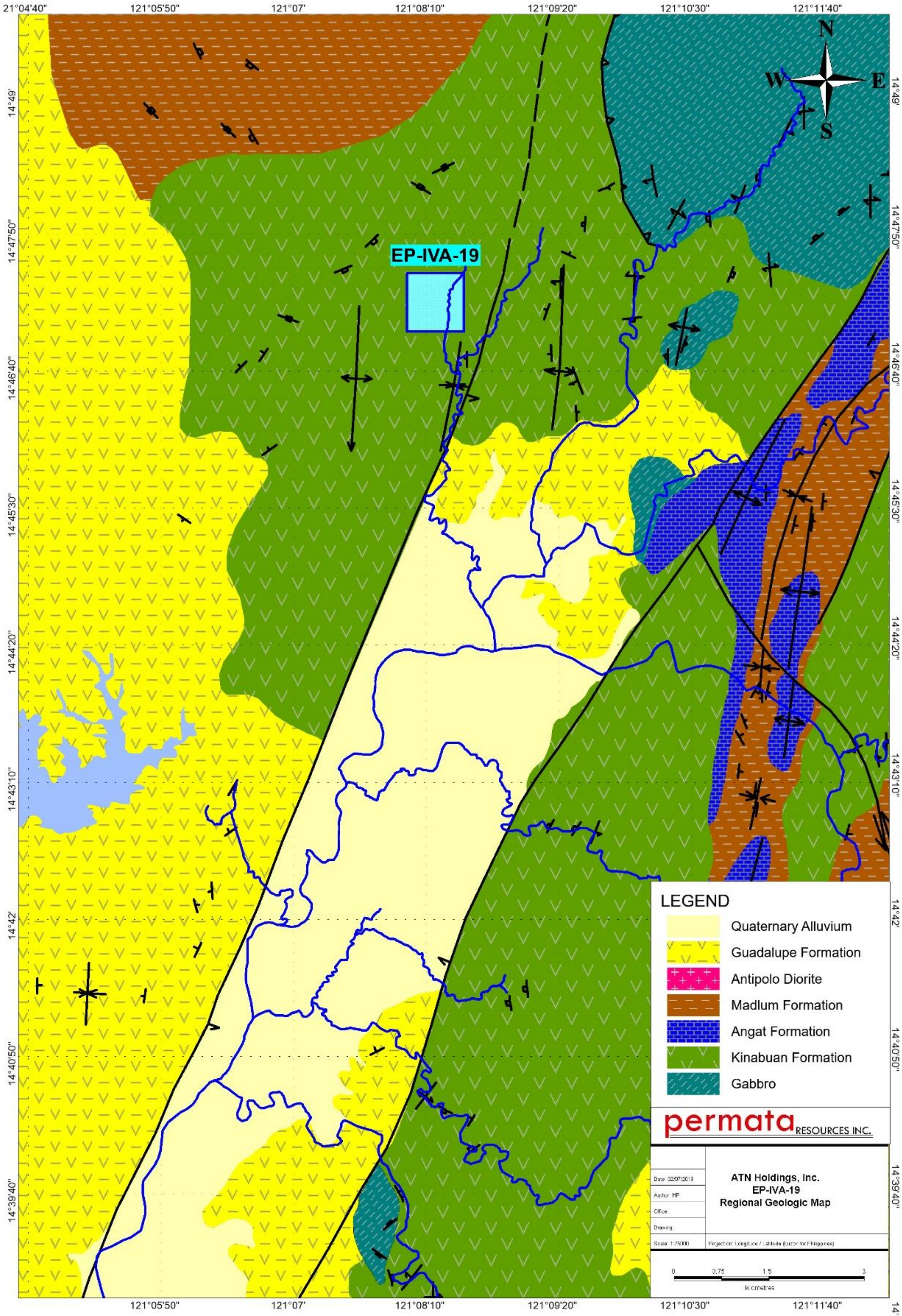
During Pliocene-Pleistocene time, the Antipolo Basalt and the Guadalupe Formation were emplaced. The **Antipolo Basalt** is exposed in the hills surrounding Antipolo such as those in Binangonan and Morong. It is brecciated and amygdaloidal. The **Guadalupe Formation** consists of two members, namely, Alat Conglomerate and Diliman Tuff. The Alat Conglomerate describes as an extensive belt along the hills and lowlands of eastern Bulacan and southeastern Nueva Ecija while the Diliman Tuff covers a large portion of Metro Manila and southern Rizal province. It is mainly composed of tuffs and pyroclastic breccias with subordinate tuffaceous sandstone. It is flat lying and medium to thinly bedded. Among the fossils contained in the tuff are plant leaves and remains of deer and elephant.



Geologic Time Scale adopted from International Commission on Stratigraphy (2009)

Source: MGB, 2010

Figure 14 – Stratigraphic Column for Southern Sierra Madre (MGB, 2010).



Source: Modified from Montalban Geological Quadrangle map, MGB 1983

Figure 15 – Regional Geologic map of Montalban district

2.1.2.2.3 Local Geology

Based from the MGB Quadrangle map (1983), Montalban District is predominantly underlain by Late Cretaceous Kinabuan Formation (KF) which is comprised mainly of spilitic basalt flows with intercalated highly indurated sandstone and cherty beds. This formation appears to be overlain by Early to Middle Miocene Madlum and Angat Formations on the northwest and southeast of the district, respectively. Madlum Formation (MF) is composed of Buenacop limestone, and volcanic and clastic rocks mainly agglomerate, tuff, indurated wacke, basalt and andesite flows, and the lower sequence of thin to thick sandstone and silty shale with conglomerate at the base. Angat Formation (AF), on the other hand, is comprised of well-bedded to massive limestone associated with sedimentary units including limy sandstone, calcareous shale, clayey sandstone, sandy sandstone and conglomerate. The southwestern side towards Metro Manila, is extensively overlain by Guadalupe Formation, essentially consisting of thin to medium bedded, fine-grained vitric tuffs and welded volcanic breccias.

The younger Madlum and Angat Formations were not observed in the project area as it appears to be regionally folded; wherein the upper layers of the formation had been intensely eroded and later deposited as colluvium/alluvium and unconsolidated materials on lower catchment areas, and on generally flat, elevated plateau formation located north of the project area. The plateau formation is apparently being used as agricultural rice paddies and residential sites. Massive basalt and andesite rock units remains and are pervasively exposed along the river/creek courses and steep falls/gulleys, which are thought to be the volcanic flow unit presumably belonging to Kinabuan Formation. Amygdaloidal fabric and pillow structures typical to basaltic rocks were also observed in some outcrops. Underlying the volcanic flows is the Gabbro; which is thought to be part of the Montalban Ophiolitic sequence, and the pillow Basalts that crops out in the project area possibly represent the upper ophiolitic sequence. The Kinabuan formation are extensively distributed in the district, its competent rock units and to some extent, the pillow Basalt and Gabbros of Montalban Ophiolite are being quarried for rock aggregates and armor rocks in Montalban and San Mateo down to Antipolo, (eg. Monterock and Hardrock aggregates, respectively). Numerous small to large-scale mountain rock quarry aggregates are currently operating in the Montalban district (eg. Montalban Milex, Oxford Mines and Primerock).

The aggregates deposit in the project area is characterized by coherent units of massive to weakly sheared bluish-gray to green-gray basalt, basaltic andesite and minor outcrops of gray hornblende andesite. The deposit was mapped as outcrops along the mainstream traversing the central part of the property. Massive basalt outcrops continued towards the headstream of main river and along the east-northeast trending tributaries where it extensively exposed along the steep falls near the existing access trails. Weathered counterparts are observed at ridge sides and higher elevated parts while it became fresher towards hill slopes, along the river beds and river bank exposures. Minor outcrops of volcanic breccia were also mapped. Weathered andesite crops out on the ridge trail towards the northeast corner of the property, while fresher sections of andesite were mapped along the headwaters of Laan River.

Geologic discontinuities such as fractures and joints were not frequently observed in the outcrops; although the site lies close to the prominent NE trending West Valley Fault (WVF). The north-easternmost segment of the WVF crosses east of the project area. Weak to moderate sheared outcrops were noted along the headstream of Laan River that traverses from the eastern side of the project area. These sheared outcrops are possible manifestation of the WVF. The north-northeastern river that run across the middle of the project area appears to represent the NW splay of the West Valley Fault.

Photo 2. Basalt and Basaltic Andesite outcrops exhibiting semi-pillow structure (B & C) and carbonate-clay vein stockworks (D). Massive, fresh bluish-green colored basalt (A)

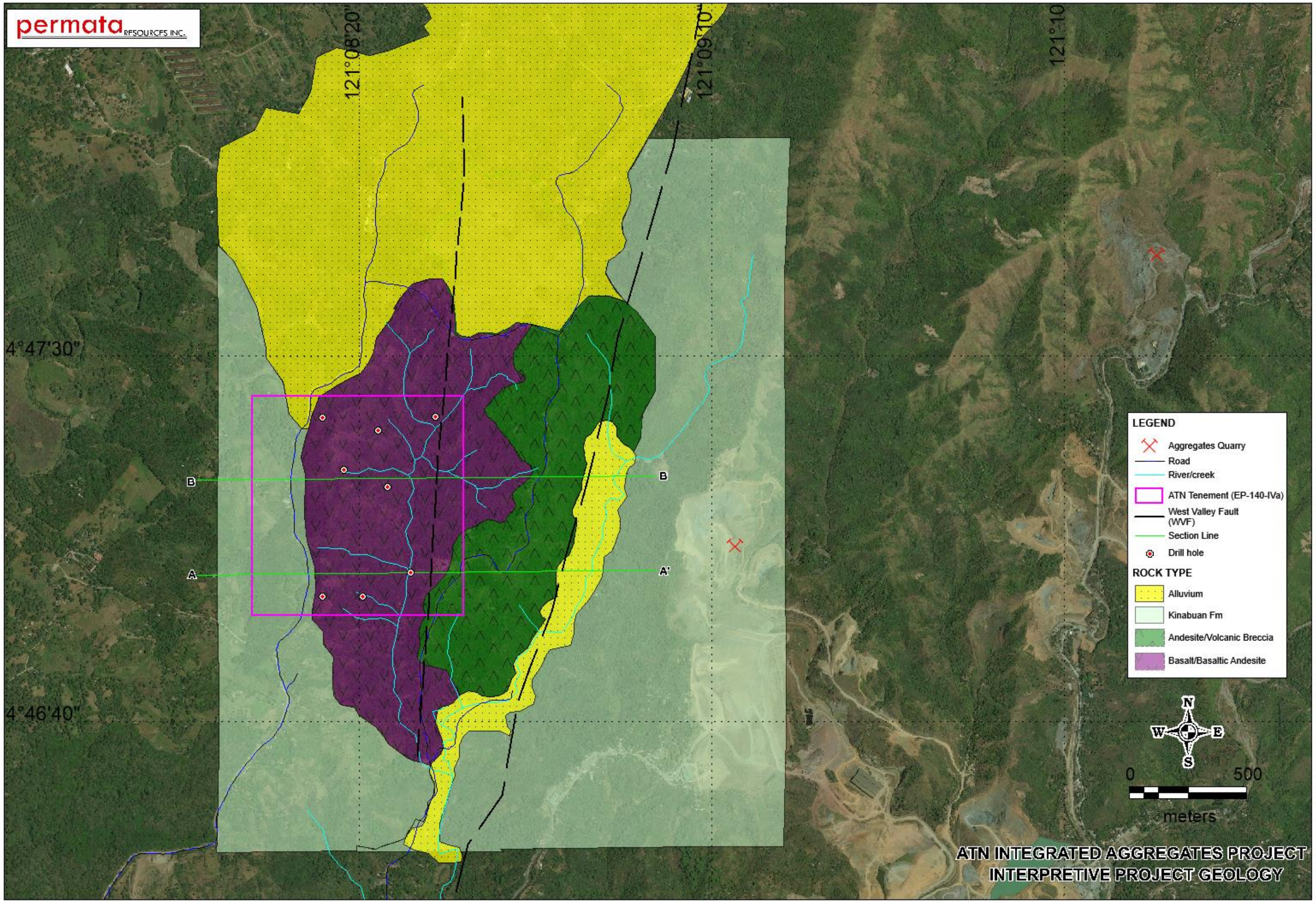


Figure 16 – ATN Integrated Aggregates Project Interpretive Geology

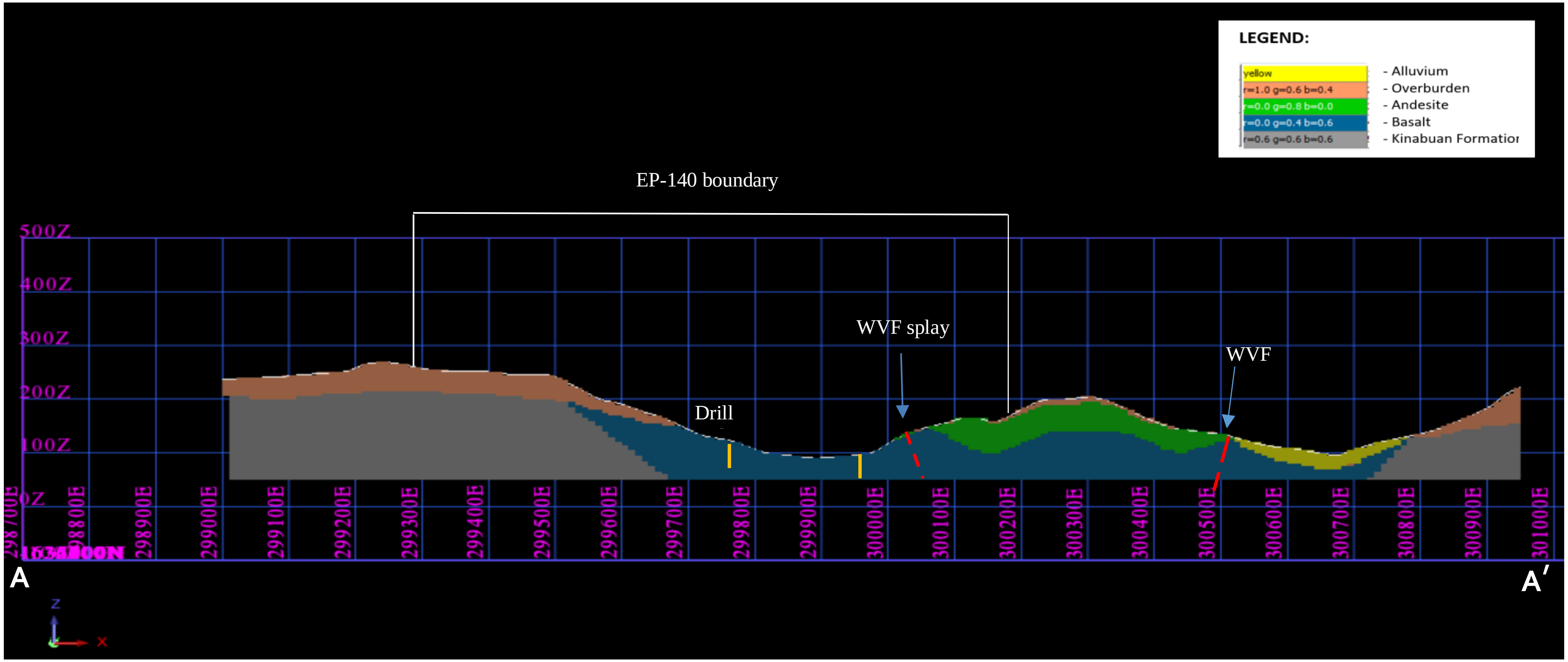


Figure 17 – Section Line along A- A' looking North. Showing the potential aggregates deposit (Basalt and Andesite) in relation to Overburden and Fault structures.

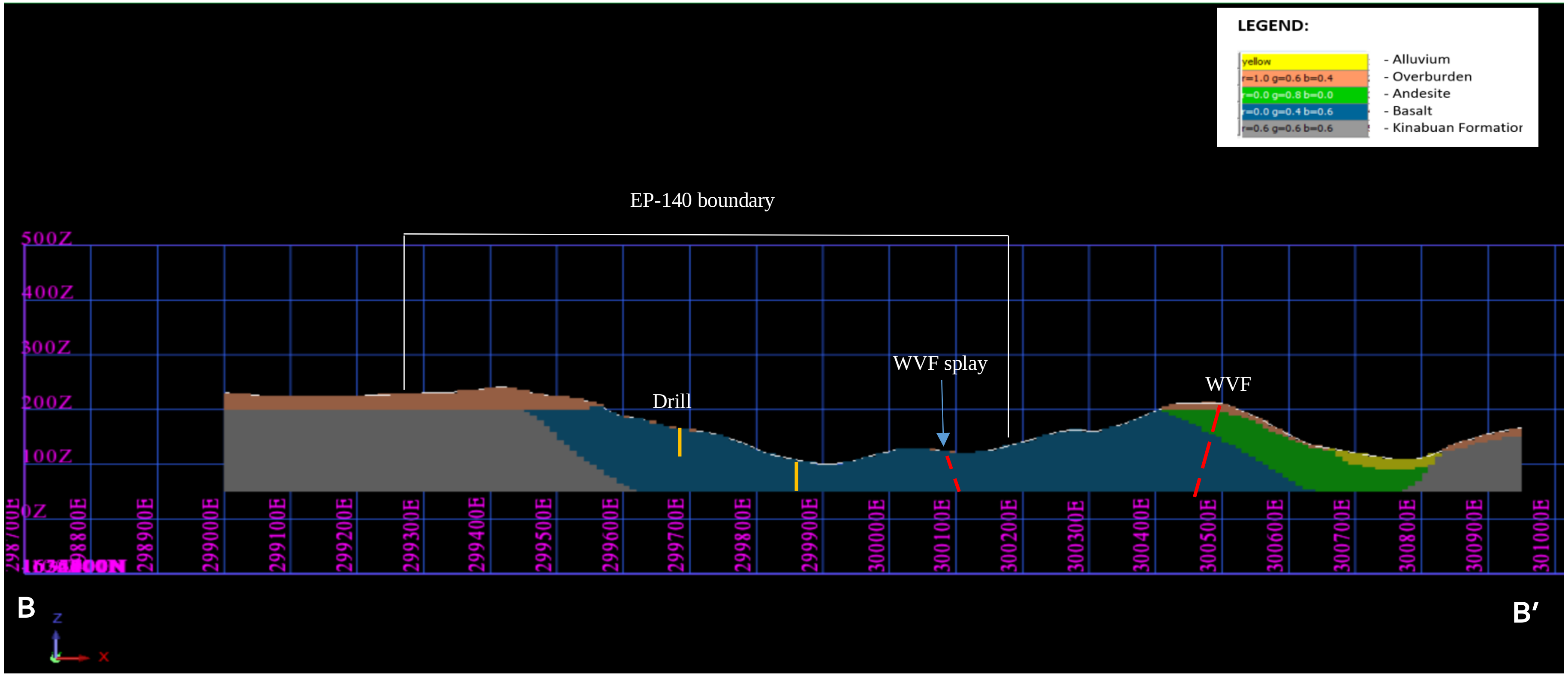


Figure 18 – Section Line along B- B' looking North. Showing the target aggregates deposit (Basalt and Andesite) in relation to Overburden and Fault structures.

2.1.2.3 Geomorphology

The project Area of ATN lies in the northernmost town of Rizal, in Montalban (now Rodriguez). It is located in the southwestern range of Sierra Madre, bounded by Bulacan at the north side; Infanta, Quezon at the east and close to Quezon City, Metro Manila at the southwestern side.

It is hilly to mountainous; with highest elevation at 260m asl located in the northwestern part of the property. The northern part is gently sloping typified by a plateau land form then abruptly grade towards south-central portion of the permitted area, forming a depression-like formation or valley shaped morphology characterized by moderate to steep slopes.

In general, San Jose del Monte, Bulacan and Rodriguez, Rizal, including the project area, falls under slope range value of 30% to 50% and >50% characterized by steep to very steep terrain (**Figure 19**).

The drainage on the project area is defined by two major north-northeast trending river which drains towards Wawa river then to Marikina River basin. Its tributaries have rectangular pattern displaying right-angled banks which indicates structurally controlled system (**Figure 20**).

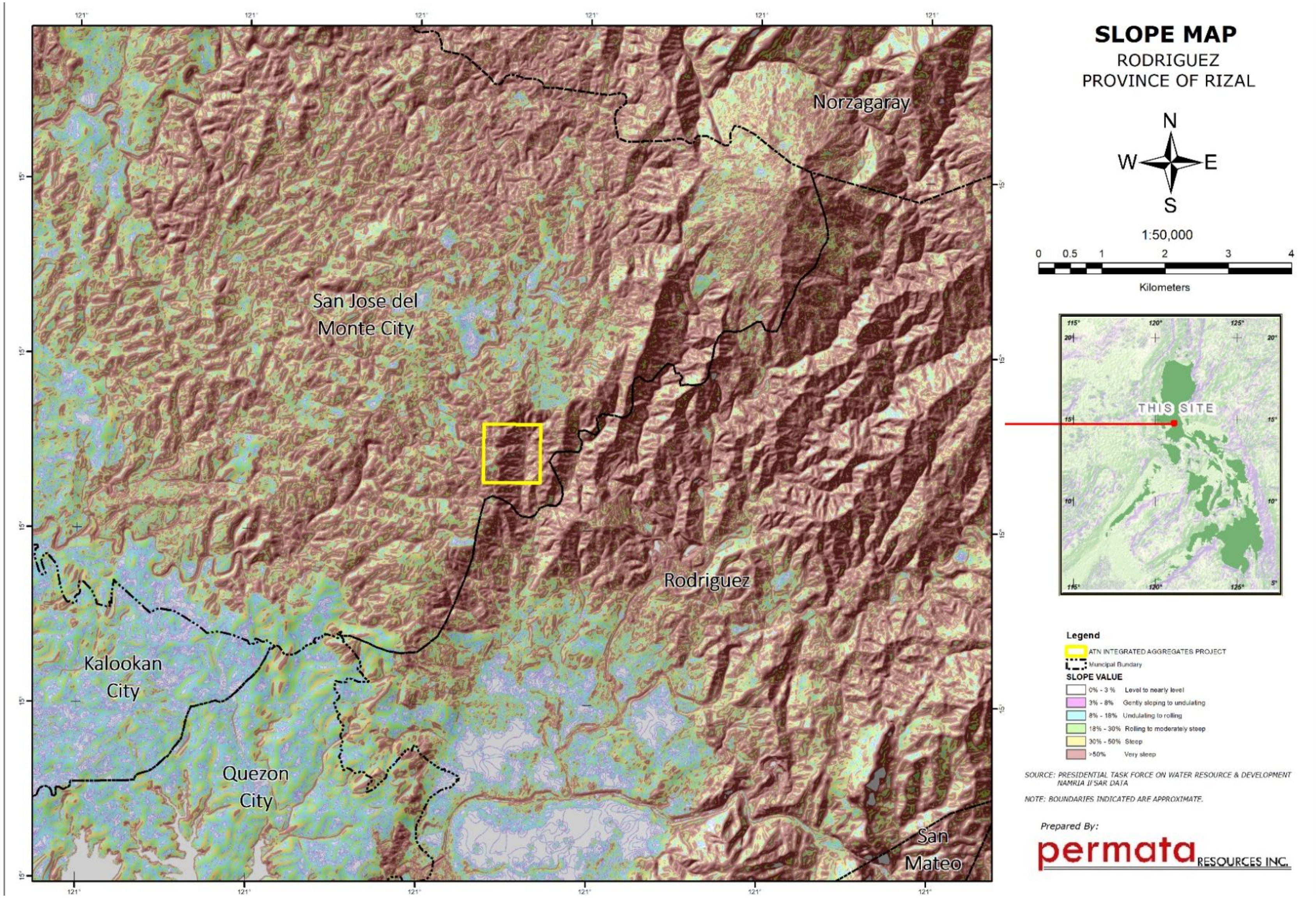


Figure 19 – Slope Map of ATN Integrated Aggregates Project and adjacent vicinity

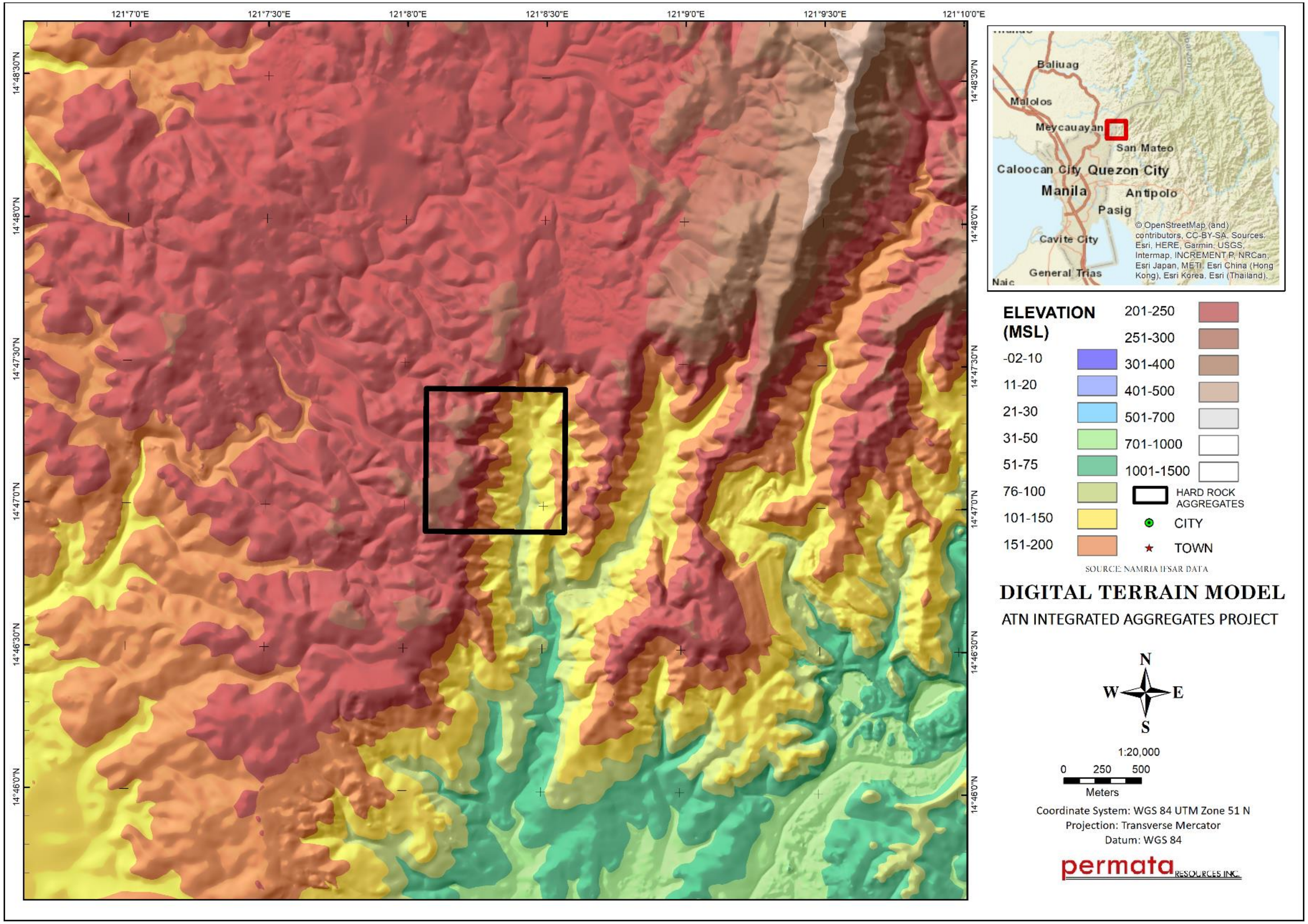


Figure 20 – ATN Integrated Aggregates Project Digital Terrain Model

2.1.3 Geologic Hazards

Based on the available data of Philippine Institute of Volcanology and Seismology (PHIVOLCS), Mines and Geosciences Bureau (MGB) and other pertinent secondary data, the geologic hazards that my directly influence the study area are ground-shaking as a direct result of seismic activity, mass movement in the form of earthquake-triggered and/or rain-induced landslides, liquefaction and flooding hazard. These Geo-hazards are reviewed and assessed its impact to the project area.

2.1.3.1 Seismic Hazards

The Philippine archipelago being located in an island arc system is a tectonically active region frequently affected by numerous crustal movements at varying depths and magnitudes. The seismically active belts lie along and peripheral to the delineated convergent zones bounding the archipelago and along the active Philippine Fault Zone. The Philippine Fault Zone (PFZ) is the most active and is physiographically traceable to about 1,200km starting from south of the Philippines in Mindanao to Luzon. It has many structure extensions and consists of a number of sub-parallel faults, branches and splays.

East of the project area, roughly 400m to 600m, is the northeastern most segment of West Valley Fault System (WVFS). An active subduction zone (Philippine trench) located east of Luzon while on the west is the Manila Trench which results in a number of subduction related tectonic earthquakes. **Figure 22** shows the seismicity map of the Philippines with magnitudes Mw >4.1 (A) & >5.1 (B) based from PHIVOLCS, Philippine Earthquake Model, 2017 historical and Instrumental, and PSHA Database. As shown in the map, the project area and adjacent provinces, lower magnitude earthquake at Mw 4.2 to 5.2 are common while there is no recorded earthquake with magnitude above Mw 5.2. Earthquake with magnitude greater than Mw 6.46 are concentrated in the east and west-northwest coast of Luzon which probably relates to seismicity originated from Philippine Fault and Manila Trench, respectively. The highest earthquake (>Mw 7.66) event was recorded in 1990 and 1645; with an epicenter originating from north-northeast side of Sierra Madre, roughly 100km north of the project area. The resulted seismic hazard possibly relates to the intersection of Digdig Fault and Philippine Fault segment that brought devastating earthquake with magnitude of Mw 7.8 in Luzon and Metro Manila as well, on July 1990.

Ground shaking is the direct result of seismic activity which usually results to damage in infrastructure. The degree of damage associated with ground tremors is attributed to several factors including wavelength and duration of shaking, the epicentral distance, the nature of the underlying materials (subsoil/bedrock conditions), the degree of water saturation of soil/rock media, and the character of infrastructures within the area (Johnson and DeGraff, 1988). Generally, the shallower the focus of the earthquake and the nearer the site from the epicentral area, the stronger is the felt intensity. Earthquake intensity is notably less in areas underlain by bedrock compared to those underlain by soft foundation materials (e.g. sand and clay). Other factors such as the degree of weathering and the presence of structures (fractures, joints, beddings, faults) may further increase the effects of ground motion.

PHILVOLCS, on their recent study entitled Philippine Earthquake Model (PEM): A Probabilistic Seismic Hazard Assessment of the Philippines and of Metro Manila (2017), was aimed to do a detailed seismic hazard mapping for the purpose of estimating a uniform peak horizontal ground accelerations (PGA) that have a 10% probability of exceedance in 50 years for rocks and stiff soil (soft rock). Accordingly, for rock site classification, the project area lies within 0.4 (g) halo in 500 & 0.5 (g) in 1,000-year return period respectively (**Figure 23**), and 0.6 (g) in 2,500-year return period (**Figure 24a**). For stiff soil (soft rock) the project area lies within 0.5 (g) halo in a 500-year return period (**Figure 24b**).

Peak Ground Acceleration (PGA) by definition is the maximum ground acceleration that occurred during earthquake shaking at a location. It gives one an idea as to how hard the earth shakes at a given geographic location, taking consideration the strength of the quake, distance from the source and type of rocks/soil in the area.

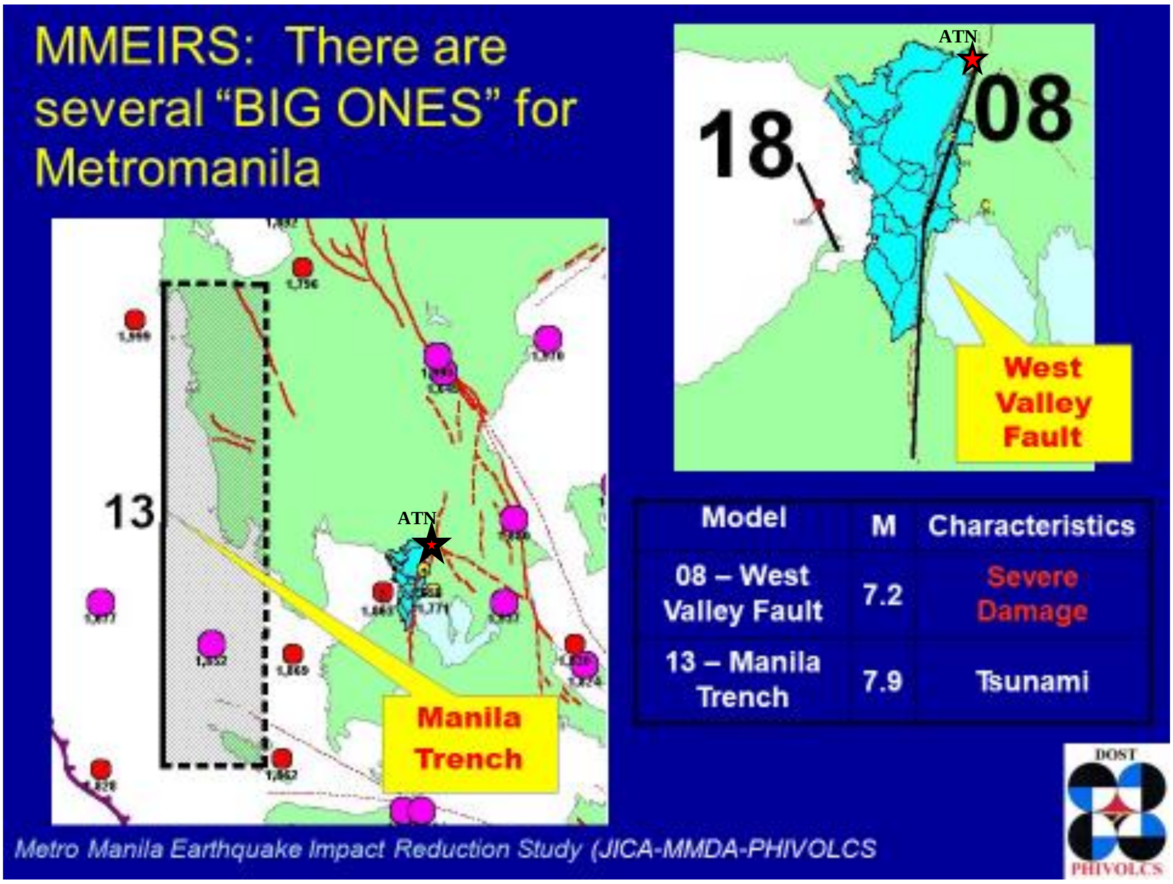
Since the characteristics of the rock exposures within the project site is generally composed of competent volcanic bedrocks such as basalt, andesite and some volcanic breccias, the computations for the design of the civil structures must consider the respective characterization of the underlying lithology.

Moreover, based from Metro Manila Earthquake Impact Research Study (MMEIRS) conducted by JICA-MMDA-PHIVOLCS, there are three (3) earthquake scenarios that could affect Metro Manila and nearby provinces such as Rizal to which the project site is located. The models are as follow:

- **Model 08** with the earthquake generator identified as the West Valley Fault which could produce a 7.2 Magnitude and Seismic Intensity (PEIS) of VIII for most of Metro Manila and IX alongside Marikina River and Manila Bay. Tsunami possibility is none.

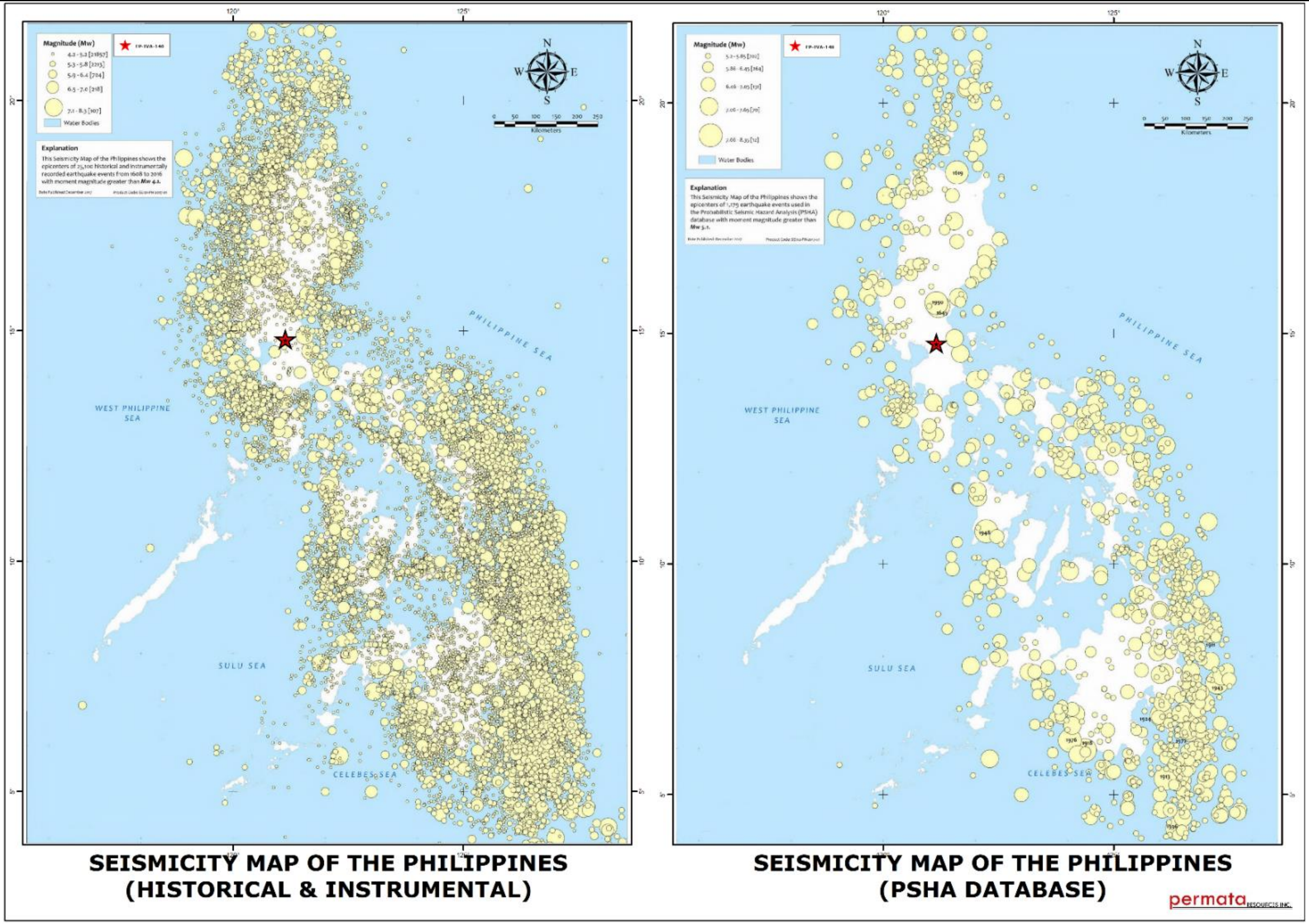
- **Model 13** with a Magnitude of 7.9 and may originate from the subduction along Manila trench. It could produce a Seismic Intensity of VIII and VII which could affect West of Metro Manila and other areas, respectively. Since the earthquake will be generated from the West Philippine Sea, a possibility of tsunami may occur alongside Manila Bay with maximum height of 4m and an average of 2m; and

- **Model 18** that may generate from the offshore fault in Manila Bay. It could produce a Seismic Intensity of VIII and VII; however, the possibility of tsunami is small.



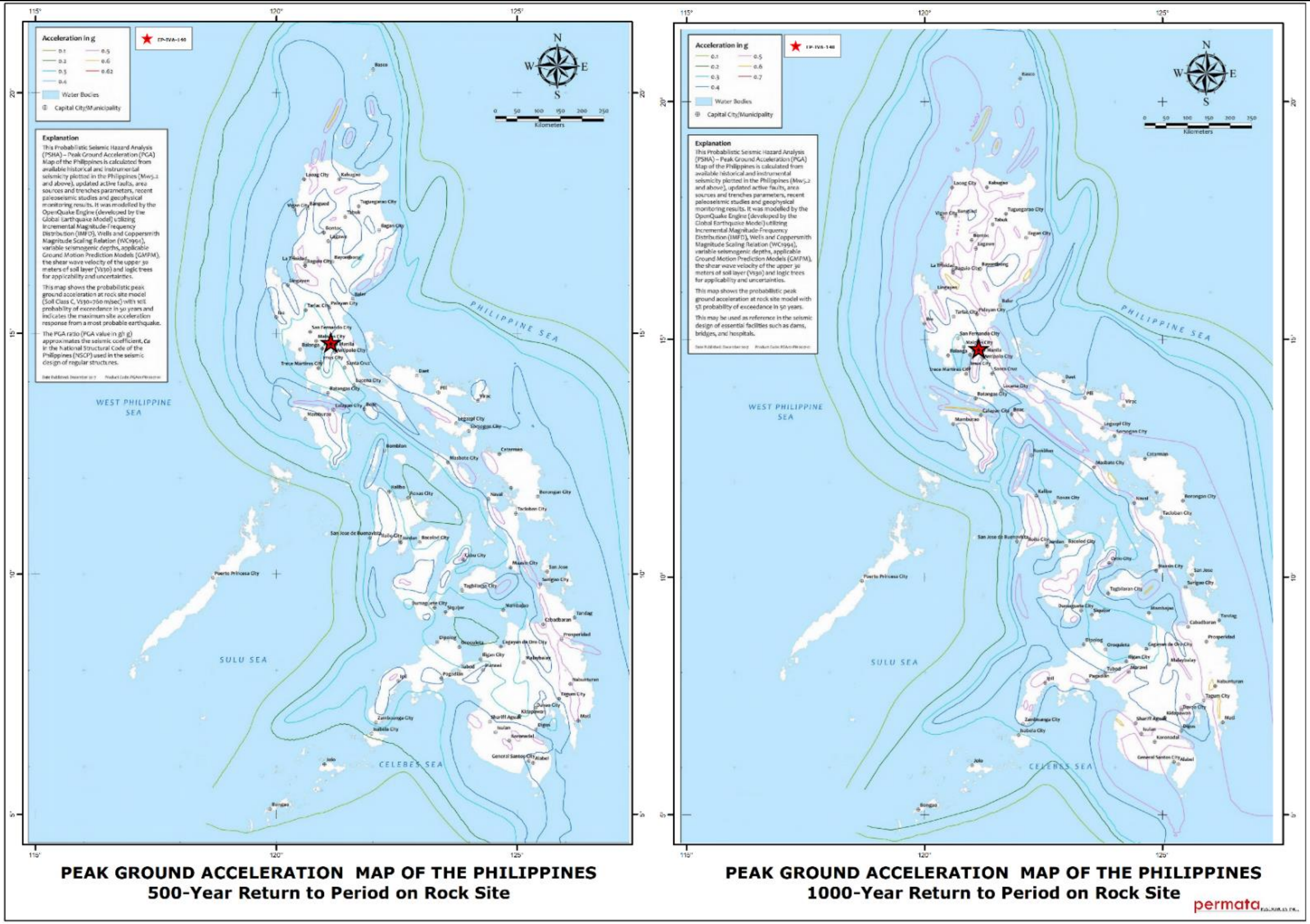
Source: Metro Manila Earthquake Impact Research Study (MMEIRS), JICA-MMDA-PHIVOLCS, 2011

Figure 21 – Earthquake Model scenarios that could affect Metro Manila and the project site (red star) located in Rodriguez, Rizal.



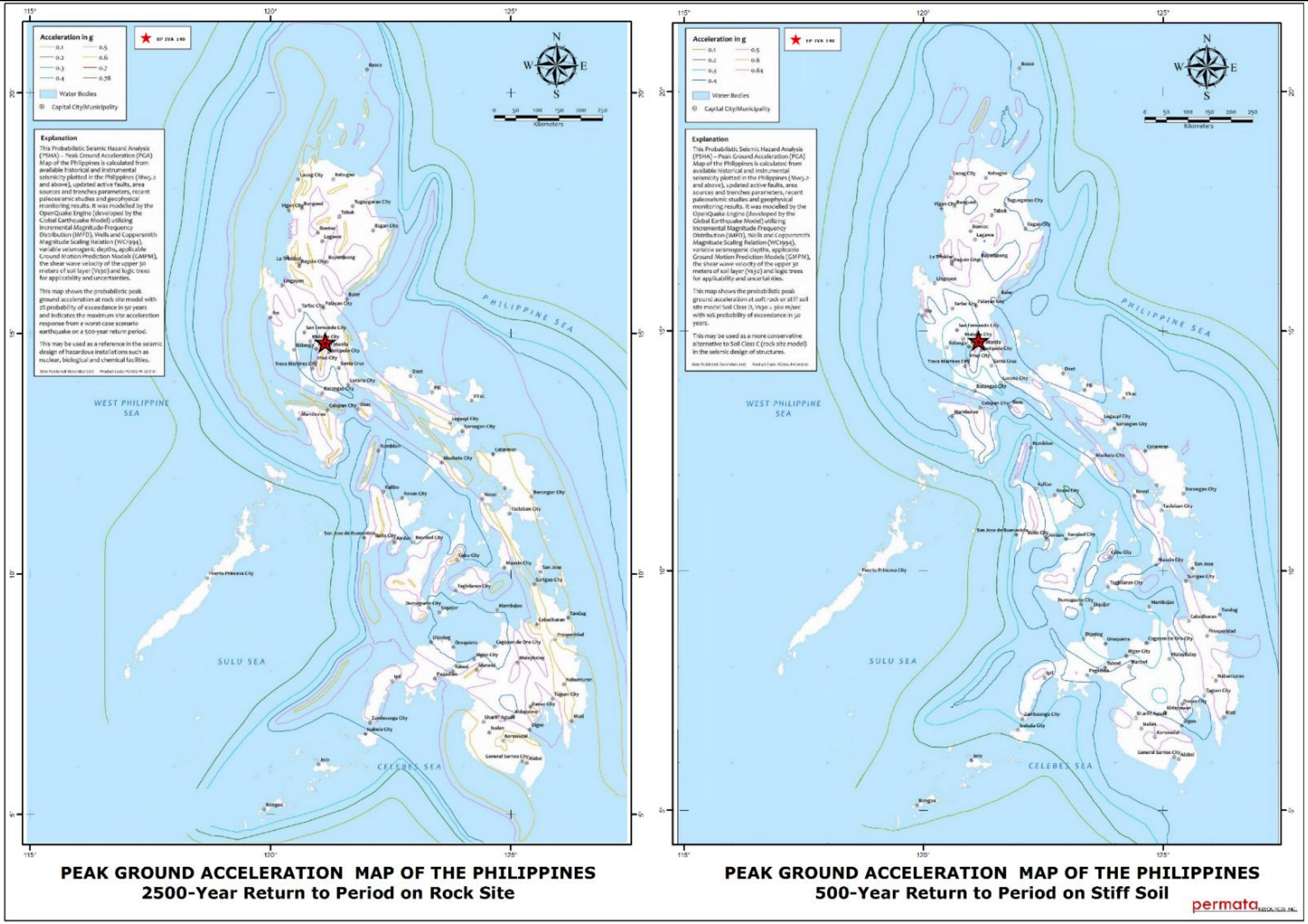
Source: The Philippine Earthquake Model, 2017, PHIVOLCS

Figure 22 – Seismicity Map of the Philippines Mw > 4.1 (A) & Mw > 5.1 (B); Historical and Instrumental, and PSHA Database



Source: The Philippine Earthquake Model, 2017, PHIVOLCS

Figure 23 – Peak Ground Acceleration (PGA) Map of the Philippines, 500 & 1,000 Year Return Period for Rock site



Source: The Philippine Earthquake Model, 2017, PHIVOLCS

Figure 24 – Peak Ground Acceleration (PGA) Map of the Philippines, 2,500 (A) Year Return Period for Rock Site & 500 (B) Year Return Period for Stiff Soil

2.1.3.2 Ground Rupture

Based on Region IV-A active faults map of PHIVOLCS, the active fault that occurs near to the project area is the northeast trending West Valley Fault System (VFS) that runs from Sierra Madre southward to Tagaytay City.

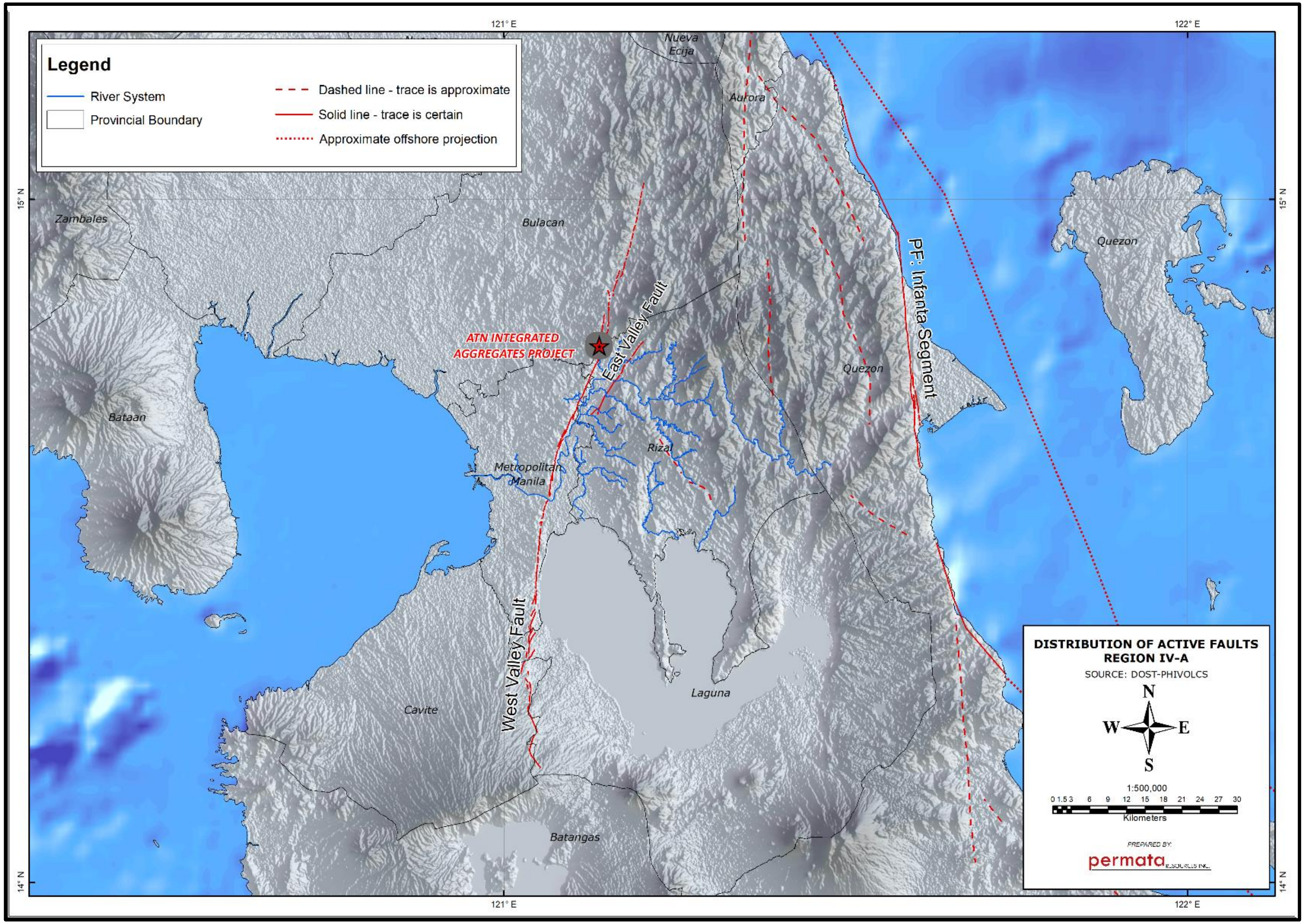
The Valley Fault System consists of two northeast trending faults: the Western and Eastern valley that bound the Marikina Valley. The fault system transects parts of western Rizal towns (San Mateo and Montalban) and eastern Metro Manila; particularly the cities of Quezon, Marikina, Pasig, Makati, Pateros, Taguig and Muntinlupa.

The north-easternmost segment of West Valley Fault (WVF) occurs roughly 400m to 600m east of the project area. Of particular concern is the N-NE trending river that traverses through the tenement which possibly a splay of WVF. Exploration drilling conducted by the company in the project area has reported intercepts of gougy, sheared to brecciated sections in some of the drill holes that possibly relates to WVF splay.

The north-easternmost segment of East Valley Fault is about 6.3km east of the project area. Roughly 49 km east of the project area is the Philippine Fault segment called the Infanta segment that cut along the coastal towns of Quezon, Infanta and Baler; then connects northwards towards Digdig and Gabaldon in Nueva Ecija.

Generally during earthquake, properties built on top of an active fault will be greatly affected by the ground rupture. House or building construction should be at least 5 meters away from the trace of the fault. Active faults are those faults that moved in the last 10,000 years.

Since the project area lies close to the trace of WVF splay, it is probable that the impact of earthquake may be greater to the surrounding areas and the project's future infrastructures. It is anticipated however, that engineering design of the quarry infrastructures, i.e. crushing plant, will adhere to the standard seismic parameter set for earthquake model. Further, capital equipment and design of infrastructures will be impermanent or mobile so that possible impact related to ground rupture would be lighter or, otherwise, avoidable.



Source: Map modified from DOST-PHIVOLCS, July 2018

Figure 25 – Distribution of active faults in Region IVA. NE segment of West Valley Fault crosses close to ATN Aggregates Project

2.1.3.3 Mass Movement

Landslides is a type of mass movement which are commonly used for combinations of failure, sliding and flowing; while rock falls are free drops of materials from precipitous slopes which range from small earth clods or rock fragments to enormous masses.

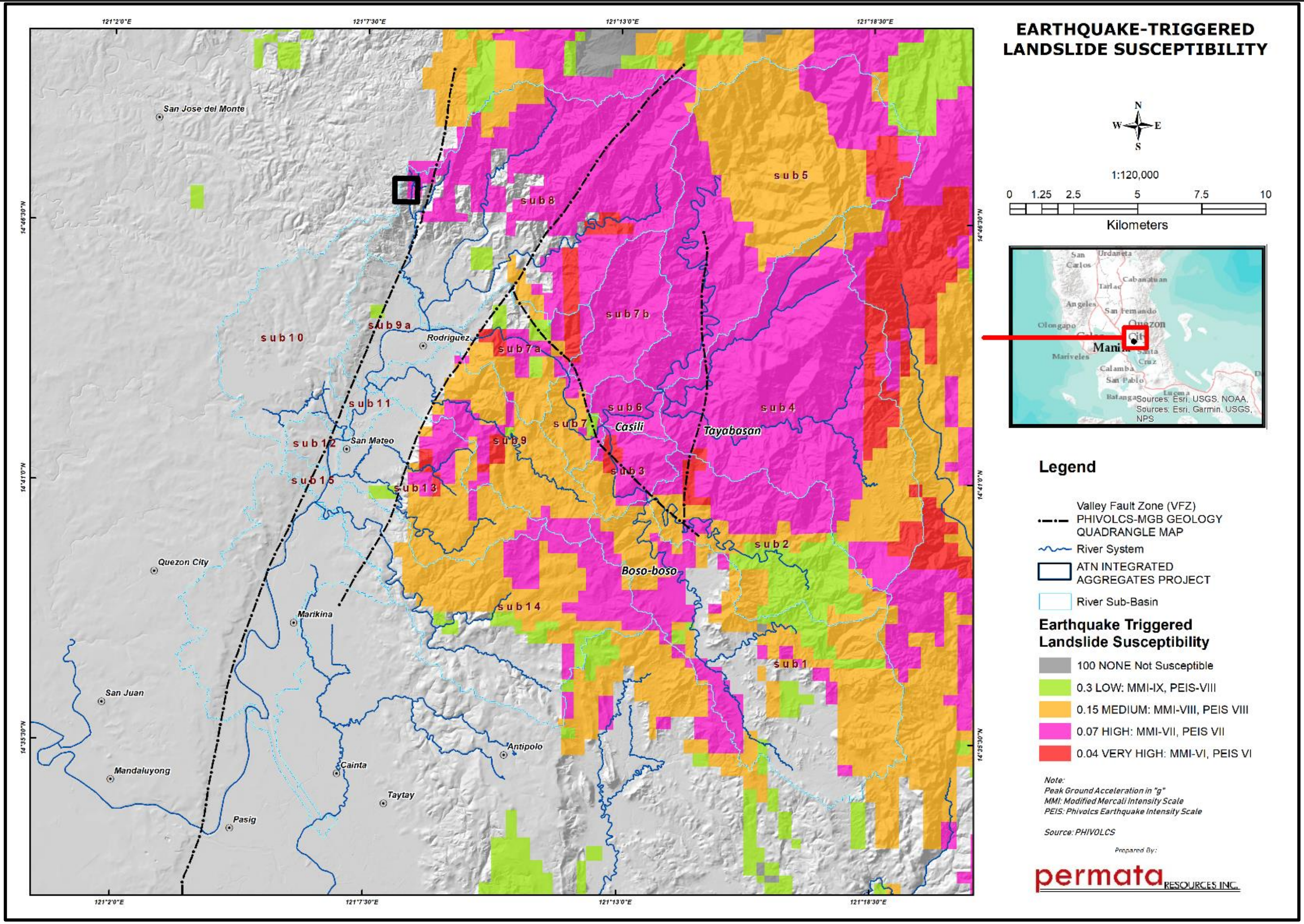
Most common triggering mechanisms for mass movement of materials are ground shaking (earthquake or due to a volcanic eruption) and excessive rainfall. Hydrological processes such as precipitation and infiltration have a major role on landslide initiation (Sidle and Ochiai, 2006). Introduction of water into pore spaces contributes to the increased chance for slope failures. These processes are particularly important in slopes consisting of unconsolidated/loose earth materials (soils, sands, gravels). Oversaturation during extended periods of rainfall often trigger unconsolidated materials to act with fluid-like consistency, hence, moving faster downslope.

Sometimes pre-existing landslide susceptibilities are aggravated by human activities which include deforestation (e.g. brought about by “kaingin” or slash-and-burn farming methods), slope modifications or through steepening of the slope following road construction and mine/quarry development; and building of heavy infrastructures (e.g. houses, buildings, etc.) on slopes. The underlying materials (i.e. soil, rock, fractured and weathered rocks) determine an area’s susceptibility to mass wasting. Hence, loose materials such as soils and other non-cohesive aggregates are prone to mass wasting, in comparison to hard, non-fractured rocks (Sidle and Ochiai, 2006). The degree of weathering and the presence of fractures and foliations also augments the tendency for slopes to fail. The presence of faults and activity along such structures initiate mechanical and chemical weathering which weaken the materials. Movement along faults also acts as triggers for landslides to occur. Uncontrolled blasting, overloading and/or over steepening of the slopes may likewise contribute to mass movement.

Earthquake occurrence is usually accompanied by landslide hazards. Based on the PHIVOLCS Earthquake-triggered Landslides (ETL) susceptibility map, most of the eastern part of the project tenement is highly susceptible to ETL. This conforms with the actual condition of the project area wherein there is presence of thick overburden comprised of loose soil and weathered materials capping the aggregates deposit coupled by steep slope indicating that the ground is susceptible to both earthquake-triggered and rain-induced landslides. The occurrence of weak zones such that of the splay of WVF within the tenement further induced its susceptibility to mass movement.

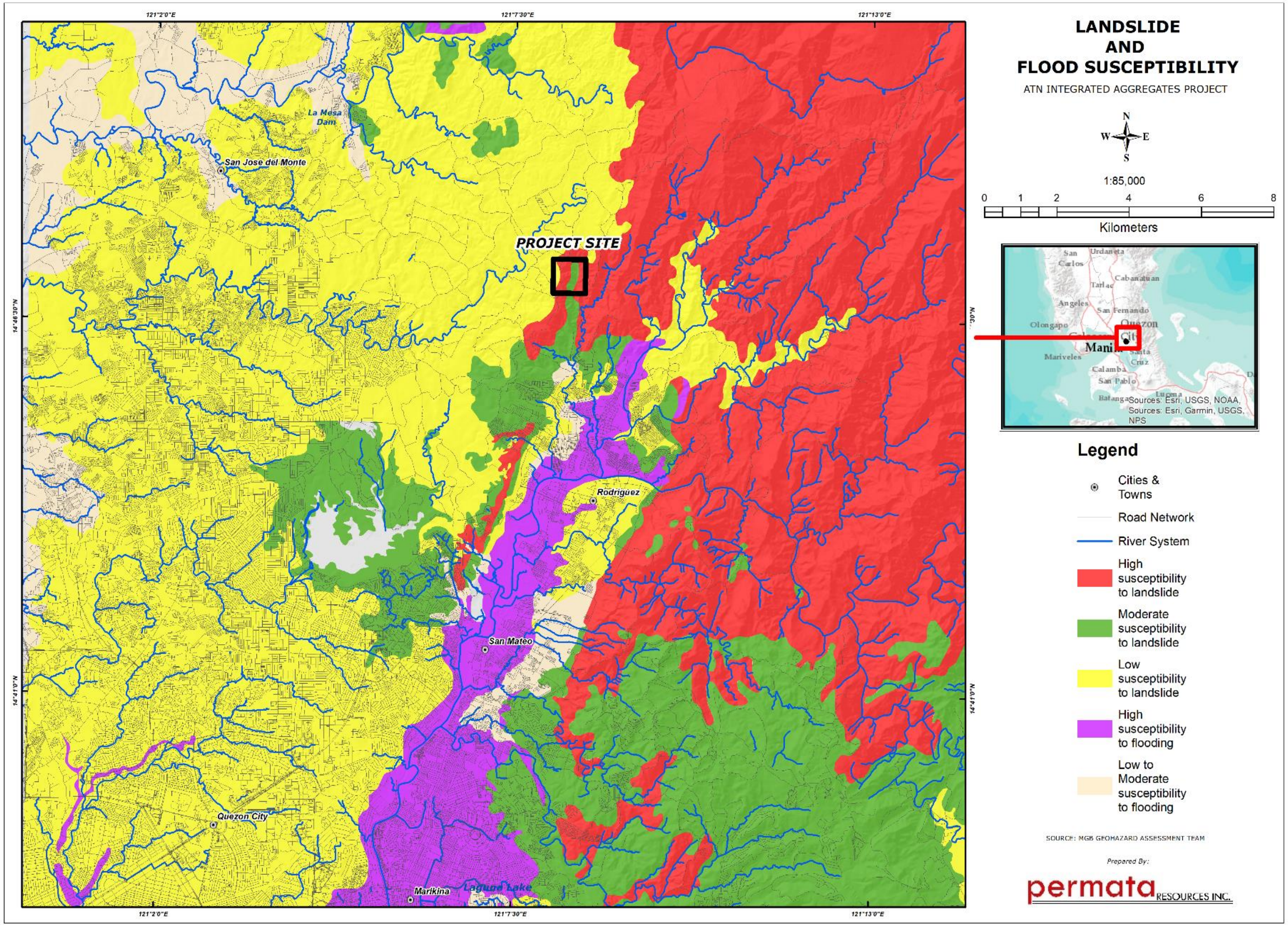
In the study conducted by DENR-MGB on rain-induced landslides, it indicated that about 22.39% of Region 4A are classified with high landslide susceptibility (MGB, Mapping and analysis of areas susceptible to Geologic Geohazards). This includes the project area which falls under moderate to high susceptibility to Rain-induced Landslides.

The risk of landslides that may be induced by earthquake and rainfall may be reduced once the weak overburden capping the aggregates deposit is cut and unloaded from the steep slopes and eventually stabilized.



Source: Map modified from DOST-PHIVOLCS Earthquake-triggered Landslides Susceptibility map

Figure 26 – Earthquake-triggered landslides that may affect the project area



Source: Modified from Landslide and Flood susceptibility quadrangle map of Quezon City, Angat, Bulacan & Rizal Provinces, DENR-MGB

Figure 27 – Landslides and Flood Susceptibility Map of the project area and adjacent vicinity

2.1.3.4 Liquefaction

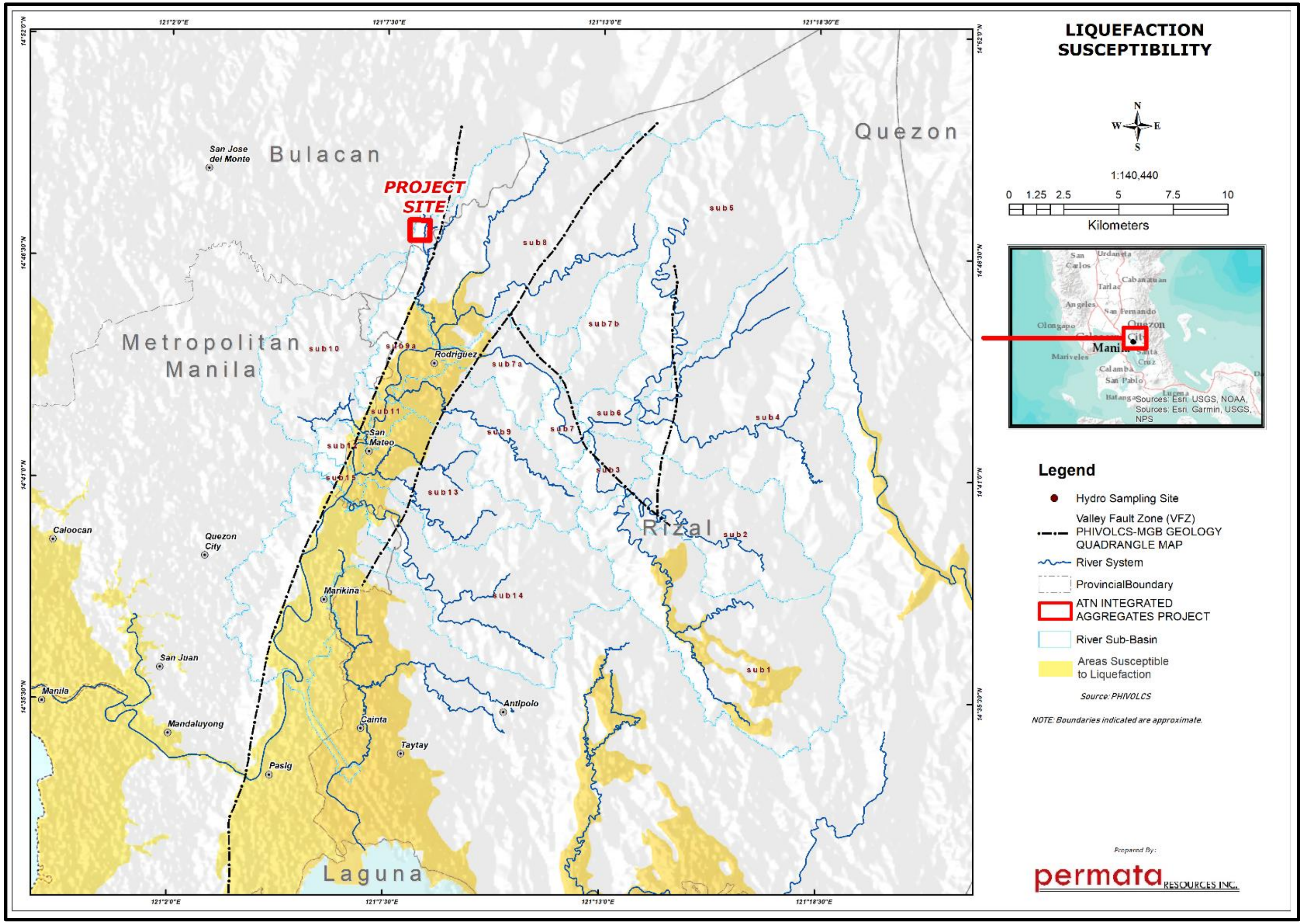
Liquefaction is the condition where loose, water rich sediments behave like liquid during strong ground shaking, leading to fissuring of roads and subsidence of building, houses and roads.

From the PHIVOLCS liquefaction susceptibility of Region-4A, the areas susceptible to liquefaction during earthquake are generally the low-lying areas along the Marikina River Valley, which is essentially underlain by loose quaternary alluvial sediments consist of silt, sand and gravel deposits.

Based from Metro Manila Earthquake Impact Research Study (MMEIRS) joint study of Phivolcs, MMDA and JICA, the settlement and structures along the Marikina River, wherein the Valley River Fault System cuts through, may be affected by relatively high to high liquefaction potential. These areas are covered by the lower stretches of Marikina river sub-basins. Some prominent areas that will be affected within the mentioned sub-river basins, from south to north are Barangays Concepcion and Tumana areas, Parang, Nangka and Banaba in Marikina; Barangays Ampid, Guitnang Bayan and Maly in the town of San Mateo; San Jose, Balite and along Wawa River and Payatas-Bagong Silangan in Quezon City.

In the project area, the underlying bedrock is dominantly resistant volcanic rocks, hence, liquefaction incident is low. However, the thick overburden capping the aggregates deposit that range to about 20m to 30m is susceptible to liquefaction. The risk on this part of the deposit will be reduced once the upper weak layers have been developed to proper bench cut and eventually stabilized.

The northern part outside the project area, where a flat agricultural ground was observed, could be susceptible to liquefaction as this is characterized by loose, unconsolidated alluvial deposits.



Source: Map modified from DOST-PHIVOLCS, liquefaction susceptibility map of Region IV-A, September 2018

Figure 28 – Liquefaction susceptibility of project area and vicinity.

2.1.3.5 Flooding Hazard

Flood is an overflow of water that submerges land that is usually dry. It is the function of the total amount and distribution of precipitation and the rate at which it infiltrates the rock or soil and the topography. There are two types of floods, upstream flood and downstream flood. Upstream flood is confined in the upper part of the drainage areas caused by intense rainfall of short duration over a relatively small area while downstream flood is confined in the lower parts of drainage areas caused by storms of long duration that saturate the soil and produced increased run off. The contribution of increased run off from thousands of tributary basins may cause a large flood downstream.

Based from the 5-year flood simulation model of Project NOAH (figure 19), flooding hazard within the Marikina River Basin is particularly confined in the lower stretches of the identified river sub-basins and can be classified as downstream flooding.

The recent flooding brought by continuous rains enhanced by tropical storm Karding on August 11, 2018 has affected most of the settlements on and near the Marikina river and its major confluences. During the field validation, the local people has confirmed flooding incidents in some barangays located prior to the project site. For example, in Kasiglahan village, Brgy. San Jose, Montalban had experienced a knee-deep, waist and up to chest-level flooding, accordingly it reached up to 2m high flood. Barangays Burgos, Manggahan and Rosario in the town of Montalban, Rizal were also flooded. Also, some of the flooded barangays in San Mateo, Rizal include Dulong Bayan 1, Dulong Bayan 2, Barangay Guitnang Bayan, Barangay Ampid 1 and 2, Barangay Banaba and Barangay Maly. In Antipolo City, Marcos Highway-Vermont creek bridge area had also experienced a knee-deep flooding leaving stranded commuters *(Source: Philippine News Agency, Monsoon rains cause flooding, landslides in Southern Tagalog, Saul Pa-a, Aug 12, 2018).*

The river that runs through the project area appears to be the main headwater of left tributary of Montalban river, which flow downstream towards south-southeast to the confluence of Montalban and Wawa river. Since there are no community observed along the river bank that crosses within the tenement, hence the risk of upstream flooding as flash flood, if it will occur may be low in the project area. However, soil erosion in opened areas augmented by excessive water run off during rain fall may contribute to increase sedimentation downstream. The bulk of the settlement lies outside the tenement on the elevated ground in the northern plateau area of Barangay Macabud wherein upstream flooding would be unlikely.

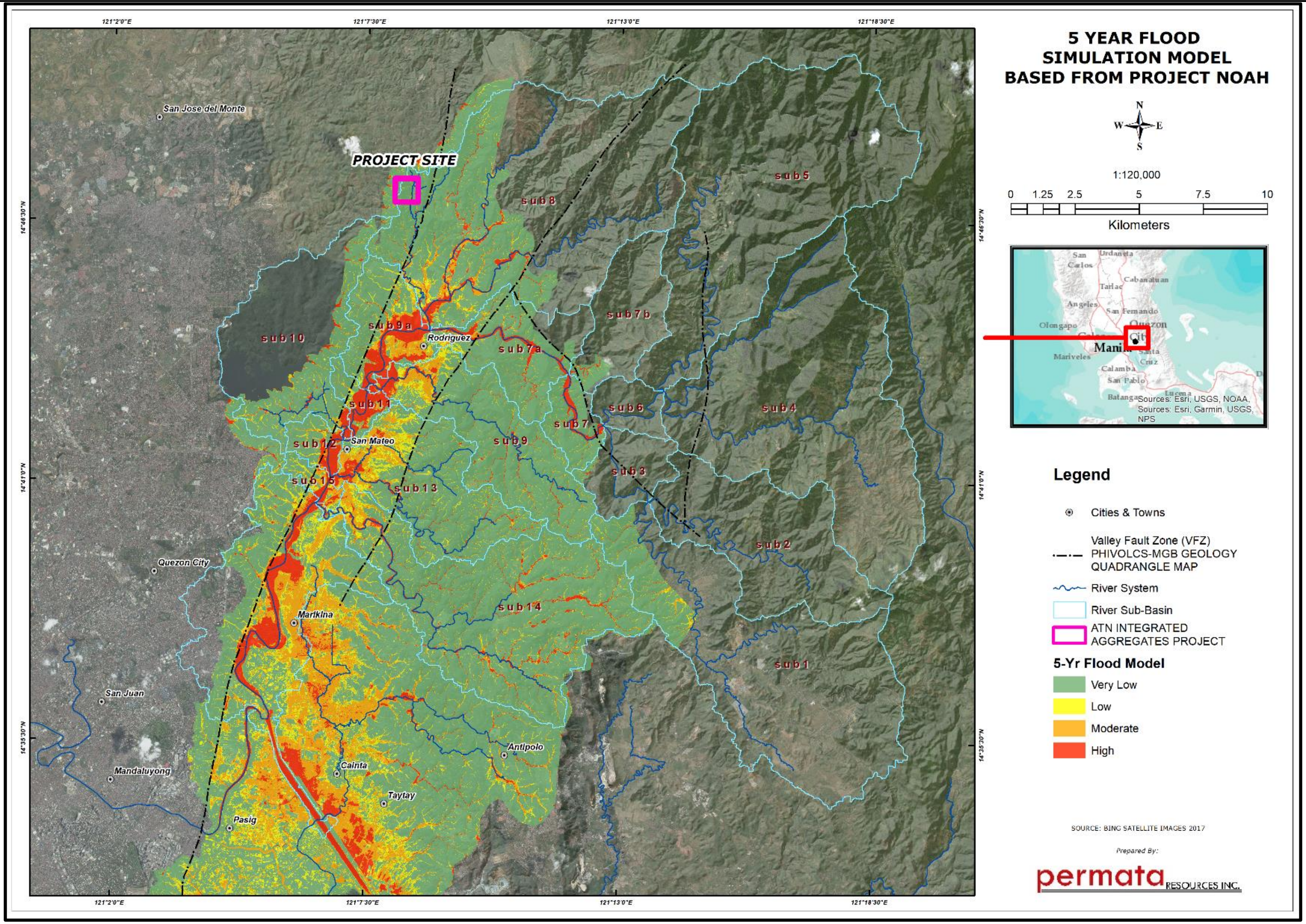


Figure 29 – Five-year Flood Simulation Model, Project NOAH

IMPACTS AND MITIGATING MEASURES ON GEOLOGY/GEOMORPHOLOGY

Massive earthworks and permanent alteration of the original topography would be created during the construction and operation phases of the project. These ground disturbances may result in mass movements especially in very steep areas. Activities that would generate most significant impact to geology and geomorphology are site preparation such as overburden removal and grading, quarry development and road construction.

The abovementioned identified impacts will be prevented/managed through the implementation of a geotechnical site investigation prior to earthworks, construction and mining activities. Formulation and implementation of suitable engineering measures and sound geotechnical design based on local geology and geomorphology will also be carried out.

Identified Impacts	Mitigating Measures
Change in Geomorphology - Land use change in the areas to be occupied by mine infrastructures	- Removed soil will be conserved and stockpiled in a pre-determined area and later used in rehabilitation and backfilling activities. - Rehabilitation/revegetation planning will be conducted in accordance with the FMRDP and in consultation with stakeholders even before Project commences. - The perimeter of the quarry area shall be progressively rehabilitated and re-graded to match the surrounding landforms. - The stockpile shall be graded to a stable relief
Inducement of subsidence/collapse - Generation of open areas with greater potential for runoff, erosion and landslides	- Provision of series of silt traps to catch siltation/sedimentation generated from the opened areas. - Installation of landslide control structures. - Implementation of appropriate quarry (pit) slope/bench design coupled with suitable slope/ground failure monitoring plan to detect instability at an early and non-critical stage so that safety measures could be initiated to prevent impending slope stability problems or minimize impacts. - Intensive hydrogeological studies during project development to identify potential impact of ground water inflows to the quarry. - During operation, implement slope stabilization measures on the identified unstable or weak portions of the benches, and on the identified potential mass movement; through reduction of unacceptable materials to reduce the weight of soil/overburden (shear stress) by; a. removal of soil mass at the top of potential slope failure b. flattening of cut slopes above the road/access and; c. benching of cut slopes. - Avoid high, steep wall benching which could induce unstable slope and mass movement.

Impacts of identified Geologic hazards - Earthquake-triggered (ETL) and Rain-induced Landslides (RIL) - Localized rainfall-induced upstream flooding hazard. - Seismic hazards & Ground rupture (close to West Valley Fault) - Liquefaction	- Conduct of regular geo-hazard assessment that should include identification, risk assessment, risk rating, and risk mitigation. The objective of the geo-hazard monitoring is to provide management with hazard and mitigation tool to continue to lower risk to their personnel and operation. - Engineering design of the quarry infrastructures, i.e. crushing plant, to adhere to the standard seismic parameter set for earthquake model to address the possible effects of the active fault near the project area in the north-easternmost branch of West Valley Fault and its N-NE splay.

2.1.4 Pedology

Soil is generally a variable mixture of minerals, organic matter, water and air. It covers the earth in a thin layer and primarily gives mechanical support to plants. It is the product of action of the physical, biological, and chemical forces upon the rocks for thousands of years. Soil formation is apparently a slow process. Soil characteristics vary greatly from place to place. It is, therefore, very necessary to understand these characteristics because the more we understand these characteristics, the more we can manage the soil in determining the capacity of the soil to produce the products needed by man.

The carry out the study, primary and secondary data through fieldwork and review of existing literature and maps was done. Primary data gathering was through soil sampling.

2.1.4.1 Baseline Conditions

2.1.4.1.1 Soils of Rizal Province

The soils of Rizal Province have been classified according to the 1975 USDA Soil Taxonomy. The prime and agricultural lands are classified under the series level and are mapped as phases of soil series. Mountain and escarpment soils are classified in the subgroup or great group category and are mapped as phases of subgroup, great group, soil associations or complexes. Soils of the swampy areas are classified as miscellaneous land types due to low agricultural value or are built-up areas, rockland, escarpment or quarry. At present, there have been proliferation of rock quarrying activity in the province particularly in the towns of Rodriguez, Marikina and Tanay. This is in response to the national government initiatives (Build, Build, Build project) for urban and rural development. Soils of the freshwater mashes are classified in higher category (great group).

Five (5) major landscapes were delineated, namely, coastal, lacustrine, alluvial, hilly and mountainous landscapes. Each landscape is further subdivided into different landforms where each landform may have one or more kinds of soil.

The BSWM have established twenty-eight (28) soil series, one (1) great group, five (5) soil associations, two (2) soil complexes and seven (7) miscellaneous land types. The soil series are distinguished from one another in accordance with differences in parent material, physiographic position, texture, depth, drainage and chemical characteristics. Great soil groups contain soils that have the same kind of horizons in the same sequence and have similar moisture or temperature regimes. A soil association is a group of defined and named taxonomic soil units occurring together in an individual and characteristic pattern over a geographic region, or a mapping unit in which two or more defined taxonomic units occurring together in a characteristic pattern are combined because the scale of the map or the purpose for which it is being made does not require delineation of the individual soils. A soil complex is a mapping unit where two or more taxonomic units are so intimately intermixed geographically that it is undesirable or impractical because of the scale being used to separate them. A miscellaneous land type is a mapping unit for land areas that have little or no natural soils; that are too nearly inaccessible for orderly examination, or that for any reason it is not feasible to classify the soils.

Soil mapping units (SMU) as they appear on the map are subdivision of soil taxonomic units based on the degree of slope, erosion, or flooding. There are eighty-seven (87) SMU's that are recognized in the province, seven (7) of which are mapped as miscellaneous land types.

The 1988 soil survey and classification of Rizal Province has listed the following soil series, soil associations and complexes, miscellaneous land types and other taxonomic units:

A. Soil Series

1. Boulevard	8. Burgos	15. Maysan	22. Sampaloc
2. Baras	9. Binangonan	16. Batia	23. Tutulo
3.Marikina	10. Philcomsat	17 San Luis	24 Calantas
4. Cupang	11. Teresa	18. Carmona	25. Pinugay
5. Pinagbuhatan	12.Guadalupe	19. Tulay	26. Lumbangan
6. San Manuel	13. Novaliches	20. Antipolo	27. Inarawan
7. Jala-jala	14. Camarin	21. Kay Bardon	28. Bugarin

B. Soil Association

1. Inceptisols-Riverwash Association
2. Tropudalfs-Eutropepts Association
3. Dystropepts- Tropudalps-Tropudalps Association
4. Eutropepets – Troporthents Association
5. Dystropepts- Troporthents Association

C. Soil Complex

1. Lithic Eutropepts- Escarpment Complex
2. Lithic Troporthents- Escarpment Complex

D. Miscellaneous Land Types

1. Clayey tidal swamp	5. River terrace escarpment
2. Built-up areas	6. Limestone rockland
3. Volcanic rockland	7. Quarry
4. Escarpment	

E. Other Taxonomic Name

1. Fluvaquents

The soils are first described according to series or taxonomic units, then their corresponding mapping units. The descriptions are based on concepts as they are found in the field. Miscellaneous land types are also described. The concepts are followed by a listing of mapping units distinguished within the series or other taxonomic unit and their proportionate extent.

Table 12. Soils of Rizal Province, Their Mapping Units, and Their Corresponding Area and Percentage

Soil Series Taxonomic Name/Miscellaneous Land Type	Mapping Unit Name	Mapping Unit Symbol	Total area of Soil Series	Area (%)		
				Has.	Percent of Area	Percent of Series
Fluvaquents	Fluvaquents, 0 - 2 percent slope, very severely flooded	FqAf4	497.0	497.0	0.27	100.00
Boulevard	Boulevard clay, 0 - 2 percent slope, slightly flooded	BdAf1	1,508.0	392.0	0.21	25.89
	Boulevard clay, 0 - 2 percent slope, moderately flooded	BdAf2		480.0	0.27	31.83
	Boulevard clay, 0 - 2 percent slope, severely flooded	BdAf3		636.0	0.34	42.28
Baras	Baras clay, 0 - 2 percent slope	BrA	1,506.0	758.0	0.41	50.33
	Baras clay, 0 - 2 percent slope, slightly flooded	BrAf1		488.0	0.26	32.40
	Baras clay, 2 - 5 percent slope	BrB		260.0	0.14	17.27
Marikina	Marikina Clay, 0 - 2 percent slope	MkA	3,506.0	1,482.0	0.80	42.27
	Marikina Clay, 0 - 2 percent slope, slightly flooded	MkAf1		1,684.0	0.91	48.03
	Marikina Clay, 0 - 2 percent slope, moderately flooded	MkAf2		340.0	0.18	9.70
Cupang	Cupang Clay, 0 - 2 percent slope	CpA	1,843.0	1,843.0	0.99	100.0
Pinagbuhatan	Pinagbuhatan clay, 0 - 2 percent slope	PgA	5,491.0	3,727.0	2.00	67.87
	Pinagbuhatan clay, 0 - 2 percent slope, slightly flooded	PgAf1		652.0	0.35	11.87
	Pinagbuhatan clay, 0 - 2 percent slope, moderately flooded	PgAf2		640.0	0.34	11.66

Soil Series Taxonomic Name/Miscellaneous Land Type	Mapping Unit Name	Mapping Unit Symbol	Total area of Soil Series	Area (%)		
				Has.	Percent of Area	Percent of Series
	Pinagbuhatan clay, 2 - 5 percent slope	PgB		472.0	0.25	8.60
Jala-jala	Jala-jala clay, 0 -2 percent slope	JaA	3,128.0	615.0	0.33	19.60
San Manuel	San Manuel clay loam, 0 - 2 percent slope	SmA	2,417.0	2,060.0	1.11	85.23
	San Manuel clay loam, 0 – 2 percent slope, slightly flooded	SmAf1		357.0	0.19	14.77
Jala-jala	Jala-jala clay, 0 -2 percent slope	JaA	3,128.0	615.0	0.33	19.60
	Jala-jala clay, 0 -2 percent slope, slightly flooded	JaAf1		42.0	0.02	1.34
	Jala-jala clay, 2 - 5 percent slope	JaB		2,209.0	1.19	70.62
	Jala-jala clay, 5 - 8 percent slope	JaC		262.0	0.14	8.38
Burgos	Burgos clay, 2 - 5 percent slope	BgB	3,939.5	3,939.5	2.12	100.00
Binangonan	Binangonan clay, 0 - 2 percent slope	BnA	1,339.7	549.0	0.30	40.98
	Binangonan clay, 2 - 5 percent slope	BnB		790.7	0.43	59.02
Philcomsat	Philcomsat clay, 2 - 5 percent slope	PcB	1,869.8	1,869.8	1.01	100.00
Teresa	Teresa clay, 0 -2 percent slope	TaA	887.2	546.7	0.29	61.62
	Teresa clay, 2 - 5 percent slope	TaB		340.5	0.18	38.38
Inceptisols - River wash Association	Inceptisols - River wash association, 0 - 2 percent slope	IrA	2,534.0	169.0	0.09	6.67
	Inceptisols - River wash association, 2 - 5 percent slope	IrB		2,365.0	1.27	93.33
Guadalupe	Guadalupe clay, 0 - 2 percent slope	GdA	12,780.0	3,318.0	1.78	25.96
	Guadalupe clay, 2 - 5 percent slope	GdB		5,044.0	2.71	39.47
	Guadalupe-Urban land complex 5 -15	GduCC/D		4,418.0	2.38	34.57

Soil Series Taxonomic Name/Miscellaneous Land Type	Mapping Unit Name	Mapping Unit Symbol	Total area of Soil Series	Area (%)		
				Has.	Percent of Area	Percent of Series
	percent slope					
Maysan	Maysan clay, 2 - 5 percent slope	MyB	284.0	284.0	0.15	100.00
Novaliches	Novaliches-urban land complex, 2-5 percent slope	NvucC/B		2,090.0	1.12	12.53
	Novaliches-urban land complex, 5-15 percent slope	NvucC/D	16,685.0	8,475.0	4.56	50.79
	Novaliches clay 5-8 percent slope, slightly eroded	NvC1		1,473.5	0.79	8.83
	Novaliches clay, 8-15 percent slope, slightly eroded	NvD1		2,644.0	1.42	15.85
	Novaliches clay, 8-15 percent slope, moderately eroded	NvD2		525.0	0.28	3.14
	Novaliches clay, 15-25 percent slope, moderately eroded	NvE1		1,477.5	0.80	8.86
Camarin	Camarin clay, 8 -15 percent slope	CmD1	1,312.0	1,312.0	0.71	100.00
Batia	Batia clay, 5-8 percent slope	BtC	144.0	144.0	0.08	100.00
San Luis	San Luis clay, 2-5 percent slope	SlB1	3,422.0	1,554.0	0.84	45.41
	San Luis clay, 2-5 percent slope, slightly eroded	SlC1		1,868.0	1.0	54.59
Carmona	Carmona clay, 8-15 percent slope	CrD	696.0	696.0	0.37	100.00
Tulay	Tulay clay, 2-5 percent slope, slightly eroded	TyB1	7,453.0	743.0	0.40	9.97
	Tulay clay, 5-8 percent slope, slightly eroded	TyC1		1,061.0	0.57	14.24
	Tulay clay, 8-15 percent slope, moderately eroded	TyD1		2,918.0	1.57	39.15
	Tulay clay, 8-15 percent slope, moderately eroded	TyD2		85.0	0.05	1.14

Soil Series Taxonomic Name/Miscellaneous Land Type	Mapping Unit Name	Mapping Unit Symbol	Total area of Soil Series	Area (%)		
				Has.	Percent of Area	Percent of Series
	Tulay clay, 15-25 percent slope, slightly eroded	TyE1		1,091.0	0.58	14.64
	Tulay clay, 25-45 percent slope, slightly eroded	TyF1		1,346.0	0.72	18.06
	Tulay clay, 25-45 percent slope, moderately eroded	TyF2		209.0	0.11	2.80
Antipolo	Antipolo clay, 5-8 percent slope	ApC	9,140.0	441.0	0.24	4.82
	Antipolo clay, 5-8 percent slope, slightly eroded	ApD1		889.0	0.48	9.73
	Antipolo clay, 25-45 percent slope, slightly eroded	ApF2		7,810.0	4.20	85.45
Kay Bardon	Kay Bardon clay, 5-8 percent slope, slightly eroded	KbC1	2,755.0	109.0	0.06	3.96
	Kay Bardon clay, 15-25 percent slope, moderately eroded	KbE1		547.0	0.29	19.86
	Kay Bardon clay, 15-25 percent slope, moderately eroded	KbE1		547.0	0.29	19.86
	Kay Bardon clay, 25-45 percent slope, moderately eroded	KbF2		1,629.0	0.88	59.12
	Kay Bardon clay, 45-65 percent slope, moderately eroded	KbG2		470.0	0.25	17.06
Sampaloc	Sampaloc clay, 5-8 percent slope, slightly eroded	SpC1	2,194.0	374.0	0.20	17.05
	Sampaloc clay, 8-15 percent slope, slightly eroded	SpD1		397.0	0.21	18.09
	Sampaloc clay, 15-25 percent slope, slightly eroded	SpE1		842.0	0.45	38.38
	Sampaloc clay, 15-25 percent slope, moderately eroded	SpE2		581.0	0.31	26.48
Tutulo	Tutulo clay, 2-5 percent slope	TtB	2,297.0	990.0	0.53	43.10

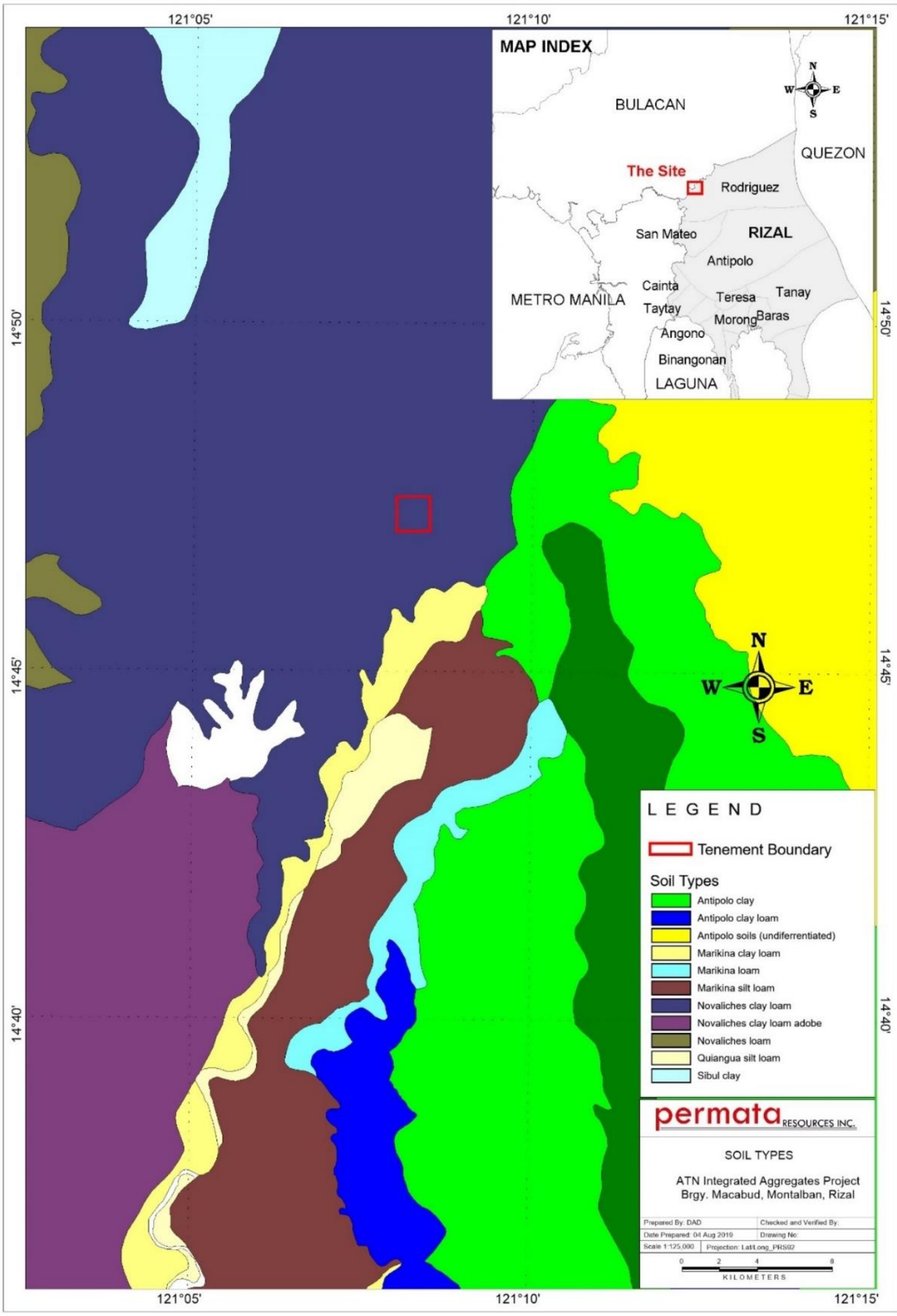
Soil Series Taxonomic Name/Miscellaneous Land Type	Mapping Unit Name	Mapping Unit Symbol	Total area of Soil Series	Area (%)		
				Has.	Percent of Area	Percent of Series
	Tutulo clay, 2-8 percent slope	TtB/C		133.0	0.07	5.79
	Tutulo clay, 5-8 percent slope	TtC		1,092.0	0.59	47.54
	Tutulo clay, 8-15 percent slope	TtD		82.0	0.05	3.57
Calantas	Calantas clay, 5-8 percent slope, slightly eroded	CaC1	4,388.0	563.0	0.30	12.84
	Calantas clay, 8-15 percent slope, slightly eroded	CaD1		1,387.5	0.75	31.62
	Calantas clay, 15-25 percent slope, slightly eroded	CaE1		501.5	0.27	11.42
	Calantas clay, 25-45 percent slope, moderately eroded	CaF2		1,715.0	0.92	39.08
	Calantas clay, 45-65 percent slope, moderately eroded	CaG2		221.0	0.12	5.04
Inarawan	Inarawan clay, 25-45 percent slope, moderately eroded	IaF2	2,449.0	2,449.0	1.32	100.00
Pinugay	Pinugay clay, 15-25 percent slope, moderately eroded	PyE2	5,053.0	1,006.0	0.54	19.91
	Pinugay clay, 25-45 percent slope, slightly eroded	PyF1		1,469.0	0.79	29.07
	Pinugay clay, 25-45 percent slope, moderately eroded	PyF2		1,727.5	0.93	34.18
	Pinugay clay, 45-65 percent slope, moderately eroded	PyG2		851.0	0.46	16.84
Lumbangan	Lumbangan clay, 25-45 percent slope, slightly eroded	LmF1	9,433.0	4,142.0	2.23	43.91
	Lumbangan clay, 45-65 percent slope, moderately eroded	LmG2		5,291.0	2.83	56.09
Bugarin	Bugarin clay, 15- 25 percent slope, moderately eroded	BaE2	1,413	680	0.37	48.13
	Bugarin clay, 25-	BaF1		733.0	0.40	51.87

Soil Series Taxonomic Name/Miscellaneous Land Type	Mapping Unit Name	Mapping Unit Symbol	Total area of Soil Series	Area (%)		
				Has.	Percent of Area	Percent of Series
	45percent slope, slightly eroded					
Lithic Eutropept-Escarpment Complex	Lithic Eutropept-Escarpment Complex, 15-25 percent slope, slightly eroded	Le/EptE1	1,076.0	1,076.0	0.58	100.00
Lithic Troporthent-Escarpment complex	Lithic Troporthent-Escarpment complex, 45-65 percent slope, moderately eroded	Lt/EptG2	1,204.0	1,204.0	0.65	100.00
Tropudalfs-Eutropepts Association	Tropudalfs-Eutropepts Association, 8 -15 percent slope, slightly eroded	TeD1	21,519.4	362.0	0.19	1.68
	Tropudalfs-Eutropepts Association, 45-65 percent slope, slightly eroded	TeG1		21,157.4	11.38	98.32
Dystropepts-Tropudalps Tropudults Association	Dystropepts-Tropudalps Tropudults Association 45-65 percent slope, slightly eroded	DttG1	17,543.3	17,543.3	9.43	100.00
Eutropepts-Troporthents Association	Eutropepts-Troporthents Association 45-65 percent slope, slightly eroded	EtG1	3,265.4	3,265.4	1.76	100.00
Dystropets-Troporthents Association	Dystropets-Troporthents Association, >45% slope, slightly eroded	TdG/H1	15,245.2	15,245.2	8.20	100.00
Miscellaneous Land Types	Clayey tidal swamp	CSt	994.0	994.0	0.53	100.00
	Built-up areas	BU	6,683.0	6,683.0	3.59	100.00
	Volcanic rockland	VR	616.0	616.0	0.33	100.00
	Escarpment	Ept	4,052.0	4,052.0	2.18	100.00
	River Terrace escarpment	Rte	481.0	481.0	0.26	100.00
	Limestone rockland	LR	869.0	869.0	0.47	100.00
	Quarry	Qy	48.0	48.0	0.03	100.00
GRAND TOTAL	185,961.0	185,961.0	100.00	100.00		

Source: BSWM, 1988

2.1.4.1.2 Soils of the Project Area

Based on the BSWM soil map of Rizal province, the soil of the proposed belong to the Antipolo series. Presented below is the soil series description and a typifying pedon morphological, physico-chemical properties of the soil sampling sites (Antipolo series).



Source: BSWM

Figure 30 – Segment of The Soil Map of Rizal Province Showing the approximate Location of the Proposed ATN Aggregates Project

Antipolo Series

The Antipolo series is a member of the fine, mixed, isohyperthermic family of Typic Tropudalfs. They are moderately deep to deep well drained soils occurring on undulating to rolling basaltic hills and ridges with localized valley. A horizons are brown to dark brown, dark brown, yellowish-brown or dark reddish brown clay; clay loam, or silty clay loam. Argillic Bt horizons are yellowish red, strong brown, reddish brown, or yellowish-brown clay with none to few distinct clear brown, reddish brown, dark reddish brown or yellowish red mottles and sometimes light gray to gray when used for paddy rice. Partial and highly weathered rock fragments are present and increases in abundance with depth. Iron and manganese concretions may occur. C horizon, 40 - 90 cm deep, are strong brown or yellowish red clay with common to many weathered rock fragments. Few Fe-Mn concretions may also occur in this layer. Underlying this horizon is hard consolidated bedrock.

Typifying Pedon

Antipolo clay and vegetated with forest trees, shrubs and grasses has the following morphological, physical and chemical characteristics:

HORIZON DEPTH (cm) DESCRIPTION

A 0 – 11 Reddish brown (5YR 4/4) moist, silty clay loam; moderate small and medium angular to subangular blocky structure; sticky, plastic, firm; common fine and medium roots; clear wavy boundary; pH 5.5.

Bat 11 – 30 Yellowish red (5 YR 4/6) moist, clay; moderate small and medium angular to subangular blocky structure; few fine faint diffuse reddish brown (5 YR 5/4) mottles; sticky, plastic, firm; common fine and medium roots; diffuse wavy boundary; pH 5.7.

Bt 30 – 48 Yellowish red (5 YR 4/6) moist, clay; moderate small and medium angular to subangular blocky structure; sticky, plastic, firm; few partially and highly weathered basaltic and tuffaceous rock fragments; few fine roots; diffuse wavy boundary; pH 5.7.

BC 48 – 57 Yellowish red (5 YR 4/6) moist, clay; moderate small and medium angular to subangular blocky structure; sticky, plastic, firm; common partially weathered brownish yellow (10 YR 6/8) volcanic rock fragments; clear irregular boundary; pH 5.9.

C 57 – 84 Yellowish red (5 YR 4/6) moist, clay; moderate small and medium angular to subangular blocky structure; sticky, plastic, firm; many partially and highly weathered black volcanic rock fragments; common iron coated manganese concretions; pH 6.3.

R 84 below Bedrock.

The Antipolo series as mapped by the BSWM has three (3) soil mapping units and is presented below:

- Antipolo clay 5 – 8 percent slopes, ApC, (441.0 has or 0.24 percent of the total Provincial area).
- Antipolo clay, 8 – 15 percent slopes, slightly eroded ApD1, (889.0 has or 48 percent of the total Provincial area).

- Antipolo clay, 25 – 45 percent slopes, moderately eroded, ApF2, (7,810.0 has or 4.20 percent of the total Provincial area).

Drainage and Permeability

The Antipolo series are well drained soils, permeability is expected to be moderate.

Range in Characteristics

Solum thickness (A and B horizon) ranges from 40 -90 cm. Generally, the soils have moderate natural fertility for upland crops and high for paddy rice. Organic matter content is adequate for paddy rice but moderate for upland crops. Exchangeable K, base saturation and cation exchange capacity are adequate. Soil reaction is also adequate (pH 5.4 to 6.0). Available P is deficient or low for upland crops and paddy rice.

- A horizons 8 – 25 cm thick are brown to dark brown, dark brown, yellowish brown, dark reddish brown clay, clay loam or silty clay loam with distinct clear brown to dark reddish brown mottles. Consistence is firm when moist, sticky and plastic when wet. Structure is moderate small medium angular to subangular blocky.
- Argillic Bt horizons, 40 – 90 cm deep, are yellowish red, reddish brown, strong brown or yellowish brown clay with distinct clear brown, reddish brown or dark reddish brown mottles. Consistence is firm when moist, sticky and plastic when wet. Structure is moderate small to medium angular to subangular blocky. Presence of partially and highly weathered rock fragments are common and increases in abundance with depth.
- C horizons, or the substratum are strong brown or yellowish red clay with common to many weathered and strongly weathered rock fragments. This horizon is underlain by hard consolidated bed rock.

2.1.4.2 Soil Quality

2.1.4.2.1 Methodology

The site selection criteria within the project area 84.7092 hectares of the four (4) soil sampling locations were made in accordance with the present land use, and the slope. The dominant vegetative cover, and the elevation of the soil sampling locations within the proposed project area were recorded and documented in the form of digital photographs together with its geographic coordinates and is presented in the tables below.

Undisturbed Soil Sampling: Soil Bulk Density

Bulk density (BD) is the weight of soil in a given volume. Determining soil bulk density is important because it reflects the soil's ability to function for structural support, water and solute movement, soil aeration and directly affects soil resistance to erosion. Compacted soil has a high bulk density (i.e. 1.6 gcm^{-3}) and can be an indicator of high resistance to erosion. However, at this bulk density, root penetration is restricted, poor water infiltration and aeration.

Using a 100cc stainless steel core cylinder, all of the soil sampling Locations were sampled for the immediate surface (0 -5 cm depth) bulk density.

Disturbed Soil Sampling

From each sampling location, disturbed composite soil samples were collected within the 0-30 cm depth of the topsoil. Representative soil samples were collected randomly in a zigzag manner within the selected sampling sites. There are 12-15 random soil sampling sites for one composite sample. Organic debris, stone fragments and other unwanted litters were carefully removed on site. Each of the five (5) composite samples were mixed thoroughly in a big polyethylene bag, quartered twice, rejecting the three (3) quarter portions of the sample. From the remaining one (1) quarter, approximately two (2) kilograms of the samples were finally collected per location and kept in a 12”X16” black polyethylene plastic bags and labeled accordingly.

Photo 3. Composite Sample Homogenization and Quartering

Table 13. Sampling locations and coordinates of the four surface soil sampling locations

S1	S2	S3	S4
Coordinates N 14^0 47’ 06.2” E 121^0 08’ 35.1”	Coordinates N 14^0 47’ 23.4” E 121^0 08’ 23.5”	Coordinates N 14^0 47’ 06.2” E 121^0 08’ 14.7”	Coordinates N 14^0 47’ 03.3” E 121^0 08’ 15.3”
Elevation: 207 masl	Elevation: 115 masl	Elevation: 152 masl	Elevation: 137 masl
 Land Use: Predominantly open grassland/shrubland interplanted with banana and other fruit trees. Undulating terrain	 Land Use: Open grassland dominated by cogon, talahib, creeping vines interplanted with random patches of banana. Undulating terrain.	 Land Use: Dense mixed open grassland, dominated by buho, cogon, hagonoy, and bush trees species (ipil-ipil). Rolling to undulating terrain.	 Land Use: Dense mixed cropland/orchard planted to bush trees and assorted fruit trees (Jackfruit, avocado, banana). Rolling to undulating terrain.

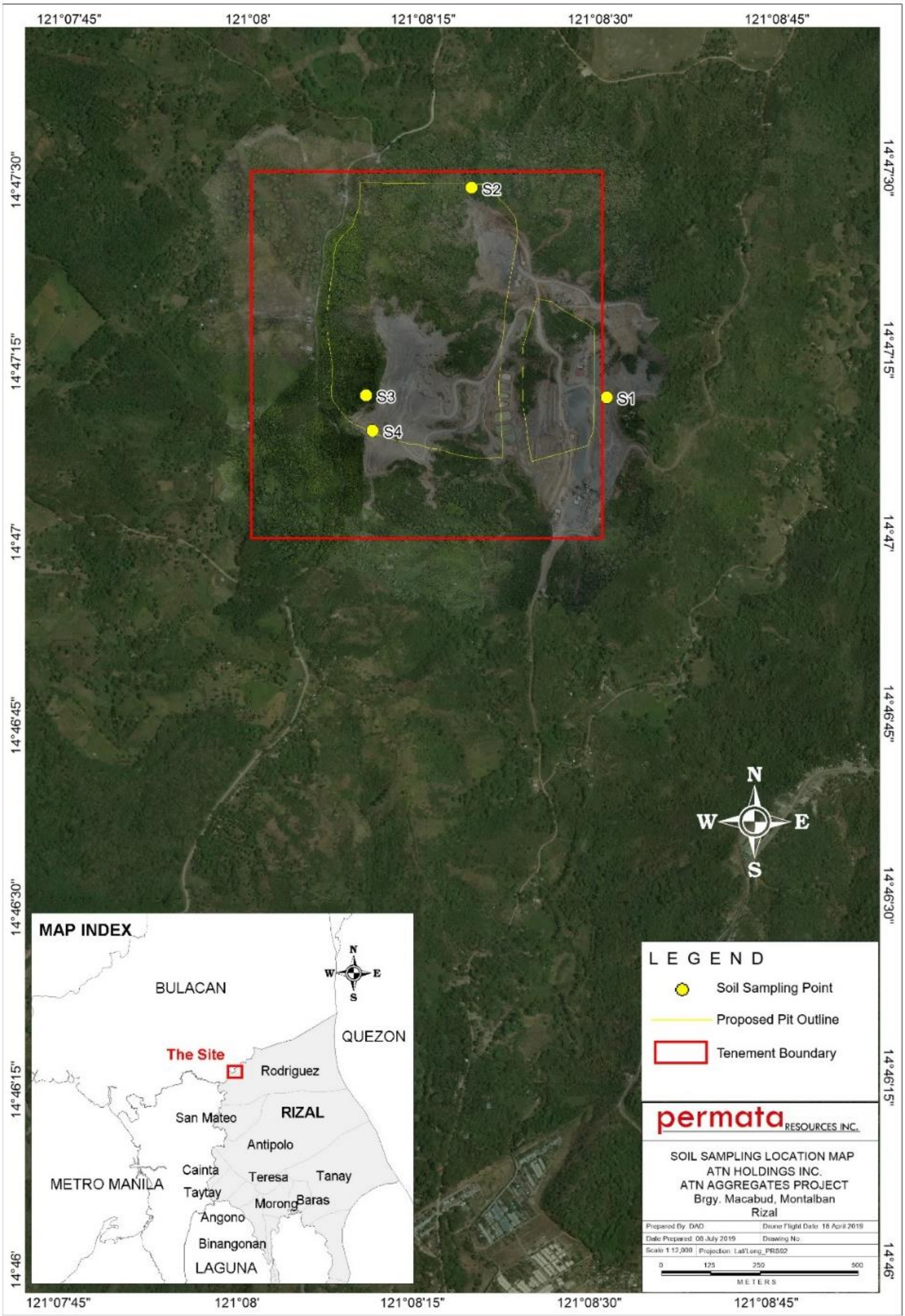


Figure 31 – Soil Sampling Map

Table 14. Requested soil chemical analyses

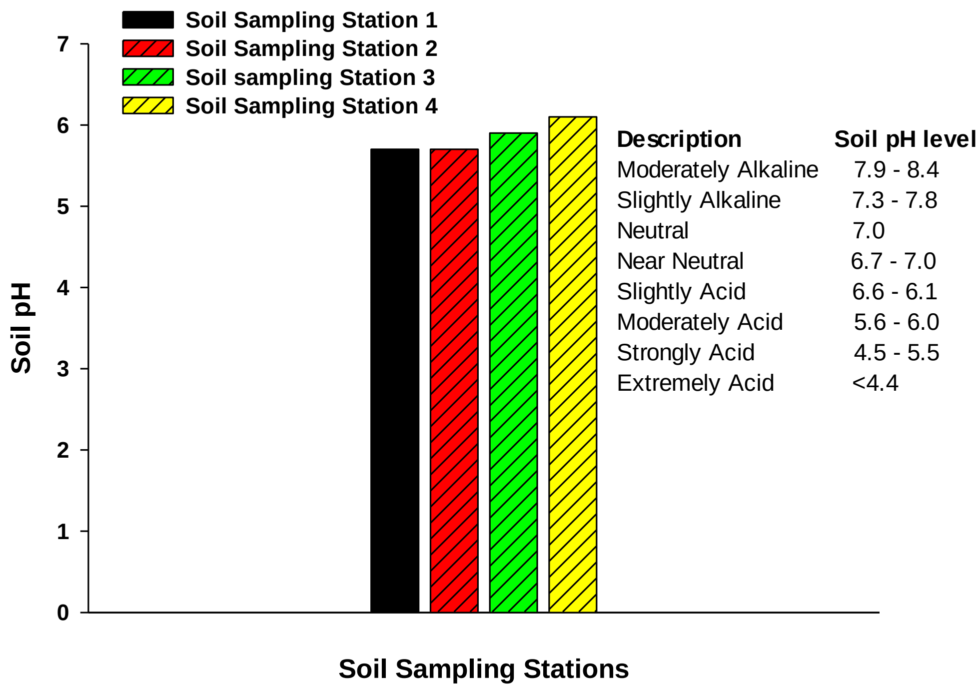
Chemical/Physical Properties
pH (H_2O 1:1)
Available Phosphorus (P, ppm)
Organic Matter (OM, %)
Total Nitrogen (N, ppm)
Calcium (Ca, ppm)
Magnesium (Mg, ppm)
Sodium (Na, ppm)
Manganese (Mn, ppm)
Available Potassium (K, ppm)
Arsenic (AS, ppm)
Chromium (Cr^{+6}, ppm)
Copper (Cu, ppm)
Zinc (Zn, ppm)
Mercury (Hg, ppm)
Lead (Pb, ppm)
Iron (Fe, ppm)
Bulk density (0-5 cm)

2.1.4.2.2 Soil Chemical Properties

Surface Soil pH

pH stands for "potential of Hydrogen" and is a measure of the relationship of hydrogen ions (H+) to hydroxyl ions (OH-). Soil pH is a measure of hydrogen ions (H+) in the soil. In other words, a soil pH value is a measurement of the concentration of ions held to soil particles and organic matter. Most of the plants require a soil that is slightly acidic, usually within a pH range of 6.2 to 6.8. Soil pH is very important because it directly affects soil nutrient availability. Plant roots can only absorb nutrients after they have been transformed into certain ionic forms. Only within certain pH ranges can sufficient amounts of these nutrients be transformed into these ionic forms.

Shown in the graph below is the soil pH soil of the sampling stations. The laboratory analysis using electrometric method revealed that the pH of the soil of sampling stations 1, 2, and 3 is 5.7; 5.7; 5.9, respectively, are moderately acidic (pH 5.6 to 6.0). Soil Sampling station 4 has a 6.1 pH and is rated as slightly acid by the Bureau of Soils and Water Management (BSWM) standard for pH.



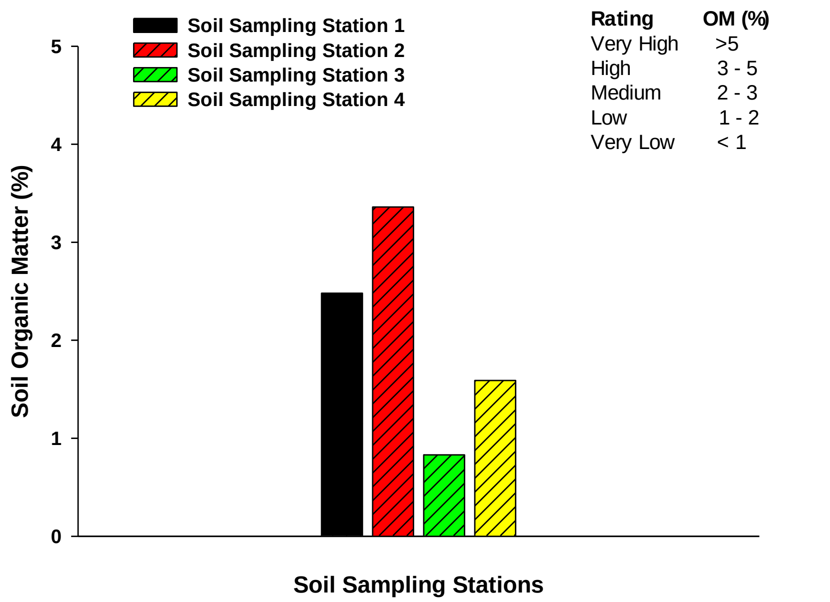
Graph 1. Soil Surface pH of the Soil Sampling Stations

<u>Surface Soil Organic Matter Content</u>

Plants obtain nutrients from two natural sources: soil organic matter (SOM) and minerals. SOM includes any plant or animal material that returns to the soil and goes through the decomposition process. In addition to providing nutrients and habitat to organisms living in the soil, SOM also binds the soil particles into aggregates, and improves the water holding capacity of soil matrix.

The laboratory test of the surface soil in the project area using the titrimetry method revealed that the soils of the proposed project area, when compared to the BSWM set of standards for OM, ranges from very low to high. Soil sampling station 3 have the lowest SOM content of 0.83%. This is followed by soil sampling station 4 at 1.59%. Soil sampling Station 1 and 2, on the other hand, have 2.48% and 3.36% SOM and, is rated to be medium to high, respectively.

The observed differences of SOM of the soil surfaces within the proposed project site can be attributed to the present dominant land use. S3 and S4 have an undulating to steep rolling terrain and were observed to be disturbed by machineries. Surface soil erosion may have transported the OM present in the soil surface to the lower portion of the landscape. Soil sampling stations 1 and 2 are positioned with a gentler slope and have a mixed grassland vegetative cover known to produce more SOM and is retained on the immediate surface of the soil.

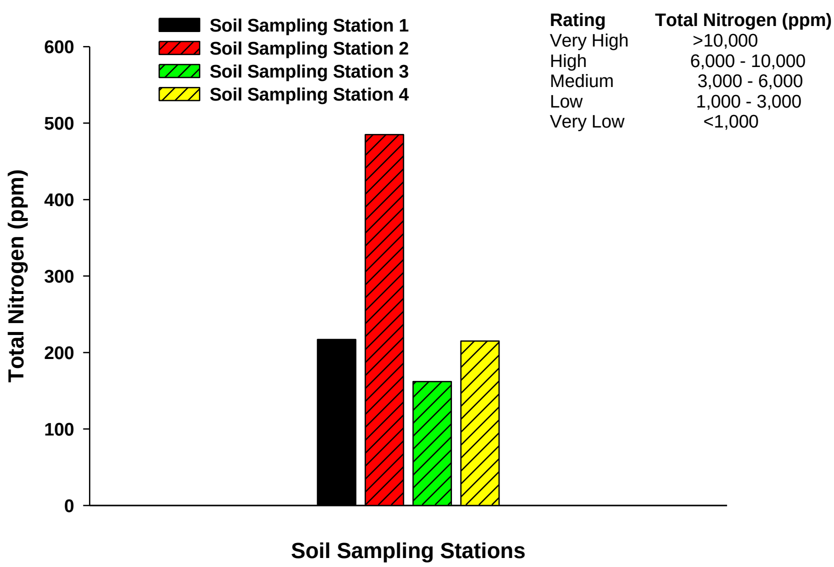


Graph 2. Soil Surface Organic Matter Content of the Soil Sampling Stations

Surface Soil Nitrogen Content

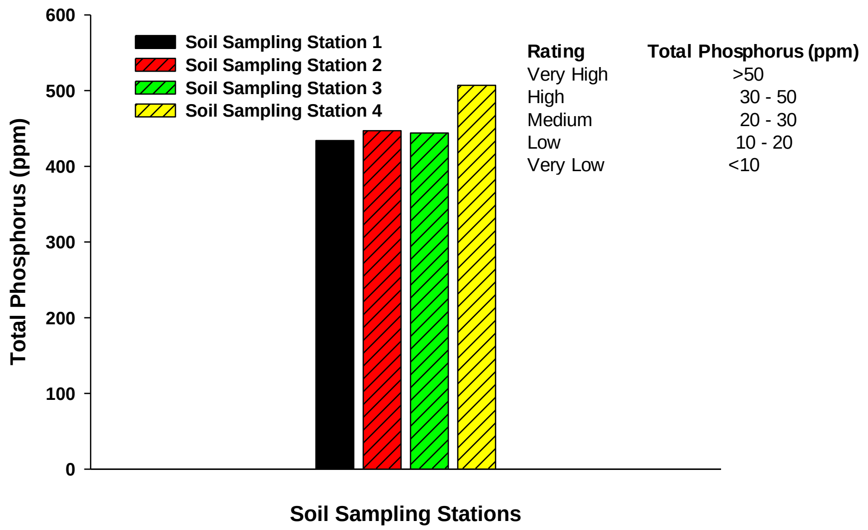
Essential Nutrient nitrogen (N) is one of the macro nutrients needed by plants in large amounts for its vegetative growth and development. Being one of the major components of chlorophyll, it provides green color of the leaves and determines the size and quality of the produce. However, this essential nutrient is the most unstable in soils and can be easily lost through various transformations under acidic soil reaction like leaching and denitrification.

Based on the analyzed samples, all of the sampling locations have very low N content (i.e. <1,000 ppm) when compared to the BSWM standard for total nitrogen. The inherent steep slope of the project site may have lost soil total nitrogen on its immediate surface through erosion. Other factors may involve volatilization of the element under dry soil condition.



Graph 3. Soil Surface Nitrogen Content of the Soil Sampling Stations

Surface Soil Exchangeable Phosphorus Content



Graph 4. Soil Surface Phosphorus Content of the Soil Sampling Stations

Phosphorus is an essential macro-element, required for plant nutrition. It participates in metabolic processes such as photosynthesis, energy transfer and synthesis and breakdown of carbohydrates. It is found in the soil in organic compounds and in minerals. Nevertheless, the amount of readily available phosphorus is very low compared with the total amount of phosphorus in the soil.

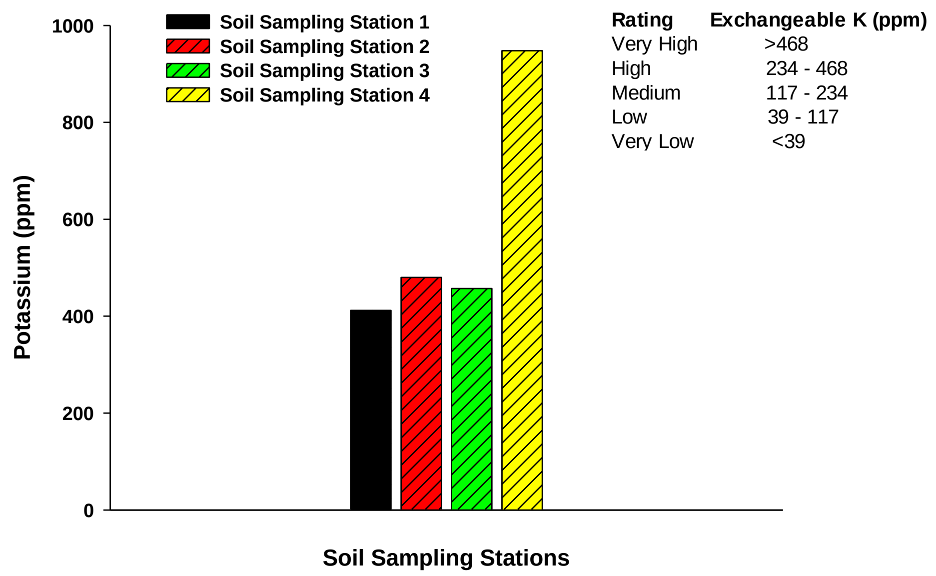
Plants can only take up phosphorus dissolved in the soil solution and since most of the soil phosphorus exists in stable chemical compounds, only a small amount of phosphorus is available to the plant at any given time. Moreover, its availability to plants is highly governed by the soil pH. In acidic soils phosphorus tends to react with aluminum, iron and manganese, while in alkaline soils the dominant fixation is with calcium. The optimal pH range for maximum phosphorus availability is 6.0-7.0 (Mortvedt *et al*., 1999).

P contents of the sampling stations of the proposed project site showed that there are elevated levels of P in all of the soil sampling stations; reaching a maximum amount of 507.0 ppm in soil sampling station 2. This is 10.14 times more than the adequate level set by the BSWM standard of 50 ppm. The lowest exchangeable P content was observed in soil sampling station with 434.0 ppm; which is still high above to the adequacy. The elevated levels of the soil sampling stations confirmed what is written in the literature that the Philippine soils have abundant phosphorus.

Surface Soil Potassium Content

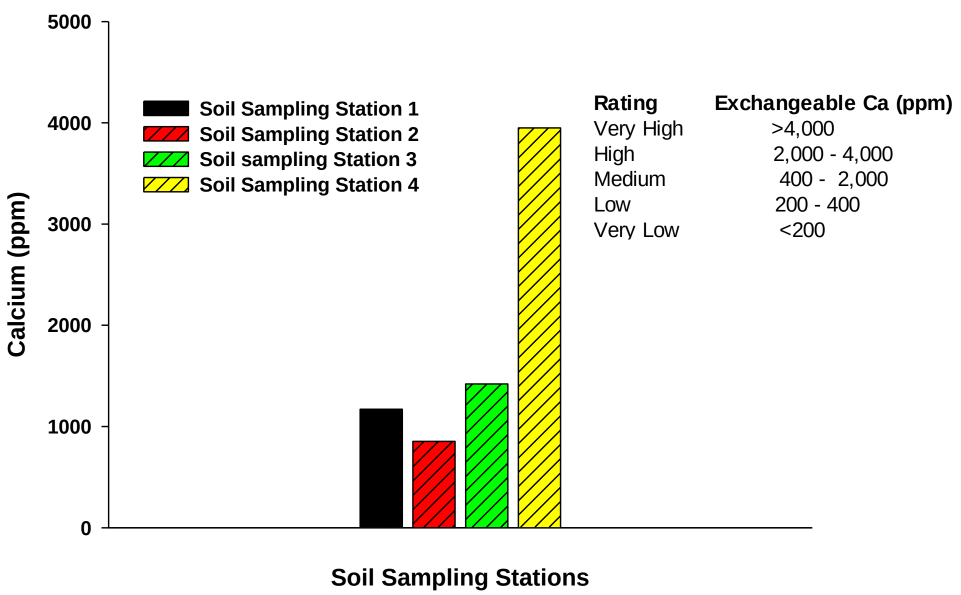
Essential element Potassium (K) is the great regulator in plant physiological processes. It is active in numerous enzyme systems which control metabolic reactions, particularly in the synthesis of proteins and starches. Micronutrients, which have similar functions, are required only in minute amounts. In contrast, potassium must be present in large quantities. Most plant were found to require high amount of potassium in their systems. However, when the soil is experiencing an aquic moisture regime (i.e. more than 2,000 mm rainfall a year more or less evenly distributed within the year) K deficiency may occur as K is highly soluble with water and is easily lost thru leaching and runoff.

The graph below shows the surface soil K content of the soil sampling Stations. When compared to the BSWM Standard for Potassium, the soil sampling stations is rated to have high K content of 412.0, 480.0, and 457.0 ppm, respectively. On the other hand, soil sampling station 4 is rated to have a very high K content of 948.0 ppm.



Graph 5. Soil Surface Potassium Content of the Soil Sampling Stations

Surface Soil Calcium Content



Graph 6. Soil Surface Calcium Content of the Soil Sampling Stations

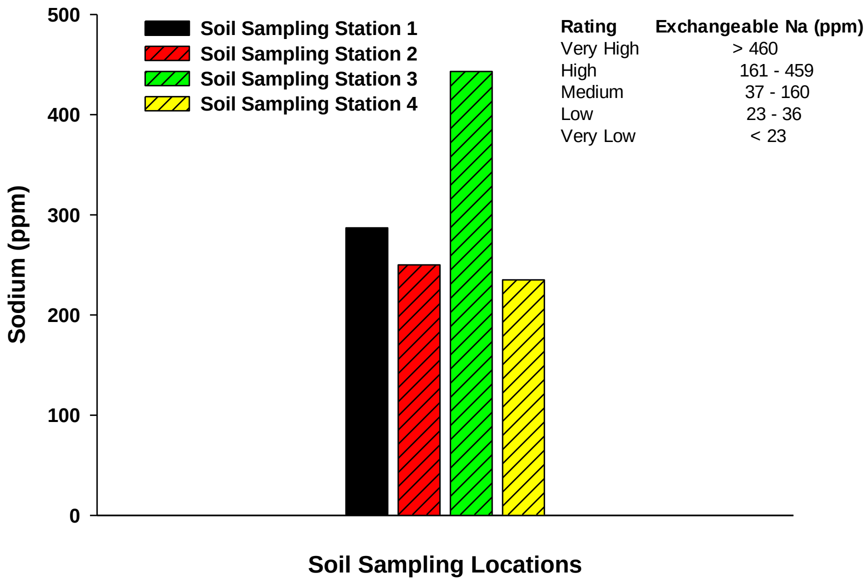
Calcium as an essential nutrient is present in adequate amounts in most soils. It is a component of several primary and secondary minerals in the soil, which are essentially insoluble for agricultural considerations. These materials are the original sources of the soluble or available forms of Ca. Calcium is also present in relatively soluble forms, as a cation (positively charged Ca^{++}) adsorbed to the soil colloidal complex. The ionic form is considered to be available to crops.

Calcium is not considered a leachable nutrient. However, over hundreds of years, it will move deeper into the soil. Because of this and the fact that many soils are derived from limestone bedrock, many soils have higher levels of Ca and a higher pH in the subsoil.

Soils with acidic reaction usually have less Ca, and high pH soils normally have more. Soils derived from limestone, marl, or other high Ca minerals will tend to have high Ca levels, while those derived from shale or sandstone will tend to have lower levels.

Shown in the graph above is the soil surface Calcium content of the sampling stations. Using the BSWM rating for Calcium, there is medium amount of calcium on soil sampling stations 1,2 and 3 at 1,170.0, 853.0, and 1,420.0, respectively. Soil Sampling station 4, on the other hand, is rated to have a high calcium content at 3,950.0.

Surface Soil Sodium Content



Graph 7. Soil Surface Sodium Content of the Soil Sampling Stations

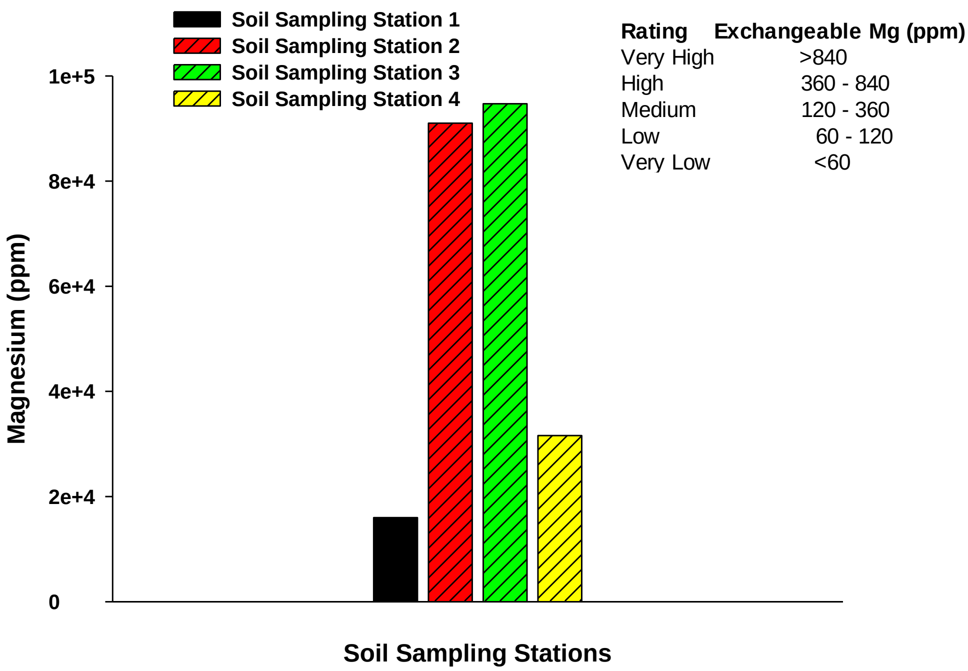
Though not a plant food nutrient, sodium plays a critical role in soil and plants health. The primary problem posed by high sodium is not a toxicity hazard but a rapid decline in soil structure that can begin when sodium base saturation exceeds the critical 5% level. High sodium reduces soil permeability, resulting in drainage and compaction problems that cause a decline in plants vigor.

Sodium level of the soil sampling stations are rated as high levels with 287.0, 250.0, and 235.0 ppm for soil sampling stations 1, 2, and 4, respectively; to very high levels of 443.0 ppm for soil sampling station 3 when compared to the BSWM sets of standards for Na.

The proposed project site surface soil may be high in salts (e.g. Sodium salts) because the parent rock from which it was formed contains salts. Also, area is planted with various species of fruit trees that are normally fertilized and sprayed with pesticides. The majority of sodium pockets in soil are from concentrated runoff of pesticides, fertilizers and other soil amendments.

Surface Soil Magnesium Content

Magnesium (Mg) is one of the micro-metallic essential nutrients needed by higher plants for growth and development. It is also one of the components of the green pigment in the plant leaves (i.e. chlorophyll) and act as catalyst to the translocation of phosphorus in the plant vascular tissues. It also aids in the formation of fats and oil in fruits. Mg, being an essential microelement, is only needed by plants in small quantity. Soil concentration of Mg above the adequate limit pose as soil pollutants.



Graph 8. Soil Surface Magnesium Content of the Soil Sampling Stations

The levels of exchangeable Mg in the soil sampling stations is shown in **Graph 8**. The results showed that the soil sampling stations have 16,000.0, 91,000.0, 94,700.0, and 31,600 ppm of Mg for sampling stations 1, 2, 3, and 4, respectively. When compared to the BSWM set of standards for Mg, it showed that all of the soil sampling locations are high above the adequacy level of 840 ppm.

Given such, these levels are considered to be in the toxic level in terms of plant nutrition. Exceedance of these essential micro elements needed by the plant are detrimental as this may impair plant growth and development and may even cause their failure to complete their life cycle. However, the soil of the proposed project site is exhibiting an acidic soil reaction that tends to reduce the availability of the element to the plants.

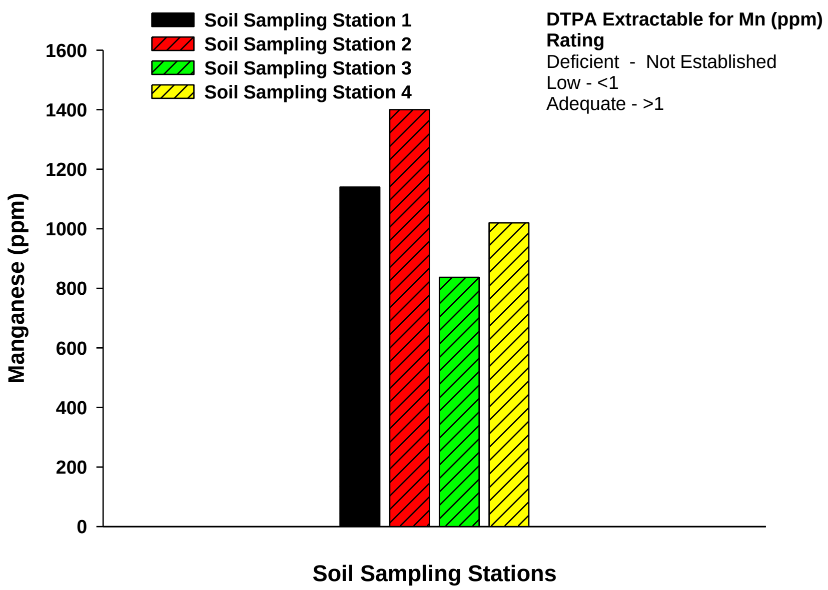
Conditions such as, low soil pH, low temperatures, dry soil conditions and high levels of competing elements, such as potassium and calcium, reduce the availability of magnesium. Under such conditions, magnesium deficiency is more likely. Further, due to the large hydrated radius of the magnesium ion, the strength of its bond to the exchange sites in soil is relatively low. Acidic soils increase the tendency of magnesium to leach, because they have less exchangeable sites (lower CEC). Other positive-charged ions, such as potassium and ammonium may also compete with magnesium and reduce its uptake and translocation from the roots to upper plant parts. Therefore, excessive applications of these nutrients might prompt magnesium deficiency even in very high concentrations in the soil like the proposed project site.

Surface Soil Manganese Content

The variety of changes undergone by manganese in soils has been the subject of study by many workers, particularly by those interested in 'manganese deficiency'. This is a condition of the soil in which manganese may occur abundantly and yet is not available to the plants in the form or in the amount required for healthy growth (Mann and Quastel, 1946).

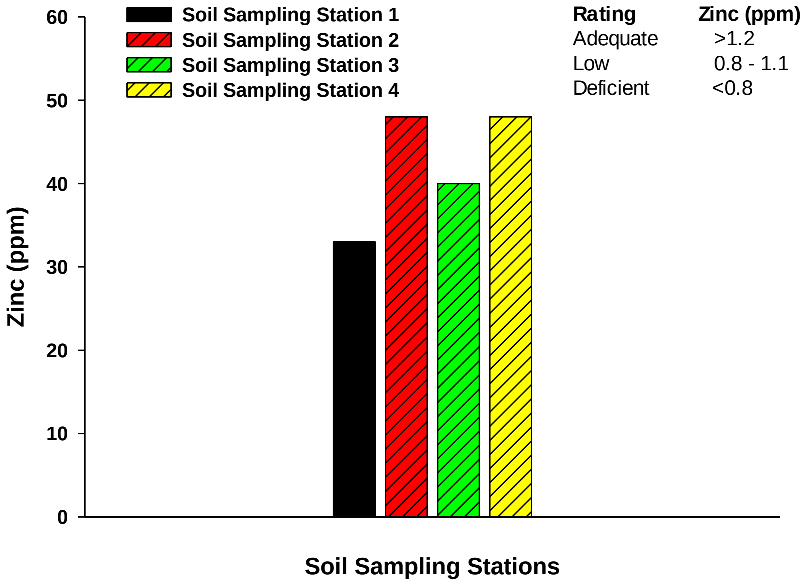
In mineral soils at low pH like the proposed quarry site, Mn toxicity may become one of the limiting factors of plant growth. However, in low pH soils the uptake of divalent Mn is greatly depressed by other divalent cations such as Ca, Mg and Zn which was found to be abundant in the proposed project site. According to Marschner (1988), the general pattern of depressed cation uptake rates by plants is lowering the pH in the range from 7 to 3 (Islam et. Al., 1980) is particularly evident with Mn.

The graph below summarizes the result of the laboratory analysis of the surface soil of the soil sampling stations. All of the sampling stations have very high Mn concentrations ranging from 837.0 ppm to 1140.0 ppm. This indicate the possibility of the occurrence of toxicity of the vegetative cover. However, because of the inherent chemical property of the soil of the project site (i.e. low, pH, presence of abundant divalent cations) potential toxicity is counter balanced in a more moderate degree.



Graph 9. Soil Surface Magnesium Content of the Soil Sampling Stations

Surface Soil Zinc Content



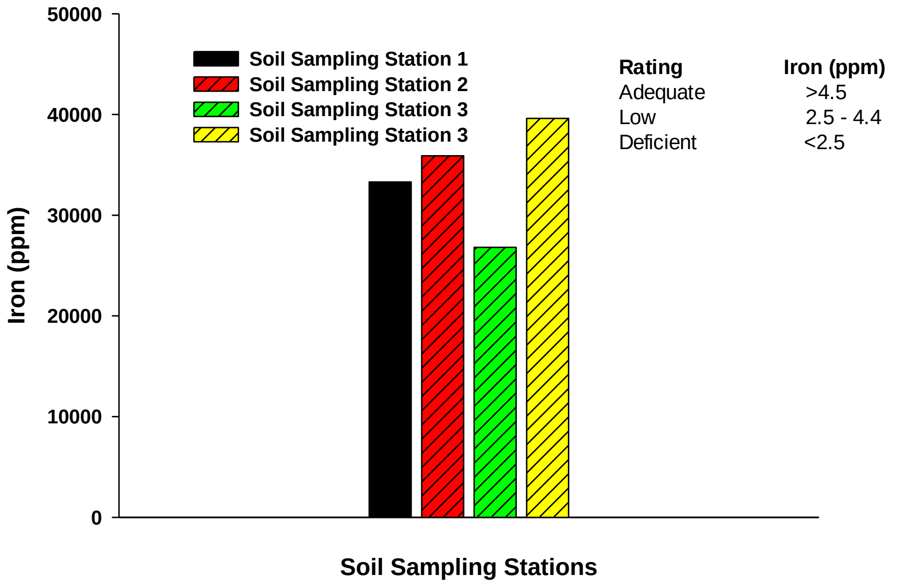
Graph 10. Soil Surface Zinc Content of the Soil Sampling Locations

The presence of micro-metallic element zinc in the surface soil is summarized in the graph above. Results showed that when compared to the adequate level of 1.2 ppm set by the BSWM standard, all of the soil sampling stations have elevated levels of Zinc of 33.0, 48.0, 40.0, and 48.0 ppm for the soil Sampling stations 1, 2, 3 and 4, respectively.

The relatively high concentrations of zinc in the soil samples of the investigated area were related to anthropogenic sources such as agricultural activities (i.e. use of and application of Zn containing agri-chemicals) that may have contributed to accumulation of zinc in the immediate soil surface.

Surface Soil Iron Content

Soil micro-metallic iron (Fe) function in higher plants is an essential component in the synthesis and maintenance of chlorophyll in plants. Also, Fe has been strongly associated with protein metabolism in the grains of produce. Soils found in the proposed ATN quarry site may contain high levels of total Fe, but in forms unavailable to plants. Visible Fe deficiency, or Fe chlorosis, is common in many plants around the mine were observed during the assessment field work. This disorder on these type of soils is not always attributable to Fe deficiency; this condition is known as calcium-induced iron chlorosis.



Graph 11. Soil Surface Iron Content of the Soil Sampling Stations

All of the sampling locations are enriched with very high concentrations of Fe in the topsoil with 33,300.0, 35,900.0, 26,800.0, and 39,600.0 ppm for the soil sampling stations 1, 2, 3 and, 4 respectively. All of said values are considered to be in the toxic levels (Lindsay 1979).

2.1.4.2.3 Soil Heavy Metal Analysis

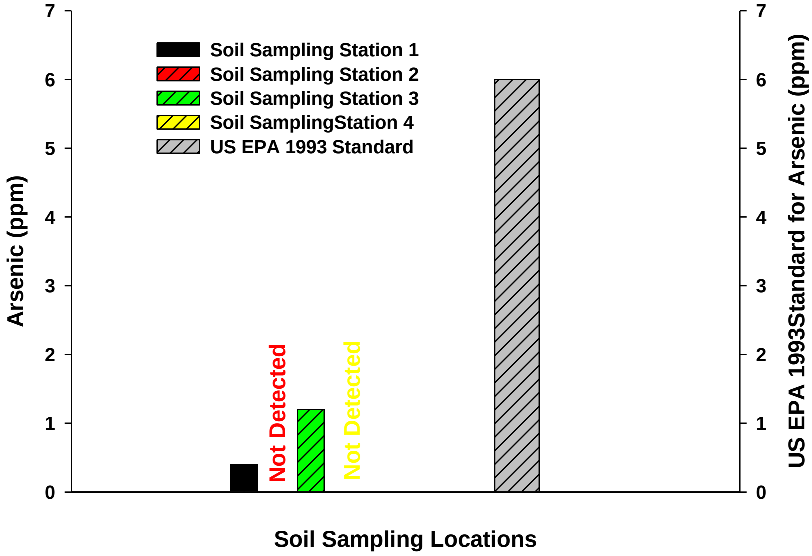
Mining, manufacturing, and the use of synthetic products (e.g. pesticides, paints, batteries, industrial waste, and land application of industrial or domestic sludge) can result in heavy metal contamination of urban, and agricultural soils (Soil Quality - Urban Technical Note 2000).

Heavy metals in soil occur naturally, but rarely at toxic levels. Nevertheless, the soil can be contaminated by industries involved in large scale open pit aggregates quarrying and other quarrying activities like limestone extraction for cement manufacture.

Crushed rock aggregate quarrying generates considerable volumes of quarry dust which significantly leads to production of considerable amounts of wastes harboring a number of heavy metals (Hameed and Sakar,2009).

Arsenic Content

Arsenic (As) is a naturally occurring element in the earth's crust and is found in the deep bedrock materials (Tiimub and Monney, 2015). Arsenic is usually present in the environment in inorganic form. The inorganic arsenic easily dissolves and enters underground and surface waters. The presence of arsenic in the environment may be attributed to one of the following sources: residual arsenic from former pesticide use, smelter emission from fines of quarry such as arsenopyrites. According to IARC (1980), inorganic form of arsenic leads to increased incidence of skin cancer which had been observed in populations consuming drinking water with high inorganic arsenic concentration.



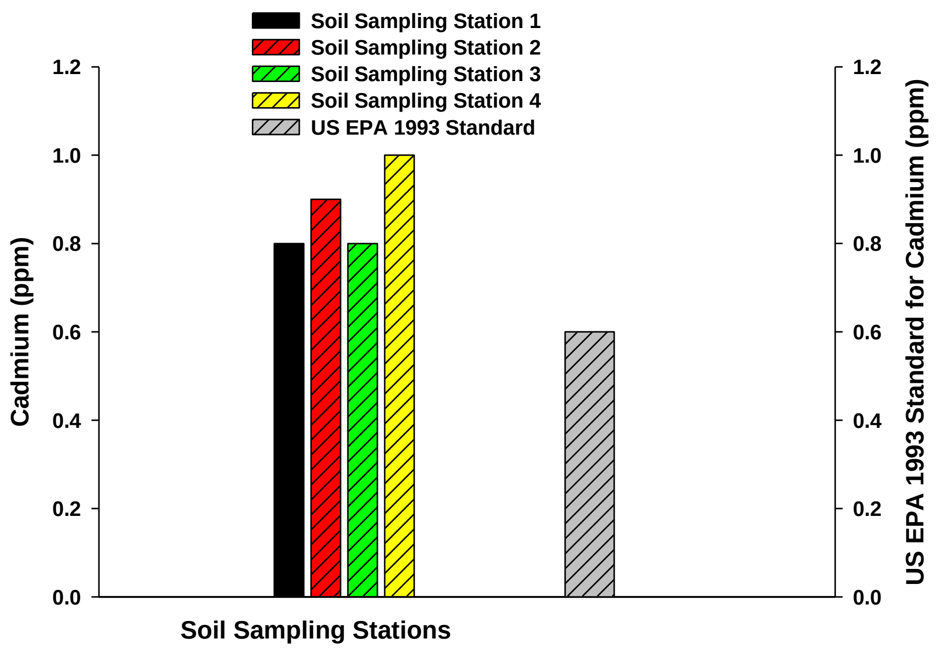
Graph 12. Soil Surface Arsenic Content of the Soil Sampling Stations

Graph 12 summarizes the results of heavy metal laboratory analysis for Arsenic. All of the soil sampling locations have very low to nothing (i.e., not detected) arsenic content on the surface when compared to the permissible As limit given by the US EPA (1993) standard of 6 ppm at 0.40, 0, 1.20, 0 ppm for soil sampling stations 1, 2, 3, and 4, respectively. The results confirmed the statement of Tiimub and Monney (2015) that arsenic is found deeply in bedrock materials. Further, any weathered Arsenic in the top soil of the proposed quarry site surface and because of Arsenic high solubility to water may have been lost thru runoff and leaching.

Cadmium Content

Cadmium is a relatively rare element. It is uniformly distributed in the Earth's crust, where it is generally estimated to be present at an average concentration of between 0.15 and 0.2 ppm (Hiatt and Huff, 1975).

Cadmium occurs in nature in the form of various inorganic compounds and as complexes with naturally occurring chelating agents; organocadmium compounds are extremely unstable and have not been detected in the natural environment. Industrial and municipal wastes are the main sources of cadmium enrichment in the soil.



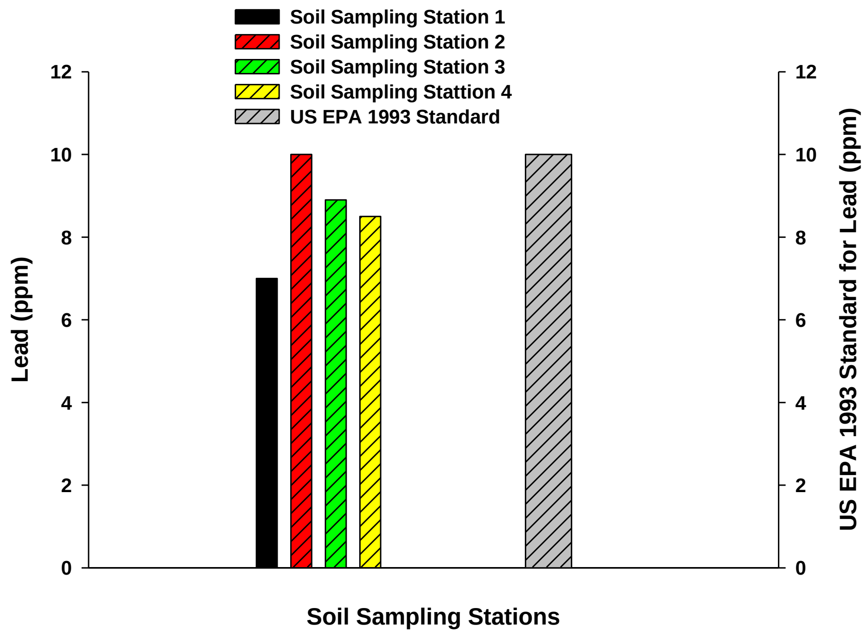
Graph 13. Soil Surface Cadmium Content of the Soil Sampling Stations

As shown the graph above, the cadmium content of all of the soil sampling stations is above the permissible limit set by the US EPA (1993) of 0.6 ppm for Cd at 0.80, 0.90, 0.80, and 1.0000 for the soil sampling stations 1, 2, 3 and 4, respectively. The slight elevated levels of Cadmium in the proposed ATN project area maybe anthropogenic in nature. The area being previously cultivated by the earlier occupants may have deliberately used phosphate fertilizers to grow their agricultural crops known to contain trace elements like Cadmium. Repeated use may have accumulated the heavy metal and is being picked up by the latest soil testing activities conducted.

Lead Content

Lead is a heavy metal and often occurs naturally in the soil in concentrations ranging from 10 to 50 ppm. Low-level lead contamination is common in urban areas where the soil sampling stations under investigation is located on the mountainous upland areas of Rizal Province. This is perhaps due of the widespread use of lead in man-made products and industrial processes.

Shown in **Graph 14** is the lead content of the soil sampling stations. All of the soil sampling stations are within the permissible level of 10.0 ppm set by the US EPA (1993).



Graph 14. Soil Surface Lead Content of the Soil Sampling Stations

Mercury Content

Mercury (Hg) is a dense, silvery-white metal that melts at -38.9°C. Mercury is present in the earth's crust at an average concentration of 0.08 mg kg^{-1}; cinnabar mercury [II] sulfide, HgS) is the most common mercury ore. Igneous, metamorphic, and sedimentary rocks contain mercury at concentrations up to 0.25, 0.40, and 3.25 ppm, respectively (Jonasson, and Boyle, 1971).

According to the New Hampshire Department of Environment (2003) mercury is introduced into the environment in three ways. First, mercury is emitted into the atmosphere naturally from volcanoes, the weathering of rocks, forest fires, and soils. Second, mercury is emitted as a result of human activities such as the burning of fossil fuels and municipal or medical waste. Lastly, mercury can be re-introduced into the environment through natural processes such as evaporation of ocean water. Because mercury is highly persistent once released into the environment, all sources are of concern. Once it is released into the atmosphere, mercury is transported and deposited on the earth's surface by rain and, as well as wind storms and forest fires. The transport and deposition of mercury is dependent upon many variables such as meteorological conditions, other chemical pollutants emitted along with mercury, and the chemical make-up of the air mass.

Laboratory test results of the soil sampling stations revealed that Mercury is not detectable.

Hexavalent Chromium Content

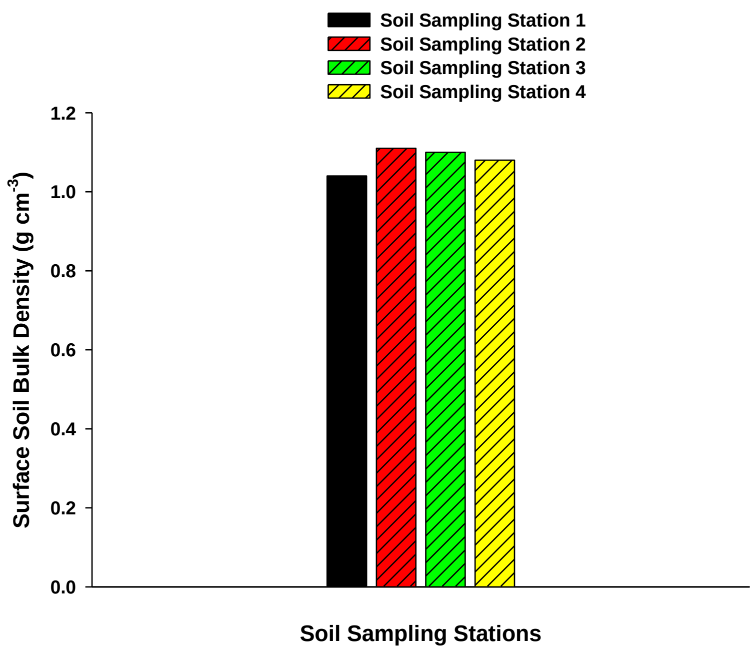
Chromium (Cr) is an element found naturally in rocks, soil, plants, and animals, including people. It occurs in combination with other elements as chromium salts, some of which are soluble in water. The pure metallic form does not occur naturally. Chromium does not evaporate, but it can be present in air as particles (US EPA 2014).

Chromium is abundant in nature. Its valence states range from -2 to +6, but in natural environments, it is generally found as trivalent chromium [Cr(III)] or hexavalent chromium [Cr(VI)]. This form exists in oxidizing conditions and can move down through soil to underlying groundwater.

Cr (VI) are released to the environment primarily from stationary point sources (facilities that are identified individually by name and location) resulting from human activities. Other sources of hexavalent chromium presence in the soil is through the cement-producing plants (cement contains chromium), the wearing down of asbestos linings that contain chromium, emissions of chromium-based automotive catalytic converters, and tobacco smoke ATSDR (2018).

Based on the soil chemical laboratory analysis all of the soil sampling stations revealed that the presence of Hexavalent chromium is not detectable.

2.1.4.2.4 Soil Surface Bulk Density



Graph 15. Soil Surface Bulk Density of the Soil Sampling Stations

Soil bulk density is the oven dry weight over volume and is commonly expressed in g cc^{-3}. A non-disturbed surface soil commonly has a low bulk density when compared to disturbed soils. Ideally for rapid water infiltration, gas exchange and aeration and root penetration of the plants a bulk density value of less than 1 g cc^{-3} is highly ideal. A bulk density value of >1.6 g cc^{-}3 is considered to be a compacted soil.

Shown in the graph above is the immediate soil surface bulk density (0 – 5 cm depth) of the proposed project. All of the soil sampling locations have more than 1 g cc^{-3} bulk density values in their undisturbed state of 1.040, 1.11, 1.10, and 1.08 g cc^{-3}. This indicate that these soils have rapid infiltration rates and is not compacted to restrict air movement. Therefore, they have a soil physical condition that is ideal for plant growth and development.

IMPACTS AND MITIGATING MEASURES ON SOIL

Construction/site preparation phase of the project entails clearing of vegetation, stripping of topsoil, quarry development, and installation of ancillary and plant facilities. These activities could result to accelerated erosion in the area by exposing bare soil to erosive agents especially to runoff. Stripped topsoil that would be eventually stockpiled in designated topsoil areas are characteristically loose and can be easily eroded in the absence of soil conservation measures. Moreover, since topsoil thickness in the area is not uniform, there is a possibility that topsoil and subsoil will be mixed in some areas during stripping. Said mixing will result to a soil mixture that is poorer in quality. Also, stockpiling of topsoil for future reclamation purposes (e.g. soil capping of waste dump) may lead to degradation of soil quality since stockpiling such for prolonged periods will deteriorate the soils biological components.

During operation phase, the volume of stockpiled waste materials increases as basalt extraction progresses. Although the waste dump will progressively be rehabilitated, some portions of the waste dump will remain to be bare and prone to erosive agents (eg. wind and water). Soil contamination caused by accidental spill of used oil/lubricants from the motorpool and plants is also a potential impact, especially during operation and abandonment phase. Frequent passing of vehicles during the entire project duration could also result to soil compaction that would compromise the potential of the soil for plant establishment due to fewer pore spaces that impede the movement of water and root penetration through the soil profile.

Upon decommissioning, the footprints of the disturbed areas are expected to be bare, unproductive and highly erodible.

To mitigate the aforesaid impacts, the coverage of the disturbed areas shall be minimized through progressive/immediate rehabilitation to prevent soil erosion. Land clearing shall also only be confined in the proposed footprint of facilities and unnecessary removal of vegetation shall be strictly avoided. To prevent collapse/slumping of stockpiles, side slopes of stockpiles shall be maintained below their angle of repose and piled in benches.

Stripping of topsoil will be scheduled in order for construction of facilities to immediately commence after stripping. This would also aid in minimizing exposed areas and avoid stockpiling of topsoil for long periods. Soil degradation due to prolonged stockpiling shall be mitigated by placing the topsoil in small mounds and seeding while loss of soil structure due to compaction shall be mitigated with the application of appropriate soil amendments.

To prevent mixing of soil during stripping, the maximum depth of cut will be about 10 cm and will be adjusted when necessary. Disturbed areas and stockpiles shall also be protected from surface runoff by constructing diversion canals to route ‘non-contact’ water away from these areas. Moreover, locations of stockpile shall avoid areas encompassing natural drainage lines to prevent down cutting of the base of stockpiles. Buffer zones surrounding the disturbed areas shall be established to prevent further transport of eroded materials downstream.

Identified Impacts	Mitigating Measures
- Increase in surface erosion and down slope sedimentation brought about by mine quarry development activities - Earthworks, mine facility construction	- Progressive ground clearing/ preparation will be employed to minimize the area disturbed at any one time; and - Progressive soil rehabilitation will be

Identified Impacts	Mitigating Measures
activities, and movement of heavy equipment will highly disturb the soil surface (i.e. compaction) and induce accelerated erosion susceptibility of the soil.	conducted in disturbed or cleared areas that will not be used for further development over the course of the project.
- Top soil removal from the development of mine infrastructures, ancillary facilities and new access roads.	- Erosion/sedimentation controls will be installed to mitigate surface erosion and the consequent down slope or downstream sedimentation. These will include: ▪ Installation of rainwater and runoff collecting systems at the toe of work areas; and ▪ "Vengineering" (i.e. planting of vegetation with high rainfall intercepting capacity and high transpiration rate characteristics to serve as re-evaporators/biological pumps, respectively). - Top soil removed during the clearing, re-grading and ground preparation activities during construction will be utilized as backfill to low lying areas and service roads; - Ground preparation and grubbing will be conducted progressively to minimize the total area of soil cover removal at any one time; and - Formulation of a topsoil management plan (TMP) to address topsoil removal, stock filing, and archiving of topsoil inventory for the project progressive rehabilitation activities.
- Improper disposal of domestic wastes - Soil Contamination due to accidental fuel and lubricant spills from vehicles and equipment may occur	- All domestic wastes will be sold to recyclers. Residual waste will be disposed to a designated sanitary landfill; - All fuel and oil refilling stations will be fitted with auto shut off valves to avoid accidental spills and concrete flooring fitted with oil and water separator to contain any accidental spill; - All used oils, lubricants and chemicals will be sold to recyclers; - Contaminated soils will be removed and disposed off-site; and - Provision of materials recovery facility with oil and water separator to contain any accidental spill.

2.1.5 Terrestrial Ecology

Terrestrial floristic and faunal investigation was carried out to identify the possible impacts of the proposed project to local ecological conditions, assess the level of impacts, and propose measures to mitigate these impacts. Specifically, the assessment sought to:

- Conduct ecological measurements of the floral and faunal assemblages of the Project Site and its vicinity;
- Assess the conservation status of flora and fauna documented in the area based on national legislation and IUCN/CITES criteria; and
- Identify, assess, and propose mitigation measures of the potential impacts of the Project to local biodiversity and ecological conditions.

Threatened Philippine flora and fauna are covered by various national legislations, notably:

- Wildlife Resources Conservation and Protection Act (2001);
- DENR Memorandum Circular 2007-2 (Critical Habitats);
- Republic Act No. 7586 – the National integrated Protected Areas System Act;
- DAO 2004-15 and DAO 2007-1 amended in DAO 2007-24 defining conservation categories for Philippine flora and fauna as Threatened Species, Critically Endangered Species, Endangered Species, Vulnerable Species, Other Threatened Species and Other Wildlife Species; and
- DENR Administrative Order No. 2017-11- Updated National List of Threatened Philippine Plants and Their Categories.

Since the species lists for fauna was not yet updated under WRCP Act of 2001, DAO 2004-15, and DAO 2017-11, the study team included the IUCN Red List and CITES Appendix I, II, and III categories as references in relation to the more current international criteria for Philippine flora and fauna.

2.1.5.1 Methodology

2.1.5.1.1 Terrestrial Flora

A combination of quadrat sampling technique and transect survey was used to assess the terrestrial flora within the vicinity of the proposed project area. The team selected the two (2) quadrats along the transect lines of 1-2 kilometers during the transect walk survey. The quadrats were distributed in such a way that all existing vegetation cover was represented. Generally, the area has three (3) vegetation types namely; closed forest, open forest and brushland. For trees, individual species with diameter-at-breast height (dbh) or greater than three centimeters inside the 100m x 100m plots were assessed. In addition, 10m x 10m subplots were established for the intermediate growth or plants with dbh less than 3 cm (i.e. poles, saplings) and 5m x 5m subplots for the understorey vegetation (i.e., seedlings, grasses).

Table 15. Location of terrestrial flora sampling and observation sites

Site Code	Name of Sampling/ Observation Sites	Elevation (masl)	Geo Coordinates Latitude/Longitude
(Q1)	Sitio Laan, Brgy. Macabud, Rodriguez, Rizal Province	85.1 m	14°46’56.60"N 121°8’26.10"E

Site Code	Name of Sampling/ Observation Sites	Elevation (masl)	Geo Coordinates
			Latitude/Longitude
(Q2)	Sitio Laan, Brgy. Macabud, Rodriguez, Rizal Province	130.4 m	14°46’55.60"N 121°8’21.70"E
(Q3)	Sitio Laan, Brgy. Macabud, Rodriguez, Rizal Province	221.6 m	14°46’56.00"N 121°8’14.90"E
(Q4)	Sitio Laan, Brgy. Macabud, Rodriguez, Rizal Province	261 m	14°47’19.80"N 121°8’14.40"E
(Q5)	Sitio Laan, Brgy. Macabud, Rodriguez, Rizal Province	221.3 m	14°47’23.20"N 121°8’16.30"E
(Q6)	Sitio Laan, Brgy. Macabud, Rodriguez, Rizal Province	118.8 m	14°47’20.20"N 121°8'31.50"E

Photo 4. The pictures above were taken during the establishment of transect lines and quadrats that will serve as the observation points during the conduct of terrestrial assessment in the area

Photo 5. The photos above were taken during the measurement of Diameter at Breast Height (DBH) of trees sighted at the ATN project area.

2.1.5.1.2 Terrestrial Fauna

The ecological assessment of the terrestrial vertebrate within the vicinity of the proposed project area, was carried out through opportunistic survey to determine whether the surrounding area supports valuable terrestrial vertebrate fauna communities that will potentially be impacted by the expansion of the project. The exploration focused on forest animal groups namely (i)birds, (ii)frogs and reptiles, (iii)bats (or flying mammals), and (iv)non-volant mammals which belongs to a group called "vertebrates" or animal with backbones. Interviews were also performed but were limited only to conspicuous and easily identifiable species (e.g. birds, monitor lizard, snake, insects, etc.). Using the most common metrics such a species richness, Shannon diversity, dominance, evenness and relative abundance were described. Global conservation status of the species was also presented.

Field Survey

Collection of samples were undertaken in four (4) stations. Different types of vegetation were observed in every station which correlates the current situation of the fauna assessment of its ecosystem. Global Positioning System (GPS) were used to locate the areas and for mapping purposes.

Table 16. Location and description of each sampling stations within the project area

Station	Location	Coordinates	Remarks
Station 1	Near Lilid River, Sitio Laan, Brgy. Macabud, Rodriguez, Rizal Province	14°46'56.60"N 121°8'26.10"E	Station 1 has an agro-ecosystem type of vegetation planted with different types of fruits, root crops and trees such as manga, avocado, sampaloc rimas, banana, cassava, ipil-ipil, kapok, labnog and tibig.
Station 2	Near the Cemetery, Sitio Laan, Brgy. Macabud, Rodriguez, Rizal Province	14°46'56.00"N 121°8'14.90"E	This station was planted with mahogany tree which allows some animals to roost; specially birds and reptiles.
Station 3	Near the existing quarry site, Sitio Laan, Brgy. Macabud, Rodriguez, Rizal Province	14°47'19.80"N 121°8'14.40"E	Station 3 is an open brushland type with agricultural crops on its surroundings good for some insect-eating animals.
Station 4	Within the proposed quarry area, Sitio Laan, Brgy. Macabud, Rodriguez, Rizal Province	14°47'20.20"N 121°8'31.50"E	Mostly planted with bamboos and some fruits.

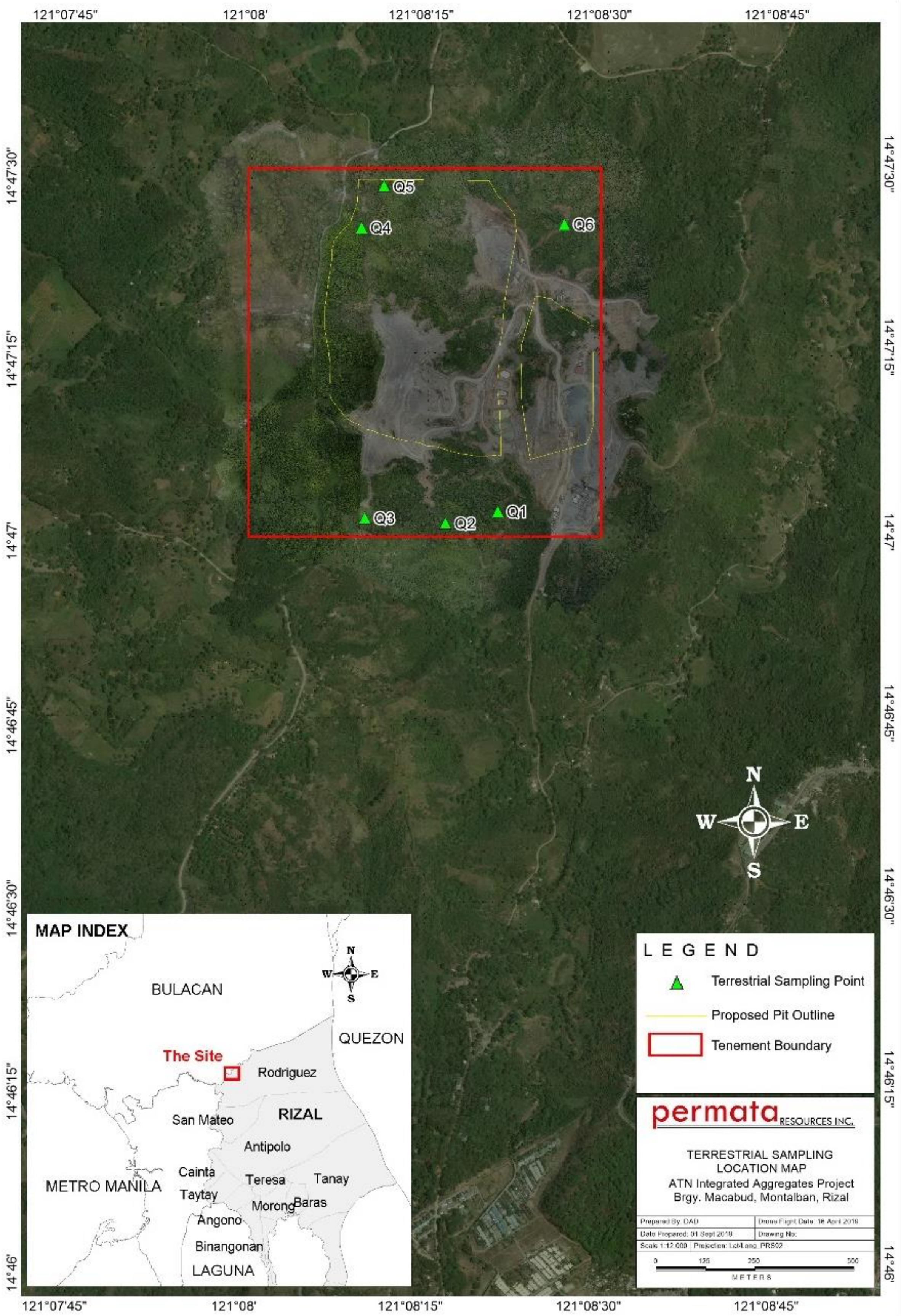


Figure 32 – Terrestrial Flora Sampling and Observation Sites

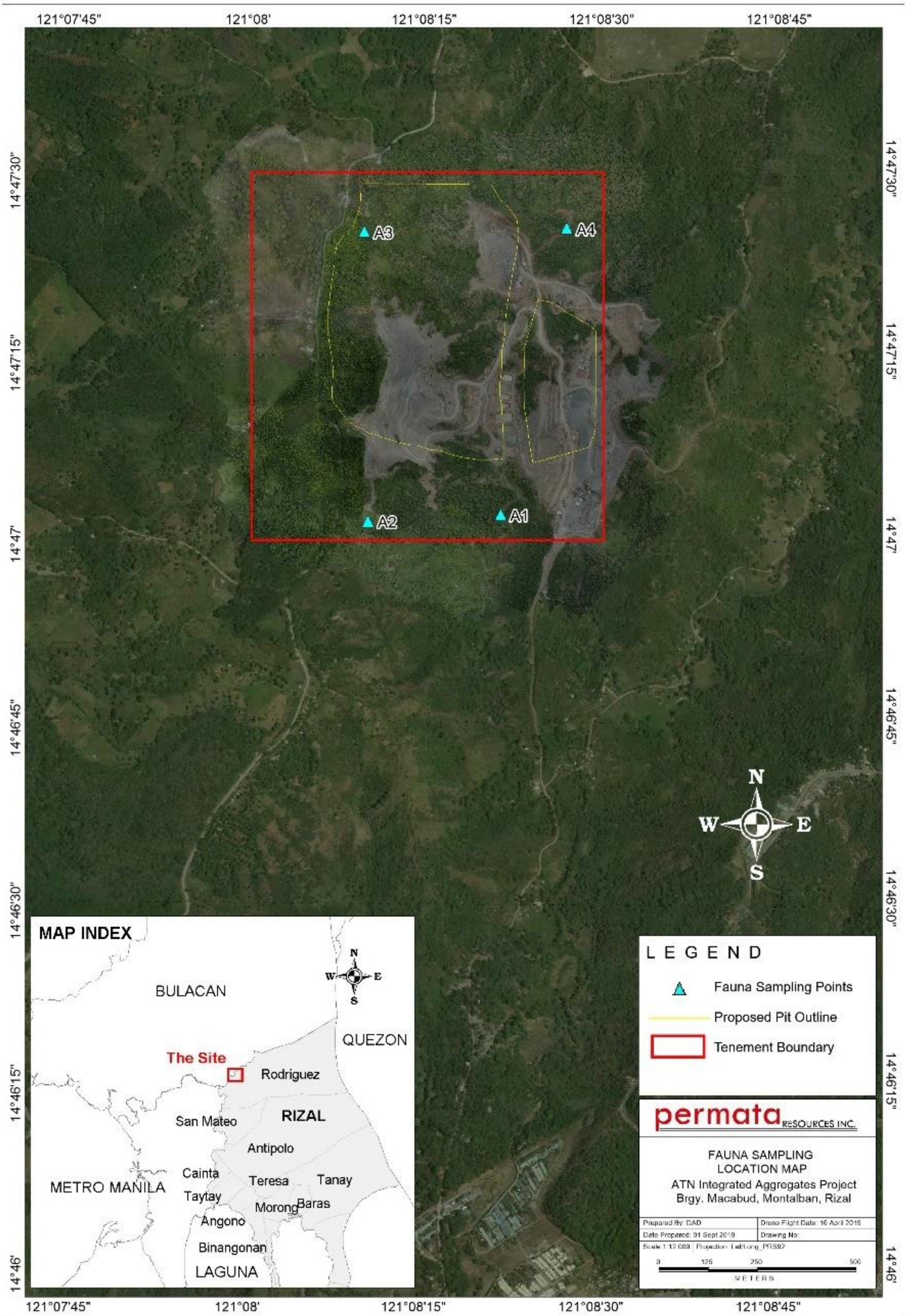


Figure 33 – Terrestrial Fauna Sampling and Observation Sites

Photo 6. Fauna Sampling Station 1 located near the river at Sitio Laan, Brgy. Macabud, Rodriguez, Rizal Province

Photo 7. Fauna Sampling Station 2 located near the cemetery at Sitio Laan, Brgy. Macabud, Rodriguez, Rizal Province

Photo 8. Fauna Sampling Station 3 located near the quarry area of ATN at Sitio Laan, Brgy. Macabud, Rodriguez, Rizal Province

Photo 9. Fauna Sampling Station 4 located inside the quarry area of ATN at Sitio Laan, Brgy. Macabud, Rodriguez, Rizal Province

A specific team is responsible for each animal group. Each team is comprised by biologists who acted as a field researcher and one local researcher. The local researchers/laborers were at first oriented to the rationale of the activity and the specific objectives of the field expedition and the modified method for each of the four animal groups was discussed. The co-researchers were then assigned to assists in the field monitoring for each fauna groups. Species identification was aided using specific fauna keys such as Strange, 2000 for birds Ingle, N.R. and L.R. Heaney (1992) for bats, Heaney *et. al*., 1999 for non-flying mammals Diesmos *et.al.,* 2015 for amphibians and Brown *et.al.,* 2000 and Mc Leod *et. al.,* 2011 for reptiles. Journals and materials in the worldwide web also aided in the identification of species.

A. Birds Survey

All of the birds that were perceived visually or detected through calls within 30m of the observer were counted. The researchers walked at a slow and constant speed to ensure proper, non-biased observations, DSLR cameras and photographic field guides were used to confirm the observations. All observations were recorded on the field. Nocturnal birds, or those active at night, were also noted when encountered or heard during the transect walk for nocturnal mammals. The observed birds were identified based on their morphology, behavior and calls according to Kennedy (2000) and Fisher and Hicks (2006), and the ecological status (ie. Endemism). Conservation status was determined using the data provided by the International Union for the Conservation of Nature (IUCN 2014), and the published literature and field guides were used to determine the feeding guilds of the identified species. Birds were listed following the four (4) techniques discussed below:

1. **Survey using mist nets.** This technique employs specialized nets called “mist nets” to catch flying bird. Each net was set along suspected or ideal flyways (across and along waterways, forest edges and clearings, feeding trees and near forest canopy) to catch birds that happen to pass in the area. Checking was done regularly every 30 minutes especially late afternoon. The birds trapped are immediately removed from the nets to prevent them from getting stressed and to die. Birds captured are kept in clean cloth bags and kept in a cool, ventilated place if not processed immediately. For each bird capture, morphometric of birds were measured by a caliper. After taking photos of a few individuals for each captured species, birds were marked with red nail polish to avoid recounting if captured after released.
2. **Line transect survey.** Transect walk follows the established foot trail along riparian zone, open and cultivated area, forest edges and interior. The transect walks were conducted in the morning at 500 hrs and in the afternoon at 1600 hrs where bird activities are assumed to be highest; and extended up to 1900 hrs to take into account nocturnal species. A hand-held Global Positioning System was used for the coordinates of each sampling point. All birds seen and heard from both sides of the transect line were recorded. Information such as the mode of observation, weather, habitat type, species, number of individuals, and the stratum where the bird was seen were recorded. Key informant interviews of the local residents were also made to enhance the data gathering.
3. **Opportunistic listing.** This technique simply means listing all birds that were seen casually around the forests. Such random instances may be during hikes from and back to camp, when transects were being established, during vegetation sampling, and during raptor observations, among others.
4. **“Sit and Wait’.** The technique is effective in observing and identification of displaying raptors or birds-of-prey such as eagles, harriers, hawks and kites. This was also utilized in taking photographs of shy birds species were the researchers sit and wait while partially hidden in a bush waiting for a good view of to be photo-captured birds. This technique is aided with a pair of binoculars and a telephoto camera.

B. Bat (Flying Mammals)

The technique utilizes specialized nets called “mist nets” set along suspected or ideal flyways (across and along waterways, forest edges and clearings, feeding trees and near forest canopy) to catch bats. The mono filament net will appear invisible from afar. Each net measured 6m x 12m and will be installed either individually or in series in areas that are accessible for checking. Nets were left open during the night and field researchers keep watch of the nets during the first two hours of the evening to retrieve “microbat” or insect-feeding bats netted. These groups of bats have a very sharp teeth so that if left entangled will chew the way out of the nets. Other groups of bats, “megabats” have blunt teeth and are active the whole night feeding on fruits. These groups, including a few larger microbats, will be retrieved early in the following day and hanged on suitable, shaded areas in the forest after measurements and identification. Bats identification will be made possible through the bat field identification guide (Ingle et al, 1992). Measurements such as (i) forearm length, (ii) ear length, (iii) hind foot length, (iv) tail length and (v) total length were measured using a caliper. Weight will also be measured using a Pesola spring balance. Digital photos will be taken and compiled for each captured individual indicating the picture and species ID number in the data sheet. Prior to the release of all captured bats, sugar solutions will be given through a dropper to replenish the energy lost during the periods of handling. Red nail polish will be used to mark the nails of the captured animals to avoid recounting.

C. Volant mammals (Non-flying mammals)

This includes all other land mammals divided into (i) nocturnal, arboreal mammals, (ii) rodents and shrews, and (iii) other large mammals. The survey methods employed for each of these sub-groups includes:

1. **Nocturnal, arboreal mammals (Flying Lemur, Civets, and Flying squirrels).** Same transect line was used for birds. A team of at least three personnel walked the 2km transect and searched for arboreal mammals across all levels of the forests. Researchers also noted (i) the time an animal was detected, (ii) its position in the forest, (iii) its approximate distance from the observes, and the (iv) point at along the transect to which it was closest. Maturity of this kind of mammals were also recognized. Transect walk was carried out during the first three hours of the evening when animal activities were at its peak.
2. **Rats, squirrels and shrews.** Live traps were used to survey forest rats, shrews and squirrels. Traps were placed in suspected runways, along bushes, rotting logs, root tangles and burrows baited with pieces of half roasted coconuts laced with peanut butter. Traps were visited twice each day, once the early morning and once in the late afternoon to check for captured animals. Captured animals were immediately retrieved for measurements of external metrics including (i) total length (TL), (ii) body length (BL), (iii) tail length (Tail), (iv) ear length (Ear) and (v) hind foot length. Weight were also noted using a Pesola spring. Identification of the captured animals were aided with field identification key (Ingle and Heaney, 1992).
3. **Small land mammals**. Opportunistic listing for documenting other large mammals was carried out; relying on indirect evidences of its presence such as fecal droppings in palm civets, forest tracks of wild pigs and deer and even pieces of mammal bones and skulls.

D. Amphibians and Reptiles

An opportunistic method was done in collecting samples. The techniques involved establishing 200m transect in the forest and finding as many as possible on both sides of the line. These lines were searched during the day, one in the morning from 9:00am to 11:00am and one in the afternoon from 1:00pm to 3:00pm; were the activity of reptilians were active during this ours. At night time, frogs were surveyed during the first four hours of the evening. Any animal that were encountered along the way including snakes were captured and documented. With the aid of caliper and measuring tape, morphometric of amphibians and reptiles was measured and recorded.

Data analysis

A. Flora

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 aspect of the species importance in a community. Importance values were determined using the following formula:

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

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

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

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

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

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

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

The diversity indices of the different sampling areas, which include the Shannon index (H) and Evenness index (J), were also computed. The indices were computed using the following formula:

$$Shannon - Weiner\ Index\ (H) = -\sum \left(\frac{ni}{N}\right) \ln \left(\frac{ni}{N}\right)$$

where:
ni = the total number of individuals in each species
N = the total number of all individuals

$$Pielou's\ Evenness\ Index\ (J) = \frac{H1}{\ln S}$$

where:
S = total number of species

B. Fauna

The species assemblage for each animal group was described using the most common metrics: (i) species richness, (ii) species evenness, (iii) Shannon-Weaver index of diversity and (iv) relative abundance. The report also described few species that were identified by the World Conservation Union or IUCN as globally "threatened" species.

Species richness – refers to the cumulative number of recorded species and provides information on the commonness and rarity of species.

Shannon-Weaver Index of Diversity – a diversity index is a mathematical measure that combines species richness and evenness as a measure of diversity. Species diversity was calculated using Shannon information statistics referred as the Shannon-Weaver Index of Diversity (H'):

$$H' = \sum_{i=1}^{S} (pilnpi)$$

Where S is the total number of observed species, *i* is the species number and *pi* is the proportion of individuals of the total sample belonging to the *ith* species. The value of Shannon-Weaver Index of Diversity is constrained between 0 to 5. Lower diversity value normally indicates more uniform species relative to the population.

Species evenness – it is the measure of biodiversity which quantifies how equal the community is numerically. It is a measure of the homogeneity of abundances in a sample or a community. The evenness of the avifauna community was calculated using the Pielou's evenness index (E):

$$E=H'/H'max$$

where H' is the value derived from Shannon diversity index and H'max is the maximum value of H' calculated as H'max = In S. The value of Pielou's evenness index ranges between 0 to 1. higher values of E means a less variation in communities between species.

Similarities between the vertebrate taxa across sampling points were calculated using the Bray-Curtis Similarity Index and cluster analysis was performed to groups samples with the most similarity. Similarity index and cluster analysis were calculated using the software PAST version 2.17. All indices are computed for rarefied samples or individuals to reduce the bias of comparisons.

Relative abundance for the observed fauna groups were calculated after Ibañez (2010). For birds, this was expressed as the number of birds per 100 birds and calculated by getting the ratio of the total individuals for each species and the total individuals for all the species (N), and then multiplied by 100 birds or:

$$RA = \frac{\text{Total no. of individuals seen or heard}}{\text{Total no. of birds seen (or netted)}} \times 100 \text{ birds}$$

Relative abundance per species was measured separately for mist net and transect line data. Not all species were encountered by both techniques so that some species only had one abundance value.

For bats, relative abundance estimates for each species was expressed as the number of bats per 100 net nights, calculated by getting the ratio of the total number of individuals caught per species and the cumulative number of net nights (total number of nets used x the no. of nights nets were opened). The ratio was then multiplied by 100 or:

$$RA = \frac{\text{Total no. of individuals per species}}{\text{Total no. of net nights}} \times 100 \text{ net nights}$$

The relative abundance for rodents and shrews was expressed as the number of rodents and shrews caught per 100 trap nights. This was calculated by getting the ratio of the number of individuals trapped per species and the cumulative number of trap nights (total no. of traps used x the number of nights they were used). The ratio was then multiplied by 100 or:

$$RA = \frac{\text{Total no. of individuals per species}}{\text{Total no. of trap nights}} \times 100 \text{ trap nights}$$

Relative abundance of nocturnal arboreal mammals was expressed as the number of animals detected per 100 hours of transect. This was calculated by getting the ratio of the number of individuals detected for each species and the total number of hours spent for the transect survey. The ratio was then multiplied by 100, or:

$$RA = \frac{\text{Total no. of individuals detected per species}}{\text{Total transect hours}} \times 100 \text{ transect hours}$$

Description of species with conservation priorities identified by the World Conservation or IUCN is provided. Percentage of Philippine endemic species was also calculated. Percent endemicity provides a broad evaluation of the importance of the area being a habitat for unique species (Ibañez, 2010).

2.1.5.2 Baseline Conditions

2.1.5.2.1 Flora Composition

General Situation

Generally, the forest cover of the project area varies from closed-canopy to open canopy forest and some portions of brushlands. The closed-canopy forests were second-growth and residual forest dominated with Fabaceae, Euphorbiacea and Moraceae family tree species. The forest floor of the closed-canopy forest has poor undergrowth due to the thick forest litter (e.g. leaves, twigs, branches etc.) The open forest is relatively young with the highest recorded diameter at breast height (dbh) at only 34 cm; while majority of the individual species have dbh that falls between the ranges of 3 cm to 18 cm. The open portions are brushland which is dominated by ferns such as pako-pako, herbs such as kantutay and hagonoy, some shrubs and small trees

The vicinity and project site are inhabited and most portions of the land are already cultivated and planted with agricultural crops such as cassava, banana, mangga, and coconut. Forest trees sighted in the proposed project site were mostly non-endemic and dominated with planted tree species such as Mahogany, Gmelina, *Acacia mangium* and Ipil-ipil. The whole area can be considered as Agro-ecosystem already because most of the vegetation in the proposed project site was agricultural crops.

Photo 10. Quadrat 1 with an agricultural ecosystem and open-canopy forest established within the proposed project at Sitio Laan, Brgy. Macabud, Rodriguez,Rizal Province.

Photo 11. Aerial photograph of the terrestrial ecology assessment study area showing the six (6) quadrats established in the proposed integrated aggregates quarry project of ATN Holdings Inc. at Brgy. Macabud, Rodriguez, Rizal Provinc

Photo 12. Open-canopy forest where the quadrat 2 was established and the area is dominated with Mango, Ipil-ipil and Kapok.

Photo 13. Quadrat 3 with closed-canopy Mahogany plantation forest located at the upper portion of Sitio Laan, Brgy. Macabud, Rodriguez, Rizal Province.

Photo 14. Quadrat 4 established within a farm located planted with Mango, Coconut, Banana etc.

Photo 15. The panaromic photo above shows the quadrat 5 established along the Lilid Creek dominated with bamboos, tibig, hagimit and ferns.

Photo 16. Quadrat 6 with a brushland and portion of open-canopy forest located at Sitio Laan, Brgy. Macabud, Rodriguez, Rizal Province

Species Composition

A total of two hundred twenty (120) species were recognized belonging to the seed plants, ferns and their allies from the six quadrats sampled. The table below shows the number of families and species per plant type recorded in the project area.

Table 17. Summary of species composition

Plant Type	No. of Families	No. of Species
Trees	30	58
Grass/Shrubs/Herbs/Vines	24	52
Ferns/Pterophytes	3	3
Epiphytes/Mosses	2	2
Palms	1	5
Total	**60**	**120**

The most speciose (having several species) of all sixty (60) families recorded are Moraceae with nine (9) species followed by Euphorbiaceae with eight (8) species and Fabaceae with seven (7) species.

Table 18. Lists of tree species recorded in ATN's project area

Local /Common Name		Scientific Name	Family Name
1	Mangga	*Mangifera indica Linn*	Anacardiaceae
2	Guyabano	*Annona muricata*	Anonaceae
3	Lanete	*Wrightia pubescens*	Apocynacea
4	Malapapaya	*Polyscias nodosa*	Araliaceae
5	Hagdan Uwak	*Oroxylum indicum*	Bignoniaceae
6	Kapok	*Ceiba pentadra*	Bombaceae
7	Anonang	*Cordia dichotoma*	Boraginaceae
8	Hanagdong	*Trema orientalis*	Cannabaceae
9	Talisay	*Terminalia catappa*	Combretaceae
10	Binuang	*Octomeles sumatrana*	Datiscaceae
11	Pararubber	*Hevea brasiliensis*	Euphorbiaceae
12	Hamindang	*Macaranga bicolor*	Euphorbiaceae
13	Binunga	*Macaranga tanarius*	Euphorbiaceae
14	Tuba-tuba	*Jathropa cutcas*	Euphorbiaceae
15	Narra	*Pterocarpus indicus*	Fabaceae
16	Madre de cacao	*Glericidia sepium*	Fabaceae
17	Ipil-ipil	*Leucaena leucocephala*	Fabaceae
18	Alibangbang	*Bauhinia monandra*	Fabaceae
19	Mangium	*Acacia mangium*	Fabaceae
20	Rain Tree	*Samanea saman*	Fabaceae
21	Sampaloc	*Tamarindus indica Linn*	Fabaceae
22	Bago	*Gnetum gnemon L.*	Gnetaceae
23	Paguringon	*Cratoxylum sumatranum*	Hypericaceae
24	Avocado	*Persea gratissima*	Lauraceae
25	Banaba	*Lagerstroemia piriformis*	Lythraceae
26	Bitan-ag	*Kleinhovia hospita*	Malvaceae
27	Sayapo	*Trichospermum eriopodum*	Malvaceae
28	Lanzones	*Lansium domesticum*	Meliaceae
29	Gmelina	*Gmelina arboria*	Meliaceae
30	Santol	*Sandoricum koetjape Merr*	Meliaceae
31	Colo	*Dysoxylum decandrum*	Meliaceae
32	Mahogany	*Swietenia macrophyla*	Meliaceae
33	Kamansi/Rimas	*Artocarpus communis*	Moraceae
34	Antipolo	*Artocarpus blancoi*	Moraceae
35	Jackfruit	*Artocarpus heterophylla lam.*	Moraceae
36	Labnog	*Ficus hauili*	Moraceae
37	Tibig/Tubog	*Ficus nota*	Moraceae
38	Hagimit	*Ficus minahassae*	Moraceae
39	Is-is	*Ficus odorata*	Moraceae
40	Niyog-niyogan	*Ficus pseudopalma*	Moraceae
41	Tagisang Bayawak	*Ficus variegata*	Moraceae
42	Malunggay	*Moringa Oleiferam Lam.*	Moringaceae

Local /Common Name		Scientific Name	Family Name
43	Guava	*Psidium guajava*	Myrtaceae
44	Duhat	*Syzygium cumini*	Myrtaceae
45	Bougainvillea	*Bougainvillea sp.*	Nyctaginaceae
46	Iba	*Averrhoa balimbi*	Oxalidaceae
47	Balimbing	*Averrhoa carambola*	Oxalidaceae
48	Bangkoro/Noni	*Morinda citrifolia*	Rubiaceae
49	Bangkal	*Nuclea orientalis*	Rubiaceae
50	Kape	*Coffea Arabica Linn.*	Rubiaceae
51	Pomelo	*Citrus grandis*	Rutaceae
52	Caimito	*Chrysophyllum cainito Linn.*	Sapotaceae
53	Loktob	*Duabanba moluccana*	Sonneratiaceae
54	Cacao	*Theobroma cacao*	Stercullaceae
55	Aratilis	*Muntingia calabura Linn.*	Tiliaceae
56	Alagasi	*Leucosyke capitellata*	Urticaceae
57	Kahoi Dalaga	*Mussaenda philippica Merr.*	Urticaceae
58	Handamay	*Pipturus arborescens*	Urticaceae

Table 19. List of other plants (herbs, ferns, epiphytes, shrubs, grasses, palms, vines) recorded in ATN's project area

No.	Local /Common Name	Scientific Name	Family Name
A. Epiphytes			
1.	Broom Pork Moss	*Homalothecium sericeum*	Brachytheciaceae
2.	Pocket Moss	*Fissidens taxifolius*	Fissidentaceae
B. Pterophytes/Ferns			
1.	Pakong Alakdan	*Blechnum oriente L.*	Blechnaceae
2.	Pako-pako	*Blechnum fraseli L.*	Blechnaceae
3.	Kilob	*Gleichenia linearis* Burm	Gleicheniaceae
C. Palms			
1	Coconut	*Cocos nucifera*	Arecaceae
2	Bunga	*Areaca catechu L.*	Arecaceae
3	Pugahan	*Caryota cumingii Lodd.*	Arecaceae
4	Limuran/Kalape	*Calamus ornatus Blume*	Arecaceae
5	Manila Palm	*Adonidia merrillii*	Arecaceae
D. Grasses/Shrubs/Herbs/Vines			
1	Bonga-bonga	*Amarnathea Sessilis*	Amaranthaceae
2	Kulitis	*Amaranthus spinosus L.*	Amaranthaceae
3	Kudiapa	*Celosia argentea L.*	Amaranthaceae
4	Gabi-gabi	*Caladium bicolor*	Araceae

No.	Local /Common Name	Scientific Name	Family Name
5	Gabi	*Colocacia esculenta*	Araceae
6	Arrow head	*Syngonium podophyllum*	Araceae
7	Hagonoy	*Chromolaena odorata*	Asteraceae
8	Dila-dila	*Elephantopus scaber*	Asteraceae
9	Sambong	*Blumea balsamifera*	Asteraceae
10	Alugbati	*Basella alba Linn.*	Basellaceae
11	Pineapple	*Ananas comosus*	Bromeliaceae
12	Elepante/Erysipela plant	*Heliotropium indicum L.*	Boraginaceae
13	Papaya	*Carica papaya*	Caricaceae
14	Kamote	*Ipomea batatas*	Convolvulaceae
15	Kamu-kamuti	*Ipomea triloba L.*	Convolvulaceae
16	Daat	Scleria scrobiculata	Cyperaceae
17	Boto-botones/Mutha	*Cyperus rotundas L.*	Cyperaceae
18	Cassava	*Manilot esculenta*	Euphorbiaceae
19	Tawa-tawa	*Euphorbia hirta L.*	Euphorbiaceae
20	Tangan-tangan	*Ricinus communis Linn.*	Euphorbiaceae
21	Gapas-gapas	*Mallotus mollissimus*	Euphorbiaceae
22	False bird of paradise	*Heliconia sp.*	Heliconiaceae
23	Mayana	*Coleus scutellarioides (L.) Benth*	Lamiaceae
24	Pansi pansi	*Hyptis capitata Jacq.*	Lamiaceae
25	Akapulko/Asunting	*Cassia alata Linn.*	Leguminosae
26	Makahiya	*Mimosa pudica Linn.*	Mimosaseae
27	Banana	*Musa acuminata*	Musaceae
28	Saging saging	*Acgecarus condoniculatum*	Myrsinaceae
29	Burambot	*Passiflora foetida Linn.*	Passifloraceae
30	Baliw	*Pandanus tectorius*	Pandaceae
31	Sili	*Capsicum annuum*	Piperaceae
32	Cow weed	*Anoxophus compresus*	Poaceae
33	Paragis/Wire grass	*Eleusine indica*	Poaceae
34	Amorseco	*Andropogon acciculatas*	Poaceae
35	Cogon	*Imperata cylindrica*	Poaceae
36	Carabao grass	*Paspalum conjugatum*	Poaceae
37	Talahib	*Saccharum spontaneum*	Poaceae
38	Amor seco	*Andropogon aciculatus Retz.*	Poaceae
39	Bila-bila	*Eleusine indica L*	Poaceae
40	Cogon	*Imperata cylindrica*	Poaceae
41	Kawayan Tinik	*Bambusa spinosa Roxb.*	Poaceae
42	Yellow Bamboo	*Bambusa bulgaris Schrad.*	Poaceae

No.	Local /Common Name	Scientific Name	Family Name
43	Kawayan Bayug	*Bambusa merrilliana*	Poaceae
44	Climbing Bamboo/Pawa	*Arthrostylidium Longiforum*	Poaceae
45	Kawayan Buho	*Schizostachyum lumampao*	Poaceae
46	Talahib/Bugang	*Saccharum spontaneum Linn.*	Poaceae
47	Lokdo	*Drynaria quercifolia Linn.*	Psilotaceae
48	Sili	*Capsicum sp.*	Solanaceae
49	Talong talong	*Solanum torvum*	Solanaceae
50	Kantutay	*Lantana camara L.*	Verbenaceae
51	Alimpuyas	*Curcuma zedoaria (Berg.) Rose*	Zingiberaceae
52	Tagbak	*Kolowratia elegans*	Zingiberaceae

From the six (6) quadrats established along transects per location, a total of 366 individuals belonging to 58 species of trees were recorded to have a diameter of > 5 cm. The average density is 0.0366 tree/sq.m, or roughly 3 trees for every 100 square meters. The most frequent tree species is Ipil-ipil *(Leucaena leucocephala)* and Mangga *(Mangifera indica)* that are found in all quadrats. Based on the computed importance value (IV), the most important species is *Mangifera indica* commonly known as Mangga at 39.158.

The intermediate and undergrowth layers have almost the same species richness at 16.15 and 15.89 species, respectively. The most frequent species at the intermediate layer is *Chromolaena odorata (*Hagonoy) which is present in all quadrats. The most numerous is the *Paspalum conjugatum (*Carabao Grass*)* which had recorded 84 individuals; followed by *Chromolaena odorata (*Hagonoy) with 57. At the understorey, the most dominant vegetation is *Paspalum conjugatum (*Carabao Grass*)*.

Table 20. List of the recorded tree species with highest importance value (IV)

Rank	Common Name	Scientific Name	Family Name	Importance Value (IV)
1	Mangga	*Magifera indica*	Anacardiaceae	39.158
2	Raintree	*Samanea saman*	Fabaceae	22.677
3	Mahogany	*Swetenia macrophylla*	Meliaceae	19.723
4	Kapok	*Ceiba pentadra*	Bombaceae	15.103
5	Ipil-ipil	*Leucaena leucocephala*	Fabaceae	13.627
6	Narra	*Pterocarpus indicus*	Fabaceae	13.125
7	Talisay	*Terminalia catappa*	Combretaceae	12.990
8	Caimito	*Chrysophyllum cainito Linn.*	Sapotaceae	12.820
9	Antipolo	*Artocarpus blancoi*	Moraceae	11.980
10	Santol	*Sandoricum koetjape Merr*	Meliaceae	11.655

Diversity Indices

The diversity of the sampling areas was analyzed by using the PAST software to compute the Shannon-Weiner Index and Pielou's Evenness Index. The Shannon index assumes that individuals are randomly sampled from a large population and that all species are represented in the sample. It gives an estimate of species richness and distribution. The Evenness index is the ratio of the observed diversity to maximum diversity.

Table 21. Diversity indices and number of species for transect lines/quadrats

Sampling Quadrats	Geographical Location	Biodiversity Indices		Number of Individuals
	Latitude/Longitude	Shannon (H)	Evenness (J)	
(Q1)	14°46'56.60"N 121°8'26.10"E	3.313	0.7626	83
(Q2)	14°46'55.60"N 121°8'21.70"E	3.097	0.7137	68
(Q3)	14°46'56.00"N 121°8'14.90"E	1.439	0.3515	68
(Q4)	14°47'19.80"N 121°8'14.40"E	1.961	0.8881	18
(Q5)	14°47'23.20"N 121°8'16.30"E	2.885	0.7459	68
(Q6)	14°47'20.20"N 121°8'31.50"E	3.032	0.7151	60

Endemism

Out of the total one hundred twenty (120) species identified, there are fifteen (15) Philippine endemics (only found in the Philippines) that were found in the sampling sites.

Table 22. List of endemic species recorded in ATN's project area

Local /Common Name		Scientific Name	Family Name
1	Pugahan	*Caryota cumingii Lodd.*	Arecaceae
2	Limuran/Kalape	*Calamus ornatus Blume*	Arecaceae
3	Manila Palm	*Adonidia merrillii*	Arecaceae
4	Hamindang	*Macaranga bicolor*	Euphorbiaceae
5	Narra	*Pterocarpus indicus*	Fabaceae
6	Antipolo	*Artocarpus blancoi*	Moraceae
7	Tibig	*Ficus nota*	Moracea
8	Hagimit	*Ficus minahassae*	Moraceae
9	Kamansi/Rimas	*Artocarpus communis*	Moraceae
10	Is-is	*Ficus odorata*	Moraceae
11	Niyog-niyogan	*Ficus pseudopalma*	Moraceae
12	Pugahan	*Caryota cumingii Lodd.*	Palmae

	Local /Common Name	Scientific Name	Family Name
13	Limuran/Kalape	*Calamus ornatus Blume*	Palmae
14	Kahoi Dalaga	*Mussaenda philippica Merr*	Rubiaceae
15	Tagbak	*Kolowratia elegans*	Zingiberaceae

Conservation Status

The conservation status of species is based on the DAO No. 2017-11 better known as '*'The National List of Threatened Philippine Plants and their Categories'*. From the 120 identified species in the six sampling quadrats, only four (4) species are included in the National Red List.

Table 23. List of identified threatened plants found in the project area

No	Common Name	Scientific Name	Family Name	Conservation Status (DAO No. 2017-11)	Location
1	Narra	*Pterocarpus indicus*	Fabaceae	Vulnerable	Quadrat 1,2,6
2	Antipolo	*Artocarpus blancoi*	Moraceae	Vulnerable	Quadrat 1,2,5,6
3	Manila Palm	*Adonidia merrillii*	Arecaceae	Vulnerable	Quadrat 1
4	Limuran/Kalape	*Calamus ornatus*	Arecaceae	Vulnerable	Quadrat 1,2

2.1.5.2.2 Fauna Composition

Bats Survey

A. Composition, Richness and Diversity

Mammals are particularly important for nature conservation as they balance the needs of the individual in our ecosystem. Among all mammals, only bats can fly because they have unique wings that are thin membranes of skin. These are the primary predator of many insects that fly at night like mosquitoes, leafhopper, and all agricultural and forest pests. Like humans, bats also have their den (a safe place within an animal's territory where it can sleep and rear its family). *Insectivorous microchiroptera* (microbats) are dependent on two habitat components for their survival: roost sites and foraging sites. Human activities such as degradation, harvesting of bats for food, disturbance and potential future land-use changes are some of the major threats that affect the natural habitat of bats.

Five (5) different species of bats were captured with 98 total number of individual species that belong to the families Pteropodidae and Rhinolophidae. This could be attributed to the presence of the insects and fruiting and flowering plants. High capture rate of bat species in station 1 could due to the vegetation and food availability within the vicinity as presence of tubog and some fruiting plants attract the bats in the area.

Table 24. Species richness and diversity of bats recorded within the vicinity of the proposed project site

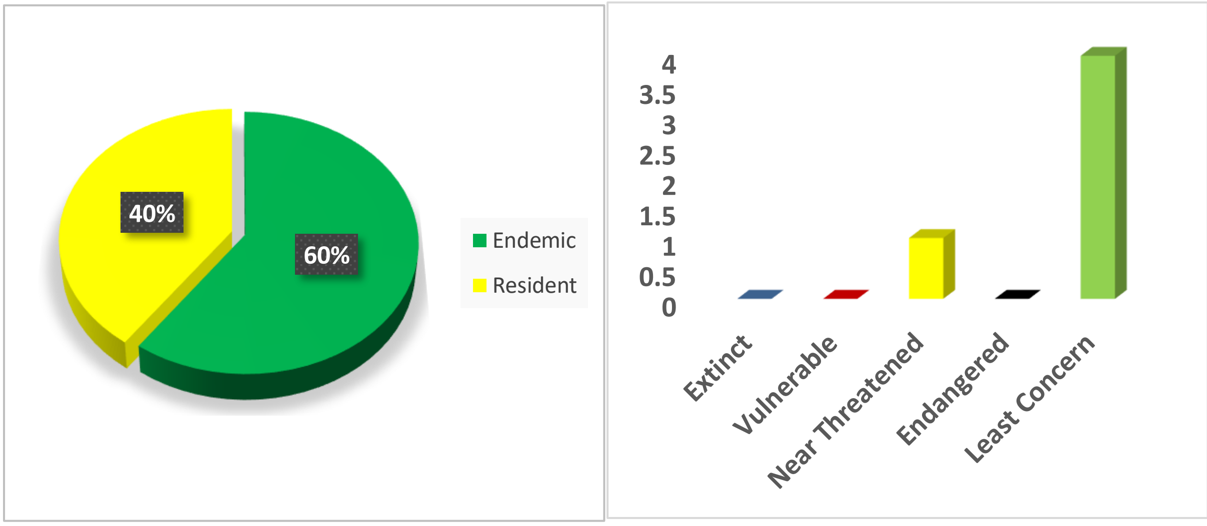
	S1	S2	S3	S4
Taxa_S	4	4	4	5
Individuals	37	25	22	14
Dominance_D	0.3002	0.2736	0.3017	0.2653
Simpson_1-D	0.6998	0.7264	0.6983	0.7347
Shannon_H	1.282	1.339	1.275	1.433
Evenness_e^H/S	0.9011	0.9541	0.8944	0.838

Photo 17. Photos taken during the retrieval of and identification of flying fauna such as birds and bats.

Table 25. Overall bat/flying mammal species that were captured within the vicinity of proposed project site

FAMILY	SCIENTIFIC NAME	ENDIMICITY	IUCN	AREA 1				S-RA	RA
				S1	S2	S3	S4		
Pteropodidae	*Cynopterus brachyotis*	R	LC	15	9	5	3	32	32.65
Pteropodidae	*Eonycteris robusta*	E	NT	7	4	2	1	14	14.28
Pteropodidae	*Ptenochirus jagori*	E	LC	4	5	9	4	22	22.44
Pteropodidae	*Ptenochirus minor*	E	LC	11	7	6	5	29	29.59
Rhinolophidae	*Hipposideros diadema*	R	LC	0	0	0	1	1	1.02
	Total number of individual	98							100

B. Endemicity and Conservation Status of Bats



Graph 16. Distribution status and Conservation status of bats within the vicinity of the project area

Based on the data given above, one (1) species (*Eonycteris robusta*) out of five (5) flying mammals was listed as near threatened while the rest were considered as least concern. This species was measured as near threatened because its population is declining due to human activities such as disturbance of their habitat, and deteriorating forest in the area.

<u>Avifauna Survey</u>

A. Composition, Richness and Diversity

At least fourteen (14) species with 209 individuals from different family of birds were observe in each sampling stations; one of which is endemic while the rest are resident or species that are commonly found in different areas in the world. Endemic species such as *Cyornis lemprieri,* commonly known as Palawan Blue Flycatcher, was observed in the area. Said species was classified as near threatened (NT) by IUCN Red List of Threatened Species.

Station 1 was dominated with *Columba livia domestica* (domestic pigeon); with relative abundance of 15.78 of the total individuals of seen/heard species in the area. Domesticated pigeon is a type of bird species that is highly adaptable in disturbed areas and can reproduce as much as they can.

Shannon_H and Evenness_e^H/S indicate that each station were equally distributed with avifauna species.

Table 26. Species richness and diversity of avifauna recorded within the proposed project area

	S1	S2	S3	S4
Taxa_S	14	12	12	12
Individuals	76	48	59	26
Dominance_D	0.1015	0.09635	0.1566	0.1036
Simpson_1-D	0.8985	0.9036	0.8434	0.8964
Shannon_H	2.453	2.401	2.101	2.365
Evenness_e^H/S	0.83	0.9195	0.6814	0.8868

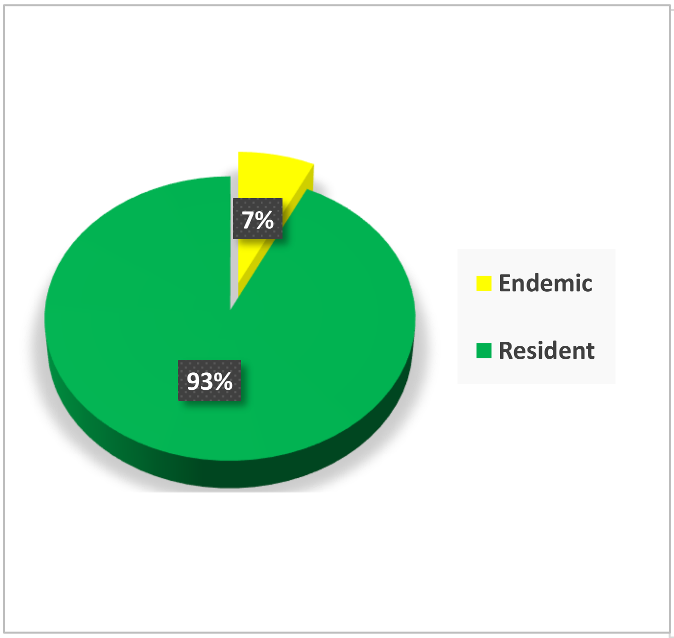
Table 27. Overall avifauna species that were captured within the vicinity of the proposed project area

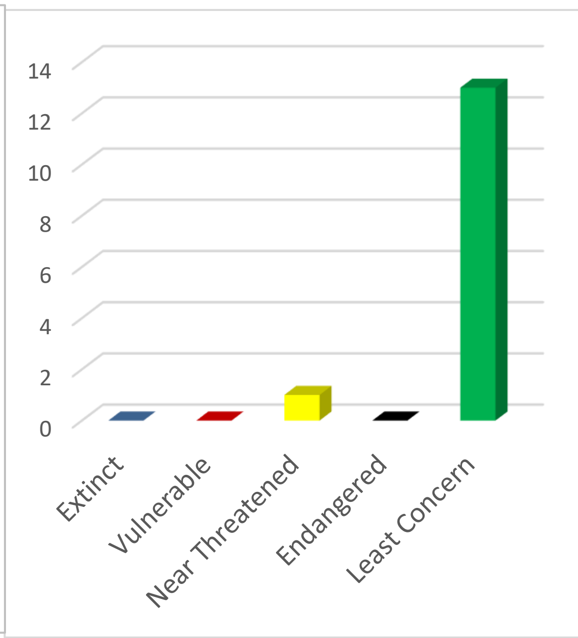
Family	Common name	Scientific name	Range	IUCN	AREA 1				TOTAL	S-RA
					S1	S2	S3	S4		
Alcedinidae	White collared kingfisher	*Todiramphus chloris*	R	LC	5	3	2	4	14	6.69
	White -throated kingfisher	*Halcyon smyrnensis*	R	LC	4	6	1	2	13	6.22
Artamidae	White-breasted woodswallow	*Artamus leucorynchus*	R	LC	10	4	6	2	22	10.52
Columbidae	Zebra Dove	*Geopelia striata*	R	LC	5	3	1	3	12	5.74
	Domistic Pigeons	*Columba livia domestica*	R	LC	15	6	8	4	33	15.78
Estrildidae	Chestnut munia	*Lonchura atricapilla*	R	LC	9	6	17	3	35	16.74
Hirundinidae	Tree swallow	*Tachycineta bicolor*	R	LC	5	4	10	2	21	10.04
Laniidae	Olived backed sunbird	*Cinnyris jugularis*	R	LC	5	3	4	1	13	6.22
Monarchidae	Black-naped monarch	*Hypothymis azurea*	R	LC	3	0	1	0	4	1.91
Muscicapidae	Palawan Blue Flycather	*Cyornis lemprieri*	E	NT	1	0	0	0	1	0.47
Nectariniidae	Brown Shrike	*Lanius cristatus*	R	LC	3	1	4	1	9	4.30
Oriolidae	Black naped oriole	*Oriolus chinensis*	R	LC	2	3	0	1	6	2.87
Pycnonotidae	Yellow-vented Bulbul	*Pycnonotus goiavier*	R	LC	5	3	4	1	13	6.22
Rhipiduridae	Sunda Pied Fantail	*Rhipidura javanica*	R	LC	4	6	1	2	13	6.22
Total					76	48	59	26	209	100

B. Endemicity and Conservation Status of Avifauna

In terms of conservation status, thirteen (13) species of birds that was heard, seen and captured by nets are listed as Least Concern; while one (1) species, *Cyornis lemprieri,* was listed as near threatened. It is also an endemic species or a certain species which can be found only in the Philippines based on the IUCN Red List Status of Birds.

The graph below shows that 7% of the total percentage are endemic while the remaining 93% percent are resident and one species was listed as near threatened; the rest are least concern.





Graph 17. Distribution status and conservation status of avifauna within the vicinity of the proposed project area

Herpetofauna Survey

A. Composition, Richness and Diversity

Amphibian monitoring yielded three (3) species of amphibians; which was dominated by the highly adaptive and invasive *Rhinella marina* or the Cane Toad with relative abundance of 31.66. The Philippine endemic Giant Philippine Frog, *Limnonectes magnus,* was also observed in the area with relative abundance of 26.66. Populations of *L. magnus* was believed to be declining due to overharvesting for food. *Hylarana grandocula* commonly known as the Big Eyed Frog was also observed mainly in bamboo areas within station 4 with relative abundance of 20.83.

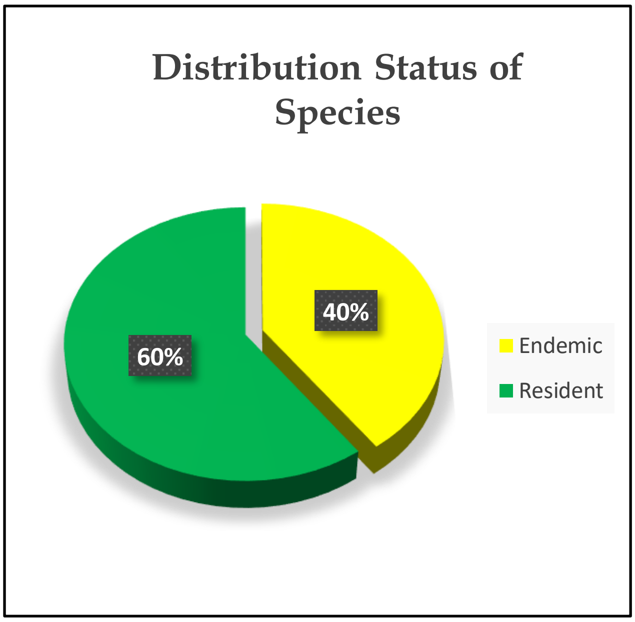
Two (2) species of reptiles from Scincidae family were also observed during the sampling. This include one endemic, *Lamprolepis smaragdina philippinica* or the Emerald skink with a total relative abundance of 13.33 and the Common sun skink (*Eutropis multifasciata*) with relative abundance of 7.5 was distributed at station 1, station 2 and station 3.

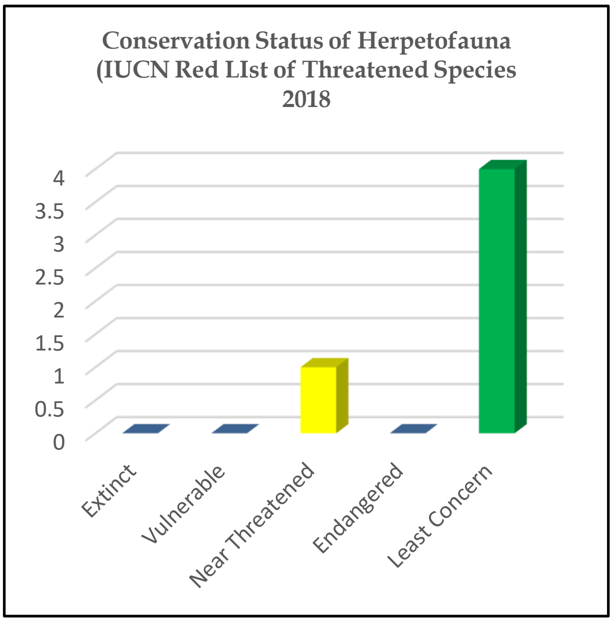
Table 28. Species richness and diversity of herpetofauna recorded within the vicinity of proposed project area

	Station 1	Station 2	Station 3	Station 4
Taxa_S	5	2	2	1
Individuals	102	9	8	1
Dominance_D	0.3001	0.8025	0.625	1
Simpson_1-D	0.6999	0.1975	0.375	0
Shannon_H	1.301	0.3488	0.5623	0
Evenness_e^H/S	0.7347	0.7087	0.8774	1

Shannon_H and Evenness_e^H/S in the sampling stations have different values. In station 1, station 2 and station 3, the result of Shannon_H are both high in value which could be associated to the types of vegetation in each area while the value of Shannon_H in station 4 has low value due to low level of food availability in the area

A. Endemicity, Conservation Status and Multivariate Analyses of Amphibians





Graph 18. Distribution status and conservation status of herpetofauna within the vicinity of the proposed project area

Two (2) species of amphibians were recorded as Philippine endemic: *Limnonectes magnus* which is listed as near threatened and *Hylarana grandocula* registered as least concern according to the IUCN Red List of Threatened Species 2019. These two species gathered 40% of the overall percentage of species distribution in the area while 60% of the species were identified as resident, like the invasive species of amphibians, *Rhinella marina* and reptile species *Lamprolepis smaragdina philippinica*, and *Eutropis multifasciata*. Four species from herpetofauna were recorded as least concern including *Hylarana grandocula*, *Rhinella marina*, *Lamprolepis smaragdina philippinica*, and *Eutropis multifasciata;* while only *Limnonectes magnus* was identified as near threatened

Table 29. Overall Herpetofauna species that were captured within the vicinity of the proposed project area

Classification	Family Name	Scientific Name	Common Name	Range	IUCN STATUS	S1	S2	S3	S4	TOTAL	S-RA
Amphibians	Bufonidae	*Rhinella marina*	Cane Toad	R	LC	38	0	0	0	38	31.66
	Ranidae	*Hylarana grandocula*	Big-eyed frog	E	LC	25	0	0	0	25	20.83
	Dicroglossidae	*Limnonectes magnus*	Giant Philippine Frog	E	NT	32	0	0	0	32	26.66
Reptiles	Scincidae	*Lamprolepis smaragdina philippinica*	Emerald Skink	R	LC	2	8	6	0	16	13.33
		Eutropis multifasciata	Common sun skink	R	LC	5	1	2	1	9	7.5

Rodents Survey

A. Composition, Richness and Diversity

Existence of non-flying mammals sometimes may vary to the quality of the habitat of the area. During the sampling period, only one (1) species of rodent was captured and recorded. Observed *Rattus tanezumi* from the family of Muridae has seven (7) individual species listed. It is native to forests and brushy areas but can now be found alongside the rapid expansion of the human population. The rodents were captured by using rat traps installed in each area.

Photo 18. Pictures taken during the installation of snap traps and retrieval of rodents.

Table 30. Overall Rodent Species that were Captured within ATN's project area

Family	Scientific name	Endimicity	IUCN Status of Rodents	S1	S2	S3	S4	S-RA
Muridae	*Rattus tanezumi*	LC	R	1	3	0	3	7

IMPACTS AND MITIGATING MEASURES ON TERRESTRIAL FLORA AND FAUNA

Clearing of vegetation will result to the removal of ecologically and economically important species and destruction of wildlife habitat; which in turn will result to the displacement of wildlife. Stripping of topsoil could cause seed displacement that would affect the ecological recovery of vegetation in the project site. Accelerated soil erosion as a result of clearing and earthworks will contribute to soil nutrient loss necessary for plant growth. The removal of photosynthesizing plants will affect CO_2 sequestration causing some degree of effect on the microclimate. Removal of vegetation, top soil, leaf litter, rock crevices, decaying logs, tree stumps, etc. will lead to the complete transformation of the habitat causing displacement and even direct killing of wildlife most especially those that are less mobile (i.e., amphibians, reptiles, small non-volant mammals, nestlings and other young individuals).

Construction of new access roads may cause formation of internal habitat fragmentation leading to isolation and decreased dispersal capabilities of different wildlife. It may also lead to habitat loss causing population reduction, create continuous disturbance at forest edges leading to decreased habitat quality and alteration of faunal assemblage, intrusion of commensal and other invasive species, and mortality due to vehicular traffic. The area will also be more accessible attracting illegal hunters and poachers of animals for food, trading or pets.

To address the said impacts and given that conservation of all species may not be possible, priority shall be given to ecologically and economically important species identified in the area. A tree nursery shall be established to propagate the seeds/propagules of these species, which will provide seedlings for future reforestation and rehabilitation requirements. The development of the tree plantation shall use the indigenous species and apply assisted natural regeneration (ANR) techniques. In addition, clearing and site preparation shall be done in stages. Poaching of wildlife shall be strictly prohibited to mitigate population reduction and allow their safe movement.

Excavated topsoil shall be used to rehabilitate disturbed/worked areas and/or shall be temporarily stockpiled in the designated topsoil areas. The topsoil shall be seeded to promote vegetative growth and to maintain and improve the soil quality. Cut trees shall be chipped and spread out evenly which can also serve as growing medium for rehabilitation. Whenever possible, tree-balling and immediate transfer of trees to open areas in the barangay will be done. A tree cutting permit shall be secured prior to any cutting and clearing.

Schedule of activities will also be carefully considered and implemented. Personnel, heavy equipment, other vehicles, etc. shall be confined only to pre-determined designated areas and shall not occupy other areas to prevent further disturbances to terrestrial flora and fauna. Regular replacement and/or maintenance of equipment particularly mufflers of vehicles shall be done to minimize noise. For new roads to be opened up, heavily disturbed (e.g., grassland, scrubland, etc.) areas or trails shall be considered and prioritized. Progressive rehabilitation of disturbed areas shall be carried out. For new roads to be opened up, heavily disturbed (e.g., grassland, scrubland, etc.) areas or trails shall be considered and prioritized in the design of road layout. Riparian zones will be given high priority for regeneration activities to connect separated habitat areas.

Existing wildlife in the area shall be protected through an active and continuous wildlife protection and conservation campaign with the participation of all key stakeholders (e.g., communities, DENR, LGUs, etc.) within and around the project site. Progressive rehabilitation of disturbed areas shall be carried out.

Impacts	Mitigating Measures
- Removal of ecologically and economically important species	- Priority for conservation shall be given to ecologically and economically important species identified in the area; - Establishment of a nursery to propagate the seeds/propagules, which will provide seedlings for future rehabilitation requirements; - Tree plantation development using the indigenous species and assisted natural regeneration (ANR) techniques; and - Enhance agro-forestry technologies suitable for the area.
- Removal of wildlife habitat and	- Avoid unnecessary clearing of vegetation; and

Impacts	Mitigating Measures
displacement of wildlife	- Strictly prohibit poaching of wildlife to mitigate population reduction and allow their safe movement.
- Enhanced soil erosion	- Excavated topsoil shall be spread out in the surrounding areas; and - Install erosion control facilities.
- Removal of photosynthesizing plants	- Whenever possible, tree-balling and immediate transfer of trees to open areas within the project area will be done (Applicable only to the critically endangered tree species); and - A tree cutting permit shall be secured prior to any clearing and cutting/harvesting operation.
- Transformation of habitat causing displacement and even direct killing of wildlife	- Schedule of activities shall be carefully considered and implemented; and - Personnel, heavy equipment, other vehicles, etc. shall be confined only to pre-determined designated areas and shall not occupy other areas so as to avoid further disturbances
- Formation of internal habitat fragmentation due to the creation and construction of entirely new access roads	- For accessibility, existing roads will be utilized and improved
- Construction of the access roads may also lead to habitat loss causing population reduction, create continuous disturbance at forest edges leading to decreased habitat quality and alteration of faunal assemblage, intrusion of commensal and other invasive species, and mortality due to vehicular traffic.	- For new roads to be opened up, heavily disturbed (e.g., grassland, scrubland, etc.) areas or trails shall be prioritized as the location
- The area will be more accessible to illegal hunters and poachers	- Poaching of wildlife and hunting will be strictly prohibited; - An active and continuous wildlife protection and conservation campaign will be pursued with the participation of all key stakeholders (e.g., communities, LGUs, etc.) within and around the project site; and - Regular replacement and/or maintenance of equipment particularly mufflers of vehicles to minimize noise.

2.2 Water

This section presents results of the conducted baseline characterization of the project area based on hydrology and hydrogeology and water quality. The EIA study on water resources aims to:

- Obtain baseline water quality data;
- Describe the water resources conditions at the project site and the surrounding areas;
- Assess how the project will impact upon the water resources during the various stages of the project; and
- Develop and formulate mitigation and enhancement strategies to safeguard the depletion of water quantity, and the degradation of quality of the current domestic and industrial uses.

2.2.1 Hydrology and Hydrogeology

2.2.1.1 Hydrogeology

The project area is underlain by volcanic formation consisting of basalt, andesite and volcanic breccias, which are generally impermeable and low porosity rocks as compared to sediments-derived rock layers such as sandstone. This hydro-geological characters apparently correlates with the Groundwater Availability Map of the Philippines, wherein the project area is classified under local and less productive aquifers and rocks with limited potential, low to moderate permeability.

Moreover, the inherent primary structures such as voids and cavities, and related secondary structures in the form of fractures/joints or discontinuities, serve as good permeable network for groundwater flow in the rock formation. One indication of groundwater flow in the bedrock or structure is through the presence of spring, which was not observed in the project area.

There are no existing observation wells and collected historical observation well data in the project area. Indication of water flow, however, was observed through exploration drilling conducted by the company. Five out six drill holes have intercepted evidences of chemical weathering through oxidation at an average depth at 28.18m, which indicates water saturation. The base of oxidation was observed in one drill hole at 21.40m depth and in deeper level at 44.60m.

In addition, physical evidences of joint discontinuities and shears, though weak in intensity, were observed in some outcrops along the river within the project area that may imply water saturation as subsurface water flows may have utilized these permeable structures as conduit routes. Fault structures that crosses near and within the project area may also serve as ground water pathway.

The phreatic line (water table) is inferred to follow the topographic profile and seemingly it flows directly towards the river inside the tenement. On the east side outside the project area, groundwater also seeks its level towards the river. A low-lying hill on the east side of the tenement, appears to be the recharge zone while the possible recharge zones within the project area would be coming from the elevated zones on the western and northern sides of the project area wherein denser vegetation predominates. The groundwater flows are inferred to be in N-S, NE-SW and NW-SE directions.

Water infiltration could be higher in the overburden, which apparently cap the aggregates deposit; while it is expected to be lower thru less permeable volcanic bed rocks. Presence of groundwater in significantly permeable layers such as overburden and weathered rocks, especially during intense rainfall, may induce potential slip failure. Groundwater can represent issues during surface mining and its removal can prove costly. Piping, uplift pressure and flow of water into the pit or quarry can lead into hazards like erosion and failure of the quarry/pit sides.

Presence of discontinuities in the rock mass make it permeable and serves as natural groundwater pathway. Discontinuities could also contain lenses of water along structures which may serve as good aquifer. An aquifer is a geologic layer of porous and permeable material through with water flows and is stored.

In essence, the volcanic layer act as very low hydraulic-conductive unit while the thick overburden capping the aggregates deposit serve as low to high hydraulic-conductive layer. The overburden and unconsolidated alluvial deposits found in elevated grounds of Brgy. Macabud could serve as good aquifer and could be tapped as potential water source. Good water source could also be found at lower elevation in the project area, near potential structural trap and porous layers lying close to the river bank and flood plain.

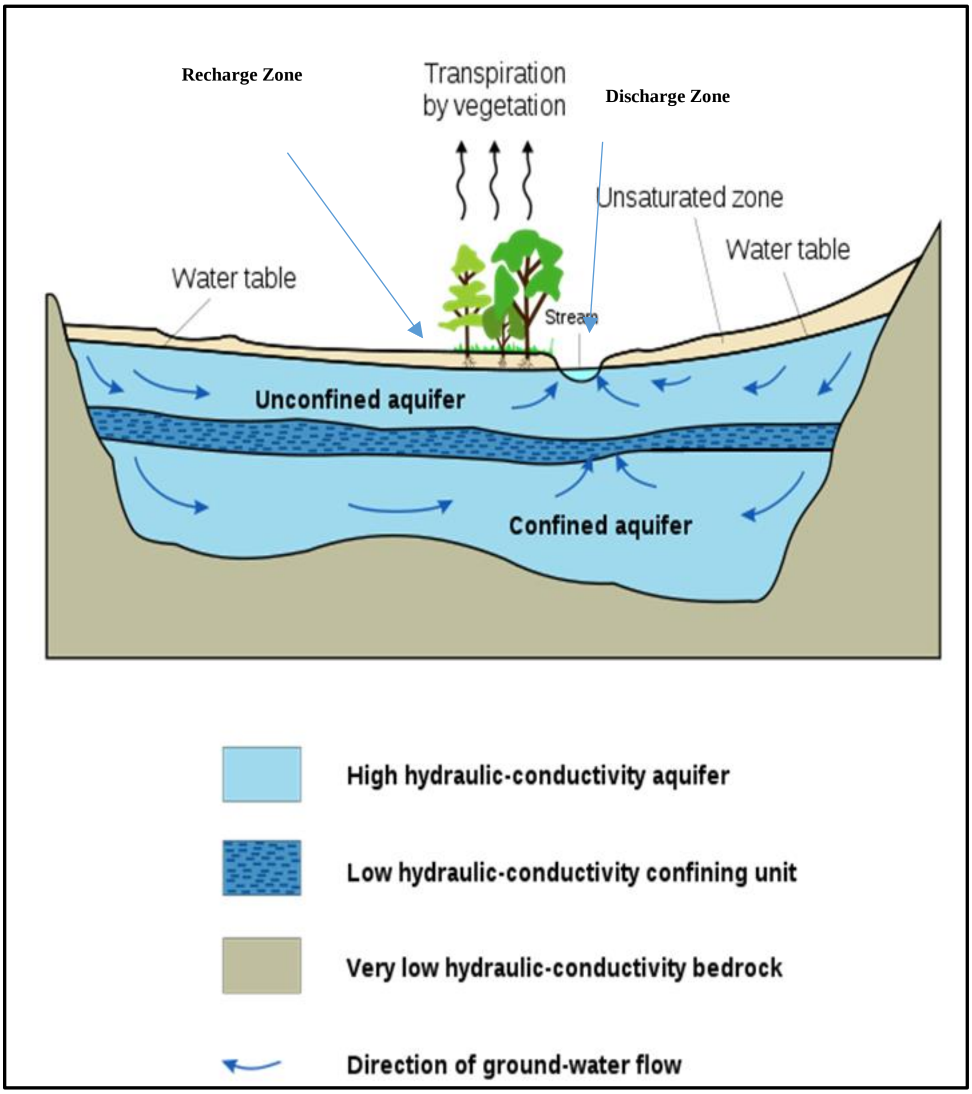


Figure 34 – Hydraulic Conductivity in relation to Recharge and Discharge Zone

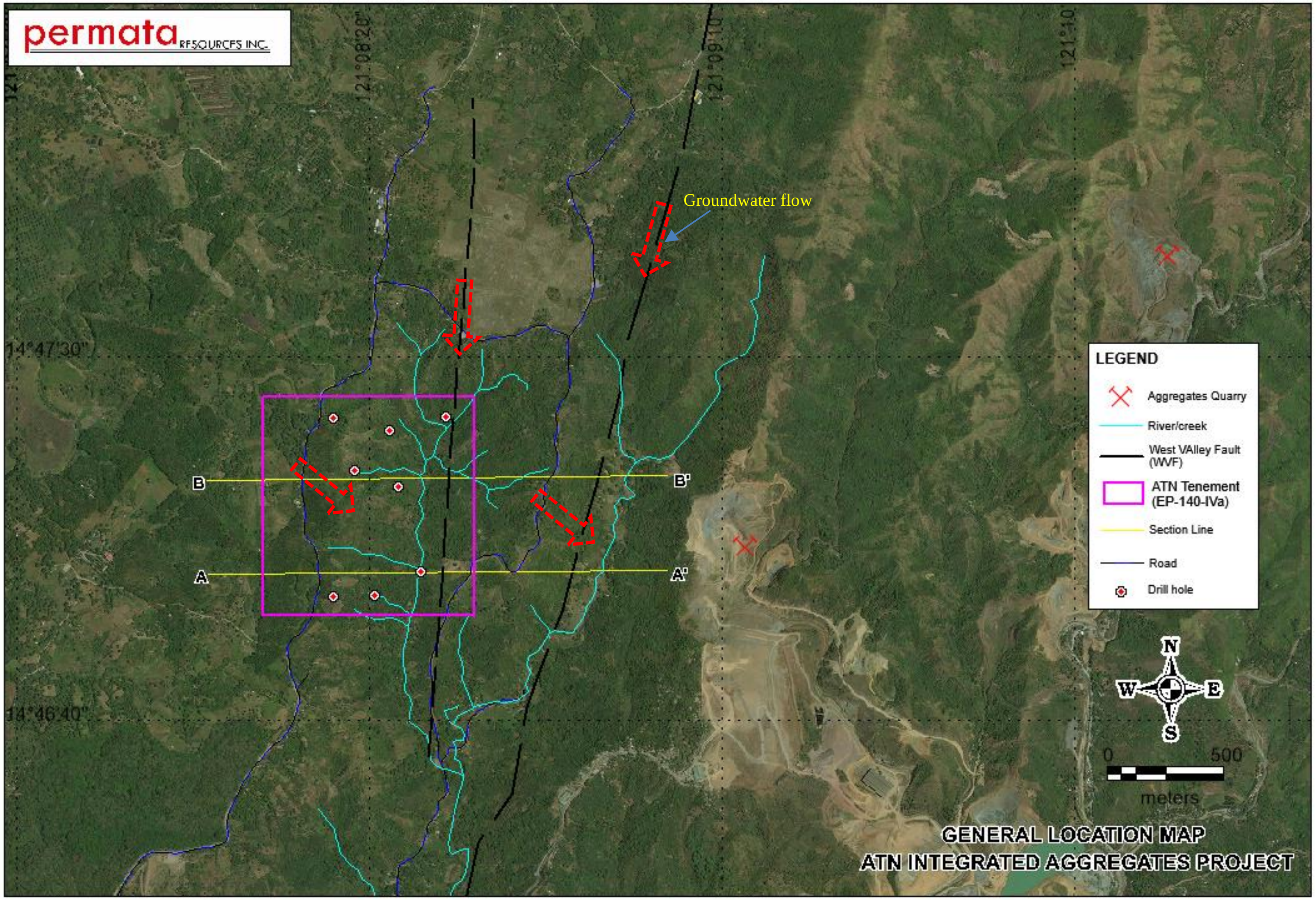


Figure 35 – Possible Groundwater flow direction in the project area and vicinity

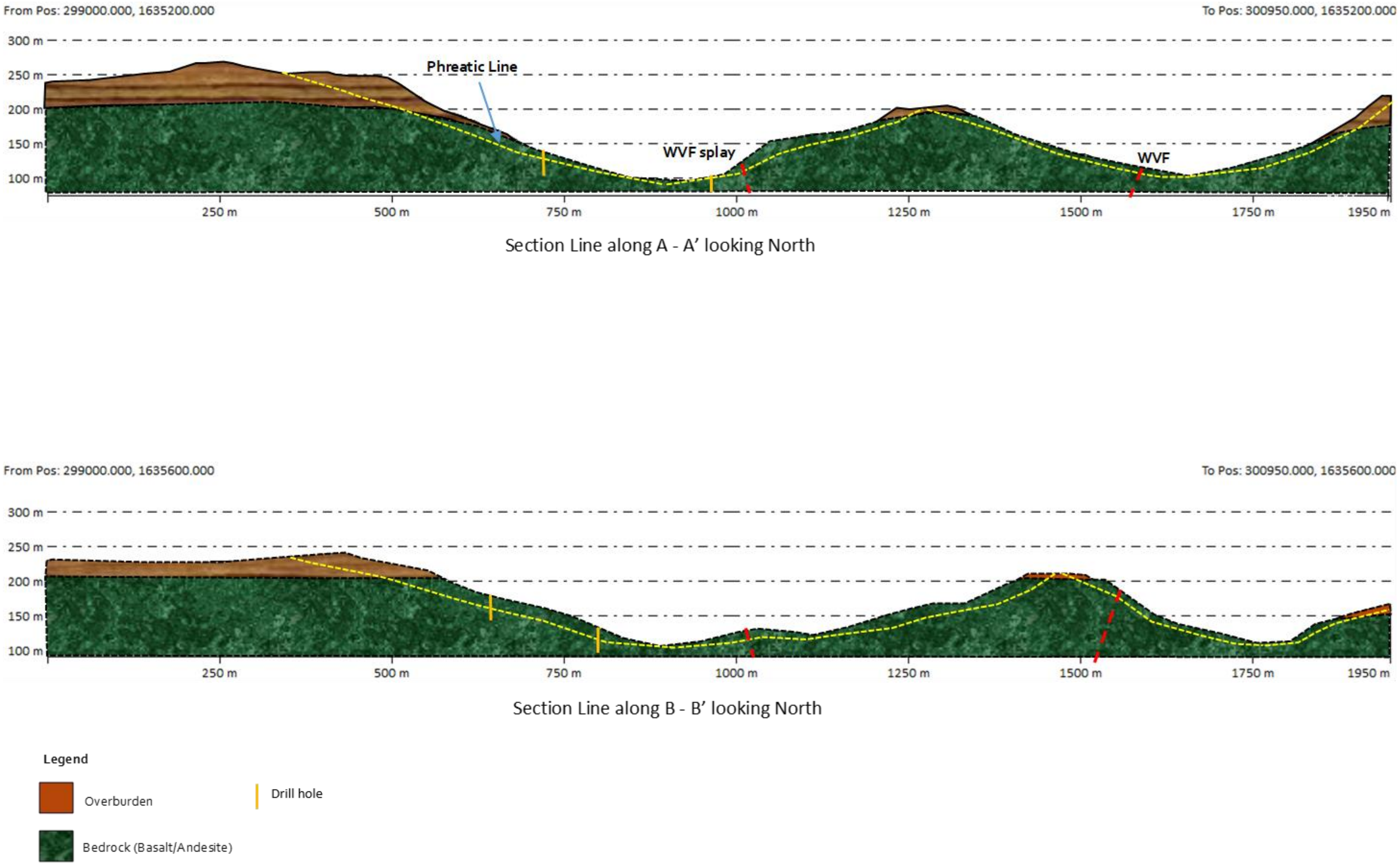
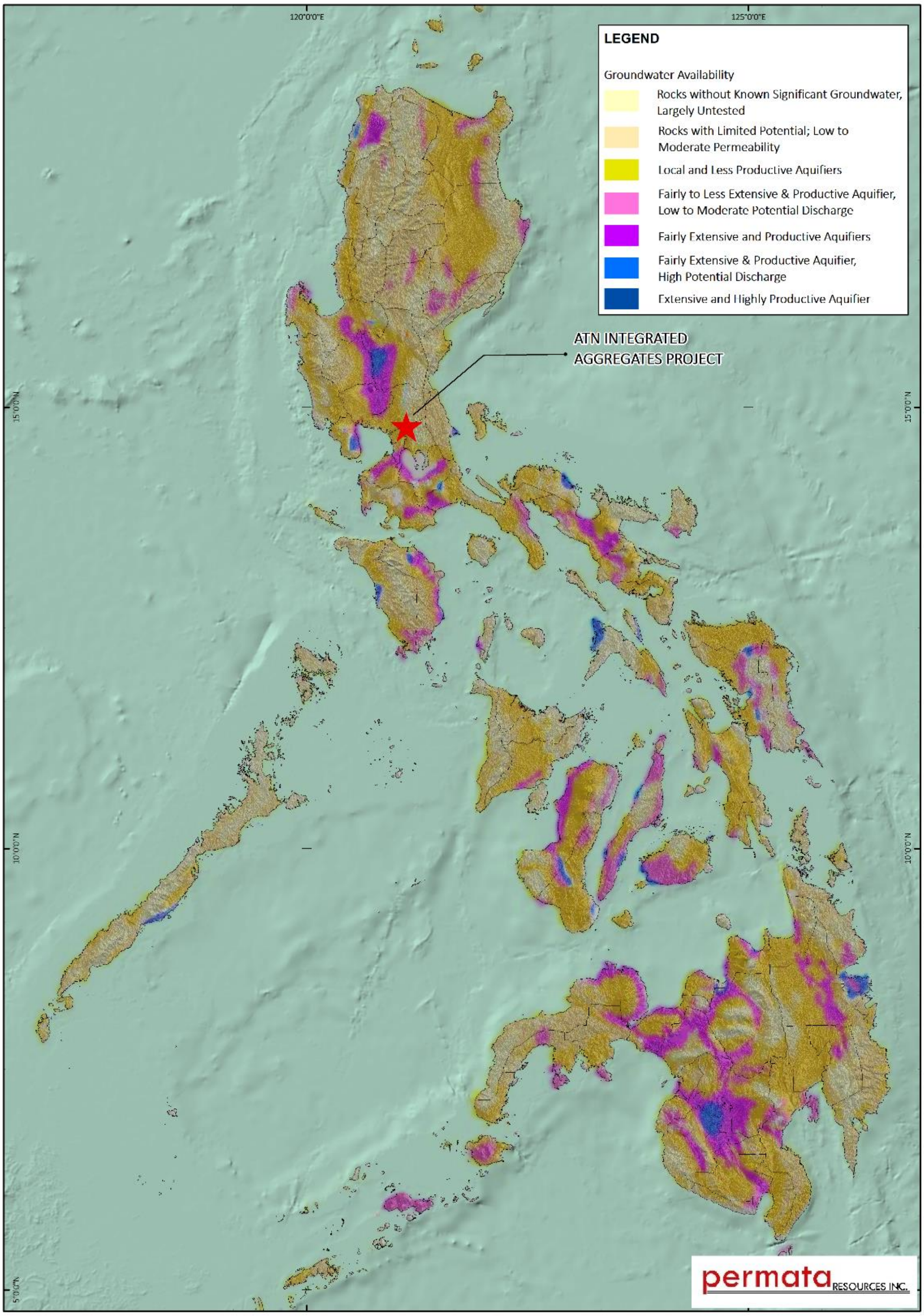


Figure 36 – Inferred Phreatic Line (water table) in the project area in relation to slope and fault structure



Source: DENR

Figure 37 – Groundwater Availability Map of the Philippines

IMPACTS AND MITIGATING MEASURES ON HYDROLOGY/HYDROGEOLOGY

The construction and operation phase of the project will entail clearing and grubbing of vegetation and stripping of topsoil which would cause an increase in surface runoff and soil erosion. If not mitigated, loose materials may reach nearby water bodies. Siltation of streams reduces their carrying capacities resulting to overflow in low-lying areas. Increased surface runoff would result to abnormal increase in river discharge resulting to river scour and channel erosion.

Erosion shall be prevented through progressive rehabilitation. Buffer zones surrounding the channels shall also be established to prevent loose materials from reaching the rivers/creeks in the area. Additional mitigating measures such as siltation ponds shall be strategically placed to prevent further transport of the sediments from the tributaries to the main creek/rivers.

2.2.2 Water Quality

This section presents the results of water quality baseline monitoring conducted on 24 June 2019.

2.2.2.1 Methodology

The middle portion of the selected sampling locations having the deepest water level and with fastest current was chosen as the sampling point. Grab samples were collected by first rinsing the container provided by the commissioned water quality Laboratory at least three times using the stream water before the actual sample collection. Sampling were made by submerging the grab water sampler, facing downward at a depth approximately 20 cm or whenever the water depth of stream permits.

The stream/surface water sampling activity was conducted between 9:00 am to 2:00 pm. To avoid any sample contamination, it was initially rinsed, at least three times before obtaining the water samples for measurements.

Each parameter has a specific type of container and volume. Sampling containers were prepared according to the specifications approved by AS/NZS 5667.1.:1998 and the United States EPA 2007. Samples were cool stored (approx. 6°C). Appropriate preserving reagents were added to prolong holding time of the samples whenever necessary.

Table 31. Container requirements and sample maximum holding time

Parameters	Sample Volume	Container	Handling/ Preservation	Maximum Holding Time
TSS TDS	1L	Polyethylene washed with phosphate-free detergent and ion free water	Cool stored at ≤ 6^{O} C	7 Days 7 Days
BOD	1L	Polyethylene washed with phosphate-free detergent and ion free water	Cool stored at ≤ 6^{O} C	48 hours
Oil and Grease	1L	Wide mouthed glass, with Aluminum foil	Cool stored at ≤ 6^{O}	28 Days
Cr^{+6}	500 ml	Polyethylene rinsed with Nitric Acid (HNO_3)	Cool stored at	28 Days

Parameters	Sample Volume	Container	Handling/ Preservation	Maximum Holding Time
			≤ 6^{O} C	
Total Metals - Arsenic (As) - Cadmium (Cd) - Lead (Pb) - Mercury (Hg)	1L	Polyethylene rinsed with Nitric Acid (HNO_3)	Cool stored at ≤ 6^{O} C; Filtered on site	6 Months

The table below lists the laboratory methods use by Ostrea Mineral Laboratories Inc. for the analysis of samples using the Standard Methods for the examination of Water and Waste Water 22nd Ed. These are the same procedures as described in the DAO 2016-08.

Table 32. Laboratory Analytical Methods

Parameters	Laboratory Method
Oil and Grease	Liquid-Liquid, Partition- Gravimetric
Color	Visual comparison
Total Suspended Solids (TSS)	Gravimetry, dried at 103 – 105 ° C
Chemical Oxygen Demand (COD)	Open reflux
Biological Oxygen demand (BOD)	5 – Day BOD Test
Ammonia as NH^3 - N	Ammonia-Selective Electrode
Nitrate as $NO3^-$ - N	Colorimetric, Brucine
Chloride	Argentometric
Zinc	Direct air- Acetylene Flame
Cadmium (Cd)	Direct air- Acetylene Flame
Lead (Pb)	Direct air- Acetylene Flame
Mercury (Hg)	Manual Cold Vapor Atomic Absorption Spectrometric
Hexavalent Chromium (Cr^{+6})	Direct air- Acetylene Flame
Thermotolerant (Fecal) Coliform	Multi Tube Fermentation

Sampling Locations

Four (4) surface water quality sampling locations within and outside the project site were established. Surface water quality sampling stations included the upstream and downstream portion of an unnamed river (SW1; SW2, respectively) and a tributary of the unnamed river south east of the area in the upstream portion (SW3) and downstream portion (SW4). The type of waterway was determined based on the river morphology as described by Ramsey and Burckley (1966).

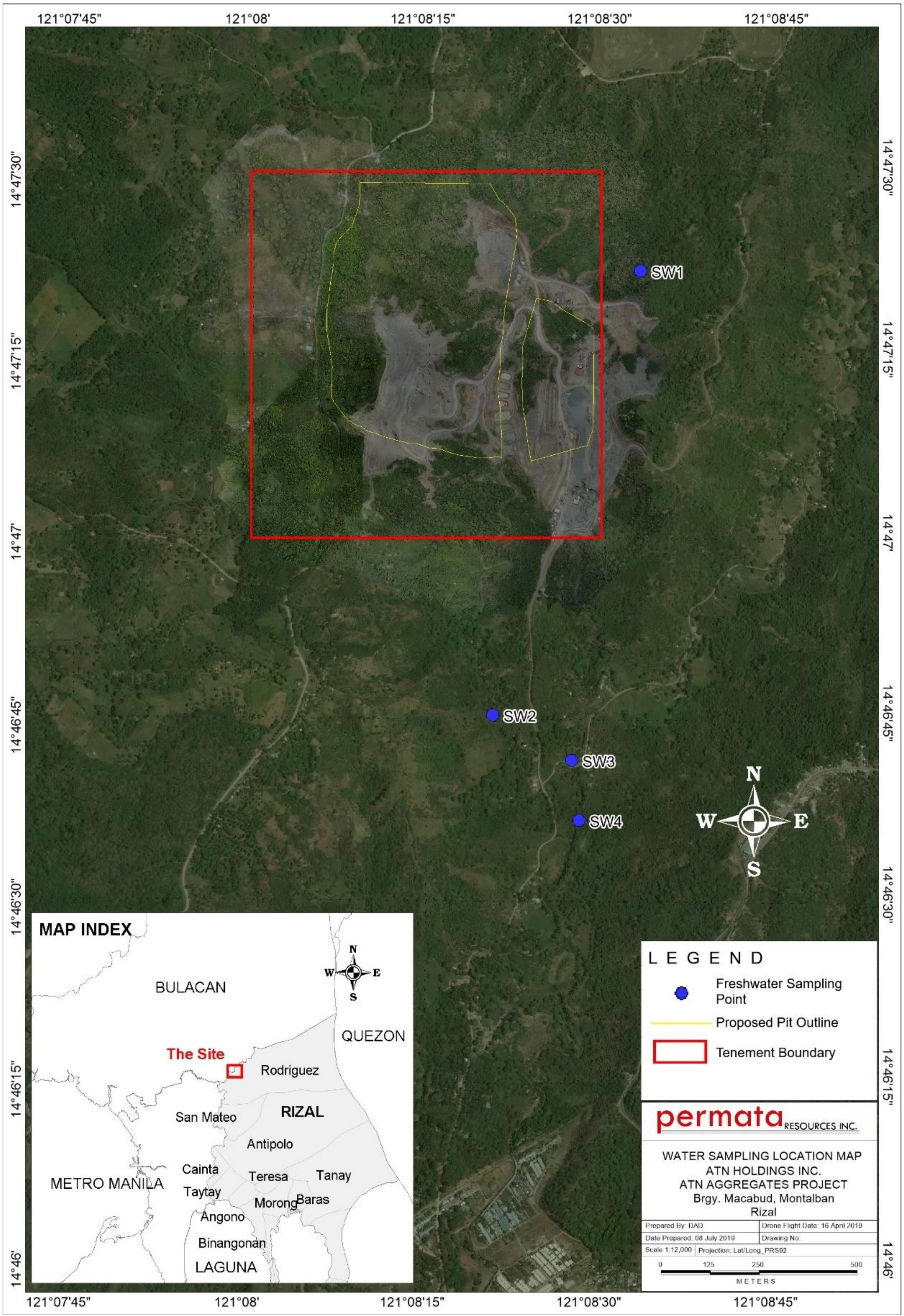


Figure 38 – Location of Water Sampling Stations

2.2.2.2 Water Classification

2.2.2.2.1 Fresh Water

The guidelines stipulated in DAO No. 34, Revised Water Usage and Classification/Water Quality Criteria, were used in the assessment of the current status of surface water quality in the study area. Philippine fresh, coastal and marine waters are classified based on their beneficial use. Beneficial use shall include, but not be limited to, the use of water for domestic, recreational, fishery, industrial and agricultural use.

Water quality sampling used the Water Body DENR AO 2016-08 Classification and Usage of Freshwater (**Table 33)**.

Table 33. Water Body Classification and Usage of Freshwater

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

Note: For unclassified water bodies, classification will be based on the beneficial use as determined by the Environmental Management Bureau (EMB).

The results of the laboratory analyses were compared to the national water quality environmental standards DENR AO 2016-08. This included the physical and chemical properties, organic and inorganic composition, bacteriological properties and the presence of heavy metals was determined by subjecting all of samples to chemical analyses.

Table 34. Parameters analyzed for stream/surface and effluents water quality

DENR AO 2016-08 STANDARDS (Stream/Surface)	
	Class C
pH	6.5 – 9.0
Color (ACU)	75
Surfactants (MBAS)	1.5
Total Suspended Solids (mg l^{-1})	80
Dissolved Oxygen	5
Biochemical Oxygen Demand (mg l^{-1})	7
Chemical Oxygen Demand (mg l^{-1})	-
Total Dissolved Solids (mg l^{-1})	-
Oil and grease (mg l^{-1})	2

DENR AO 2016-08 STANDARDS (Stream/Surface)	
Phosphate (mg l^{-1})	0.5
Ammonia as NH3 – N (mg l^{-1})	0.05
Nitrate as $NH3^{-}$ - N	7
Cadmium (mg l^{-1})	0.005
Lead (mg l^{-1})	0.05
Hexavalent Chromium (mg l^{-1})	0.01
Mercury (mg l^{-1})	0.002
Zinc (mg l^{-1})	0.2
Thermotolerant (Fecal) Coliform (MPN/100 ml^{-1})	200

2.2.2.3 Baseline Conditions

According to Chapman, *et. al.* (2013), surface waters refer to rivers, streams, lakes, ponds and reservoirs. When rain falls on the land, it either seeps into the ground to recharge groundwater aquifers or becomes runoff which flows downhill over and through the soil into streams, rivers, ponds and lakes. However, surface water bodies do not just receive water from runoff, many receive inputs from groundwater, the contribution of which generally increases during periods of low flow.

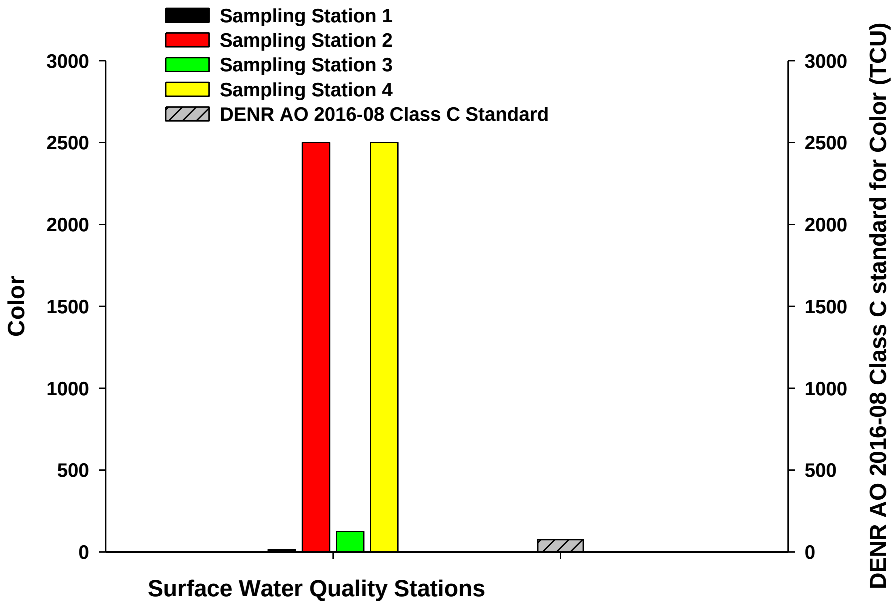
All surface waters contain dissolved (solutes) and suspended (particulate) inorganic and organic substances. The distinction between dissolved and suspended substances is based on filtration, usually through a 0.45 μm membrane filter although other size filters are also used. Particulate matter can impact the turbidity (a measure of the amounts of suspended particles in the water) which can reduce the light penetration into the water body. High turbidity may impact aquatic life as it reduces the opportunity for photosynthesis.

The major dissolved ions in surface waters, which occur at concentrations exceeding 1 mg L^{-1}, are bicarbonate ($HCO3^{-}$), sulphate ($SO4^{2-}$), chloride (Cl^{-}), calcium (Ca^{2+}), magnesium (Mg^{2+}), sodium (Na^{+}) and potassium (K^{+}). These seven ions, along with silica (which occurs as $Si(OH)_4$ at the pH of most natural waters), constitute ~95% of the total dissolved inorganic solutes in surface waters. This reflects their relative abundance in the earth's crust and the fact that they are moderately to very soluble. In contrast, the metals and metalloids, which occur at much lower concentrations, are generally found in or bound to the particulate matter in surface waters.

2.2.2.3.1 Stream Water Color

Presence of suspended and dissolved particles in water influence the surface water color. Suspended material in water bodies may be a result of natural causes and/or human activity. Transparent water with a low accumulation of dissolved materials appears blue and indicates low productivity. Dissolved organic matter, such as humus, peat or decaying plant matter, can produce a yellow or brown color. Some algae or dinoflagellates produce reddish or deep yellow waters. Water rich in phytoplankton and other algae usually appears green. Soil runoff produces a variety of yellow, red, brown and gray colors.

The weathering of rocks and soils, the present land-use activity and the type of trees and plants growing within the watershed will influence the types and amount of dissolved and suspended material found in a lake or stream.



Graph 19. Surface Water Color

Presented in the graph is the surface water color laboratory analysis of the grab water samples taken at the sampling stations. Surface water sampling station 1 (SW1) gave the lowest true color unit (TCU) of 15.0. This indicated that the upstream portion of the unknown river on the lower eastern side of the project area have low suspended particulates. Sampling the downstream portion of the unknown river of its surface water indicated elevated levels of particulates (brownish) at 2,500 TCU; which is 33.33 times more when compared to the DENR AO 20-16 Class C standard of 75 TCU.

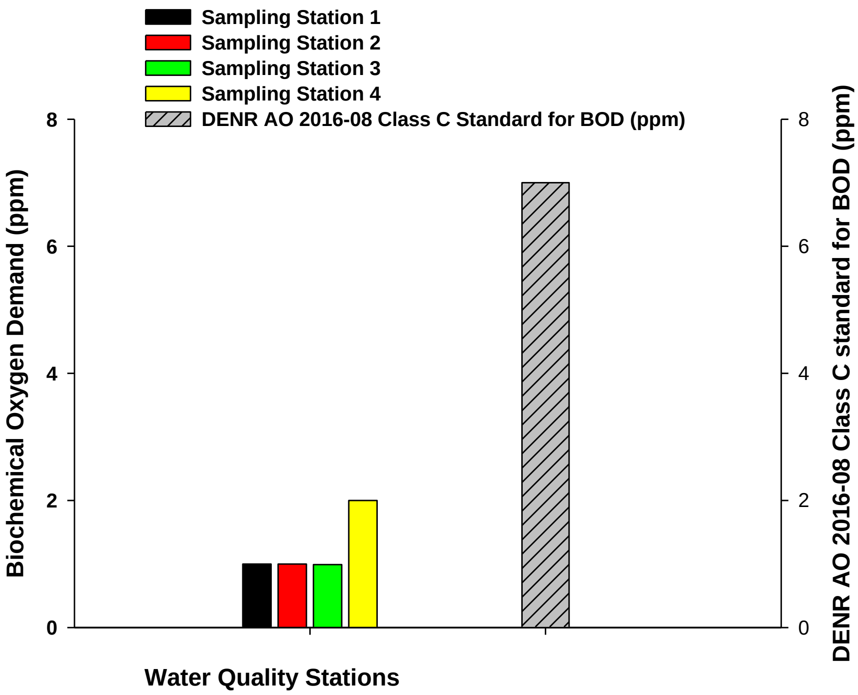
Station 3 is the upstream portion of a tributary of the unknown river that traverses the quarry area. The laboratory result indicated an elevated level of suspended particulates at 125.0 TCU; which is 1.67 more when compared to the Class C standard of the DENR AO- 2016-8.

Reaching the downstream portion (SW4) of the tributary of the unknown river gave an elevated TCU level of 2,500.0. This indicates the presence of suspended particulates in the surface water. The observed high TCU of the two downstream stations (SW2 and SW4) can be attributed to algal bloom and may have been brought about by the presence of suspended assorted nutrients coming from decomposed organic matter and other solutes that can accumulate in these river portions.

2.2.2.3.2 Stream Water Biochemical Oxygen Demand

Biochemical oxygen demand (BOD, also called biological oxygen demand) is the amount of dissolved oxygen needed (i.e., demanded) by aerobic biological organisms to break down organic material present in a given water sample at certain temperature over a specific time period. The BOD value is most commonly expressed in milligrams of oxygen consumed per liter of sample during 5 days of incubation at 20°C and, is often used as a surrogate of the degree of organic pollution of water Biochemical Oxygen Demand is an important water quality parameter because it provides an index to assess the effect of discharged wastewater will have on the receiving environment. The higher the BOD value, the greater the amount of organic matter or “food” available for oxygen consuming bacteria. If the rate of water dissolved oxygen (DO) consumption by bacteria exceeds the supply of DO from aquatic plants, algae photosynthesis or diffusing from air, unfavorable conditions occur. Depletion of DO causes stress on aquatic organisms, making the environment unsuitable for life.

Further, if there is a discharge of organic pollutants into a river, the oxygen concentration will quickly drop which might result in death of many aquatic animals that need to extract oxygen from the water to survive.



Graph 20. Surface Water Biochemical Oxygen Demand

When compared to the Class C DENR AO 2016-08 standard of 7 ppm, the upstream portion (SW1) of unknown river is much lower than the standard of only 1.0 mg l^{-1} and is therefore within the acceptable standard. In contrast, the downstream portion of the same river (SW2) have a BOD content of 1.0 ppm. BOD of the unknown river indicated the absence of putrescible organic matter in water. On the other hand, sampling the upstream and downstream portion of the tributary of the unknown river gave a similar BOD values of 0.99 and 2 mg l^{-1} for SW3 and SW4, respectively. The low BOD in these surface waters is an indicator of good quality water of the proposed quarry site.

2.2.2.3.3 Stream Water Chemical Oxygen Demand

In environmental chemistry, the chemical oxygen demand (COD) is an indicative measure of the amount of oxygen that can be consumed by reactions in a measured solution. It is commonly expressed in mass of oxygen consumed over volume of solution which is in milligrams per liter (mg l^{-1}) or equally the same as part per million (ppm). A COD test can be used to easily quantify the amount of organics in water. The most common application of COD is in quantifying the amount of oxidizable pollutants found in surface waters of our rivers or wastewater. It is also useful in terms of water quality by providing a metric to determine the effect an effluent will have on the receiving body, much like biochemical oxygen demand (BOD).

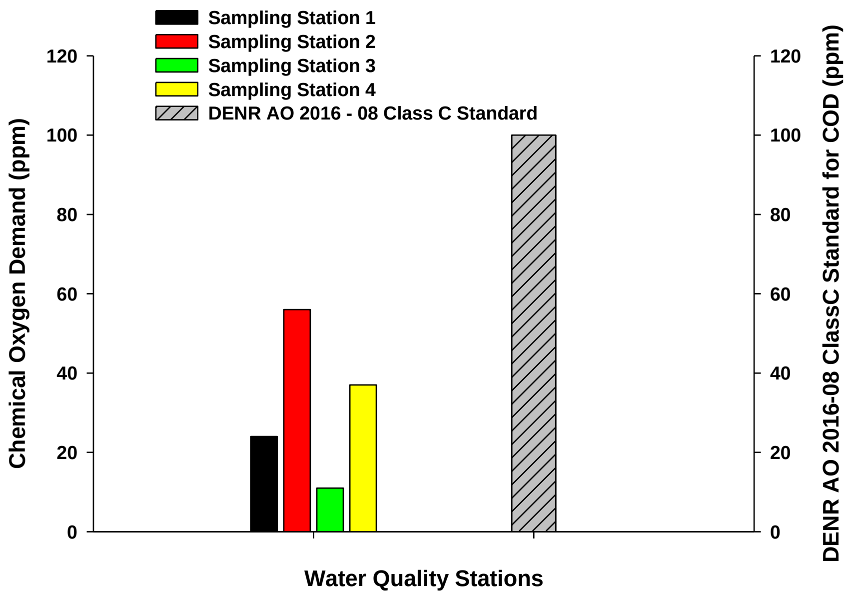


Figure 2.3 Surface Water Chemical Oxygen Demand

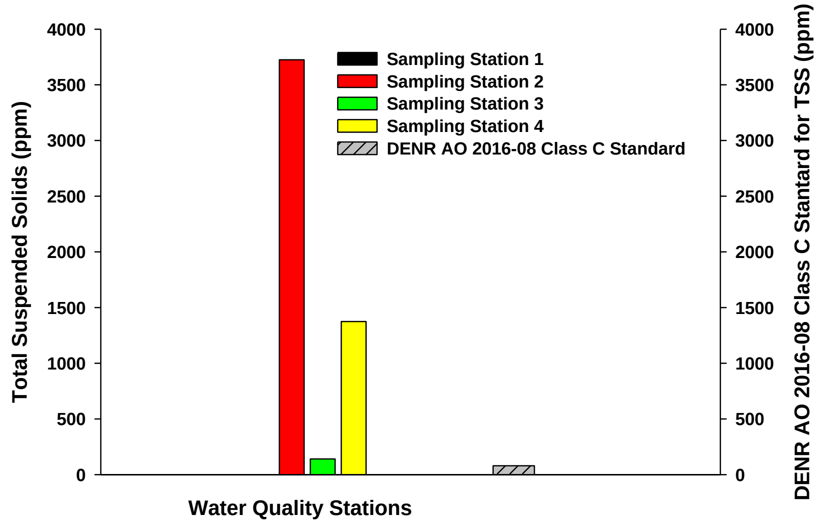
The results of the laboratory chemical analysis reveal that all of the sampling stations are lower when compared to the DENR AO 2016-08 Class C standard of 100 ppm at 24.0, 56.0, 11.0, and 37.0 for SW1, SW2, SW3, and SW4, respectively.

2.2.2.3.4 Stream Water Total Suspended Solids

Total suspended solids (TSS) is the dry weight of sediments present after filtering a water sample, expressed in ppm. These suspended solid particles can come from soil erosion, runoff, discharges, stirred bottom sediments or algal blooms.

TSS gives a measure of the turbidity of the water. Suspended solids cause the water to be milky or muddy looking due to the light scattering from very small particles in the water. In most cases, water with TSS concentration less than 20 ppm is considered to be clear; while those with levels between 40 and 80 ppm tends to appear cloudy and water with concentrations over 150 ppm to be dirty.

Shown in the graph below is the level of TSS of the four surface water sampling locations. Results showed that SW1 has a very low TSS content with 3.0 ppm. Reaching the downstream sampling station (SW2) however, gave a very high TSS content of 3,725.0 ppm; indicating contamination of the surface water, perhaps from soil erosion and runoff. The upstream and downs stream sampling stations of the unknown river tributary (SW3 and SW4) follows the same pattern but this time, the SW3 slightly exceeded the 80 ppm Class C standard set by the DENR AO 2016-08 of 141.0 ppm while, the SW4 sampling station have a very high amount of suspended solid particulates of 1,375.0 ppm.

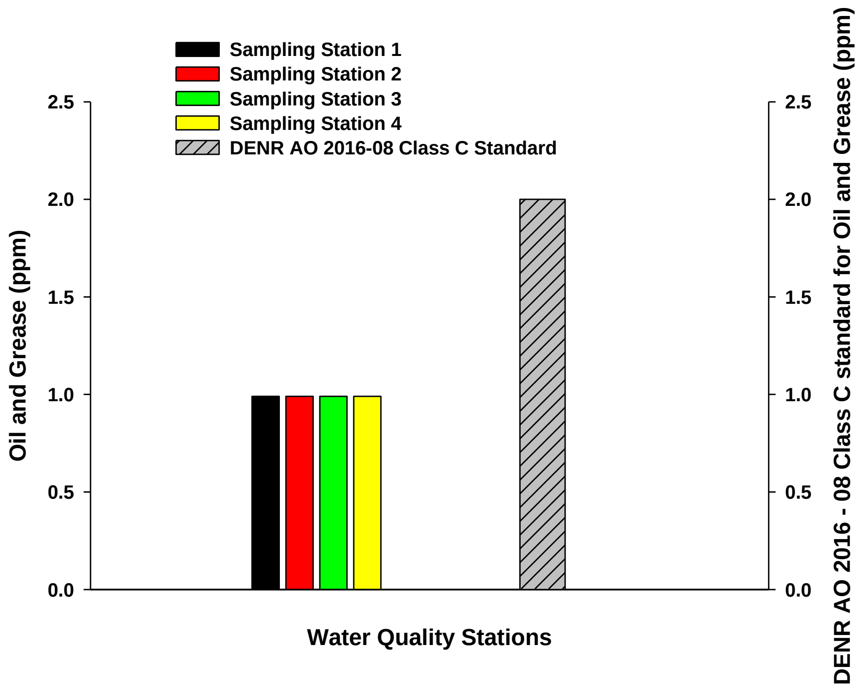


Graph 21. Surface Water Total Suspended Solids

2.2.2.3.5 Stream Water Oil and Grease

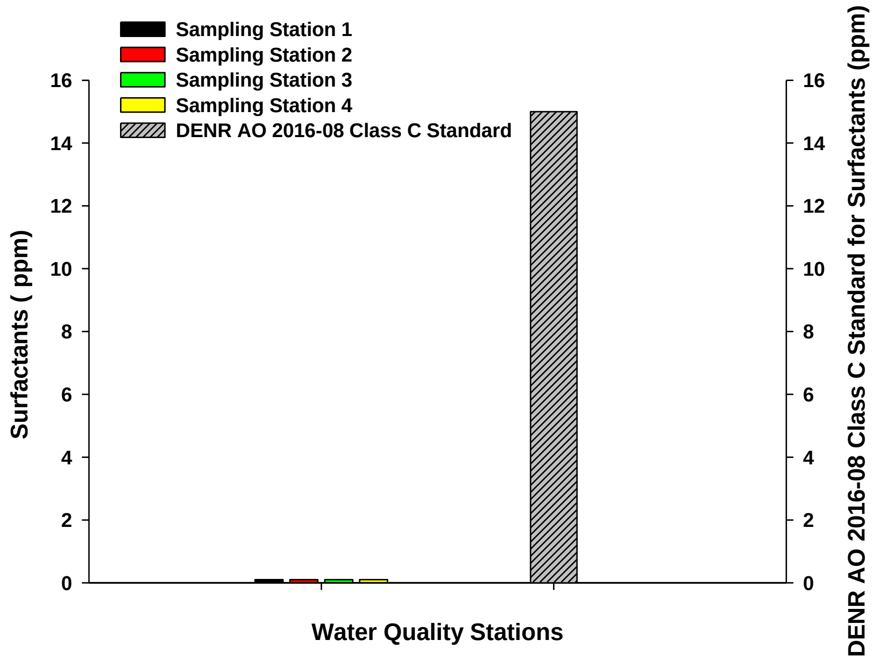
Oil and grease include not only petroleum oils but also vegetable and natural oils. Sediments, biota, and decaying life forms are often high in natural oils lipids which make up part of the oil and grease measure.

Based on the laboratory analysis, all of the surface water sampling stations have less than 1.0 ppm oil and grease content. This is 100 percent lower to the DENR AO 2016 -08 Class C standard of 2.0 ppm.



Graph 22. Stream Water Oil and Grease Content

2.2.2.3.6 Stream Water Surfactant Content



Graph 23. Stream Water Surfactants Content

Surfactants are a diverse group of chemicals that are best known for their wide use in detergents and other cleaning products (Wikipedia). After use, residual surfactants are discharged into sewage systems or directly into surface waters, and most of them end up dispersed in different environmental compartments such as soil, water or sediment. The toxic effects of surfactants on various aquatic organisms are well known.

Examples of surfactants are the following:

- Soaps (free fatty acid salts)
- Fatty acid sulfonates (the most common of which is sodium laryl sulfate, or SLS)
- Ethoxylated compounds, such as ethoxylated propylene glycol.

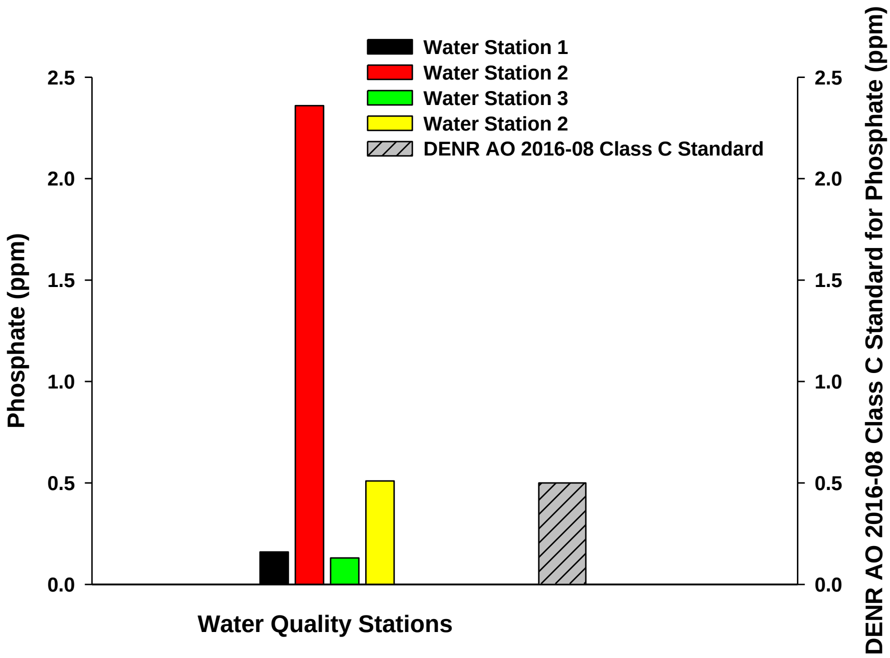
The proposed project area has a very negligible surfactant content (< 0.10 ppm) in the nearest natural body of water.

2.2.2.3.7 Stream Water Phosphate Content

Phosphorus is an essential element for organisms and plants. However, a rise in its concentration in natural bodies of water results in the proliferation of algae, which leads to the eutrophication of the water.

Soil erosion is a major contributor of phosphorus to streams. Phosphates enter waterways from human and animal waste, phosphorus rich bedrock, laundry, cleaning, industrial effluents, and fertilizer runoff. These phosphates become detrimental when they over fertilize aquatic plants and cause stepped up eutrophication (Oram, 2014).

Based on the laboratory analysis, the highest phosphate content was at SW2 with 2.36 ppm. The lowest on other hand, was at SW3 with 0.13 ppm. While SW 1 and SW4 gave 0.16 and 0.51 ppm, respectively. When compared to the Class C standard of the DENR AO 2016-08 of 0.5 ppm, the surface water station 2 (SW2) showed a considerable amount of phosphate in the surface water. This indicates an enrichment of dissolved phosphorus that most likely came from the phosphorus rich bedrocks undergoing weathering around the proposed project area.



Graph 24. Stream Water Phosphate Content

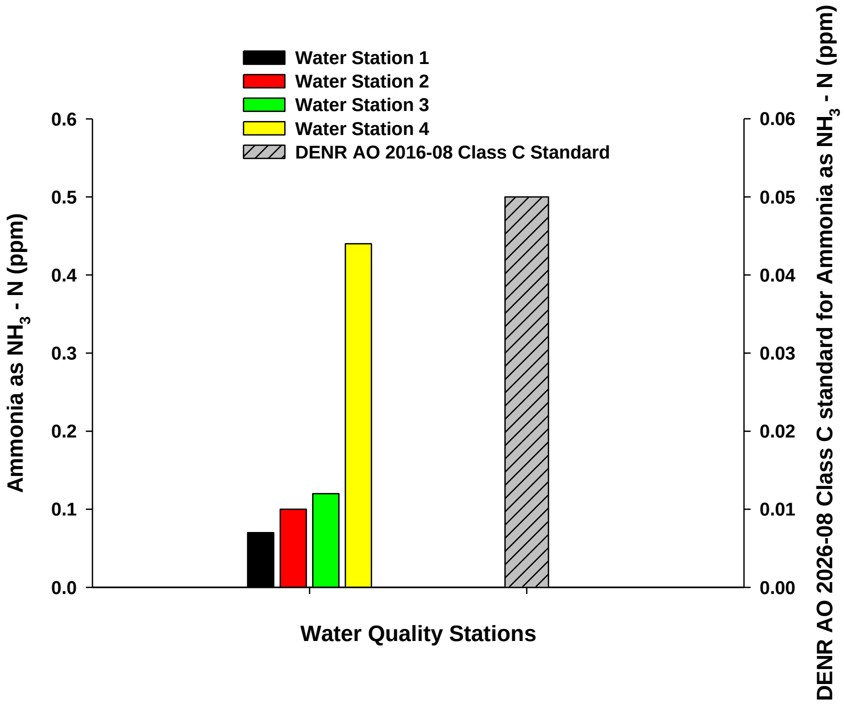
2.2.2.3.8 Stream Water Ammonia as NH3 – N

Ammonia is a common naturally occurring substance. It is also manufactured by man. At normal environmental conditions, pure ammonia is a colorless, pungent-smelling, caustic (corrosive) gas. It is stored under high pressure as a liquid. It is highly soluble in water and reacts with acids to form ammonium salts.

The main sources of ammonia are natural: from decaying organic matter and from the excreta of humans and animals. Man-made sources (such as from the use of commercial fertilizers, and waste disposal sites or industrial processes) are smaller.

The main local problem of ammonia, when it is present in the air, is the unpleasant odor, which is detectable even at low concentrations. The harm caused by ammonia in water bodies is more serious, because it is very toxic to aquatic organisms. Low concentrations of ammonia in soil are natural and actually essential for plant nutrition. Over-fertilization can, however, lead to excessive concentrations which could result in its leaching to water bodies.

The graph below summarizes the ammonia content of the sampling stations. Based on the laboratory analysis, all stations have exceeded the DENR AO 2016-08 Class C standard of 0.05 ppm. This can be brought about by the vegetative cover producing organic litters that is continuously undergoing decomposition. The mineralized ammonia N being soluble with water may have leached and carried by surface runoff to the natural bodies of water near the proposed project site.



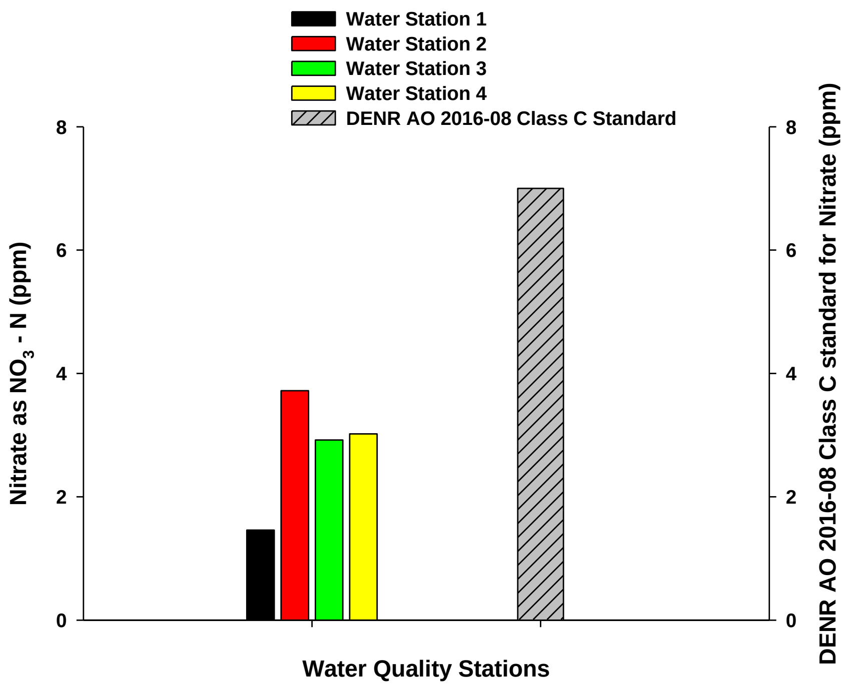
Graph 25. Stream Water Ammonia Content as NH_3 – N

2.2.2.3.9 Surface Water as NO3- - N Content

Nitrates are a form of nitrogen that is found in several different forms in terrestrial and aquatic ecosystems. These forms of nitrogen include ammonia (NH_3), nitrates (NO_3), and nitrites (NO_2). Nitrates are essential plant nutrients, but in excess amounts they can cause significant water quality problems (US EPA, 2012).

Together with phosphorus, nitrates in excess amounts can accelerate eutrophication, causing dramatic increases in aquatic plant growth and changes in the types of plants and animals that live in the stream. This, in turn, affects dissolved oxygen, temperature, and other water quality indicators. Excess nitrates can cause hypoxia (low levels of dissolved oxygen) and can become toxic to warm-blooded animals at higher concentrations (10 ppm or higher) under certain conditions. The natural level of ammonia or nitrate in surface water is typically low (less than 1 ppm); in the effluent of wastewater treatment plants, it can range up to 30 ppm.

Sources of nitrates include wastewater treatment plants, runoff from fertilized lawns and cropland, failing on-site septic systems, runoff from animal manure storage areas, and industrial discharges that contain corrosion inhibitors.



Graph 26. Stream Water Nitrate Content

Laboratory results showed low nitrate content in all of the water bodies sampled near the proposed quarry project when compared to the DENR AO 2016-08 Class C standard of 7 ppm.

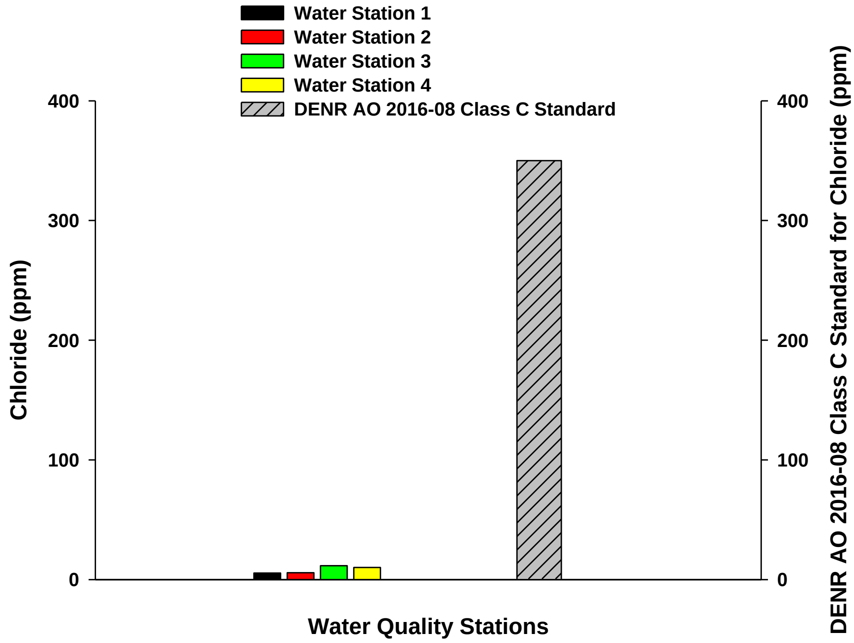
2.2.2.3.10 Surface Water Chloride Content

Chlorides are present in both fresh and salt waters, and are essential elements of life. Salts such as table salt, are composed of ions that are bonded together. When table salt is mixed with water, its sodium and chloride ions separate as they dissolve. Chloride ions in the environment can come from sodium chloride or from other chloride salts such as potassium chloride, calcium chloride and magnesium chloride.

Scientists who study watersheds use elevated chloride levels as one indicator of pollution in a body of water (Hunt 2012).

High chloride concentrations in fresh waters can harm the aquatic organism by interfering with osmoregulation – the biological processes by which they maintain the proper concentration of salt and other solutes in their body fluids. Difficulty with osmoregulation can hinder survival, growth and reproduction.

Based on the laboratory results, all sampling station have very low concentration of chlorides when compared to the DENR AO 2016-08 Class C standard of 350 ppm.



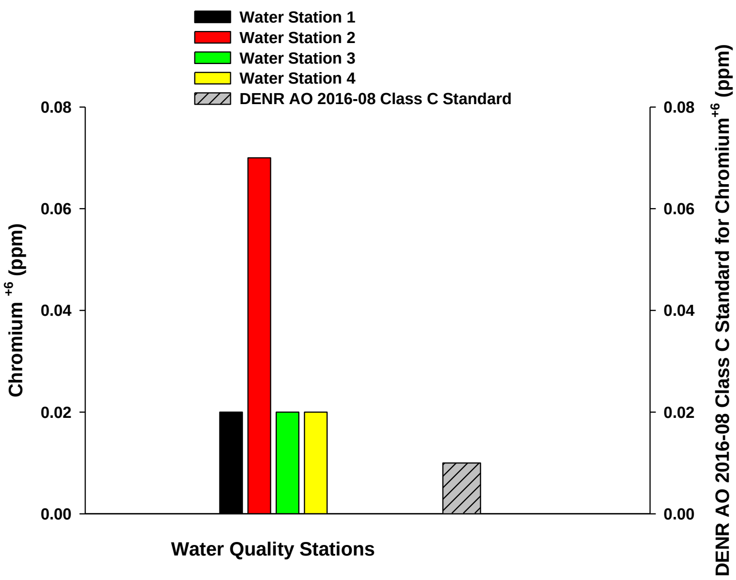
Graph 27. Surface Water Chloride Content

2.2.2.3.11 Inorganic Chemical Constituent of the Project site (Heavy Metals)

Surface Water Chromium^{+6} Content

Chromium is an odorless and tasteless metallic element. Chromium is found naturally in rocks, plants, soil and volcanic dust, and animals. The most common forms of chromium that occur in natural waters in the environment are: Trivalent chromium (chromium^{+3}) Hexavalent chromium (chromium^{+6}).

Hexavalent chromium can occur naturally in fresh water from the erosion of chromium deposits found in rocks and soils.



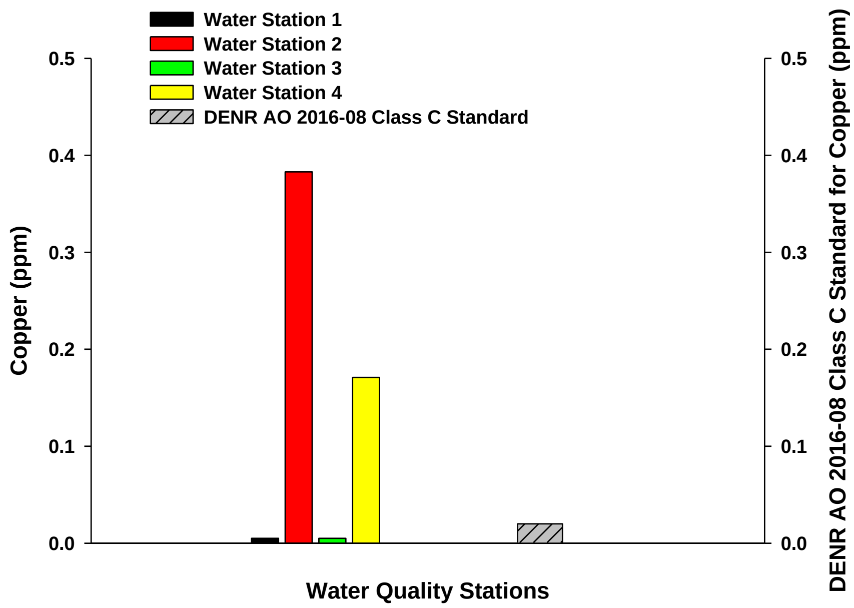
Graph 28. Surface Water Hexavalent Chromium Content

As shown in **Graph 28**, concentrations of hexavalent chromium in the sampling stations are elevated with 0.02, 0.07, 0.02, and 0.02 ppm for SW1, Sw2, SW3 and SW4, respectively; when compared to the DENR AO 2016-08 class C standard of 0.01 ppm.

The occurrence of elevated levels of most of the water parameters, including hexavalent chromium in the downstream (SW2) of the unknown river may be due to the slow water velocity that caused the accumulation of all dissolved materials (solutes).

Surface Water Copper Content

Copper is an abundant trace element that occurs naturally in the Earth's crust and surface waters. Copper can be found as a pure metal in nature and has a high thermal and electrical conductivity.



Graph 29. Surface Water Copper Content

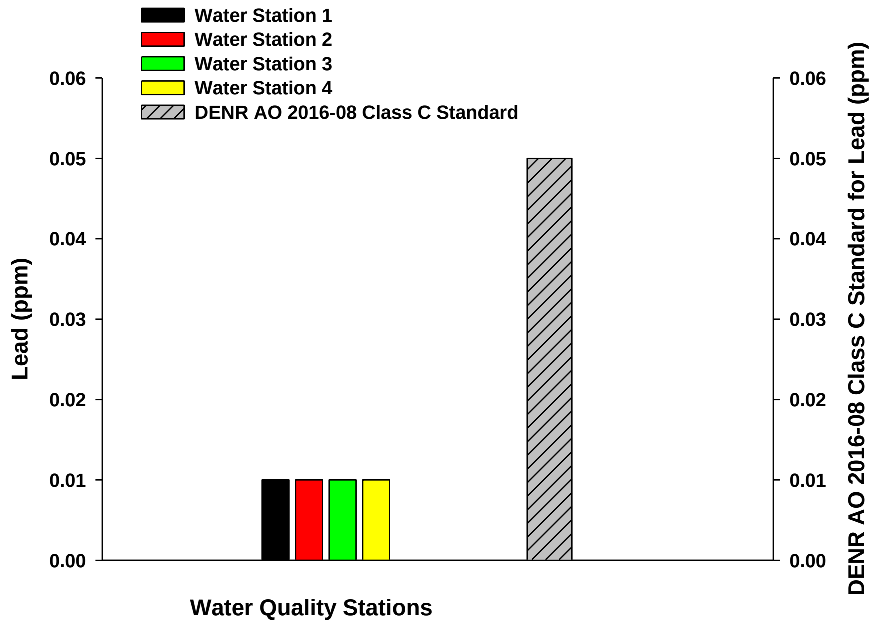
Copper is commonly found in aquatic systems as a result of both natural and anthropogenic sources. Natural sources of copper in aquatic systems include geological deposits, volcanic activity, and weathering and erosion of rocks and soils. Anthropogenic sources of copper include mining activities, agriculture, metal and electrical manufacturing, pesticide use and more (US EPA, 2016).

The presence of copper in surface water is of concern because it is an essential nutrient at low concentrations, but is toxic to aquatic organisms at higher concentrations.

The concentration of dissolved copper in the sampling stations are at <0.005.0, 0.3830, <0.005, and 0.1710 ppm for SW1, SW2, SW3, and SW4, respectively. The two downstream surface water sampling stations (SW2and SW4) have elevated concentrations of copper when compared to the Class C standard of the DENR AO 2016-08 of 0.02 ppm. This result indicated that there is an accumulation of dissolved copper in these areas of the natural bodies of water. Most possible source is from the weathered rocks and soil and, perhaps, agriculture where agrichemicals that contain copper are used.

Surface Water Lead Content

Lead is a widespread, naturally occurring element found throughout the earth's crust and is commonly enriched in many materials in mining districts. It occurs in virtually all rocks, soils, sediments, and waters at low concentration; however, it can occur at high concentrations over large areas because of natural and human-caused processes (US EPA 2019).



Graph 30. Surface Water Lead Content

Lead can be dispersed in the environment by natural processes and through intentional transport. A primary natural transport mechanism is via water. Although lead concentrations in water are generally lower than those of other dissolved species, lead can be transported in natural waters attached to colloidal or suspended particles. Depending on environmental conditions, sediment-associated lead in the river bank can be reintroduced into the river over both short and long periods.

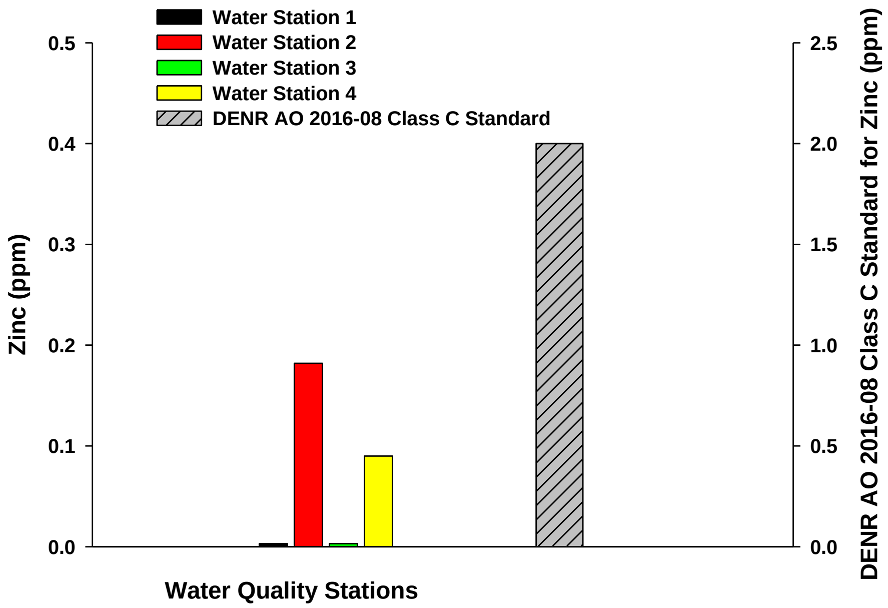
Based on the laboratory results, lead levels in all stations, when compared to the DENR AO 2016-08 Class C standard of 0.05 ppm, have concentrations of < 0.01 ppm of dissolved lead.

Surface Water Zinc Content

Zinc in its elemental form is a bluish-white metal and is naturally found at low concentrations in many rocks and soils; principally as sulphide ores and to a lesser degree as carbonates.

Zinc can be introduced into water naturally by erosion of minerals from rocks and soil however, zinc ores are only slightly soluble in water. Zinc is only dissolved at relatively low concentrations. High natural levels of zinc in water are usually associated with higher concentrations of other metals such as lead and cadmium. Most zinc is introduced into water by artificial pathways such as by-products of steel production or coal-fired power stations, or from the burning of waste materials. Zinc is also used in some fertilizers that may leach into groundwater (SaskH_2O, 2008).

Laboratory analysis reveal that all sampling stations have minimal concentrations of dissolved zinc at <0.0030, 1820, <0.003, and 0.090 ppm for SW1, Sw2, SW3, and SW4, respectively. The concentration values are much lesser when compared to the Class C Standard of the DENR AO 2016-08 of 2.0 ppm.



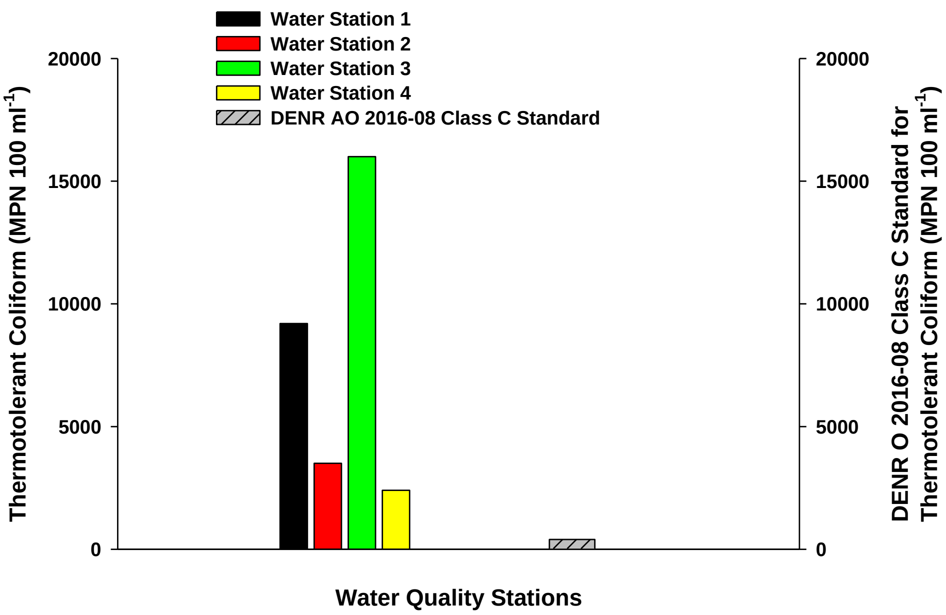
Graph 31. Surface Water Zinc Content

2.2.2.3.12 Surface Water Bacteriological Property

Coliform bacteria are the commonly used bacterial indicator for sanitary quality of water (Rompré, *et.al*., 2000, Tallon *et.al*., 2005, Elayse *et.al.,* 2012). They are defined as members of genera or species within the family Enterobacteriace capable of growth at 37°C (total coliforms) or 44°-45° C (thermotolerant coliforms) that possess β-galactosidase (Edberg *et.al.*, 2000). Coliform bacteria are abundant in the feces of warm-blooded animals but can also be found in soil, aquatic environments and vegetation. Unlike other coliform bacteria, *Escherichia coli* are almost exclusively of fecal origin and can be detected in elevated densities in human and animal feces, sewage and water subjected to recent fecal pollution. It is therefore considered the best fecal indicator microorganism (Edberg *et.al.*, 2000, WHO, 2004).

Fecal bacteria have been used as an indicator to the possible presence of pathogens in surface waters and the risk of disease based on epidemiological evidence of waterborne diseases. Consequently, because of the difficulties to detect the many possible pathogens (such as *Salmonella* sp, *Shigella* sp, diarrheogenic *E. coli*, *Giardia lamblia*, *Cryptosporidium parvum* and enteric viruses) concentrations of fecal bacteria including thermotolerant coliforms, enterococci and *E. coli*, are used as the primary indicators of fecal contamination (US EPA, 2004). Studies suggest that *E. coli* is a more reliable indicator of fecal pollution and the occurrence of pathogens in water than total and thermotolerant coliforms (Edberg *et.al.*, 2000, Leclerc *et.al*.,2001). Therefore, the use of *E. coli* as the main bacterial indicator instead of other coliform bacteria has been proposed in water quality monitoring programs which tailors the microbiological quality of water.

Based on the results of the laboratory analysis, the presence of fecal coliform in the sampling stations are at 9,200.0, 3,500.0, 16,000.0, and 2,400.0 MPN 100 ml^{-1} for SW1, SW2, SW3 and SW4, respectively. These values are very high when compared to the DENR AO 2016-08Class C standard of 400 MPN 100 ml^{-1}.



Graph 32. Surface Water Microbiological Quality

The presence of fecal contamination is an indicator of the potential health risk for individuals exposed to this water. The presence of domesticated animals like goats, cows and carabaos seen grazing on the grassy areas of the proposed project site could probably be the source of the very high coliform contamination.

IMPACTS AND MITIGATING MEASURES ON WATER QUALITY

Potential project impact on water quality during construction phase would be the contamination of surface and groundwater with sediments and hazardous substances such as oil and grease. Loose materials brought about by soil disturbances due to construction activities would increase the potential for soil erosion. During operation phase, the removal and dumping of waste materials/waste rocks would also add to the sediment load of streams if the loose and highly erodible materials arising from the stockpiles are not properly managed.

The expected increase in population due to possible migration of mine workers would also result to increased solid waste generation in the area, including sewage. Domestic wastewater coming from the administrative complex may cause total and fecal coliform contamination if not properly managed. The motorpool complex are also potential sources of hazardous materials such as fuel, oil and grease.

To mitigate the aforesaid, domestic wastewater shall be properly managed through the provision of septic tanks which shall be built according to standards. Hazardous chemicals/wastes shall be contained separately and shall be disposed according to the set guidelines by the government. Siltation of rivers/creeks shall be mitigated by addressing soil erosion through progressive rehabilitation, maintenance of buffer zones, provision of drainage systems and pollution control structures such as siltation ponds. Regular monitoring of surface and groundwater quality shall also be strictly implemented.

2.2.3 Freshwater Ecology

2.2.3.1 Methodology

Collection of samples were undertaken from three (3) freshwater sampling stations. Different types of riparian zone and vegetation were observed in every station and correlated the current situation of freshwater biota of the river within the premises of the mining site. Global Positioning System (GPS) were used to locate the areas and for mapping purposes.

2.2.3.1.1 Plankton Collection and Analysis

Daytime horizontal towing was conducted in each established sampling sites. Conical plankton net (length: 0.45m; mouth diameter: 0.35 m; mesh size opening: 50 µm) was towed at a length of 3m from the water surface or based on the water depth (shallow areas are less than 1m in depth). The sample collected at the cod-end was transferred into the designated plastic sampling bottle wrapped with carbon paper to avoid light exposure. In each station, three (3) tows were done for the three (3) bottles prepared with Lugol's solution. The samples in each station were preserved immediately at the sampling sites.

A drop (0.05ml/50µl) of sample preserved with Lugol's solution was placed into a Sedgwick rafter. Each plankton cell or individual species encountered under the compound microscope (Leica BME) was identified, but only those cells (phytoplankton) and individuals (zooplankton) within the four (4) large squares were counted. Two (2) drops from each of the collected samples were analyzed and the average was taken. Plankton species were identified up to the genus level and if possible, up to the species level using the references of Palmer (1960), Botes (2003), and van Vuuren *et al*. (2006). Prior to counting, the total volume of the collected sample was measured and recorded. The number of cells per ml of the actual water sampled was calculated by dividing the number of cells per cubic meter by $1X10^6$. The abundance of each phytoplankton and zooplankton groups was expressed as cells/ml.

$$\text{Cells/ml} = N \cdot \frac{1000 \cdot V1}{Vs}$$

Where:
N= average number of cells/species
V1= Volume of plankton sample in ml
Vs= Volume of water filtered in ml
$Vs = Pi\ r^2\ L$(Volume = cubic meters (m^3) of water)
Where: Pi = 3.1415926536...
r^2= radius of net opening (in m), squared
L = Length (distance net was towed/hauled, in m)

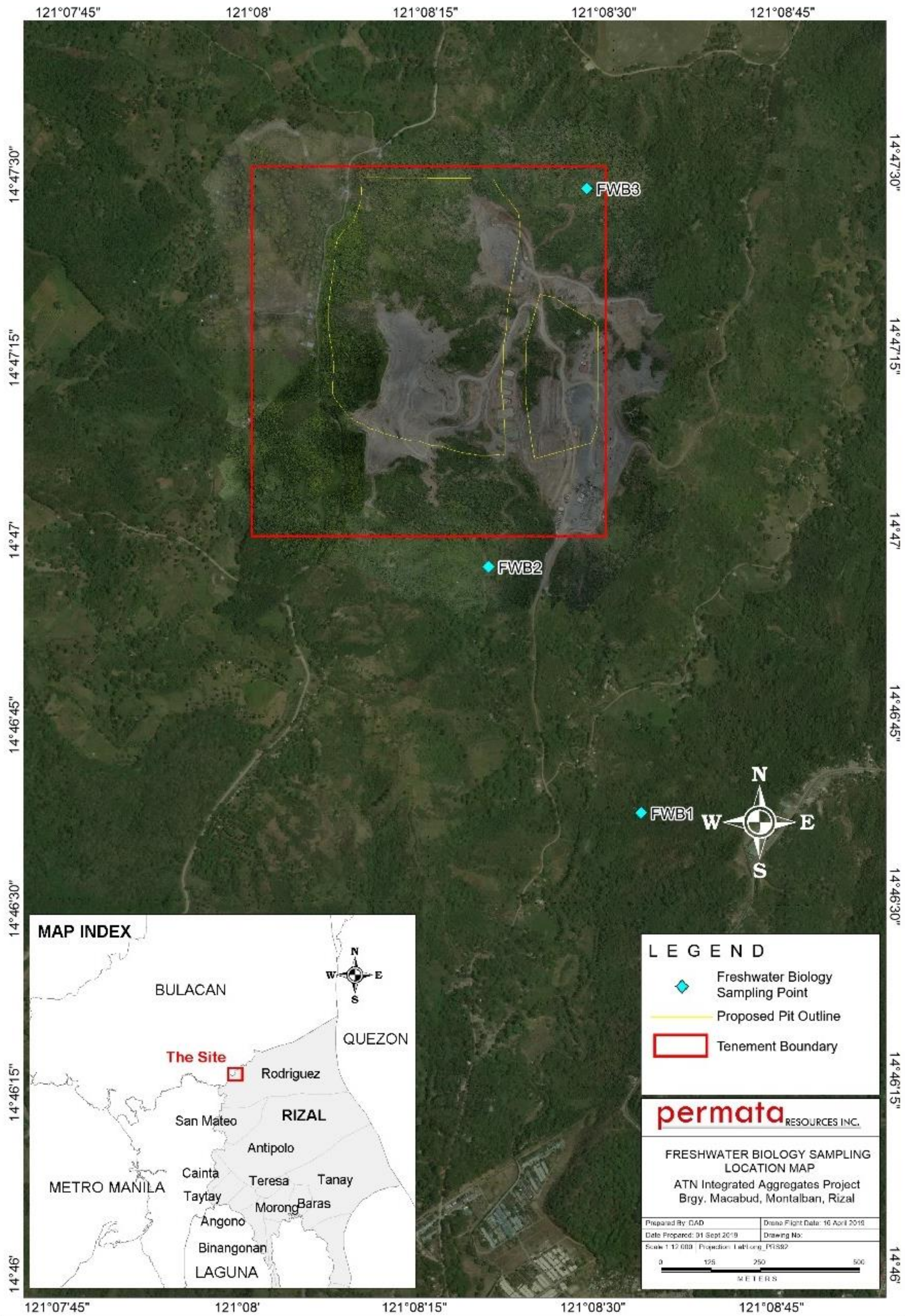


Figure 39 – Freshwater Biology Sampling Stations within the Proposed Project Site

2.2.3.1.2 Aquatic Macroinvertebrates Diversity and Distribution

Sampling was conducted following the reach-wide benthos (Multi habitat) method (SWAMP, 2007). Each station covered three 100-meter reach for the collection of macroinvertebrates. 500µm D-net; 0.3 m width (-1.0 ft. frame width) was used and was placed in the water as to the mouth of the net perpendicular to face the flow of the water. Twenty jabs were undertaken over each of the 100 m length. The jabs obtained from the habitats were composited, obtaining a single homogenous sample. Sampling points were alternated between the left, center and right positions along transect. Samples collected from every jab were placed in containers with 10% formalin. The composited samples were thoroughly rinsed with running water in a 500 µm–mesh sieve to remove fine sediments. The sorted organisms were then placed in vials and were preserved in 95% ethanol.

Collected samples were identified up to the lowest practical level, generally genus or species. Macroinvertebrate guides for identification from the internet and journals were used for identification. Macroinvertebrates were initially grouped into three (3) Taxa groups—Taxa 1, Taxa 2 and Taxa 3 based on their sensitivity or tolerance to pollution or aquatic disturbance (Barbour *et al.,* 1999). Taxa 1 members are pollution sensitive organisms found in good water quality (i.e. most members of order Ephemeroptera, Plecoptera, Trichoptera, and Coleoptera). Taxa 2 species can exist in a wide range of water quality conditions or generally moderate water quality (i.e. most orders belonging to Hemiptera, Diptera, Odonata, Decapoda, and Veneroida); Taxa 3 are species that can exist in a wide range of water quality conditions and highly tolerant to poor water quality. This taxon would include Tubificida, Gastropoda, Hirudinidae, Cerithioidea and Isopoda.

2.2.3.1.3 Measuring Water Quality Using Water Quality Index (WQI)

Species were scored according to their classification using a matrix that has its corresponding points of a particular species regardless of its abundance (Mandaville, 2002). The sum was obtained for all scored species and divided into the total of families scored.

Table 35. Water Quality Index (WQI)

Score	Indication
7.6-10	very clean water
5.1-7.5	rather clean- clean water
2.6- 5.0	rather dirty water- average
1.0- 2.5	dirty water
0	very dirty water (no life at all)

2.2.3.1.4 Analysis

Several diversity indices (Abundance, Evenness, Richness and Shannon – Weiner Index of diversity) and non-parametric analyses were determined using the Paleontological Statistics Software (PAST®).

2.2.3.2 Baseline Conditions

2.2.3.2.1 Description of Sampling Stations

Different types of riparian zone and vegetation were observed in every sampling station which correlates the current situation of freshwater biota of the river within the premises of the proposed mining site. Global Positioning System (GPS) were used to locate the areas and for mapping purposes.

Table 36. Location and description of each sampling stations within the project area.

Station code	Location	Description
FWB1 (Down Stream)	14°46'32"N , 121°8'38"E (Sitio Laan Barangay Macabud, Rodriguez, Rizal Province)	Vegetation of the area was brushy type. Movement of water is in low gradient with muddy soil. Shallow water occurred during the sampling.
FWB2 (Middle Stream)	14°46'52"N , 121°8'25"E (Sitio Laan Barangay Macabud, Rodriguez, Rizal Province)	River sections sampled were mostly shallow, and interspersed with narrow pools with unclear water caused by the erosion of muddy soil in the area. Area was covered with patches of large trees and spare of brush-type vegetation.
FWB3 (Upper Stream)	14°47'23"N , 121°8'33"E (Sitio Laan Barangay Macabud, Rodriguez, Rizal Province)	Water is slightly clear with enormous stones which serves as riparian of the river. River section is narrow and shallow shaded with large trees and different types of shrubs.

Photo 19. FWB1 river station within the vicinity of the project area

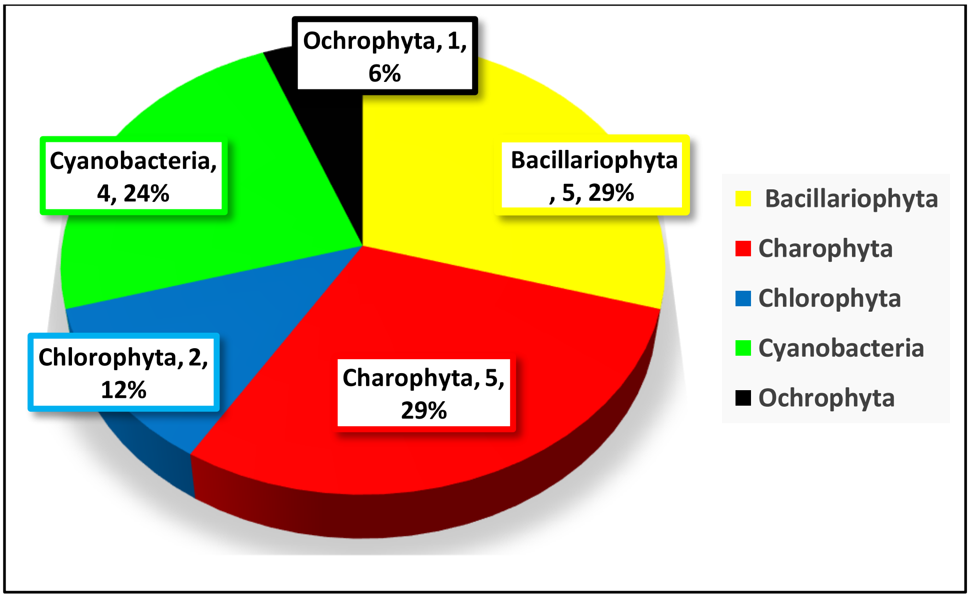
Photo 20. FWB2 river station within the vicinity of the proposed project area

Photo 21. FWB3 river station within the vicinity of the proposed project area

2.2.3.2.2 Freshwater Phytoplankton Assessment

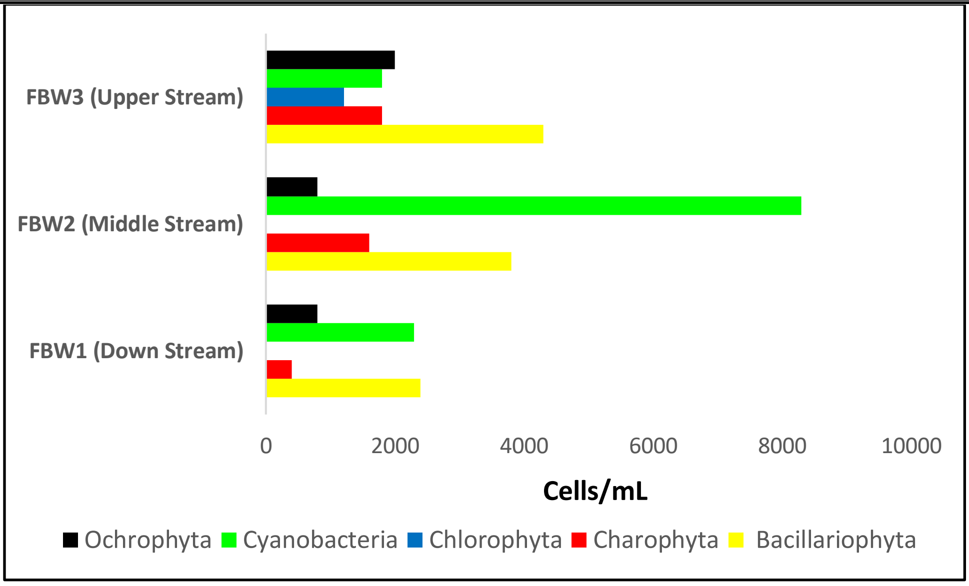
Seventeen (17) species with 31,500 cell/mL in five (5) different divisions were identified from the collected specimen at the project area. Bacillariophyta and Charophyta has the highest number of individual counts gathered, with 29% of the total percent composition of the species collected. Second is the Cyanobacteria with four (4) species identified and 24% of the composition while Chlorophyta got only 12%; which is half of the ratio of Cyanobacteria. However, Ochrophyta species has the lowest percentage of 6% with only one (1) species were identified in this division.

Each species has significant value and importance based on their distribution into the ecosystem. The dominance number of species of Bacillariophyta are extremely important for some aquatic species because this type of species are photosynthetic and serves as food source of some freshwater aquatic organisms; while Charophyta can be used to detect the presence of fish in a body of water, as well as indicate the overall quality of the water. An abundance of Charophyta means productive water. Percent composition of phytoplankton species was based on the number of species collected which was categorized according to its division.



Graph 33. Percent Composition of Phytoplanktons Species Collected

As shown in the graph below, Cyanobacteria has the highest count in the density comparison with 8,300 cell/mL, which dominates in FWB2 (Middle Stream). Cyanobacteria are important in many ecosystems as they produce gaseous oxygen as a product of their photosynthetic process. These bacteria and their descendants are credited with the production of all the oxygen gas on earth but are also capable of producing a variety of toxins. Cyanobacteria produces toxins to kill off other local species, giving themselves more room for growth. These toxins arise when environmental conditions are optimal for cyanobacteria to reproduce explosively and exponentially, resulting in algal blooms. These blooms are not only harmful for many aquatic species, but also for humans who ingest contaminated fish and shellfish or swim in or are exposed to contaminated water. The decreasing counts of Bacillariophyta and Charophyta from the sampling station indicates that FWB3 freshwater station is not disturbed and water quality is better than the other two sites (FWB 1 and FWB2). Moreover, among three stations, FWB3 has an equal distribution of aquatic species because all five division of species collected were present in the area**.**



Graph 34. Density Comparison of Phytoplankton Species Identified per Sampling Stations

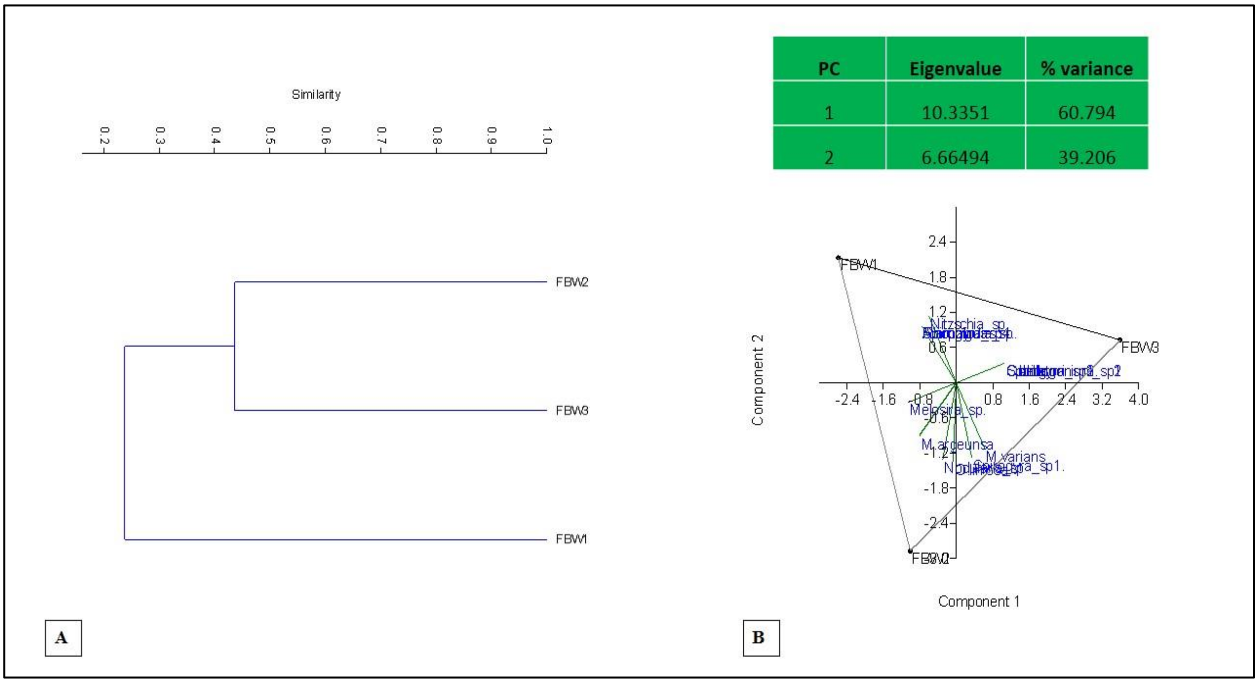
Table 37. Phytoplankton density (cells/mL) in the surface water stations within the project area

ABUNDANCE TABLE cell/mL					
Phylum	**Species**	**FWB1**	**FWB2**	**FWB3**	**TOTAL**
Bacillariophyta	*Aulacoseira ambigua*	400	0	0	400
	Melosira varians	400	3800	3200	7400
	Nitzschia sp.	1500	0	300	1800
	Rhopalodia sp.	100	0	0	100
	Synedra ulna	0	0	800	800
Charophyta	*Spirogyra* Link	0	0	300	300
	Spirogyra sp1.	0	1600	900	2500
	Spirogyra sp2.	0	0	300	300
	Spirogyra sp3.	0	0	300	300
	Spirogyra sp4.	400	0	0	400
Chlorophyta	*Oedogonium* sp1	0	0	400	400
	Oedogonium sp2.	0	0	800	800
Cyanobacteria	*Nodularia* sp.	0	500	0	500
	Oscillatoria limosa	100	3700	900	4700
	Oscillatoria sp1.	0	0	900	900
	Microsystis argeunsa	2200	4100	0	6300
Ochrophyta	*Melosira* sp.	800	800	2000	3600
	ABUNDANCE	5900	14500	11100	31500

Table 38. Phytoplankton diversity in surface water stations within the proposed project area

	FWB1	FWB2	FWB3
Taxa_S	8	6	12
Individuals	5900	14500	11100
Dominance_D	0.2364	0.2302	0.1499
Simpson_1-D	0.7636	0.7698	0.8501
Shannon_H	1.673	1.576	2.168
Evenness_e^H/S	0.6657	0.8058	0.7282

Diversity indices shows that FWB3 is diverse in terms of number of species collected and number of individual species; with 11,100 (cell/mL). The Shannon_H of FBW3 is 2.168 which means that the diversity and evenness from the undisturbed habitat are much higher than in the site from the highly disturbed habitat (FWB2 and FWB1). FWB3 also has a greater number of species present, but the individual species in the community are distributed more equitably among these species.



Graph 35. Cluster Analysis (A) and Principal Component Analysis (B) of Phytoplankton Density across Surface Water Stations within the project area of ATN

Cluster analysis is a statistic used to quantify the compositional dissimilarity between two different sites based on counts at each site, while principal component analysis (PCA) is a statistical procedure that uses an orthogonal transformation to convert a set of observations of possibly correlated variables (entities each of which takes on various numerical values) into a set of values of linearly uncorrelated variables called principal components.

Graph 35A shows that the dissimilarity between the sampling locations and the number of species collected, number of individuals per species and number of species raw count (cell/mL). In terms of abundance, FWB1 has the lowest raw count (cell/mL) but much higher in FWB2 in terms of number of species recorded. FWB2 gathered only six species which recorded as low in species richness but has the highest total number of individual per species while FBW3 has the highest number of species but lesser number of raw count (cell/mL) than FWB2. Dissimilarity of the species distribution in every station indicates different classification of water quality in each station.

2.2.3.2.3 Freshwater Macroinvertebrate Assessment

Macroinvertebrates are important components of stream ecosystems that are a link in the transfer of material and energy from producers to top level consumers and also act as excellent bioindicators of stream health. These are organisms most commonly used for biological monitoring of freshwater ecosystems worldwide. This is because as they are found in most habitats and have generally limited mobility, these are quite easy to collect by way of well-established sampling techniques, and there is a diversity of forms that ensures a wide range of sensitivities to changes in both water quality (of virtually any nature) and habitats (Hellawell, 1986; Abel, 1989).

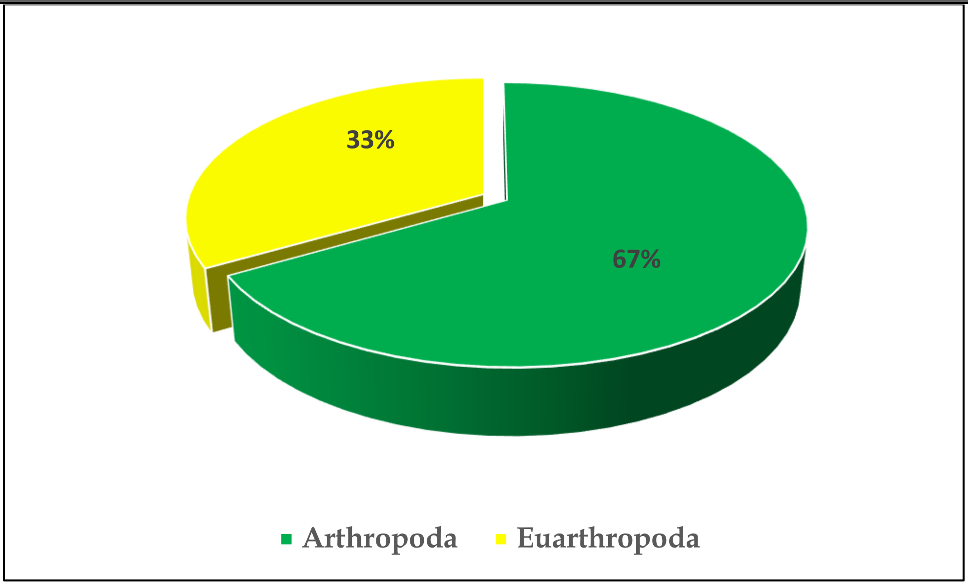
A total of nineteen (19) individual species were captured during the macroinvertebrate sampling within the vicinity of ATN Aggregate Quarry Project in Sitio Laan Barangay Macabud, Rodriguez, Rizal Province. In three different stations (Downstream, Middle Stream, and Upper Stream) three (3) species of macroinvertebrates where identified which belongs to two (2) families in categorization. Down Stream has the highest number of species captured with 7 individual species belongs to two family while middle stream and upper stream got 6 individual species. Based on researcher's observation, low biodiversity of macroinvertebrate organisms vary to the ecosystem of the area. Muddy soil affect the water quality and also affect the diversity of macroinvertebrate species in the area.

Table 39. Inventory of aquatic macroinvertebrates in surface waters within the proposed project area and their corresponding taxa groupings based on sensitivity/tolerance to pollution

Phylum	Order	Family	Scientific name	Taxa
Arthropoda	Decapoda	Palaemonidae	*Macrobrachium* sp.	2
		Panaeidae	*Limnonetra sp*	2
Euarthropoda	Hemiptera	Gerridae	*Limnogonus sp.*	2

Percent composition of two major groups, Arthropoda and Euarthropoda, were classified based on the total number of species in each classified family. Arthropoda gathered two species belonging to family Palaemonidae and Panaeidae and one species belonging to Euarthropoda. In phylum Arthropoda, family Panaeidae has 11 species collected. Phylum Arthropoda gathered sixty-seven percent of the total composition while the remaining thirty-three percent belongs to Euarthropoda.

In terms of taxa categorization, all collected species were identified and categorized in Taxa 2 which means that the area was dominated with species that can exist in a wide range of water quality conditions or generally moderate water quality species that are very intolerant of pollution.



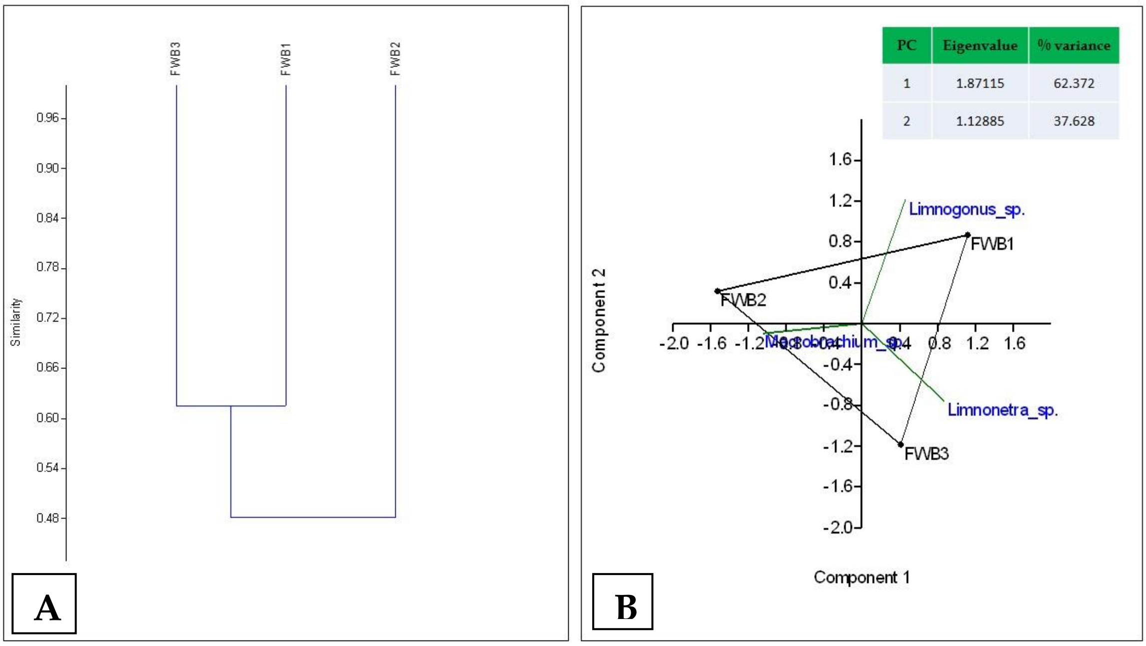
Graph 36. Percent (%) composition of macroinvertebrates major groups within the vicinity of ATN Aggregate Quarry Project.

Water quality index (WQI) values shows that the three sampling stations fall into "Rather Clean-clean" water category. The result of WQI was based on the observation of water quality during the sampling and through the presence of macroinvertebrates bioindicators in the area. Thus, there is a need for other physico-chemical tests/ parameters to support the status of these waters other than through the presence of bioindicator macroinvertebrates.

Table 40. Diversity indices of aquatic macroinvertebrates in the study stations within the proposed project area

	FWB1	FWB2	FWB3
Taxa_S	2	3	2
Individuals	7	6	6
Dominance_D	0.5102	0.3889	0.7222
Simpson_1-D	0.4898	0.6111	0.2778
Shannon_H	0.6829	1.011	0.4506
Evenness_e^H/S	0.9898	0.9165	0.7846

The table above shows that FWB2 has the highest number of species identified and FWB1 has the highest number in terms of individual count of organisms. H^ values of diversity indices of FWB1, FWB2 and FWB3 fall into <2.0 (less than 2.0) which means that the sampling stations are in low biodiversity in terms of macro organisms and there is no equal distribution of species in the area.



Graph 37. Multivariate Analyses of Abundance of Macroinvertebrates (A) Dendogram of Similarity; (B). Principal Component Analyses (PCA) of Macroinvertebrate Populations

Multivariate analysis emphasized species richness and the similarity of the number of individual counts in each sampling sites. Based on the graph above, the middle stream displays that the area was abundant in terms of species. The vegetation and the tranquility of the area enabled the organisms stay and survive. Presence of *Limnonetra sp.* and *Limnogous sp.* in FWB1 and FWB3 congregated with 0.65% in similarity. In a similarity index, a value of 1 means that the two communities being compared share all their species, while a value of 0 means they share none. Clustering of sampling sites samples were based on the similarities of number of species richness and abundance that the researchers collected during the sampling. Therefore, the 0.65% similarity of FWB1 and FWB3 means that they share none.

IMPACTS AND MITIGATING MEASURES ON FRESHWATER ECOLOGY

Riparian zones should be rehabilitated to enhance the macro-invertebrates and plankton diversity. Information of common plants identified thriving in the riparian zone shall also be utilized as basis for choosing appropriate species for planting.

Assessment of other biophysico-chemical features of the monitoring stations shall also be carried out (i.e. monthly/quarterly determination of basic physico-chemical features, heavy metal assessments in both waters and sediments; assessment of fish assemblages in monitoring stations).

2.3 Air and Noise

2.3.1 Meteorology/Climatology

2.3.1.1 Methodology

Baseline meteorological conditions were based on the nearest surface synoptic station of PAGASA located in Science Garden Complex in Diliman, Quezon City (herein referred as Science Garden PAGASA Station). This surface synoptic station is about 18 km south-southwest from the southwest corner of the EP boundary of the project. The following are the meteorological parameters and the periods of record:

- Normal monthly rainfall and temperature – 1981 to 2010; and
- Lowest and highest air temperature, greatest daily rainfall, and strongest winds – 1961 to 2018

Projected changes of rainfall and air temperature were based on the climate study of DOST-PAGASA published in 2018 entitled, “Observed Climate Trends and Projected Climate Change in Philippines”. This climate study provides updates on the climate projections also prepared by PAGASA in 2011.

GHG emissions of the project emanating from project operation were estimated using the GHG emissions calculation tools, which were developed by Clear Standards, Inc. in collaboration with the World Resources Institute (2015). The emission factors used in the emission calculations tool were from the following sources:

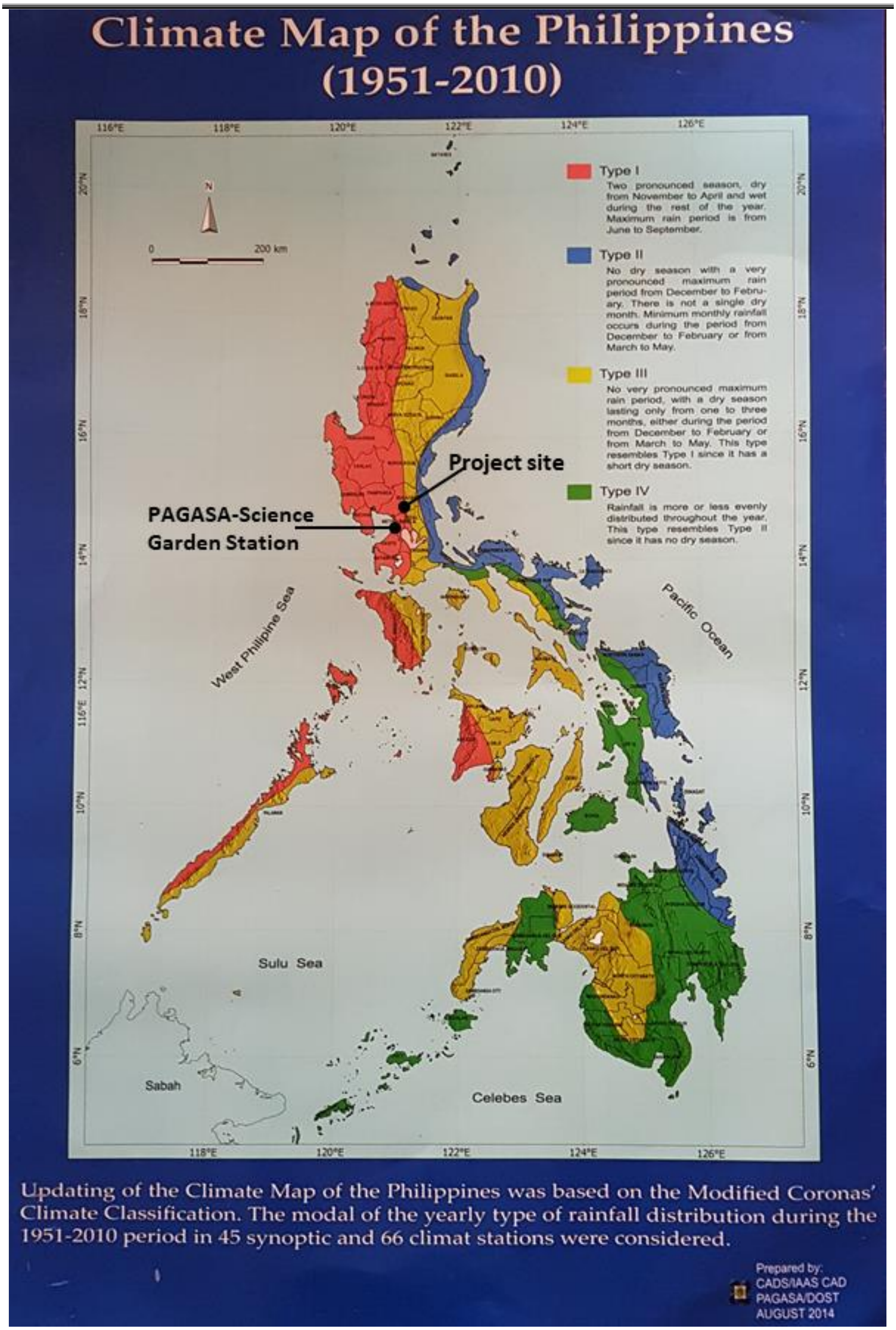
- United Kingdom Department for Environment, Food and Rural Affairs (DEFRA),
- US Environmental Protection Agency (EPA); and
- Intergovernmental Panel on Climate Change’s (IPCC) 2006 Guidelines for National Greenhouse Gas Inventories.

2.3.1.2 Baseline Conditions

2.3.1.2.1 Local Climate

The project site is in an area zoned as Type I Climate, though it appears adjacent or along the boundary between Type I and Type III climate. Type III climate resembles Type I climate as the former has a short dry season. Type I climate has two (2) pronounced seasons, namely: dry and wet season. Dry season is from November to April and wet during the rest of the year.

The annual average rainfall at Science Garden PAGASA Station based on record from 1981 to 2010 is 2574.5 mm. This rainfall amount is about the same as the annual average rainfall in the Philippines.



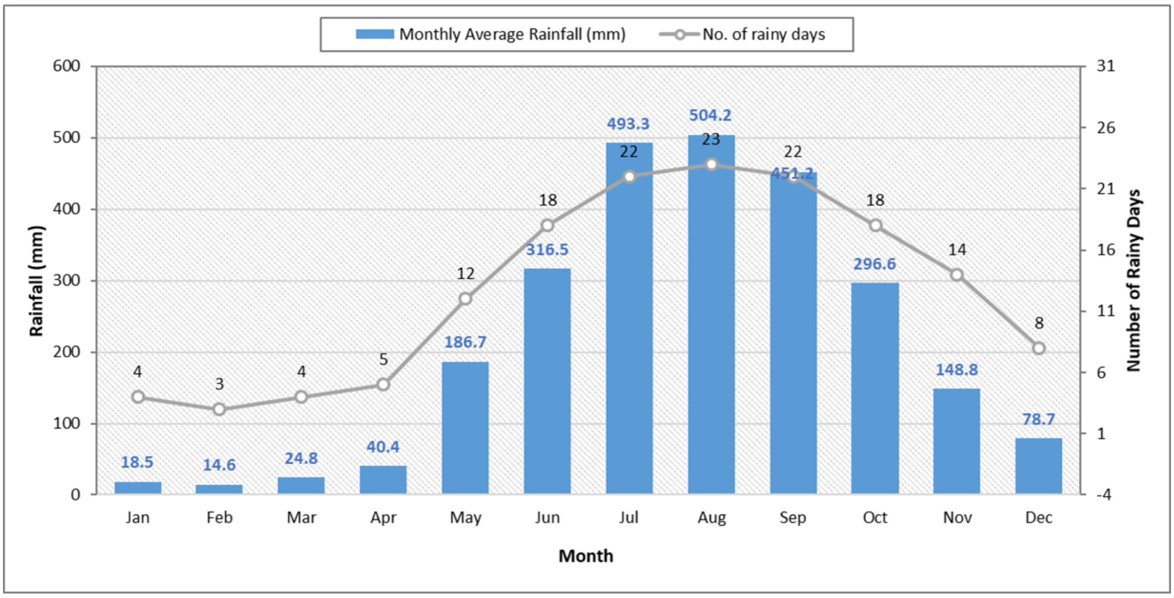
Source: PAGASA, 2007

Figure 40 – Climate Map of the Philippines showing the Project Location

2.3.1.2.2 Rainfall

Rainfall amount appears to gradually increase from March to April, and abruptly increase in May and in August. It then gradually decreases in September and with about 150 mm decrease of rainfall from October to November.

August is the rainiest month with 504.2 mm of rainfall and 23 days of rainfall. On the contrary, the driest month is February with only 14.6 mm of rainfall and three (3) days of rainfall.

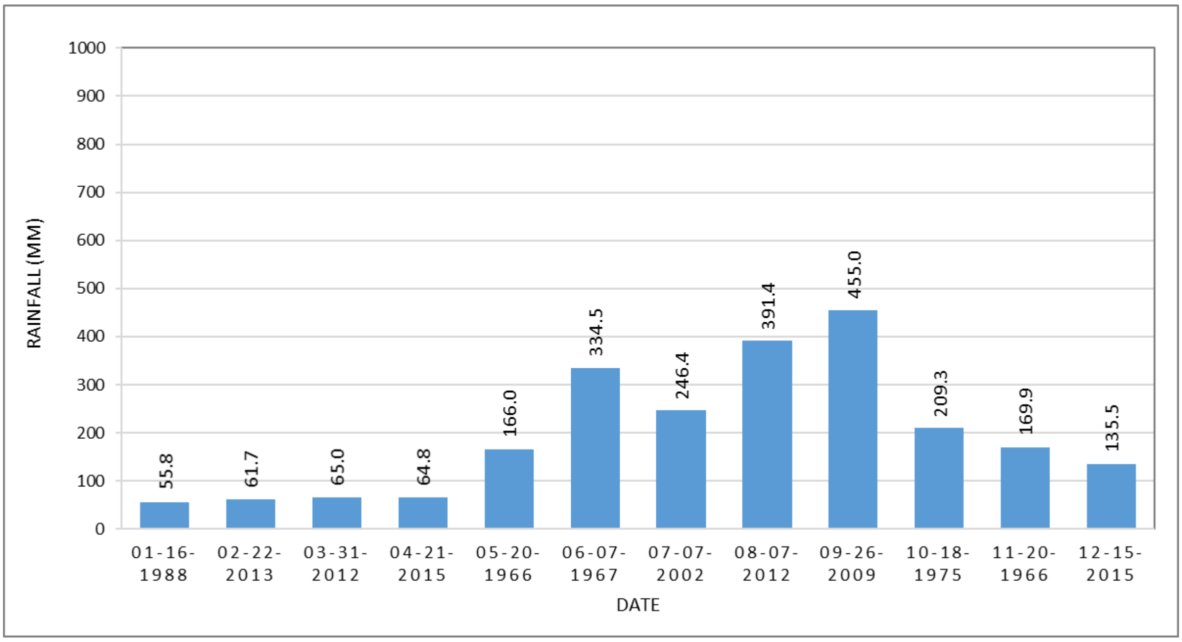


Source: Climatological normal for Science Garden PAGASA Station, 1981 to 2010

Graph 38. Monthly average rainfall and number of rainy days for Science Garden PAGASA Station

<u>Extreme Recorded Rainfall Events</u>

The highest recorded rainfall at the Science Garden PAGASA station was 455 mm on 26 September 2009. This was recorded during the passage of Tropical Storm Ondoy, which brought heavy rainfall and flooding in Metro Manila and nearby provinces.



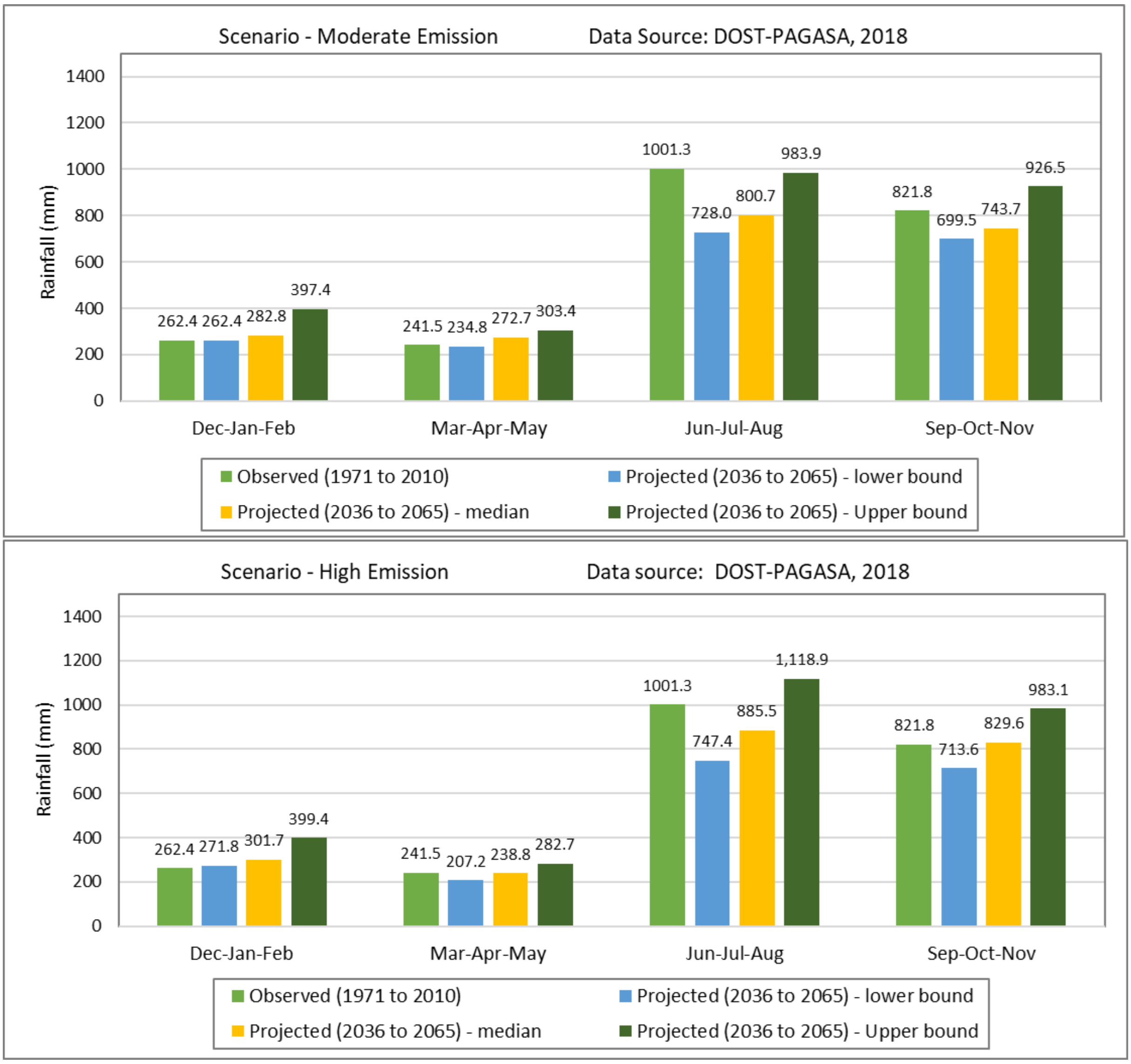
Source: Climatological extremes for Science Garden PAGASA Station, as of 2018

Graph 39. Highest recorded daily rainfall based on data from 1961 to 2018

Projected Changes of Rainfall

Based on the recent climate study of the DOST-PAGASA (2018), the projected rainfall in December to February (northeast monsoon season) appear to increase (lower to upper bounds) in both the medium and high emission scenarios.

During transition season from the northeast to southwest monsoon seasons (March to May) and the rest of the year, the projected rainfall (lower, median, and upper bounds) were not consistent, though it generally increase at upper bounds under medium and high emission scenarios, except during wet season from July to August (medium emission scenario) in which the projected rainfall decreases from the baseline years.



Source: DOST-PAGASA, 2018

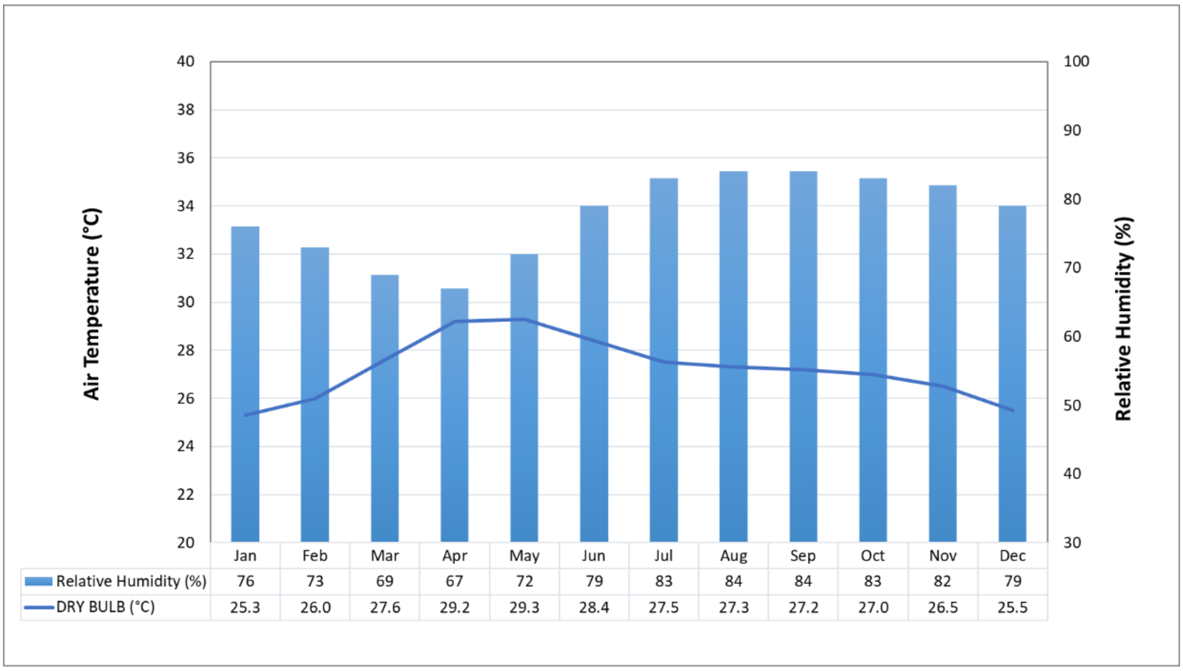
Graph 40. Projected change of rainfall under moderate (top) and high emission scenario (bottom)

2.3.1.2.3 Air Temperature

The graph below shows the monthly average air temperature and relative humidity. The hottest month is May with monthly average temperature of 29.3°C followed by April with 29.2°C. April is also the least humid month with 67% relative humidity. High humidity is experience during the southwest monsoon season.

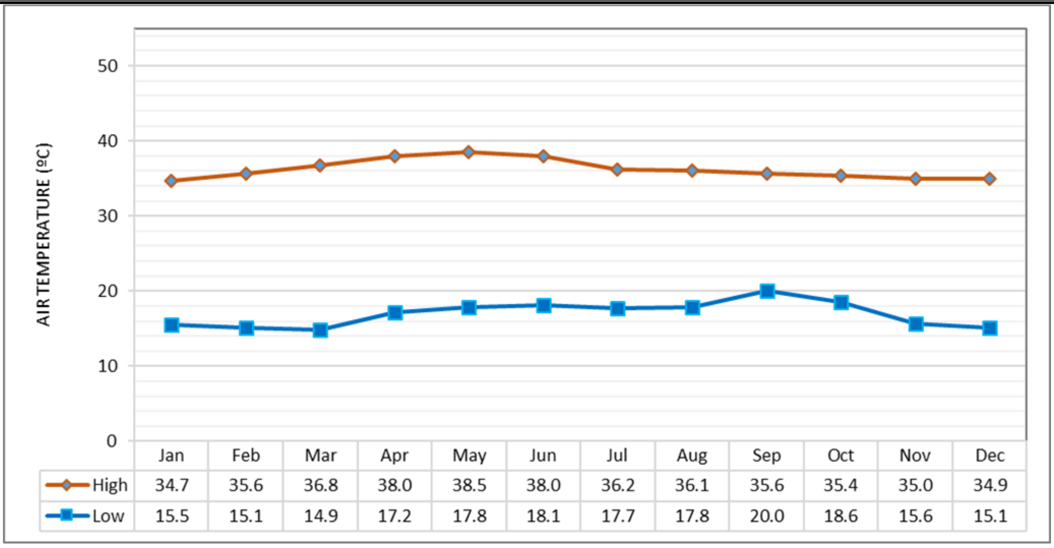
Extreme Recorded Air Temperatures

The highest recorded air temperature was 38.5°C in May while the lowest was 14.9°C in March. Extreme air temperatures (1st 3 highest) were observed in April, May and June; while extreme lows in December to March.



Source: Climatological normals for Science Garden PAGASA Station (1981 to 2010)

Graph 41. Monthly average air temperature and relative humidity for Science Garden PAGASA Station

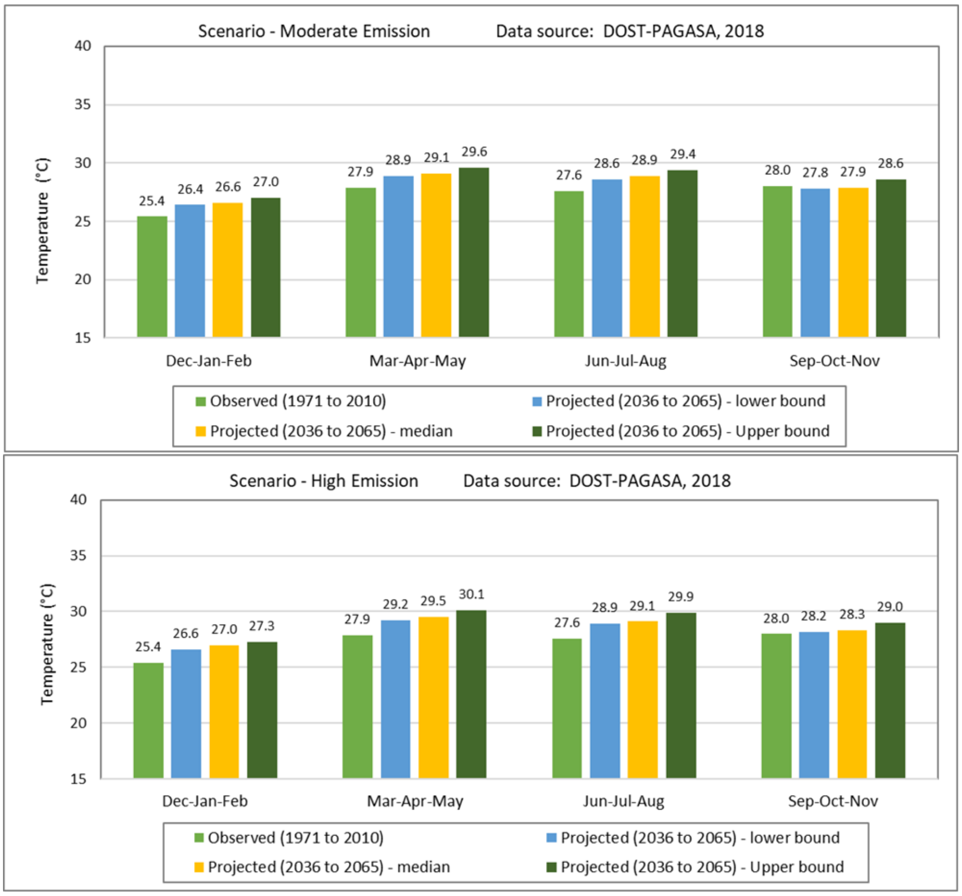


Source: Climatological extremes for Science Garden PAGASA Station, 1961 to 2018

Graph 42. Highest and lowest recorded monthly air temperatures at Science Garden PAGASA Station

Projected Change in Air Temperature

Based on DOST-PAGASA (2018), air temperature will increase in all periods of the year under medium and high emission scenarios. Air temperature will increase from 0.6 to 1.8 °C and from 1 to 2.3 °C from the baseline years under medium and high emission scenarios, respectively.



Source: DOST-PAGASA, 2018

Graph 43. Projected change of air temperature under moderate (top) and high emission scenario (bottom)

2.3.1.2.4 Wind Speeds and Wind Directions

Winds in the area change with the monsoon winds. Prevailing wind directions are from the southwest during the southwest monsoon season (June to September) and from the north and northeast in October to February during the transition and the northeast monsoon season. Southeast winds prevail during the dry months in March and April and from the south in May.

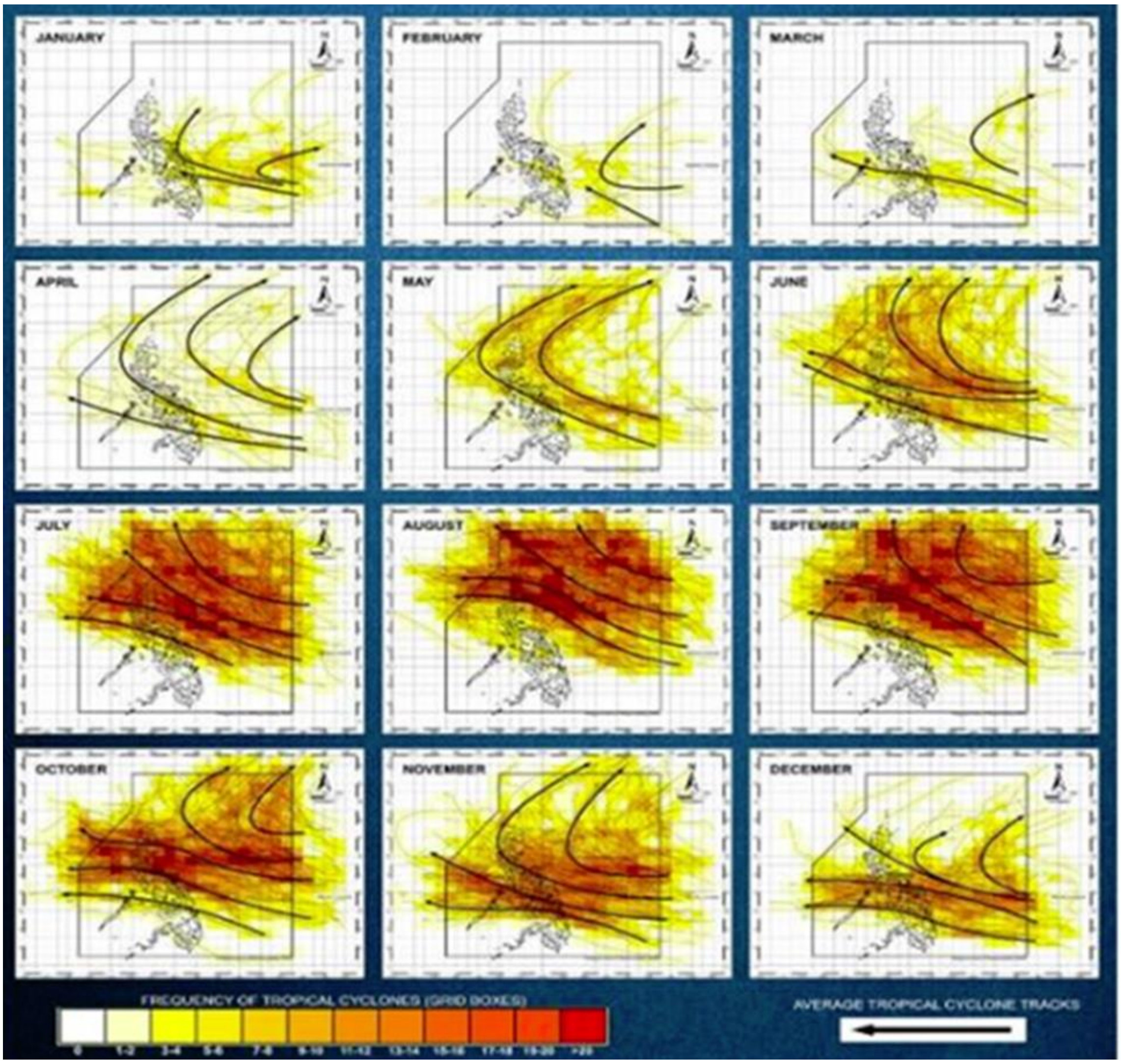
The monthly average wind speed range from 1 to 2 m/s with annual average of 1 m/s

Table 41. Monthly average wind speed and wind direction

Month	Wind Direction (16 pt)	Wind Speed (m/s)
January	N	1
February	NE	1
March	SE	1
April	SE	1
May	S	1
June	SW	1
July	SW	2
August	SW	2
September	SW	1
October	N	1
November	N	1
December	N	1
Annual	N	1

2.3.1.2.5 Cyclone Frequency

Tropical cyclones are more frequent in Rizal and nearby provinces in July, and in September to December. In April to June, the average cyclone tracks appear closer in Rizal and nearby provinces, though the frequency is less during the southwest monsoon period as compared to other periods.



Source: PAGASA

Figure 41 – Frequency of Tropical Cyclones

2.3.1.3 Contribution in terms of Greenhouse Gas Emissions

Greenhouse gas (GHG) emissions emanating from project operation were estimated using the GHG protocol tools for mobile and stationary combustions of the World Resources Institute (WRI). These tools can estimate GHG emissions by providing the type of fuel and the estimated fuel consumption per year.

The table below shows the estimated fuel consumption and the estimated CO_2e per year. Assuming 300 days of operation per year and 10% outages per year for the stand-by generator sets, the total estimated CO_2e per year is 13,189.828 tons. Note that this is only a rough estimate of annual CO_2e on a per year basis, though actual emissions will vary depending on production rates and usage of equipment and generator sets.

Annex C shows the spreadsheets used to calculate fuel consumption and CO_2e.

Table 42. Estimated fuel consumption and CO_2 emissions

Type	Fuel Consumption (m^3 per year)	GHG Emissions (CO^2e) (MT per year
Vehicles/mobile sources	3,538.56	9,470.334
Generator sets (2 stand-by units and 1 unit for welding machines)	1,385.15	3,719.494
Total	4,923.71	13,189.828

IMPACTS AND MITIGATING MEASURES ON METEOROLOGY/CLIMATOLOGY

Contribution in Terms of Greenhouse Gas Emissions

The main sources of GHG emissions in the Project are as follows:

- Fuels used in the operation of heavy machinery and equipment such as excavator, bulldozer, payloader, crusher, backhoe and grader; and
- Fuel used in the operation of trucks and service vehicles.

Below are the proposed mitigation measures as regard to GHG emissions.

a. Prepare and implement a GHG emissions accounting program in accordance with international standards, such as those of the developed by the World Resources Institute (WRI) and the World Business Council on Sustainable Development (WBCSD). This protocol sets the global standard to measure, manage, and report greenhouse gas emissions. GHG emissions are reported according to the following scope:

    - Scope 1 emissions – measure emissions that are directly owned and controlled sources. These include emissions from the exhaust stacks and vehicles owned by the proponent.
    - Scope 2 emissions – measure emissions from purchase of electricity or acquired electricity, steam, heat, and cooling; and
    - Scope 3 emissions – indirect emissions, such as extraction and production of purchase materials, transport-related activities in vehicles not owned or controlled by the proponent and electricity related activities (e.g., transmission and distribution losses) not covered in Scope 2 (source:www.ghgprotocol.com);

b. Minimize idling time by shutting equipment off when not in use or reducing the time of idling to not more than 3 minutes;
c. Use of heavy equipment and trucks that are fuel efficient;
d. Optimize use of vehicles and heavy equipment (reduce number of vehicle trips, when appropriate);
e. Optimize lighting at workplaces and access roads; and
f. Offset GHG emissions by implementing an extensive reforestation program for the project.

2.3.2 Air Quality

2.3.2.1 Methodology

2.3.2.1.1 Regulatory Setting

National Ambient Air Quality Standards (NAAQS)

Table 43 presents the National Ambient Air Quality Standards (NAAQS) of the primary air pollutants. These standards are enforceable and should be complied by the owner or person in-charge of an industrial operation, process or trade (DAO 2000-81). The averaging period or sampling time of the air pollutants specified in the NAAQS are shorter in duration than those of the National Ambient Air Quality Guidelines (NAAQG).

Table 43. National Ambient Air Quality Standards (NAAQS) of selected air pollutants

Pollutant	Concentration ($\mu g/Nm^3$)	Averaging Time (min)	Reference
Sulfur Dioxide (SO_2)	340	60	Table 3 of DAO 2000-81
Nitrogen Dioxide (NO_2)	260	60	Table 3 of DAO 2000-81
Total Suspended Particulates (TSP)	300	60	Table 3 of DAO 2000-81
Particulate Matter less than 10 microns (PM_{10})	200	60	Table 3 of DAO 2000-81

Notes:
1) $\mu g/Nm^3$ – microgram per normal cubic meter
2) NAAQS for CO – not specified

National Ambient Air Quality Guidelines (NAAQG)

The table below shows the NAAQG for the primary air pollutants, such as SO_2, NO_2, TSP and CO. The short-term NAAQG values are maximum limits represented by 98-percentile values not to be exceeded more than once per year.

The NAAQG values are used for air quality management purposes, such as determining time trends and evaluating stages of deterioration or enhancement of the air quality. These values are generally intended as goals or objectives for the protection of health and/or public welfare.

Table 44. National Ambient Air Quality Guideline (NAAQG) for TSP, PM_{10}, $PM_{2.5}$, SO_2, and NO_2

Pollutants	Short-term Concentration[a]			Long Term Concentration[f]		
	$\mu g/Nm^3$	ppm	Averaging Time	$\mu g/Nm^3$	ppm	Averaging Time
Total Suspended Particulates (TSP)[b]	230	-	24 hours	90	-	1 year[g]
Suspended Particulates less than 10 microns (PM_{10})[bc]	150	-	24 hours	60	-	1 year[g]
Sulfur Dioxide (SO_2)[b]	180	0.07	24 hours	80	0.03	1 year
Nitrogen Dioxide (NO_2)	150	0.08	24 hours	-	-	-
Other air pollutants	Table 1 of DAO 2000-81					

[a] Maximum limits represented by ninety-eight percentile (98%) values not to exceed more than once a year.
[b] SO_2 and Suspended Particulate matter are sampled once every six days when using the manual methods. A minimum of twelve sampling days per quarter or forty-eight sampling days each year is required for these methods. Daily sampling may be done in the future once continuous analysers are procured and become available.
[c] Provisional limits for PM_{10} until sufficient monitoring data are gathered to base a proper guideline.
[d] As per DAO No. 2013-13: "Establishing the Provisional National Ambient Air Quality Guideline Values for Particulate Matter 2.5 ($PM_{2.5}$)", NAAQGV for $PM_{2.5}$ (24 hours) was upgraded from 75 µg/Nm^3 to 50 µg/Nm^3 on January 1, 2016.
[e] Evaluation of this guideline is carried out for 24-hour averaging time and averaged over three moving calendar months. The monitored average value for any three months shall not exceed the guideline value.
[f] Arithmetic mean.
[g] Annual geometric mean

2.3.2.1.2 Sampling and Analysis

Ostrea Mineral Laboratories, Inc. conducted the ambient air and noise monitoring on 21 to 24 July 2019. Four (4) locations were sampled for 24-hour continuous air sampling and four (4) locations for one (1) hour and 30-minutes air sampling.

Table 45. Coordinates of air sampling stations and the pollutants sampled

Station ID	Location	Latitude (deg)	Longitude (deg)	Pollutants Sampled	Averaging Period
AQ1	About 700 m from ATN quarry site	14°49’09.4” N	121°8’10.2” E	TSP, PM_{10}, $PM_{2.5}$,NO_2, SO_2, Pb, As, Cd, Sb, Hg	24 hours and 1 hour for TSP, PM_{10}, $PM_{2.5}$,NO_2, and SO_2; 30 minutes for As, Cd, Sb, and Hg
AQ2	Residential area beside Iglesia Ni Cristo (INC) church	14°47’32.6” N	121°8’46.6” E	TSP, PM_{10}, $PM_{2.5}$,NO_2, SO_2, Pb, As, Cd, Sb, Hg	24 hours and 1 hour for TSP, PM_{10}, $PM_{2.5}$,NO_2, and SO_2; 30 minutes for As, Cd, Sb, and Hg
AQ3	Residential area in Brgy. Macabud; about 500 m from ATN quarry site	14°46’21.8” N	121°7’51.9” E	TSP, PM_{10}, $PM_{2.5}$,NO_2, SO_2, Pb, As, Cd, Sb, Hg	24 hours and 1 hour for TSP, PM_{10}, $PM_{2.5}$,NO_2, and SO_2; 30 minutes for As, Cd, Sb, and Hg
AQ4	Near residential area in Stio Laan-Jovil INC Church	14°46’28.1” N	121°8’29.6” E	TSP, PM_{10}, $PM_{2.5}$,NO_2, SO_2, Pb, As, Cd, Sb, Hg	24 hours and 1 hour for TSP, PM_{10}, $PM_{2.5}$,NO_2, and SO_2; 30 minutes for As, Cd, Sb, and Hg

*TSP = Total suspended particulates (TSP); PM_{10}= Particulate Matter at 10µm or less; $PM_{2.5}$= particulate matter at 2.5µm or less;NO_2 = nitrogen dioxide; SO_2 = sulfur dioxide; Pb=lead; As=arsenic; Cd=cadmium, Sb=Antimony, and Hg=mercury

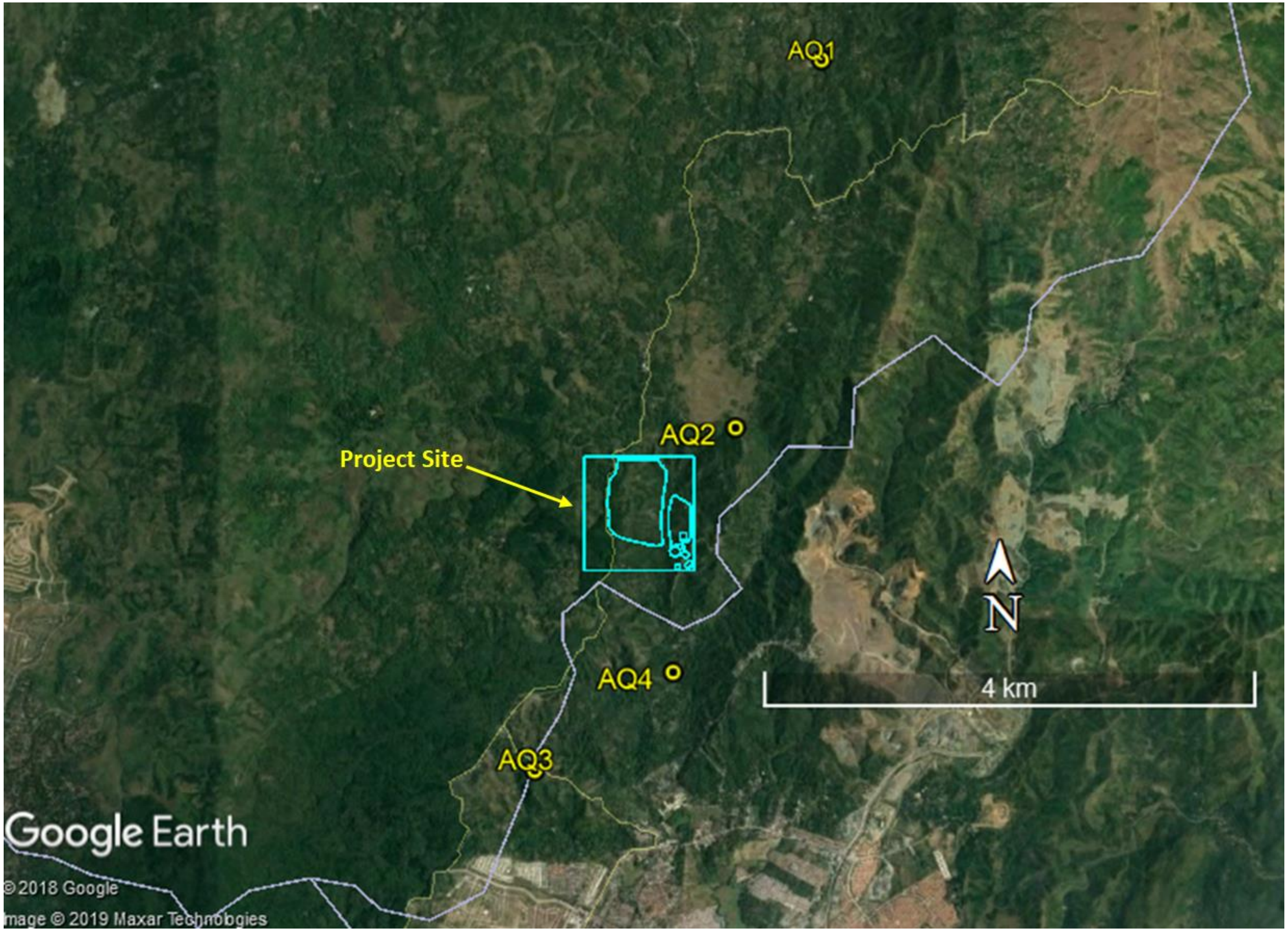


Figure 42 – Locations of air monitoring stations

The methods of sampling and analysis for particulates, gases, and trace metals were based from the United States Environmental Protection Agency (USEPA), except for NO_2 which was from the Methods of Air Sampling & Analysis 3rd Ed.

Table 46. Methods of air sampling and analysis

Pollutant	Sampling and Analysis Procedures
Total suspended particulates (TSP)	High Volume / Gravimetric
Particulate Matter 10 (PM_{10})	High Volume / Gravimetric
Particulate Mater 2.5 ($PM_{2.5}$)	High Volume / Gravimetric
Sulfur Dioxide (SO_2)	Gas Bubbler / Pararosaniline
Nitrogen Dioxide (NO_2)	Gas Bubbler / Griess-Saltzman
Lead (Pb)	High Volume / Flame AAS
Antimony (Sb)	High Volume / Flame AAS
Arsenic (As)	High Volume I Hydride Generation AAS
Cadmium (Cd)	High Volume / Flame AAS
Mercury (Hg)	High Volume / Cold Vapor AAS

The following briefly describes the methods of air sampling and analysis:

a. TSP

An air sampler draws ambient air at a constant flow rate into a specially shaped inlet and through a filter. The sampler flow rate and the geometry of the shelter favors the collection of particles up to 25-50 pm (aerodynamic diameter). Filter samples were then analyzed gravimetrically.

b. PM_{10}

Air was drawn into a covered housing and through a filter by means of a high flow-rate blower at a flow rate that allowed suspended particles with diameter of 10 microns to pass to the filter surface. The mass concentration of suspended particulate was computed by measuring the mass of collected particulate and the volume of the air sampled.

c. $PM_{2.5}$

An electrically powered air sampler draws ambient air at a constant volumetric flow rate into a specially shaped inlet and through an inertial particle size separator (impactor) where the suspended particulate matter in the $PM_{2.5}$ size range was separated for collection on a polytetrafluoroethylene (PTFE) filter over the specified sampling period. The mass concentration of $PM_{2.5}$ in the ambient air was computed as the total mass of collected particles in the $PM_{2.5}$ size range divided by the actual volume of air sampled. The results were expressed in micrograms per Normal cubic meter of air ($\mu g/Nm^3$).

d. SO_2

This method was based on the absorption of sulfur dioxide from air in a solution of potassium tetrachloromercurate. A dichlorosulfitomercurate complex that resisted oxidation by oxygen in the air was formed, which was then reacted with pararosaniline methyl sulfonic acid. The intensity of the color produced was measured by a spectrophotometer. This was then correlated with amount of SO_2 present in the air samples by means of calibration curve.

e. NO_2

NO_2 was absorbed in an azo dye-forming reagent. A stable pink color was produced within 15 minutes or more, which may be read visually or in appropriate instrument at 550 nm.

f. Lead (Pb), antimony (Sb) and cadmium (Cd)

Suspended particulate matter were collected on a glass-fiber filter using a high-volume sampler. Collected samples were digested and analyzed through flame AAS.

g. Arsenic (As)

Suspended particulate matter were collected on a glass-fiber filter using a high-volume sampler. Collected samples were digested and analyzed through Hydride Generation AAS.

h. Mercury (Hg)

Suspended particulate matter were collected on a glass-fiber filter using a high-volume sampler. Collected samples were digested and analyzed through Cold Vapor AAS.

2.3.2.2 Emission Estimates

Impact assessment involved the determination of the type and number of equipment, which were provided by the proponent, and estimation of the emission rates of particulates (TSP, PM_{10}, and $PM_{2.5}$) and gaseous air pollutants (SO_2 and NO_2). Emission rates of the air pollutants were estimated using the emission factors of the U.S.EPA and the National Pollution Inventory (NPI) of the Australian Government.

The following are the three (3) major sources of air emissions at the project site and the corresponding activities:

- Quarry area - bulldozing, materials handling, grading at mine, unpaved roads (transport of haul trucks), motor vehicle emissions (tailpipes), and blasting
- Crusher area – diesel generator sets, truck loading and unloading, primary and secondary crushing, screening, conveyor transfer points, and truck loading of materials to trucks for delivery; and
- Batching plant.

Presented below are the emission factors, which were used to estimate air emissions.

a. Bulldozing

The emission factors of TSP, PM_{10} and $PM_{2.5}$(in kg/hr) arising from bulldozing activities were based on AP-42 Emission factor (Table 11.9-2), as follows:

$$EF_{TSP(bulldozing)} = \frac{2.6s^{1.2}}{M^{1.3}}$$
Equation 1

$$EF_{PM10(bulldozing)} = 0.75x\frac{0.45\ s^{1.5}}{M^{1..4}}$$
Equation 2

$$EF_{PM2.5(bulldozing)} = 0.105\ x\ E_{TSP} = \frac{0.273\ s^{1.2}}{M^{1.3}}$$
Equation 3

where, s, is the material silt content (%) and, M is the material moisture content (%).

b. Materials Handling

Emission factors for TSP, PM_{10} and $PM_{2.5}$(in kg/ton) arising from movement of haul-trucks and front-end loaders/shovels for the unloading/loading of materials were estimated using Section 13.2.4 of AP-42, as follows.

$$EF_{Materials\ Handling} = k\ (0.0016)\frac{\left(\frac{U}{2.2}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}}$$
Equation 4

where U and M are the mean wind speed (m/s) and the material moisture content (%), respectively. The particle size multiplier, k, is 0.74 for TSP, 0.35 for PM_{10} and 0.053 for $PM_{2.5}$.

c. Grading at Mine

Emission factors for TSP (in kg/vehicle kilometre travelled) for grading and scraping of unpaved roads were based on Table 11.9-2 of AP-42, as follows:

$$\boldsymbol{E_{TSPgrading-scraping} = 0.0034\ x\ S^{2.5}} \quad \textbf{Equation 5}$$

where, S, is the mean vehicle speed (km/h). For PM_{10}, the emission factor (in kg/vehicle kilometre travelled) is,

$$\boldsymbol{E_{PM10grading-scraping} = 0.6\ x\ 0.0056\ x\ S^{2.0}} \quad \textbf{Equation 6}$$

d. Haul Trucks Along Unpaved Roads

Emission factors arising from operation of trucks (e.g., hauling of materials) along unpaved access roads (in lb/vehicle mile travelled) were obtained from Chapter 13.2 of AP-42, as follows:

$$EF_{UnpavedRoad}=k\left(\frac{s}{12}\right)^{a}\left(\frac{W}{3}\right)^{b} \quad \textbf{Equation 7}$$

where k, a, and, b, are constants shown in the table below.

Table 47. Constants used on emission factors for unpaved roads

Constant	Industrial Roads		
	PM_{30}*	PM_{10}	$PM_{2.5}$
K (lb/VMT)	4.9	1.5	0.15
a	0.7	0.9	0.9
b	0.45	0.45	0.45
**Assumed equivalent to total suspended particulate matter (TSP)* *Source: Table 13.2.2-2 of AP-42*			

The above equations and constants were converted to metric units to obtain the emission factors in vehicle kilometre travelled (or kg/VKT).

The emission factor (Equation 7) was adjusted to account for the natural mitigation by rainfall using the formula,

$$E_{Funpaved(cor)}=EF_{unpaved}\left(\frac{365-P}{365}\right)$$

Equation 8

Where:

- $EF_{unpaved(cor)}$= the annual size specific emission factor extrapolated for natural mitigation (lb/VMT), and
- P = number of days in a year with at least 0.254 mm (0.01 in) of rainfall

e. Motor Vehicle Combustion

Tailpipe emissions emanating from operation of heavy equipment were estimated using emission factors prescribed in *NPI Emission Estimation Technique l for Combustion Engine V3.0 (June 2008)*. Computation of emission rates included estimation of fuel consumption as provided in the report of Klanfar, et. al. (2016) entitled, “Fuel Consumption and Engine Load Factors of Equipment in Quarrying of Crushed Stone”. This reference provides good estimates of fuel consumption rate based on calculated load factor.

The table below shows the list of heavy equipment used for quarry operation and the corresponding engine rated power, the average load factor as provided by Klanfar, et.al (2016), and the fuel consumption rate and emissions factors.

Table 48. Emission factors for heavy equipment operations

Source	Rated Power (kW)	Average Load Factor	Fuel Consumption based on Average Load factor (l/hr)	Emission Factor (kg/hr)		
				Total Particulates	PM10	PM2.5
Komatsu-PC350 Excavator	194	0.56	28.12	0.00378	0.002904	0.002673
SEM Dozer	162	0.48	20.13	0.00399	0.003069	0.002805
SEM Wheel loader	162	0.27	11.32	0.00458	0.003520	0.003168
HOWO Dump trucks	251	0.23	14.92	0.00234	0.001800	0.001700
Water truck	112	0.23	6.66	0.00299	0.002300	0.002200
Fuel truck	112	0.23	6.66	0.00299	0.002300	0.002200
Komatsu-Grader	123	0.5	15.92	0.00349	0.002688	0.002464
Hydraulic drilling machine	125	0.61	19.74	0.00468	0.003600	0.003300

f. Blasting

The emission factor in AGH EH (2006) provided the revised emission factor of TSP during blasting operation, as follows.

$$E_{TSP\ (blasting)} = 0.000222\ x\ A^{1.5} \qquad \textbf{Equation 9}$$

Where, A, is the area blasted (m^2). Equation (8) was recommended as replacement to the emission factor presented in Chapter 11 of AP-42. PM_{10} emission was estimated at 52% of the TSP emission, as provided in AP-42.

g. Diesel Generator Sets

The project has been using three (3) units of diesel generator sets. The two (2) units, which are used during power interruptions, have rated capacities of 1600 kVA (1280 kW), and the third unit has 750 kVA (600 kW). The third unit is intended as power supply for welding machines.

As the rated capacities of the above-mentioned generator sets greater are than 600 hp (or 447.4 kW) (or large diesel engines), the applicable emission factors are those intended for diesel engines greater than 600 hp (or 447.4, specifically for “Diesel Fuel)”. The table below presents the emission factors of the primary air pollutants emanating from “large diesel engines”.

Table 49. Emission factors for primary air pollutants meaning from diesel industrial engines

Pollutant	Emission Factor (lb/MMBtu)
Total particulates	0.0697
PM_{10}	0.0573
NO_X	0.049
SO_X	0.505
CO	0.85
Source: Table 3.4.1, Section 3.4 (Large Diesel and All Stationary Dual-fuel Engines of U.S.EPA AP-42	

h. Crusher Area

The emission factors related to crushing operations (except operation of stand-by generator sets) were based from based from Table 11.19.2-1 in Section 11.19.2 (Crushed Stone Processing and Pulverized Mineral Processing) of the U.S.EPA AP-42.

The applications of these emission factors were patterned from the study conducted Trinity Consultants (2016) for a proposed gravel pit operation. There are emission factors with "no data" or (ND) as presented in Table 11.19.2-1 in Section 11.192 of the U.S. EPA AP-42; although there are specific notes or instructions to use, for example, the emission factors for PM_{10} intended for tertiary crushers as upper limits for primary and secondary crushing.

Table 50. Emission factors for crushing related activities (in kg/Mg)

Source	Total PM	Total PM10	Total PM2.5
Truck loading of material	0.000113	0.0000500	0.0000093
Truck unloading of material at crusher	0.000018	0.0000080	0.0000015
Primary crushing	0.002700	0.0012000	0.0000500
Secondary crushing	0.002700	0.0012000	0.0000500
Screening (2 points)	0.012500	0.0043000	0.0007960
Conveyor transfer points (primary to secondary crushing)	0.001500	0.0005500	0.0001019
Conveyor transfer points (secondary to screening)	0.001500	0.0005500	0.0001019
Conveyor transfer points (screening to wash screen)	0.001500	0.0005500	0.0001019
Truck loading of material to trucks	0.000113	0.0001125	0.0001125

i. Aggregate Handling and Storage Piles

Fugitive particulate emissions are also generated during movement of truck and transfer of materials at or within the area where the stockpiles are located; including wind erosion at the stockpiles, as these are left uncovered because of the need to transfer materials within crusher site.

The table below shows the emission factors for particulate emissions emanating from aggregate handling and storage piles.

Table 51. Emission factors for aggregate handling and storage piles

Pollutant	Emission factor (kg/Mg)
TSP	0.000491
PM_{10}	0.000232
$PM_{2.5}$	0.000035

j. Concrete Batching Plant Operations

The emission factors of TSP and PM10 for concrete batching plant operation were obtained from Section 11.12 Concrete Batching of AP-42 while for PM2.5 emissions, a particle size multiplier was obtained from Table 1 of Background Document for Revisions to Fine Fraction Ratios Used for AP-42 Fugitive Dust (U.S.EPA 2006). The batching plant operation included aggregate and sand transfer, cement loading and unloading to elevated silo, weigh hopper loading and mixer loading.

Table 52. Emission factors of concrete batching plant operations

Operation/ Activity	TSP	PM_{10}	$PM_{2.5}$	Units
Aggregate transfer	0.0035	0.0017	0.00026	$kg/tons_{aggregate}$
Sand transfer	0.0011	0.00051	0.000077	$kg/tons_{sand}$
Pneumatic cement unloading to elevated silo (controlled)	0.0005	0.00017	0.000026	$kg/tons_{cement}$
Weigh hopper loading	0.0026	0.0013	0.00020	$kg/tons_{aggregate\&\ sand}$
Mixer loading (central mix) (controlled)	0.0092	0.0028	0.00042	$kg/tons_{cement}$
Source: Section 11.12 AP-42				

2.3.2.3 Air Quality Results

Background monitoring involved sampling of particulates (TSP, PM_{10}, and $PM_{2.5}$), SO_2, NO_2 and metals (lead, antimony, arsenic, cadmium, and mercury).

Background levels of particulates (TSP, PM_{10}, and $PM_{2.5}$) were way below the ambient guidelines and standards set for these air pollutants. The highest measured TSP at 24-hour and 1-hour average sampling were 37 and 22 µg/Nm^3, respectively. The ambient guideline and standards for TSP are set at 230 and 300 µg/Nm^3, respectively.

The highest measured 24-hour and 1-hour average concentrations of PM_{10} were 23 and 14 µg/Nm^3, respectively, while the ambient guideline and standard are set at 150 and 200 µg/Nm^3, respectively. For $PM_{2.5}$, the measured concentrations were also way below the prescribed guideline value.

NO_2 at one-hour average sampling was not detected at the four (4) locations, though remarkably, NO_2 levels at 24-hour sampling at two locations (Stations AQ2 and Station AQ4) were measured at 2.1 and 3.3 µg/Nm^3, respectively. NO_2 levels at the other two 24-hour average stations (Stations AQ1 and AQ3) were below detection limit (<0.4 µg/Nm^3).

SO_2 (24-hour and 1-hour average concentrations) was not detected (or below detection limits) at the time of monitoring.

Metals in ambient air (lead, antimony, arsenic, cadmium, and mercury) were all not-detected (less than the detection limits) at the time of monitoring.

Sources of air emissions at the time of monitoring were fugitive particulates from vehicular movements at unpaved and access roads to the project site. The project was also operational at the time of monitoring, although there were relatively lower emissions due to occurrence of rainfall at the time of monitoring.

<u>Meteorological observations during sampling</u>

As air monitoring was conducted within wet season or southwest monsoon, there were occasional rainfall at the time of monitoring. Ostrea (2019) also noted occurrence of rainfall two (2) days prior to start of sampling, which likely resulted to suppression of fugitive particulates in the area. Prevailing wind directions at the time of monitoring were from the southwest.

Table 53. Measured 24-hour average air concentrations of particulates, gaseous air pollutants and metals in ambient air

Station ID	Location	Date/Time Start of Sampling	Date/Time End of Sampling	TSP	PM_{10}	$PM_{2.5}$	NO_2	SO_2	Pb	Sb	As	Cd	Hg
AQ1	About 700 m from ATN quarry site	22 July 2019/ 12:00 P.M.	23 July 2019/ 12:00 P.M.	10	3	-	<0.4	<4	<0.0006	<0.00008	<0.00002	<0.00005	<0.000003
AQ2	Residential area beside Iglesia Ni Cristo (INC) church	22 July 2019/ 12:00 P.M.	23 July 2019/ 12:00 P.M	37	1 2	3.8	2.1	<4	<0.0006	<0.00008	<0.00002	<0.00005	<0.000003
AQ3	Residential area in Brgy. Macabud; about 500 m from ATN quarry site	23 July 2019/ 2:20 P.M.	24 July 2019/ 2:20 P.M	33	9	-	<0.4	<4	<0.0006	<0.00008	<0.00002	<0.00005	<0.000003
AQ4	Near residential area in Stio Laan-Jovil INC Church	23 July 2019/ 2:40 P.M.	24 July 2019/ 2:40 P.M	33	23	9.3	3.3	<4	<0.0006	<0.00008	<0.00002	<0.00005	<0.000003
NAAQG				**230**	**150**	**50**	**150**	**180**	**1.5**	**-**	**-**	**-**	**-**

Table 54. Measured one-hour average air concentrations of particulate and gaseous air pollutants

Station ID	Location	Date/Time Start of Sampling	Date/Time End of Sampling	TSP	PM_{10}	$PM_{2.5}$	NO_2	SO_2
AQ1	About 700 m from ATN quarry site	21 July 2019/ 1:45 P.M. 12:30 P.M*	02 July 2019/ 2:45 P.M. 1:30 P.M*	10	5	13	<0.03	<0.2
AQ2	Residential area beside Iglesia Ni Cristo (INC) church	21 July 2019/ 12:30 P.M.	21 July 2019/ 1:30 P.M.	15	11	13	<1	<7
AQ3	Residential area in Brgy. Macabud; about 500 m from ATN quarry site	23 July 2019/ 12:30 P.M.	24 July 2019/ 1:30 P.M.	12	8	4	<1	<7
AQ4	Near residential area in Stio Laan-Jovil INC Church	23 July 2019/ 12:30 P.M. 1:40 P.M.**	23 July 2019/ 1:30 P.M. 2:40 P.M**	22	14	24	<1	<7
NAAQS				**300**	**200**	**-**	**260**	**340**

*for TSP sampling only
**for PM2.5 sampling only

Table 55. Measured concentrations of metals in ambient air (30-minute averaging period)

Station ID	Location	Date/Time Start of Sampling	Date/Time End of Sampling	Pb	As	Cd	Sb	Hg
AQ1	About 700 m from ATN quarry site	21 July 2019/ 1:30 P.M.	21 July 2019/ 2:00 P.M.	<1.0	<0.025	<0.075	<0.125	<0.005
AQ2	Residential area beside Iglesia Ni Cristo (INC) church	21 July 2019/ 1:30 P.M.	21 July 2019/ 2:30 P.M.	<1.0	<0.025	<0.075	<0.125	<0.005
AQ3	Residential area in Brgy. Macabud; about 500 m from ATN quarry site	23 July 2019/ 1:30 P.M.	23 July 2019/ 2:00 P.M.	<1.0	<0.025	<0.075	<0.125	<0.005
AQ4	Near residential area in Stio Laan-Jovil INC Church	23 July 2019/ 1:30 P.M.	23 July 2019/ 2:00 P.M.	<1.0	<0.025	<0.075	<0.125	<0.005
NAAQS				**20**	**20**	**10**	**20**	**-**

Photo 22. Shown are the crusher (left) and buildings and some heavy equipment (right) at the project site

Photo 23. Mined area west of the project site

Photo 24. Some trucks and heavy equipment used at the project

Photo 25. Generator set (600 kVA) used for welding machines

Photo 26. Two (2) units of generator sets used as back-up power in case of power interruption

IMPACTS AND MITIGATING MEASURES ON AIR QUALITY

The operation of the project is expected to generate regulated air pollutants. Air emissions could be generated during operation of heavy equipment and other vehicles, the crusher, and the concrete batching plant. The following are the significant quarrying and other project activities that generate regulated air emissions:

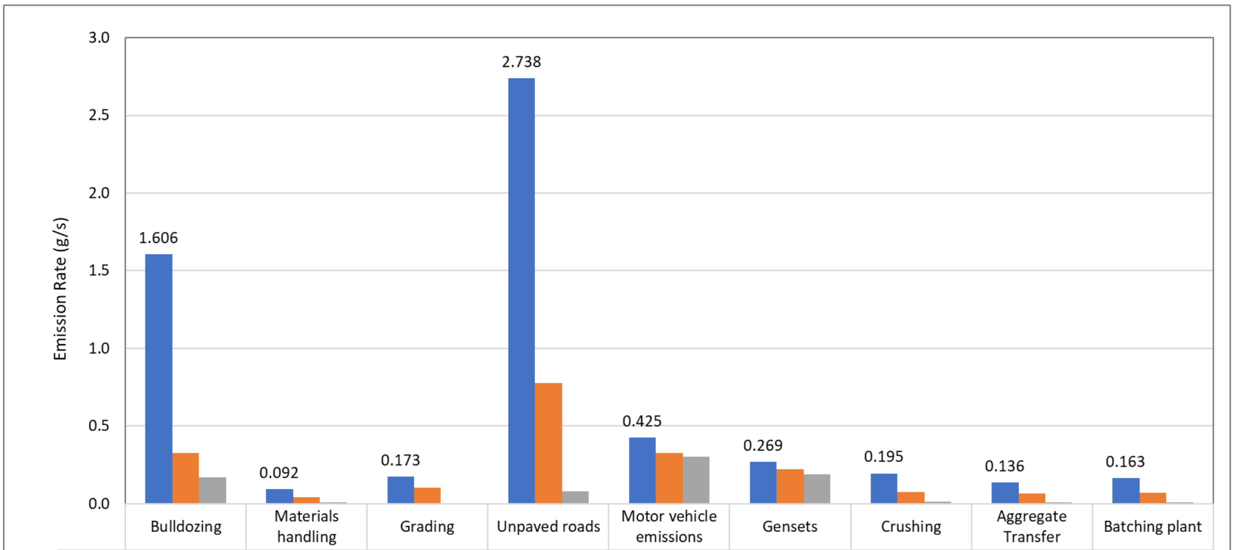
- Bulldozing;
- Materials handling (mine site and quarry area);
- Grading;
- Travel of haul trucks and other vehicles along access roads;
- Tailpipe emissions from vehicles;
- Blasting;
- Diesel generator sets;
- Crusher;
- Aggregate handling and storage piles; and
- Concrete batching plant.

Emission estimates of the above sources and activities were estimated using available emission factors from the U.S.EPA AP-42 and the National Pollution Inventory (NPI) of the Australian Government.

Results of emission estimates suggest that hauling of materials along the unpaved roads (mine site to crusher area) has the highest estimated emission rates at 2.738 g/s. The second highest is bulldozing at 1.606 g/s and the third from motor vehicle emissions (0.425 g/s). It should be noted, however, that total air emissions per source or activity may vary as the emission related activities are highly variable. For example, bulldozing may not be required at all time, thus a significant reduction of this emission in the long term.

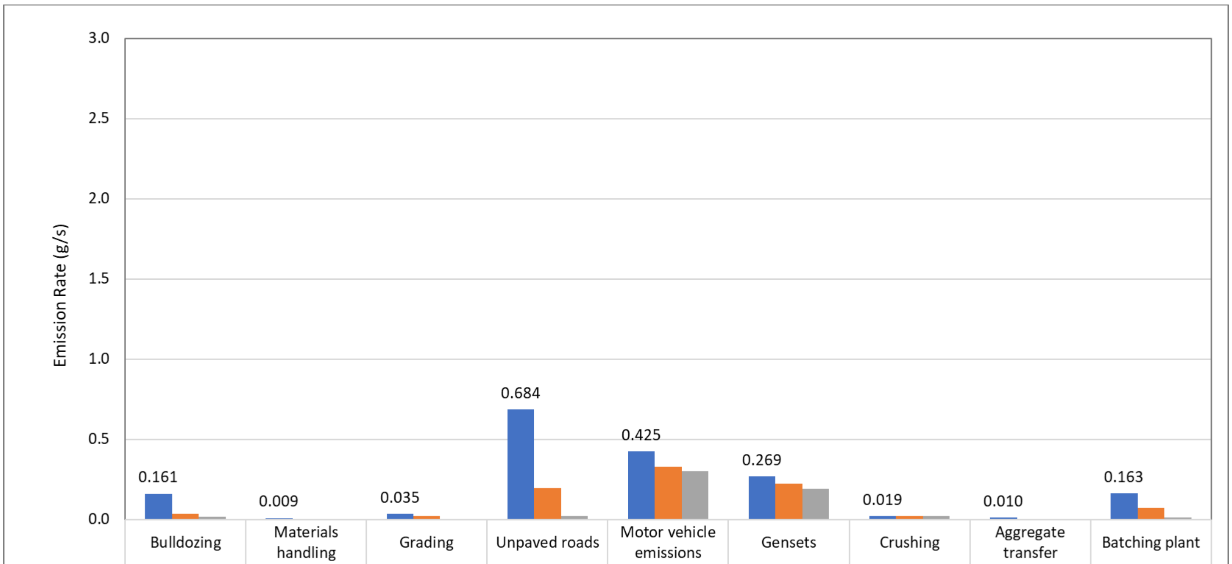
The estimated air emissions under controlled scenarios, i.e., water spraying to control dust emissions, show significant reduction of air emissions, particularly particulates. Operation of vehicles (haul trucks) along unpaved roads was reduced to 0.684 g/s at control efficiency of 75%. No reduction was assumed from motor vehicle and diesel generator sets emissions due to unavailability of emission factors for controlled emissions.

Note that emission rate for blasting operation is in kg/blast, thus this was not included in the figures below. Blast operation, however, was estimated to generate about 0.22 kg/blast of TSP and 0.1144 and 0.023 kg/blast of PM_{10} and $PM_{2.5}$, respectively.



	Bulldozing	Materials handling	Grading	Unpaved roads	Motor vehicle emissions	Gensets	Crushing	Aggregate Transfer	Batching plant
TSP	1.606228	0.091811	0.172674	2.737939	0.425449	0.269175	0.194614	0.136471	0.163431
PM10	0.326242	0.043424	0.103604	0.778571	0.327269	0.221287	0.073233	0.064547	0.071090
PM2.5	0.168654	0.006576	0.005353	0.077857	0.302191	0.189233	0.011386	0.009774	0.010835

Graph 44. Plot of uncontrolled emission rates of particulates (g/s)



	Bulldozing	Materials handling	Grading	Unpaved roads	Motor vehicle emissions	Gensets	Crushing	Aggregate transfer	Batching plant
TSP	0.160623	0.009181	0.034535	0.684485	0.425449	0.269175	0.018945	0.010235	0.163431
PM10	0.032624	0.000000	0.020721	0.194643	0.327269	0.221287	0.018945	0.000000	0.071090
PM2.5	0.016865	0.000000	0.001071	0.019464	0.302191	0.189233	0.018945	0.000000	0.010835

Graph 45. Plot of controlled emission rates of particulates (g/s)

Table 56. Emission estimates of diesel generator sets

Emission ID	Description	Capacity (kVA)	Pollutant	U.S.EPA Emission Factor	Emission Factor Units	U.S.EPA AP-42 E.F. Rating	Data Quality	Fuel consumption (gal/hr)	Emission Rate (kg/hr)	g/s
Genset 1	Diesel generator	1,600	Total particulates	0.0697	lb/MMBtu	B	Above average	90.9312	0.392	0.109
			PM_{10}	0.0573	lb/MMBtu	B	Above average	90.9312	0.322	0.090
			$PM_{2.5}$	0.049	lb/MMBtu	B	Above average	90.9312	0.276	0.077
			NO_X	3.2	lb/MMBtu	B	Above average	90.9312	18.007	5.002
			SO_X	0.505	lb/MMBtu	B	Above average	90.9312	2.842	0.789
			CO	0.85	lb/MMBtu	C	Above average	90.9312	4.783	1.329
Genset 2	Diesel generator	1,600	Total particulates	0.0697	lb/MMBtu	B	Above average	90.9312	0.392	0.109
			PM_{10}	0.0573	lb/MMBtu	B	Above average	90.9312	0.322	0.090
			$PM_{2.5}$	0.049	lb/MMBtu	B	Above average	90.9312	0.276	0.077
			NO_X	3.2	lb/MMBtu	B	Above average	90.9312	18.007	5.002
			SO_X	0.505	lb/MMBtu	B	Above average	90.9312	2.842	0.789
			CO	0.85	lb/MMBtu	C	Above average	90.9312	4.783	1.329
Genset 2	Diesel generator	750	Total particulates	0.0697	lb/MMBtu	B	Above average	42.8	0.185	0.051

Emission ID	Description	Capacity (kVA)	Pollutant	U.S.EPA Emission Factor	Emission Factor Units	U.S.EPA AP-42 E.F. Rating	Data Quality	Fuel consumption (gal/hr)	Emission Rate (kg/hr)	g/s
			PM_{10}	0.0573	lb/MMBtu	B	Above average	42.8	0.152	0.042
			$PM_{2.5}$	0.049	lb/MMBtu	B	Above average	42.8	0.130	0.036
			NO_X	3.2	lb/MMBtu	B	Above average	42.8	8.476	2.354
			SO_X	0.505	lb/MMBtu	B	Above average	42.8	1.338	0.372
			CO	0.85	lb/MMBtu	C	Above average	42.8	2.251	0.625

Table 57. Emission estimates of TSP emanating from crusher related operation

Emission ID	Description	Source of Emission Factor	U.S.EPA Emission Factor	Emission Factor Units	U.S.EPA AP-42 E.F. Rating	Maximum Material Throughput (tons per hour)	Emission Rate (kg/hr)	g/s
Cr-1	Truck loading of material	Table 11.19.2-1 of AP-42	1.125E-04	kg/Mg	E	500	0.0035	0.0010
Cr-2	Truck unloading of material at crusher	Table 11.19.2-1 of AP-42	1.800E-05	kg/Mg	E	500	0.0006	0.0002
Cr-3	Primary crushing	Table 11.19.2-1 of AP-42	2.700E-03	kg/Mg	E	500	0.0835	0.0232
Cr-4	Secondary crushing	Table 11.19.2-1 of AP-42	2.700E-03	kg/Mg	E	500	0.0835	0.0232
Cr-5	Screening (2 points)	Table 11.19.2-1 of AP-42	1.250E-02	kg/Mg	E	500	0.3868	0.1074
Cr-6	Conveyor transfer points (primary to secondary crushing)	Table 11.19.2-1 of AP-42	1.500E-03	kg/Mg	E	500	0.0464	0.0129
Cr-7	Conveyor transfer points	Table 11.19.2-1 of AP-42	1.500E-03	kg/Mg	E	500	0.0464	0.0129

Emission ID	Description	Source of Emission Factor	U.S.EPA Emission Factor	Emission Factor Units	U.S.EPA AP-42 E.F. Rating	Maximum Material Throughput (tons per hour)	Emission Rate (kg/hr)	g/s
	(secondary to screening)							
Cr-8	Conveyor transfer points (screening to wash screen)	Table 11.19.2-1 of AP-42	1.500E-03	kg/Mg	E	500	0.0464	0.0129
Cr-9	Truck loading of material to shipping trucks	Table 11.19.2-1 of AP-42	1.125E-04	kg/Mg	E	500	0.0035	0.0010

Table 58. Emission estimates of PM10 emanating from crusher related operation

Emission ID	Description	Source of Emission Factor	U.S.EPA Emission Factor	Emission Factor Units	U.S.EPA AP-42 E.F. Rating	Maximum Material Throughput (tons per hour)	Emission Rate (kg/hr)	g/s
Cr1	Truck loading of material	Table 11.19.2-1 of AP-42	5.000E-05	kg/Mg	E	500	0.0015	0.0004
Cr2	Truck unloading of material at crusher	Table 11.19.2-1 of AP-42	8.000E-06	kg/Mg	E	500	0.0002	0.0001
Cr3	Primary crushing	Table 11.19.2-1 of AP-42	1.200E-03	kg/Mg	C	500	0.0371	0.0103
Cr4	Secondary crushing	Table 11.19.2-1 of AP-42	1.200E-03	kg/Mg	C	500	0.0371	0.0103
Cr5	Screening (2 points)	Table 11.19.2-1 of AP-42	4.300E-03	kg/Mg	C	500	0.1330	0.0370
Cr6	Conveyor transfer points (primary to secondary crushing)	Table 11.19.2-1 of AP-42	5.500E-04	kg/Mg	D	500	0.0170	0.0047
Cr7	Conveyor transfer points (secondary to screening)	Table 11.19.2-1 of AP-42	5.500E-04	kg/Mg	D	500	0.0170	0.0047
Cr8	Conveyor transfer points (screening to wash screen)	Table 11.19.2-1 of AP-42	5.500E-04	kg/Mg	D	500	0.0170	0.0047
Cr9	Truck loading of material to shipping trucks	Table 11.19.2-1 of AP-42	1.125E-04	kg/Mg	E	500	0.0035	0.0010

Table 59. Emission estimates of PM2.5 emanating from crusher related operation

Emission ID	Description	Source of Emission Factor	U.S.EPA Emission Factor	Emission Factor Units	U.S.EPA AP-42 E.F. Rating	Maximum Material Throughput (tons per hour)	Emission Rate (kg/hr)	g/s
Cr1	Truck loading of material	Table 11.19.2-1 of AP-42	9.259E-06	kg/Mg	E	500	0.00029	0.00008
Cr2	Truck unloading of material at crusher	Table 11.19.2-1 of AP-42	1.480E-06	kg/Mg	E	500	0.00005	0.00001
Cr3	Primary crushing	Table 11.19.2-1 of AP-42	5.000E-05	kg/Mg	E	500	0.00155	0.00043
Cr4	Secondary crushing	Table 11.19.2-1 of AP-42	5.000E-05	kg/Mg	E	500	0.00155	0.00043
Cr5	Screening (2 points)	Table 11.19.2-1 of AP-42	7.960E-04	kg/Mg	E	500	0.02463	0.00684
Cr6	Conveyor transfer points (primary to secondary crushing)	Table 11.19.2-1 of AP-42	1.019E-04	kg/Mg	E	500	0.00315	0.00088
Cr7	Conveyor transfer points (secondary to screening)	Table 11.19.2-1 of AP-42	1.019E-04	kg/Mg	E	500	0.00315	0.00088
Cr8	Conveyor transfer points (screening to wash screen)	Table 11.19.2-1 of AP-42	1.019E-04	kg/Mg	E	500	0.00315	0.00088
Cr9	Truck loading of material to shipping trucks	Table 11.19.2-1 of AP-42	1.125E-04	kg/Mg	E	500	0.00348	0.00097

Pursuant to the implementing rules and regulations of the Philippine Clean Air Act (PCAA) of 1999 (or DAO 2000-81), it is prohibited to emit particulate matter (or fugitive particulates) without taking reasonable precautions to prevent such emission. These emission sources include vehicular movement, transportation of materials, construction, demolition or wrecking or industry related activities such as loading, storing or "handling".

Furthermore, DAO 2000-81 also specifies that reasonable measures shall be implemented to limit particulate emissions (or fugitive emissions). These mitigation measures included, among others, the following (Source: Section 13(a), Rule XXV of DAO 2000-81):

- Use, where possible, of water or chemicals for control of dust from construction and quarrying or clearing of lands;
- Application of water or suitable chemicals on roads, materials of stockpiles and other surface which create airborne dust problem; and
- Installation and use of hood fans and fabric filters or any other suitable control devices to enclose and vent the handling of dusty materials. Adequate containment methods shall be employed during sandblasting or other similar operations.

In addition to the above-mentioned mitigation measures, the following are the recommended mitigation measures.

- Wet suppression or water spraying of exposed areas and areas to be graded/bulldozed
- Installation of temporary wind barriers, if needed. This depends on site conditions and the severity of the fugitive emissions
- Road grading to be done separately at other roadways (separate from bulldozing activities) to minimize total cumulative dust
- Provision of covers for trucks hauling spoils and other materials (if materials will be transferred off-site),
- Provision of wheel-washing system for vehicles leaving the project site. This system aims to remove mud at tires of the vehicles, which are potential sources when left at public roads;
- Regular maintenance of trucks to reduce or maintain tailpipe emissions.
- Provision of dust suppression system (water spraying) prior to and during unloading (materials handling)
- Use of dust and wind barriers downwind and upwind of the crusher area, respectively, during dry and wind conditions, if necessary.
- Watering or wetting of the area to be blasted before blasting. Immediately after blasting, allow dust to settle down prior to commencing other quarry operations in vicinities of the blasted area.
- When possible, conduct blasting during relatively low wind speeds to avoid dispersion of dust at nearby households/residences.

Identified Impacts	Mitigating Measures
Quarry and crushing related activities	- Provision of dust suppression system (water spraying) prior to and during unloading for materials handling; and - Provision of wind breaks, if necessary, particularly during dry weather conditions with moderate to strong winds.
Travelling of haul trucks and other types of vehicles on paved and unpaved	- Regular wet suppression or water spraying during dry weather condition; - Regular sweeping of roads to remove dust source;

Identified Impacts	Mitigating Measures
roads	- Reduction of wind speeds by installing temporary wind barriers along haul roads during high wind conditions; - Strict implementation of speed limits; - Provide trucks with appropriate cover, such as solid sliding cover on top of trucks, tarp that completely covers that whole transported material; - Provide wheel washing facilities for vehicles leaving the quarry and project site. The wheel washing facility should be used to remove muds at the tires of trucks and heavy equipment; - In case of very dry weather condition where wetting of dry surfaces would be effective for short duration, consider re-routing of vehicles away from area sensitive receptors (households or residences); and - Regular maintenance of trucks to reduce or maintain tailpipe emissions.
Generator sets	- Provision of a vertical stack without caps to enhance dispersion of air pollutants; - Regular maintenance of the diesel engines (i.e., change oil and filter change) to reduce particulate and carbon emissions; and - Conduct stack emissions sampling to check compliance with emission standards.
Blasting operation	- Watering of blast area before blasting, if dust may likely be dispersed at nearby households/residences; - Allow dust to settle down prior to commencing other quarry operations in vicinities of the blasted area; and - As possible, conduct blasting during relatively low wind speeds to avoid dispersion of dust at nearby households/residences.
Other sources/activities (land clearing, bulldozing)	- Regular wet suppression or water spraying during dry weather condition; and - Limit or restrict land clearing during dry periods and when wind speeds are moderate to high.

2.3.3 Noise

2.3.3.1 Methodology

The impact assessment on noise quality involved the a) discussion of the applicable noise standards, b) characterization of measured ambient noise levels prior to the operation of the proposed project (baseline monitoring), and c) the general information related to noise emissions of heavy equipment.

2.3.3.1.1 Regulatory Setting

The then National Pollution Control Commission (NPCC) provided the ambient noise standards on general areas, as stipulated in NPCC (1978) and NPCC (1980). **Table 60** shows the allowable noise by time periods at residential, commercial, light, and heavy industrial areas. Note that the primary land use of the area should be applied, in case there is no official classification of the area.

Table 60. Environmental quality standards for noise in general Areas

Category	Maximum Allowable Noise (dBA) by time periods		
	Daytime (9:00 A.M. to 6:00 P.M).	Morning/Evening (5:00 A.M. to 9:00 AM/ 6:00 P.M. to 10:00 P.M.	Nighttime (10:00 P.M. to 5:00 A.M).
AA	50	45	40
A	55	50	45
B	65	60	55
C	70	65	60
D	75	70	65
Class AA- a section of contiguous area which requires quietness, such as areas within 100 meters from school site, nursery schools, hospitals and special house for the aged Class A - a section of contiguous area which is primarily used for residential area Class B - a section of contiguous area which is primarily a commercial area Class C - a section of contiguous area reserved as light industrial area Class D-a section which is primarily reserved as heavy industrial area			

Source: NPCC 1980

Attenuated noise levels from construction equipment to households or residences should not exceed the ambient noise standards provided in the table above. Ambient noise standards intended for residential areas aim to protect the public from excessive noise, whether the activity is during construction or operation of a project, or from other noise emanating activities.

NPCC (1980) provided correction factors applicable to areas directly facing roads. Section 78 of NPCC (1980), however, shows discrepancies on the correction factors for four-lane roads or wider and the definition of heavy industrial area. Correction factors of +5 dBA and 10 dBA apply for both four-lane roads, but none for two-lane roads.

As the correction factors are intended on noise from mobile sources, it is prudent to consider a correction factor of +5 dBA to areas directly facing two-lane roads. Further, it is deemed assumed that Class B shall be for light industrial and not for heavy industrial areas, as the latter falls under Class D (Heavy Industrial Area).

Nuisance

Depending on the degree of noise emitted by operation of the proposed project, it may generate nuisance to noise sensitive receptors, i.e., residences. Nuisance is regulated in Article 694 of Republic Act No. 386 (Civil Code of the Philippines). It is defined as "*any act, omission, establishment, business, condition of property, or anything else which annoys or offends the senses or injures or endangers the health and safety of others, or other effects as provided in Article 694*.

Further, Article 695 in RA No. 386 provides that "*nuisance is either public or private. A public nuisance affects a community or neighborhood or any considerable number of persons, although the extent of the annoyance, danger or damage upon individuals may be unequal. A private nuisance is one that is not included in the foregoing definition*".

Workplace Standards

The Department of Labor and Employment (DOLE) sets the limits of permissible noise levels for workers. The workplace standards generally apply within workplaces. The permissible noise levels are proportional to the duration of exposure of workers, that is, the longer the exposure time, the lower is the permissible noise level.

Table 61. Permissible noise exposure

Duration per day, hours	Sound levels, dBA, slow response
8	90
6	92
4	95
3	97
2	100
1 ½	102
1	105
½	110
¼	115
*ceiling value: Noise exposure in excess of 115 dBA is not allowed	

Source: DOLE 1990

2.3.3.1.2 Sampling and Analysis

Ostrea Mineral Laboratories, Inc. (Ostrea) conducted background noise monitoring in vicinities of the project site. Sound levels were monitored using an Extect Instruments sound level meter (SLM) at four (4) stations, the locations of which were the same as those of the ambient air monitoring.

2.3.3.2 Noise Level Results

The succeeding tables below show the results of noise monitoring conducted at four (4) locations. Measured noise levels were generally within the ambient noise standard set for residential areas, except when vehicles passed near the monitoring location during sampling. Sources of noise were generally from residents, animals, insects, and passing vehicles.

Noise from the operation of the project was not noted or audible at the noise sampling stations due to wide distances from the quarry site to the monitoring stations (more than 400 m). The recommended locations of air and noise stations, as suggested by the preparer, was not sampled due to field limitations, i.e., availability of power supply and accessibility, as advised by the sampling team. Monitoring of noise levels, however, shall focus at residences nearest the project site as the project is already operational.

Table 62. Median of noise levels at Station AQ1

Period	Date	Time	Noise (dBA)	NPCC Standard for Class A (residential areas)	Source of Noise
Morning	23 July 2019	0711H-0726H	51	50	Birds, insects
Daytime	23 July 2019	1014H-1029H	56	55	Passing vehicles
Evening	22 July 2019	1933H-1948H	48	50	Insects
Nighttime	July 22, 2019	2330H-2345H	44	45	Insects

Table 63. Median of noise levels at Station AQ2

Period	Date	Time	Noise (dBA)	NPCC Standard for Class A (residential area)	Source of Noise
Morning	July 23, 2019	0721H-0736H	39	50	Residential area, animals
Daytime	July 23, 2019	1121H-1136H	40	55	Residential area
Evening	July 22, 2019	2106H-2121H	42	50	Insects, frogs, strong winds
Nighttime	July 23, 2019	0205H-0220H	39	45	Insects

Table 64. Median of noise levels at Station AQ3

Period	Date	Time	Noise (dBA)	NPCC Standard for Class A (residential area)	Source of Noise
Morning	24 July 2019	0555H-0607H	52	50	Passing vehicles, residents, dogs, chickens
Daytime	23 July 2019	1128H-1143H	55	55	Passing vehicles, strong winds
Evening	23 July 2019	1923H-1938H	57	50	Passing vehicles, residents, insects
Nighttime	24 July 2019	0033H-0048H	50	45	Insects, strong winds

Table 65. Median of noise levels at Station AQ4

Period	Date	Time	Noise (dBA)	NPCC Standard for Class A (residential area)	Source of Noise
Morning	24 July 2019	0733H-0748H	39	50	Residential area
Daytime	23 July 2019	1532H-1547H	40	55	Residential area
Evening	23 July 2019	2101H-2116H	38	50	Animal noise, strong winds
Nighttime	24 July 2019	0103H-0118H	38	45	Animal noise, strong winds

IMPACTS AND MITIGATING MEASURES ON NOISE

Sources of noise during project operation are the heavy equipment and movement of vehicles (e.g., trucks), crusher, and other equipment at the project site. At a distance of 15.24 m (or 50 ft), noise levels emanated by heavy equipment are higher than those prescribed for residential areas (**Table 66**). The location of the nearest receptor, however, are relatively far (more than 400 m) from the crusher. Thus, noise levels presented in the table below will likely attenuate at the said distance.

Regular noise monitoring, however, should be conducted during nighttime to check compliance with ambient noise standards or if the operation of the project will cause nuissance at nearby residences. Mitigation measures shall also be implemented to ensure compliance with local regulations, if necessary.

Table 66. Noise levels at 50 ft from selected equipment and corresponding usage factor

Equipment Description	Specification Lmax at 50 ft	Acoustical Use Factor (%)
Backhoe	80	40
Concrete batch plant	83	15
Concrete mixer truck	85	40
Dozer	85	50
Drill rig truck	84	20
Dump truck	84	40
Front end loader	80	40
Generator	82	50
Grader	85	40

Source: U.S. FHWA Final Report, 2006

Below are the proposed noise mitigation measures during construction of the project.

- Require all heavy equipment and other equipment using internal combustion engines (e.g., generator sets) to install effective mufflers. Significant noise is emitted due to intake and exhaust of the internal combustion engine, which could be effectively reduce using mufflers;
- Impose speed limits at access roads near residential areas and within construction site;
- Limit use of equipment at nighttime, especially equipment that emits high noise levels, when such activity could cause nuisance at nearby households;
- Enclose high noise emitting equipment with temporary barriers and sound absorbing materials (if necessary);
- Locate noisy equipment or facility away from the residential area; and
- Specify in the contract with the contractors the mitigation measures during construction period. This is to ensure that the proposed mitigation measures are implemented. Penalties for non-compliance should also be specified in the contract.

2.4 People

The assessment explores the personal profile of the respondents, the economic profile of the households, housing condition, their access to education, health services and information, the background of the community, and their personal perception of the proposed project.

The study employed the following techniques:

- Review of available secondary data, reports, relevant studies and other information;
- Conduct of reconnaissance survey of the project area that is to be affected by the proposed project;
- Conduct of social preparation through information, education and communication (IEC) in the Municipality, the affected barangay and other stakeholders;
- Sector consultations through focus group and individual discussions;
- Gathering and review of relevant primary data critical to the study;
- Archaeological assessment; and
- Conduct of perception survey to determine their perception about the project.

2.4.1 Profiles

2.4.1.1 Socio-Economic Profile of Rodriguez, Rizal

2.4.1.1.1 Population

The Municipality of Rodriguez, formerly known as Montalban, has a steady growth of population with a total count of 280,904 as of 2010. It has an average growth rate of 7.9 percent as recorded by the National Statistics Office census. Composed of twelve (12) barangays, San Jose is the most populous (108,586) while Barangay Puray comes least (2,941). Barangay Macabud has an overall population of 6,605.

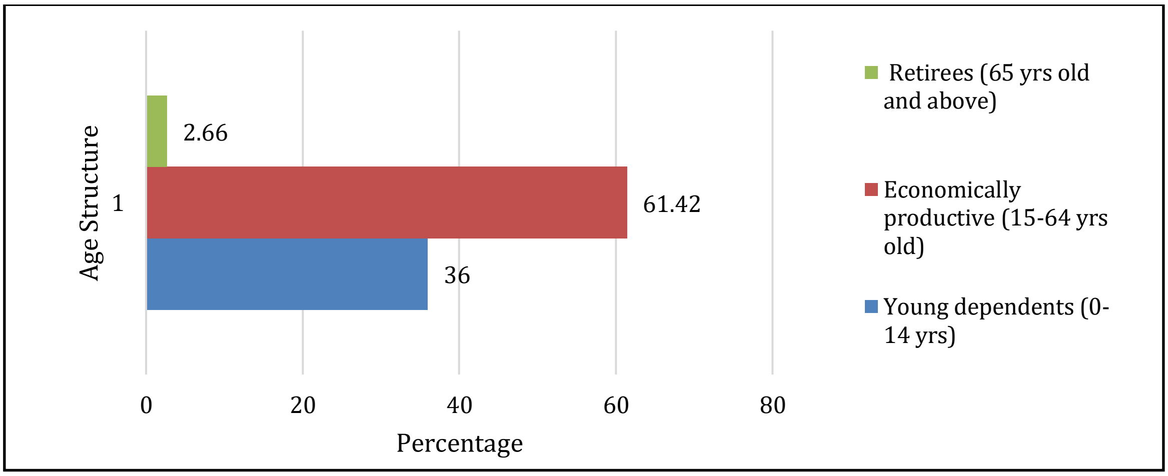
Table 67. Population Distribution of Rodriguez Rizal by Barangay, 1990–2010

Barangay	Census Year				
	1990	1995	2000	2007	2010
Rodriguez	67,074	79,668	115,167	223,594	280,904
Balite (Pob.)	6,182	6,943	7,849	8,827	9,114
Burgos	15,483	19,536	25,146	34,032	38,554
Geronimo	3,365	3,830	4,584	4,450	5,417
Macabud	2,021	2,327	3,124	6,338	6,605
Manggahan	5,862	7,031	8,220	11,170	12,557
Mascap	1,645	2,056	2,089	4,293	4,425
Puray	1,311	1,746	1,772	2,937	2,941
Rosario	3,530	4,109	4,558	5,414	5,881
San Isidro	1,905	2,178	2,618	28,614	62,114
San Jose	15,222	17,627	40,372	93,567	108,586
San Rafael	10,548	12,285	14,835	23,952	24,710

Source: NSO

Population by Age Ratio

Rodriguez has a relatively young population. Young dependents ages 0-14 years comprise 36% of total population while economically productive individuals with ages 15-64 comprise 61.42% of total population. Retirees on the other hand, comprise only 2.66% of total population.



Graph 46. Rodriguez Population by Age Structure

2.4.1.1.2 Health and Sanitation

Rodriguez has its functional and operational health office (CHO) that provides and administers health services to local people. Its primary health care system includes 1-25 bed infirmary (Montalban Infirmary); 4 rural health units (RHU)—comprised of three (3) physicians or medical doctors, nine (9) nurses, twenty one (21) midwives, two (2) medical technologists, and one (1) pharmacist; and 23 barangay health centers that are supervised by Midwives and are generally augmented by barangay health workers (BHW) spread all throughout the eleven (11) barangays.

2.4.1.1.3 Education

Rodriguez has 37 elementary (28 public & 9 private) schools and 24 high (15 public & 9 private) schools; all under the supervision of the Department of Education (DepEd) schools district. It also has five (5) tertiary schools under the control of the Commission on Higher Education (CHED). Said tertiary schools are the Pamantasan ng Montalban, University of Rizal System (URS-Rodriguez), St. Joseph's College of Quezon City (Montalban Campus), Asian Institute of Computer Studies (AICS) and, Froebellian College of Science and Technology. The private sector’s share in the provision of basic education is noteworthy for the upper-income families. Public schools cater mostly to middle-income and lower-income families.

With an ideal teacher–student ratio in elementary education of 1:30 (Azim Premji Foundation, 2010), Rodriguez’s educational statistics is competitive enough with a noted Teacher–student ratio of 1:48 and 1:59 in District I and II, respectively.

2.4.1.1.4 Social Welfare Services

The Municipal Social Welfare and Development Office (MSWDO) undertakes the following programs and activities using locally generated resources: Community Organizing and Sustainable Livelihood Program; Operation of Day Care Centers; Supplemental nutrition for malnourished children; Disability Prevention & Integration Program for Persons with Disability; Center for Senior Citizens; Welfare Programs for women, youth, drug & substance abusers, and; Parent Effectiveness, Pre-marriage Counselling, and similar programs.

Services are focused on the bottom or 30% of the households to alleviate indigence given the high poverty incidence of population. Selected households in socialized housing sites and upland tribal areas are covered by the 4Ps program.

2.4.1.1.5 Housing

The municipality ranked fourth in the number of housing units at 50,368 in the provincial survey conducted in 2007. Housing development is keeping pace with its increasing population and economic progress. At present, there are 61 subdivisions and residential villages within the municipality; while other real estate and housing developments are underway. There is an ongoing massive housing resettlement project in the municipality namely the South Ville Project that sprawled into 143.97 hectares of land in San Jose and San Isidro. It is planned to accommodate 15,000 households. Nine thousand (9,000) households have been resettled, mostly from the riversides of Pasig River, Sta. Ana Manila, and various parts of Quezon City.

2.4.1.1.6 Security and Protective Services

Rodriguez' peace and order is maintained by the Philippine National Police (PNP) with 112 uniformed men and staff stationed at the center of town. PNP has eleven (11) sub-stations and outposts. The policeman to population ratio, using the 2010 population, stands at 1: 2,508 and is below the ideal 1:1,000 ratio. The Bureau of Fire Protection (BFP) station of Rodriguez has sixteen (16) firemen and trained personnel and two (2) fire trucks. The fireman to population ratio is 1:17,557, which is way below the ideal ratio of 1:2,000. The Municipality's recorded monthly crime rate from 2008 to 2009 has increased from 9.01 to 10.10. Hundreds of police deputies or barangay tanods are considered 'force multipliers' who complement the PNP in providing safety and protection to all residents. Civilian traffic enforcers and volunteers from the town's Public Safety & Order Office (PSOO) also assisted and augmented the police force (Rodriguez Comprehensive Development Plan 2016 – 2021).

2.4.1.1.7 Sports and Recreation

The municipality has two (2) major public recreational facilities; excluding play courts inside schools, institutions, and private compounds. The municipal plaza measures 2,060 square meters and has been converted into a roofed multi-purpose center that functions alternately as an auditorium, social hall, or as covered basketball court. Another major public facility is located in Brgy. San Jose measuring 4.04 hectares. For cockfighting enthusiasts, the Montariza cockpit remains to be functional. There are fifteen (15) public play courts for basketball and volleyball that also function as open venues for community gatherings and social affairs.

2.4.1.1.8 Economic Characteristics

Agriculture

The agricultural lands throughout the municipality, combined areas planted with grains (both rice and corn), are at 508 hectares. Combined areas planted with fruits, root crops and other commodities such as coconut, coffee, cacao and rubber summed up to 163.5 hectares. There are 92 combined hectares planted with a variety of vegetables (New Agriculture data, 2012).

Mango is the main commodity produced by the municipality, where it shares an approximate land area of 449 hectares and 418 farmers together with other high valued crops like coffee, coconut, citrus, banana, and papaya. However, agriculture has considerably decline in terms of area being cultivated, output, and labor share since the 1990s with the rise of quarrying, and the hauling and waste-disposal activities brought about by the operation of the municipality's sanitary landfill.

Tourism

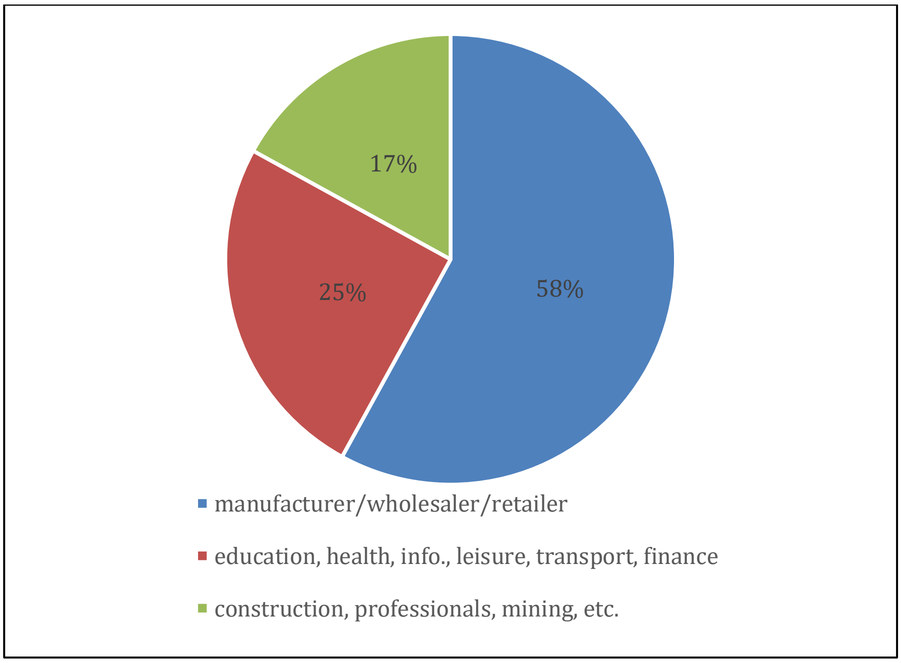
Rodriguez has several tourist attractions. Various recreational spots around the municipality capitalize on the town's panoramic views and rustic landscapes to lure visitors, both domestic and foreign. Among the known tourists' attractions are the Wawa Gorge in Sitio Wawa, a hidden paradise for eco-adventurers who are into hiking, trekking, rock climbing, spelunking, swimming, camping, and even extreme sports; the historic Pamitinan Cave that is part of the Pamitinan Protected Landscape under NIPAS and is valuable for its incalculable forest biodiversity; the Avilon Zoo is the largest zoological park in the Philippines in terms of land area; Mount Irid in the Sierra Madre mountain range with summit at 1,448 meters or 4,751 feet ASL that is touted as a mountaineer's ultimate conquest; and the Puray caves and Puray waterfalls.

Mining and Quarrying

Mining/quarrying/crushing is a major economic activity in Rodriguez. Thousands of cubic meters of rock, sand, and construction aggregates are quarried annually. Aside from environmental impacts on locality, the ticklish issue in quarrying has been the LGU's share of the gross revenues generated, and whether this share is spent on stakeholders and on local environment.

Commerce, Trade and Other Services

In 2012, there are about 3,075 business establishments registered in the municipality. Of this, 58.02% are manufacturers, wholesalers and retailers, 25.40% are in education/health services, information, leisure and hospitality, transportation/warehousing/utilities and financial activities while the remaining 16.58% are involved in construction, professional/business services, natural resources/mining, and other services. It has several banks and lending institutions namely: Bank of the Philippine Islands, BPI Family Savings Bank, RCBC Savings Bank, Inc., Banco de Oro, Premiere Development Bank, Rural Bank of Montalban, Inc., Builders SLA Inc., Philippine Savings Bank, Allied Bank, Bank of Makati, and the eleven (11) lending/financing investment companies and ten (10) cooperatives that are established in the area. Joining them is the growing money remittance industry like M Lhuillier, Cebuana Lhuiller, Smart Padala, lobe G-Cash, Western Union, Palawan Express and LBC Padala. These institutions serve to stimulate local capital formation and mobilization of savings for investment (Rodriguez Comprehensive Development Plan 2016 – 2021).



Graph 47. Registered Business Distribution in Rodriguez

2.4.1.1.9 Infrastructure and Physical Base Characteristics

Land Transport

Rodriguez is strategically located in relation to NCR, Central Luzon and CALABARZON. In 2012, the Transport and Traffic Management Office (TTRAMO) of the municipality has registered a total number of 7,284 units. The registered vehicles were sorted as follows: public utility jeepneys, 1,110 units; AUV/FX service, 217 units; tricycles with franchise, 2,653 units; and private tricycles, 3,304 units. TTRAMO also registered a total of 52 associations that operate the public transport vehicles. There are 27 associations for public utility jeepneys, six (6) associations for AUV/FX service and nineteen (19) associations for the tricycles with franchise. It is noticeable that the total number of private and tricycles with franchise is 5,957 units. There is a total of 1,444 units of registered public transport vehicles in the municipality. A previous provincial report counted 14,433 privately-owned vehicles of different kinds. On any given day, there could be around 4,500 vehicles of all sorts circulating or contributing to traffic volume in the town center.

Roads and Bridges

Rodriguez has three national roads, namely, A. Mabini in Barangay Burgos, JP Rizal in Barangay Manggahan, and E. Rodriguez in Barangay San Jose. It has a national road total length of 4.87 km. There is no provincial road and the barangay roads have a total length that is almost double to that of the municipal roads' total road length. This indicates the good road networks that provide easy access to the municipal barangays. There are six (6) bridges in the municipality with a total length of 1.429 km. The sturdiest bridge among them is the E. Rodriguez Bridge in Barangay San Jose which connects the Eastern and Western banks of the Marikina River and was built in 1977.

With height of 40 meters, width of 15 meters, linear length of 120 meters and a loading capacity of over 30 tons, it is of high quality and in excellent condition.

Communication

Large nation-wide companies such as PLDT, Smart, Globe, Digitel and PT&T provides land-based telephone services, mobile communication, and internet services in Rodriguez. Telephone lines in most offices and homes in urban areas were installed. Cell sites have been established in elevated areas. Internet shops and cyber-cafes are present in nearly every populated section of town. Given the popularity of mobile phones, the HLURB standard of one (1) phone for every 5,000 population has been surpassed.

Rodriguez also has a branch of Philippine Postal Corporation. As estimated, post office handles daily around 1,500 pieces of mail for domestic destinations and about 500 letters to international destinations. Several letter-carrier and courier services are accessible in all urban barangays. Telegraphic services also operate in the municipality. However, there are no local radio stations and TV stations.

Solid Waste

Rodriguez approximately generates 12,410 tons of garbage per year or about 28 to 40 tons of garbage per day (RESWMP 2014). Nine percent (9%) of municipal garbage remained uncollected and illegally dumped according to a Provincial document report in 2007. Waste collection services are under contract to a private provider that collects the solid wastes from the seven (7) urban and one (1) rural (San Rafael) barangays. Unfortunately, upland barangays Macabud, Mascap and Puray are not reached by the waste service collection.

Water

The average consumption in the municipality is 22 cubic meters per month, which translates to 119 liters per capita per day. Manila Water Company, Inc. operates six (6) deep-well pumping stations in Rodriguez that offers services around 41.567 individual connections covering an estimated 249,402 individuals. Its total number of households in 2012 is estimated to be around 83,000 - 40,000 of these households (48.19%) has no access to piped water distribution at Level III standards. There are 105 deep wells and 1,861 artesian wells spread all over Rodriguez. The Wawa River Dam, with an investment of US$150 million, can generate 300 Million Liters per Day (MLD) according to Korean investor KWater. At optimal capacity, the dam can provide water for 940,000 people beyond the borders of Rodriguez.

Power

Manila Electric Company (MERALCO) services the power requirements of households of the eleven barangays. Based on a June 2012 report, MERALCO provides power supply to 53,722 households, 2,037 commercial establishments, six (6) industrial establishments, and 57 streetlamp posts. Given that the total number of households in 2012 is estimated at around 83,000, there are likely to be 30,000 (36.14%) households that have no access to steady power supply.

2.4.1.2 Profile of Barangay Macabud

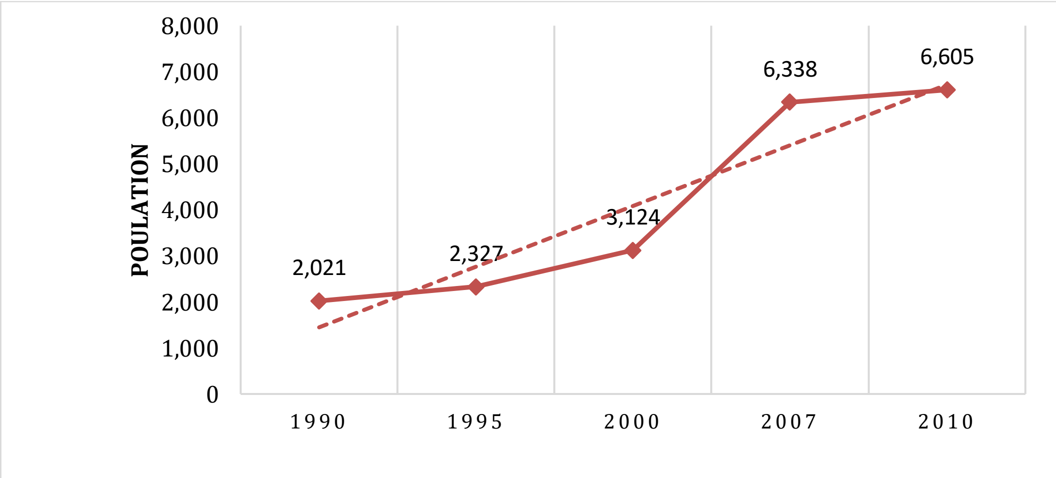
2.4.1.2.1 Population Density

Barangay Macabud's population, as determined by the 2010 Census, was 6,605. The barangay shares 0.023 percent of the total population of the municipality.

Table 68. Population distribution of Barangay Macabud, 1990–2010.

Barangay	Census Year				
	1990	1995	2000	2007	2010
Rodriguez	67,074	79,668	115,167	223,594	280,904
Balite (Pob.)	6,182	6,943	7,849	8,827	9,114
Burgos	15,483	19,536	25,146	34,032	38,554
Geronimo	3,365	3,830	4,584	4,450	5,417
Macabud	2,021	2,327	3,124	6,338	6,605
Manggahan	5,862	7,031	8,220	11,170	12,557
Mascap	1,645	2,056	2,089	4,293	4,425
Puray	1,311	1,746	1,772	2,937	2,941
Rosario	3,530	4,109	4,558	5,414	5,881
San Isidro	1,905	2,178	2,618	28,614	62,114
San Jose	15,222	17,627	40,372	93,567	108,586
San Rafael	10,548	12,285	14,835	23,952	24,710

Sharp increases in population size has been recorded. From a population of just 2,021 on the year 1990, it increased to around 4,000 counts during the year 2010.

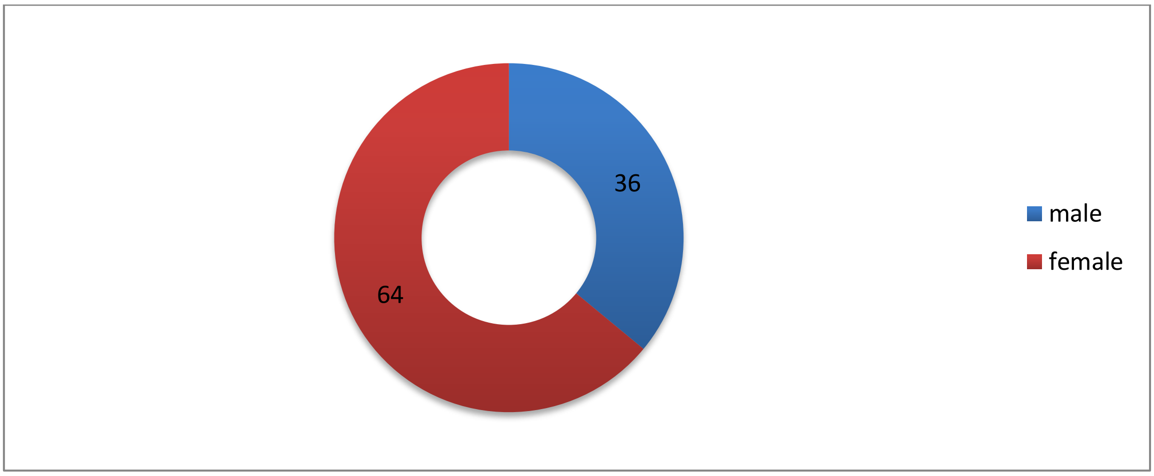


Graph 48. Barangay Macabud Population Growth History

2.4.1.3 Household Profile

2.4.1.3.1 Gender

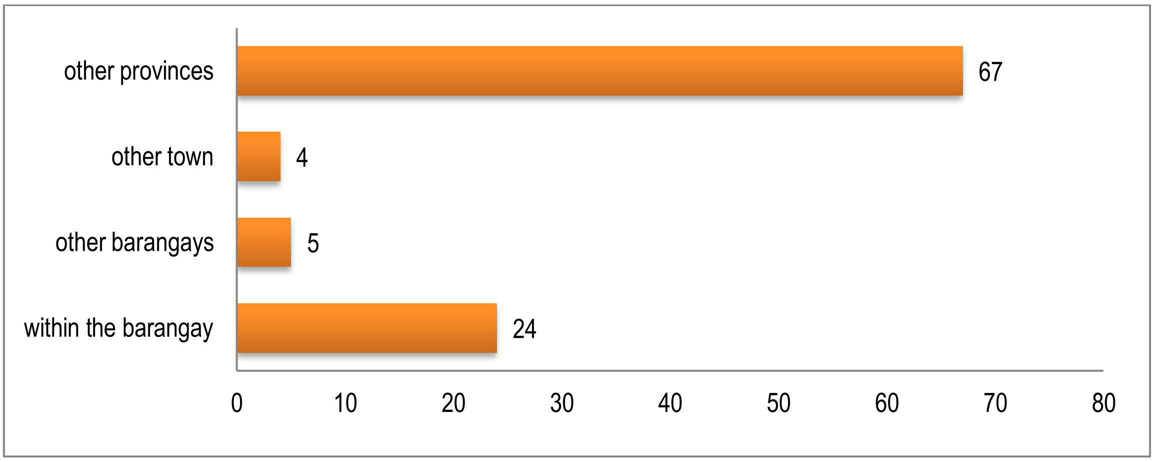
It is the biological characteristics of the respondents either male or female. In the study, a total number of 100 participants were surveyed. Thirty-six (36) percent are male while most of them are female, sharing 64 percent of the samples.



Graph 49. Percentage Distribution of Respondents According to Gender

2.4.1.3.2 Place of Birth

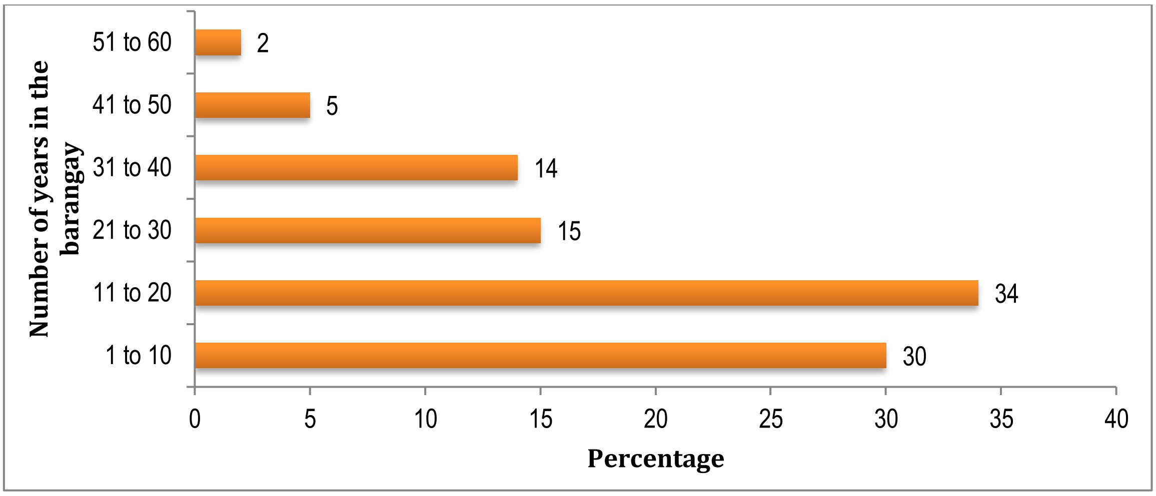
Majority of the respondents' count with 67 percent are born from other provinces, 24 percent were from Barangay Macabud, four (4) percent were born in other areas outside the municipality, while five (5) percent were born from other barangays.



Graph 50. Percentage Distribution of Respondents According to Place of Birth

2.4.1.3.3 Migration History

It is the movement by people from one place to another with the intention of settling temporarily or permanently in the new location. As reflected in the graph below, only two (2) percent are the longest settlers living at the barangay for 51-60 years. Most of them (34%) have been staying at the area for at least 11-20 years. With the implementation of the project, the outcome is still indefinite. It could either create a positive or negative impact to the community. In correspondence to this concept, its effect to the barangay's population is significant. The number of people migrating could possibly increase or decrease depending on the project's end results.

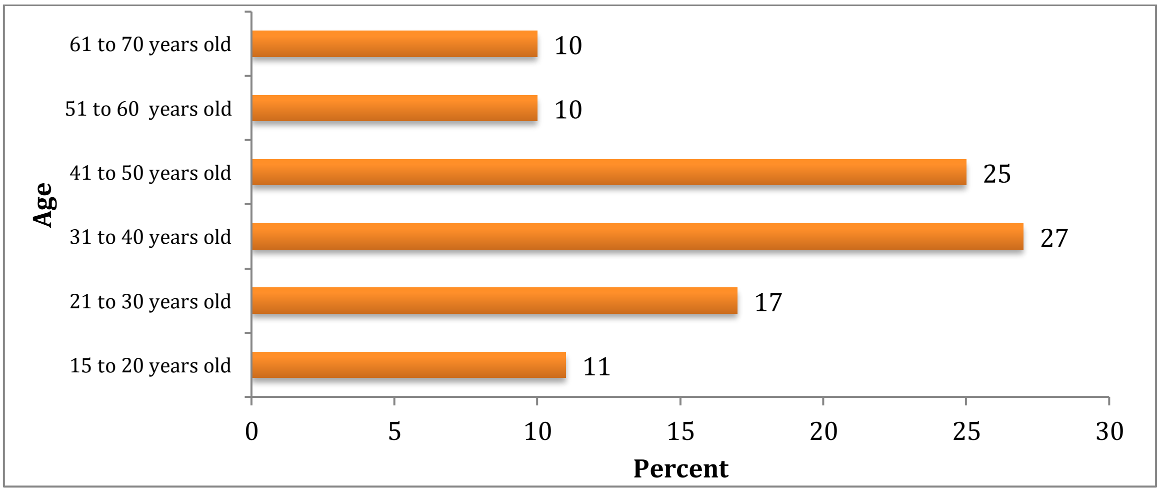


Graph 51. Distribution of Respondents According to Number of Years in the Barangay

2.4.1.3.4 Age

The study shows that most of the respondents are in the productive age of 31 to 40 years (27.0%). This was followed by the age group 41-50 years (25.0%), then by the age 21-30 years (17.0%); whereas the age group 51-60 years and 61-70 years both comprises ten (10) percent of the respondents and eleven (11) percent of them fall within 15 to 19 years of age.

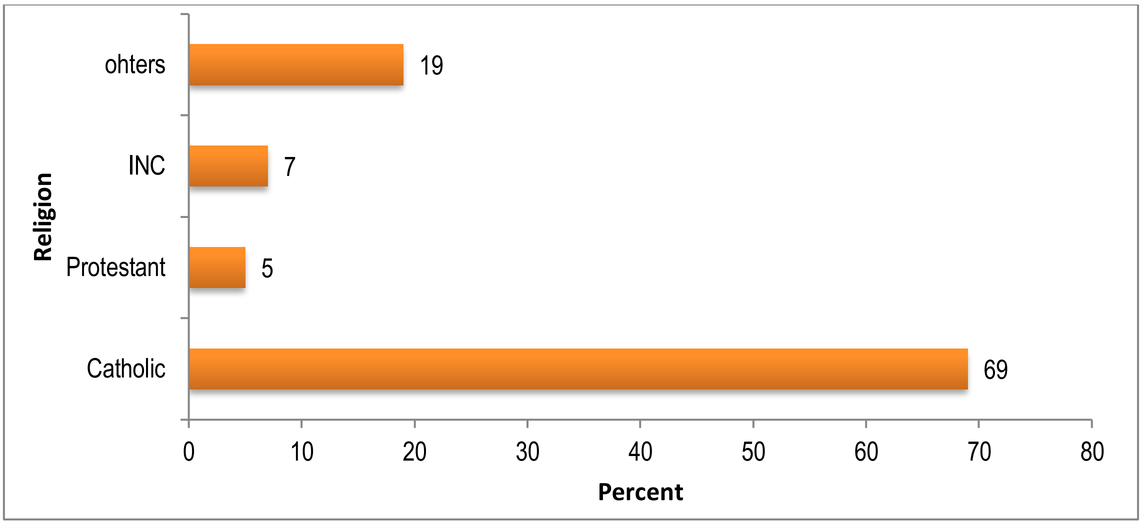
One basic indicator of employment is the working age population. Considering that majority of the respondents are in their productive age, this implies that most of them are capable to work, currently working, or in need of work.



Graph 52. Distribution of Respondents According to Age.

2.4.1.3.5 Religion

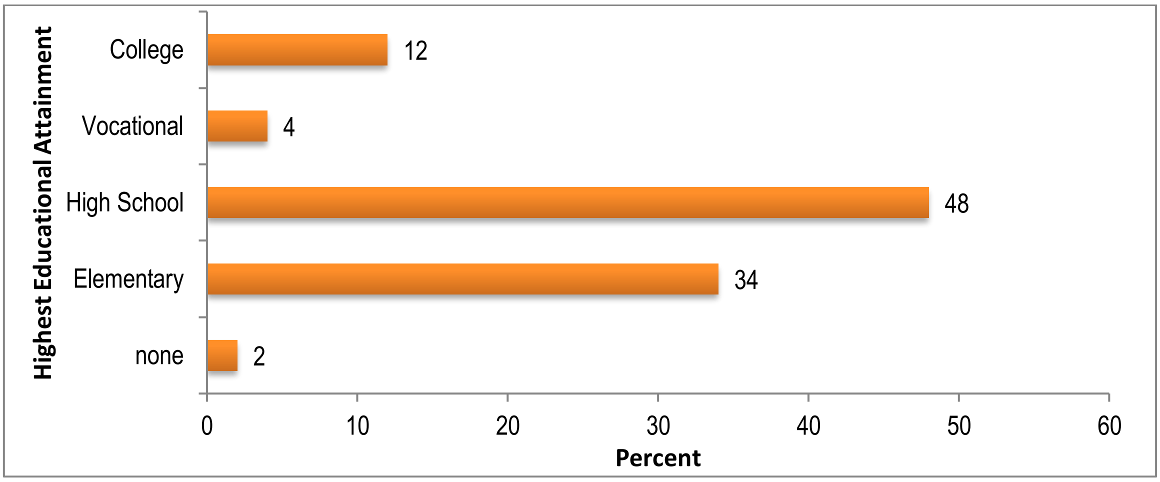
It refers to a set of beliefs, feelings, doctrines and practices that define the relations between human being and sacred or divinity. Survey shows that the large part of the respondents were members of Roman Catholic religious organization (69%), followed by other unspecified religions, then comes the INC with seven (7) percent, and Protestant comes least at five (5) percent.



Graph 53. Percentage Distribution of Respondents According to Religion

2.4.1.3.6 Highest Educational Attainment

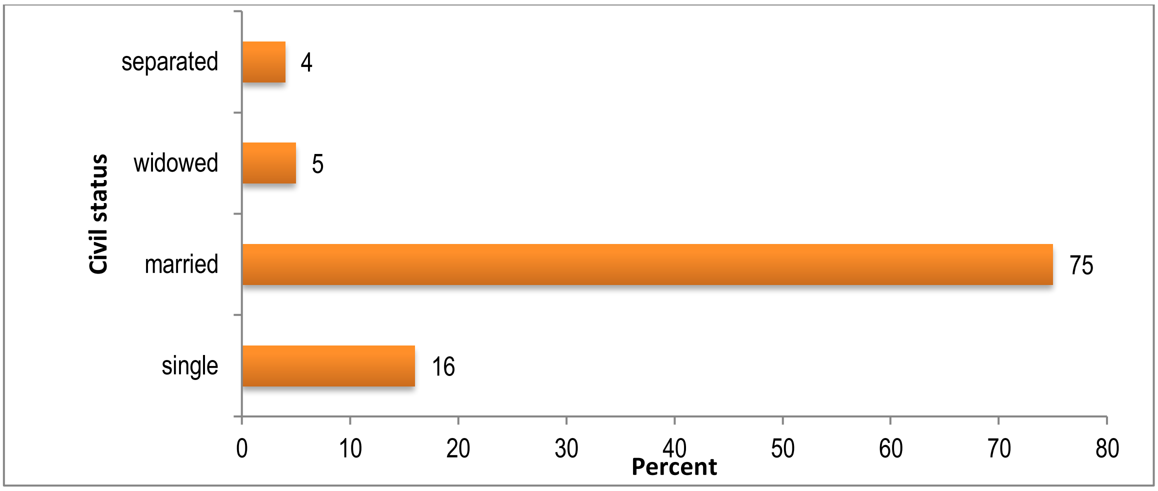
It refers to the level of education attained by the respondents. As per the conducted survey, most of them, comprising of about 48 percent, obtained secondary education. Thirty-four (34) percent attained Elementary level and only twelve (12) percent are college degree holder, four (4) percent earned vocational courses, while two (2) percent has not been to school. This could explain the low monthly income (less than the standard monthly income of 1,000-4,999) and non-involvement to professional jobs.



Graph 54. Distribution of Respondents According to Highest Educational Attainment

2.4.1.3.7 Civil Status

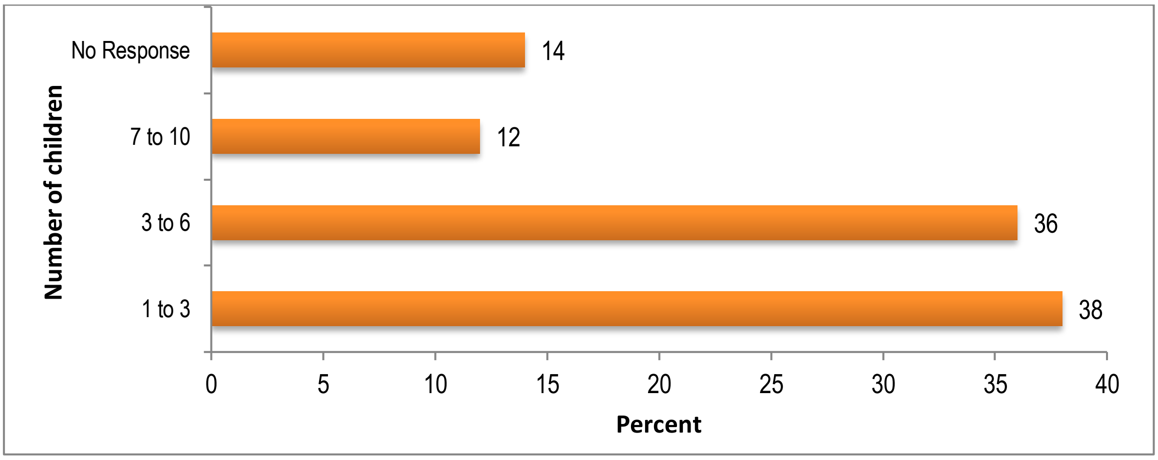
It was discovered that majority of the respondents or 75 percent are married, sixteen (16) percent are single, five (5) percent are widowed, and four (4) percent are separated.



Graph 55. Percentage Distribution of Respondents According to Civil Status

2.4.1.3.8 Number of Children

Large percentage of the respondents (38%) has one (1) to three (3) children. Thirty-six (36) percent of them has three (3) to six (6) children; while twelve (12) percent has seven (7) to ten (10) children. The remaining fourteen (14) percent did not give a response.

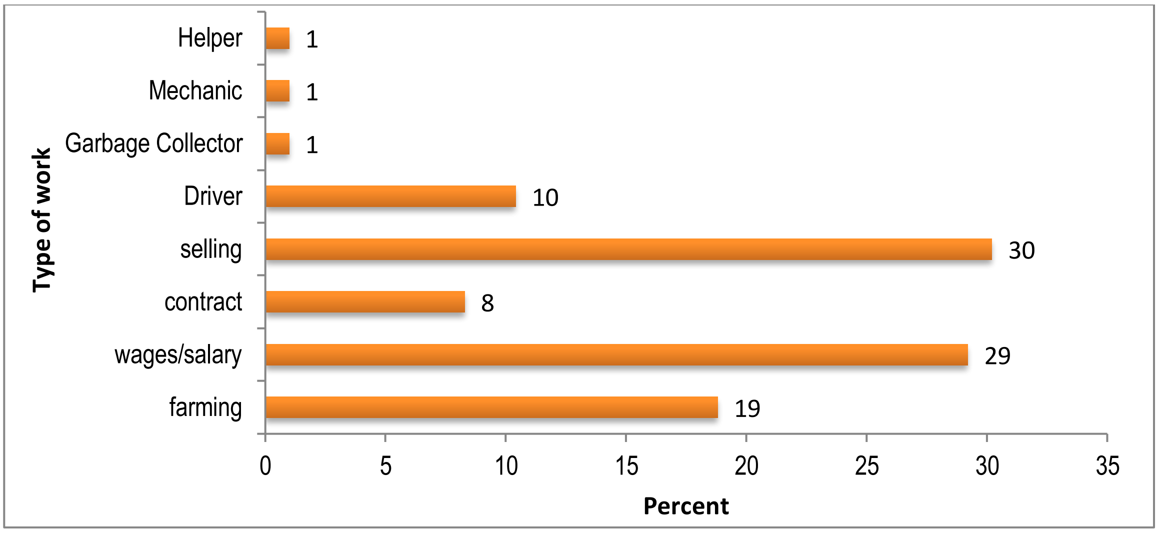


Graph 56. Percentage Distribution of Respondents According to Number of Children

2.4.1.4 Household Income and Employment

2.4.1.4.1 Type of Work

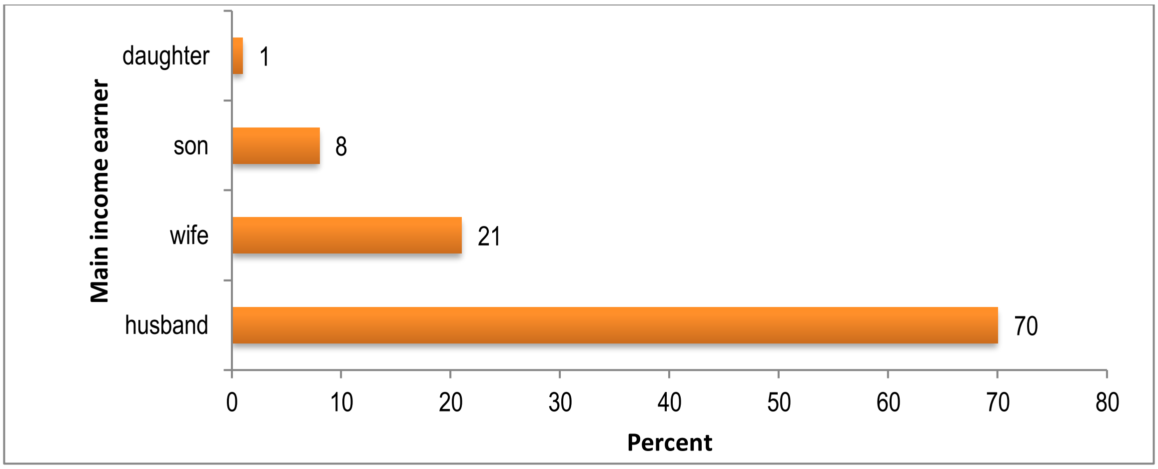
Most of the respondents (30%) are engaged in selling. Twenty-nine percent are salary dependent. Nineteen percent are engaged to farming, ten percent are drivers, eight percent are contractual workers, and one percent are helper, mechanic and garbage collectors. In reference to the Highest Educational Attainment, only twelve percent of the respondents were college graduates.



Graph 57. Percentage Distribution of Respondents According to Type of Work

2.4.1.4.2 Main Income Earner

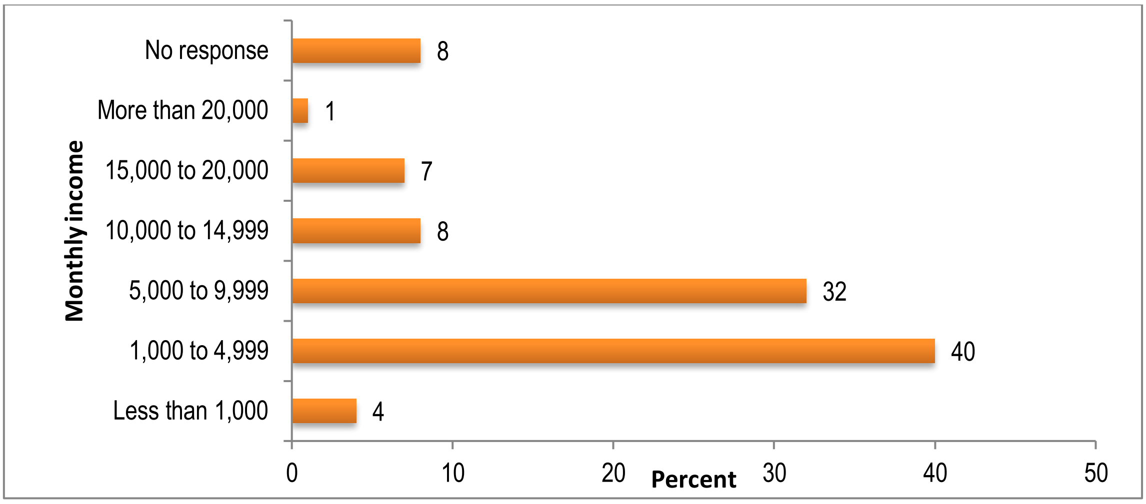
The main income earner of the majority of the respondents is the head of the family (70%), followed by the mother (21%), son (8%), and daughter (1%).



Graph 58. Percentage Distribution of Respondents According to Main Income Earner

2.4.1.4.3 Household's Estimated Monthly Income

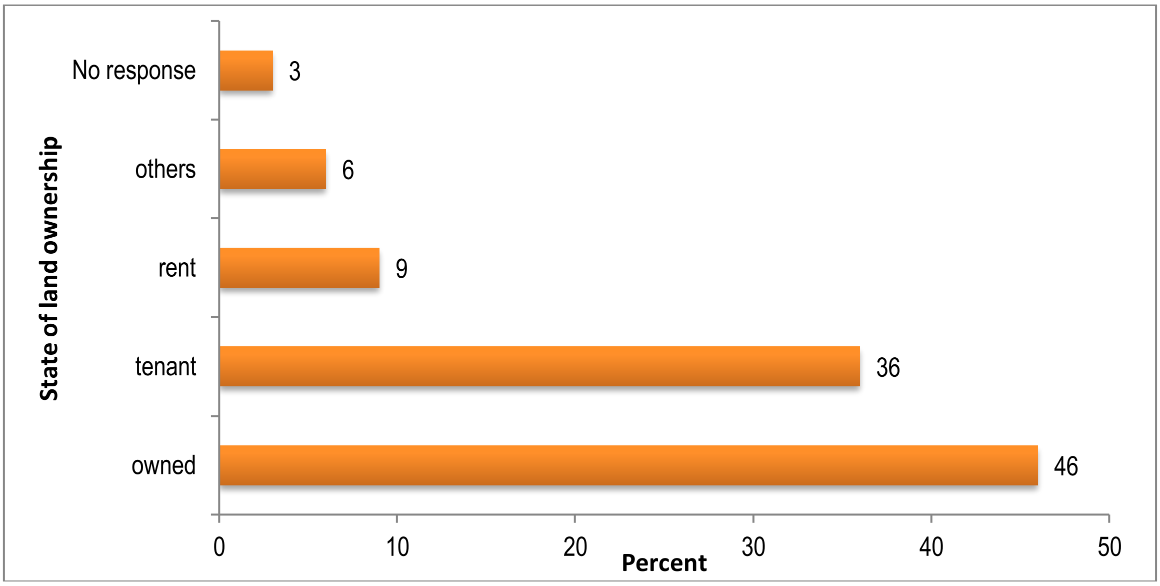
The graph below presents the household's monthly income of the respondents. It was revealed that most of the them (40%) has a monthly household income ranging from 1,000 to 4,999 pesos while some (1%) has a total monthly income of more than 20,000 pesos. The poverty threshold or the minimum level of income deemed adequate in the province of Rizal amount to 24,198 in 2015 (PSA). In the case of Macabud's resident's, most of them earns 1,000-4,999 pesos per month which is considered way lesser than the average standard income.



Graph 59. Percentage Distribution of Respondents According to Estimated Monthly Income

2.4.1.4.4 Land Ownership

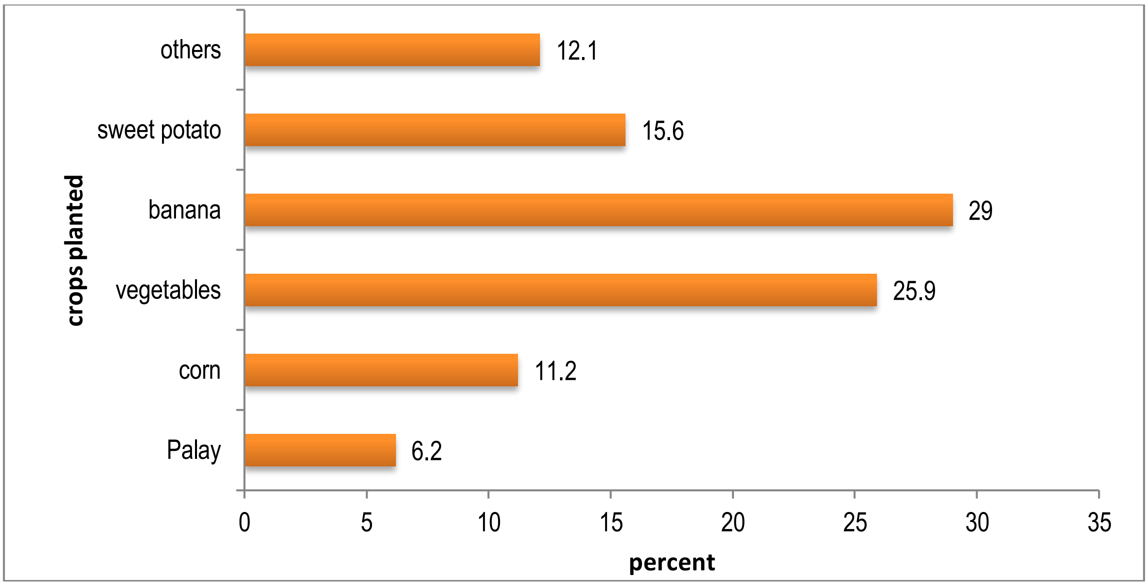
Forty six percent owns the land in the barangay, thirty-six percent are just tenants, while nine percent are renters. This means that the majority of the residents have no full control of the land and has no authority to make decisions as far as land use is concern.



Graph 60. Percentage Distribution of Respondents According to Land Ownership

2.4.1.4.5 Crops Planted

Large percentage of the respondents are planting bananas (29%), followed by vegetables (25.9%), then camote (15.6%), corn (11.2%), and palay with (6.2%).

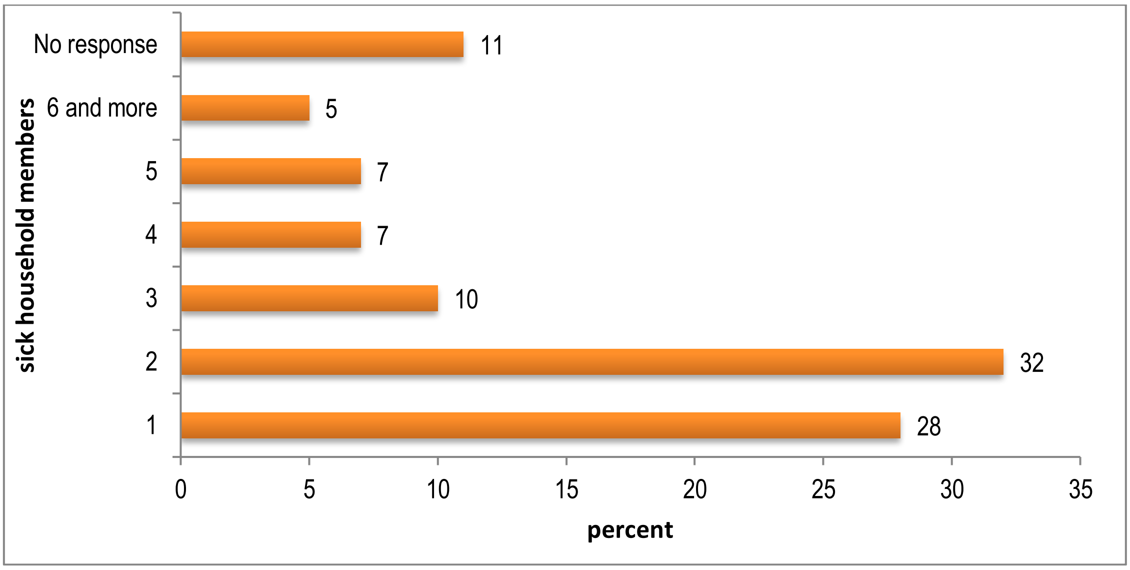


Graph 61. Percentage Distribution of Respondents According to Crops Planted

2.4.1.5 Health and Sanitation

2.4.1.5.1 Sick Household Members

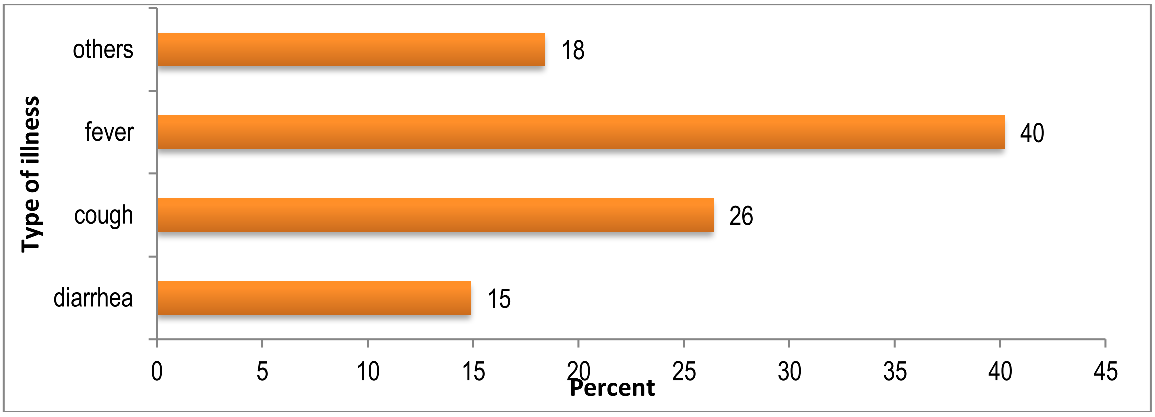
Majority of the participants (32%) responded that two (2) of their family members got sick. Least of them (5%) answered that more than six (6) members of their household suffered from illnesses. This is an indicator that there is a great need for the barangay to create specific health programs to practically address the residents' problems on health and sanitation.



Graph 62. Percentage Distribution of Respondents According to Sick Household Members

2.4.1.5.2 Type of Illness

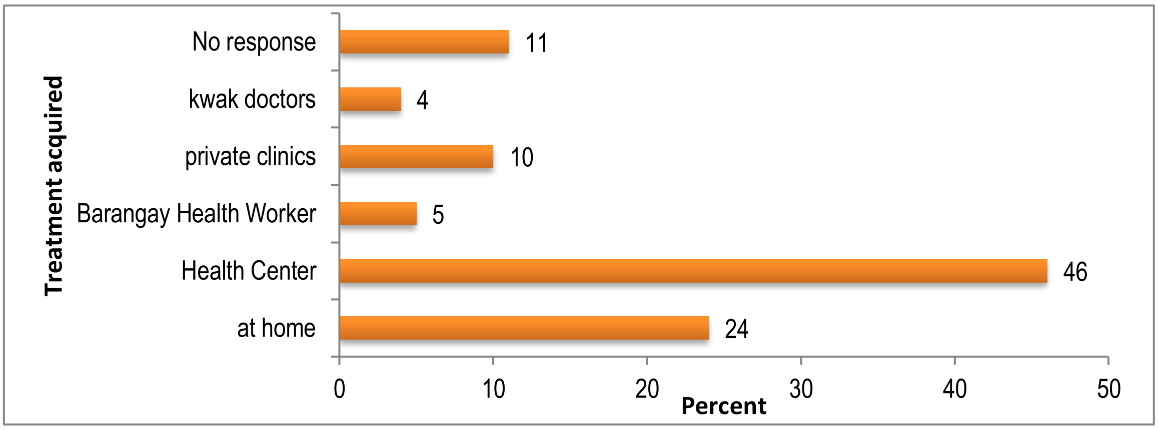
The participants surveyed suffers from different illnesses. The most common illness is fever gaining 40 percent, followed by cough with 26 percent, other illnesses with 18 percent, and diarrhea with 15 percent. It is evident that the respondents acquired different illnesses in their respective households. This could be reflected on the nature of sanitation being practiced on the area so as the characteristics of their health situations and it is primarily an area of concern especially for the local officials.



Graph 63. Percentage Distribution of Respondents According to Type of Illness

2.4.1.5.3 Treatment Required

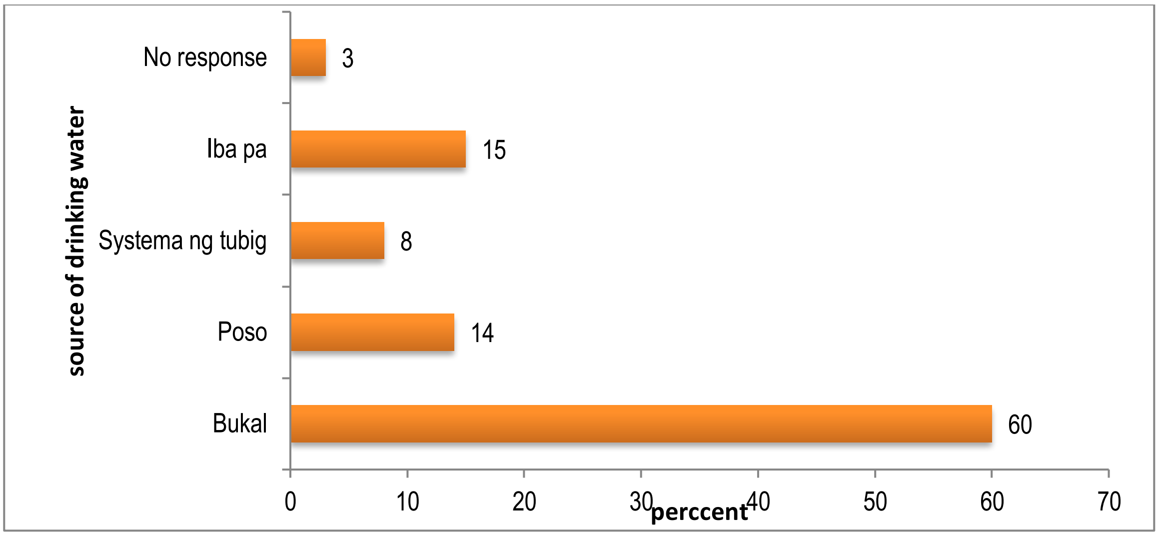
Most of the respondents (46%) have had their illnesses treated through Health Centers. Twenty-four percent answered at home, ten percent was treated on private clinics, five percent seek the help of Barangay Health Workers.



Graph 64. Percentage Distribution of Respondents According to Type of Treatment Required

2.4.1.5.4 Source of Drinking Water

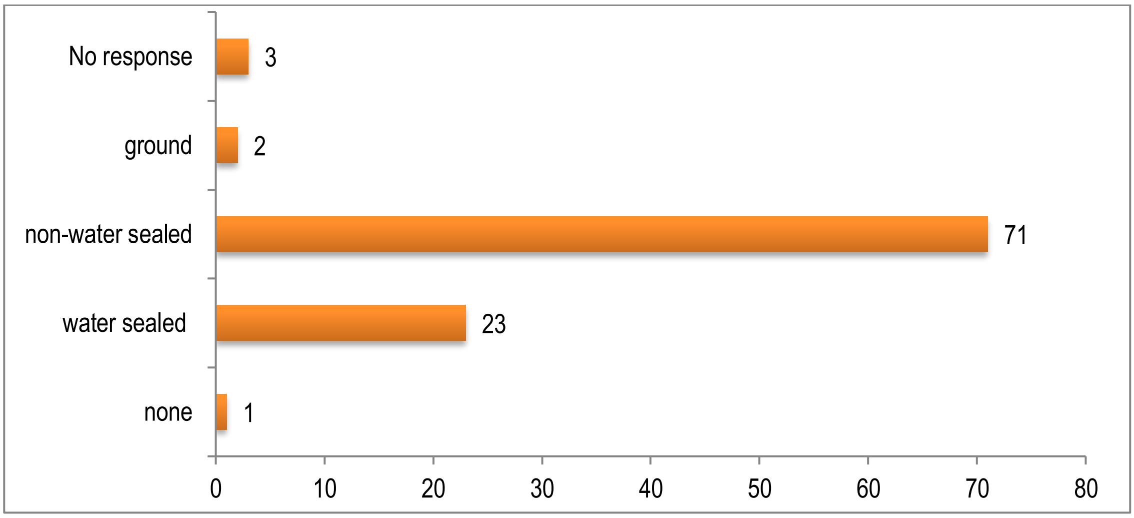
The major source of water of the community is the local springs (60%). On the other hand, fourteen percent of the respondents depend on deep wells, while eight percent are connected to a community water system. Residents have low access to safe drinking water.



Graph 65. Percentage Distribution of Respondents According to Source of Drinking Water

2.4.1.5.5 Type of Toilet Facility

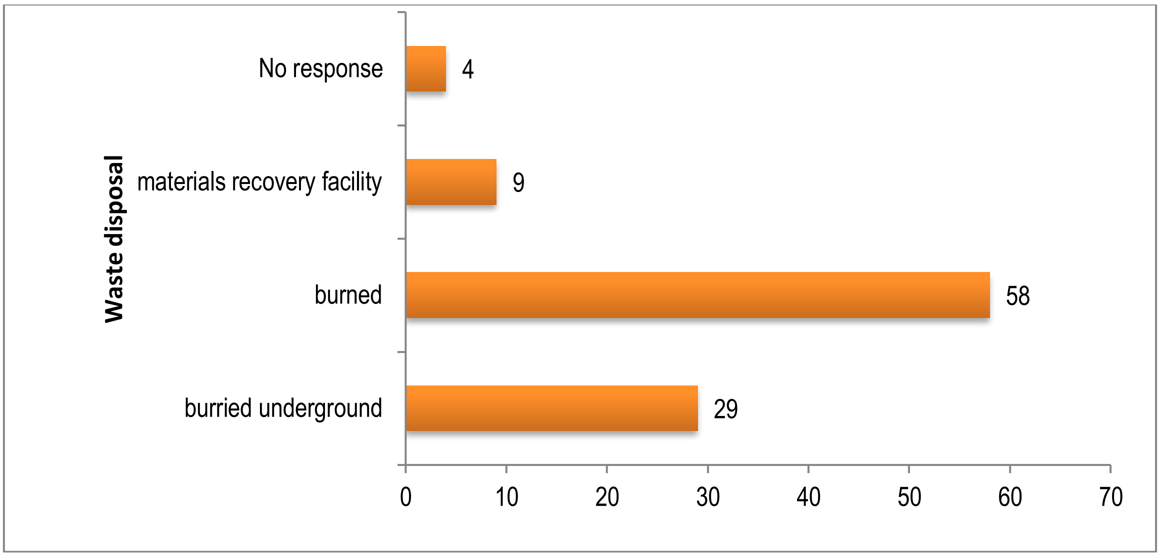
Majority or seventy-one percent of the respondents have non-water sealed toilet. Twenty-three percent has water sealed toilets, one percent has no toilet facilities at all and, the remaining six percent of respondents has no functional toilet facilities.



Graph 66. Percentage Distribution of Respondents According to Type of Toilet Facility

2.4.1.5.6 Waste Disposal

Majority of the respondents (58%) burns their garbage and refuses to follow proper waste disposal, twenty-nine percent bury it on the ground, nine percent said it was collected by the barangay and, four percent did not respond.

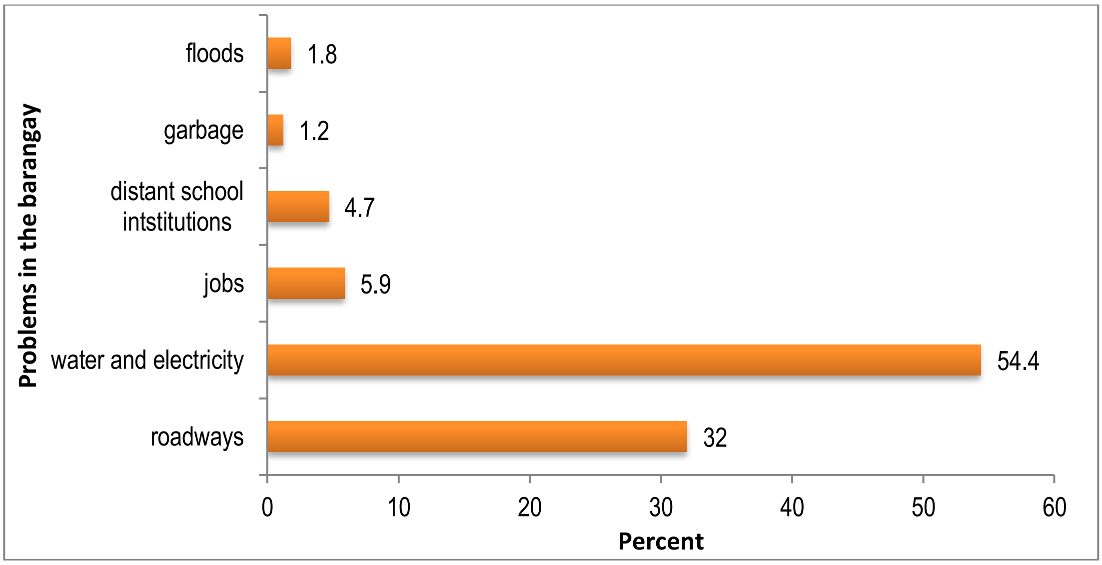


Graph 67. Percentage Distribution of Respondents According to Waste Disposal

2.4.1.6 Issues/Problems in the Barangay

2.4.1.6.1 Problems in the Barangay

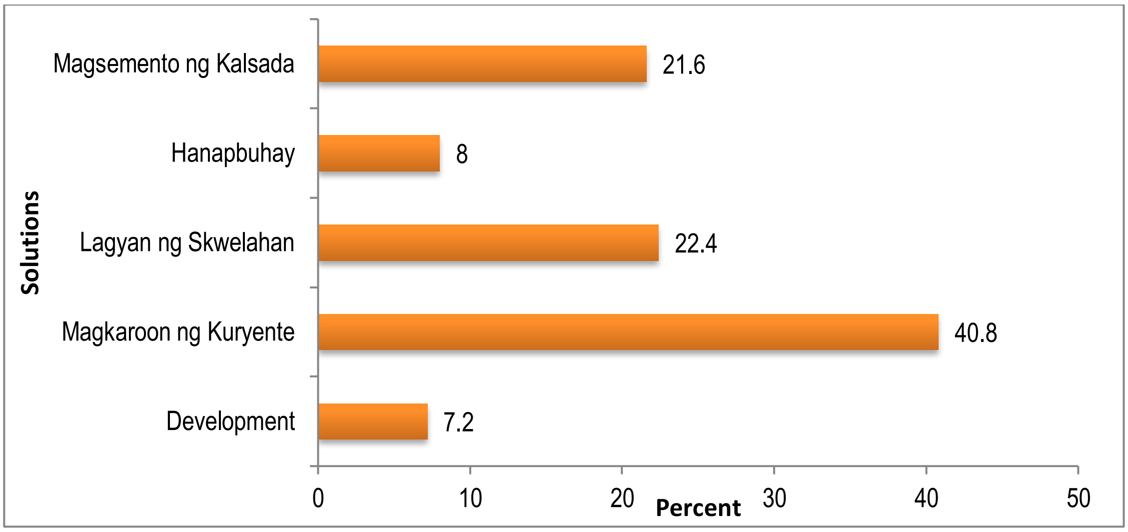
Most of the respondents (54%) are concerned about their barangay's electricity and water system. It is followed by their problem with roadways/highways. Six percent have issues with their works/jobs, five percent are concerned with the far distance between their homes and the school, two percent has problem with flooding and one percent wanted to address the issue about garbage.



Graph 68. Percentage Distribution of Respondents According the Problems in the Barangay

2.4.1.6.2 Solutions

Respondents were asked on how to properly address the above-mentioned problems in their Barangay. Most of them (41%) wanted to have electricity connection, twenty-two percent stressed the importance of having a school and concrete road network, and eight percent asked for jobs.

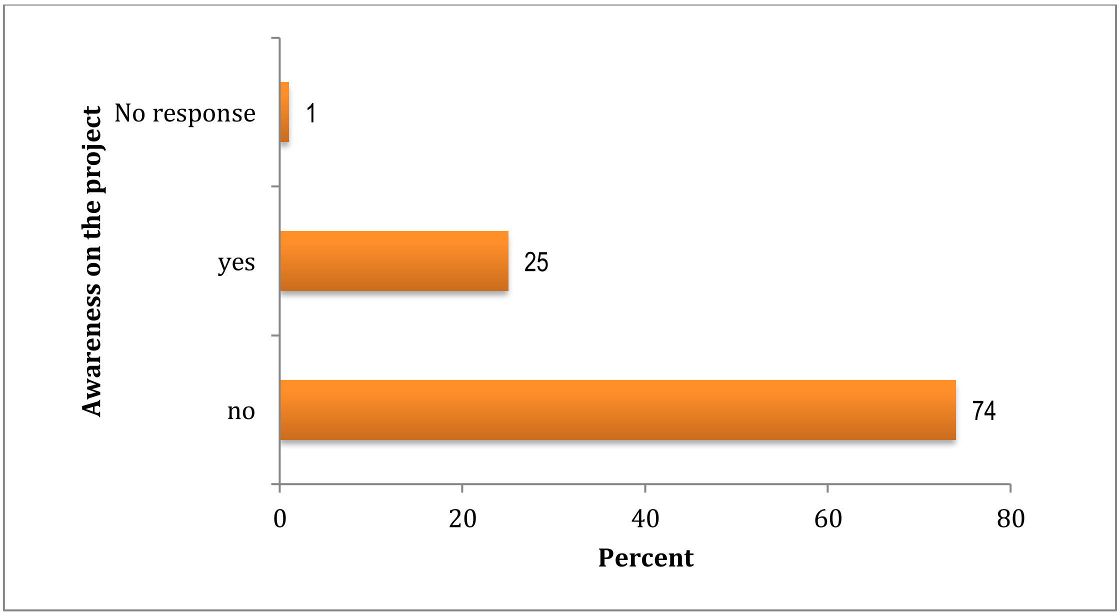


Graph 69. Percentage Distribution of Respondents According to Solutions for the Problem

2.4.2 Perception on the Proposed Project

2.4.2.1 Awareness on the proposed ATN Integrated Aggregates Project

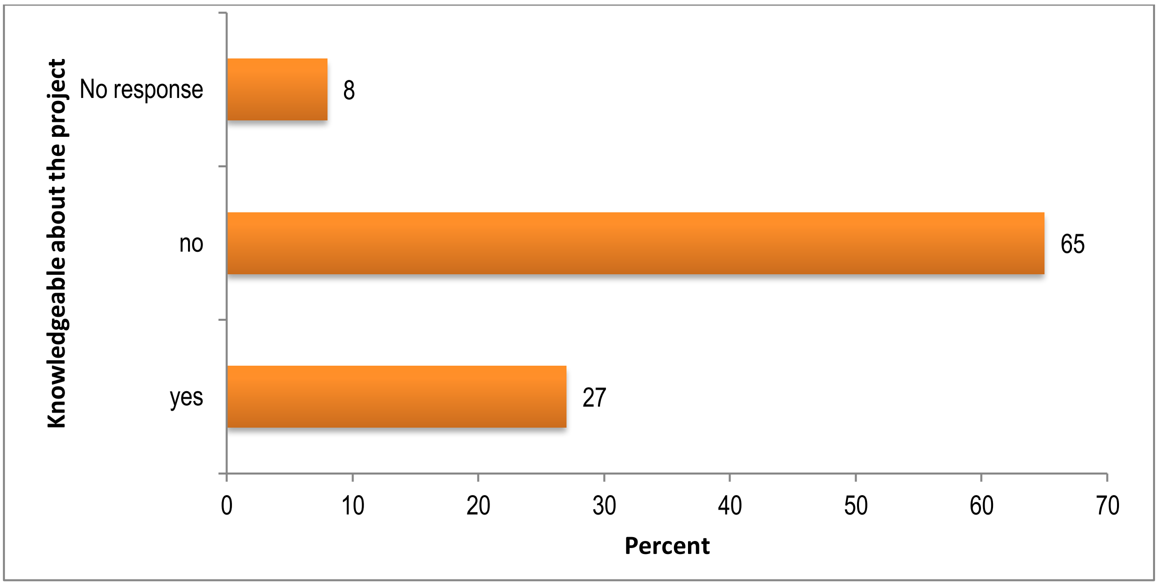
Seventy four percent of the respondents are not aware about the proposed project.



Graph 70. Percentage Distribution of Respondents According to Awareness on the Proposed Project

2.4.2.2 Knowledge about the Proposed Project

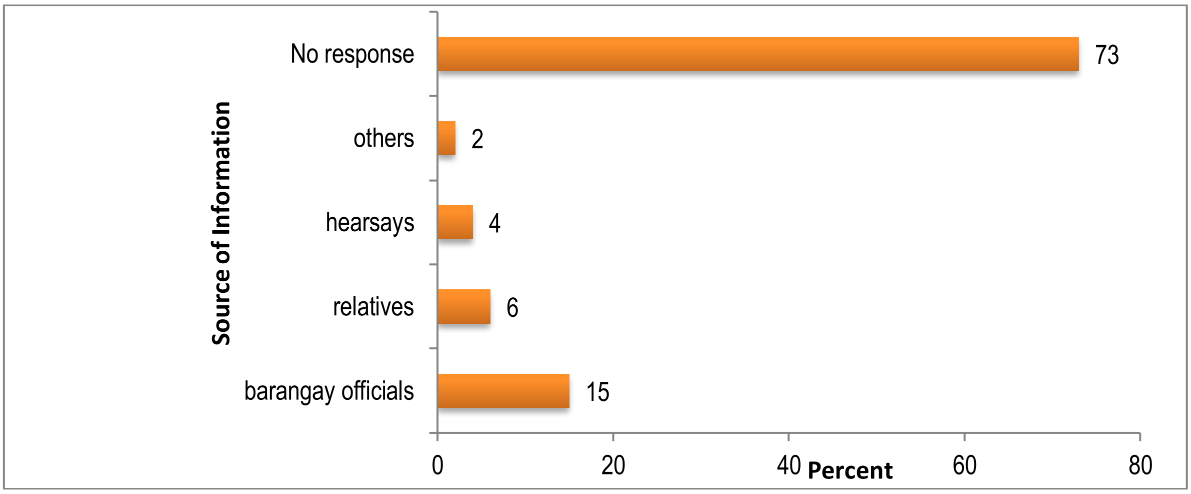
Seven out of ten of the respondents did not know about the project.



Graph 71. Distribution of Respondents According to their Knowledge About the Proposed Project.

2.4.2.3 Source of Information

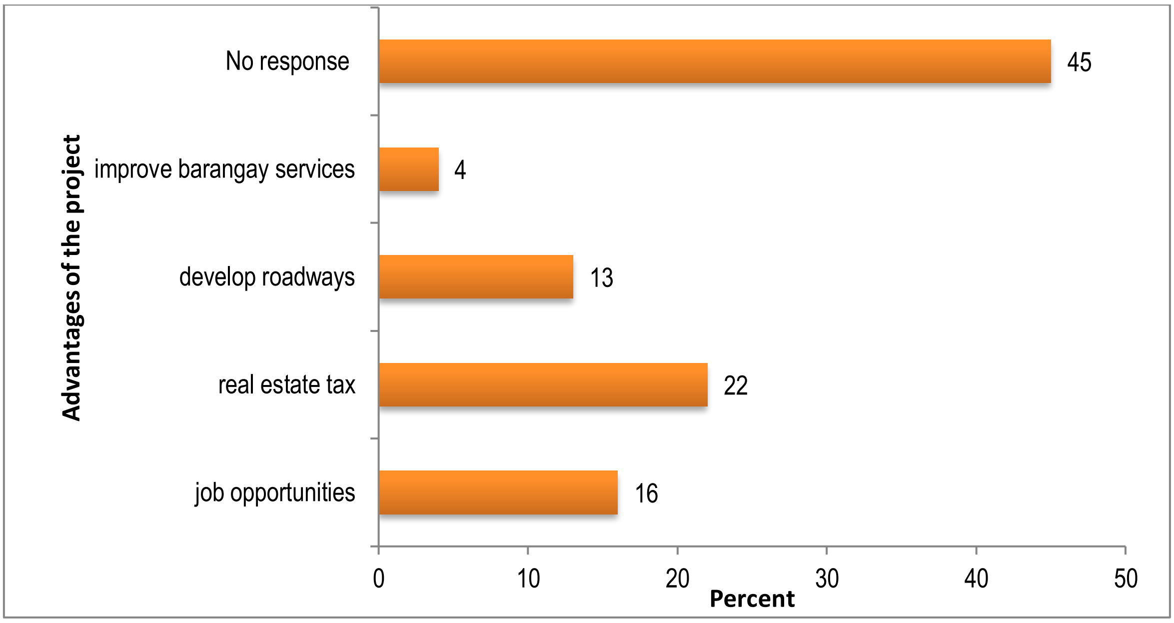
From the 27 percent of fully aware respondents, fifteen percent said that they were informed by the barangay. Six percent said that they were informed by their relatives while four percent responded that they heard it through hearsays. Two percent answered that they were informed by other people or its neighbor.



Graph 72. Percentage Distribution of Respondents According to Source of Information about the Project

2.4.2.4 Perceived Advantages of the Project

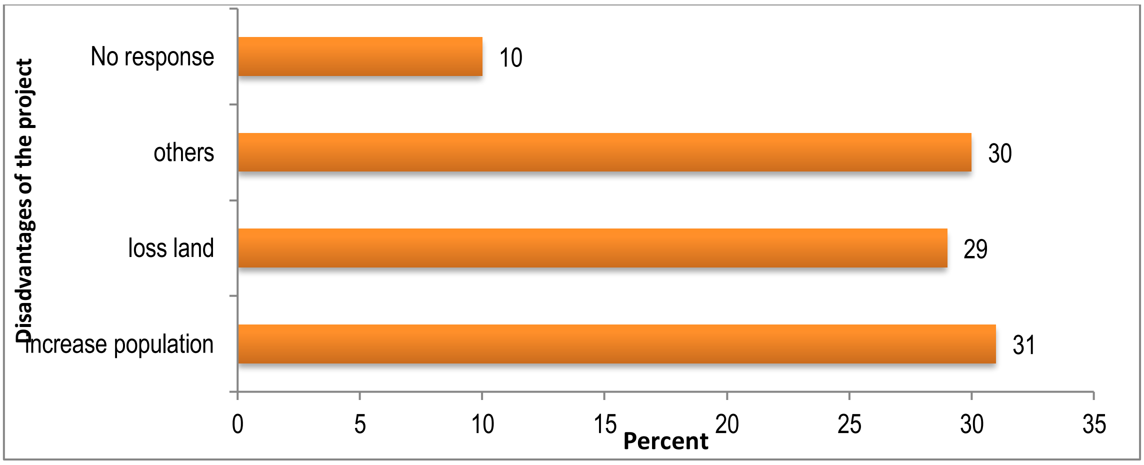
Most of them (22) believed that the project is advantageous in terms of real estate tax. Sixteen percent believed that it will create employment opportunities. Thirteen (13) percent hopes that this will improve the quality of roadways. Four (4) percent says it can improve the barangay's services and forty-five percent did not give any response at all.



Graph 73. Percentage Distribution of Respondents According to Support to Perceived Advantages of the Project

2.4.2.5 Perceived Disadvantages of the Project

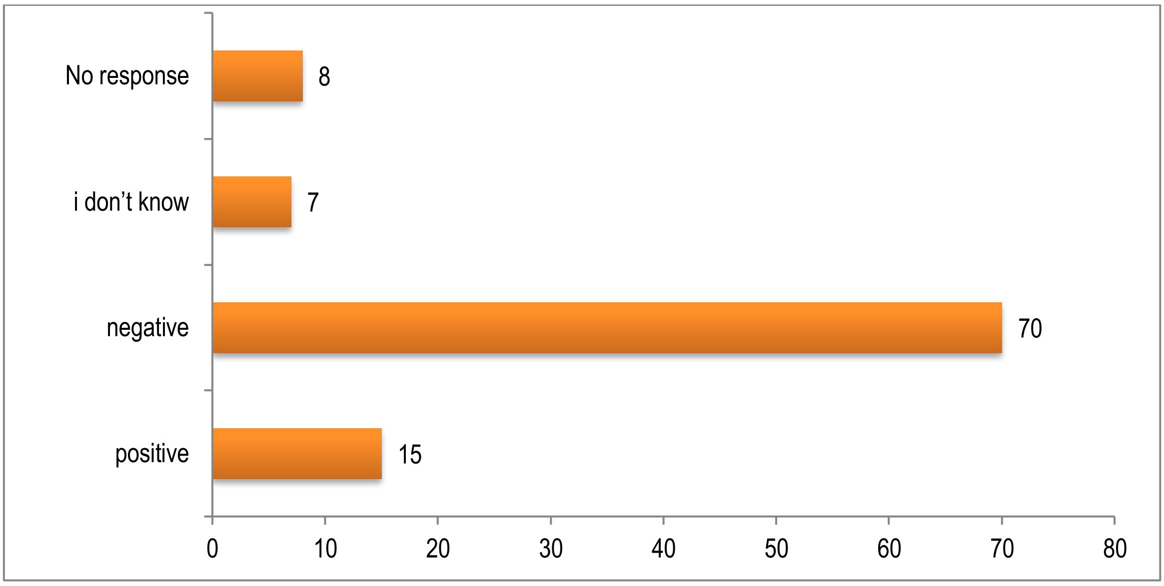
Most of the respondents (31%) expect that it will increase the population count in Macabud. Twenty nine percent are afraid to lose their lands, thirty percent of the remaining respondents has unspecified reasons, and ten percent did not respond.



Graph 74. Percentage Distribution of Respondents According to Perceived Disadvantages of the Project

2.4.2.6 Perceived Effects of Mining and Quarrying

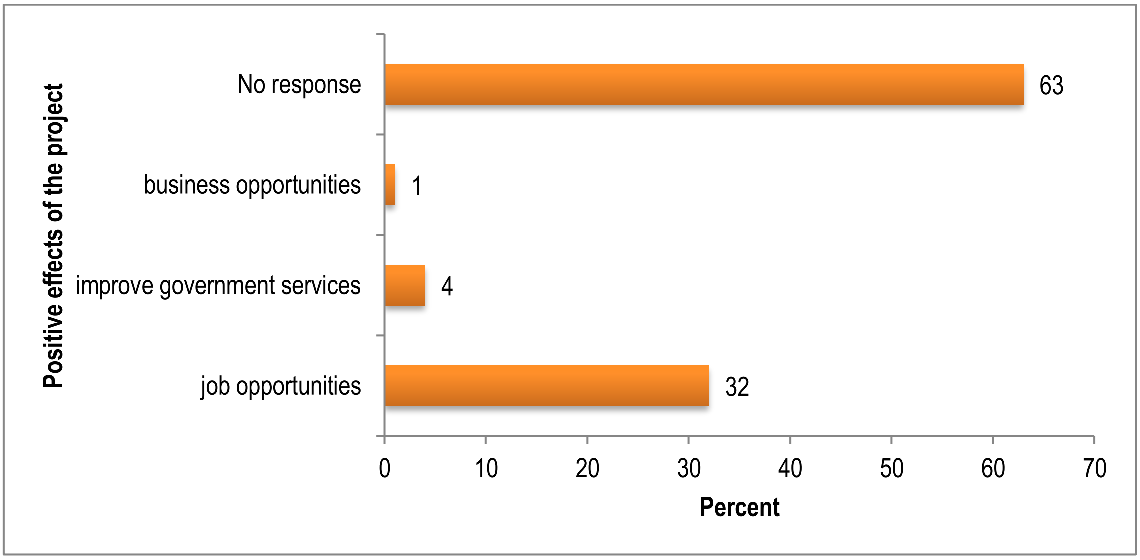
Most respondents that were surveyed answered that mining has a negative impact to the community (70%). Only fifteen percent believes on the positive impacts it might contribute. Seven percent are unaware and has no idea on the possible impact of mining.



Graph 75. Distribution of Respondents According to the Effects of Mining

2.4.2.7 Perceived Positive Effects of the Project

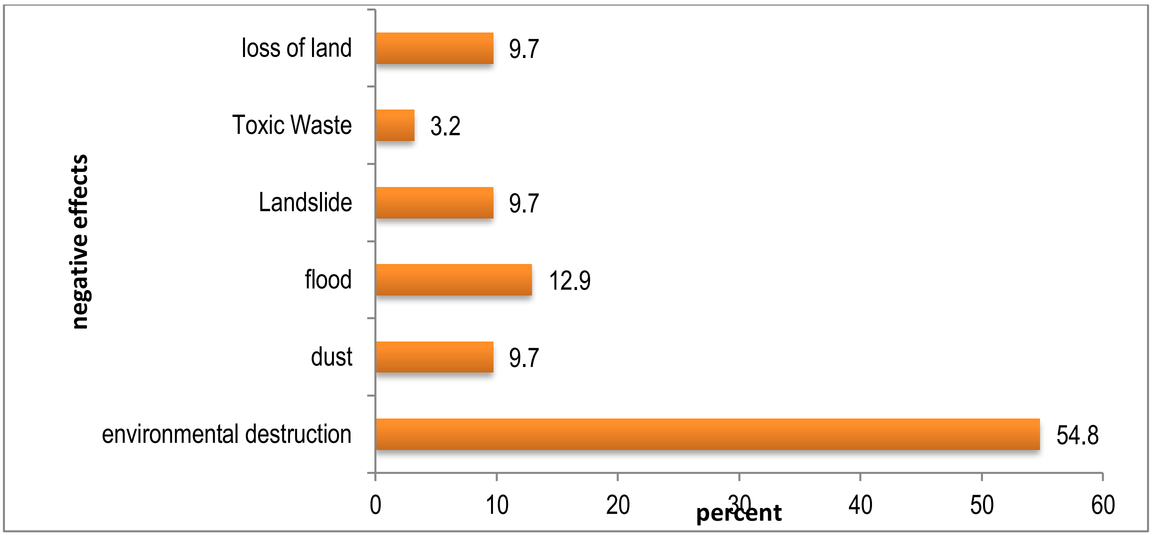
Most of the respondents believed that the project is advantageous in terms of giving job opportunities to the community. Four percent hopes that it will improve and increase the services offered in their Barangay, and one percent says it can increase the number of businesses in the area.



Graph 76. Distribution of Respondents According to the Positive Effects of the Project

2.4.2.8 Perceived Negative Effects of the Project

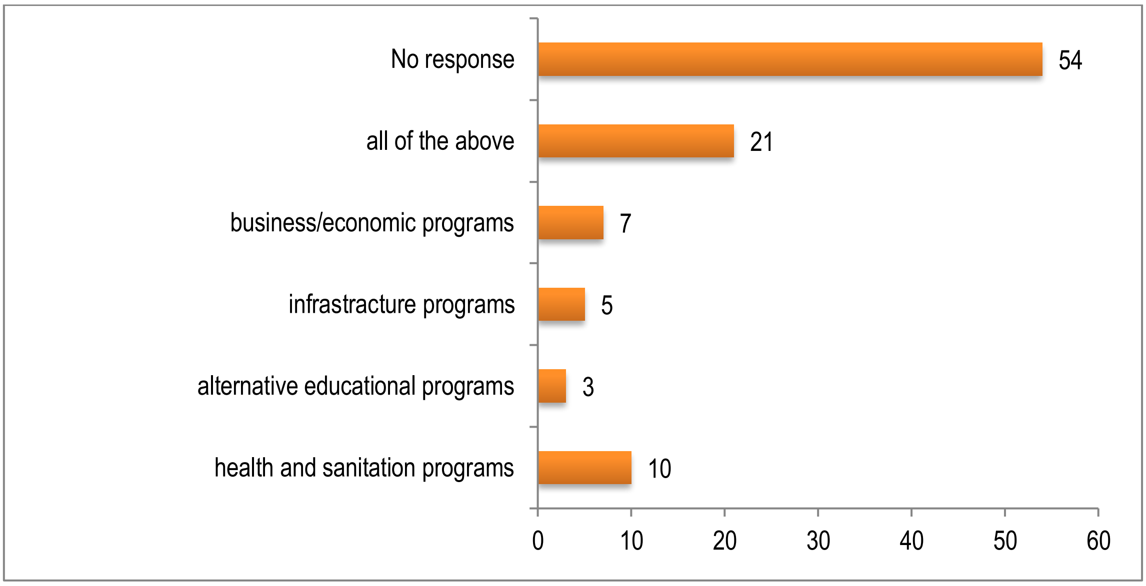
More than half of the respondents are alarmed on the possible impacts it would create to the environment, 12.9 percent are afraid it might cause flashfloods in the area, 9.7 percent fear to lose their jobs and experience landslides, and 3.2 percent believes it can produce toxic wastes to their barangay.



Graph 77. Distribution of Respondents According to the Negative Effects of the Project.

2.4.2.9 Possible Programs for the Barangay

Most of the respondents (21%) or two out of ten answered that programs for Education, Health and Sanitation, Infrastructure, and Employment should be proposed.



Graph 78. Distribution of Respondents According to the Possible Programs for the Barangay

IMPACTS AND MITIGATIONS FOR SOCIO-ECONOMIC

Development/construction Phase

- Advent of fear and insecurity to community due to loss of areas for their livelihood; and
- Loss from agricultural income due to removal of crops and use of the land for mine development and road works.

Operation Phase

- Entry of migrant workers with families which might cause health problems due to diseases, overuse of public utilities /services, competition of resources, social conflicts, and security breaches peace and order, increase in pollution due to solid and liquid wastes;
- Generation of dust, waste and noise; and
- Taxes paid locally and shared by municipal, barangay, and tribal communities.

Decommissioning

- Termination of LGU revenues from taxes, permits and share when mining operations ceases.

To mitigate the abovementioned impacts, the following shall be employed:

Psycho-social

- Extensive IEC shall be implemented throughout the whole Project life and during decommissioning to ensure that stakeholders are well informed on all facets of the Project, which shall include, among others, the nature and operation of the mine, mitigating measures and benefits.

Health and safety

- Ensure the health and safety well-being of the stakeholders through strict implementation of the various environmental and health and safety programs. Community participation, when applicable, in emergency drills shall also be encouraged.

Economic

- The company, as mandated by law, will ensure that priority hiring will be bestowed on the impact community. During pre-construction stage, a skills inventory assessment of the local labor force has to be conducted to gain understanding of the quality and supply of existing local labor force. If existing labor force does not meet the needed skills requirement, a skills training program will be instituted by the project proponent this early to give local residents of project impact barangays the chance to qualify and compete for available employment opportunities offered by the project. Alternative livelihood program will also be made available to other members of the community who will not be employed in the Project;
- Loss of livelihood/income due to loss of farmlands from the construction/operation of the Project shall be addressed through appropriate compensation packages. These and

other applicable management and social development measures are to be encompassed in the SDMP that will be prepared; and

- The required taxes and/or royalties shall also be paid diligently by the company.

Identified Impacts	Mitigating Measures
Psycho-social concerns due to Physical and socio-economic disruption from change in land use - Fear and loss of livelihood and small farm/agroforest lands - Fear of landslides and flooding due to quarrying activities	- IEC on the nature and operation of the mine, mitigating measures and benefits
Economic - Opportunity loss of income from agricultural activities due to removal of crops and use of the land for mine development and road works - Generation of employment - Generation of livelihood opportunities spurred by the multiplier effect of the construction activities - Local government generation of revenues from fees and permits	- Preferential hiring of qualified barangay residents (LGCP R.A. 7160; 1995 PMA R.A. 7942) - Barangay consultation on job requirements and qualification - Training to upgrade local skills of residents who can be hired by the project - Development of small and medium enterprises like transport, construction and utility services - Prompt processing of permits and payment of necessary fees
Increase in Population, Health, and Safety risks - In-Migration - Entry of migrant workers with families which might cause: - health problems due to diseases, overuse of public utilities /services, - competition of resources, - social conflicts, peace and order, - increase in pollution due to solid and liquid wastes. - Increase in traffic flow causing air (dust) and noise pollution	- Policy on preferential hiring of qualified barangay residents (LGCP R.A. 7160; 1995 PMA R.A. 7942) - Management of entry of migrant workers. - Health certificate for workers prior to hiring into the project. - Proponent provides health clinic with a Doctor, Nurse and Health workers in the quarry area. - Assistance in providing access to health and education services through the SDMP - Increase and train barangay tanods to be deployed in areas where migrant workers reside. - Buffer zones should be established around the perimeter of the quarry area. - Proper scheduling of hauler trucks to avoid late hours hauling and road congestion. - IEC on the community in terms of traffic safety - Sprinkling of roads during dry seasons - Assistance to the LGU on traffic management - Provision of safety facilities

Identified Impacts	Mitigating Measures
	- Provision of PPE to every personnel - Conduct of safety orientation and training - Annual Health Monitoring - Possible establishment of alternative mine haul road
Peace and Order - Economic activities and other services near the quarry development and construction area that might cause problems on peace and order and security breaches	- Coordination with the Barangay LGU to ensure authorized establishments and control of unauthorized entry of outsiders. - Proper induction of construction workers.
Cultural and Historical - Possible unearthing of historical artifacts and/or fossil remains	- Safeguard possible archeological site and immediately inform the National Museum in case of finds
- Economic activities and other services near the quarry development and construction area that might cause problems on peace and order and security breaches	- Coordination with the Barangay LGU to ensure authorized establishments and control of unauthorized entry of outsiders. - Proper induction of construction workers.
- Enhancement socio-economic welfare of the community - Local government generation of revenues from taxes, permits and LGU share in the quarrying activities - Payment of local taxes and fees to Municipal and Barangay Local Government Units - Generation of employment - Generation of livelihood opportunities by putting-up food stalls, variety stores and other services near the quarry area which might cause problems of congestion, peace and order and security breaches	- Implementation of community development programs through Social Development Management Plan equivalent to 1.5% of Operating cost based on the identified needs of the communities - Total taxes paid to the national government will exceed >Excise Tax: 60% goes to the national government; 40%, to the local government-- ▪ 20% for host Provinces ▪ 45% for host Municipalities ▪ 35% for host Barangays - Occupation Fees and Real Property Tax to province and municipalities - IEC on nature of jobs the proponents require and qualification - Consultation on job requirements and qualification - Skills training to upgrade local skills of residents that can be hired by the project - Implementation livelihood development programs through the SDMP - Coordination with the Barangay LGU to monitor issuance of business permits in small- to medium- scale commercial establishments to ensure proper zoning of business areas, peace and order, solid waste management

3 RISK ASSESSMENT

Risk assessment is the overall process of risk analysis and risk evaluation.

Risk analysis is the systematic use of available information to determine how often specified events may occur and the magnitude of their consequences. It is a systematic approach for describing and/or calculating risk and involves the identification of undesired events, and the causes and consequences of these events. Risk evaluation, on the other hand, is the process used to determine risk management priorities by comparing the level of risk against predetermined standards, target risk levels or other criteria.

In risk assessment, the words hazards and risks are often used and it is necessary to be clear. For the purposes of this report, a hazard is anything that has the potential to cause harm while risk is the probability that the hazard will cause actual harm.

During the risk assessment, hazards are evaluated in terms of the likelihood that a problem may occur and the damage it would cause if such event would occur. Adequate safety and emergency preparedness require consideration all of the possible hazards that could be encountered. Some hazards, however, are more likely to cause problems than others at a given time and some would result in greater damage than others.

These differences are identified by conducting a risk analysis. The outcome of such can be used to target resources at the types of events that are most likely to occur and/or are most destructive.

Emergency situations that are very likely to happen and would do considerable damage to people and property were targeted for immediate remediation and/or plans will be made for effective response if remediation isn't possible.

The main elements of the risk management process based on AS/NZS 4360:2004 are:

- Communicate and consult - Communicate and consult with internal and external stakeholders as appropriate at each stage of the risk management process and concerning the process as a whole.
- Establish the context - Establish the external, internal and risk management context in which the rest of the process will take place. Criteria against which risk will be evaluated should be established and the structure of the analysis defined.
- Identify risks - Identify where, when, why and how events could prevent, degrade, delay or enhance the achievement of the objectives.
- Analyze risks - Identify and evaluate existing controls. Determine consequences and likelihood and hence the level of risk. This analysis should consider the range of potential consequences and how these could occur.
- Evaluate risks_- Compare estimated levels of risk against the pre-established criteria and consider the balance between potential benefits and adverse outcomes. This enables decisions to be made about the extent and nature of treatments required and about priorities.
- Treat risks - Develop and implement specific cost-effective strategies and action plans for increasing potential benefits and reducing potential costs.
- Monitor and review - It is necessary to monitor the effectiveness of all steps of the risk management process. This is important for continuous improvement. Risks and the

effectiveness of treatment measures need to be monitored to ensure changing circumstances do not alter priorities.

A qualitative/quantitative approach was applied using a risk matrix, which is used to assess the likelihood and the severity or consequences of each hazard and to give it a "risk rating". It rates impact or consequence on the horizontal axis, ranging from insignificant to catastrophic while event likelihood is rated on the vertical axis, ranging from rare to almost certain.

Table 69. Risk rating matrix

Likelihood Level (L)	Descriptor	Insignificant (1)	Minor (2)	Moderate (3)	Significant (4)	Catastrophic (5)	Risk Rating (LxI)
5	Almost Certain	5	10	15	20	25	Extreme ≥ 15
4	Likely	4	8	12	16	20	High ≥10- ≤14
3	Possible	3	6	9	12	15	Medium ≥5 - ≤9
2	Unlikely	2	4	6	8	10	Low ≤ 4
1	Rare	1	2	3	4	5	

The definitions of risk rating are as follows:

- **Extreme** - These risks are classed as critical risks requiring immediate attention. They may have a high or probable likelihood of occurrence and their potential consequences are such that they must be treated as a high priority.
- **High** - These risks are classed as significant. They may have high or low likelihood of occurrence; however, their potential consequences are sufficiently serious to warrant appropriate consideration.
- **Moderate or Medium** - These risks are less significant, however may cause upset and inconvenience in the short-term.
- **Low -** These risks are both unlikely to occur and not significant in their impact.

To determine the degree of risks, a ***Risk Register*** was prepared for the Project based on the safety, environmental and social risks. The Risk Register details the potential major risks identified during the decommissioning and rehabilitation stages of the project, their grading in terms of likelihood of occurring and seriousness of impact on the project. The initial plans for mitigating each high level risk and responsibilities of the prescribed mitigation strategies are discussed under the Risk Management.

The ***Risk Register*** has six (6) columns with the following description.

- The Risk: what can happen and how it can happen
- The consequences of an event happening
- Existing/proposed controls
- Consequence Rating
- Likelihood Rating
- Level of Risk

Qualitative measures of **"Consequence"** or impact (based on AS/NZS 4360:1999)

Table 70. Qualitative measures of consequence

Level	Descriptor	Example of Description
1	Insignificant	No injuries, low financial loss
2	Minor	First aid treatment, on-site release immediately contained, medium financial loss
3	Moderate	Medical treatment required, on-site release contained with outside assistance, high financial loss
4	Major	Extensive injuries, loss of production capability, off-site release with no detrimental effects, major financial loss
5	Catastrophic	Death, toxic release off-site with detrimental effect, huge financial loss

Qualitative measures of **"Likelihood"** (based on AS/NZS 4360:1999).

Table 71. Qualitative measures of likelihood

Level	Descriptor	Description
A	Almost certain	Is expected to occur in most circumstances
B	Likely	Will probably occur in most circumstances
C	Possible	Might occur at some time
D	Unlikely	Could occur at some time
E	Rare	May occur only in exceptional circumstances

Qualitative risk analysis matrix – level of risk (based on AS/NZS 4360:1999).

Table 72. Qualitative risk analysis matrix

Likelihood	Consequences				
	Insignificant 1	Minor 2	Moderate 3	Major 4	Catastrophic 5
A (almost certain)	M	H	E	E	E
B (likely)	L	M	H	E	E
C (possible)	L	M	M	H	E
D (unlikely)	L	L	M	M	H
E (rare)	L	L	L	L	M

E	=	**Extreme Risk**	- Immediate action required.
H	=	**High Risk**	- Inter-department attention required.
M	=	**Moderate Risk**	- EHS Personnel attention required.
L	=	**Low Risk**	- Manage by routine procedures.

3.1 Sources of Risks

3.1.1 On Safety

Table 73. Risk Analysis-Safety

Risk	How it can happen	Receptor	Consequence(s)	Proposed Controls	Consequence Rating	Likelihood Rating considering controls	Level of Risk
Falling from high places/facilities/benches	Non-observance of safety precautions; Unsafe acts/ conditions	Personnel/contractors	Body injury or death	Safety and Health Program (SHP); conduct of safety training and seminars	5	E	M
Hit by falling rocks from upper benches/slides	Unstable slopes, non-observance of safety precautions; unsafe acts/conditions; No PPE	Personnel/contractors	Body injury or death	Implementation of the SHP; conduct of safety trainings and seminars; Putting safety signage; Use of PPEs; Daily safety briefing; Proper mine planning	5	E	M
Vehicular accidents	Reckless driving; Poor maintenance of vehicle; Lack of safety warning devices	Personnel/contractors	Body injury or death	Implementation of SHP; Warning/safety signages established	5	E	M
Caught between moving parts	Unsafe acts/condition; Lack of training	Personnel/contractors	Body injuries	Implementation of SHP; Provision and usage of PPEs; Trainings conducted for the usage of equipment; Warning/safety signages established	4	D	M
Noise	Exposure to high level of noise	Personnel/contractors	Hearing impairment	SHP; Provision and usage of PPEs	3	D	M
Dust Exposure	Lack of PPE;	Personnel/contractors	Shortness of breath,	SHP; Provision and usage of PPEs,	2	C	M

Risk	How it can happen	Receptor	Consequence(s)	Proposed Controls	Consequence Rating	Likelihood Rating considering controls	Level of Risk
			respiratory illness, eye injury	installation of dust control measures			
Trips and slips	Unsafe acts/conditions; Non-observance of safety precautions	Personnel/contractors	Body injury/muscular stress	SHP	2	D	L
Fly rocks, noise and vibration due to blasting	Unsafe acts/conditions; Non-observance of safety precautions	Personnel/contractors	Body injury/muscular stress	SHP	2	D	L
Untimely firing of explosives	Unsafe acts/conditions; Non-observance of safety precautions	Personnel/contractors	Body injury/muscular stress	SHP	5	E	M

3.1.2 On the Environment

Table 74. Risk Analysis-Environment

Risk	How it can happen	Receptor	Consequence(s)	Proposed Controls	Consequence Rating	Likelihood Rating Considering Controls	Level of Risk
Failure of pollution control devices	Poor design and/or maintenance	Nearby water bodies; Flora and fauna; Community	Pollution of nearby water bodies which could lead to consequential effects to flora, fauna, and the community	Design and operation of pollution control devices in accordance with what was prescribed in the law and in relation with the thorough study conducted; Periodic	5	D	H

Risk	How it can happen	Receptor	Consequence(s)	Proposed Controls	Consequence Rating	Likelihood Rating Considering Controls	Level of Risk
				maintenance of pollution control devices			
Stop operation due natural calamities	Catastrophic events like typhoon, earthquake, etc.	Personnel/contractors	Stoppage of operation	Emergency response program.	3	E	L
Failure of the FMR/DP	Lack of management support (operational and financial); Issuance of Ceased and Desist Order (CDO)	Host ecosystem and community	Incomplete rehabilitation and/or decommissioning of the affected areas	Funding and technical mechanism provided in the FMR/DP and the FMRDF; Implementation of the approved FMR/DP and compliance to government regulations	5	E	M
Excessive dust generation	Wind dispersal of particulates; Vehicle and/or equipment generated dust.	Nearby community; Vegetation	Impact on the visual amenity, safety of personnel and health of community; "smothering" of vegetation	Establish vehicular speed limits; Constant water spraying; Covering of materials being hauled by trucks; installation of dust suppression devices	2	C	M
Noise Pollution	Excessive noise associated vehicles and equipment	Fauna and community	Agitation/disturbance to fauna and nearby communities	Installed mufflers on vehicles; Restriction of work hours during day time	2	D	L
Generation of wastes	Improper disposal of wastes	Fauna, personnel/contractors and community	Impact on soil quality, fauna and their habitat, health of community and personnel	Establishment of MRF; segregation of waste and proper disposal	2	C	M

3.1.3 On Social

Table 75. Risk Analysis-Social

Risk	How it can happen	Receptor	Consequence(s)	Existing Controls	Consequence Rating	Likelihood Rating Considering Controls	Level of Risk
Threat on economic and social collapse of impact communities upon closure	Unable to sustain the economic and social development brought by the project	Community	Rapid economic and social collapse; Migration	Implementation of the established SDMP; Operationalization of the Community Relations Office; IEC Campaigns and dialogues	4	C	H
Occurrences of accidents among workers and the community	Ineffective implementation of safety and health program during Mine rehabilitation	Community	Accidents	Implementation of established environmental and safety and health programs	4	D	M
Failure to re-employ retrenched employees increasing the unemployment rate in the area	Ineffective program to further develop the competencies of employees in order to ensure employability	Community; Personnel	Loss of source of income	Implementation of the established SDMP; Operationalization of the Community Relations Office; IEC Campaigns and dialogues	3	D	M
Failure to develop the skills of the community on project management	Mismanagement and failure to maintain the SDMP PPAs	Community	Loss of source of income	Implementation of the established SDMP; Operationalization of the Community Relations Office; IEC Campaigns and dialogues	3	D	M
Health risk to the impact communities	Mismanagement of physical hazards	Community	Increase in the occurrences of various illnesses/diseases	Implementation of established environmental and safety and health programs	3	D	M
Collapse of	Developed culture of	Community	Rapid economic	Implementation of the	2	D	L

Risk	How it can happen	Receptor	Consequence(s)	Existing Controls	Consequence Rating	Likelihood Rating Considering Controls	Level of Risk
livelihood activities in the community/ business related to the operation	income dependency of communities to the operation		collapse; Migration	established SDMP; Operationalization of the Community Relations Office; IEC Campaigns and dialogues			

3.2 Risk Management

The succeeding Risk Management Plan contains measures/activities that ATN will implement in order to address/mitigate the identified risks.

3.2.1 On Safety

Table 76. Risk Management on Safety

Risk	Level of Risk	Proposed Action/Risk management	Responsibilities	Resources	Timeframe	Monitoring
Falling from high places/facilities/benches	M	Implementation of the SHP; Conduct of safety seminars/briefings/ trainings; Setting up of safety signage; Provision and use of PPEs	SHED Personnel All departments and Employees/contractors	SHP fund	Throughout mine life and Decommissioning /abandonment	Company Internal Monitoring; 3rd Party; MMT
Caught between moving parts	M	Implementation of the SHP; Conduct of safety seminars/briefings/ trainings; Setting up of safety signage; Provision and use of PPEs	SHED Personnel All departments and Employees/contractors	SHP fund	Throughout mine life and Decommissioning /abandonment	Company Internal Monitoring; 3rd Party; MMT
Hit by falling rocks from upper benches/slides	M	Implementation of the SHP; conduct of safety trainings and seminars; Putting safety signage; Use of PPEs; Daily safety briefing; Proper mine	SHED Personnel All departments and Employees/contractors	EPEP, FMR/DP and SHP funds	Throughout mine life and Decommissioning /abandonment	Company Internal Monitoring; 3rd Party; MMT

Risk	Level of Risk	Proposed Action/Risk management	Responsibilities	Resources	Timeframe	Monitoring
		planning				
Vehicular accidents	M	Implementation of the SHP; Conduct of safety seminars/briefings/ trainings; Setting up of safety signage	SHED Personnel All departments and Employees/contractors	SHP fund	Throughout mine life and Decommissioning /abandonment	Company Internal Monitoring; 3rd Party; MMT
Noise	M	Implementation of the SHP; Conduct of safety seminars/briefings/ trainings; Setting up of safety signage; Provision and use of PPEs; Maintenance of equipment	SHED Personnel All involved Employees	EPEP, FMR/DP and SHP funds	Throughout mine life and Decommissioning /abandonment	Company Internal Monitoring; 3rd Party; MMT
Dust Exposure	M	Implementation of the SHP; Conduct of safety seminars/briefings/ trainings; Setting up of safety signage; Provision and use of PPEs; Proper mine planning	SHED Personnel All involved Employees/contractors	EPEP and SHP funds	Throughout mine life and Decommissioning /abandonment	Company Internal Monitoring; 3rd Party; MMT
Trips and slips	L	Implementation of the SHP; Conduct of safety seminars/briefings/ trainings; Setting up of safety signage; Provision and use of PPEs	SHED Personnel All involved Employees/contractors	SHP Fund	Throughout mine life and Decommissioning /abandonment	Company Internal Monitoring; 3rd Party; MMT
Fly rocks, noise and vibration due to blasting	L	Implementation of the SHP; Conduct of safety seminars/briefings/ trainings; Setting up of safety signage; Provision and use of PPEs; observance of safety precautions	SHED Personnel All involved Employees/contractors	SHP Fund	Throughout mine life	Company Internal Monitoring; 3rd Party; MMT
Untimely firing of explosives	M	Implementation of the SHP; Conduct of safety seminars/briefings/ trainings; Setting up of safety signage; Provision and use of PPEs; observance of safety precautions	SHED Personnel All involved Employees/contractors	SHP Fund	Throughout mine life	Company Internal Monitoring; 3rd Party; MMT

3.2.2 On the Environment

Table 77. Risk Management on the Environment

Risk	Level of Risk	Proposed Action/Risk management	Responsibilities	Resources	Timeframe	Monitoring
Failure of pollution control devices	H	Design and operation of pollution control devices in accordance with what was prescribed in the law and in relation with the thorough study conducted; Periodic maintenance of pollution control devices	All departments SHED Personnel Personnel in charge of the management of said structures	EPEP Fund	Throughout mine life and Decommissioning /abandonment	Company Internal Monitoring; 3rd Party; MMT
Failure of the FMR/DP	M	Implementation of the funding and technical mechanism provisions in the FMR/DP and the FMRDF; Implementation of the approved FMR/DP and compliance to government regulations	Closure Team SHED Personnel Personnel	FMR/DP Fund	Decommissioning /abandonment	Company Internal Monitoring; 3rd Party; MMT
Stop operation due natural calamities	L	Emergency response program.	SHED Personnel All involved Employees/contractors	EPEP and FMR/DP Fund	Throughout mine life and Decommissioning /abandonment	Company Internal Monitoring; 3rd Party; MMT
Excessive dust generation.	M	Establish vehicular speed limits; Constant water spraying; Covering of materials being hauled by trucks	All departments and employees SHED personnel	EPEP Fund	Throughout mine life and Decommissioning /abandonment	Company Internal Monitoring; 3rd Party; MMT
Noise Pollution	L	Installation mufflers on and maintenance of all vehicles; Restriction of work hours during day time	SHED Personnel Personnel	FMR/DP Fund	Throughout mine life and Decommissioning /abandonment	Company Internal Monitoring; 3rd Party; MMT
Generation of wastes	M	Establishment of MRF; segregation of waste and proper disposal	All departments and employees SHED personnel	EPEP and FMR/DP Fund	Throughout mine life and Decommissioning /abandonment	Company Internal Monitoring; 3rd Party; MMT

3.2.3 On Social

Table 78. Risk Management on Social

Risk	Level of Risk	Proposed Action/Risk management	Responsibilities	Resources	Timeframe	Monitoring
Threat on economic and social collapse of impact communities upon closure	H	Effective implementation of the Social Development and Management Program in order to sustain the economic and social development of the communities even after the mine ceases operation Implementation of the FMR/DP Social Plan for the impact communities	Closure Team Community Relations Personnel	SDMP Fund; FMR/DP Fund	Decommissioning /abandonment	Company Internal Monitoring; 3rd Party; MMT
Occurrences of accidents among workers and the community	M	Effective implementation of safety procedures Prevent entry of community residents in unsafe areas by implementing effective security measures	All departments and employees SHED personnel Community Relations Personnel	EPEP, FMR/DP and SHP Funds	Throughout mine life and Decommissioning /abandonment	Company Internal Monitoring; 3rd Party; MMT
Failure to re-employ retrenched employees increasing the unemployment rate in the area	M	Continuous implementation of competency building program for employees	Closure Team Community Relations Personnel	FMR/DP Fund	Decommissioning /abandonment	Company Internal Monitoring; 3rd Party; MMT
Failure to develop the skills of the community on project management	M	Institutionalization management capabilities of the communities and specially the LGUs	Community Relations Personnel	FMR/DP Fund	Decommissioning /abandonment	Company Internal Monitoring; 3rd Party; MMT
Health risk to the	M	Effective implementation of	All departments and employees	EPEP and FMR/DP	Throughout mine	Company Internal

Risk	Level of Risk	Proposed Action/Risk management	Responsibilities	Resources	Timeframe	Monitoring
impact communities		environmental impact mitigation programs	SHED personnel	Funds	life and Decommissioning /abandonment	Monitoring; 3rd Party; MMT
Collapse of livelihood activities in the community/ business related to the operation	L	Development of viable livelihood projects and identifying markets outside the operation	Community Relations Personnel	FMR/DP Fund	Decommissioning /abandonment	Company Internal Monitoring; 3rd Party; MMT

4 IMPACT MANAGEMENT PLAN

The Impacts Management Plan (IMP) is formulated to minimize the potential adverse impacts while enhancing the beneficial effects of implementation of the project. This IMP, as summarized in **Table 79,** shall serve as the implementing guideline to ensure that environmental requirements are met during the project implementation and basis for the preparation of the EPEP, SHP, SDMP and FMR/DP. Programs indicated can be updated during the monitoring of the perceived project impacts.

Land Resources

Perceived impacts on land include, among others, changes in natural topography/slope; vegetation removal (removal of ecologically and economically important species); loss of topsoil; and soil compaction and erosion.

To address such, thorough geotechnical site investigation, mine planning shall be carried out and appropriate and site-specific engineering measures (i.e. maintenance of specific slope and height of benches and stockpiles) shall be implemented. Rehabilitation works, which shall include revegetation or reforestation of disturbed areas will also be carried out.

Water Resources

The impacts of the Project on water resources are on alteration of water quality. This shall be mitigated and controlled through proper planning, sound engineering practices, and installation of pollution control devices (e.g. provision of proper drainage, silt traps, settling ponds, etc.)

Air and Noise Quality

Possible adverse effects on air and noise quality shall be managed/minimized through effective planning (i.e. setting of speed limits, scheduling of activities, etc.). Provisions of suitable buffer zones, regular water sprinkling, installation of filters/dust suppression devices, covering the trucks with tarpaulin or canvass during transport of aggregates and proper maintenance of heavy equipment.

Socio-Economic

Significant social impacts include formation of negative attitude towards the project, loss of livelihood/income, influx of migrant workers and resource competition. These shall be mitigated through the implementation different programs such as the IEC, SDMP, and the established safety, health and environmental programs/procedures.

Table 79. Matrix of Major Impacts, Mitigation/Enhancement Measures and Environmental Management Plan

Project Activity	Environmental/Social Component to be Affected	Potential Impacts	Options for Prevention, Mitigation or Enhancement	Responsible Entity	Cost (PhP)	Guarantee/ Financial Agreements
Development/Construction Phase						
Site preparation (clearing, grubbing and stripping of topsoil) Construction of benches/mine facilities/haul roads Stockpiling of topsoil	Land	- Change in land use of areas occupied by the mine facilities - Loss of topsoil and decrease in soil quality/productivity - Soil contamination	- Planning of rehabilitation will be in accordance with the FMR/DP and in consultation with stakeholders - Removed soils will be conserved and stockpiled in a pre-determined area and will be in rehabilitation and backfilling activities - Stockpiles shall be graded to a stable relief - Progressive ground preparation/grubbing to minimize the area removed with soil cover at any one time	ATN	Included in project cost	ECC and EPEP
		- Inducement of land slides	- Safe working slopes and land slide control structures will be established - Train pertinent personnel on recognition of the various slope/ground failure modes, hazard warning signs and standard operating procedures to be observed in the case of ground failure events or impending event	ATN	Included in project cost	ECC and EPEP
		- Generation of wastes	- Materials recovered from vegetation removal shall be used as: ▪ Trash lines on steep slopes to mitigate soil erosion ▪ Materials for construction and/or composted and used for the fertilization of the seedlings in the nursery, seedling outplanting and field maintenance - Proper disposal of construction debris and solid wastes - Implementation of an Integrated Solid Waste Management Plan: Reduce, reuse, recycle	ATN	Included in project cost	ECC and EPEP
	Terrestrial	- Loss of vegetation and	- For accessibility, existing roads will be utilized	ATN	Included	ECC and EPEP

Project Activity	Environmental/Social Component to be Affected	Potential Impacts	Options for Prevention, Mitigation or Enhancement	Responsible Entity	Cost (PhP)	Guarantee/ Financial Agreements
	Ecology	habitat - Increase in noise - Mortality of small, less mobile animals due to project activities - Habitat Fragmentation	and improved - For new roads to be established, heavily disturbed (e.g., grassland, scrubland, etc.) areas or trails shall be prioritized as the location - Whenever possible, tree-balling and immediate transfer of trees to open areas within the project area will be done (Applicable only to the critically endangered tree species) - Tree cutting permit shall be secured prior to any clearing and cutting - Strictly prohibit poaching of wildlife to mitigate population reduction and allow safe movement - Vegetation removal kept at minimum through planned clearings - Establishing voluntary conservation zones and biological corridors within the Project area		in project cost	
	Surface hydrology	- Increase in surface runoff and river discharge - Decline in river carrying capacity due to siltation	- Construction of a drainage system within the project area - Proper stockpiling of excavated materials with appropriate drainage to minimize sedimentation.	ATN	Included in project cost	ECC and EPEP
		- Increases sewage and solid wastes, including petroleum based products	- Placement of regulatory signs on proper waste disposal of construction solid wastes - Provide proper waste disposal facilities for petroleum products and solid wastes - Provide sufficient toilet facilities for workers	ATN		
	Air and Noise	- Ambient air pollution - Occupational health	- Regular spraying of water in active construction areas	ATN	Included in project	ECC and EPEP

Project Activity	Environmental/Social Component to be Affected	Potential Impacts	Options for Prevention, Mitigation or Enhancement	Responsible Entity	Cost (PhP)	Guarantee/ Financial Agreements
		effects	- Replacement of vegetation in non-construction areas - Compacting of exposed soil - Provision of tarpaulin cover on trucks transporting construction materials - Immediate hauling of spoils - Impose speed restrictions - Regular maintenance of heavy equipment and motor vehicles		cost	
		- Increased ambient sound levels	- Regular maintenance of heavy equipment mufflers (noise) - Provision of ear mufflers to workers operating noisy equipment - Proper scheduling of noisy activities during day time			
	People	- Employment and Economic Opportunities - Population Influx - Loss of income from agricultural activities due to removal of crops and use of the land for mine development and road works	- Policy on the preferential hiring of locals - Pre-employment training to community residents - Training and development of local service cooperative - Preferential hiring of locals will be announced	ATN	Included in project cost	ECC and SDMP
		- Exposure to safety and Health Hazards	- Safety and Health Program for workers and impact communities. - Community Health Survey - Assistance to the LGU on traffic management	ATN	Included in project cost	SDMP and SHP
		- Proliferation of vices that affects the peace	- Values orientation seminars to workers and community residents	ATN	Included in project	SDMP

Project Activity	Environmental/Social Component to be Affected	Potential Impacts	Options for Prevention, Mitigation or Enhancement	Responsible Entity	Cost (PhP)	Guarantee/ Financial Agreements
		and order in the area	- Conduct of activities that promotes community cohesion - Assistance to the LGU on Peace and Order management		cost	
		- Increased income of LGUs due to tax revenues	- Prompt payment of taxes to the Local and National Government	ATN	Included in project cost	ECC and EPEP
		- Possible unearthing of historical artifacts and/or fossil remains	- Safeguard possible archeological site and immediately inform the National Museum in case of finds	ATN CRO, National Museum	Included in the project cost	Included in EPEP
Operation Phase						
Quarry	Land	- Generation of open areas with greater potential for runoff, erosion and landslides	- Establishment of safe working slopes and installation of land slide control structures - Implementation of a suitable and appropriate slope/ground failure monitoring plan to detect instability at an early and non-critical stage (eg. drone survey) - Train pertinent personnel on recognition of the various slope/ground failure modes, hazard warning signs and standard operating procedures to be observed in the case of ground failure events or impending event; - Identification, early recognition and monitoring of warning signs of potential and impending slope stability problems - Progressive rehabilitation of disturbed areas - “Vengineering” (i.e. planting of vegetation with high rainfall intercepting capacity and high transpiration rate characteristics to serve as re-evaporators/biological pumps,	ATN	Included in project cost	ECC and EPEP

Project Activity	Environmental/Social Component to be Affected	Potential Impacts	Options for Prevention, Mitigation or Enhancement	Responsible Entity	Cost (PhP)	Guarantee/ Financial Agreements
			respectively) - Utilization of removed topsoil for backfilling low-lying areas and service roads - Formulate a topsoil management plan (TMP) to address topsoil removal, stockpiling, and archiving of topsoil inventory for the project's progressive rehabilitation activities			
	Soil Quality	- Decrease in surface soil quality due to compaction, shearing and dust deposition during quarrying and hauling activities - Improper disposal of domestic wastes - Soil Contamination due to accidental fuel and lubricant spills from vehicles and equipment	- Constant monitoring of the surface soil physico-chemical quality (i.e. Bulk density, metals, plant essential nutrient elements, pH) - Use vegetative cover (i.e. Grass and shrub species with known tolerance to acidic soil conditions; hyper/accumulator of metals to expedite and enhance soil quality - All domestic wastes will be sold to DENR accredited recyclers. Residual waste will be disposed to a designated sanitary land fill - All used oils, lubricants will be sold to recyclers. Residual waste will be disposed to a designated sanitary land fill - Contaminated soils will be removed and disposed off-site - Provision of refuse storage facility with oil and water separator to contain any accidental spill	ATN	Included in project cost	ECC and EPEP
	Air and Noise	- CO_2 generation - Dust generation - Noise generation	- Implement regular inspection and preventive maintenance of heavy equipment, machineries and service vehicles - Use electric or fuel-efficient equipment, machineries and vehicles and maximize its operation, if possible - Water spraying	ATN	Included in project cost	ECC and EPEP

Project Activity	Environmental/Social Component to be Affected	Potential Impacts	Options for Prevention, Mitigation or Enhancement	Responsible Entity	Cost (PhP)	Guarantee/ Financial Agreements
			- Mining activities to be confined during daytime			
	Water	- Increase in surface runoff and river discharge - Decline in river carrying capacity due to siltation - Water pollution - Water resource use	- Establishment of siltation ponds and implementation of sediment and erosion control plan - Provision of drains to access roads to contain and limit sedimentation downstream of the quarry - Strengthen water monitoring system by keeping a record of daily water extraction and consumption. - Rainwater harvesting through decentralized impoundments	ATN	Included in project cost	ECC and EPEP
	Terrestrial Ecology	- Removal of ecologically and economically important species and wildlife habitat - Removal of photosynthesizing plants - Mortality of small, less mobile animals due to project activities - Accessibility of area to illegal hunters and poachers of animals	- Priority conservation for ecologically and economically important species identified in the area - Establishment of a nursery to propagate the seeds/propagules of these species, which will provide seedlings for future rehabilitation requirements - Tree plantation development using the indigenous species and assisted natural regeneration (ANR) techniques - Enhancement of Agro-forestry technologies suitable for the area - Prevention of unnecessary clearing of vegetation - Strictly prohibit poaching of wildlife to mitigate population reduction and allow safe movement. - Personnel, heavy equipment, other vehicles, etc. shall be confined only to pre-determined	ATN	Included in project cost	ECC and EPEP

Project Activity	Environmental/Social Component to be Affected	Potential Impacts	Options for Prevention, Mitigation or Enhancement	Responsible Entity	Cost (PhP)	Guarantee/ Financial Agreements
			designated areas and shall not occupy other areas to avoid further disturbances - An active and continuous wildlife protection and conservation campaign will be pursued with the participation of all key stakeholders (e.g., communities, LGUs, etc.) within and around the project site.			
	People	- Safety and health risks to workers	- Provision of PPE to every personnel - Conduct of safety orientation and training	ATN	Included in project cost	EPEP and SHP
Crushing, batching and CHB plant	Water	- Water pollution - Water resource use	- Strengthen water monitoring system by keeping a record of daily water extraction and consumption. - Alternative source of water such as rainwater harvesting through decentralized impoundments - Water monitoring system by keeping a record of daily water extraction and consumption.	ATN	Included in project cost	ECC and EPEP
		- Water contamination from leaks and spills from vehicles and equipment, fuel and oil tanks and used oil storage	- Access roads will be provided with drains - Site water management that includes the provision of facilities that would reutilize effluent to ensure minimal effluent discharge (specially constructed tanks, pipe systems), and planting of vegetation–grassy plots, flowering shrubs, and fruit trees. - Training on in proper handling and implementation of good housekeeping practices.	ATN	Included in project cost	ECC and EPEP
	Air and Noise	- CO2 generation - Dust generation - Noise generation	- Implement regular inspection and preventive maintenance of heavy equipment, machineries and service vehicles - Use electric or fuel-efficient equipment,	ATN	Included in project cost	ECC and EPEP

Project Activity	Environmental/Social Component to be Affected	Potential Impacts	Options for Prevention, Mitigation or Enhancement	Responsible Entity	Cost (PhP)	Guarantee/ Financial Agreements
			machineries and vehicles and maximize its operation, if possible - Water spraying - Installation of dust suppression devices			
	People	- Safety and health risks to workers	- Provision of PPE to every personnel - Conduct of safety orientation and training	ATN	Included in project cost	EPEP and SHP
Stockpiling of waste rock Hauling of materials	Land	- Soil erosion	- Proper and strategic siting of stockpiles - Progressive reclamation of exposed waste rocks - Stockpiling below angle of repose - Stockpiling in benches - Provision of rock facing and installation of large boulders along the toe line increase stability	ATN	Included in project cost	EPEP
	Water	- Siltation of nearby water body	- Proper management of stockpile - Addition of soil amelioration and seeding of stockpiled topsoil - Provision of drainage	ATN	Included in project cost	EPEP
	Air and noise	- Ambient air pollution - Occupational health effects - Increased ambient sound levels	- Regular spraying of water in active construction areas - Replacement of vegetation in non-construction areas - Compacting of exposed soil - Provision of tarpaulin cover on trucks transporting aggregates - Impose speed restrictions - Regular maintenance of heavy equipment and motor vehicles - Regular maintenance of heavy equipment mufflers (noise)	ATN	Included in project cost	EPEP and SHP

Project Activity	Environmental/Social Component to be Affected	Potential Impacts	Options for Prevention, Mitigation or Enhancement	Responsible Entity	Cost (PhP)	Guarantee/ Financial Agreements
			- Provision of ear mufflers to workers operating noisy equipment - Proper scheduling of noisy activities during day time			
	People	- Safety and health risk to workers and communities near the haul roads	- Provision of PPE to every personnel - Conduct of safety orientation and training - Implementation of speed limit and other relevant safety procedures	ATN	Included in project cost	EPEP and SHP
Operations of motorpool	Land	- Contamination of soil	- Provision of procedures for proper handling, storage, and transport of used oils, lubricants and chemicals - Provision of relevant pollution control devices (i.e. oil and water separator, auto shutoff valves) - Contaminated soils will be removed and disposed off-site. - Provision of Refuse storage facility with oil and water separator to contain any accidental spill.	ATN	Included in project cost	EPEP
	Water	- Contamination of water				
	People	- Safety and health risks to workers	- Provision of procedures for proper handling, storage, and transport of used oils, lubricants and chemicals - Provision of PPE - Implementation of proper housekeeping	ATN	Included in project cost	EPEP and SHP
Operationalization of administrative complex	Land, water, people	- Contamination of soil and water - Health risks to workers and the community	- Implementation of proper housekeeping - Provision of proper domestic waste handling and disposal - Provision of a materials recovery facility for wastes - Implementation of segregation	ATN	Included in project cost	EPEP
Abandonment Phase						
Decommissioning	Land	- Erosion of newly	- Establishment of newly restored areas with	ATN	Included	Encompassed by

Project Activity	Environmental/Social Component to be Affected	Potential Impacts	Options for Prevention, Mitigation or Enhancement	Responsible Entity	Cost (PhP)	Guarantee/ Financial Agreements
of equipment Rehabilitation of disturbed areas Dismantling of structures		replaced soils - Difficulty in plant establishment within footprints due to soil compaction	proper drainage and soil erosion control structures - Soil amelioration		in project cost	the FMR/DP
		- Permanent land use change - Generation of wastes	- Rehabilitation of the project area to the agreed and approved final land use embodied in the FMR/DP - The final perimeter and cover of the quarry area will have an undulating profile to facilitate drainage and future land use - Recyclable materials will be sold to recyclers. Residual wastes will be hand over to the municipal garbage collectors. Hazardous waste will be transported to accredited disposal companies - Decommissioning of infrastructures and rehabilitation of quarried out areas will be conducted in accordance with the project FMR/DP	ATN	Included in project cost	Encompassed by the FMR/DP
	Water	- Contamination of water quality due to failure of the siltation ponds	- Design impoundment structures relative to seismic and structural parameters - Monitoring of structural integrity for the duration of operation of these facilities and beyond mine closure - Development of an Emergency Response Plan to handle possible siltation pond failure	ATN	Included in project cost	Encompassed by the FMR/DP
	Air and Noise	- Ambient air pollution - Occupational health effects	- Regular spraying of water in active areas - Provision of tarpaulin cover on trucks transporting decommisioned materials - Impose speed restrictions - Regular maintenance of heavy equipment	ATN	Included in project cost	Encompassed by the FMR/DP

Project Activity	Environmental/Social Component to be Affected	Potential Impacts	Options for Prevention, Mitigation or Enhancement	Responsible Entity	Cost (PhP)	Guarantee/ Financial Agreements
		- Increased ambient sound levels	and motor vehicles - Regular maintenance of equipment mufflers (noise) - Provision of ear mufflers to workers operating noisy equipment - Proper scheduling of noisy activities during day time			
	People	- Termination of LGU revenues - Loss of employment/livelihood opportunities - Discontinuation of the social services offered by ATN through CSR and SDMP	- Extensive IEC prior to decommissioning - Implementation of a post-mining Social development plan	ATN (CRO), barangay, MLGU	Included in project cost	Encompassed by the FMR/DP

5 SOCIAL DEVELOPMENT PLAN AND IEC IMPLEMENTATION

As mandated by law, the proponent has to create and implement a five-year Social Development and Management Plan (SDMP). In essence, the goal of the creation of such is to address the various possible socio-economic issue raised by the stakeholders. Its formulation has to be in consultation with the various stakeholders and taking into consideration existing barangay and/or municipal development plans. In so doing, duplication of projects will be prevented and available funds will be maximized.

The implementation, monitoring, and evaluation of the SDMP will be executed in coordination and partnership between the company, through its Community Relations Officer (CRO) and various stakeholders (i.e. LGUs, government agencies). Through this system, the participation and awareness of the stakeholders regarding the various aspects of the Project is ensured.

In view of the foregoing and in lieu of the yet to be established SDMP, an Indicative Social Development Plan (ISDP) was created. This plan was drafted through consultation with the decision makers and multi-sectoral representatives of the project affected communities.

Table 80. Conducted Consultations

Sector	Date of Consultation	Activity
Barangay Macabud	11 to 14 April 2019	IEC
	24 April 2019	Initial Perception Survey
	16 May 2019	Public Scoping

The objectives of the consultation were to:

- Identify the basic needs and welfare of the community as basis for the framework of social development program of the project affected Municipality/Barangay within the project area;
- Prepare an indicative sustainable plan based on the requirement stipulated in the RPM for DAO 2003-30; and
- Establish a working relation with company's CRO and the various community stakeholders with the goal of improving the quality of life of the project affected communities by enabling them to becoming self-reliant.

The SDP also provided an opportunity for identifying the following:

- Address key socio-economic issues and concerns by the various stakeholders, including those that were raised during the public scoping;
- Identify and design the recommended measures in response to the issues and concerns that were raised;
- Identify the lead agency or organization responsible in implementing the measures; and
- Set timelines to implement these measures consistent with the plans and programs of the lead agencies.

In the long term, it is expected that the economic benefits from tax revenues, funds from the mandated services of the inter-agencies and the socio-economic benefits from the Mining law will be the main sources of funds to sustain the implementation of the ISDP/IIPDP.

The information collected from the perception survey will also form part of the ISDP that shall mainly address the following issues:

- Possibility of destructing the roads and bridges that the hauling trucks and service vehicle will use;
- Possibility of traffic congestion due to the increased activity in the mining area;
- Possibility of unsafe surroundings;
- Possibility of landslides;
- Perceived influx of people or in-migration due to increased economic activity;
- Perceived fears of environmental "destruction" or degradation due to pollution of land, air, water and resources, and health risks;
- Possibility of losing the homes and farmlands of local residents; and
- Possibility of losing their source of livelihood

In précis, the overall focus of the Indicative SDP is to assure DENR EMB/MGB that ATN is capable of mitigating impacts, which include, among others, the safety and health programs, environmental preservation, and alternative livelihood programs of the affected communities. The company will consider local needs in making strategic partnerships with all concerned stakeholders.

Indicative Social Development Plan

Based on baseline information generated from surveys, focus group discussions, and systematic review of pertinent documents, the table below contains an indicative social development and IEC plans generated for ATN's Integrated Aggregates Project.

Table 81. Indicative social development plan for ATN Integrated Aggregates Project

Program Area	Component	Projected Beneficiaries	Partner Institutions	Timeframe	Fund Source
Development of Host and Neighboring Communities	Enterprise Development and Networking - Identification and Development of Appropriate Livelihood Program - Skills Training Enhancement Project (STEP) - Product Innovation and Marketing	- Women - Senior Citizen - Youth - PWDs - Unemployed Individuals	- People's Organizations/Associations - BLGU - MLGU - TESDA - DA - DOLE - Academe	Pre-Construction, Construction & Operation Stage	ATN
	Assistance to Infrastructure Development and Support Service - Resettlement Project - Road Maintenance - Leve 1 and 2 Water System Development - Lighting Facility Improvement - Support to Rehabilitation and Maintenance of Public Infrastructures (Schools, Market, Gym, etc)	- Project-Affected Persons/Families - MLGU - BLGU - Religious Group - Farmer's Association - Association of Women - Community - DepEd - Business Firms (MSMEs)	- LGU - DPWH - PNP - DOH - Maynilad - MER - DepEd	Operation & Post Operation Stage	ATN & LGU
	Access to Education and Educational Support Programs - Scholarship Program - Infrastructure Support - Research support grants	- Youth (OSY) - DepEd - Commission of Higher Education (CHEd) - Researchers	- LGU - DepEd - CHEd - Academe	Operation & Post Operation Stage	ATN and LGU
	Access to Health Services, Health Facilities, and Health Professionals	- BLGU - MLGU	- BLGU - MHOs/BHCs	Operation & Post Operation Stage	ATN, LGU, DoH

Program Area	Component	Projected Beneficiaries	Partner Institutions	Timeframe	Fund Source
	- IEC on Proper Sanitation Practices - Improve Health Facility (Ex. Health Centers, Facilities & Equipment) - Outreach Program of Health	- BHCs/BHWs - MHOs/MHWs - Community/Households			
	Socio-cultural Support Program - Capacity building - Support to Community Socio-cultural and values-formation activities (ex. Fiesta)	- BLGU - MLGU - Religious Groups - Youth - Women - Senior Citizen	- LGU - POs - Religious Organizations - PNP	Operation & Post Operation Stage	ATN & LGU
2. Public Awareness and Education on Mining and Quarrying Technology and Development	Information and Education Campaign - IEC on Responsible Mining and Quarrying - Sponsorship on Mining Forum, Meetings, Conferences	- Community/Households - MLGUs/BLGUs - Religious Sector - NGOs - MSMEs - Youth	- LGU - DepEd - Academe -	Operation & Post Operation Stage	ATN
	Disaster Preparedness Training and Drills - Training on DRRM - Improve DRRM Facility and Equipment	- Community/Households (PWDs, Youth, Senior Citizen, Women, etc) - BLGUs	- MDRRMO - BDRRMO - PNP/AFP - LGU - POs	Pre-Construction, Construction, Operation & Post Operation Stage	ATN and LGU

Indicative IEC Plan

Table 82. Indicative IEC Plan for the ATN Integrated Aggregates Project

Needs	Implementation	Community Implementation Plan (Strategies)	Government/ Non-Government Agency Services	Proponent
Full Information about: - The EIA process - The Mining Project - Benefits of the Project	Before project implementation	- 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	1. Commercial Broadcasting Stations 2. Municipal & Barangay	ATN

Needs	Implementation	Community Implementation Plan (Strategies)	Government/ Non-Government Agency Services	Proponent
on their Socio-cultural/economic and bio-physical environment - Consequential impact of the operation to residents of the community - Compliance with the EMoP, EMP, and ECC conditions - Social Development Projects		illustrations to further clarify the components of the Project. a. Illustrated and simplified EIA process in local dialect of the affected community written in English and Filipino, b. The Mining Project: This shall contain: ▪ the project description, project time frame, project facilities, management of Social and Environmental impacts, potential project benefits a graphic illustration about the quarry production operation ▪ the process of Environmental Impact Assessment, roles and responsibilities of stakeholders ▪ The Social Development and Management Plan ▪ On the residents who will be affected by the quarry activities showing their right to complain for violations of ECC conditions.	Information Officers 3. Elementary and High School Students 4. Barangay Committee on Education and Culture 5. Sangguniang Kabataan Barangay	
	During project operations	- 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, ATN will implement regular consultations with the barangays for an open dialogue on the issues, problems and concerns related to the implementation and sustainability of the project.		

Needs	Implementation	Community Implementation Plan (Strategies)	Government/ Non-Government Agency Services	Proponent
		(Multi-partite Monitoring Team) - Group discussions of the sectoral groups affected by the mining activities, the legal processes with the application of priority job placement, and other benefits - Workshops on Solid Waste Management and Preparation of IEC materials ▪ Posters and Wall Comics ▪ A graphic illustration of information on "What are being quarried?" and the rationale of the project in the context of their experiences in relation to mining - Stakeholders Consultation ▪ Using the feed-back mechanism through information booths in the Municipality of Rodriguez and concerned barangays. - Community Forum ▪ This strategy enables the Company to discuss the progress of the project with key-persons of the company/resource persons. This also encourages multi-sectoral interest groups to ask questions. ▪ Establishment of open-line communication with the concerned barangays/ communities through the CRO, this will ensure prompt resolution of community concerns.		

Resettlement Action Framework

The most crucial socio-economic impact of this project is the resettlement of some formal and informal settler families (ISF) residing in the proposed quarry area. To serve as a guide in ensuring the observance of rights and privileges of the company and the community, this resettlement framework plan was crafted. It contains the legal framework of resettlement, entitlement matrix, resettlement process, institutional framework, and organizational responsibilities, as well as the valuation of assets and compensation of losses, and the monitoring and evaluation plan. The purpose of this plan are as follows:

- To physically resettle project-affected people in a safe location away from ATN's proposed project area; and
- To resettle project-affected people in a locality which is reasonable to their resources of income and employment or where employment opportunities are determined to be adequate to restore or improve income levels and employment.

The plan is crafted based on the existing resettlement structure of Barangay Macabud.

Legal Framework. This resettlement plan is rooted from laws and regulations of the country. It technically defines the scope and coverage of resettlement system, process, and mechanisms as stipulated in R.A 7279. The details are presented in the table below.

Table 83. Legal Framework on Resettlement Action Plan[1].

Key Issue/s	Philippine Policy	Operational Definition
Persons Considered as Project-Affected Persons (PAPs)	PAPs consist of all members of a household who will be adversely affected by the project because their real property shall be acquired for government infrastructure projects.	Everyone who occupies land or structure and those that conduct livelihood activities at cut-off date within the project location shall be identified and properly recorded including their condition in life, and their personal circumstances. Each person identified in the survey shall be considered PAP and shall be provided with assistance as provided for in this resettlement action plan and the framework including compensation for their structures as well as rehabilitation

[1] Adopted and modified from Metro Manila Flood Management Project conducted by DPWH and MMDA on November, 2016.

Key Issue/s	Philippine Policy	Operational Definition
		measures to improve or at least restore livelihood and living standard.
Loss of Income or Sources of Livelihood	Major government policies (e.g. RA 7279, RA 10752) are silent regarding loss of income directly resulting from land acquisition. However, some agency-specific policies like the DPWH LARRIP Policy 2007 and DO 327 s. 2003 cover income loss: LARRIP on Income Loss. "For loss of business/ income, the PAF will be entitled to an income rehabilitation assistance not to exceed P 15,000 for severely affected structures, or to be based on the latest copy of the PAF's Tax record for the period corresponding to the stoppage of business activities". DO 327 s. 2003 provides transitional allowance for severely affected shop owners for their computed income loss during demolition and reconstruction of their shops.	The project should compensate for lost income and provide rehabilitation measures to improve livelihoods and living conditions of PAPs or at least restore them to pre-project level.
Treatment of Informal Settlers	R.A. 7279 states that eligible homeless and poor informal settlers are entitled to resettlement if they are affected by development projects. However, R.A. 7279 limits this to residential informal settlers and is silent on informal structures on public or private land used for commercial purposes. Government also exclude from the eligibility list people who were previously resettled.	The project will replace lost structures and other assets of informal settlers. Replacement options include rehousing, cash compensation, rental support while waiting for the housing units to become available, transportation costs, and rehabilitation costs to restore lost livelihood. PAPs found to be previously resettled are not automatically excluded especially if they returned due to lack of livelihood in the resettlement sites.

Entitlement Matrix. The resettlement action plan will focus on four key entitlements. These include:

- Compensation at replacement cost for lost structures and fixed or immovable assets (Note: this may be for ISFs who will opt for cash compensation and not for house and lot options in resettlement sites. Otherwise, it may be looked at as double compensation, and may potentially create tension between PAPs and host resettled ISFs or between ISFs and the proponent.);
- Affordable in-site or near-site physical resettlement at locations in reasonable proximity to places of work and sources of income, which is essential to preclude any significant increase in travel costs and time to work places. As an option, in-site resettlement may take the form of redevelopment of the area or another area in its vicinity. Off-site locations experiencing growth and urbanization where employment opportunities are available are not preclude however due diligence on job market opportunities and skills training will have to be undertaken and should form part of this RAP to support a sustainable outcome, especially for those who are unskilled;
- Transitional allowances and related support measures which are needed to assist PAPs with movement to the resettlement location and rental expenses as needed while resettlement accommodations are under construction; and
- Investments in human development, such as skills training for family members which are needed to improved employability and income.

The following are the categories of project-affected people, its potential impacts, and the entitlement based on the provision of the Resettlement Policy Framework and local and national policies of the Philippine Government.

Table 84. Entitlement Matrix

PAP Category	Potential Impact	Entitlement
Resident owner of informal structure	Loss of dwelling, potential loss of access to work place.	For those that will not avail of housing assistance: - Compensation at full replacement cost for lost structures/assets based on market value of materials and labor. The proponent will also provide free transportation assistance for those who will opt to go back to provinces. For those that will avail of housing assistance: - Inclusion in social (amortized) rehousing schemes; or provision of subsidized housing rental unit for those unable to afford a mortgage. - Rental subsidy / voucher for up to 24 months while waiting for the availability of the units in resettlement site; or staging area. (This entitlement may be extended to meet the completion date of resettlement housing.) - Transition allowance for moving costs to resettlement site. - Moving assistance – trucks for personal belongings; vans for women and children. - Free access to skills training and related livelihood restoration programs for male and

PAP Category	Potential Impact	Entitlement
		female family members.
Renter of informal structure	Loss of dwelling, potential loss of access to work place.	- Inclusion in social (amortized) rehousing schemes; or provision of subsidized housing rental unit for those unable to afford a mortgage. - Rental subsidy / voucher for up to 24 months (extendible if needed) while waiting for the availability of the units in resettlement site - Transition allowance for moving costs to new rental unit. - Moving assistance – trucks for personal belongings; vans for women and children - Free access to skills training and related livelihood restoration programs for male and female family members.
Sharer/Rent-Free Households	Loss of dwelling, potential loss of access to work place	- Inclusion in social (amortized) rehousing schemes; or provision of subsidized housing rental unit for those unable to afford a mortgage. - Rental subsidy / voucher for up to 24 months (extendible if needed) while waiting for the availability of the units in resettlement site - Transition allowance for moving costs to new rental unit. - Moving assistance – trucks for personal belongings; vans for women and children - Free access to skills training and related livelihood restoration programs for male and female family members.
Vulnerable People (All PAPs with children, 1 HH with PWD)	Resettlement could affect social support networks and physical conditions of vulnerable PAPs (children, pregnant women, persons with disabilities (PWD) and illnesses.	On top of assistance depending on which options they chose (housing or cash compensation), welfare agency additional support will be provided to ensure that vulnerable people are assisted as needed in resettlement transition. E.g. Vans provided for women and children; special assistance for pregnant women, PWDs, etc.
Professional squatters		Will go through a process of thorough screening. Resettlement programs screen the lists to exclude those who have been previously resettled from being resettled once again. There are cases, both of individuals and more organized schemes, where people take up assets at resettlement sites, dispose or abandon the assets, and return to the project site.
Economically displaced individuals	Negative impact on Land-based livelihoods	Participation in livelihood restoration and assistance programs
Planters and/or owners of crops	Loss of trees and crops	Compensation in cash at agreed replacement rates

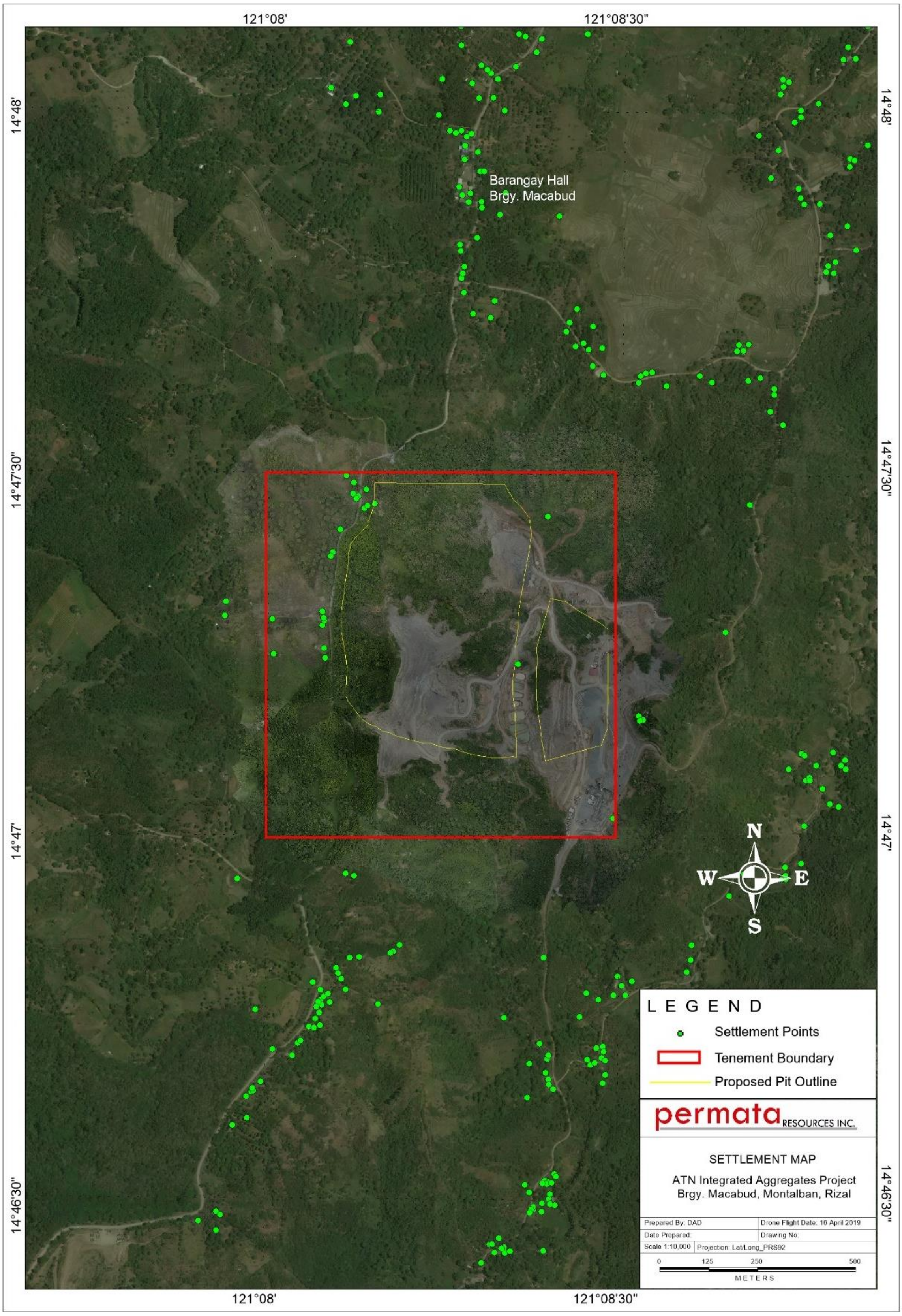


Figure 43 – Settlement Map of the Proposed ATN Integrated Aggregates Project

Resettlement Process, Institutional Framework, and Organizational Responsibilities. The process, institutional, and the organizational arrangements of this resettlement plan are at this point tentative since the specifics of implementation arrangements have to be finally agreed yet with the company and the community in close coordination and cooperation with the local government units and other concerned agencies. There will be a continuous survey/consultation during the implementation that will cover issues on resettlement site options, entitlements, timing, and key steps to be considered in the process. The resettlement sites will be determined by the proponent in consultation with the project-affected households, and the local government units. Initial consultations will serve as a starting point to inform and include the participation of PAPs in resettlement. The company will designate a community contact individual who will ensure regular interaction with the PAPs to ensure timely and effective provision of information as the RAP is planned and implemented and to facilitate solution of issues or management of grievances. PAPs will be given priority in employment for structure demolitions, resettlement site preparation and construction.

Valuation of Asset and Compensation of Losses. The analysis on resettlement will be extended by considering the value of affected assets (i.e. housing structure), and the compensation amount. As set out in the RPF, the proponent will consult the project-affected people once DENR-EMB will issue with an ECC.

Implementation Schedule. The resettlement plan will be implemented immediately as soon as the ECC will be issued and permits will be secured. The activities to be considered in the process of resettlement are shown in **Table 85**.

Table 85. Timeline of Activities for Resettlement

Activity	Time			
	Q1	Q2	Q3	Q4
Establish Resettlement Team				
Appoint / deploy Community Contact person	X			
Initiate consultation process	X			
Resettlement site identification and acquisition	X			
ESMP formulation for resettlement site		X		
Payment of transitional support		X		
Assess / program skills training needs for PAPs		X		
Physical relocation of PAPs to transitional sites		X		
Site preparation and construction		X	X	X
Initiate training program for PAPs			X	X
Physical relocation to resettlement site			X	X
Monitoring & Evaluation				X
External Evaluation / Closure Report				X

Resource Requirement. Financial requirement of resettlement plan has to be determined by the proponent, LGU, community, and other concerned agencies. However, potential cost items are already identified. These covers the compensation for structures, shifting allowance for temporary sites, food assistance, skills assistance, housing unit price, transport/shifting to resettlement site, and cost for monitoring and assessment.

6 ENVIRONMENTAL COMPLIANCE MONITORING

This section presents the proposed framework for compliance monitoring of the project, which includes, among others, the environmental parameters necessary to monitor the identified key environmental impacts of the proposed project.

Moreover and as required by DENR Memorandum Circular No. 2010-14 and RPM for DAO 2003-30, and as a pro-active tool in minimizing/eliminating adverse project consequences to the environment, an "Environmental Quality Performance Level" (EQPL) has been identified for each critical parameter associated with identified significant project impacts. The limit level shall be the regulated threshold of pollutant (standard that must not be exceeded) while the action level is set lower than the limit level wherein management measures must be implemented so as not to reach the regulated threshold.

The following mechanisms and monitoring schemes are also discussed:

- Environmental Monitoring Plan;
- Multi-sectoral Monitoring Framework; and
- Environmental Guarantee and Monitoring Fund Commitment.

6.1 Environmental Monitoring Plan

The EQPLs presented in the Environmental Monitoring Plan are applicable for Effluent and Emissions regulations. The limit indicated in the EQPL range represents the DAO 90-35 standards for the particular parameter, as well as Clean Air Act standards for the emissions. Moreover, the values for the EQPL alert and action are only indicative values that will be used as a guide in the management scheme. This will be further revised and/or updated during project implementation.

Table 86. Environmental Monitoring Plan

<table>
<tr><th rowspan="3">Key environmental Aspects per project phase</th><th rowspan="3">Potential Impacts per Environmental sector</th><th rowspan="3">Parameter To be monitored</th><th colspan="3">Sampling and Measurement Plan</th><th rowspan="3">Lead person</th><th rowspan="3">Estimated cost (Php)</th><th colspan="6">EQPL Management Scheme</th></tr>
<tr><th rowspan="2">Method</th><th rowspan="2">Frequency</th><th rowspan="2">Location</th><th colspan="3">EQPL Range</th><th colspan="3">Management measure</th></tr>
<tr><th>Alert</th><th>Action</th><th>Limit</th><th>Alert</th><th>Action</th><th>Limit</th></tr>
<tr><td colspan="14">**Construction Phase**</td></tr>
<tr><td rowspan="3">Site preparation (clearing, grubbing and stripping of topsoil)

Construction of mine facilities/ haul roads Stockpiling of topsoil</td><td>The Land: Decrease in diversity and abundance

Possible removal of species</td><td>Flora: Biodiversity indices, species richness and abundance

Rehabilitation and restoration work to establish forest cover

Fauna: Biodiversity indices, species richness and abundance</td><td>Sampling and interviews; Transect, quadrats</td><td>Semi-annual</td><td>Baseline sampling stations</td><td>Proponent through MEPEO; MMT; Third party consultant</td><td>150,000 / sampling</td><td colspan="6" rowspan="3">Not Applicable</td></tr>
<tr><td>Land use change in the areas to be occupied by Quarry and infrastructures</td><td>Volume of top soil removed/ stockpiled</td><td>Random Sampling, Stock piled topsoil</td><td>Quarterly</td><td>ATN Aggregates Project Quarry Area</td><td>Proponent through MEPEO; MMT; Third party consultant</td><td>100,000 / monitoring</td></tr>
<tr><td>Loss of top soil due to ground/site preparation activities</td><td>Area and Volume of top soil, removed/stockpiled. Number of trees felled</td><td>Area measurement by the Length and Width method, Random Sampling.

100% inventory of trees</td><td>Quarterly</td><td>ATN Aggregates Project Quarry Area</td><td>Proponent through MEPEO; MMT; Third party consultant</td><td>100,000 / monitoring</td></tr>
</table>

Key environmental Aspects per project phase	Potential Impacts per Environmental sector	Parameter To be monitored	Sampling and Measurement Plan			Lead person	Estimated cost (Php)	EQPL Management Scheme					
								EQPL Range			Management measure		
			Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
			felled										
	Increase in surface erosion and down slope sedimentation brought about by the quarry development activities Earthworks, of the Crushing plant facility construction activities, and movement of heavy equipment will highly disturb the soil surface (i.e. compaction) and induce accelerated erosion susceptibility of the soil	Soil Quality including heavy metals (Health significance and aesthetic quality)	Random Composite sampling	Annually	Soil Quality Monitoring stations	Proponent through MEPEO; MMT; Third party consultant	100,000 / monitoring						
	Improper disposal of domestic wastes may contaminate the soil Soil Contamination due to accidental fuel	Volume of oil and grease, spare parts	Direct measurement	Semi annual	ATN Aggregates Project Motor pool area and storage facilities Haulers/contractors,	Proponent through MEPEO; MMT; Third party consultant	Part of operation cost						

Key environmental Aspects per project phase	Potential Impacts per Environmental sector	Parameter To be monitored	Sampling and Measurement Plan			Lead person	Estimated cost (Php)	EQPL Management Scheme					
								EQPL Range			Management measure		
			Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
	and lubricant spills from vehicles and equipment may occur				Maintenance mechanic, MMT								
	Water Quality: Siltation and decrease in water quality	Surfactants	Anionic Surfactants as MBAS	Semi annual	Same stations during Baseline Data Gathering	Proponent through MEPEO; MMT; Third party consultant	150,000 / monitoring	48.0 mg l^{-1}	49.0 mg l^{-1}	Not > 50.0 mg l^{-1}	Conduct re- testing to verify 1.Check operation of treatment facility and possible sources upstream of High /low of parameters 2. If the problem is within the pollution Control facility, inform unit manager to conduct trouble shooting/ to ensure the parameters are	1. Check operation of the Pollution facilities and possible sources upstream of the high/low parameters of surface water	Conduct re-testing to verify 1. If problem is upstream of the treatment facility inform area/unit to conduct trouble shooting/adjustment as to ensure the parameters are within the allowable limit 2. Upon completion of the trouble shooting/adjustments, conduct re-testing using 3rd party DENR accredited sampling firm
		Oil and Grease	HEM Partition-Gravimetry					1.5 mg l^{-1}	1.8 mg l^{-1}	Not > 2.0 mg l^{-1}			
		Color	TCU										
		Ammonia as NH_3	Ammonia Selective Electrode					30.0 mg l^{-1}	40.0 mg l^{-1}	Not >50 mg l^{-1}			
		Nitrate as NO3	Colorimetric Brucine										
		Phosphate	Stannous Chloride										
		BOD	Azide Modification Winkler					6.5 mg l^{-1}	6.8 mg l^{-1}	Not > 7.0 mg l^{-1}			
		COD	Open Reflux					80 mg l^{-1}	90 mg l^{-1}	Not >100 mg l^{-1}			
		TSS	Gravimetric (dried at 103 - 105^{0}C)					90.0 mg l^{-1}	95.0 mg l^{-1}	Not > 100.0 mg l^{-1}			
		Chloride	argentometric					250 mg l^{-1}	300 mg l^{-1}	Not > 350 mg l^{-1}			
		Cr^{+6}	Direct air-Acetylene Flame					0.005 mg l^{-1}	0.008 mg l^{-1}	Not > 0.01 mg l^{-1}			
		Cd	Direct air-Acetylene Flame					0.003 mg l^{-1}	0.004 mg l^{-1}	Not >0.005 mg l^{-1}			
		Cu	Direct air-					0.01 mg	0.015	Not >			

Key environmental Aspects per project phase	Potential Impacts per Environmental sector	Parameter To be monitored	Sampling and Measurement Plan			Lead person	Estimated cost (Php)	EQPL Management Scheme					
			Method	Frequency	Location			EQPL Range			Management measure		
								Alert	Action	Limit	Alert	Action	Limit
			Acetylene Flame					l^{-1}	mg l^{-1}	0.02 mg l^{-1}	within the allowable limit		
		Pb	Direct air-Acetylene Flame					0.03 mg l^{-1}	0.04 mg l^{-1}	Not > 0.05 mg l^{-1}			
		Zn	Direct air-Acetylene Flame					1.0 mg l^{-1}	1.5 mg l^{-1}	Not >2.0 mg l^{-1}			
	Air: Dust generation; vehicle emissions; noise generation	TSP, NO_2, SO_2 and noise	1-hr ambient averaging period	Quarterly	Baseline sampling stations / or may vary depending on the final project design (i.e. where appropriate)	Proponent through MEPEO; MMT	100,000 / monitoring		TSP= 250µg / Ncm NO_2= 200 µg / Ncm SO_2= 290 µg / Ncm	TSP= 300µg / Ncm NO_2= 260 µg / Ncm SO_2= 340 µg / Ncm			
	Psycho-social: Physical and socio-economic disruption from change in land use Fear and loss of livelihood, landslides and flooding due to quarrying activities	IEC conducted	FGDs, KIIs, household survey (when necessary) examination of official records and documentation	Annual	Impact communities	Proponent through CRO	150,000.00/ monitoring	Manifestations/ observations during monitoring activities	Incident Report	Complaint Received	Implement measures to arrest possible occurrence of negative impact	Verify and validate report Implement measures to arrest negative impact	Investigate Take action based on the result of investigation Assess the degree of impact Implement measures to mitigate negative impact

Key environmental Aspects per project phase	Potential Impacts per Environmental sector	Parameter To be monitored	Sampling and Measurement Plan			Lead person	Estimated cost (Php)	EQPL Management Scheme					
								EQPL Range			Management measure		
			Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
													Provide necessary assistance to the community
	Economic: Opportunity loss of income from agricultural activities due to removal of crops and use of the land for mine development and road works Generation of employment, livelihood opportunities and revenues from fees and permits	Compliance on the prioritization of hiring of qualified barangay residents by Contractors Conducted Barangay consultation on job requirements and qualification and training to upgrade local skills of residents IEC about the project and payment of taxes and fees	FGDs, KIIs, household survey (when necessary) examination of official records and documentation	Annual	Impact communities	Proponent through CRO	150,000.00/ monitoring	-do-	-do-	-do-	-do-	-do-	-do-
	Increase in Population, Health, and Safety risks: In-Migration Entry of migrant workers with	Inventory of migrant workers Implementation of the Social Development	FGDs, KIIs, household survey (when necessary) examination of official	Quarterly/Annual	Impact communities	Proponent through CRO	150,000.00/ monitoring	-do-	-do-	-do-	-do-	-do-	-do-

Key environmental Aspects per project phase	Potential Impacts per Environmental sector	Parameter To be monitored	Sampling and Measurement Plan			Lead person	Estimated cost (Php)	EQPL Management Scheme					
								EQPL Range			Management measure		
			Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
	families which might cause: health problems due to diseases, overuse of public utilities /services, competition of resources, social conflicts, peace and order, increase in pollution	Program Implementation of Health Program	records and documentation										
	Cultural and Historical Possible unearthing of historical artifacts and/or fossil remains	Found artifacts and/or fossil remains	Examination of official records and documentation	As needed	Construction and Quarry Area	Proponent through CRO	150,000.00/ monitoring	-do-	-do-	-do-	-do-	-do-	-do-
Operation Phase													
Clearing of vegetation Quarry, crushing, batching and CHB plant operations Generation and discharge of turbid run-off from project operations/ facilities Vehicular	Land: Decrease diversity and abundance (i.e. flora and fauna) Possible removal of species	Flora: Species diversity and abundance; rare and endangered species Fauna: Species diversity and abundance; rare and endangered species Rehabilitation	Sampling and interviews Transect survey, mist netting and cage trapping Site observation and documenta	Semi-annual Semi-annual Semi- annual	Baseline sampling stations	Proponent through MEPEO; MMT; 3rd party consultant	150,000 / sampling	Not Applicable					

Key environmental Aspects per project phase	Potential Impacts per Environmental sector	Parameter To be monitored	Sampling and Measurement Plan			Lead person	Estimated cost (Php)	EQPL Management Scheme					
								EQPL Range			Management measure		
			Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
movement Operation of motorized heavy equipment, vehicles and diesel power sources		and restoration work in establishing forest cover	tion										
	Generation of wastes	housekeeping	Observations records	Quarterly	Applicable areas	Proponent through MEPEO; MMT, third party	25,000.00/ monitoring	Not applicable					
	Improper disposal of domestic wastes may contaminate the soil Soil Contamination due to dust emissions during crushing/hauling. Accidental fuel and lubricant spills from vehicles and quarry equipment may occur Loss of soil quality	Quarry refuse materials Volume of used oil and grease Soil Physico-Chemical properties (pH, OM, N, P, K , and Heavy Metals like As, Cd, Pb and Hg (Bulk Density, Depth of silt deposition)	Direct measurement Random soil sampling.	Semi annual Annually	ATN Quarry Motor pool area and storage facilities, Soil Monitoring Stations	ATN, MMT, Pollution Control officer	Part of operation Cost	RA 9003	Soil Quality Management plan	RA 9003			
	Stream Water Quality	Surfactants	Anionic Surfactants	Semi-annual for the first 3	Same stations	Proponent through	150,000 / monitoring	48.0 mg l-1	49.0 mg l-1	Not > 50.0	Conduct re- testing	1. Check	Conduct re-testing verify

Key environmental Aspects per project phase	Potential Impacts per Environmental sector	Parameter To be monitored	Sampling and Measurement Plan			Lead person	Estimated cost (Php)	EQPL Management Scheme					
			Method	Frequency	Location			EQPL Range			Management measure		
								Alert	Action	Limit	Alert	Action	Limit
	Monitoring		as MBAS	years then Annually thereafter	during Baseline Data Gathering	MEPEO; MMT, third party				mg l-1	to verify 1.Check operation of treatment facility and possible sources upstream of High /low of parameters 2. If the problem is within the pollution Control facility, inform unit manager to conduct trouble shooting/ to ensure the parameters are within the allowable limit	operation of the Pollution facilities and possible sources upstream of the high/low parameters of surface water	1. If problem is upstream of the treatment facility inform area/unit to conduct trouble shooting/adjustment as to ensure the parameters are within the allowable limit 2. Upon completion of the trouble shooting/adjustments, conduct re-testing using 3rd party DENR accredited sampling firm
		Oil and Grease	HEM Partition-Gravimetry					1.5 mg l-1	1.8 mg l-1	Not > 2.0 mg l-1			
		Color	TCU										
		Ammonia as NH3	Ammonia Selective Electrode					30.0 mg l-1	40.0 mg l-1	Not >50 mg l-1			
		Nitrate as NO3	Colorimetric Brucine										
		Phosphate	Stannous Chloride										
		BOD	Azide Modification Winkler					6.5 mg l-1	6.8 mg l-1	Not > 7.0 mg l-1			
		COD	Open Reflux					80 mg l-1	90 mg l-1	Not >100 mg l-1			
		TSS	Gravimetric (dried at 103 - 1050C)					90.0 mg l-1	95.0 mg l-1	Not > 100.0 mg l-1			
		Chloride	argentometric					250 mg l-1	300 mg l-1	Not > 350 mg l-1			
		Cr+6	Direct air-Acetylene Flame					0.005 mg l-1	0.008 mg l-1	Not > 0.01 mg l-1			
		Cd	Direct air-Acetylene Flame					0.003 mg l-1	0.004 mg l-1	Not >0.005 mg l-1			
		Cu	Direct air-Acetylene Flame					0.01 mg l-1	0.015 mg l-1	Not > 0.02 mg l-1			
		Pb	Direct air-Acetylene Flame					0.03 mg l-1	0.04 mg l-1	Not > 0.05 mg l-1			
		Zn	Direct air-Acetylene					1.0 mg l-1	1.5 mg l-1	Not >2.0			

Key environmental Aspects per project phase	Potential Impacts per Environmental sector	Parameter To be monitored	Sampling and Measurement Plan			Lead person	Estimated cost (Php)	EQPL Management Scheme					
			Method	Frequency	Location			EQPL Range			Management measure		
								Alert	Action	Limit	Alert	Action	Limit
			Flame							mg l-1			
		Thermo tolerant Coliform	Multiple tube Fermentation					150 MPN 100 ml-1	175 MPN 100 ml-1	Not >200 MPN 100 ml-1			
	Air: Dust generation; vehicle emissions; noise generation	TSP, PM10, NO_2, SO_2 and noise	1-hr ambient averaging period	Quarterly	Baseline sampling stations / or may vary depending on the final project design (i.e. where appropriate)	Proponent through MEPEO; MMT	100,000 / monitoring		TSP= 250µg / Ncm NO_2= 200 µg / Ncm SO_2= 290 µg / Ncm	TSP= 300µg / Ncm NO_2= 260 µg / Ncm SO_2= 340 µg / Ncm			
	Economic: Enhancement socio-economic welfare of the community Local government generation of revenues from taxes, permits Generation of employment, livelihood opportunities	Employment, Tax revenues to LGUs, community projects initiated by the proponent, other benefits of the community from the project	FGDs, KIIs, household survey (when necessary) examination of official record (e.g. revenue reports)	Annual	Project affected barangay	Proponent through CRO; MMT, third party							
	Increase in Population	Inventory of migrant	FGDs, KIIs, household	Quarterly/Annual	Impact communit	Proponent through	150,000.00/ monitoring						

Key environmental Aspects per project phase	Potential Impacts per Environmental sector	Parameter To be monitored	Sampling and Measurement Plan			Lead person	Estimated cost (Php)	EQPL Management Scheme					
								EQPL Range			Management measure		
			Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
	Health, and Safety risks In-Migration which might cause: health problems, competition of resources, social conflicts, peace and order, increase in pollution Increase in traffic flow	workers Implementation of the Social Development Program Implementation of Health Program Safety Reports Inventory of PPEs	survey (when necessary) examination of official records and documentation		ies	CRO							
Abandonment													
Final Mine Rehabilitation and Decommissioning	People: Termination of LGU revenues from taxes, permits and share Loss of Jobs/ Unemployment of mine workers Loss of market for established livelihood dependent on the mine operation Transfer of company	As discussed in the FMR/DP	Based on Methodology in FMR/DP					Manifestations/ observations during monitoring activities	Incident Report	Complaint Received	Implement measures to arrest possible occurrence of negative impact	Verify and validate report Implement measures to arrest negative impact	Investigate Take action based on the result of investigation Assess the degree of impact Implement measures to mitigate negative impact Provide necessary assistance to the

Key environmental Aspects per project phase	Potential Impacts per Environmental sector	Parameter To be monitored	Sampling and Measurement Plan			Lead person	Estimated cost (Php)	EQPL Management Scheme					
								EQPL Range			Management measure		
			Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
	social assets/ facilities and services to the community Discontinuation of the social services offered by ATN through CSR and SDMP												community
	Water: Water quality The People: Health Hazard	Based on the result of the Environmental Site Assessment (ESA) that will be conducted prior to abandonment	Based on the recommendation of the ESA that will be conducted prior to abandonment			Proponent through MEPEO; MMT; 3rd party consultant							
	Permanent land use change in areas that was occupied by the active quarry areas and its ancillary facilities	Based on the result of the Environmental Site Assessment (ESA) that will be conducted prior to abandonment	Based on the recommendation of the ESA that will be conducted prior to abandonment			Proponent through MEPEO; MMT; 3rd party consultant							
	Generation of Solid Waste	Volume and Weight measurement	Direct measurement	Semi annual		Proponent through MEPEO; MMT; 3rd party consultant							

6.2 Multi-sectoral Monitoring Framework

Based on the guidelines/requirements of the RPM for DAO No. 2003-30, DAO No. 2010-21, DAO No. 2017-15, and DAO No. 2018-18, the Multi-partite Monitoring Team (MMT) that will be established shall be tasked to assess and validate compliance of the Project with the relevant environmental standards.

The MMT will be composed by representatives of the following offices:

- Mines and Geosciences Bureau Regional Office No. VII (Chairman)
- Department of Environment and Natural Resources Regional Office No. VII (Member)
- Environmental Management Bureau Regional Office No. VII (Member)
- LGU – Barangay Macabud (Member)
- Provincial Environment and Natural Resources Officer/Community Environment and Natural Resources Officer (Member)
- NGO Representative (Member)
- ATN Holdings, Inc. (Member)

The abovementioned multi-sectoral monitoring team shall have the following functions:

- Monitor, assess, and validate the project's compliance as stated in the EIA Report, ECC, EPEP, and other relevant environmental standards;
- Set-up project specific (location-based) environmental standards in accordance with environmental standards identified above;
- Prepare members of the MMT to handle monitoring activities through proper trainings;
- Management and disposition of complaints formally filed against the project proponent and its contractors; and
- Management of funds allocated for the above purposes.

This MMT is organized, as stipulated the Philippine Environmental Impact Statement System (PEISS), in order to encourage public participation, promote greater stakeholder vigilance and provide appropriate check and balance mechanisms in the monitoring of project implementation. It is also recommendatory to EMB/MGB and have the primary responsibility of validation of Proponent's environmental performance, with the following specific functions:

- Validate project compliance with the conditions stipulated in the ECC and the EMP;
- Validate Proponent's conduct of self-monitoring;
- Receive complaints, gather relevant information to facilitate determination of validity of complaints or concerns about the project and timely transmit to the Proponent and EMB recommended measures to address the complaint;
- Prepare, integrate and disseminate simplified validation reports to community stakeholders; and
- Make regular and timely submission of MMT Reports based on the EMB-prescribed format.

6.3 Environmental Guarantee and Monitoring Fund Commitment

As per PEISS, the Environmental Monitoring Fund (EMF) and Environmental Guarantee Fund (EGF) as follows:

Environmental Monitoring Fund (EMF) - a fund that a proponent establishes in support of the activities of the MMT. EMF administration and management guidelines based on the framework agreed upon and specified in the MMT MOA.

Environmental Guarantee Fund (EGF) - fund required to be established for all co-located or single projects that have been determined by DENR to pose a significant public risk or where the project requires rehabilitation or restoration.

For mining projects, however, a financial mechanism called the **Contingent Liability and Rehabilitation Fund (CLRF)** is established in lieu of the EMF and EGF. This CLRF is an environmental guarantee fund mechanism that ensures the just and timely compensation for damages and progressive and sustainable rehabilitation for any adverse effect a mining operation or activity may cause. This fund is further broken down as follows: Environmental Trust Fund (ETF), Mine Rehabilitation Fund (MRF), MWTF Reserve Fund (MWTFRF), and Final Mine Rehabilitation and Decommissioning Fund (FMRDF).

The MRF is established and maintained by each operating mine as a reasonable environmental deposit to ensure the availability of funds for the satisfactory compliance with the commitments and performance of the activities stipulated in the EPEP/Annual EPEP and this comes in two (2) forms: the Monitoring Trust Fund (MTF), which covers the maintenance and other operating budget for the transportation and travel expenses, cost of laboratory analysis, and other reasonable expenses incurred by the multi-partite monitoring team in the amount of PhP150,000.00 which is replenishable every quarter; and the Rehabilitation Cash Fund (RCF), which is being used to ensure compliance with the approved rehabilitation activities and schedules for specific mining phase including research as defined in the EPEP/AEPEP in the amount equivalent to ten per cent (10%) of the total amount needed to implement the EPEP or Php 5 Million, whichever is lower.

Alternatively, the FMRDF is the cost used to implement the final mine rehabilitation and decommissioning plan which is after the life of the mine.

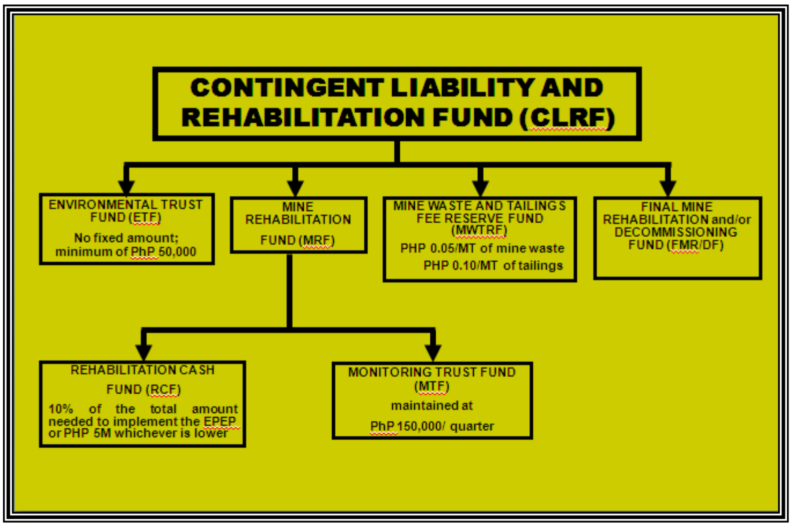


Figure 44 – Components of the Contingent Liability and Rehabilitation Fund

The MWTFRF are pertinent costs collected based on the amount of mine waste and tailings generated by a mining project and are used for payment of compensation for damages caused by mining pollution. Mine wastes costs Php 0.05/MT produced while Tailings costs Php 0.10/MT produced. Conversely, the ETF is used for payment to mining-related compensable damages other than those caused by mine waste and tailings and should be at least Php 50,000.00.

For the implementation of the Social Development and Management Program, an SDMP fund shall be established by the company. This fund should be 1.5% of the operating cost and should be utilized in this manner: 75% of the 1.5% is for the development of the host and neighboring communities (i.e. skills development/training, provision of health facilities, etc.); 10% of the 1.5% for the development of mining technologies and geosciences (i.e. expenditures for scholars on mining technology and geosciences); and 15% of 1.5% for the development and institutionalization of Information, Education, and Communication (IEC) (i.e. publication of IEC materials on social, environment, and/or other issues).

ATN is committed in establishing the above needed funds after approval of all pertinent permits/documents.

7 EMERGENCY RESPONSE POLICY AND GENERIC GUIDELINES

A comprehensive system of procedures that includes, among others, the identification of potential occurrence of emergencies, appropriate response procedures, and personnel training will be established by the company to address emergency situations.

As part of the mandated Safety and Health Program (SHP), emergency plan procedures for specific emergency situations will be created and enacted. Corollary, appropriate equipment essential for carrying said procedures will also be identified and acquired. Adequate prevention systems and/or early warning devices will be installed throughout the project area.

Moreover, periodic drills will be conducted to test the procedures, understanding of all personnel regarding said procedures, and the readiness of the response teams.

7.1 Emergency Response Team

An Emergency Response Team, shall be established by the company and shall form part of the Safety and Health Office. This team, headed by the designated Safety Manager, will be activated whenever an emergency is reported and shall be comprised, but not limited, of the following:

- First Aid Team;
- Rescue and Recovery;
- Logistics;
- Security and Crowd Control;
- Fire Brigade;
- Internal and External Communications; and
- Hazardous Material Control.

7.2 Emergency Procedures

Specific procedures for each type of emergency shall be created, documented, employed, and disseminated. These procedures shall also be given as part of the training of personnel.

7.2.1 Fire

Fuel handling and storage facilities and other areas that utilize and/or store combustible materials will be installed with all the necessary fire prevention, warning, suppression, and control equipment. Fire emergency procedures shall also be posted in these areas.

Fire prevention programs and trainings shall be established and conducted on a regular basis to ensure the effectiveness of the procedures.

7.2.2 Landslides

The continuous geotechnical assessments in the mining area shall be the source of inputs to the contingency plan for this type of incident. Moreover, areas prone to landslides and subsidence would also be further identified during the course of development and operation phases of the project. With such early detection and constant observations, loss of lives and damage to property could be prevented.

Training of personnel, especially those stationed on areas prone to the occurrence of said incident, will be conducted. Appropriate personal protective equipment will also be made available to each and every personnel.

7.2.3 Kidnappings and Unrests

To handle this type of emergency, the help and cooperation of external authorities such as the local police will be sought. In the creation of emergency procedures for such, legal and criminal aspects will be considered.

7.2.4 Oil/Fuel Spills

Procedures for proper handling, transport, and storage of oil/fuel will be incorporated with specific steps in controlling potential and actual spillage and/or leakage. Necessary and appropriate cleanup equipment, supplies, and personal protective equipment will also be provided.

7.2.5 Flood, Storm, and/or Heavy Rains

Adequate early warning notification, information dissemination, and constant communication with appropriate government agencies will be secured and implemented to address this emergency.

7.2.6 Vehicular Accidents

Standard operating procedures/guidelines shall be established to prevent this accident within and outside the project area. Proper first aid and medical transport procedures will also form part of the aforesaid procedures/guidelines.

7.3 Program Implementation Requirements

ATN shall initiate the establishment and implementation of this program, as part of its SHP, immediately upon commencement of project activities. Personnel responsible for spearheading these programs will be subjected to appropriate trainings and necessary accreditation. Documentation and record relative to the safety and health implementation will be maintained and made accessible to all interested parties and government agencies.

The emergency response policy and safety and health management system may be subjected to third party certification in the future.

8 ABANDONMENT/DECOMMISSIONING/REHABILITATION AND GENERIC GUIDELINES

As with the end of every industry, the closure of the Project can affect the host community, create loss/decrease in taxes, loss of employment, income and/or business opportunities derived from the project. In view of these, the company will create an abandonment/rehabilitation strategy, which would be embodied in the mandated FMR/DP. To guide the creation of said plan, the following objectives will be considered:

- Rehabilitate the disturbed areas to a condition that is beneficial to the environment and conforms to the land use plan of the municipality and/or province that is mutually concurred by the community, government agencies, and the company;
- Rehabilitate/re-vegetate all the disturbed areas within the project area affected by mining operations by reshaping/re-contouring affected areas prior to re-vegetation;
- Manage and control off-site contamination by fortifying environmental control structures and implementation of appropriate rehabilitation methods;
- Remove unnecessary Project facilities and equipment used in the operation;
- Conduct a comprehensive management and monitoring of rehabilitated areas until such time that the area is sustaining and is biologically and physically acceptable with the preferred final land-use;
- Monitor SDMP implementations and implement post-capacity training on the alternative skills and livelihood opportunities that were initiated during the onset of the Project's operation;
- Minimize long term visual impacts due to the inactivity of the mine site by employing effective mitigation and measures creating landforms with vegetation compatible with the surrounding thus establishing a functional post-disturbance land use capability;
- Eliminate safety and health risks of the inactive mine site to the surrounding communities; and
- Provide the estimated cost that will be incurred from the implementation of the identified rehabilitation and/or decommissioning strategies and the consequent final land use.

8.1 Decommissioning Plan

To carry out the transitional stage between cessation of operation and actual closure, the company will establish a Closure Team that will oversee the implementation of the decommissioning strategies indicated in the table below. This team, to be headed by the Resident Manager, will be composed of the various department heads and personnel working under the safety and health, environment, and social departments.

Table 87. Decommissioning Strategy

Decommissioning Strategy	Timeframe
Mobilization of the Closure Team. Start of IEC Campaign as part of social preparation, creation of Mine Closure ComRel Plan, performance evaluation of the last 5-year SDMP and consultation for the final review of the FMR/DP	Closure Planning. Three (3) years before closure
Inventory of all equipment and facilities by the Closure Team.	Part of Closure Planning Within two (2) years

Decommissioning Strategy	Timeframe
	before Closure
Assessment of the conditions of equipment and facilities and extent of revegetation activities by the Closure Team.	Part of Closure Planning Within 2 years before Closure
Planning and review of decommissioning procedures vis-à-vis the standard operating procedures. Coordination with contractors.	Part of Closure Planning Within one (1) year before Closure
Cross matching of company personnel and residents with the decommissioning tasks. Trainings/seminars will be provided as the need arises. Consultation with stakeholders. Strengthening of IEC Campaign as part of social preparation.	Part of Closure Planning Within 1 year before Closure
Decommissioning of equipment and facilities.	Decommissioning and Rehabilitation Phase Within 6 months after closure
Post assessment by the Closure Team on the decommissioned equipment and facilities.	Decommissioning and Rehabilitation Phase Within and after 1 year of closure
Rehabilitation of the decommissioned project component.	Decommissioning and Rehabilitation Phase Within and after 2 year of closure

8.2 Final Mine Rehabilitation Plan

The rehabilitation strategies that will be utilized will depend on the final land use that will be consented and concurred with the Project stakeholders. Nonetheless and upon completion of the dismantling and/or decommissioning of structures/facilities/equipment, the company foresees to clear and revegetate all disturbed areas.

Basic strategies, such as the following, will be employed during the rehabilitation plan to achieve the final land use and to control erosion and sedimentation prior to revegetation:

- Proper closure/rehabilitation of quarry areas and siltation ponds;
- Reshaping of the disturbed area to make it suitable for the desired final land use;
- Spreading of top soil on the affected areas and ensure that it is capable of supporting plant growth;
- Introduction of self-sustaining vegetation consistent with the final land use;
- Construction/maintenance of drainage system;
- Maintenance of nursery to meet the rehabilitation requirements; and
- Monitor and manage rehabilitate areas.

8.2.1 Proposed Final Land Use for Project Components

The proposed final land use for the project will be a stable and revegetated mined-out area that is sustainable and promotes the recolonization of the pre-project flora and fauna.

Table 88. Indicative Final Land Use of Project Components

Mine Component	Final Land Use
Quarry area	Revegetated area. Carried out by backfilling using the materials from the waste dump, soil conditioning, planting with endemic species and maintenance works.
Admin building, staff house, motorpool and nursery	Facilities/structures that are usable maybe donated to the community. This however will depend on the FMR/DP consultation to be conducted upon the issuance of the ECC and/or during the preparation of the FMR/DP report.
Crushing, Batching and CHB Plants	Revegetated area. Decommissioning of structures and equipment. Soil conditioning, planting with endemic species and maintenance works.
Siltation Ponds	Revegetated area. All siltation ponds in the mining area will be maintained until full rehabilitation of the mined-out parcels. As rehabilitation is progressive, settling ponds that are no longer required will be decommissioned and rehabilitated. The excavated materials may, in the future have economic value; otherwise, these will be used for backfill, grading or removed from the site.
Haul roads and mine access roads	If considered useful by the community, internal haul road can be left. If not required, these will be re-planted; water diversion measures will be installed for runoff interception and to enhance re-vegetation. Signs, guardrails and barriers will be removed or retained depending upon the consultation with the stakeholders.
Unused chemicals and wastes	Remaining chemicals such as petrochemicals, reagents, and other associated chemicals will be collected and taken away from the affected areas. Due to the progressive waste disposal policy, residual waste will be minimal.
Stockpile/Stockyard Area	Revegetated area. This will entail backfilling using the materials from the waste dump, soil conditioning, planting with endemic species and maintenance works.

A Final Mine Rehabilitation and Decommissioning Plan will be prepared and submitted to the Mines and Geosciences Bureau for review and approval. Among the plans to be considered are appropriate rehabilitation and decommissioning plans that will best benefit the community.

8.3 Social Plan

The Social Plan provides the welfare of the workers and the impact communities during the closure process.

8.3.1 Retrenchment Packages

For this, ATN will comply with the minimum requirement of the Philippine Labor Code, specifically, that indicated in Article 283 which provides the required retrenchment package in cases of closures or cessation of operation not due to serious business losses or financial difficulties. Separation pay will be equivalent to one (1) month pay or at least one-half (1/2) month pay for every year of service, whichever is higher.

Written notice to the employees and the Department of Labor and Employment will also be made at least one (1) month prior to the intended date of retrenchment.

8.3.2 Labor Support Policies and Programs

The company will provide a wide range of placement services to its personnel to allow their transition towards alternative jobs or in becoming self-employed. These services can be through the following:

8.3.2.1 Job Search

Information on job-openings will be announced and job fairs will be conducted. The Human Resources/Administrative Office will facilitate job matching on the available job openings in the market.

8.3.2.2 Skills Training and Education Program

Provision of job-related courses/trainings that are focused towards a future career. These may vary from office skills to artisan multi-skills training, computer technology, etc. Coordination with TESDA will be conducted.

8.3.2.3 Enterprise Awareness

Trainings on entrepreneurial skills development will also be implemented and opportunities for livelihood endeavors will be presented.

8.3.2.4 Counseling

ATN will inform the workers on the status of operation and prepare them psychologically on the planned mine closure. Counseling for workers to be retrenched and their families will be conducted.

8.3.2.5 Transfer of Social Assets

Any material from removed facilities and structures that have no value for the company but may have value or use for the localities will be given and distributed for whatever purpose it may serve to them. Nevertheless, the transfer of social assets and services will depend on the outcome of the consultation with the stakeholders in the future.

8.4 Maintenance and Monitoring Plan

8.4.1 Maintenance and Monitoring Program and Procedures

The Closure Team, spearheaded by the environmental, community relations, safety and health members, shall implement the maintenance and monitoring plans pertinent to the decommissioning and rehabilitation activities. It is worth noting that this said monitoring is in addition to the monitoring and/or audit that will be conducted by the Mine Rehabilitation Fund Committee (MRFC) through the MMT, the Contingent Liability Rehabilitation Fund Steering Committee (CLRFSC) and the MGB.

Moreover and in compliance with regulations, the company will submit a progress report containing details of full, partial, and on-going activities relative to the implementation of the FMR/DP. This report will be submitted to the MRFC for review and evaluation within thirty (30) days from the end of the term of the preceding work and financial plan. The results of the review and evaluation shall be integrated in the succeeding year's work and financial plan[2].

The more detailed and applicable maintenance and monitoring plans will be prepared/formulated two (2) years prior to closure by the Closure Team, in coordination with the MMT. By doing such, a realistic plan based on actual scenario can be made.

8.4.2 Long Term Management and Maintenance

Upon completion of the FMR/DP implementation and assessment of the company that the objectives of project closure have been achieved, the company will prepare and submit a Final Rehabilitation Report with third party Environmental Audit (FRR with EA) for pre-evaluation by the MRF Committee and final approval by the CLRF Steering Committee.

The MRFC and CLRFSC, after due review and evaluation of the FRR with EA, may issue a Certificate of Final Relinquishment to the company signifying approval of the FRR with EA and freeing the Company from any further obligations insofar as the rehabilitated area/s are concerned.

Nonetheless, if residual care is still needed, the company will submit a Site Management Plan detailing how the identified residual rehabilitation commitments are to be managed along with the corresponding funding requirement.

[2] Section 187-D of DAO No. 2010-21

9 INSTITUTIONAL PLAN FOR EMP IMPLEMENTATION

The Mine Environmental Protection and Enhancement Office (MEPEO) of the company, as mandated by law, will be created and shall be tasked to oversee and take the lead in the implementation of all environmental impact control programs and activities. The unit shall also play an important role in the implementation of the Final Mine Rehabilitation and Decommissioning Plan.

As provided in DAO No. 2010-21 and RPM for DAO 2003-30, the MEPEO shall implement the following:

- Plan and manage the implementation of the approved EPEP/AEPEP;
- Monitor and police compliance of Contractors on their implementation of provisions of the EPEP and AEPEP;
- Monitor and evaluate the effectiveness of the mitigating and enhancement measures;
- Plan, propose and implement modifications or additional measures deemed necessary to effectively protect the environment;
- Coordinate with relevant oversight agencies and other entities including the local government units to ensure their effective participation in the implementation of the EPEP and AEPEP;
- Initiate, plan and implement rehabilitation and abandonment programs;
- Liaise with the Community Relations Officer (CRO) and the Mine Safety Personnel in creating a holistic Safety and Health, Environmental and community relations program for the Project;
- Ensure compliance to the various Philippine environmental laws; and
- Ensure the timely submission of pertinent reportorial requirements.

The figure below shows the organizational chart of ATN.

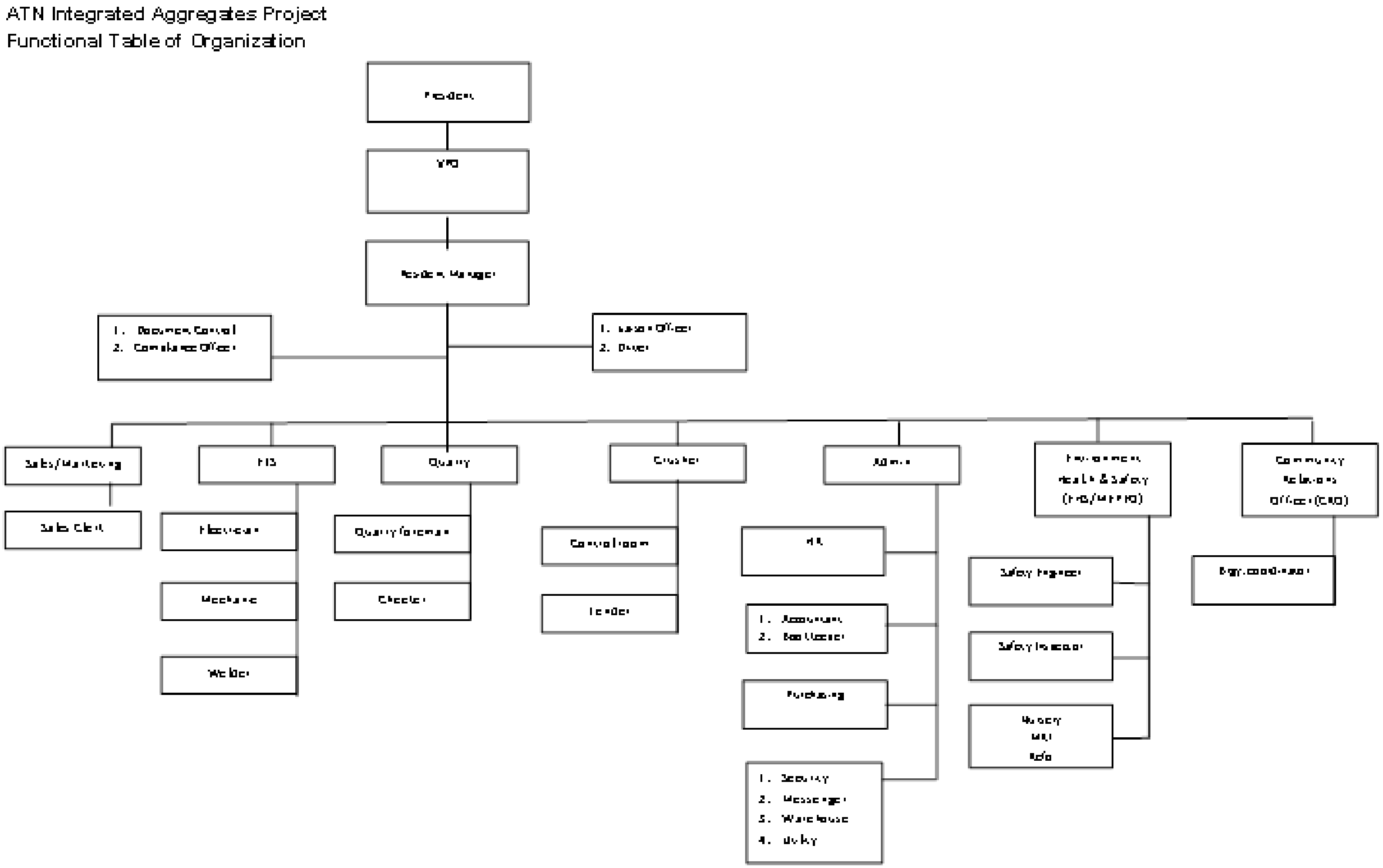


Figure 45 – Organizational Chart of ATN

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