ENVIRONMENTAL IMPACT STATEMENT

EAGLE CEMENT CORPORATION

Main Office: 153 EDSA Bgy. Wack Wack, Mandaluyong City, Philippines
Plant Site: Brgy. Akle, San Ildefonso, Bulacan, Philippines

GIVE BACK TO COMMUNITY

ENVIRONMENTALLY SUSTAINABLE

PROFICIENCY IN PRODUCTION

WORLD CLASS PLANT FACILITIES

HIGH-QUALITY CEMENT PRODUCTS

Table of Contents

LIST OF FIGURES

LIST OF TABLES

LIST OF PLATES

LIST OF ANNEXES

EXCECUTIVE SUMMARY

A. PROJECT FACTSHEET

I. Project Information

Project Name	**Eagle Cement MPSA No. 245-2007-III Quarry Project**
Location	Barangay Akle, San Ildefonso Bulacan, Bulacan and Barangay Talbak, Dona Remedios Trinidad, Bulacan
Project Type	Quarry Project (Resource Extractive Industry)
MPSA Area Covered	82.6033 hectares
Project Area Covered	69.9011 hectares
Production Capacity	7,000,000 MT per year
Commodity	Limestone
Project Components	- Quarry Operation - Access and Haul Roads - Siltation ponds

II. Proponent Profile

Company Name	**Eagle Cement Corporation**
Address	Main Office: 155 EDSA Bgy. Wack Wack, Mandaluyong City, Philippines Plant Site: Brgy. Akle, San Ildefonso, Bulacan, Philippines
Contact Number	Phone Number: +63 2 301-3453 Fax Number: +63 2 723-9283
Contact Person	**Ms. Annaline Buizon** CSR Manager
Email Address	avbuizon@eagle-cement.com.p

III. Project Preparer

AXceltechs Inc.

Address	Unit 10C, Lansbergh Place, 170 Tomas Morato, Quezon City
Authorized Representative/ Contact Person(s)	**ENGR. PAULO NONI T. TIDALGO** Managing Director
Contact Number	(02) 376-0043

B. PROCESS DOCUMENTATION OF THE CONDUCT OF ENVIRONMENTAL IMPACT ASSESSMENT

The terms of reference used for this Environmental Impact Assessment (EIA) was consistent with that stipulated in the Revised Procedural Manual (RPM) for Department of Environment and Natural Resources (DENR) Administrative Order (DAO) No. 2003-30, Implementing Rules and Regulations of Presidential Decree No. 1586 "*Establishing the Philippine Environmental Impact Statement System*".

The Environmental Impact Study (EIS) Team is comprised 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. EIS Team

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

EIS Team Member	*Field of Expertise/Module*	*Registration*
Paulo Noni T. Tidalgo, EM, RN	Environment, ERA, Mining and Geology	IPCO - 103
Bernardo V. Valmonte, Jr. EM	Mining and Geology	IPCO - 0723
Dr. Wilfredo Sanidad	Soil Quality	IPCO - 139
Catherine L. Addawe, AgE	Water Quality and Hydrology	IPCO - 055
Ronald Pahunang	Meteorology, Air and Noise Quality	IPCO-173
Thelma D. Dela Cruz, DVM, MSc(Env.Sci), MOH	Environmental Risk Assessment	IPCO-387

EIS Team Member	Field of Expertise/Module	Registration
Einre Jinji Elcid Quiambao	Terrestrial and Freshwater Ecology	IPCO-154
Thomas V. Tanedo	Socio Economic	IPCO-112
Jess M. Addawe	GIS	IPCO – 056
Czarina May M. Olores, SE	Project Manager /Environmental Impact Assessment	IPCO – 075

II. EIA Study Schedule and Area

The technical scoping was held last October 02, 2018, which was participated by DENR Environmental Management Bureau (EMB) personnel, EIA Review Committee members, Eagle Cement Corporation and Axceltechs Inc.

Activity	Date
Public Scoping	July 27, 2018
Technical scoping	October 02, 2018
Soil Sampling	November 16 to 18, 2018
Water Sampling	October 22 – 23, 2018
Social Survey/Assessment	December 5, 2019
Terrestrial Survey	November 22 to 26, 2019
Air Sampling	October 22 – 23, 2018 February 28, 2019
Freshwater Ecology	November 22 to 26, 2018

The EIA study covers the whole MPSA area (82.6033 hectares), the direct and indirect impact areas of the proposed project are based on the result of the baseline data assessment. The identification of direct impact area was based on DAO 2017 – 15. The table below presented the summary of Direct Impact Areas based on the proposed project operation:

Aspect	Direct Impact Area
Water	- Receiving water bodies of the quarry project (Conlong River) - Underlying aquifer
Air	- Area/community near the periphery of the quarry - Barangays Akle and Talbak
Noise	- Area/community within the periphery of the quarry - Barangays Akle and Talbak
Terrestrial	- Vegetated area within the MPSA - Barangays Akle and Talbak

Aspect	Direct Impact Area
People	- Barangays Talbak and Akle

III. EIA Methodology

Primary and secondary data were utilized for the assessment of the project impacts. Primary data were obtained from the conducted on-site investigation and field sampling/surveys while secondary data were acquired from the proponent and government agencies/institutions. Relevant and previously conducted studies were also considered. The following are the sampling/assessment methodologies employed by the EIS team for the study:

Module		Methodology
Land	Land Use	Gathering and review of secondary data
	Natural Hazards	Gathering and review of secondary data
	Pedology	Grab sampling and laboratory analysis
	Terrestrial	Transect walk, quadrat sampling, and trapping
Water	Hydrology and Hydrogeology	Gathering and review of secondary data
	Water Quality	In-situ measurements; grab sampling and laboratory analysis
	Freshwater Ecology	- Collection of samples using kick net and plankton net. - Gathering and review of secondary data - Interview
Air and Noise	Meteorology	Gathering and review of secondary data
	Air and Noise Quality	High volume samplers, Personal Sampler and sound level meter for noise and review of monitoring data
People	Socio-economic Profile	- Gathering and review of secondary data - Key informant interviews - Perception survey - Focus group discussions

Public Participation

Stakeholder's participation in the conduct of EIA study includes the following undertakings:

- Information, Education and Communication (IEC) and preliminary perception survey was conducted on April 19, 2018, while the Public Scoping was done on July 27, 2018. Among the attendees were Barangay officials, Purok Leaders, Public School Teachers, and representatives from Non-Government Organizations.
- The Focus Group Discussion and perception survey were undertaken on December 5, 2018. Most of the attendees of these activities expressed their support to Eagle Cement Corporation's proposed project.

Issues/Concerns	*How the issue is address in the EIS/Public Scoping*
Project Description	
I would like to verify the total MPSA hectarage covered by Barangay Talbak.	70% of the total MPSA area is covered by Brgy. Talbak.
Land	
What are the preparations of the company to alleviate the impacts of the proposed project considering that there is a possibility that the mountain will be flattened?	The Impact Management Plan to be implemented by the company is discussed in pages 384 to 405
People	
In terms of employment, we are looking forward that our Barangay will be prioritized in hiring of employees.	Hiring of local skilled workers will be prioritized by the company.
What is the possible impact of the project to Barangay Talbak? Will it be able to provide additional income in our Barangay? Will there be health programs, educational assistance and assistance on the construction of baranagay infrastructures?	Since Barangay Talbak will be the host community for the proposed project, the barangay will be benefited by the SDMP. The Social Development and Management Program is discussed in pages 441 to 447.
General Comments	

Issues/Concerns	*How the issue is address in the EIS/Public Scoping*
My concern is regarding the MMT activities, like for example in Holcim quarry they regularly invite us whenever there is a monitoring activiity or meeting. We are also expecting the same way from Eagle Cement since the project covers Barangay Talbak.	The project is still under pre-operation stage. Currently, the company is securing all necessary permits prior to operation. Once the company was able to complete the pertinent government requirements, that is the time they can start with project implementation and formulate a Multi-partite Monitoring Team for EMB's further approval. Discussed in pages 459 to 460
Who's authorized to be part of the MMT in Barangay Talbak?	Discussed in pages 459 to 460

The Public Hearing was conducted last February 06, 2020, 9:00 A.M. at Akle Elementary School, Barangay Akle, Municipality of San Ildefonso, Bulacan. Below are the issues and concerns raised during the activity:

Issues / Concerns	*Response*
SOCIO	
We are looking forward that the company will implement priority hiring of employees to those who are from Talbak and Akle.	Currently, Eagle Cement Corporation employs 90% of skilled employees from Bulacan. Majority of the said percentage is from Barangay Akle and Talbak. Pages 35 to 36.
It is possible that the excise tax will proceed directly to the Municipality of DRT without going through the National. Based on our experience with other companies, we didn't receive any excise tax coming from national. If tax will be turnover directly to us, many will benefit especially in the livelihood and infrastructure.	The municipality of DRT shall receive the occupational fee. However, you also have a share in the excise tax. Based on our experience with other companies the problem exists in the filling-up of the BIR form. A particular company shall indicate the location of the mining/quarry area where the ore is being extracted. However, some companies usually indicate the main office address e.g.

Issues / Concerns	***Response***
	Makati thus, the whole portion of the excise will proceed to Makati.
Is it true that Eagle Cement banned the hiring of eligible female safety officer coming from Barangay Akle?	It is not true that Eagle Cement banned the hiring of female safety officer coming from Akle. As long as the company is lacking for safety officer and there is a qualified candidate from Akle we will prioritize the said applicant.
WATER	
Will it be possible to replant the trees to be affected by the project? The trees absorb the rain water that alleviates the flooding in our barangay.	The company will continuously implement the tree planting and revegetation programs.
Based on our experience specifically in Barangay Bayabas Holcim Quarry operation, when the pit reaches the lower portion of the quarry we noticed that the aquifer has been deep that resulted to water shortage.	The company conducted a georesisitivity to assess the aquifer lever in MPSA s245. As per the assessment, MPSA 245 area is not a good source of groundwater since the aquifer is too deep.
AIR / NOISE	
How far is Talbak High School from the quarry site? What is the impact of the project in our school specifically for the safety of our learners in terms of air and noise quality/pollution?	Talbak Highschool is located more than 5 kilometers away from MPSA 245.
PROJECT DESCRIPTION / GENERAL COMMENTS	
How can you assure that our houses will not be affected by blasting operations from cracking and other damages?	The company is implementing controlled blasting procedures and ensures the employment of 300 meters safe zone before blasting activities. Also, prior to blasting, the company will inform the community through a siren or an alarm. A vibrometer was also utilized to check the vibration level if it is within the safe standard.

Issues / Concerns	*Response*
	Further, there is an ongoing assessment/study on the quarry areas of Eagle Cement. The study includes the identification of measures on how to alleviate damages during quarry operation.

C. SUMMARY OF BASELINE CHARACTERIZATION

Module	*Summary of Baseline Conditions*
Pedology	The soils of Bulacan Province are composed of twenty-four (24) soil series and one (1) soil variant consisting of seventy-two (72) soil mapping units and five miscellaneous land types (Soil Survey Report Bulacan Province 1987). Soil in the project area comprises of Sibul Series. The Sibul series consists of moderately deep to deep well drained fine clayey soils that occur on sloping to rolling moderately dissected rounded limestone foothills or on steep to very steep limestone hills and ridges of the hilly landscape.
Terrestrial	A total of 48 species belonging to 25 taxonomic families were observed in the study area. All other plant species that can be observed inside the area but not covered by the plots were also included in the assessment for the general species composition but not in the specific computations for diversity indices and dominance in specific plots. Actual observation revealed a total of 34 species, majority of which are birds (88%). There were also species of reptiles composed of 2 lizards (6%) coming from different families. Meanwhile, using the mistnet, 2 species of bats (6%) from the same family were captured and recorded.
Hydrology	The proposed 69.9-hectare quarry project of Eagle Cement Corporation is within the drainage area of Conlong River based on the topographic map in ***Figure 66***. The project area, characterized by karst topography, has a moderate relief with elevations in the range of 100 m to 200 m. Based on the Exploration Report on Geology and Limestone Resources covering the project area, the region is characterized by karst topography and features sinkholes, poljes (high walls/karst topography) and a few caves. There are no water bodies traversing the project area. Conlong River is located approximately 1.5 km north of the proposed project area flowing in a westerly direction. It has an approximate drainage area of 2,783 hectares (27.83 km2) with a reference point located at

Module	Summary of Baseline Conditions
	121° 1'51.87"E; 15° 4'21.45"N. Another surface water body near the proposed project site is Salapangan River. It is located south of the proposed project site and also flows in a westerly direction. Both Conlong River and Salapangan River are tributaries of the lower reach of the Pampanga River which is the main river of the Pampanga River Basin. Both tributaries converge into Pampanga River at a point which is approximately 30 km from the project site and 40 km from the Manila Bay where the mouth of the Pampanga River is located.
Water Quality	Surface Water Quality All surface water samples tested were compliant with the DAO 2016-08 Class C water quality guidelines for all the parameters tested except for dissolved oxygen (DO) in water sample from station S1 (DO=4.61 mg/l) and for the parameter Fecal Coliform wherein all the surface water samples exceeded the WQG value (ranged from 240 to 2,400 MPN/100 ml). The low DO level in station S1 was probably due to the very low flow (almost stagnant) in that section of Conlong River during the time of sampling. It is worth noting that traces of lead (Pb) were observed in the water sample from Station S1 at 0.04 mg/l but is still below the WQG value. Total suspended solids (TSS) were also found to be at very low concentrations in all surface water samples ranging from 2.5 mg/l to 8.5 mg/l during the time of sampling. Traces of oil and grease (O&G) were found in all samples ranging from 0.4 mg/l in S1 to 0.7 mg/l in S3. Groundwater Quality Results for the groundwater samples show values within the Class A WQG for all parameters except for the parameters color (stations GW2=200 apparent CU and GW3=80 apparent CU), Fecal Coliform (for all GW stations) and pH (GW3=9.02). In terms of metals As, Cd, Pb, Hg and Cr^{6+}, all groundwater samples exhibited metal concentrations below their respective method detection limits (MDL) except for station GW3 wherein Pb was detected at a concentration equal to 0.006 mg/l (but still within the WQG).
Noise Quality	Measured noise levels (Leq) in October 2018 ranged from 59.21 to 64.07 dBA while in February 2018 from 44.0 to 65.5 dBA. Measured noise levels in February 2018 were generally lower than those measured in October 2018. CRL, however, has not provided the data or possible causes of noise reduction in February 2018 sampling.

Module	Summary of Baseline Conditions
	Sources of noise at the time of monitoring were from vehicles passing near the sampling stations, which were noted at all monitoring stations. Animal and community noise were also observed at Stations N1, N2, and N3. Noise from the cement plant was audible/noted at Station N4. In comparison with the ambient noise standard, noise levels in October 2018 were higher than the daytime noise standard for residential areas set at 55 dBA, except at Station N5 in which noise standard for commercial area applies at this location.
Air Quality	Measured TSP levels ranged from 8.1 to 378.9 µg/Nm^3 with an average of 105.2 µg/Nm^3. Except for TSP measured at Station A5 on October 23, 2018, which was greater than the ambient air quality standard for TSP set at 340 µg/Nm^3. TSP levels at the rest of the monitoring stations for two (2) periods were within the NAAQS value set for TSP. Sources of fugitive emissions at the area is dust emissions along roads. PM_{10} levels ranged from 5.5 to 196.6 µg/Nm^3 with average concentration of 72.4 µg/Nm3. PM_{10} levels were within the ambient air quality standard set for PM_{10} at 200 µg/Nm$^{3.}$ Sources of PM_{10} were generally the same as those of TSP. Measured gaseous air pollutants (SO_2 and NO_2) were relatively lower and within the NAAQS of 340 and 360 µg/Nm^3, respectively. Highest measured SO_2 was 0.3 µg/Nm^3 while for NO_2 was 38.4 µg/Nm^3
Socio-Economic	The respondents were asked on their perceived positive and negative effects of the proposed project by Eagle Cement. There were 109 or 30.36% from the respondents that perceived additional job opportunities with the proposed project, 18.38% or 66 additional income to the barangay and provision of free medicines with 51 or 14.21% of respondents. Also, 13.65% or 49 perceived additional livelihood opportunities for their households, 32 or 8.91% with additional sports facilities for youth, 4.74% or 17 less environmental threats and 4.18 or 15% of the respondents perceived negative issues or problem to be addressed for the community. About 3.06% of the respondents perceived less traffic, while 1.67% of the respondents seeing no positive effect of the proposed project to the household. Only 0.84% of the respondents said the one

Module	Summary of Baseline Conditions
	of the positive effects of the proposed project will be the installation of jetmatic in their barangay.

D. EIA SUMMARY

I. Project Alternative

The project will solely cover quarry operation, the depth of the pit and its location will depend on the exploration activities conducted by the company, thus no other site alternative considered in terms of quarry area. The location of the haul road to be constructed will be connected to the existing haul road of MPSA 181. The opposite side of the designated quarry block of MPSA 245 cannot be considered as an alternative site since the slope in specific area is very steep. Further, considering the type and location of mineral to be extracted, the only feasible mining/quarry method for the project is surface mining method, thus, there were no other alternative method considered for the project.

II. Major Project Impact

EIA Study Module	Impact	Mitigation
Terrestrial Ecology	Loss of vegetation due to site clearing	– Progressive rehabilitation of disturbed areas
Land	– Loss of top soil due to ground/site preparation activities	– Rehabilitation/revegetation planning will be conducted in accordance with the EPEP
	– Increase in surface erosion and down slope sedimentation brought about by quarry development activities – Top soil removal – Change in topography due to blasting activity	– To minimize the impact on the natural topography, quarry activity will be conducted in conformance with the mining plan and bench parameter of at least 3m bench width and minimum of 10m bench height. – Erosion/ sedimentation controls will be installed to mitigate surface erosion and the consequent down

EIA Study Module	Impact	Mitigation
		slope or downstream sedimentation.
Water Quality	Siltation / degradation of surface water quality particularly Conlong River	– Construction of a drainage system connecting all drainage canals to a series of adequately-sized settling ponds. – Construction of drainage canals at the bench toe to prevent scouring or roads. – Regular desilting of settling ponds especially before and during the wet season. – Enhancement of the riparian ecosystem.
Air ad Noise	– Local increase in TSP, SOx, NOx and noise levels – Air pollution due to Quarry operation	– Proper and regular maintenance of equipment – Water spraying; quarry activities to be confined during daytime as much as possible – Strictly implement covering of hauling trucks and water spraying; – Preventive maintenance of vehicles and equipment – Establishment of buffer zone – Imposition of speed limits – Provision of dust and noise PPEs to employees – Regular monitoring of air quality

III. Risk and Uncertainties

The following are the risk and uncertainties identified during the preparation of the EIA study.

Module	Risk and Uncertainties	Mitigating Measures
Land	Slope Stability	Strict implementation of mining plan and regular monitoring of benches and other steep areas.

Module	*Risk and Uncertainties*	*Mitigating Measures*
People	Safety during the transport of blasting materials	Strict adherence to blasting materials protocol. Transport and handling shall be conducted by accredited contractors.

1.0 PROJECT DESCRIPTION

1.1 Project Background

Eagle Cement Corporation is a fully integrated Filipino-owned company primarily engaged in the business of manufacturing, marketing, sale and distribution of cement under the brands Advance Type 1P, Exceed Type 1P and Strongcem Type 1.

The Company has the newest, state-of-the-art, and single largest cement manufacturing plant in the Philippines. The Company is the 4th largest player in the Philippine cement industry based on sales volume, with the fastest growing market share among all competitors in the industry since it started commercial operations in 2010.

The Company was incorporated and registered with the Securities and Exchange Commission (SEC) on June 21, 1995.

Eagle Cement plant is located in San Ildefonso, Bulacan and was established in 2008 under the vision and passion of its CEO and President, Mr. John Paul L. Ang with the goal to provide high quality cement for the Filipino people.

MPSA 245-2007-III was issued to Eagle Cement Corporation on July 25, 2007 by the Department of Environment and Natural Resources. The company proposes to operate 69.90111 hectares out of the 82.6033 hectares MPSA area. Limestone is the main commodity of commercial interest within the Contract Area being the main ingredient needed in cement manufacturing with minor occurrences of clay and sandstone–mudstone units intercalated as lenses within the limestone beds. The company proposes to utilized quarrying as the mining method. The MPSA area has an existing ground surface elevation of 210 MASL, while the mine final pit bottom will have an elevation of 70 MASL. The proposed total depth of the quarry is 140 meters.

Eagle Cement Corporation is currently operating MPSA-181-2002-III with an issued Environmental Compliance Certificate that covers the Cement Plant and Quarry operations. The existing support facilities and manpower of MPSA 181 will be shared to the proposed operation of MPSA 245.

1.2 Project Location and Area

The proposed project is located in Barangay Akle, Municipality of San Ildefonso and Barangay Talbak, Dona Remedios Trinidad both in the Province of Bulacan covered by MPSA 245-2007 with a total area of 82.6033 hectares, the project will cover an area of 69.9011 hectares encompassed by the following geographical coordinates:

Corner	*Latitude*	*Longitude*
1	15° 03’ 30.00”	121° 04’ 10.52”
2	15° 03’ 38.35”	121° 04’ 10.78”
3	15° 03’ 42.96”	121° 04’ 07.01”
4	15° 03’ 45.09”	121° 04’ 00.00”
5	15° 04’ 00.00”	121° 04’ 00.00”
6	15° 04’ 00.00”	121° 04’ 30.00”
7	15° 03’ 30.00”	121° 04’ 30.00”
1	15° 03’ 30.00”	121° 04’ 10.52”

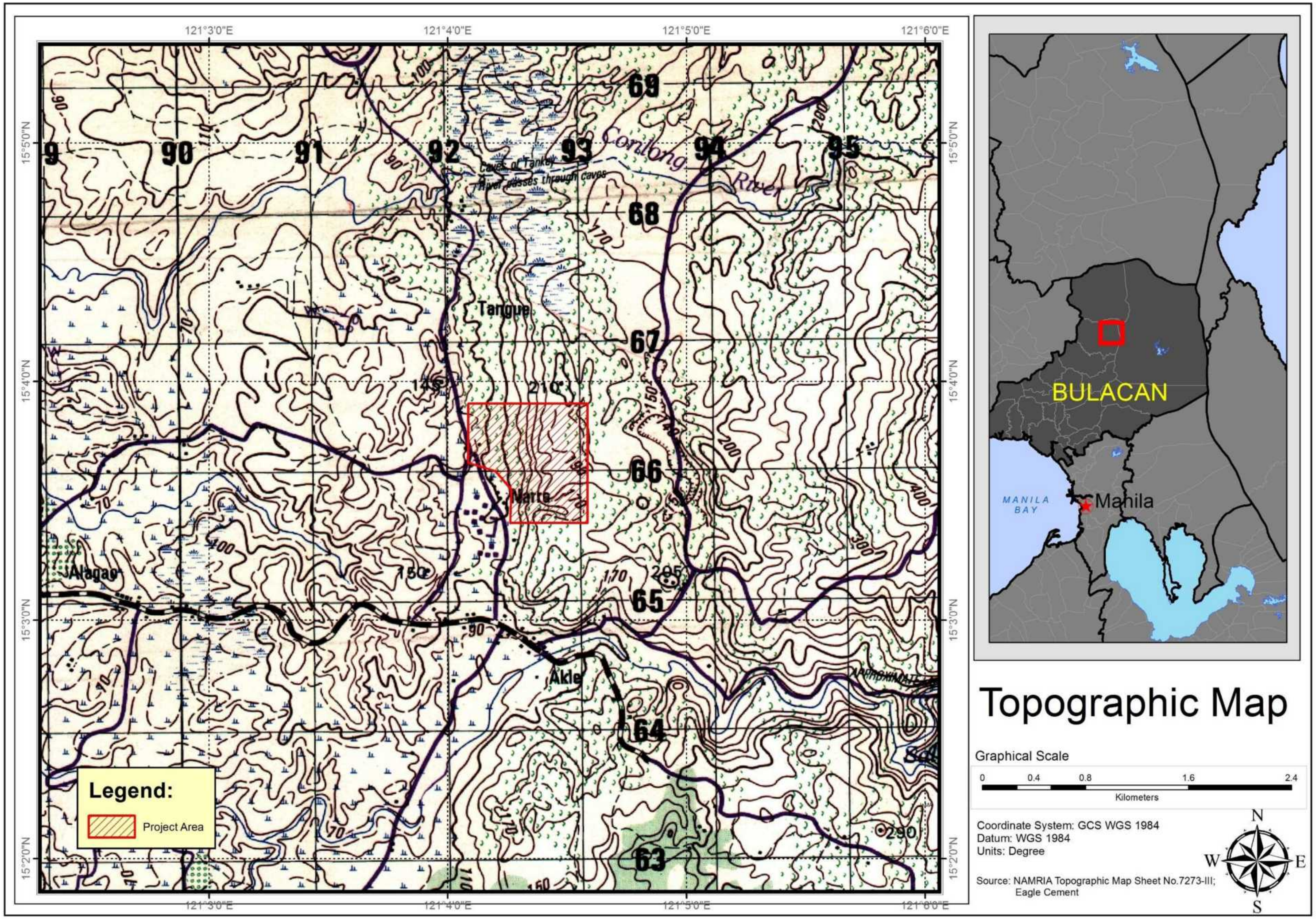


Figure 1 - Location Map

Figure 2 - 360 Degrees Stitched Drone Shot

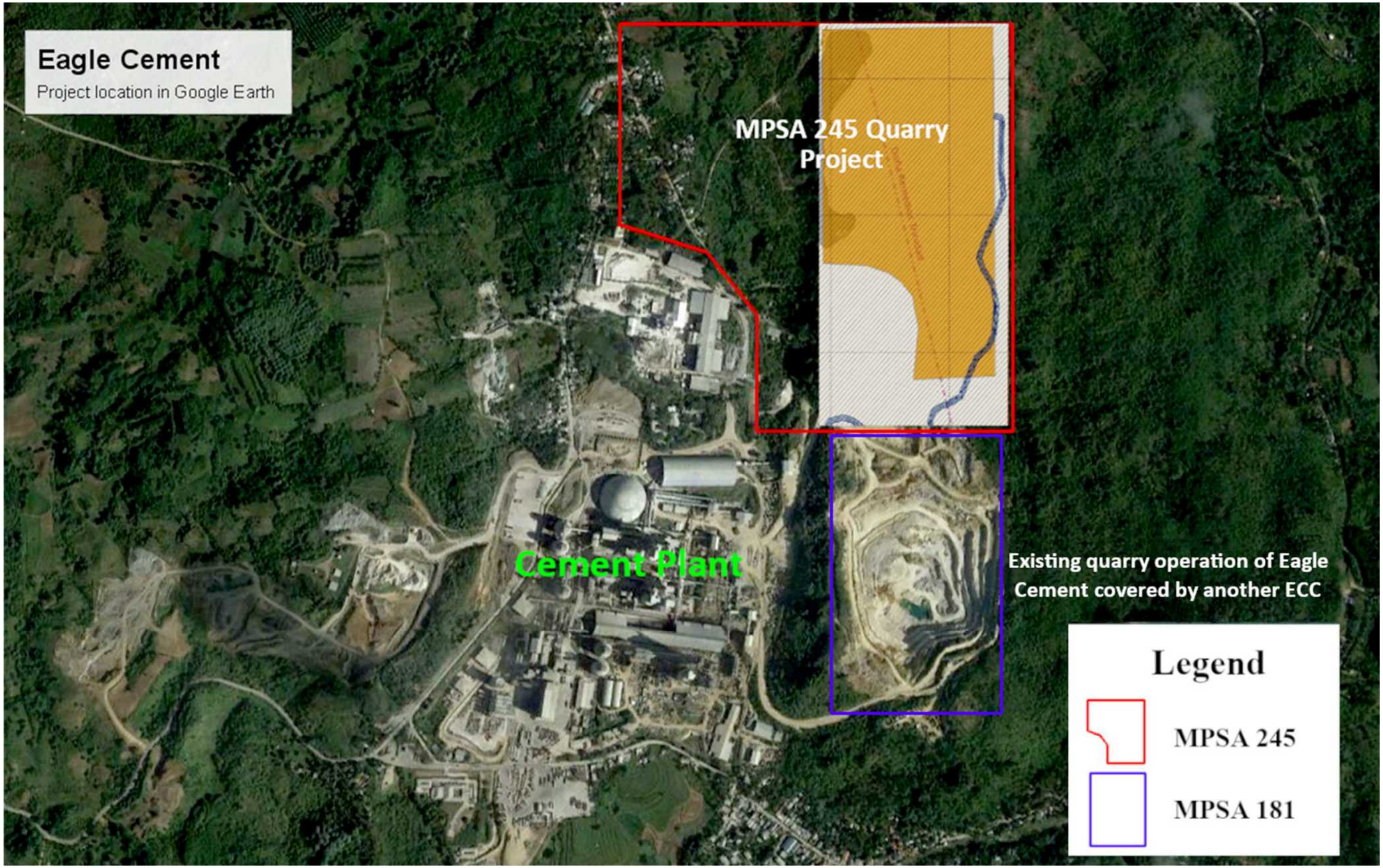


Figure 3 - Project Vicinity

1.2.1 Accessibility

From Manila, the contract area can be reached via the North Luzon Expressway (NLEX) and exiting at Sta. Rita toll gate. Then, turn right by driving along the Cagayan Valley Road (Maharlika Highway) up to Poblacion, San Ildefonso, Bulacan. From Poblacion, Akle can be reached via the San Ildefonso-Akle-DRT Road. By road distance, the contract area is about 85 kilometers from Manila with a travel time of approximately two (2) hours under normal traffic condition.

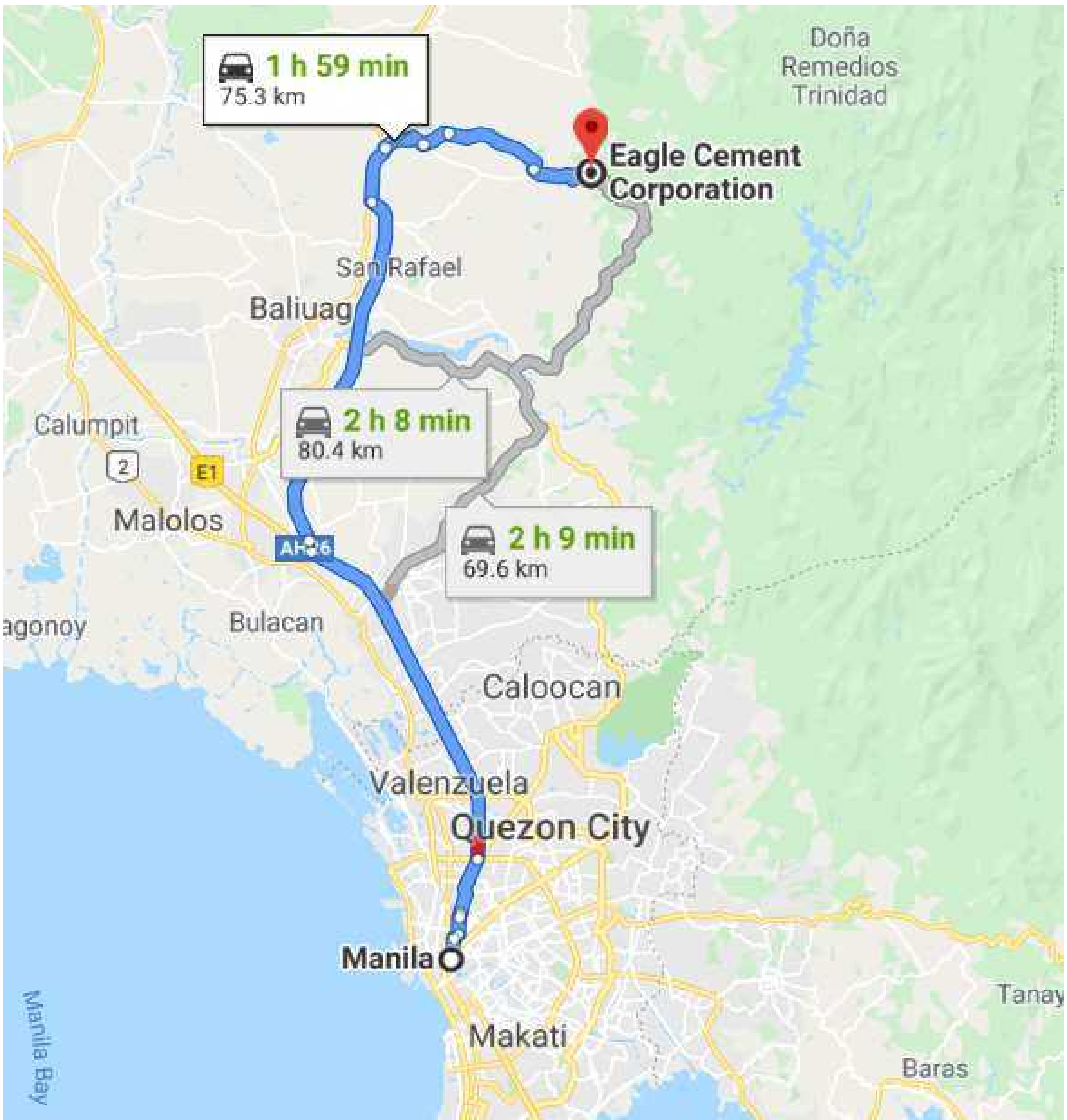


Figure 4 - Accessibility Map

1.2.2 Impact Area

The area subjected to Environmental Impact Assessment (EIA) is base on the perceived direct and indirect impact area of the proposed 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 project area. On the other hand, areas not directly subjected to any activities/construction and those outside the project area but is within the jurisdiction of the Municipalities of San Ildefonso and Dona Remedios Trinidad (e.g. stretch of river draining the project area, communities along haul roads) is considered as indirect impact areas.

Consistent with the provision of DAO 2010-21, known as the "*Consolidated Implementing Rules and Regulations of the Philippine Mining Act of 1995"*, the direct impact barangay are Barangay Akle and Talbak while the indirect impact area are the Municipality of San Ildefonso and Dona Remedios Trinidad.

Table 1 - Identified Impact Area per Component

Aspect	*Direct Impact Area*
Water	Based on the EIA study, the identified direct impact areas of the project is the receiving water body (Conlong River) and the underlying aquifer surrounding the proposed operation ***Figure 5***. There are no water bodies traversing the project area. Conlong River is located approximately 1.5 km north of the proposed project area flowing in a westerly direction.
Air and Noise	The identification of direct impact area in terms of noise and air quality were based on the worst-case scenario of the proposed quarry operation. As per the EIA study, the direct impact areas are Barangays Akle and Talbak (***Figure 6*** and ***Figure 7***). Some of the households in Barangay Akle located near the MPSA area will be greatly affected by the noise and air emissions to be produced by the quarry operation especially during blasting and hauling activities. However, the company opted not to concentrate in the said area and utilized it as a buffer zone for the quarry operation.
Terrestrial	The direct impact area in terms of terrestrial ecology is the vegetated portion to be occupied by the quarry operation, settling ponds and roads ***Figure 8***.

Aspect	*Direct Impact Area*
People	Barangays Talbak and Akle are the host barangays for the proposed project since the MPSA area is covered by the two barangays. In terms of socio-economic, the MPSA 245 quarry project is foreseen to increase in local taxes, generation of employment, and livelihood programs to assist the community.

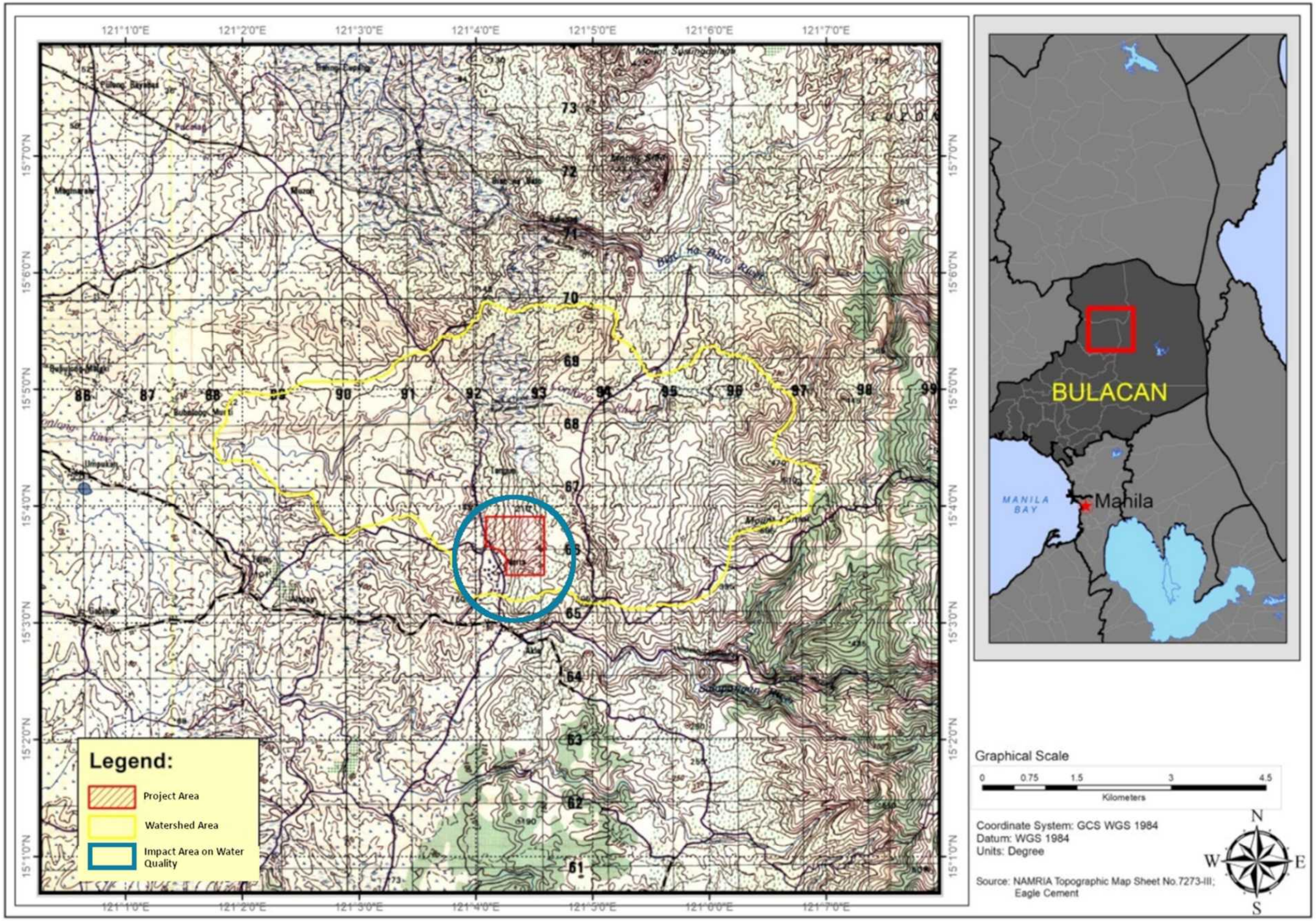


Figure 5 - Primary Impact Area on Water

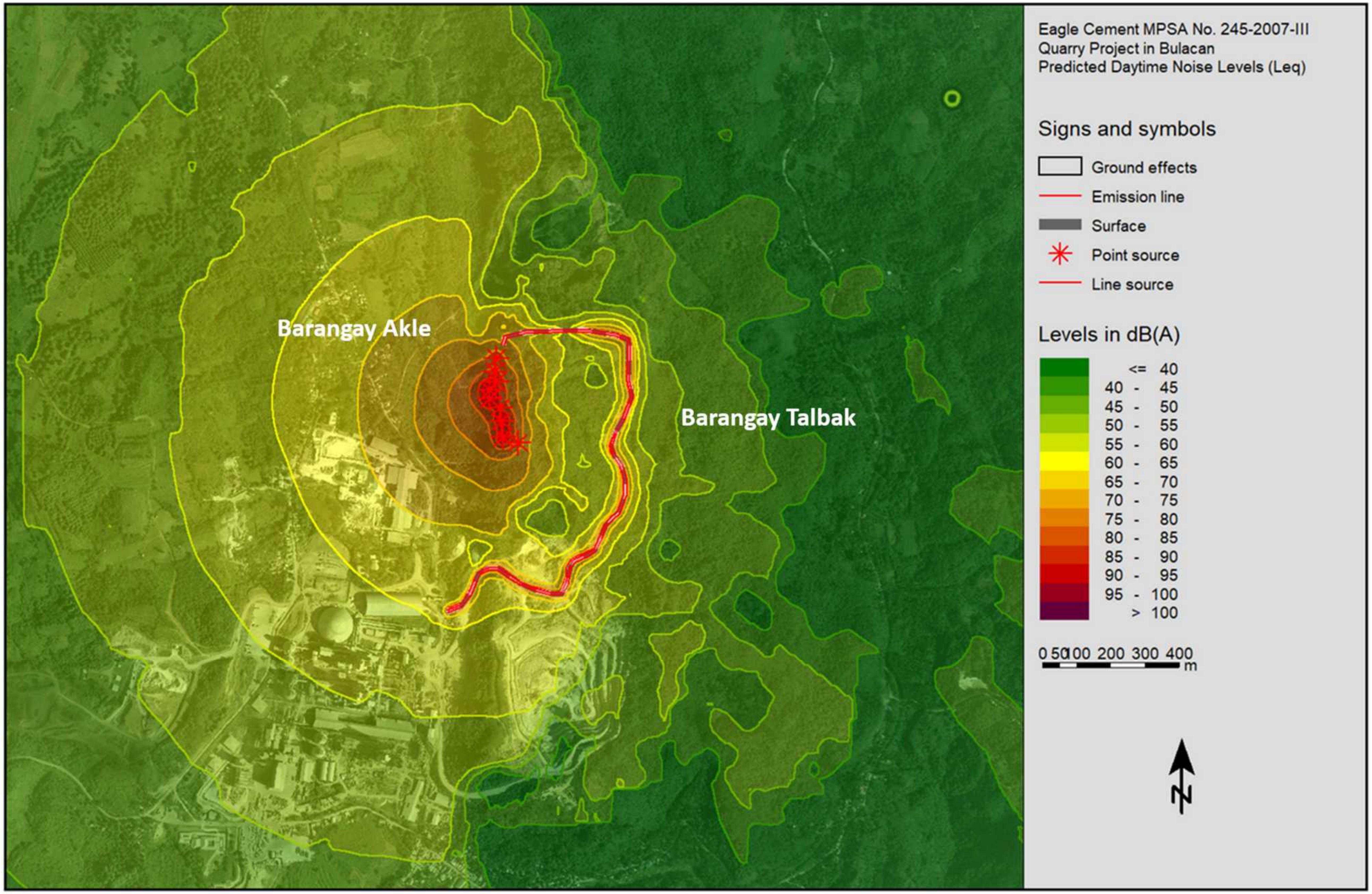


Figure 6 - Impact Area for Noise

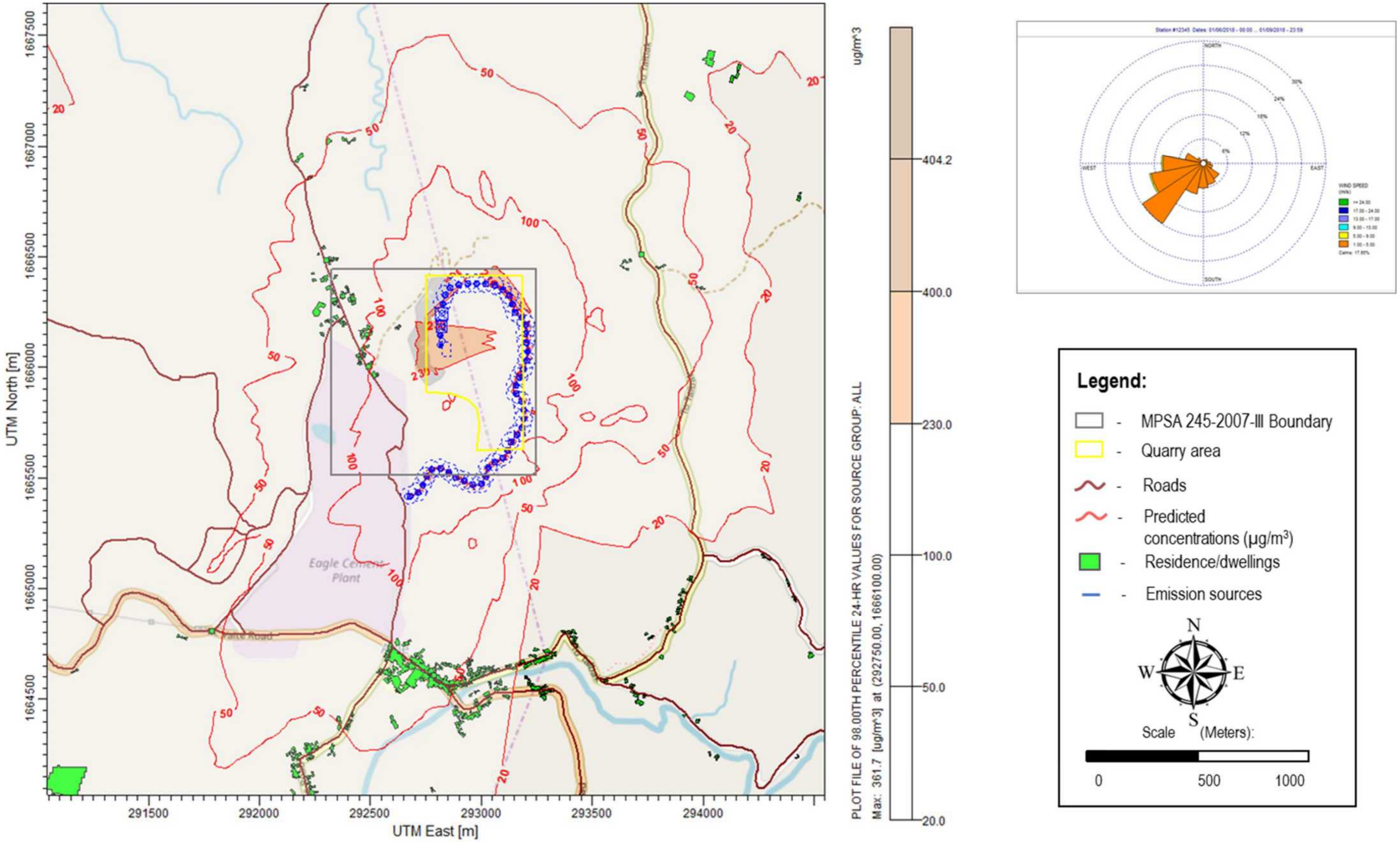


Figure 7 - Impact Area for Air

Figure 8 - Direct Impact Area on Terrestrial Ecology

1.3 Project Rationale

Eagle Cement Corporation is one of the biggest cement producing company in the Philippines, with the advancing economy of the country, the demand for cement products are continuously growing.

The advent of industrialization gave rise to the construction of various infrastructures such as high-rise buildings, roads, commercial centers, housing units, etc. In the establishment of these concrete structures/products, cement serves as the major ingredient for its creation.

The "build, build, build" policy of the current Duterte Administration further fuels the demand for cement on a greater scale.

In order to support the growing demand of cement products in the country, Eagle Cement will conduct a series of quarry expansion which include this proposed quarry project to provide the raw materials requirement of the existing cement plant.

The project will contribute to national economy by way of:

- Generation of employment especially to the people of Barangays Akle and Talbak; Municipalities of San Ildefonso and Dona Remedios Trinidad; and Province of Bulacan;
- Increase in local taxes and licenses;
- Allotment of Social Development and Management Plan expenditures;
- Business enterprises development; and
- Extend much needed assistance to the immediate community in terms of health, training, livelihood programs, education and technology.

1.4 Project Alternative

1.4.1 <u>Alternative Site Location and Process Selection</u>

The project will solely cover quarry operation, the depth of the pit and its location will depend on the exploration activities conducted by the company, thus no other site alternative considered in terms of quarry area. The location of the haul road to be constructed will be connected to the existing haul road of MPSA 181. The opposite side of the designated quarry block of MPSA 245 cannot be considered as an alternative site since the slope in specific area is very steep. Further, considering the type and location of mineral to be extracted, the only feasible mining/quarry method for the project is surface mining method, thus, there were no other alternative method considered for the project.

1.4.2 Alternative Source of Fuel

If in the event that fuel supply in the plant is not efficient, the project will source its fuel in the nearest Petron Station which is located outside the Cement Plant .

1.4.3 Environmental Impact

The major environmental impact that will be brought about by the project operation considering all the alternatives and the nature of project are dust emission, implementation of community development programs through Social Development Management Plan and generation of revenues from taxes, permits and LGU share in the quarrying activities

Dust generation is foreseen to arise during construction and operation phase; however, environmental management plan such as water sprinkling and provision of buffer area thru planting of trees will be undertaken to alleviate its probable occurrence. The implementation of SDMP will enhance the socio-economic welfare of the community. Further, the company will ensure the prompt payment of taxes and fees to the government.

1.4.4 Consequences of not Proceeding with Project

In terms of physical environment, the MPSA area will remain unchanged and undisturbed. As regards with, socio economic, continues opportunity for employment provided by Eagle Cement Corporation that extends to other places in the Municipalities of San Ildefonso and Dona Remedios Trinidad and the entire Province of Bulacan other than of Barangays Akle and Talbak will not be probable. Additional revenues from taxes, with no “project option”, the opportunity for additional SDMP assistance and tax revenue are not possible.

1.5 Project Components and Process

1.5.1 Quarry Operation

Method of operation to be utilized by the project is quarrying using conventional heavy equipment. The quarry operation will be divided into three (3) stages; the quarry development, the production stages and rehabilitation.

Development phase is the stage in quarrying where preparation for full blasts production will be carried out. It will involve stripping, removal of vegetative covers and the overburden, drill and blasting, establishment of bench face and a floor, drainage canals and access roads to the deposit. The production bench will be divided into a series of slices of ten (10) meter high and a 70° bench slope during production stage and five (5) meters in development areas. Development work will generally start from the uppermost portion of the area and progresses downward. A portion of the deposit will be sliced until a bench face with a slope of about 70° and a floor width of 30 meters, will be formed enough to sustain the safe movement of quarry equipment. Once a bench is formed, a new working level below (10m) will be worked out to form another set of production bench. Should topography warrant, the cycle of creating a new working level (benches) at lower elevation will continue until desired target is reached. Limestone will be extracted while access and benches are being established. Generally, the working parameters of the limestone quarry will be the following:

	Devt / Prod'n stage	Final Pit
Bench slope	70° - 75°	30°
Bench height	10m	5m
Bench width	5m (min.)	15m
Pit slope	60° (max.)	45°

The extraction or production stage is the actual removal of the deposit from the developed (cleared) benches. The major activities in this stage are drilling for quality control and blasting, ripping and dozing on ground followed by loading and hauling.

Blasted limestone materials from the bench will be loaded by either a wheel loader or power shovel excavator into a 35 and 50-ton Off Road Highway Truck and will be transported to the Cement Plant (with an existing ECC). The cycle of drilling for quality control, blasting, excavation, loading and hauling continues until all programmed benches have been subjected for production and resource exhaustion.

Typical quarry cycle involves the following:

Development Stage

Site Clearing

⇩

Production Stage

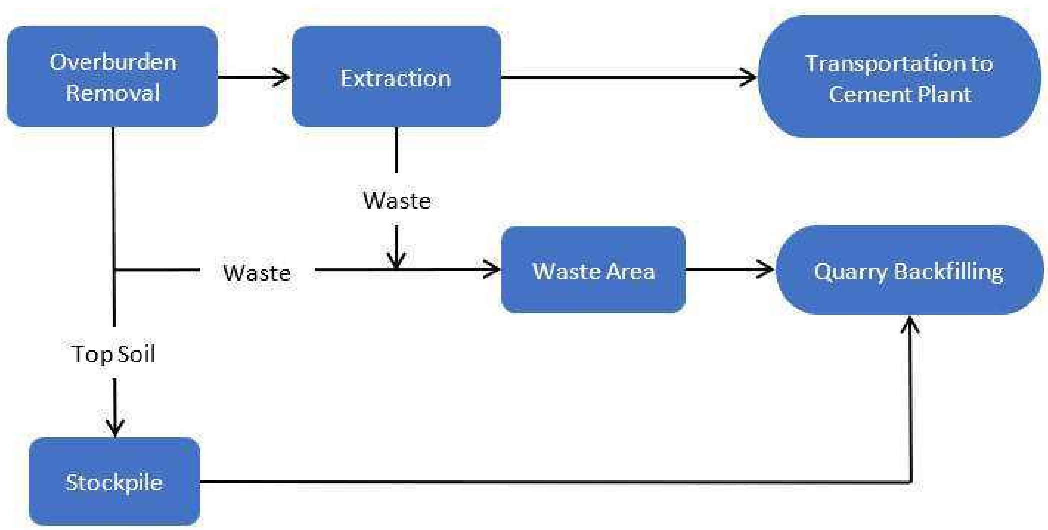
Drilling for sampling and grade control
Blasting, Ripping and dozing
Loading and Hauling

⇩

Rehabilitation Stage

Implementation of the Final Mine Rehabilitation and/or Decommissioning Plan

The process flow diagram of the quarry operation involves the following:



Basically, the topsoil extracted from the quarry area will be used as mixing materials in the cement plant, thus, generation of waste materials is considered to be very minimal.

Buffer zone (***Figure 12***) will be established to alleviate the impact of the project to the nearest community. The buffer zone covers the grotto that is being utilized as a prayer area of the community. This initiative is proposed by the company to protect and preserve the religious beliefs of the public.

Figure 9 - Quarry Plan

1.5.1.1 Drilling and Blasting

Drilling and Blasting will be part of the production operation. Blasting shall be performed in outmost care and with the highest degree of practice in safety. Only blasting contractor that has the most advance blasting technology, duly registered and has the necessary license from government agency shall be awarded with the contract.

Non-electric detonation will be use for the initiation of the blasting sequence. This to minimize the effect of blasting such as air blast, excessive ground vibration and fly rock. To avoid any accident from happening, a strict blasting procedure will be followed in coordination with the contractor and the company. The following is the blasting methodology to be followed:

1.5.1.1.1 Blasting Methodology

A. General Methodology:

Blasting operations shall be conducted using pack emulsion or boosters as primers and ammonium nitrate as column charge. Full delay system of initiation shall be done using non-electric down line detonators and non-electric surface delays detonators. Starter initiator to be used shall be ordinary lead in-line.

B. Drilling & Blasting Parameters:

- Blast Hole Diameter: 89 mm
- Drill depth: 10 meters
- Burden and Spacing: 3.5m x 4m
- Drilling Pattern: Staggered
- Powder Factor: 0.30 kg/bcm to 0.36 kg/bcm
- Sub-drill: 10% of burden
- Stemming Height: 30% of Hole Depth

C. Fly-Rock, Noise, Vibration Control:

- All overlying loose materials and loose rocks shall be removed by bulldozer 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 or community.

- Blaster to prepare drilling layout to ensure the correctness of burden, spacing, and depth of hole
- Protective works, such as the use of blasting mats, shall be done in blast area in very close proximity to vital facilities and community.
- Full delay system of initiation shall be used. Only none electric down the hole detonators and trunk line delay detonators shall be used. Delay time between adjacent holes shall not be less than 17ms. Firing will be one hole at any given time.
- Stemming materials to be used composed of rock fragments sized 5/8 of hole diameter mixed with drill cuttings and compacted properly.

D. Safety Methodology:

The company and the contractor shall conform with DENR Administrative Order (D.A.O) No. 2000 – 98 known as the Mine Safety and Health Standards. Only a Licensed Blaster shall supervise the whole blasting activity. All manufacturers' safety guidelines and PNP rules and regulations shall be followed in conducting the blasting operation /activity. The company shall inform the nearby communities as to the time and date of any blasting operation.

1. Explosives Transport

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

2. Handling & Charging

- Only the Licensed blaster shall do the charging and priming.
- Primer should be assembled only before charging.
- Stemming height should be greater or equal to the designed burden of the layout. Size of stemming materials shall be 5/8 of the hole diameter mixed with some fine materials and compacted using a tamping stick.
- Only non-conductive materials should be used for charging or tamping. Tamping sticks should be flat at the bottom.

- Tamping of stemming materials should be done carefully not to hit the down line initiator causing it to misfire or initiated prematurely.
- Final connection of loaded holes should only be done when the exact firing time has been confirmed.
- A final inspection of the whole lay out should be made by the blaster, after which he will declare that the area is ready to be blasted.

3. Clearing & Traffic Control

- Clearing of blasting area shall be done by 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 such as lunch or snack. No blasting will be allowed during night time.
- All possible entries towards the blasting area, at least 200 meters from the blast site, should be barricaded. Also, all equipment and personnel within 200 meters shall be evacuated for safety.
- When all roadblocks are in place, licensed blaster shall conduct final clearing of the area. It is only the Drilling and Blasting Supervisor or Project Manager who will 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 should bear a minimum of three (3) minutes period to allow the blaster to seek cover.
- A blasting timer should be made by licensed blaster as a warning shot, which will fire around five (5) to ten (10) seconds prior to the main blast.
- After checking all the connection, the blaster will seek the approval of Drilling and Blasting supervisor to fire the shot.
- Only 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 30 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.

- Only the Drill and Blast Supervisor or Project Manager shall declare that blasting is over and barricades can be lifted. All equipment and personnel can now return and go back to resume their work.

5. Location and Management of Explosive Magazine

The existing quarry operation of Eagle Cement utilizes drilling and blasting. Nitro Asia is the current drill and blast contractor of the company, the same service provider will be employed for the proposed operation. The magazine is located 1 kilometer away from the community and has an approved plan, and location design from the Philippine National Police Regional Director as per requirement prior to installation. The structure of the magazine storage is constructed at a stable ground and located away from inhabitant building and public road. It is secured with double fence and gated with security outlook. The magazine storage has 3 locks, these locks have separate keys each of which are handled by Eagle Cement Corporation Security Department, San Ildefonso PNP and Nitro Asia (contractor). Only authorized person has access to any key. The primers and detonators are stored separately. Each magazine is equipped with lightning arrestors and illuminating lights. Monthly inventory is conducted and submitted to EMB Region 3. Also, military and CAFGU area present in the area to maintain the peace and order at all times.

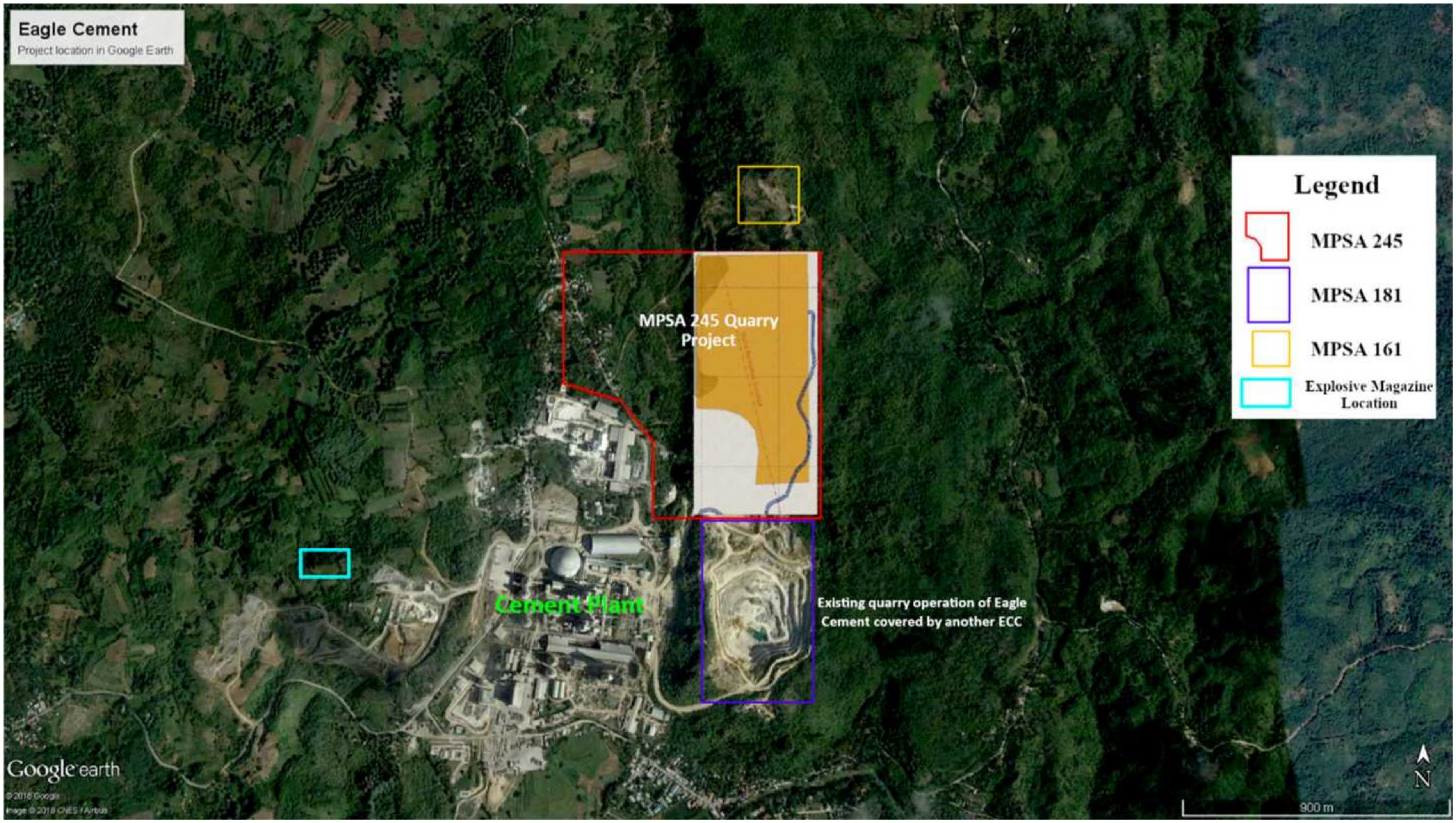


Figure 10 - Explosive Magazine Location Map

1.5.2 Access and Haul Roads

Quarry development will start from the construction of access/haul road within the quarry site, which is designed to facilitate opening of benches. The haul roads will be maintained at a width of 15 meters or three times the width of the largest quarry equipment with a maximum grade of 8-12%. Pre-emptive measures through implementation of appropriate slope/ground failure monitoring plan will be adopted to identify any instability at an early, non-critical stage so that safety measures can be initiated to prevent or minimize impacts.

1.5.3 Support Facilities

1.5.3.1 Fuel Requirements

The fuel requirement for the 11 years quarry operation is 27,750,000 Liters.

Table 2 - Fuel Requirement

	Annual Capacity	Fuel Requirement at est. 0.5L/ton
Year 1	3,000,000.00	1,500,000.00
Year 2	3,500,000.00	1,750,000.00
Year 3	4,000,000.00	2,000,000.00
Year 4	4,000,000.00	2,000,000.00
Year 5	4,000,000.00	2,000,000.00
Year 6	5,000,000.00	2,500,000.00
Year 7	5,000,000.00	2,500,000.00
Year 8	6,500,000.00	3,250,000.00
Year 9	6,500,000.00	3,250,000.00
Year 10	7,000,000.00	3,500,000.00
Year 11	7,000,000.00	3,500,000.00
Total	***55,500,000.00***	***27,750,000.00***

1.5.4 Pollution Control Devices

1.5.4.1 Siltation ponds

Siltation ponds will be constructed within the project area (MPSA 245-2007). The ponds shall be made of compacted earth, rock, and strategically placed adjacent to the quarry active area. The quarry's surface run-off will be directed to a 2-stage siltation ponds with approximate area of 10,800 sq m (120 m x 90 m), through a 114 meters channel line and open culvert from the quarry siltation ponds. The effluent coming from the pond will be monitored for Total Suspended Solids (TSS), Color, and pH. Based on the existing operation the run-off coming from the quarry site is only observed during wet season. Water recovered from the settling pond is utilized in road sprinkling.

Siltation ponds will be desilted as the need arises. To minimize the silt load, siltation traps along the drainage system will be built inside the active areas. Also, diversion canals will be regularly maintained to assure efficiency. The construction of these structures will conform to engineering practices and will be kept at a minimal area so as to limit the impacts on land.

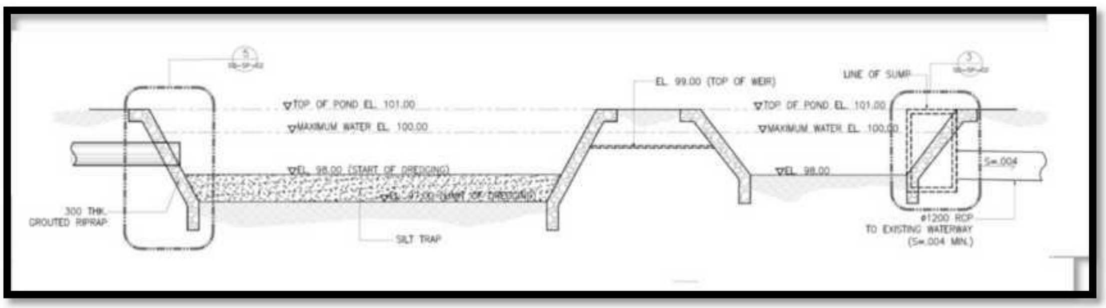


Figure 11 - Design of the 2-stage siltation ponds.

Siltation pond 1:

- Area: 104 sq m
- Capacity: 208 cubic m
- Desilting Schedule: Quarterly

Siltation pond 2:

- Area: 89.78 sq m
- Capacity: 314.23 cubic m
- Desilting Schedule: Quarterly

Table 3 - Identified Pollutants

Pollutants/Waste	Control/Management
Cleared and grubbed vegetation	• Minimize ground disturbance through strict ground clearing clearance procedure. • Revegetation of buffer zones and immediate rehabilitation of non-usable areas with endemic species upon project operation.
Topsoil and subsoil	• Minimize ground disturbance.

Pollutants/Waste	Control/Management
Sediment-laden runoff	• Use of properly sized, graded, and lines stormwater management system. • Whenever needed, flattening of slopes and reduction of slope lengths by silt fence. • Regular desilting of drainage canals, silt traps and siltation ponds.
Dust	• Minimize ground clearings, disturbance and good scheduling of works. • Observance of speed limits – 20kph. • Surface gravelling of roads to reduce the source of dust emission. • Wet suppression of access and haul roads. • Revegetated buffer zones. • Immediate rehabilitation of non-usable area.
Noise	• Minimize disturbance and scheduling of blasting activity. • Restriction of noisy activities during resting hours of the day. • Observance of speed limits – 20kph. • Regular maintenance and immediate repairs of equipment. • Revegetated buffer zones. • Implementation of an effective IEC program.
Flyrocks, vibration and airblast	• Sounding of siren and clearing of and restricting access to blast area and safety buffer zone. • Suspension of vehicular traffic within the buffer zone during blasting. • Regular community information and consultation program.

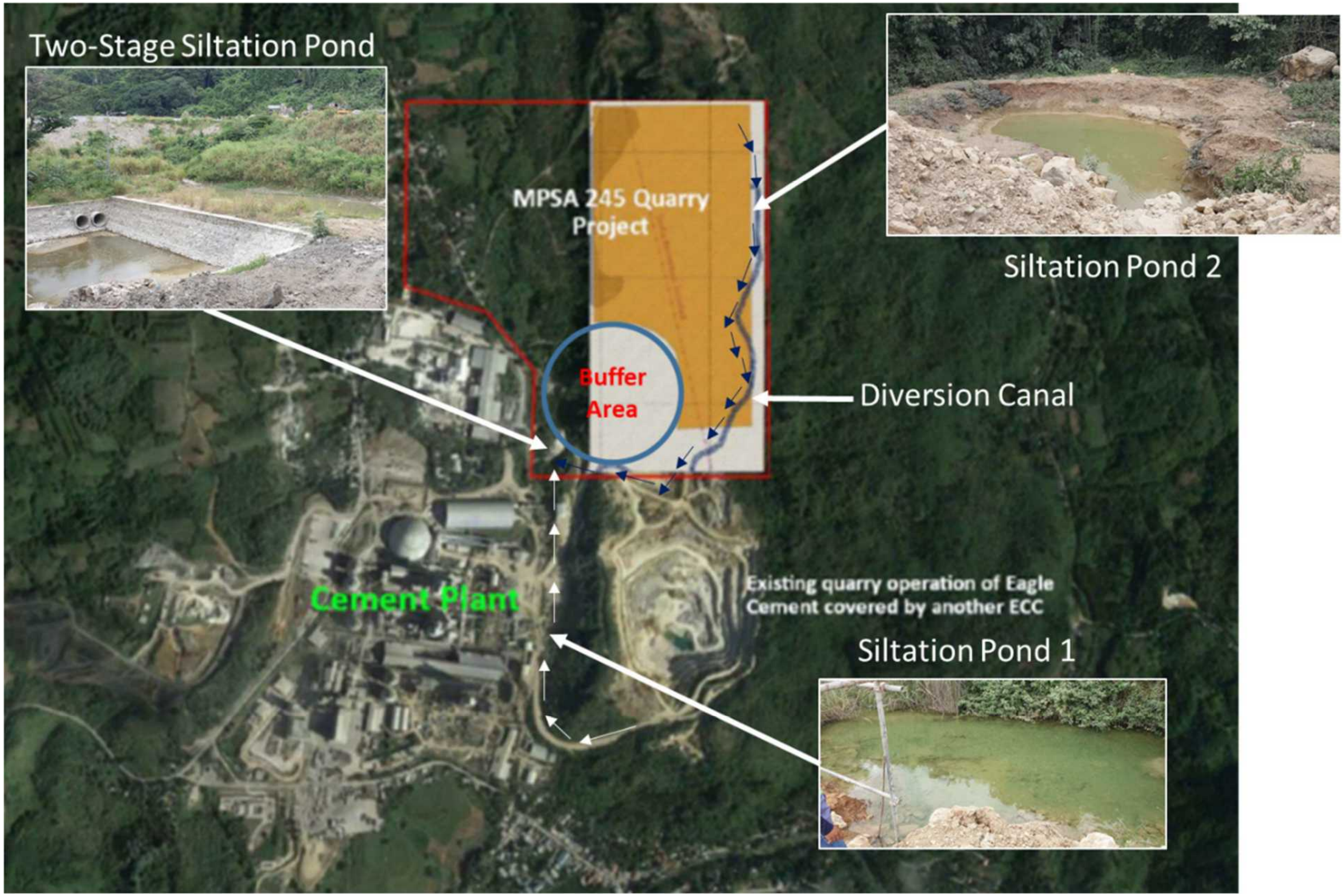


Figure 12 - Site Development Map

1.6 Project Size

1.6.1 Resource Estimate

The measured and indicated resources in MPSA 245 were obtained with the use of GEMCOM Surpac software. At an average grade of 45 percent CaO and a density of 2.4t/m^3, the measured and indicated resource estimates are 8.22 and 46.82 million metric tons, respectively. Inferred resources which could be considered as a potential resource amounts to 70.9 Million Metric Tons. The resource estimates were conducted by PMRC Competent Person Geologist Rolando Pena with Geologist PRC License No. 068 and Competent Person Accreditation No. 07-08-08 from the Geological Society of the Philippines.

The table below summarizes the resource estimate:

Table 4 - Summary of Resource Estimates in Million Metric Tons

Measured Resource	*Indicted Resource*	*Subtotal*	*CaO (%)*	*Inferred Resource*
8.22	46.82	55.04	47.65	70.9

1.6.2 Production Capacity

The project will have a total production capacity of 7,000,000 MT/year, based on the resource estimate the total resource can support the project operation minimum of 11 years, however, since the company is continuously conducting exploration activities within the MPSA area, the projected life of mine will be prolonged. Presented below is the production schedule of the proposed project:

Year	*Production*
1	3,000,000.00
2	3,500,000.00
3	4,000,000.00
4	4,000,000.00
5	4,000,000.00
6	5,000,000.00
7	5,000,000.00
8	6,500,000.00

Year	Production
9	6,500,000.00
10	7,000,000.00
11	7,000,000.00
Total	**55,500,000.00**

1.6.3 Project Size

The total project area covered by the project is 69.9011 hectares within MPSA 245 – 2007-III.

1.7 Project Phases

1.7.1 Pre-construction

The activity during this phase are as follows:

- Strengthening of the exploration activities; and
- Securing of necessary environmental permits from government agencies and Local Government Unit (LGU).

1.7.2 Construction

Construction of haul road and access road shall be the first activity during this phase. The construction of these facilities shall be conducted in a manner wherein minimal disturbance will be created. All roads shall follow the topographic contour of the area and shall be equipped with road drainage for further environmental measures.

Temporary settling ponds shall be developed within the construction area to cater the mitigation of possible siltation and water contamination. If the constructed ponds will no longer be usable during the operation phase, such facility shall be dewatered, backfilled and revegetated.

1.7.3 Operation

The quarry operation will employ quarrying method. Proper benching shall be utilized in the individual quarry sites. Once the over burden has been stripped, terrace-like extraction faces will be cut from the topmost strata progressing downward to serve as quarry levels for positioning equipment that will conduct excavation and loading activities thereat. Access from one bench level to another will be provided by ramps or spiral roadways.

Quarrying will be executed by multiple benching pattern, which provides greater operation flexibility and production output, and will be carried out by combined tractor and excavator/loader operations. 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 average height of 50 cm will be provided on the unprotected crest site for added safety.

Excavation and loading shall be done by means of a mechanical loader/excavator (backhoe/payloader) and haul trucks. The excavators shall strip the limestone materials and load directly to the waiting dump trucks to be transported directly to the cement plant. Drilling and blasting operation will be utilized by the project.

Siltation ponds shall be made of compacted earth, rock, and strategically placed adjacent to the mine active area to block the water runoff laden with silt and impound/trap the water to allow the silt to settle, thereby, clear water will be utilized in the road sprinkling to alleviate the generation of dust.

Fuel requirement to support the quarry operation is estimated at 27,750,000.00 L for the 11 years mine life. Water requirement will be minimal since the project will only cover quarry operation and all other facilities will be shared from the Cement Plant operation.

1.7.4 Abandonment

Abandonment stage will start after the permit life or upon exhaustion of the minerals within the MPSA area.

1.7.4.1 Rehabilitation Strategy

The proposed final land uses for each project component will determine the rehabilitation of the Project. The area disturbed will be cleared and revegetated. Involvement of the host community will be the prime strategy to ensure the success of rehabilitation.

The preparation of the area will be done using heavy equipment such as dump trucks, loaders, bulldozers, etc. The final land configuration will incorporate road network to make as many areas accessible as possible with provisions for drainage system.

The parameters considered in the rehabilitation plan to control erosion and sedimentation prior to revegetation are the following:

i. Stabilization of the quarry slope areas.
ii. Spreading of top soil on the affected areas.
iii. Introduction of self-sustaining vegetation.
iv. Construction/maintenance of drainage system.
v. Maintenance of nursery to meet the rehabilitation requirements.

1.7.4.2 Site Restoration Plan

1.7.4.2.1 Quarry

The backfilling of benches and other open areas will be the first stage of surface preparation. The average thickness of backfill will range from 0.5 to 5 meters depending on the surface foundation. The backfilled materials will then be leveled and graded, such that the slope will be towards bench toe line. This will allow the surface run off to be drained towards the drainage along the respective toe line of the benches.

During the rehabilitation stage, only authorized personnel/individual will be given access to the quarry. Signages will be established to warn the personnel on the possible risk of falling from cliffs and other possible accidents.

1.7.4.2.2 Siltation ponds

The siltation ponds will be maintained during the implementation of the final mine rehabilitation plan to effectively mitigate water pollution. Fences and signage will be established to alleviate the possible accident specifically drowning of personnel and the community. Prior to the abandonment, the siltation ponds will be rehabilitated by leveling the pond with its dike and will be revegetated with appropriate plant species. Further, continues water monitoring and sediment sampling within the area will be conducted to assess water quality.

1.7.4.2.3 Rehabilitation Earthworks

In employing appropriate rehabilitation earthworks, baseline information and pre and post assessment of all disturbed land is correlated to arrive with the most appropriate measures proximate to the intended post mining land uses. Extraction of waste rocks from the development of stopes may temporarily alter the topography and landscape. However, these materials will be transported back to backfill and rehabilitate mined-out stopes. These can also be re-used as back-filling material for the maintenance of the roads.

1.7.4.2.4 Nursery Operation

The company will share the nursery of the Cement Plant. Seedlings of different tree species will be propagated and raised in the area

1.7.4.2.5 Selection of species to be planted and planting scheme

The following plan species and spacing will be considered in the rehabilitation activity:

Scientific Name	Common Name	Spacing
Leaucaenaleucocephala L.	Ipil-ipil	3 x 3
GliciridiasepiumJacq. Kunth ex Walp	Kakawate	3 x 3
Macarangatanarius (L.)	Binunga	3 x 3
Dendrocnide meyeniana (Walp.) Chew	Lipangkalabau	3 x 3
Chrysopogon zizanioides	Vetiver	1 x 1

1.7.4.2.6 Maintenance and Protection

1.7.4.2.6.1 Replanting

This will be done when 20% of the planted seedlings/wildlings died due to stress, injuries from transport, planting techniques damages by pests, poor quality of planting stock etc.

1.7.4.2.6.2 Care and Maintenance

1. Watering

Heavy watering at long intervals is better during the early days of planting. With the installation of drip irrigation system, watering will not be a problem as long as the source of water will not be dried out.

2. Fertilization

Conduct fertilization at the start or toward the end of rainy season. The used of integrated fertilization techniques seeds as moisture or combination of organic, inorganic and biological fertilizer will be encouraged. Initially, recommended organic fertilizer is the 14-14-14 at 20g per plant or depending on the result of soil analysis conducted in the site.

3. Weeding and mulching

Weeding is done before the weeds suppress the seedling or as often as necessary. The grass of weeds cut will be placed as much around the seedling to reduce evaporation and prevent re-growth of weeds. All climbers found during weeding activities will be cut or suppressed.

4. Protection

The plantation must be protected from astray animals and passersby. A fire breaks or fire lines measuring 8-10 meters wide should be constructed around the perimeter of the plantation area. Pest and disease likewise will be monitored and the necessary prevention technique will be imposed during outbreak.

1.7.4.3 Maintenance and Monitoring Program and Procedures

During the implementation of the FMRDP, the EAGLE CEMENT CORPORATION'S Closure Team will oversee the implementation of the maintenance and monitoring plans. It will be guided by the closure criteria and performance standards discussed in the previous sections. The environmental, community relations, safety and health personnel of EAGLE CEMENT CORPORATION will spearhead the maintenance and monitoring.

This will be in addition to the monitoring and/or audit conducted by the Mine Rehabilitation Fund Committee (MRFC) through the Multi-partite Monitoring Team (MMT) and the Contingent Liability Rehabilitation Fund Steering Committee and the Mines and Geosciences Bureau (MGB).

In compliance with regulation, EAGLE CEMENT CORPORATION will likewise submit a progress report containing details of fully, partially, and on-going rehabilitation activities relative to the implementation of the FMRDP. The report will be submitted to the MRF Committee 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[1].

The maintenance and monitoring plans will be prepared by EAGLE CEMENT CORPORATION Closure Team in coordination with the MMT. This will be formulated 2 years prior to closure. The intent is to have a realistic plan based on actual scenario as possible.

1.7.4.4 Long Term management and maintenance

At the end of the FMRDP implementation based on the assessment of that the objectives of project closure, as contained in the approved FMRDP have been achieved, EAGLE CEMENT CORPORATION 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 MRF Committee and/or CLRF Steering Committee, after due review and evaluation of the FRR with EA, may issue a Certificate of Final Relinquishment to EAGLE CEMENT CORPORATION signifying approval of the FRR with EA and freeing EAGLE CEMENT CORPORATION from any further obligations insofar as the rehabilitated area/s are concerned.

[1] DAO 2010-21

1.8 Manpower Requirement

Quarrying operation will be conducted by a general mining contractor. In-house manpower requirement for the proposed project will be from the existing quarry operation of the company. The workforce presented below will be shared from the existing Quarry operation.

Position	*No. of Personnel*
Project Manager	1
Quarry Supervisor (Mining Engineer)	1
Grade Control Engineer (Mining Engineer)	1
Operation Supervisor	3
Mine Planner	1
Drill and Blast Engineer	1
Operation Foremen	3
MEPEO	1
Pollution Control Officer	1
Forrester	1
Community Relation Officer	1
COMREL Assistant	1
Safety Engineer	1
Rental Coordinator	1
Project Nurse	1
Accounting Staff	1
HR Staff	1
Bulldozer Operator	1
Loader Operator	1
Backhoe Operator	2
Dump Truck Drivers	10
Grader Operator	1
Driller	1
Drill Helper	1
Blasting Engineer	1
Shot firer	3
Blasting Helper	15
Heavy Equipment Mechanic	1
Tire man	1
Helper Mechanic 2	2

Position	*No. of Personnel*
Fuel Truck Driver	1
Service Driver	1
Lube man	1
Water Truck Driver	1
Utility/Helper	7
Billing Clerk	1
TOTAL	**61**

1.9 Project Costs

The proposed project is an extension of the current quarry operations of the company. All the equipment and support facilities are erected and the required personnel requirement are on board.

	Annual Capacity	*Operating Cost*
Year 1	3,000,000.00	297,000,000.00
Year 2	3,500,000.00	346,500,000.00
Year 3	4,000,000.00	396,000,000.00
Year 4	4,000,000.00	396,000,000.00
Year 5	4,000,000.00	396,000,000.00
Year 6	5,000,000.00	495,000,000.00
Year 7	5,000,000.00	495,000,000.00
Year 8	6,500,000.00	643,500,000.00
Year 9	6,500,000.00	643,500,000.00
Year 10	7,000,000.00	693,000,000.00
Year 11	7,000,000.00	693,000,000.00
Total	***55,500,000.00***	***5,494,500,000.00***

2.0 ASSESSMENT OF ENVIRONMENTAL IMPACT

2.1 Land

2.1.1 Land Use and Classification

2.1.1.1 Impact in Terms of Compatibility with Existing Land Use

2.1.1.1.1 Municipality of Doña Remedios Trinidad Bulacan[2]

The Municipality is composed of the following general land uses: forest, built-up areas, agriculture and open spaces, quarry area/mined out area, roads and trails, and rivers and creeks (see ***Figure 13*** and ***Figure 14***). Majority of the project area or approximately 70% is covered by the Municipality of Doña Remedios Trinidad Bulacan, the proposed project is located within the forested land use.

Among these land uses, forest comprise the greatest land area. Forests occupy the entire eastern portion of the municipality. This type of land use extends toward Norzagaray on the south, Quezon Province on the east, and Nueva Ecija Province on the north. Some of the forest areas in the municipality are declared as protected areas by the Department of Environment and Natural Resources. The eastern side is designated as watershed reservations (Biak na Bato) while a portion of the western side is under the National Integrated Protected Areas System (Sierra Madre). These parts of the forest areas must be maintained in their protected area status. Meanwhile, the central ship of the municipality running from north to south is mostly allocated for forestry programs of the DENR. Hence, management as well as any alteration in the use of this part of the forest area should be referred and approved first by the department. Aside from this, parts of the designated alienable and disposable area on the western side of Dona Remedios Trinidad, which are currently undeveloped, are also covered with forests. Conversion of forests in the A & D lands must also be properly planned and implemented to maximize the use of the land and to contribute to the general welfare of the municipality and its people. Overall, forests cover a land area of 60,624.85 hectares or 64.82% of the total land area of the municipality.

Following the forests in terms of most land areas covered are agriculture. Based on maps provided by the Municipal Planning and Development Office and satellite images identifying existing agricultural lands, the municipality has 17,195.45 hectares or 18.38% of total land area. The westernmost portions of Dona Remedios Trinidad are also observed to have more of this type of

[2] *Source: Volume 1 Comprehensive Land Use Plan of Doña Remedios Trinidad*

land use than the central and eastern portions. The lower elevation and gentler slope in this part of the municipality as compared to the central and eastern parts are possible reasons for this trend in land use. Human interference is greater when elevation is lower and when the slope is not that sleep. Also, more activities can be done in these areas, in this case the western portion of the municipality which would affect the land uses.

Built-up areas are scattered sporadically on the western portion of the municipality. These areas are either situated in a linear fashion along the major roads as in the case of Barangay Pulong Sampaloc, or in clusters as can be seen in Barangays Camachile and Sapang Bulak. Built-up areas in the municipality are composed mostly of residential units, while some are used for institutional and commercial purposes. Most built-up areas in Dona Remedios Trinidad are situated side by side with agricultural areas and open spaces. This reveals that one of the main sources of income for the residents of the municipality is farming.

In terms of location, greater number of settlements and denser built-up areas can be seen on the western part of the municipality, because it is declared as alienable and disposable land. Moreover, the elevation on this part is lower and the slope is gentler, so building of structures in this part is easier and less costly. Furthermore, existing roads, which flank the western side of the municipality, also facilitate construction on this portion. Meanwhile, smaller pockets of settlements can also be observed in the central areas of Dona Remedios Trinidad towards the forest areas, and are also located along roads, trails, and rivers. These settlements may be owned by families whose source of income is the forest and its products. Almost 3.36 percent of the land area of the municipality is designated as built up areas or a total of 335.57 hectares.

Patched of land with observable removal of the vegetation and topsoil can be seen in some parts of the municipality. These are assumed to be sites of mining and quarrying operations. Covering a land area of 1,135.88 hectares or 1.21%, these extractive land uses are located on the western and central portions of Dona Remedios Trinidad, usually interspersed inside forest areas or adjacent to open spaces. It can also be observed that most of these sites have their own service roads or trails especially created to cater to the needs of their operations.

It can be observed that Dona Remedios Trinidad is full of interconnected rivers, creeks, and other surface water bodies. Most notable and the largest of these is the Angat Watershed that is located at the southern central portion of the municipality and stretches towards the Municipality of Norzagaray. This type of land use has a land area of approximately 7,785.69 hectares, covering 8.32% of the territory of the municipality. These rivers act as natural barriers dissecting the vast territory of the municipality into smaller and manageable land areas. These can be used as basis for setting up of boundaries for the different barangays in the municipality.

Roads and trails connecting the barangays and settlements of Dona Remedios Trinidad are another type of general land use in the municipality. The major road stretches from north to south on the westernmost portion of the municipality. Meanwhile, some of the roads also connect Dona Remedios Trinidad to other municipalities such as Angat, San Ildefonso, and San Miguel. Some trails are also used by residents to travel back and forth from DRT to other municipalities and vice-versa. Minor roads and trails then branch out from this major artery moving towards the municipality's eastern and mountainous side. Most of these trails lead towards pockets of settlements whose inhabitants choose to stay near the forest, which is the source of their livelihood. On the other hand, mining and quarrying sites are located at the end of some of the trails. Consequently, these trails may be created by the operators of these sited for the specific purpose of transporting the extracted materials from the mining and quarrying sites. The total occupied land area of the type of land use is 814.79 hectares, which is 0.87% of DRT.

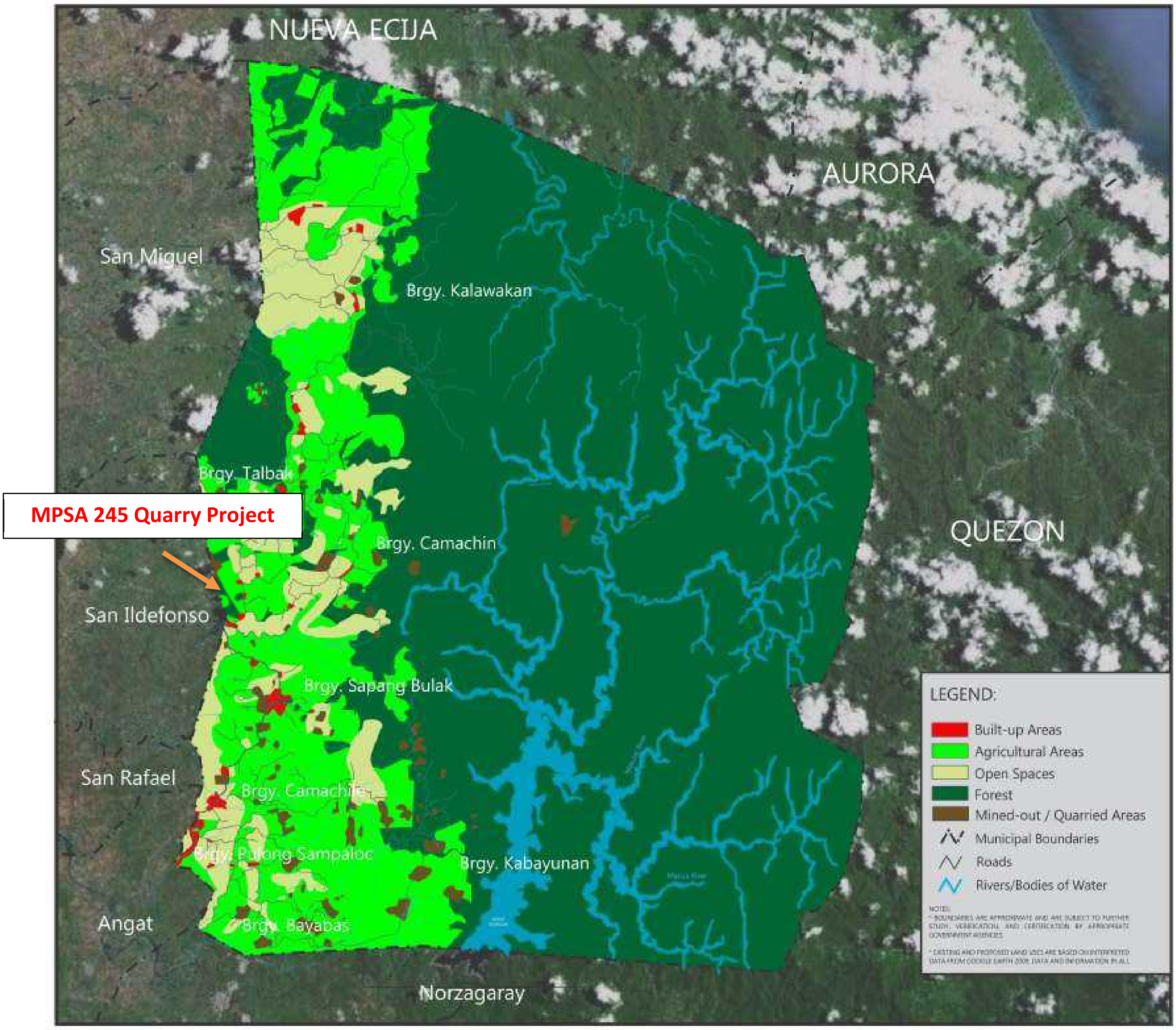


Figure 13 - Land Use Map of Dona Remedios Trinidad

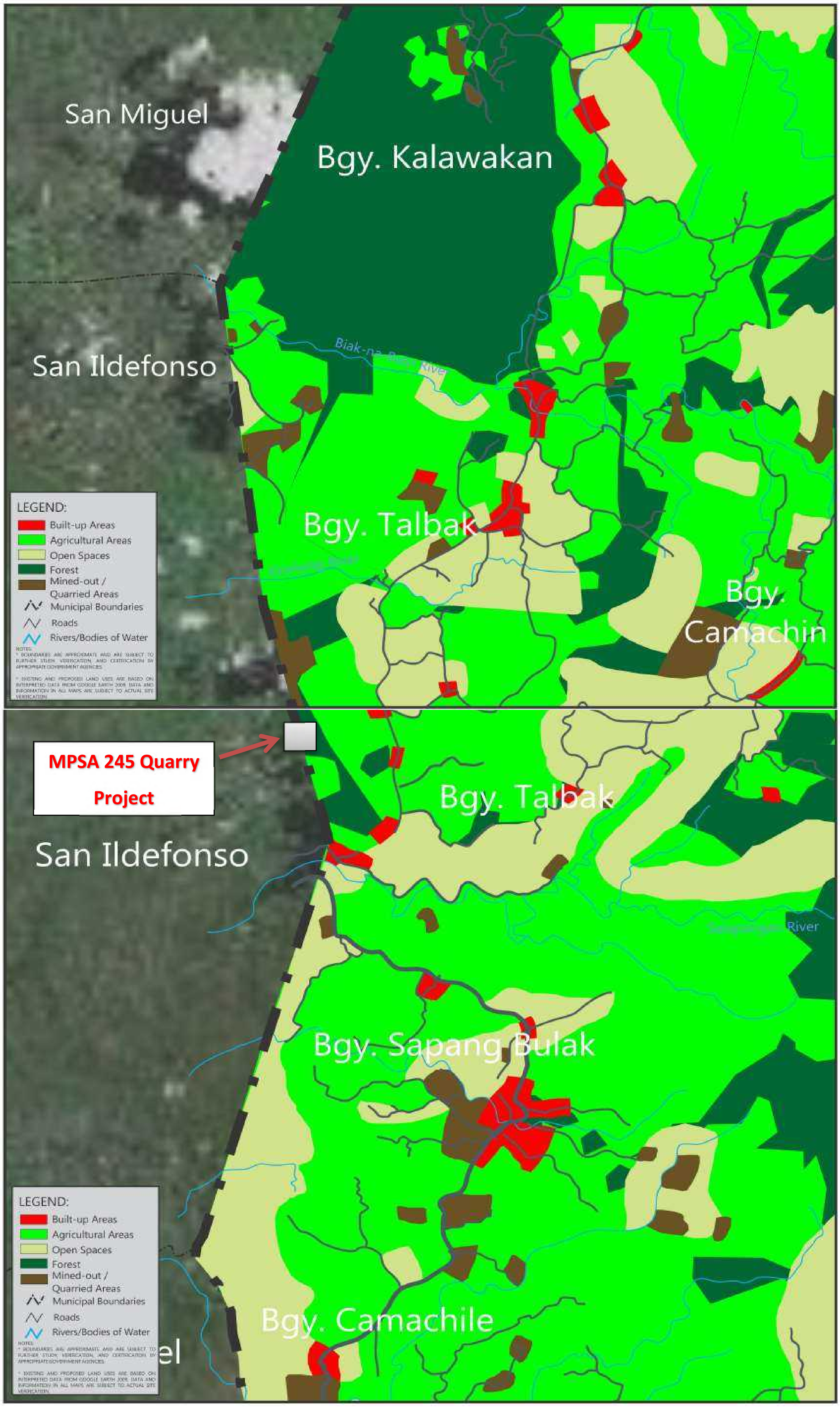


Figure 14 - Land Use Plan of Barangay Talbak DRT

2.1.1.1.2 Municipality of San Ildefonso

Majority of the area of San Ildefonso Bulacan is dedicated for agriculture and farming. The proposed project is located on the southwest portion of the municipality straddling the boundary between Barangay Akle and Municipality of Doña Remedios Trinidad encompassed by forest land (***Figure 15***). As of July 2019, Municipal Office of San Ildefonso Bulacan is yet to have an approved CLUP.

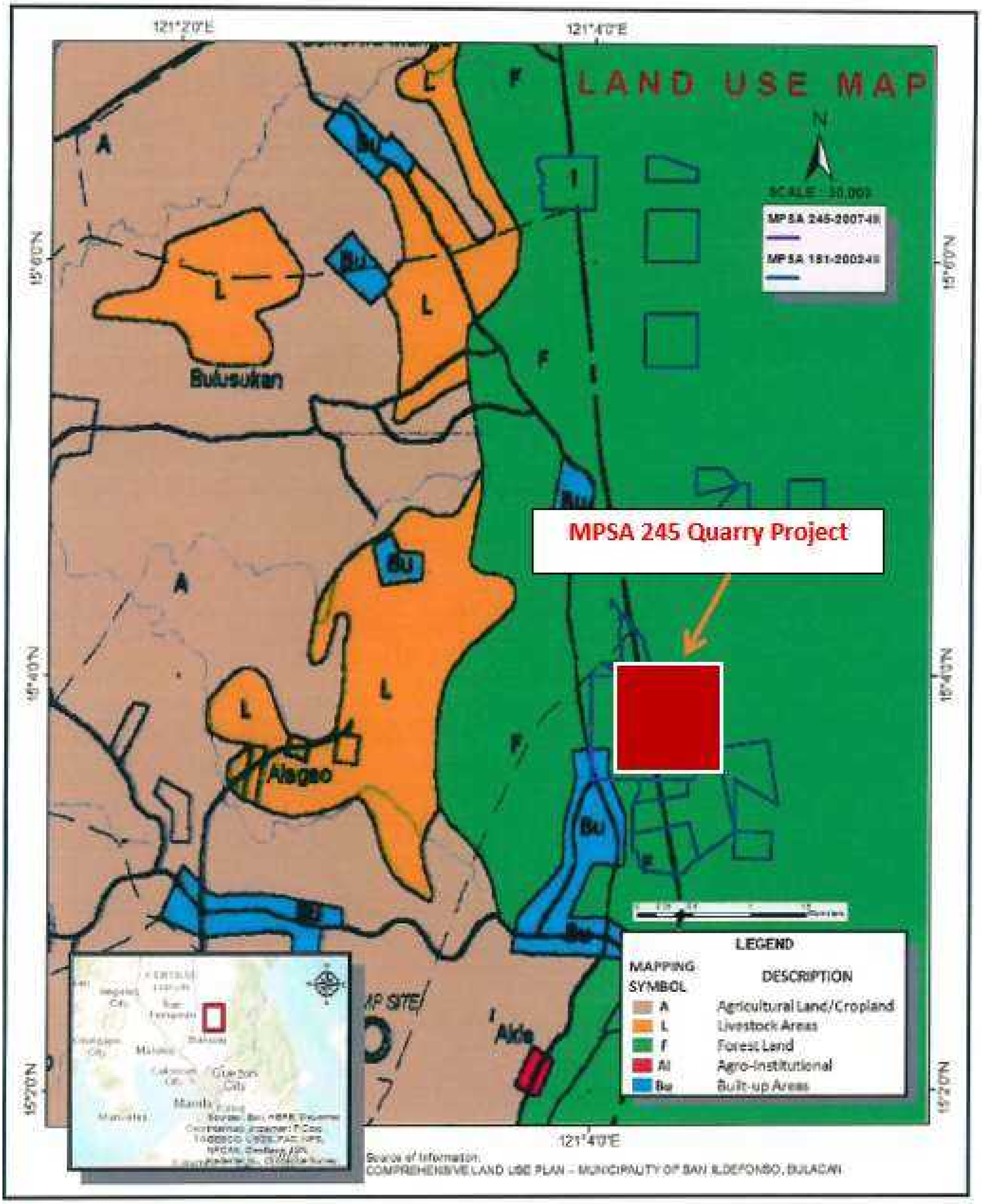


Figure 15 - Land Use Map of San Ildefonso Bulacan

2.1.1.2 Impact on Compatibility with Classification as an Environmentally Critical Area

The proposed project area is non-ECA as compared with the categories stated in MC 2014-005. In the province of Bulacan there are two areas declared by law as National Park namely Angat Watershed and Biak na Bato. Angat Waterdhed is approximately situated 15 kilometers away from the project, while Biak na Bato is located in San Miguel Bulacan with a distance of about 7 kilometers from the project.

Based on the protected area map of Bulacan ***Figure 16***, the location of MPSA 245 is classified as "non-agriculture uses"

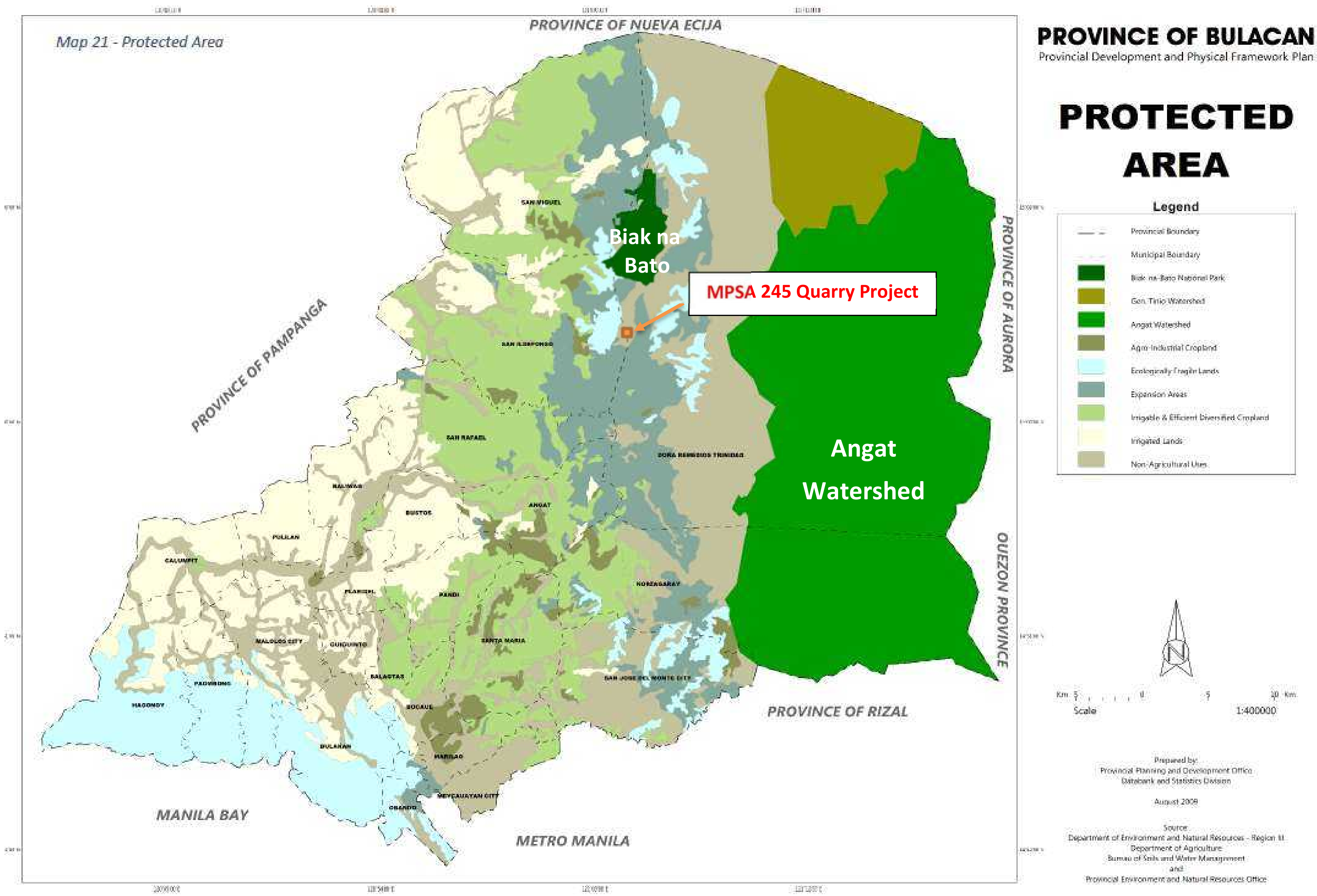


Figure 16 - Protected Area Map of Bulacan

2.1.1.3 Impact in Existing Land Tenure Issues

There are no known CARP areas/CARP-related issues within the project area.

2.1.1.4 Impairment of Visual Aesthetic

The quarrying activities will have permanent and irreversible impact on the slopes and natural topography of the MPSA area. It will require the removal of vegetation from the active mining area and the eventual excavation of mineral thereat. These changes will be confined within the MPSA area which is far from the community.

The progressive rehabilitation program of the project will ensure the re-greening of the area according to its final landform design. Careful planning and timely execution of environmental plans shall be observed by the company to safeguard not only the interests of stakeholders, but also the environment. Good housekeeping will be done along with the implementation of the reforestation program. This will contribute to the maintenance of a tidy and a well-preserved working environment.

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

During pre-operation and operation stage of the project, loss of vegetation and topsoil removal will be unavoidable to make way for the development of access road, settling pond and quarry operation, thus, solid waste generation would increase during the mentioned activities.

To alleviate the impact of solid waste to Materials recovered from vegetation removal can be utilized as:

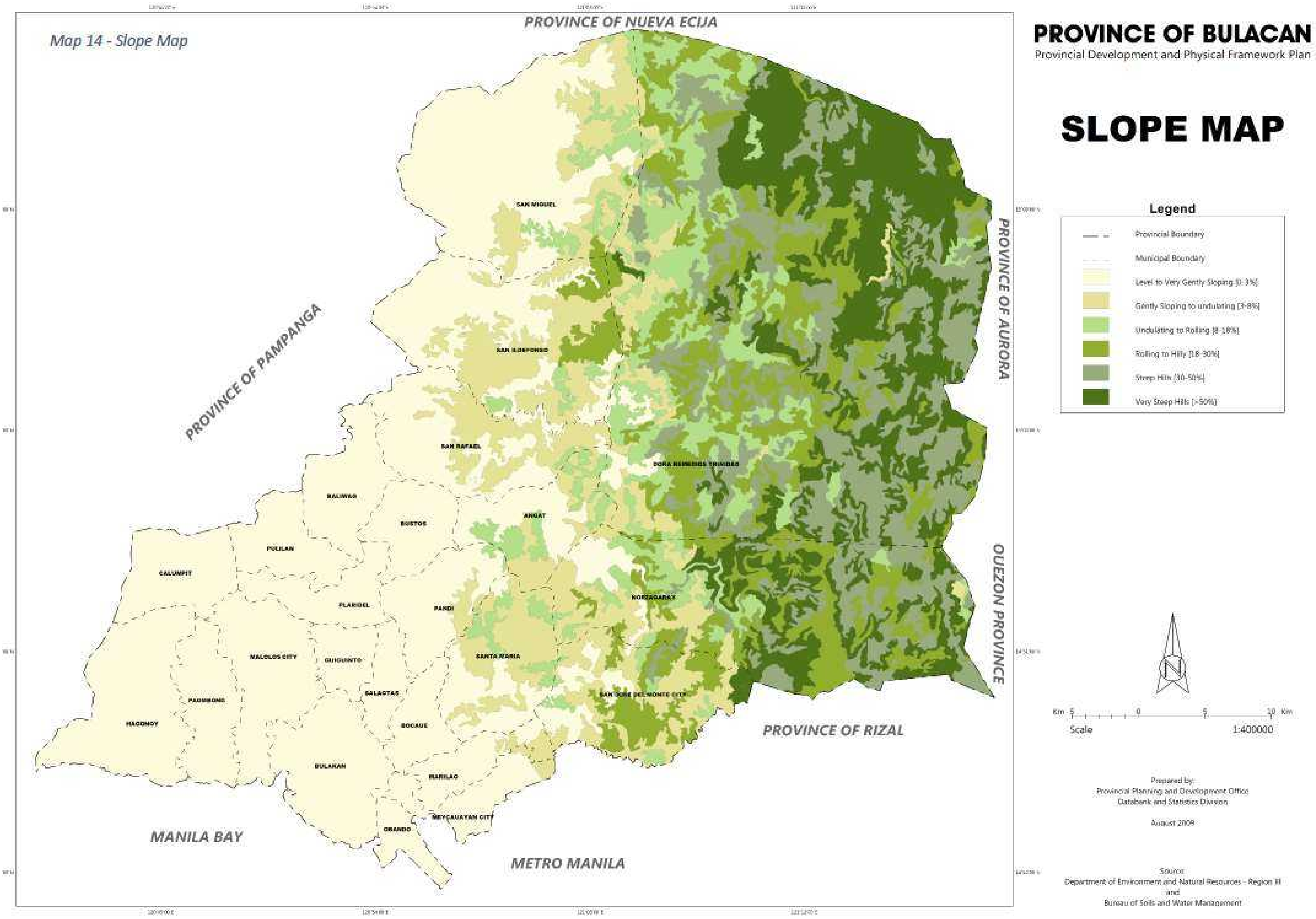
- Trash lines on steep slopes to mitigate soil erosion
- Compost material/surface mulch for immediate soil cover and for improving SOM content of soils
- Chipping of cut trees and using the chipped material as a growing medium for rehabilitation

2.1.2 Geology/Geomorphology

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

2.1.2.1.1 Terrain/Physiography

The topography of the permit area ranges from 100 meters to 160 meters above mean sea level. The lower elevation is dominated by rolling topography with protruding limestone bodies that are either in-situ or product of collapsed limestone boulders.



Source: Provincial Development and Physical Framework of Bulacan

Figure 17 - Slope Map

2.1.2.2 Change in Sub-surface Geology/Underground Conditions

2.1.2.2.1 Reginal Geologic Setting[3]

The municipalities of San Ildefonso and DRT, where the project site is located, are in the northern part of eastern Bulacan. In the vicinity of the western foothills of Southern Sierra Madre range and the edge of the north trending Central Luzon Basin. The basement of the Southern Sierra Madre mountain range consists principally of Late Cretaceous ophiolitic rocks. Dioritic intrusions that commenced in, Middle Eocene time formed batholitic masses from Isabela in the north to Aurora province in the south. Magmatic activity that persisted up to Late Oligocene gave rise to stocks of quartz diorite, diorite and alkali rocks. Magmatism is associated with the subduction of the West Philippine Basin along the ancient East Luzon Trough during the Paleogene period, that was driven, by seafloor spreading from the Central Basin Spreading center. Subduction ceased at the closed of the Paleogene with the accretion of Banham Rise (rafted towards eastern Philippines by the seafloor spreading) the eastern margin of northern Luzon. Since the accretion of Benham Rise, no subduction-related magmatism has taken place in the eastern strip of Northern Luzon.

Sedimentation took place in the areas covered by the Southern Sierra Madre with the onset of the Cenozoic era. The Paleogene period was a time of deposition of limestones, clastic sedimentary rocks, volcaniclastic rocks, volcanic flows, and pyroclastic rocks. During the Neogene period, after the cessation of subduction beneath the eastern section of northern Luzon, sedimentation gave rise to limestone and clastic sedimentary rocks.

Bulacan province partly occupies the edge of the eastern part of Central Luzon Basin. The sedimentary sequence that constitutes the eastern part of the basin came from the uplifted portions of what is now the southern Sierra Madre range. The sedimentary rocks comprising the western flank of the basin us derived from the rocks underlying the Zambales Range on the western part of Luzon (**Figure *18***).

[3] Source: Final Exploration Report MPSA 245

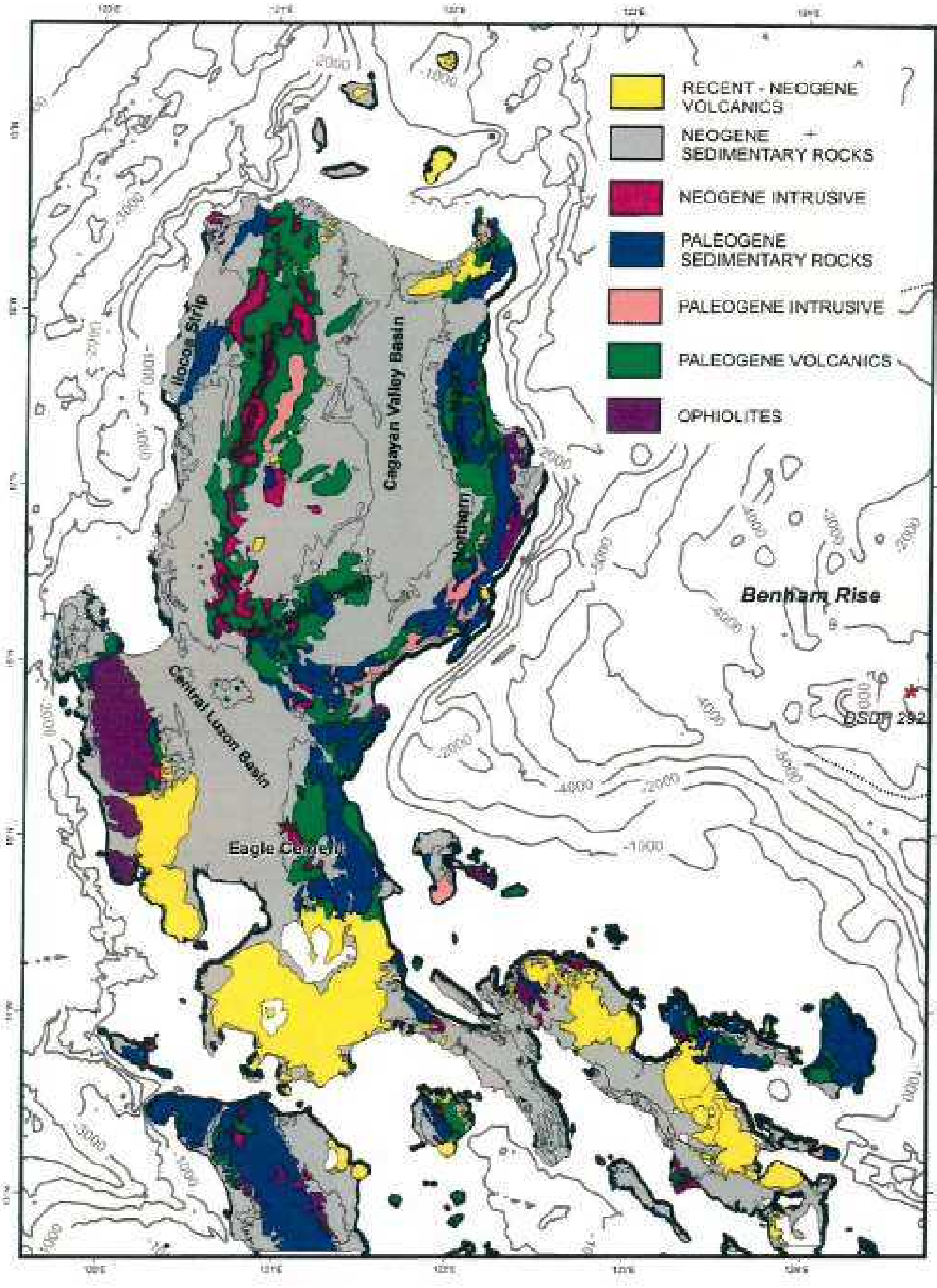


Figure 18 - Geologic Map of Northern Luzon showing approximate Location of Eagle Cement Project in Bulacan

2.1.2.2.2 Stratigraphy[4]

The main Central Luzon Basin, located between the Zambales Range and Southern Sierra Madre, is composed of two different sedimentary packages. The eastern half is composed of rocks derived from Sierra Madre range, while the western half were deposits sourced from Zambales range (fig)). However, since a portion of the Central Luzon Basin extends north to connect with the Ilocos Trough, the rocks in this northern extension were derived from the Central Cordillera.

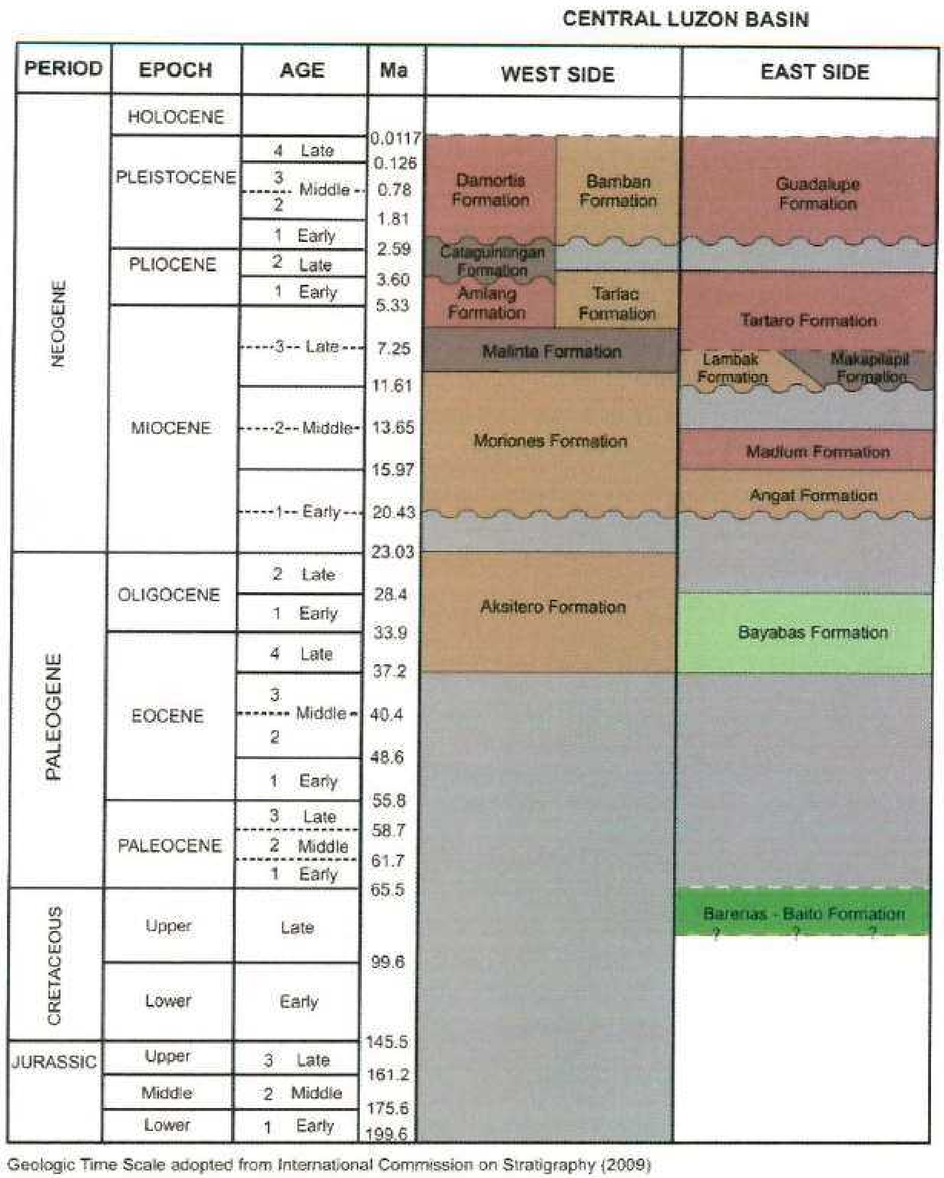


Figure 19 - Stratigraphic Column for the Central Luzon Basin. Note the Differences Between the East and West Sides.

[4] Source: Final Exploration Report MPSA 245

On the western flank of Central Luzon Basin, which includes the province of Bulacan, the basement consists of the volcanic and sedimentary carapace of the ophiolite which is represented by the **Barenas-Baito Formation** and the **Bayabas Formation**. The Late Cretaceous Barenas – Baito Formation is composed of volcanic flows and breccias with intercalated thin to medium bedded sandstones, siltstones and argillites and subordinate chert and conglomerate lenses. It is best exposed along Bernas and Baito creeks in Norzagaray, Bulacan. Overlying the Barenas-Baito northern of Norzagaray are andesite flows, pyroclastic rocks and tuff breccias with sand-siltstone interbeds and occasional conglomerate and limestone lenses that make up the Late Eocene-Early Oligocene Bayabas Formation. Late Eocene quartz diorite, probably equivalent to the **Sta. Ines Diorite** is overlain by the Bayabas and Angat formations. Quartz diorite intrusive bodies of batholithic scale is widespread on the eastern flank of the southern Sierra Madre range.

The sedimentary unit occupy the bottom of the basin is the early Miocene **Angat Formation**, which unconformably overlies the Bayabas Formation. It consists of a comparably thin sequence of lower clastic member and a thick upper limestone member. The lower member is mainly composed of thin beds of calcareous mudstones and clayey sandstones with sandy limestone lenses. The upper limestone member is a reefal limestone characterizes by a lower reef flank deposit and upper biohermal mass. Gonzales and others (1971) estimate a maximum thickness of more than 800 m at the Mt. Nablo area. Measured sections total around 410m along Bayabas River and 400 m along Baliculing River in the Biak-na-Bato area. It is approximately 100 m along Madium River and 20 – 50m in the Sumacbao area (Gonzales and others, 1971)

Conformably lying above the Angat Formation is the Middle Miocene **Madlum Formation**, consisting of three members, namely – lower clastic member, Alagao Volcanics and Buenacop Limestone. The sequence of shale, siltstone, sandstone and conglomerate exposed along Madlum River in San Miguel, Bulacan make up the lower clastic member. The measures thickness in this type locality is 1,005m but it could be more (Gonzales and others, 1971). The middle Alagao Volcanic member consists of andesite flows, pyroclastic bressias, tuff, argillite and greywacke which is well exposed along the San Ildefonso-Akle road in San Ildefonso Bulacan. The thickness along Bayabas River is 175 m but is much thicker along Angat River to the south (Gonzales and others, 1971). The pyroclastic breccias, the prevalent rock type, contain angular to surrounded cobble to boulder sizes of andesite, basalt and other volcanic rocks set in a tuff matrix (MGB, 2010).

2.1.2.3 Inducement of Subsidence, Liquefaction, Landslide etc.

2.1.2.3.1 Flooding

Flooding, which is the temporary covering of land by water outside of its natural or normal confines, greatly affects Bulacan. Heavy rains and tidal flooding are the principal causes and the affected areas are generally low-lying with relatively flat slopes making water run-off to be slower/receding time longer towards the natural drainage and streams. Silted river systems and clogged waterways contribute or aggravate to the rapid flood water rise during heavy rains.

Based on the geohazard map visualization (***Figure 20***) from the Mines and Geosciences Bureau, the area proposed project area is not susceptible to flooding since the location of the project in an upland area.

The amount of rainfall that will trigger flooding (frequent events) in Bulacan was arrived at 160.5 mm/day. The return period for frequent flooding event is estimated at two (2) years while the rare event of flooding is estimated around 20 years.

Table 5 - Frequent Flooding Events

Flooding Event	*Return Period*
Frequent	2
Likely	15.78
Rare	41.96

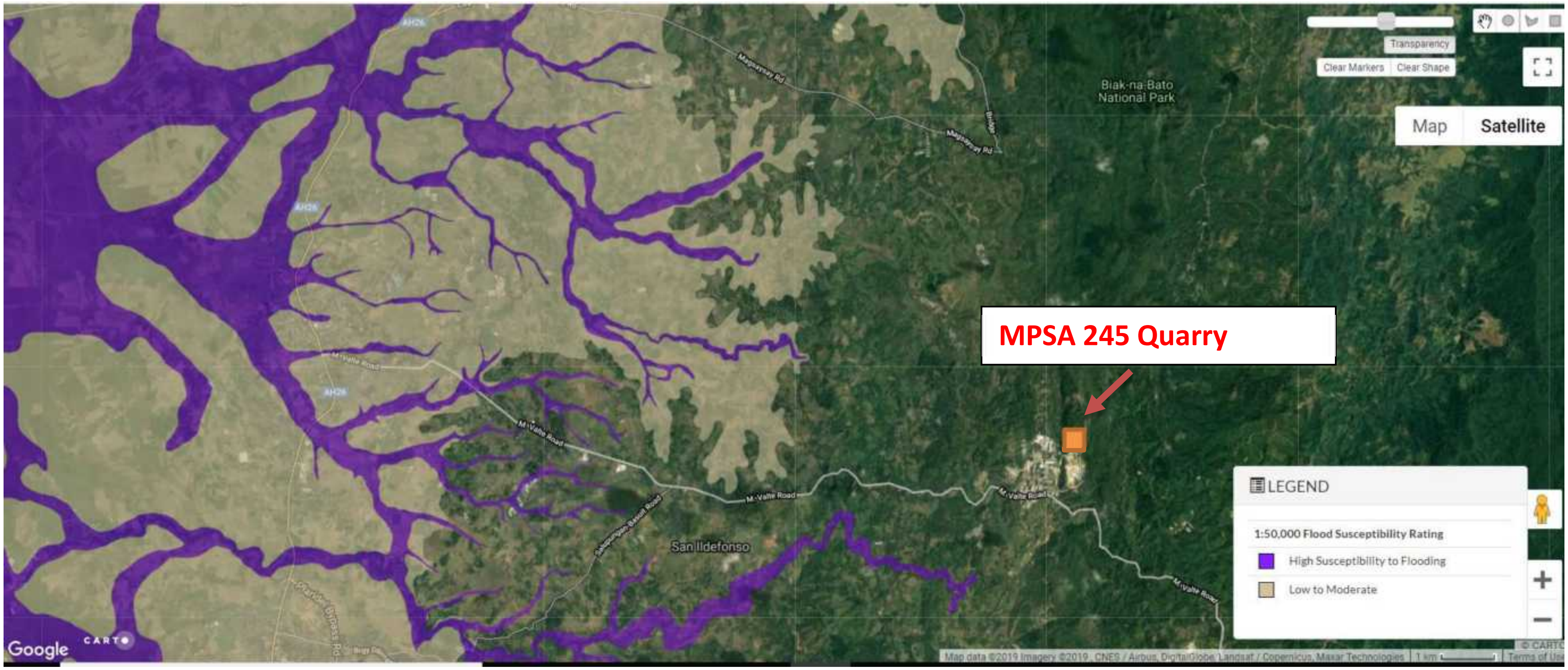


Figure 20 - Flood Susceptibility Map

Source: Mines and Geosciences Bureau website

2.1.2.3.2 Rainfall-induced Landslides

Rainfall-induced landslide refers to the usually sudden downward movement of loosened materials (rock and earth) due to rain. This also includes displacements and flows which occur in unconsolidated soil materials though highly localized, it can be particularly hazardous due to its frequency of occurrence. Mudflows are flows of rock, earth and other debris saturated with water which develop when water rapidly accumulates in the ground such as during heavy rainfalls, changing the earth into a flowing river of mud. This can flow rapidly down the slopes or through channels and can strike with little or no warning at avalanche speeds.

Based on the geohazard map visualization (***Figure 21***) from the Mines and Geosciences Bureau, the upland areas on the eastern side of the province showed the town of Dona Remedios Trinidad is characterized by moderate to high susceptibility rain-induced landslides.

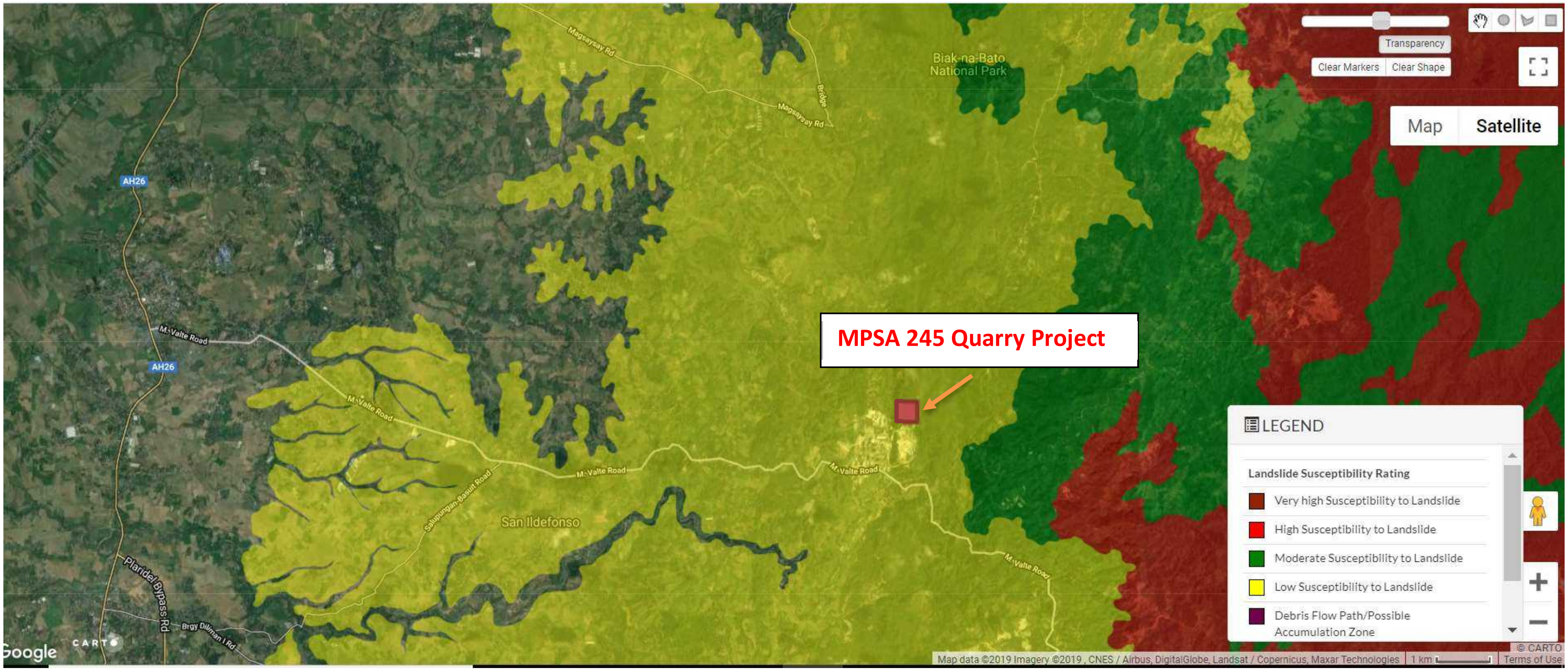


Figure 21 - Rainfall Induced Landslide Map

Source: Mines and Geosciences Bureau website

2.1.2.3.3 Ground Shaking

The ground shaking hazard map showed that Bulacan is susceptible to strong Intensity VIII earthquake which is classified as very destructive based on the PHILVOLCS Earthquake Intensity Scale (PEIS).

The province had experienced seven earthquakes for the past 400 years that caused significant damage. The 1645 and 1990 earthquake recorded nearly the same magnitude at 7.8 and 7.9 respectively. The historical data shows that Bulacan is prone to strong earthquakes which have resulted to damages of great extend and fatalities. To minimize the impact of ground shaking given that there will be a recurrence is slope stabilization.

2.1.2.4 Impact Management

Change in topography is inherent to any surface mining activity. Activities that would generate the most significant impact to geology and geomorphology are the site preparation (i.e. overburden removal and grading) and the quarrying activity itself.

To minimize the impact on the natural topography, mining activity will be conducted in conformance with the mining plan and bench parameter of at least 3m bench width and minimum of 10m bench height. The mined-out areas will be recontoured following the topography. The contours shall be appropriately designed (catch bench width, bench height, bench angle, general slope angle, slope height, etc.) based on the geology of the area and on the original land configuration of the area to be quarried.

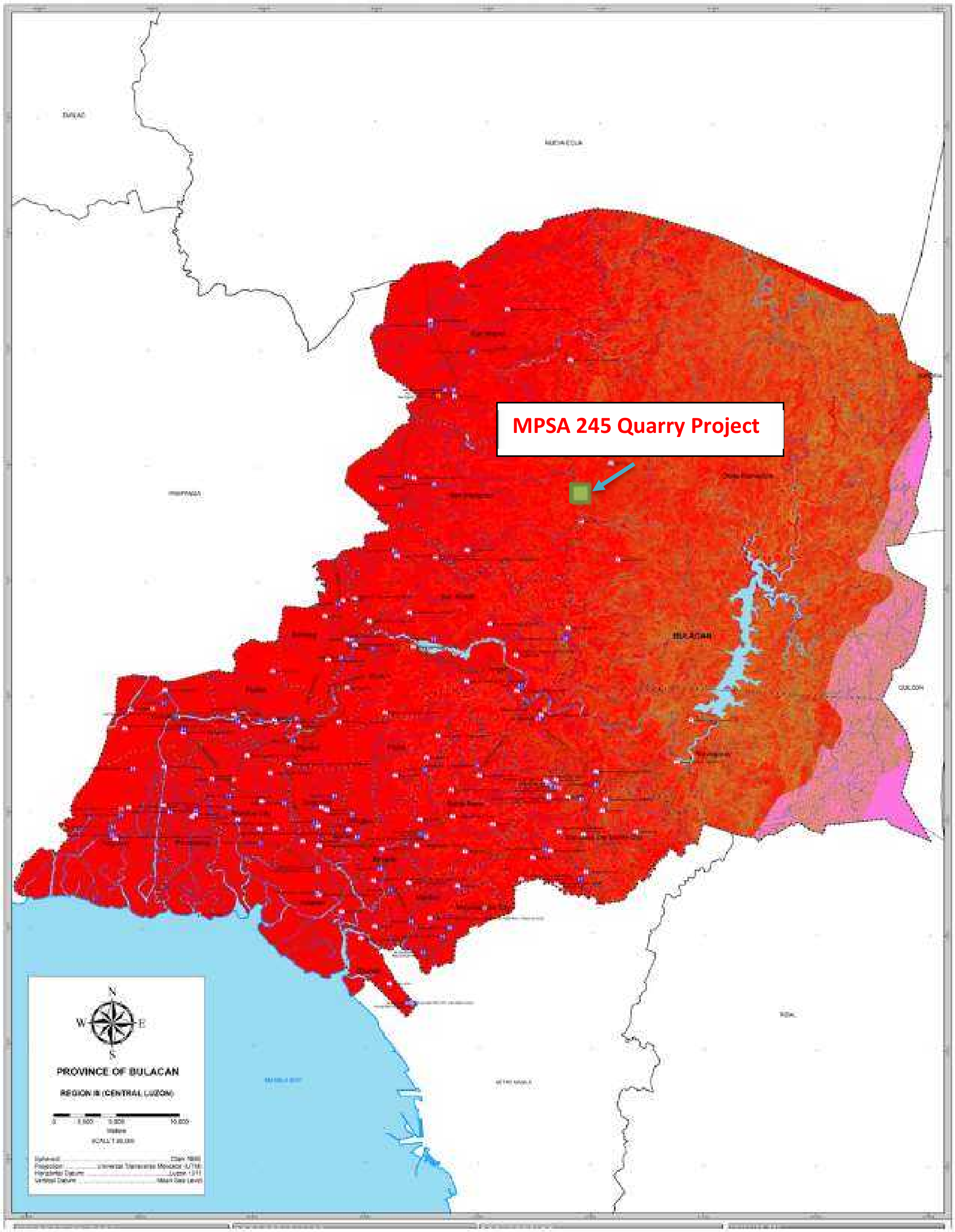


Figure 22 - Ground Shaking Hazard Map of Bulacan

2.1.3 Pedology

2.1.3.1 General Description of the Province of Bulacan

2.1.3.1.1 Location and Extent

Bulacan province is one of the provinces comprising the Central Plain of Luzon. It contains a total area of about 267,200 hectares which also includes the town of Valenzuela, now integrated to Metro Manila. The southern tip of the province is about 17 kilometers north of Manila. The town of San Miguel is the northernmost town of the province, is about 75 kilometers from Manila.

Bulacan lies approximately between 14^0 40’ 10” and 15^0 15’ 50” north latitude and between 120^0 38’ 10” and 121^0 20” 00” east longitude. It is bounded by Nueva Ecija on the north, Quezon province on the east, and Rizal province on the south. The western portion is bounded by Manila Bay and Pampanga Province. Malolos, the capital is about 45 kilometers, or 30 minutes trip by car or bus from Manila.

2.1.3.1.2 Relief and Drainage

The province is divided into five (5) major landscapes. Adjacent to Manila Bay to its north and east is the level to nearly level swampy coastal landscape. The Nearly level broad alluvial terraces and depressions which is located further inland comprises the upper Candaba Swamp and flood plains. These landforms have an elevation of less than 20 meters above mean sea level (MASL).

The higher piedmont landscape which is 30 – 100 meters above mean sea level have dominantly undulating to rolling topography. This landscape is located further inland towards the east and it runs from north to south of the province. Still located more inland to the east are the conglomeratic, volcanic and limestone hills and ridges. Their elevation generally ranges from 100 – 300 (MASL).

The towering volcanic mountains with an elevation of 300 meters or more occupies the eastern half of the province. The highest mountain peak, Mt. Oriod, has an elevation of about 1, 170 meters above mean sea level.

Several rivers and their tributaries serve as the principal drainage system of the province. The two largest rivers, the Angat and Pampanga Rivers, drain the central part. Other smaller rivers such as Meycauayan, Guiginto, Labangan, Marilao, Bocaue and, Bigaa Rivers drain the southern portion. The numerous tributaries of Pampanga River serve as outlet for excess water and run-off in the coastal areas. All these river systems have their exit at Manila Bay to the west.

2.1.3.1.3 Agriculture, Land Use and Vegetation

Bulacan is primarily an agricultural area. The most common crops grown are rice, corn, vegetables (string beans, tomatoes, eggplant, bitter gourd, squash, pechay), root crops (cassava, sweet potato, upland taro, radish) water melon and tree crops (mango, atis, avocado, papaya, calamansi, pomelo, caimito).

Rice comprises the most extensive cultivated crop. Corn serves only as a secondary crop. It is commonly grown as green corn, vegetable or animal feed. The main corn areas are located in the towns of Angat, San Jose Del Monte, Norzagaray and San Miguel.

Watermelon has been grown in commercial scale in the towns of Sta. Maria, Marilao, Bocaue and Norzagaray. This crop is planted in rotation with rice.

The tree crops most commonly grown are mangoes, atis, avocado, chico, papaya, calamansi and caimito. Of these, mango is the most important and grown most extensively.

The swampy areas along Manila Bay are mainly devoted for fishpond. Some of these areas are vegetated with nipa or mangrove trees. The swampy areas are situated in Obando, Bulacan, Malolos, Paombong and Hagonoy, the coastal towns.

The rolling to hilly areas ere dominantly idle, open grassland or brushland. Only limited area is cultivated to annual upland crops. Tree crops mostly in small patches are also common. Grasses, bushes, secondary or tertiary growth forest comprises the major vegetative cover of the eastern mountainous portion of the province. Only a small portion is left as virgin forest due to continuous and indiscriminate logging.

2.1.3.2 The Soils of Bulacan Province

2.1.3.2.1 General

The soils of Bulacan Province are composed of twenty-four (24) soil series and one (1) soil variant consisting of seventy-two (72) soil mapping units and five miscellaneous land types (Soil Survey Report Bulacan Province 1987). Their extent and corresponding percentage are shown in ***Table 6***. The twenty four (24) soil series recognized and mapped are: 1) Matimbo, 2) Obando, 3) Masantol series of the coastal landscape; 4) San Fernando; 5) Corgante; 6) Bigaa; 7) Bantog; 8)Tagulod; 9)

Kapalangan; 10) Quingua, 11) San Manuel, 12) Gapan, and 13) Peñaranda series of the alluvial landscape; 14) Mysan, 15) Pulong Buhangin; 16) Batis; 17) Awayan; 18) Prensa; 19) Mahipon; and 20) Kalayakan series of the piedmont landscape and 21) Paradise; 22) Novaliches; 23) Kay Bamban and 24) Sibul series of the Hilly landscape. The miscellaneous land types include the 1) clayey tidal swamp; 2), loamy tidal swamp; 3) mucky swamp; 4 rivers and streams; and 5) mountainous land.

Table 6 - Area and Percentage of Soil Series and Miscellaneous Land Types of Bulacan Province[**]

A. Soil Series	Area in (Has)	Percent (%)
Dolongan[*]	382.5	0.14
Matimbo	1,702.5	0.64
Obando	592.5	0.22
Masantol	3,532.5	1.32
San Fernando	1,262.5	0.47
Corgante	537.5	0.21
Bigaa	1,075.0	0.40
Bantog	5,942.5	2.22
Tagulod	21,706.3	8.13
Quingua	8,957.5	3.35
San Manuel	6,647.5	2.48
Gapan	407.5	0.15
Peñaranda	662.5	0.25
Kapalangan	842.5	0.31
Mysan	2818.3	1.05
Pulong Buhangin	6,207.2	2.33
Batia	13,226.3	5.91
Awayan	26,803	10.04
Prensa	3,157.5	1.18
Mahipon	825.5	0.31
Kalayakan	1,005.0	0.38
Paradise	7,464.8	2.79
Novaliches	3,331.3	1.25
Kay Bamban	5,488.8	2.06
Sibul	21,526.3	8.05
B. Miscellaneous land Type		
Rivers and Streams	3,914.7	1.47

A. Soil Series	Area in (Has)	Percent (%)
clayey tidal swamp	3,387.5	1.27
Loamy tidal swamp	4,122.5	1.54
Mucky tidal swamp	9,720.0	3.64
Mountainous land	92,022.5	34.44
GRAND TOTAL	**267,200.0**	**100.0**

** Variant*

*** Source: Soil Survey and Classification of Bulacan Province (1987)*

2.1.3.3 Soils of the Project Area

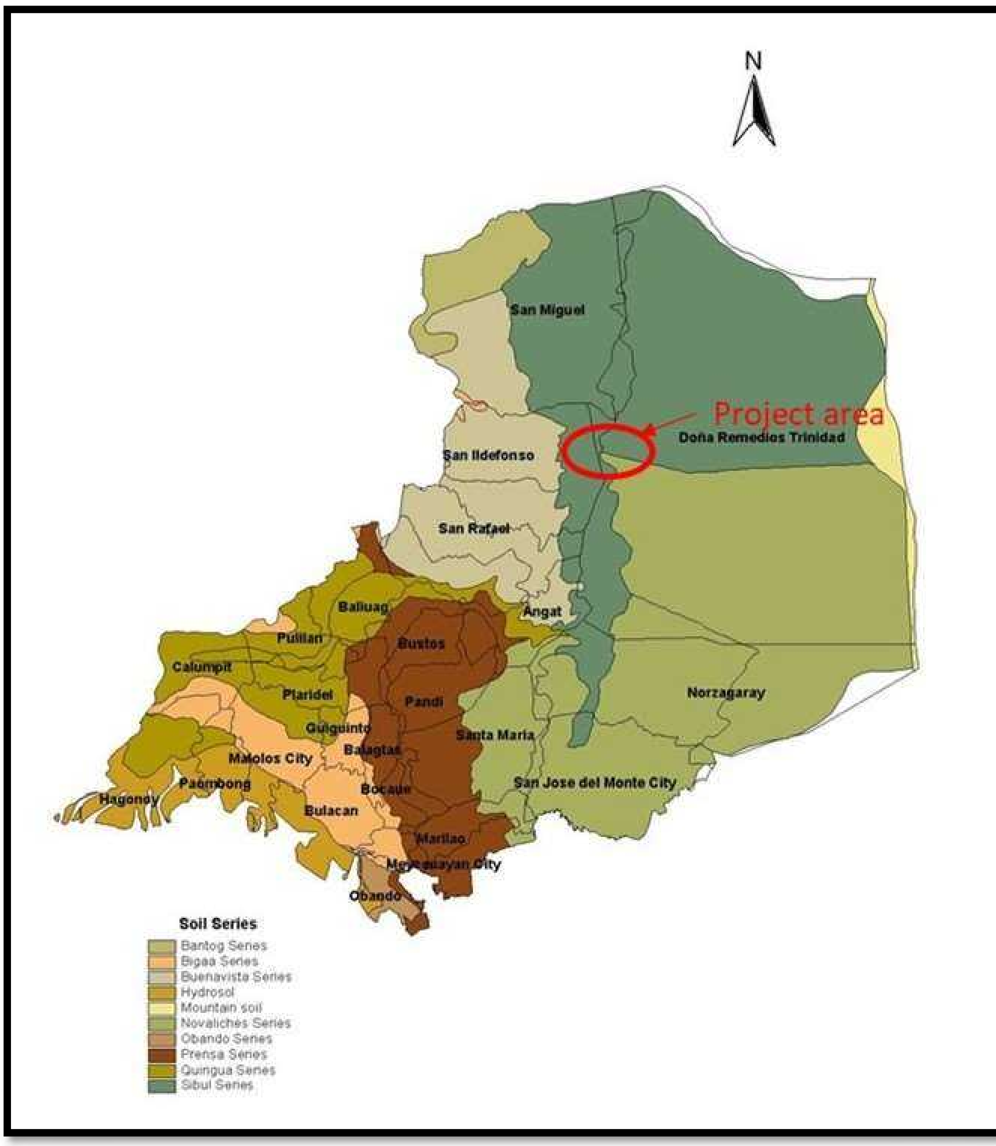


Figure 23 - Soil Map Showing the Soil Series of The Project Area

The soils of the project area as mapped by the BSWM (1987) belongs to the Sibul series (***Figure 23***).

The Sibul series consists of moderately deep to deep well drained fine clayey soils that occur on sloping to rolling moderately dissected rounded limestone foothills or on steep to very steep limestone hills and ridges of the hilly landscape.

In a representative profile of Sibul series, the surface layer 24 cm thick has light yellowish brown, clay in texture. The subsoil; (argillic horizon) to a depth of 120 cm is light yellowish brown to brown silty clay, clay loam or clay with strong medium angular blocky structure breaking to subangular blocky structure common small and medium soft limestone fragments occur in the middle and lower subsoil. The substratum is yellowish brown sticky, plastic, firm clay. Common medium soft weathered tuff rock fragments occur in this layer.

These soils have low organic matter content and moderate inherent fertility. Available phosphorus is moderate but high in exchangeable potassium and base saturation. Available moisture holding capacity is also moderate. Soil reaction is medium acid. Salinity level poses no problem for normal plant growth.

The Sibul series is relatively extensive consisting of approximately 21,526.3 hectares or 8.05 percent of the total area of the province.

A representative profile of Sibul series in an area with an open grassland vegetation in the town of Norzagaray (121^0 05’ 51’’ E and, $14^0$52’ 13” N) has the following morphological, physical and chemical characteristics:

Horizon	*Depth (cm)*	*Description*
A	0 – 24	Light yellowish brown (10YR 6/4) dry, clay; no mottles; weak common medium angular breaking to subangular blocky structure; no concretion; sticky, plastic when wet, firm; common very few fine roots; abrupt clear boundary; pH 6.4.
B1	24 – 63	Light Yellowish brown (10YR 6/4) moist, clay; few fine faint diffuse brownish yellow (10YR 6/6) mottles; sticky, plastic, firm; strong medium angular blocky breaking under pressure to subangular blocky structure; no concretions; very few fine roots; clear wavy boundary; pH 6.4.

Horizon	Depth (cm)	Description
Bt21	63 – 85	Brown (10YR 5/3) mist, clay; weak common medium angular breaking to subangular blocky structure; sticky, plastic, firm; no concretion; common small medium hard angular to subangular gravels; very few fine roots; abrupt clear boundary; pH 6.4
Bt22	85- 120	Brown (10YR 5/3) moist, clay; weak common medium angular breaking to subangular blocky structure; sticky, plastic, firm; few small and medium hard angular to subangular gravel and probably limestones; very few small soft weathered tuff rock fragments; diffuse boundary; pH 6.2.
C	120 – 150	Yellowish brown (10YR 5/4) moist, clay; strong common medium angular blocky breaking under pressure to subangular blocky structure; sticky, plastic, firm; few medium black Mn concretions; common medium soft weathered tuff rock fragments; pH 6.0.

The A horizons, 10 to 30 cm thick, are light yellowish brown, pale brown dark brown, brown or dark grayish brown clay with moderately weak medium angular to subangular blocky structure. The subsoil to a depth of 100 cm are light to dark yellowish brown, brown to dark brown, dark grayish brown or grayish brown clay loam, silty clay loam or clay with occasionally few brownish yellow mottles. Few to common weathered limestone rock fragments occur in the lower subsoil. The stratum is very pale brown, light brown, brown or dark grayish clay or clay loam with common limestone fragments.

The Sibul series is associated with the deeper clayey Bamban soils of the volcanic hilly landscape and the slightly lower clayey gravelly Paradise series of the low elongated conglomeratic and agglomeratic ridges and hills.

2.1.3.3.1 Soil Mapping Units

2.1.3.3.1.1 Sibul Clay, 2.0 to 5.0 percent slopes (SbC), 8,017.5 hectares

This mapping unit occurs on gently sloping to undulating moderately dissected rounded limestone foothills in the mid-northern portion of the province. The most extensive among the mapping units, it occupies about 3 percent of the total area of the Province. Most of the profiles exhibit similar characteristics with that representative profile for the series. Included are slightly steeper and slightly eroded small areas. The main land use and vegetative cover consists of grasses, brushes and, trees.

2.1.3.3.1.2 Sibul clay, 5.0 to 8.0 percent slopes, slightly eroded (SbD1), 1,320.0 hectares.

Mapped in the eastern part of San Ildefonso, this mapping unit occurs on slightly eroded moderately sloping to moderately undulating rounded limestone foothills of the hilly landscape. In most areas, the soil profiles have similar characteristics with that representative profile for the series. Small areas with steeper slopes, shallower soils and with moderate erosion are included under this mapping unit.
The vegetative cover consists principally of grasses, brushes and trees.

2.1.3.3.1.3 Sibul clay, 8.0 to 15.0 percent slopes, slightly eroded (SbE1), 7,477.5 Hectares.

This unit occurs on slightly dissected moderately sloping to rolling rounded limestone foothills at the western boundary of Doña Remedios Trinidad town. This unit constitutes about 2.8 percent of the total area of the province. The dominant soils have similar characteristics with that described representative profile for the series. Small slightly shallower, moderately eroded steeper areas are included in this unit.

Grasses, brushes and tree constitutes the dominant vegetative cover.

2.1.3.3.1.4 Sibul clay, 8.0 to 15.0 percent slopes, moderately eroded (SbE2), 4,902.5 Hectares.

This mapping unit occupies the moderately eroded rolling to hilly limestone areas in the mid-northern portion of the project along San Miguel - Doña Remedios Trinidad municipal boundary. This unit is extensive covering about 1.8 percent of the total area of the Province.

Except in some small areas, most of the soils have similar characteristics with that representative profile for the series. Included are shallower profiles on steeper severely eroded slopes.
Grasses, shrubs brushes and trees comprise the main vegetative cover.

2.1.3.3.1.5 Sibul clay, 15.0 – 25.0 percent slopes, moderately eroded (SbF2), 1,215.0 Hectares.

Located north and south of the Angat river and extending up to Brgy. Bigti to the south and Doña Remedios Trinidad – Norzagary boundary to the north, this unit occurs on rolling to hilly moderately eroded limestone landscape. Mostly, the soil profiles have characteristics similar with that profile representing the series. Included are small areas with shallower soil depth, more eroded and slightly steeper slopes.

The vegetative cover consists mainly of grasses, brushes and trees.

2.1.3.3.1.6 Sibul clay, 25.0 – 50.0 percent slopes, moderately eroded (SbG2), 6, 611.3 Hectares.

This mapping unit occurs on moderately eroded steep to hilly dominantly limestone landscape at the middle northern portion of the project along Doña Remedios Trinidad – San Miguel municipal boundary. The dominant soils have similar characteristics with that representative profile of the series. Some profiles with thinner sola, severely eroded and steeper areas are included.

The main vegetation consists of grasses, shrubs, brushes and trees. This unit comprises about 2.5 percent of the total area of the province.

2.1.3.4 Soil Quality

2.1.3.4.1 Methodology

The proposed project is located in Barangay Akle, Municipality of Sa Ildefonso and, Barangay Talbak, Doña Remedios Trinidad both in the Province of Bulacan covered by MPSA 245-2007- III with a total area of 82.6033 hectares, the proposed project will cover an area of 69.9011 hectares.

The study on soils, and land use covered the review of existing literatures and maps of the project area including the Soil Survey Report (1987), Land Resources Evaluation Project (1987) province of Bulacan, and at the same time relevant records about the Eagle Cement Quarry Project available in Mines and Geo-sciences Bureau (MGB) central office, climatic data from PAGASA were gathered and evaluated.

Ocular observation trip was initially made by the Axceltechs, Inc. Team on the early hours of November 16, 2018. This was followed by a field survey and, the soil sampling activities during the remaining hours of the same day.

The site selection criteria of the four (4) soil sampling locations namely Soil sampling Location 1 (S1), Soil sampling Location 2 (S2), Soil sampling Location 3 (SS3), Soil sampling Location 4 (S4) within the MPSA coverage were made in accordance with the present land use, and slope. The Dominant present land uses of the quarry area were recorded and documented in the form of digital photographs together with its geographic coordinates and is presented in ***Table 7***.

2.1.3.4.1.1 Soil Sampling

2.1.3.4.1.1.1 <u>Undisturbed Soil sampling</u>

2.1.3.4.1.1.1.1 <u>Surface Soil Bulk Density Determinations</u>

Figure 24 - Soil sampling for Bulk Density Using Stainless steel cores

Table 7 - Photograph and Geographic Coordinates and the Present Land Use of the Soil Sampling Locations

S1	*S2*	*S3*	*S4*
Coordinates **N 15^0 04' 03.4"** **E 121^0 04' 31.4"**	**Coordinates** **N 15^0 03' 51.4"** **E 121^0 04' 29.9"**	**Coordinates** **N 15^0 03' 36.9"** **E 121^0 04' 29.0"**	**Coordinates** **N 15^0 03' 32.0"** **E 121^0 04' 26.6"**
 **Land Use:** Predominantly sparsely covered grassland/shrubland with small slightly weathered limestone pebbles to large Limestone slabs and boulders on the soil surface.	 **Land Use:** Presence of large limestone boulders inter planted with very sparse grass and shrub tree species mainly ipil ipil.	 **Land Use:** Dense cover of shrubs and, climbing vine species with partly weathered limestone and presence of small to large limestone boulders in the soil surface. Sloping terrain.	 **Land Use:** Dense brushy vegetative cover and presence of exposed small to large limestone boulders.

Table 8 - Soil Quality Laboratory Result

Parameters	*Stations*			
	S1	*S2*	*S3*	*S4*
pH	6.30	6.80	7.80	7.40
Soil Organic Matter	5.02	4.53	2.12	4.33
Total Nitrogen	2,840	3,000	1,320	2,590
Phosphorus	364	582	563	1,460
Potassium	204	215	121	612
Calcium	324	875	13,400	6,210
Sodium	17	17	25	33
Magnesium	1,070	1,280	1,250	181
Zinc	15	18	17	17
Iron	21,100.00	29,500.00	29,100.00	28,100.00
Conductivity	137.00	157.00	212.00	205.00
Arsenic	3.30	3.90	4.80	3.40
Cadmium	0.50	3.60	0.80	0.80
Lead	12.00	11.00	10.00	12.00
Mercury	0.20	0.10	0.30	0.30

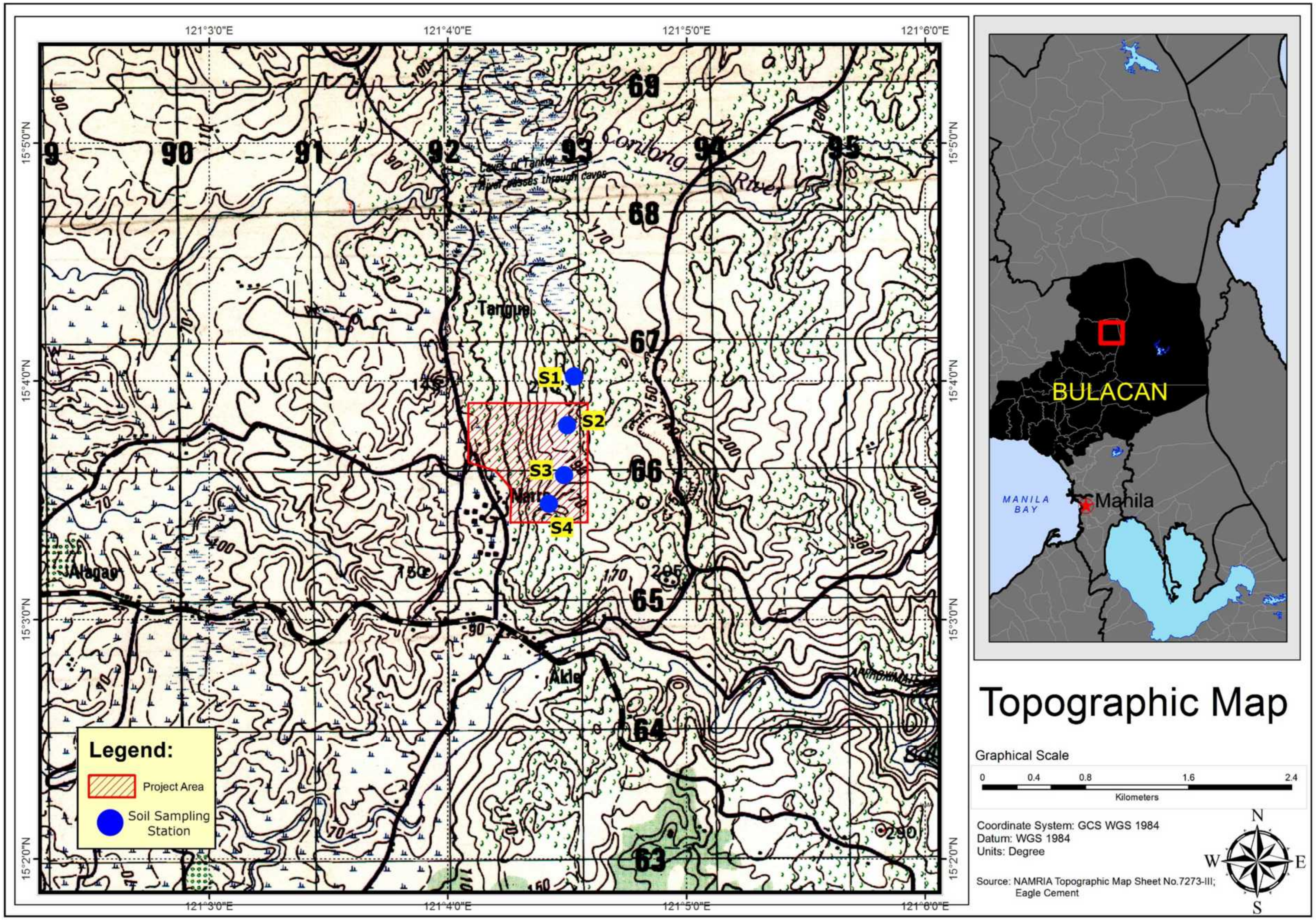


Figure 25 - Soil Sampling Location Map

From each soil sampling sites established undisturbed soil samples using 100 cc cores were collected from the immediate surface (0 - 5 cm depth) replicated twice for the surface soil bulk density determinations. (***Figure 24***).

2.1.3.4.1.1.1.2 Slake Test

To measure the aggregate stability of the immediate soil surface, a slake test was conducted *in-situ*. The slake test were done in all of the sampling sites and, is an indicator of soil cohesiveness especially when rapid soil wetting occurs. The soil physical property will determine the soil stability in terms of erosion potentials even when mechanical manipulation is employed (i.e. tillage, excavations). The assessment was done with sun dried soil samples and is further explained below:

A soil fragment (at least 1 cm x 1 cm in size) is gently immersed in distilled or rainwater and response to rapid wetting is observed for a period of time (i.e. 10 minutes). The soil is therefore classified in terms of its response to wetting and is described below:

Slake test is not applicable on sandy/stony soils (**Class 0**).

Class 1 = Very unstable. Soil fragment disintegrates in <5 seconds; very fine bubbles may emerge.
Class 2 = Unstable. Soil fragment goes slumping within 5-10 seconds.
Class 3 = Moderately Stable. Slumping of sub-crust but most of the crust is intact.
Class 4 = Very Stable. No slumping of particles is evident after several minutes of being immersed in water; whole fragment remains intact with no swelling; large bubbles may emerge.

2.1.3.4.1.1.2 Disturbed Soil Samplings

From each soil sampling location, disturbed composite soil samples were collected within the 0 – 30 cm. depth using an ordinary mini trowel. The representative soil samples were randomly collected in a zigzag pattern within the selected sampling sites. There are at least 8 -10 random soil sampling sites for one composite sample. Presence of organic debris, stone fragments and other unwanted litters were carefully removed from the collected composite samples on site.

Using a clean used sack, each of the four (4) composite samples were manually mixed thoroughly and then, quartered twice, rejecting the two (2) quarter of the sample. From the remaining 2 quarter, approximately 1.5 kilograms of samples were finally collected per location and kept in a 12" X 16" polyethylene plastic bag and labeled accordingly.

All of the soil samples were chemically and physically analyzed at the CRL Environmental Corporation Laboratory, Bldg. 2, Berthaphil Compound 1, Berthaphil Inc. Industrial Park, Jose Abad Santos Ave., CFZ Pampanga, submitted on November 19, 2018 for the soil physical and chemical characteristics.

The parameters requested are presented in *Table 9*. Laboratory results of analyses were reported on December 12, 2018.

The impact of the proposed project on the soil and the vegetation/land use were assessed and mitigation measures were given.

Table 9 - Requested Soil Chemical Analyses of The Eagle Cement Mpsa No. 245-2007-Iii Quarry Project

Chemical Properties
pH (H_2O 1:1)
Available Phosphorus (P, ppm)
Organic Matter (OM, %)
Total Nitrogen (N, ppm)
Electrical Conductivity (EC, µS cm^{-1})
Calcium (Ca, ppm)
Magnesium (Mg, ppm)
Sodium (Na, ppm)
Available Potassium (K, ppm)
Trace Metals/Heavy Metals
Copper Cu(ppm)
Zinc (Zn, ppm)
Mercury (Hg, ppm)
Lead (Pb, ppm)

2.1.3.4.2 Results and Discussion

2.1.3.4.2.1 Chemical Properties of the Soil Sampling Locations

The soils of Eagle cement quarry as classified by the BSWM is a calcareous soil. A calcareous soil are those soils with high calcium carbonate content whose physical problems of land and water use for crop production are primarily denominated yet the high content of $CaCO_3$, especially the active fraction with high specific surface area (FAO Soils Bulletin No. 21, 1972); (Loeppert and Suarez, 1996).

2.1.3.4.2.1.1 Soil pH

It is the degree of acidity or alkalinity of a soil expressed in pH value. The optimum pH requirement of most plants varies between 6.0 to 7.5 below or above this range, nutrient availability decrease or increase.

Calcareous soils like the Eagle Cement quarry is often characterized to have high pH value because of the presence of high amount of Calcium Carbonate ($CACO_3$) and the associated mineral Magnesium.

Cereal crops grow best if the soil pH is between 6.0 to 7.2, root crops and vegetables pH preference is between 5.6 to 7.0, while fruit trees, industrial and forest crops requires a soil pH between 5.4 to 6.5 for their optimum growth.

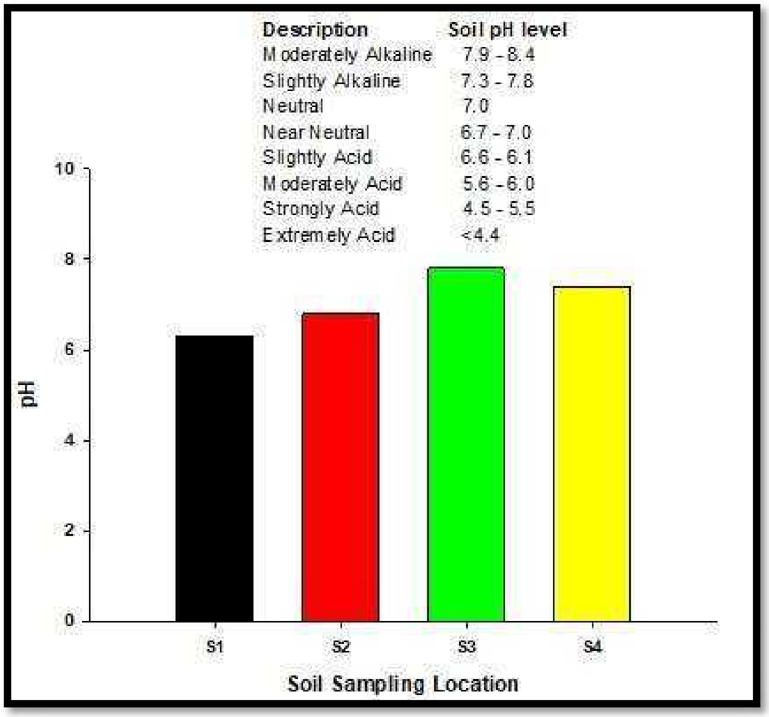


Figure 26 - Soil Surface pH of the Soil Sampling Locations

Shown in ***Figure 26*** is the surface soil pH of the 4 soil sampling locations. Soil sampling location 1 (S1) have the lowest pH value of 6.3 and is described to be slightly acid when compared to the soil pH scale of standards of the BSWM. The highest pH of the soil sampling sites was given by S3 of 7.8 and is described to be slightly alkaline. Soil sampling sites 2 and 4 are having a pH value of 6.8, 7.4 and is described to be near neutral and slightly alkaline, respectively.

The observed very slight pH level differences in these sites are the results of the differences in vegetative cover. Where S1 is having a denser cover and surface soil litter derived from the shrubs and grass understory vegetation in contrast with the rest of the soil sampling sites within the project area. Where, it was observed to be undergoing various stages of litter decomposition. The biological process that is actively undergoing greatly affects the soil reaction most especially in the surface horizon, where the initial product of organic matter decomposition are strong organic acids and, is being captured by the latest soil testing activity. According to Fuehring, (1972) high pH levels observed in these soils is the result of unavailable phosphorous and micronutrient zinc and iron.

2.1.3.4.2.1.2 Soil Organic Matter (SOM)

Soil Organic Matter (SOM) content influences the physical and chemical properties of soils. It helps to improve the soil structure, conserve soil moisture and enhance the existence of useful micro-organisms resulting to high Cation Exchange Capacity (CEC), increased Water Holding Capacity (WHC) and improves soil consistence and infiltration rates of clayey soils.

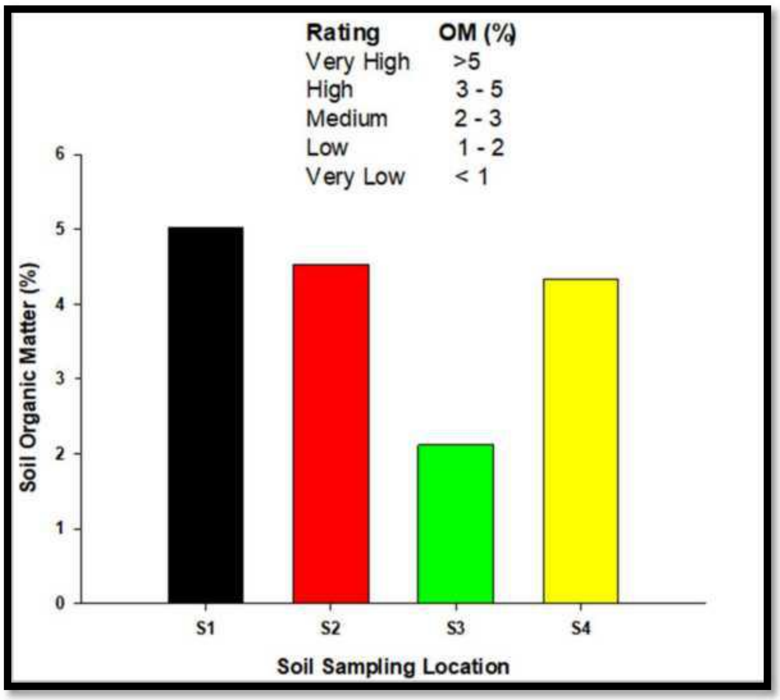


Figure 27 - Soil Organic Matter Content of the Soil Sampling Locations

The laboratory test of the surface soil in the project area (***Figure 27***) revealed that the soil in the proposed project area of the quarry ranges from medium (2.12 % in S3) to very high (5.02% in S1). Soil Sampling locations 2 and 4 are within the high SOM content of 4.53 and 4.33 % respectively, when compared to the BSWM set of standards for SOM.

Differences in the SOM content among soil sampling locations can be attributed to the differences in slope and the vegetation cover of the soil sampling sites. Soil sampling site S3 being the lowest is located on the undulating to rolling terrain. There is also noted not much surface litter cover that may serve as mulch to prevent surface erosion. Never the less, all of the soil sampling sites have a considerable SOM content in the immediate soil surface to nurture the vegetation for growth and survival.

2.1.3.4.2.1.3 Total Nitrogen

One of the essential elements needed by plants for growth and development is nitrogen (N). Being one of the major components of the chlorophyll it provides green color of the leaves and determines the size and the protein content of the produce. However, essential plant nutrient N is the most unstable in soils and can be easily lost through various transformations (e.g. volatilization, nitrification).

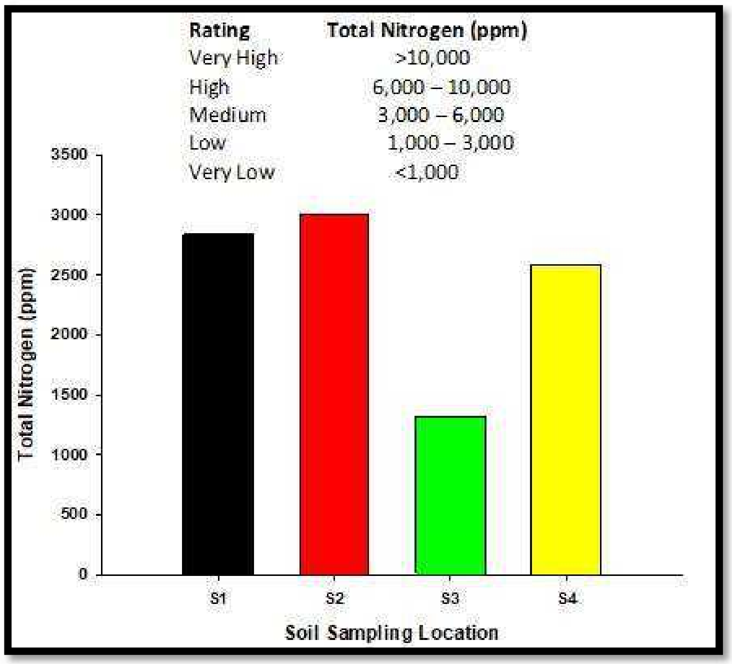


Figure 28 - Total Nitrogen Content of the Soil Sampling Locations

The slightly alkaline pH values found in the soil sampling locations as discussed in this module affects the rates of N transformations, which in turn can influence the efficiency of N use by the existing vegetation. The transformation of N via nitrification (i.e. *Nitrification* is the conversion of ammonium (NH_4^+) to nitrate (NO_3^-) by soil bacteria) and is rapidly accelerated in soils with pH values between 7 and 8, and decreases with decreasing pH values.

Figure 28 summarizes the surface soil N content of the sampling locations. All of the sampling locations have low N content (i.e. within 1,000 – 3,000 ppm). This can be attributed to the inherent high pH of the soil parent material. These results confirmed and explain the findings of Loeppert and Suarez, (1996) where, they characterized calcareous soil to normally have high pH level, and have low level of its total Nitrogen.

2.1.3.4.2.1.4 Surface Soil Phosphorus Content

Essential element phosphorus (P) is normally abundant among Philippine soils but its availability to plants is highly governed by the soil pH. The availability of P in calcareous soils is usually restricted. Maximum availability to plants of both native and applied P in the form of Commercial P fertilizers is in the pH range of 6.0 to 7.5. At higher pH values, phosphate anions react with Ca and Mg to form phosphate compounds of limited solubility (Mortvedt *et al*., 1999). In other word, native soil P can be abundant but is being fixed, rendering the essential nutrient to be less available to plants.

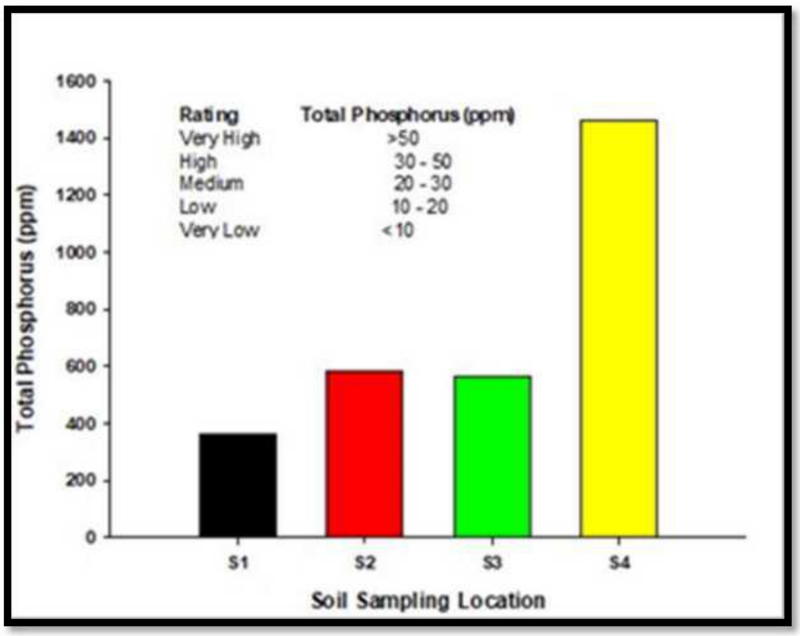


Figure 29 - Soil Surface Phosphorus Content

Figure 29 summarizes the P contents of the four soil sampling locations. All of the soil sampling locations showed that there is an elevated level of P reaching a maximum amount of 1,460.0 ppm (soil sampling location S4). This is about 30 times more when compared to the adequate level set by the BSWM standards. The Lowest of the soil sampling locations soil P content was given by S1 of only 364.0 ppm, which is still high above to the adequacy level of 50 ppm. The elevated Levels of all sampling locations can be attributed to the parent material where these soils were derived.

2.1.3.4.2.1.5 Surface Soil Potassium Content

Figure 30 shows the surface soil potassium (K) content of the four soil sampling locations. The lowest was given by soil sampling location No. 3 of 121.0 ppm. When compared to the set of standards by the BSWM, it is rated to be of medium K content. The highest was found in Soil sampling location No. 4 of 612.0 ppm and is rated to be very high in terms of its K content.

Available potassium (K) are usually found in an adequate supply in calcareous soils. This is due to native high levels of exchangeable K (Brady and Weil, 1999). However, when the soil is experiencing an aquic moisture regime (i.e. more than 2000 mm rainfall a year) K deficiency may occur as K is highly soluble with water and is easily lost thru leaching and runoff. Over all, the soil of the Eagle Cement quarry area has an adequate K in its immediate soil surface.

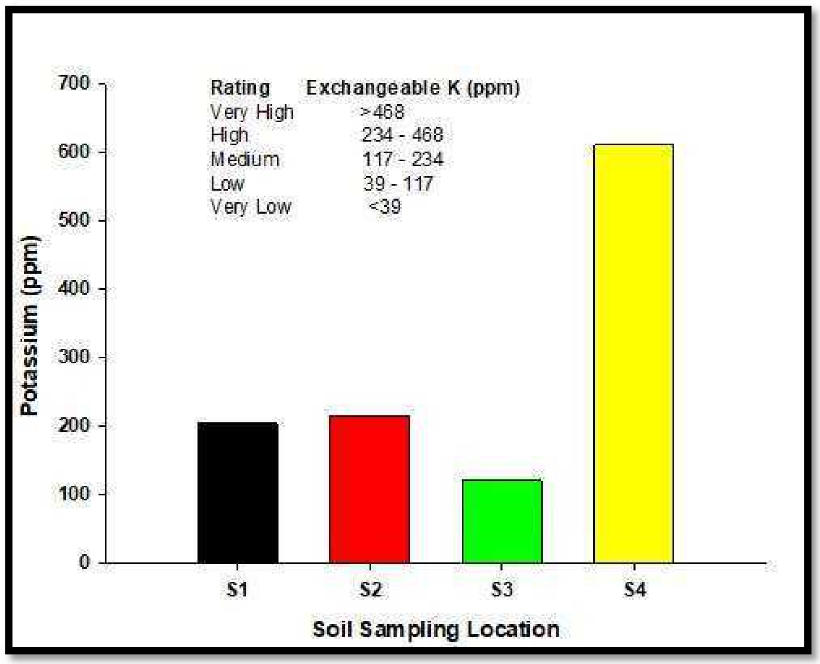


Figure 30 - Surface Soil Potassium Content of the Soil Sampling Locations

2.1.3.4.2.1.6 <u>Surface Soil Calcium Content</u>

The presence of Calcium (Ca) on the surface of the Soil sampling locations are presented in ***Figure 31***. Soil sampling locations Nos. 3 and 4 have an elevated level of Ca many times above the adequate limit of 4,000 ppm (i.e. 13,400.0; 6,210.0 ppm for S3 and S4, respectively). S1 and S2 are rated as low to medium of 324.0 and 875.0 ppm, respectively.

The native Ca content of the soil in the area (i.e. being a calcareous soil and the constant low elevation dust formation every heavy vehicle passing along the limestone quarry haul road area specially during dry road surface soil conditions inevitably have increased the Ca content of the topsoil.

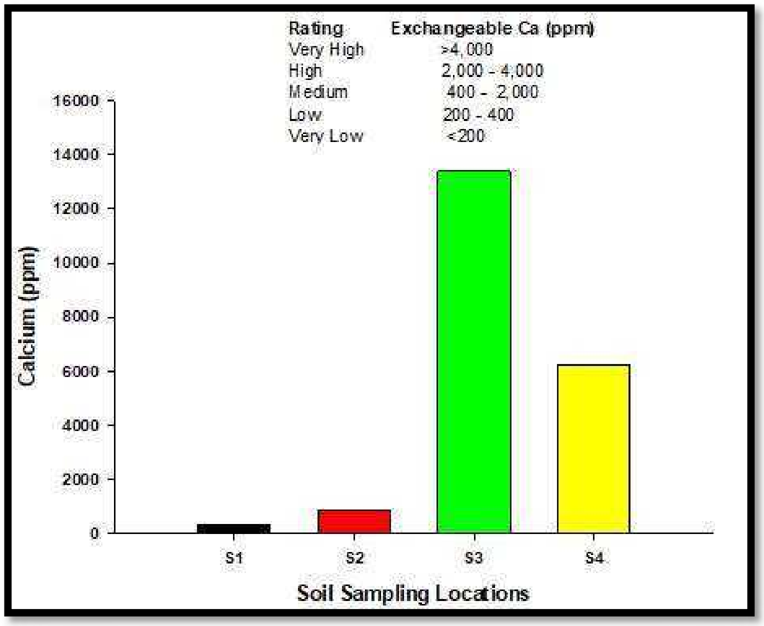


Figure 31 - Soil Surface Calcium Content of the Soil Sampling Locations

2.1.3.4.2.1.7 Surface Soil Sodium Content

The soil provides the essential plant nutrient sodium (Na) in plants. There is a natural accumulation of sodium in soil from fertilizers, pesticides, run off from shallow salt-laden waters and the breakdown of minerals which releases salt in the form of Na. Nearness to the sea is also a good source of Na in the soil. The exchangeable Na is very necessary for the plant in order to maintain its cell wall turgidity. However, excessive Na in the soil taken up by plant roots can cause serious vitality problems. Plants exposed to excessive Na will wilt resulting to stunted growth and, eventually plant death as a result of plasmolysis. Only very few plant species can tolerate high Na content in the soil. Among those are the coconut, and various mangrove species.

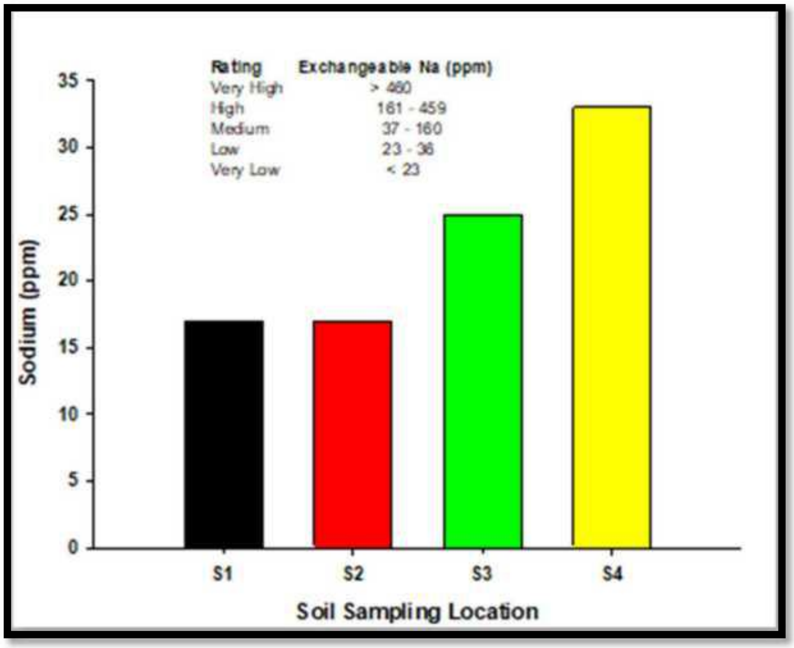


Figure 32 - Soil Surface Sodium Content of the Soil Sampling Locations

The laboratory soil test for sodium level of the soil sampling locations (***Figure 32***) indicated a low to very low Na content. (i.e. 17.0 ;17.0 ;25.0; 33.0 ppm for S1, S2, S3 and S4, respectively). This indicate that the soil has no salinity problems.

2.1.3.4.2.1.8 <u>Soil Surface Magnesium Content of the Soil Sampling Locations</u>

Magnesium (Mg) as an essential nutrient in higher plants and, is a component 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.

Calcareous soils found in the project area Mg content (***Figure 33***) have medium to very high Mg content of 1,070.0; 1,280.0; 1,250.0; 181.0 for S1, S2, S3, S4, respectively. When compared to the BSWM set of standards for Mg content, it indicated a medium (S4) to very high Mg content (S1, S2 and S3). These values reveal a common Mg content on the topsoil since these soils are derived from limestone parent materials (Ca – Mg association). 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 in plants.

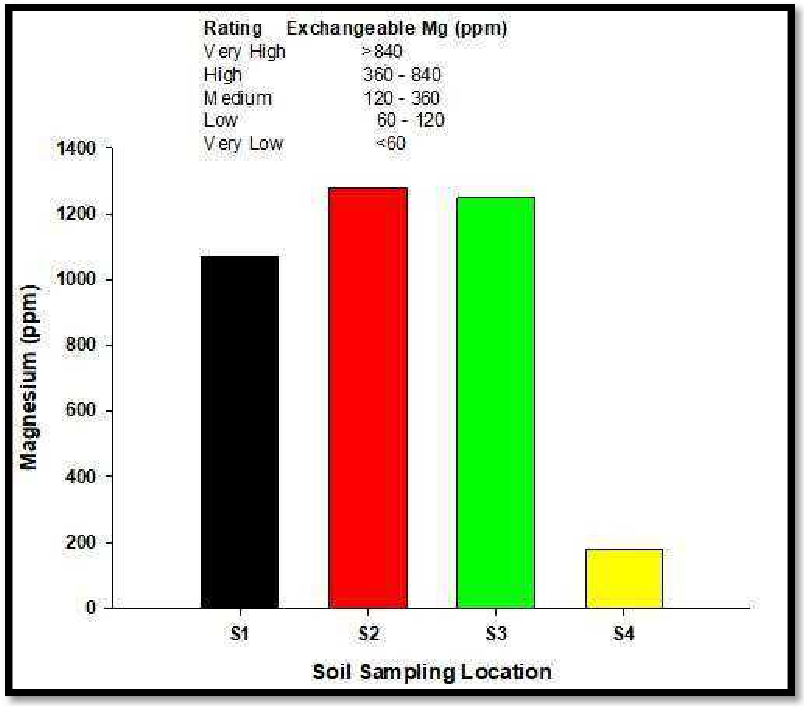


Figure 33 - Soil Surface Magnesium Content of the Soil Sampling Locations

2.1.3.4.2.1.9 Surface Soil Zinc Content

Zinc (Zn) is a trace element found in varying concentrations in all soils, plants and animals and, it is essential for the normal healthy growth of higher plants, animals and humans. Zinc is needed in small but critical concentrations and, if the amount available is not adequate, plants and/or animals will suffer from physiological stress brought about by the dysfunction of several enzyme systems and other metabolic functions in which zinc plays a part. Zinc is an essential component of various enzyme systems for energy production, protein synthesis, and growth regulation.

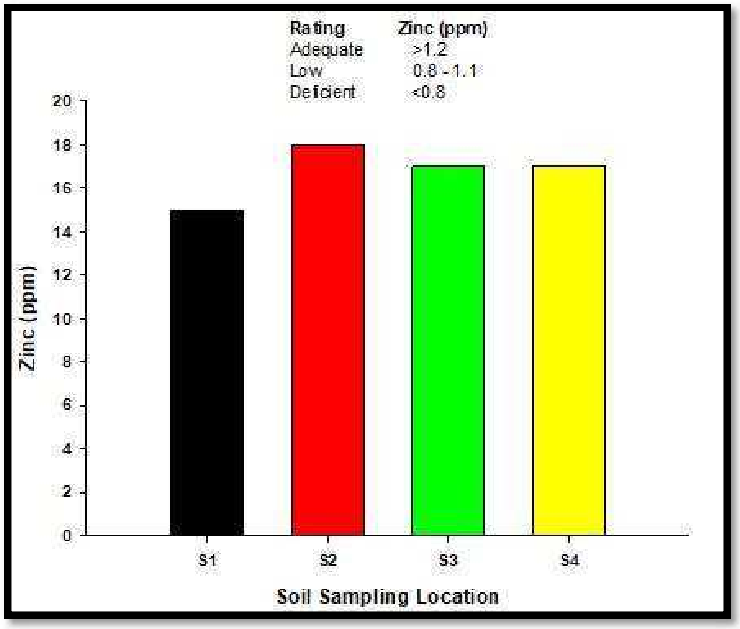


Figure 34 - Soil Surface Zinc Content of the Soil Sampling Locations

Figure 34 shows the laboratory results using flame atomic absorption spectrometry (FAAS) of micro-metallic zinc content of the four soil sampling locations of the Eagle Cement quarry. All of the soil sampling sites demonstrate adequate levels of Zn when compared to the BSWM sets of standards. Where, 15.0 ;18.0 ;17.0 ;17.0 for S1, S2, S3 and S4, respectively. However, the soil reaction of the soil sampling locations has a slightly acid pH reaction to slightly alkaline. This pH level in the soil will render the availability of Zn to be impaired. The soil reaction values, clearly, explain the observed stunted growth of the existing vegetation and is caused apparently by Zn deficiency (i.e. small leaves, slight yellowing and very poor and stunted growth).

2.1.3.4.2.1.10 <u>Soil Surface Iron Content of the Sampling Locations</u>

Iron (Fe) as an essential micro-metallic plant nutrient is essential in the synthesis and maintenance of chlorophyll in plants. Also, Fe has been strongly associated with protein metabolism. Calcareous soils found in the Eagle Cement Quarry may contain elevated levels of total Fe, but in forms unavailable to higher plants. Visible Fe deficiency, or Fe chlorosis, is common in many plants around the quarry were observed during the assessment field work. This disorder on calcareous soils is not always attributable to Fe deficiency; this condition is known as lime-induced Fe chlorosis.

Figure 35 showed that the surface soil of the Eagle Cement quarry area has more than adequate level of iron and, is considered to have reached the toxicity level when compared to the BSWM sets of standards. The lowest Fe content of 29.1; 29. 5ppm was inferred in S3 and S2, respectively. This is approximately 6.5 times above the adequate level set by the BSWM standard and, the highest was given by S4 of 28,100.0 ppm. A similar value of about 21,100.0 is given by S1.

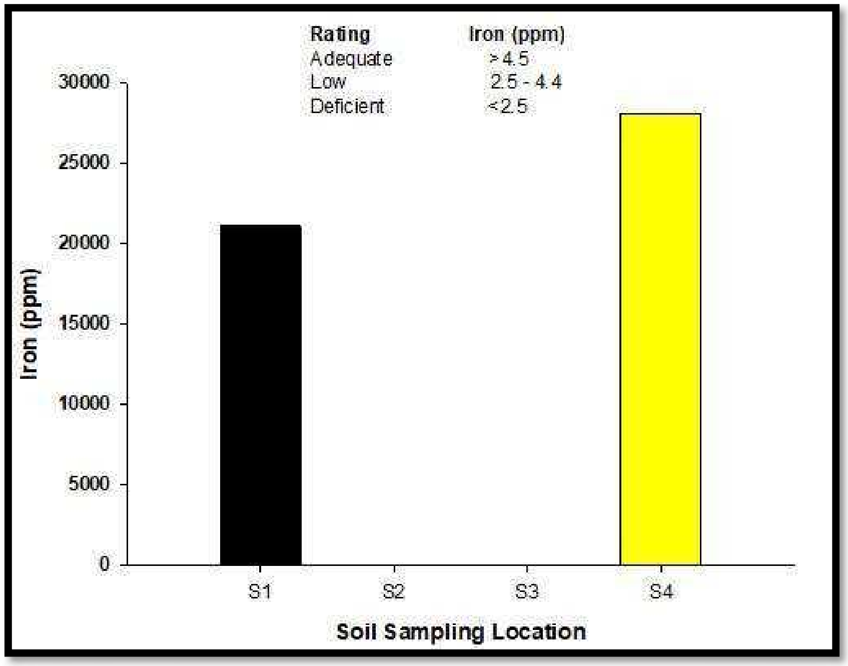


Figure 35 - Soil Surface Iron Content of the Sampling Locations

2.1.3.4.2.1.11 Surface Soil Electrical Conductivity

Soil electrical conductivity (EC) measures the ability of the soil solution to conduct electricity and is expressed in µS cm $^{-1}$. Because pure water is a poor conductor of electricity, increase in soluble salts of the soil solution result in proportional increases in the solution EC.

The range of electrical conductivity value of the four soil sampling locations using the laboratory method of conductimetry ranges from 137.0 - 205.0 µS cm^{-1}and the standard value of electrical conductivity should be between 0 to 1,000 µS cm^{-1} for good soil. Thus, the results show that the soil samples around that area are suitable for the growth of plants in terms of EC (***Figure 36***).

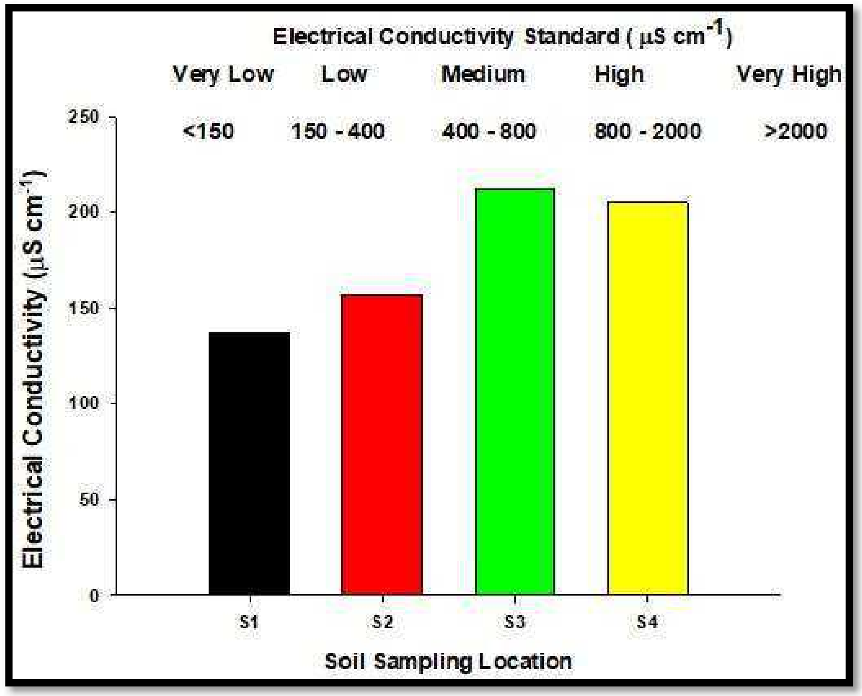


Figure 36 - Surface Soil Electrical Conductivity

2.1.3.4.2.2 Heavy Metal Analysis of the Soil Sampling Locations

Soil contamination by heavy metals is of most important apprehension throughout the industrialized world (Hinojosa eat a., 2004). Heavy metal pollution not only result in adverse effects on various parameters relating to plant quality and yield but also cause changes in the size, composition and activity of the microbial community Yao and Huang (2003). Therefore, heavy metals are considered as one of the major sources of soil pollution.

Heavy metal pollution of the soil is caused by various metals especially Cu, Ni, Cd, Zn, Cr, and Pb (Hinojosa eat a., 2004). The adverse effects of heavy metals on soil biological and biochemical properties are well documented. The soil properties like the levels of organic matter, clay contents and pH have major influences on the extent of the effects of metals on biological and biochemical properties (Speira et.al., 1999).

Heavy metals indirectly affect soil enzymatic activities by shifting the microbial community which synthesizes enzymes. Heavy metals exhibit toxic effects towards soil biota by affecting key microbial processes and decrease the number and activity of soil microorganisms (Shun-hong 2009). Conversely, long-term heavy metal effects can increase bacterial community tolerance as well as the tolerance of fungi such as arbuscular mycorrhizal (AM) fungi, which can play an important role in the restoration of contaminated ecosystems (Mora et. al., 2005. Chen et al. (2010) suggested that heavy metals caused a decrease in bacterial species richness and a relative increase in soil actinomycetes or even decreases in both the biomass and diversity of the bacterial communities in contaminated soils. Karaca et al (2010) reported that the enzyme activities are influenced in different ways by different metals due to the different chemical affinities of the enzymes in the soil system. Cd is the more toxic to enzymes than Pb because of its greater mobility and lower affinity for soil colloids. Cu inhibits b-glucosidase activity more than cellulose activity. Pb decreases the activities of urease, catalase, invertase and acid phosphatase significantly. Phosphatase and sulfatase are inhibits by pentavalent arsenic (As^{+5}) but that urease was unaffected. Cd contamination has a negative effect on the activities of protease, urease, alkaline phosphatase and arylsulfatase but no significant effect on that of invertase. Each soil enzyme exhibits a different sensitivity to heavy metals. The order of inhibition of urease activity generally decreased according to the sequence Cr > Cd > Zn > Mn > Pb.

Diversity and activity of soil microbes play significant roles in recycling of plant nutrients, maintenance of soil structure, detoxification of noxious chemicals and the control of plant pests and plant growth communities are important indices of soil quality. It is important to investigate the functioning of soil microorganisms in ecosystems exposed to long- term contamination by heavy metals (Wang et.al., 2007). Chromium is commonly present in soils as trivalent chromium (Cr^{+3}) and hexavalent chromium (Cr^{+6}), which are characterized by distinct chemical properties and toxicities. Cr^{+6}) is a strong oxidizing agent and is highly toxic, whereas Cr^{+3} is a micronutrient and a non-hazardous species 10 to 100 times less toxic than Cr^{+6} (Garnier 2006). Cr^{+6}has been reported to cause shifts in the composition of soil microbial populations, and known to cause detrimental effects on microbial cell metabolism at high concentrations (Shun-hong 2009). Ashraf and Ali (2007) also reported that the heavy metals exert toxic effects on soil microorganism hence results in the change of the diversity, population size and overall activity of the soil microbial communities and observed that the heavy metal (Cr, Zn and Cd) pollution influenced the metabolism of soil microbes in all cases. In general, an increase of metal concentration adversely affects soil microbial properties e.g. respiration rate, enzyme activity, which appears to be very useful indicators of soil pollutions. In case of soil contaminated with lead (Pb) slight change was observed in the soil microbial profile.

Mercury (Hg) is considered to be a “priority hazardous substance” due to its toxicity, mobility, long-range transport in the atmosphere, and methylation processes. The contamination of soil with Hg has attracted public concern as it can be easily incorporated into the food chain. The development of appropriate technologies to manage the risk of Hg and other heavy metals in soil is particularly important.

Heavy Metals Effects on Plants

Some of these heavy metals i.e. As, Cd, Hg, Pb or Se are not essential for plants growth, since they do not perform any known physiological function in plants. Others i.e. Co, Cu, Fe, Mn, Mo, Ni and Zn are essential elements required for normal growth and metabolism of plants, but these elements can easily lead to poisoning when their concentration greater than optimal values (Garrido, 2002, Rascio and Izzo (2011). The use of compost to improve agricultural yield without caring with possible negative effects might be a problem since the waste composts are most applied to improve soils used to grow vegetables. Considering the edible part of the plant in most vegetable species, the risk of transference of heavy metals from soil to humans should be a matter of concern (Jordao et.al., 2006).

Uptake of heavy metals by plants and subsequent accumulation along the food chain is a potential threat to animal and human health (Sprynskyy et al., 2007). The absorption by plant roots is one of the main routes of entrance of heavy metals in the food chain (Jordao et.al., 2006). Absorption and accumulation of heavy metals in plant tissue depend upon many factors which include temperature, moisture, organic matter, pH and nutrient availability. The uptake and accumulation of Cd, Zn, Cr and Mn in Beta vulgaris (Spinach) were higher during the summer season, whereas Cu, Ni, and Pb accumulated more during the cooler months of the year (Sharma et.al., (2007). It may be expected that during the summer season the relatively high decomposition rate of organic matter is likely to release heavy metals in soil solution for possible uptake by plants. The higher uptake of heavy metals i.e. Cd, Zn, Cr and Mn during the summer season may be due to high transpiration rates as compared to the winter season due to high ambient temperature and low humidity (Sharma et.al., (2007).

Heavy metal accumulation in plants depends upon plant species and the efficiency of different plants in absorbing metals is evaluated by either plant uptake or soil to plant transfer factors of the metals (Khan et.al., 2008). Elevated Pb in soils may decrease soil productivity, and a very low Pb concentration may inhibit some vital plant processes, such as photosynthesis, mitosis and water absorption with toxic symptoms of dark green leaves, wilting of older leaves, stunted foliage and brown short roots (Bhattacharyya et. al., 2008). Heavy metals are potentially toxic and phytotoxicity for plants resulting in chlorosis, weak plant growth, yield depression, and may even be accompanied by reduced nutrient uptake, disorders in plant metabolism and reduced ability to fixate molecular nitrogen in leguminous plants (Guala et.al., 2010). Seed germination was gradually delayed in the presence of increasing concentration of lead (Pb), it may be due to prolong incubation of the seeds that must have resulted in the neutralization of the toxic effects of lead by some mechanisms e. g. leaching, chelation, meta binding or/and accumulation by microorganisms.

2.1.3.4.2.2.1 Arsenic (As)

Arsenic is widely distributed in the environment. The earth crust contains an average of 5 μg^{-1} of As frequently in association with other elements such as Cu, Pb and Zn (Tetratech EM Inc., 2001). It is highly soluble in water and the most common symptom of As causes skin poisoning and exhibit harmful effects on kidneys and the central nervous system is highly associated with As (Adelakan et. al., 2011).

Figure 37 summarizes the heavy metal laboratory analysis for Arsenic. All of the sampling locations have low levels of As when compared to the U.S. EPA (1993) standard of 6 ppm. The lowest As content was found on S1 of 3.3. ppm in contrast, the highest concentration of As was observed on S3 of 4.80 ppm. The rest of the soil sampling locations (S2 and S4) have very negligible amount of As in the surface soil.

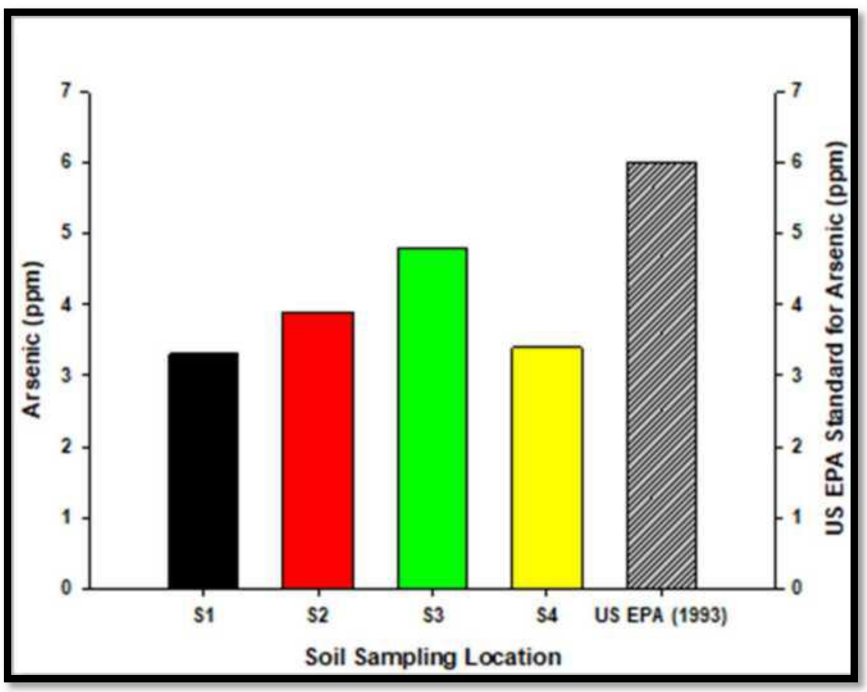


Figure 37 - Soil Surface Arsenic Content of the Soil Sampling Locations

2.1.3.4.2.2.2 Cadmium (Cd)

Cadmium in nature is relatively rare element and, it occurs in nature in the form of various inorganic compounds and as complexes with naturally occurring chelating agents.

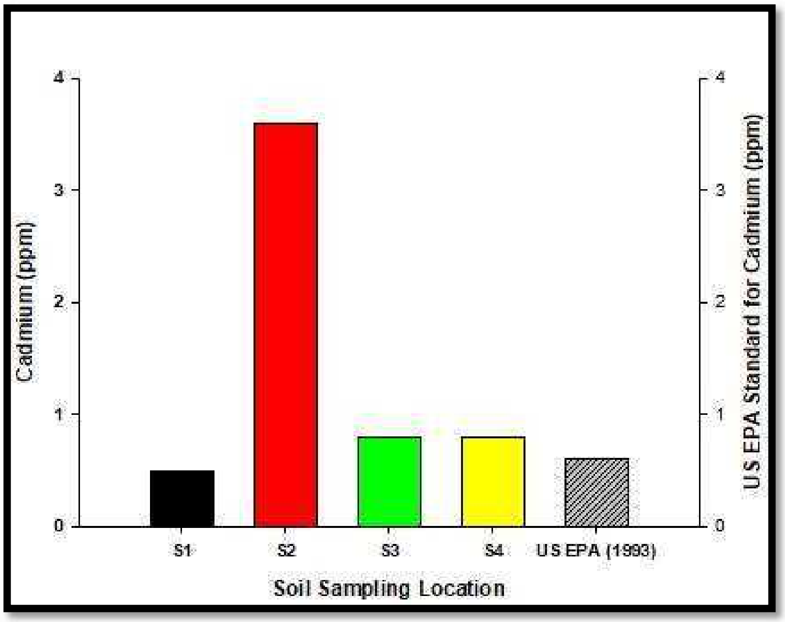


Figure 38 - Soil Surface Cadmium Content of the Soil Sampling Locations

As shown in ***Figure 38*** the cadmium content of the soil sampling locations is slightly above the permissible limits set by the US EPA (1993) of 0.6 ppm for S2, S3 and S4 of 3.60; 0.80; 0.80 ppm, respectively. Exception was found in S1 of 0.50 ppm which is slightly below the standard.

With regards to plant nutrition Cd is considered to be a non-essential element but may be absorbed by the plant roots. Cd presence in the soil decrease root respiration, water and nutrient uptake and inhibit cell mitosis in root meristematic regions (Gemmell, 1977). This may explain the observed poor vegetative growth in the quarry area.

2.1.3.4.2.2.3 Lead (Pb)

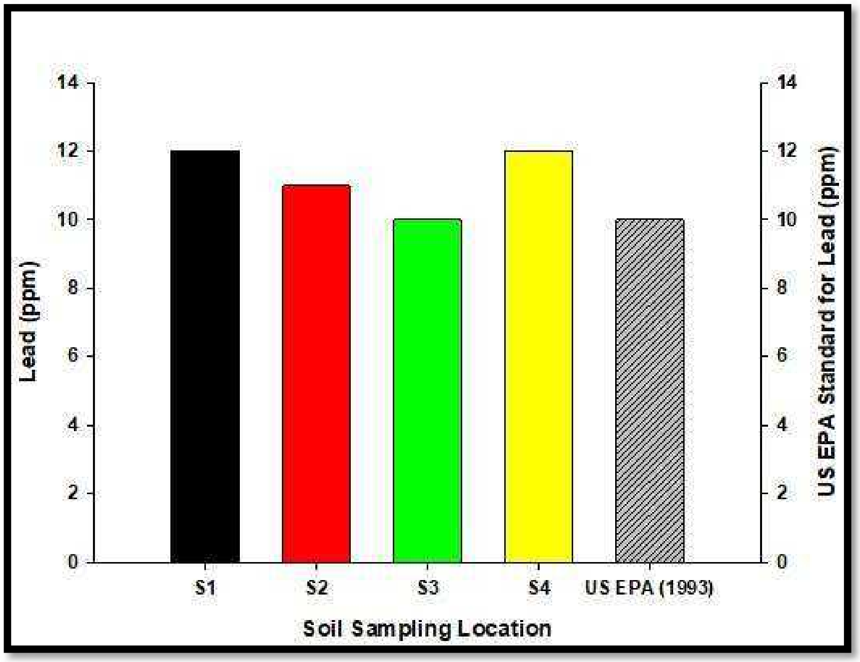


Figure 39 - Soil Surface Lead Content of the Soil Sampling Locations

According to Sobolev and Begonia, (2008) heavy metal Lead (Pb) is the most common environmental contaminant found in soils. Unlike other metals, Pb has no biological role, and is potentially toxic to soil microorganisms. Its excessive accumulation in living organisms is always detrimental.

In cement plants, there is always an indication of Pb enrichment within the vicinities of the processing plants and, diminishes as you are farther from the cement plant. Although the lead pollution from mining activities presents a relatively localized problem, its magnitude is considered significant.

As shown in ***Figure 39*** the presence of lead (Pb) in the Eagle Cement quarry area soil sampling locations are slightly above the permissible limits set by the USEPA (1993) standard of 10 ppm for S1 S2 and S4 of 12.0; 11.0 and 12.0 ppm, respectively. Exception was found in S3 of 10.0 ppm Pb and is within the permissible limit for Pb. The presence of Pb in these areas basically undisturbed areas of the quarry area of Eagle Cement maybe due to the use of Pb containing fuels for decades in the Country. Vehicular emissions fall out normally reaches these undisturbed areas and, are normally intercepted by the existing vegetation leaves. When there is a rainfall event, this vehicular emission fall outs are washed away from the leaf surface and eventually reaches the soil surface and, accumulation thru time is realized.

2.1.3.4.2.2.4 Mercury (Hg)

Mercury (Hg) in relation to the soil is not an essential element needed by plants but, can be absorbed by plants in excessive amounts. Hg is one of the highly toxic compounds found in nature and exist in oxidation the form elemental Hg^0 mercurious ion (Hg^+) and mercuric ion (Hg^{++}). The means of presence in soil is characterized by absorption between the colloidal surface where this is mainly found in the upper surface soil (0 - 5 cm). In general, Hg is not translocated below the surface layer of the soil (0 - 10 cm). Thus, Hg not adsorbed in the soil matrix will be either absorbed by the plants through ionic exchange in the soil solution, precipitated, volatilized under high temperature.

The presence of element Hg in the four soil sampling locations within the Eagle Cement proposed quarry area is summarized in ***Figure 40***. All of the sampled sites are within the acceptable limits set by the US EPA (1993) standard of 0.30 ppm. Presence of traces of Hg in these areas are considered incidental.

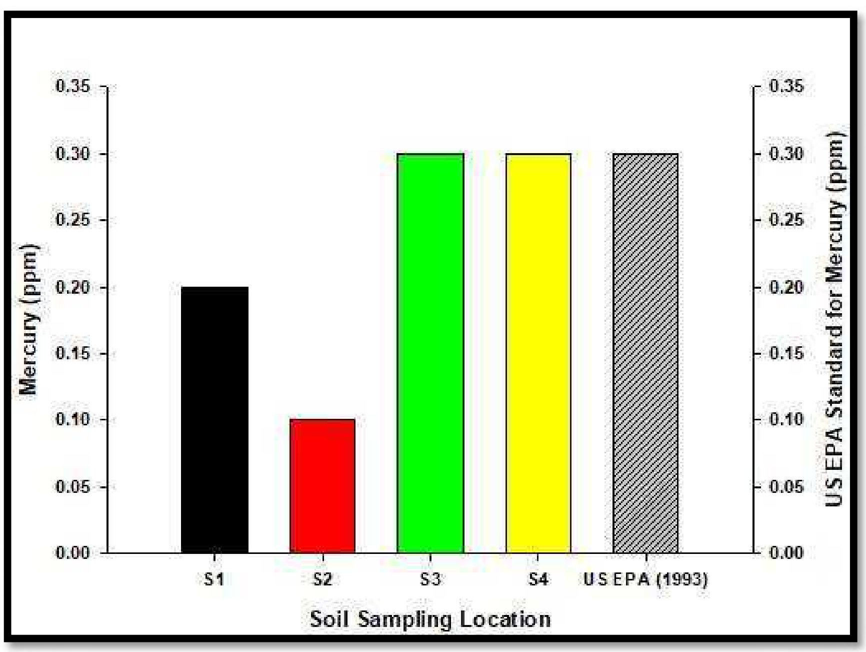


Figure 40 - Soil Surface Mercury Content of the Soil Sampling Locations

2.1.3.4.3 Soil Physical Properties of the Soil Sampling Locations

2.1.3.4.3.1 Soil Surface Bulk Density

Soil bulk density is the oven dry weight over volume. 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.

Shown in Figure 3.5.3.1 is the immediate soil surface bulk density (0 – 5 cm depth) of the proposed quarry area of Eagle Cement. All of the soil sampling locations have less than 1 g cc^{-3} bulk density values in their undisturbed state. 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.

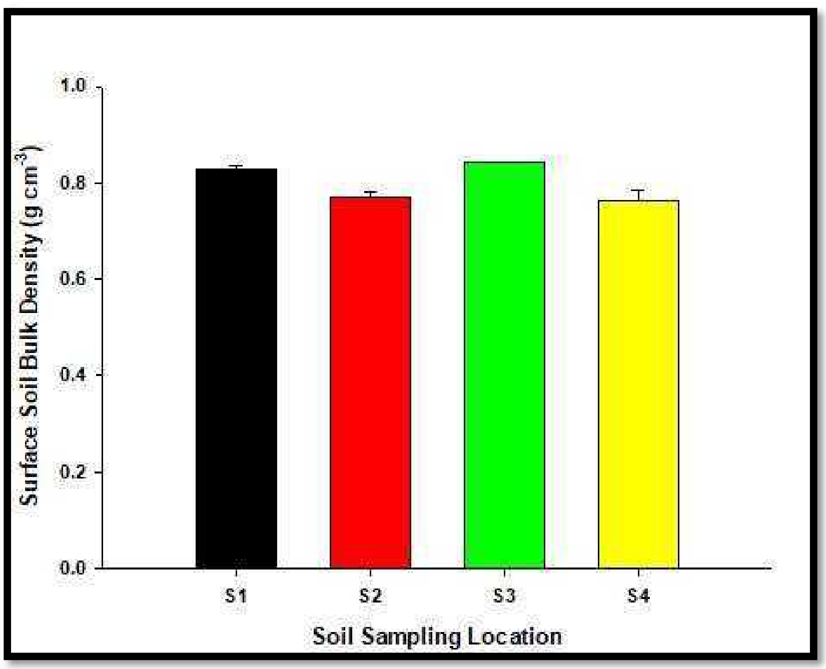


Figure 41 - Soil Surface Bulk Density of the Soil Sampling Locations

2.1.3.4.4 Slake Test of the Soil Sampling Locations

Slaking is defined as the breakdown of large soil aggregates (>2-5 mm) into smaller sized micro-aggregates (<0.25 mm) when they are suddenly immersed in water.

Slaking occurs when aggregates are not strong enough to withstand internal stresses caused by rapid water uptake. Internal stresses result from differential swelling of clay particles, trapped and escaping air in soil pores, rapid release of heat during wetting, and the mechanical action of moving water.

Slaking is important because it indicates the stability of soil aggregates resistance to erosion and suggests how well soil can maintain its structure to provide water and air for plants and soil biota when it is rapidly wetted. It is very handy that it can be measured under field conditions in a very short period of time (Herrick et. al. 2001).

Limited slaking suggests that organic matter is present in soil to help bind soil particles and micro-aggregates into larger, stable aggregates.

2.1.3.4.4.1 Slake Test, Soil Sampling Location S1

Figure 42 - Start of Slake Test, Soil Sampling Location, S1

***Figure 43 - Minutes After Slake Test, Soil Sampling Location*, S1**

Slake test of Soil Sampling Location S1 is shown in ***Figure 42*** (start of the slake test) and ***Figure 43*** (end of the Slake test). The soil fragment (at least 2 cm x 2 cm in size) was taken at the immediate soil surface of S1. Soil response using a distilled water to rapid wetting is observed for a period of 10 minutes. The result shows that the soil can be classified as Class 4 or Stable. After 10 minutes of being immersed in water, there is no evidence of slumping of the soil particles. A small swelling of the aggregate was observed but, the whole fragment remains intact (***Figure 43***, no evidence of disintegration of particles).

The undisturbed soil of S1 of the proposed quarry area is therefore resistant to the erosive forces of rapid wetting.

2.1.3.4.4.2 Slake Test, Soil Sampling Location S2

The start of slake test for S2 is shown in ***Figure 44***. The soil fragment (at least 2 cm x 2 cm in size) was taken at the immediate soil surface of the soil sampling location. No rapid scape of air bubbles from the aggregate sample was observed.

Figure 44 - Start of Slake Test, Soil Sampling Location, S2

Figure 45 - Minutes After Slake Test, Soil Sampling Location, S2

In ***Figure 45*** shows the response of the aggregate soil sample to rapid wetting within 10 minutes of wetting. The result showed that the soil can be classified as Class 4 or Stable. There was no observed slumping of the crust.

2.1.3.4.4.3 Slake Test, Soil Sampling Location S3

The slake test for Soil Sampling no. 3 (S3) is summarized in ***Figure 46*** and ***Figure 47***.

Similarly, the aggregate sample was carefully immersed with the distilled water using a stainless steel pan and the slaking property was observed within 10 minutes. The result shows that the soil remain intact, no slumping was observed. This soil is then classified as class 4 or Stable.

Figure 46 - Start of Slake Test, Soil Sampling Location, S3

Figure 47 - Minutes After Slake Test, Soil Sampling Location, S3

2.1.3.4.4.4 Slake Test, Soil Sampling Location S4

Figure 48 - Start of Slake Test, Soil Sampling Location, S4

Figure 49 - Minutes After Slake Test, Soil Sampling Location, S4

For the soil sampling location no. 4 (S4) the slake test also demonstrated that the soil is stable no slumping was observed after 10 minutes of submergence (***Figure 48*** and ***Figure 49****).* There is only a slight swelling of the soil when it is immersed for a period of 10 minutes. This soil is therefore classified as Class 4.

2.1.3.5 Impact Management

Identified impact for pedology and soil quality are the following:

- Loss of top soil due to ground/site preparation activities and vehicular and human movement (i.e. excavation of the foundations of Quarry components and new haul/access roads).
- Earthworks, Quarry facility construction activities, and movement of heavy equipment will highly disturb the soil surface (i.e. compaction/soil shearing) and induce accelerated erosion susceptibility of the soil.
- Soil Contamination due to accidental fuel and lubricant spills from vehicles and quarrying plant equipment may occur.

To mitigate the above-cited impacts the following measures shall be implemented by ECC:

- Bulk of the total project area will be reverted to its pre-mining land use by strict adherence to the approved EPEP and FMRDP.
- Soils that will be removed will be conserved and stockpiled in a pre-determined area and later to be used in rehabilitation.

Heavy Metals Mitigating Measures

In recent years, intensive research have been initiated on remediation of metal polluted soil due to the public concerns on ecosystem deterioration. Plants as stated above are used as an effective tool in remediation of metal polluted soil. A simple and quick management of soils contaminated with metals is by using the natural micro-organisms of the soil proven to be effective to restore highly disturbed soils brought about by mining/quarrying activities.

In natural ecosystem, plants are associated with soil microorganisms which plays an important role in enhancing plant growth in metal contaminated site and phytoremediation process. Among the microorganisms, the lowly arbuscular mycorrhizal fungi (AMF) contributes markedly in the phytoremediation process in metal contaminated site by enhancing plant stress tolerance and metal extraction from soil (phytoextraction) and immobilization of metals in soil (phyto-stabilization) (Krishnamoorthy et. al., 2019).

2.1.4 Terrestrial

2.1.4.1 Terrestrial Flora Assessment

2.1.4.1.1 Methodology

Establishment of the plots necessary for the assessment were done using available online satellite images. Tracking and plotting were done using Orux Maps.

To assess the floral assemblage of the area, nested-quadrat technique was done. A transect of approximately two (2) kilometers were established in 7 stations/transects. These stations were selected to represent different forest covers identified inside the study area. Along the transect, three (3) 20x20 m plots were established to identify the canopy, intermediate and understory floral cover of the area.

For the canopy layer, only trees with diameter-at-breast-height (DBH) ≥ 10cm were included. For understorey, trees with 10cm≥DBH>5cm were included, while those with DBH<5cm were counted on the understory and regenerants.

All other plant species that can be observed inside the area, but not covered by the plots, were also listed but were not included in the computation for the Importance Values. Refer to ***Figure 50*** for the map of the assessment stations.

Figure 50 - Satellite Image Overlay of the Sampling Stations.

For all of the floral species intercepted by the plots, parameters such as Density, Frequency and Dominance were computed. Relative values of these trees were used to calculate the Importance Values (IVs) of each trees assessed among all stations. Importance Values determine which species affects the area in terms of forest dynamics. The parameters computed were as follows:
Density is the total number of individuals of each species in all the quadrats divided by the total size of quadrats studied. Density is calculated by the equation:

$$Density = \frac{Number\ of\ individual\ in\ a\ specific\ quadrat}{Size\ of\ the\ quadrat}$$

Relative density measures the density of the plant species in all of the quadrat assessed. It is the numerical strength of a species in relation to the total number of individuals of all the species and can be calculated as:

$$Density = \frac{Total\ number\ of\ individuals\ of\ a\ species\ in\ all\ quadrats}{Total\ size\ of\ the\ individuals}$$

Frequency refers to the degree of dispersion of individual species in an area and usually expressed in terms of percentage occurrence.

$$AAbsolute\ frequency = \frac{Number\ of\ quadrats\ in\ which\ a\ species\ occured}{Number\ of\ quadrats\ studied}$$

Relative frequency compares the absolute frequency of a species to the frequencies of all species found on the plots. It is the degree of dispersion of individual species in an area in relation to the number of all the species occurred. This can be calculated using the formula:

$$Relative\ frequency = \frac{Calculated\ absolute\ frequency\ of\ a\ species}{Total\ frequencies\ of\ all\ the\ species}\ x\ 100$$

Dominance of a species is determined by the value of the basal cover while **relative dominance** is the coverage value of a species with respect to the sum of coverage of the rest of the species in the area. These can be computed as:

$$Absolute\ dominance = Mean\ basal\ area\ (MBA)\ x\ No.of\ individuals\ of\ a\ species$$

$$Relative\ dominance = \frac{Dominance\ of\ a\ species}{Dominace\ of\ all\ species}\ x\ 100$$

Shannon-Wiener Diversity Index (H) is calculated using the formula below and the result was compared to the Modified Fernando Biodiversity Index to obtain the relative value of the diversity. This index measures the diversity of the area using the number of species present.

$$H' = \sum_{i=1}^{S} pi \ln pi$$

Where;

H' = Species diversity index

S = The number of species

Pi= The proportion of individuals of each species belonging to the i^{th}species of the total number of individuals

Pielou's species evenness index is another biodiversity index used to describe how evenly distributed the species in the study area are. This can be calculated using the formula,

$$J' = \frac{H'}{H'_{max}}$$

Where:

J' = Species evenness

H' = Computed Shannon-Weiner Index

H'_{max} = lnS

S = Species richness

The computed values can be interpreted using the Fernando's Biodiversity Scale which is elaborated on ***Table 10.***

Table 10 - The Fernando's Biodiversity Scale used in interpreting indices

Relative Values	*Shannon-Weiner Index (H')*	*Evenness*
Very High	3.50 – 4.00	0.75 – 1.00
High	3.00 – 3.49	0.50 – 0.74
Moderate	2.50 – 2.90	0.25 – 0.49
Low	2.00 – 2.49	0.15 – 0.24
Very Low	1.99 and below	0.14 and below

2.1.4.1.2 Floral Assessment Result

Assessment was conducted on random sites with different forest cover types. It was found that the area contains a variety of vegetation type ranging from open forest, grassland, and regeneration forests. The complete list of sampling stations is in ***Table 11.***

Table 11 - Location of the sampling points.

Station	*Coordinates*	*Elevation (masl)*	*Dominant Type of Vegetation*
1	15° 3'55'' N, 121° 4' 35" E	167.67	Open shrubland dominated by small cassava plans and patches of ipil-ipil.
2	15° 3' 53" N, 121° 4' 34" E	165.51	Open shrubland and grassland dominated by *Mimosa* sp.
3	15° 3' 45" N, 121° 4' 35" E	164.59	Wooded forest edge with varied trees averaging about 10m tall.
4	15° 3' 41" N, 121° 4' 35" E	164.29	Wooded area with observed dominance of ipil-ipil.
5	15° 3' 34" N, 121° 4' 33" E	167.03	Sparsely-vegetate area with stands of taluto.
6	15° 3' 29" N, 121° 4' 27" E	163.07	Wooded area with trees averaging 10m tall.
7	15° 3' 26" N, 121° 4' 31" E	157.82	Forest edge with mixture of brushes and small trees.

The first station is a forest edge located. It is characterized by shrubs, grasses and small trees with varying height but not more than 5 meters tall. Smaller tree recruits of Ipil-ipil were found in the area. Commercially-important cassava is also dominant.

The second station is abrushland dominated by several species of shrubs and grasses. Significant cover of *Mimosa* sp. is curtained on the station. For the third station, an area dominated by small trees with averaging at 10m and small shrubs were assessed. Small stands of (*Gliricidia Sepium*) kakawate and balakat were observed.

Station four is a closed forest where high stands (>10m) of Ipil-ipil and (*Gmelinaarborea*) Gmelina were observed. It has a steep slope overviewing parcels of sparsely-vegetated areas.

Station five is a sparsely-vegetated area with mixture of brushes and stands of (*Pterocymbium Tinctorium)* taluto. Other species of small trees were also found like balakat and kalumpang.

Station six is a conglomerate of small trees. Small individuals of some reforestation species such as (*Alstoniamacrophylla*Wall. ex G.Don) Batino and *(Acacia mangium)* Mangium.

Station seven is located on a forest edge. Kakawate and Ipil-ipil is still present on the last station. Bigger trees such as binunga and kupang were also found. Numerous species of shrubs were also located on the area.

2.1.4.1.2.1 Species Composition and Diversity Indices

A total of 48 species belonging to 25 taxonomic families were observed in the study area. All other plant species that can be observed inside the area but not covered by the plots were also included in the assessment for the general species composition but not in the specific computations for diversity indices and dominance in specific plots. ***Table 12*** shows the complete list of observed floral species in the area.

Family Fabaceae is the most represented family with eight (8) species, while Families Poaceae and Euphorbiaceae have five (5). Dominance of Family Fabaceae is observed in many types of ecosystems since the family is not limited to a single growth habit. ***Figure 51*** shows the distribution of number of species among families observed on the site.

Table 12 - Complete list of plant species observed on the area.

Species	*Scientific Name*	*Family*	*Habit*
Lamio	*Dracontomelon dao (Blanco) Merr. & Rolfe*	Anacardiaceae	tree
Laneteng pula	*Wrightia candollei Vidal*	Apocynaceae	tree
Galamay-amo	*Schefflera elliptica (Blume) Harms*	Araliaceae	shrub
Bigonia	*Begonia* sp.	Begoniaceae	shrub
Anabiong	*Trema orientalis (L.) Blume*	Cannabaceae	tree
Hagonoy	*Chromolaena odorata (L.) R.M.King&H.Rob.*	Compositae	shrub
Thickhead	*Crassocephalum crepidioides (Benth.) S.Moore*	Compositae	shrub
Tuhod-manok	*Synedrella nodiflora (L.) Gaertn.*	Compositae	shrub
Mile-a-minute	*Mikania micrantha Kunth*	Compositae	vine
Red ipomoea	*Ipomoea hederifolia L.*	Convolvulaceae	vine
Tamling	*Coccinia grandis (L.) Voigt*	Cucurbitaceae	vine
Cassava	*Manihot esculentaCrantz*	Euphorbiaceae	shrub
Binunga	*Macaranga tanarius (L.) Muell.-Arg.*	Euphorbiaceae	tree

Species	Scientific Name	Family	Habit
Alim	*Melanolepis multiglandulosa (Reinw. Ex Blume) Reichb. f. &Zoll.*	Euphorbiaceae	tree
Banato	*Mallotus philippensis (Lamk) Muell.-Arg.*	Euphorbiaceae	tree
Takip-asin	*Macaranga grandifolia (Blanco) Merr.*	Euphorbiaceae	tree
Ipil-ipil	*Leucaena leucocephala (Lam.) de Wit*	Fabaceae	tree
Aklengparang	*Albizia procera (Roxb.) Benth*	Fabaceae	tree
Kupang	*Parkia timoriana (DC.) Merr.*	Fabaceae	tree
Rain tree	*Albizia saman (Jacq.) Merr.*	Fabaceae	tree
Centrosema	*Centrosema pubescensBenth.*	Fabaceae	vine
Mucuna	*Mucuna* sp.	Fabaceae	vine
Kakawate	*Gliciridia sepium (Jacq.) Kunth ex Walp*	Fabaceae	tree
Makahiya	*Mimosa* sp.	Fabaceae	shrub
Climbing bamboo	*Flagellaria indica*	Flagellariaceae	bamboo
Gmelina	*Gmelina arboreaRoxb.*	Lamiaceae	tree
Alagaw	*Premna odorata Blanco*	Lamiaceae	tree
Walis-walisan	*Sida acutaBurm.f.*	Malvaceae	shrub
Bayok	*Dombeya diversifolia,* Spreng	Malvaceae	tree
Tan-ag	*Kleinhovia hospita L.*	Malvaceae	tree
Kalumpang	*Sterculia foetida L.*	Malvaceae	tree
Ficus	*Ficus* sp.	Moraceae	tree
Hauili	*Ficu sseptica*	Moraceae	tree
Balete	*Ficus* sp.	Moraceae	tree
Datiles	*Muntingia calabura L.*	Muntingiaceae	shrub
Kurunggut	*Passiflora foetida L.*	Passifloraceae	vine
pansitpansitan	*Peperomia pellucida (L.) Kunth*	Piperaceae	shrub
Buho	*Schizostachyum* sp.	Poaceae	bamboo
Kawayantinik	*Bambusa blumeana Schult.f.*	Poaceae	bamboo
Bikal	*Dinochloa* sp	Poaceae	bamboo
Pennisetum	*Pennisetum polystachion (L.) Schult.*	Poaceae	grass
Parag-is	*Eleusine indica (L.) Gaertn.*	Poaceae	grass
Balakat	*Ziziphus talanai (Blanco) Merr*	Rhamnaceae	tree
Severinia	*Severinia* sp.	Rutaceae	shrub
Kusibeng	*Sapindus saponaria L.*	Sapindaceae	tree
Lipang kalabau	*Dendrocnide meyeniana (Walp.) Chew*	Urticaceae	tree

Species	Scientific Name	Family	Habit
Coronitas	*Lantana camara L.*	Verbenaceae	shrub
Mali-mali	*Leea guineenseG.Don*	Vitaceae	shrub

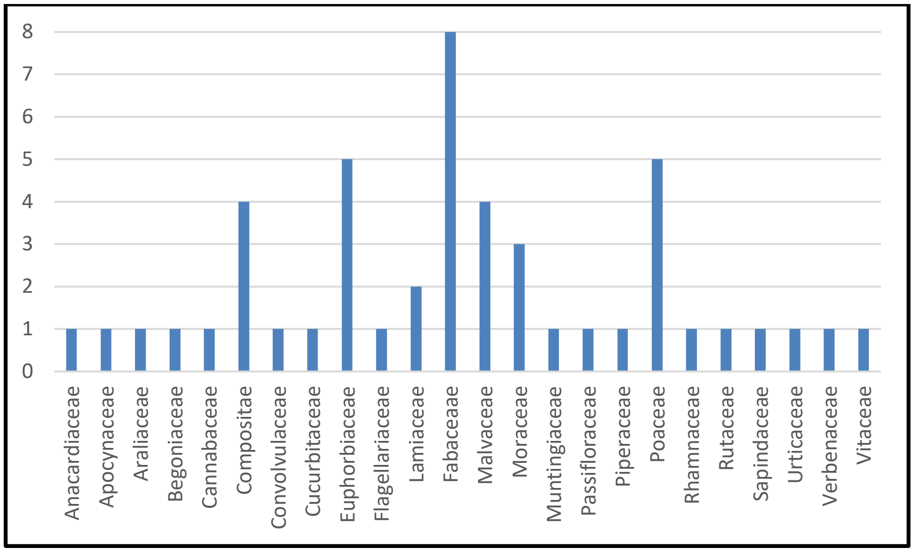


Figure 51 - Number of Observed Species Per Taxonomic Families

Based on the plots assessed, the most abundant tree species is (*Leaucaenaleucocephala*L.) Ipil-ipil of Family Fabaceae with 19 individuals recorded. (*Macarangatanarius* (L.) Binunga Muell.-Arg.*)*of Family Euphorbiaceae and (*Gliciridiasepium*Jacq. Kunth ex Walp) Kakawate of Family Fabaceae are the next most abundant species with eight (8) recorded individuals.

The over-all species diversity described by Shannon-Weiner Index (H') of the area is 2.016. based on the Fernando Scale, it translates into a Low diversity. The value differs across the seven (7) established stations. The values range from Low to Very Low diversity based on the Fernando's Biodiversity Scale. Transect 3 (T3) registers a diversity (H'=2.04), which is the highest among the assessed areas but still registered a Low diversity. Varied diversity indices are expected since multiple vegetative communities were observed on the sampling site. ***Figure 52*** shows the Shannon-Weiner Value of species diversity in each sampling station.

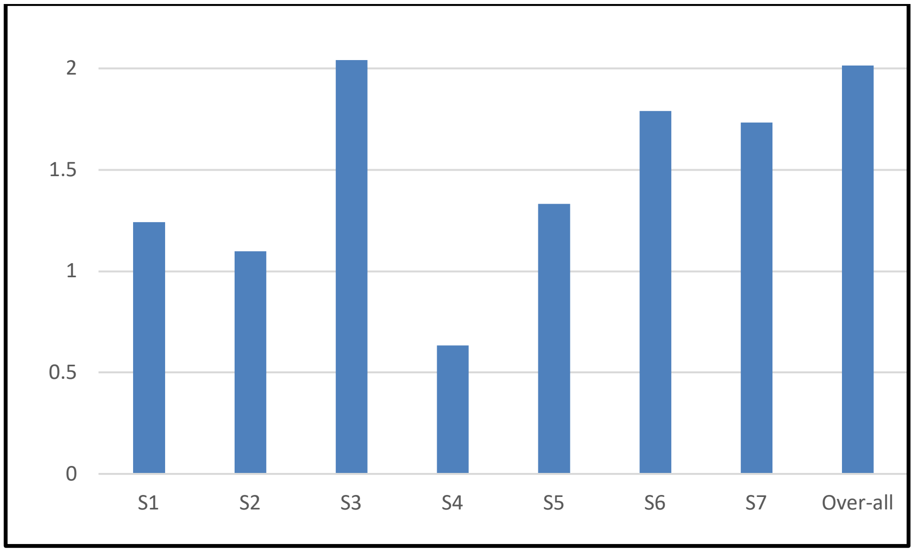


Figure 52 - Shannon-Weiner (H') Species Diversity of the Assessment Stations

Contrary to the varied diversity indices, species evenness (J') as described by Pielou's Index were generally high all throughout the assessed transects. All of the values obtained registera Very High species evenness, except to Stations 1 and 4, indicating that species are present in uniform distribution and dominance of certain species is not highly significant. Only Station 1 registers a High evenness of 0.74. Station 4 has the lowest evenness of 0.47, which is accounted to the dominance of Ipil-ipil in the area. Over-all, the area assessed registered a High evenness of 0.63. ***Figure 53*** shows the complete values of the computed and Pielou's species evenness (J').

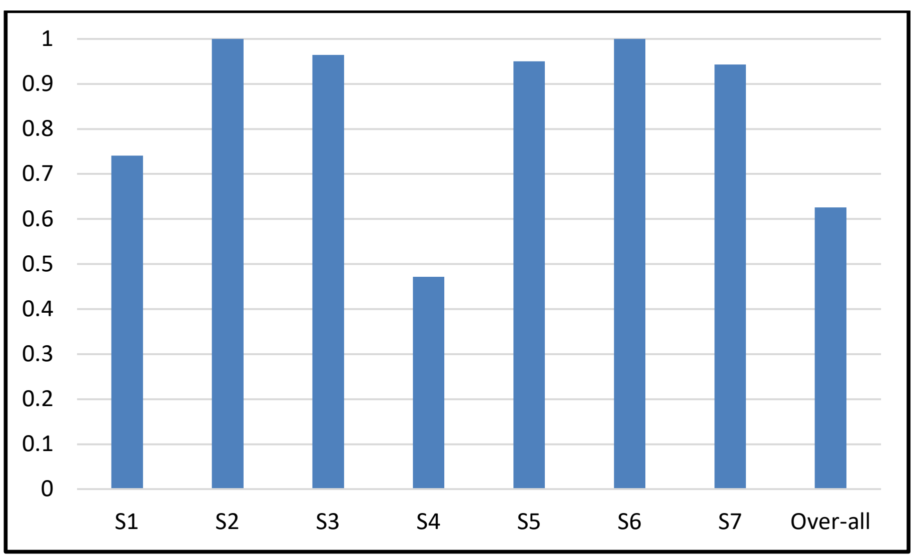


Figure 53 - Species Evenness of The Sampling Stations

Importance Values (IVs) of the trees intercepted in all seven (7) stations were also analysed (***Table 13***). The respective IVs of the plants were the summation of their computed Relative Density, Relative Frequency and Relative Dominance. It has to be noted that trees with DBH ≥10cm are included in the computation of the IV. From the results, Ipil-ipil has the highest IV (75%) which is accounted heavily to its Relative Density. It is followed by (*M. tanarius*) Binunga and(*G. sepium*) Kakawate both with 47%. Although both are small trees, like Ipil-ipil, their abundance in the transects established accounts to their high IV. (*Ziziphustalanai*) Balakat of Family Rhamnaceae is also at the top of the list of the floral species (IV=30%).

Table 13 - Tree Species and the Computed Indices

Common Name	*Scientific Name*	*Relative Density*	*Relative Frequency*	*Relative Dominance*	*IV*
Ipil-ipil	*Leucaena leucocephala* (Lam.) de Wit	0.36	0.12	0.27	75%
Kakawate	*Gliricidia sepium* L.	0.15	0.21	0.11	47%
Binunga	*Macaranga tanarius* (L.) Muell.-Arg.	0.15	0.21	0.11	47%
Balakat	*Ziziphus talanai* (Blanco) Merr	0.06	0.06	0.18	30%
Alagaw	*Premna odorata* Blanco	0.08	0.06	0.05	18%
Kalumpang	*Sterculia foetida* L.	0.04	0.06	0.08	17%
Taluto	*Pterocymbium tinctorium (Blanco) Merr.*	0.04	0.06	0.04	14%
Kupang	*Parkia timoriana* (DC.) Merr.	0.04	0.06	0.04	14%
Takipasin	*Macaranga grandifolia* (Blanco) Merr.	0.04	0.06	0.03	13%
Tan-ag	*Kleinhovia hospita* L.	0.02	0.06	0.02	10%
Lipangkalabau	*Dendrocnide meyeniana* (Walp.) Chew	0.02	0.03	0.03	8%
Alim	*Melanolepis multiglandulosa* (Reinw. Ex Blume) Reichb. f. &Zoll.	0.02	0.03	0.02	7%
TOTAL		1.00	1.00	1.00	3

2.1.4.1.2.2 Understory and Regenerants

Assessment of the smaller plants such as understory species and regenerants were also conducted inside the established plots. These species include shrubs, grasses, herbs, palms, vines and ferns. Assessment of these smaller plants is essential particularly in predicting what species will probably dominate the area through time. It will also give an idea on what species have a higher chance of maintaining their stands. ***Table 14*** shows the most dominant understory and regenerant species observed in the area.

Table 14 - List of Dominant Regenerant Species Observed in the Understory of The Area

Common name	*Scientific name*	*Stations observed*
Ipil-ipil	*Leucaena leucocephala (Lam.) de Wit*	1,2,3,5,6,7
Kakawate	*Gliciridia sepium (Jacq.) Kunth.exWalp.*	1,2,3,4,6,7
Lipangkalabau	*Dendrocnide meyeniana (Walp.) Chew*	2,3,5,6
Binunga	*Macaranga tanarius (L.) Muell.-Arg.*	3,4,7
Tan-ag	*Kleinhovia hospita L.*	2,3,7
Datiles	*Muntingia calabura L.*	2,6
Binunga	*Macaranga tanarius (L.) Muell.-Arg.*	1,4

Shrubs like *Begonia* sp. Was found thriving in the cliff walls near Station 4. This species is known to be shade-loving and is usually found in areas near water source. The individuals were found in the crevices of a limestone wall. Other shrub found in the area includes *Lantana camara*) Coronita (of family Verbenaceae and (*Leea guineense* G. Don) Mali-mali of Family Vitaceae.

Figure 54 - Shrubs Like Mimosa Sp And Herbs Hagonoy (Chromolaena Odorata) Found in the Area

Grasses (Family Poaceae) are also observed on the site. Species like *Pennisetum polystachion* (L.) Schult. and *Eleusine indica* (L.) Gaertn were found in almost all of the sampling stations and even on the roadside buffers of the area. A comparison of the abundance of floral species according to their growth habit is listed on ***Figure 55****.*

Regenerants of trees were also recorded. It is observed that Ipil-ipil has regenerants in almost all of the sampling station. As supported by the recorded high IV, particularly its density, Ipil-ipil will continue to dominate the areas given the existing conditions. Regenerants of other trees such Balakat, Datiles(***Figure 56***) and Kalumpang were also observed.

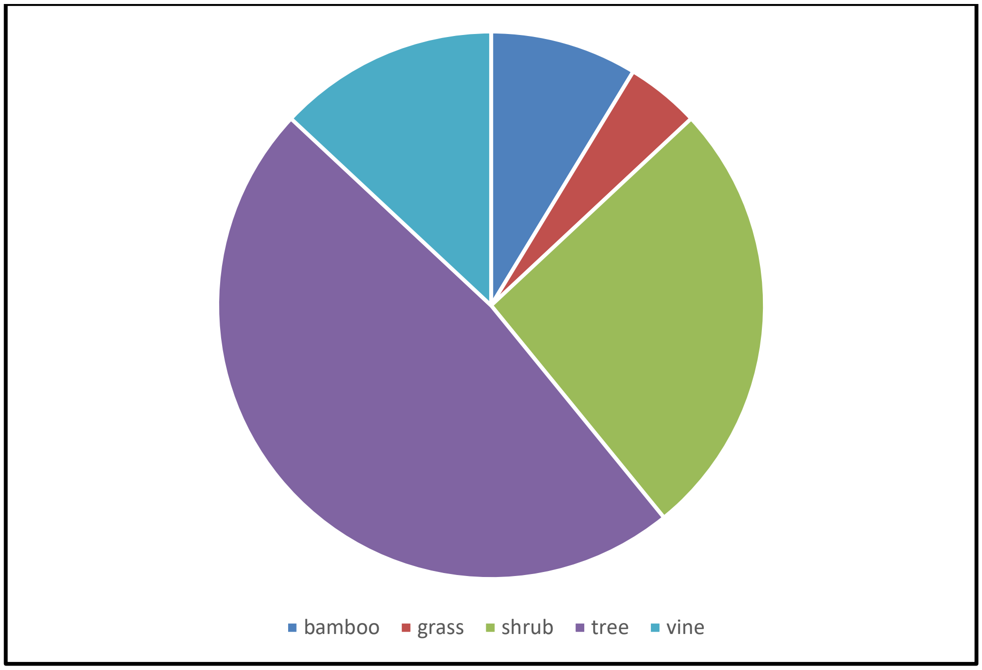


Figure 55 - Diversity of Plant Habits Observed on the Site

Figure 56 - Regenerants of Datiles (Muntingia Calabura) Observed on Station 6.

Endemicity and Vulnerability

One of the main considerations in assessment and monitoring of floral species is the presence of flagship species or those with conservation values. To assess this, determination of the species residency and vulnerability was done. Based on literature review of the range of all the species observed, it was found that all 46 species were indigenous to the Philippines. This means that these species are found here in the Philippines but can also be found on other areas of the world. No endemic species were observed on the area.

It has to be noted, however, that some of the plants listed by Center of Agricultural and Biosicence International as invasives are found thriving in the area. One of the examples of this is coronitas (*L. camara*).

Vulnerability of the species to threats like over-exploitation and habitat loss were also determined. It was found out that two vulnerable species are present on the site. These are Balakat (*Z. talanai*) and *Begonia* sp. According to the IUCN Redlist, Balakat is threatened by habitat loss and massive logging. *Begonia* species are vulnerable because of over-exploitation of the plants for ornamental uses. It is highly recommended that these species will be given prime importance in planning and implementing the rehabilitation plan of the mining area.

Ethnobotany

Local usages of the different plants observed on the sites were listed to see how the nearby community utilize the forest. Of the species recorded, most of the usable plants exhibit medicinal properties while other species are used as food and for utilities. ***Table 15*** shows some of the common plants and their respective uses.

Table 15 - Some of The Identified Plants with Ethno-Botanical Importance

Common Name	Scientific Name	Uses
Alim	*Melanolepis multiglandulosa (Reinw. Ex Blume) Reichb. f. &Zoll.*	Cough
Bigonia	*Begonia* sp.	Ornamental
Banato	*Mallotus philippensis (Lamk) Muell.-Arg.*	Anti-bacterial
Casava	*Manihot esculenta*	Food
Takip-asin	*Macaranga grandifolia (Blanco) Merr.*	Astringent
Ipil-ipil	*Leucaena leucocephala (Lam.) de Wit*	Furniture
Aklengparang	*Albizia procera (Roxb.) Benth*	Anti-rheumatism

Common Name	Scientific Name	Uses
Rain tree	*Albizia saman (Jacq.) Merr.*	Furniture
Gmelina	*Gmelina arboreaRoxb.*	Furniture
Alagaw	*Premna odorata Blanco*	Furniture
Kalumpang	*Sterculia foetida L.*	Diuretic
pansitpansitan	*Peperomia pellucida (L.) Kunth*	Anti-inflammatory, analgesic
Buho	*Schizostachyum* sp.	Ornamental, utilities
Kawayantinik	*Bambusa blumeanaSchult.f.*	Ornamental, utilities

Cassava (*Manihot esculenta*) was found thriving in Station 1 and some patches were also found in other stations assessed. The occurrence of the economically-important crop in the area, whether human-induced or natural, shows that the soil composition can support the plant. Plants with medicinal properties whether tree, shrub or herb species were also recorded in the site. Medicinal herbs such pansit-pansitan (*P. pellucida*) (***Figure 57***) were also found on the understory in Stations 6 and 7.

Figure 57 - Pansit-Pansitan (P. Pellucida) A Known Medicinal Herb Observed in Station 6

A very important bamboo species, Buho (*Schizostachyum* sp.*)* was also found in the area. The species was found on the Stations 3 and 4. This bamboo is used for ornamental and construction purposes.

2.1.4.1.3 Possible Threats Due to The Proposed Projects and Possible Mitigation Measures

In the area assessed, it is evident that some of the patches of the trees observed are located just meters away from the roads. It is then suggested that careful planning of the final road plan for the project must be employed to consider the most efficient route that will entail the least damage to the local floral assemblage.

During the operations phase, impact in the local ecosystem is unavoidable since clearance of the forest is expected, parcels will be activated for extraction of the limestone. Subsequently, damages to the local ecosystem are expected, maintenance of buffer zones in the circumference of the damaged area is needed. These buffer zones must be designed to neutralize the effects of the mining activities, thus preventing the effects to reach other parts of the forests. One of the major examples of these are riparian buffer ones. These buffer zones are designed to prevent the damages of the mining activities to reach the streams and rivers. Usually, a layer of riparian vegetation is left untouched to serve as the buffer zone of the area. No major stream is located inside the target area for operation.

The proposed operation is not expected to have a negative effect on the livelihood and health of the community since the MPSA area is not accessible due to its terrain. Also, the operation will be confined within the Eagle Cement area, hauling of quarried materials from MPSA 245 to the plant will not require the use of barangay road since there are established access roads within the mining tenements and the cement plant.

Progressive rehabilitation shall be implemented by the company. Conservation of the local biodiversity must be incorporated on the progressive rehabilitation strategies. This can be done by using a mixture of known reforestation trees such as the leguminous plants that are capable of nitrogen-fixing with other indigenous trees that were determined to be part of the original landscape of the area. Re-vegetation of most mining areas involves different considerations due to the changes in the physical and chemical conditions brought by the mining operations. The land topography, for example is drastically changed by mining operations. The necessary flattening and alteration of the original slope for the access road requires different conditions for the selection of species for rehabilitation.

Results of the floral assessment showed that the current assemblage is not highly diverse, thus, there is no foreseen impact on the food security of the community. Trees that are fast growing such as Ipil-ipil and kakawate are the most dominant. It will also be advantageous since they are nitrogen-fixing. In terms of the regenerants and understory, these fast-growing trees are also the most prevalent. This means that the rehabilitation of the damaged parcels, once mined-out, will be easier because of abundance of recruits from these plants. Extensive care is necessary once the rehabilitation of some areas will start since it was observed that the area's exposure to sunlight is very high. The reflectivity of the white limestones makes the sunlight more intense.

Aside from trees, other smaller plants such as shrubs, herbs, ferns and grasses can help in reforesting the area. As discussed on the floral composition of the mining sites, different understory species can be found on the area. This will also ensure diversity of species found on the area. From the ecological succession model, grasses and smaller plants are first plants to spring naturally in a damaged area.

Bamboo species are also known to be effective in mine rehabilitation. It is noted that Boho, (*S. lumampao*(Blanco) Merr) was found in abundance in some of the studied transects. Bamboo species are known for their stability and dense root systems, these qualities can make them suitable in rehabilitation of the site.

2.1.4.2 Terrestrial Fauna Assessment

2.1.4.2.1 Methodology

Faunal assessment was conducted across different microhabitats within the proposed quarry project site within MPSA 245. For avian fauna, an ocular observation of birds along roadside was conducted by walking moderately while listing all encountered birds either in flight or perched (***Figure 58***). Using a Nikon 10 x 25 binocular, zoom camera and book guide on Philippine birds, birds were easily identified. Audio observation through bird calls or songs were also noted.
Sightings of other forms of wildlife such as birds, reptiles, mammals and amphibians, even tracks, feces and other signs that can be attributed to certain species outside the transect survey and are present within the area were considered as well. Ethno survey or information from the local communities of other existing wildlife in the area was also considered. Identification of recorded species was aided using field guides such as Kennedy et.al (2000) and electronic references like IUCN RedList and Avibase (World Bird Database).

Figure 58 - Satellite Image Overlay of The Transect Walk with The Location of The Trapping Site

For bats and other cryptic birds, mist nets were used to validate other present volant animals that are not observed during the transect survey. The net is made up of black nylon mesh with pouches, measuring 3 x 9 meters. The nets were set up strategically along the fly path of the bird, commonly near fruit trees or an opening in a vegetated area. Captured specimens were released after it was recorded.

Collected data were computed for the determination of abundance and diversity values. Shannon-Weiner diversity index (H') formula (Σ s = (-pi Ln pi)) was used, where pi is the proportion of total samples belonging to the i nth species and S is the number of species (Odum, 1971). Pielou's species evenness (J') is also computed to describe how evenly distributed the species in the study area are. This is calculated using the formula: J' = H'/H'max.

2.1.4.2.2 Faunal Assessment Result

The proposed site is characterized as a mixed secondary vegetation dominated by pioneer plant species such as Takip-asin (*Macaranga grandifolia* (Blanco) Merr.), Binunga (Macaranga tanarius (L.) Muell.-Arg.), Tan-ag (*Kleinhovia hospita* L.), Ipil-ipil (*Leucaena leucocephala* (Lam.) de Wit), akleng-parang (*Albizia procera* (Roxb.) Benth), Tibig (*Ficus nota* (Blanco) Merr.) and alim (*Melanolepis multiglandulosa* (Reinw. Ex Blume) Reichb. f. &Zoll.).

Alongside are shrubs such as Hagonoy (*Chromolaena odorata* (L.) R.M.King&H.Rob.), Makahiya (*Mimosa pudica*L.), synedrella (*Synedrella nodiflora* (L.) Gaertn) , Lantana (*Lantana camara* L.) that were observed in some open areas along the road (***Figure 59***).

Bamboos of different species also occupy a great portion of the area together with some vines of mile-a-minute (MikaniamicranthaKunth), Velvet bean (Mucuna sp.) and Centrosema (*Centrosema pubescens* Benth.). The *Muntingia calabura,* locally known as datiles, was the only fruit-bearing tree that is non-commercial, found scattered within the project site. Patches of grasses such as cogon (*Imperata cylindrica* (L) P. Beauv.), *Pennisetum* sp., and *Eleusine indica* were also found to be the foraging areas of some grain-eating birds like the munias.

Actual observation revealed a total of 34 species, majority of which are birds (88%). There were also species of reptiles composed of 2 lizards (6%) coming from different families. Meanwhile, using the mistnet, 2 species of bats (6%) from the same family were captured and recorded.

Figure 59 - Panoramic View of the Portion of the Transect Line

Table 16 - Terrestrial vertebrates observed in Doña Remedios Trinidad, Bulacan

Class	*Families*	*Number of Species*	*Number of individuals*
Birds	23	30	92
Reptiles	2	2	2
Mammals	1	2	8
Total	26	34	102

2.1.4.2.2.1 Avifauna

2.1.4.2.2.1.1 Species Composition and Diversity

Birds survey across the 82 ha proposed area revealed a total of ninety-two (92) individual birds, represented by thirty (30) species that belong to twenty three (23) families**.** The highest abundance of bird group came from the passerines or perching bird with 21 representative birds, followed by doves and pigeons, and swifts with 2 species each (***Table 17***).

Table 17 - Distribution of Bird Species in Terms of Bird Group

Groups	Number
Perching birds	21
Doves, pigeons and dodo	2
Swifts	2
Parrots and their relatives	1
Cuckoos	1
Kingfishers and bee-eaters	1
Waterbirds	1
Diurnal birds of prey	1

Out of the twenty-three (23) families observed, Muscicapidae was most well represented with 3 species. Two species each were recorded belonging to families Apodidae, Columbidae, Estrildidae, Locustellidae and Pycnonotidae. Seventeen (17) families were represented by one species each. ***Figure 60*** shows the number of species observed per family of birds.

Merops philippinus, under the family Meropidae was observed to be the dominant species (n=11). These are bee-eaters, found sweeping back and forth in flight catching bees and other insects. Next to it are the *Pycnonotus goivaier* (n=9), *Lonchura leucogastra*(n=6), *Collocalia esculenta* (n=5). Seven (7) species were tied at 4 individuals, 4 species with 3 individuals, 6 species at 2 heads while the rest with one individual each. Some of the bird species observed in the area is shown in ***Figure 61***. ***Figure 60*** shows the complete list of birds observed in the area.

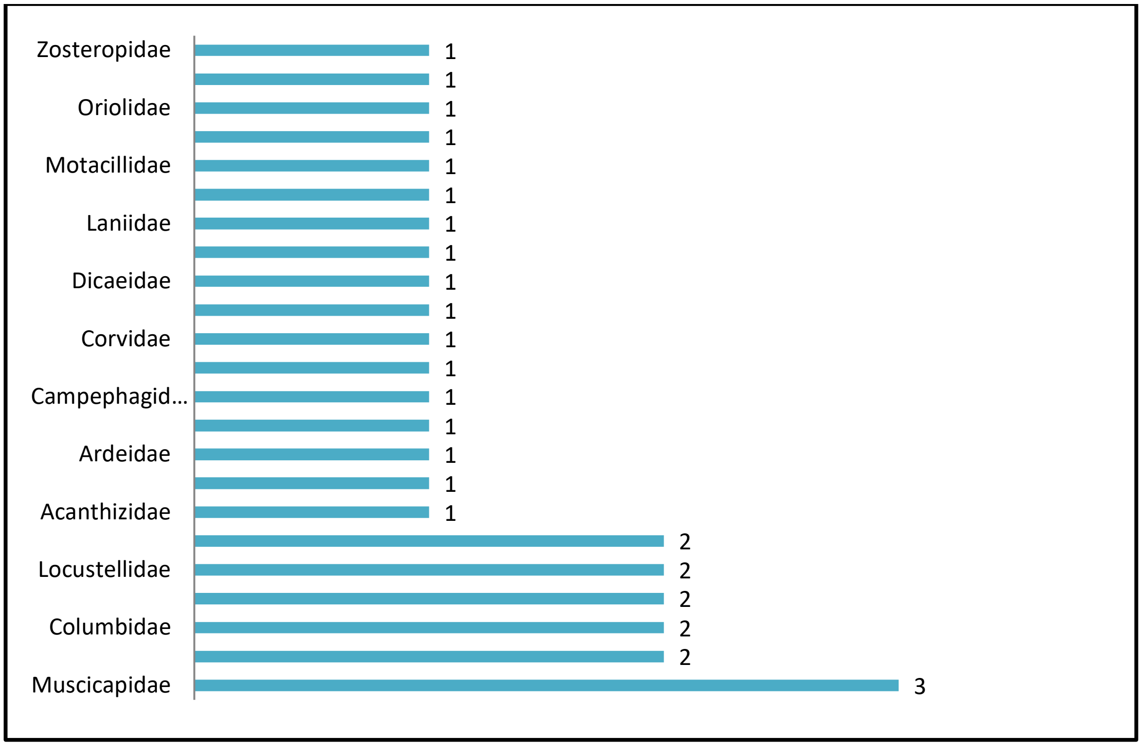


Figure 60 - Number of Species Observed Per Family of Birds

Species diversity was computed using the Shannon-Weiner index. Based on computation, the species diversity is moderately high (**H'=3.1602).** Dominant species is present with a little competition between species.The competition however may not affect the existence of other species in the area since species distribution is more likely evenly distributed (**J=0.9184**).

Figure 61 - Some of the bird species observed in the area (a. Yellow-vented bulbul, b. Blue-tailed bee-eater, c. Olive-backed sunbird, d. Blue-rock thrush, e. Chinese sparrow-hawk, and f. Guaiabero)

Island endemics comprise about 27% of all identified bird species present in the area. These are birds that are restricted only in the country. Among these birds are *Collocalia troglodytes*, *Orthotomus derbianus, Phapitreron leucotis, Loriculus philippensis, Hypsipetes philippinus, Gerygone sulphurea, Centropus viridis and Dicaeum australe.* About 17% of the total bird community comprise the migrants while resident birds were 56% (***Figure 62***).The presence of a number of endemic species indicate that the area is still an important habitat for birds despite the disturbances and noise such as blasting activities conducted in the nearby plant.

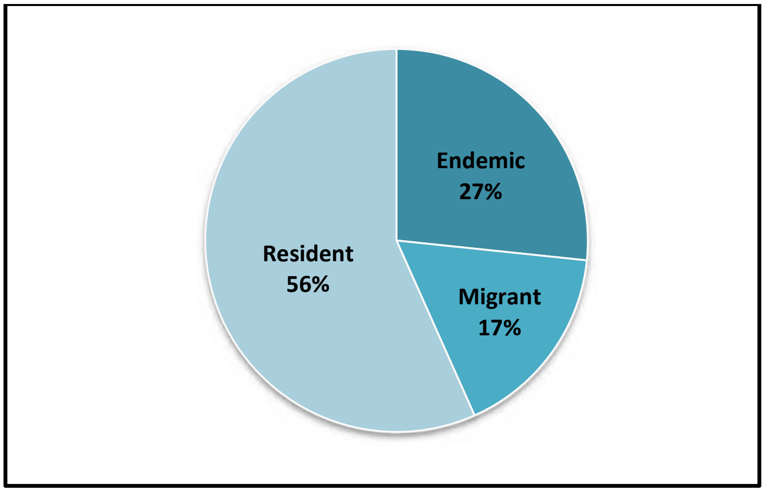


Figure 62 - Distribution of Birds in Terms Of Residency

Foraging behavior Swas grouped into 7 trophic levels to determine the different feeding behaviors and the food source of birds in the area. Results showed that insectivores or insect eating birds(60%) was the dominant group as compared to all other feeding guilds in the area (***Figure 63***). Insectivorous birds are said to increase plant growth by consuming herbivorous insects and reducing insect damage (Sipura, 1999). Study by Marquis and Whelan (1994) showed that declines in populations of insectivorous birds may reduce forest productivity because of potentially higher numbers of leaf—chewing insects and the concomitant negative effect on plant growth.Among these insectivorous birds are the *M. philippinus*, which was also observed as the most dominant among all other birds. Other birds of this kind are the swifts, cuckoos and perching birds.

Other feeding guilds observed in the area were frugivores or fruit-eating(10%),granivores or grain feeders(10%),combination of frugivores and granivores(7%) and nectarivores or nectar feeder (7%). Piscivore-invertebrate eaters or fish eating and the carnivores or flesh-eating birds were found least observed.

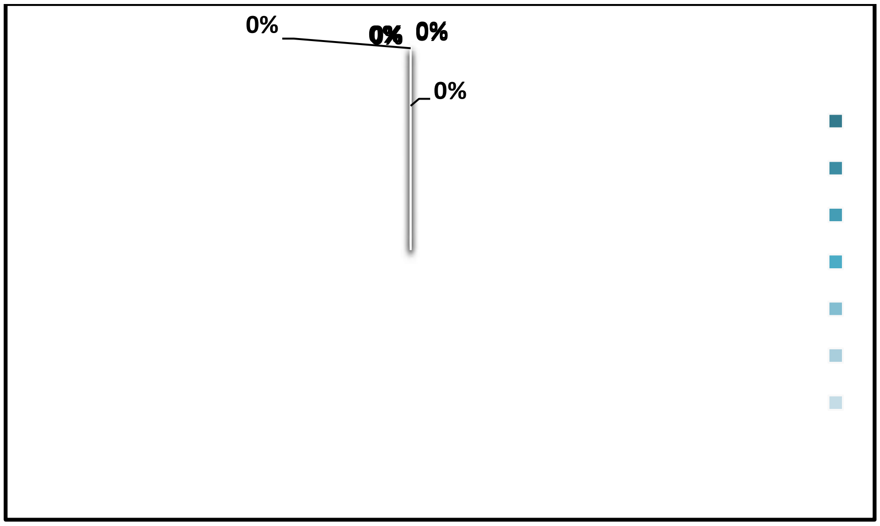


Figure 63 - Distribution of Birds in Terms of Feeding Guilds

2.1.4.2.2.2 Other Terrestrial Fauna

Eight frugivorous bats composed of 2 species under the Family Pteropodidae were captured using the mistnet. These are the *Ptenochirus jagori* and *Eonycteris spelaea* (***Figure 64***). These 2 species of bats are widely distributed and commonly seen in disturbed and agricultural areas. Live traps baited with roasted coconut were also in placed however were not able to capture any rodent.

Figure 64 - Captured bat species(a. Ptenochirusjagoriand b.Eonycterisspelaea)

Two species of lizards were accidentally observed namely the *Draco volans* and *Gekko gecko*. These species are also common and not listed as threatened species. The *D. volans* was spotted gliding from one tree to another (***Figure 65***) during the setting up of the mistnet while *G. gecko* was heard during the transect survey.

Figure 65 - Draco Volans was Spotted Gliding from One Tree to Another

2.1.4.2.3 Possible Threats and Mitigation Measures

Proposed project operation entails site clearing of the area. This will remove vegetation cover which will cause direct habitat loss for faunal species residing within the disturbed areas and vicinities. Similarly, the loss of mature trees will decrease the sources of seeds and regenerants. Wildlife species feed on seeds and the loss of the feeding grounds will drive away these wildlife species.

Buffer zones should be maintained to neutralize effects of mining activities. These buffer zones will also serve as refuge for displaced wildlife species. Progressive rehabilitation of damaged areas should include strategies for conservation of biodiversity. Temporary cages/shelters should be constructed for accidentally caught and turned over species.

Site screening and noise control measures should be adopted. These include internal traffic routing, optimizing blasting design, and restricting vehicle speed, among others. Significant noise would cause stress to wildlife however, wildlife species are mobile and can migrate to immediate vicinities that will not be used for the quarry operations.

2.2 Water

2.2.1 Hydrology/Hydrogeology

2.2.1.1 Drainage

The proposed 69.9-hectare quarry project of Eagle Cement Corporation is within the drainage area of Conlong River based on the topographic map in ***Figure 66***. The project area, characterized by karst topography, has a moderate relief with elevations in the range of 100 m to 200 m. Based on the Exploration Report on Geology and Limestone Resources covering the project area, the region is characterized by karst topography and features sinkholes, poljes ((high walls/karst topography)) and a few caves. There are no water bodies traversing the project area. Conlong River is located approximately 1.5 km north of the proposed project area flowing in a westerly direction. It has an approximate drainage area of 2,783 hectares (27.83 km^2) with a reference point located at 121° 1'51.87"E; 15° 4'21.45"N. Another surface water body near the proposed project site is Salapangan River. It is located south of the proposed project site and also flows in a westerly direction. Both Conlong River and Salapangan River are tributaries of the lower reach of the Pampanga River which is the main river of the Pampanga River Basin. Both tributaries converge into Pampanga River at a point which is approximately 30 km from the project site and 40 km from the Manila Bay where the mouth of the Pampanga River is located (***Figure 67***). The length of Pampanga River is estimated to be 260 km with its headwaters at Caraballo Mountains.

The Pampanga River Basin is located in the Central Luzon Region and is the fourth largest river basin in the Philippines with a drainage area of approximately 11,195 km^2 (RBCO[5]). It is drained through the Pampanga River and the Labangan Channel into the Manila Bay.

[5] *18 Major River Basins and 3 Principal River Basins in the Philippines*. (n.d.). Retrieved May 5, 2019, from River Basin Control Office: http://rbco.denr.gov.ph/18-major-river-basins/

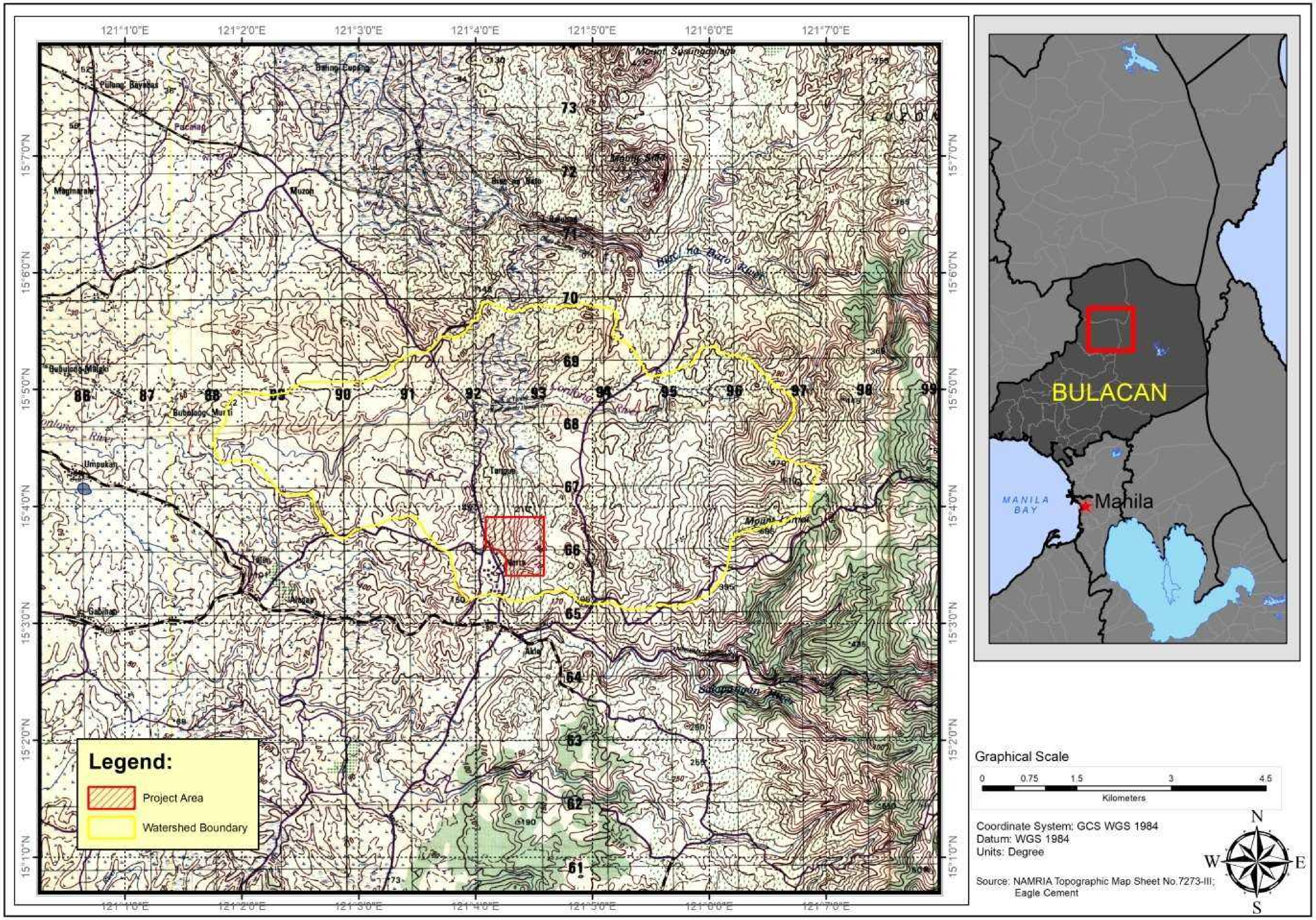
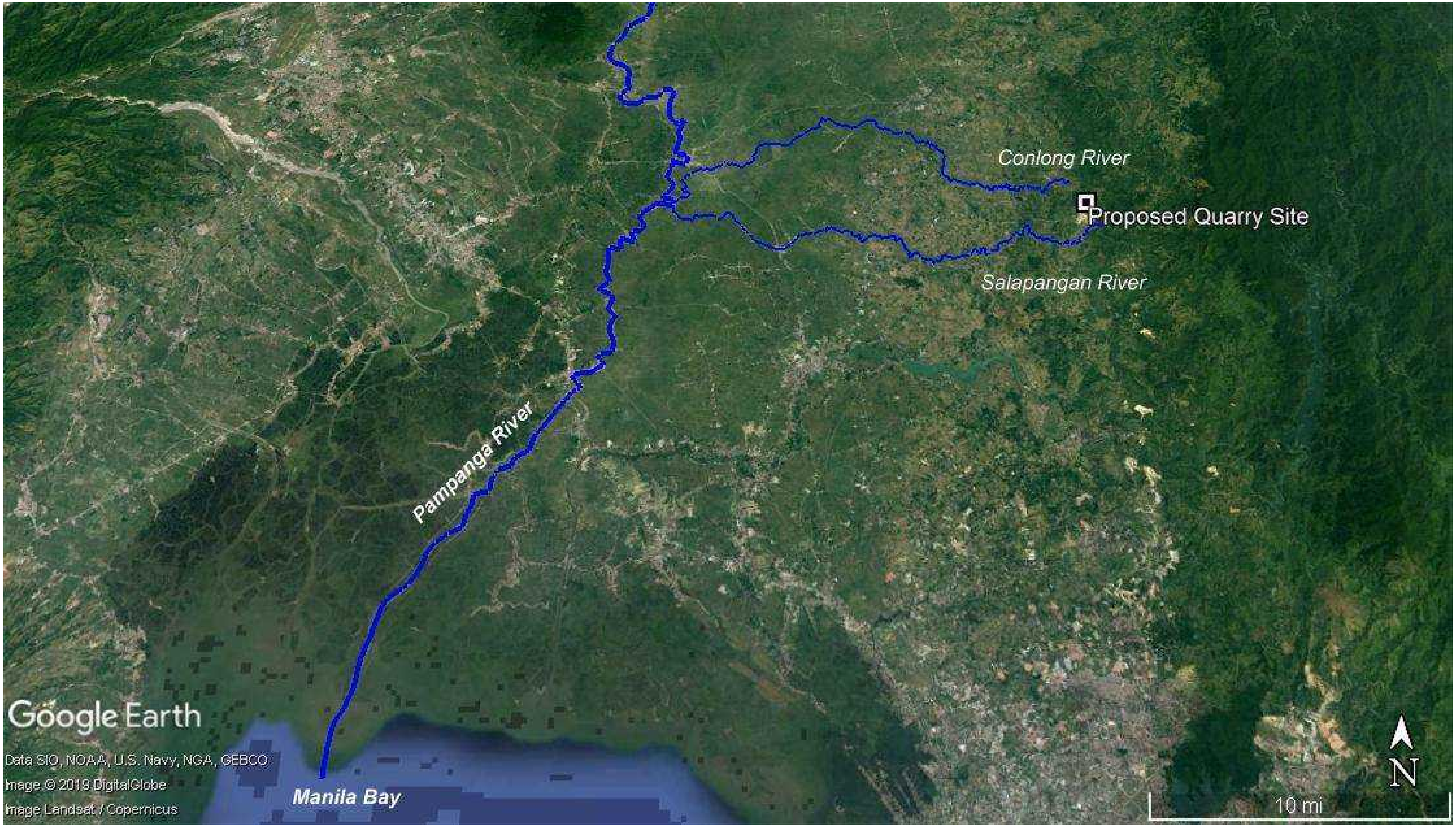


Figure 66 - Topographic map showing the location of the quarry project within the Conlong Subwatershed



(Image source: Google Earth Pro)

Figure 67 - Satellite Image Showing the Relative Location of The Proposed Quarry Project to The Pampanga River

2.2.1.2 Regional Hydrogeology

The proposed quarry project is within an area with local and less productive aquifers as shown in the groundwater potential map in ***Figure 68***. There were no springs found within the project site. Based on the water permits granted by NWRB, there are two major wells in the municipality of San Ildefonso, one is owned by the San Ildefonso Water District in Brgy. Malibampang (well capacity = 30.62 lps; static water level = 23 m) and the other is owned by Eagle Cement Corporation in Brgy. Akle (well capacity = 38.23 lps; static water level = 15.40 m).

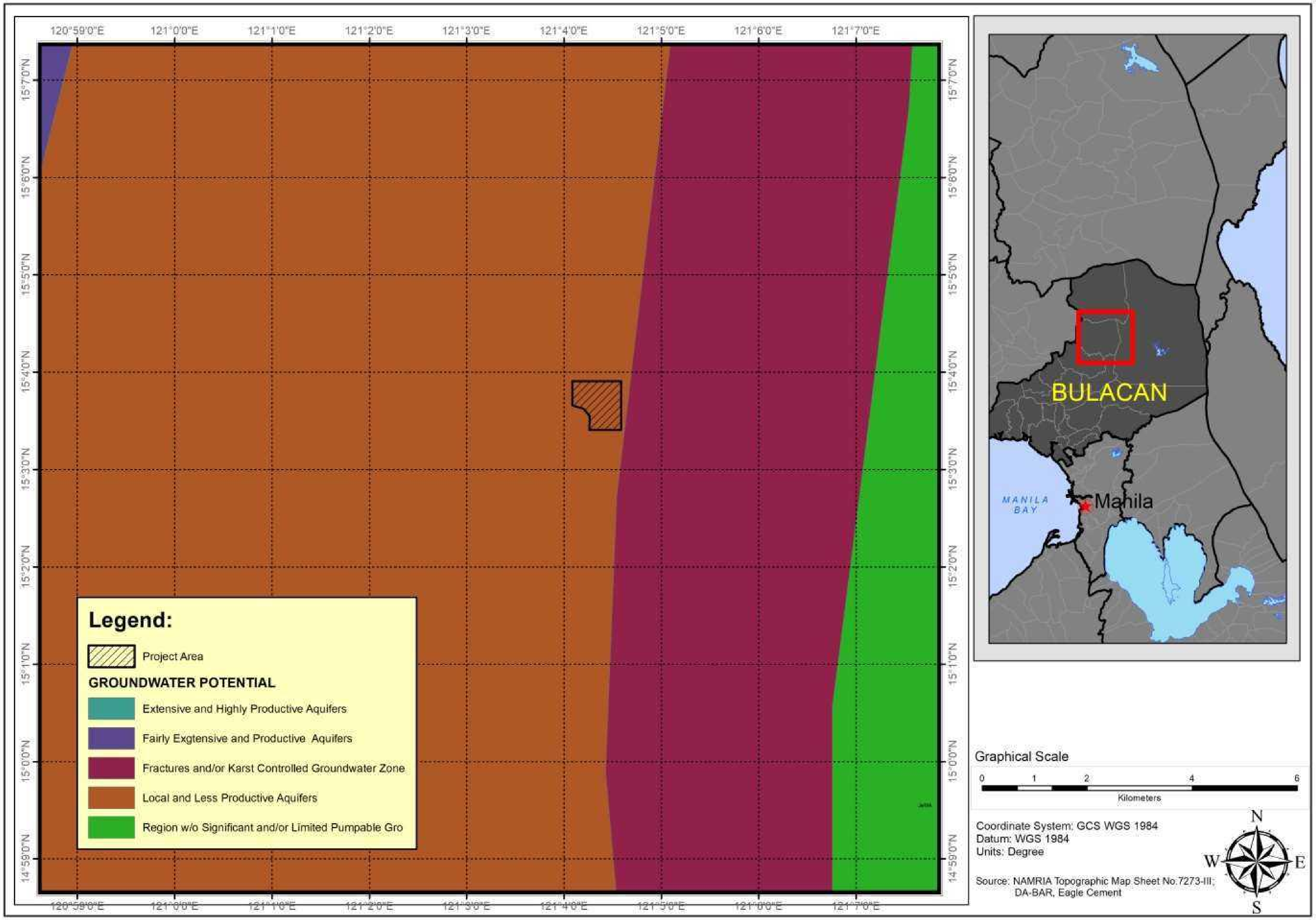


Figure 68 – Hydrogeologic Map

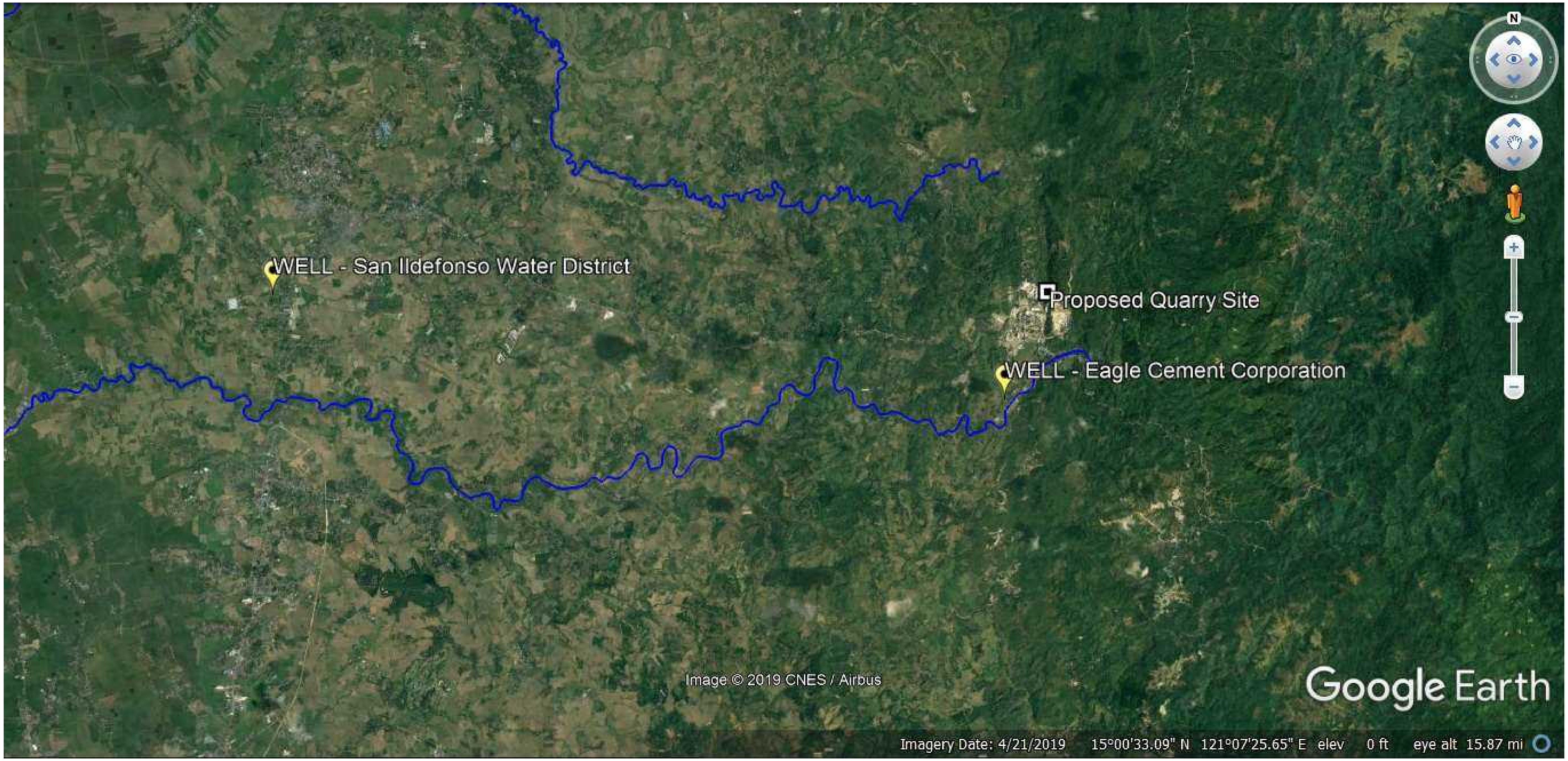


Figure 69 - Location of wells in San Ildefonso based on the water permits granted by NWRB

2.2.1.3 Water Use

The proposed quarry project's main water use would be the water spraying of roads and other open areas that could be sources of dust pollution that may affect the nearby communities. Progressive rehabilitation will also be implemented thus water will also be needed to maintain the revegetated areas. The operation of the proposed project, however, is not expected to cause any water use competition since the project water demand is deemed to be minimal.

The estimated water consumption per year is 72,000 cubic meters. The water consumption presented is based on the existing consumption of the contractor of the existing quarry operation. The same contractor will operate the proposed project.

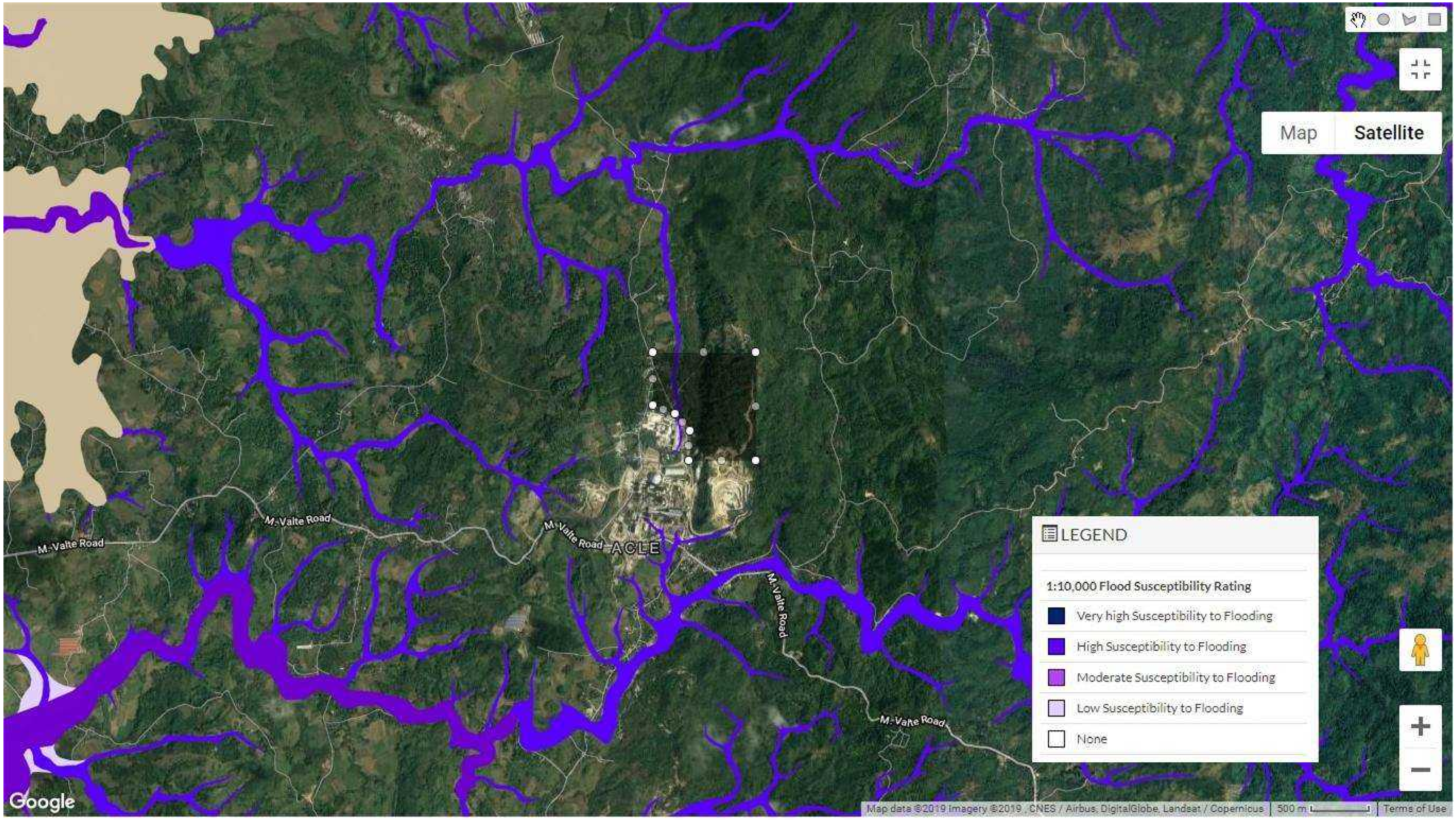
Water for domestic use will be sourced from groundwater supplied by the existing plant. The source of water for road dedusting will come from the existing siltation pondss and water impounded in the existing quarry pit.

2.2.1.4 Hydrologic Hazards

Based on the flood susceptibility map generated by the Mines and Geosciensces Bureau through their online Geohazard Map Visualization, a portion of the project area is highly susceptible to flooding (***Figure 70***). This area is the valley portion west of the project site leading to the Conlong River. In addition, based on the result of the geohazard assessment of the barangays in Bulacan Province conducted by MGB-R3, Barangay Akle was found to be susceptible to flooding (MGB-R3, 2012)[6].

---

[6] Mines and Geosciences Bureau (Region III). (2012, November 19). *Summary of Geohazard Assessment in Region 3.* Retrieved May 10, 2019, from Mines and Geosciences Bureau (Region III): http://region3.mgb.gov.ph/mgb_roIII_files/pdf/Geohazard_Assessment_Map/bulacan_exec-summar.pdf



Source: gdis.mgb.gov.ph/mgbgoogle/

Figure 70 - Flood Susceptibility Rating Map (1:10,000)

2.2.1.5 Impact Management

2.2.1.5.1 Change in Drainage Pattern

The drainage pattern in the quarry area will inevitably be changed due to the quarrying activities to be conducted. These changes will be permanent and are considered to be significant. Thus, to control surface runoff and prevent it from eroding open areas in the quarry and flooding depressed areas in the quarry, drainage canals of sufficient depth to handle surface runoff shall be established along the bench toe. Access roads shall also be provided with drainage canals. All drains will be connected to a series of settling ponds.

2.2.1.5.2 Water Use Competition

The proposed quarry project is not expected to cause water use competition. Water will only be used for road spraying which will be done as needed since the access roads of the project is distant from the community. Water to be used during rehabilitation is also considered to be minimal. The main source of water by the project operation is the Cement Plant process water.

2.2.1.5.3 Climate Change Projection

Climate change has a direct impact on water resources. Projected decrease in rainfall may cause water stress while projected increase may result to flooding events. Based on PAGASA's climate change projection in 2020 and 2050 under medium-range emission scenario in Bulacan Province, decrease in seasonal rainfall change (in %) is greatest during the months of March-April-May (MAM) wherein rainfall is projected to decrease by 23% in 2020 and 36.4% in 2050. Increase in rainfall, on the other hand, is projected to be greatest during the months of June-July-August (JJA) with a projected increase of 12.8% in 2020 and 23.6% in 2050. These projections indicate that the province would be more vulnerable to water shortages during the dry season and to flooding during the wet season. With this, a disaster risk reduction and climate change adaptation plan shall be developed in coordination with the host barangay and local government unit.

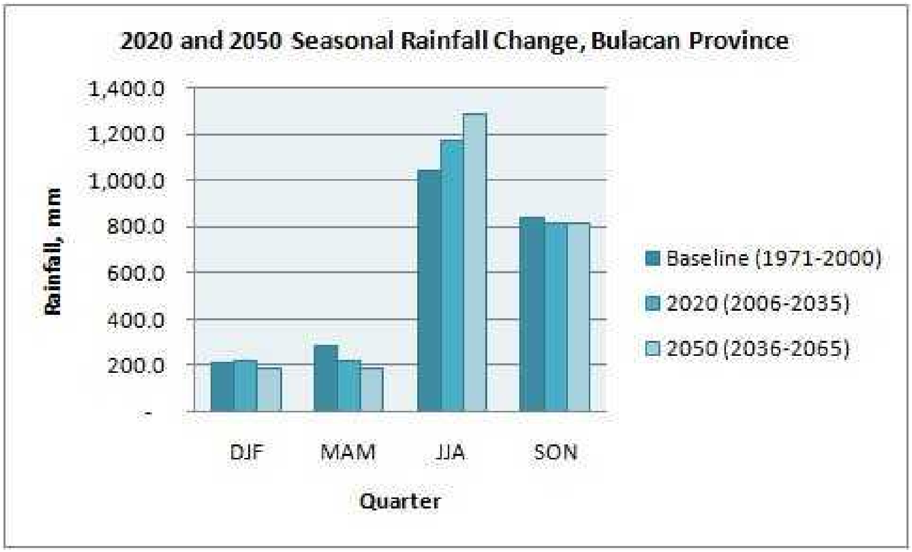


Figure 71 - Seasonal rainfall change projections (2020 and 2050) in Bulacan Province

2.2.2 <u>Water Quality</u>

2.2.2.1 Methodology

Baseline study on water quality was conducted on October 22, 2018. The surface waters in the area were initially assessed using a NAMRIA topographic map. Watershed delineation was conducted to determine where the runoff coming from the project area drains into (receiving water body) since there are no surface water bodies traversing the project area. Based on the topographic map, the project is located within the drainage area of Conlong which is a tributary of Pampanga River. The lower reach of Pampanga River, where the Conlong River is located, has been classified by the DENR as Class C (RBCO)[7]. The results of the water quality tests were compared to Class C values based on the actual beneficial use of Conlong and Salapangan Rivers (agriculture, irrigation and livestock watering, washing). In addition, although these rivers are not listed under the classified rivers of DENR, both are tributaries of the lower reach of the Pampanga River which has been classified by the DENR as Class C (River Basin Control Office website on the 18 Major River Basins in the Philippines).

Two (2) surface water quality monitoring stations were established along Conlong River, one at the upstream (control) and another downstream of the valley traversing the project site. Two (2)

[7] River Basin Control Office. (n.d.). *18 Major River Basins and 3 Principal River Basins in the Philippines*. Retrieved May 5, 2019, from DENR River Basin Control Office: http://rbco.denr.gov.ph/18-major-river-basins/

surface water quality monitoring stations were also established along Salapangan River located south of the project site for baseline purposes. There are no surface water bodies within the proposed project site. Similarly, groundwater quality sampling stations were located outside the proposed quarry area since there were no springs or wells within the area. Groundwater is commonly used by the surrounding communities for domestic purposes through shallow tube wells either hand pumped or jet pumped. Three (3) groundwater quality stations were established in the community centers surrounding the proposed project site. The locations of the four (4) surface water quality and three (3) groundwater quality baseline monitoring stations are shown in ***Figure 72*** and described in ***Table 18***.

Grab sampling method was used to collect the water samples for parameters to be tested in the laboratory. Dissolved oxygen (DO), pH and temperature were tested on site using a handheld water tester.

Results of surface water quality tests were compared to the Class C guidelines set in the DENR Administrative Order 08 of 2016 (DAO 2016-08) - *Water Quality Guidelines and General Effluent Standards of 2016* to determine the baseline water quality of the surface water resources that may be impacted by the proposed project. Results for groundwater samples on the other hand were compared to DOA 2016-08 Class A guideline values.

Note that sediment transport modeling was not conducted for this project since there is no surface water body traversing the quarry area. In addition, the adequately-sized settling ponds which will be placed in series will also be constructed for this project. Due to the limestone's high porosity and high permeability properties, surface runoff is projected to be minimal and that the settling ponds to be constructed are adequate enough to contain the sediments coming from the quarry area. Most of the rainfall received within the quarry area is expected to percolate into the groundwater. This is in addition to the fact that the surface water body draining the project area, which is the Conlong River, is approximately 1.5 km away from the proposed project site.

Table 18 - Description of the water quality sampling stations

Station ID	Location	Geographic coordinates	Elevation
Surface Water			
S1	Conlong River downstream	15°04'48.4" N; 121°03'59.9" E	72 m
S2	Conlong River upstream	15°04'50.0" N; 121°04'56.8" E	119 m
S3	Salapangan River upstream	15°02'48.2" N; 121°04'58.8" E	95 m
S4	Salapangan River downstream	15°02'09.1" N; 121°03'47.3" E	67 m

Station ID	Location	Geographic coordinates	Elevation
Groundwater			
GW1	Shallow tube well	15°03’34.9” N; 121°04’01.5” E	108 m
GW2	Shallow tube well	15°05’17.5” N; 121°05’37.3” E	177 m
GW3	Shallow tube well	15°04’20.0” N; 121°04’52.6” E	167 m

Plate 1 - Surface Water Quality Sampling Station S1, Conlong River downstream

Plate 2 - Surface Water Quality Sampling Station S2, Conlong River upstream

Plate 3 - Surface Water Quality Sampling Station S3, Salapangan River upstream

Plate 4 - Surface Water Quality Sampling Station S4, Salapangan River downstream

Plate 5 - Groundwater Quality Sampling Station GW1

Plate 6 - Groundwater Quality Sampling Station GW2

Plate 7 - Groundwater Quality Sampling Station GW3

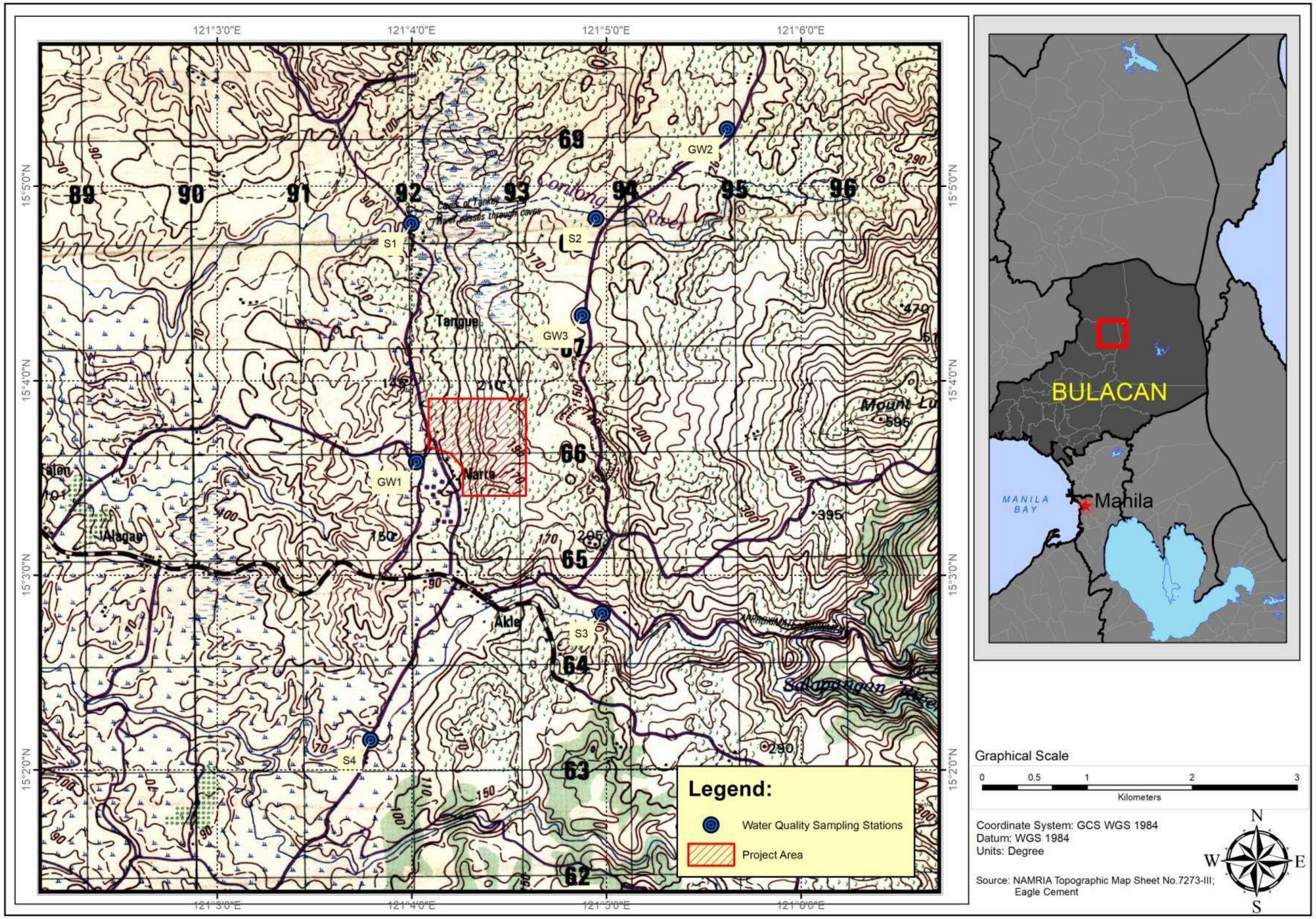


Figure 72 - Baseline Water Quality Sampling Stations

2.2.2.2 Results and Discussion

All surface water samples tested were compliant with the DAO 2016-08 Class C water quality guidelines for all the parameters tested except for dissolved oxygen (DO) in water sample from station S1 (DO=4.61 mg/l) and for the parameter Fecal Coliform wherein all the surface water samples exceeded the WQG value (ranged from 240 to 2,400 MPN/100 ml). The high recorded coliform value was possibly caused by the current use of the river such as: animal bathing and recreation. The low DO level in station S1 was probably due to the very low flow (almost stagnant) in that section of Conlong River during the time of sampling. It is worth noting that traces of lead (Pb) were observed in the water sample from Station S1 at 0.04 mg/l but is still below the WQG value. Total suspended solids (TSS) were also found to be at very low concentrations in all surface water samples ranging from 2.5 mg/l to 8.5 mg/l during the time of sampling. Traces of oil and grease (O&G) were found in all samples ranging from 0.4 mg/l in S1 to 0.7 mg/l in S3.

Results for the groundwater samples show values within the Class A WQG for all parameters except for the parameters color (stations GW2=200 apparent CU and GW3=80 apparent CU), Fecal Coliform (for all GW stations) and pH (GW3=9.02). In terms of metals As, Cd, Pb, Hg and Cr^{6+}, all groundwater samples exhibited metal concentrations below their respective method detection limits (MDL) except for station GW3 wherein Pb was detected at a concentration equal to 0.006 mg/l (but still within the WQG).

Parameter	*Surface Water Stations*					*Groundwater Stations*			
	S1	*S2*	*S3*	*S4*	*WQG: DAO 2016-08 Class C**	*GW1*	*GW2*	*GW3*	*WQG: DAO 2016-08 Class A***
Primary Parameters									
BOD, mg/l	1	1	1	2	*7*				
Chloride, mg/l	3.0	3.0	3.0	5.5	*350*	50	18	4.5	*250*
Color, TCU	8	8	8	8	*75*	5 (a)	200 (a)	80 (a)	*50*
Dissolved Oxygen (minimum), mg/l	4.61	5.76	6.77	5.34	*5*				
Fecal Coliform, MPN/100 ml	240	920	920	2,400	*200*	>23	2.2	23	*<1.1*
Nitrate as NO_3-N, mg/l	0.3	0.08	<0.02	0.2	*7*	0.5	0.6	0.07	*7*
pH (range)	7.61	7.98	8.11	7.79	*6.5-9.0*	6.85	6.72	9.02	*6.5-8.5*
Phosphate, mg/l	<0.01	<0.01	<0.01	<0.01	*0.5*	0.01	<0.01	<0.01	*0.5*
Temperature, °C	26.7	25.2	25.8	27.4	*25-31*	28.7	27.5	28.2	*26-30*
Total Suspended Solids, mg/l	3.0	2.5	2.5	8.5	*80*	<2.5	16	27	*50*

Parameter	Surface Water Stations					Groundwater Stations			
	S1	S2	S3	S4	WQG: DAO 2016-08 Class C*	GW1	GW2	GW3	WQG: DAO 2016-08 Class A**
Secondary Parameters - Metals									
Arsenic, mg/l	<0.008	<0.008	<0.008	<0.008	*0.02*	<0.008	<0.008	<0.008	*0.01*
Cadmium, mg/l	<0.001	<0.001	<0.001	<0.001	*0.005*	<0.001	<0.001	<0.001	*0.003*
Lead, mg/l	0.04	<0.005	<0.005	<0.005	*0.05*	<0.005	<0.005	0.006	*0.01*
Mercury, mg/l	<0.0002	<0.0002	<0.0002	<0.0002	*0.002*	<0.0002	<0.0002	<0.0002	*0.001*
Hexavalent Chromium, mg/l	<0.002	<0.002	<0.002	<0.002	*0.01*	<0.002	<0.002	<0.002	*0.01*
Secondary Parameters - Organics									
Oil and Grease, mg/l	0.4	0.5	0.7	0.5	*2*	0.8	0.5	0.7	*1*

2.2.2.3 Impact Mitigation

2.2.2.3.1 Siltation of Surface Water Bodies

Although limestone is known to have high porosity and permeability (meaning less surface runoff), and that the receiving water body, Conlong River, is approximately 1.5 km from the proposed project site, eroded particles may still reach the river if no mitigation measures are in place. To minimize erosion, quarrying as well as rehabilitation of mined out areas will be done progressively. In addition, adequately-sized settling ponds in series will be constructed for the project. Sediments shall be impounded from the first to the third pond in succession. The ponds shall be made of Siltation of surface water bodies.

Siltation of surface water bodies is one of the possible significant impacts of the proposed quarry operation, if not mitigated compacted earth, rock, and strategically placed adjacent to the quarry active area. Silt-laden runoff draining from the quarry area will be routed to the siltation ponds to allow settling of silt materials. Effluent coming from the silt pond shall comply with applicable water quality standards prior to release to the nearby surface waters.

Aside from the settling ponds, diversion canals will be installed around the quarry area to prevent overland flow and erosion at the quarry area for environmental and safety reasons. Drainage canals will also be constructed alongside roads to prevent erosion and possible destruction of roads.

Settling ponds and drainage canals shall be maintained through desilting to ensure that these structures are effective at all times especially during the rainy season.

2.2.2.3.2 Groundwater contamination

Groundwater in limestone areas is usually vulnerable to contamination due to the high porosity and high permeability properties of limestone. However, there are no project components (infrastructure) in the quarry area that could possibly be point sources of contaminants. Haul trucks could be sources of hydrocarbon leaks or spills if not well-maintained. To avoid possible leaks or spills, haul trucks used for quarrying shall undergo regular inspection and maintenance.

2.2.3 Freshwater Ecology

The freshwater ecology survey was conducted in order to provide information on the general conditions of freshwater environment and determine how the proposed project would affect the general use and ecology of rivers. The survey includes the assessment of aquatic communities such as phytoplankton, zooplankton, benthic macroinvertebrates, and fish. The study is a vital component in any project as it serves as baseline information and basis for effective evaluation and management of impacts on freshwater ecosystems.

2.2.3.1 Sampling Stations

Field survey was conducted in four sampling stations. The description of the surveyed sites is shown in ***Table 19***.

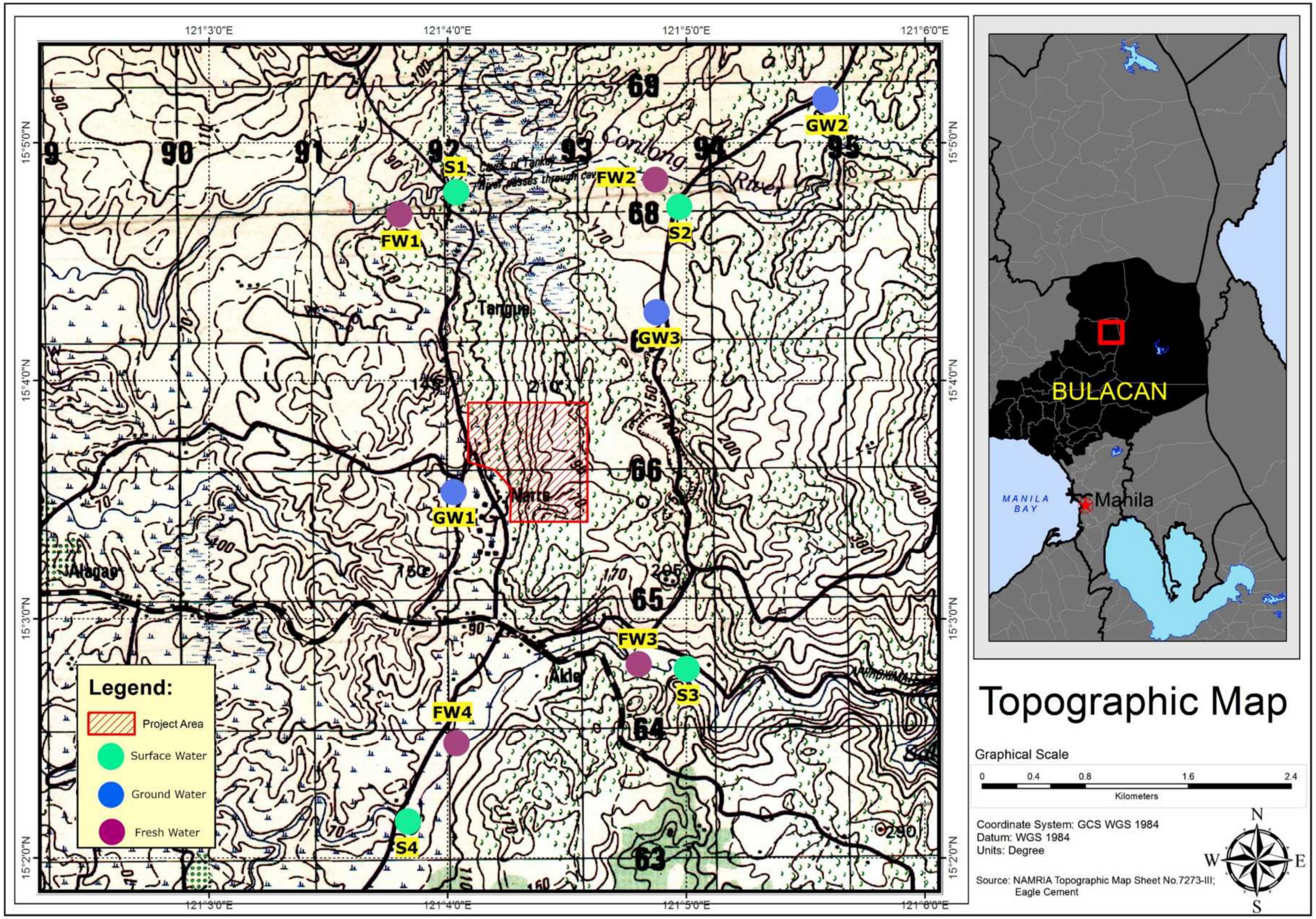


Figure 73 - Map of the Freshwater Ecology Component Sampling Stations

Table 19 - Summary of Habitat and Environmental Parameters of Freshwater Ecology Component Sampling Stations in San Ildefonso, Bulacan (November 2018).

Water quality station	*Station 1*	*Station 2*	*Station 3*	*Station 4*
River System	Conlong River	Conlong River Downstream	Salapangan River	Salapangan River Downstream
GPS Coordinates	N 15° 4’ 45.95” E 121° 3’ 49.08”	N 15° 4’ 51.95” E 121° 4’ 54.35”	N 15° 2’ 48.51” E 121° 4’ 48.65”	N 15° 2’ 29.61” E 121° 4’ 1.3”3
Current weather	Sunny	Sunny	Sunny	Sunny
Substrate	Gravel/rocks, clay	Gravel/rocks in stream	Gravel/rocks in stream	Gravel/rocks, clay
Use	Irrigation, bathing of animals	Irrigation for agricultural areas	Recreational use, washing of clothes	Irrigation for agricultural areas,
Biological Oxygen Demand (mg/L)	1	1	1	2
Fecal Coliform (MPN/100mL)	240	920	920	2,400
Nitrate-N (mg/L)	0.3	0.08	<0.02	0.2
Phosphate-P (mg/L)	<0.01	<0.01	<0.01	<0.01

2.2.3.2 Methodology

Four sampling stations in two river systems that may likely be impacted by the project were surveyed. Field assessment was carried out through direct observation and field sampling. Biological indicators such as benthic macroinvertebrates, zooplankton, phytoplankton, were collected and analyzed in order to assess the overall impact of the project. Fish data were based on interviews of local communities and review of existing literature.

2.2.3.2.1 Benthic macroinvertebrates

Benthic macroinvertebrates are useful biological indicators of changes in the aquatic ecosystems. These organisms are mostly preferred in monitoring the health of stream and river systems because they have varying sensitivities to changes in water quality. They are also easily collected due to their relatively sedentary life cycle.

Samples were collected using a 0.5 m^2 rectangular kick net, with a 500 µm mesh size. Each sample was taken manually by vigorously kicking the sediments upstream of the net for 30 seconds. Composite samples collected from the pool, riffle, and run habitats were combined and stored in plastic containers and were immediately fixed with 95% ethanol. These were brought to the laboratory for further analysis and identification. A dissecting microscope was used to sort morphologically similar individuals. After sorting, the taxonomic family level of the macroinvertebrates will be identified using the keys of Dudgeon (1999), and the Mekong River Commission (2006).

Plate 8 - Benthic macroinvertebrates collection using rectangular kick net

Using the macroinvertebrate data, the following biological metrics were calculated: (i) total invertebrate density, (ii) taxon richness, and (iii) Simpson's index of Diversity. Moreover, the current condition of the four river systems was determined using the Hilsenhoff's Family Biotic Index (HBI), a biotic index for assessing organic and nutrient pollution using tolerance values of arthropod families (Hilsenhoff, 1988).

2.2.3.2.2 Plankton

Plankton organisms respond rapidly to environmental changes, which makes them very useful in evaluating water quality. All species or assemblages tolerate a limited range of chemical, physical, and biological conditions. Monitoring these biological communities is relatively inexpensive and reliable assessment of the condition of aquatic systems.

Plankton samples were obtained by towing a 30-cm wide plankton net with a mesh size of 64 microns, horizontally at a distance of about 1m. This was done ten times; filtering approximately 100L of surface water. Two replicates were drawn from each site and were placed in properly-labeled 500 ml screw-capped bottles. These were immediately fixed with formaldehyde (5% by volume) and brought to the laboratory for processing and further analysis.

Zooplankton and phytoplankton samples were filtered and concentrated to 50ml. Enumeration was done by transferring 1ml aliquot sample in the Sedgewick-Rafter counting chamber, and then observed under a compound microscope. Plankton were identified to the lowest possible taxa using taxonomic keys such as those of Mamaril et al. (1986), Segers (2004; 2007) and Bellinger and Sigee (2010). Zooplankton density was estimated and expressed as number of individuals/m^3, while phytoplankton density was expressed as cells/m^3.

Diversity indices such as: (i) total plankton density, (ii) taxon richness, and (iii) Shannon index of Diversity, were calculated using Paleontological Statistical Package for Education and Data Analysis (PAST) version 2.17c.

Plate 9 - Plankton collection using conical plankton net

2.2.3.2.3 Fish

Secondary biological data on freshwater fish and other aquatic fauna were gathered through literature search from government and private institutions. Chance interviews and queries were also undertaken among residents to supplement the information that are vital to the study.

Table 20 - Diversity and Biotic Indices of Plankton and Benthic Macroinvertebrates

Index	*Formula/definition*	*Implication/interpretation*	*References*
Total species abundance	Is the density or number of aquatic macro invertebrates per unit area	Abundance decreases when flow is high, an increase in fine sediment	Barbour et.al., 1999 & Vinson, 2000
Species or taxa Richness	Total number of species present; reflects the health of the community through a measurement of the variety of taxa present	Species richness increases with increasing habitat diversity, suitability and water quality 26= not impacted 19-26=slightly impacted 11-18=moderately impacted 0-10=severely impacted	Plafkin et.al., 1989

Index	Formula/definition	Implication/interpretation	References
Shannon-Wiener Diversity Index (H')	H'= Σ (ni/N)(log ni/N)	> 4= clean water 3-4=slightly polluted 2-3=moderately polluted < 2=very polluted	Shannon & Wiener, 1963 and Trivedi, 1979


Plate 10 - Left; Sorting and counting of benthic macroinvertebrates using ice cube box and forceps. Right; identification and photo documentation using stereomicroscope

2.2.3.3 Results and Discussion

The freshwater ecology assessment of Eagle Cement Project focused on the three functional aquatic groups – phytoplankton, zooplankton and benthic macroinvertebrates. The data obtained from the assessment will serve as baseline information on the water quality, biological indicators, and existing pollution (if present) in the sampling stations. Knowledge of the composition, abundance and diversity of these organisms in a particular river system may aid in understanding the management strategies needed in monitoring the possible project impacts.

Biological indicators such as phytoplankton and zooplankton are commonly used in river assessment protocols since they are more reactive to changes in the environment. They are used because they are straightforward, can quantitatively describe water quality, are applicable in a wide area, and provide information on background conditions and natural variability (Onyema 2013). Furthermore, the collection, identification and analysis of these organisms are relatively easier and less costly than fish assessments.

Benthic macroinvertebrates, like plankton, are useful biological indicators of changes in the aquatic systems. Their life span of 1-2 years, relatively immobile lifestyle, and varying sensitivities to water quality changes make them effective gauge of ecosystem disturbances. Macroinvertebrate communities are altered when environmental modifications or pollution (organic, inorganic, heavy metal contamination, etc.) are present. There are three groups of benthic macroinvertebrates grouped according to their tolerance to pollution: (1) pollution sensitive organisms, which are found in good quality water; (2) somewhat pollution tolerant organisms can exist in good or fair quality water; and (3) pollution tolerant organisms that can survive in any quality of water.

Fish species and their larvae rely on the density and distribution of plankton for survival. The population dynamics of phytoplankton and zooplankton affects the breeding success of nekton. Variations in river channels and discarding of untreated wastewater in the river systems may pose a threat to the existence of locally important fishes.

2.2.3.4 Result of Analysis of Biological Communities

2.2.3.4.1 Phytoplankton

Four phytoplankton divisions including Bacillariophyta (11 genera), Chlorophyta (4 genera), Cyanophyta (4 genera) and Dinophyta (2 genus) were recorded in the four sampling stations in the proposed Eagle Cement Project. Their relative abundance was recorded in ***Figure 74*** which showed Bacillariophyta or diatoms (31.86%), Chlorophyta or green algae (36.80%), Cyanophyta or blue-green algae (31.18%), and Dinophyta or dinoflagellates (0.17%).

A total of 30,506 phytoplankton cells were present in the four sampling stations. The most abundant were green algae *Spirogyra* with 7,484 cells/m^3 which is an indicator of organic pollution (Palmer, 1969). It is present in Stations 1, 3 and 4 and its density is highest in station 1. This was followed by the Cyanophyta genus *Merismopedia* with density of 4,365 cells/ m^3. *Merismopedia* however, is only present in 2 stations but its peak density is recorded in Station 4. It is noteworthy that there were several indicators of pollution present which include *Navicula, Aulacoseira, Pleurosigma, Oscillatoria, Nitzschia,* and *Fragilaria* (Palmer, 1969).

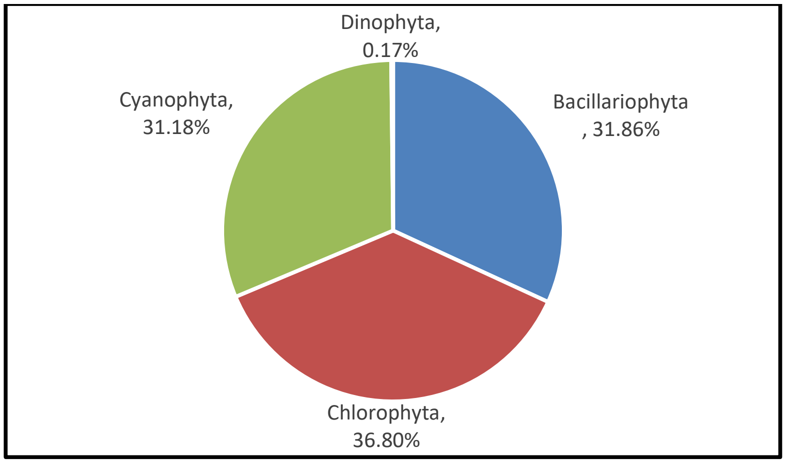


Figure 74 - Relative abundance of phytoplankton major groups

Cyanophyta or blue-green algae are good biological indicators because they are known to be tolerant of pollution due of their ability to utilize high nutrient levels (Mendes et al. 2012). The presence of *Aphanizomenon sp. and Oscillatoria sp.* in Station 4 is quite alarming These phytoplankton species produce cyanotoxins that may be harmful and toxic to animals and humans. They have been known to tolerate high levels of stress in aquatic environments and produce toxins under high concentrations of phosphorus. In future aquatic assessments, the density and distribution of this particular plankton species should be monitored closely.

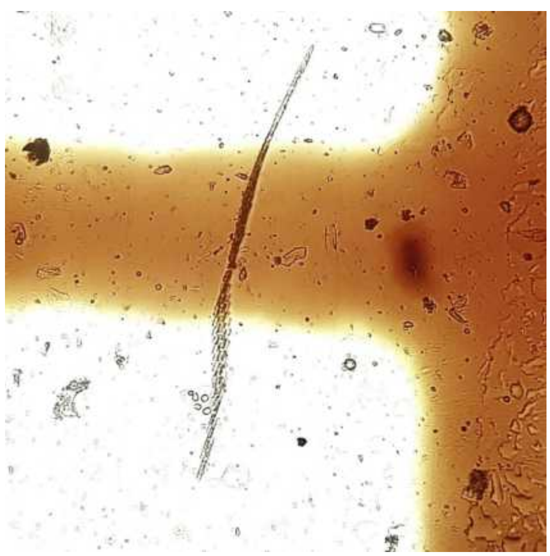


Plate 11 - Colonies of phytoplankton Aphanizomenon sp.

The phytoplankton present with their distribution and abundance is shown in ***Table 21.*** The highest density of phytoplankton was exhibited in Station 4 with 15,695 cells/ m^3, followed by

Station 1 with 9,459 cells/ m^3. The density of phytoplankton in Stations 2 (2,546 cells/ m^3) and Station 3 (2,806 cells/ m^3) are relatively lower.

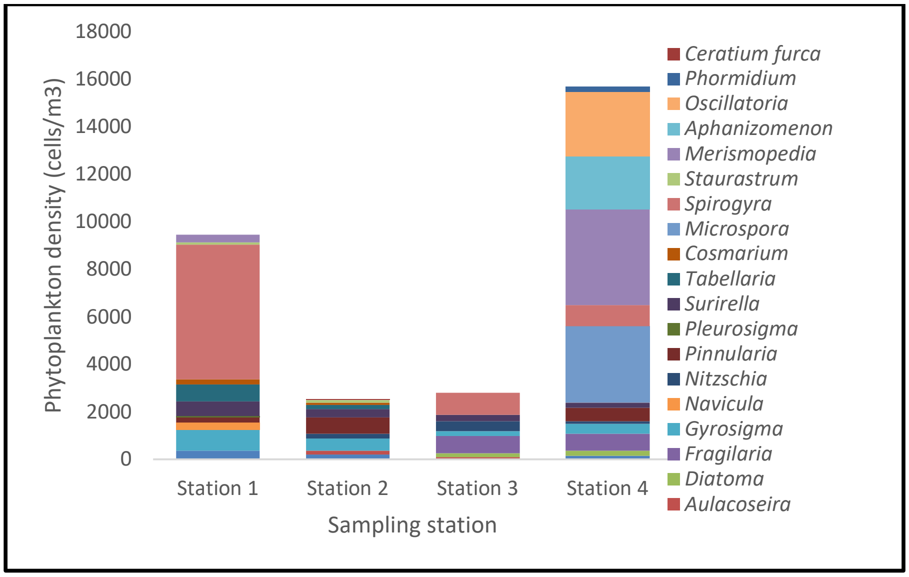


Figure 75 - Phytoplankton density across the four sampling stations

Table 21 - Composition, distribution, and abundance of phytoplankton in San Ildefonso, Bulacan (November 2018)

Phytoplankton (cells/m3)	*Station 1*	*Station 2*	*Station 3*	*Station 4*
Bacillariophyta				
Amphipleura	364	208	0	156
Aulacoseira	0	156	104	0
Diatoma	0	0	156	208
Fragilaria	0	0	728	728
Gyrosigma	883	520	208	416
Navicula	312	0	0	0
Nitzschia	0	208	416	104
Pinnularia	208	676	0	572
Pleurosigma	52	0	0	0
Surirella	624	364	260	208
Tabellaria	728	156	0	0
Chlorophyta				
Cosmarium	208	104	0	0
Microspora	0	0	0	3222
Spirogyra	5665	0	935	883
Staurastrum	104	104	0	0

Phytoplankton (cells/m3)	*Station 1*	*Station 2*	*Station 3*	*Station 4*
Cyanophyta				
Aphanizomenon	0	0	0	2235
Oscillatoria	0	0	0	2702
Merismopedia	312	0	0	4054
Phormidium	0	0	0	208
Dinophyta				
Ceratium furca	0	52	0	0

The computed species index of diversity (H') for the phytoplankton community ranged from 1.502 to 2.046, while the Simpson index is 0.61 to 0.84. These values are relatively low and are indicative of a disturbed environment. Taxa richness is highest in Station 4 with 13 genera present, followed by Station 1 and 2 with 11 and 10 genera present, respectively. While lowest taxa richness is recorded in Station 3 with 7 genera present.

Table 22 - Diversity of phytoplankton in 4 sampling stations in San Ildefonso, Bulacan (November 2018)

Diversity Index	*Station 1*	*Station 2*	*Station 3*	*Station 4*
Taxa richness	11	10	7	13
Total Individuals	9460	2548	2807	15696
Dominance_D	0.3824	0.157	0.2187	0.1668
Simpson_1-D	0.6176	0.843	0.7813	0.8332
Shannon_H	1.502	2.046	1.695	2.027

2.2.3.4.2 Zooplankton

Analysis of samples taken from the four sampling stations showed 3 major zooplankton groups. Only three taxa were encountered in the proposed project site. Generally, the zooplankton are sparse in terms of number of individuals and taxa richness. There were no zooplankton present in Stations 1 and 4 which may be indicative of disturbed environment as similarly exhibited by phytoplankton communities. The zooplankton taxa present, their distribution and diversity were recorded in ***Table 22.*** Results showed very low density of 52 individuals/m^3. This may be indicative of the stressful environment in the habitat of zooplankton communities.

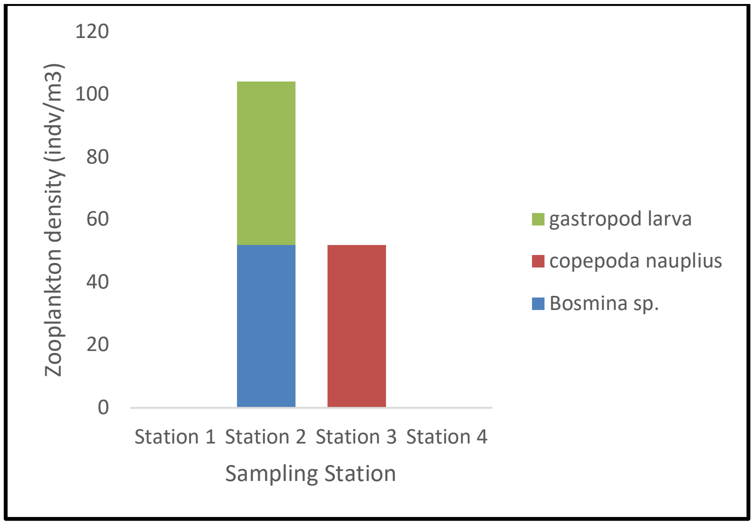


Figure 76 - Zooplankton density across the four sampling stations

Table 23 - Composition, distribution and abundance of zooplankton in San Ildefonso, Bulacan (November, 2018)

Zooplankton (indv/m3)	*Station 1*	*Station 2*	*Station 3*	*Station 4*
Arthropoda				
Bosmina sp.	0	52	0	0
copepoda nauplius	0	0	52	0
Mollusca				
gastropod larva	0	52	0	0

2.2.3.4.3 Benthic macroinvertebrates

A total of 7 families of benthic macroinvertebrates were identified in the samples collected from the various sampling stations. The benthic macrofauna is composed of 39.99% Gastropoda, 26.16% Trichoptera, 13.85% Bivalvia, 12.31% Ephemeroptera, and 7.69% Diptera as shown in ***Figure 77***.

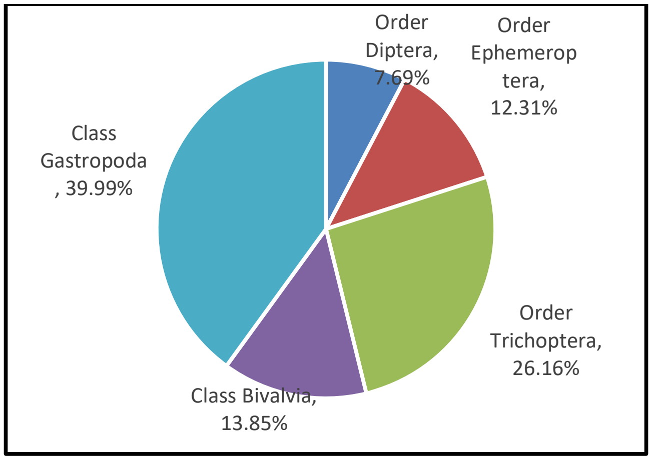


Figure 77 - Relative abundance of benthic macroinvertebrate communities

Figure 78 shows the density (individuals/m^2) of benthic organisms in the proposed project site. The total number of individuals collected from the rivers surveyed was 2,888 ind/m^2, with highest density in Station 4. There were six families recorded in Stations 3 and 4, while Stations 1 and 2 recorded two and three families of benthic macroinvertebrates, respectively.

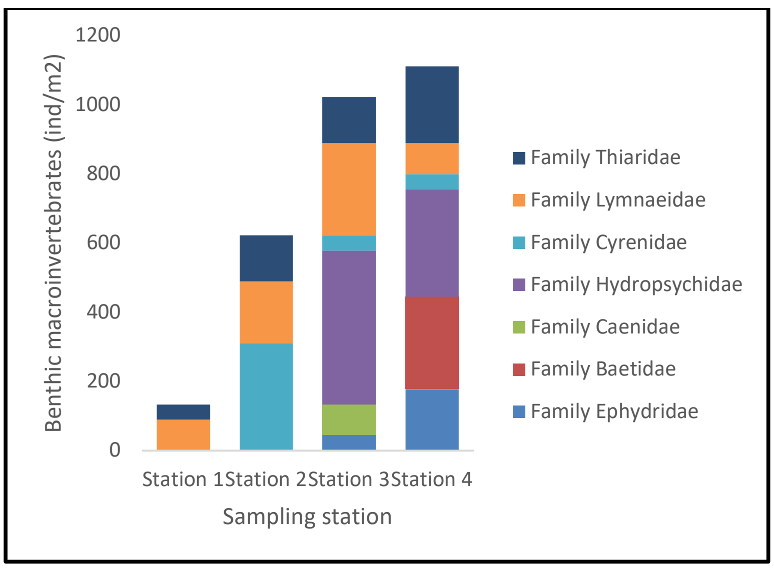


Figure 78 - Benthic macroinvertebrate density across 4 sampling stations

Hydropsychidae, commonly known as net-spinning caddisflies, are the most abundant benthic macroinvertebrates with a total density of 756 ind/m^2. They are present in Stations 3 and 4. They are mostly found in streams or rivers with moderate to high current velocities, which may explain their absence in Stations 1 and 2 due to the lack of current in these stations. Most caddisfly larvae feed on algae, particularly diatoms, and detritus. Their high frequency in Stations 3 and 4 are congruent with the presence of diatoms in these stations and may also be attributed to the high levels of fecal coliform in the water. Different species of caddisflies vary in their tolerance to water pollution, but in general, these are susceptible to sewage, pesticides, and industrial effluents (Hoell,1998). In future assessments, the distribution and density of these organisms are effective biological indicators to gauge the impacts of the project in the river systems.

Diversity is one way to detect water quality problems, like how the presence or absence of macroinvertebrate species shows the state of the quality of the water (Kripa et al. 2013). It refers to the number of different kinds of organisms found in a biological community. In general, communities with high diversity are more stable. Pollution and/or frequent habitat disturbance can displace intolerant organisms, and therefore reduce diversity. So, if an area becomes polluted or disturbed, the total number of organisms may stay the same but species diversity may decrease. (Sanguansin, 1981; and Soata, 2000). The benthic macroinvertebrates collected in the proposed project site are common in freshwater lotic environments and their distribution reflected this.

Plate 12 - The most dominant benthic macroinvertebrates observed: Family Hydropsychidae

2.2.3.4.4 Fish and other fauna

Fish data were collected through chance interviews of residents and literature search. Freshwater fish species and other aquatic fauna recorded in the proposed site were common and widespread forms which are well adapted to tropical freshwater systems. The locals reported 6 fish and other aquatic animals that can be caught at the sampling stations. Tilapia (*Oreochromis niloticus*), Biya (Gobiidae), Dalag (*Channa sp.*), Hito (*Clarias sp.)*, shrimps, and small crabs have been reported as present in the river systems.

2.2.3.5 Potential Impacts and Options for Prevention and Mitigation

Considering the distance of the proposed project area to the nearest water body, MPSA 245 will have a little to minimal impacts on the aquatic bodies. Also, industrial activities in the area. The river systems do not host endemic or potentially threatened freshwater organisms.

2.3 Air

2.3.1 <u>Meteorology</u>

This section presents the following as provided in Annex 1-A of MC 2010-14 (Standardization of Requirements and Enhancement of Public Participation in the Streamlined Implementation of the Philippine EIS System) and Item 3.0 in the ECC Application Screening Form.

- Project's possible effect on local climate, if any, and description of monthly average rainfall, monthly temperature, extreme recorded rainfall and temperature, and wind rose diagrams
- Climate change projections in 2020 and 2050 using PAGASA's projected values; and
- Projects' contribution to global greenhouse gas, if any.

2.3.1.1 Methodology

Meteorological data from PAGASA Synoptic Station at Science Garden in Diliman, Quezon City were used to characterize the synoptic condition at the proposed project area. PAGASA-Science Garden Station, which is the nearest synoptic station from the project site, is located about 46 km south of the project site.

2.3.1.1.1 Projected Changes of Rainfall, Air Temperature and Extreme Weather Events

The projected changes of rainfall, air temperature, and extreme weather events in 2020 and 2050 were based from the Climate Change in the Philippines (2011) by PAGASA. PAGASA (2011) used the Providing Regional Climates for Impact Studies (PRECIS) model to project the rainfall and temperature changes in 2020 (2006 to 2035) and 2050 (2036 to 2065) at three scenarios, namely: A2 (high range), A1B (mid-range) and B2 (low –range). The A1B scenario, however, was considered by PAGASA (2011) because of high influence of past emissions of Carbon Dioxide (CO_2).

Further, PAGASA (2011) also projected the extreme weather events from 2006 to 2035 and from 2036 to 2065. Extreme weather events refer to days with the following:

- Maximum temperature greater than 35 ºC,
- Rainfall less than 2.5 mm of rainfall; and
- Rainfall greater than 200 mm.

2.3.1.1.2 Wind Roses

Wind roses were generated from meteorological data purchased by Axceltechs, Inc. from PAGASA-Central Office in Quezon City. The data consists of three-hourly and/or hourly observations of wind speed, wind direction, dry bulb temperature, cloudiness, and rainfall.

Using the wind rose plotting software, WRPLOT, which was developed by Lakes Environmental Software, Inc, wind roses were generated by inputting the date, time, wind speeds, and wind directions. Wind rose shows the frequency of occurrence of winds at various wind direction sectors and ranges of wind speeds.

2.3.1.1.3 Greenhouse Gas (GHG) Emissions

GHG emissions of the project were qualitatively discussed based on the type of equipment to be used for the project.

2.3.1.2 Baseline and Projected Change in Meteorological Conditions

2.3.1.2.1 Climate and Rainfall

The climate of the project site belongs to Type I climate (***Figure 79***). This type of climate is characterized by two (2) pronounced seasons. The dry season from November to April and the wet season during the rest of the year with maximum rain period from June to September. Most areas along the western seaboard of the Philippines belong to Type I climate.

Based on PAGASA-Science Garden Station, which is the nearest PAGASA's synoptic station from the project site and also belongs to same climate type as the project site, the highest monthly average rainfall occurred in August with 504.2 followed by July (493.3 mm), September (451.2 mm), and June (316.5 mm). These rainy months fall within the maximum rain period described for Type I climate (***Figure 80***).

The least rainy month is February with 14.6 mm followed by January (18.5 mm) and March (24.8 mm). These months fall within the northeast monsoon and dry season in the Philippines.

2.3.1.2.2 Observed Extreme Rainfall

The highest recorded rainfall at PAGASA-Science Garden Station was 455 mm on September 26, 2009 (***Figure 81***). This occurred during the passage of Tropical Storm Ondoy, which brought heavy rainfall and flooding in Metro Manila and nearby provinces. Months with extreme recorded rainfall occur from June to September.

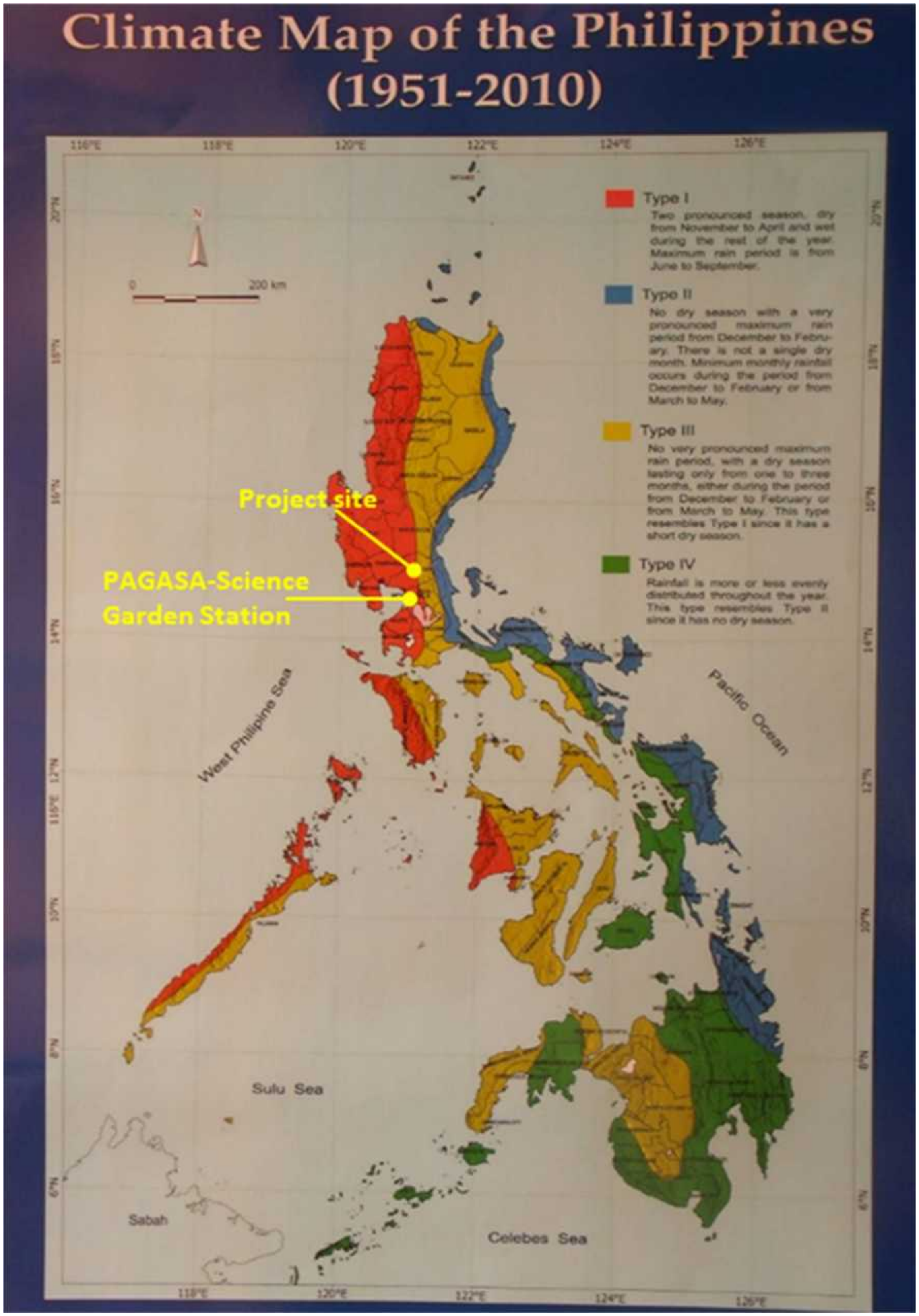


Figure 79 - Climate map of the Philippines (Source: PAGASA)

Table 24 - Climatological Normals (1981-2010) in Science Garden (Source: PAGASA 2019)

Month	Rainfall (mm)	No of rainy days	Temperature (°C)						VP (mbs)	Rel. Hum. (%)	MSLP (mbs)	Wind (m/s)		Clouds (Okta)	No. of days With	
			Max	Min	Mean	Dry Bulb	Wet Bulb	Dew Pt.				Dir.	Speed		TSTM	LTNG
Jan	18.5	4	30.6	20.8	25.7	25.3	22.2	20.9	24.6	76	1012.3	N	1	5	1	0
Feb	14.6	3	31.7	20.9	26.3	26	22.3	20.8	24.4	73	1012	NE	1	5	0	0
Mar	24.8	4	33.4	22.1	27.8	27.6	23.2	21.5	25.4	69	1011.3	SE	1	4	2	1
Apr	40.4	5	35	23.7	29.4	29.2	24.4	22.7	27.2	67	1009.7	SE	1	4	4	2
May	186.7	10	34.7	24.7	29.7	29.3	25.3	23.9	29.5	72	1008.5	S	1	5	12	8
Jun	316.5	18	33.1	24.6	28.8	28.4	25.5	24.5	30.6	79	1008.1	SW	1	6	17	9
Jul	493.3	22	31.9	24.1	28	27.5	25.2	24.4	30.5	83	1007.7	SW	2	6	19	9
Aug	504.2	23	31.3	24.2	27.8	27.3	25.2	24.5	30.6	84	1007.4	SW	2	7	17	6
Sept	451.2	22	31.6	24	27.8	27.2	25.1	24.4	30.4	84	1010.6	SW	1	6	18	9
Oct	296.6	18	31.6	23.5	27.6	27	24.7	23.9	29.5	83	1008.8	N	1	6	11	6
Nov	148.8	14	31.4	22.7	27.1	26.5	24.1	23.2	28.4	82	1010.1	N	1	5	5	1
Dec	78.7	8	30.5	21.6	26	25.5	22.8	21.7	25.9	79	1011.5	N	1	5	1	0
Annual	**2574.4**	**153**	**32.2**	**23.1**	**27.7**	**27.2**	**24.2**	**23**	**28.1**	**78**	**1009.8**	**N**	**1**	**5**	**107**	**51**

Latitude: 14°38' 41.35" N

Longitude: 121°02'40.45" E

Elevation: 43.0 m

Notes:

VP – Vapor Pressure
mbs – millibar
MSLP – mean sea level pressure
Dir – direction
TSTM – thunderstorm
LTNG – lightning

Table 25 - Climatological Extremes (as of 2018) for Science Garden (Source: PAGASA 2019)

Month	Temperature (°C)				Greatest Daily Rainfall (mm)		Highest Wind (m/s)			Sea Level Pressure			
	High	Date	Low	Date	Amount	Date	Speed	Dir	Date	High	Date	Low	Date
Jan	34.7	01-17-1998	15.5	01-27-1987	55.8	01-16-1988	24	ESE	01-17-1972	1021.4	01-21-2005	998.8	01-22-1989
Feb	35.6	02-24-1967	15.1	02-04-1987	61.7	02-22-2013	22	SSE	02-02-1992	1021.7	02-14-2017	1002.3	02-09-1985
Mar	36.8	03-26-1983	14.9	03-01-1963	65.0	03-31-2012	13	S	03-16-1992	1021.0	03-05-2005	997.8	03-28-1988
Apr	38.0	04-25-1998	17.2	04-05-1963	64.8	04-21-2015	26	SSE	04-07-1992	1016.9 1016.9	04-05-1998 04-03-2017	1001.4	04-16-2007
May	38.5	05-14-1987	17.8	05-03-1962	166.0	05-20-1966	21	N	05-10-1992	1015.1	05-28-1986	992.4	05-17-1989
Jun	38.0	06-02-1993	18.1	06-27-1961	334.5	06-07-1967	37	SW	06-25-1972	1014.9	06-07-1997	978.7	06-26-1993
Jul	36.2	07-20-1998	17.7	07-23-1961	246.4	07-07-2002	36	NNW	07-09-1977	1015.0	07-01-1979	989.2	07-15-1978
Aug	36.1	08-17-2017	17.8	08-23-1964	391.4	08-07-2012	32	N	08-22-2000	1015.3	08-23-2002	994.2	08-24-1978
Sep	35.6	09-10-2017	20.0	09-08-1964	455.0	09-26-2009	35	NE	09-28-2006	1016.0	09-28-1997	987.4	09-30-1995
Oct	35.4	10-09-2003	18.6	10-31-1967	209.3	10-18-1975	30	SE	10-11-1989	1016.0	10-25-1986	978.7	10-23-1988
Nov	35.0	11-01-2001	15.6	11-12-1962	169.9	11-20-1966	50	NNW	11-03-1995	1019.1	11-18-1979	980.6	11-03-1995
Dec	34.9	12-06-2018	15.1	12-13-1988	135.5	12-15-2015	22	SE	12-22-1997	1020.0	12-27-2001	998.1	12-02-2004
Annual	38.5	05-14-1987	14.9	03-01-1963	455.0	09-26-2009	50	NNW	11-03-1995	1021.4	01-21-2005	978.7	06-26-1993 10-23-1988
Period of Record	1961 to 2018				1961 to 2018		1961 to 2018			1961 to 2018			

Latitude: 14°38’ 41.35” N

Longitude: 121°02’40.45” E

Elevation: 43.0 m

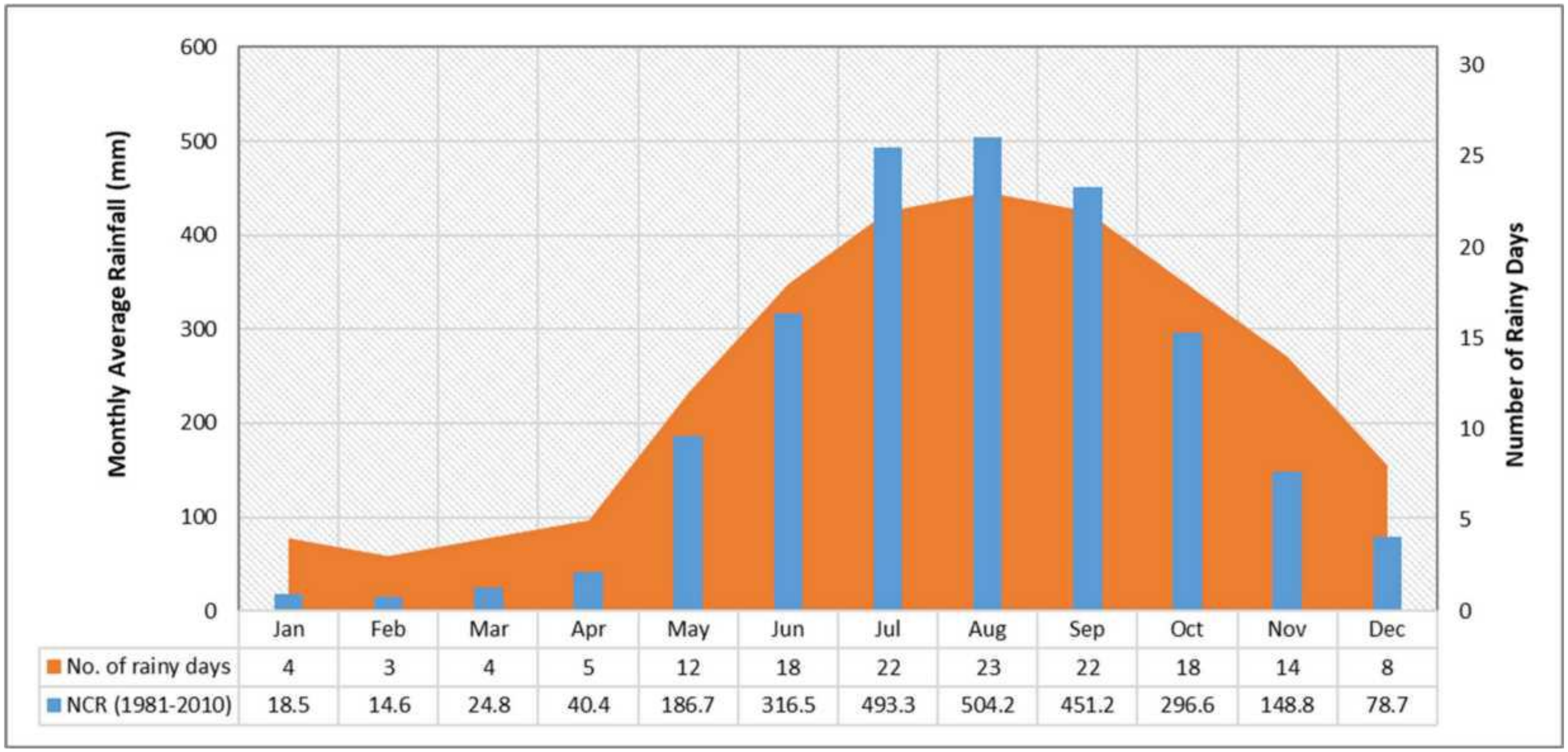


Figure 80 - Monthly average rainfall and number of rainy days for PAGASA-Science Garden Station

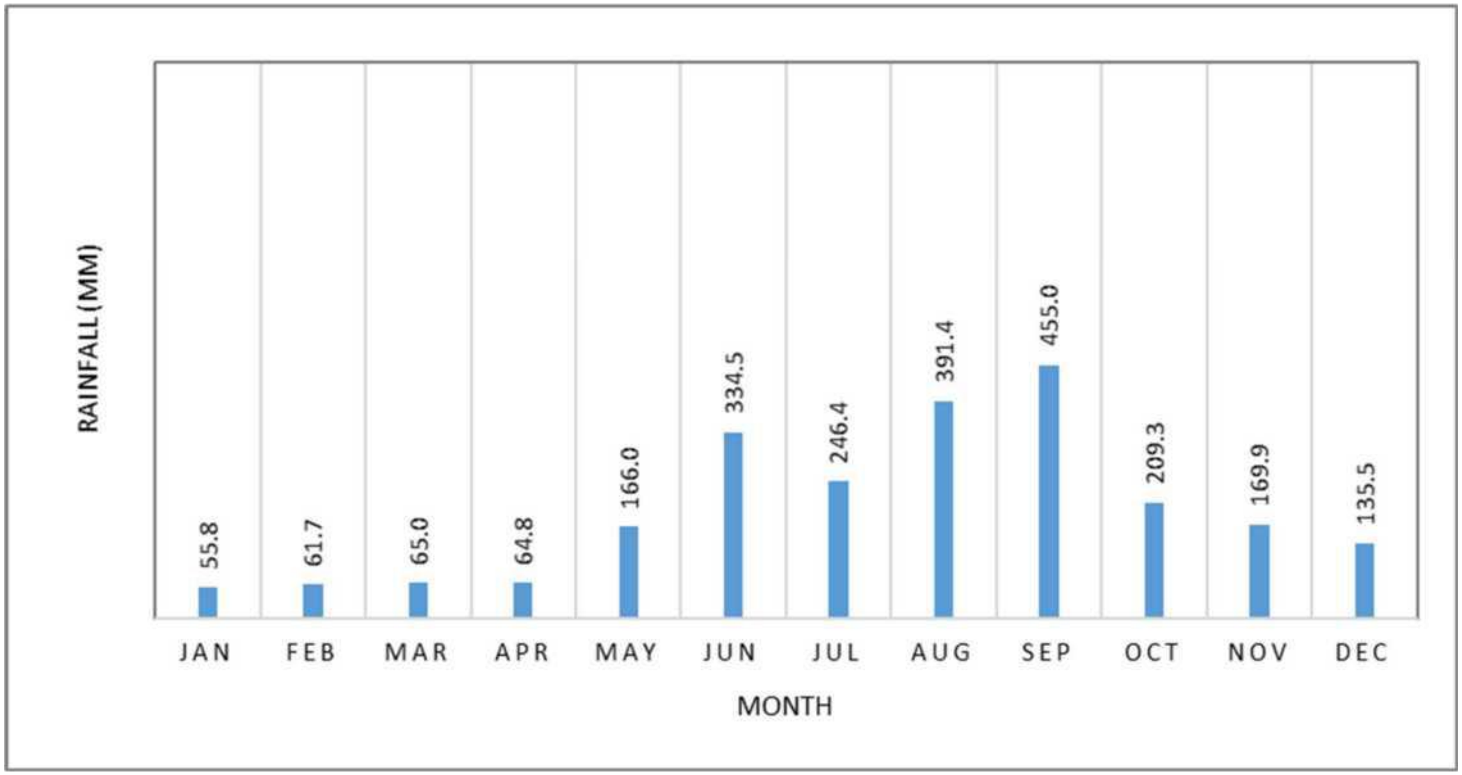


Figure 81 - Monthly extreme rainfall (PAGASA- Science Garden)

2.3.1.2.2.1 Projected Increase in Rainfall and Extreme Rainfall Events

PAGASA (2011) provided projections on climate in four (4) difference periods, namely: 1) March, April, and May, 2) June, July and August, 3) September, October, and November, and 4) December, January and February. The transition months from SW to NE monsoon are from March to May and from NE to SW are from September to November.

The projected change in rainfall for the province of Bulacan shows increased of rainfall in 2020 and 2050 from the baseline years (1971 to 2000) (***Figure 82***). The projected changes in rainfall in 2020 and 2050 for the other periods, however, appear to slightly decrease from the baseline years, particularly on dry months. PAGASA (2011) indicated that dry season will be drier in most provinces in the Philippines and that there will be rainfall increases in most areas of Luzon and Visayas during the southwest monsoon.

The number of days also appear to decrease from the baseline (1971 to 2000) of 7,476 days to 6302 and 6220 from 2006 to 2035 (centered in 2020) and from 2036 to 2065) centered in 2050, respectively (***Figure 83***). Dry day is a day with less than 2.5 mm of rainfall.

In terms of projected extreme rainfall events greater than 200 mm, Bulacan province will experience increases in extreme rainfall, as shown in ***Figure 84***.

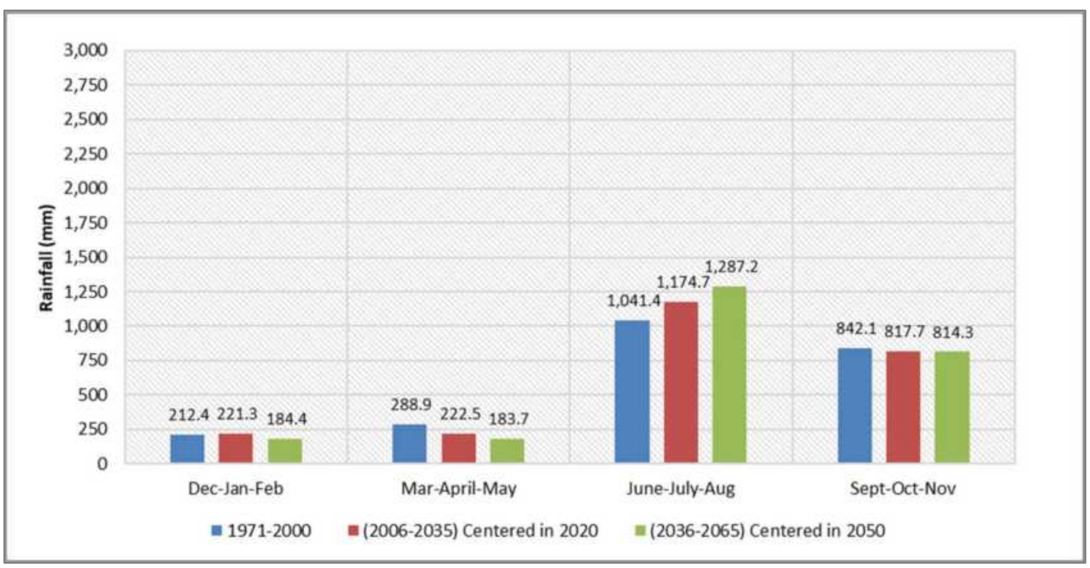


Figure 82 - Projected change in rainfall for the province of Bulacan (Data Source: PAGASA, 2011)

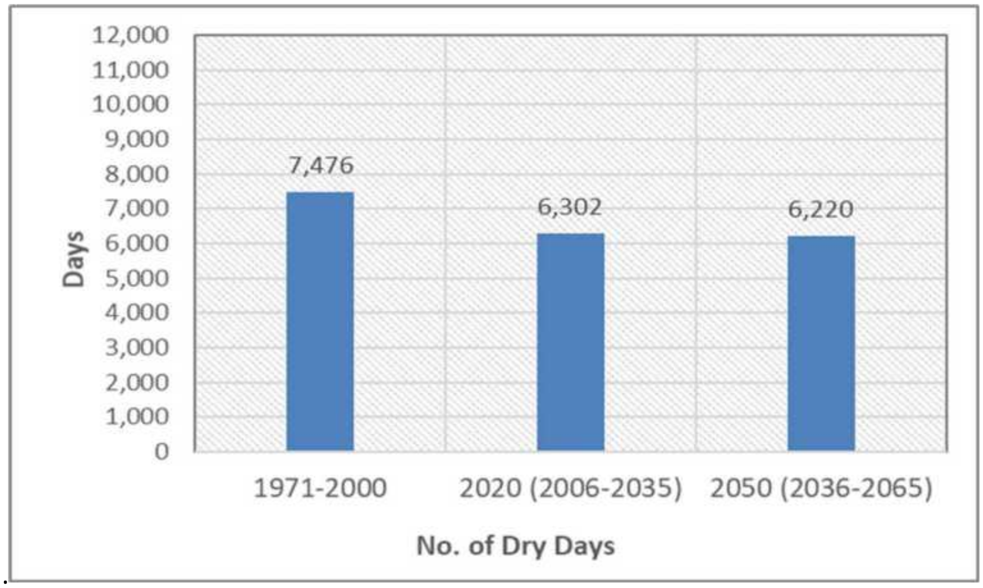


Figure 83 - Number of dry days

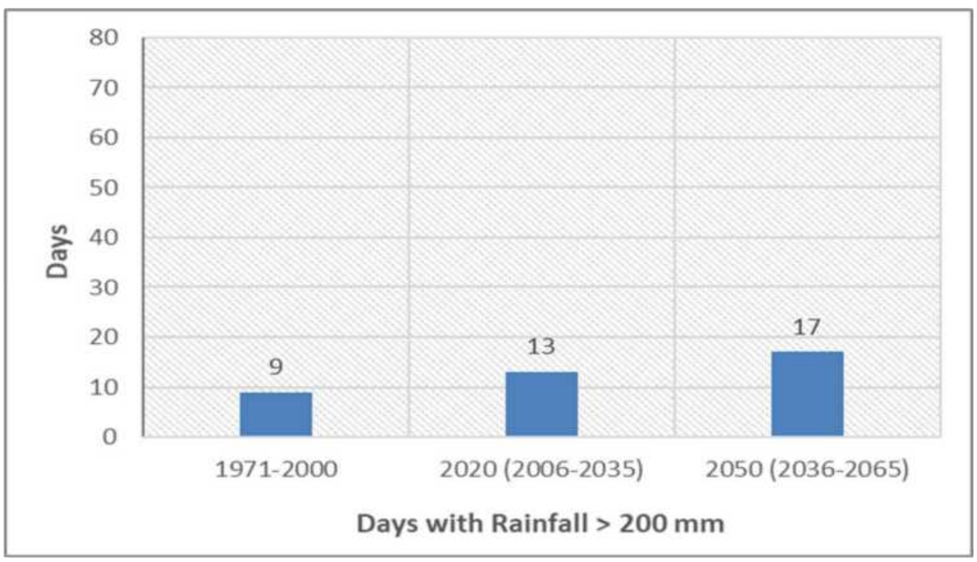


Figure 84 - Days with rainfall greater than 200 mm

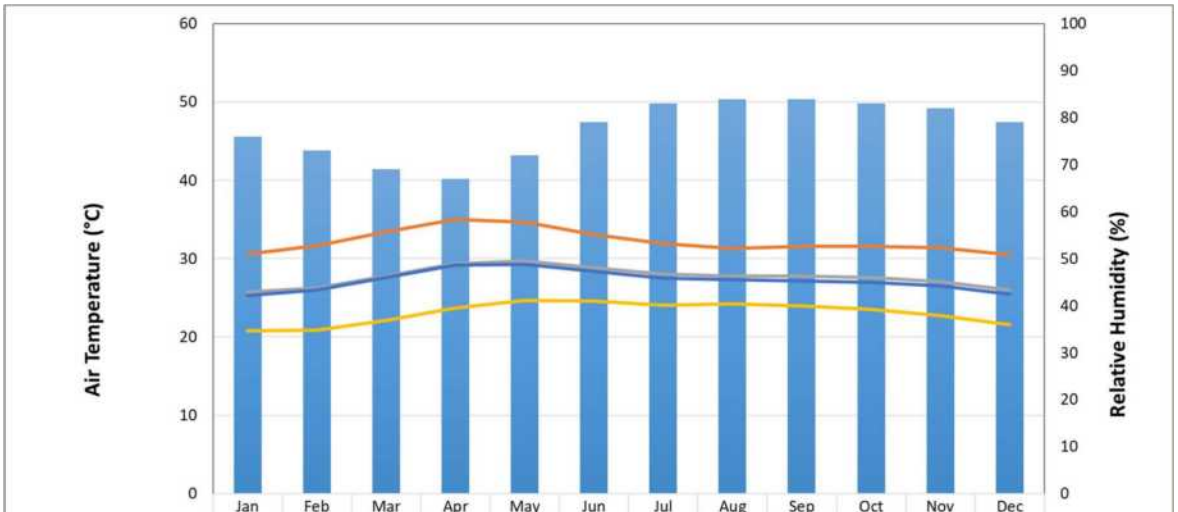
2.3.1.2.2.2 Change in Air Temperature

a) Climatological Air Temperature

Figure 85 shows the plots of the monthly average rainfall and relatively humidity for PAGASA-Science Garden Station. Highest and lowest monthly average air temperatures are 29.3 and 25.3 ºC, which fall in April and January, respectively.

The monthly average maximum air temperature is 35 ºC while the monthly average minimum is 20.8 ºC. The annual average air temperature is 27.2 ºC.

Plot of monthly relative humidity shows highest in August and September with 84% and lowest in April with 67%. As shown in ***Figure 85***, there appears an inverse relationship between relative humidity and air temperature. This is because as air temperature increases, the amount the air vapor the air can hold increases, thereby decreasing the amount of relative humidity.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Relative Humidity (%)	76	73	69	67	72	79	83	84	84	83	82	79
MAX (°C)	30.6	31.7	33.4	35.0	34.7	33.1	31.9	31.3	31.6	31.6	31.4	30.5
MEAN (°C)	25.7	26.3	27.8	29.4	29.7	28.8	28.0	27.8	27.8	27.6	27.1	26.0
MIN (°C)	20.8	20.9	22.1	23.7	24.7	24.6	24.1	24.2	24.0	23.5	22.7	21.6
DRY BULB (°C)	25.3	26.0	27.6	29.2	29.3	28.4	27.5	27.3	27.2	27.0	26.5	25.5

Figure 85 - Month average air temperature for PAGASA-Science Garden (Data Source: PAGASA)

Extreme Recorded Air Temperatures

Figure 86 shows the plot of the highest and lowest recorded air temperature from January to December. The highest recorded air temperature was 38.5 ºC on May 14, 197 and the lowest was 14.9 ºC on March 1, 1963.

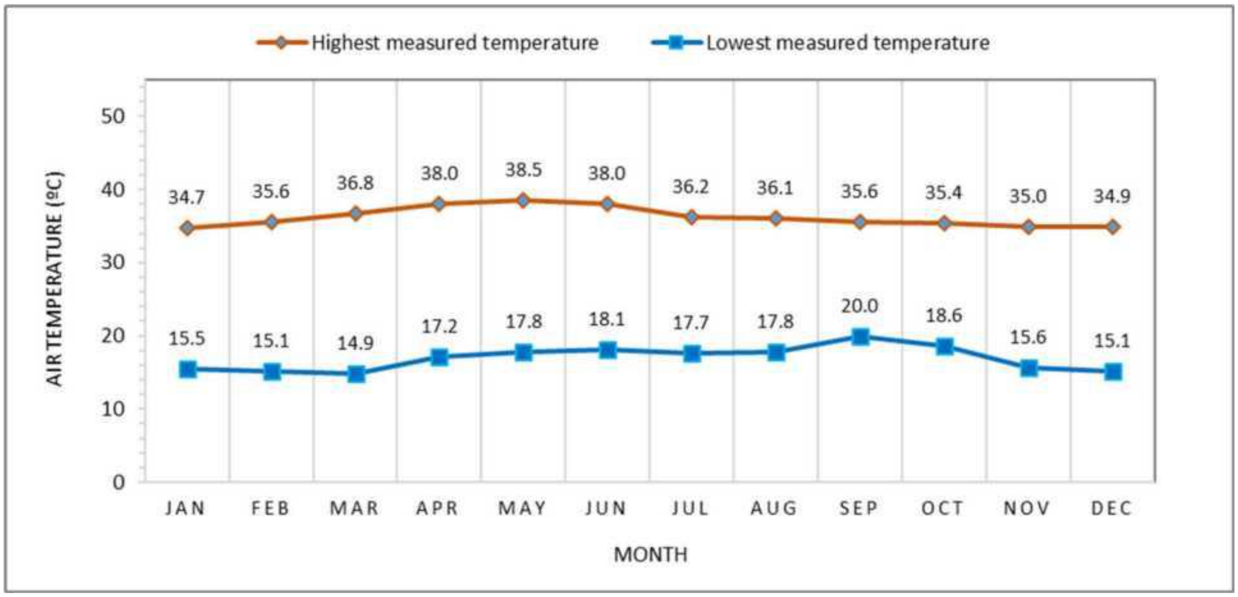


Figure 86 - Monthly extreme rainfall (lowest and highest air temperature)

b) Projected Increase in Air Temperature

There is significant increase on the number of days greater than 35 ºC in 2020 (2006 to 2035) of 889 days and 2031 days in 2050 (2036 to 2065). The projected increase in air temperature and increase on extreme temperature events (i.e., greater than 35 ºC) were highly attributed to the projected increase in CO_2 emissions under an average scenario.

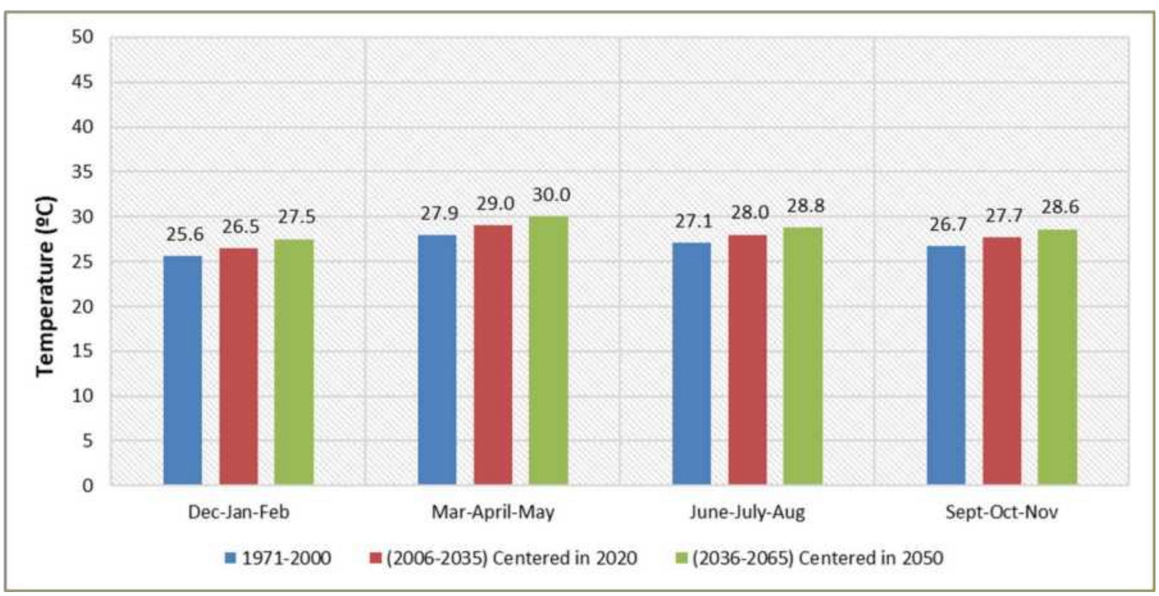


Figure 87 - Projected change in temperature in Bulacan in 2020 and 2050

There is significant increase on the number of days greater than 35 ºC in 2020 (2006 to 2035) of 889 days and 2031 days in 2050 (2036 to 2065). The projected increase in air temperature and increase on extreme temperature events (i.e., greater than 35 ºC) were highly attributed to the projected increase in CO_2 emissions under an average scenario.

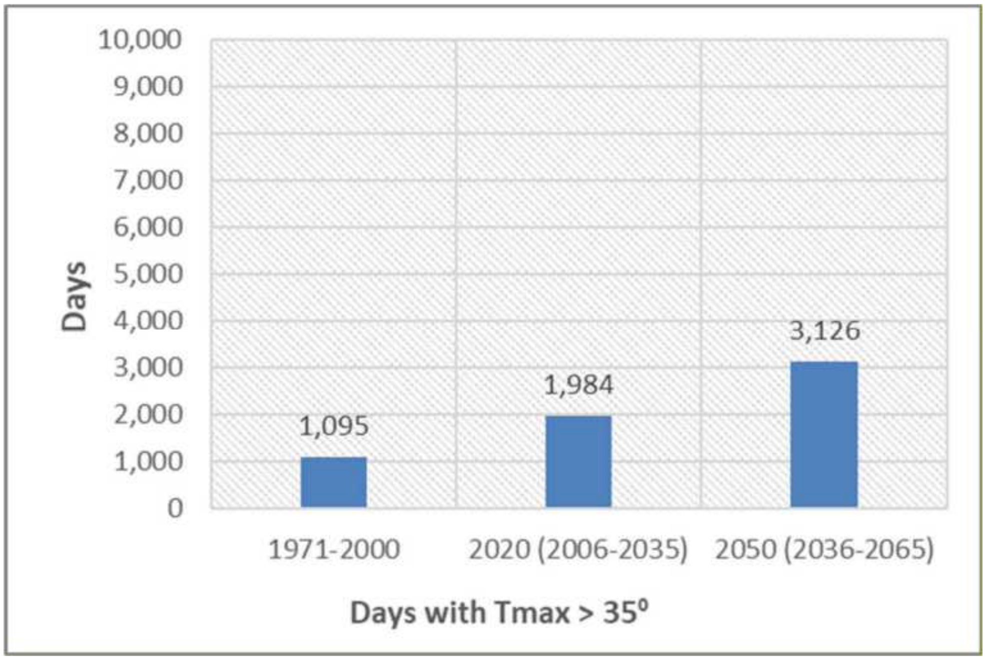


Figure 88 - Projected extreme temperature events in Bulacan in 2020 and 2050

2.3.1.2.2.3 Prevailing Wind Flows

Based on the climatological normal from 1981 to 2010 (***Table 24***), monthly wind directions are generally from the north and the northeast. From March to April, wind direction comes from the southeast, and from the south in May. Wind directions are from the southwest from June to September. These months fall within the southwest season.

Wind roses were generated for months or periods that fall within the southwest and northeast monsoons from 2015 to 2018. The three-month wind roses (December to February) representing northwest monsoon show prevailing winds from the north (***Figure 89***), northeast (***Figure 91***) and northeast and southeast (***Figure 93***). Winds from the north and other directions were also noted, but at lower frequencies.

During the southwest monsoon, prevailing winds are expectedly from the South-West quadrant (***Figure 90***, ***Figure 92***, and ***Figure 94***),

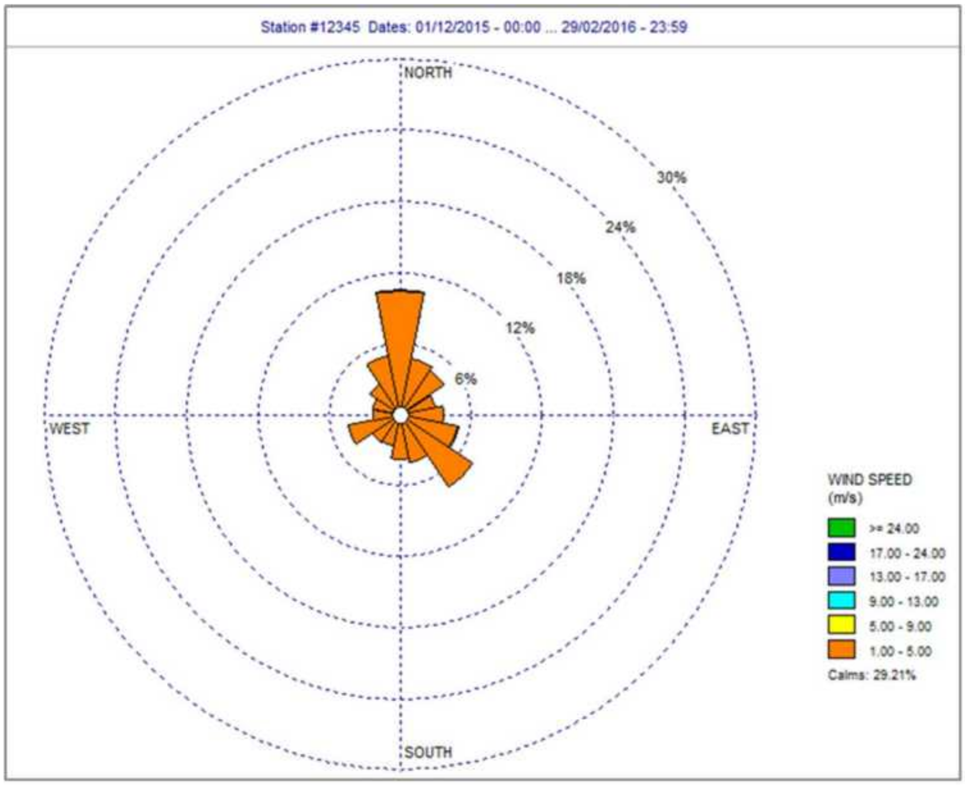
Figure 89 to ***Figure 94*** also show the wind class frequency distributions for each of the six (6) periods from 2015 to 2018. Wind speeds from 1 to 5 m/s, which are categorized as light winds, are the most frequent with annual averages ranging from 66.3 to 80.2%.

Calm conditions (wind speeds less than 1.5 m/s) occurred about 17.7 to 32.6% at each period. Wind speeds from 5 to 9 m/s, which are described as moderate to fresh winds were recorded at 0.1 to 0.8%.

Extreme Wind Speeds

The greatest recorded wind speed at PAGASA-Science Garden Station was 50 m/s on November 3, 1995. This occurred during the passage of Typhoon Rosing which severely affected Bicol Region, CALABARZON, and the National Capital Region (NCR).

.



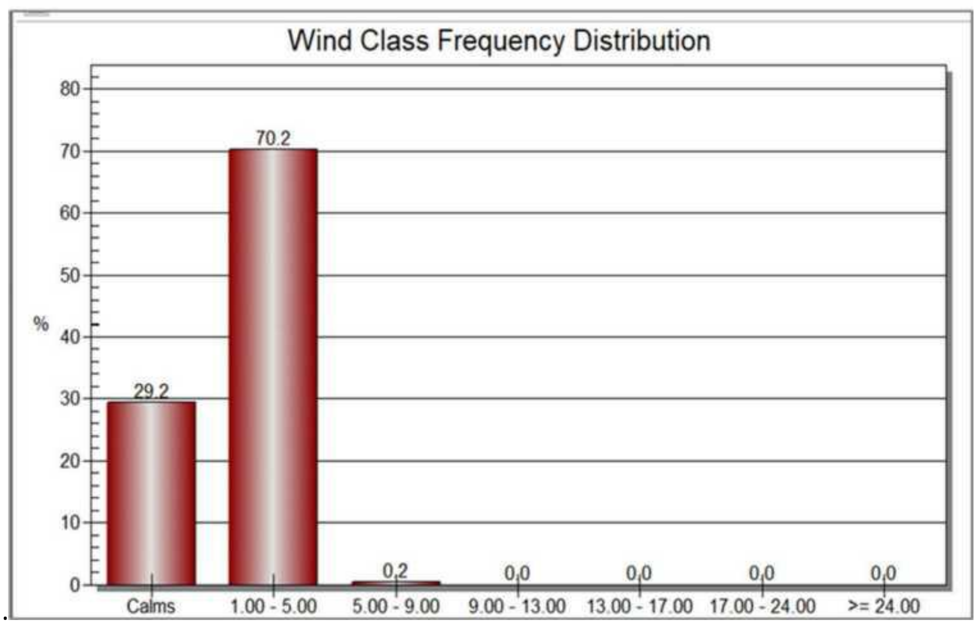
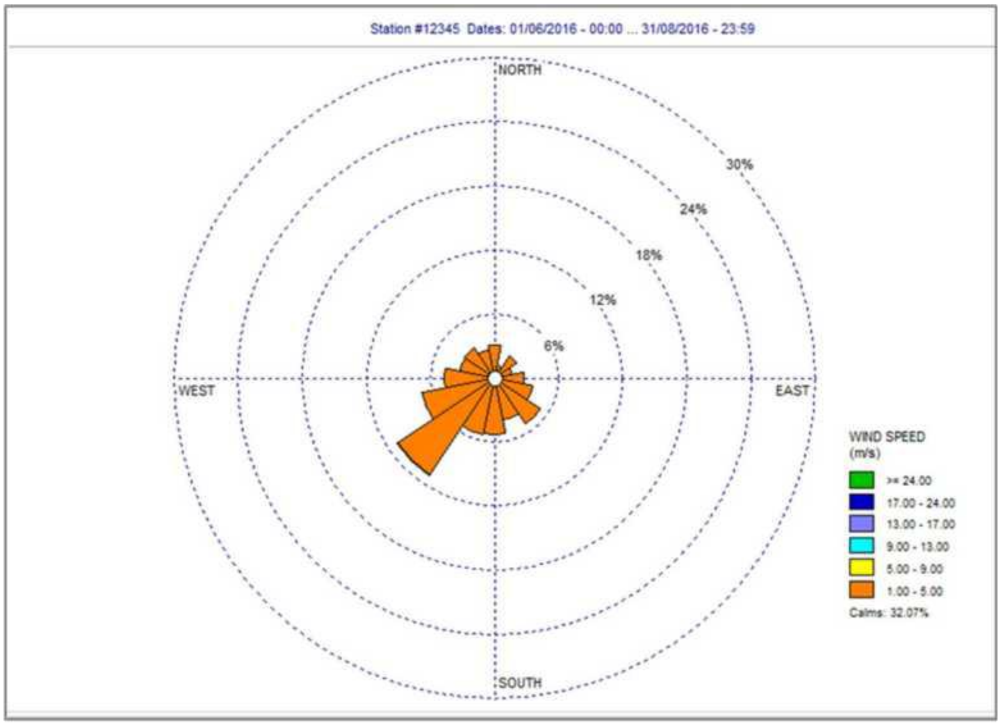


Figure 89 - Wind rose (top) and wind class frequency distribution (bottom) (Period: Dec 2015 to Feb 2016)



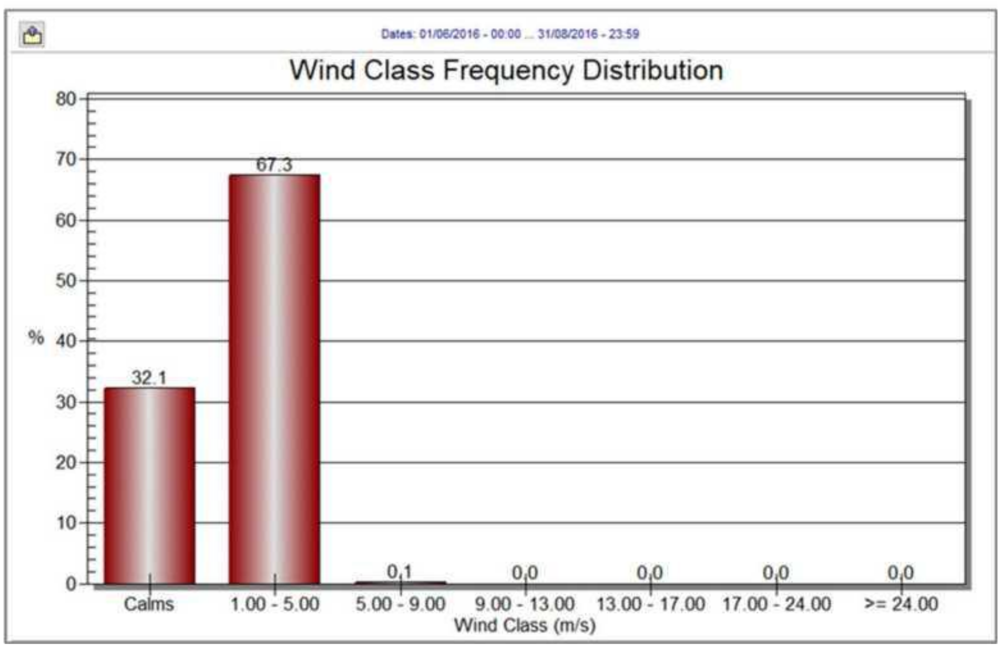
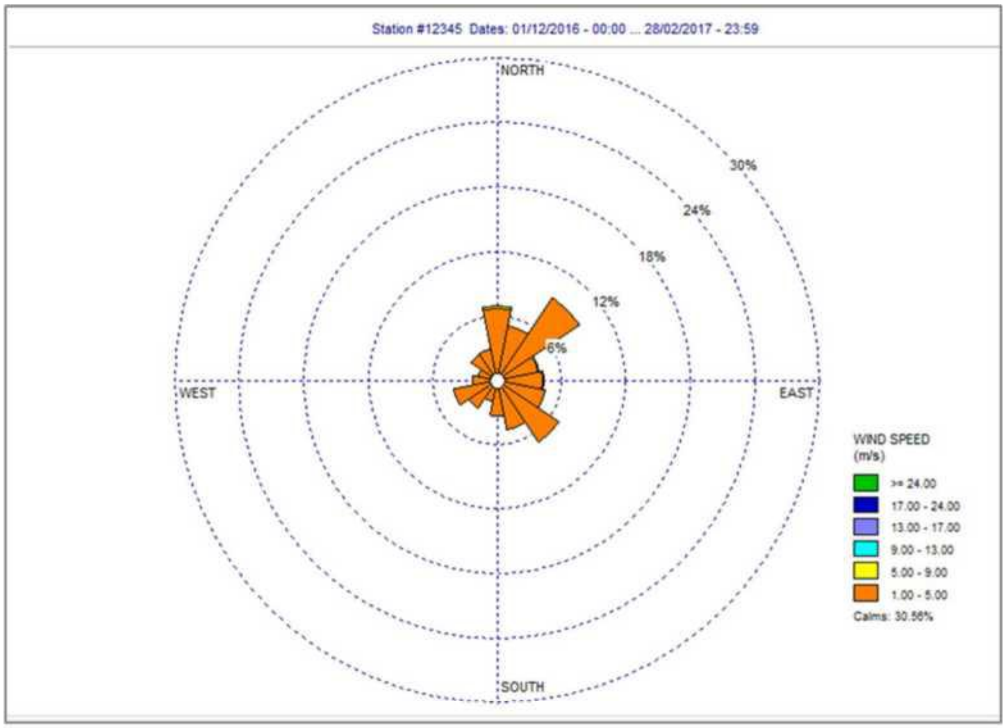


Figure 90 - Wind rose (above) and wind class frequency distribution (Period: June 2016 to Aug 2016)



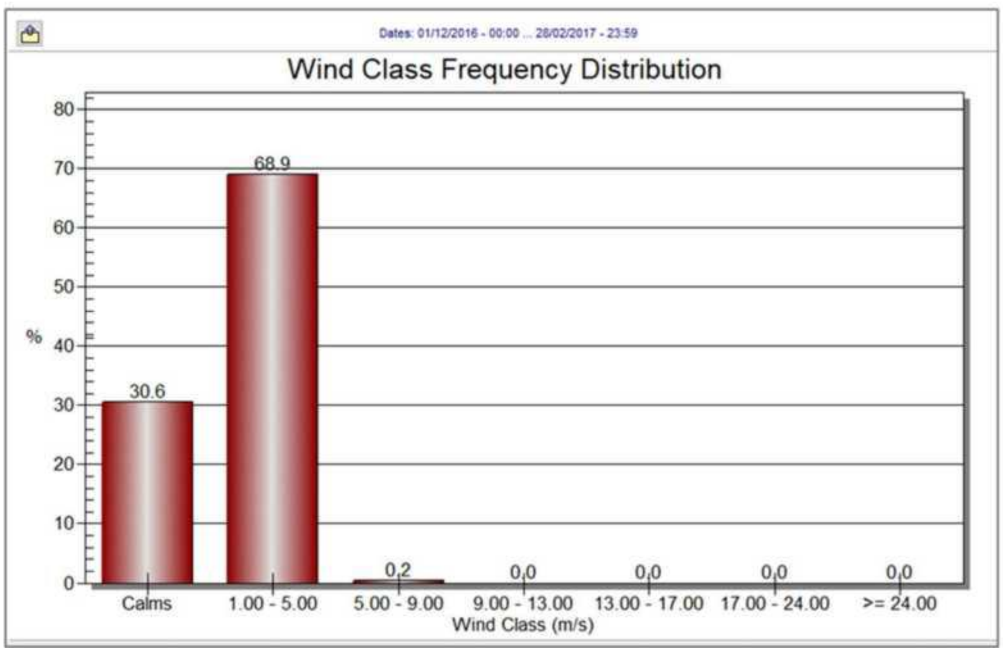
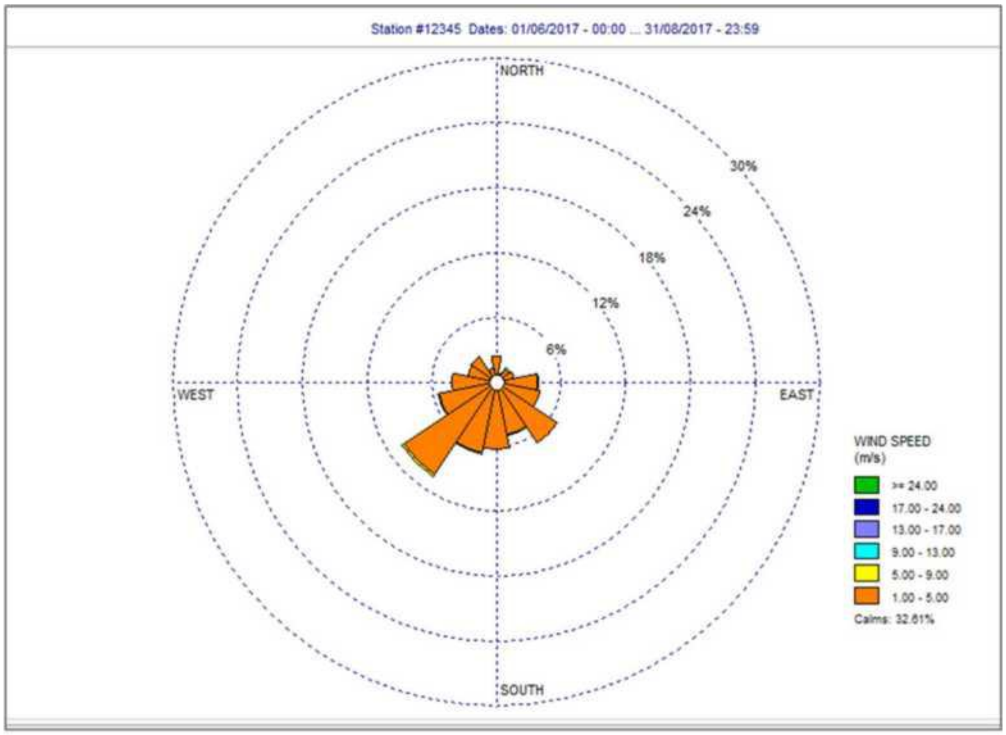


Figure 91 - Wind rose (above) and wind class frequency distribution (Period: Dec 2016 to Feb 2017)



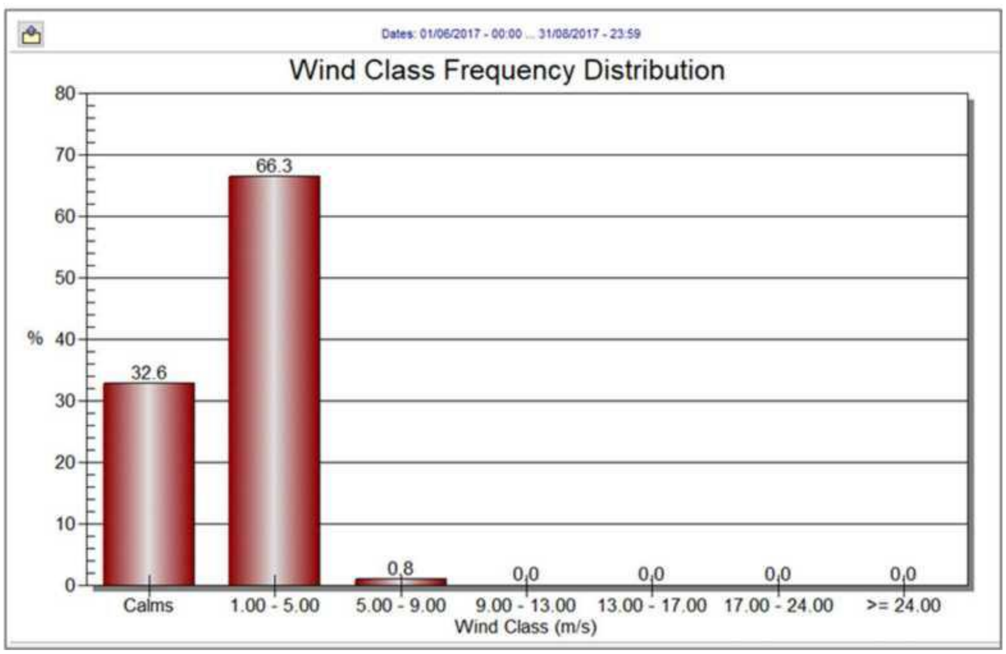
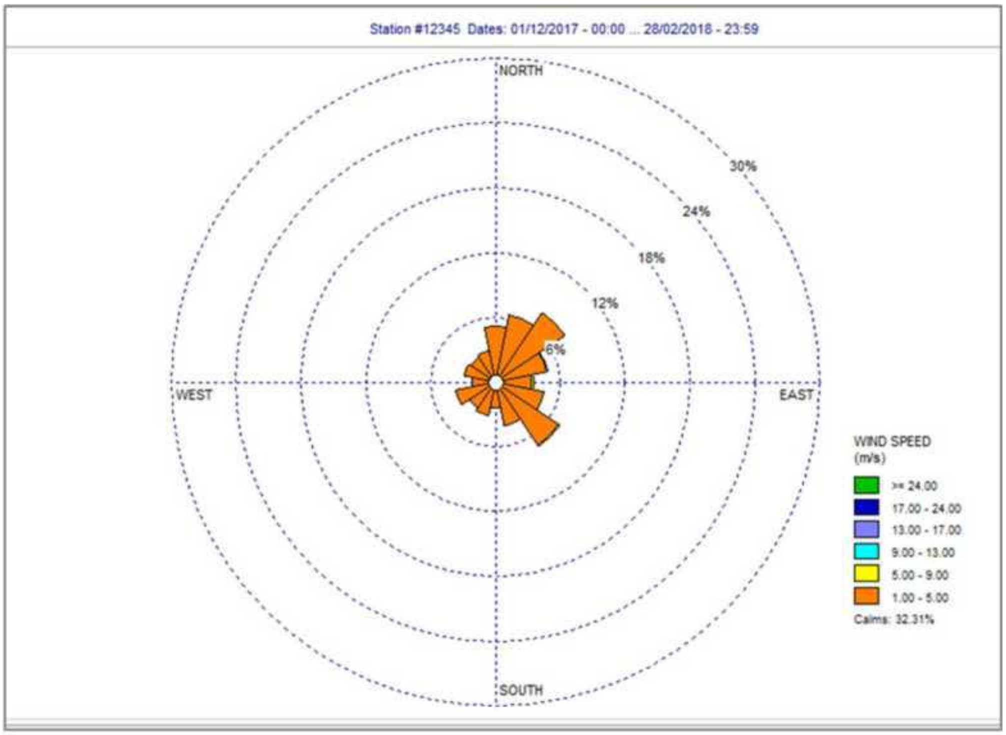


Figure 92 - Wind rose (above) and wind class frequency distribution (Period: June 2017 to Aug 2017)



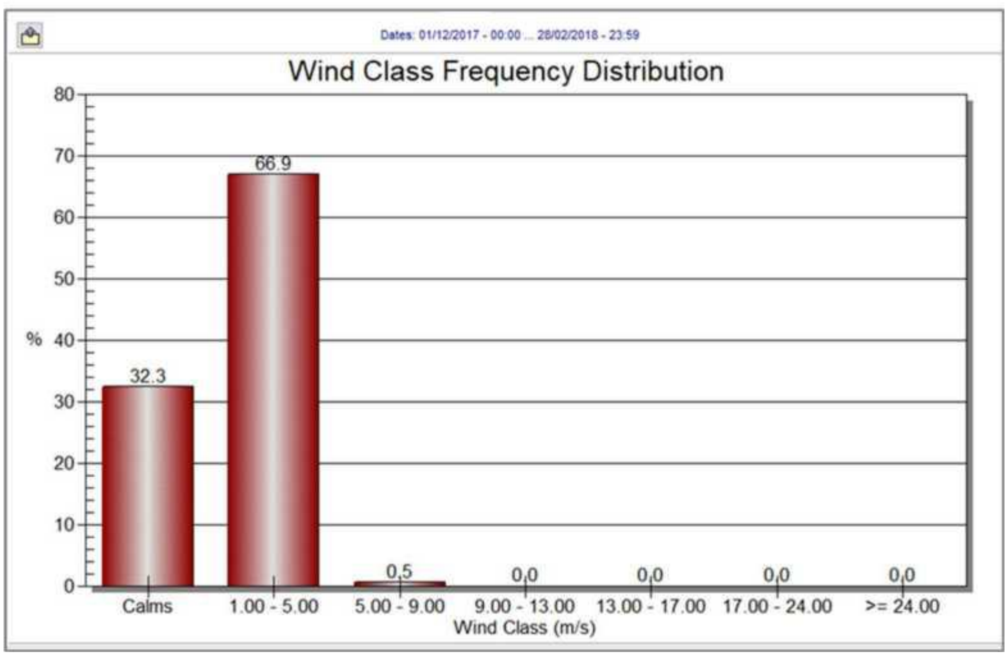
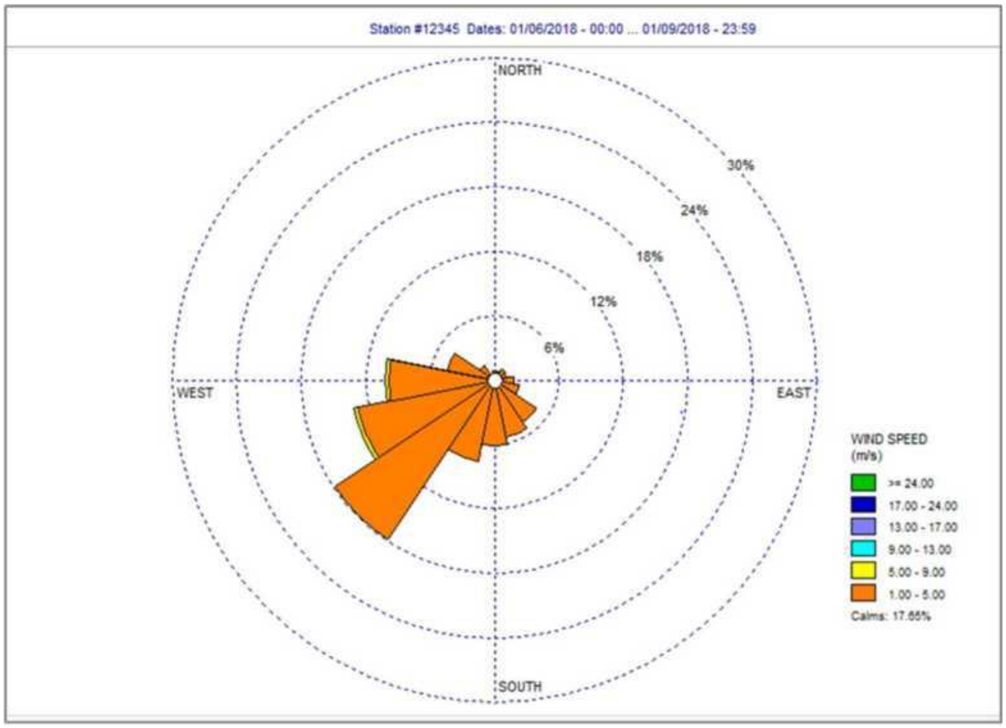


Figure 93 - Wind rose (above) and wind class frequency distribution (Period: Dec 2017 to Feb 2018)



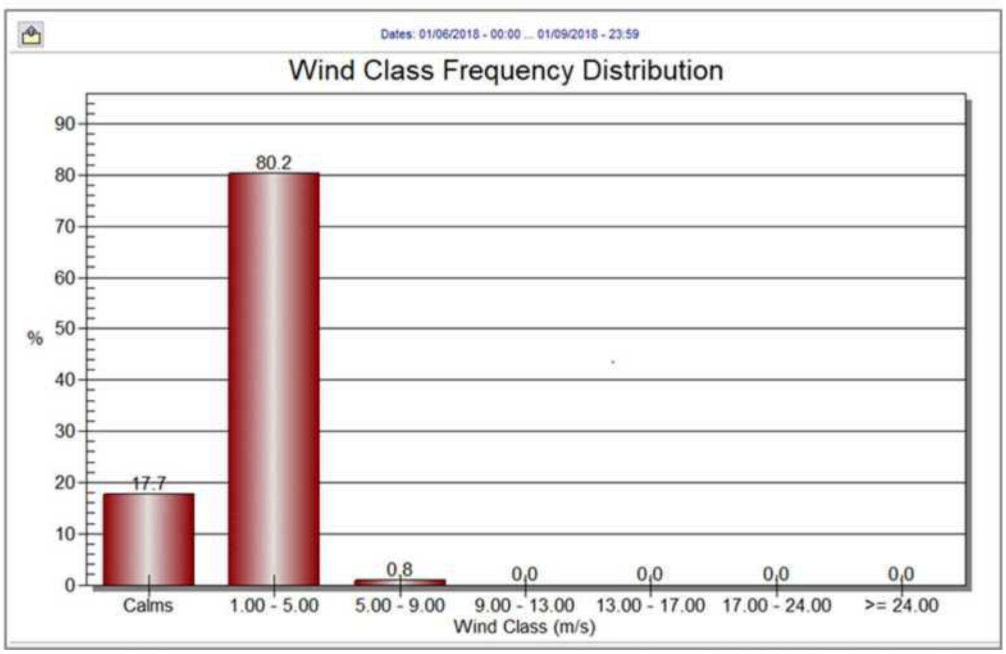


Figure 94 - Wind rose (above) and wind class frequency distribution (Period: June 2018 to Aug 2018)

2.3.1.3 Contributions in Terms of Greenhouse Gas Emissions

The proposed project will emit Carbon Dioxide (CO_2) due to operation of haul trucks and other equipment that utilizes diesel engines, i.e., dozers and graders. Although there is no emission standard of CO_2 specific for diesel engines (mobile), it is recommended that GHG accounting and mitigation and adaptation programs should be implemented.

GHG accounting program aims to determine the a) baseline CO_2 emissions of the project, and b) effectivity of the GHG reduction program. GHG accounting should be in accordance with international accepted protocol, such as the those developed by World Research 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 according to the following scope.

- Scope 1 emissions – emissions that are directly owned and controlled sources. These include emissions from diesel generator sets and vehicles owned by the proponent.
- Scope 2 emissions – 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*)

The other common measures to reduce carbon footprint include, among others, the following:

a) Minimize opening of vegetated areas and maximize use of existing bare areas (if any) as lay-down or contractor's area.
b) Implement vehicle fleet management,
c) Use of fuel-efficient heavy equipment and trucks,
d) Reduce the number of vehicle trips (when appropriate),
e) Minimize or eliminate unnecessary idling of vehicles; and
f) Offset GHG emissions by implementing an extensive reforestation program for the project in compliance with the EMB-DENR MC no. 2011-005.

2.3.2 Air Quality

2.3.2.1 Methodology

2.3.2.1.1 Assessment of Existing Air Quality

Ambient air monitoring was conducted by CRL Calabarquez Corporation (CRL) at five (5) locations in October 2018 and February 2019 (*Table 26*). The sampling locations were assigned at receptors (residences and commercial areas) in vicinities of the project site. ***Figure 95*** shows the locations of the monitoring stations and the photographs taken during air monitoring pollutants monitored were total suspended particulates (TSP), particulate matter less than or equal to 10 micron (or PM_{10}), sulfur dioxide (SO_2) and nitrogen dioxide (NO_2). The averaging sampling period was one-hour for above-mentioned air pollutants.

Table 26 - Coordinates and elevations of the air sampling stations

Station ID	Location	Latidue (deg)	Longitude (deg)	Pollutants Sampled
A1	Brgy. Akle, Sitio Narra	15°3’39” N	121°4’11” E	TSP, PM_{10}, NO_2, SO_2
A2	Brgy. Akle, Sitio Narra, Near Quarry	15°3’23” N	121°4’5” E	TSP, PM10, NO_2, SO_2
A3	Doña Remedios Trinidad, Brgy. Talbak, Near Bulacan Brgy. Hall	15°5’19.8” N	121°5’39.1” E	TSP, PM10, NO_2, SO_2
A4	Brgy. Akle, In Front of Centro Akle St.	15°2’53” N	121°4’23.3” E	TSP, PM10, NO_2, SO_2
A5	In Front of Petron Gas Station	15°3’1.2” N	121°4’23.3” E	TSP, PM10, NO_2, SO_2
*TSP = Total Suspended Particulate Matter; PM_{10}= Particulate Matter at 10µ; NO_2 = Nitrogen Dioxide; SO_2 = Sulfur Dioxide				

Two (2) types of air samplers were used during monitoring (***Table 27***). High volume samplers were used to sample TSP and PM_{10} while a personal sampler (SKC) for SO_2 and NO_2. The high-volume sampler was equipped with all-weather shelter timer and flowchart meter. The personal sampler was provided two (2) impingers, each of the impinger/bubbler was used to collect samples of SO_2 and NO_2.

Table 27 - Equipment used and corresponding sampled air pollutants (Source: CRL, 2018)

Equipment Name/Description	Brand/Model	Parameters Measured
High Volume Sampler	Tisch Environmental/5009 and Graseby	TSP, PM10
Personal Sampler	SKC	NO2, SO2

The following briefly describes the methods of air sampling and analysis, as discussed in CRL (2019).

a) TSP

Ambient air was drawn through a glass fiber filter over one-hour for TSP. The weights of the filter papers containing the particulates less the initial weights of the filter papers prior to sampling over that of the standard volume of air sampled give the concentrations of TSP.

b) PM_{10}

Ambient air, with particle size less than 10µm was entered in a Graseby inlet by means of vacuum system. The air passes through a venturi type casing resulting to a flow rate of approximately 40 cubic feet per minute. The particles were collected in a glass fiber filter and determined by measuring gravimetrically. The filter paper containing the sample was weighed hence the final weight of the sample over that of the standard volume of air sampled gave the concentration of PM10.

c) SO_2 and NO_2

A known volume of air was sampled with a wet-chemical system where a constant volume of air sample passes through a suitable reagent (absorbing reagent) that was reactive to the specific pollutant desired. As the air sample passes through the bubbler rack, the air diffuses forming air bubbles and slowly reacts to the chemical reagent forming a complex ion. The personal sampler was calibrated with NIST traceable digital calibrator to assure its accuracy. The samples were then analyzed using prescribed and approved methods.

All samples collected (filter papers and chemical reagents) were brought to CRL laboratory in Clark, Pampanga for analysis.

Figure 95 - Locations of Air Sampling Stations and Photographs of Air Sampling Equipment (pictures taken by CRL)

2.3.2.2 Dispersion Modelling Methodology

Table 28 shows the dispersion model and preprocessors used and the summary of the model inputs. The details of the model inputs are discussed in the subsequent sections.

Table 28 - Dispersion Model and Preprocessor Used in the Study and Summary of Model Set-Up

Item No	Particular	Remarks
1	Air dispersion model and preprocessors	Licensed AERMOD View Air Dispersion Model (Version 9.6.5). AERMOD View is Graphical User Interface (GUI) for U.S.EPA's AERMOD
	Terrain preprocessor	AERMET View (terrain preprocessor of AERMOD View). AERMET View is a GUI for U.S.EPA's AERMET
	Meteorological preprocessor	AERMAP View (meteorological preprocessor of AERMOD View. AERMAP View is a GUI for U.S.EPA's AEMAP
2	Pollutants modelled and averaging period	
	TSP and PM_{10}	24-hour averaging period (98th percentile) and 3-month average. Three-month average concentrations were then converted to annual average)
3	Source types and inputs	Please refer ***Table 29*** below
4	Building profile inputs	Not included. Emission sources are generally mobile (or vehicle types)
5	Modelling domain size	10 km x 10 km (10,000 m x 10,000 m)
6	Topography and receptors	Based on Shuttle Radar Topography Mission (SRTM) data, as downloaded using the terrain preprocessor (named AERMAP View) of AERMOD View
	a) Multi-tier	Total of three (3) tiers, as follows: • 20 m grid spacing from center of the modelling domain to 1000 m, • 100 m grid spacing from 1000 to 3000 m • 200 m grid spacing from 3000 to 5000 m
	b) Plant boundary	Assigned along the boundaries of the quarry project site
7	Meteorological input data	Surface and profile data generated from PAGASA-Science Garden Station. Meteorological data cover the following periods: a) Dec. 1, 2015 to Feb 28, 2016

Item No	Particular	Remarks
		b) June 1, 2016 to Aug 31, 2016 c) Dec 1, 2016 to Feb 29, 2017 d) June 1, 2017 to Aug 31, 2017 e) Dec 1, 2017 to Feb 28, 2017 f) June 1, 2017 to Aug 31, 2017
8	Modelling scenarios and simulated air pollutants	Without and with mitigation measures for each modelling period shown in Item 7 above

2.3.2.2.1 Dispersion Model

A licensed AERMOD View Air Dispersion Model Version 9.6.5 (Licensed number/serial No. AER0006927) was utilized in this study (***Plate 13***). AERMOD View is a Graphical User Interface (GUI) developed by Lakes Environmental Software, Inc. in Canada for U.S.EPA's AERMOD. Pursuant to DENR MC 2008-003 (Guidelines for Air Dispersion Model), AERMOD is one of the required air dispersion models to be used in Tier 4 air quality impact assessment.

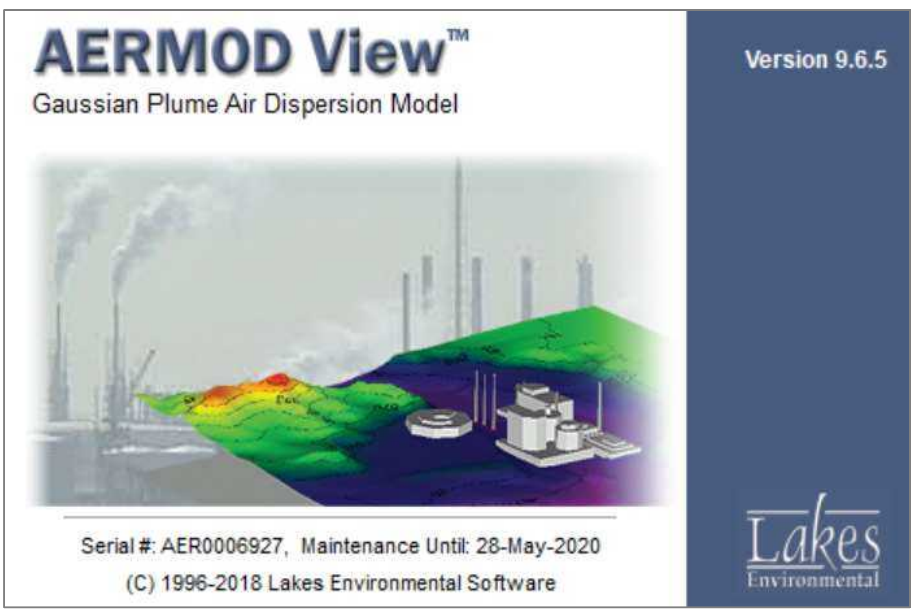


Plate 13 - Screenshot of the licensed AERMOD View Air Dispersion Model (Serial No. AER0006927)

2.3.2.2.2 Pollutants Modelled and Averaging Periods

The air pollutants modelled were TSP and PM_{10} at averaging periods of 24-hour (98^{th} percentile) and 3-months as the latter were limited to three (3) months of data representing the northeast and southwest monsoons from 2015 to 2018. As there is no 3-month averaging standard or guideline value for TSP and PM10, the predicted concentrations at the foregoing averaging period were then converted to its annual average using the conversion factor/formula in Appendix B of DAO 2008-003.

In accordance with Section 3, Rule X, Part III of DAO 2000-81 (IRR of the PCAA), the specified averaging period is 24 hours at 98th percentile and annual averaging periods.

2.3.2.2.3 Source Types and Input

Table 29 shows the emission sources and types of emission sources, i.e., volume and line area source, used in the dispersion modelling. The emission sources were selected based on the list of equipment provided by the proponent (Eagle Cement), the type of the project, and the site development plan, i.e., proposed access roads and quarry area. The locations of residences/households, gridded receptors, and indicative emission sources are shown in ***Figure 96***.

The emission factors and assumptions used in determining the emission rates of TSP and PM10 are discussed below.

Table 29 - Sources of air emissions and corresponding types of sources

No.	Emission Source	Type of Source	Sources
1	Bulldozing	Area Polygon	Emissions during drilling at the quarry area
2	Drilling	Volume source	Emissions during drilling at the quarry area
3	Materials handling	Volume source	Emissions during materials handling at the quarry area
4	Grading and scraping	Line area source	Emissions during grading and scraping along road
5	Haul trucks travelling along unpaved road	Line volume sources	Emissions during transport of materials from quarry to the crusher
6	Motor vehicle emissions	Line volume sources	Tailpipe emissions of off-road trucks travelling along unpaved road

The emission factors used to determine the particulate emissions from non-point emission sources/activities, such as materials handling, stockpile erosion and unpaved roads, are provided below.

i) Bulldozing

The emission factor for TSP (in kg/hr.unit) arising from bulldozing activities was based on AP-42 Emission factor (Section 11.9), as follows.

$$\mathbf{E_{TSP(bulldozing)}} = \frac{\mathbf{2.6\ s^{1.2}}}{\mathbf{M^{1.3}}} \qquad \text{Equation 1}$$

where, s, is the material silt content (%) and, M is the material moisture content (%). For PM_{10} emissions (in kg/hr.unit), the emission factor is,

$$\mathbf{E_{PM10(bulldozing)}} = \mathbf{0.75\ x} \frac{\mathbf{0.45\ s^{1.2}}}{\mathbf{M^{1.3}}} \qquad \text{Equation 2}$$

ii) Drilling

Emissions of TSP from drilling operations were estimated from Section 11.9 of AP-42 (U.S.EPA 1998), as follows:

$$\mathbf{E_{TSP(drilling)}} = \mathbf{0.59}\,\frac{kg}{hole} \qquad \text{Equation 3}$$

A factor (or multiplier) of 0.47 was multiplied to Equation (3) to represent the emission factor of PM10. This factor was derived from Section 13.2.4 (Aggregated Handling and Storage Piles) in AP-42.

$$\mathbf{E_{PM10(drilling)}} = \mathbf{0.2273}\,\frac{kg}{hole} \qquad \text{Equation 4}$$

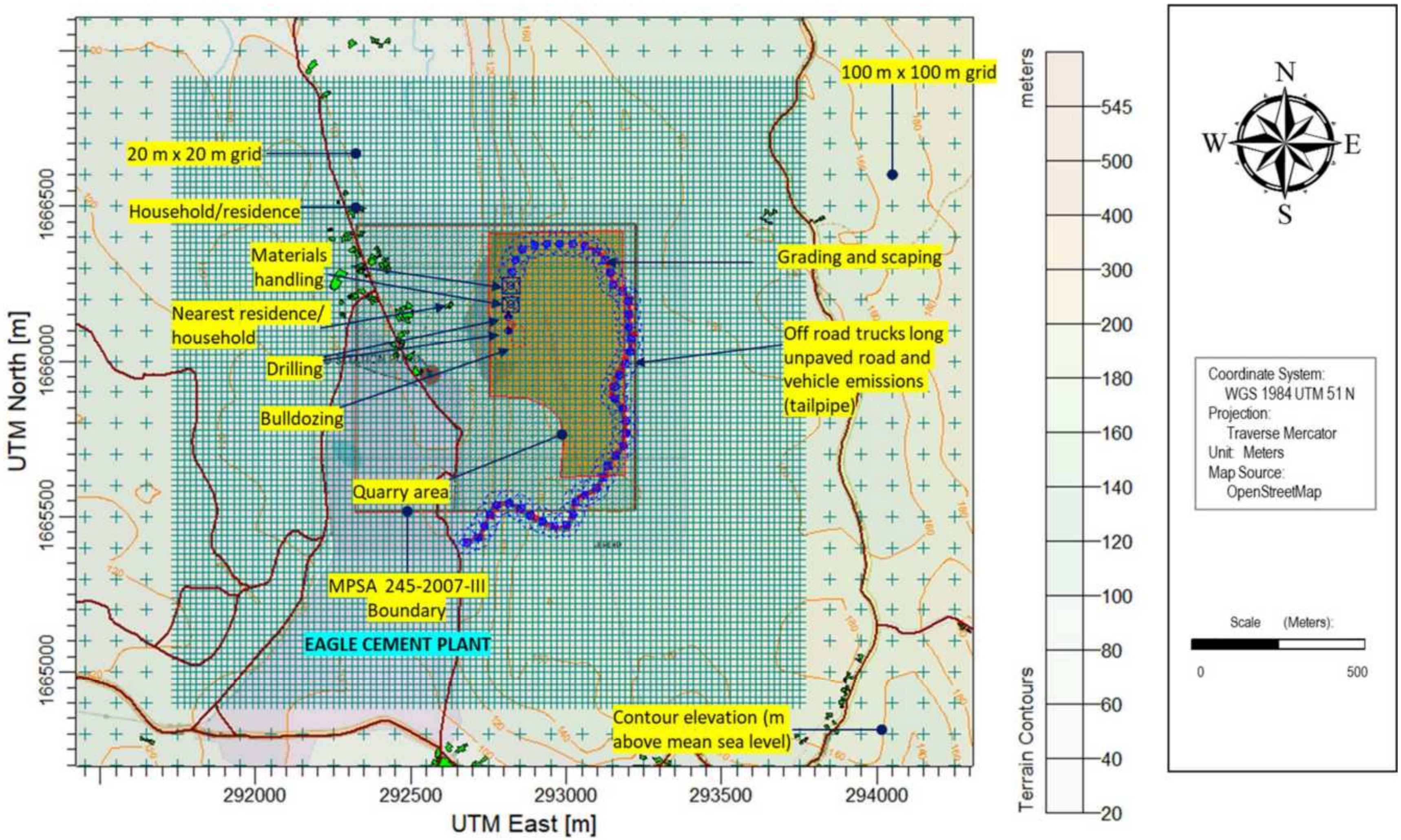


Figure 96 - Locations of Residences/Households, Gridded Receptors, and Indicative Emission Sources

iii) Materials Handling

TSP and PM_{10} emissions (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.

$$\mathbf{E_{Materials\ Handling}} = \mathbf{k\,(0.0016)}\,\frac{\left(\frac{U}{2.2}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}} \qquad \text{Equation 5}$$

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 and 0.35 for PM_{10}.

iv) Grading and Scraping

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:

$$\boldsymbol{E_{TSP grading-scraping} = 0.0034\ x\ S^{2.5}} \qquad \textbf{Equation 6}$$

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

$$\boldsymbol{E_{PM10 grading-scraping} = 0.6\ x\ 0.0056\ x\ S^{2.0}} \qquad \textbf{Equation 7}$$

v) Haul Trucks Travelling 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:

$$\boldsymbol{E_{UnpavedRoad} = k\left(\frac{s}{12}\right)^{a}\left(\frac{W}{3}\right)^{b}} \qquad \textbf{Equation 8}$$

where k, a, and, b, are constants shown below.

Constant	*TSP*	*PM10*
K (lb/VMT)	4.9	1.5
a	0.7	0.9
b	0.45	0.45

Source: Table 12.2.2.2 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 8) was adjusted to account for the natural mitigation by rainfall using the formula,

$$E_{unpaved(cor)} = E_{unpaved}\left(\frac{365-P}{365}\right)$$ **Equation 9**

where

- $E_{unpaved(cor)}$ = 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

vi) Motor Vehicle Emissions

Vehicle exhaust emissions (TSP and PM_{10}) of trucks used to haul raw materials from the quarry to the crusher of the cement plant were estimated using the emission factor published by the National Pollution Inventory (NPI) of the Department of the Environment, Water, Heritage and Arts in Australia (NPI 2008).

The emission factor of PM_{10} for very heavy goods vehicle (HGV) was computed at 1.2 kg/m^3 (Table 22 of NPI, 2008) where the volume (m^3) is the diesel fuel consumption. For TSP, the emission factor was computed at 1.5 kg/m^3 using particle size difference of 30% between TSP and PM_{10}.

Plate 14 to ***Plate 16*** show the screenshots of the source inputs.

2.3.2.2.4 Building Profile Inputs

Building profile inputs (e.g., heights and widths of buildings) were not included, as the emission sources are generally mobile (or vehicle types).

Source Pathway - Source Inputs

AERMOD

Volume Sources

Source Type	Source ID	X Coordinate [m]	Y Coordinate [m]	Base Elevation (Optional)	Release Height [m]	Emission Rate [g/s]	Length of Side [m]	Building Height [m]	Initial Lateral Dim. [m]	Initial Vertical Dim. [m]
VOLUME	VOL1	292814.43 2a-Drilling	1666144.87	146.57	2.00	0.16389	13.28	Surface-Based	3.09	0.47
VOLUME	VOL2	292822.02 3a-Materials Handling	1666243.51	146.49	4.00	0.04973	55.02	Surface-Based	12.80	0.93
VOLUME	VOL3	292821.07 3b - Materials Handling	1666183.76	148.37	4.00	0.04973	49.32	Surface-Based	11.47	0.93
VOLUME	VOL4	292815.04 2b-Drilling	1666099.62	145.31	2.00	0.16389	13.28	Surface-Based	3.09	0.47

Polygon Area Sources

Source Type: AREA POLY

Source: PAREA1 (1-Bulldozing)

Base Elevation (Optional)	Release Height [m]	Emission Rate [g/(s-m^2)]	Initial Vertical Dim. [m]	Number of Vertices (or sides)	X Coordinate for Vertices [m]	Y Coordinate for Vertices [m]
150.29	0.00	0.00007		4	292823.32	1666116.97
		0.00007			292823.32	1666050.13
		0.00007			292864.29	1666047.97
		0.00007			292864.29	1666110.50

Plate 14 - Screenshot of source inputs for bulldozing, drilling, and materials handling

Source Pathway - Source Inputs

AERMOD

Line Volume Sources

Source Type: LINE VOLUME

Source: SLINE1 (5-Unpaved roads (off-road trucks))

Length of Side [m]	Emission Rate [g/s]	Building Height [m]	X Coordinate for Points [m]	Y Coordinate for points [m]	Base Elevation [m]	Release Height [m]
21.00	6.75203		292668.51	1665417.34	108.36	3.74
			292695.30	1665419.57	111.15	3.74
			292717.62	1665435.20	113.13	3.74
			292728.78	1665446.36	116.33	3.74
			292737.71	1665470.91	113.23	3.74
			292751.10	1665499.93	111.35	3.74
			292762.26	1665524.48	112.39	3.74
			292780.12	1665540.11	116.29	3.74
			292802.44	1665546.81	130.00	3.74
			292847.08	1665533.41	148.64	3.74
			292867.17	1665513.32	161.15	3.74
			292900.66	1665493.23	167.21	3.74
			292943.07	1665479.84	170.64	3.74
			292963.16	1665468.68	171.10	3.74
			292992.18	1665468.68	170.52	3.74
			293012.27	1665479.84	169.36	3.74
			293018.96	1665502.16	169.31	3.74
			293027.89	1665535.64	166.50	3.74
			293034.59	1665557.97	162.11	3.74
			293056.91	1665569.13	160.23	3.74
			293079.23	1665580.29	155.20	3.74
			293099.32	1665593.68	152.19	3.74
			293117.18	1665618.24	151.38	3.74
			293123.88	1665649.49	155.52	3.74
			293143.96	1665676.27	162.06	3.74
			293164.05	1665700.83	162.79	3.74
			293188.61	1665734.31	160.90	3.74
			293193.07	1665781.19	161.33	3.74

Project File: D:\PROJ\2019\PJ020-EAGLE\1000-for plates\1000-for plates.isc

AERMOD View by Lakes Environmental Software SO1 - 2 1 Jun 2019

Plate 15 - Screenshot of source inputs for off-road trucks travelling along unpaved roads

Source Pathway - Source Inputs

AERMOD

Line Area Sources

Source Type: LINE AREA

Source: ARLN1 (4-Grading)

Length of Side [m]	Emission Rate [g/s]	Initial Vertical Dimension [m]	X Coordinate for Points [m]	Y Coordinate for points [m]	Base Elevation [m]	Release Height [m]
7.50	6.91E-6		292678.17	1665417.83	108.96	0.00
			292720.19	1665438.84	113.75	0.00
			292733.32	1665467.72	111.99	0.00
			292756.95	1665504.49	113.73	0.00
			292767.45	1665533.37	113.74	0.00
			292819.97	1665546.50	135.29	0.00
			292854.10	1665525.49	153.85	0.00
			292901.37	1665499.23	167.20	0.00
			292930.25	1665475.60	169.77	0.00
			292961.76	1665465.10	171.12	0.00
			292998.52	1665467.72	170.16	0.00
			293019.53	1665504.49	169.18	0.00
			293024.78	1665541.25	163.86	0.00
			293045.78	1665567.50	161.48	0.00
			293079.92	1665578.01	155.14	0.00
			293106.18	1665596.39	152.15	0.00
			293124.56	1665627.90	151.41	0.00
			293140.31	1665664.66	162.23	0.00
			293158.69	1665704.04	161.92	0.00
			293179.70	1665727.68	160.66	0.00
			293192.83	1665769.69	161.01	0.00
			293190.20	1665803.82	162.99	0.00
			293190.20	1665845.84	167.46	0.00
			293145.56	1665890.47	172.56	0.00
			293145.56	1665921.98	176.72	0.00
			293166.57	1665966.62	179.16	0.00
			293184.95	1666008.63	179.68	0.00
			293208.58	1666042.77	175.56	0.00

Project File: D:\PROJ\2019\PJ020-EAGLE\1000-for plates\1000-for plates.isc

AERMOD View by Lakes Environmental Software SO1 - 6 1 Jun 2019

Plate 16 - Screenshot of Source Inputs for Grading and Scraping

2.3.2.2.5 Modelling Domain or Calculation Area

The modelling domain or calculation area covers an area of 10 km x 10 km with the center of the domain about the center of the quarry area (***Figure 97***). Areas within about 5 km from the project site were included to ensure that all receptors (residences or households) were covered in the simulations.

2.3.2.2.6 Topography and Receptors

<u>Multi-tier receptors</u>

Multi-tier grid receptors were generated within the modelling domain or calculation area (***Plate 17***). Gridded receptors were assigned at the following:

- 20 m grid receptors from center of modelling domain to 1000 m
- 100 m grid receptors from 1000 to 3000 m
- 200 m grid receptors from 3000 to 5000 m

At each receptor or calculation point, the elevations (m above mean sea level) and the hill height were directly computed by AERMAP View using the coordinates as inputs.

The gridded receptors are finely spaced (20 m grid interval) at the project site and vicinities to ensure all receptors were included in the simulations. The nearest household/residence is located about 120 m east of the western boundary of the quarry area.

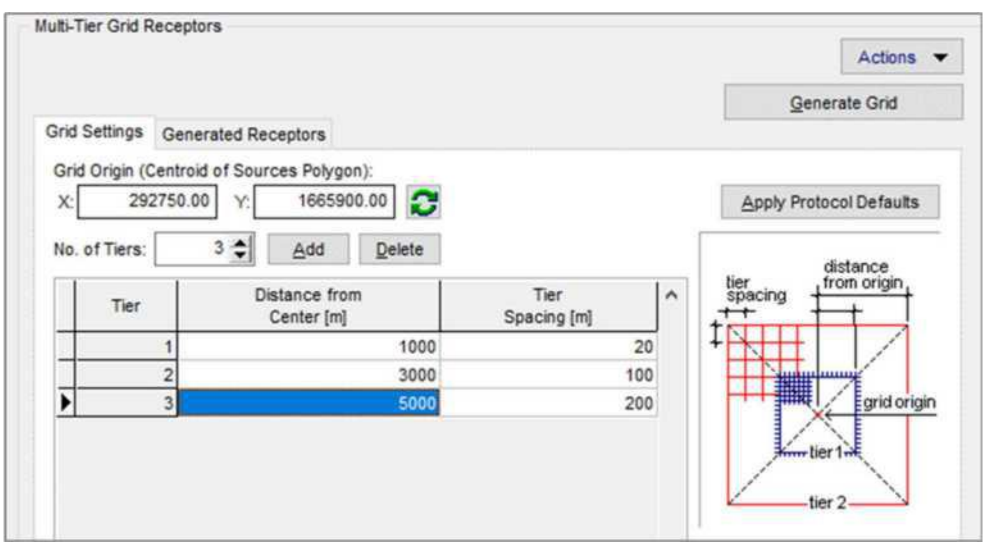


Plate 17 - Screenshot of Discrete Cartesian and Plant Boundary Receptors

Topography or Elevations of Receptors

The topography or elevations of the modelling domain and receptors were derived from the Shuttle Radar Topography Mission (SRTM) data, as extracted and processed using the AERMAP View module of AERMOD View.

Figure 98 and ***Figure 99*** show the two-and three-dimensional views of the topography in the project site and vicinities, respectively. Elevations within the MPSA range from about 120 to 160m.

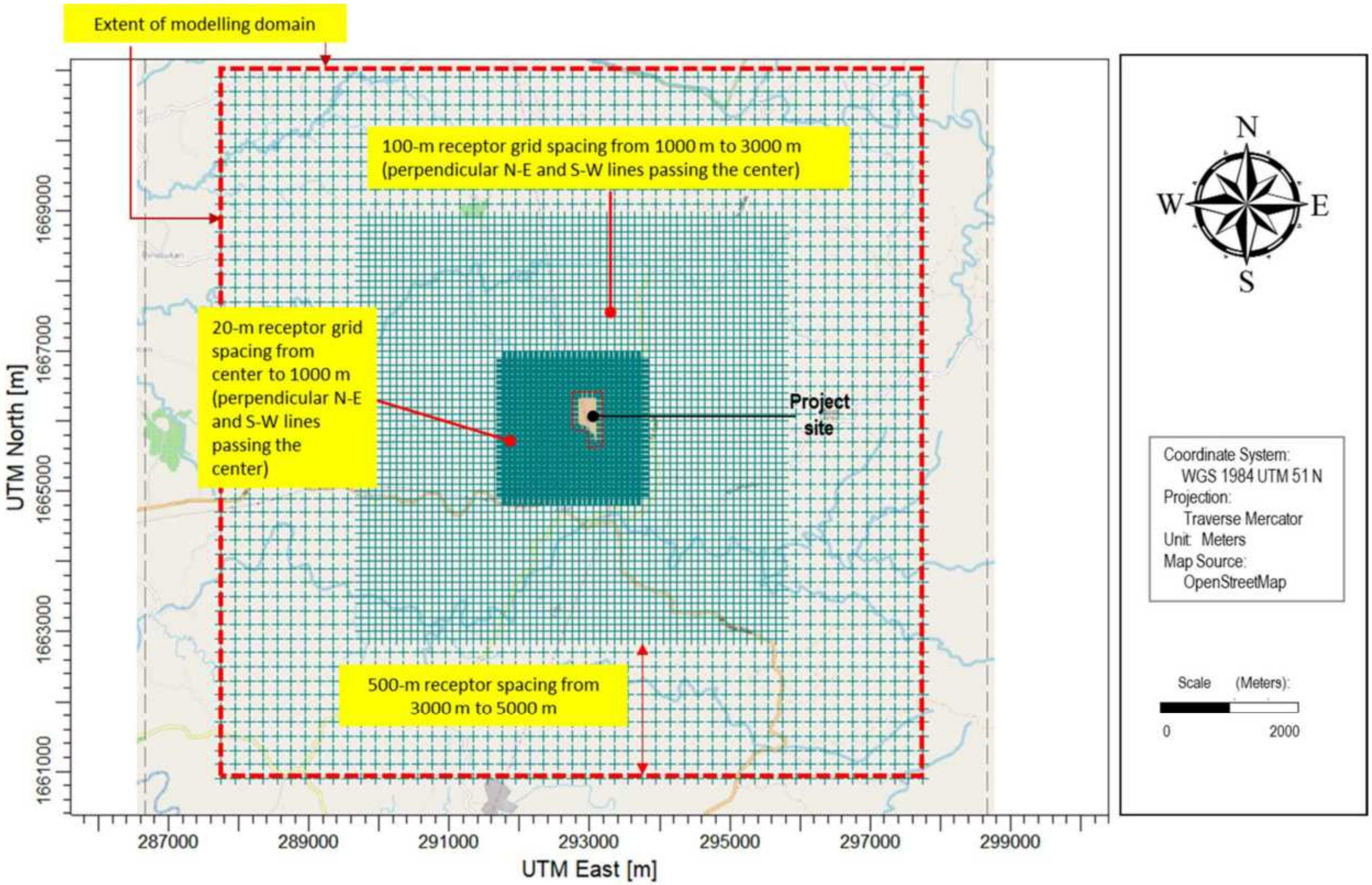


Figure 97 - Modelling domain and receptors

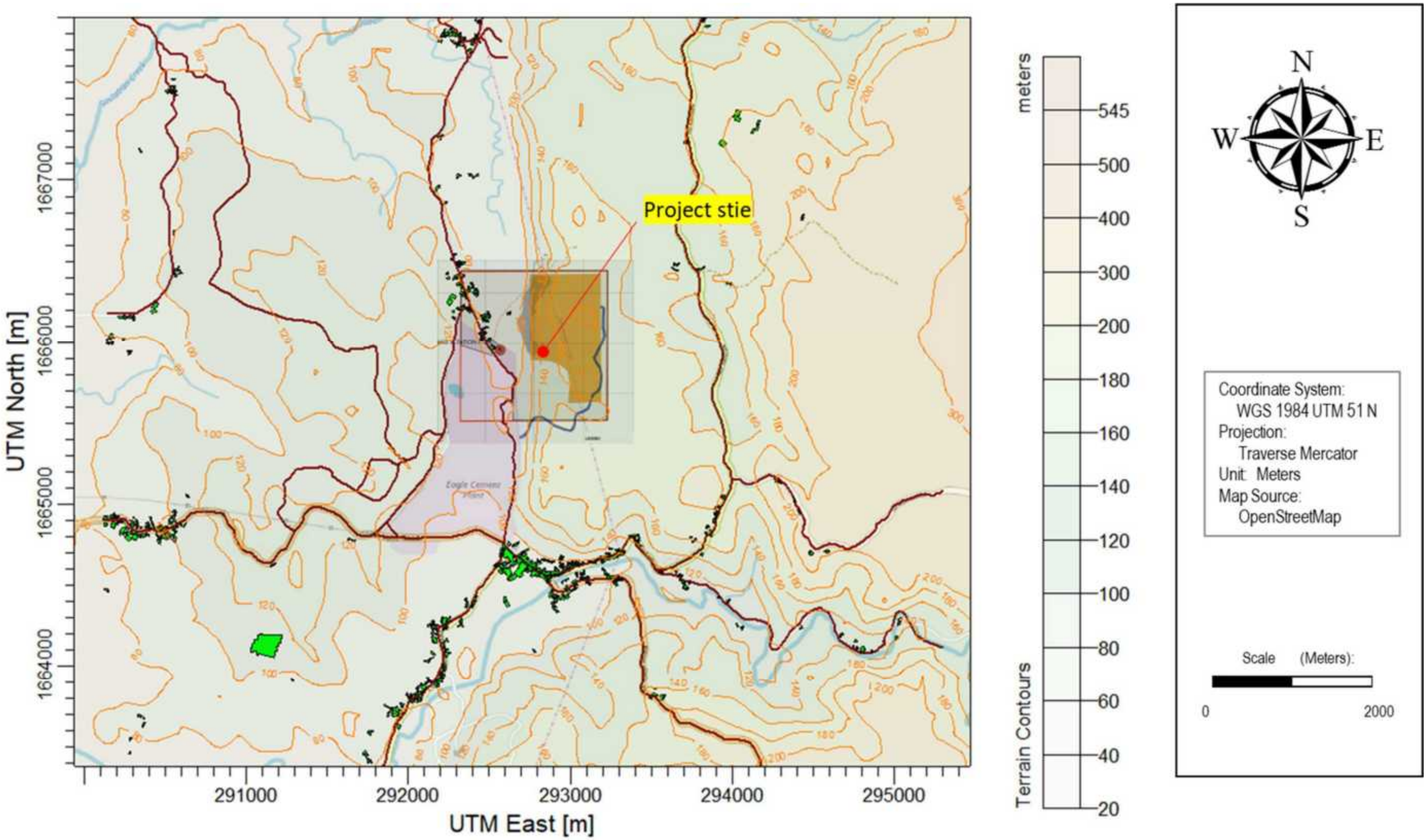


Figure 98 - Topography (two-dimensional) within and in vicinities of the project site

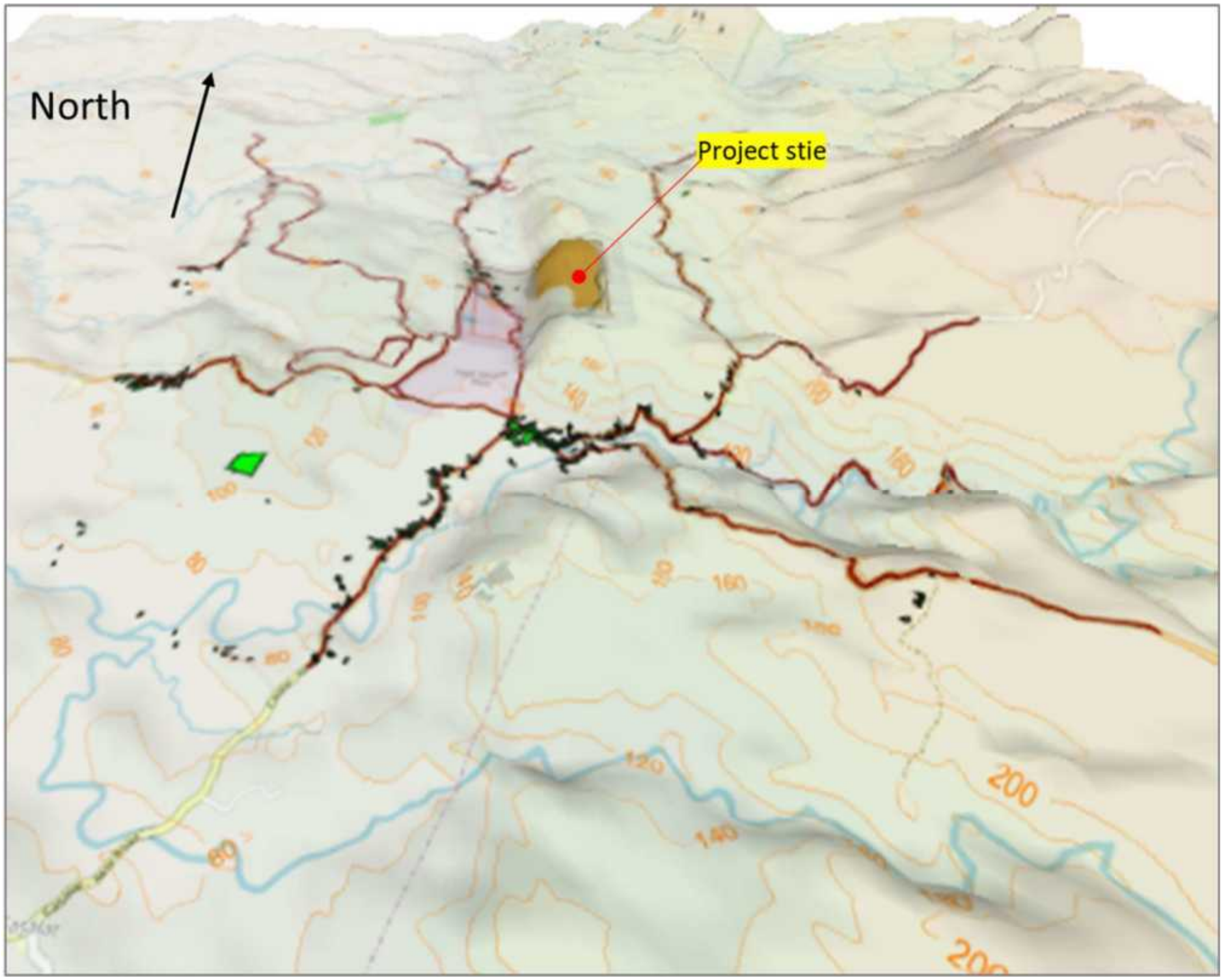


Figure 99 - Three-dimensional view of the topography of the project area and vicinities

2.3.2.2.7 Meteorological Input Data

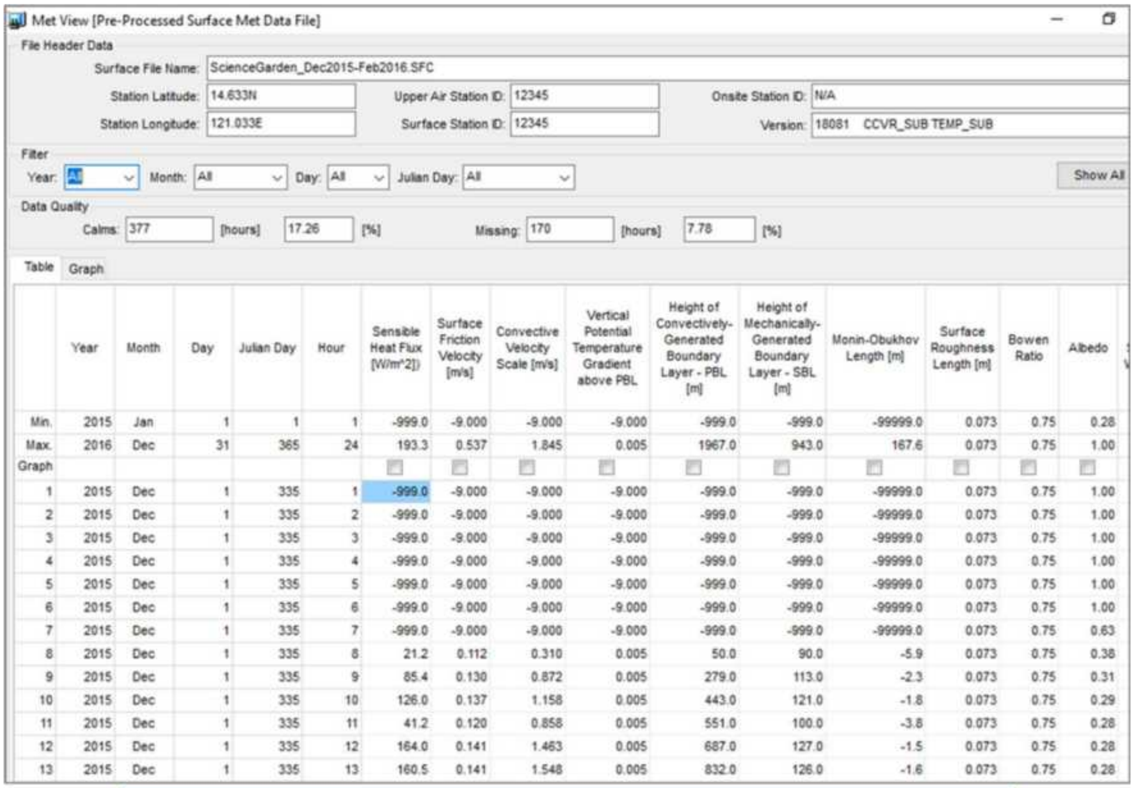
Meteorological data used in the dispersion modelling covered six (6) different periods with each period covering three (3) months, as follows:

1) Dec. 1, 2015 to Feb 28, 2016;
2) June 1, 2016 to Aug 31, 2016;
3) Dec 1, 2016 to Feb 29, 2017;
4) June 1, 2017 to Aug 31, 2017;
5) Dec 1, 2017 to Feb 28, 2017; and
6) June 1, 2017 to Aug 31, 2017

Meteorological data consist of hourly and three-hourly wind speed, wind direction, ambient air temperature, cloudiness, and rainfall, which were purchased from PAGASA Central Office in Quezon City. Time periods in these data were converted to local time as the data were originally in Coordinated Universal Time (UTZ). Thus, meteorological data extended eight (8) hours the next day for each period presented above, i.e., February 28, 2015 at 00 UTZ to March 1, 2015 at 8:00 A.M.

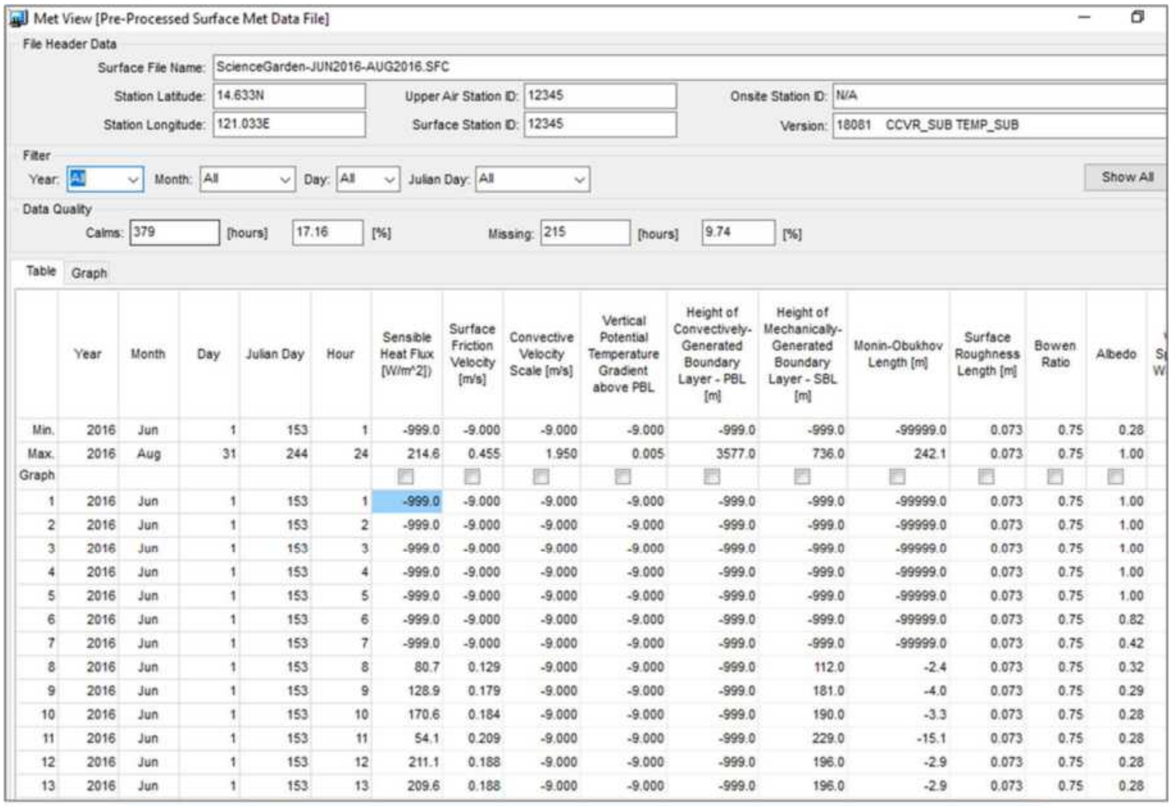
Missing hourly data in the three-hourly data were interpolated using the preceding and subsequent data. For example, missing data on 12:00 NN and 1 P.M. were interpolated using available data on 11:00 A.M. and 2:00 P.M. In case of several missing three-hourly data, a value of -999 representing missing data was assigned for each missing hour.

Plate 18 to ***Plate 23*** show the screenshots of the meteorological input data files (*.sfc and *.pfl), which were generated using AERMET View – a meteorological preprocessor of AERMOD View.



	Year	Month	Day	Julian Day	Hour	Sensible Heat Flux [W/m^2])	Surface Friction Velocity [m/s]	Convective Velocity Scale [m/s]	Vertical Potential Temperature Gradient above PBL	Height of Convectively-Generated Boundary Layer - PBL [m]	Height of Mechanically-Generated Boundary Layer - SBL [m]	Monin-Obukhov Length [m]	Surface Roughness Length [m]	Bowen Ratio	Albedo
Min.	2015	Jan	1	1	1	-999.0	-9.000	-9.000	-9.000	-999.0	-999.0	-99999.0	0.073	0.75	0.28
Max.	2016	Dec	31	365	24	193.3	0.537	1.845	0.005	1967.0	943.0	167.6	0.073	0.75	1.00
Graph															
1	2015	Dec	1	335	1	-999.0	-9.000	-9.000	-9.000	-999.0	-999.0	-99999.0	0.073	0.75	1.00
2	2015	Dec	1	335	2	-999.0	-9.000	-9.000	-9.000	-999.0	-999.0	-99999.0	0.073	0.75	1.00
3	2015	Dec	1	335	3	-999.0	-9.000	-9.000	-9.000	-999.0	-999.0	-99999.0	0.073	0.75	1.00
4	2015	Dec	1	335	4	-999.0	-9.000	-9.000	-9.000	-999.0	-999.0	-99999.0	0.073	0.75	1.00
5	2015	Dec	1	335	5	-999.0	-9.000	-9.000	-9.000	-999.0	-999.0	-99999.0	0.073	0.75	1.00
6	2015	Dec	1	335	6	-999.0	-9.000	-9.000	-9.000	-999.0	-999.0	-99999.0	0.073	0.75	1.00
7	2015	Dec	1	335	7	-999.0	-9.000	-9.000	-9.000	-999.0	-999.0	-99999.0	0.073	0.75	0.63
8	2015	Dec	1	335	8	21.2	0.112	0.310	0.005	50.0	90.0	-5.9	0.073	0.75	0.38
9	2015	Dec	1	335	9	85.4	0.130	0.872	0.005	279.0	113.0	-2.3	0.073	0.75	0.31
10	2015	Dec	1	335	10	126.0	0.137	1.158	0.005	443.0	121.0	-1.8	0.073	0.75	0.29
11	2015	Dec	1	335	11	41.2	0.120	0.858	0.005	551.0	100.0	-3.8	0.073	0.75	0.28
12	2015	Dec	1	335	12	164.0	0.141	1.463	0.005	687.0	127.0	-1.5	0.073	0.75	0.28
13	2015	Dec	1	335	13	160.5	0.141	1.548	0.005	832.0	126.0	-1.6	0.073	0.75	0.28

Plate 18 - Screenshot of the surface data file (December 2015 to February 2016)



Met View [Pre-Processed Surface Met Data File]

File Header Data

Surface File Name: ScienceGarden-JUN2016-AUG2016.SFC

Station Latitude: 14.633N | Upper Air Station ID: 12345 | Onsite Station ID: N/A

Station Longitude: 121.033E | Surface Station ID: 12345 | Version: 18081 CCVR_SUB TEMP_SUB

Filter

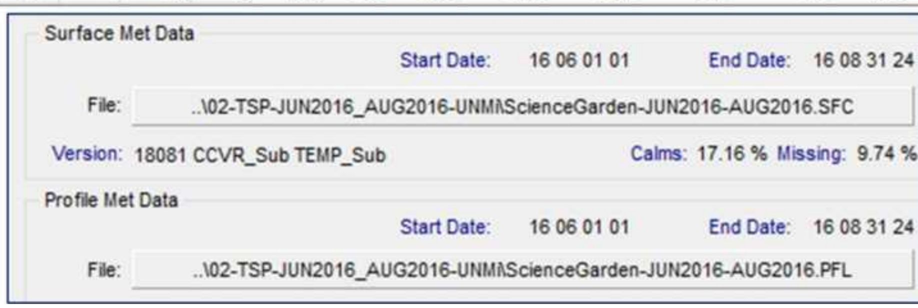
Year: All | Month: All | Day: All | Julian Day: All | Show All

Data Quality

Calms: 379 [hours] 17.16 [%] | Missing: 215 [hours] 9.74 [%]

Table | Graph

	Year	Month	Day	Julian Day	Hour	Sensible Heat Flux [W/m^2])	Surface Friction Velocity [m/s]	Convective Velocity Scale [m/s]	Vertical Potential Temperature Gradient above PBL	Height of Convectively-Generated Boundary Layer - PBL [m]	Height of Mechanically-Generated Boundary Layer - SBL [m]	Monin-Obukhov Length [m]	Surface Roughness Length [m]	Bowen Ratio	Albedo
Min.	2016	Jun	1	153	1	-999.0	-9.000	-9.000	-9.000	-999.0	-999.0	-99999.0	0.073	0.75	0.28
Max.	2016	Aug	31	244	24	214.6	0.455	1.950	0.005	3577.0	736.0	242.1	0.073	0.75	1.00
Graph															
1	2016	Jun	1	153	1	-999.0	-9.000	-9.000	-9.000	-999.0	-999.0	-99999.0	0.073	0.75	1.00
2	2016	Jun	1	153	2	-999.0	-9.000	-9.000	-9.000	-999.0	-999.0	-99999.0	0.073	0.75	1.00
3	2016	Jun	1	153	3	-999.0	-9.000	-9.000	-9.000	-999.0	-999.0	-99999.0	0.073	0.75	1.00
4	2016	Jun	1	153	4	-999.0	-9.000	-9.000	-9.000	-999.0	-999.0	-99999.0	0.073	0.75	1.00
5	2016	Jun	1	153	5	-999.0	-9.000	-9.000	-9.000	-999.0	-999.0	-99999.0	0.073	0.75	1.00
6	2016	Jun	1	153	6	-999.0	-9.000	-9.000	-9.000	-999.0	-999.0	-99999.0	0.073	0.75	0.82
7	2016	Jun	1	153	7	-999.0	-9.000	-9.000	-9.000	-999.0	-999.0	-99999.0	0.073	0.75	0.42
8	2016	Jun	1	153	8	80.7	0.129	-9.000	-9.000	-999.0	112.0	-2.4	0.073	0.75	0.32
9	2016	Jun	1	153	9	128.9	0.179	-9.000	-9.000	-999.0	181.0	-4.0	0.073	0.75	0.29
10	2016	Jun	1	153	10	170.6	0.184	-9.000	-9.000	-999.0	190.0	-3.3	0.073	0.75	0.28
11	2016	Jun	1	153	11	54.1	0.209	-9.000	-9.000	-999.0	229.0	-15.1	0.073	0.75	0.28
12	2016	Jun	1	153	12	211.1	0.188	-9.000	-9.000	-999.0	196.0	-2.9	0.073	0.75	0.28
13	2016	Jun	1	153	13	209.6	0.188	-9.000	-9.000	-999.0	196.0	-2.9	0.073	0.75	0.28



Surface Met Data

Start Date: 16 06 01 01 End Date: 16 08 31 24

File: ..\02-TSP-JUN2016_AUG2016-UNM\ScienceGarden-JUN2016-AUG2016.SFC

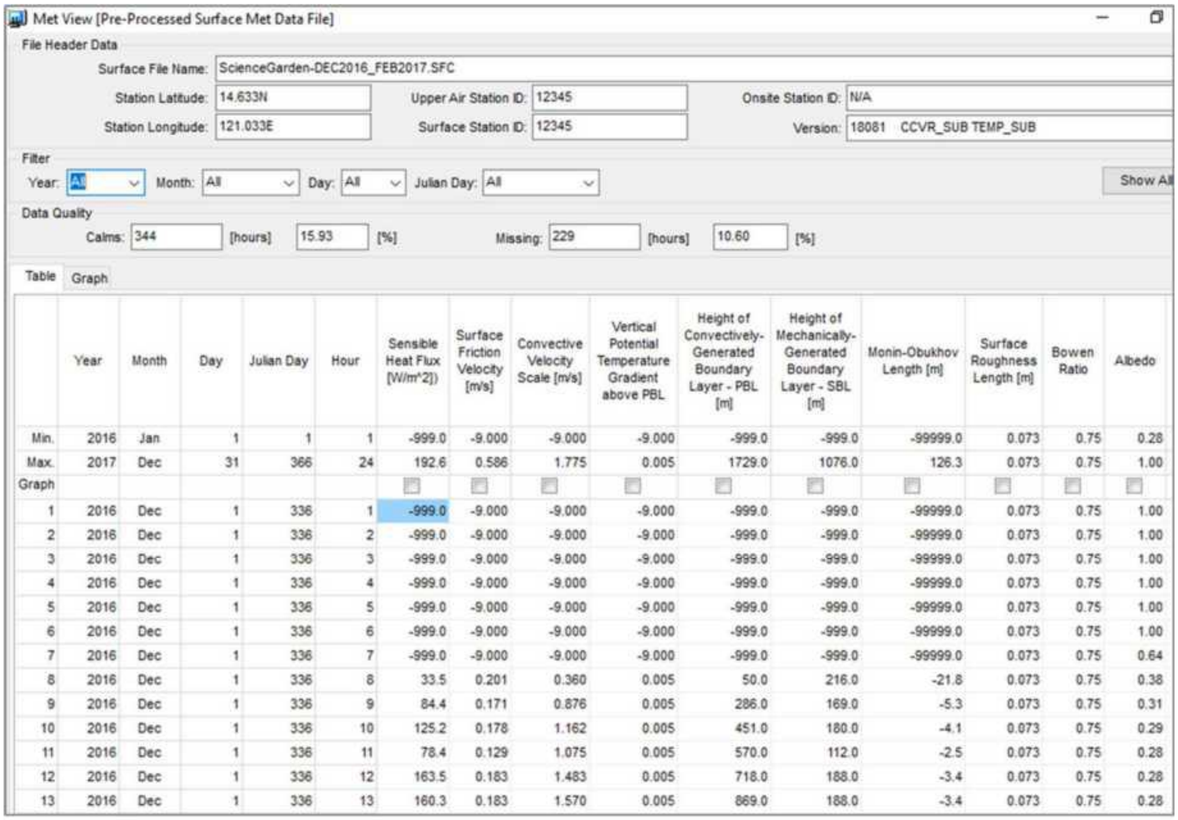
Version: 18081 CCVR_Sub TEMP_Sub Calms: 17.16 % Missing: 9.74 %

Profile Met Data

Start Date: 16 06 01 01 End Date: 16 08 31 24

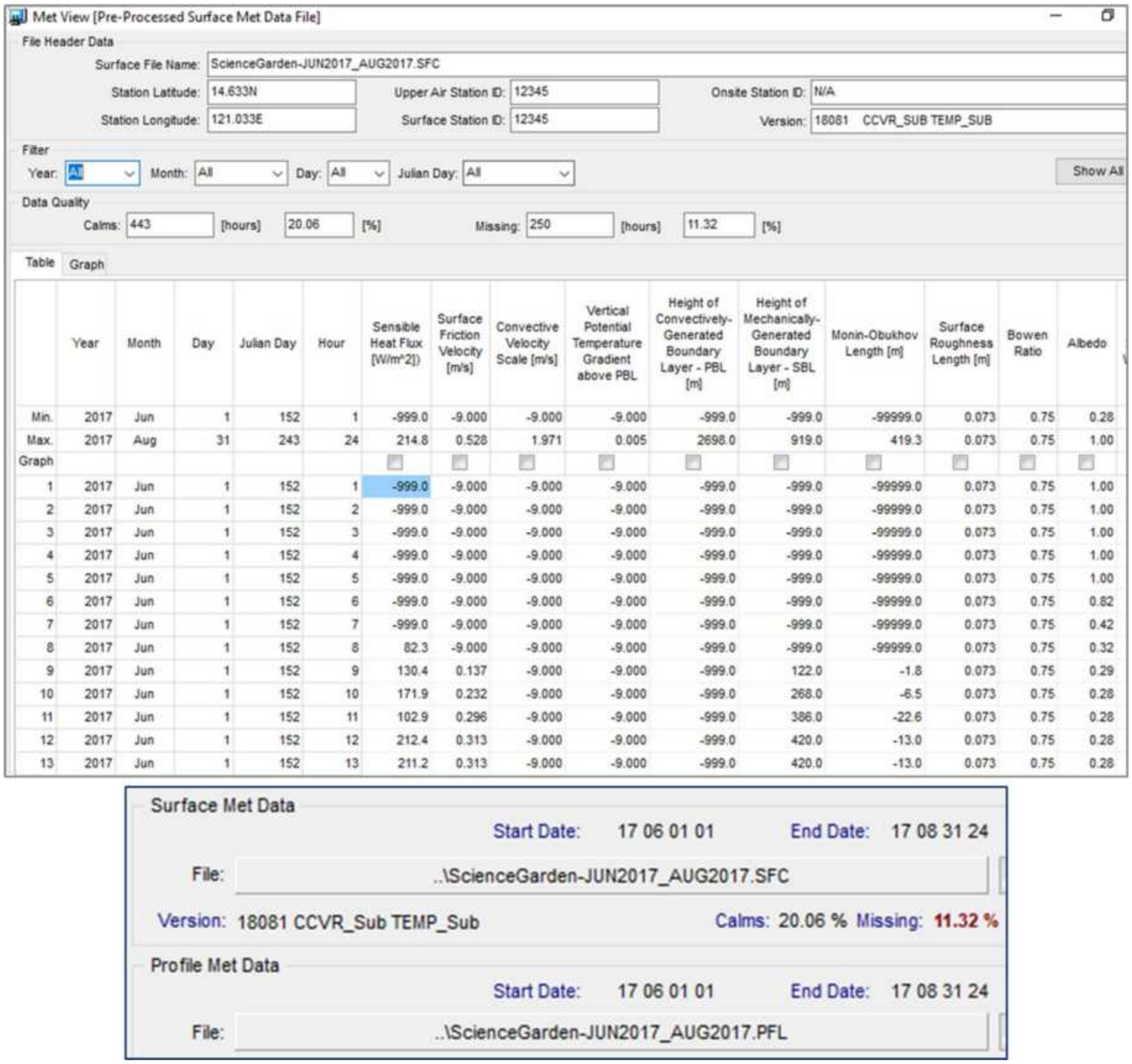
File: ..\02-TSP-JUN2016_AUG2016-UNM\ScienceGarden-JUN2016-AUG2016.PFL

Plate 19. Screenshot of the surface data file (June 2016 to August 2016)



	Year	Month	Day	Julian Day	Hour	Sensible Heat Flux [W/m^2])	Surface Friction Velocity [m/s]	Convective Velocity Scale [m/s]	Vertical Potential Temperature Gradient above PBL	Height of Convectively-Generated Boundary Layer - PBL [m]	Height of Mechanically-Generated Boundary Layer - SBL [m]	Monin-Obukhov Length [m]	Surface Roughness Length [m]	Bowen Ratio	Albedo
Min.	2016	Jan	1	1	1	-999.0	-9.000	-9.000	-9.000	-999.0	-999.0	-99999.0	0.073	0.75	0.28
Max.	2017	Dec	31	366	24	192.6	0.586	1.775	0.005	1729.0	1076.0	126.3	0.073	0.75	1.00
Graph															
1	2016	Dec	1	336	1	-999.0	-9.000	-9.000	-9.000	-999.0	-999.0	-99999.0	0.073	0.75	1.00
2	2016	Dec	1	336	2	-999.0	-9.000	-9.000	-9.000	-999.0	-999.0	-99999.0	0.073	0.75	1.00
3	2016	Dec	1	336	3	-999.0	-9.000	-9.000	-9.000	-999.0	-999.0	-99999.0	0.073	0.75	1.00
4	2016	Dec	1	336	4	-999.0	-9.000	-9.000	-9.000	-999.0	-999.0	-99999.0	0.073	0.75	1.00
5	2016	Dec	1	336	5	-999.0	-9.000	-9.000	-9.000	-999.0	-999.0	-99999.0	0.073	0.75	1.00
6	2016	Dec	1	336	6	-999.0	-9.000	-9.000	-9.000	-999.0	-999.0	-99999.0	0.073	0.75	1.00
7	2016	Dec	1	336	7	-999.0	-9.000	-9.000	-9.000	-999.0	-999.0	-99999.0	0.073	0.75	0.64
8	2016	Dec	1	336	8	33.5	0.201	0.360	0.005	50.0	216.0	-21.8	0.073	0.75	0.38
9	2016	Dec	1	336	9	84.4	0.171	0.876	0.005	286.0	169.0	-5.3	0.073	0.75	0.31
10	2016	Dec	1	336	10	125.2	0.178	1.162	0.005	451.0	180.0	-4.1	0.073	0.75	0.29
11	2016	Dec	1	336	11	78.4	0.129	1.075	0.005	570.0	112.0	-2.5	0.073	0.75	0.28
12	2016	Dec	1	336	12	163.5	0.183	1.483	0.005	718.0	188.0	-3.4	0.073	0.75	0.28
13	2016	Dec	1	336	13	160.3	0.183	1.570	0.005	869.0	188.0	-3.4	0.073	0.75	0.28

Plate 20. Screenshot of the surface data file (December 2016 to February 2017)



Met View [Pre-Processed Surface Met Data File]

File Header Data

Surface File Name: ScienceGarden-JUN2017_AUG2017.SFC

Station Latitude: 14.633N | Upper Air Station ID: 12345 | Onsite Station ID: N/A

Station Longitude: 121.033E | Surface Station ID: 12345 | Version: 18081 CCVR_SUB TEMP_SUB

Filter

Year: All | Month: All | Day: All | Julian Day: All | Show All

Data Quality

Calms: 443 [hours] 20.06 [%] Missing: 250 [hours] 11.32 [%]

Table Graph

	Year	Month	Day	Julian Day	Hour	Sensible Heat Flux [W/m^2])	Surface Friction Velocity [m/s]	Convective Velocity Scale [m/s]	Vertical Potential Temperature Gradient above PBL	Height of Convectively-Generated Boundary Layer - PBL [m]	Height of Mechanically-Generated Boundary Layer - SBL [m]	Monin-Obukhov Length [m]	Surface Roughness Length [m]	Bowen Ratio	Albedo
Min.	2017	Jun	1	152	1	-999.0	-9.000	-9.000	-9.000	-999.0	-999.0	-99999.0	0.073	0.75	0.28
Max.	2017	Aug	31	243	24	214.8	0.528	1.971	0.005	2698.0	919.0	419.3	0.073	0.75	1.00
Graph															
1	2017	Jun	1	152	1	-999.0	-9.000	-9.000	-9.000	-999.0	-999.0	-99999.0	0.073	0.75	1.00
2	2017	Jun	1	152	2	-999.0	-9.000	-9.000	-9.000	-999.0	-999.0	-99999.0	0.073	0.75	1.00
3	2017	Jun	1	152	3	-999.0	-9.000	-9.000	-9.000	-999.0	-999.0	-99999.0	0.073	0.75	1.00
4	2017	Jun	1	152	4	-999.0	-9.000	-9.000	-9.000	-999.0	-999.0	-99999.0	0.073	0.75	1.00
5	2017	Jun	1	152	5	-999.0	-9.000	-9.000	-9.000	-999.0	-999.0	-99999.0	0.073	0.75	1.00
6	2017	Jun	1	152	6	-999.0	-9.000	-9.000	-9.000	-999.0	-999.0	-99999.0	0.073	0.75	0.82
7	2017	Jun	1	152	7	-999.0	-9.000	-9.000	-9.000	-999.0	-999.0	-99999.0	0.073	0.75	0.42
8	2017	Jun	1	152	8	82.3	-9.000	-9.000	-9.000	-999.0	-999.0	-99999.0	0.073	0.75	0.32
9	2017	Jun	1	152	9	130.4	0.137	-9.000	-9.000	-999.0	122.0	-1.8	0.073	0.75	0.29
10	2017	Jun	1	152	10	171.9	0.232	-9.000	-9.000	-999.0	268.0	-6.5	0.073	0.75	0.28
11	2017	Jun	1	152	11	102.9	0.296	-9.000	-9.000	-999.0	386.0	-22.6	0.073	0.75	0.28
12	2017	Jun	1	152	12	212.4	0.313	-9.000	-9.000	-999.0	420.0	-13.0	0.073	0.75	0.28
13	2017	Jun	1	152	13	211.2	0.313	-9.000	-9.000	-999.0	420.0	-13.0	0.073	0.75	0.28

Surface Met Data

Start Date: 17 06 01 01 End Date: 17 08 31 24

File: ..\ScienceGarden-JUN2017_AUG2017.SFC

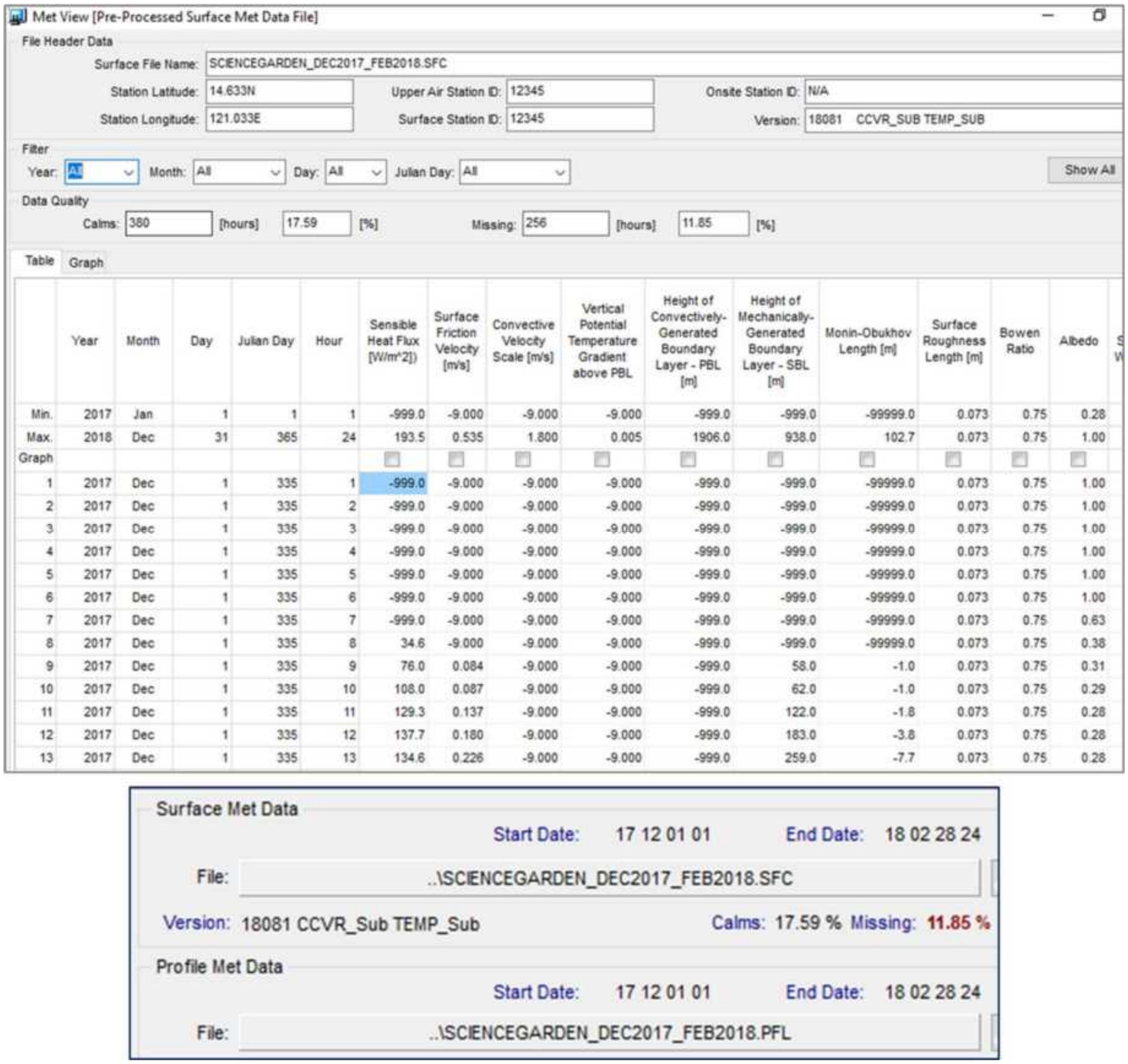
Version: 18081 CCVR_Sub TEMP_Sub Calms: 20.06 % Missing: 11.32 %

Profile Met Data

Start Date: 17 06 01 01 End Date: 17 08 31 24

File: ..\ScienceGarden-JUN2017_AUG2017.PFL

Plate 21. Screenshot of the surface data file (June 2017 to August 2017)


Met View [Pre-Processed Surface Met Data File]

File Header Data

Surface File Name: SCIENCEGARDEN_DEC2017_FEB2018.SFC

Station Latitude: 14.633N Upper Air Station ID: 12345 Onsite Station ID: N/A

Station Longitude: 121.033E Surface Station ID: 12345 Version: 18081 CCVR_SUB TEMP_SUB

Filter

Year: All Month: All Day: All Julian Day: All Show All

Data Quality

Calms: 380 [hours] 17.59 [%] Missing: 256 [hours] 11.85 [%]

Table Graph

	Year	Month	Day	Julian Day	Hour	Sensible Heat Flux [W/m^2])	Surface Friction Velocity [m/s]	Convective Velocity Scale [m/s]	Vertical Potential Temperature Gradient above PBL	Height of Convectively-Generated Boundary Layer - PBL [m]	Height of Mechanically-Generated Boundary Layer - SBL [m]	Monin-Obukhov Length [m]	Surface Roughness Length [m]	Bowen Ratio	Albedo
Min.	2017	Jan	1	1	1	-999.0	-9.000	-9.000	-9.000	-999.0	-999.0	-99999.0	0.073	0.75	0.28
Max.	2018	Dec	31	365	24	193.5	0.535	1.800	0.005	1906.0	938.0	102.7	0.073	0.75	1.00
Graph															
1	2017	Dec	1	335	1	-999.0	-9.000	-9.000	-9.000	-999.0	-999.0	-99999.0	0.073	0.75	1.00
2	2017	Dec	1	335	2	-999.0	-9.000	-9.000	-9.000	-999.0	-999.0	-99999.0	0.073	0.75	1.00
3	2017	Dec	1	335	3	-999.0	-9.000	-9.000	-9.000	-999.0	-999.0	-99999.0	0.073	0.75	1.00
4	2017	Dec	1	335	4	-999.0	-9.000	-9.000	-9.000	-999.0	-999.0	-99999.0	0.073	0.75	1.00
5	2017	Dec	1	335	5	-999.0	-9.000	-9.000	-9.000	-999.0	-999.0	-99999.0	0.073	0.75	1.00
6	2017	Dec	1	335	6	-999.0	-9.000	-9.000	-9.000	-999.0	-999.0	-99999.0	0.073	0.75	1.00
7	2017	Dec	1	335	7	-999.0	-9.000	-9.000	-9.000	-999.0	-999.0	-99999.0	0.073	0.75	0.63
8	2017	Dec	1	335	8	34.6	-9.000	-9.000	-9.000	-999.0	-999.0	-99999.0	0.073	0.75	0.38
9	2017	Dec	1	335	9	76.0	0.084	-9.000	-9.000	-999.0	58.0	-1.0	0.073	0.75	0.31
10	2017	Dec	1	335	10	108.0	0.087	-9.000	-9.000	-999.0	62.0	-1.0	0.073	0.75	0.29
11	2017	Dec	1	335	11	129.3	0.137	-9.000	-9.000	-999.0	122.0	-1.8	0.073	0.75	0.28
12	2017	Dec	1	335	12	137.7	0.180	-9.000	-9.000	-999.0	183.0	-3.8	0.073	0.75	0.28
13	2017	Dec	1	335	13	134.6	0.226	-9.000	-9.000	-999.0	259.0	-7.7	0.073	0.75	0.28

Surface Met Data

Start Date: 17 12 01 01 End Date: 18 02 28 24

File: ..\SCIENCEGARDEN_DEC2017_FEB2018.SFC

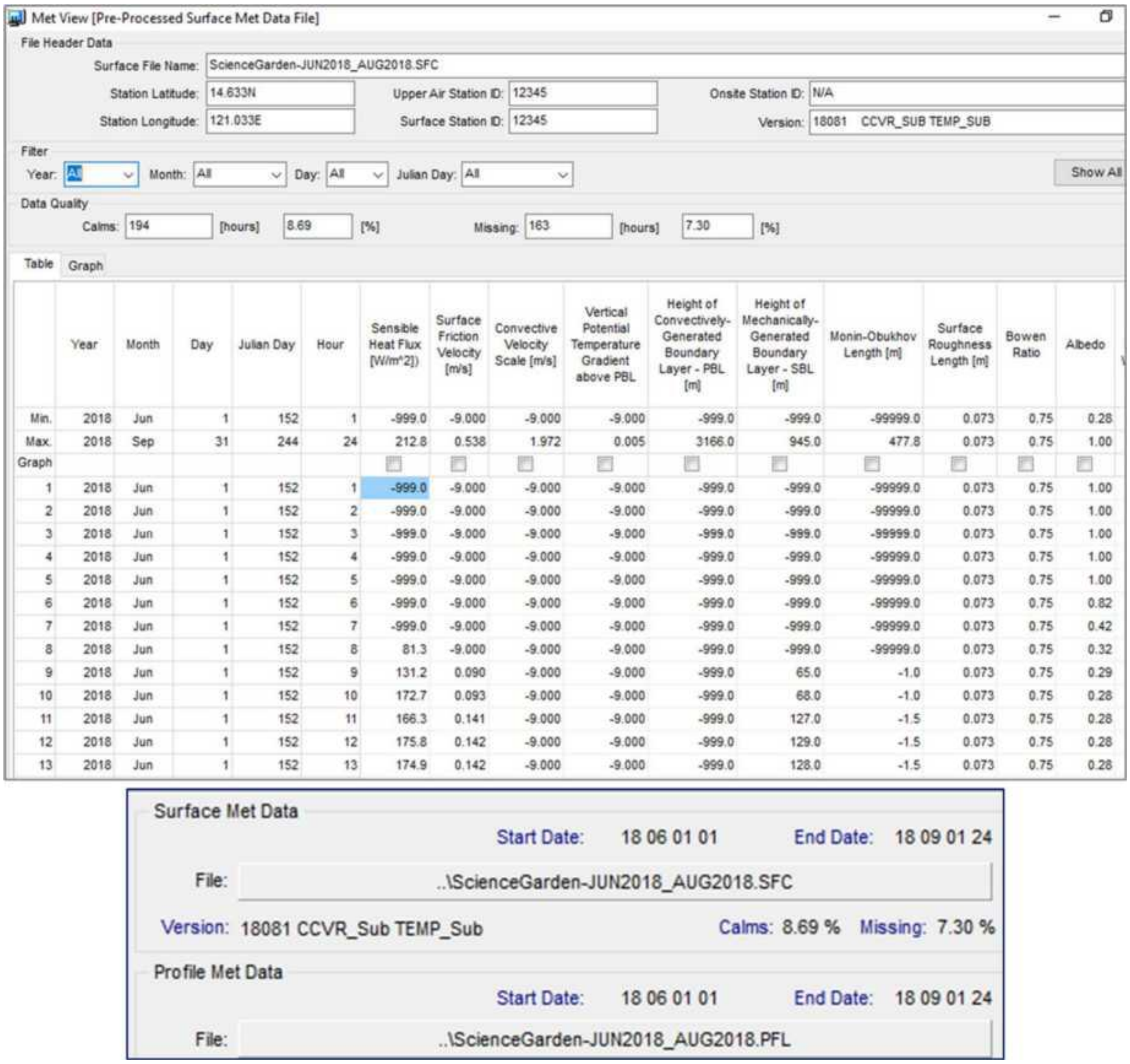
Version: 18081 CCVR_Sub TEMP_Sub Calms: 17.59 % Missing: 11.85 %

Profile Met Data

Start Date: 17 12 01 01 End Date: 18 02 28 24

File: ..\SCIENCEGARDEN_DEC2017_FEB2018.PFL

Plate 22. Screenshot of the surface data file (December 2017 to February 2018)



	Year	Month	Day	Julian Day	Hour	Sensible Heat Flux [W/m^2])	Surface Friction Velocity [m/s]	Convective Velocity Scale [m/s]	Vertical Potential Temperature Gradient above PBL	Height of Convectively-Generated Boundary Layer - PBL [m]	Height of Mechanically-Generated Boundary Layer - SBL [m]	Monin-Obukhov Length [m]	Surface Roughness Length [m]	Bowen Ratio	Albedo
Min.	2018	Jun	1	152	1	-999.0	-9.000	-9.000	-9.000	-999.0	-999.0	-99999.0	0.073	0.75	0.28
Max.	2018	Sep	31	244	24	212.8	0.538	1.972	0.005	3166.0	945.0	477.8	0.073	0.75	1.00
Graph															
1	2018	Jun	1	152	1	-999.0	-9.000	-9.000	-9.000	-999.0	-999.0	-99999.0	0.073	0.75	1.00
2	2018	Jun	1	152	2	-999.0	-9.000	-9.000	-9.000	-999.0	-999.0	-99999.0	0.073	0.75	1.00
3	2018	Jun	1	152	3	-999.0	-9.000	-9.000	-9.000	-999.0	-999.0	-99999.0	0.073	0.75	1.00
4	2018	Jun	1	152	4	-999.0	-9.000	-9.000	-9.000	-999.0	-999.0	-99999.0	0.073	0.75	1.00
5	2018	Jun	1	152	5	-999.0	-9.000	-9.000	-9.000	-999.0	-999.0	-99999.0	0.073	0.75	1.00
6	2018	Jun	1	152	6	-999.0	-9.000	-9.000	-9.000	-999.0	-999.0	-99999.0	0.073	0.75	0.82
7	2018	Jun	1	152	7	-999.0	-9.000	-9.000	-9.000	-999.0	-999.0	-99999.0	0.073	0.75	0.42
8	2018	Jun	1	152	8	81.3	-9.000	-9.000	-9.000	-999.0	-999.0	-99999.0	0.073	0.75	0.32
9	2018	Jun	1	152	9	131.2	0.090	-9.000	-9.000	-999.0	65.0	-1.0	0.073	0.75	0.29
10	2018	Jun	1	152	10	172.7	0.093	-9.000	-9.000	-999.0	68.0	-1.0	0.073	0.75	0.28
11	2018	Jun	1	152	11	166.3	0.141	-9.000	-9.000	-999.0	127.0	-1.5	0.073	0.75	0.28
12	2018	Jun	1	152	12	175.8	0.142	-9.000	-9.000	-999.0	129.0	-1.5	0.073	0.75	0.28
13	2018	Jun	1	152	13	174.9	0.142	-9.000	-9.000	-999.0	128.0	-1.5	0.073	0.75	0.28

Plate 23 - Screenshot of the surface data file (June 2018 to August 2018)

2.3.2.2.8 Modelling Scenarios

Table 30 and ***Table 31*** show the modelling scenarios for TSP and PM_{10}, respectively. Modelling simulations included with and without mitigation measures. Total of twelve (12) modelling runs was performed for TSP, in which two (2) simulations were performed for each period. As discussed earlier, the average periods were 24 hours (98th percentile), and three (3) months.

Table 30 - Modelling simulations for TSP for all non-points sources (except blasting)

Run No.	Pollutant	Period	Averaging Period	Mitigation Measures
1	TSP	Dec. 1, 2015 to Feb 28, 2016	24 hours at 98-percentile; 3 months*	Without
2	TSP	Dec. 1, 2015 to Feb 28, 2016	24 hours at 98-percentile; 3 months	With
3	TSP	June 1, 2016 to Aug 31, 2016	24 hours at 98-percentile; 3 months	Without
4	TSP	June 1, 2016 to Aug 31, 2016	24 hours at 98-percentile; 3 months	With
5	TSP	Dec 1, 2016 to Feb 29, 2017	24 hours at 98-percentile; 3 months	Without
6	TSP	Dec 1, 2016 to Feb 29, 2017	24 hours at 98-percentile; 3 months	With
7	TSP	June 1, 2017 to Aug 31, 2017	24 hours at 98-percentile; 3 months	Without
8	TSP	June 1, 2017 to Aug 31, 2017	24 hours at 98-percentile; 3 months	With
9	TSP	Dec 1, 2017 to Feb 28, 2017	24 hours at 98-percentile; 3 months	Without
10	TSP	Dec 1, 2017 to Feb 28, 2017	24 hours at 98-percentile; 3 months	With
11	TSP	June 1, 2017 to Aug 31, 2017	24 hours at 98-percentile; 3 months	Without
12	TSP	June 1, 2017 to Aug 31, 2017	24 hours at 98-percentile; 3 months	With
*3-month average – converted to annual average				

Table 31 - Modelling simulations for PM_{10} for all non-points sources (except blasting)

Run No.	***Pollutant***	***Period***	***Averaging Period***	***Mitigation Measures***
1	PM_{10}	Dec. 1, 2015 to Feb 28, 2016	24 hours at 98-percentile; 3 months*	Without
2	PM_{10}	Dec. 1, 2015 to Feb 28, 2016	24 hours at 98-percentile; 3 months	With
3	PM_{10}	June 1, 2016 to Aug 31, 2016	24 hours at 98-percentile; 3 months	Without
4	PM_{10}	June 1, 2016 to Aug 31, 2016	24 hours at 98-percentile; 3 months	With
5	PM_{10}	Dec 1, 2016 to Feb 29, 2017	24 hours at 98-percentile; 3 months	Without
6	PM_{10}	Dec 1, 2016 to Feb 29, 2017	24 hours at 98-percentile; 3 months	With
7	PM_{10}	June 1, 2017 to Aug 31, 2017	24 hours at 98-percentile; 3 months	Without
8	PM_{10}	June 1, 2017 to Aug 31, 2017	24 hours at 98-percentile; 3 months	With
9	PM_{10}	Dec 1, 2017 to Feb 28, 2017	24 hours at 98-percentile; 3 months	Without
10	PM_{10}	Dec 1, 2017 to Feb 28, 2017	24 hours at 98-percentile; 3 months	With
11	PM_{10}	June 1, 2017 to Aug 31, 2017	24 hours at 98-percentile; 3 months	Without
12	PM_{10}	June 1, 2017 to Aug 31, 2017	24 hours at 98-percentile; 3 months	With
*3-month average – converted to annual average				

2.3.2.3 Baseline Ambient Air Quality

Table 32 shows the results of the background air monitoring conducted at five (5) locations in October 2018 and February 2019. The monitoring stations were assigned around the proposed project site, specifically at residences/household areas.

Measured TSP levels ranged from 8.1 to 378.9 µg/Nm^3 with an average of 105.2 µg/Nm^3. Except for TSP measured at Station A5 on October 23, 2018, which was greater than the ambient air quality standard for TSP set at 340 µg/Nm^3. TSP levels at the rest of the monitoring stations for two (2) periods were within the NAAQS value set for TSP. Sources of air emissions at the area is dust emissions along roads.

PM_{10} levels ranged from 5.5 to 196.6 µg/Nm^3 with average concentration of 72.4 µg/Nm3. PM_{10} levels were within the ambient air quality standard set for PM_{10} at 200 µg/Nm$^{3.}$ Sources of PM_{10} were generally the same as those of TSP.

Measured gaseous air pollutants (SO_2 and NO_2) were relatively lower and within the NAAQS of 340 and 360 µg/Nm^3, respectively. Highest measured SO_2 was 0.3 µg/Nm^3 while for NO_2 was 38.4 µg/Nm^3

Table 32 - Measured 1-hour average ambient air concentrations (in µg/Nm^3) in October 2018 and February 2019 (Data source: CRL, 2019)

Station No.	Location	Date and Time of Sampling	TSP	PM_{10}	SO_2	NO_2
A1	Brgy. Akle, Sitio Narra	22-Oct-18/ 1515H - 1615H	83.5	50.9	ND	ND
		28-Feb-19/ 1320H - 1420H	34.9	27.2	ND	ND
A2	Brgy. Akle, Sitio Narra, Near Quarry	23-Oct-18/ 0915H - 1015H	96.4	67.9	0.3	26.3
		28-Feb-19/ 1450H - 1550H	8.1	5.5	ND	ND
A3	Doña Remedios Trinidad, Brgy. Talbak, Near Bulacan Brgy. Hall	23-Oct-18/ 1120H - 1220H	67.0	36.3	ND	38.4
		28-Feb-19/ 1000H - 1100H	56.4	48.8	ND	ND

Station No.	Location	Date and Time of Sampling	TSP	PM_{10}	SO_2	NO_2
A4	Brgy. Akle, In Front of Centro Akle St.	23-Oct-18/ 1315H - 1415H	89.9	60.0	ND	34.0
		28-Feb-19/1 1150H - 1250H	151.7	141.5	ND	ND
A5	In Front of Petron Gas Station	23-Oct-18/ 1445H - 1545H	**378.9**	196.6	0.3	ND
		28-Feb-19/ 1605H - 1705H	84.9	79.0	ND	ND
NAAQS		**1-hr average**	**300**	**200**	**340**	**260**

2.3.2.4 Key Impact Assessment

2.3.2.4.1 Predicted Concentrations of Gaseous and Particulate Pollutants

Figure 100 to ***Figure 111*** and ***Figure 112*** to ***Figure 123*** show the predicted concentrations (24-hour at 98th percentile) of TSP and PM_{10}, respectively. ***Table 33*** shows the highest predicted concentrations within the modelling domain (including those in the quarry area) while ***Table 34*** shows the highest predicted concentrations at households in vicinities of the project site (quarry area).

The results presented below were based on total of twelve (12) simulations for TSP and twelve (12) simulations for PM_{10}. Simulations were performed for six (6) different periods from 2015 to 2018 and assuming unmitigated and mitigated emissions.

Simulations involved determination of predicted concentrations at averaging periods of 24-hour (98th percentile) and 3-months as the latter were limited to three (3) months of data representing the northeast and southwest monsoons from 2015 to 2018. As there is no 3-month averaging standard for TSP and PM10, the predicted concentrations at the foregoing averaging period were then converted to its annual average using the conversion factor/formula in **Appendix B** of DAO 2008-003. In accordance with Section 3, Rule X, Part III of DAO 2000-81 (IRR of the PCAA), the specified averaging period is 24 hours at 98th percentile and annual averaging periods.

2.3.2.4.1.1 Dispersed emissions within the modelling domain (including quarry area).

The highest predicted concentrations considering all tiered receptors (within modelling domain) were located at immediate vicinities of the emission sources (non-point sources) and within the quarry area (***Table 33*** and ***Figure 100*** to ***Figure 123***). The results, however, are not comparable with the ambient guideline and standards of the PCAA and its IRR, because ambient guidelines and standards generally apply outside the project area (or outside work areas). Workplace air quality standards of the Department of Labor and Employment (DOLE) may apply at areas within the quarry area.

Although this study focused on the determination of compliance with the ambient guidelines and standards prescribed in the PCAA and its IRR, additional simulations were performed to check compliance with the 8-hour average standard of the DOLE. Results of dispersion modelling without mitigation measures (8-hour average concentration of TSP) was 3314 $\mu g/m^3$ (***Figure 124***), which is within the DOLE workplace standard set at 10,000 $\mu g/m^3$ at 8-hour average. Predicted concentrations at household areas, particularly at nearest household located about 200 m from the edge of the quarry area, was about 1500 $\mu g/m^3$, which exceeded ambient guidelines and standards (when converted to its corresponding averaging periods).

2.3.2.4.1.2 Dispersed emissions at household areas

Dispersed air emissions at households/residences in the vicinities of the project site (or outside the quarry area boundaries) appear to exceed the ambient guidelines for TSP and PM10, if mitigation measures to control dust emissions will not be implemented during project operation (***Table 34*** and ***Figure 100*** to ***Figure 124***).
Without mitigation measures, predicted 24-hour average TSP and PM_{10} concentrations ranged from 516.8 to 730 $\mu g/m^3$and 147.8 to 204.1 $\mu g/m^3$, respectively. TSP levels at the nearest household exceeded the NAAQG set at 230 $\mu g/m^{3.}$ For PM_{10}, there were predicted concentrations close to the NAAQG value set at 150 ug/Nm3, though most of the predicted concentrations exceeded the corresponding guideline values.

With mitigation measures at maximum control efficiencies prescribed for each emission activity, i.e., 80% maximum control efficiency for unpaved, predicted concentrations at household areas appear to comply with the ambient guideline values set for TSP and PM10 (***Table 34***).

Operations of equipment/vehicles used in quarry projects are expected to emit high levels of fugitive emissions, if not properly mitigated. For example, transport of off-road trucks along haul roads (unpaved roads) from the quarry to the crusher of the cement plan are expected to generate high levels of TSP and PM10, particularly during dry season (without rainfall) and with relatively higher wind speeds (light to gentle winds).

Mitigation measures should be implemented diligently to ensure that dispersed emissions at household areas and other areas outside the quarry area comply with the ambient air quality standards and guideline values set in the PCAA and its IRR. The proposed measures are discussed in the next sub-section.

Table 33 - Predicted highest concentrations of 24-hour (98th percentile) and annual average conc of TSP and PM10 within the modelling domain

Run No.	***Period***	***Mitigation***	***TSP***		***PM_{10}***		***Reference Figure***	
			24-hr 98th percentile (μg/m³)	***Annual average (μg/m³)***	***24-hr 98th percentile (μg/m³)***	***Annual average (μg/m³)***	***TSP***	***PM_{10}***
1	Dec. 1, 2015 to Feb 28, 2016	Without	**1279.1**	**341.9**	425.7	127.8	*Figure 100*	*Figure 112*
2	Dec. 1, 2015 to Feb 28, 2016	With	404.2	84.3	95.5	27.9	*Figure 101*	*Figure 113*
3	June 1, 2016 to Aug 31, 2016	Without	1144.2	338.0	400.2	122.6	*Figure 102*	*Figure 114*
4	June 1, 2016 to Aug 31, 2016	With	372.5	78.7	89.3	26.7	*Figure 103*	*Figure 115*
5	Dec 1, 2016 to Feb 29, 2017	Without	1320.7	411.3	462.3	153.4	*Figure 104*	*Figure 116*
6	Dec 1, 2016 to Feb 29, 2017	With	375.2	97.5	102	33.5	*Figure 105*	*Figure 117*
7	June 1, 2017 to Aug 31, 2017	Without	1005.5	329.4	339.7	116.6	*Figure 106*	*Figure 118*
8	June 1, 2017 to Aug 31, 2017	With	338.3	85.0	74.2	25.4	*Figure 107*	*Figure 119*
9	Dec 1, 2017 to Feb 28, 2017	Without	1298.7	401.2	455.7	146.7	*Figure 108*	*Figure 120*
10	Dec 1, 2017 to Feb 28, 2017	With	449.4	99.4	100.7	31.9	*Figure 109*	*Figure 121*
11	June 1, 2017 to Aug 31, 2017	Without	1091.4	277.4	407.7	101.4	*Figure 110*	*Figure 122*
12	June 1, 2017 to Aug 31, 2017	With	361.7	67.9	90.8	22.3	*Figure 111*	*Figure 123*
			Highest predicted concentrations within the quarry area/project site – these are comparable with the DENR ambient standards and guideline values as the locations of predicted highest concentrations were within the quarry area/project site in which workplace standards apply				Please refer coordinates of the highest predicted concentrations at each map/figure	

Table 34 - Predicted highest concentrations 24-hour (98th percentile) and annual average concentrations of TSP and PM^{10} at household/residences

Run No.	Period	Mitigation	TSP		PM10		Remarks
			24-hr 98th percentile (µg/m³)	Annual average (µg/m³)	24-hr 98th percentile (µg/m³)	Annual average (µg/m³)	
1	Dec. 1, 2015 to Feb 28, 2016	Without	**730.4**	**158.3**	**204.1**	**43.7**	Exceeded NAAQG for TSP and PM_{10} (except annual)
2	Dec. 1, 2015 to Feb 28, 2016	With	219.4	45.8	31.2	7.5	Within NAAQG for TSP and PM_{10}
3	June 1, 2016 to Aug 31, 2016	Without	**534.9**	**148.2**	**158.2**	**41.0**	Exceeded NAAQG for TSP and PM_{10} (except annual)
4	June 1, 2016 to Aug 31, 2016	With	168.9	41.4	27.8	7.4	Within NAAQG for TSP and PM_{10}
5	Dec 1, 2016 to Feb 29, 2017	Without	**600.2**	**179.5**	**169.3**	**49.4**	Exceeded NAAQG for TSP and PM_{10} (except annual)
6	Dec 1, 2016 to Feb 29, 2017	With	175.7	51.4	27.9	8.7	Within NAAQG for TSP and PM_{10}
7	June 1, 2017 to Aug 31, 2017	Without	**516.8**	**163.1**	**148.7**	**45.5**	Exceeded NAAQG for TSP
8	June 1, 2017 to Aug 31, 2017	With	155.8	45.7	26.3	8.3	Within NAAQG for TSP and PM_{10}
9	Dec 1, 2017 to Feb 28, 2017	Without	**557.1**	**181.9**	**166.6**	**50.0**	Exceeded NAAQG for TSP and PM10 (except annual)
10	Dec 1, 2017 to Feb 28, 2017	With	161.6	51.6	30.1	8.9	Within NAAQG for TSP and PM_{10}
11	June 1, 2017 to Aug 31, 2017	Without	**528.4**	**95.9**	**147.8**	**26.7**	Exceeded NAAQG for TSP
12	June 1, 2017 to Aug 31, 2017	With	159.7	26.5	25.3	5.2	Within NAAQG for TSP and PM_{10}
	Applicable NAAQG (PCAA and DAO 2000-81)		**230**	**90**	**150**	**60**	

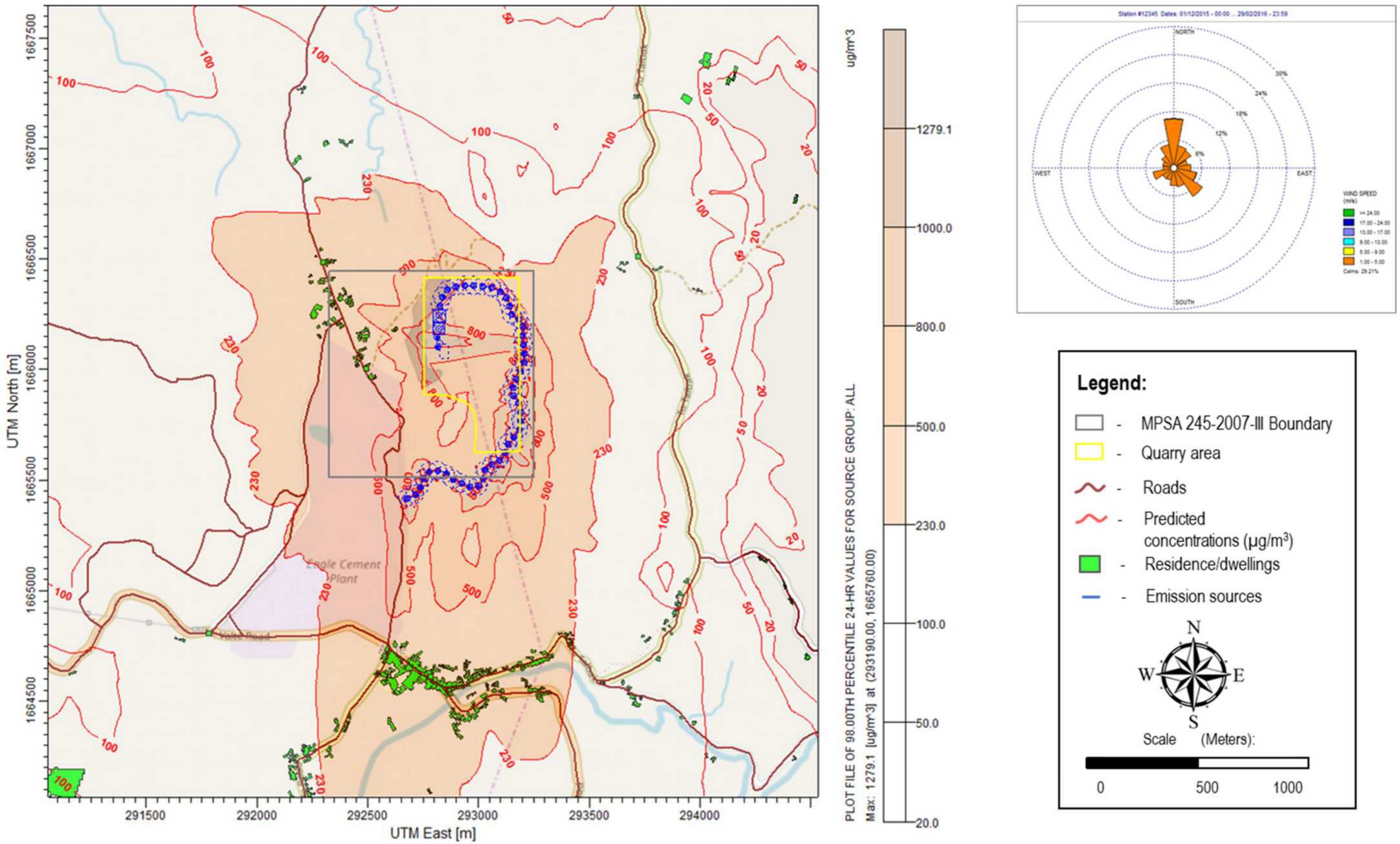


Figure 100 - Predicted 24-hr average concentration of TSP (at 98th percentile) from quarry operations (without mitigation measures) (Period: Dec. 1, 2015 to Feb 28, 2016)

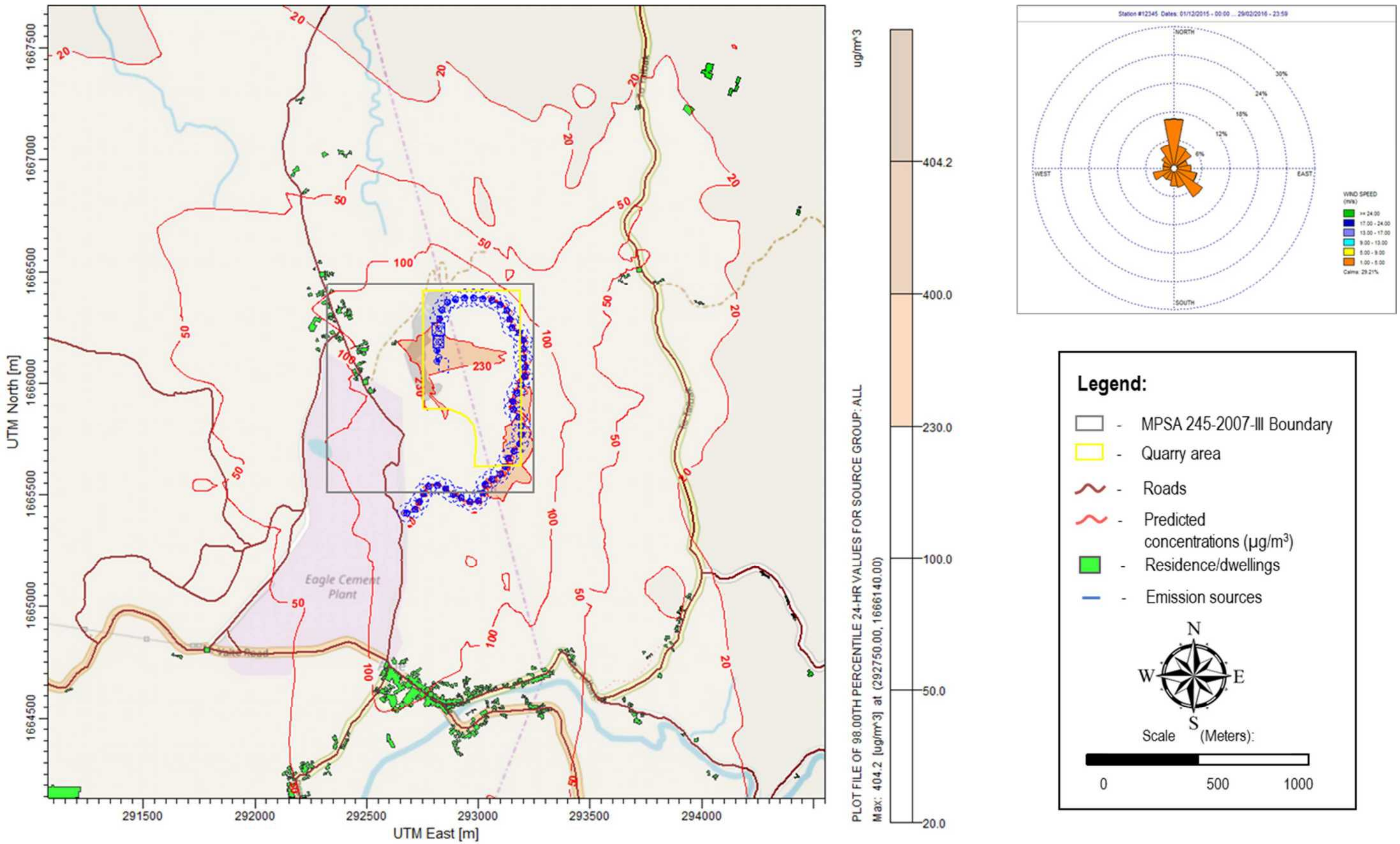


Figure 101 - Predicted 24-hr average concentration of TSP (at 98th percentile) from quarry operations (with mitigation measures) (Dec. 1, 2015 to Feb 28, 2016)

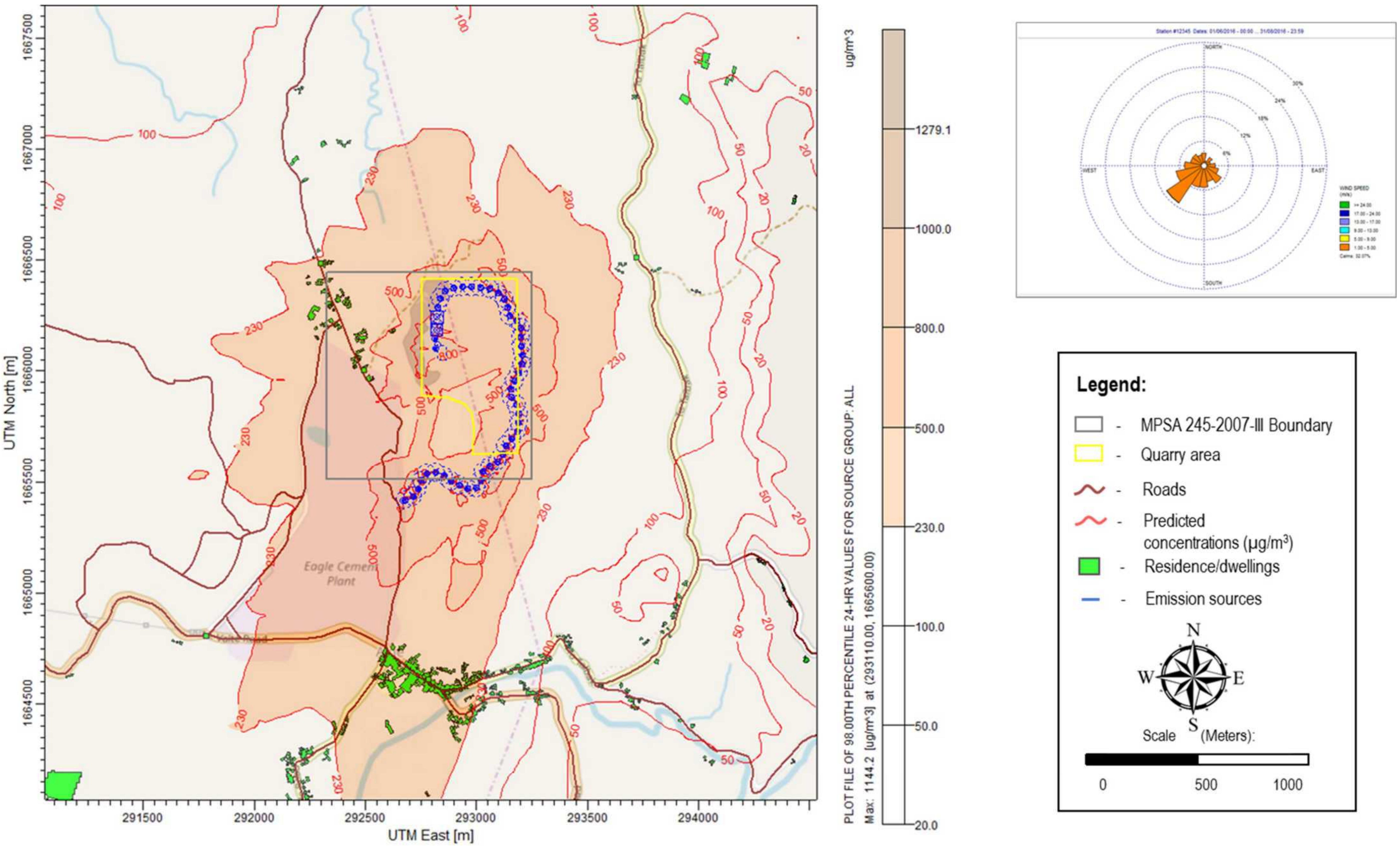


Figure 102 - Predicted 24-hr average conc. of TSP (at 98th percentile) from quarry operations (without mitigation measures) (Period: June 1, 2016 to Aug 31, 2016)

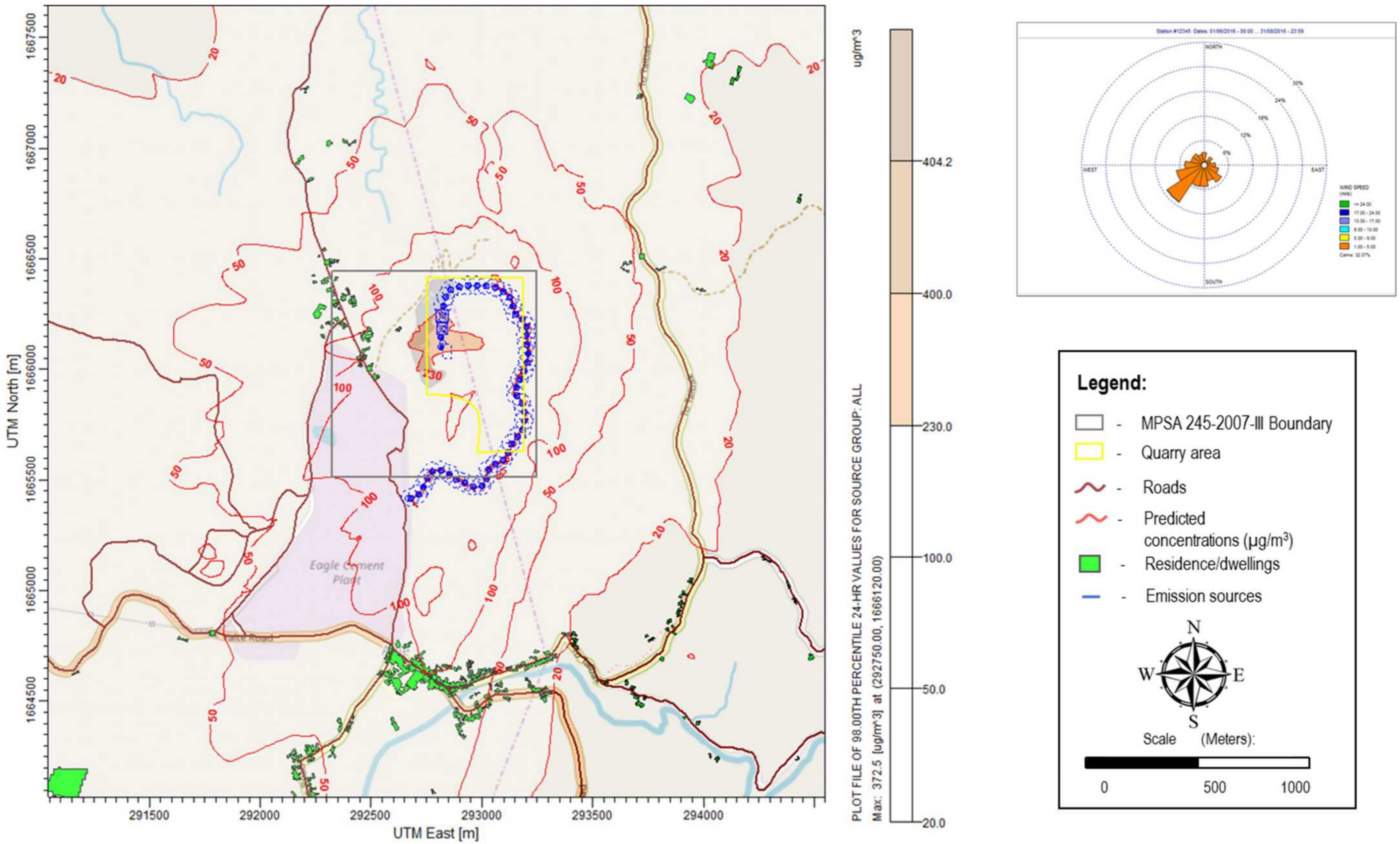


Figure 103 - Predicted 24-hr average conc of TSP (at 98th percentile) from quarry operations (with mitigation measures) (June 1, 2016 to Aug 31, 2016)

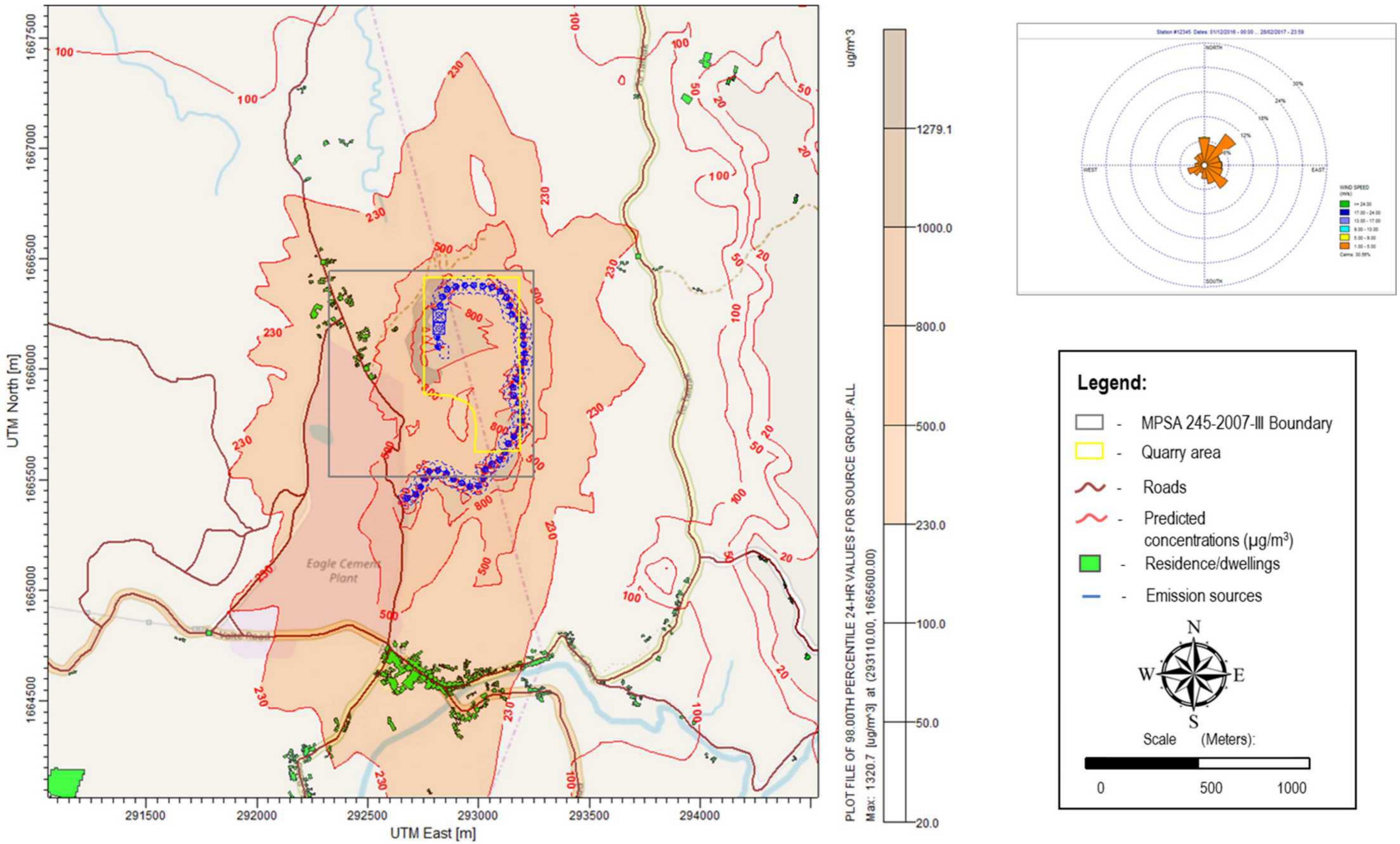


Figure 104 - Predicted 24-hr average conc. of TSP (at 98th percentile) from quarry operations (without mitigation measures) (Period: Dec. 1, 2016 to Feb 29, 2017)

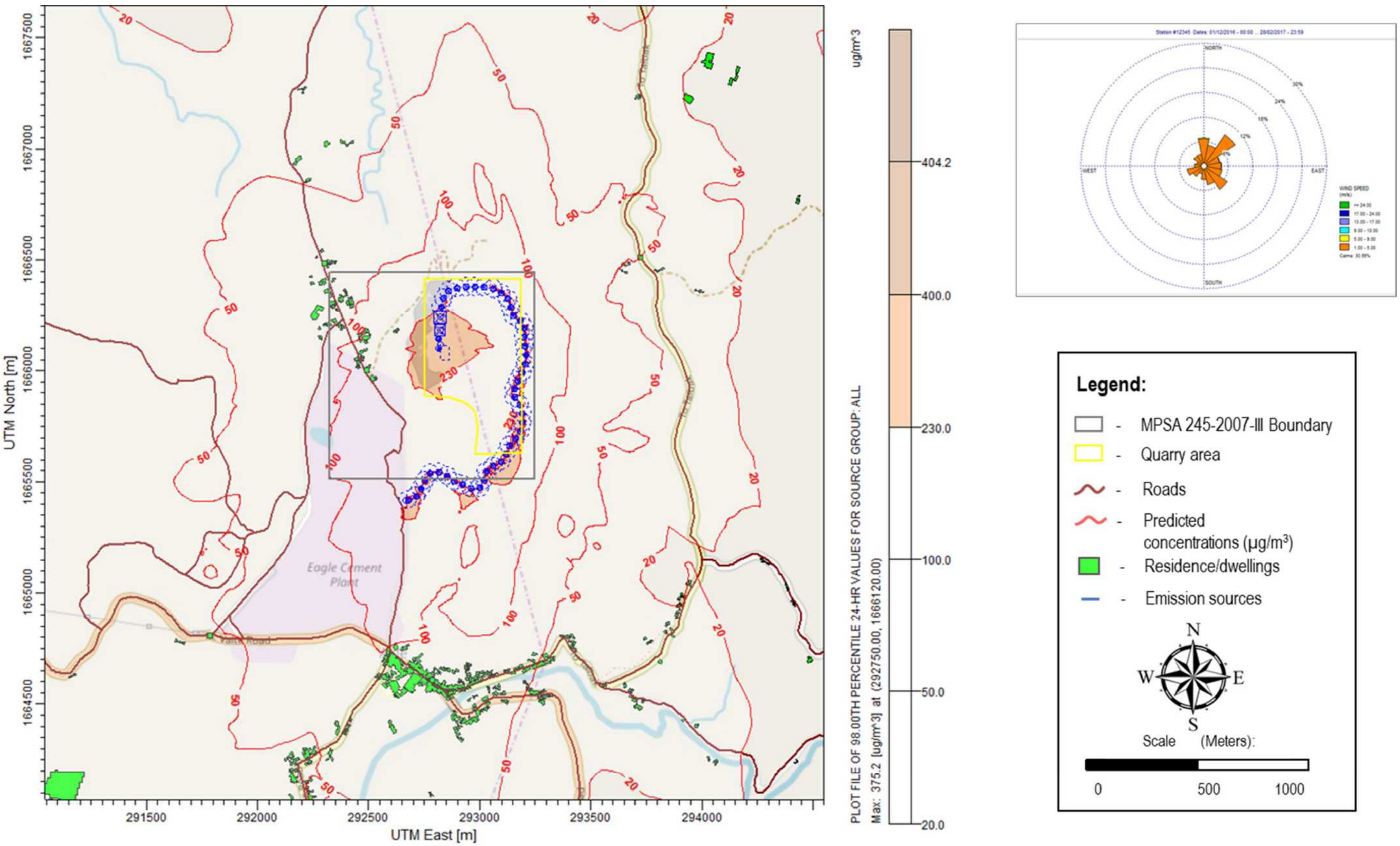


Figure 105 - Predicted 24-hr average conc of TSP (at 98th percentile) from quarry operations (with mitigation measures) (Dec. 1, 2016 to Feb 29, 2017)

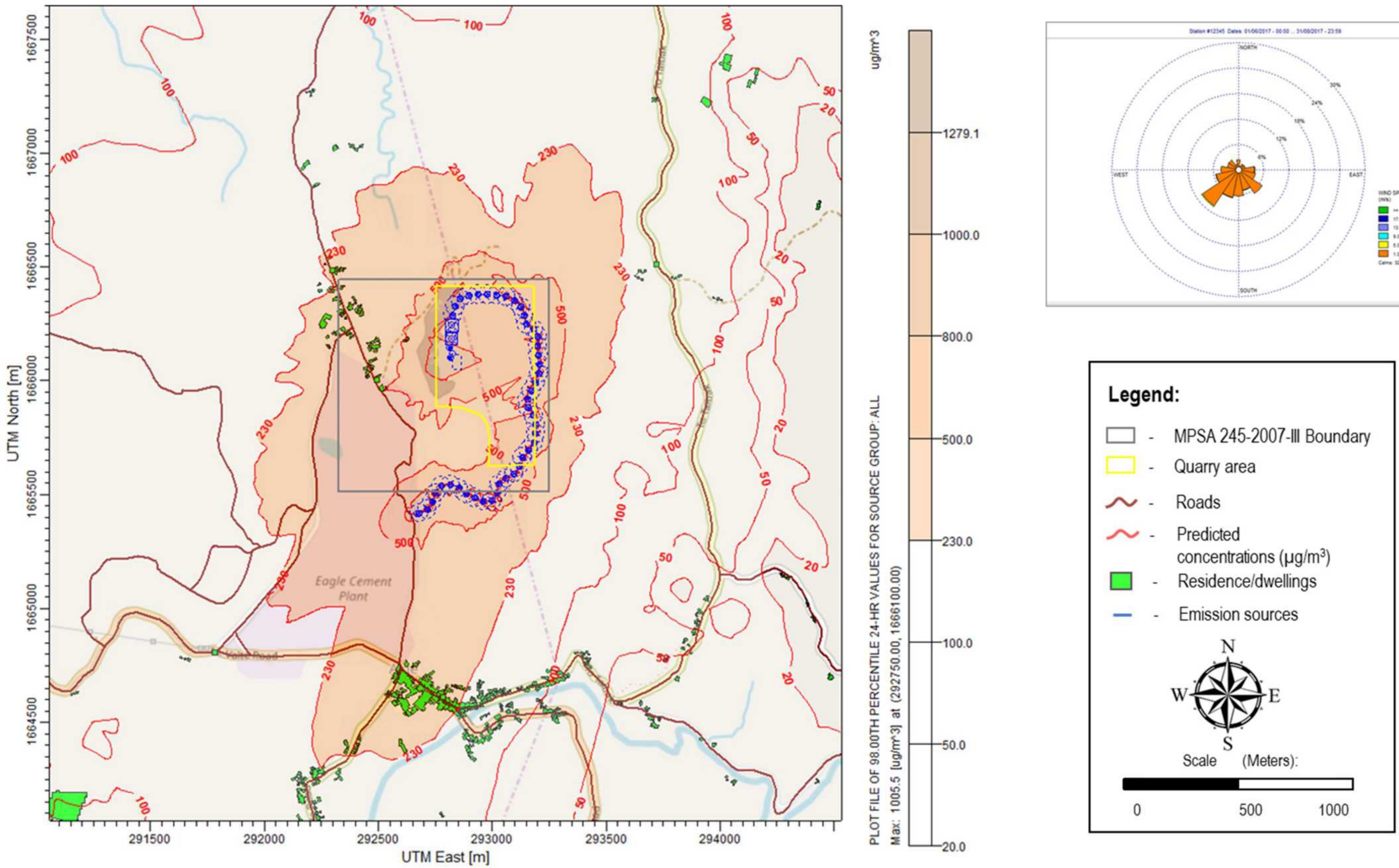


Figure 106 - Predicted 24-hr average conc. of TSP (at 98th percentile) from quarry operations (without mitigation measures) (Period: June 1, 2017 to Aug 31, 2017)

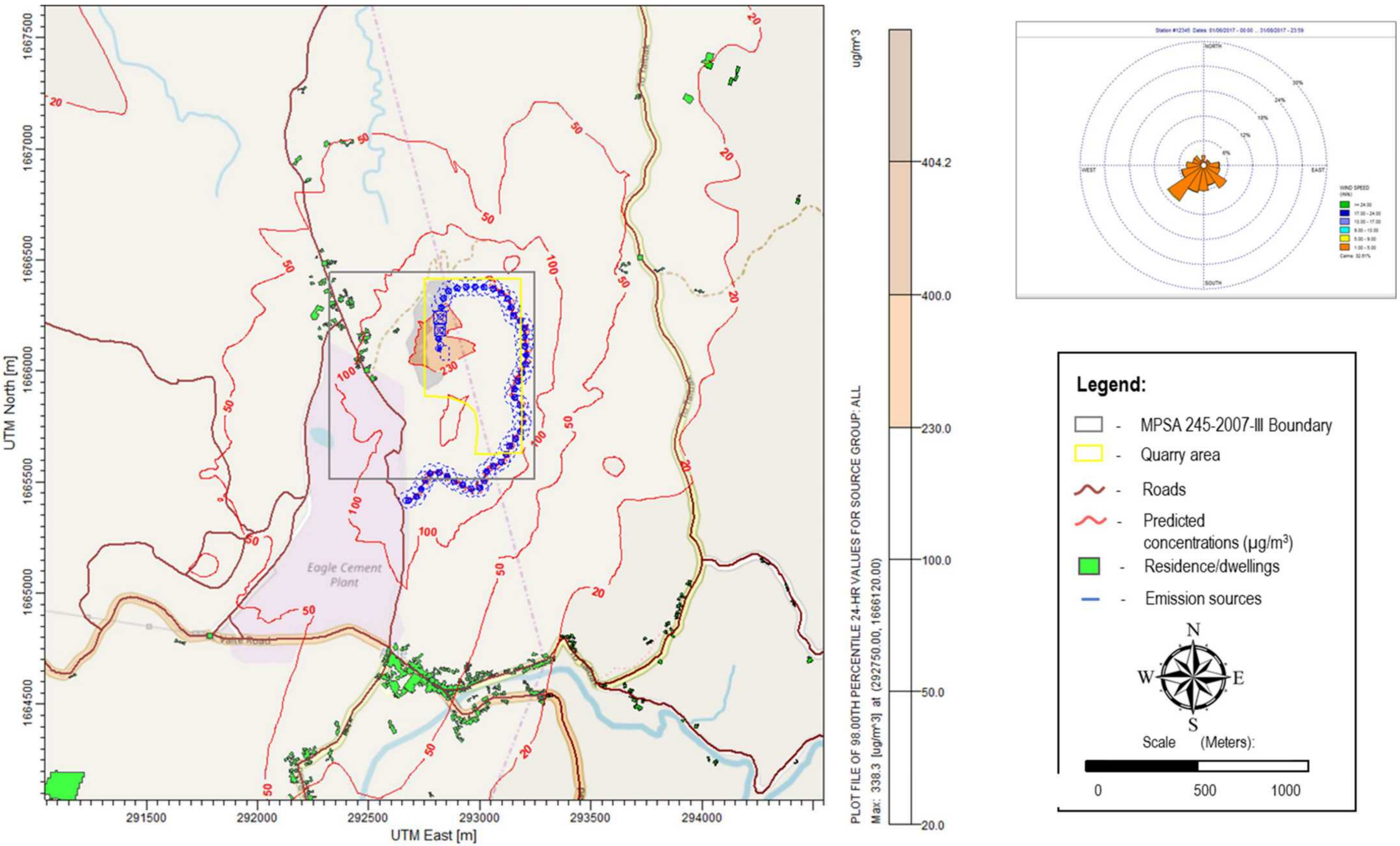


Figure 107 - Predicted 24-hr average conc of TSP (at 98th percentile) from quarry operations (with mitigation measures) (June 1, 2017 to Aug 31, 2017)

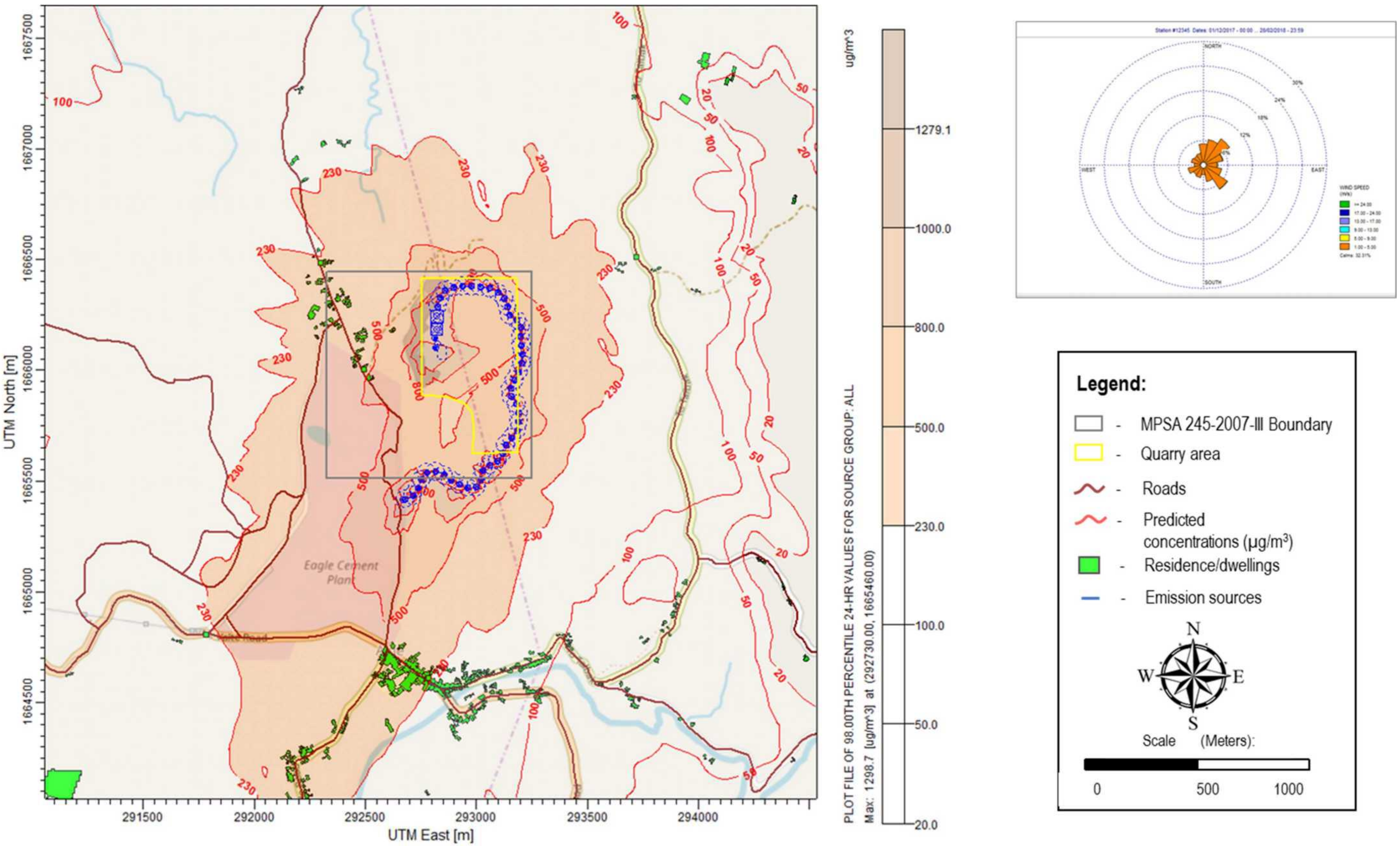


Figure 108 - Predicted 24-hr average conc. of TSP (at 98th percentile) from quarry operations (without mitigation measures) (Period: Dec. 1, 2017 to Feb 28, 2018)

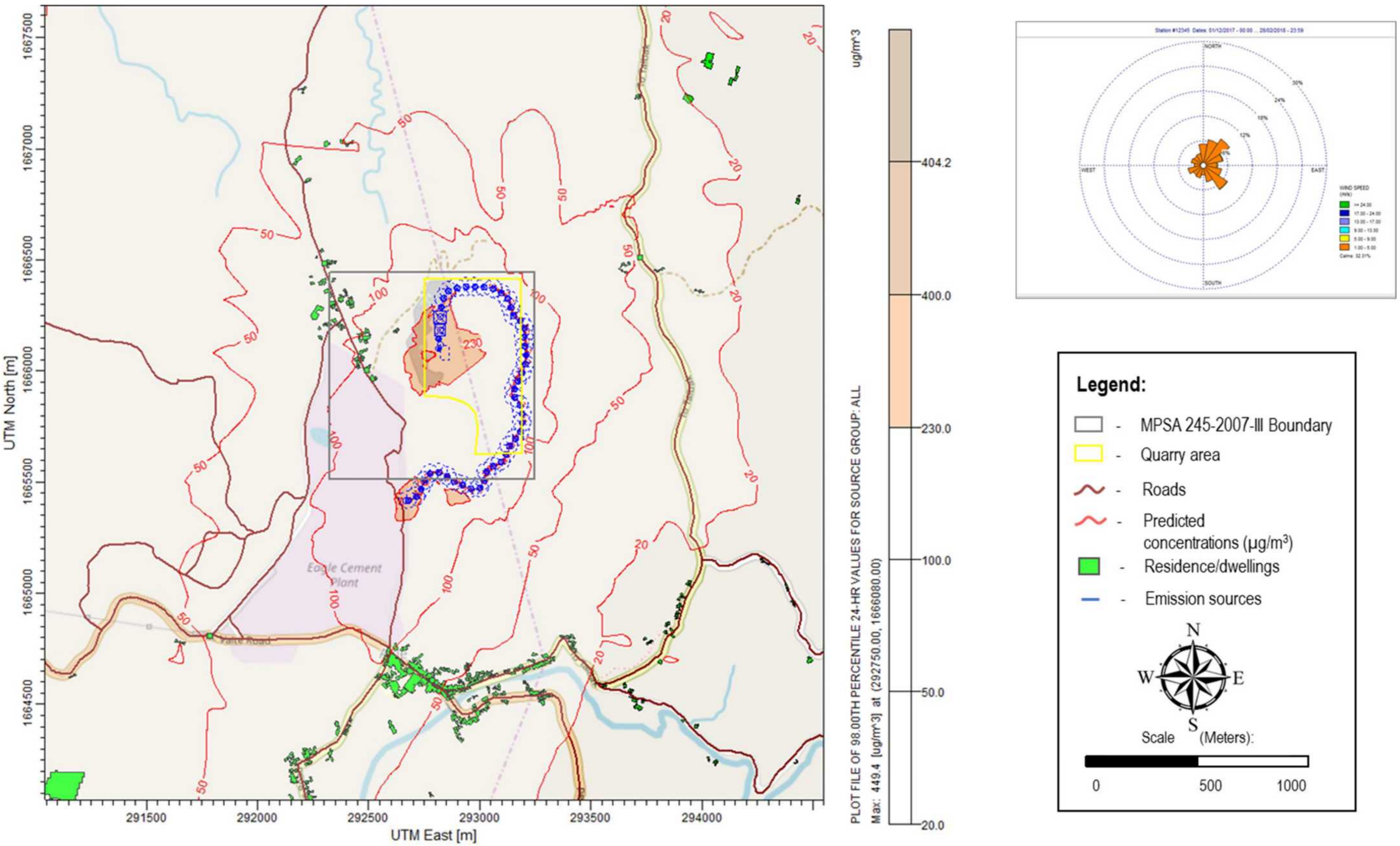


Figure 109 - Predicted 24-hr average conc of TSP (at 98th percentile) from quarry operations (with mitigation measures) (Dec. 1, 2017 to Feb 28, 2018)

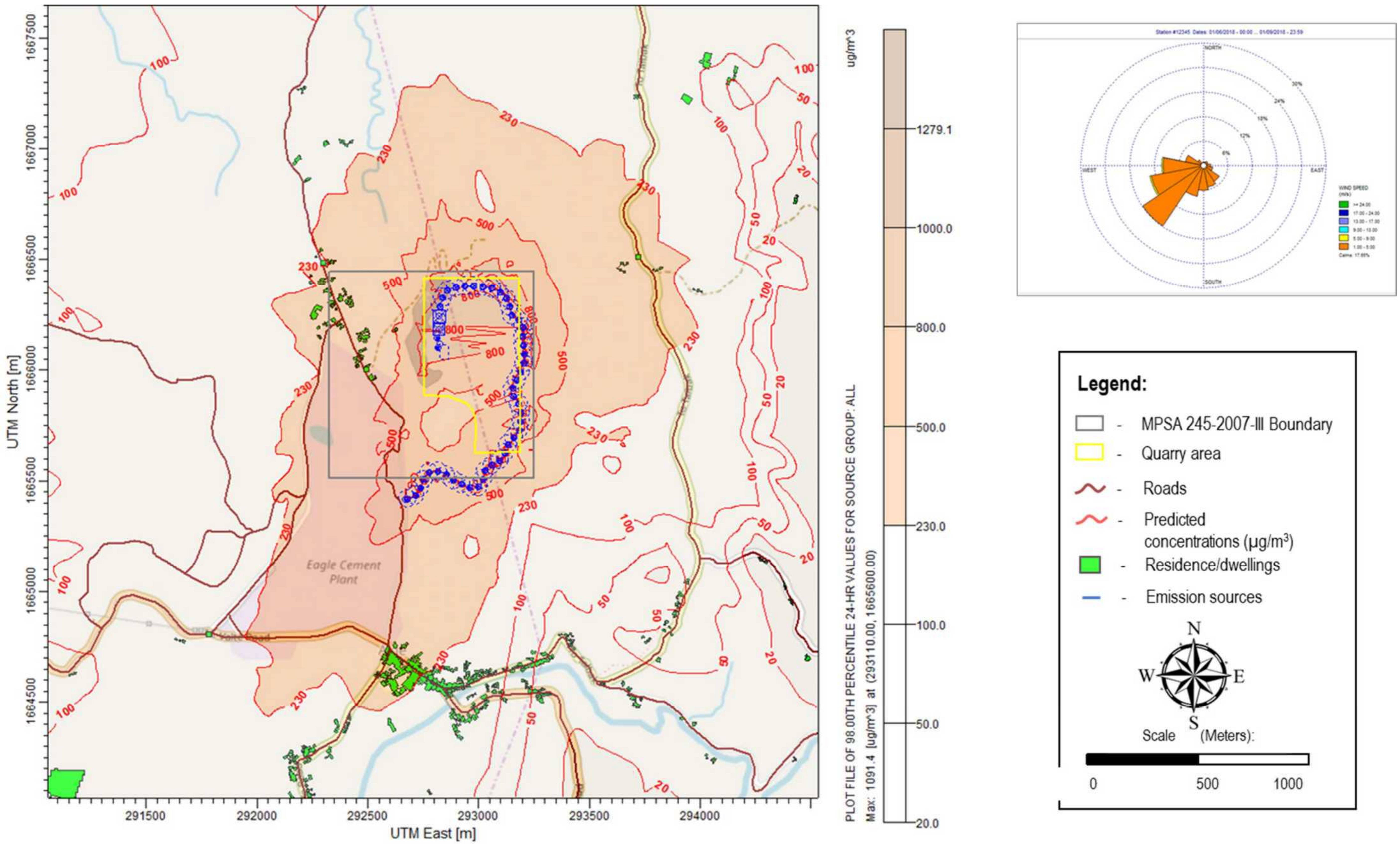


Figure 110 - Predicted 24-hr average conc. of TSP (at 98th percentile) from quarry operations (without mitigation measures) (Period: June 1, 2018 to Aug 31, 2018)

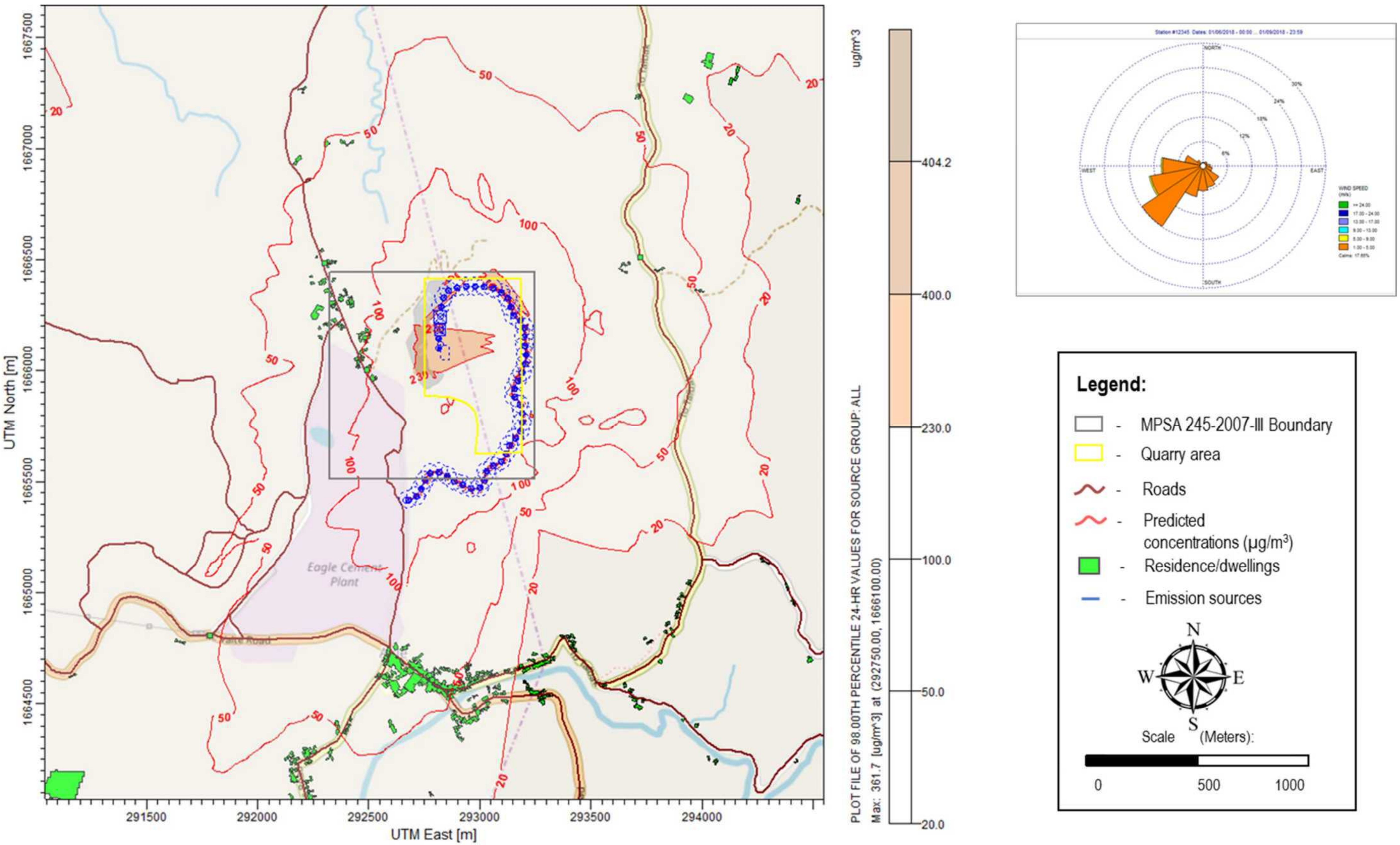


Figure 111 - Predicted 24-hr average conc of TSP (at 98th percentile) from quarry operations (with mitigation measures) (June 1, 2018 to Aug 31, 2018)

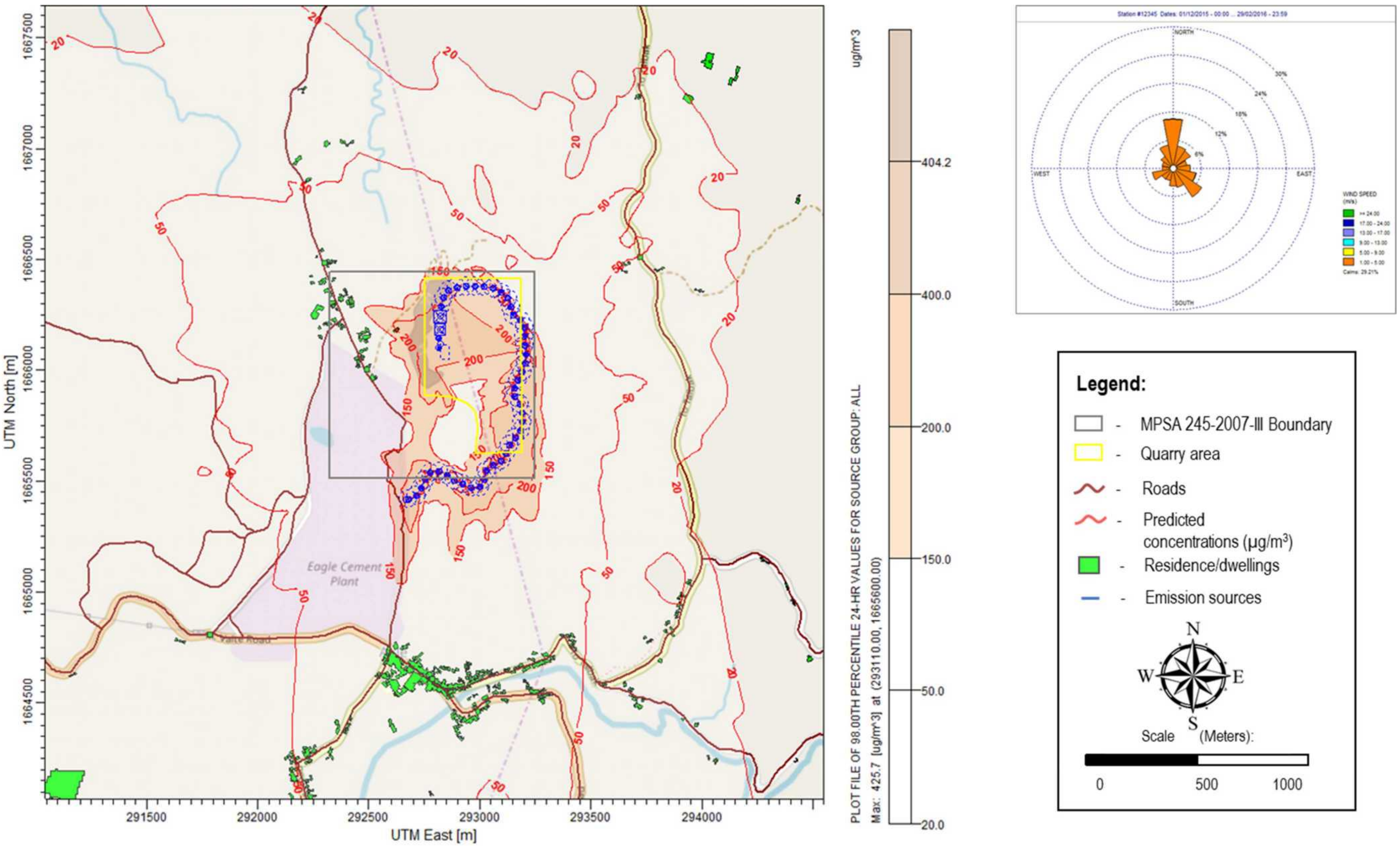


Figure 112 - Predicted 24-hr average conc. of PM10 (at 98th percentile) from quarry operations (without mitigation measures) (Period: Dec. 1, 2015 to Feb 28, 2016)

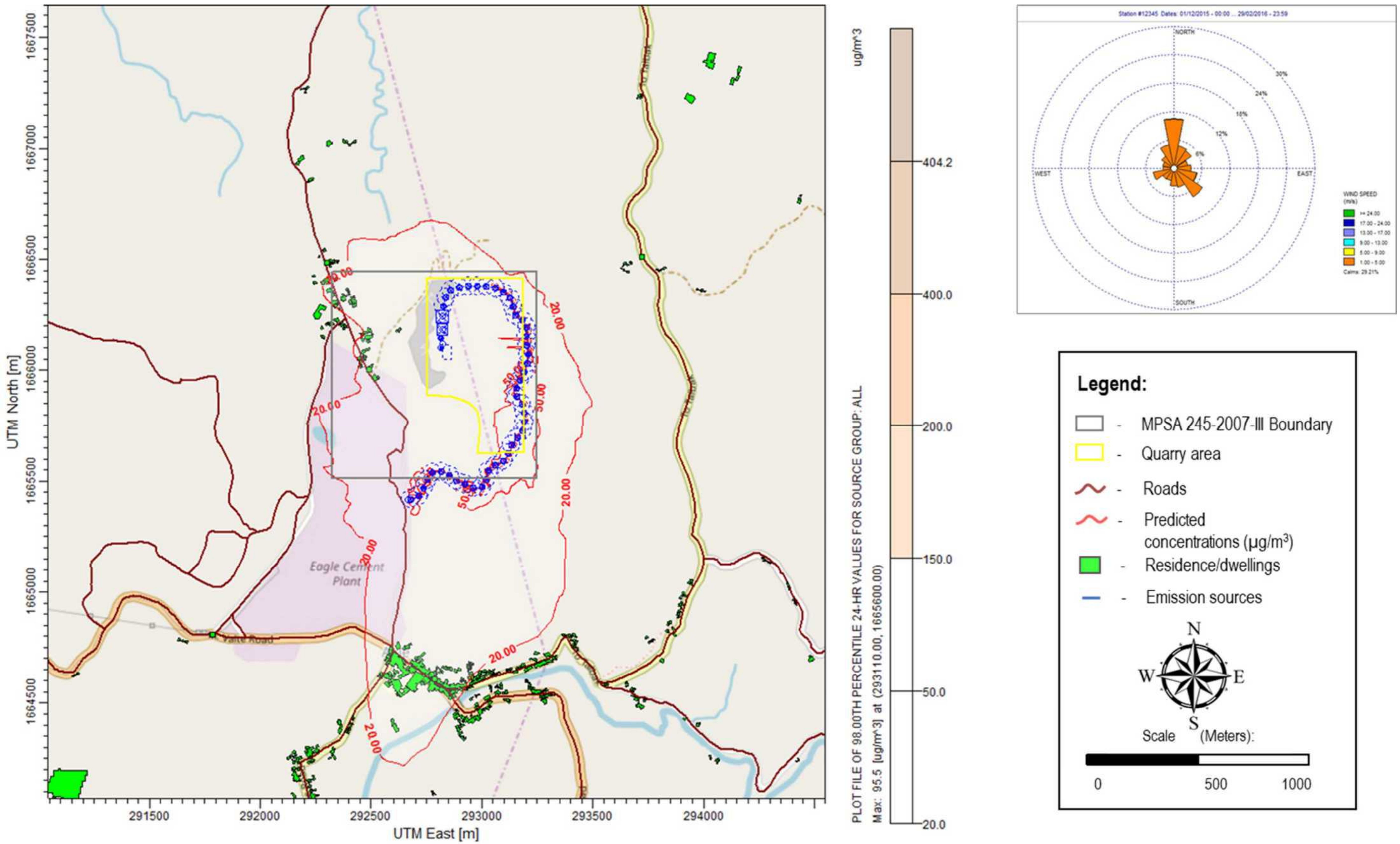


Figure 113 - Predicted 24-hr average conc of PM10 (at 98th percentile) from quarry operations (with mitigation measures) (Dec. 1, 2015 to Feb 28, 2016)

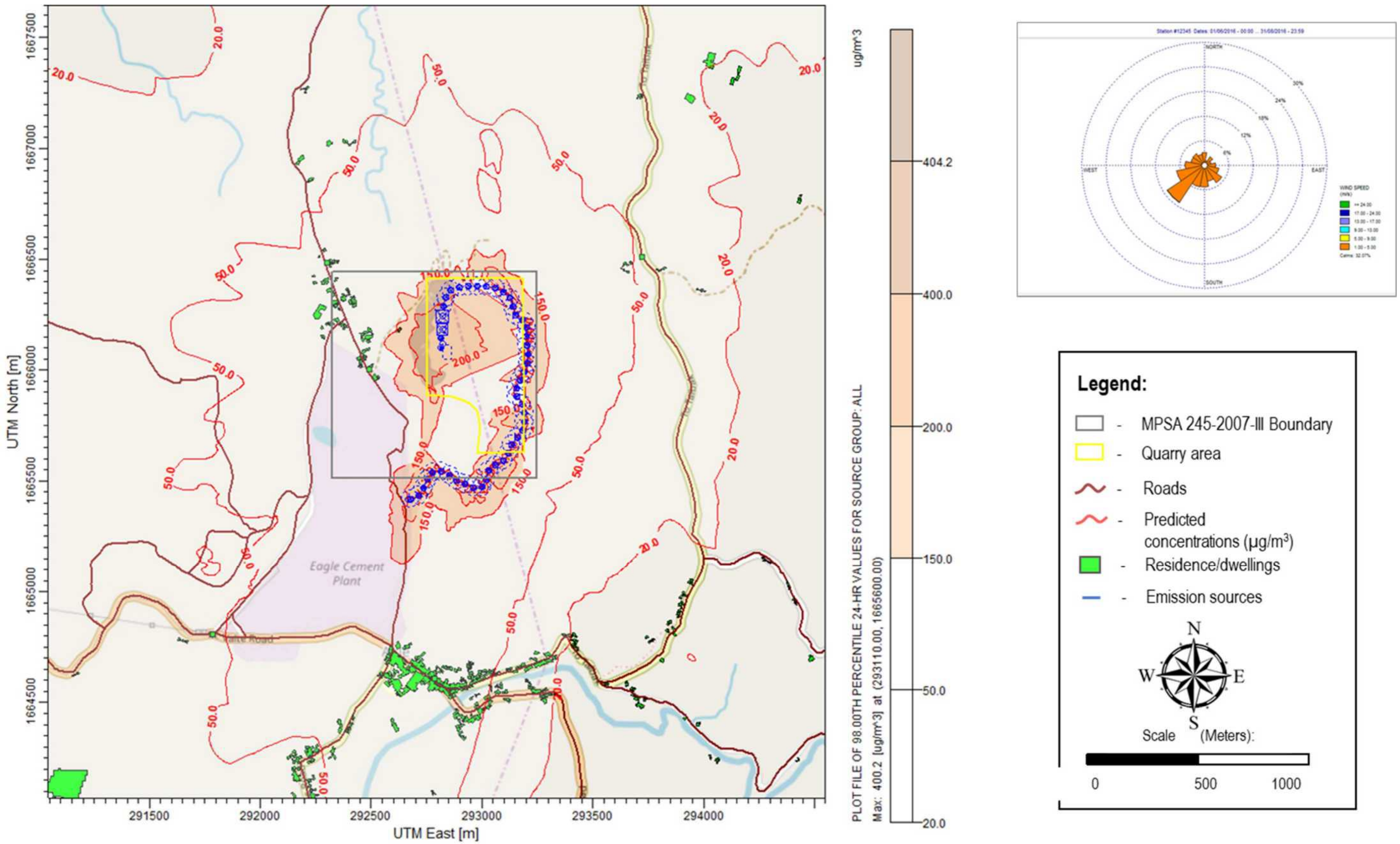


Figure 114 - Predicted 24-hr average conc. of PM10 (at 98th percentile) from quarry operations (without mitigation measures) (Period: June 1, 2016 to Aug 31, 2016)

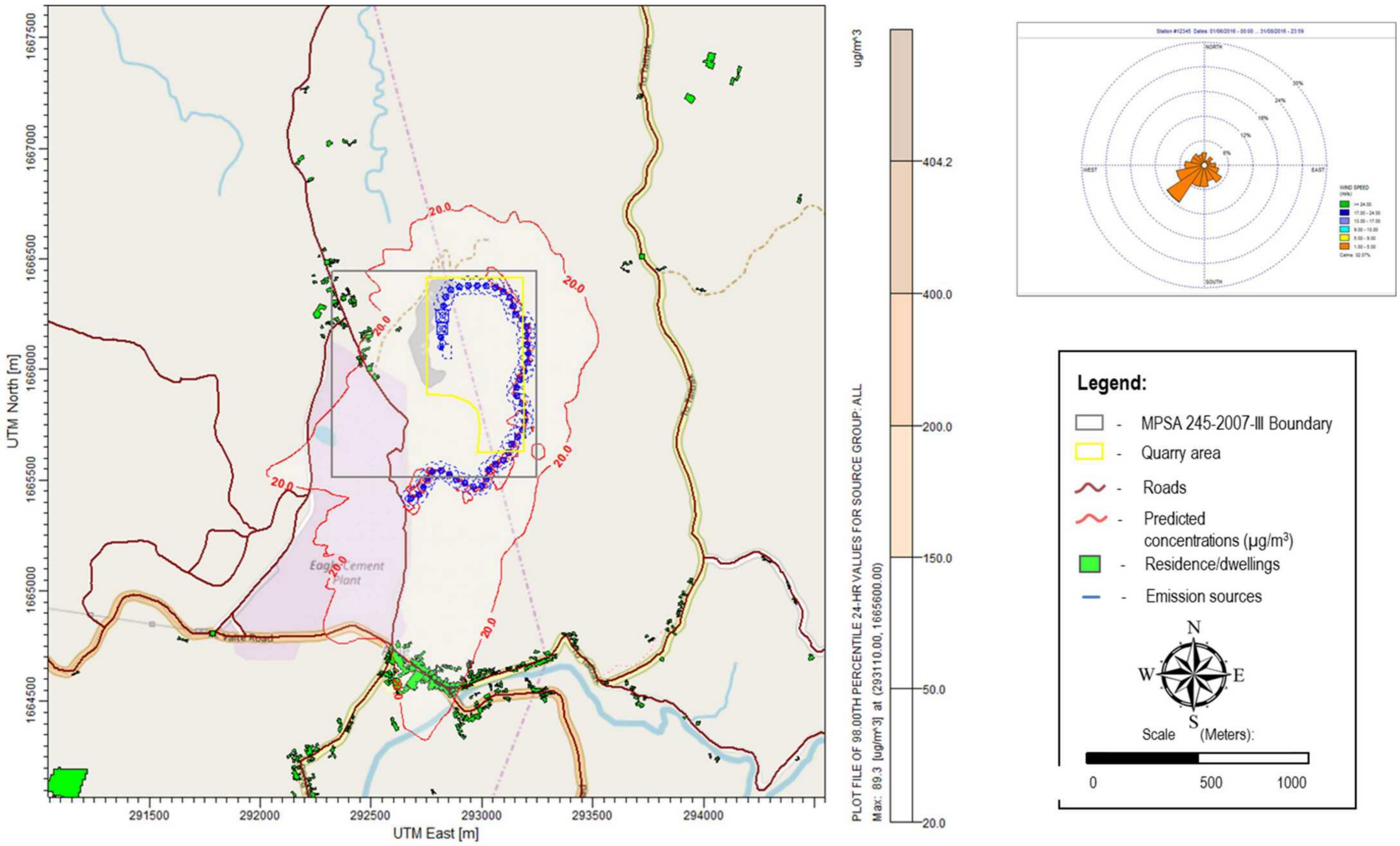


Figure 115 - Predicted 24-hr average conc of PM10 (at 98th percentile) from quarry operations (with mitigation measures) (June 1, 2016 to Aug 31, 2016)

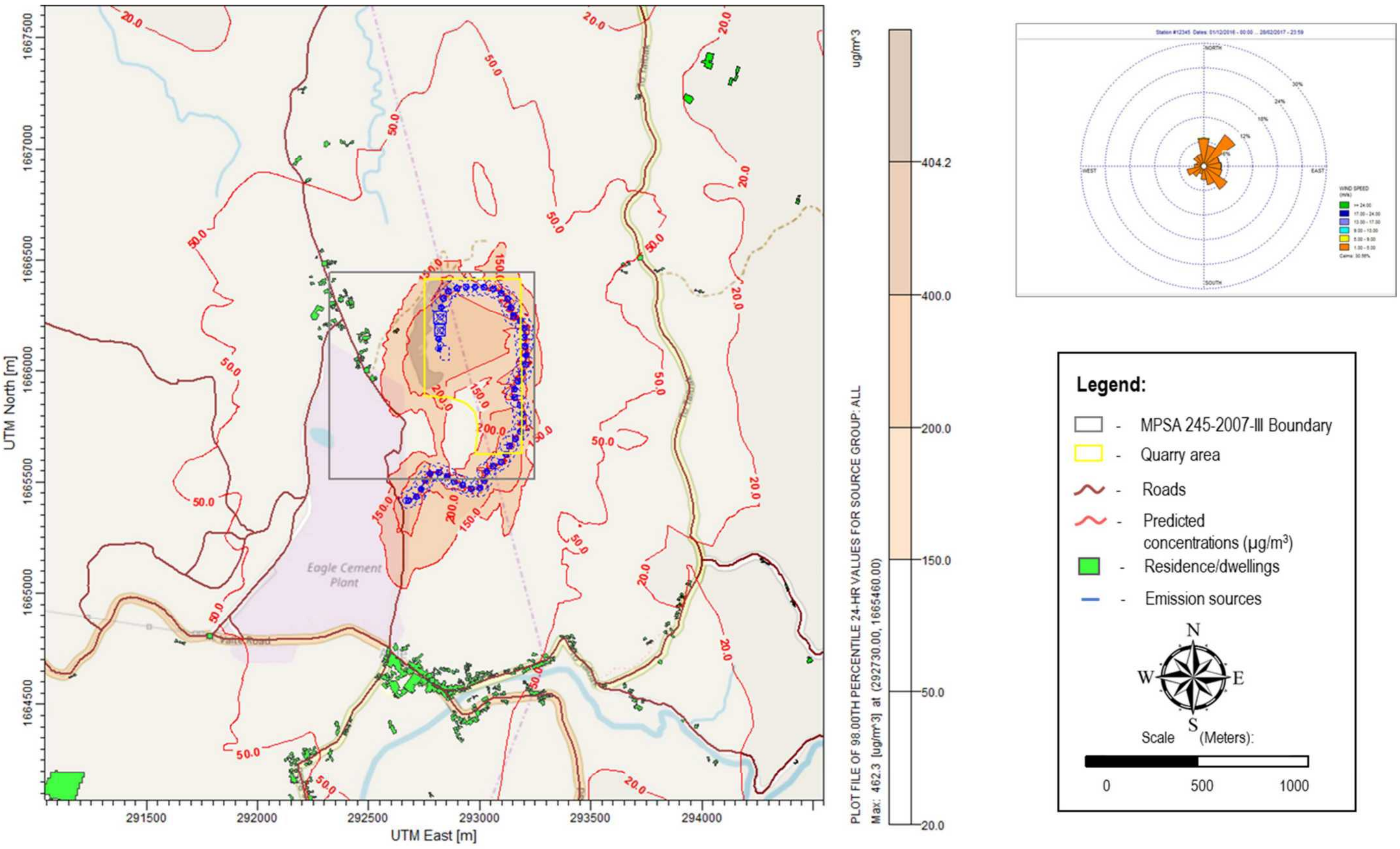


Figure 116 - Predicted 24-hr average conc. of PM10 (at 98th percentile) from quarry operations (without mitigation measures) (Period: Dec. 1, 2016 to Feb 29, 2017)

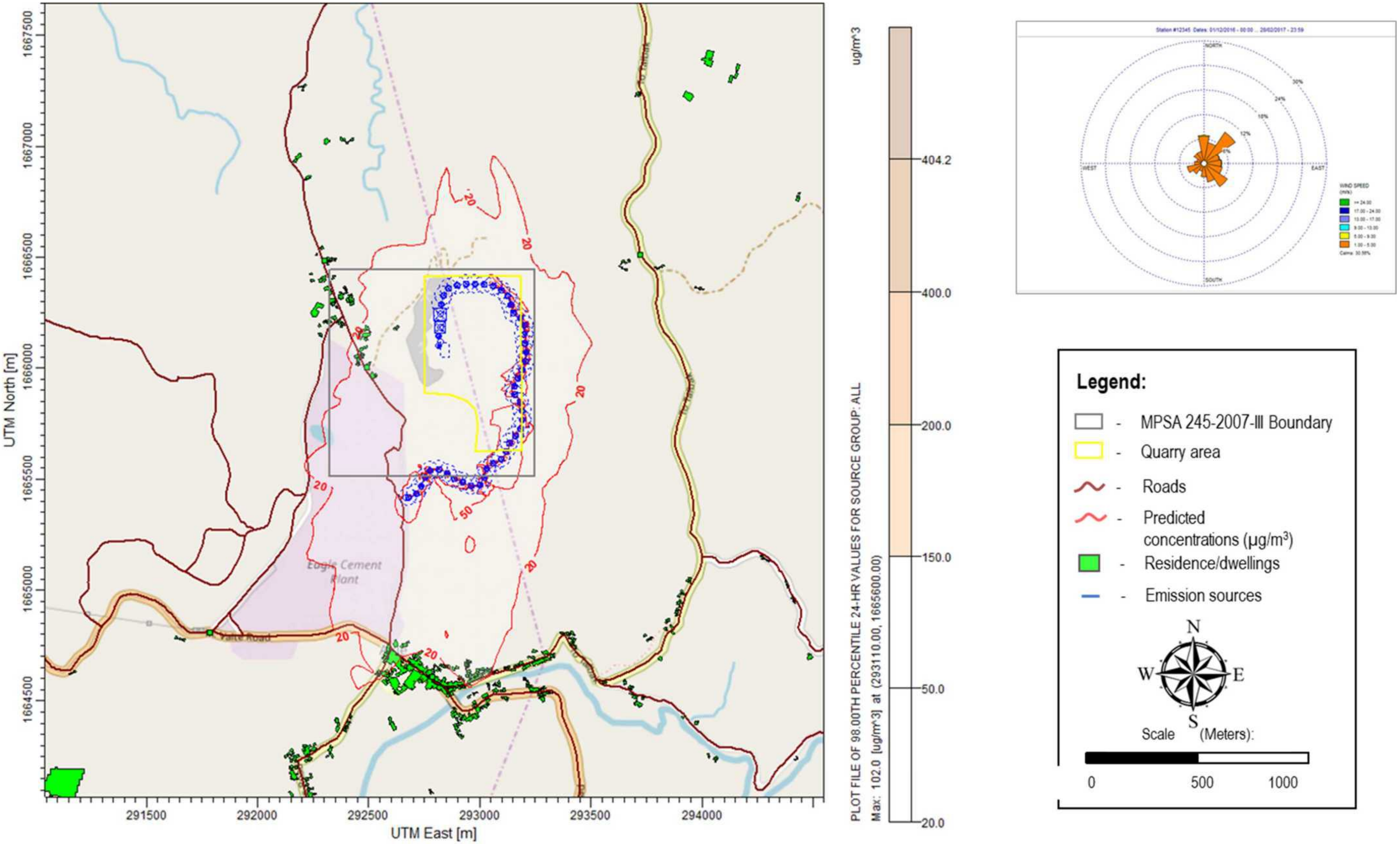


Figure 117 - Predicted 24-hr average conc of PM10 (at 98th percentile) from quarry operations (with mitigation measures) (Dec. 1, 2016 to Feb 29, 2017)

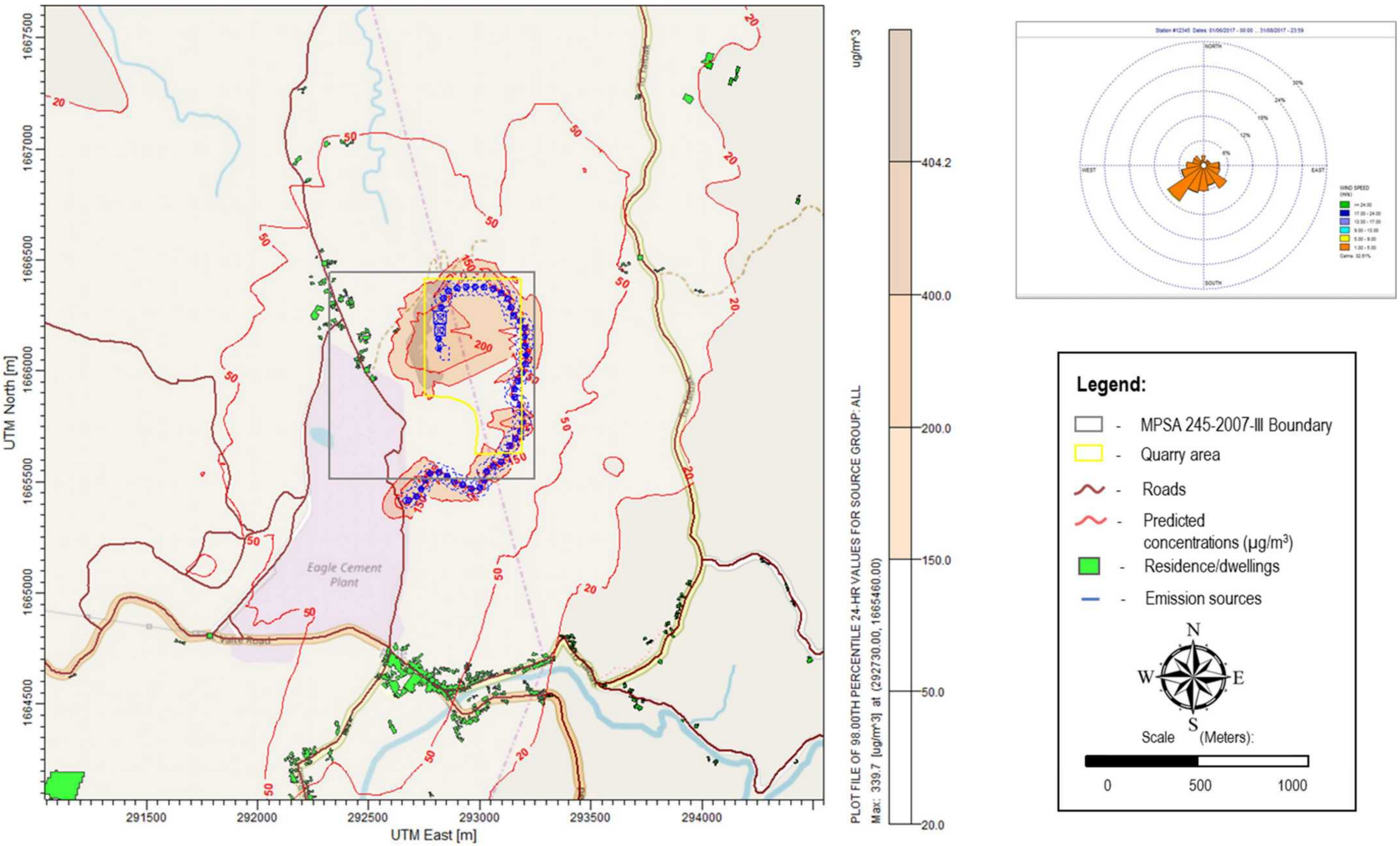


Figure 118 - Predicted 24-hr average conc. of PM10 (at 98th percentile) from quarry operations (without mitigation measures) (Period: June 1, 2017 to Aug 31, 2017)

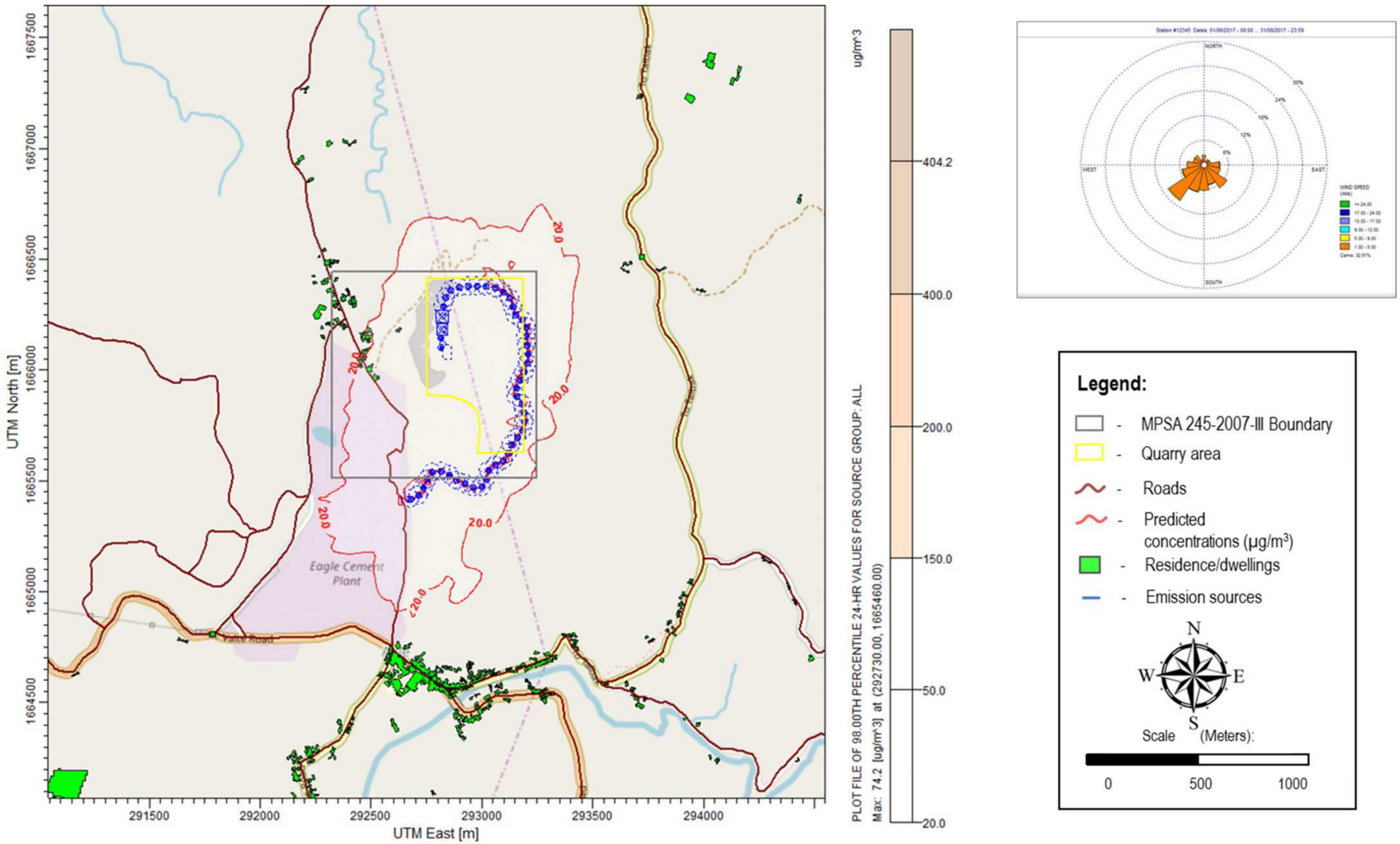


Figure 119 - Predicted 24-hr average conc of PM10 (at 98th percentile) from quarry operations (with mitigation measures) (June 1, 2017 to Aug 31, 2017)

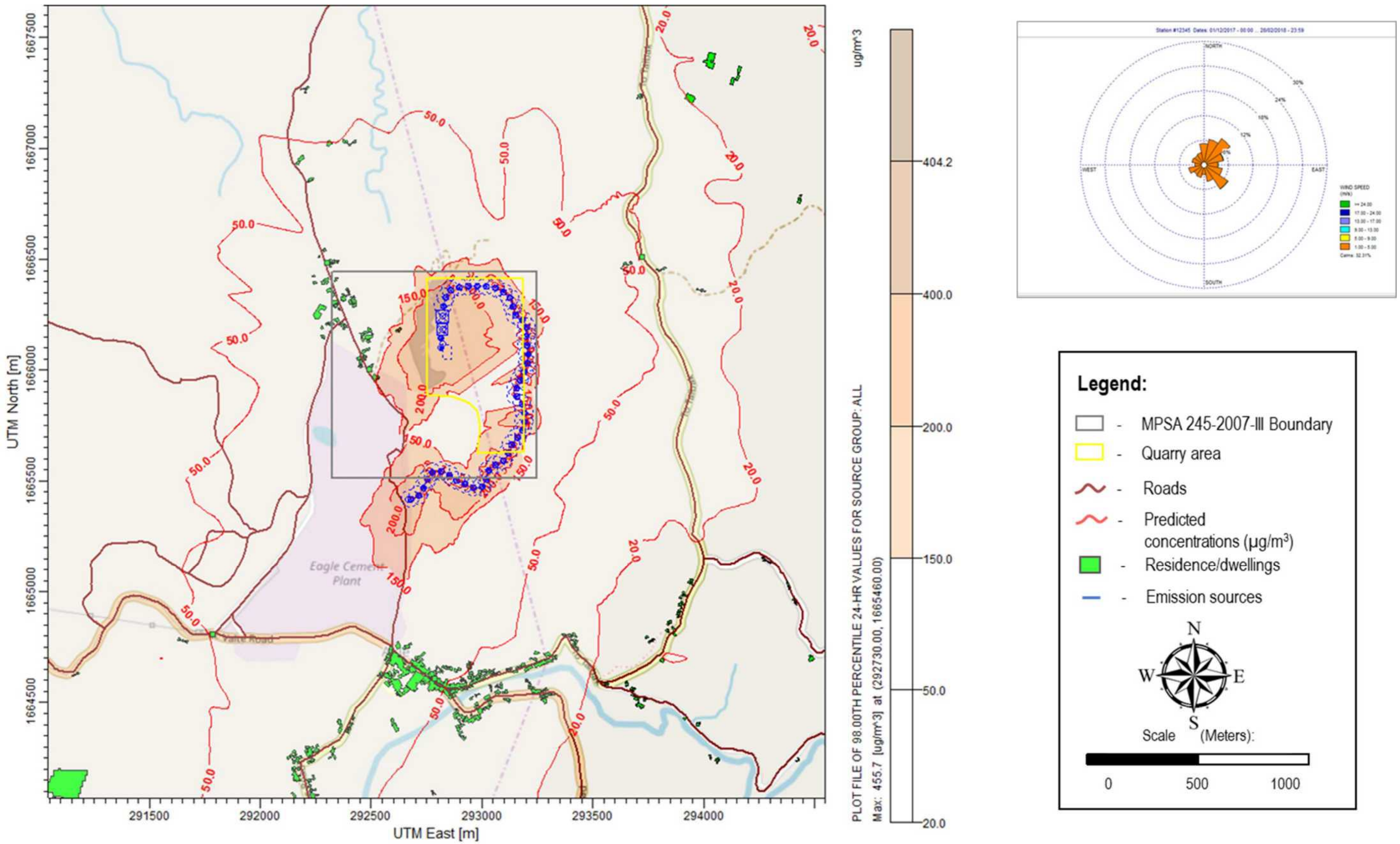


Figure 120 - Predicted 24-hr average conc. of PM10 (at 98th percentile) from quarry operations (without mitigation measures) (Period: Dec. 1, 2017 to Feb 28, 2018)

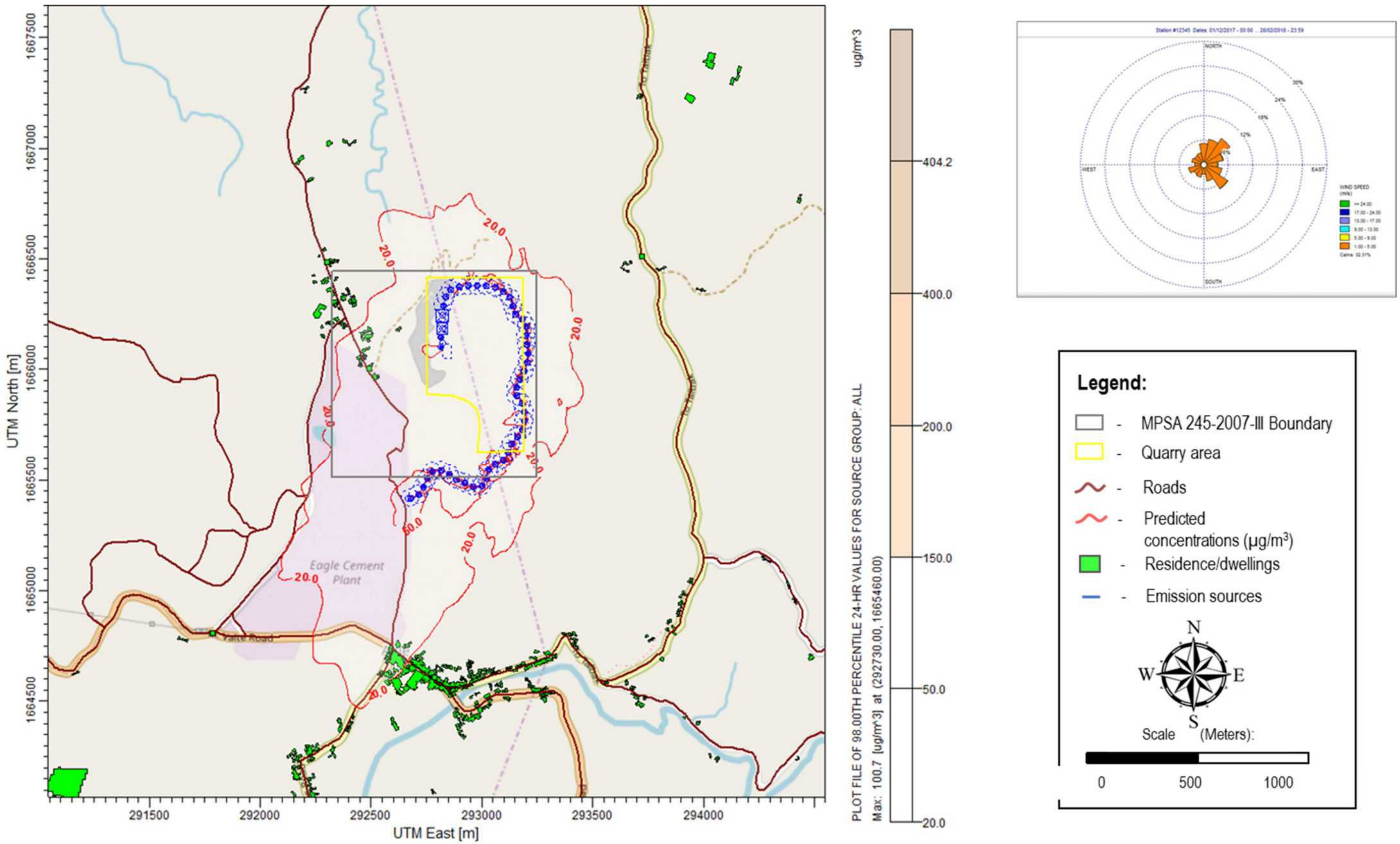


Figure 121 - Predicted 24-hr average conc of PM10 (at 98th percentile) from quarry operations (with mitigation measures) (Dec. 1, 2017 to Feb 28, 2018)

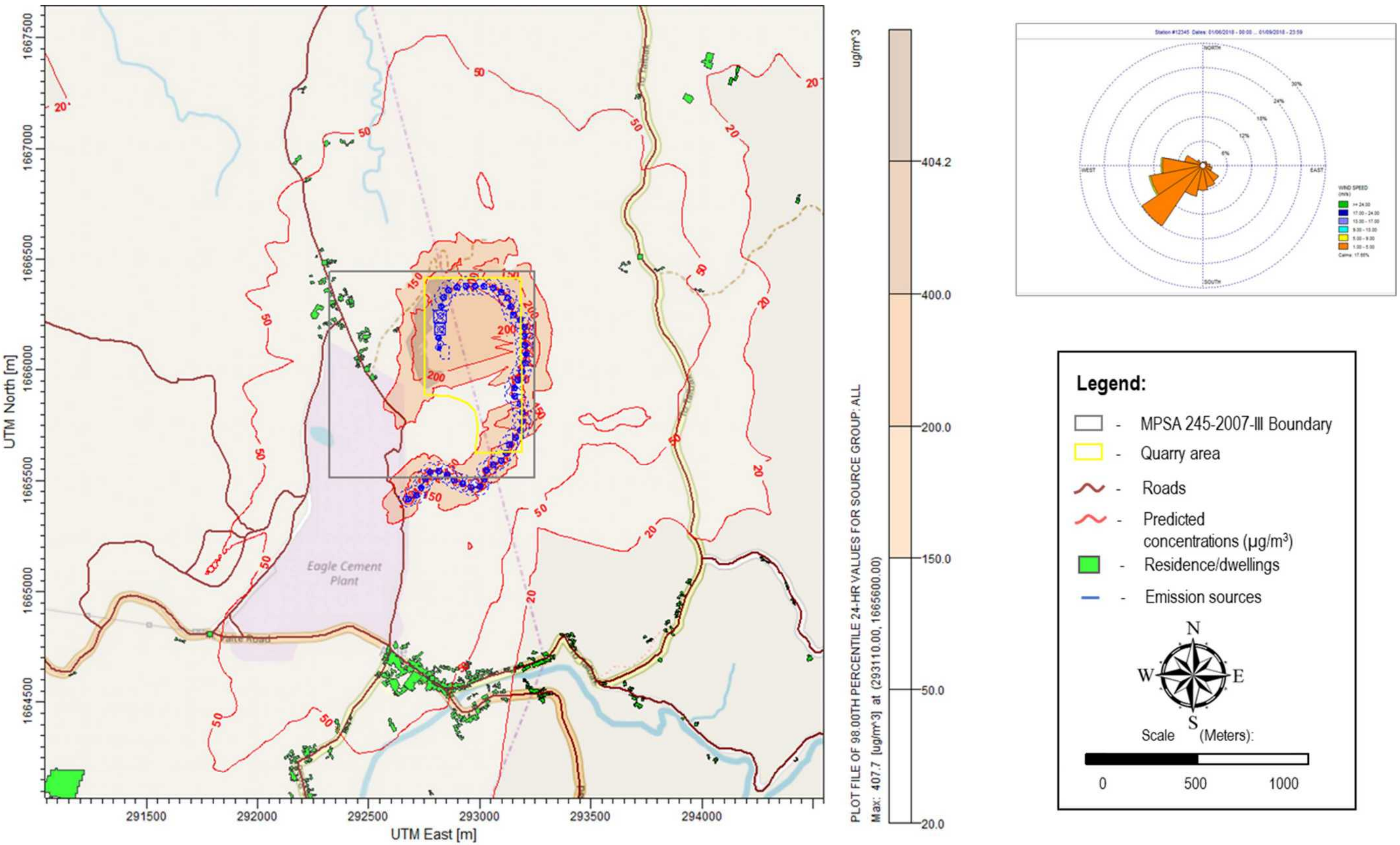


Figure 122 - Predicted 24-hr average conc. of PM10 (at 98th percentile) from quarry operations (without mitigation measures) (Period: June 1, 2018 to Aug 31, 2018)

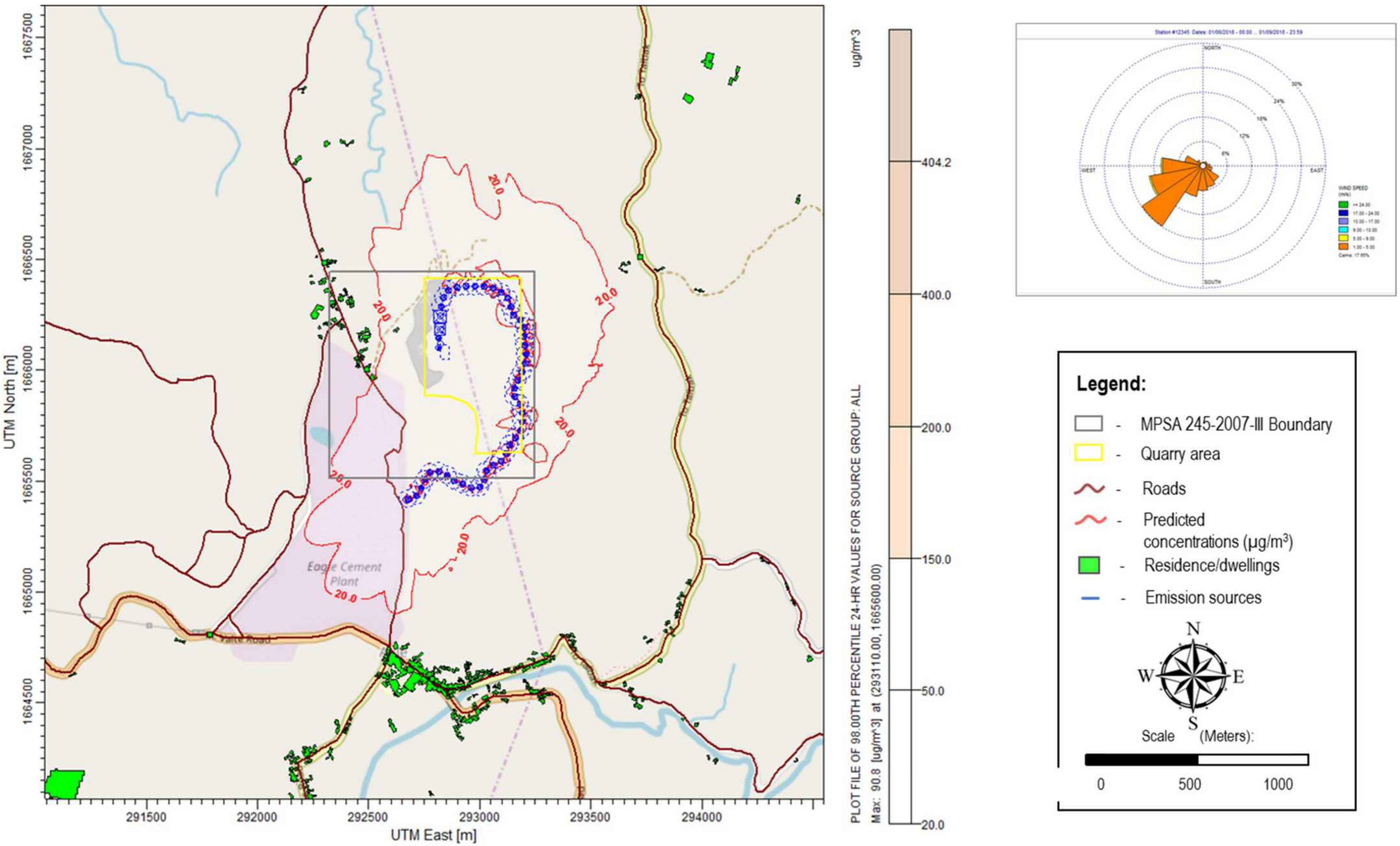


Figure 123 - Predicted 24-hr average conc of PM10 (at 98th percentile) from quarry operations (with mitigation measures) (June 1, 2018 to Aug 31, 2018)

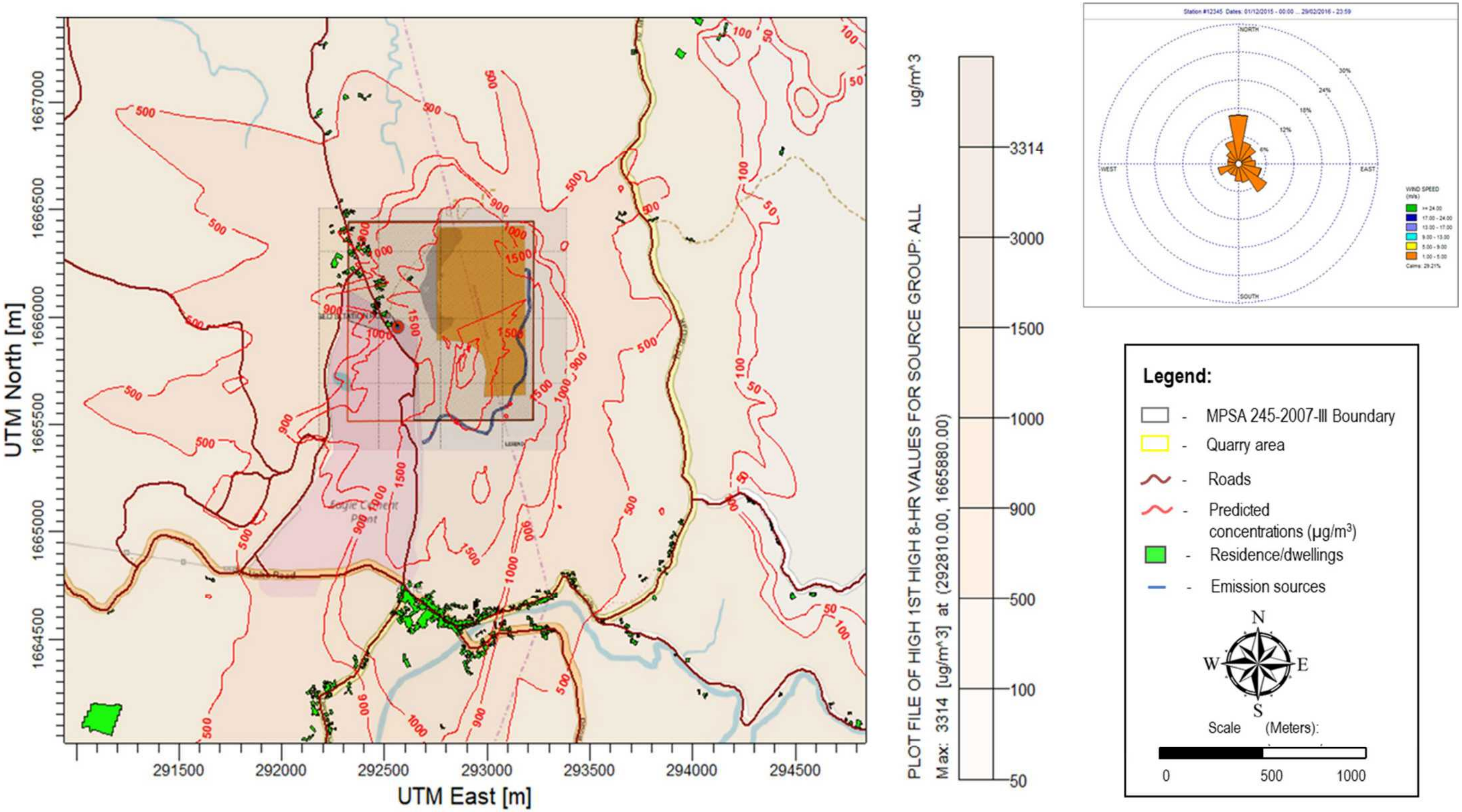


Figure 124 - Sample plot of predicted 8-hour average concentrations of TSP (Period: Dec. 1, 2015 to Feb 28, 2016)

2.3.2.4.1.3 Mitigation Measures

Section 13 (Prohibited Acts) in Rule XXV (Stationary Sources) of the implementing rules of Philippine Clean Air Act (or DAO 2000-81) prohibit emissions of particulate matter (or fugitive particulates) from any other source without taking reasonable precautions to prevent such emission. These sources include vehicular movement, transportation of materials, construction, demolition or wrecking or industry related activities such as loading, storing or "handling". Thus, sources of fugitive emissions or particulates from the proposed project (quarry operations) are subject to this provision.

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

1) Water sprinkling to control dust generation from construction and quarrying or clearing of lands;
2) Application of water on roads, materials of stockpiles and other surface which create airborne dust problem; and
3) 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.

Specifically, the following dust generating activities and corresponding mitigation measures will be implemented for the project.

a) Bulldozing and grading

Wet suppression or water spraying and installation of temporary wind barriers, if necessary, especially during dry days and when winds are light to moderate. To minimize cumulative dusts emissions from hauling activities and grading/maintenance activities of haul roads during dry and windy conditions, road grading to be done separately at other roadways, when necessary.

b) Transport of haul trucks and other vehicles

Wet suppression or water spraying, strict implementation of speed limits, provision of covers for trucks hauling spoils and other materials (if materials will be transferred off-site), and regular maintenance of trucks to reduce or maintain tailpipe emissions.

c) Loading and unloading of materials (materials handling)

Provision of dust suppression system (water spraying) prior to and during unloading, and regular removal of spillage, use of dust and wind barriers downwind and upwind of the quarry area, respectively, during dry and wind conditions, if necessary.

d) Wind erosion of exposed areas

Water spraying over exposed areas and installation of temporary barriers to reduce wind speed and avoid opening or clearing of new areas during early stage of construction, if such area is not immediately needed

e) Blasting operation

As possible, conduct blasting during relatively low wind speeds to avoid dispersion of dust at nearby households/residences.

2.3.3 Noise Quality

2.3.3.1 Methodology

2.3.3.1.1 Baseline Monitoring

CRL conducted noise level monitoring at the five (5) locations in October 2018 and February 2019 (***Table 35*** and ***Figure 125***). CRL (2019) indicated that a Lutron sound level meter was used to measure the lowest and highest noise levels at 3 minutes per interval over 1-hour period. The equivalent noise levels (Leq) were then calculated by computing its logarithmic average (CRL 2019). The results were then compared with the ambient noise standards specified in the circular of the then National Pollution Control Commission (NPCC) in 1978 (***Table 36***)

Table 35 - Coordinates and elevations of the air sampling stations

Station ID	*Location**	*Latidue (deg)*	*Longitude (deg)*
N1	Brgy. Akle, Sitio Narra	15°3’39” N	121°4’11” E
N2	Brgy. Akle, Sitio Narra, Near Quarry	15°3’23” N	121°4’5” E
N3	Doña Remedios Trinidad, Brgy. Talbak, Near Bulacan Brgy. Hall	15°5’19.8” N	121°5’39.1” E

Station ID	Location*	Latidue (deg)	Longitude (deg)
N4	Brgy. Akle, In Front of Centro Akle St.	15°2'53" N	121°4'23.3" E
N5	In Front of Petron Gas Station	15°3'1.2" N	121°4'23.3" E
*Note: Locations of noise stations are the same as the air sampling stations			

Table 36 - Environmental quality standards for noise in general areas (NPCC 1980)

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.	Night-time (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

Figure 125 - Locations of noise sampling stations and photographs taken during noise sampling

2.3.3.1.2 Noise Emissions Modelling

2.3.3.1.2.1 Noise Model

SoundPlan Essential (SPE) Noise Model Version 4.1 (SoundPlan) was used to determine the attenuated sound levels arising from the quarry operation. SoundPlan is capable of modelling noise emissions from roads, railways, and industrial facilities. The screenshot of the licensed SoundPlan and the standards used in this study are shown in ***Plate 24***.

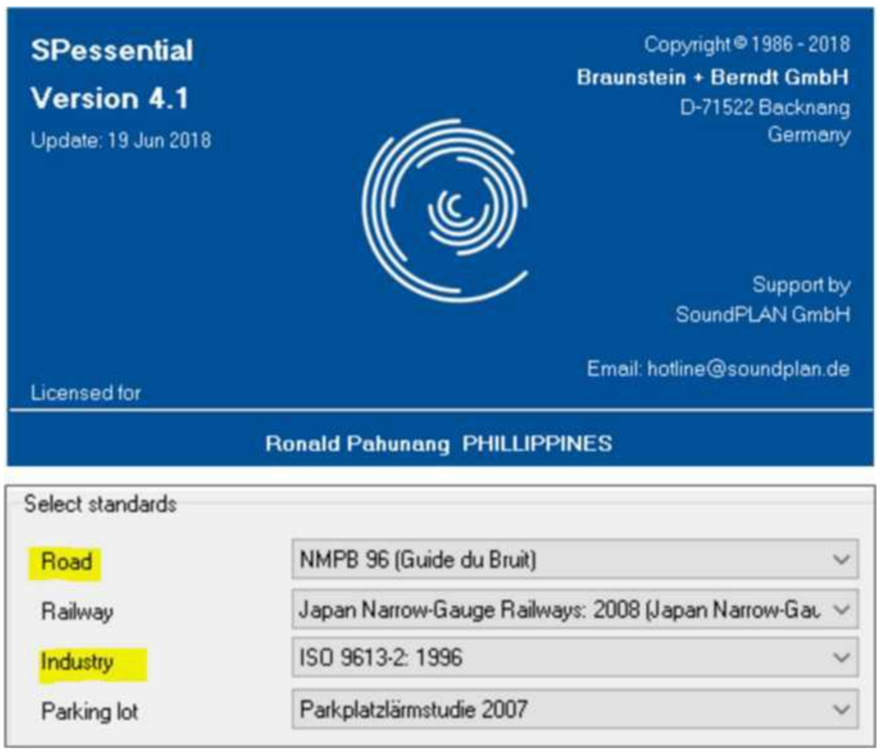


Plate 24 - Licensed SoundPlan and noise standards used in noise modelling

SoundPlan implements ISO 9613-2 (*Acoustics – Attenuation of sound during propagation outdoors. Part 2: General Method of Calculation)* on modelling noise emissions from industrial facilities. ISO 9613-2 specifies an engineering method to calculate attenuation of sound as emitted outdoors from various types of sources, such as point source, industrial noise sources, construction activities and other point (stationary or moving points sources), but excluding aircraft in flight and noise from blasting activities.
ISO 9613-2 accounts for the following factors:

- Directivity of the source (or the orientation of the source);
- geometrical divergence or travel of sound with distance,

- atmospheric absorption,
- ground effect,
- barrier, and
- miscellaneous sources, such as foliage of trees and shrubs, industrial sites, and clusters of houses or buildings.

2.3.3.1.2.2 Sources of Noise

Plate 25 shows the list of noise sources and its corresponding sound power level. The list of equipment was provided by the proponent while the sound power levels were obtained from SoundPlan library, equipment brochures, and related noise impact assessment studies.

Figure 126 shows the indicative locations of the emission sources. Haul trucks were assumed to operate continuously along the haul road from the quarry to the crusher of the existing cement plant of Eagle Cement. A grader was also assumed to operate along the haul road.

The rest of the noise sources/heavy equipment were assumed operating simultaneously near the west boundary of the quarry area closest households or residences. This assumed "worst-case" scenario as most of the sources were in vicinities of nearby residences.

Road Industry

Source name	Reference	Level Day dB(A)	Level Night dB(A)	Corrections Cwall dB(A)	Corrections CI dB(A)	Corrections CT dB(A)
Hydraulic excavator1	Lw/unit	106.0	106.0	-	-	-
Hydraulic excavator2	Lw/unit	106.0	106.0	-	-	-
Hydraulic breaker1	Lw/unit	124.0	124.0	-	-	-
Hydraulic breaker2	Lw/unit	124.0	124.0	-	-	-
Hydraulic drill1	Lw/unit	122.3	122.3	-	-	-
Hydraulic drill2	Lw/unit	122.3	122.3	-	-	-
Wheel loader 1	Lw/unit	106.0	106.0	-	-	-
Vibratory impactor	Lw/unit	105.7	105.7	-	-	-
Crawler tractor	Lw/unit	102.2	102.2	-	-	-
Road grader 1	Lw/unit	106.0	106.0	-	-	-

Road Industry

Station km	ADT Veh/24	Vehicles (Light / Hea day Veh/h	night Veh/h	Speeds (Light / Heavy / Tr day km/h / km/h /	night km/h / km/h /	Road surface	Multiple Reflecti dB(A)	Gradient Min / Ma %	Emission level day dB(A)	night dB(A)
1					Traffic direction: Both directions					
0+000	240	0 / 10	0 / 10	0 / 30 / stea	0 / 30 / stea	Rough texture paving stones (>=5mm	-	-13.0 / 4	81.2 - 81.7	81.2 - 81.7
1+133	240	0 / 10	0 / 10	0 / 10 / stea	0 / 10 / stea	Rough texture paving stones (>=5mm	-	-1.8 / 4.2	83.0 - 83.5	83.0 - 83.5
1+385	240	10 / 0	10 / 0	0 / 20 / stea	0 / 20 / stea	Rough texture paving stones (>=5mm	-	-30.7 / -0	65.4 - 70.7	65.4 - 70.7
1+645	-	-	-	-	-	-	-	-	-	-

Plate 25 - List of noise sources and its corresponding sound power

2.3.3.1.2.3 Elevation Points

Elevations or topography used in the noise modelling were obtained from the Shuttle Radar Topography Mission (SRTM) digital terrain data. SRTM data were processed as follows.

a) Multi-tier grid receptors were created in AERMAP View – a terrain preprocessor of AERMOD View. These grid receptors contained the following:

    - 20 m x 20 m grid from about the center of the quarry area to 1 km; and
    - 100 m x 100 m grid from 1 km to 3 km

b) SRTM digital terrain data were then imported in AERMAP View. This preprocessor then generated the coordinates and elevations (in WGS84 UTM Zone 51) and exported a text file (in *.csv format) to be furthered process in a mapping software.

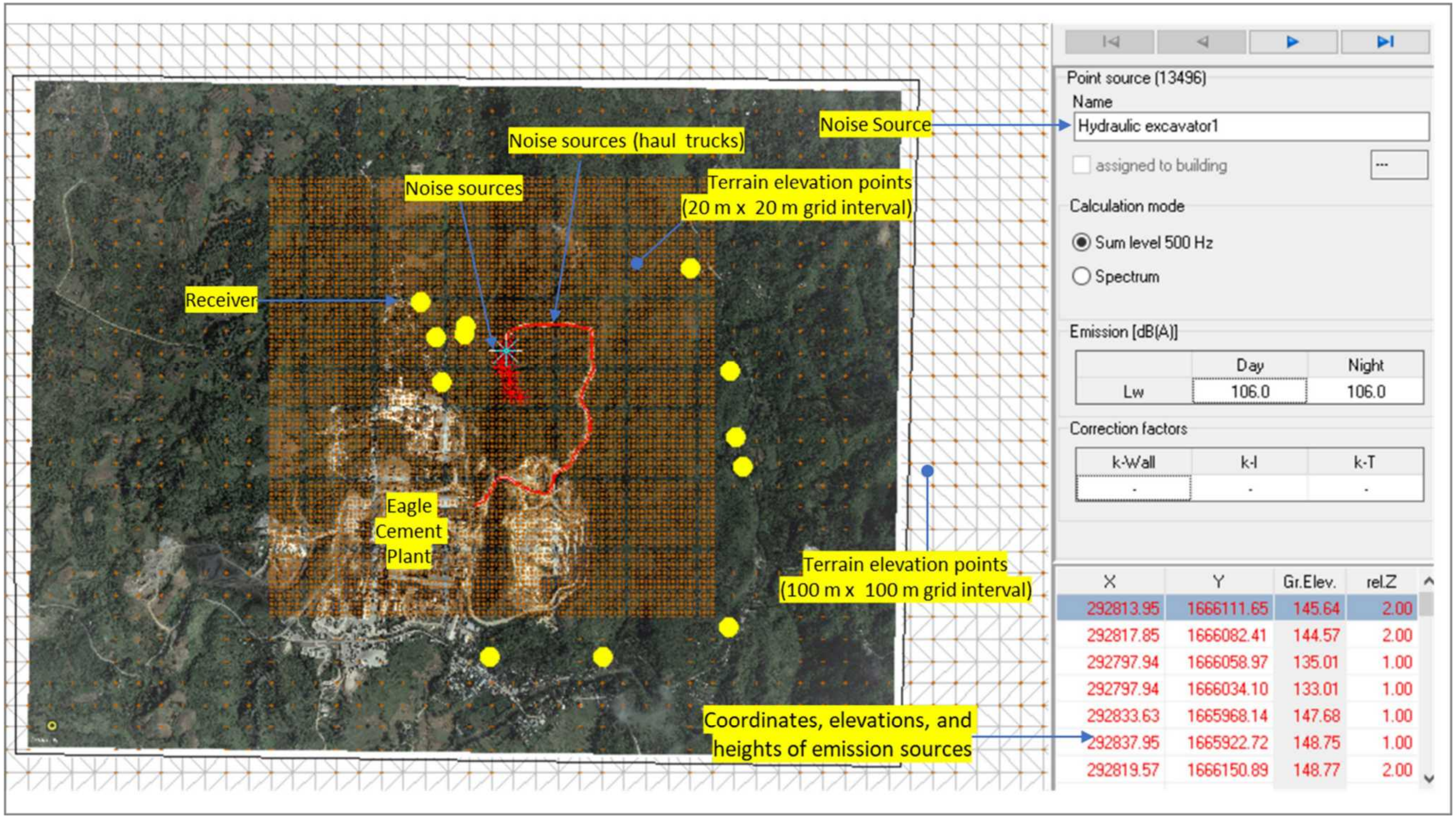


Figure 126 - Screenshot of noise emission sources, elevation points, receivers, and emission levels

c) The text files (*.csv format) were then converted as drawing file and imported in SoundPlan as *.dxf file. The .dxf file contains the coordinates and elevations in a format readable by SoundPlan.

SoundPlan can directly generate topography by importing GoogleEarth imagery. To be consistent with the elevation data used in the air dispersion modelling, however, topography from SRTM data were instead used in the noise modelling.

Note that the topography at the project site (quarry) will change during project operation, specifically during extended period of operations, i.e., months and years. This would lower the elevations at the quarry relative to the households, which may result to possible reduction of attenuated noise from quarry operation.

Modelling scenarios, however, assumed initial quarry operation (or early months of operation) and without significant change in topography, and as indicated above, noise sources/heavy equipment were also assumed operating simultaneously near the west boundary of the quarry area closest households or residences. This could be considered as “worst-case” scenario as most of the sources were in vicinities of nearby residences.

2.3.3.1.2.4 Meteorology

Meteorological input data were based from PAGASA-Science Garden Station, as follows:

- Dry bulb temperature = 27.2 °C,
- Relative Humidity = 78%, and
- Barometric pressure = 1009.8

The above parameters are normal average values from 1981 to 2010.

2.3.3.1.2.5 Receivers

Table 37 shows the coordinates and elevations of the twelve (12) receivers wherein specific noise levels were calculated. The discrete receivers (colored yellow in ***Figure 126***) represent the clusters of residences or households around the project site.

Note that in addition to the twelve (12) discrete receivers, attenuated noise levels were computed at grid distance of 10 m x 10 m. These grid receptors are also called “receivers” within the modelling domain.

Table 37 - Coordinates and elevations of receivers assigned around the project site

Receptor No.	UTM (x)	UTM (y)	Floor Elevation (m)
1	292636.7	1666219.4	97.61
2	292630.2	1666184.7	96.85
3	292429.2	1666328.2	99.25
4	292503.2	1666173.4	94.3
5	292530.1	1665968.8	96.7
6	292744.4	1664716.5	101.19
7	293256.4	1664716.5	107.32
8	293828.4	1664853.9	172.41
9	293890.9	1665578.3	147.69
9	293890.9	1665578.3	150.49
10	293860.1	1665713.4	147.4
11	293832.9	1666019.3	142.84
12	293657.1	1666483.6	153.12

2.3.3.2 Background Noise Levels

Table 38 shows the measured noise levels at five (5) locations in October 2018 and February 2018. Measured noise levels (Leq) in October 2018 ranged from 59.21 to 64.07 dBA while in February 2018 from 44.0 to 65.5 dBA. Measured noise levels in February 2018 were generally lower than those measured in October 2018. CRL, however, has not provided the data or possible causes of noise reduction in February 2018 sampling.

Sources of noise at the time of monitoring were from vehicles passing near the sampling stations, which were noted at all monitoring stations. Animal and community noise were also observed at Stations N1, N2, and N3. Noise from the cement plant was audible/noted at Station N4.

In comparison with the ambient noise standard, noise levels in October 2018 were higher than the daytime noise standard for residential areas set at 55 dBA, except at Station N5 in which noise standard for commercial area applies at this location.

In February 2018 sampling, noise levels (L_{eq}) at Station N1, N2, and N3 were within the daytime noise standard for residential areas, except at Station N4 wherein the measured noise level was

65.6 dBA. Noise from vehicular traffic was the main source of noise at this location (Station N4). Noise from the cement plant was also noted at this location (Station N4).

Table 38 - Measured noise levels in October 2018 and February 2019

Station No.[1]	Location	Date/Time of Sampling	Noise Level (dBA)	Noise Standard (dBA)[2]	Sources of Noise
N1	Brgy. Akle, Sitio Narra	22-Oct-18/ 1515H - 1615H	**59.21**	55*	• Animal noise, occasional passing vehicles, residential activities • Vehicle pass by in October sampling – 20 tricycles and 20 motorcycles
		28-Feb-19/ 1320H - 1420H	48.9	55*	
N2	Brgy. Akle, Sitio Narra, Near Quarry	23-Oct-18/ 0915H - 1015H	**61.27**	55*	• Animal noise, wind generated noise occasional passing of vehicles • Vehicle pass by in October 2018 sampling – 7 trucks, 15 tricycles and 20 motorcycles passed
		28-Feb-19/ 1450H - 1550H	44.0	55*	
N3	Doña Remedios Trinidad, Brgy. Talbak, Near Brgy. Hall	23-Oct-18/ 1120H - 1220H	**61.98**	55*	• Animal noise, occasional passing vehicles and residential activities • Vehicle pass by in October 2018 sampling – 5 trucks, 12 tricycles and 18 motorcycles
		28-Feb-19/ 1000H - 1100H	54.7	55*	
N4	Brgy. Akle, In Front of Centro Akle St.	23-Oct-18/ 1315H - 1415H	63.45	55*	• Vehicle noise and plant operation (cement plant) • Vehicle pass by in October 2018 sampling – 18 trucks, 15 tricycles and 22 motorcycles
		28-Feb-19/1 1150H – 1250H	65.6	55*	
N5	In Front of Petron Gas Station	23-Oct-18/ 1445H – 1545H	64.06	65**	• Noise from vehicles
		28-Feb-19/ 1605H - 1705H	**65.5**	65**	

Notes:

1) Designations of station ID/numbering by CRL (2019):

- Station N3 in February 2019 report is Station N1 in October 2019 report

Station No.[1]	Location	Date/Time of Sampling	Noise Level (dBA)	Noise Standard (dBA)[2]	Sources of Noise
• Station N4 in February 2019 report is Station N2 in October 2019 report • Station N1 in February 2019 report is Station N3 in October 2019 report • Station N2 in February 2019 report is Station N4 in October 2019 report • Station N5 in February 2019 report is Station N5 in October 2019 report 2) Ambient Noise Standards *Class "A" (A section or contiguous area, which is primary used for the residential purposes, Daytime) **Class "A" (A section or contiguous area, which is primary used for the residential purposes, Daytime)					

2.3.3.3 Impact Assessment and Mitigation Measures

2.3.3.3.1 Predicted and Cumulative Noise Impacts

Modelling involved the following scenarios:

1) Simultaneous operation of all equipment listed in ***Plate 25***, and
2) Reduction on the number of operating equipment

The second scenario aimed to determine the noise levels with reduction of operating equipment, particularly at nighttime when noise levels should be within its background levels or within ambient noise standard set for residential areas. This is to avoid possible complaints from nearby residences during this period.

1) Simultaneous Operation of All Equipment

The predicted noise levels at five (5) receivers (receiver Nos. 1 to 5) were expectedly higher than other receivers (receivers Nos. 6 to 12) due to its proximity with the assumed locations of noise sources/equipment. Attenuated noise levels at receiver nos. 1 to 5 ranged from 62.5 to 69.3 dBA (both for daytime and nighttime) while those at the receiver nos. 6 to 12 were within the ambient noise standard set at 45 dBA (***Figure 127*** and ***Plate 26***).

The first value (or 1st column) at each receiver (Receivers 1 to 12) in ***Figure 127*** are the predicted daytime noise levels while the 2nd value (or 2nd column) are the predicted nighttime noise levels.

Predicted nighttime and daytime noise levels were equal at all receivers as the number of equipment and its sound power were the same for the two (2) time periods.

Noise contours representing the predict noise levels show high noise levels along the haul route and in vicinities of the noise sources/equipment (***Figure 128*** and ***Figure 129***). There appears significant reduction of noise on the east side of the modelling domain (in green contour) due to blocking effect of terrain or topography.

2) Reduction on the Number of Operating Equipment

As predicted noise levels were relatively higher at residences east of the quarry area or project site, additional simulation was performed to determine reduction of noise with limited operating equipment during nighttime.

Results shown in ***Figure 130*****,** and ***Figure 131*** and ***Plate 27*** suggest apparent reduction on the number of operating equipment at nighttime as one of the mitigation measures to lessen noise at household areas. Noise levels were reduced to 44.6 to 51.4 dBA at household areas east of the project site. Although the predicted noise levels were higher than ambient noise standard at residential area set at 45 dBA, observed noise levels may be lower or higher depending on other factors, such as the intensity of noise emissions (or sound power) and the usage factor (percentage of operating time of each equipment).

Thus, noise monitoring should be conducted during construction and operation to check exceedances with the ambient noise standards, particularly during nighttime. In the event of excessive noise levels due to the project, mitigation measures should be implemented to avoid complaints from nearby households/residences.

3) Cumulative Noise Impact

Table 39 shows the cumulative noise impacts (background and predicted) at the air monitoring stations. Results show that operation of the project will not likely affect the background noise levels at Stations N3, N4, and N5 as its background noise levels were higher than those predicted. Due to proximity of Station N1 with the project site, there is predicted increased on background noise level arising from the operation of the quarry. At Station N2, however, background noise levels appear to vary during monitoring in February and October, which resulted to probable increase or decrease of noise levels.

Table 39 - Baseline and predicted noise levels

Station No.	Location	Baseline Noise (dBA)	Predicted Noise (dBA)	Predicted plus baseline (dBA)	Noise Level Increase from Baseline?
N1	Brgy. Akle, Sitio Narra	59.21	68.1	65.6	Yes
		48.9	68.1	65.1	Yes
N2	Brgy. Akle, Sitio Narra, Near Quarry	61.27	58.6	60.1	No
		44.0	58.6	55.7	Yes
N3	Doña Remedios Trinidad, Brgy. Talbak, Near Bulacan Brgy. Hall	61.98	37.5	59.0	No
		54.7	37.5	51.8	No
N4	Brgy. Akle, In Front of Centro Akle St.	63.45	38.0	60.5	No
		65.6	38.0	62.6	No
N5	In Front of Petron Gas Station	64.06	39.2	61.1	No
		65.5	39.2	62.5	No

2.3.3.3.2 Proposed Mitigation Measures and Monitoring Program

Operation of the project is expected to generate high noise levels, which may exceed noise standards at households/residences in vicinities of the project site, if no mitigation measures will be implemented.

To effectively implement mitigation measures, noise monitoring should be performed at residences around the project during operation, particularly at residences/households located west of the quarry area. Noise monitoring should be conducted at four (4) time periods of the day (daytime, early evening, early morning, and nighttime).

Mitigation measures should include the following:

1) Reduction on the number of operating equipment, particularly during nighttime and early morning/evening periods.
2) Installation of effective or appropriate mufflers at tailpipes of mobile equipment
3) Strictly impose speed limits at access roads and within the quarry area,
4) Provision partial or total enclosure of high noise sources, if practicable as possible.
5) Blasting operation should be performed during daytime.

If operation during nighttime or early evening is necessary, residents and local government units (LGUs) who have jurisdiction of the area should be informed of the said activity. Consequently, adequate control measures, i.e., provision of partial or total enclosure of high noise sources, should be implemented to reduce nighttime noise levels. In any event, however, noise emissions from the project should not cause nuisance to residents in vicinities of the quarry area.

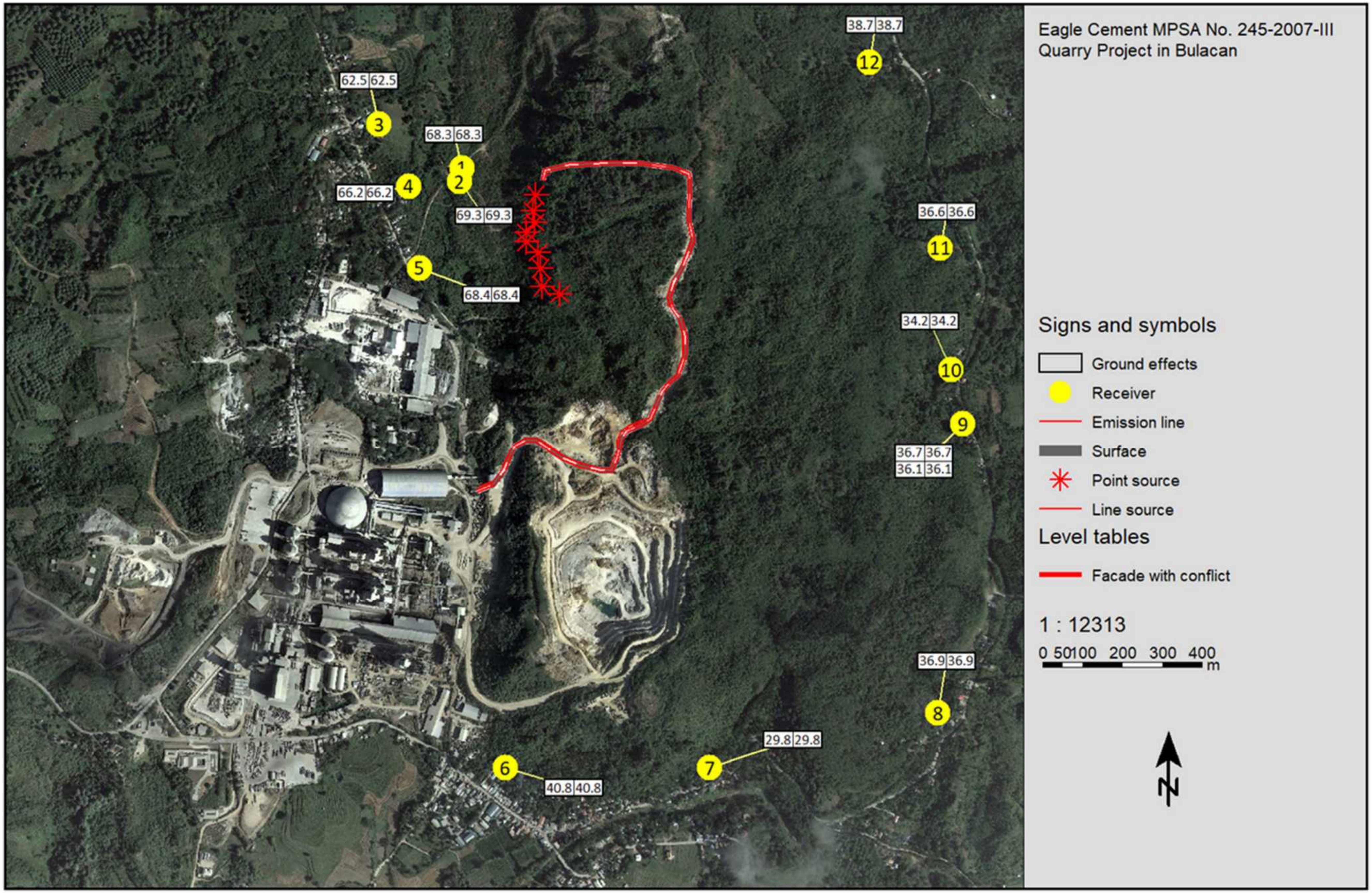


Figure 127 - Predicted noise levels (daytime and nighttime) at receiver points arising from emissions of all indicative noise sources

Receivers | Contributions

No.	Receiver name	Coordinates X	Coordinates Y	Building side	Floor	Height	Limit Day	Limit Night	Level Day	Level Night	Conflict Day	Conflict Night
		in meter				m	dB(A)		dB(A)		dB	
1	1	292636.65	1666219.42	-	GF	97.61	55	45	68.3	68.3	13.3	23.3
2	2	292630.23	1666184.74	-	GF	96.85	55	45	69.3	69.3	14.3	24.3
3	3	292429.19	1666328.17	-	GF	99.25	55	45	62.5	62.5	7.5	17.5
4	4	292503.22	1666173.38	-	GF	94.30	55	45	66.2	66.2	11.2	21.2
5	5	292530.14	1665968.78	-	GF	96.70	55	45	68.4	68.4	13.4	23.4
6	6	292744.35	1664716.54	-	GF	101.19	55	45	40.8	40.8	-	-
7	7	293256.42		-	GF	107.32	55	45	29.8	29.8	-	-
8	8	293828.44	1664853.92	-	GF	172.41	55	45	36.9	36.9	-	-
9	9	293890.88	1665578.31	-	GF	147.69	55	45	36.1	36.1	-	-
					1.Fl	150.49	55	45	36.7	36.7	-	-
10	10	293860.11	1665713.43	-	GF	147.40	55	45	34.2	34.2	-	-
11	11	293832.94	1666019.30	-	GF	142.84	55	45	36.6	36.6	-	-
12	12	293657.12	1666483.57	-	GF	153.12	55	45	38.7	38.7	-	-

Plate 26 - Screenshot of predicted noise levels with all indicative noise sources and applicable noise standards

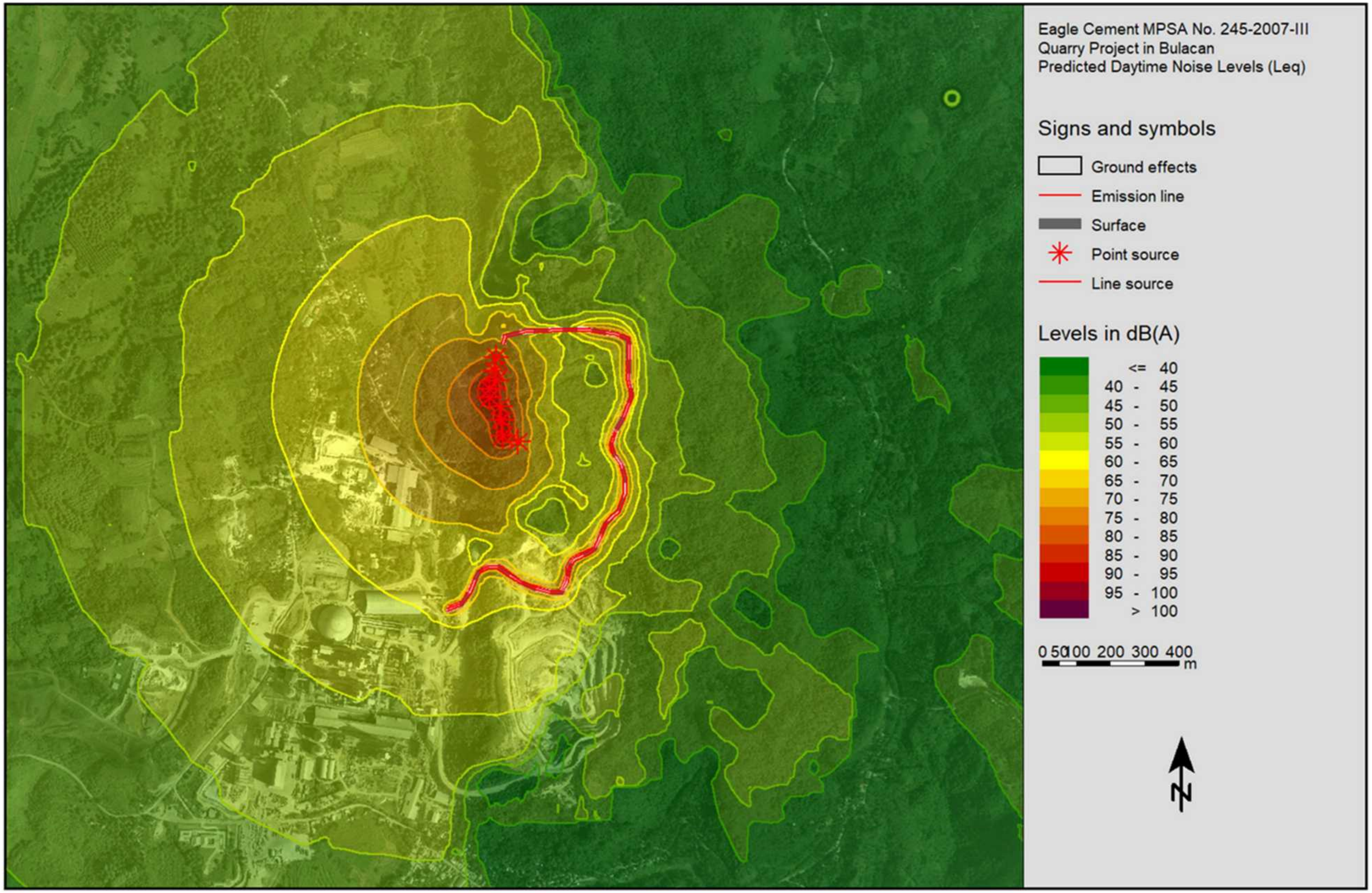


Figure 128 - Predicted noise levels during daytime arising from operation of all indicative noise sources

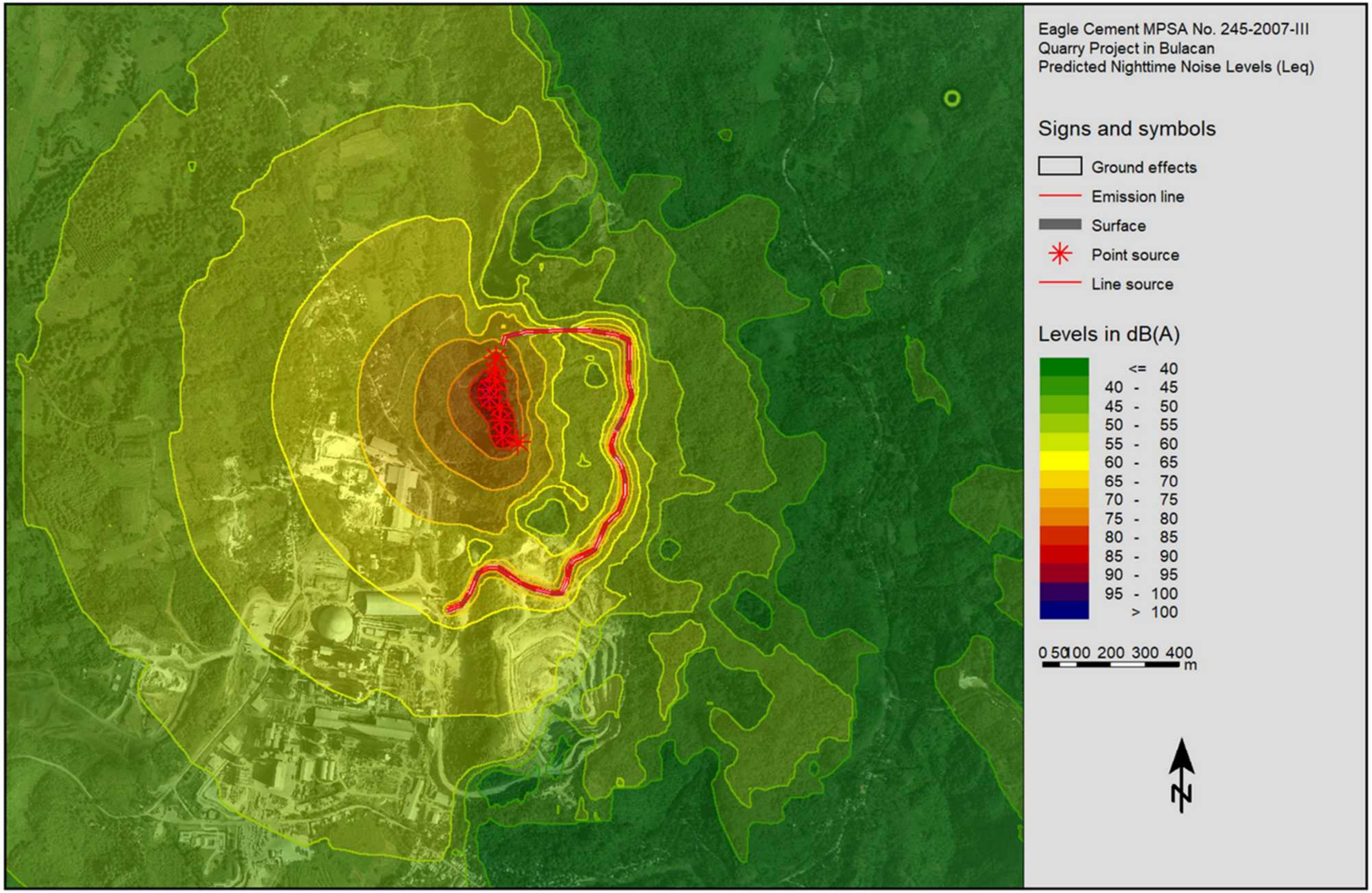


Figure 129 - Predicted noise levels during nighttime arising from operation of all indicative noise sources

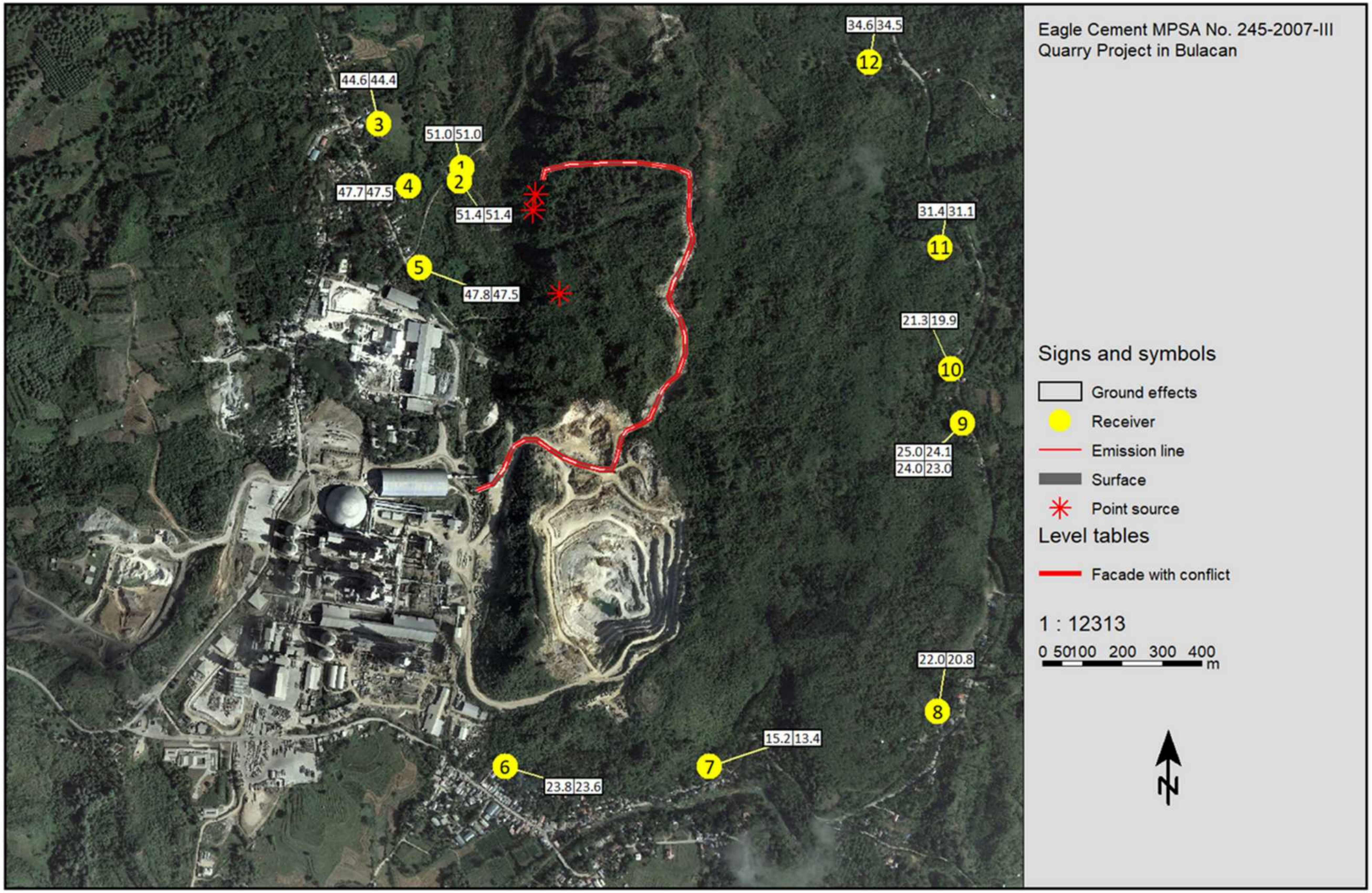


Figure 130 - Predicted noise levels at receiver points with reduction on the number of operating noise sources or mining equipment

Receivers | Contributions

No.	Receiver name	Coordinates X (in meter)	Coordinates Y (in meter)	Building side	Floor	Height m	Limit Day dB(A)	Limit Night dB(A)	Level Day dB(A)	Level Night dB(A)	Conflict Day dB	Conflict Night dB
1	1	292636.65	1666219.42	-	GF	97.61	55	45	51.0	51.0	-	6.0
2	2	292630.23	1666184.74	-	GF	96.85	55	45	51.4	51.4	-	6.4
3	3	292429.19	1666328.17	-	GF	99.25	55	45	44.6	44.4	-	-
4	4	292503.22	1666173.38	-	GF	94.30	55	45	47.7	47.5	-	2.5
5	5	292530.14	1665968.78	-	GF	96.70	55	45	47.8	47.5	-	2.5
6	6	292744.35	1664716.54	-	GF	101.19	55	45	23.8	23.6	-	-
7	7	293256.42		-	GF	107.32	55	45	15.2	13.4	-	-
8	8	293828.44	1664853.92	-	GF	172.41	55	45	22.0	20.8	-	-
9	9	293890.88	1665578.31	-	GF	147.69	55	45	24.0	23.0	-	-
					1.Fl	150.49	55	45	25.0	24.1	-	-
10	10	293860.11	1665713.43	-	GF	147.40	55	45	21.3	19.9	-	-
11	11	293832.94	1666019.30	-	GF	142.84	55	45	31.4	31.1	-	-
12	12	293657.12	1666483.57	-	GF	153.12	55	45	34.6	34.5	-	-

Plate 27. Screenshot of predicted noise levels and applicable noise standards with reduction of operating noise sources or mining equipment

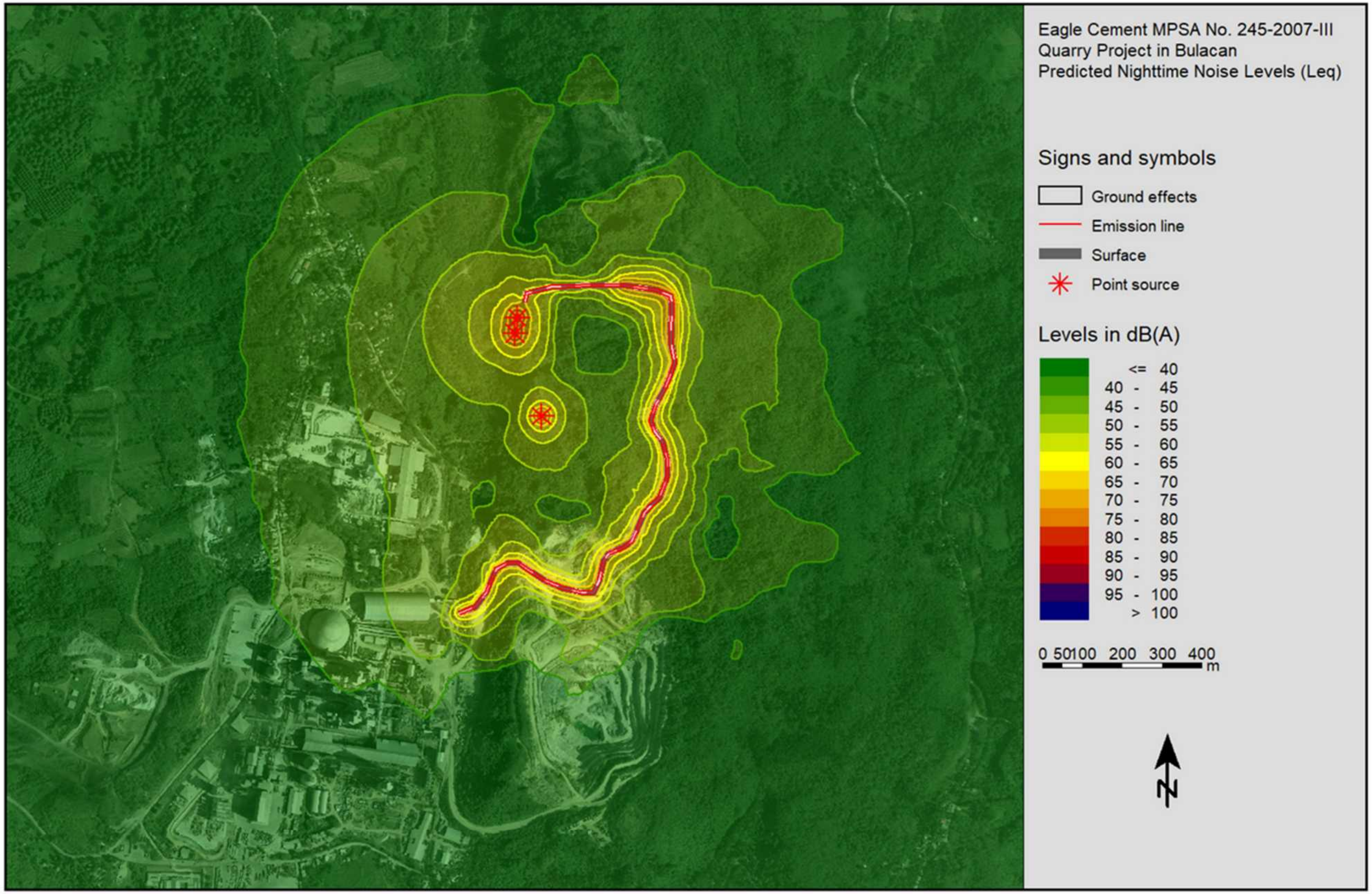


Figure 131 - Predicted noise levels during nighttime with reduction of the number of operating noise sources or mining equipment

2.4 People

The proposed project is located in Barangay Talbak Municipality of Doña Remedios Trinidad and Barangay Akle Municipality of San Ildefonso both situated in the province of Bulacan. Barangay Talbak and Barangay Akle are considered as the direct impact barangays.

The Municipality of Doña Remedios Trinidad is also known as "Bulacan's Last Frontier" because of its natural environment and is the least travelled town in the province. It covers a land area of approximately 93,926.927 hectares or a third of Bulacan. It is bounded on the north by the Municipalities of Gapan and General Tinio in Nueva Ecija; on the south by Norzagaray, Bulacan; on the east by General Nakar, Quezon, and Dingalan, Aurora; and on the west by four Bulacan municipalities, namely San Miguel, San Rafael, San Ildefonso, and Angat. It has a population of 22,663 (PSA -2015). It has a total of 8 barangays, one of which is the direct impact barangay – Barangay Talbak. Barangay Talbak is located approximately 36 kilometers from the Municipality of Doña Remedios Trinidad. Barangay Kalawakan borders Barangay Talbak to the North, Barangay Sapang Bulak to the south, Barangay Camachin to its east and Barangay Biak na Bato to its west. The barangay is considered a rural, agricultural and upland barangay and has a total land area of 2, 140.49 hectares. The barangay is comprised of a total of 3 puroks.

The Municipality of San Ildefonso covers a land area of 12,871 hectares or 128.71 square kilometers which constitutes 4.60% of the total area of Bulacan. It has a total population of 104,471 (PSA – 2015). It has 36 barangays, which is one of the direct impact barangays – Barangay Akle. Barangay Akle is bordered by Baranagay Buhol na Mangga to the North, Municipality of Doña Remedios Trinidad to the East, Barangay Casalat to the South and Barangay Alagao to the West. The barangay is considered as agricultural and industrial area and has a total land area of 734.29 hectares. The barangay is comprised of 7 puroks.

2.4.1 Demographic Baseline Information of Impact Areas

2.4.1.1 Methodology

In gathering information to situate the actual demographic and socio-economic conditions of the primary impact areas, various methods were used. These methods include review of secondary information sources, conduct of perception surveys and focus group discussions.

Secondary information and data were sourced from the published survey and census reports of the Philippine Statistics Authority (PSA), Municipal Health Office Data, Data from the City Mayors office as well as the latest Local Development Plans of Doña Remedios Trinidad and San Ildefonso. These include the following:

- 2012-2022 Comprehensive Land Use Plan and Zoning Ordinance Doña Remedios Trinidad, Bulacan;
- 2010, Census of Population and Housing, PSA;
- 2015, Census of Population, PSA;
- 2017 Socio-Economic Profile San Ildefonso
- 2012 Community Based Monitoring System San Ildefonso

2.4.1.2 Results and Discussion

2.4.1.2.1 Barangay Talbak

According to the 2015 Census of the Philippine Statistics Authority the population of Barangay Talbak is 1,746. The population grew from 713 in 1990 to 1,746 in 2015, an increase of 1,033 people. The latest census figures in 2015 denote a positive growth rate of 2.57%, or an increase of 218 people, from the previous population of 1,528 in 2010. This means that the population of barangay increased yearly. The increase in population growth may have implications in the economic situation as well as the delivery of basic services to each family in the community.

Table 40 – Population and Growth Rate of Barangay Talbak and Municipality of Doña Remedios Trinidad, 2010 and 2015

Area	2010 Population	2015 Population	Population Growth Rate (%)
Barangay Talbak	1,528	1,746	2.57
Doña Remedios Trinidad	19,878	22,663	2.53

Source: 2010 Census of Population and Housing
2015 Census of Population (Philippine Statistics Authority, 2015)

2.4.1.2.1.1 Population Composition

Based on the on the Household Population by age group and age composition, the data shows that the age group of 10 – 14 years old has the highest percentage (12.89%) in Barangay Talbak (***Table 41***), while in the Municipality of Doña Remedios Trinidad the age – group of 5 – 9 years old has the highest percentage (12%), (***Table 42***).

Table 41 – Household Population by age Group and Age Composition: Barangay Talbak, 2015

Age Group	Both Sexes	Age Composition (%)
Under 1	27	1.55
1 – 4	169	9.68
5 – 9	207	11.86
10 – 14	225	12.89
15 – 19	185	10.60
20 – 24	160	9.16
25 – 29	144	8.25
30 – 34	122	6.99
35 – 39	126	7.22
40 – 44	81	4.64
45 – 49	95	5.44
50 – 54	66	3.78
55 – 59	42	2.41
60 – 64	45	2.58
65 – 69	22	1.26
70 – 74	15	0.86
75 – 79	7	0.40
80 years old and over	8	0.46
TOTAL	**1,746**	**100**

Table 42 – Household Population by Age Group and Sex, and Age Composition, and Sex Ratio: Dona Remedios Trinidad, 2015

Age Group	Both Sexes	Male	Female	Age Composition (%)	Sex Ratio
Under 1	522	274	248	2.30	1.10:1
1 – 4	2,325	1,177	1,148	10.26	1.03:1
5 – 9	2,721	1,412	1,309	12.00	1.08:1
10 – 14	2,674	1,407	1,267	11.80	1.11:1
15 – 19	2,515	1,329	1,186	11.10	1.12:1
20 – 24	2,177	1,146	1,031	9.61	1.11:1
25 – 29	1,733	895	838	7.65	1.07:1
30 – 34	1,492	782	710	6.58	1.10:1
35 – 39	1,355	717	638	5.98	1.12:1
40 – 44	1,233	649	584	5.44	1.11:1

Age Group	*Both Sexes*	*Male*	*Female*	*Age Composition (%)*	*Sex Ratio*
45 – 49	1,100	588	512	4.85	1.15:1
50 – 54	899	485	414	3.97	1.17:1
55 – 59	688	374	314	3.04	1.19:1
60 – 64	515	274	241	2.27	1.14:1
65 – 69	293	142	151	1.29	0.94:1
70 – 74	184	88	96	0.81	0.92:1
75 – 79	133	59	74	0.59	0.80:1
80 years old and over	104	41	63	0.46	0.65:1
TOTAL	**22,663**	**11,839**	**10,824**	**100**	**1.09:1**

Source: Philippine Statistics Authority, 2015 Census of Population

The shape of the population pyramid of the Municipality of Doña Remedios Trinidad is indicative of the population distribution in the municipality and reflects the pattern of fertility, mortality and migration trends in the past. It also tells the past, present and future stories of the areas. It also clearly reflects workforce migration with the increase in the productive population and with a large portion of economically active population.

2.4.1.2.1.2 Gender Ratio

There are 109 males per 100 females in the Municipality of Doña Remedios Trinidad.

2.4.1.2.1.3 Dependency Ratios

The population belonging to the age group 15-64 is economically productive and comprises most of the work force in the area. While those belonging to the age groups of below 1 to age 15, and the age groups of more than 65 years old are considered dependents. Dependency ratio is the ratio of both age groups and is a measure if there are sufficient numbers of people who can support the dependent population.

In Barangay Talbak**,** 1,066 of the population belong to the productive age group. It means that 61% of the population has the capacity to earn income, while 680 or about 39% of the populations are dependent. Comparing to the Municipality of Doña Remedios Trinidad, 13,707 or 60% of the populations have the potential to earn.

Based from the data, in the impact barangays, Barangay Talbak the dependency ratio is 100:64. This means that the impacts barangay, for every 100 economically active individuals there are 64 dependents. In the Municipality of Doña Remedios Trinidad the ratio is 100:86 which means that for every 100 active earners, 86 are dependents. The national dependency ratio in 2015 was 100:51, which means that there are many more dependent populations per income earners in the impacts barangays compared to their respective municipalities and the whole country.

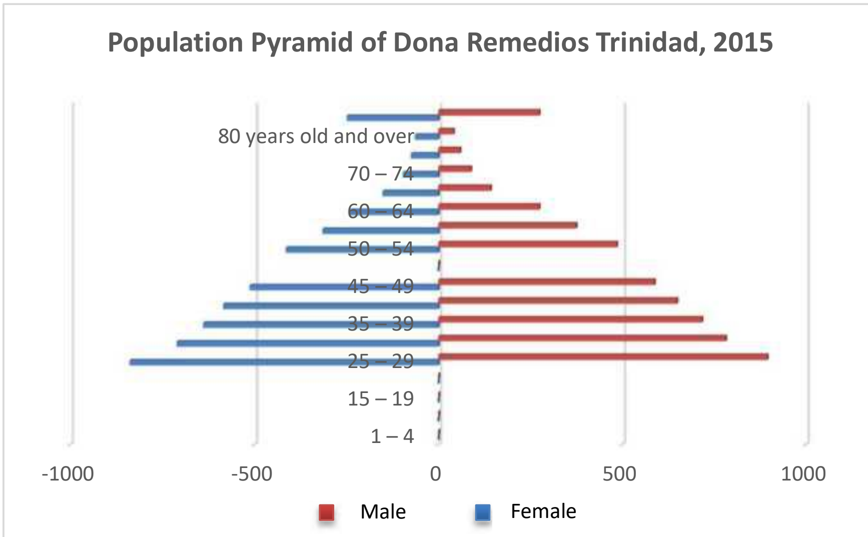


Figure 132 - Population Pyramid Municipality of Doña Remedios Trinidad

Table 43 - Dependency Ratio Barangay Talbak and Doña Remedios Trinidad

Age Group	Barangay Talbak		Doña Remedios Trinidad	
	No.	Dependency Ratio	No.	Dependency Ratio
Working Age (15-64)	1,066		13,707	
Dependent Population	680	64:100	11,803	86:100
Young (0-14)	628	59:100	11,089	81:100
Old (65 and above)	52	5:100	714	5:100

Source: Philippine Statistics Authority, 2015 Census of Population

2.4.1.2.1.4 Reproductive Age

Women of reproductive age refer to all women in the age group of 15 – 49 and are capable of child bearing. In the Municipality of Doña Remedios Trinidad 51% of the total female population can become pregnant and bear child. 5,499 females in Doña Remedios Trinidad are of reproductive age. Given the fertility rate of Filipino Women (3.5 birth per women), the age group of under 1 are apt to increase in the coming year.

2.4.1.2.1.5 Population Distribution and Density

Population density is a measurement of population living in a unit of area (square kilometers). It is an indication if an area is overcrowded, and if the area has suitable capacity to provide for its people. The average number of persons living in a square kilometer of land in the Philippines in 2015 is 337.

Table 44 - Population Density of Barangay Talbak and the Municipality of Doña Remedios Trinidad, 2015

Area	2015 Population	Land Area (square kilometers)	Population Density (No. of Persons per square kilometers)
Barangay Talbak	1,746	21.40	82
Doña Remedios Trinidad	22,663	932.96	25

Source: Philippine Statistics Authority, 2015 Census of Population

The total population density of Barangay Talbak is 82 persons per square kilometer of land, given that there are 1,746 inhabitants in an area measuring 21.40 square kilometers. The impact barangay is more densely populated compared to the Municipality of Doña Remedios Trinidad.

2.4.1.2.1.6 Average Household Size

The average household size is the number of persons residing within a household in a particular area. ***Table 45*** shows the average household size in the barangay and the municipality. The averaged family in Barangay Talbak is 4.2. The average household in Barangay Talbak is lower compared to the average household size of Doña Remedios Trinidad. However, the average household size of Doña Remedios Trinidad is higher compared to the national average of 4.4 per household.

Table 45 - Number of Household Size and Average Household Size of Barangay Talbak and Municipality of Doña Remedios Trinidad

Area	2015 Population	2015 No. of Household	Average Household Member
Barangay Talbak	1,746	415	4.2
Doña Remedios Trinidad	22,663	5,090	4.5

Source: Philippine Statistics Authority, 2015 Census of Population

2.4.1.2.1.7 Other Demographic Information

2.4.1.2.1.7.1 Ethnicity

In the province of Bulacan there are more than 10 ethnicities, majority of which is 76.6% reported Tagalog as their ethnicity. The other 23.4% were reported as belonging to these ethnic groups: Bisaya/Binisaya (7.6%), Bikol/Bicol (4.9%), Ilocano (2.8%), Waray (1.9%), Hiligaynon/Ilonggo (1.3%), Cebuano (1.1%), Kapampangan (1.0%), Pangasinan/Panggalato (0.8%), Masbateño/Masbatenon (0.2%), and others.

2.4.1.2.1.7.2 Marital Status

Marital status describes the individual's state of being married, single, widowed, divorced or live in.

In the household population of 10 years and over of Barangay Talbak, It shows that 40.28% are married, 38.94% are single, 3.13% are widowed, 1.04% are divorced 16.60% are living in (***Table 46***). The data also shows that for the majority of the categories, females surpassed the number of males.

Table 46 - Household Population 10 Years Old and Over by Marital Status and Sex: Barangay Talbak, 2015

Marital Status	Both Sexes		Male		Female	
	No.	%	No.	%	No.	%
Single	523	38.94	312	59.66	211	40.34
Married	541	40.28	270	49.91	271	50.09
Widowed	42	3.13	11	26.19	31	73.81
Divorced/Separated	14	1.04	3	21.43	11	78.57
Common-law/Live in	223	16.60	110	49.33	113	50.67

Marital Status	Both Sexes		Male		Female	
	No.	%	No.	%	No.	%
Unknown	0	0	0	0	0	0
Total	1,343	**100**	**706**	**52.57**	**637**	**47.43**

Source: Philippine Statistics Authority, 2015 Census of Population

Of the household population of 10 years and over in Doña Remedios Trinidad, 39.12% were married while 41.36% were never married. The rest of the population was categorized as follows: in common-law/live-in marital arrangement (15.29%), widowed (2.83%), and divorced/separated (1.37%). Among the never-married persons, 57.91% persons were males while 42.09% were females. For the rest of the categories for marital status, the females outnumbered the males.

Table 47 - Household Population 10 Years Old and Over by Marital Status and Sex: Doña Remedios Trinidad, 2015

Marital Status	Both Sexes		Male		Female	
	No.	%	No.	%	No.	%
Single	7,071	41.36	4,095	57.91	2,976	42.09
Married	6,687	39.12	3,336	49.89	3,351	50.11
Widowed	483	2.83	136	28.16	347	71.84
Divorced/Separated	234	1.37	99	42.31	135	57.69
Common-law/Live in	2,614	15.29	1,306	49.96	1,308	50.04
Unknown	6	0.04	4	66.67	2	33.33
Total	**17,095**	**100**	**8,976**	**52.51**	**8,119**	**47.49**

Source: Philippine Statistics Authority, 2015 Census of Population

2.4.1.2.1.7.3 Highest Educational Attainment

Educational attainment is a good indicator of well-being of a population and also shows the future trend for economic development. Young adults who have higher levels of education are more likely to achieve economic success compared to those that have not. In addition to this, completing more years of education protects against unemployment, leads to higher wages, qualifies to a broader range of jobs and are also connected to higher levels of socio-economic as well as socio-emotional well-being. It is also a good indicator of the gap between gender issues for women.

Based from the data gathered for the educational attainment of 5 years old and over in Barangay Talbak, it shows that there are 782 or 50.45% children that are still in elementary, 555 or 35.81% are in secondary level. The category of no grade completed and preschool have the same number of 64 or 4.13ndividuals (***Table 48***).

Table 48 - Household Population 5 Years Old and Over: Barangay Talbak, 2015

Highest Educational Attainment	Both Sexes		Male		Female	
	No.	%	No.	%	No.	%
No Grade Completed	64	4.13	38	59.38	26	40.63
Preschool	64	4.13	38	59.38	26	40.63
Elementary	782	50.45	427	54.60	355	45.40
Highschool	555	35.81	275	49.55	280	50.45
Post Secondary	21	1.35	7	33.33	14	66.67
College Undergraduate	45	2.90	20	44.44	25	55.56
Academic Degree Holder	18	1.16	7	38.89	11	61.11
Post baccalaureate	1	0.06	0	0	1	100
Not Reported	0	0	0	0	0	0
Total	**1,550**	**100**	**812**	**52.39**	**738**	**47.61**

Source: Philippine Statistics Authority, 2015 Census of Population

Table 49 shows the data on education attainment in the Municipality of Doña Remedios Trinidad, of the household population aged five years and over, 51.41% had attended or completed elementary education, 32.60% had reached or finished high school, 4.47% were college undergraduates, and 2.84% were academic degree holders. Among those with an academic degree, the females (62.34%) outnumbered the males (37.66%). Contrary, more males (66.67%) than females (33.33%) had pursued post baccalaureate courses.

Table 49 - Household Population 5 Years Old and Over by Highest Educational Attainment and Sex: Doña Remedios Trinidad, 2015

Highest Educational Attainment	Both Sexes		Male		Female	
	No.	%	No.	%	No.	%
No Grade Completed	903	4.56	499	55.26	404	44.74
Preschool	671	3.39	354	52.76	317	47.24
Elementary	10,186	51.41	5,595	54.93	4,591	45.07
Highschool	6,460	32.60	3,255	50.39	3,205	49.61

Highest Educational Attainment	Both Sexes		Male		Female	
	No.	%	No.	%	No.	%
Post Secondary	127	0.64	51	40.16	76	59.84
College Undergraduate	886	4.47	408	46.05	478	53.95
Academic Degree Holder	563	2.84	212	37.66	351	62.34
Post baccalaureate	3	0.02	2	66.67	1	33.33
Not Stated	16	0.08	12	75.00	4	25.00
Total	**19,815**	**100**	**10,388**	**52.42**	**9,428**	**47.58**

Source: Philippine Statistics Authority, 2015 Census of Population

2.4.1.2.1.7.4 Disability

Philippine Statistics Authority categorizes disability that can be physical, mental, or sensory motor impairment such as partial or total blindness, low vision, partial or total deafness, oral defect, having only one hand or no hands, one leg or no leg, mild or severe cerebral palsy, retarded, mentally ill, mental retardation, and multiple impairment.

In Barangay Talbak in general, there are 30 individuals with disability, 18 males and 12 females.

2.4.1.2.1.7.5 Housing

The tenure status and type of housing reveals in part the economic status of households and the quality of the people's lives in general. Based on the data in 2010, majority of households in the Municipality of Doña Remedios Trinidad owns or pay amortization (65.08%), 0.62% rented, 30.19% are free of rent with owner's consent. Furthermost, almost 41% or 1,806 of the houses are made up of materials such as bamboo, sawali, cogon and nipa while 79% or 3,478 houses have galvanized iron/aluminum roofs.

Table 50 - Number of Households by Tenure Status of the Lot: Doña Remedios Trinidad, 2010

Tenure Status of the Lot	Total Households	%
Owned/being amortized	2,932	65.08
Rented	28	0.62
Rent-free with consent of owner	1,360	30.19
Rent-free without consent of owner	81	1.80
Not Applicable	104	2.31

Tenure Status of the Lot	*Total Households*	*%*
Not Reported	-	
Total	**4,505**	**100**

Source: National Statistics Office, 2010 Census of Population and Housing

Construction Materials of the Outer Walls	*Total Occupied Housing Units*
Concrete/Brick/Stone	1,433
Wood	724
Half Concrete/Brick/Stone/ and Half Wood	351
Galvanized Iron/Aluminum	22
Bamboo/Sawali/Cogon/Nipa	1,806
Asbestos	1
Glass	-
Makeshift/Salvaged/Improvised Materials	51
Others	2
No walls	21
Not Reported	12
Total	**4,423**

Construction Materials of the Roof	*Total Occupied Housing Units*
Galvanized iron/Aluminum	3,478
Tile Concrete/Clay Tile	6
Half Galvanized Iron and Half Concrete	38
Wood	15
Cogon/Nipa/Anahaw	761
Asbestos	-
Makeshift/Salvaged/Improvised Materials	53
Others	72
Not Reported	-
Total	**4,423**

Source: National Statistics Office, 2010 Census of Population and Housing

2.4.1.2.1.7.6 Migration Pattern

2.4.1.2.1.7.6.1 In Migration

Migration patterns are directly associated with higher annual family income as well as expenditures. In migration pertains to the movement of people across a specific boundary for the purpose of establishing permanent residence within the country.

Among the 2,615,086 household population five years old and over who were enumerated in the province of Bulacan in 2001, 94.1% were non-movers. These are persons whose city/municipality of residence in 2005 was the same as in 2010. The other 5.9% had resided in a city or municipality other than the city/municipality where they were residing at the time of the 2010 CPH. About 123,700 persons resided in another province in 2005 while about 3,200 resided in a foreign country. Meanwhile, the number of those who were residing in another city or municipality but within the province was 28,500.

In the Municipality of Doña Remedios Trinidad (***Table 51***) there are 53% males and 47% females came from the same city or municipality, and 52% of males and 48% females come from other city or municipality. Males with 52% have the leading number of migration from other province compared to females with 48%.

Table 51 - Household Population 5 Years Old and Over by Sex, Place of Present Residence, Place of Residence 5 Years Ago: Doña Remedios Trinidad, 2010

Sex	Household Population 5 Years Old and Over	Place of residence 5 Years Ago				
		Same City/Municipality	Other City/Municipality Same Province	Other Province	Foreign Country	Unknown
Both Sexes	17,355	16,794	176	381	3	1
Male	9,163	8,869	92	199	3	-
Female	8,192	7,925	84	182	-	1

Source: National Statistics Office, 2010 Census of Population and Housing

2.4.1.2.1.7.6.2 Out – Migration

Of the 3,292,071 household population 15 years old and over in Bulacan, 3.03% (or 99,879 persons) were overseas workers. Male overseas workers outnumbered their female counterparts as they comprised 1.77% of all the overseas workers from this province. Overseas workers aged 45 years and over made up the largest age group, comprising 25% of the total overseas workers from this province in 2015, followed by the age groups 35-39 years (18.39%), 30 to 34 years (18.28%), and 25 to 29 years (15.69%).

Table 52 - Overseas Workers 15 Years Old and Over by Sex and Age Group, Bulacan: 2015

Age Group	Both Sexes		Male		Female	
	No.	%	No.	%	No.	%
Below 20	1,036	1.04	493	47.59	543	52.41
20 – 24	7,033	7.04	3,627	51.57	3,406	48.43
25 – 29	15,669	15.69	7,961	50.81	7,708	49.19
30 – 34	18,261	18.28	9,976	54.63	8,285	45.37
35 – 39	18,365	18.39	10,605	57.75	7,760	42.25
40 – 44	14,548	14.57	8,820	60.63	5,728	39.37
45 years old and over	24,967	25.00	16,754	67.10	8,213	32.90
Total	**99,879**	**100**	**58,236**	**58.31**	**41,643**	**41.69**

Source: Philippine Statistics Authority, 2015 Census of Population

2.4.1.2.1.8 Availability of Public Services

2.4.1.2.1.8.1 Health

There are currently eight operational health centers in Doña Remedios Trinidad, one for each barangay of the municipality. A Rural Health Unit (RHU) is also in existence located in Barangay Pulong Sampaloc.

According to the Municipality Health Office the leading cause of morbidity in Doña Remedios Trinidad are Acute Upper Respiratory Infections and wounds of all type. These may be cause by the type of work of some residents in the mining and quarrying sites and their lifestyle.

Table 53 - Ten Leading Cause of Morbidity, Doña Remedios Trinidad, 2017

Causes of Morbidity	No. of Cases
1. AURI (Acute Upper Respiratory Infections)	7540
2. WOUND ALL TYPES	3305
3. AGE (Acute Gastroenteritis)	2324
4. HPN (Hypertension)	2248

Causes of Morbidity	*No. of Cases*
5. Flu Like Symptoms	1830
6. Hypersensitivity	1784
7. Hyper acidity	1300
8. UTI (Urinary Tract Infection)	814
9. Bronchial Asthma	683
10. Arthritis	657

Source: Municipal Health Office, Doña Remedios Trinidad

As of 2014, the crude birth rate in the municipality is 174.27% live birth per 10,000 population while the crude death rate is 24.22% per 10,000 population. The two leading cause of death are all types of cancer and chronic obstructive pulmonary disease.

Table 54 - Top 10 Mortality 2017 (Ten Leading Causes of Mortality, 2017, Doña Remedios Trinidad)

Cause of Mortality	*No. of Cases*
1. Cancer all Types	13
2.COPD (Chronic Obstructive Pulmonary Disease)	9
3.Multiple Gun Shot Wound	7
4.Cardio Vascular Accident	6
5. Pneumonia	4
6. Cardio Vascular Disease	4
7. Congestive Heart Failure	4
8. DM (Diabetes Mellitus)	3
9. Multiple Head Injury	3
10.Anemia	3

Source: Municipal Health Office, Doña Remedios Trinidad

Hypertension and diabetes are the most common non-communicable diseases in the municipality which are lifestyle and age related.

Based on the records and the research or surveys, Barangay Talbak has a total of 33 children with an age range of 0 to 5 years old. In the number mentioned 24 or 80% of the children belong to the normal weight range, 4 or 12% is overweight, 2 or 6 % is underweight, and 3 or 9% is malnourished.

Table 55 - List of Barangay and Number of Non-Communicable Disease, Doña Remedios Trinidad, 2018

Barangay	Non Communicable Disease		
	Hypertension only	Diabetes Mellitus only	Both Hypertension / Diabetes Mellitus
Pulong Sampaloc	178	14	0
Camachile	277	49	26
Sapang Bulac	116	7	5
Bayabas	96	5	8
Talbak	63	11	6
Camachin	67	3	3
Kabayunan	92	3	6
DM CLUB	0	16	88
Kalawakan	335	29	32
GENERAL TOTAL	**1224**	**137**	**174**

Source: Municipal Health Office: Doña Remedios Trinidad, 2018

There are public health programs and projects being implemented by the Provincial Health Office of Bulacan.

PROGRAMS AND PROJECTS:
DISEASE-FREE ZONE INITIATIVES

- Rabies Elimination Services
- Leprosy Elimination Services
- Malaria Control Services

INTENSIFIED DISEASE PREVENTION AND CONTROL

- Tuberculosis Control Services
- HIV/AIDS and Sexually Transmitted Infection Control Services
- Dengue Control Services

EMERGING AND RE-EMERGING INFECTION PREVENTION AND CONTROL SERVICES

- Avian Influenza

CHILD HEALTH

- Expanded Program on Immunization (EPI)
- Breastfeeding Program
- Integrated Management of Childhood Illnesses (IMCI)
- Nutrition Services
- Dental Health Services
- Newborn Screening
- Mother-Baby Friendly Hospital (MBFH) Initiatives/Breastfeeding

MATERNAL HEALTH

- Immunization and Supplementation
- Facility-Based Deliveries
- Pre-Natal Visits and Post Partum Women
- BemONC/CEmONC Facility Mapping and Upgrading
- Women's Health Team

HEALTHY LIFESTYLE AND MANAGEMENT OF HEALTH RISKS

- Diabetes Prevention and Control Program
- Cancer Prevention and Control Program
- Renal Disease Control Program
- Cardiovascular Disease Prevention and Control Program
- Voluntary Blood Services Program
- Water and Sanitation Program
- Surveillance and Epidemic Management System
- Health Emergency Preparedness and Response System

HEALTH EDUCATION AND PROMOTION

HEALTH GOVERNANCE

- Local Health Systems Development
- Local Human Resource Strengthening
- Sectoral Development Approach for Health Implementation
- Local Health Information Development and Utilization

- Province-wide Investment Plan for Health

2.4.1.2.1.8.2 Sanitation

The Municipal Health Office of Doña Remedios Trinidad, recorded that 63.59% of the households in the municipality have toilets. However, this means that 36.41% of the households do not have access to toilets. In Barangay Talbak there is 5.02% with sanitary toilets while 10.63% households lack sanitary latrines. This situation could translate to increase prevalence of diseases connected with unsafe defecation practices, such as diarrhea and parasitism.

Table 56 - List of Barangay and Households with Sanitary Toilets, Doña Remedios Trinidad, 2018

Barangay	*Households with toilet*	*%*	*Households without toilet*	*%*
Pulong Sampaloc	826	18.83%	73	2.91%
Camachile	816	18.60%	412	16.41%
Sapang Bulac	531	12.11%	180	7.17%
Bayabas	309	7.05%	188	7.49%
Talbak	220	5.02%	267	10.63%
Camachin	264	6.02%	99	3.94%
Kabayunan				
Tagalog	*78*	1.78%	*155*	6.17%
Dumagat	*13*	0.30%	*211*	8.40%
Kalawakan 1				
Proper	248	5.65%	162	6.45%
Kalayakan	363	8.28%	147	5.85%
Duplas	321	7.32%	84	3.35%
Durumugan	72	1.64%	40	1.59%
Bulodam	41	0.93%	29	1.15%
Cucong	26	0.59%	55	2.19%
Kalawakan 2				
talamsi 1,2, kambu	21	0.48%	169	6.73%
Tubigan	72	1.64%	182	7.25%
Calumpit	165	3.76%	58	2.31%
GRAND TOTAL	**4386**	**100**	**2511**	**100**

Source: Municipal Health Office, Doña Remedios Trinidad, 2018

2.4.1.2.1.8.3 Education

Table 57 present the household population who are currently attending school in the Municipality of Doña Remedios Trinidad in 2015. The data shows that the total household populations in the age group of 5 – 24 are 10,087 individuals in Doña Remedios Trinidad.

Table 57 - Household Population 5 to 24 Years Old Who Were Currently Attending School by Age Group and Sex: Municipality of Doña Remedios Trinidad, 2015

Age Group	*Household Population 5 to 24 Years Old*			*Household Population 5 to 24 Years Old Who Were Currently Attending School*		
	Both Sexes	Male	Female	Both Sexes	Male	Female
5 – 9	2,721	1,412	1,309	2,542	1,316	1,226
10 – 14	2,674	1,407	1,267	2,479	1,276	1,203
15 – 19	2,515	1,329	1,186	1,281	639	642
20 – 24	2,177	1,146	1,031	183	92	91
Total	**10,087**	**5,294**	**4,793**	**6,485**	**3,323**	**3,162**

Source: Philippine Statistics Authority, 2015 Census of Population

In Barangay Talbak there are 235 youth with an age range of 6-12 years old that should be in elementary but 9% of the youth with the age range of 6 – 12 were out of school for some reasons. Youth with an age range 13 – 16 have a total number of 167 and 9% with the said age were out of school. A total of 402 youths with an age range of 6 – 16 years old are supposed to be in school but 9% of the total number were out of school or cannot go to school due to poverty or helping their parents earn money.

Table 58 - Number of youth (6 – 16) based on Age and Education, Barangay Talbak

Age	*Attending School*		*Out-of-school youth*	
	Female	*Male*	*Female*	*Male*
6 – 12	102	113	5	15
13 – 16	80	72	4	11
6 – 16	182	185	9	26

2.4.1.2.1.8.4 Social Welfare

The Provincial Social Welfare and Development Office (PSWDO) is the social welfare of the province that is mandated to provide basic services to disadvantaged members of the community.

It was tasked to provide programs and services to disadvantaged families and communities, to promote welfare of women, persons with disability, children and youth, and senior citizens and to provide them with opportunities to help them become productive, self-reliant and attain a better quality of life.

The programs services are as follows:

INDIGENTS

- Point of Care for the public clinic in sa Bulacan
- Burial Assistance
- Financial Assistance
- Medical Assistance

PERSONS WITH DISABILITY

- Organization of Municipal Federation of PWDs
- Bisikleta Bilis Kita
- Provision of wheelchairs and other assistive devices
- Abilympics/Paralympics

CHILDREN AND YOUTH

- Early Childhood Care and Development
- Cross Road Seminar
- Children's Congress
- Food Supplementation
- Child Labor

WOMEN AND FAMILY

- Gender and Development
- Effective Parenting
- Self-Employment Assistance
- Sa Iyong Pag-iisa May Kaagapay Ka *(Women Inmates)*
- Repro-Health and Nutrition Training for Would-be-Couples
- Aid for abused women

- Recognition for Outstanding Women & Women Organization during Women's Month Celebration
- PABASA sa Nutrisyon

SENIOR CITIZEN

- Technical assistance in meetings and workshop
- Lakbay Saya
- Celebration of Elderly Week
- Giving shots againts Pneumonia and Flu
- Giving assistive devices

VICTIMS OF CALAMITIES

- Relief Operation
- Provision of housing materials
- Stress Debriefing

NGOs AND VOLUNTEERS

- Leadership Training
- Capability Building
- Distributing, uniforms, bags and IDs

2.4.1.2.1.8.5 Peace and Order

Law and Order in the province of Bulacan is being maintained by the Philippine National Police (PNP). In Barangay Talbak there are 20 barangay tanod that are roving in the area.

2.4.1.2.1.9 Public Utilities and Infrastructure

2.4.1.2.1.9.1 Water Supply Services

Sources of water in Barangay Talbak are from Doña Remedios Trinidad Water District which supplies household waters. A total of 35 households are connected to the Water District of the municipality and 10% have their own jetmatic pump as their source of water for their households.

2.4.1.2.1.9.2 Power Supply Services

Barangay Talbak is supplied by MERALCO. Manila Electric Company (MERALCO) is the largest electric distribution utility company and the largest private sector utility in the Philippines. It provides electricity to over six million customers in 36 cities and 75 municipalities in a franchise area covering 9,337 km^2 that includes Metro Manila, the provinces of Rizal, Cavite, Bulacan, and parts of the provinces of Pampanga, Batangas, Laguna, and Quezon. The franchise covers the core of the country's industrial, commercial, and population centers.

2.4.1.2.1.9.3 Communication Facilities

In the Province of Bulacan there are twenty-three (23) towns that have telephone lines provided either by PLDT, DIGITEL, DATELCOM, and RACITELCOM. On the other hand, among the service providers of mobile communication includes GLOBE, SMART, and SUN CELLULAR. And lastly, electronic mailing has also become a major means of communication. Among the internet service providers are Winsystems, Bulacan.net, Mosaic Communications Company (Mozcom), Pacific Internet, and the abovementioned mobile companies. Further, there are still seventeen (17) telegraph facilities, twenty-five (25) post offices, and sixteen (16) postal stations operating in Bulacan. Major courier service providers have also set up their substations in the Province such as FedEX, DHL, LBC, JRS, and 2GO of Aboitiz.
In Barangay Talbak the residents rely on mobile phones, the services of which are being provided by Globe, Sun and Smart telecommunication companies. The cell sites of these three companies are located in Barangay Camachile in the Municipality of Doña Remedios Trinidad.

2.4.1.2.1.9.4 Transport Facilities

There are fourteen (14) bus companies in the province with 32 buses and terminals actively operating in the province of Bulacan with 32 buses and terminals actively operating in the Municipalities of Angat, Balagtas, Baliwag, Bocaue, Hagonoy, San Rafael, San Miguel, Santa Maria, and the City of San Jose Del Monte.

In 2012, there are a total of 271,003 registered vehicles in the province of Bulacan. From the total number of registered vehicles, 88% or 239,821 are privately owned, 0.33% or 885 are government vehicles and 11% or 30,297 are vehicles for hire.

Table 59 - Transportation, Province of Bulacan, 2012

Type of Motor Vehicle	Year 2012
Private	239,821
Government	885
For Hire	30,297
Total	**271,003**

In Barangay Talbak the most popular mode of public transport are motorcycles, tricycles and jeepneys.

2.4.1.2.1.9.5 Road Network System

Bulacan connects Manila to other parts of the Northern and Eastern provinces via the four major roads which are: the North Luzon Expressway (NLEx), Manila North Road (better known as McArthur Highway), Daang Maharlika Road, and the NCR-Bulacan-Boundary Bigte-Ipo-Dam Road. Aside from the four main highways that traverse the province, all roads are widely dispersed throughout Bulacan.

Bulacan has a total of 607.78 km of roads, 331.01 of these are of provincial roads while 276.77 national roads. Most (84%) of the provincial roads are concrete which has 279.00km in length, while 15 percent (48.11 km) are asphalt and 1 % (3.90 km) are gravel.

Bulacan had a total of 139.94 km (41.07%) concrete road in good condition; while under fair condition are 195.08 km (58.93%) and zero (0) under poor condition. The San Ildefonso Akle Road and Pulong Sampaloc-Buasaw-Akle road although classified under fair condition is still gravel.

Overall there are 118 bridges in the province of Bulacan.

2.4.1.2.1.9.6 Airport

Aside from NAIA, the Diosdado Macapagal Internation Airport (DMIA) in Clark Freeport Zone in Pampanga also serves Metro Manila and Central Luzon. Another airport near Bulacan and the Municipality of Doña Remedios Trinidad is the Baler Airport in Aurora. It is a community airport capable of handling small propeller aircraft with regular schedule flights twice a week.

2.4.1.2.1.10 Socio – Economic Information

2.4.1.2.1.10.1 Main Sources of Income and Sources of Livelihood

According to CLUP 2012-2022, Bulacan is classified as first class in income classification and has major projects such as high-value crops, marble, furniture, leather crafts, aquaculture, sweets and native delicacies, pyrotechnics, jewelry and meat and meat products. In the Municipality of Doña Remedios Trinidad the main source of income are from agriculture and manufacturing.

2.4.1.2.1.10.2 Employment Profile

In Doña Remedios Trinidad the number of employed or gainful worker in 2015 is 8,377 individuals. Among them, skilled agricultural forestry and fishery works and elementary occupations are the most numerous of occupations with 5,226 or 62% of all employed workers 15 years old and above. The remaining 38% performs task or employed in different areas such as managers, professionals, technicians and associate professionals, clerical support workers, service and sales workers, craft and related trades workers, plant and machine operators and assemblers, armed forces occupations and others.

The data also showed that males have more opportunities than females. In 2015, 6,219 males are employed, compared to 2,158 females. Seventy four percent of all major occupations go to the males.

Skilled agricultural forestry and fishery workers grow and harvest field or tree and shrub crops, gather wild fruits and plants, breed, tend or hunt animals, produce a variety of animal husbandry products, cultivate, conserve and exploit forests, breed or catch fish and cultivate or gather other forms of aquatic life in order to provide food, shelter and income for themselves and their households. In the municipality, they number about 3,975 workers or 48% of all the gainful workers. Elementary occupations consist of simple routine tasks that require the use of hand held tools and often some physical effort. The tasks include, selling goods in streets and public places or door to door, providing street services such as cleaning, washing, pressing, caretakers of apartments, cleaners of hotel, offices and other buildings, delivering messages and simple farming, fishing and hunting among others. They number about 1,251 workers or 15% of the total workers 15 years old and above.

Table 60 - Gainful workers 15 years old and above by major occupational group and sex, Municipality of Doña Remedios Trinidad, 2015

Sex and Major Occupation Group	Total Gainful Workers 15 Years Old and Over		
	Both Sexes	Male	Female
	8,377	6,219	2,158
Managers	429	138	291
Professionals	185	57	128
Technicians and Associate Professionals	171	76	95
Clerical Support Workers	164	64	100
Service and Sales Workers	772	413	359
Skilled Agricultural Forestry and Fishery Workers		3,286	689
Craft and Related Trades Workers	763	586	177
Plant and Machine Operators and Assemblers	632	617	15
Elementary Occupations	1,251	953	298
Armed Forces Occupations	20	20	-
Other Occupation Not Elsewhere Classified	-	-	-
Not Reported	15	9	6

Source: Philippine Statistics Authority, 2015 Census of Population

Labor and Employment

According to the Barangay Socio-Economic/Ecological Profile and Development Plan of Barangay Talbak, the total number of labor forces is 1,721 that have an age range of 15 years old to 65 years old that still provides to the needs of their family but only 1% or 15 individuals is gainfully employed, 2% or 32 were unemployed and 97% or 1,674 were underemployed.

Table 61 - Number of Labor Force based on Age, Barangay Talbak

Age	Employed	Unemployed	Underemployed
15 – 19			180
20 – 24	10		150
25 – 29		7	195
30 – 34	2		221
35 – 39	3		186
40 – 44		8	170

Age	Employed	Unemployed	Underemployed
45 – 49			122
50 – 54		2	151
55 – 59		5	142
60 – 64		10	90
65 above			67
Total	**15**	**32**	**1,674**

2.4.1.2.1.10.3 Poverty Incidence

The annual monthly per capita poverty threshold is the measure of the minimum income for an individual to meet his/her basic needs. These include food, clothing, housing, transportation, health and education expenses. In the province of Bulacan, the monthly minimum income is pegged at P1,832 monthly or 21,989 yearly (***Table 62***)in 2015. This means that the individual in Bulacan must earn P1,832 or higher for him/her to meet the family's basic need.

Table 62 - Annual Per Capita Poverty Threshold, Bulacan, 2015

Year	Annual (Pesos)	Monthly (Pesos)
2009	18,434	1,536
2012	19,910	1,659
2015	21,989	1,832

Source: Philippine Statistics Office, 2015 Census of Population

Table 63 showed the poverty incidence in the province of Bulacan. Poverty incidence is the proportion of families with income less than or below the poverty threshold. It showed that the poverty threshold in Bulacan is 3.3, which means that for every 100 families in Bulacan, 3 are considered poor and doesn't meet the basic needs of the family.

Table 63 - Poverty Incidence 2010, 2012, 2015

	2009	2012	2015
Bulacan	**4.6**	**5.4**	**3.3**

2.4.1.2.1.10.4 Business and Commercial Establishment

Barangay Pulong Sampaloc and Talbak have been identified as the potential sites for business centers in Doña Remedios Trinidad. This is evident in the presence of commercial activities, a result of its strategic location, in the center and down south of the municipality. Enhancement and intensification of business activities in these areas are required to achieve this development. Aside from the business centers, DRT is expecting a number of economic generators to stimulate development. They include, but are not limited to, the satellite government center in Barangay Kalawakan; a proposed municipal public market and the pilgrimage site of Our Lady of Piat in Barangay Pulong Sampaloc; and the tourist destinations scattered in the eight barangays. Upon its completion, the influx of tourists and visitors are expected. These support facilities such as commercial establishments are proposed to be situated near these areas to cater to the demands of the people.

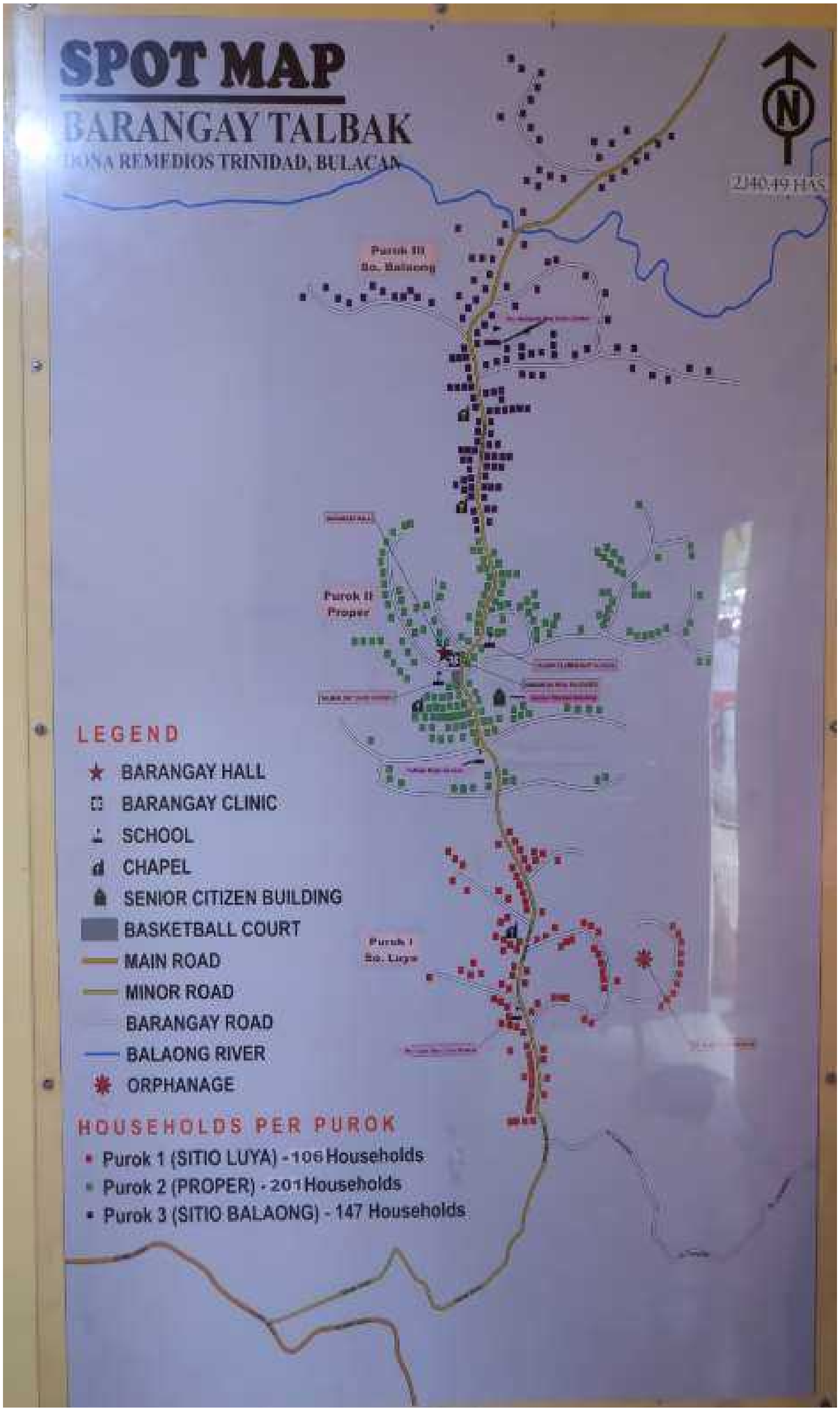


Figure 133 - Spot Map of Barangay Talbak

Figure 134 - Spot Map of Barangay Akle

2.4.1.2.2 Barangay Akle

In Barangay Akle, the population of Barangay Akle grew from 2,378 in 1990 to 4,330 in 2015, an increase of 1,952 people. The latest census figures in 2015 denote a positive growth rate of 5.19%, or an increase of 1,010 people, from the previous population of 3,320 in 2010. This means that the population of Barangay Akle increased yearly. Increased in population growth may have implications in the economic situation as well as the delivery of basic services to each family in the community.

Table 64 - Population and Growth Rate of Barangay Akle and Municipality of San Ildefonso, 2010 and 2015

Area	2010 Population	2015 Population	Population Growth Rate (%)
Barangay Akle	3,320	4,330	5.19
San Ildefonso	95,000	104,471	1.82

Source: 2010 Census of Population and Housing
2015 Census of Population (Philippine Statistics Authority, 2015)

2.4.1.2.2.1 Population and Composition

On the household population by age group and age composition, in Barangay Akle (***Table 65***) the age group that has the highest composition is the age group of 5 – 9 years old (11.73%). It is approximately the same compared to the Municipality of San Ildefonso in which 10.52% of the population are in the same age group of 5 – 9.

Table 65 - Household Population by Age Group and Age Composition: Barangay Akle, 2015

Age Group	Both Sexes	Age Composition (%)
Under 1	89	2.06
1 – 4	422	9.75
5 – 9	508	11.73
10 – 14	405	9.35
15 – 19	390	9.01
20 – 24	446	10.30
25 – 29	419	9.68
30 – 34	347	8.01
35 – 39	297	6.86
40 – 44	240	5.54
45 – 49	215	4.97

Age Group	Both Sexes	Age Composition (%)
50 – 54	174	4.02
55 – 59	155	3.58
60 – 64	107	2.47
65 – 69	48	1.11
70 – 74	27	0.62
75 – 79	23	0.53
80 years old and over	18	0.42
TOTAL	**4,330**	**100**

Table 66 - Household Population by Age Group and Sex, and Age Composition, and Sex Ratio: San Ildefonso, 2015

Age Group	Both Sexes	Male	Female	Age Composition (%)	Sex Ratio
Under 1	2,075	1,151	924	1.99	1.25:1
1 – 4	8,296	4,377	3,919	7.96	1.12:1
5 – 9	10,975	5,760	5,215	10.52	1.10:1
10 – 14	10,101	5,157	4,944	9.69	1.04:1
15 – 19	10,128	5,183	4,945	9.71	1.05:1
20 – 24	10,132	5,202	4,930	9.72	1.06:1
25 – 29	8,865	4,536	4,329	8.50	1.05:1
30 – 34	7,968	4,080	3,888	7.64	1.05:1
35 – 39	7,205	3,638	3,567	6.91	1.02:1
40 – 44	5,912	3,042	2,870	5.67	1.06:1
45 – 49	5,913	2,985	2,928	5.67	1.02:1
50 – 54	4,760	2,381	2,379	4.56	1.00:1
55 – 59	3,809	1,830	1,979	3.65	0.92:1
60 – 64	2,953	1,458	1,495	2.83	0.98:1
65 – 69	1,999	909	1,090	1.92	0.83:1
70 – 74	1,312	578	734	1.26	0.79:1
75 – 79	952	365	587	0.91	0.62:1
80 years old and over	931	312	619	0.90	0.50:1
All Ages	**104,286**	**52,944**	**51,342**	**100**	**1.03:1**

Source: Philippine Statistics Authority, 2015 Census of Population

The shape of the population pyramid of the Municipality of San Ildefonso is indicative of the population distribution in the municipality and reflects the pattern of fertility, mortality and migration trends in the past. It also tells the past, present and future stories of the areas. It also clearly reflects workforce migration with the increase in the productive population and with a large portion of economically active population.

2.4.1.2.2.2 Gender Ratio

There are 103 males per 100 females in the Municipality of San Ildefonso.

2.4.1.2.2.3 Dependency Ratios

In Barangay Akle,(***Table 67***) 2,790 of the population belong to the productive age group and it means that 64% of the population has the capacity to earn income, while 1,540 or about 36% of the populations are dependents. Compared to San Ildefonso, 67,645 or 65% of the populations have the potential to earn and 36,641 or 35% of the populations are dependent.

Based from the data, in the impact barangay, Barangay Akle the dependency ratio is 100:55. This means that for every 100 economically active individuals there are 55 dependents. In Municipality of San Ildefonso the ratio is 100:54 which means that for every 100 active earners 54 are dependents. The national dependency ratio in 2015 was 100:51, which means that there are many more dependent populations per income earners in the impact barangay compared to the municipality and the whole country.

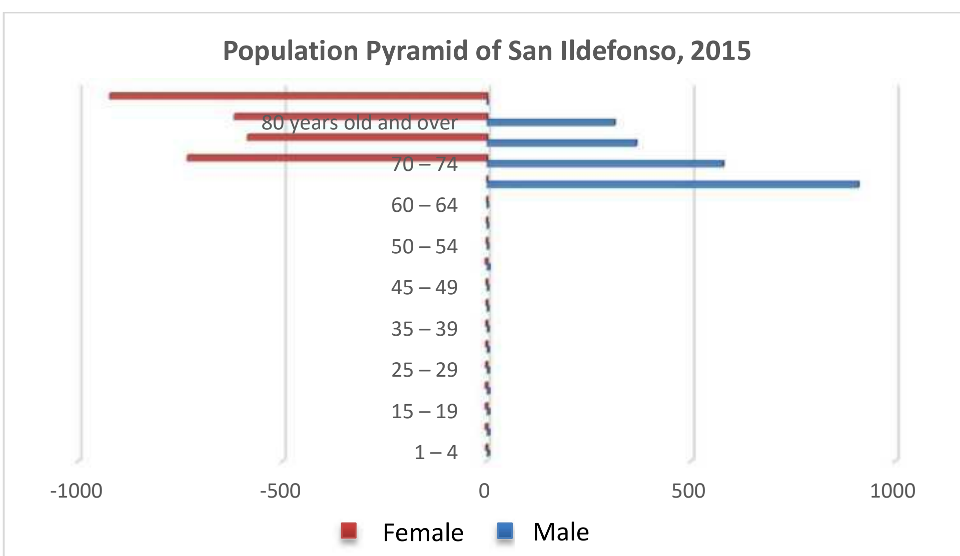


Figure 135 - Population Pyramid Municipality of San Ildefonso

Table 67 - Dependency Ratio Barangay Akle and San Ildefonso

Age Group	Barangay Akle		San Ildefonso	
	No.	Dependency Ratio	No.	Dependency Ratio
Working Age (15-64)	2,790		67,645	
Dependent Population	1,540	55:100	36,641	54:100
Young (0-14)	1,424	51:100	31,447	46:100
Old (65 and above)	116	4:100	5,194	8:100

Source: Philippine Statistics Authority, 2015 Census of Population

2.4.1.2.2.4 Reproductive Age

Women of reproductive age refer to all women in the age group of 15 – 49 and are capable of child bearing. In the Municipality of San Ildefonso, 53% of the total female population can become pregnant and bear children. 27,457 females in San Ildefonso are of reproductive age. Given the fertility rate of Filipino Women (3.5 birth per women), the age group of under 1 are apt to increase in the coming year.

2.4.1.2.2.5 Population Distribution and Density

In Barangay Akle the total population density is 590 persons per square kilometer of land with 4,330 inhabitants in an area of 7.34 square kilometers. It is lightly populated compared to Municipality of San Ildefonso that has a population density of 812 individuals residing in every square kilometer of land.

Table 68 - Population Density of Barangay Akle and Municipality of San Ildefonso, 2015

Area	2015 Population	Land Area (square kilometers)	Population Density (No. of Persons per square kilometers)
Barangay Akle	4,330	7.34	590
San Ildefonso	104,471	128.71	812

Source: Philippine Statistics Authority, 2015 Census of Population

2.4.1.2.2.6 Average Household Size

The average household size is the number of persons residing within a household in a particular area. *(**Table 69**)* shows the average household size in the impact barangay and the municipality. The averaged family in Barangay Akle is 4.0. The average household in Barangay Akle is lower compared to the average household of the municipality.

Table 69 - Number of Household by Household Size and Average Household Size of Barangay Akle and Municipality San Ildefonso

Area	2015 Population	2015 No. of Household	Average Household Member
Barangay Akle	4,330	1,083	4.0
San Ildefonso	104,471	24,257	4.3

Source: Philippine Statistics Authority, 2015 Census of Population

2.4.1.2.2.7 Other Demographic Information

2.4.1.2.2.7.1 Marital Status

For the Household Population of 10 years old and over in Barangay Akle, the data indicates that there are 38.87% of the population are married, 36.67% are single, 20.33% are living in, 2.57% are widowed and 1.57% are separated (***Table 70***). The total number of singles consist of 58.40% male and 41.60% female. The number of males (50.35%) and females (49.65) that are married were relatively closed. For the rest of the categories, the females dominate in numbers compared to the number of males.

Table 70 - Household Population 10 Years Old and Over: Barangay Akle, 2015

Marital Status	Both Sexes		Male		Female	
	No.	%	No.	%	No.	%
Single	1,214	36.67	709	58.40	505	41.60
Married	1,287	38.87	648	50.35	639	49.65
Widowed	85	2.57	22	25.88	63	74.12
Divorced/Separated	52	1.57	17	32.69	35	67.31
Common-law/Live in	673	20.33	333	49.98	340	50.52
Unknown	0	0	0	0	0	0
Total	**3,311**	**100**	**1,729**	**52.22**	**1,582**	**47.78**

Source: Philippine Statistics Authority, 2015 Census of Population

Table 71 describes the marital status in the Municipality of San Ildefonso; it shows that there are more males than females that haven't married. Of the household population of 10 and above, 44.94% were married while 40.28% were single. The rest of the population was categorized as follows: in common-law/live-in marital arrangement (8.73%), widowed (4.45%), and divorced/separated (1.56%). Among the never-married persons, 54.70% persons were males while 45.30% were females. For the rest of the categories for marital status, the females outnumbered the males.

Table 71 - Household Population 10 Years Old and Over by Marital Status and Sex: San Ildefonso, 2015

Marital Status	Both Sexes		Male		Female	
	No.	%	No.	%	No.	%
Single	33,408	40.28	18,275	54.70	15,133	45.30
Married	37,274	44.94	18,500	49.63	18,774	50.37
Widowed	3,694	4.45	817	22.12	2,877	77.88
Divorced/Separated	1,296	1.56	468	36.11	828	63.89
Common-law/Live in	7,243	8.73	3,582	49.45	3,661	50.55
No response	25	0.03	14	56.00	11	44.00
Total	**82,940**	**100**	**41,656**	**50.22**	**41,284**	**49.78**

Source: Philippine Statistics Authority, 2015 Census of Population

2.4.1.2.2.7.2 Highest Educational Attainment

Of the household population 5 years and over in Barangay Akle, there are 1,429 or 37.42% children in elementary, 1,799 or 47.11% students are in highschool. For college undergraduate there is a total of 209 individuals, 126 are attending pre-school and 114 are academic degree holders.

Table 72 - Household Population 5 Years and Over: Barangay Akle, 2015

Highest Educational Attainment	Both Sexes		Male		Female	
	No.	%	No.	%	No.	%
No Grade Completed	64	1.68	31	48.44	33	51.56
Preschool	146	3.82	77	52.74	69	47.26
Special Education	1	0.03	0	0	1	100

Highest Educational Attainment	Both Sexes		Male		Female	
	No.	%	No.	%	No.	%
Elementary	1,429	37.42	753	52.69	676	47.31
Highschool	1,799	47.11	954	53.03	845	46.97
Post Secondary	57	1.49	19	33.33	38	66.67
College Undergraduate	209	5.47	106	50.72	103	49.28
Academic Degree Holder	114	2.99	58	50.88	56	49.12
Post baccalaureate	-	-	-	-	-	-
Not Reported	-	-	-	-	-	-
Total	**3,819**	**100**	**1,998**	**52.32**	**1,821**	**47.68**

In the Municipality of San Ildefonso (***Table 73***), of the household population aged five years and over, 38.59% had attended or completed elementary education, 35.46% had reached or finished high school, 9.32% were college undergraduates, and 10.14% were academic degree holders. Among those with an academic degree, the females (58.33%) outnumbered the males (41.67%). Similarly, more females (68.75%) than males (31.25%) had pursued post baccalaureate courses.

Table 73 - Household Population 5 Years Old and Over by Highest Educational Attainment and Sex: San Ildefonso, 2015

Highest Educational Attainment	Both Sexes		Male		Female	
	No.	%	No.	%	No.	%
No Grade Completed	1,549	1.65	814	52.55	735	47.45
Preschool	2,775	2.95	1,472	53.05	1,303	46.95
Elementary	36,315	38.59	19,109	52.62	17,206	47.38
Highschool	33,364	35.46	17,034	51.06	16,330	48.94
Post Secondary	1,638	1.74	765	46.70	873	53.30
College Undergraduate	8,773	9.32	4,352	49.61	4,421	50.39
Academic Degree Holder	9,545	10.14	3,977	41.67	5,568	58.33
Post baccalaureate	48	0.05	15	31.25	33	68.75
Not Stated	76	0.08	47	61.84	29	38.16
Total	**94,100**	**100**	**47,593**	**50.58**	**46,507**	**49.42**

Source: Philippine Statistics Authority, 2015 Census of Population

2.4.1.2.2.7.3 Disability

In Barangay Akle, one (1) individual had visual abnormality, three (3) with speech problem, nine (9) with orthopedic disorder, one (1) with chronic illness, one (1) with intellectual problem and seven (7) with learning difficulty.

2.4.1.2.2.7.4 Housing

In Municipality of San Ildefonso, 83.27% owns or pay amortization, 4.54% rented and 11.55% are free of rent with consent of the owner. Furthermost, almost 65% of the houses are made up of durable materials such as concrete, bricks and while 84% or 17,182 houses have galvanized iron/aluminum roofs.

Table 74 - Number of Households by Tenure Status of the Lot: San Ildefonso, 2010

Tenure Status of the Lot	*Total Households*	*%*
Owned/being amortized	17,250	83.27
Rented	940	4.54
Rent-free with consent of owner	2,392	11.55
Rent-free without consent of owner	89	0.43
Not Applicable	44	0.21
Not Reported	1	0
Total	**20,716**	**100**

Source: National Statistics Office, 2010 Census of Population and Housing

Table 75 - Occupied Housing Units by Construction Materials of the Outer Walls and Roof: San Ildefonso, 2010

Construction Materials of the Outer Walls	*Total Occupied Housing Units*
Concrete/Brick/Stone	13,441
Wood	1,621
Half Concrete/Brick/Stone/ and Half Wood	3,419
Galvanized Iron/Aluminum	78
Bamboo/Sawali/Cogon/Nipa	1,702
Asbestos	4
Glass	1
Makeshift/Salvaged/Improvised Materials	203
Others	10

No walls	-
Not Reported	82
Total	**20,561**
Construction Materials of the Roof	***Total Occupied Housing Units***
Galvanized iron/Aluminum	17,182
Tile Concrete/Clay Tile	88
Half Galvanized Iron and Half Concrete	1,615
Wood	701
Cogon/Nipa/Anahaw	742
Asbestos	2
Makeshift/Salvaged/ improvised Materials	215
Others	16
Not Reported	-
Total	**20,561**

Source: National Statistics Office, 2010 Census of Population and Housing

In Municipality of San Ildefonso, 83.27% owns or pay amortization, 4.54% rented and 11.55% are free of rent with consent of the owner. Furthermost, almost 65% of the houses are made up of durable materials such as concrete, bricks and while 84% or 17,182 houses have galvanized iron/aluminum roofs.

2.4.1.2.2.7.5 Migration Pattern

2.4.1.2.2.7.5.1 In Migration

In the Municipality of San Ildefonso (***Table 76***) there are 50% males and females came from the same city or municipality, and 46% of males and 54% females come from other city or municipality. Males with 52% have the leading number of migration from other province compared to females with 48%.

Table 76 - Household Population 5 Years Old and Over by Sex, Place of Present Residence, Place of Residence 5 Years Ago: San Ildefonso, 2010

Sex	Household Population 5 Years Old and Over	Place of residence 5 Years Ago				
		Same City/Municipality	Other City/Municipality Same Province	Other Province	Foreign Country	Unknown
Both Sexes	84,467	82,608	483	1,232	140	4
Male	42,565	41,624	222	641	77	1
Female	41,902	40,984	261	591	63	3

Source: National Statistics Office, 2010 Census of Population and Housing

2.4.1.2.2.8 Availability of Public Services

2.4.1.2.2.8.1 Health

In the Municipality of San Ildefonso there are 33 health stations, and 39 private hospitals and clinics. And there are 17 public health nurses, 16 rural health midwives, 1 sanitary inspector, 1 medical technologist, 2 dentists and 1 nutritionist. In the municipality the leading cause of morbidity are diseases of the heart and cancer.

Table 77 - Mortality, San Ildefonso

Cause of Mortality	No. of Cases
1. Diseases of the heart	101
2. Cancer	43
3. Accident (ex. hit by a vehicle)	22
4. Diabetes	21
5. Complication during pregnancy or childbirth	15
6. Disease of the lungs	14
7. Tuberculosis	13
8. Disease of the vascular system	11
9. Pneumonia	10
10. Diarrhea	2

Source: 2012, Community-Based Monitoring System (CBMS)

In Barangay Akle there is 1 Barangay Health Station, for 2017, they have recorded 11 children with low weight, 6 above normal and 621 children have normal weight.

2.4.1.2.2.8.2 Sanitation

The Municipality of San Ildefonso has almost 100% of household with access to safe water and 91% of households with access to sanitary toilets. In Barangay Akle out of 720 households only 88% or 634 households have access to sanitary toilets.

Table 78 - Access to Safe Water and Access to Sanitary Toilets in Barangay Akle, 2017

Barangay	No. of Households	With Access to Safe Water	With Access to Sanitary Toilets
Akle	720	720	634

Source: 2017, Socio-Economic Profile, San Ildefonso

2.4.1.2.2.8.3 Education

Table 79 presents the household population who are currently attending school in the Municipality of San Ildefonso in 2015. The data shows that the total household populations in the age group of 5 – 24 are 41,336 individuals in San Ildefonso.

Table 79 - Household Population 5 to 24 Years Old Who Were Currently Attending School by Age Group and Sex: Municipality of San Ildefonso, 2015

Age Group	Household Population 5 to 24 Years Old			Household Population 5 to 24 Years Old Who Were Currently Attending School		
	Both Sexes	Male	Female	Both Sexes	Male	Female
5 – 9	10,975	5,760	5,215	10,520	5,507	5,013
10 – 14	10,101	5,157	4,944	9,621	4,833	4,788
15 – 19	10,128	5,183	4,945	6,165	3,025	3,140
20 – 24	10,132	5,202	4,930	1,233	683	550
Total	**41,336**	**21,302**	**20,034**	**14,048**	**14,048**	**13,491**

Source: Philippine Statistics Authority, 2015 Census of Population

In the Municipality of San Ildefonso there are 11 private pre-elementary and elementary schools, 6 secondary private schools, 42 day care centers, 38 public pre-elementary and elementary schools, 5 public secondary schools, 1 vocational school and 1 tertiary school as of school year 2017-2018.

Based on the Socio- Economic of the Municipality of San Ildefonso, There are 3 Day Care Centers in Barangay Akle and for school year 2017 – 2018 they have a total of 165 enrollees consists of 88 boys and 77 girls. There is also 2 elementary schools in Barangay Akle, namely Akle Elementary School with 807 enrollees and Narra Primary School with 291 enrollees. For Secondary School, Akle High School have a total of 804 enrollees. In ALS (Alternative Learning System) there are a total of 24 enrollees.

2.4.1.2.2.8.4 Peace and Order

Law and Order in the province of Bulacan is being maintained by the Philippine National Police (PNP). There are 65 police forces in Municipality of San Ildefonso for the year 2017 there are 709 blotters recorded and the average monthly crime rate is 55 per 100,000 populations. In Barangay Akle there are 21 barangay tanods and 2 patrol vehicles.

2.4.1.2.2.8.5 Public Utilities and Infrastructure

2.4.1.2.2.8.5.1 Water Supply Services

In Barangay Akle they have their own water system regulated by their Sanggunian.

2.4.1.2.2.8.5.2 Power Supply Services

Barangay Akle is supplied by MERALCO. Manila Electric Company (MERALCO) is the largest electric distribution utility company and the largest private sector utility in the Philippines. It provides electricity to over six million customers in 36 cities and 75 municipalities in a franchise area covering 9,337 km^2 that includes Metro Manila, the provinces of Rizal, Cavite, Bulacan, and parts of the provinces of Pampanga, Batangas, Laguna, and Quezon. The franchise covers the core of the country’s industrial, commercial, and population centers.

2.4.1.2.2.8.5.3 Communication Facilities

In Barangay Akle the residents rely on mobile phones, the services of which are being provided by Globe, Sun and Smart telecommunication companies. The cell sites of these three companies are located in Barangay Camachile in the Municipality of Doña Remedios Trinidad; On the other hand a Globe Telecommunication Tower or cell site has been established in Barangay Akle.

2.4.1.2.2.8.5.4 Transport Facilities

In Barangay Akle the most popular mode of public transportation are motorcycles, tricycles and jeepneys.

2.4.1.2.2.9 Socio-Economic Information

2.4.1.2.2.9.1 Main Sources of Income and Sources of Livelihood

Data shows that in San Ildefonso there are 38 manufacturing establishments and 1,072 commercial establishments, where in; in Barangay Akle there is 1 manufacturing establishment and 21 commercial establishments.

2.4.1.2.2.9.2 Employment Profile

Table 80 presents the number of gainful workers in the Municipality of San Ildefonso. There are 44,497 employed workers. Among them, Skilled Agricultural Forestry and Fishery Workers and Craft and Related Trades Workers are the numerous occupations with 15,546 or about 35% of all employed workers 15 years old and above. The remaining 65% performs tasks or employed in different areas such as managers, professionals, technicians and associate professionals, clerical support workers, service and sales workers, plant and machine operators and assemblers, elementary occupations, armed forces occupations and others. It also shows that males have more opportunities than females. In 2015, 29,390 males are employed compared to only 15,107 females. 66% of all major occupations go to the males. Skilled agricultural forestry and fishery workers grow and harvest field or tree and shrub crops, gather wild fruits and plants, breed, tend or hunt animals, produce a variety of animal husbandry products, cultivate, conserve and exploit forests, breed or catch fish and cultivate or gather other forms of aquatic life in order to provide food, shelter and income for themselves and their households. In the municipality, they number about 7,987 workers or 48% of all the gainful workers. Craft and related workers apply their specific knowledge and skills in the fields of mining and construction, form metal, erect metal structures, set machine tools, or make, fit, maintain and repair machinery, equipment or tools, carry out printing work as well as produce or process foodstuffs, textiles, or wooden, metal and other articles, including handicraft goods. Tasks performed by craft and related trades workers usually include: extracting and working solid minerals; constructing, maintaining and repairing buildings and other structures. They number about 7,559 or 17% of the total workers 15 years old and above.

Table 80 - Gainful workers 15 years old and above by major occupational group and sex, Municipality of San Ildefonso, 2015

Sex and Major Occupation Group	Total Gainful Workers 15 Years Old and Over		
	Both Sexes	Male	Female
	44,497	29,390	15,107
Managers	3,281	1,239	2,042
Professionals	2,343	741	1,602
Technicians and Associate Professionals	2,902	1,783	1,119
Clerical Support Workers	2,165	976	1,189
Service and Sales Workers	5,678	2,767	2,911
Skilled Agricultural Forestry and Fishery Workers	7,987	7,172	815
Craft and Related Trades Workers	7,559	4,334	3,225
Plant and Machine Operators and Assemblers	5,369	5,210	159
Elementary Occupations	7,122	5,108	2,014
Armed Forces Occupations	26	23	3
Other Occupation Not Elsewhere Classified	-	-	-
Not Reported	65	27	28

Source: Philippine Statistics Authority, 2015 Census of Population

2.4.1.2.2.10 Labor and Employment

In the 33,928 members of labor force in the Municipality of San Ildefonso 65% or 22,212 are males and 35% or 11,716 are females. Out of 33,646, 90% or 30,646 are employed with almost 60% or 20,219 males and 31% or 10,427 females. And 10% of the total numbers are unemployed with 6% or 1,993 males and 4% or 1,289 females. In Barangay Akle there is a total 1,281 labor force members with 77% or 986 males and 23% or 295 females. Out of the total number, 89% or 1,143 are employed with 61% or 913 males and 18% or 230 females; and 11% or 128 are unemployed with 6% or 73 males and 5% or 65 females.

Table 81 - Employment and Unemployment Rate of Barangay Akle and Municipality of San Ildefonso

Barangay	Number of Members of the labor force			Employed Members			Unemployed Members		
	Both Sexes	Male	Female	Both Sexes	Male	Female	Both Sexes	Male	Female
San Ildefonso	33,928	22,212	11,716	30,646	20,219	10,427	3,282	1,993	1,289
Akle	1,281	986	295	1,143	913	230	138	73	65

2.4.1.2.2.10.1 Business and Commercial Establishment

In the Municipality of San Ildefonso the 2 major economic activities are 1) Agricultural, it is the main surce of livelihood/income in the Municipality. The agricultural crop production is dominated by rice, corn, vegetables, root crops, banana and fruit trees. Backyard swine and poultry production serves as alternative livelihood for farmers. 2) Manufacturing, there are manufacturing establishments operating in the locality. The largest of which is the Eagle Cement Corporation, a cement manufacturing company located at Barangay Akle. Next to that is the Solid Development Corporation situated at Barangay Mataas na Parang and its main product is textiles. These two companies are among the major local sources of income of the municipality. In which in Barangay Akle there are 21 commercial establishments.

2.4.2 Perception Survey

2.4.2.1 Methodology

In compliance with the provisions of DENR Administrative Order No. 2017-05 or the “Guidelines on Public Participation under the Philippine Environmental Impact Statement (EIS) System”, an Initial Perception Survey was conducted on April 19, 2018 and several perception surveys for the communities/puroks was conducted on December 4 and 7, 2018.

The Barangays covered in this study are those considered as direct impact areas when the proposed project ensues its operation. These include Barangay Talbak (Host Barangay) and Barangay Akle (Neighboring Barangay). The initial perception survey was focused on the said two Barangays. A total of 45 respondents in Barangay Akle and 38 respondents in Barangay Talbak were surveyed representing the households and the institutional leaders and industrial entities in the barangay. A series of perceptions surveys was also conducted which focused on the puroks and the people of Barangays Talbak and Akle. Respondents from Talbak were 55, while respondents from Akle were 54 with 109 total representatives of the households from the impact barangays participated in the survey.

Table 82 presents the total number of respondents (including the respondents in the initial perception survey), the puroks and the corresponding number of respondents. A total of 192 individuals participated in the perception survey from the selected purok of Barangays Talbak and Akle. Purposive sampling was used in identifying the survey respondents. Community leaders, representatives from institutional and industrial entities, and homeowners and purok leaders, as well as random residents, were selected. The target sample size for the perception survey was based on 90% level of confidence and 10% margin of error.

Table 82 - Puroks and Number of Respondents

Puroks	*Number of Respondents*
Initial Perception Survey	
Talbak	38
Akle	45
Total	**83**
Perception Survey	
Talbak	**55**
Balaong	9
Centro	2
Luya	2
Nayon	5
Proper	19
Did not specify	18
Akle	**54**
Centro	8
Hulo	23
Luwasan	2
Narra	1
Sinambalan	1
Did not specify	19
Grand Total	**192**

The survey questionnaire was divided into seven (7) major components: (1) Personal Information; (2) Household Information; (3) Housing Condition; (4) Health Information; (5) Perceived Community Problems and Proposed Solutions; (6) Awareness on Eagle Cement Operation; and (7) Awareness and Acceptability on the Proposed Project of Eagle Cement. The survey form used is attached as **Annex F**.

The initial survey was conducted at the Talbak Covered Court and Akle High School, while the perception survey was conducted in the different puroks of the said two Barangays, to understand and assess the needs and issues of the people of the impact barangay. The result of the perception survey was integrated into the report on the perception survey. The photo-documentation of both activities are attached as **Annex G**.

2.4.2.2 Perception Survey Result in Barangay Akle

2.4.2.2.1 Profile of Survey Respondents

2.4.2.2.1.1 Gender

The majority of the respondents are females with 73 or 73.74% of the total respondents. Males represent 26.66% or 26 out of 99 survey respondents.

Table 83 - Gender of Survey Respondents in Barangay Akle

GENDER	***AKLE***	
	No.	***%***
Male	26	26.66
Female	73	73.74
Total	**99**	**100.00**

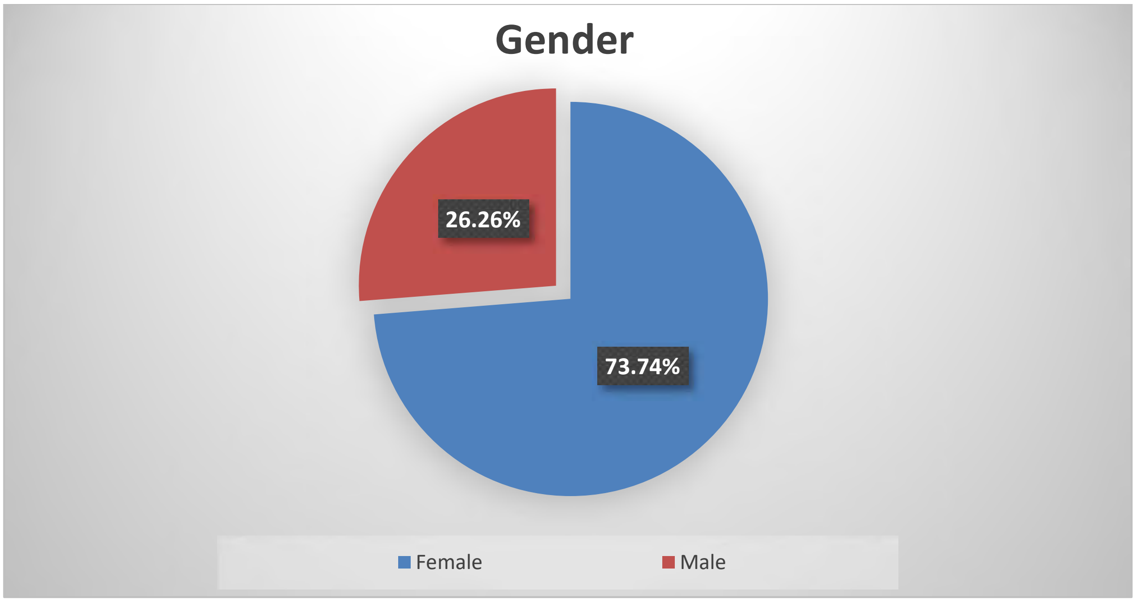


Figure 136 - Distribution of Respondents in Barangay Akle based on Gender

2.4.2.2.1.2 Birthplace

The majority or 44.44% of 99 total respondents were born within the Barangay of Akle. There were 27.27% and 14.14% of respondents who were born from Other Barangay and Provinces, respectively. The 10.10% of the respondents were from the Other City or Municipality, while 4.04% did not indicate where they were born.

Table 84 - Birthplace of Survey Respondents in Barangay Akle

BIRTHPLACE	AKLE	
	No.	%
Within Barangay	44	44.44
Other Barangay	27	27.27
Other City/ Municipality	10	10.10
Other Province	14	14.14
No Answer	4	4.04
Total	**99**	**100.00**

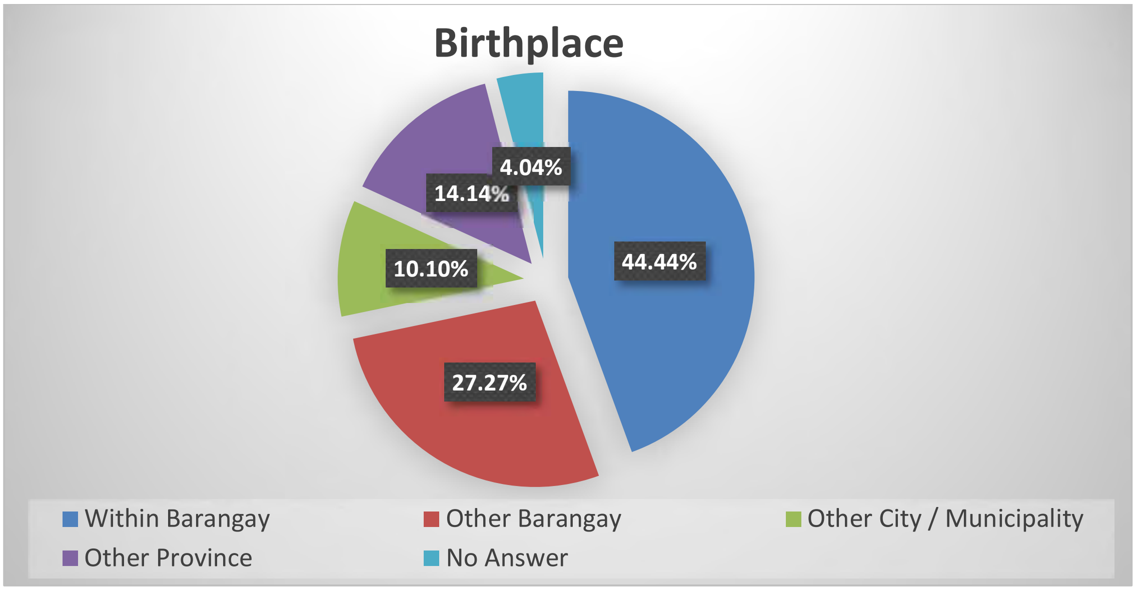


Figure 137 - Distribution of Respondents in Barangay Akle based on Place of Birth

2.4.2.2.1.3 Age

Table 85 presents the age of the respondents. Most number of respondents are in their productive age, meaning, they are still able to work for paid employment optimally, with 26.26% under the age group of 31-40 years of age. This was followed by age group 51-60 (25.25%), age group 41-50 and 21-30 with the same percentage of 15.15%. Older age group 61-70, 15-20 and 71 and above were 11.11%, 3.03% and 2.02%, respectively. The 2.02% of the respondents did not specify their age.

Table 85 - Age of Survey Respondents in Barangay Akle

AGE	AKLE	
	No.	%
15-20	3	3.03
21-30	15	15.15
31-40	26	26.26
41-50	15	15.15
51-60	25	25.25
61-70	11	11.11
71 & above	2	2.02
No Answer	2	2.02
Total	**99**	**100.00**

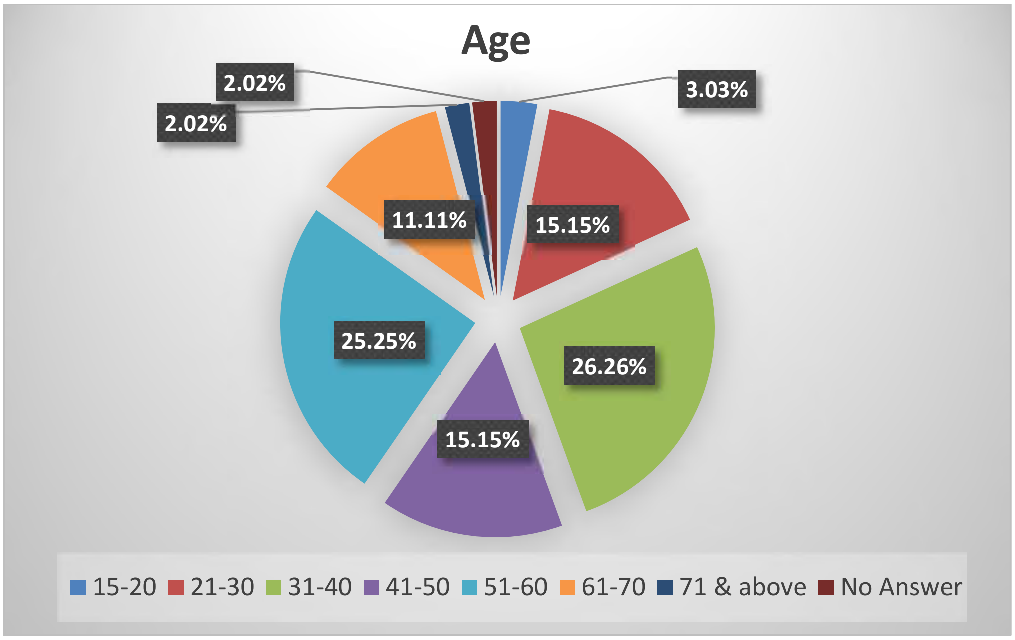


Figure 138 - Distribution of Respondents in Barangay Akle based on Age

2.4.2.2.1.4 Civil Status

Table 86 shows the civil status of the respondents. Majority of the respondents were married with 69.70% of the total respondents. There were 14.14% who were single, while about 9.09% were widow. The 6.06% of the respondents are separated and 1.01% gave no answer.

Table 86 - Civil Status of Survey Respondents in Barangay Akle

CIVIL STATUS	AKLE	
	No.	%
Single	14	14.14
Married	69	69.70
Widow	9	9.09
Separated	6	6.06
No Answer	1	1.01
Total	**99**	**100.00**

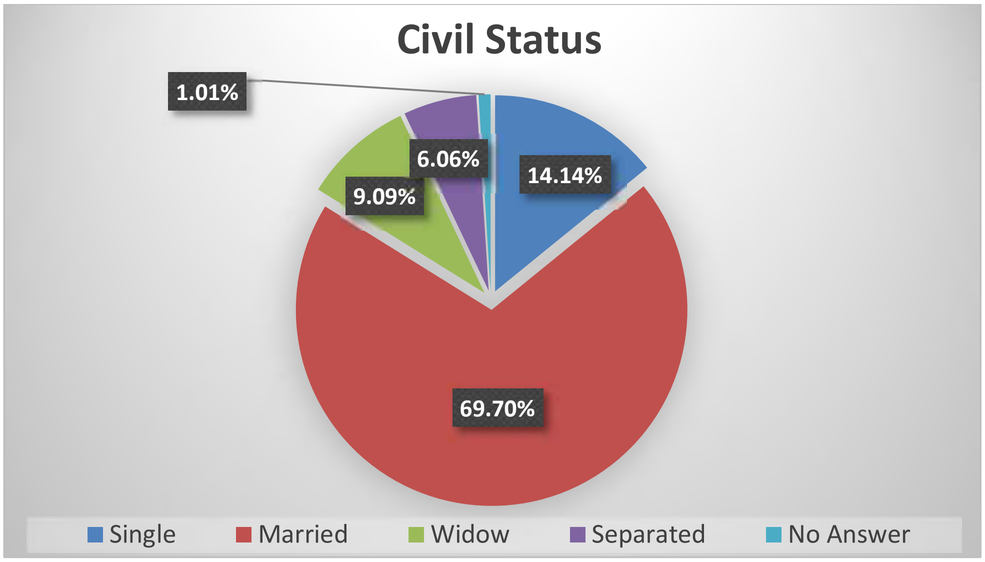


Figure 139 - Distribution of Respondents in Barangay Akle based on Civil Status

2.4.2.2.1.5 Religion

Table 87 shows that 78.79% of the respondents are Roman Catholics, followed by INC with 5.05% of the respondents. Comprising 9.09% of the total respondents, some were Protestant, Born Again and Members of other denominations. The 2.02% of respondents are Baptist and 1.01% were Seventh Day Adventist or Islam/Muslim. 3.03% of the respondents refused to divulge its religious affiliation.

Table 87 - Religion of Survey Respondents in Barangay Akle

RELIGION	AKLE	
	No.	%
Roman Catholic	78	78.79
Protestant	3	3.03
INC	5	5.05
Baptist	2	2.02
Born Again	3	3.03
Seventh Day Adventist	1	1.01
Islam/Muslim	1	1.01
Others	3	3.03
No Answer	3	3.03
Total	**99**	**100.00**

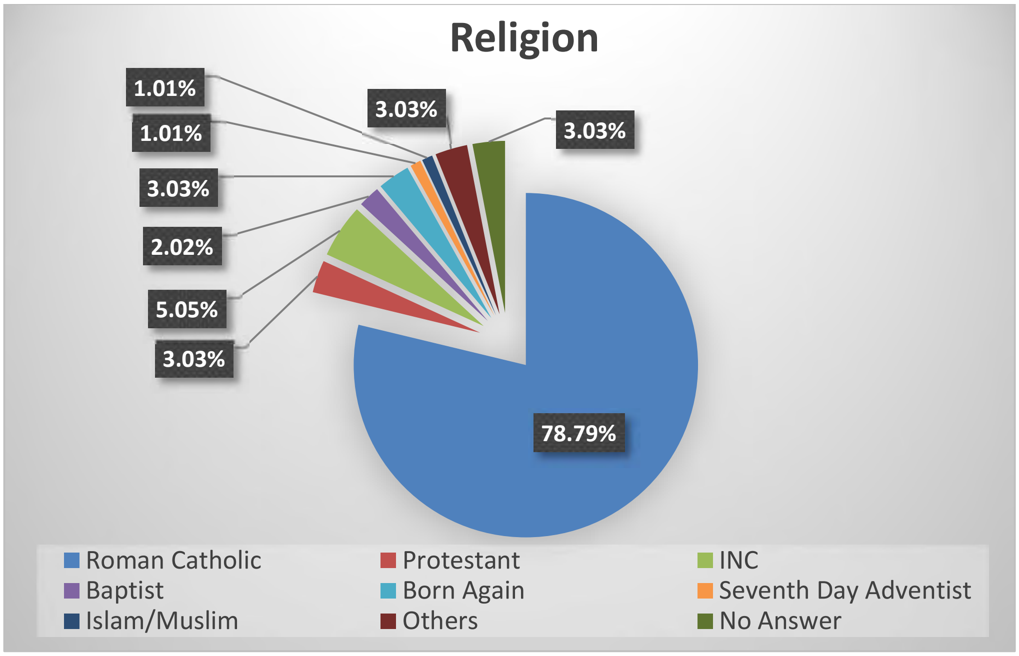


Figure 140 - Distribution of Respondents in Barangay Akle based on Religion

2.4.2.2.1.6 Educational Attainment

All of the respondents had formal education they acquired from community schools, and majority of them, 22.22%, attained high school. A little higher than those who have attended elementary education (21.21%). About 17.17% of the respondents have graduated in high school. Comprising 24.24%, some respondents were able to graduate in elementary and in college. 11.11% had reached college, while 2.02% of the respondents had vocational education. Only 2.02% of the respondents did not specify the education attainment. This only shows that all of the respondents are literate and were able to acquire basic education.

Table 88 - Educational Attainment of Survey Respondents in Barangay Akle

EDUCATIONAL ATTAINMENT	AKLE	
	No.	%
Elementary	21	21.21
Elementary Graduate	12	12.12
High School	22	22.22
High School Graduate	17	17.17
College	11	11.11
College Graduate	12	12.12
Vocational	2	2.02

EDUCATIONAL ATTAINMENT	*AKLE*	
	No.	*%*
No Answer	2	2.02
Total	**99**	**100.00**

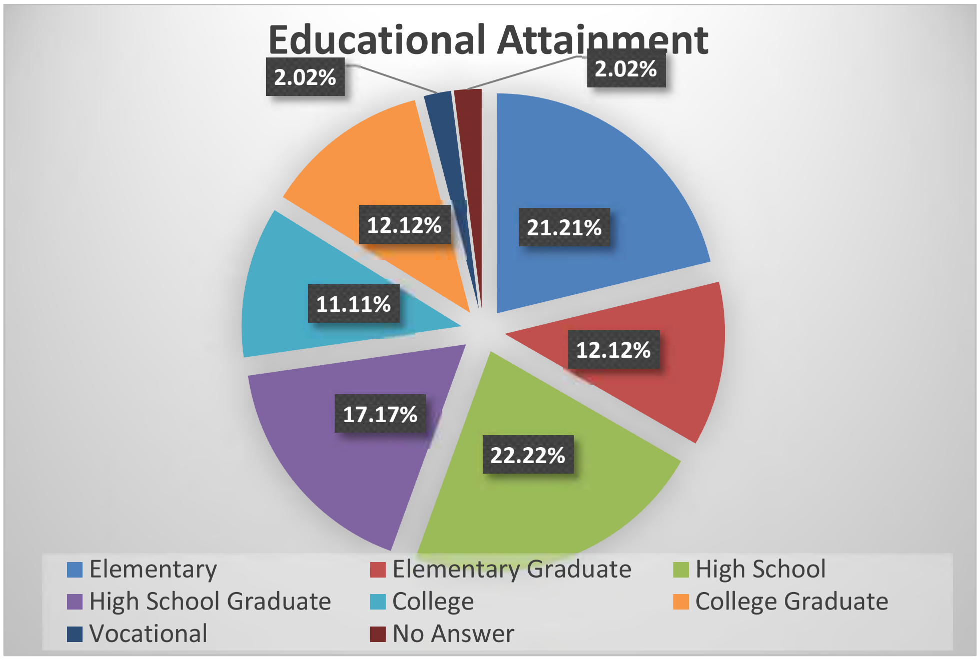


Figure 141 - Distribution of Respondents in Barangay Akle based on Educational Attainment

2.4.2.2.1.7 Income Sources and Employment

Most of the respondents (22.22%) are Barangay Official or Government Employee, followed by Farmers with 20.20% of the respondents. The 16.16% are vendors and comprising 10.10%, some respondents are employed in Private Companies, works in Construction and Factory and some are Self-Employed or Entrepreneur. About 2.08% are Service Workers and 1.01% of the respondents work as a Carpenter. However, 2.02% of the respondents do not have any source of income. It is also important to note that there were respondents who were performing two (2) different activities or occupation at the same time. This shows the need for additional income to augment their existing income.

Table 89 - Income Source of Survey Respondents in Barangay Akle

SOURCE OF INCOME	*AKLE*	
	No.	*%*
Vendor	16	16.16

SOURCE OF INCOME	AKLE	
	No.	%
Barangay Official / Gov't Employee	22	22.22
Carpentry	1	1.01
Transport Service	0	0.00
Private Employee	2	2.02
Construction	2	2.02
Farmer	20	20.20
Factory Worker	2	2.02
Self – employed / Entrepreneur	2	2.02
None	2	2.02
Other – Volunteer/Service	2	2.02
No Answer	28	28.28
Total	**99**	**100.00**

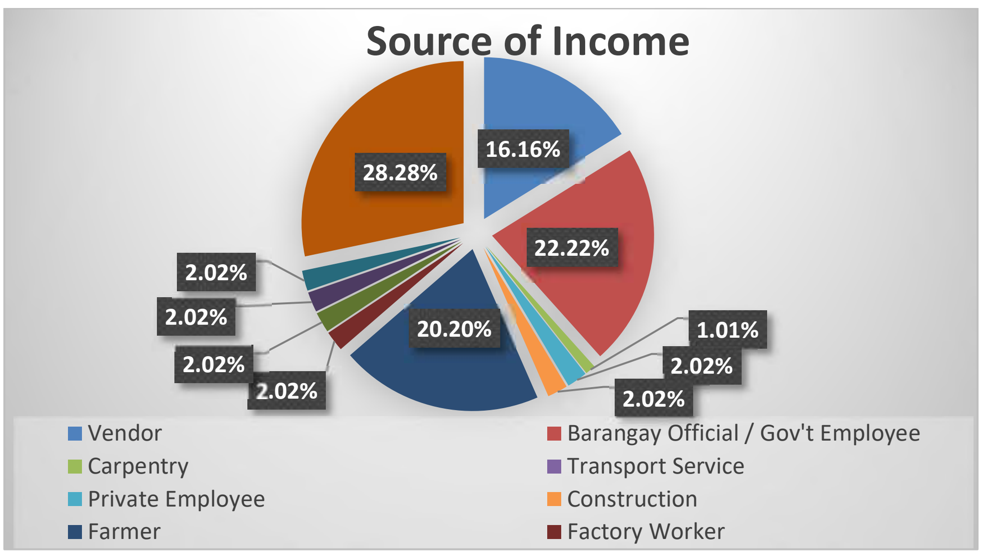


Figure 142 - Distribution of Respondents in Barangay Akle based on Source of Income

2.4.2.2.1.8 Monthly Income

Majority of the respondents (20.20%) have estimated monthly income of either Php Php 1,000 to 5,000 or Php 15,001 to 10,000. About 15.15% of the respondents has an income of Php 5,001 to 10,000 and the same percentage of 8.08% who were earning less than Php 1,000 or Php 10,001 to 15,000. And there were 1.01% of the respondents that earns over Php 20,000. The large discrepancy in the monthly family income affects the people's prevalent purchasing power and would have some implications to the socio-economic status, either they would try to find a good paying job or maybe engage in an enterprise.

Table 90 - Estimated Monthly Income of Survey Respondents in Barangay Akle

MONTHLY INCOME (PhP)	*AKLE*	
	No.	*%*
Less than 1,000	8	8.08
1,000 to 5,000	20	20.20
5,001 to 10,000	15	15.15
10,001 to 15,000	8	8.08
15,001 to 20,000	20	20.20
20,000 & above	1	1.01
No Answer	27	27.27
Total	**99**	**100.00**

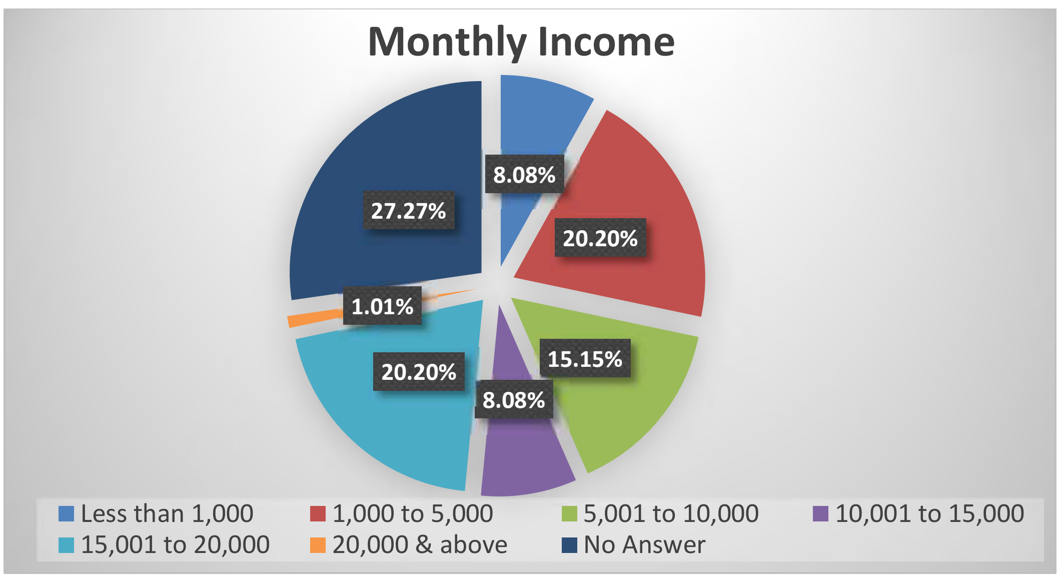


Figure 143 - Distribution of Respondents in Barangay Akle based on Monthly Income

2.4.2.2.1.9 Membership to Organization

About 44.27% of the respondents belong to an organization in the community. Majority of the active members belong to Barangay Volunteers and Senior Citizen's Organization. Below are the identified organizations (***Table 91***).

Table 91 - Organization of Survey Respondents in Barangay Akle

MEMBERSHIP TO ORGANIZATION	AKLE	
	No.	%
Organization Member	37	37.37
Not an Organization Member	42	42.42
No Answer	20	20.20
Total	**99**	**100.00**

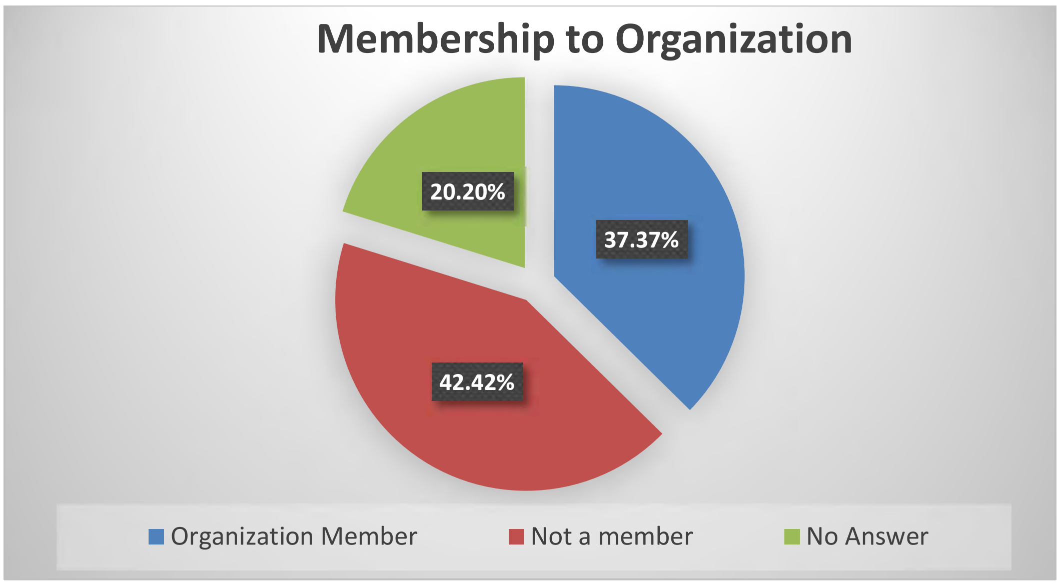


Figure 144 - Distribution of Respondents in Barangay Akle based on Organization

Table 92 - Organizations in Barangay Akle

Community Organization	Number of Respondents
4Ps	1
TODA	2
Tanod	1
Barangay Cooperative	2
Driver's Association	1
Purok Leader	2
RIC	1
Senior Citizens	7
Farmers' Organization	7

Community Organization	Number of Respondents
Women	4
Youth Organization	3
Barangay Council Volunteer	12

2.4.2.2.2 Household Information

2.4.2.2.2.1 Household Size

Majority of the respondents (31.31%) have 3-4 members per household, while 24.24% have 5-6 household size. Sharing the same percentage of 15.15%, respondents have either 1-2 or 7-8 household size. There are 6.06% of the respondents that have 9-10 household size and only 1.01% have more than 10 members each household.

Table 93 - Household Size of Survey Respondents in Barangay Akle

HOUSEHOLD SIZE	AKLE	
	No.	%
1-2	15	15.15
3-4	31	31.31
5-6	24	24.24
7-8	15	15.15
9-10	6	6.06
More than 10	1	1.01
No Response	7	7.07
Total	**99**	**100.00**

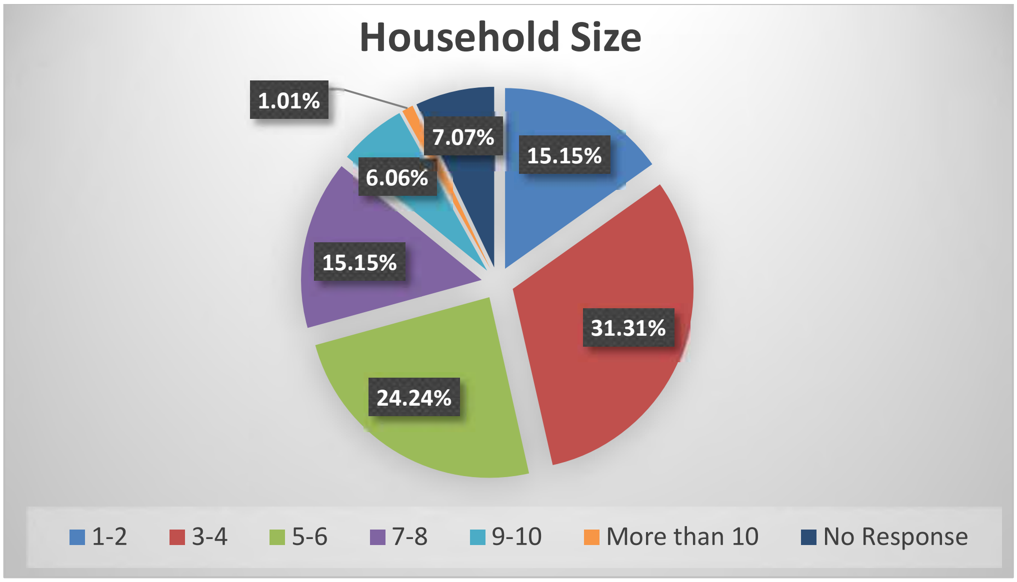


Figure 145 - Distribution of Respondents in Barangay Akle based on Household Size

2.4.2.2.2.2 Household Composition

Table 94 shows the composition of the households of the respondents. There are 40.74% of the respondents have families that extends beyond the nuclear which include aunts, uncles, grandparents, etc., who live in household, while 33.33% of the respondents that are considered a nuclear family, typically consist of parents and children. About 25.93% of the household did not specify the composition.

Table 94 - Household Composition of Survey Respondents in Barangay Akle

HOUSEHOLD COMPOSITION	*AKLE*	
	No.	*%*
Extended Family	22	40.74
Nuclear Family	18	33.33
No Answer	14	25.93
Total	**54**	**100.00**

Note: data does not include the initial perception survey

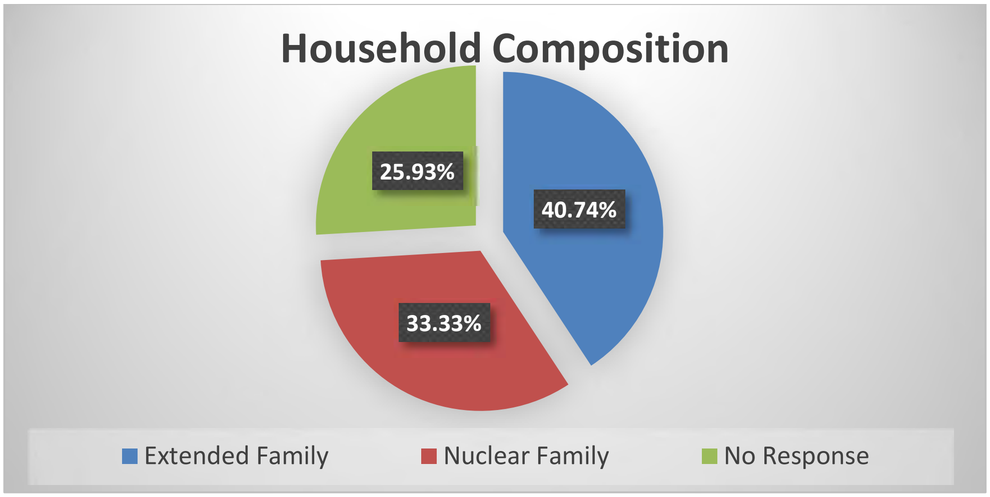


Figure 146 - Distribution of Respondents in Barangay Akle based on Household Composition

2.4.2.2.2.3 Morbidity

Table 95 shows the number of household members that got sick in the past years. There are 20.37% of the respondents have one (1) member of their household got sick, 18.52% of the respondents have two (2) members of their household that got sick, followed by 14.81% with 3 members of their family that got ill and 12.96% of the respondents have 4 members of their family that got sick. About 5.56% of the respondents have five (5) or more than six (6) members of their family that had experience some of kind of sicknesses for the past years.

Table 95 - Household Member of the Survey Respondents Who Experienced Illness in Barangay Akle

No. of HH Members	AKLE	
	No.	%
1	11	20.37
2	10	18.52
3	8	14.81
4	7	12.96
5	3	5.56
More than 6	3	5.56
No Answer	12	22.22
Total	**54**	**100.00**

Note: data does not include the initial perception survey

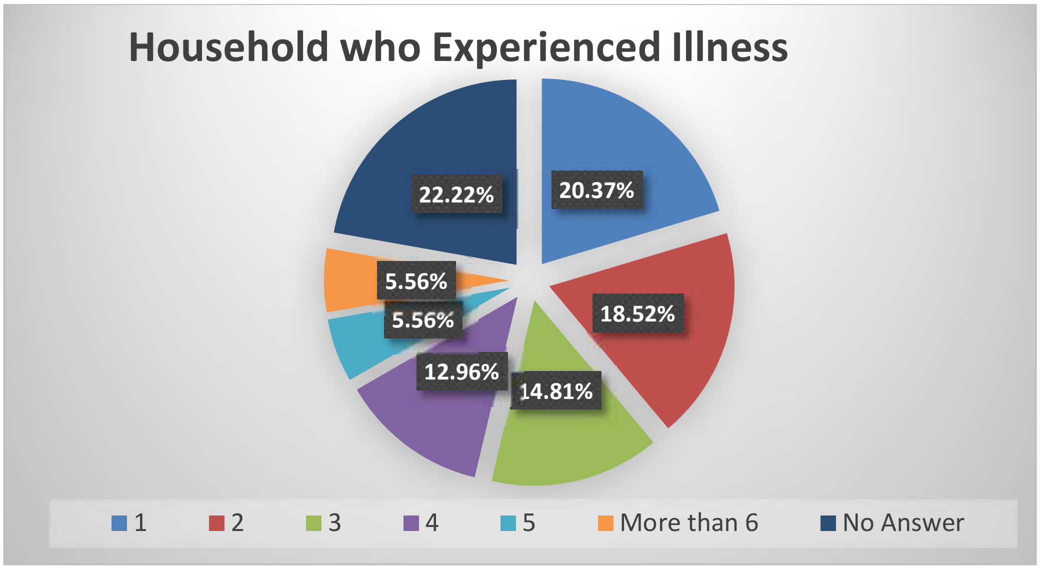


Figure 147 - Number of Household members that got sick in Barangay Akle

2.4.2.2.2.4 Common Diseases

Table 96 shows the common community diseases in Barangay Akle. Upper Respiratory tops the leading cause of morbidity with 26 cases (40.00%) followed by Fever with 23 cases (35.38%) and Diarrhea with 8 cases (12.31%). The rest of the common diseases are listed below.

Table 96 - Common Diseases of the Respondents in Barangay Akle

ILLNESS	***AKLE***	
	No.	***%***
Diarrhea	8	12.31
Fever	23	35.38
Upper Respiratory	26	40.00
Others	2	3.08
Heart Attack	2	3.08
Prostate	1	1.54
Skin Disease	1	1.54
Stroke	1	1.54
Arthritis	1	1.54
Total	**65**	**100.00**

Note: data does not include the initial perception survey

**multiple answer*

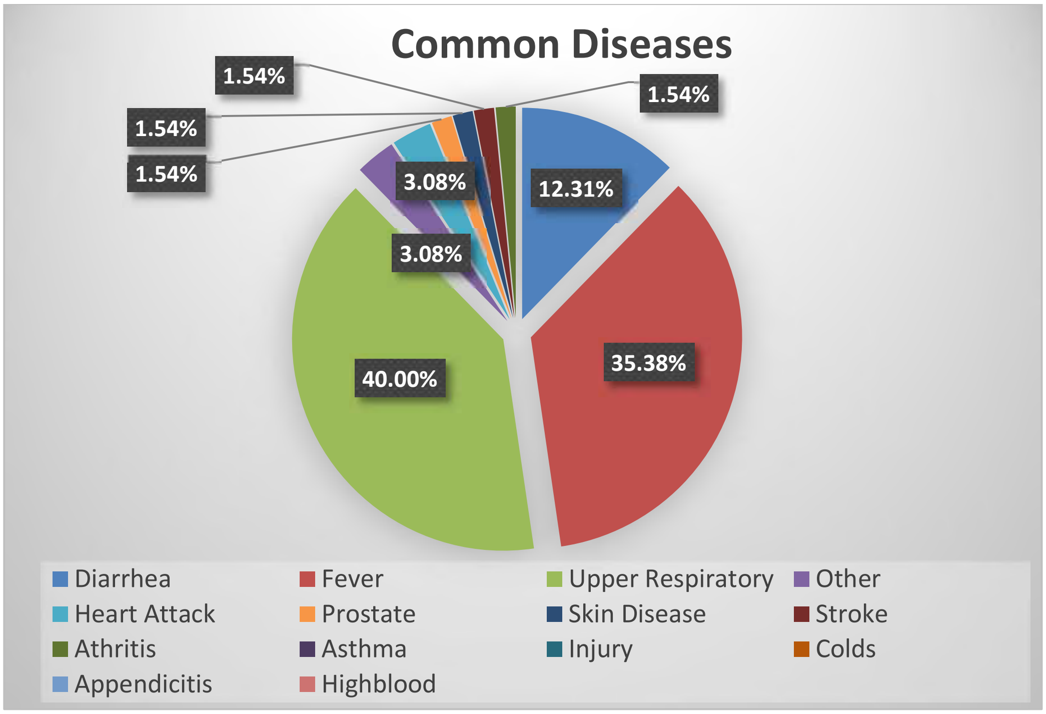


Figure 148 - Distribution of Respondents in Barangay Akle based on Experience Illness

2.4.2.2.2.5 Health Seeking Behavior

Table 97 shows the health seeking behavior of the respondents. Majority or 18 (31.03%) of the respondents prefer to be treated in Public Hospital, followed by Health Center with 10 (17.24%) households of the respondents. About 8 (13.79%) of the respondents prefer to be treated in Private Clinic, while 7 (12.07%) respondents prefer to be treated at Private Hospitals. Moreover, there are 4 (6.90%) respondents who prefer to be treated at their homes, while 3 (5.17%) of the respondents prefer to be treated by the Traditional Healer.

Table 97 - Health Facilities and Providers accessed by the Survey Respondents in Barangay Akle

HEALTH FACILITY	AKLE	
	No.	%
Home	4	6.90
Health Center	10	17.24
Public Hospital	18	31.03
Private Hospital	7	12.07
Private Clinic	8	13.79
Herbalist	3	5.17
No Answer	8	13.79

HEALTH FACILITY	***AKLE***	
	No.	***%***
Total	**58**	**100.00**

Note: data does not include the initial perception survey

**multiple answer*

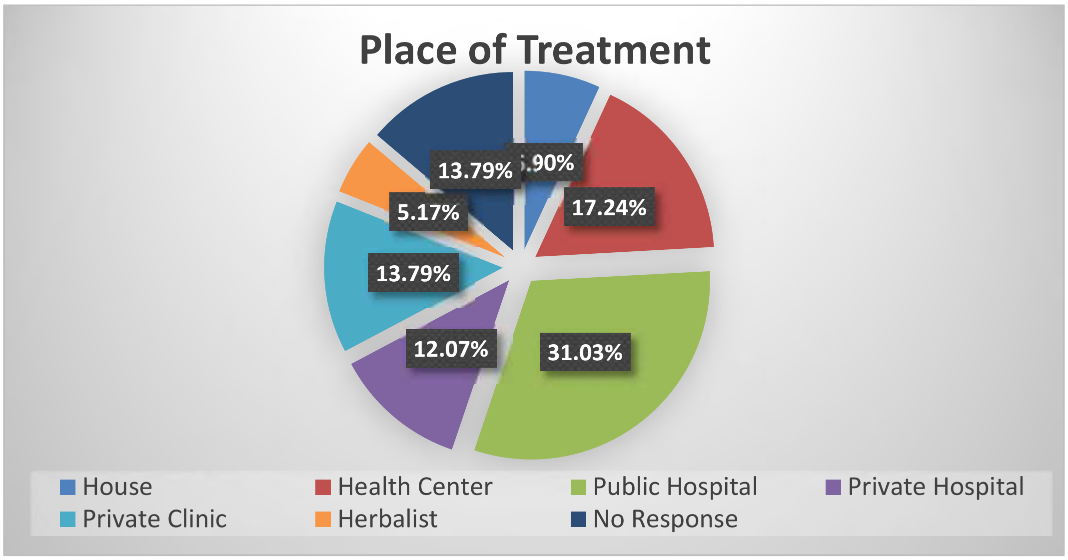


Figure 149 - Distribution of Respondents in Barangay Akle based on Place of Treatment

2.4.2.2.2.6 Waste Disposal

Table 98 presents the solid waste disposal practices of the community. The data shows that majority or 85.19% disposes their garbage through collection of the local government and 7.41% through their own garbage pits. It can be noted that 1.85% of the respondents still burns their garbage and 5.56% uses different types of disposals. This data can be related to high morbidity rates of diarrhea which can be attributed to improper solid and waste disposal in the household level.

Table 98 - Waste Disposal of Survey Respondents in Barangay Akle

WASTE DISPOSAL	***AKLE***	
	No.	***%***
Garbage Pit	4	7.41
Garbage Collection	46	85.19
Burning	1	1.85
Others	3	5.56

WASTE DISPOSAL	AKLE	
	No.	%
Total	**54**	**100.00**

Note: data does not include the initial perception survey

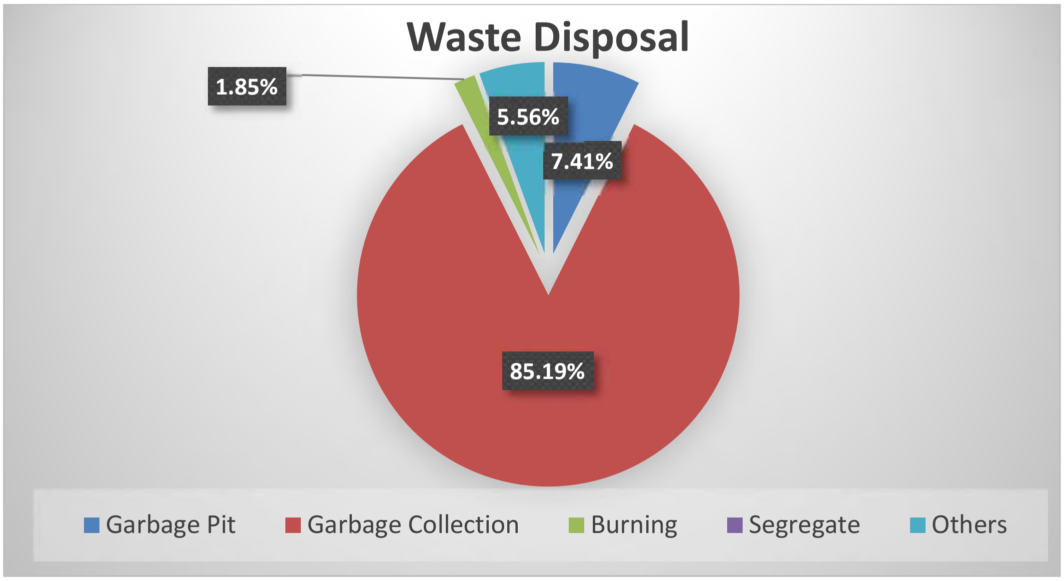


Figure 150 - Distribution of Respondents in Barangay Akle based on Waste Disposal

2.4.2.2.2.7 Sources of Drinking Water

Table 99 shows the sources of potable drinking water of the household surveyed. 38.89% of the respondents use water from Other Sources, while 27.78% of the household's source of clean drinking water is through deep wells. About 18.52% of the respondent's sourced their water through the Local Water District and 14.81% from the Spring. Sources of drinking water can be related to the number of water bourne diseases prevalent in the community especially diarrhea.

Table 99 - Sources of Drinking Water of Survey Respondents in Barangay Akle

SOURCE OF DRINKING WATER	AKLE	
	No.	%
Spring	8	14.81
Deep well	15	27.78
Local Water District	10	18.52
Others	21	38.89
Total	**54**	**100.00**

Note: data does not include the initial perception survey

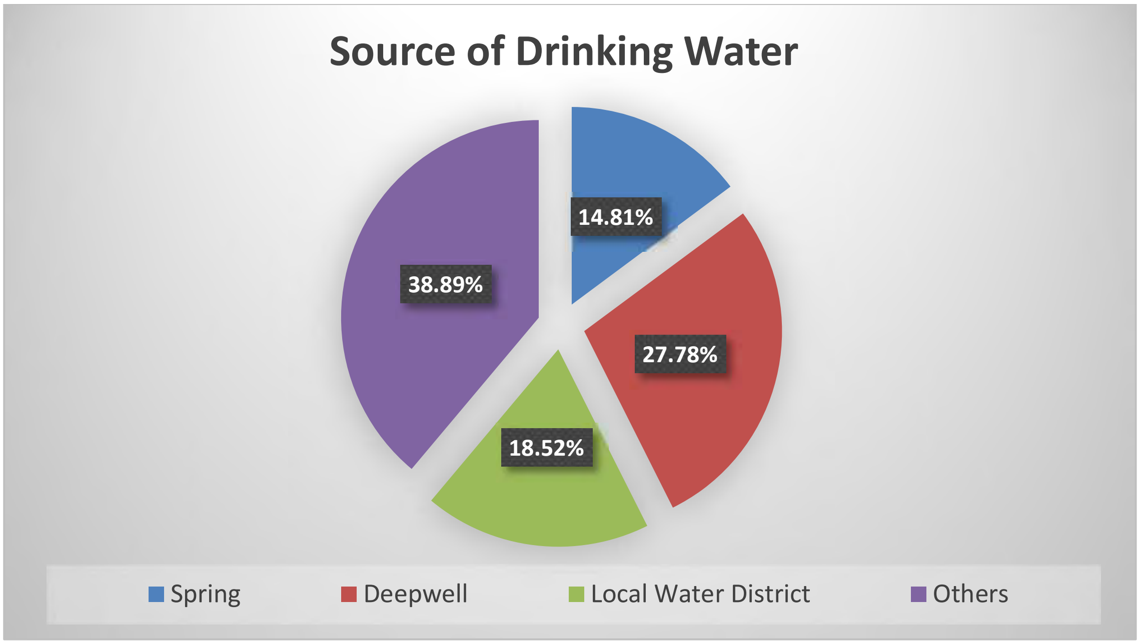


Figure 151 - Distribution of Respondents in Barangay Akle based on Sources of Drinking Water

2.4.2.2.2.8 Toilets

Table 100 shows the sanitation and hygiene practices of the respondents. It also presents access to suitable sanitation facility in the household level. There are 81.48% of the respondents that use Water Sealed and 7.41% that use flush. About 3.70% of the respondents have house with hole on the ground and 1.85% of respondents answered that they do not have their own toilet. Unsanitary practices can eventually contaminate land and water sources thus increasing the risk infection and diseases in the community.

Table 100 - Sanitation and Toilet of the Survey Respondents in Barangay Akle

SANITATION AND TOILETS	AKLE	
	No.	%
Flush	4	7.41
Water Sealed	44	81.48
House with hole on the ground	2	3.70
None	1	1.85
No Answer	3	5.56
Total	**54**	**100.00**

Note: data does not include the initial perception survey

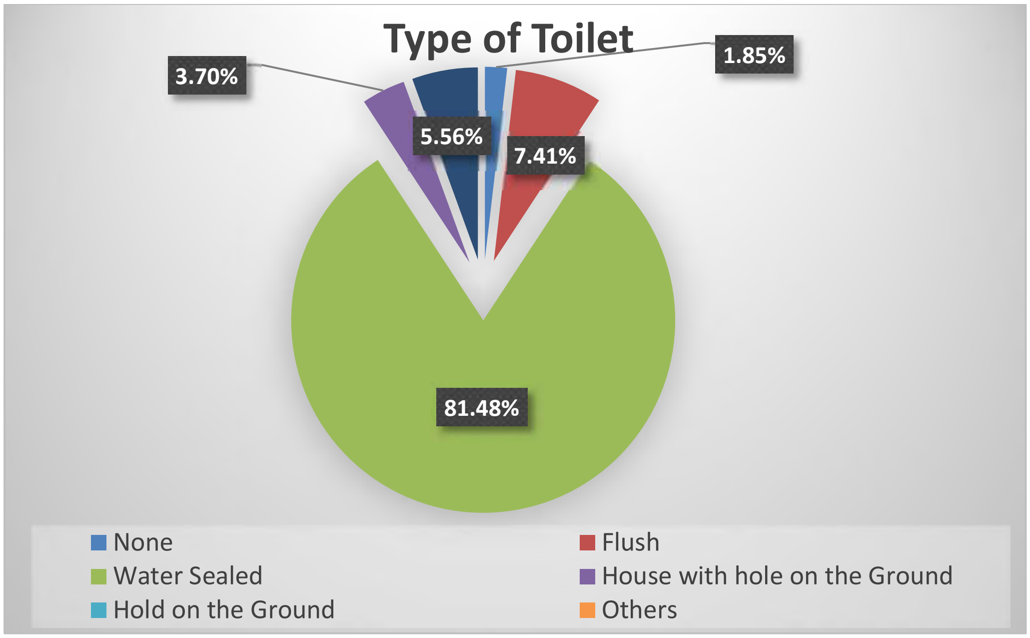


Figure 152 - Distribution of Respondents in Barangay Akle based on Type of Toilets

2.4.2.2.3 Housing Condition

2.4.2.2.3.1 House Ownership

The majority of the respondents (79.80%) own the house where they are staying and only 12.12% do not own the house that they occupy, while 8.08% did not specify their answers.

Table 101 - House Ownership of Survey Respondents in Barangay Akle

HOUSE OWNERSHIP	AKLE	
	No.	%
Owns the House	79	79.80
Does not own the House	12	12.12
No Answer	8	8.08
Total	**99**	**100.00**

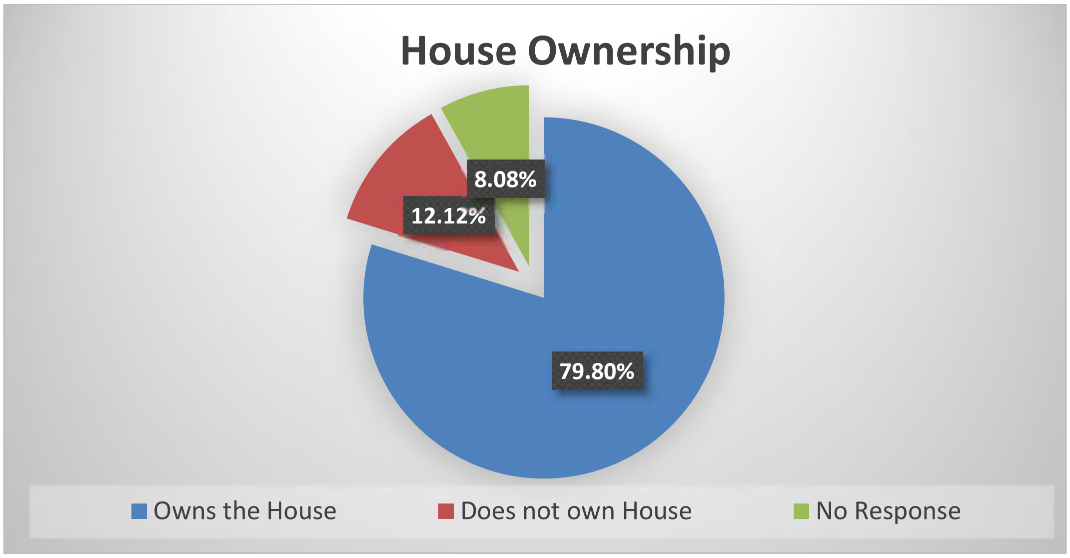


Figure 153 - Distribution of Respondents in Barangay Akle based on House Ownership

2.4.2.2.3.2 Land Ownership

Majority of the respondents (72.73%) own the land where their houses stood while 20.20% does not own the land where their houses were built.

Table 102 - Land Ownership of Survey Respondents in Barangay Akle

LAND OWNERSHIP	AKLE	
	No.	%
Owns the Land	72	72.73
Does not own the Land	20	20.20
No Answer	7	7.07
Total	**99**	**100.00**

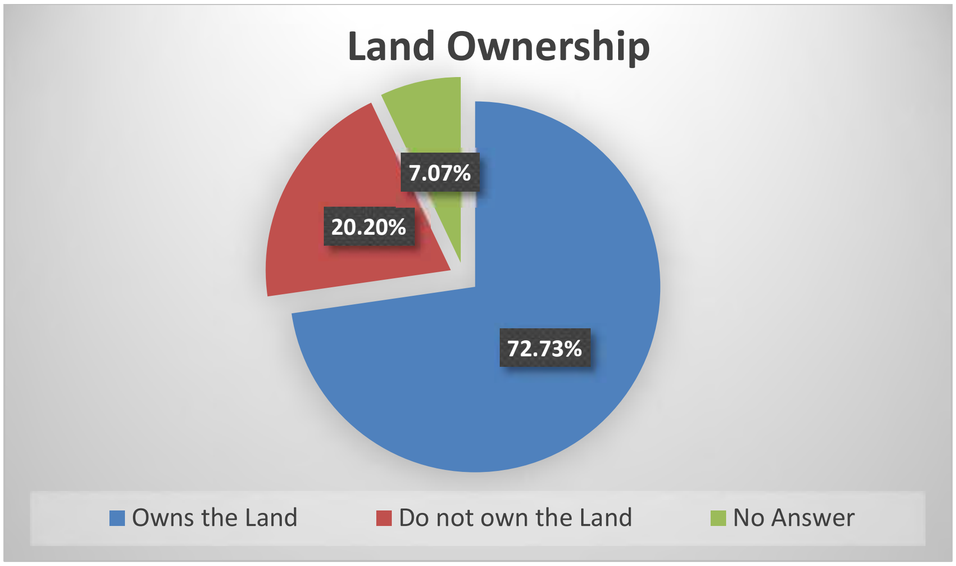


Figure 154 - Distribution of Respondents in Barangay Akle based on Land Ownership

2.4.2.2.3.3 Housing Materials

Forty seven (47) respondents used Concrete as an outer wall material of their houses, forty two (42) used G.I. Sheets, seven (7) used wood and the remaining percentage of respondents used bamboo or other kinds of material for the outer wall of their houses.

Table 103 - Outer Wall Materials of the Respondent's Houses in Barangay Akle

CONSTRUCTION MATERIALS OF THE OUTER WALLS	AKLE	
	No.	%
Wood	7	7.07
Concrete	47	47.47
Bamboo	2	2.02
G.I. Sheets	42	42.42
Others	1	1.01
Total	**99**	**100.00**

**Multiple Answer*

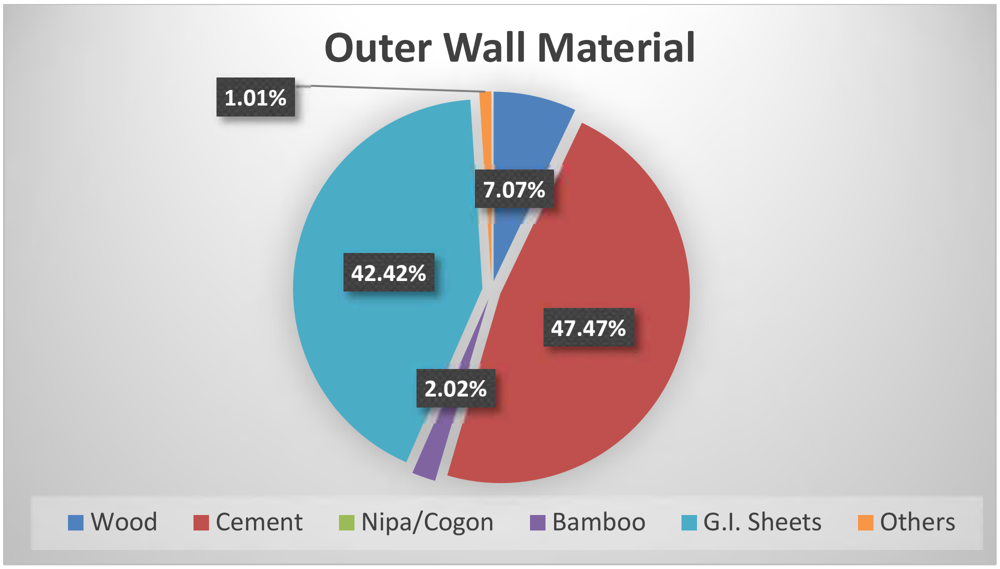


Figure 155 - Distribution of Respondents in Barangay Akle based on Outer Wall Material of their Houses

On the other hand, the most common roofing material used by the respondents (40) was G.I Sheets. There were respondents that also used concrete (37), wood (15), bamboo (3) and the rest used some other materials (1) for the roof of their houses.

Table 104 - Roof Material of the Respondent's Houses in Barangay Akle

CONSTRUCTION MATERIALS OF THE ROOF	AKLE	
	No.	%
Wood	15	15.63
Concrete	37	38.54
Bamboo	3	3.13
G.I. Sheets	40	41.67
Others	1	1.04
Total	**96**	**100.00**

**Multiple Answer*

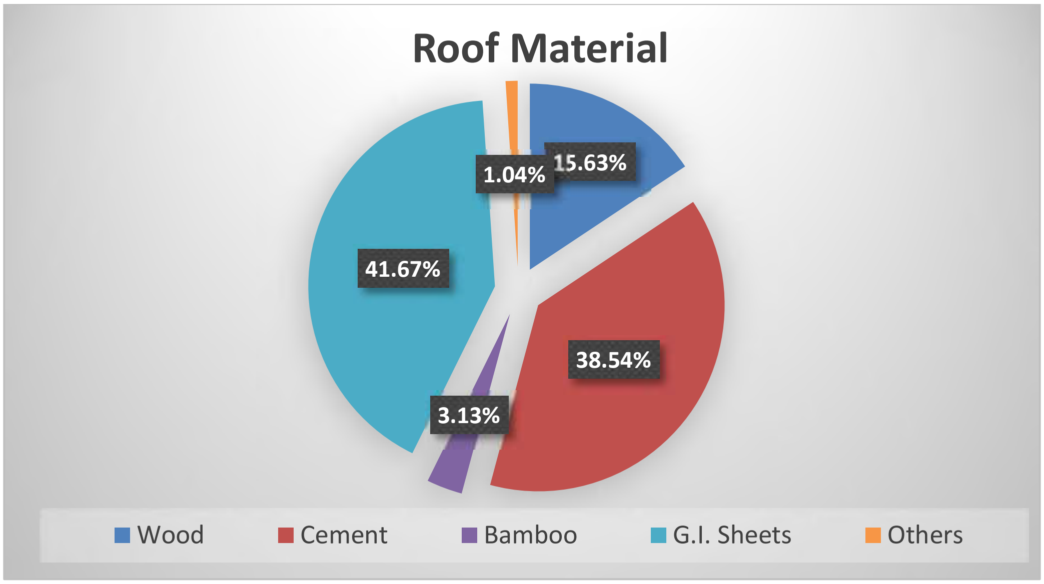


Figure 156 - Distribution of Respondents in Barangay Akle based on Roofing Material of their Houses

2.4.2.2.4 Community Problems and Concerns

The matrix bellow present the perceived problems of the respondents in Barangay Akle. Most of the responses identified were Poverty (11.01%), followed by Unemployment or Lack of Capital for Small Business with the same percentage of 8.93% and problem on Availability of Potable water (7.745) as the top three problems and concerns in the Barangay. Comprising 21.42% of the responses, Lack of Water for Irrigation, Lack of Livelihood Support and Lack of Orientation and Training on Solid Waste Management were also identified as the problem by the respondents. Concerns were also raised about the Educational Assistance (6.85%), Lack of Medical Equipment (5.65%), Lack of Support in Training People's Organization (5.36%), Limited Assistance to Develop Farming (5.06%) and Lack of Recreational Facilities (4.76%) were strongly identified by the respondents. Problem on Malnutrition and Lack of Facilities for Transportation/Roads/Bridges (3.87%) were also identified as concerns that needed attention in the community. Aside from this, Lack of School Equipment (3.57%) and Lack of Teachers (1.79%) were also point of concerns raised by the respondents. It is also important to note that some of the respondents raised their concerns about Dust as on of the community problems in their barangay (1.19%).

Table 105 - Common Community Problems and Concerns of the Respondents in Barangay Akle

COMMUNITY PROBLEMS/CONCERNS	TALBAK		Rank
	No.	%	
Unemployment	30	8.93	2nd

COMMUNITY PROBLEMS/CONCERNS	TALBAK		Rank
	No.	%	
Poverty	37	11.01	1st
Availability potable water	26	7.74	3rd
Lack of water for irrigation	24	7.14	4th
Lack of school equipment	12	3.57	11th
Malnutrition	13	3.87	10th
Educational assistance	23	6.85	5th
Lack of teachers	6	1.79	12th
Lack of medical equipment	19	5.65	6th
Lack of facilities for transportation/ roads/ bridges	13	3.87	10th
Lack of Livelihood support	24	7.14	4th
Lack of recreational facilities	16	4.76	9th
Lack of capital for small business	30	8.93	2nd
Limited assistance to develop farming	17	5.06	8th
Lack of support in training People's Organization	18	5.36	7th
Lack of orientation and training on Solid Waste Management	24	7.14	4th
Others (Signal)	4	1.19	13th
Total	**336**	**100.00**	

**Multiple Answe*

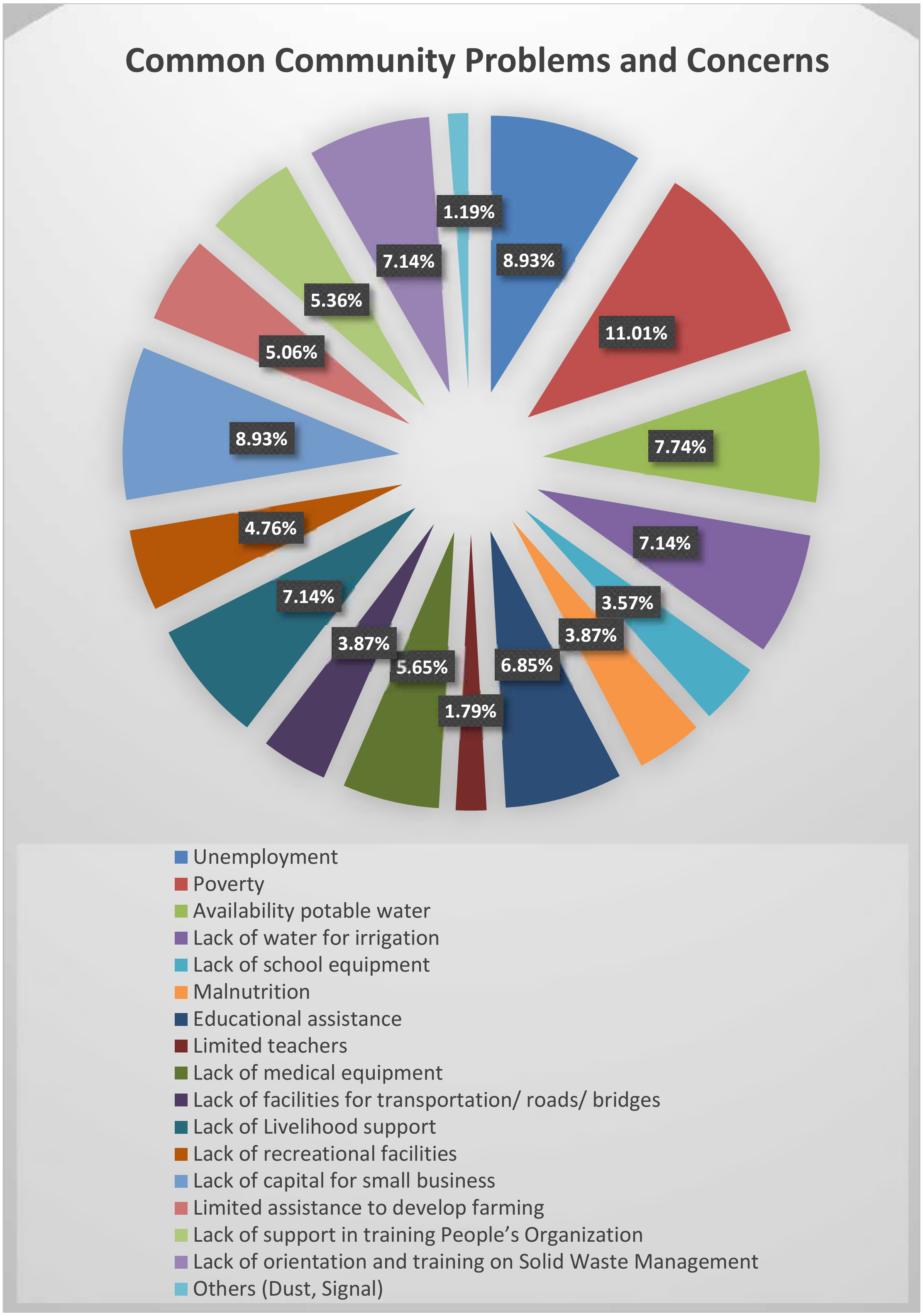


Figure 157 - Distribution of Respondents in Barangay Akle based on their Common Community Problems and Concerns

The respondents provided possible solutions to the identified community problems, specifically on the Employment (13.92%) and Livelihood (10.44%) aspects. Various proposals were provided by the respondents, summarized in the matrix below.

Table 106 - Proposed Solution of the Survey Respondents in Barangay Akle on the Identified Concerns/Problems

PROPOSED SOLUTIONS	AKLE	
	No.	%
Employment	44	13.92
Livelihood Projects	33	10.44
Livelihood Training and Assistance to Women	22	6.96
Education Assistance Project	23	7.28
Scholarship Program	27	8.54
Potable water supply	28	8.86
Medical/Dental Mission Assistance	25	7.91
Designate Materials Recovery Facility in areas within the Barangay	10	3.16
Conduct orientation on proper waste disposal	18	5.70
Assistance from government offices	20	6.33
Assistance from private companies and full implementation of CSR Program	20	6.33
Conduct community consultations at the grassroots level, plan intervention and implement	12	3.80
Values formation/ orientation to all concerned	9	2.85
Additional budget (for the barangay)	21	6.65
Others (Dust)	4	1.27
Total	**316**	**100.00**

Awareness on the Current Operation of Eagle Cement

Majority of the respondents or 51.52% expressed awareness on the current operation of Eagle Cement while 24.24% of the respondents are unaware of the operation of Eagle Cement. The remaining percentage gave no answer on the question.

Table 107 - Awareness of Respondents in Barangay Akle on the Current Operation of Eagle Cement

AWARENESS ON THE CURRENT OPERATION OF EAGLE CEMENT	AKLE	
	f	*%*
Aware	51	51.52
Not Aware	24	24.24
No Answer	24	24.24
Total	**99**	**100.00**

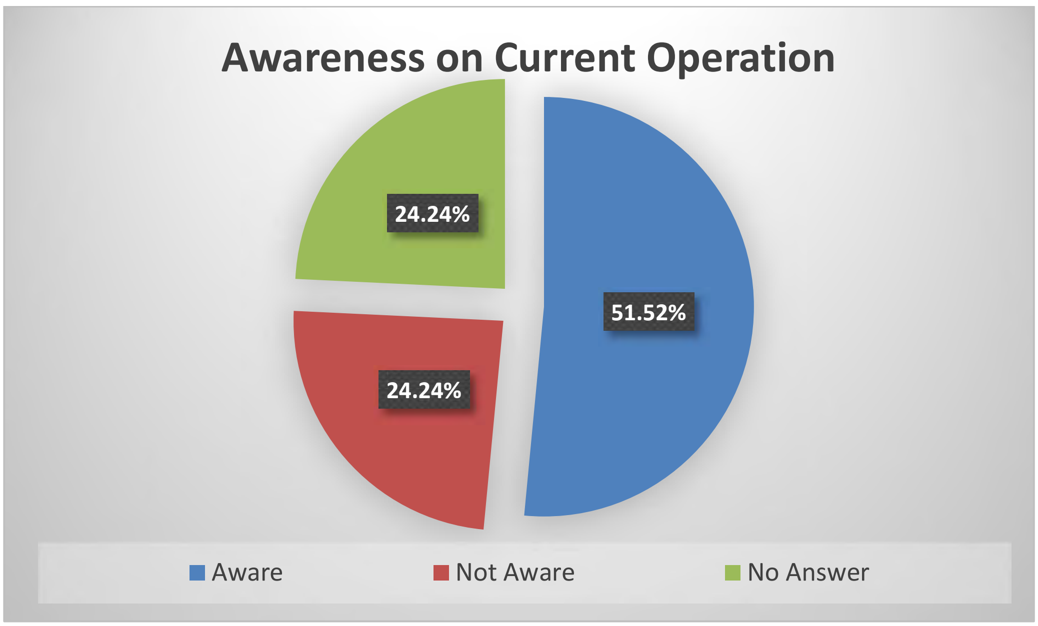


Figure 158 - Distribution of Respondents in Barangay Akle based on Awareness on the Current Operation

Majority of the respondents' place of residence (81.48%) are located near the plant of Eagle Cement, while 5.56% lives relatively far from the plant and 12.96% did not specify their place of residence.

Table 108. Houses location of the Survey Respondents in Barangay Akle

	AKLE	
	No.	*%*
Near	44	81.48
Far / Not Near	3	5.56
No Answer	7	12.96

	AKLE	
	No.	***%***
Total	**54**	**100.00**

Note: data does not include the initial perception survey

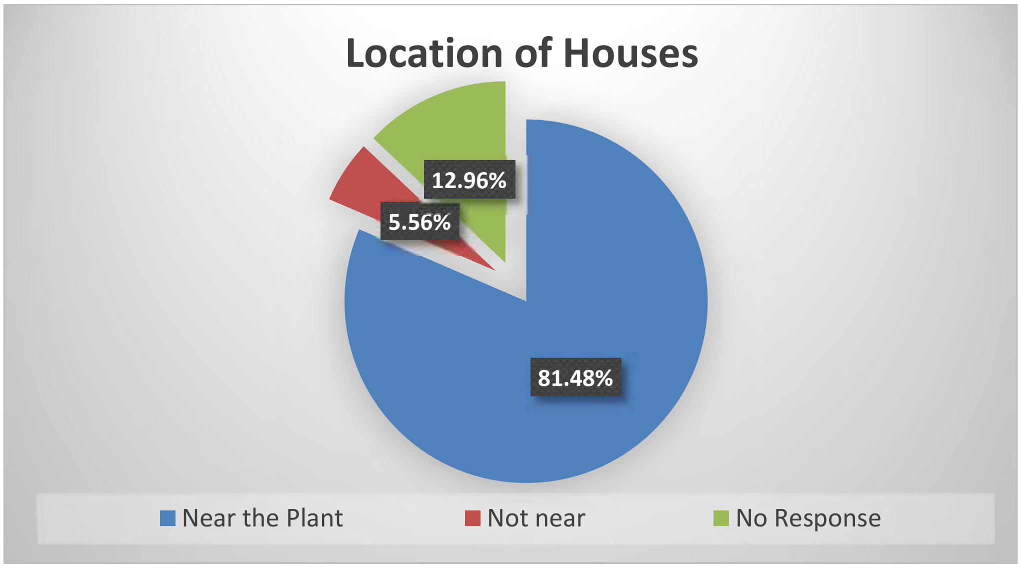


Figure 159 - Distribution of Respondents in Barangay Akle based on Location of their Houses

The respondents also expressed the positive and negative effects on the current operation of Eagle Cement to their community. The respondents mentioned about the positive effects of the presence of Eagle Cement operation in their community. Employment opportunities (19.79%) and health and nutrition assistance (14.06%) in relation to the positive effects of the operation of Eagle Cement were mentioned. The assistance that the barangay was receiving generated positive perception on the current operation. Improvement on the physical condition of the areas in barangays was also stated. It can also be noted that only 4.69% of the respondents do not see any positive effects on their household.

Table 109 - Response of the Survey Respondents in Barangay Akle about the Positive Effects of the Current Operation of Eagle Cement

POSITIVE EFFECTS OF THE CURRENT OPERATION	***AKLE***	
	No.	***%***
Employment Opportunities	38	19.79
Livelihood Opportunities	16	8.33
Health and Nutrition Assistance (Feeding Program, Medical Mission)	27	14.06

POSITIVE EFFECTS OF THE CURRENT OPERATION	AKLE	
	No.	%
Education Assistance	18	9.38
Sports Facility Improvement (Gym, Basketball Court)	12	6.25
Relocation/ Resettlement Program	9	4.69
Worker's Safety	23	11.98
Provision of Cement for Community Projects	11	5.73
Progressive place	16	8.33
No positive results	9	4.69
No Response	13	6.77
Total	**192**	**100.00**

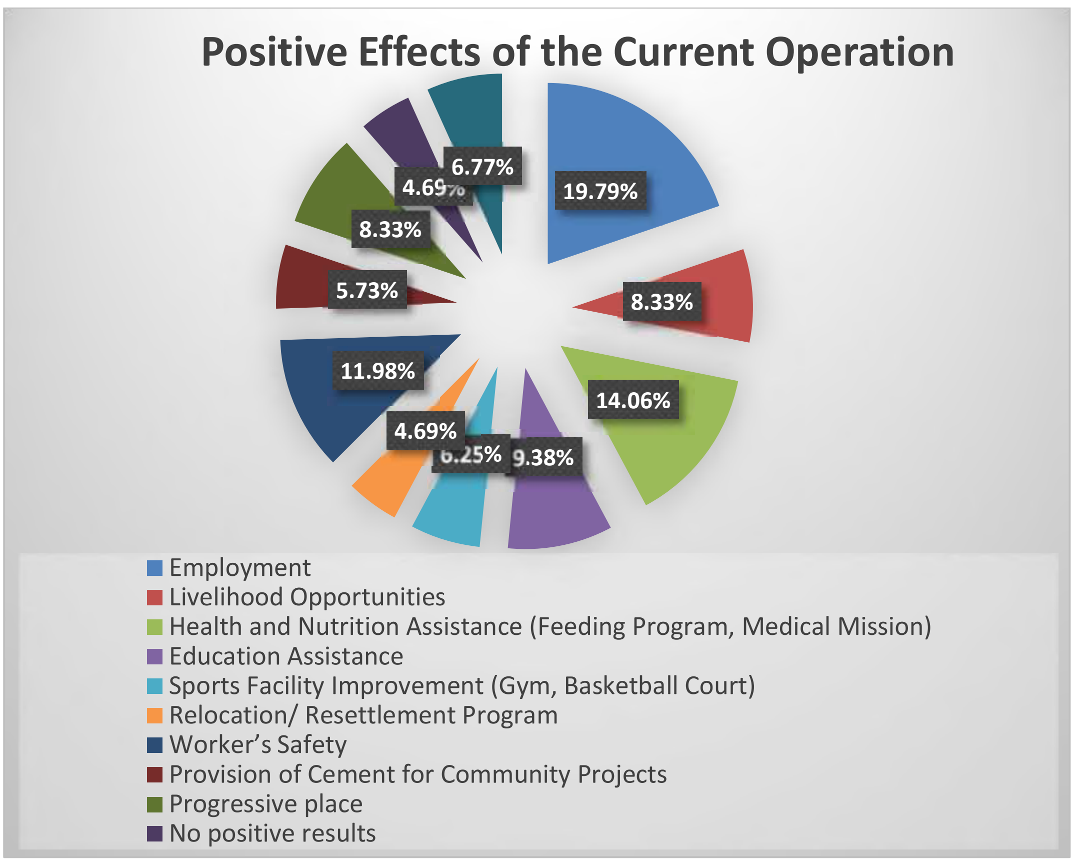


Figure 160 - Distribution of Respondents in Barangay Akle based on Positive Effects of the Current Operation

On the other hand, majority of the respondents (36.02%) saw Dust pollution as one of the negative effects of the current operation of Eagle Cement, followed by Health Hazard (23.66%). There were also other negative effects mentioned by some of the respondent such as Noise (16.13%), Traffic Disturbance (10.75%) and Improper Waste Disposal (6.45%). However, 0.54% of the respondents also mentioned that blasting and some accidents near the plant as one of the negative effects of the current operation. It can be also noted that 0.54% of the respondents stated that no negative effects were observed from the operation of Eagle Cement.

Table 110 - Response of the Survey Respondents in Barangay Akle about the Negative Effects of the Current Operation of Eagle Cement

NEGATIVE EFFECTS OF THE CURRENT OPERATION	AKLE	
	No.	%
Dust	67	36.02
Noise	30	16.13
Traffic Disturbance (Trucks)	20	10.75
Improper Waste Disposal	12	6.45
Health Hazard	44	23.66
Others (Blasting , Accident)	1	0.54
No negative results	1	0.54
No Response	11	5.91
Total	**186**	**100.00**

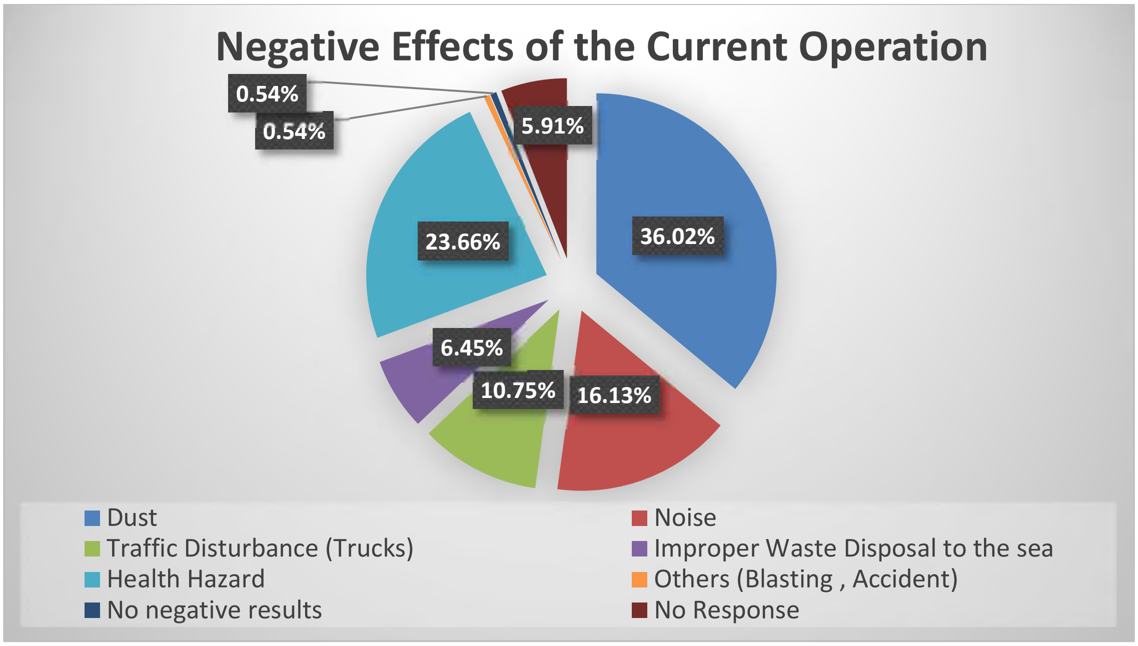


Figure 161 - Distribution of Respondents in Barangay Akle based on Negative Effects of the Current Operation

There were 59.60% of the respondents who were familiar with the different community developmental projects of Eagle Cement, while 12.12% of the respondents were unfamiliar. About 28.28% did not specify their response.

Table 111 - Awareness of Respondents in Barangay Akle on the Existing Community Projects of Eagle Cement

FAMILIARITY OF THE DEVELOPMENT PROJECTS OF EAGLE CEMENT	AKLE	
	No.	%
Familiar of Development Projects of Eagle Cement	59	59.60
Unfamiliar with Projects	12	12.12
No Answer	28	28.28
Total	**99**	**100.00**

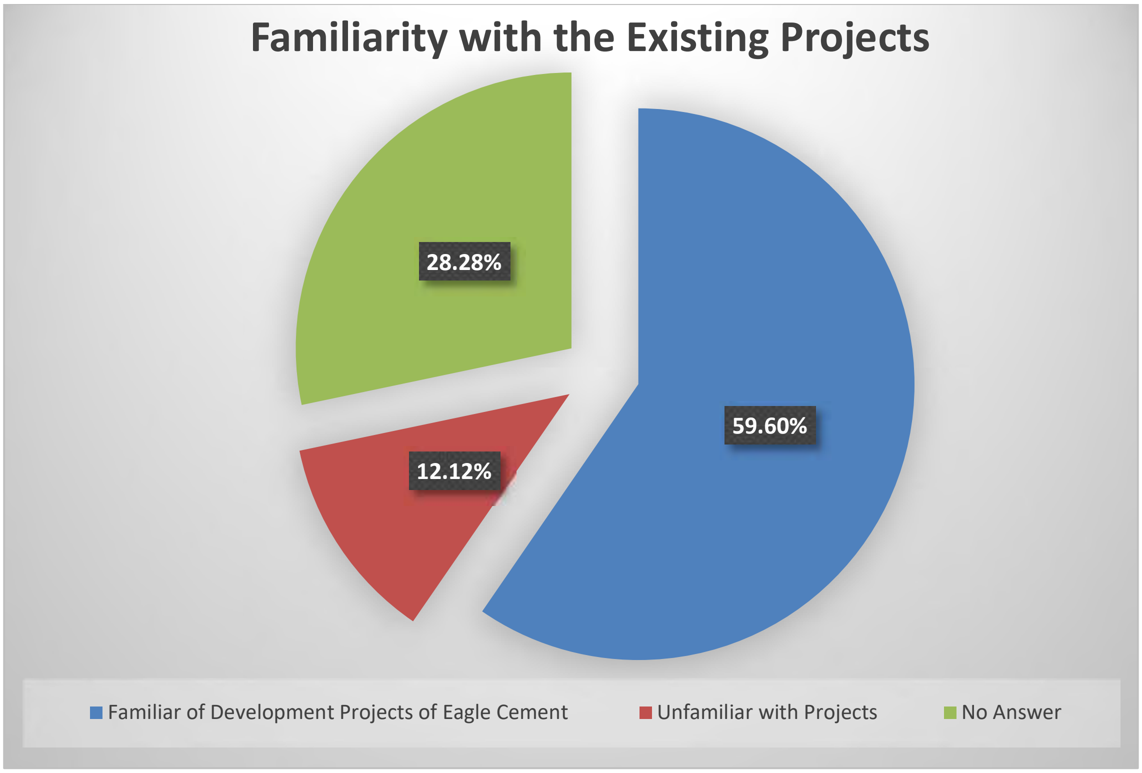


Figure 162 - Distribution of the Respondents in Barangay Akle based on Familiarity with the Existing Projects of Eagle Cement

Among those that are familiar with the projects of Eagle Cement in the community, 25.16% of the respondents are most familiar with the Health Program, followed by 24.52% of the respondent who were familiar with the educational program. Infrastructure Development (14.84%) and Sports Development Program (14.19%) also identified familiar by the respondents. The respondents also recognized the program implemented to Livelihood (12.26%) and to Barangay Development (9.03%).

Table 112 - Community Development Projects in Barangay Akle

COMMUNITY DEVELOPMENT PROJECTS	AKLE	
	No.	%
Health Program	39	25.16
Educational Program	38	24.52
Sports Development Program	22	14.19
Livelihood Program	19	12.26
Infrastructure Development	23	14.84
Barangay Development	14	9.03

COMMUNITY DEVELOPMENT PROJECTS	AKLE	
	No.	%
Total	**155**	**100.00**

**Multiple Answer*

Figure 163 - Distribution of Respondents in Barangay Akle based on Awareness to Existing Community Projects

There were 37.37% respondents that said they or their family had been part or directly benefited from the identified community development projects, while 30.30% of the respondents did not have any involvement with the projects.

Table 113 - Family's Direct Involvement with the Projects in Barangay Akle

PROJECT INVOLVEMENT	AKLE	
	No.	%
Family Involved or Benefited in the Projects	37	37.37
Not Involved	30	30.30
No Answer	32	32.32

PROJECT INVOLVEMENT	AKLE	
	No.	%
Total	**99**	**100.00**

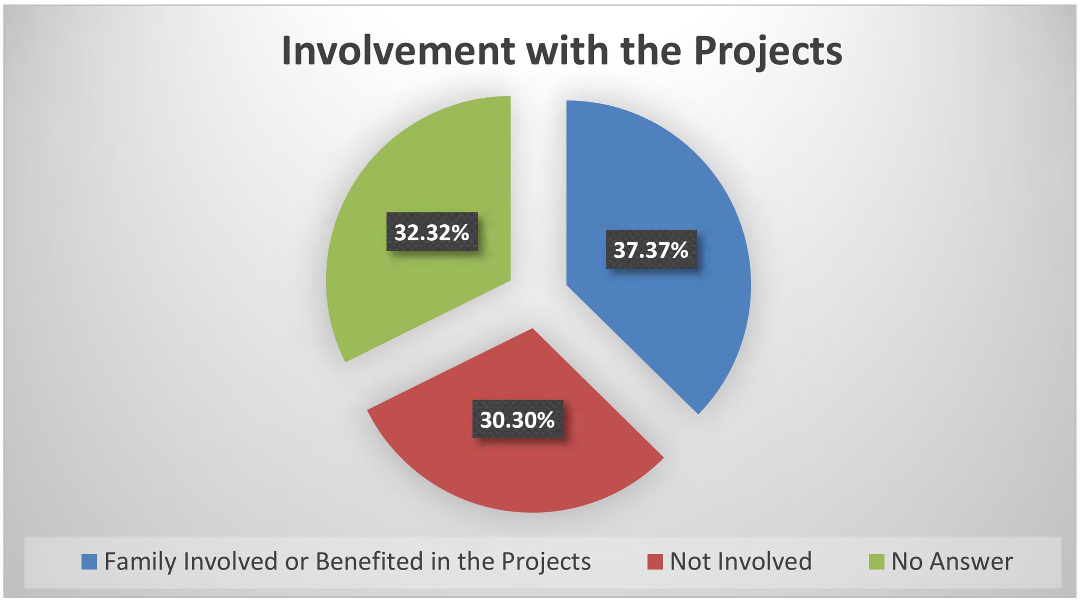


Figure 164 - Distribution of Respondents in Barangay Akle based on Involvement with the Projects

The benefits provided by Eagle Cement that were received or experienced by the respondents are presented in the matrix below.

Table 114 - Benefits directly received by the respondents in Barangay Akle

DIRECT BENEFITS RECEIVED BY THE RESPONDENTS AND THEIR FAMILIES	AKLE	
	No.	%
Employment / Jobs	5	33.33
Educational Program (Scholarship, Financial Assistance)	4	26.67
Health Program (Medical & Dental Mission, Free Medicines, Feeding Program)	3	20.00
Livelihood	1	6.67
Financial Assistance (Plant's worker)	1	6.67
Skills Development	1	6.67
Total	**15**	**100.00**

**Multiple Responses (No Initial Perception Survey)*

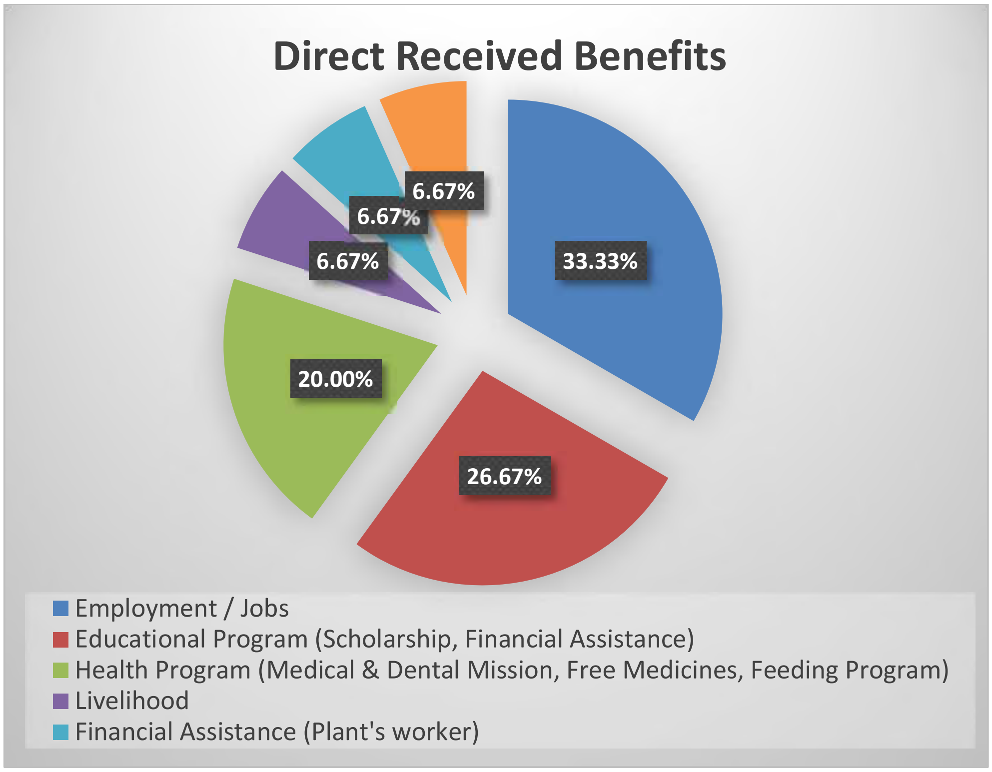


Figure 165 - Distribution of Respondents in Barangay Akle based on Direct Received Benefits

2.4.2.2.5 Awareness and Acceptability on the Proposed Project of Eagle Cement

The majority (33.33%) or 33 respondents were aware of the proposed project of Eagle Cement. There were 37 or 37.37% that were not yet aware and 29.29% or 29 respondents who refused to give an answer.

Table 115 - Awareness of the Respondents in Barangay Akle on the Proposed Project of Eagle Cement

AWARENESS ON THE PROPOSED PROJECT	AKLE	
	No.	%
Aware	33	33.33
Not Aware	37	37.37
No Answer	29	29.29
Total	**99**	**100.00**

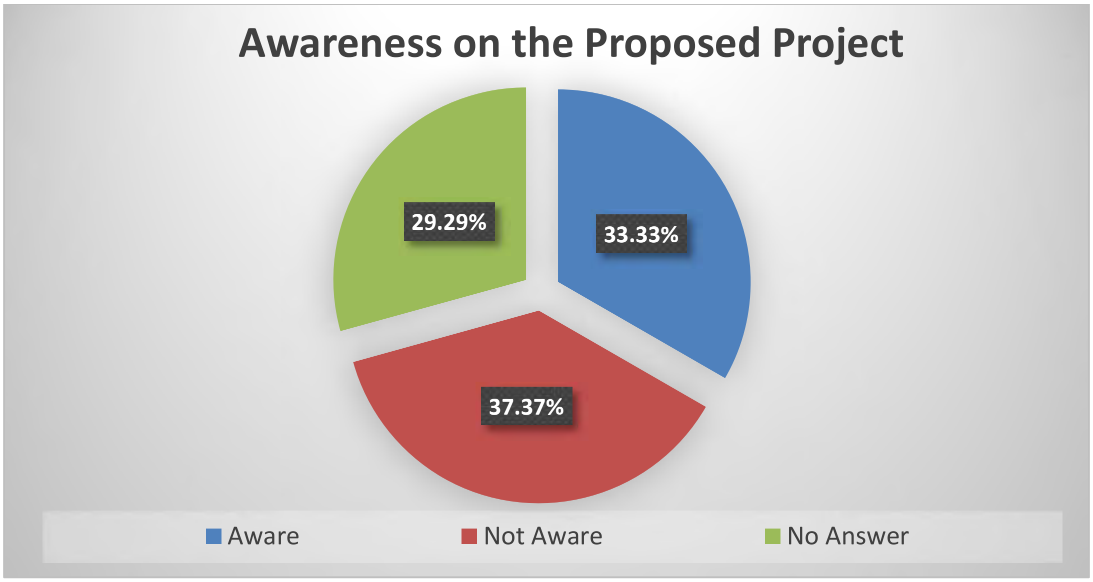


Figure 166 - Distribution of Respondents in Barangay Akle based on Awareness on the Proposed Project of Eagle Cement

For those who were aware of the proposed project, most of the information sources were from the Government/Barangay Officials and Official/Employee of Eagle Cement with the same percentage of 28.36%. The proposed project was also known to the respondents through the Barangay Meetings/ Consultations (17.91%) and through their Relatves/Friends/Neighbors (13.43%). Other sources mentioned were through the Surveys with 10.45% an from the Radio/TV/Local Newspaper (1.49%).

Table 116 - Sources of Information of the Survey Respondents in Barangay Akle about the Proposed Project of Eagle Cement

Community Development Projects	AKLE	
	No.	%
Government/ Barangay Officials	19	28.36
Relatives/ Friends/ Neighbors	9	13.43
Official/ Employee of Eagle Cement	19	28.36
Radio/TV/Local Newspaper	1	1.49
Barangay Meetings/ Consultations	12	17.91
Survey	7	10.45
Total	**67**	**100.00**

**Multiple Answer*

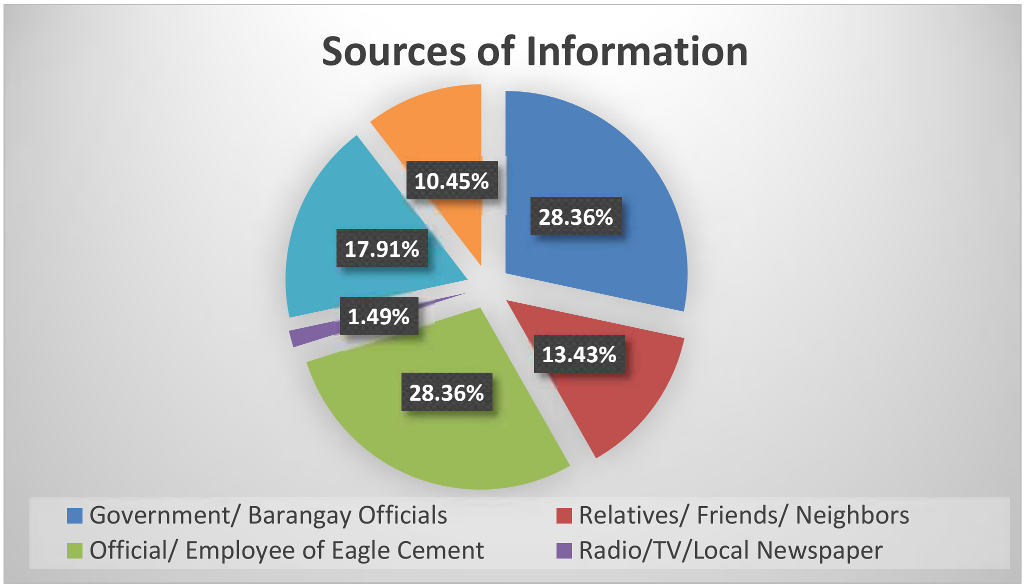


Figure 167 - Distribution of Respondents in Barangay Akle based on Sources of Information about the Proposed Project

The respondents were asked on their perceived positive and negative effects of the proposed project by Eagle Cement. Looking into the details, ***Table 117*** presents specific answer of respondents on the possible positive and negative effects of the project to their community. There were 47 or 29.38% from the respondents that perceived Additional Job Opportunities with the proposed project, 18.13% or 29 were Additional Income to the Barangay and Additional Livelihood Opportunities (13.75%). Also, 13.13% or 21 respondents perceived the Provision of Free Medicines, 13 or 8.13% were Provision of Sports Facilities for Youth and 5.63% or 9 respondents perceived the Less Environmental Threats. About 4.38% of the respondents perceived that the proposed project will be one of the means so the Negative Issues will be Addressed and the Traffic will be lessened (3.75%). Lastly, 3.75% of the respondents seeing No Positive Effects of the Proposed Project to the household.

On the other hand, 55 respondents or 35.95% stated that they perceived the proposed project to cause Air Pollution and Increase of Dust in their community. About 19.61% or 30 respondents perceived an Increase of Noise in the community, 26 or 16.99% perceived Health and Environmental hazard, 32 respondents or 14.38% perceived an Increase in Vehicular Traffic and 7.19% or 11 respondents saw Pollution or Destruction of the Environment through Improper Waste Disposal. There were 4.58% of the respondents perceived worsening of Peace of Order situation, while 0.65% said that one of the negative effects of the project would be Blasting. Nevertheless, 0.65% of the respondents perceived No Negative Effects on the proposed project of Eagle Cement.

Table 117 - Perceived Positive and Negative Effects of the Respondents in Barangay Akle regarding the Proposed Project of Eagle Cement

Effects	*Details*	*AKLE*	
		No.	*%*
Positive	Additional Job Opportunities	47	29.38
	Traffic will be lessened	6	3.75
	Less Environmental Threats	9	5.63
	Negative issues will be addressed	7	4.38
	Additional income to the Barangay	29	18.13
	Livelihood opportunities will improve economic condition of the barangay	22	13.75
	Provision of Sports Facilities for Youth	13	8.13
	Provision of Free Medicines	21	13.13
	No Positive Effects	6	3.75
	TOTAL RESPONSES	**160**	**100.00**
Negative	Air Pollution / More dust	55	35.95
	More Noise	30	19.61
	Generation of Wastes/ Improper Waste Disposal	11	7.19
	Increase in Traffic	22	14.38
	Health and Environmental Hazard	26	16.99
	Peace and Order	7	4.58
	Others (Blasting)	1	0.65
	No Negative Effects	1	0.65
	TOTAL RESPONSES	**153**	**100.00**

**Multiple Answer*

Table 118. Proposed Solution of the Survey Respondents in Barangay Akle on the Perceived Negative Impact of the Proposed Project

Perceived Negative Effects of the Proposed Project	*Proposed Solutions on the Perceived Negative Effects*
Increased Environmental and Health Impacts: • More dust • More Noise • Generation of wastes/ Improper waste disposal	Find ways to lessen the dust that have caused negative effect to the health of the community and organize the plans for the progress of the barangay.
	Provide mask
	Water sprinkling; Appoint someone to sprinkler water daily
	Proper waste disposal
	Implement controls/measures
	Site-specific hazard control should be implemented and monitored
Disturbance to the Community: • Increase in Traffic • Peace and Order • Blasting	Secure the safety of the community; Give notice or warning to the community prior to blasting to avoid accidents
	Separate road for the hauling trucks
Other Response: • No perceived negative impact • More information should be given to the community	Cooperation and Coordination with the Barangay Officials, Community and Company
	Strengthen the IEC
	Discussed the negative effects
	Meet and comply to the DENR standards and requirements
	Tree Planting
	Support for the workers

The acceptability of the respondents on the proposed project was expressed. The majority of the respondents (30.30%) or 30 were Uncertain if they will agree or not with the project. There were 26.26% who agree with the proposed project, while 10.10% of the respondents do not agree with the project. About 33.33% or 33 of the respondents refused to give an answer.

Table 119 - The Acceptability of the Survey Respondents in Barangay Akle on the Proposed Project of Eagle Cement

ACCEPTABILITY OF THE PROPOSED PROJECT	AKLE	
	No.	%
Agree	26	26.26
Do Not Agree	10	10.10
Uncertain	30	30.30
No Answer	33	33.33
Total	**99**	**100.00**

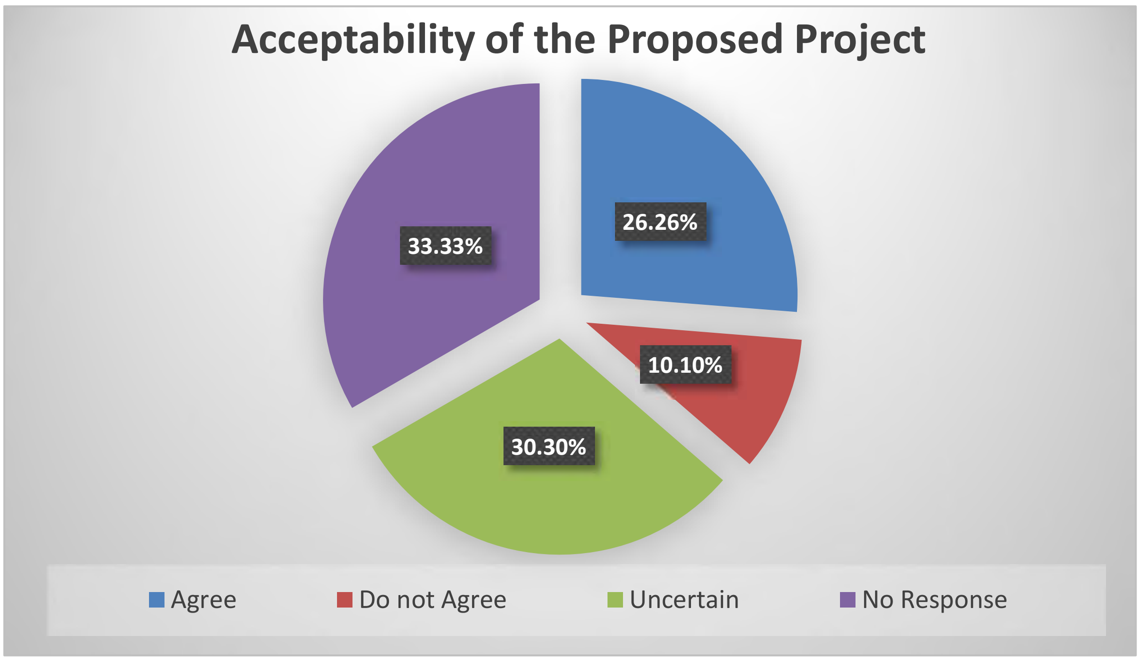


Figure 168 - Distribution of Respondents in Barangay Akle based on Acceptability of the Proposed Project

Those who expressed in agreement or disagree with the implementation of the proposed project stated their reason for their positive or negative responses. It can be observed that even though some posted negative response for the proposed project, most of their reasons are conditional with the implementation of mitigating measure which means they would support the project as long as measures are ensured and taken. The details are presented below.

REASON FOR POSITIVE RESPONSE	*REASON FOR NEGATIVE RESPONSE*
Many residents will lose their job if the operation will stop	Dust and fallen rocks when blasting
The proposed project will have impact to the growth of the economy and it will be a big help for the progress of Barangay Akle.	The participants do not have any safety assurances pertaining to the proposed project.
Help the Employees	Increase of Pollution and Noise
Employment / Additional Job	Main concern is the safety of the community
	Destruction to the Environment
	It depends on the effect of the project to the community

2.4.2.3 Perception Survey Result in Barangay Talbak

2.4.2.3.1 Profile of Survey Respondents

2.4.2.3.1.1 Gender

Table 120 - Gender of Survey Respondents in Barangay Talbak

GENDER	*TALBAK*	
	No.	*%*
Male	24	25.81
Female	69	74.19
Total	**93**	**100.00**

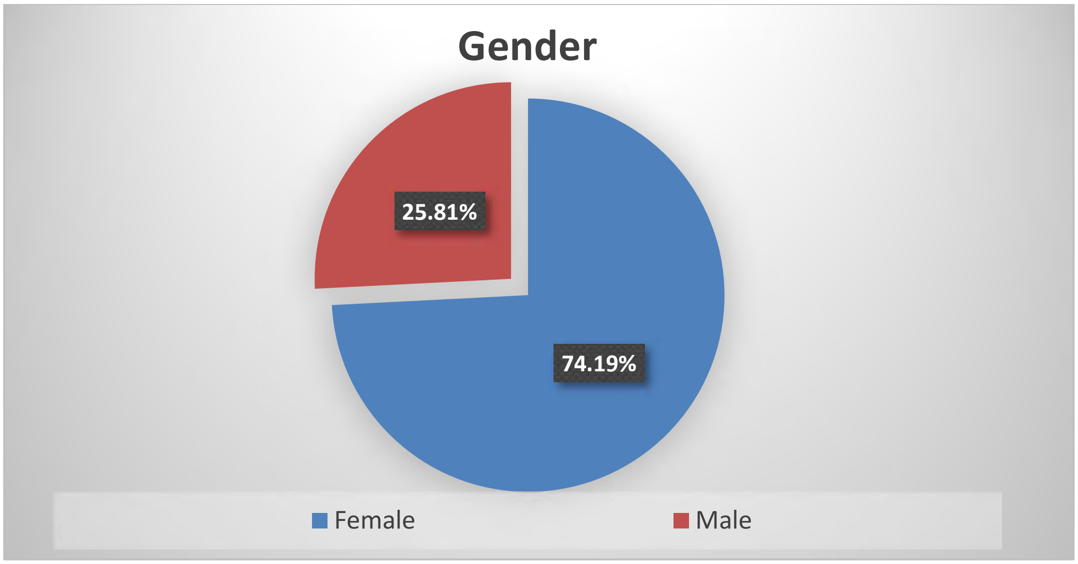


Figure 169 - Distribution of Respondents in Barangay Talbak based on Gender

Majority of the respondents are females with a total of 69 out of the 93 respondents or 74.19%. Males represent 25.81% or 24 out of 93 total survey respondents.

2.4.2.3.1.2 Birthplace

Majority of the respondents (34.41%) were born in the impact barangay, while 33.33% were from Other Provinces. There were 20.43% of them who were born from Other City/Municipality and 9.68% from Other Barangays.

Table 121 - Birthplace of Survey Respondents in Barangay Talbak

BIRTHPLACE	TALBAK	
	No.	%
Within Barangay	32	34.41
Other Barangay	9	9.68
Other City/ Municipality	19	20.43
Other Province	31	33.33
No Answer	2	2.15
Total	**93**	**100.00**

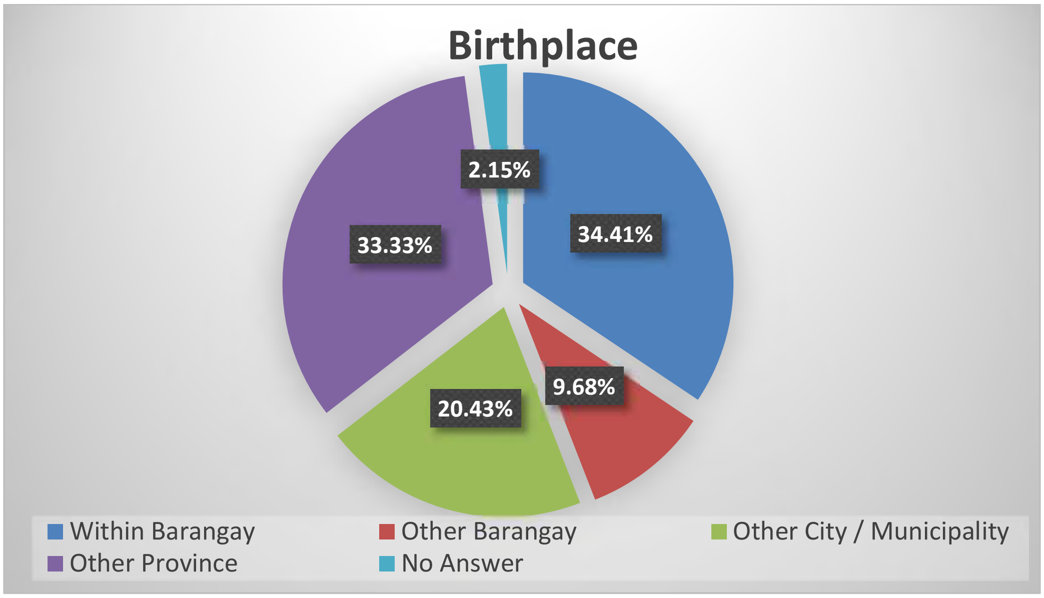


Figure 170 - Distribution of Respondents in Barangay Talbak based on Place of Birth

2.4.1.1.1.1 Age

shows the age distribution of the respondents. The most number of respondents belongs to the 41-50 age bracket with 24.73% and this was followed by the age bracket 31-40 (20.43%). With the same percentage of 13.98%, respondents were either in the age bracket of 21-30 or 61-70. There were 11.83% from 51-60 years old and 7.53% from the age group 15-20. Lastly, older age group of 71 – above were 4.30%, while 3.23% of the respondents refused to give an answer.

Table 122 - Age of Survey Respondents in Barangay Talbak

AGE	TALBAK	
	No.	%
15-20	7	7.53
21-30	13	13.98
31-40	19	20.43
41-50	23	24.73
51-60	11	11.83
61-70	13	13.98
71 & above	4	4.30
No Answer	3	3.23
Total	**93**	**100.00**

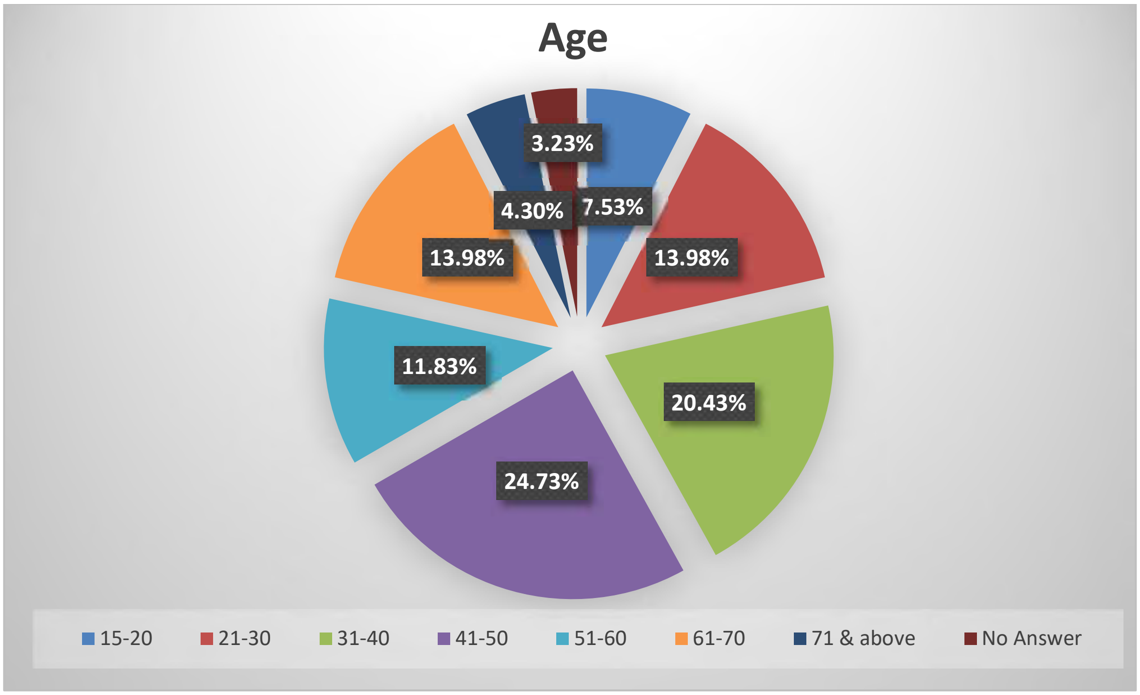


Figure 171 - Distribution of Respondents in Barangay Talbak based on Age

2.4.2.3.1.3 Civil Status

About 70.97% of the respondents confirmed that they are Married, while 17.20% of the respondents were Widowed. There were 7.53% of the respondents who were Single and 3.23% respondents were Separated. This only shows that the community holds marriage as an important social institution.

Table 123 - Civil Status of Survey Respondents in Barangay Talbak

CIVIL STATUS	TALBAK	
	No.	%
Single	7	7.53
Married	66	70.97
Widow	16	17.20
Separated	3	3.23
No Answer	1	1.08
Total	**93**	**100.00**

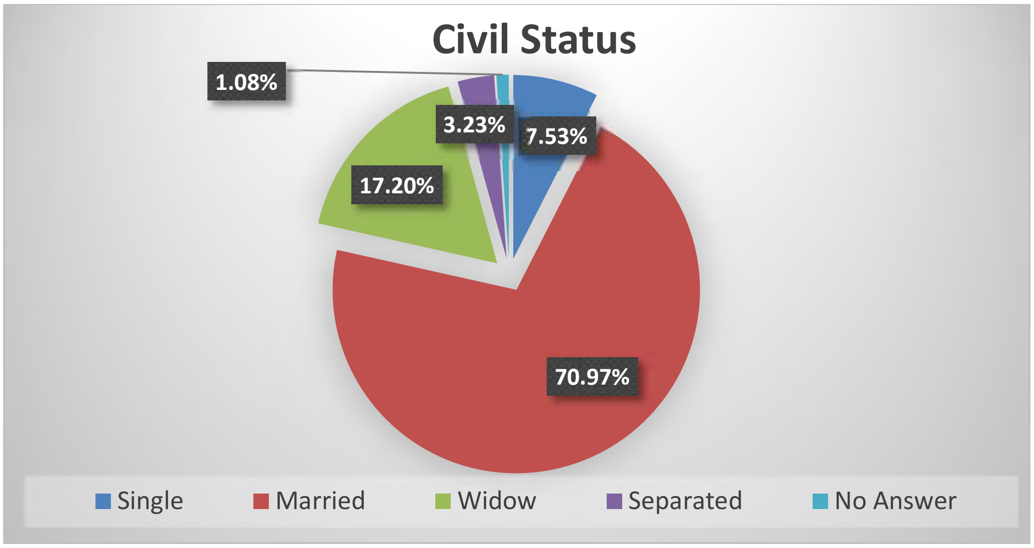


Figure 172 - Distribution of Respondents in Barangay Talbak based on Civil Status

2.4.2.3.1.4 Religion

The religion of the majority respondents (77.42%) were Roman Catholic. Comprising 12.90% of the respondents who were Iglesia ni Cristo or Born Again. The remaining percentage were Protestant (3.23%) and members of Other denominations (1.08%). 5.38% of the respondents refused to divulge its religions affiliation.

Table 124 - Religion of Survey Respondents in Barangay Talbak

RELIGION	TALBAK	
	No.	%
Roman Catholic	72	77.42
Protestant	3	3.23
INC	6	6.45
Born Again	6	6.45
Others	1	1.08
No Answer	5	5.38
Total	**93**	**100.00**

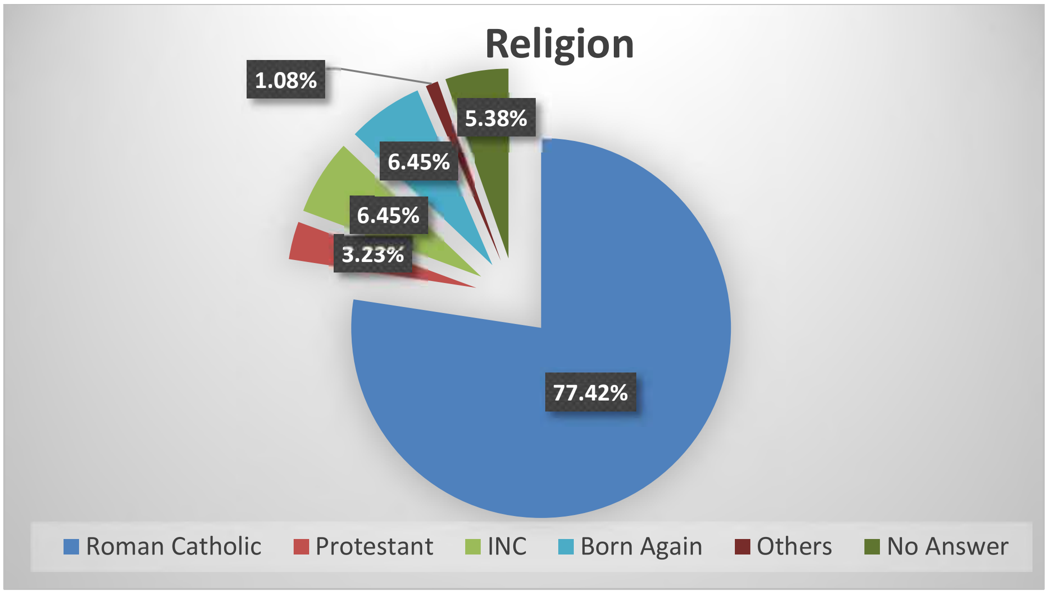


Figure 173 - Distribution of Respondents in Barangay Talbak based on Religion

2.4.2.3.1.5 Educational Attainment

All of the respondents had formal education they acquired from community schools and majority of them, 33.33%, had Elementary Education. This is higher than those who had reached High School with 23.66% and those who have graduated in High School (17.20%) and in Elementary (16.13%). Some respondents were able to attend Technical-Vocational Courses (4.30%) and Tertiary Education (3.23%). This only shows that all of the respondents are literate and were able to acquire basic education.

Table 125 - Educational Attainment of Survey Respondents in Barangay Talbak

EDUCATIONAL ATTAINMENT	TALBAK	
	No.	%
Elementary	31	33.33
Elementary Graduate	15	16.13
High School	22	23.66
High School Graduate	16	17.20
College	3	3.23
Vocational	4	4.30
No Answer	2	2.15
Total	**93**	**100.00**

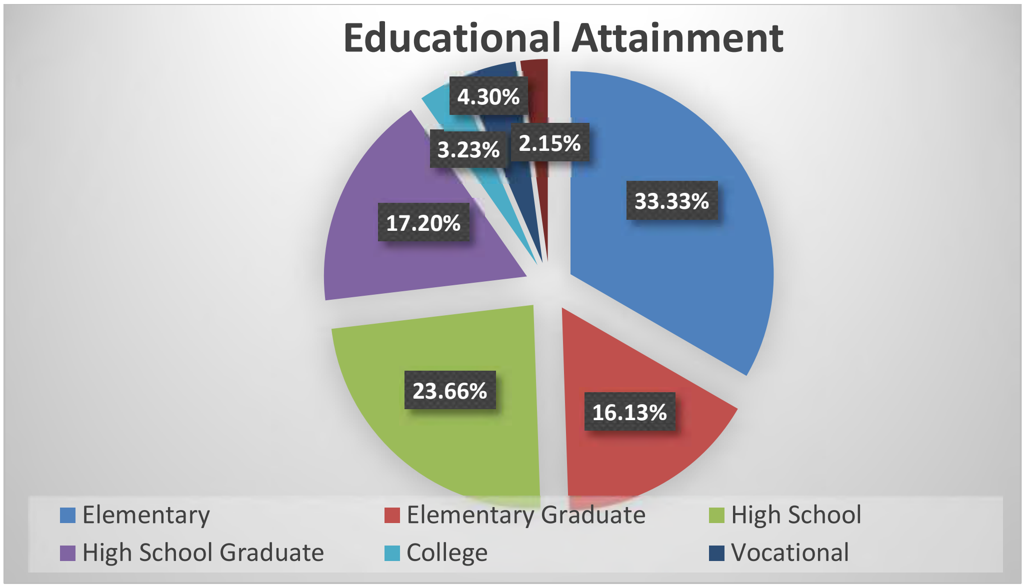


Figure 174 - Distribution of Respondents by Barangay Based on Educational Attainment

2.4.2.3.1.6 Income Sources and Employment

Majority of the respondents were Farmers with 26.88%, followed by Barangay Official / Government Employees with 15.05% of the respondents. The 9.68% are vendors, however, 4.30% of the respondents do not have any source of income. There are also Self Employed or Entrepreneur (4.30%) and 3.23% works in Construction. The remaining percentage were Transport Service, works in Private Companies and Service Workers, sharing the same percentage of 1.08%.

Table 126 - Income Source of Survey Respondents in Barangay Talbak

SOURCE OF INCOME	*TALBAK*	
	No.	*%*
Vendor	9	9.68
Barangay Official / Gov't Employee	14	15.05
Transport Service	1	1.08
Private Employee	1	1.08
Construction	3	3.23
Farmer	25	26.88
Self – employed / Entrepreneur	4	4.30
None	8	8.60
Other – Volunteer/Service	1	1.08
No Answer	27	29.03

SOURCE OF INCOME	TALBAK	
	No.	%
Total	**93**	**100.00**

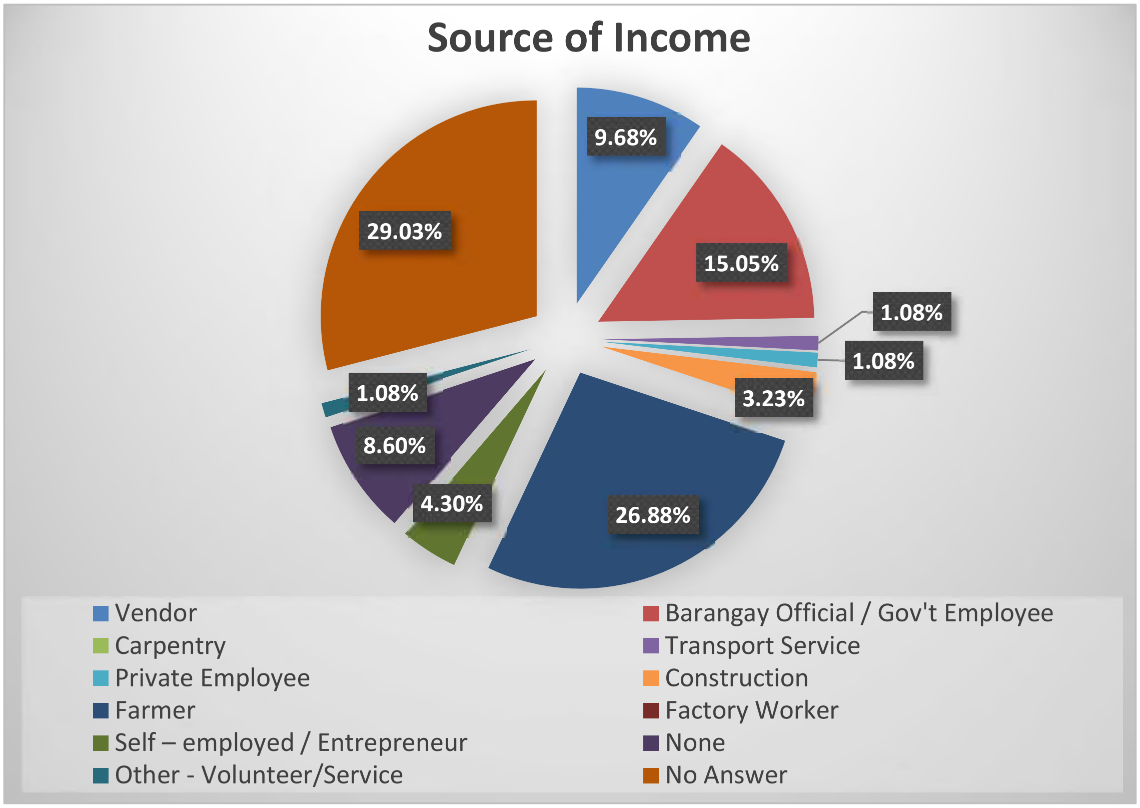


Figure 175 - Distribution of Respondents in Barangay Talbak based on Source of Income

2.4.2.3.1.7 Monthly Income

The table below shows that the majority (38.71%) of the respondents are earning between Php 1,000 and 5,000, while only 19.35% are earning less than Php 1,000. About 6.45% of the respondents have an income of Php 5,001 to 10,000 and there were only 1.08% that earns Php 15,001 to 20,000. The large. In their struggle to achieve upliftment of their socio-economic status, either they would to find a good paying job or perhaps engage in an enterprise.

Table 127 - Estimated Monthly Income of Survey Respondents in Barangay Talbak

MONTHLY INCOME (PhP)	TALBAK	
	No.	%
Less than 1,000	18	19.35
1,000 to 5,000	36	38.71

MONTHLY INCOME (PhP)	TALBAK	
	No.	%
5,001 to 10,000	6	6.45
10,001 to 15,000	0	0.00
15,001 to 20,000	1	1.08
20,000 & above	0	0.00
No Answer	32	34.41
Total	**93**	**100.00**

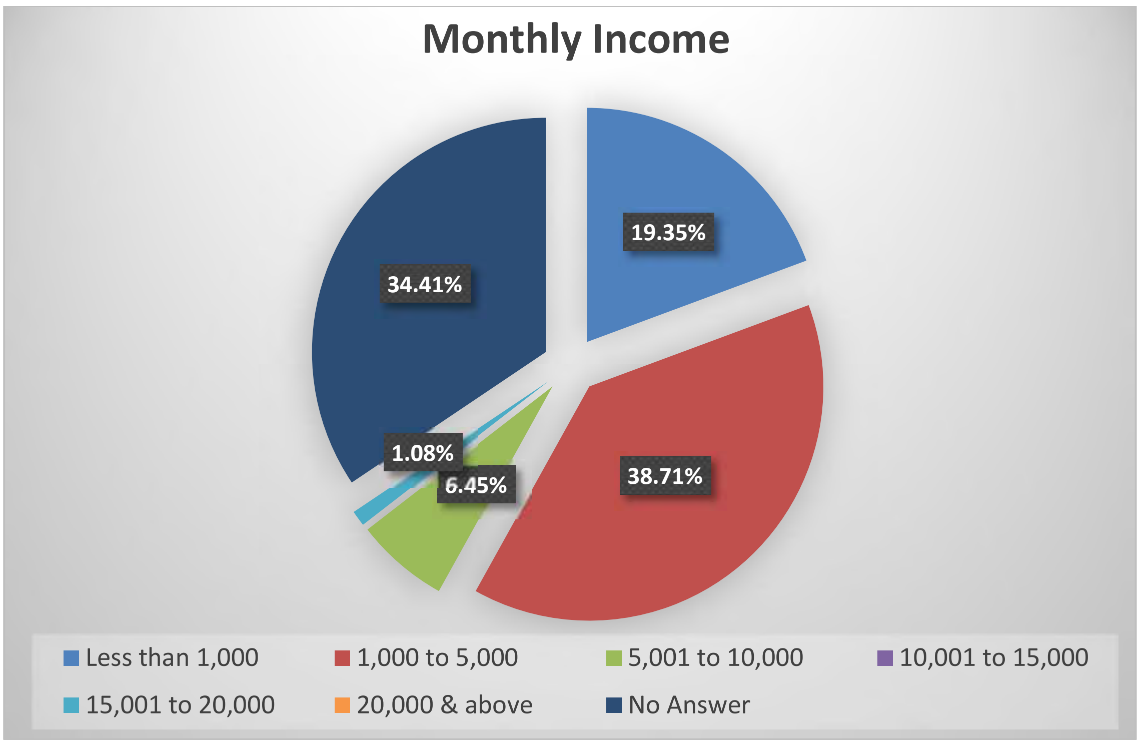


Figure 176 - Distribution of Respondents in Barangay Talbak based on Monthly Income

2.4.2.3.1.8 Membership to Organization

Majority of the respondents belong to an Organization in their community with 51.61% of the total respondents. Majority of the active members belong to Womens and Senior Citizen's Organization. Below are the identified organization by the respondents.

Table 128 - Organization of Survey Respondents in Barangay Talbak

MEMBERSHIP TO ORGANIZATION	TALBAK	
	No.	%
Organization Member	48	51.61

MEMBERSHIP TO ORGANIZATION	TALBAK	
	No.	%
Not an Organization Member	24	25.81
No Answer	21	22.58
Total	**93**	**100.00**

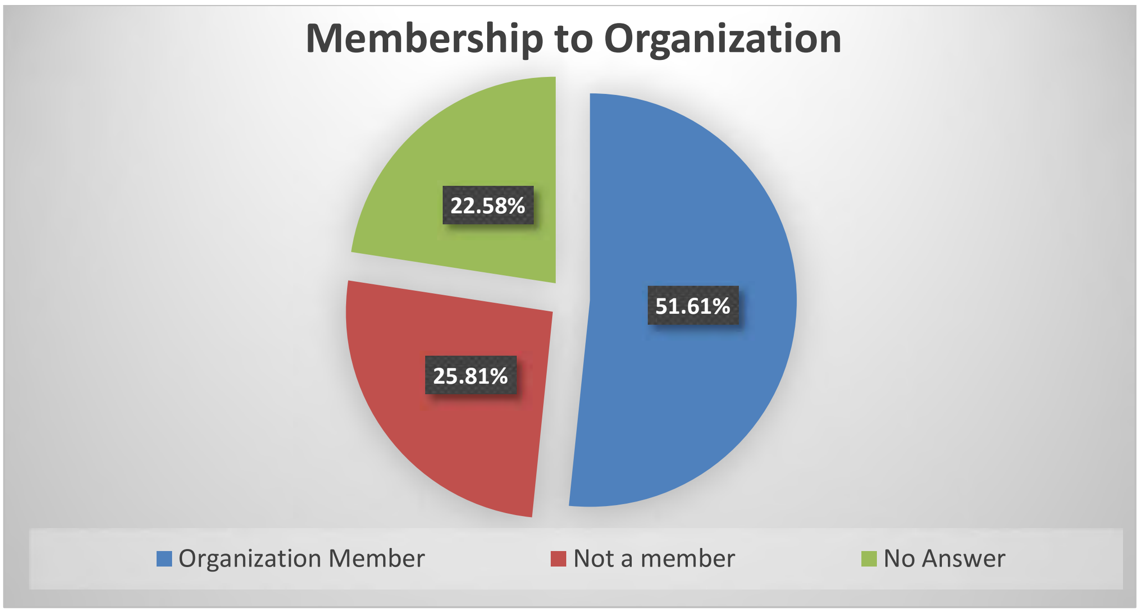


Figure 177 - Distribution of Respondents in Barangay Talbak based on Organization

Table 129 - Organizations in Barangay Talbak

Community Organization	Number of Respondents
4Ps	3
Tanod	1
BASSY	2
BERT	1
Kaagapay	3
Solo Parent Association	1
Senior Citizens	9
Farmers' Organization	8
Womens	10
Youth Organization	1
Barangay Council Volunteer	8
Faculty Club	1

2.4.2.3.2 Household Information

2.4.2.3.2.1 Household Size

Most of the respondents (37.63%) belong to 3 to 4 household size, followed by those who had 5 to 6 household size (26.885). Almost fourteen percent (13.98%) of the respondents belong to 7 to 8 household size and 11.83% belong to a relatively small household size of 1 to 2. Finally, four (4) respondents or 4.30% belongs to a 9 to 10 household size.

Table 130 - Household Size of Survey Respondents in Barangay Talbak

HOUSEHOLD SIZE	TALBAK	
	No.	%
1-2	11	11.83
3-4	35	37.63
5-6	25	26.88
7-8	13	13.98
9-10	4	4.30
More than 10	0	0.00
No Response	5	5.38
Total	**93**	**100.00**

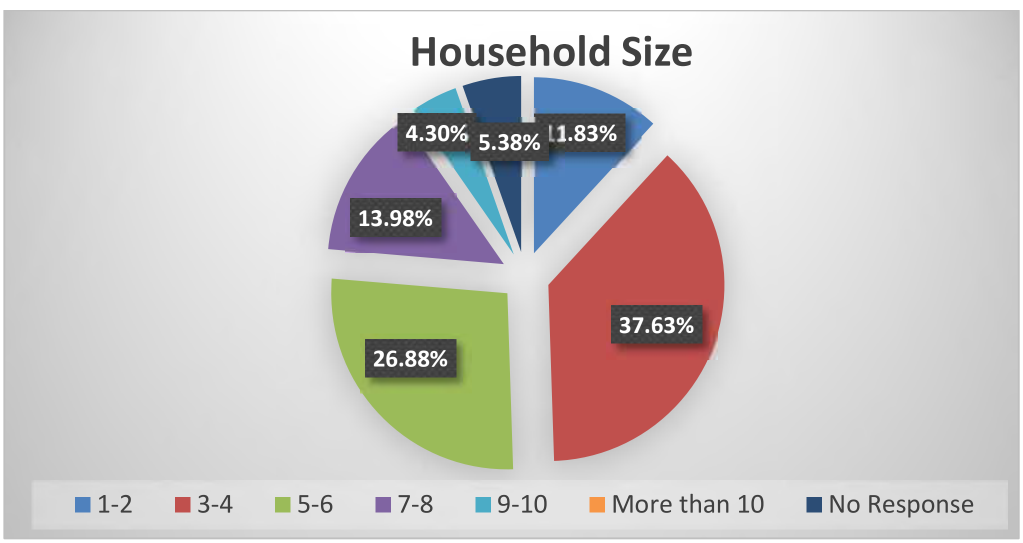


Figure 178 - Distribution of Respondents in Barangay Talbak based on Household Size

2.4.2.3.2.2 Household Composition

There are 47.27% of the respondents that are considered a Nuclear Family that consists of parents and children, while 32.73% have families that extends beyond the nuclear which include aunts, uncles, grandparents, etc., who live in a household. 20.00% of the household did not specify the composition.

Table 131 - Household Composition of Survey Respondents in Barangay Talbak

HOUSEHOLD COMPOSITION	TALBAK	
	No.	%
Extended Family	18	32.73
Nuclear Family	26	47.27
No Answer	11	20.00
Total	**55**	**100.00**

Note: data does not include the initial perception survey

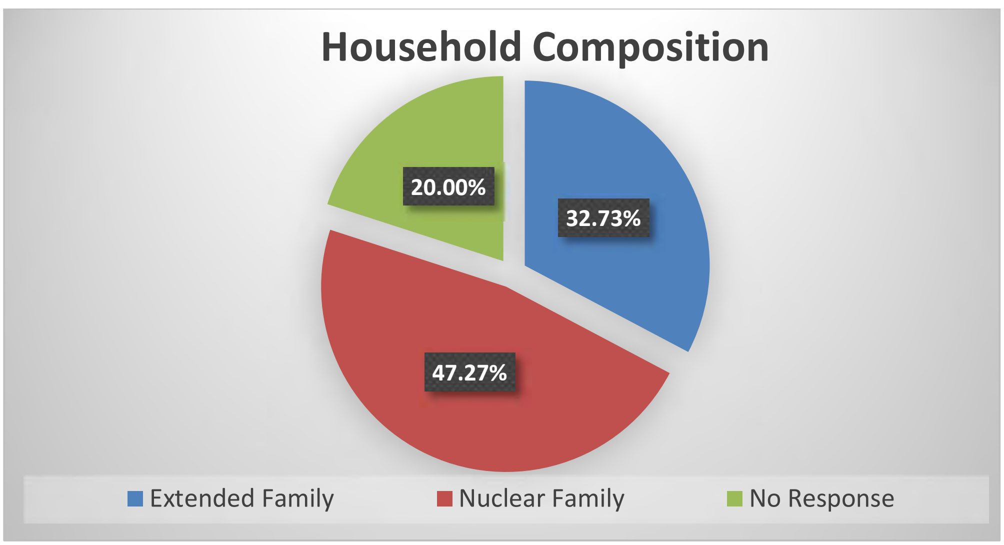


Figure 179 - Distribution of Respondents in Barangay Talbak based on Household Composition

2.4.2.3.2.3 Morbidity

Table 132 shows the number of household members that got sick in the past year. Eighteen (18) or 32.73% of them claimed that two of their family members experienced illness and nine (9) or 16.36% of the respondents replied that three of their family members also experienced illness. There were 12.73% of the respondents answered that only one of their family members that got sick for the past years, while 10.91% of them said that six of their family members experienced illness. Only 2 respondents or 3.64% of the respondents who claimed that more than 6 of their household got sick and 1.82% answered that five members of their family got sick.

Table 132 - Household Member of the Survey Respondents Who Experienced Illness in Barangay Talbak

No. of HH Members	TALBAK	
	No.	%
1	7	12.73
2	18	32.73
3	9	16.36
4	6	10.91
5	1	1.82
More than 6	2	3.64
No Answer	12	21.82
Total	**55**	**100.00**

Note: data does not include the initial perception survey

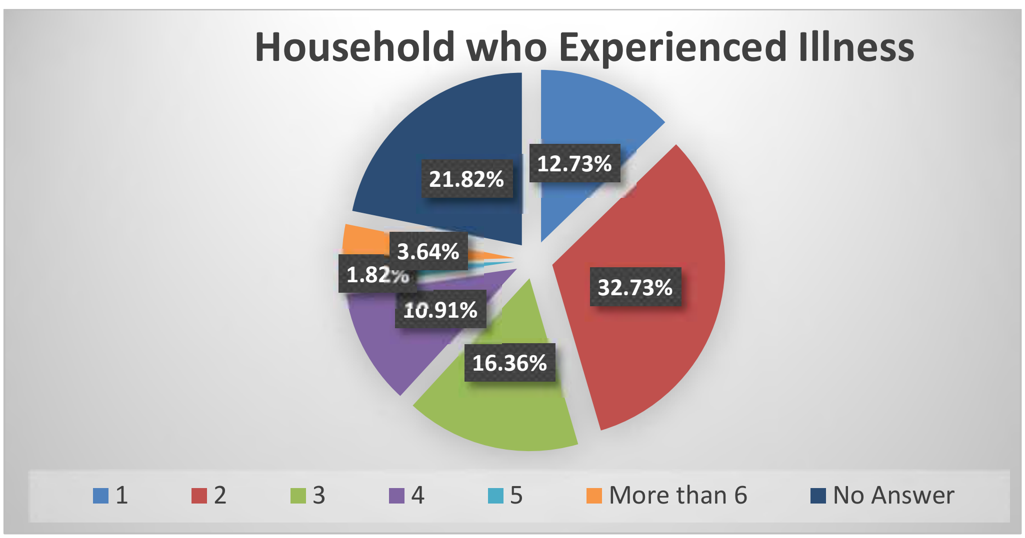


Figure 180 - Number of Household members that got sick in Barangay Talbak

2.4.2.3.2.4 Common Diseases

The matrix below (***Table 133***) shows the common community diseases in Barangay Talbak. Upper Respiratory (44.44%) tops as one of the common illnesses in their barangay, followed by Fever with 40.00% and Diarrhea with 6 cases or 6.67%. The rest of the common diseases are listed below.

Table 133 - Common Diseases of the Respondents in Barangay Talbak

ILLNESS	***TALBAK***	
	No.	***%***
Diarrhea	6	6.67
Fever	36	40.00
Upper Respiratory	40	44.44
Others	1	1.11
Asthma	2	2.22
Injury	1	1.11
Colds	2	2.22
Appendicitis	1	1.11
Highblood	1	1.11
Total	**90**	**100.00**

Note: data does not include the initial perception survey

**multiple answer*

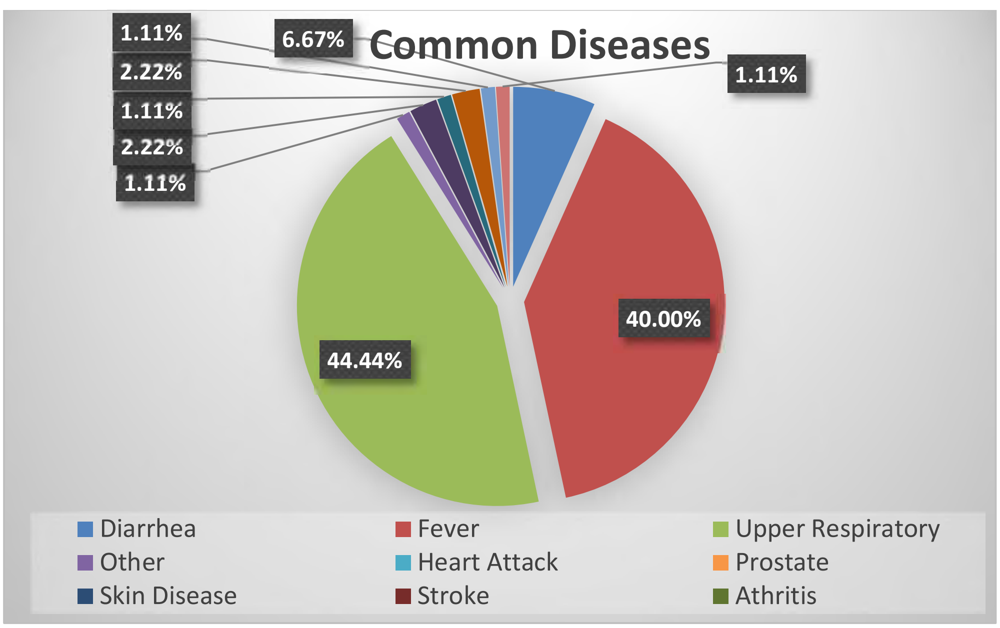


Figure 181 - Distribution of Respondents in Barangay Talbak based on Experience Illness

2.4.2.3.2.5 Health Seeking Behavior

Most of the respondents (38.81%) availed of the services of Barangay Health Center for treatment. About 25.37% prefer to be treated in Public Hospitals, while 10.45% prefer to be treated at their homes. 10 respondents prefer to treated either in Private Clinic or by the Traditional Healer. Only 4.48% of the respondents opted to treat illnesses in Private Hospitals.

Table 134 - Health Facilities and Providers accessed by the Survey Respondents in Barangay Talbak

HEALTH FACILITY	*TALBAK*	
	No.	*%*
Home	7	10.45
Health Center	26	38.81
Public Hospital	17	25.37
Private Hospital	3	4.48
Private Clinic	5	7.46
Herbalist	5	7.46
No Answer	4	5.97
Total	**67**	**100.00**

Note: data does not include the initial perception survey

**multiple answer*

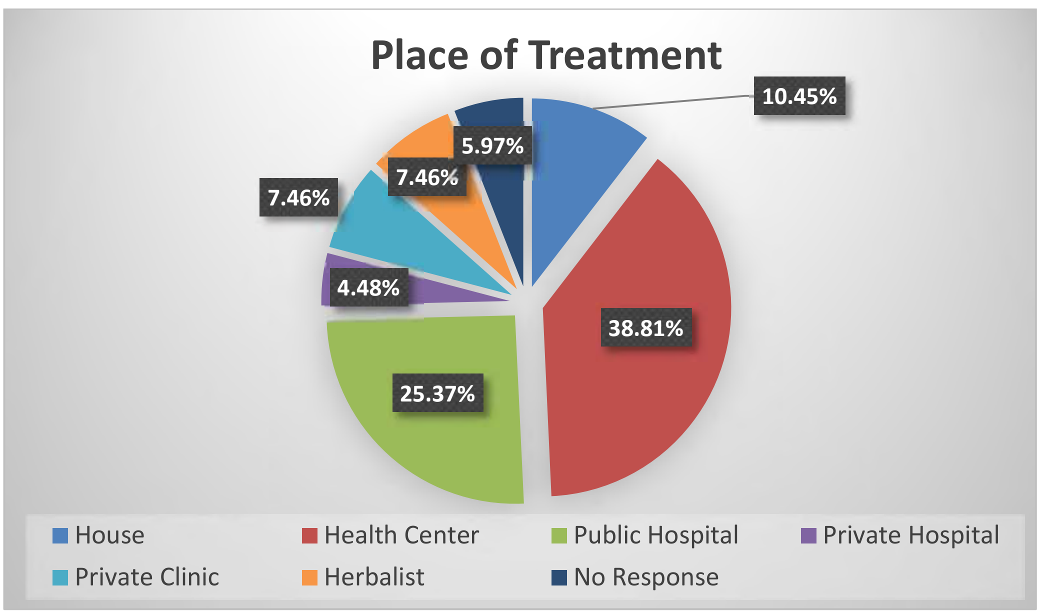


Figure 182 - Distribution of Respondents in Barangay Talbak based on Place of Treatment

2.4.2.3.2.6 Waste Disposal

Data presented in ***Table 135*** shows the type of waste disposal of the survey respondents. Majority or 38.18% disposes their garbage through their own Garbage Pits and 34.55% of them said that their wastes and garbage were collected by the barangay for disposal. Some of the respondents (18.18%) still burns their garbage and 5.45% uses different types of disposals. Only 3.64% of the respondents practice segregation.

Table 135 - Waste Disposal of Survey Respondents in Barangay Talbak

WASTE DISPOSAL	TALBAK	
	No.	%
Garbage Pit	21	38.18
Garbage Collection	19	34.55
Burning	10	18.18
Segregate	2	3.64
Others	3	5.45
Total	**55**	**100.00**

Note: data does not include the initial perception survey

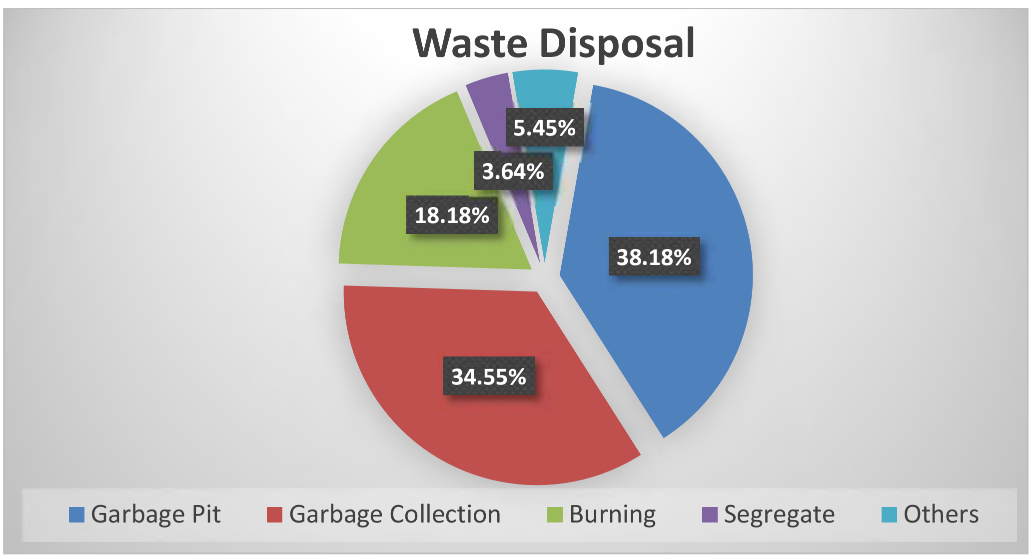


Figure 183 - Distribution of Respondents in Barangay Talbak based on Waste Disposal

2.4.2.3.2.7 Sources of Drinking Water

Table 136 shows the sources of potable drinking water of the household surveyed. More than half (40) or 72.73% of the households primary source of drinking water is through Deep Wells, while 14.55% of the respondents use water from Other sources. Some residents sourced their water through the Local Water District (10.91%) and only 1.82% from the Spring.

Table 136 - Sources of Drinking Water of Survey Respondents in Barangay Talbak

SOURCE OF DRINKING WATER	TALBAK	
	No.	%
Spring	1	1.82
Deepwell	40	72.73
Local Water District	6	10.91
Others	8	14.55
Total	**55**	**100.00**

Note: data does not include the initial perception survey

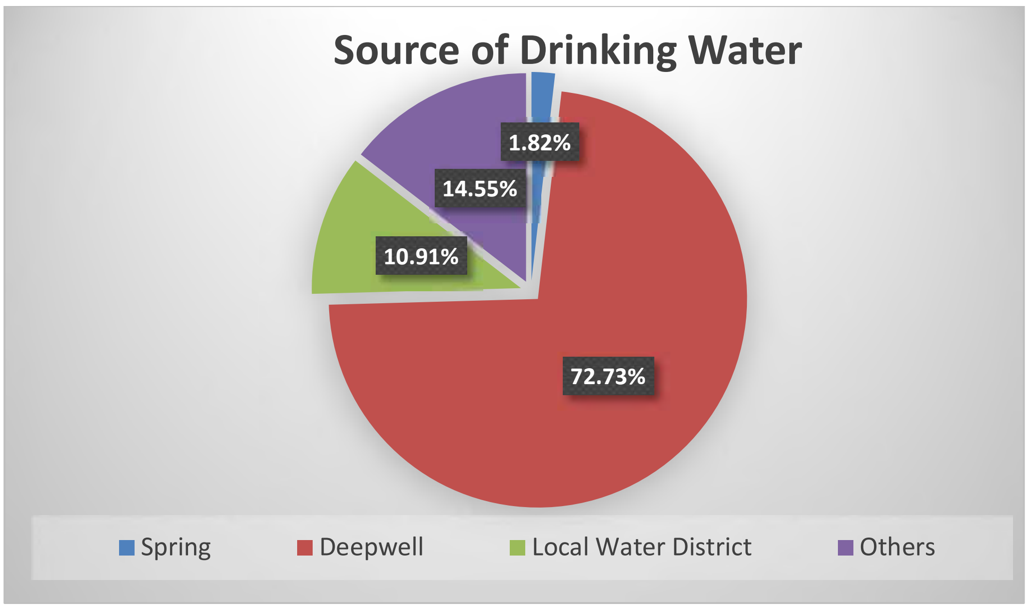


Figure 184 - Distribution of Respondents in Barangay Talbak based on Sources of Drinking Water

2.4.2.3.2.8 Toilets

Most of the respondents (67.27%) have their own Water-Sealed Toilet, while 14.55% have toilet facility with Flush mechanism. There are 7.27% of the respondents dispose their human waste through Hole on the Ground, however, 5.45% respondents answered that they do not have their own toilet. Only one respondent said they have other type of toilet facility.

Table 137 - Sanitation and Toilet of the Survey Respondents in Barangay Talbak

SANITATION AND TOILETS	TALBAK	
	No.	%
Flush	8	14.55

SANITATION AND TOILETS	***TALBAK***	
	No.	***%***
Water Sealed	37	67.27
House with hole on the ground	0	0.00
Hole on the ground	4	7.27
None	3	5.45
Others	1	1.82
No Answer	2	3.64
Total	**55**	**100.00**

Note: data does not include the initial perception survey

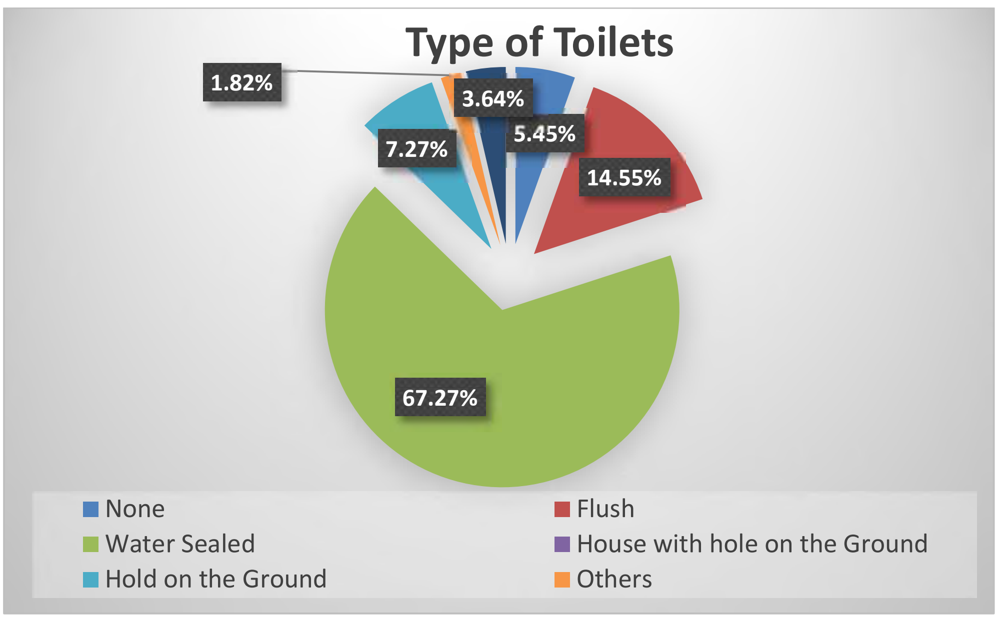


Figure 185 - Distribution of Respondents in Barangay Talbak based on Type of Toilets

2.4.2.3.3 Housing Condition

2.4.2.3.3.1 House Ownership

Majority of the respondents (73.12%) Own the House where they are staying and 18.28% of them do not own the house they occupy. Only 8.60% of the respondent did not specify their answers.

Table 138 - House Ownership of Survey Respondents in Barangay Talbak

HOUSE OWNERSHIP	TALBAK	
	No.	%
Owns the House	68	73.12
Does not own the House	17	18.28
No Answer	8	8.60
Total	**93**	**100.00**

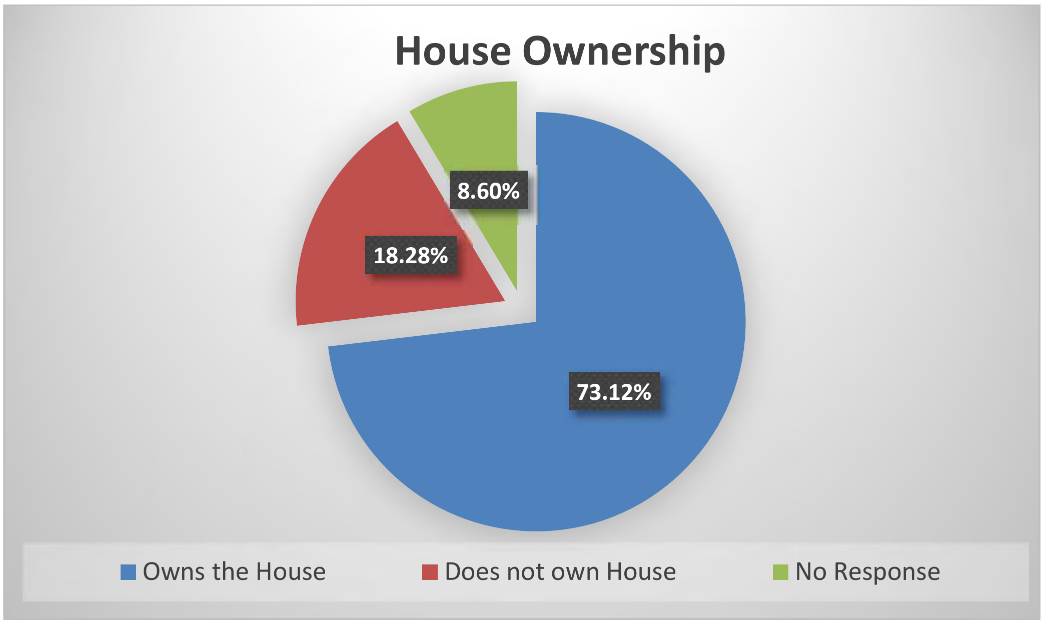


Figure 186 - Distribution of Respondents in Barangay Talbak based on House Ownership

2.4.2.3.3.2 Land Ownership

Most of the respondents (47.31%) Own the Land where their houses were built, while 45.16% of them were not lot owners of their houses.

Table 139 - Land Ownership of Survey Respondents in Barangay Talbak

LAND OWNERSHIP	TALBAK	
	No.	%
Owns the Land	44	47.31
Does not own the Land	42	45.16
No Answer	7	7.53
Total	**93**	**100.00**

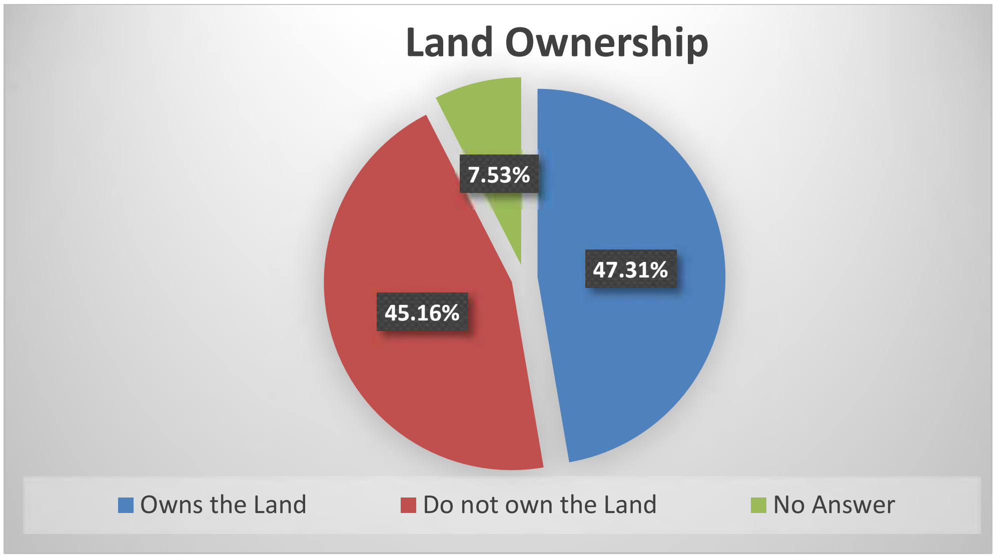


Figure 187 - Distribution of Respondents in Barangay Talbak Based on Land Ownership

2.4.2.3.3.3 Housing Materials

Table 140 shows the construction materials of the outer walls of the survey respondents houses . Almost half of the respondents (41.18%) used G.I. Sheets as an outer wall of their houses. Thirty two or 31.37% of the respondents used Wood, 21.57% used Concrete and only six or 5.88% of the respondents used Bamboo as outer walls of their houses.

Table 140 - Outer Wall Materials of the Respondent's Houses in Barangay Talbak

CONSTRUCTION MATERIALS OF THE OUTER WALLS	TALBAK	
	No.	%
Wood	32	31.37
Concrete	22	21.57
Bamboo	6	5.88
G.I. Sheets	42	41.18
Others	0	0.00
Total	**102**	**100.00**

**Multiple Answer*

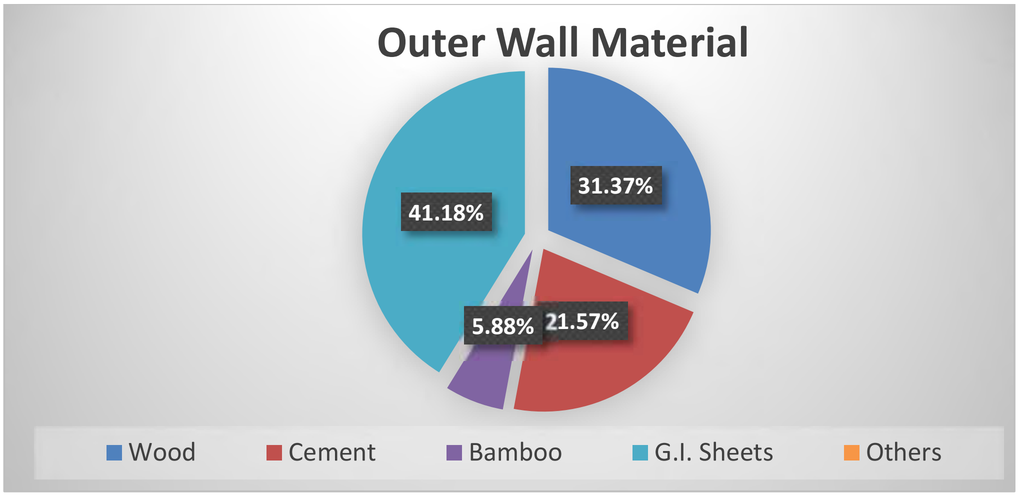


Figure 188 - Distribution of Respondents in Barangay Talbak based on Outer Wall Material of their Houses

On the other hand, the most common roofing material used by the respondents in Barangay Talbak was G.I. Sheets (33.02%), followed by Wood with 31.13%. There were respondents that also used Concrete (17.92%), Bamboo (16.04%) and other kind of roofing materials (1.89%) for their houses.

Table 141 - Roof Material of the Respondent's Houses in Barangay Talbak

CONSTRUCTION MATERIALS OF THE ROOF	TALBAK	
	No.	%
Wood	33	31.13
Concrete	19	17.92
Bamboo	17	16.04
G.I. Sheets	35	33.02
Others	2	1.89
Total	**106**	**100.00**

**Multiple Answer*

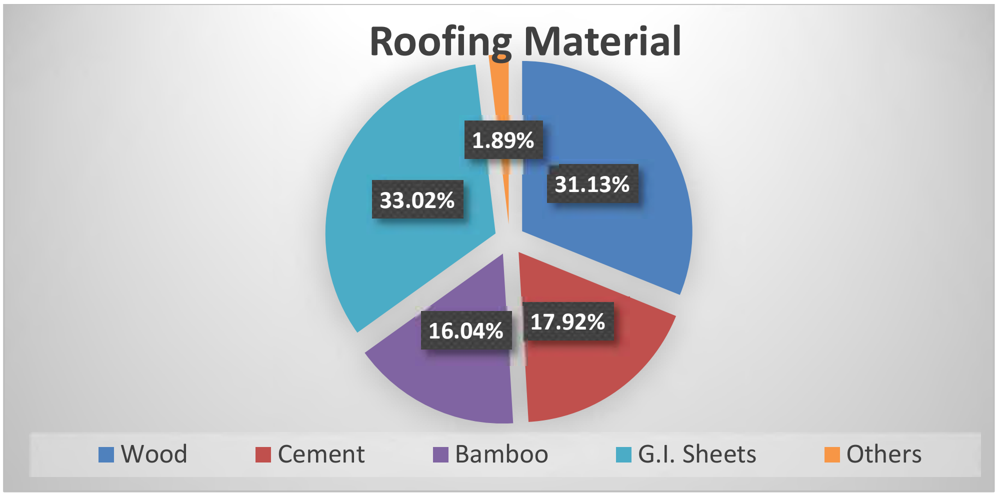


Figure 189 - Distribution of Respondents in Barangay Talbak based on Roofing Material of their Houses

2.4.2.3.4 Community Problems and Concerns

The matrix below presents the perceived problems of the respondents in Barangay Talbak. Most of the responses identified Unemployment (11.93%) as the main problem in the Barangay. Poverty (10.78%), Lack of Livelihood Support (9.63%), Lack of Capital for Small Business (8.72%), Educational Assistance (8.26%) and Availability of Potable Water (7.80%) were also identified by the respondents as the major concerns in their Barangay. Problems were also perceived on Limited Assistance to Develop Farming (6.88%), Lack of Medical Equipment (6.65%), Lack of Water for Irrigation (5.28%), Lack of School Equipment (5.05%) and Malnutrition with 4.82%. Another point of concerns raised by the respondents were Lack of Recreational Facilities (4.13%), Lack of Support in Training People's Organization (3.67%), Lack of Facilities of Transportation/Roads/Bridges (2.29%), Lack of Teachers (1.83%) and Lack of Orientation and Training on Solid Waste Management (1.61%) that needed attention in the community. Lastly, it is important to note that some of the respondents also raised their concerns about the weak cellular signal (0.69%) as another community problem in their barangay. The complete list of the perceived problems by the respondents are shown in ***Table 142***.

Table 142 - Common Community Problems and Concerns of the Respondents in Barangay Talbak

COMMUNITY PROBLEMS/CONCERNS	TALBAK		Rank
	No.	%	
Unemployment	52	11.93	1st
Poverty	47	10.78	2nd

COMMUNITY PROBLEMS/CONCERNS	***TALBAK***		***Rank***
	No.	***%***	
Availability potable water	34	7.80	6th
Lack of water for irrigation	23	5.28	9th
Lack of school equipment	22	5.05	10th
Malnutrition	21	4.82	11th
Educational assistance	36	8.26	5th
Lack of teachers	8	1.83	15th
Lack of medical equipment	29	6.65	8th
Lack of facilities for transportation/ roads/ bridges	10	2.29	14th
Lack of Livelihood support	42	9.63	3rd
Lack of recreational facilities	18	4.13	12th
Lack of capital for small business	38	8.72	4th
Limited assistance to develop farming	30	6.88	7th
Lack of support in training People's Organization	16	3.67	13th
Lack of orientation and training on Solid Waste Management	7	1.61	16th
Others (Signal)	3	0.69	17th
Total	**436**	**100.00**	

**Multiple Answer*

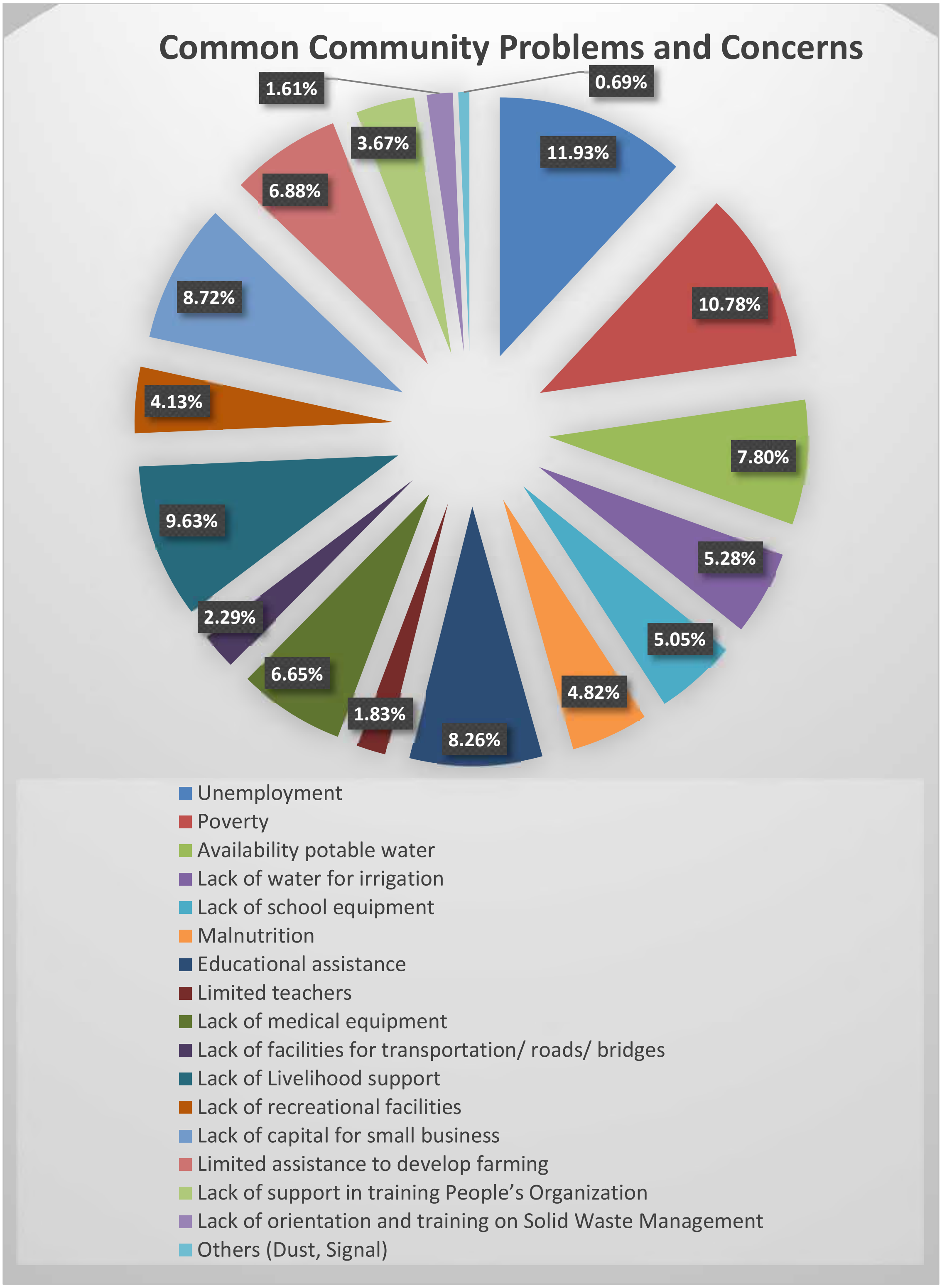


Figure 190 - Distribution of Respondents in Barangay Talbak based on their Common Community Problems and Concerns

The respondents provided possible solutions to the identified community problems. Notably, the generation of Employment (16.33%) and creation of Livelihood Projects (13.07%) is among the top proposed solution of the respondents. Other top proposals include Potable Water Supply (9.05%), Additional budget for the Barangay (8.54%), Livelihood Training and Assistance to Women (8.29%) and Scholarship Program (7.54%). Various proposals were provided by the respondents, summarized in the matrix below (***Table 143***).

Table 143 - Proposed Solution of the Survey Respondents in Barangay Talbak on the Identified Concerns/Problems

PROPOSED SOLUTIONS	*TALBAK*	
	No.	*%*
Employment	65	16.33
Livelihood Projects	52	13.07
Livelihood Training and Assistance to Women	33	8.29
Education Assistance Project	24	6.03
Scholarship Program	30	7.54
Potable water supply	36	9.05
Medical/Dental Mission Assistance	27	6.78
Designate Materials Recovery Facility in areas within the Barangay	9	2.26
Conduct orientation on proper waste disposal	16	4.02
Assistance from government offices	17	4.27
Assistance from private companies and full implementation of CSR Program	26	6.53
Conduct community consultations at the grassroots level, plan intervention and implement	15	3.77
Values formation/ orientation to all concerned	10	2.51
Additional budget (for the barangay)	34	8.54
Others (Cellular Signal)	4	1.01
Total	**398**	**100.00**

Awareness on the Current Operation of Eagle Cement

Table 144 shows the awareness of the respondents on the current operation of Eagle Cement. Majority (60.22%) of them expressed awareness on the current operation of the company.

25.81% of the respondents are unaware of the current operation and 13.98% gave no answer on the question.

Table 144 - Awareness of the Respondents in Barangay Talbak on the Current Operation of Eagle Cement

AWARENESS ON THE CURRENT OPERATION OF EAGLE CEMENT	TALBAK	
	No.	%
Aware	56	60.22
Not Aware	24	25.81
No Answer	13	13.98
Total	**93**	**100.00**

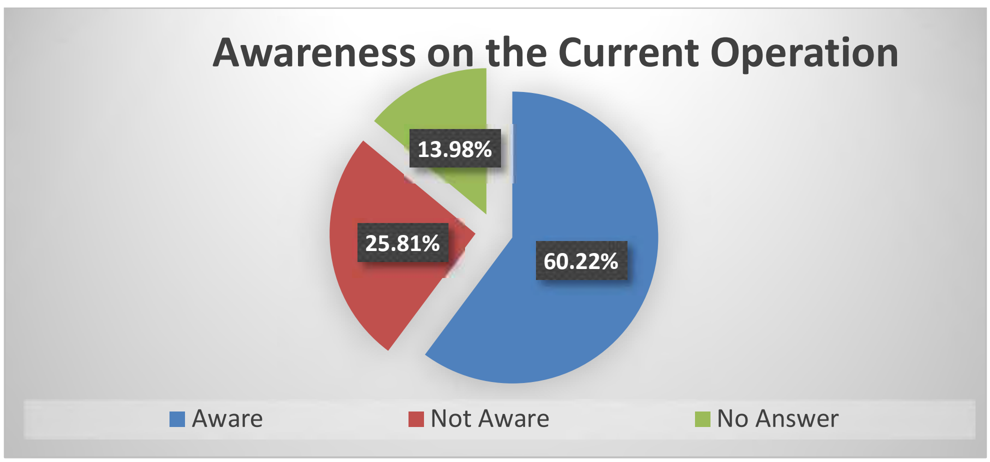


Figure 191 - Distribution of Respondents in Barangay Akle based on Awareness on the Current Operation of Eagle Cement

Majority of the place of residence of the respondents (52.73%) are located far from the plant of Eagle Cement, while 34.55% are near the and only 12.73% did not specify their place of residence.

Table 145 - Houses location of the Survey Respondents in Barangay Talbak

LOCATION	TALBAK	
	No.	%
Near	19	34.55
Far / Not Near	29	52.73
No Answer	7	12.73
Total	**55**	**100.00**

Note: data does not include the initial perception survey

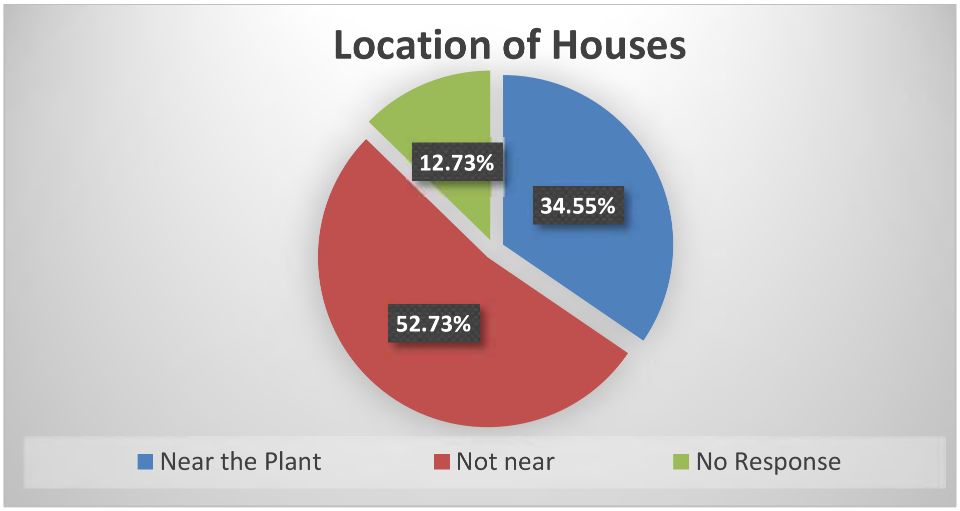


Figure 192 - Distribution of Respondents Barangay Talbak based on Location of their Houses

The respondents also expressed the positive and negative effects of the current operation of Eagle Cement to their community. The respondents mentioned about the positive effects of the presence of Eagle Cement operation in their community. Employment Opportunities (18.71%) and Health and Nutrition Assistance (15.11%) in relation to the operation of Eagle Cement were mentioned. Other impacts include Livelihood Opportunities (12.59%), Educational Assistance and Worker's Safety both with 10.79% and the Provision of Cement for Community Projects (8.99%). Only 0.36% of the respondents answered that current operation of Eagle Cement do not have any positive effects in their community. The detailed results can be seen in ***Table 146***.

Table 146 - Response of the Survey Respondents in Barangay Talbak about the Positive Effects of the Current Operation of Eagle Cement

POSITIVE EFFECTS OF THE CURRENT OPERATION	TALBAK	
	No.	%
Employment Opportunities	52	18.71
Livelihood Opportunities	35	12.59
Health and Nutrition Assistance (Feeding Program, Medical Mission)	42	15.11
Education Assistance	30	10.79
Sports Facility Improvement (Gym, Basketball Court)	16	5.76
Relocation/ Resettlement Program	9	3.24
Worker's Safety	30	10.79
Provision of Cement for Community Projects	25	8.99

POSITIVE EFFECTS OF THE CURRENT OPERATION	***TALBAK***	
	No.	***%***
Progressive place	22	7.91
No positive results	1	0.36
No Response	16	5.76
Total	**278**	**100.00**

**Multiple Answer*

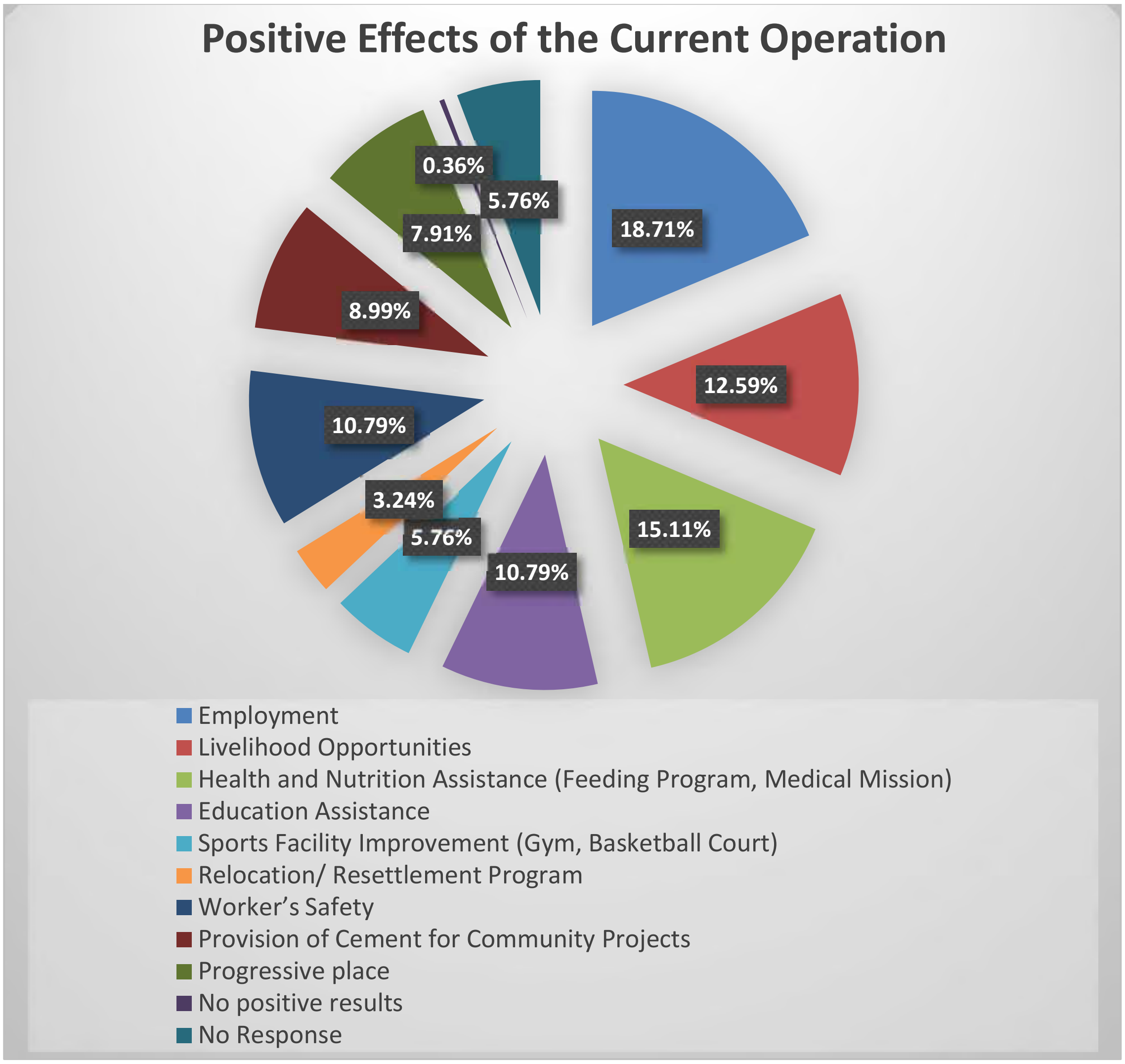


Figure 193 - Distribution of Respondents in Barangay Talbak based on Positive Effects of the Current Operation

With regard to the responses on the negative impact of Eagle Cement's operations to their community, 33.77% of the respondents cited Dust as the main negative impact, followed by

Health Hazard such as tuberculosis, cough and other respiratory diseases with 19.21%. Other negative impacts include Noise Pollution (13.25%); Improper Waste Disposal (5.96%); and Other negative effects (0.66%) such as Blasting and Accident were stated by the respondents. There were 6.62% of the respondents who said that No Negative Effects were observed from the current operation of Eagle Cement.

Table 147 - Response of the Survey Respondents in Barangay Talbak about the Negative Effects of the Current Operation of Eagle Cement

NEGATIVE EFFECTS OF THE CURRENT OPERATION	TALBAK	
	No.	%
Dust	51	33.77
Noise	20	13.25
Traffic Disturbance (Trucks)	12	7.95
Improper Waste Disposal	9	5.96
Health Hazard	29	19.21
Others (Blasting , Accident)	1	0.66
No negative results	10	6.62
No Response	19	12.58
Total	**151**	**100.00**

**Multiple Answer*

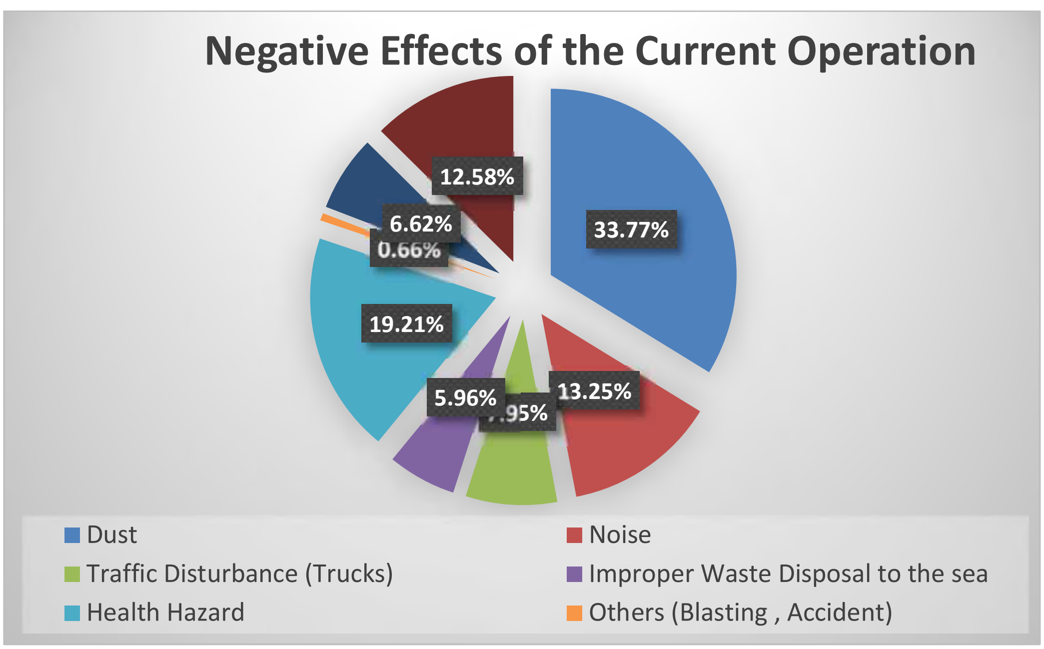


Figure 194 - Distribution of Respondents in Barangay Talbak based on Negative Effects of the Current Operation

Table 148 presents the awareness of the respondents on the existing projects of the company. More than half (73.34%) of the respondents are aware of the existing social development projects of Eagle Cement, while there are only 9.68% of them who are not aware of it. 13.98% of the respondents did not provide their answers to the question.

Table 148. Awareness of the Survey Respondents in Barangay Talbak on the Existing Community Projects of Eagle Cement

FAMILIARITY OF THE DEVELOPMENT PROJECTS OF EAGLE CEMENT	TALBAK	
	No.	%
Familiar of Development Projects of Eagle Cement	71	76.34
Unfamiliar with Projects	9	9.68
No Answer	13	13.98
Total	**93**	**100.00**

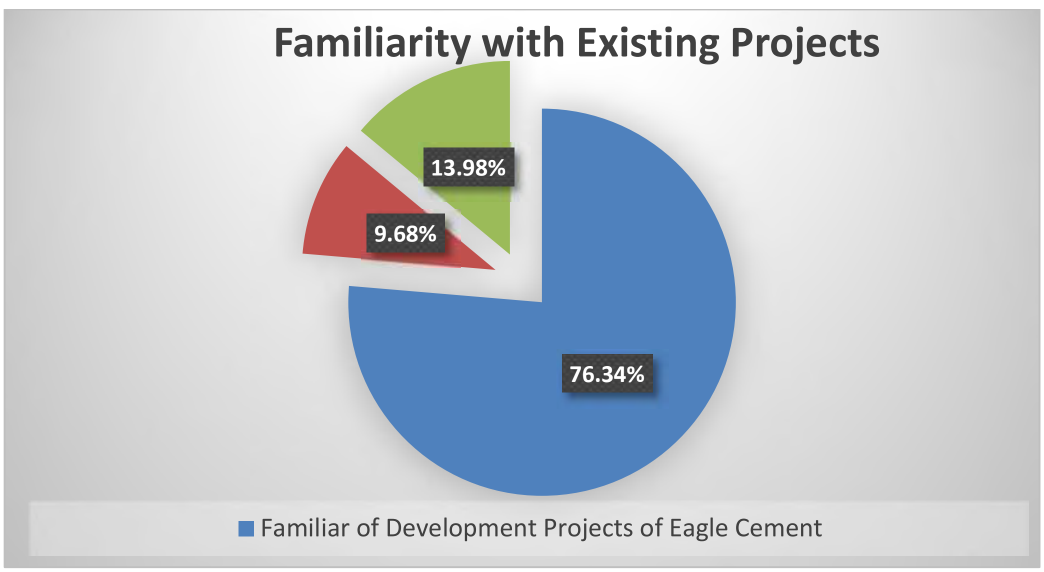


Figure 195 - Distribution of the Respondents in Barangay Talbak based on Familiarity with the Existing Projects of Eagle Cement

Among those that are familiar with the projects of Eagle Cement in the community, 32.81% of them know that there was program implemented under Health, followed by 20.31% of the respondents who were familiar with the Educational Program. Some of the other projects mentioned include Barangay Development (16.15%), Infrastructure Development (11.46%), Livelihood Program (10.94%) and Program under Sports Development with 8.33%. The details are presented in ***Table 149***.

Table 149 - Community Development Projects in Barangay Talbak

COMMUNITY DEVELOPMENT PROJECTS	*TALBAK*	
	No.	*%*
Health Program	63	32.81
Educational Program	39	20.31
Sports Development Program	16	8.33
Livelihood Program	21	10.94
Infrastructure Development	22	11.46
Barangay Development	31	16.15
Total	**192**	**100.00**

**Multiple Answer*

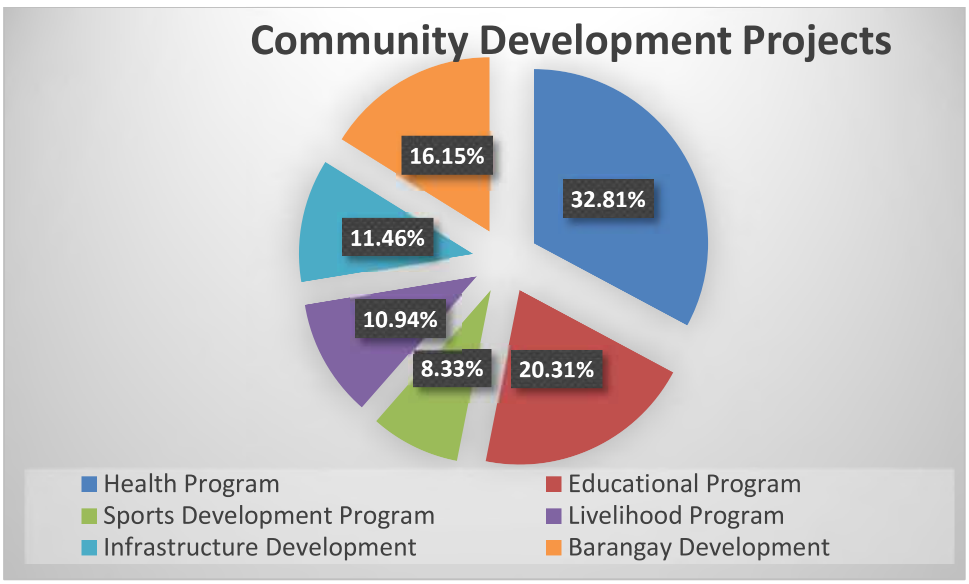


Figure 196 - Distribution of Respondents in Barangay Talbak based on Awareness to Existing Community Projects

There were 53.76% respondents that said they or their family had been part or directly benefited from the identified community development projects, while 26.88% of the respondents did not have any involvement with the projects.

Table 150 - Family's Direct Involvement with the Projects in Barangay Talbak

PROJECT INVOLVEMENT	*TALBAK*	
	No.	*%*
Family Involved or Benefited in the Projects	50	53.76

PROJECT INVOLVEMENT	*TALBAK*	
	No.	***%***
Not Involved	25	26.88
No Answer	18	19.35
Total	**93**	**100.00**

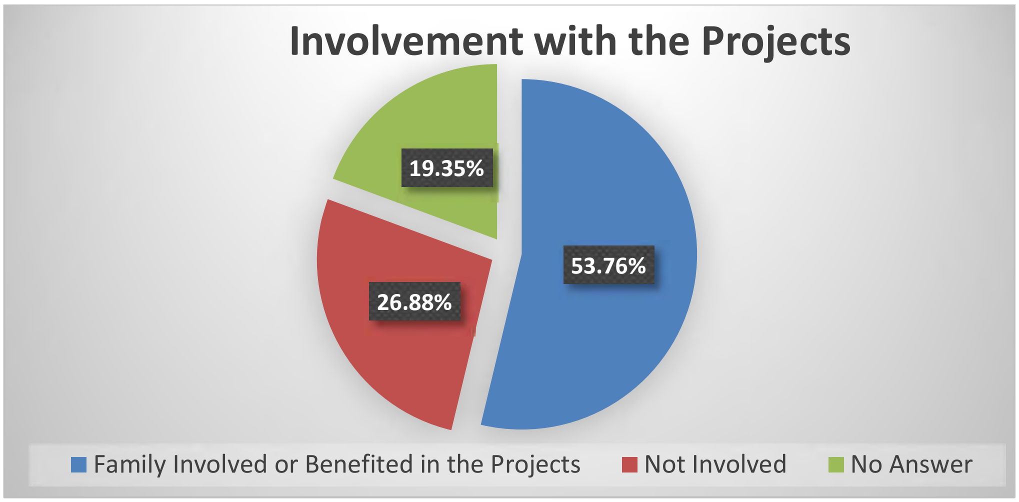


Figure 197 - Distribution of Respondents in Barangay Talbak based on Involvement with the Projects

The benefits provided by Eagle Cement that were received or experienced by the respondents are presented in the matrix below (***Table 151***).

Table 151 - Benefits directly received by the respondents in Barangay Talbak

DIRECT BENEFITS RECEIVED BY THE RESPONDENTS AND THEIR FAMILIES	*TALBAK*	
	No.	***%***
Employment / Jobs	6	20.00
Educational Program (Scholarship, Financial Assistance)	7	23.33
Health Program (Medical & Dental Mission, Free Medicines, Feeding Program)	15	50.00
Livelihood	1	3.33
Financial Assistance (Plant's worker)	0	0.00
Skills Development	1	3.33
Total	**30**	**100.00**

**Multiple Responses (No Initial Perception Survey)*

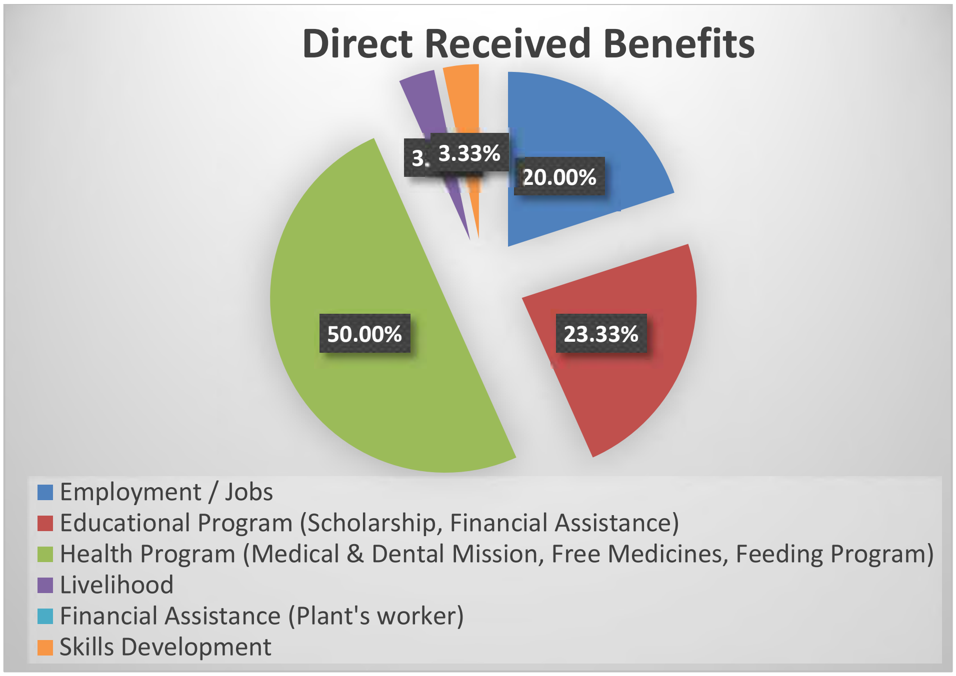


Figure 198 - Distribution of Respondents in Barangay Talbak based on Direct Received Benefits

2.4.2.3.5 Awareness and Acceptability on the Proposed Project of Eagle Cement

Table 152 shows the level of awareness of the respondents on the proposed project of Eagle Cement. Half of the respondents (49.46%) are aware of the proposed project. There are 36.56% of them who are not aware if it. Only 13.98% of the respondents did not specify their answer.

Table 152 - Awareness of the Survey Respondents in Barangay Talbak on the Proposed Project of Eagle Cement

AWARENESS ON THE PROPOSED PROJECT	TALBAK	
	No.	%
Aware	46	49.46
Not Aware	34	36.56
No Answer	13	13.98
Total	**93**	**100.00**

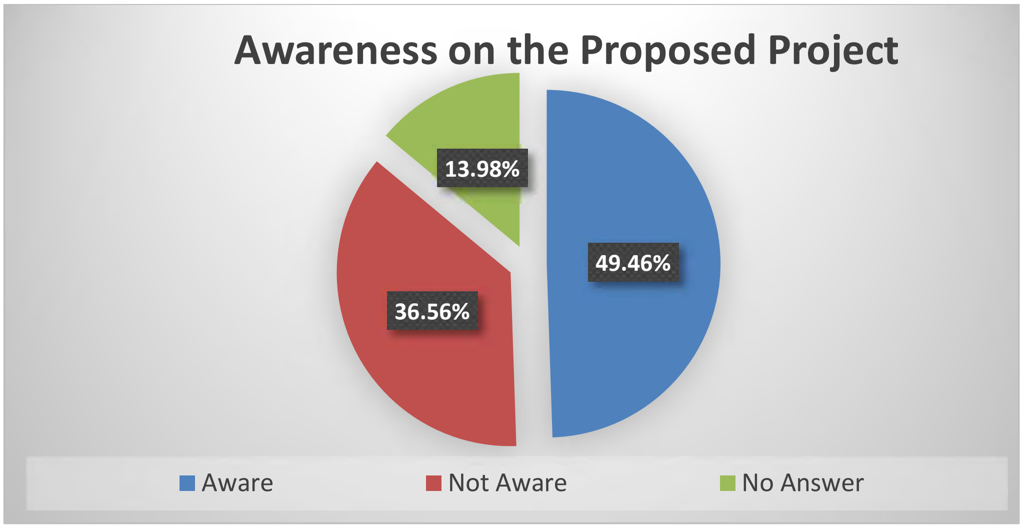


Figure 199 - Distribution of Respondents in Barangay Talbak on Awareness on the Proposed Project

For those who were aware (49.46%) of the project, most of the information sources were from the Government/Barangay Officials (35.29%); Barangay Meetings/Consultations (30.59%); and Official/ Employee of Eagle Cement (16.47%). Other sources mentioned were through Surveys with 10.59% and through Relatives/Friends/Neighbors (7.06%).

Table 153 - Sources of Information of the Survey Respondents in Barangay Talbak about the Proposed Project of Eagle Cement

Community Development Projects	*TALBAK*	
	No.	*%*
Government/ Barangay Officials	30	35.29
Relatives/ Friends/ Neighbors	6	7.06
Official/ Employee of Eagle Cement	14	16.47
Radio/TV/Local Newspaper	0	0.00
Barangay Meetings/ Consultations	26	30.59
Survey	9	10.59
Total	**85**	**100.00**

**Multiple Answer*

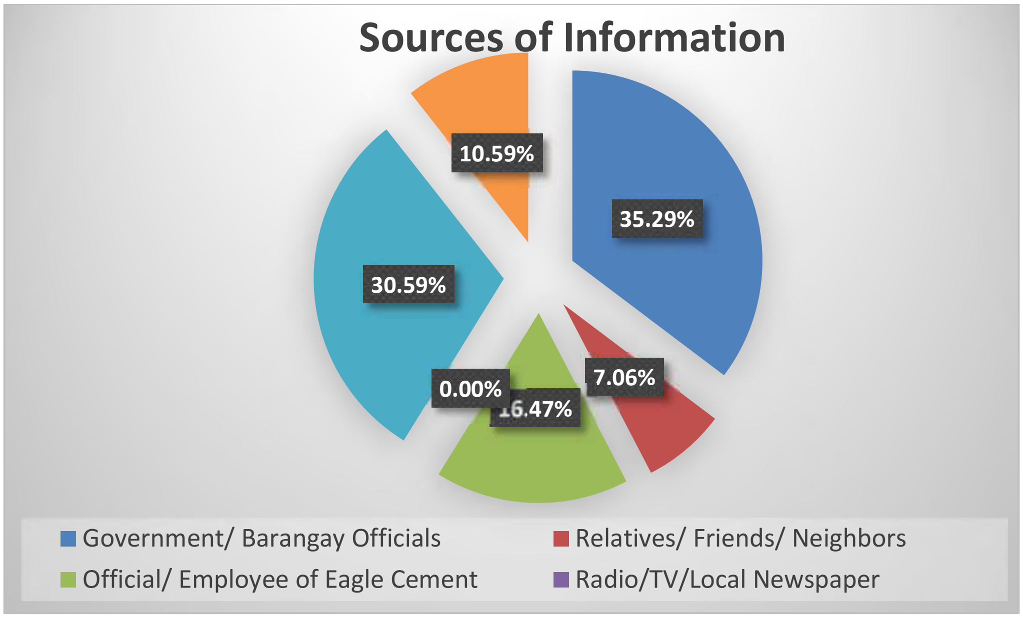


Figure 200 - Distribution of Respondents in Barangay Talbak based on Sources of Information about the Proposed Project

The respondents were asked on their perceived positive and negative effects of the proposed project by Eagle Cement. Looking into the details, ***Table 154*** presents specific answer of respondents on the possible positive and negative effects of the project to their community. 31.16% of the respondents said that the project will generate Job Opportunities in the locality and the Income in their Barangay will increase (18.59%). Respondents also perceived Provision of Medicines (15.08%) and an Additional Livelihood Opportunities for their households (13.57%) as another positive impact of the proposed project. Also, 9.55% of the respondents perceived the Provision of Sport Facilities for youth, 8 or 4.02% perceived Less Environmental Threats and some of the respondents think that the proposed project will be one of the means so that the Negative Issues or problems will be addressed (4.02%). About 2.51% o the respondents perceived Less Traffic and 1.51% said that one of the positive effects of the proposed project will be the installation of Jetmatic in their Barangay.

On the other hand, for those who think that the proposed project will produce negative impacts to the community, ***Table 154*** also shows the specific list of possible negative impacts. 33.60% of the respondents believed that the proposed project will result of Air Pollution/More dust and 29 or 23.20% respondents perceived an Increase of Noise in the community. Some respondents (20.80%) perceived that the project will result to Health and Environmental Hazards and 13 respondents or 10.40% saw pollution or destruction of the Environment through the Improper Waste Disposal. Other identified negative impacts include Increase in Traffic (7.20%) and worsening of Peace and Order (3.20%). Only 1.60% of the respondents perceived No Negative Effects on the proposed project of Eagle Cement.

Table 154 - Perceived Positive and Negative Effects of the Respondents in Barangay Talbak regarding the Proposed Project of Eagle Cement

Effects	Details	TALBAK	
		No.	%
Positive	Additional Job Opportunities	62	31.16
	Traffic will be lessened	5	2.51
	Less Environmental Threats	8	4.02
	Negative issues will be addressed	8	4.02
	Additional income to the Barangay	37	18.59
	Livelihood opportunities will improve economic condition of the barangay	27	13.57
	Provision of Sports Facilities for Youth	19	9.55
	Provision of Free Medicines	30	15.08
	Others (Poso)	3	1.51
	TOTAL RESPONSES	**199**	**100.00**
Negative	Air Pollution / More dust	42	33.60
	More Noise	29	23.20
	Generation of Wastes/ Improper Waste Disposal	13	10.40
	Increase in Traffic	9	7.20
	Health and Environmental Hazard	26	20.80
	Peace and Order	4	3.20
	No Negative Effects	2	1.60
	TOTAL RESPONSES	**125**	**100.00**

**Multiple Answer*

Recommendations on the possible actions to be undertaken to prevent or mitigate the perceived negative impacts were also gathered from the respondents. There were many suggestions that will help resolve the perceived negative effects and somehow prevent or mitigate the possible adverse impacts.

Table 155 - Proposed Solution of the Survey Respondents in Barangay Talbak on the Perceived Negative Impact of the Proposed Project

Perceived Negative Effects of the Proposed Project	*Proposed Solutions on the Perceived Negative Effects*
Increased Environmental and Health Impacts: • More dust • More Noise • Generation of wastes/ Improper waste disposal	Find ways to minimize/eliminate dust and noise
	Ensure that the operation is working well to minimize dust
	Proper waste disposal; do not throw the garbage within the vicinity of Talbak
	Find ways to lessen the dust that have caused negative effect to the health of the community and organize the plans for the progress of the barangay.
	Give additional medicines
	Implement adequate medical assistance
	Suspend the operation
	Proper equipment for the employee, surroundings and environment
	Implement controls/measures
	Site-specific hazard control should be implemented and monitored
	Health Monitoring
Disturbance to the Community: • Increase in Traffic • Peace and Order	Separate road for the hauling trucks
Other Response: • No perceived negative impact • More information should be given to the community	Cooperation and Coordination with the Barangay Officials, Community and Company
	Additional Budget
	Unity of Barangay to suspend the operation of Eagle
	Proper implementation of procedures
	Projects should be first discussed in the barangay and announce it to the public, to be able to know the opinions of the majority
	Proper communication and deliberation

Perceived Negative Effects of the Proposed Project	***Proposed Solutions on the Perceived Negative Effects***
	Discussed the negative effects
	Meet and comply to the DENR standards and requirements
	Tree Planting
	Support for the workers

The acceptability of the respondents on the proposed project was expressed. Most of the respondents (46.24%) expressed their support to the proposed project. However, there are 27.96% of the total respondents were undecided whether they will support the project or not. Lastly, 3.23% of the respondents expressed their reservation and for them the project is not acceptable.

Table 156 - The Acceptability of the Survey Respondents in Barangay Talbak on the Proposed Project of Eagle Cement

ACCEPTABILITY OF THE PROPOSED PROJECT	***TALBAK***	
	No.	***%***
Agree	43	46.24
Do Not Agree	3	3.23
Uncertain	26	27.96
No Answer	21	22.58
Total	**93**	**100.00**

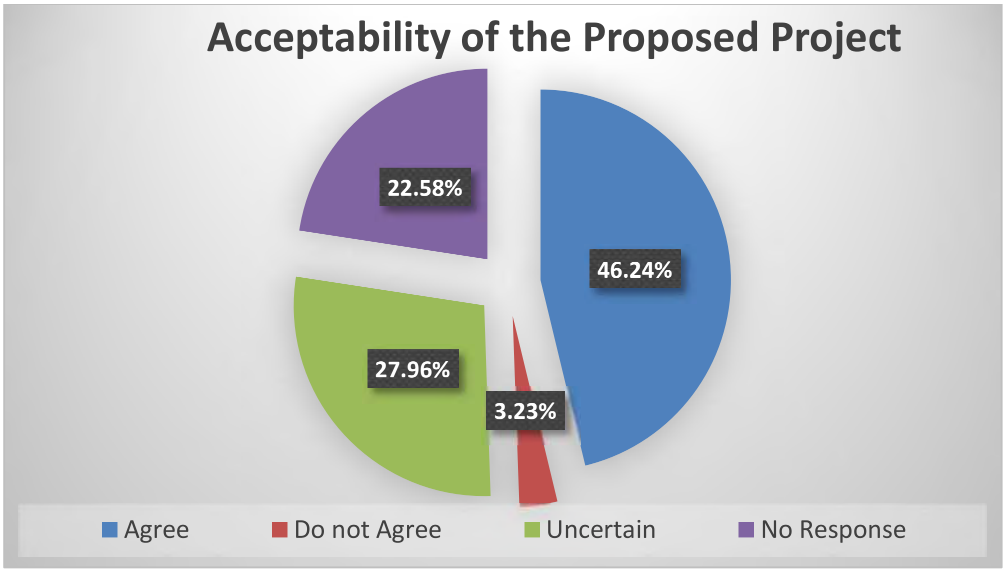


Figure 201 - Distribution of Respondents in Barangay Talbak based on Acceptability of the Proposed Project

Those who expressed in agreement or disagree with the implementation of the proposed project stated their reason for their positive or negative responses. The details are presented below.

REASON FOR POSITIVE RESPONSE	*REASON FOR NEGATIVE RESPONSE*
The proposed project will be a big help to the Barangay and Community	Destruction to the Environment
Additional Job / Employment	The participants do not have any safety assurances pertaining to the proposed project.
Educational Assistance	Respondents were unsure if the proposed project can help the community or it will be just the cause of sickness of the people living near the proposed project. Although, as per the participants, the organization has been really a big help for them.
Additional materials or equipment for disaster or calamity	Health Hazards
Frequent conduct of medical missions and supply of medicines	

REASON FOR POSITIVE RESPONSE	***REASON FOR NEGATIVE RESPONSE***
The proposed project will have impact to the growth of the economy and it will be a big help for the progress of Barangay Talbak	
Help the Employees	
Livelihood Opportunities	

2.4.3 Focus Group Discussion

Focus Group Discussions (FGD) were conducted in the two (2) identified impact barangays of Eagle Cement, Barangays Talbak and Akle. The FGD aimed to gather perception and views of stakeholders' representatives and the people in general about the current operation of Eagle Cement and the proposed project. It also aims to gather qualitative data on the experiences of the communities in the present operation of the facility and also on the perceived issues on the proposed project. The participants are asked in a focused and interactive setting and were encouraged to discuss thoughts freely with the facilitator as well as with other participants. The process of open and free discussion generated ideas and provided a wealth of information on the concerns and opinions of the people.

Separate FGDs were conducted for the impact barangays. The FGDs were conducted before the participants filled out the perception surveys. The FGDs were conducted on December 4, 2018 and it was attended by the Barangay Officials and Workers and also representatives from different Sectoral/People's Organizations.

The documentation of the conducted FGD is attached as **Annex H** and the attendance to the FGDs (**Annex I)**. The highlights of discussion, containing the responses of each group to the guide questions are presented in ***Table 157***.

Table 157 - Highlights of Focus Group Discussions

Guide Questions	*Barangay Talbak*	*Barangay Akle*
Familiarity of the proposed project	• Residents were aware of the proposed project apparently because of the community's	• The participants became familiar with the proposed project

Guide Questions	*Barangay Talbak*	*Barangay Akle*
	proximity in the company's quarry area.	through the meetings with ComRel.
Perceived Benefits of the Community and specific sectors from the proposed project	• The barangay will not only benefit from the proposed project but also the community by giving financial assistance and/or capital for livelihood. Additional perceived benefits from the proposed project were, trainings/seminar, continuous feeding program, yearly medical mission and supply of medicines, additional scholarship and sports fest program.	• Participants expressed that the proposed project will attract more people in their barangay and it will be beneficial especially to TODA. However, when it comes to farming, they see no benefits from the proposed project. Furthermore, participants mentioned that Eagle Cement do always make sure to provide to the needs of community.
Perceived negative effects of the proposed project to the community	• Participants indicated that blasting and water shortages were among the top concerns in their community. Environmental related issues such as dust pollution and environmental hazards were also raised. However, some expressed that there were no negative effects pertaining to the proposed project.	• Dust was the primary concern of the community, most especially when the hauling trucks were passing by and they also raised that perhaps the proposed project do not have much negative impact to their community compared to the current operation of Eagle Cement.
Suggestions on how to avoid/mitigate the negative effects	• The provision of water system near Sitio Luya was highly suggested. Participants also recommended the provision of water trucks to the areas	• Participants have asked to extend their concerns to management of Eagle Cement especially the issue about dust for they

Guide Questions	*Barangay Talbak*	*Barangay Akle*
	with water shortage for the mean time.	know that the solution to problem lies to the company itself. Frequently and regularly water truck sprinkling were also suggested.
Perceived benefits of the community from the proposed project	• The community will benefit from the programs/projects such as Out-of-School Youth Programs (NCII Programs), Farm to market road and road concreting going to Verdivia Falls. They also see that the proposed project will give the Barangay an additional support especially when it comes to livelihood (fruit processing, candle making, etc.) of the community and an additional training/seminar (SMAW, automotive, catering services, etc.). The participants also said that some of the benefits they will acquired from the proposed project would be the assistance for fiesta (karakol), additional barangay and school service and also solar street lights and assistance for the renovation of the church.	• The participants will benefit from the proposed project through the coordination of Eagle Cement with the community. Implementation of programs/projects such as road concreting, drainage canal and safety road signs and ramps were some of the benefits that the participants' perceived from the proposed project. Also, participants added that since the community currently has an ongoing MRF, support from Eagle Cement with recycling is expected. Community clinic, additional medicines, TODA terminal, fire truck and harvester for farmers, seminars and trainings with NCII were also expressed as the perceived benefits of the

Guide Questions	Barangay Talbak	Barangay Akle
		participants in Barangay Akle.
Community's acceptability on the proposed project	• Majority of the participants expressed support in the proposed project because as for them, Eagle Cement will continue to bring progress and development in their barangay. Some expressed that the proposed project has negative and positive impact to the community; nevertheless, they will still support the said project for the betterment of their barangay.	• Participants expressed that they will support the proposed project but Eagle Cement should support the community as well. In addition, participants mentioned that solutions to the problem should always be discussed in a proper way.

There were also participants who discussed their experience with the current operation of Eagle Cement. The primary concern that was expressed by the participants was dust pollution and blasting that affects the health, houses and safety of the residents in both Barangays. Other issues were also mentioned such as:

- Water shortage from both Barangays was raised during the discussion. Participants from Barangay Talbak suggested putting up water system near Sitio Luya, it was being said that the quarry area was nearby Sitio Luya that has caused water shortage within the vicinity. While participants from Barangay Akle expressed that since Eagle Cement constructed water pump, water supply shortage happened in their community and so they have suggested that company should share sources of water to the community even just 2 months during the dry season.

- Participants also expressed the implementation of 70:30 local/outsider hiring by Eagle Cement. Participants stated that people residing in direct impact areas should be prioritized in employment inside the plant.

- Another concerns pointed out by the participants was their experience pertaining to blasting without prior notice. As per the participants they have already informed Eagle

Cement about the issue and the company made an action towards it. In line with that, blasting caused cracks to some of the resident's houses and although the affected families informed Eagle Cement, there were no actions taken from the company. Furthermore, the participants have asked if there is a safe shade/shelter where the residents can stay every time the company will conduct blasting, because as per the company, residents should leave their houses during the blasting operation.

- Lastly, participants also expressed their issue that pertains to the plants and trees in their barangay that have turned white due to generation of dust thru trucks and cement plant production.

2.4.4 Potential Socio-Economic Impacts of the Projects

The proposed project has the potential to effect socio-economic impacts to the people and communities. These impacts are currently being experienced with the ongoing operation of Eagle Cement, the proposed project will also bring the same impacts but magnitude may vary depending on the phase of the project. Since the project will expand in terms of land area, it is rest assured that there will be no displacement of settlers or displacement/disturbance of properties. Outlined below are the identified potential socio-economic impacts of the proposed project in every phase of the project:

- **Development/Construction Phase**
  - Creation of employment opportunities
  - Population influx resulting to social tensions
  - Noise and dust pollution
  - Health and safety impacts
  - Increase in business opportunities
  - Increase in traffic and road safety hazards
  - Generation of additional revenue for the Local Government

- **Operation Phase**
  - Noise and dust pollution
  - Health and safety impacts
  - Employment opportunities
  - Increase in business opportunities
  - Improved services and community development potential
  - Generation of additional revenue for the Local Government

- **Decommissioning and Closure Phase**
  - Temporary increase in employment opportunities followed by a decrease
  - Decline in economic activities
  - Noise and dust pollution
  - Change in socio/community development benefits
  - Change in the revenue of the Local Government

2.4.5 Impact Assessment and Proposed Mitigating Measures

2.4.5.1 In Migration

The continuous operations of Eagle Cement and the implementation of the proposed project will sustain or may further contribute to the socio-economic development of Barangays Talbak and Akle. Because of this, residents from other Barangays of Bulacan or other Municipalities may be attracted to work or do business in both barangays.

Although based of the data, in migration of both short distance movers and long-distance movers in Bulacan, in 2010 was only 3.03% (or 99,879 persons) of the household population, the economic activities and the operations of industries present in the district as well as in the impact barangays may attract more workers and businesses. And also, the proposed project may prevent barangay residents to leave the area in search for employment outside the barangay, decreasing the rate of out-migration and also increasing the net migration of the area.

The opportunities bought by the presence of cement plant of Eagle Cement and the proposed project may invite workers and entrepreneurs to engage economic activities in both Barangays of Talbak and Akle, which may contribute to the natural increase of its population. As observed, the population pyramid of both Municipalities and Barangays are expansive, wherein an increasing very young population is manifested. The natural increase in population in the areas already causes competition in accessing the available economic opportunities in the areas.
Residents of other barangays and municipalities who are seeking employment and livelihood or business opportunities may migrate to Barangay Talbak or Barangay Akle. This may lead to the proliferation of informal settlers.

There is also possibility that seekers of jobs and livelihood opportunities from other areas may not require themselves to physically resettle in the barangay. If this will be the case, there will be an increase in the day-time population of the said both Barangays.

Influx or jobseekers from other areas is expected during the development and construction phase as well as during the operation phase with the introduction of other economic activities related to the cement operations. With the entry of in-migrants or increased day-time population, further competition in terms of local employment, public utilities, and access to basic services will be experienced. Immigrant workers may also introduce lifestyles and behaviors different from the local which may lead to social tensions.

As already mentioned, the natural increase in the population of Barangays Akle and Talbak, may later result to competition on the access to basic services and available resources in the community. Also, the increase in population due to in-migration and increase in day-time population will also put pressure on available basic services and competition on available resources. However, it is important to note that based on the socio-economic profile of both Barangays there had been no significant concern in terms of sanitation, education, and peace and order. These services are still within the prescribed standard in terms of adequacy to serve the current population, although there had been issues on the accessibility on basic utilities such as availability of safe drinking water, decent housing, latrines and accessibility and availability of health services.

To ensure the delivery of basic services and address some issues related to them in both Barangays and City, basic services must be improved to ensure adequacy to the increasing population. Eagle Cement has been the partner of Local Government Unity (LGU) in ensuring that better services are being provided to the residents through its Corporate Social Responsibility Program and the Social Development and Management Program (SDMP). Informal and formal consultations are made to assess the actual needs of the communities. Through the Barangay Council, Eagle Cement identifies the programs and projects for the communities addressing the felt need that required intervention and assistance. These programs and projects intend to prioritize the marginalized and most vulnerable sectors within the Barangays of Talbak and Akle namely: women, youth, senior citizens, physically and mentally challenged persons, families living below the poverty line, and farmers.
Impacts of in-migration and increase in day-time population may be mitigated and managed through the following:

- Implement policy on preferential hiring of locals from the impact barangay;
- Prioritization of hiring of qualified personnel from host barangay;
- Provide assistance to the Local Government to meet housing backlogs for informal settlement;
- Restriction of hours of activity;

- Provide assistance to the barangay to ensure efficient and effective delivery of social services;
- Proper induction of construction workers to prevent occurrence of peace and order problems or security breaches;
- Coordination with the Barangay Councils, Barangay Peace and Security Officers (BPSO) as well as with the Local Police;
- Provide assistance to the Barangay on maintenance of peace and order; and
- Implementation of EMP.

2.4.5.2 Health and Safety Impacts

The most common concern of the community, attributed to the current operations of Eagle Cement is the incidents of dust emissions from the cement plant and thru trucks. Based on the results of the perception survey and discussion with community sector representatives, it was perceived that the dust coming-out from the plant affects the health of the residents. There were also statement from the FGD that dusts affect their health and lead to health issues such as asthma affecting the old and the children of the community. The community may also be exposed to other health and safety hazards associated with Eagle Cement activities.

The current partnership of Eagle Cement and the BLGU's on the programs and projects on health services may be continued, strengthened and sustained. However, emission of dust may proliferate due to the implementation of the proposed project during construction phase.

Eagle Cement has an existing system to address the issues and concerns of the communities. Open communication is maintained thru the CSR and environment unit. Any issue is related to the Quarry Manager, who in turn endorses the concerns to the specific unit or department to address the issues. The communities are then informed of the updates and actions taken by the CSR or Environment Unit. Also, the quarterly MMT meetings have become a venue where issues and concerns are raised and resolved.

Impacts on health and safety issues may be mitigated and managed through the following:

- Implement Safety and Health Program for the workers and impact communities to reduce or avoid health and safety risks;
- Strict compliance on the proper wearing of Personal Protective Equipment (PPE) for workers;
- Provide assistance to the Barangays on the delivery of efficient and effective healthcare services;

- Establishment of buffer zone;
- Regular water spraying; and
- Implementation of Environmental Management Plan.

2.4.5.3 Increase in business opportunities

The influx of population and construction activities will increase demand for goods and services. The increase in income-earning opportunities will also increase spending potential, providing opportunities for further increased supply of goods and services, increasing the income of the people and indirectly increasing the overall wealth of the area. Introduction of new economic endeavors and establishment of new businesses will increase revenue collection of the LGUs from taxes and fees. Increase in revenue collection of the LGUs will mean improvement of basic services and infrastructure facilities. These will be experience during construction and operation phase.

Furthermore, the residents perceived that the current operation and the proposed project will bring progress to the barangay and municipality. It was also mentioned that additional programs and projects for the barangay are also expected.

A different scenario is anticipated during decommissioning and closure phase. Decommissioning activities will require temporary increase in employment opportunities; however this will be followed by streamlining of labor force upon closure. The decline on economic activities will be possible because of closure of small businesses dependent on the operation of Eagle Cement and the employment from these businesses will also most likely be affected. Change in revenue collection of the LGU will be experienced; closure of Eagle Cement may decrease the income of LGUs from taxes and other fees. Due to this, benefits from community development projects being implemented by the LGUs may not be the same and projects through the CSR Program of Eagle Cement will be ended.

The anticipated scenario during decommissioning and closure phase may be mitigated by implementing sustainable community development projects within both Barangays through its CSR Program, implements a continuing initiative to develop both Barangays of Akle and Talbak as a sustainable community.

Impacts on increase in business opportunities may be enhanced and managed through the following:

- Coordination with Barangay and Municipal LGUs to ensure proper zoning of business area, peace and order, sanitation and solid waste management;
- Explore possibilities to include training opportunities for developing business / livelihood opportunities that cater to needs of the population; and
- Provide assistance in establishing livelihood projects.

3.0 IMPACT MANAGEMENT PLAN

This section presents the Impacts Management Plan (IMP) formulated to minimize the potential adverse impacts of the project and enhance the beneficial effects of implementing the project. This plan shall be used to systematically manage the implementation of the recommended mitigating measures that are intended to address the identified possible environmental impacts of implementing the project.

The IMP as summarized in ***Table 158*** shall serve as the implementing guideline to ensure that environmental requirements are met during the project implementation and can be duly updated during the monitoring of the perceived project impacts.

Table 158 - Impact Management Plan

Project Phase / Environmental Aspect	*Environmental Component Likely to be Affected*	*Potential Impact*	*Options for Prevention or Mitigation* or Enhancement*	*Responsible Entity*	*Cost*	*Guarantee / Financial Arrangements*
II.DEVELOPMENT[i]						
– Site preparation (clearing, grubbing, stripping of topsoil and overburden removal, drilling and blasting)	Terrestrial Ecology	– Loss of vegetation due to site clearing; – Removal of economically and ecologically important species – Destruction of wildlife habitat – Disturbance/displacement of wildlife – Difficulty in plant establishment due to loss in soil productivity – Change in microclimate	– Prioritizing ecologically and economically important species in conservation – Use of indigenous species in the nursery – Strictly prohibiting poaching of wildlife – Progressive rehabilitation of disturbed areas	Eagle Cement Corp.	PhP 199 per seedling (Part of EPEP cost)	Included in EPEP, ECC work program

Project Phase / Environmental Aspect	*Environmental Component Likely to be Affected*	*Potential Impact*	*Options for Prevention or Mitigation* or Enhancement*	*Responsible Entity*	*Cost*	*Guarantee / Financial Arrangements*
		– Internal habitat fragmentation – Improved accessibility of the area may attract illegal hunters and poachers	– Routine monitoring of terrestrial flora and fauna			
	Land	– Loss of top soil due to ground/site preparation activities	– Rehabilitation/revegetation planning will be conducted in accordance with the EPEP – Bulk of the total project area will be revegetated by strict adherence to the approved EPEP and FMRDP – The perimeter of the Quarry area shall be progressively rehabilitated and re-graded to match the surrounding landforms – Establishment of safe working slopes and installation of land slide control structures.	Eagle Cement Corp.	PhP 199 per seedling (Part of EPEP cost)	Included in EPEP, ECC work program

Project Phase / Environmental Aspect	Environmental Component Likely to be Affected	Potential Impact	Options for Prevention or Mitigation* or Enhancement	Responsible Entity	Cost	Guarantee / Financial Arrangements
		– Increase in surface erosion and down slope sedimentation brought about by quarry development activities – Top soil removal – Change in topography due to blasting activity	– Progressive ground clearing/ preparation will be employed to minimize the area disturbed at any one time – 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; • "Vengineering" (i.e. planting of vegetation with high rainfall intercepting capacity and high transpiration rate characteristics to	Eagle Cement Corp.	200,000/yr (Part of EPEP cost)	Included in EPEP, ECC work program

Project Phase / Environmental Aspect	Environmental Component Likely to be Affected	Potential Impact	Options for Prevention or Mitigation* or Enhancement	Responsible Entity	Cost	Guarantee / Financial Arrangements
			serve as re-evaporators/biological pumps, respectively). – Ground preparation and grubbing will be conducted progressively to minimize the total area of soil cover removal at any one time.			
		– Generation of unwanted materials (solid waste/biomass/debris)	– Materials recovered from vegetation removal can be used as: • Trash lines on steep slopes to mitigate soil erosion • Compost material/surface mulch for immediate soil cover and for improving SOM content of soils • Chipping of cut trees and using the chipped	Eagle Cement Corp.		Included in EPEP, ECC work program

Project Phase / Environmental Aspect	***Environmental Component Likely to be Affected***	***Potential Impact***	***Options for Prevention or Mitigation* or Enhancement***	***Responsible Entity***	***Cost***	***Guarantee / Financial Arrangements***
			material as a growing medium for rehabilitation			
	Surface water quality	Siltation of Conlong River	– Installation of a drainage canals and settling ponds.	Eagle Cement Corp.	PhP 2,000,00 Included in the EPEP cost	Included in EPEP, ECC work program
	Air quality/ Ambient Noise	– Noise disturbance – Fugitive dust generation – Vehicle/equipment emissions	– Strictly implement covering of hauling trucks and water spraying; – Preventive maintenance of vehicles and equipment – Imposition of speed limits – Provision of dust and noise PPEs to employees – Regular monitoring within the quarry area and the community	Eagle Cement Corp.	PhP 300,000 per year Included in the EPEP cost	Included in EPEP, ECC work program
	Economic	Creation of employment opportunities • Availability of unskilled and semi-skilled work	– Implementation of skills development program to ensure support to local	Eagle Cement Community Relations	100,000 per year (Part of SDMP cost)	Human Resource Program Corporate

Project Phase / Environmental Aspect	***Environmental Component Likely to be Affected***	***Potential Impact***	***Options for Prevention or Mitigation* or Enhancement***	***Responsible Entity***	***Cost***	***Guarantee / Financial Arrangements***
		opportunities for the construction works –	population in obtaining employment opportunities	Office (CRO); Barangay LGU; TESDA		Social Responsibility (CSR) Program
		– Local government generation of revenues from fees and permits	– Development of small and medium enterprises like transport, construction and utility services – Prompt processing of permits and payment of necessary fees	Barangay LGU; Eagle Cement Corp., CRO;		Included in SDMP and IEC Program
	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	Eagle Cement Corp., CRO, National Museum		Included in EPEP, ECC work program
	Health and Safety	Health and Safety Impacts – Noise and Dust generation as well as the increase traffic may	– Implement Safety and Health Programs for the workers and impact communities to	Eagle Cement Safety and	100,000 per year	Occupational Safety and Health

Project Phase / Environmental Aspect	*Environmental Component Likely to be Affected*	*Potential Impact*	*Options for Prevention or Mitigation* or Enhancement*	*Responsible Entity*	*Cost*	*Guarantee / Financial Arrangements*
		negatively impact the health and safety of workers and community residents	reduce or avoid health and safety risks – Strict compliance on the proper wearing of Personal Protective Equipment (PPE) for the workers – Provide assistance to the Barangays on the delivery of efficient and effective healthcare services. – Establishment of buffer zone – Regular water spraying – Implementation of Environmental Management Plan	Health Office and CRO ; Barangay/ Municipal Health Office; Local Office of Department of Labor and Employment	Part of the SDMP and SHP Costs	Program, Community Safety and Health Projects through CSR Program
		– Immigrant workers may also introduce lifestyles and behaviors different from the locals which may lead to social tension.	– Proper induction of workers and haulers to prevent occurrence of peace and order problems or security breaches.			

Project Phase / Environmental Aspect	*Environmental Component Likely to be Affected*	*Potential Impact*	*Options for Prevention or Mitigation* or Enhancement*	*Responsible Entity*	*Cost*	*Guarantee / Financial Arrangements*
III. OPERATION PHASE						
– Quarry operation – land clearing (removal of vegetation), stripping of overburden – progressive rehabilitation of mined-out areas – Use of heavy equipment	Land Use	– Land slides and mass washings maybe induced by operation activities on high angle slopes	– Establishment of safe working slopes and installation of land slide control structures. – Installation of Warning signages in the active quarrying areas	Eagle Cement Corp.	1,000,000 per year Included in the EPEP cost	Included in EPEP, ECC work program
	Geology	– Inducement of subsidence/collapse – Generation of open areas with greater potential for runoff, erosion and landslides	– Implement a suitable and appropriate slope / ground failure monitoring plan to detect instability at an early and non-critical stage so that safety measures could be initiated to prevent or minimize impacts – Familiarize / orient / train quarry personnel, staff and workers on recognition of the various slope / ground failure modes, hazard warning signs	Eagle Cement Corp.		ECC; EPEP; Environmental Occupational Health Plan

Project Phase / Environmental Aspect	*Environmental Component Likely to be Affected*	*Potential Impact*	*Options for Prevention or Mitigation* or Enhancement*	*Responsible Entity*	*Cost*	*Guarantee / Financial Arrangements*
			and standard operating procedures to be observed in the case of ground failure events			
	Land/Soil Quality	– Soil Contamination due to accidental fuel and lubricant spills from vehicles and equipment may occur	– Contaminated soils will be removed and disposed off site. – Haul trucks will be properly maintained	Eagle Cement Corp.	200,000 per year Included in the EPEP cost	Included in EPEP, ECC work program
	Drainage morphology	Change in drainage morphology which may cause accelerated erosion	– Construction of drainage canals that will divert unimpacted surface runoff away from the work areas. – Construction of drainage canals that will convey impacted/silt-laden runoff from the quarry area to the settling ponds.	Eagle Cement Corp.	Included in the EPEP cost Php 256 per meter dredge of canal and drainage Php 699 per cubic meter	Included in EPEP, ECC work program

Project Phase / Environmental Aspect	***Environmental Component Likely to be Affected***	***Potential Impact***	***Options for Prevention or Mitigation* or Enhancement***	***Responsible Entity***	***Cost***	***Guarantee / Financial Arrangements***
			– Construction of a drainage system connecting all drainage canals to a series of adequately-sized settling ponds. – Construction of drainage canals at the bench toe to prevent scouring or roads.		including depth and width of settling ponds Php 8,000 per water quality station	
	Water Quality	Siltation / degradation of surface water quality particularly Conlong River	– Construction of a drainage system connecting all drainage canals to a series of adequately-sized settling ponds. – Construction of drainage canals at the bench toe to prevent scouring.	Eagle Cement Corp.		Included in EPEP, ECC work program

Project Phase / Environmental Aspect	***Environmental Component Likely to be Affected***	***Potential Impact***	***Options for Prevention or Mitigation* or Enhancement***	***Responsible Entity***	***Cost***	***Guarantee / Financial Arrangements***
			– Regular desilting of settling ponds especially before and during the wet season. – Regular water quality monitoring			
	Groundwater Quality	Possible contamination of groundwater due to accidental leaks/spills from the vehicles	– Regular inspection and maintenance of haul trucks used for quarrying operations.	Eagle Cement Corp.	500,000 Included in the EPEP cost	Included in EPEP, ECC work program
	Freshwater Ecology	Threat to Existence and Loss of Important Local Species and Habitat	– The river systems in the proposed project site do not host any endemic or potentially threatened freshwater organisms. – Appropriate erosion control measures will be implemented particularly	Eagle Cement Corp.	500,000 Included in the EPEP cost	Included in EPEP, ECC work program

Project Phase / Environmental Aspect	***Environmental Component Likely to be Affected***	***Potential Impact***	***Options for Prevention or Mitigation* or Enhancement***	***Responsible Entity***	***Cost***	***Guarantee / Financial Arrangements***
			during high precipitation periods.			
	Air ad Noise	– Local increase in TSP, SOx, NOx and noise levels – Air pollution due to Quarry operation	– Proper and regular maintenance of equipment – Water spraying; quarry activities to be confined during daytime as much as possible – Regular monitoring within the quarry area and the community	Eagle Cement Corp.	– Included in the EPEP cost Php 6,720 per Air station Php 1,000 per Noise station	Included in EPEP, ECC work program
	Terrestrial	– Vegetation is cleared during quarrying. – Loss of soil due to erosion would reduce survivability of plants having no substrate to anchor themselves to and obtain nutrients – Loss of habitat to birds and small animals such as lizards & amphibians	– Retain existing vegetation in areas of low mineral content – Rehabilitation of open areas and enrichment planting and reforestation in buffer zones and mined out areas – Fire protection by setting up of fire lines	Eagle Cement Corp.	– PhP 199 per seedling (Part of EPEP cost)	Included in EPEP, ECC work program

Project Phase / Environmental Aspect	*Environmental Component Likely to be Affected*	*Potential Impact*	*Options for Prevention or Mitigation* or Enhancement*	*Responsible Entity*	*Cost*	*Guarantee / Financial Arrangements*
			– Conduct 'progressive rehabilitation' of mined out parcels			
	Health and Safety	Health and Safety Impacts – Increase in traffic, potential dust and noise pollution and emissions from the plant may negatively impact on the health condition of the populace.	– Implement Safety and Health Programs for the workers and impact communities to reduce or avoid health and safety risks – Strict compliance on the proper wearing of Personal Protective Equipment (PPE) for workers – Provide assistance to the Barangays on the delivery of efficient and effective healthcare and protective services – Regular water spraying	Eagle Cement Safety and Health Office and CRO; Barangay/ Municipal Health Office; Local Office of Department of Labor and Employment	250,000 Included in the SHP cost	Included in SHP, ECC work program

Project Phase / Environmental Aspect	***Environmental Component Likely to be Affected***	***Potential Impact***	***Options for Prevention or Mitigation* or Enhancement***	***Responsible Entity***	***Cost***	***Guarantee / Financial Arrangements***
	Economic	Employment Opportunities – During the operation, minimal workforce will be added to the existing manpower of Eagle Cement. With sufficient training during the construction phase, a proportion of theses workforce may be sourced from the local communities.	• Priority hiring of locals – Coordinate with the Barangay Councils to identify local labor pool	Eagle Cement Human Resources Office (HRO) and Community Relations Office (CRO); Barangay LGU		Human Resource Program CSR Program
		– Enhancement socio-economic welfare of the community – Local government generation of revenues from taxes, permits and LGU share in the quarrying activities	– Implementation of community development programs through Social Development Management Plan equivalent to 1.5% of quarry operating cost based	Eagle Cement Corp. CRO; Barangay LGU	150,000 Included in the SDMP cost	Included in EPEP, SDMP, SHP

Project Phase / Environmental Aspect	Environmental Component Likely to be Affected	Potential Impact	Options for Prevention or Mitigation* or Enhancement	Responsible Entity	Cost	Guarantee / Financial Arrangements
		– 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	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 – Skills training to upgrade local skills of residents that can be hired by the project			

Project Phase / Environmental Aspect	*Environmental Component Likely to be Affected*	*Potential Impact*	*Options for Prevention or Mitigation* or Enhancement*	*Responsible Entity*	*Cost*	*Guarantee / Financial Arrangements*
			– Implementation livelihood development programs through the SDMP			
	Cultural and Lifestyle	– Potential social tensions due to income and wealth disparity between those who will be benefited economically from the project and those who will not be benefited. – Immigrant workers may also introduce lifestyles and behaviors different from the locals which may lead to social tension.	– Proper induction of workers and haulers to prevent occurrence of peace and order problems or security breaches.	Eagle Cement Corp. CRO; Barangay LGU		Included in EPEP, SDMP, SHP
	Climate Change	– Impact of Climate Change: La Niña and El Niño phenomenon and possible consequential disasters	– Integrating Climate Change (DENR EMB MC 5- 2011) and Organizing and enhancing capabilities of men and women for Disaster Risk Reduction Management in	Eagle Cement Corp. CRO; CDRMMC; BDRMMC	\	Included in EPEP, SDMP, SHP

Project Phase / Environmental Aspect	*Environmental Component Likely to be Affected*	*Potential Impact*	*Options for Prevention or Mitigation* or Enhancement*	*Responsible Entity*	*Cost*	*Guarantee / Financial Arrangements*
			the Barangays . IEC on DENR Special Order 2007-65, adaptation measures include protection of water aquifer, conduct of massive information and education campaign, establishment of protection measures, determination of the areas most vulnerable to natural hazards "to forewarn people," and strengthening the protection of ecosystems			
IV. ABANDONMENT PHASE						
– Rehabilitation of mined-out areas	Land Use	– Permanent land use change in areas to be occupied by the quarry areas and its facilities	– Bulk of the total project area will be reverted to revegetated area by strict adherence to the FMRDP – Buffer zones and physical barriers will be set around	Eagle Cement Corp.	5,000,000 Included in the FMRDP cost	Part of FMRDP

Project Phase / Environmental Aspect	***Environmental Component Likely to be Affected***	***Potential Impact***	***Options for Prevention or Mitigation* or Enhancement***	***Responsible Entity***	***Cost***	***Guarantee / Financial Arrangements***
			the quarry area to secure and limit access and disturbance – The final perimeter and cover of the quarry area will have an undulating profile to facilitate drainage – Stakeholders shall be consulted to for the final land use of the project area			
	Land Use	– Integrity failure of the Water reservoirs (i.e. settling ponds/sedimentation ponds) and quarry areas may cause flooding risks downstream of these structures.	– All the impoundment structures will be designed considering seismic and structural parameters – Structural integrity will be monitored for the duration of operation of these facilities and beyond mine closure. – An Emergency Response Plan will be developed to handle possible occurrence of water	Eagle Cement Corp.	3,000,000 Included in the FMRDP cost	

Project Phase / Environmental Aspect	Environmental Component Likely to be Affected	Potential Impact	Options for Prevention or Mitigation* or Enhancement	Responsible Entity	Cost	Guarantee / Financial Arrangements
			reservoir failure and downstream flooding. – Identify vulnerable areas and possible scenarios of flooding (i.e. its extent and its duration), and the necessary preventive measures			
	Biological	– Establishing vegetative cover in the area – Return of the avifauna and increase in population of small animals due to presence of habitat	– Use indigenous species that were once thriving in the area (refer to list of species) – Restore the habitat of the fauna by increasing vegetative cover	Eagle Cement Corp.	250 per seedlings Included in the FMRDP cost	
	Socio-Economic	Temporary increase in employment opportunities followed by a decrease – Closure and decommissioning of the plant and port facilities will need additional manpower. However, after the decommissioning activities,	– Development of retrenchment package and implementation of re-training activities during operational stage – Provide employees with clear and transparent information	Eagle Cement Human Resources Office (HRO) and Community	1,000,000 Included in project cost	

Project Phase / Environmental Aspect	***Environmental Component Likely to be Affected***	***Potential Impact***	***Options for Prevention or Mitigation* or Enhancement***	***Responsible Entity***	***Cost***	***Guarantee / Financial Arrangements***
		reduction of manpower employed in Eagle Cement will happen. Also, indirect employment from business enterprises depended to the operations will most likely decrease.	on planned activities and closure dates – Offer full retrenchment package or relocation to maintain employment in other operation sites where possible – Possible skills training to communities to increase employability to find other job opportunities	Relations Office (CRO)		
		– Termination of LGU revenues from taxes, permits and share when the company ceases operation – Loss of Jobs/ unemployment of mine workers – Loss of market of the established livelihood dependent on the quarry operation	– Timely announcement and preparation of decommissioning/ Abandonment – Retrenchment Package to be offered to affected employees/workers. – Assistance in job hunting or transfer employment to	Eagle Cement Corp. CRO; HR and Finance Office	1,000,000 Included in the FMRDP cost	

Project Phase / Environmental Aspect	*Environmental Component Likely to be Affected*	*Potential Impact*	*Options for Prevention or Mitigation* or Enhancement*	*Responsible Entity*	*Cost*	*Guarantee / Financial Arrangements*
		– Transfer of company social assets/ facilities and services to the community	other projects of the company. – Assistance to employees and their families in establishing livelihood or income generating activities. – Assistance to the community in establishing market/clients other than the company/ quarry operations – Identify diversity of products and services that will cater the needs of the community, adjacent barangays and municipality proper – Consultation with the community through the BLGU on the social assets/ facilities and services to be transferred, acceptable to them. A Memorandum of			

Project Phase / Environmental Aspect	*Environmental Component Likely to be Affected*	*Potential Impact*	*Options for Prevention or Mitigation* or Enhancement*	*Responsible Entity*	*Cost*	*Guarantee / Financial Arrangements*
			Agreement or Deed of Donation will be crafted in order to ensure the responsibility of the community on the sustainable management of the transferred facilities and/or services			
	Out-migration and psycho-social concerns on the closure of the operation	– The loss of employment and job opportunities in the area may result to out-migration to search for jobs in other places – Discontinuation of the social services offered by ECC through CSR and SDMP	– Establishment of livelihood projects for workers and their families as part of the retrenchment package – Ensure sustainability of the livelihood projects established through the SDMP – Assistance in the strengthening of the BLGU to increase their capacity to manage the social services to be transferred	Eagle Cement Corp. CRO; HR and Finance Office	2,000,000 Included in the FMRDP cost	Part of FMRDP

Project Phase / Environmental Aspect	*Environmental Component Likely to be Affected*	*Potential Impact*	*Options for Prevention or Mitigation* or Enhancement*	*Responsible Entity*	*Cost*	*Guarantee / Financial Arrangements*
			– IEC on the job and livelihood opportunities in accomplishing the final land-use and that the final land-use will spur economic growth to the community – Implement remaining community development activities to support the communities during closure and rehabilitation through the FMRDP Social Plan			

4.0 ENVIRONMENTAL RISK ASSSESSMENT AND EMERGENCY RESPONSE POLICY AND GUIDELINES

4.1 Environmental Risk Assessment

4.1.1 Introduction

This ERA aims to identify and analyze the hazards and assess the risks associated with the proposed limestone quarry project. It includes characterization of consequences for identified potential hazards in terms of loss of human lives or injuries, damage to or loss of assets and environmental risks.

4.1.1.1 Scope and Limitations of the ERA

This environmental risk assessment deals with the analysis of the various potential safety (fire, explosion, toxicity) and physical hazards association with the proposed quarry project. It complies with the requirements of the Procedural Guidelines for Scoping of Environmental Risk Assessment (Annex 2-7e of the Revised Procedural Manual of DAO 03-30) and focuses on safety risks, which are characterized by low probability, high consequence, accidental nature and acute effects" (EMB-EIAMD, 2007).

As a separate geological and geohazard assessment is also conducted as other component of this EIA and in other studies for the project, this ERA does not delve deeply into geological, geo-technical and structural risks. It also does not include environmental impacts from normal and other planned operations, which are discussed in detail in other components of the EIS Report.

4.1.1.2 ERA Framework

The Procedural Manual for DAO 2003-30 (Annex 2-7e) defines environmental risk assessment as "the use of universally accepted and scientific methods to assess the risks associated with a project. Risk is defined as a measure of potential human injury, death, economic loss, or environmental damage. It is determined based on the probability (likelihood) of the loss, injury/ death or damage occurring and the severity (magnitude) of the loss, injury/death or damage if it occurs. In simple terms, risk involves two measurable parameters: severity and probability.
The general ERA process is illustrated in ***Figure 202*** The various elements/steps in the risk assessment procedure are elaborated in the succeeding sections.

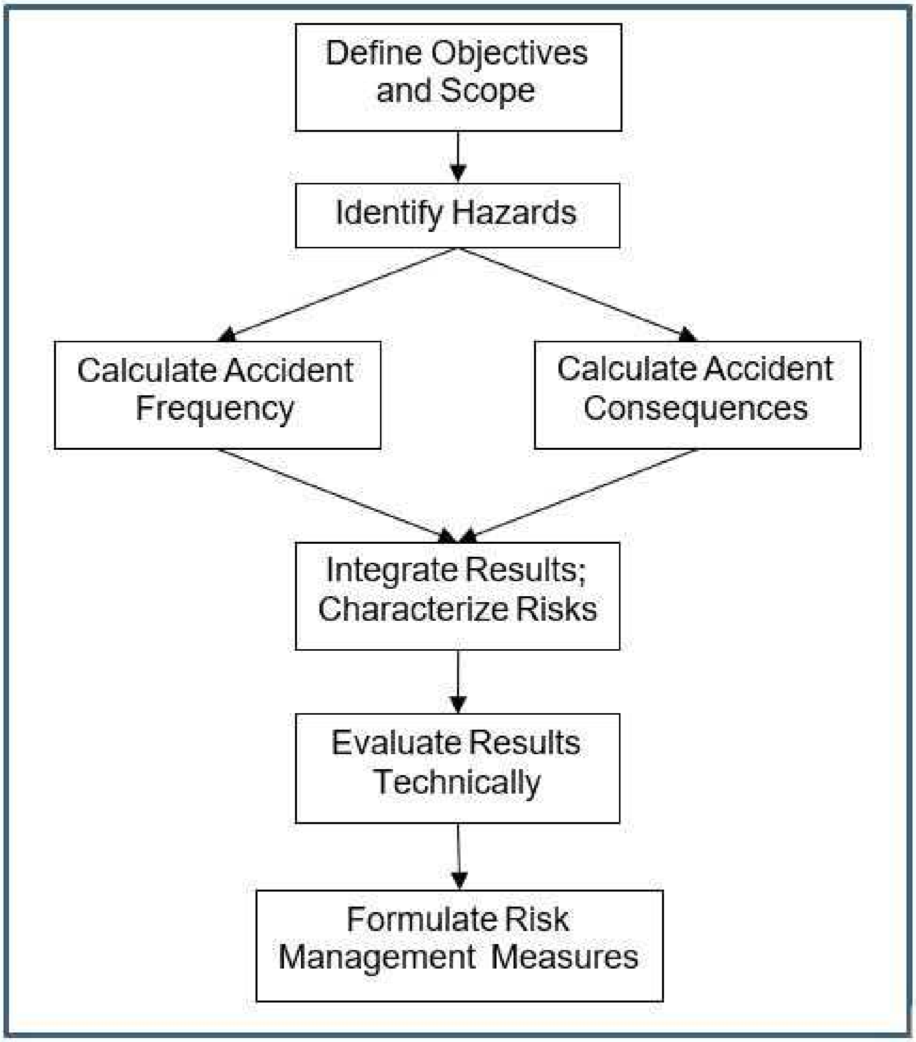


Figure 202 - The Risk Assessment Procedure

4.1.2 Risk Screening of Hazardous Substances

A risk screening procedure was undertaken to determine the type of environmental risk assessment to be undertaken and to prioritize the environmental risks presented by the various hazardous substances and activities. The criteria and process used in risk screening was based on *Annex 2-7e* (*Guidelines for the Conduct of Environmental Risk Assessment)* of the *Revised Procedural Manual of DAO 2003-30*.

The screening criteria for hazardous substances are (1) inherent hazardous characteristics of the substance and (2) maximum inventory involved. After classifying the substances according to defined categories (i.e. flammable, oxidizing, toxic, etc.), their respective maximum inventories were compared to DENR’s threshold inventory levels (Levels 1 and 2), which are defined in the *Revised DAO 2003-30* guideline. A facility that will manufacture, process or store any hazardous substance in excess of DENR's Threshold Inventory Level 2 is required to undertake a quantitative risk assessment. Those with any hazardous substance exceeding Level 1 threshold inventory but below Level 2 threshold inventory is required to undertake Hazard Analysis Study, and Emergency/Contingency Plan based on the study and worst-case scenario.

No hazardous materials or chemicals will be stored at the project site. The project will not construct or install any material storage support facility at the site, including storage facilities for fuel or blasting materials. For its fuel needs, the proposed project will utilize the existing facilities of the Eagle Cement Plant, which is covered by a separate ECC. The Blasting Contractor will be responsible for sourcing, storage and handling of the blasting materials (dynamites, ammonium nitrate, boosters, etc.) and equipment. The blasting materials will be transported to the site as per controlled blasting activity basis. Based on this information, the “q/Q” value is definitely below unity (1) even for Level 1 Threshold Inventory.

Figure 203 below shows the result of the risk screening process done.

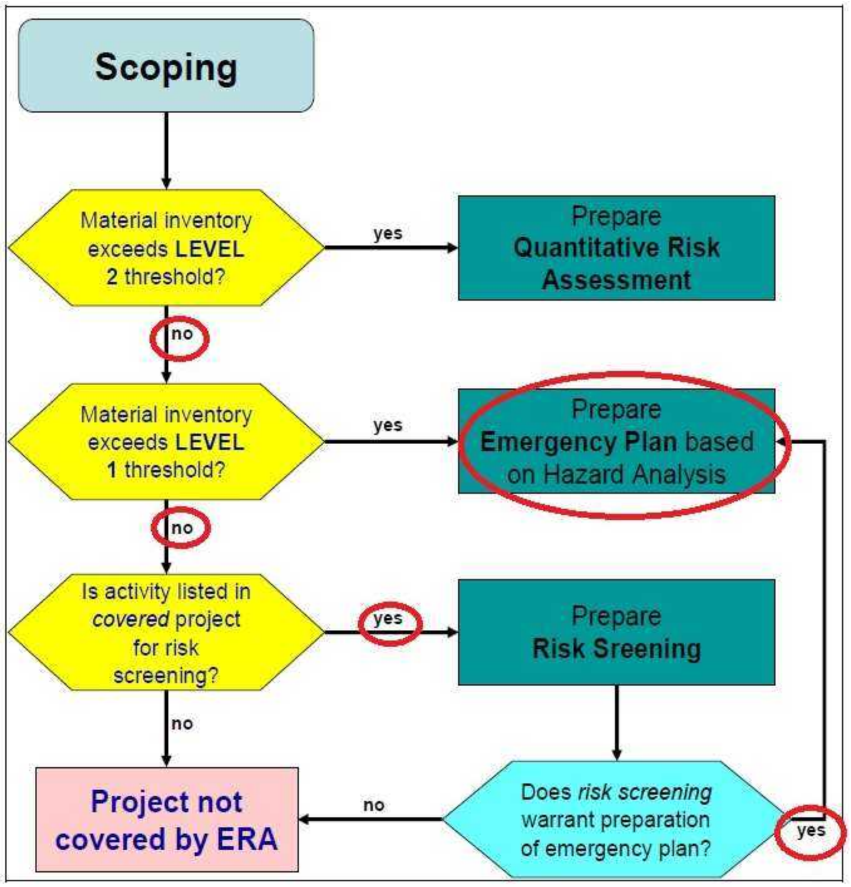


Figure 203 - Result of risk screening process

4.1.3 Hazard Identification

The various hazardous activities, conditions and substances associated with the proposed limestone quarry project of Eagle Cement Corp. were identified and reviewed. These includes all hazards, both physical and chemical, that could result to injury or fatality of the quarry project workers and the general public, particularly those in the vicinity of the quarry and/or along the transport route of the ores. Included in the analysis are various natural factors that may cause failure of structures (i.e. earthquakes, extreme weather events) and external factors such as sabotage and terrorism. Also identified were hazards associated with occupational health and safety and environmental factors such as climate change.

Hazards associated with chemicals and substances were also identified, particularly those that has the potential to cause fire, explosion and toxic releases. Identification of all hazardous substances to be used, handled and stored during the various project phases was conducted. The potential of each substance to pose hazards to the environment, the public and the facility was analyzed based on its intrinsic physical, chemical and hazard characteristics. ***Table 159*** lists the identified hazards associated with the project during development (construction) and production (operation), including occupational health and safety, natural hazards and climate change and external factors. A total of 33 hazard scenarios were identified, which were assessed in the succeeding sections of the ERA Report.

Table 159 - Hazards List and Risk Characterization of the Proposed Eagle Cement Quarry Project in Akle, San Ildefonso, Bulacan

SN	Activity/ Condition	Hazard	Initiating/Contributing Factors	At Risk Sectors	C	F	Risk *
A.	**Development Phase**						
1	Clearing of existing vegetation	▪ Being struck by felled trees, debris and equipment part	▪ human error; equipment failure; communication failure; non-adherence to SOPs	▪ Clearing team	3	2	6
2	Clearing of existing vegetation	▪ Vibration and noise from power saws and other equipment	▪ Inadequate vehicular/ equipment maintenance	▪ Clearing team	3	3	9
3	Clearing of existing vegetation	▪ Vehicular and/or equipment accidents (overturning, fall from heights, etc.)	▪ Adverse weather conditions ▪ Inherently steep slopes ▪ Unsafe practices ▪ Inadequate vehicular/ equipment maintenance	▪ Clearing team ▪ Company assets	4	3	12
4	Stripping and stockpiling of quarry overburden	▪ Landslides and rock falls	▪ Heavy rains, typhoons, earthquakes, defective engineering design;	▪ Quarry workers	4	3	12
5	Stripping and stockpiling of quarry	▪ Equipment/vehicular accidents (fall from steep slopes, being hit by rocks and	▪ Inadequate equipment/ vehicle maintenance;	▪ Equipment operators and drivers	4	3	12

SN	Activity/ Condition	Hazard	Initiating/Contributing Factors	At Risk Sectors	C	F	Risk *
	overburden	debris, collisions, etc.)	▪ human errors (failure to follow protocols, etc.)				
6	Stripping and stockpiling of quarry overburden	▪ Sediment-laden runoffs from overburden stockpiles could contribute to surface water siltation and possible contamination with toxic heavy metals and minerals	▪ Inadequate/inappro-priate berms ▪ Failure to stabilize overburden stockpiles ▪ Heavy rains	▪ Surface water bodies and adjacent lands ▪ General public	3	3	9
7	Bench Development	▪ Landslides and rock falls	▪ Heavy rains, typhoons, earthquakes, defective engineering design	▪ Quarry workers	5	3	**15**
8	Bench development	▪ Equipment/vehicular accidents (fall from steep slopes, being hit by rocks and debris, collisions, etc.)	▪ Inadequate equipment/ vehicular maintenance; human errors (failure to follow protocols, etc.)	▪ Equipment operators and spotters ▪ Quarry workers	4	3	12
B.	**Production Phase**						
9	Transport to and use of explosives (dynamites, ammonium nitrate, boosters) at the site (per blasting operation	▪ Blast overpressures, vibration and high velocity projectiles from accidental detonation/ explosions reaching sensitive receptors (people, animals, structures, etc)	▪ Mechanical impacts on explosives due to carrier vehicle accidents ▪ Ignition sources at the vicinity; lightning strikes ▪ Terroristic attacks	▪ Explosives transport team ▪ Other commuters and pedestrians at vicinity	5	3	15

SN	Activity/ Condition	Hazard	Initiating/Contributing Factors	At Risk Sectors	C	F	Risk *
	only)						
10	Controlled blasting	▪ Exposure of people to harmful blast overpressures that may cause major injuries	▪ breach of protocols ▪ operator error ▪ explosive misfiring	▪ Blasting team, trespassers, quarry workers	5	3	15
11	Controlled blasting	▪ Blast overpressures and ground vibration causing damage to nearby infrastructures	▪ Failure to follow blasting protocols (eg. miscalculation of safe distances)	▪ Company assets and community infrastructures	3	3	9
12	Controlled Blasting	▪ Harmful impact noise causing hearing impairment	▪ No or inadequate hearing PPE	▪ Blasting team, trespassers, quarry workers	3	3	9
13	Controlled Blasting	▪ Being struck by high velocity projectiles (fly rocks)	▪ breach of protocols ▪ operator error	▪ Blasting team, quarry workers	4	3	12
14	Controlled blasting	▪ Landslides and rockfalls outside of blasting area due to blast overpressure and vibration	▪ Miscalculation of amount of explosives used ▪ Prolonged and heavy rains	▪ Blasting team, quarry equipment, quarry workers	5	3	15
15	Ripping	▪ Ripping equipment accidents (fall from steep slopes, being hit by rocks and debris, collisions, etc.)	▪ Inadequate equipment maintenance ▪ Ripping operator error ▪ Non-adherence with SOPs	▪ Equipment operators; quarry workers	4	3	12
16	Dozing and Loading of quarried materials	▪ Equipment (dozers and haul trucks) accident (fall from edge of a bench, being hit by falling	▪ Very steep slopes ▪ Human error ▪ Failure to follow protocols ▪ Unsafe practices	▪ Equipment operators ▪ Quarry workers	4	3	12

SN	Activity/ Condition	Hazard	Initiating/Contributing Factors	At Risk Sectors	C	F	Risk *
		rocks, being hit by loading arm)					
17	Hauling and transport of quarried materials	▪ Generation of airborne dusts from dirt roads and from quarried materials being hauled	▪ Unpaved roads ▪ Dry road conditions ▪ Exposed ore loads	▪ Hauling truck drivers and helpers ▪ Communities at the vicinity of haul roads	3	3	9
18	Hauling and transport of quarried materials	▪ Noise from haul trucks could cause disturbance to communities along the haul route	▪ Inadequate vehicle maintenance ▪ Failure to follow delivery schedules	▪ Same as above	3	3	9
19	Hauling and transport of quarried materials	▪ Vehicular accidents at the quarry site (fall from edge of bench, collision with other vehicles/equipment or structures, overturning, etc.)	▪ Inadequate vehicle maintenance ▪ Unsafe driving practices ▪ Inadequate training of drivers	▪ Vehicle drivers, helpers and other Quarry workers	4	3	12
20	Hauling and transport of quarried materials	▪ Traffic accidents (collision with other vehicles, hitting pedestrians and/or animals, others)	▪ Same as above ▪ Unsafe road conditions	▪ Vehicle drivers and helpers, other commuters, pedestrians and residents along the haul roads	4	3	12
21	Settling Ponds	▪ Breaching of settling ponds could lead to flash floods, siltation and possible	▪ Inclement weather conditions ▪ Earthquakes	▪ Surface waters and adjoining lands	4	3	12

SN	Activity/ Condition	Hazard	Initiating/Contributing Factors	At Risk Sectors	C	F	Risk *
		contamination with heavy metals and minerals (e.g. Ca, Mg, Zn, Fe, Cd, Pb) of surface waters and nearby lands	▪ Faulty engineering design ▪ Inadequte maintenance of drainage canals and the settling pond system	▪ Aquatic ecological entities ▪ Surrounding communities			
C.	**Occupational Safety and Health**						
22	Earthworks and other quarry activities	▪ Generation of and exposure of workers to dusts, including respirable particulates that could lead to or predispose to respiratory diseases and eye irritation	▪ Inadequate PPE, inadequate/absence of protective barriers (e.g. airconditioned equipment cabin)	▪ Quarry workers; equipment operators	3	4	12
23	Equipment operation and blasting	▪ Harmful noise levels could lead to hearing impairment	▪ Inadequate maintenance of equipment ▪ Inadequate hearing PPEs ▪ Failure to observe safe distances during blasting operations	▪ Same as above	3	3	9
24	Equipment operation (e.g drilling, excavation and ripping activities)	▪ High impact vibration from equipment can predispose to musculoskeletal and nervous system disorders (eg. Hand-Arm vibration Syndrome or HAVS)	▪ Inadequate equipment maintenance ▪ Prolonged exposure to vibration	▪ Equipment operators	3	3	9

SN	Activity/ Condition	Hazard	Initiating/Contributing Factors	At Risk Sectors	C	F	Risk *
25	Working at heights	▪ Fall from the edge of a bench	▪ Inadequate PPE ▪ Human error	▪ Quarry workers	4	3	12
26	Working near unstable or loose soil/ rocks	▪ Being struck by falling rocks/debris at the foot of a face	▪ Human error; unsafe practices; inadequate training of workers	▪ Quarry workers	4	3	12
27	Working near moving equipment parts	▪ Being struck by or caught in a moving part of quarry equipment	▪ Same as above ▪ Unguarded equipment moving parts	▪ Quarry workers	3	3	9
28	Ergonomic issues (heavy lifting, prolonged standing, repetitive movement, awkward postures, etc.)	▪ Ergonomic hazards that may lead to bodily injuries and stress	▪ Inappropriate body mechanics while performing activities ▪ Inadequate rest periods ▪ Tasks performed exceed recommended limits (eg. too heavy lifted loads, etc)	▪ Workers	2	3	6
D.	**Natural Events, Climate Change Factors and Terrorism**						
29	Earthquakes	▪ Landslides and damage to structures and equipment with injuries/fatality to people	▪ Areas with steep slopes and susceptible to erosion	▪ Workers and other persons at the site ▪ Assets ▪ Ecology	5	3	**15**
30	Increased frequency and intensity of tropical cyclones	▪ Landslides and rock falls ▪ Flooding of low lying areas	▪ poor engineering design; poor maintenance of structures; defective warning	▪ Workers; contractors; nearby communities esp. along	5	3	**15**

SN	Activity/ Condition	Hazard	Initiating/Contributing Factors	At Risk Sectors	C	F	Risk *
		▪ Damage to buildings and equipment ▪ Injury or fatality from falling trees, debris, rock fragments projectiles, and equipment parts	systems; infrastructures along riverbanks and flood plains	river/stream banks			
31	Torrential rains during rainy season	▪ Same as above	▪ Same as above	▪ Same as above	5	3	**15**
32	Drier dry seasons and increased ambient temperatures	▪ Increased airborne dusts; ▪ Drying of nearby water sources could compromise dust suppression efforts	▪ Inadequate dust suppression system; earthworks; ▪ forest/ vegetation denudation; disturbance of existing water sources (springs, rivers, streams)	▪ Workers, contractors, nearby communities, enviroment	3	4	12
33	External Threats/ Terrorism	▪ Terroristic attacks and/or sabotage of quarry facilities	▪ Major damage to equipment and facilities ▪ Fatalities/ injuries to people	▪ Workers ▪ General Public ▪ Assets	4	3	**12**
Legends: SN = Scenario Number; C = Consequence; F = Frequency * -- High Risk, -- Medium Risk							

4.1.4 <u>Severity Analysis</u>

Consequence severity analysis involved the qualitative description of possible impacts on people, assets and the environment in case of occurrence of accidents or incidents due to the identified hazards. Accident or consequence is graded according to a Consequence Severity Rating Chart as shown in *Table 160*. The rating ranges from 1 to 5, with rating 1 being the lowest consequence and 5 as the highest consequence severity.

Table 160 - The Consequence Severity Rating Chart Used in Consequence Analysis

Rating	*Description*	*Consequence/Impact*	
		On-site Health and Safety	*Environment and Community*
1	Very low	Self-administered first aid treatment; No specific treatment	No community complaints; no corrective actions required; No breach of regulations
2	Low	First Aid treatment injury	Impacts confined to site; corrective actions required; no breach of regulations
3	Moderate	Medical treatment injury; possible loss time injury	Off-site environmental/ community damage could easily be contained or prevented; breach of regulations
4	High	Injuries require hospitalization	May result to uncontained environmental or community damage; multiple community complaints; may result to civil prosecution
5	Very High	Fatalities; Permanent disabilities	Long term environmental damage; May result to criminal prosecution

4.1.5 Probability/Frequency Analysis

Probability/frequency analysis of accidents or incidents due to realization of project hazards were described using a Probability of Occurrence Rating Chart as shown in ***Table 161***. Probability (frequency) were assigned with values ranging from 1 to 5, with the value of 1 corresponding to the lowest probability value and 5 having the highest probability value.

Table 161- The Probability of Occurrence Rating Chart Used in Consequence Analysis

Rating	*Description*	*Explanation*
1	Rare	Might occur at some time in exceptional circumstances
2	Unlikely	Could occur at some time although unlikely
3	Possible	Might occur at some time
4	Likely	Will probably occur, has happened
5	Almost Certain	Expected to occur, quite common

4.1.6 Risk Characterization

Risk characterization involved the integration of the results of the consequence severity analysis and consequence probability analysis. For purposes of risk prioritization, indicative risk (IR) values were computed for each of the identified hazard by getting the product of the severity rating and probability rating values from *Table 160* and *Table 161*, respectively. *Table 162* shows the resulting risk matrix.

Table 162 – Risk Matrix

Qualitative Risk Matrix			Probability/Frequency				
			1	2	3	4	5
			Rare	Unlikely	Possible	Likely	Almost Certain
Consequence/ Impact	5	Very High	5	10	15	20	25
	4	High	4	8	12	16	20
	3	Moderate	3	6	9	12	15
	2	Low	2	4	6	8	10
	1	Very Low	1	2	3	4	5

Low Risk Medium Risk High Risk

As shown in ***Table 159***, the identified hazards associated with the proposed limestone quarry project has the potential to result either to medium risks (26 of the 33 identified hazard scenarios) or high risks (7 of the 33 identified hazard scenarios).

Based on the methodology used, two hazards were classified as high risk hazards at the project site. These were landslides and rockfalls resulting from various activities/events and explosives accidents resulting to uncontained blast overpressures, vibration and fly rocks. At worst case, these hazards could result to fatalities, damage to assets and damage to ecological entities.

4.1.6.1 Risk of Landslides and Rock Falls

Landslides and rock falls are high risk hazards that may result from earthquakes; earthworks during bench development, controlled blasting; and climate-change instigated weather anomalies (increased frequency and intensity of tropical cyclones; increased frequency of heavy precipitation).

The worst-case consequence of slope failure is multiple fatalities and injuries, damage to assets and properties, and possible damage to ecological entities. If the landslide and rockfalls should result to damming/obstruction of river flows, downstream flash flooding could result upon breaching of the dam/obstruction, especially in the event of extreme rainfall. Five (5) activities/events that can lead to landslides and rockfalls are shown in ***Figure 204***.

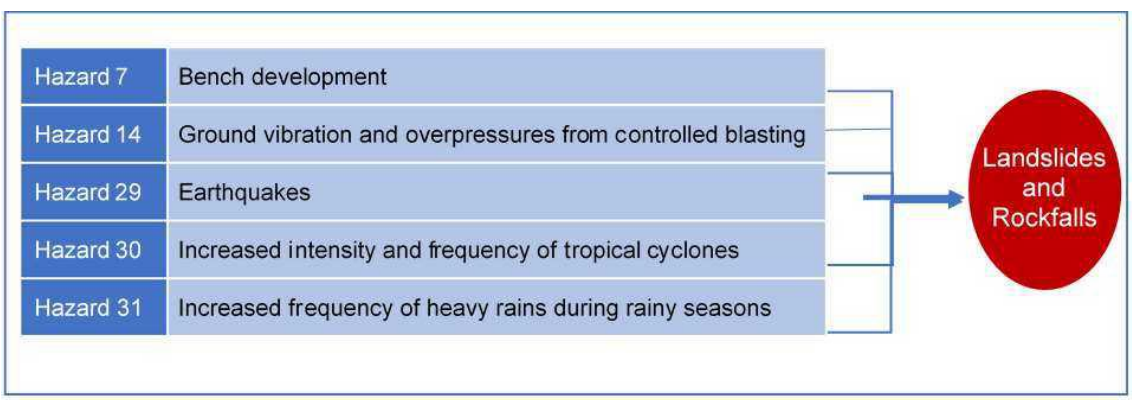


Figure 204 - Activities and events that may lead to landslide and rockfall incidents

4.1.6.2 Risks from Explosives and Blasting Accidents

The project will utilize controlled blasting activities in bench development and ore extraction. It will make use of industrial explosives such as dynamites, ammonium nitrates and boosters. The activity will be undertaken by a duly licensed third-party blasting contractor. No explosives will be stored on-site but will be transported to the site on a per blasting activity basis. The existing quarry operation of Eagle Cement utilizes drilling and blasting. Nitro Asia is the current drill and blast contractor of the company, the same service provider will be employed for the proposed operation. The magazine is located kilometers away from the community and has an approved plan, and location design from the Philippine National Police Regional Director as per requirement prior to installation. In addition, the facility has a 24-hr security personnel guarding the area for safety purposes.

The transport and conduct of controlled blasting may be classified as high risks activities. Hazards associated with explosives are blast waves or blast overpressures, high velocity missiles, vibration and high impact noise. The damaging consequences of explosion arise from the direct impact of blast overpressure or indirectly, from falling objects or missiles produced by the overpressure. The violence and speed of the reactions taking place during explosion produce blast or shock waves when an explosive material detonates. Blast waves are highly compressed air that rapidly expands in all directions from the point that the explosion is initiated. With speed that can exceed the speed of sound, the strength of the wave is measured in terms of overpressures or peak overpressures, the maximum pressure in the wave in excess of normal atmospheric pressure.

During transport, accidents could happen that may cause the inadvertent detonation of explosives, especially if regulations, supplier recommendations and appropriate protocols are not strictly adhered to. During transport, heat and mechanical impacts may contribute to accidental explosion. Exposure to heat, fire, ignition sources and lightning may contribute to accidental explosions during storage. Factors that may contribute to accidents during controlled blasting include explosives misfires, miscalculation of safe distances and breach of protocols (e.g. failure to control trespassers, failure to issue warnings and to cordon off the affected area, etc.).

The following are the significant hazards associated with blasting activities:

- Injury and death resulting from the blasting procedure; from the hole drilling, explosive application, setup of blasting cords and primers, to the explosion itself;
- Resulting toxic dust and gas generation from the explosive application to detonation;
- Vibration from the explosion; and
- Flying rocks and debris resulting from the explosion.

4.1.6.2.1 Ammonium Nitrate (AN) and Ammonium Nitrate-Fuel Oil (ANFO)

Ammonium nitrate ($H_3N{\bullet}HNO_3$, CAS# 6484-52-2) was traditionally produced as commercial crop fertilizer. The substance is not an explosive, per se, but a strong oxidizing agent. It later found use as a major component of the industrial explosive, ANFO, and in the manufacture of improvised explosive devices. It may explode if large quantities are involved in a fire. Ammonia, a highly noxious, irritating and corrosive gas, may be evolved when exposed to fire. As such, breathing the dusts and fumes from burning material should be avoided.

ANFO is a major industrial explosive used in the mining and quarrying industries. It is relatively safe, and cost effective in terms of energy output. ANFO is safe to handle, as it requires a blasting cap (booster) to detonate. It is also readily available. Fuel oil ('FO') is ordinary No. 2 diesel oil. Classified as a tertiary class high explosive, ANFO is insensitive to shock, requiring an intermediate explosive booster or secondary explosive to detonate. Tertiary explosives are largely used in large-scale mining and construction operations. Ammonium nitrate-fuel oil mixture is used for blasting rock and in mining. It also speeds up the burning of combustible materials.

4.1.6.2.2 Dynamite

A detonating explosive, dynamite contains a liquid explosive ingredient (usually nitroglycerine or a similar organic nitrate ester or both) that is uniformly mixed with an adsorbent material such as wood pulp. It usually contains materials such as nitrocellulose, sodium and/or ammonium nitrate. Based on the explosive potential of nitroglycerin, dynamite is considered a "high explosive', which means it detonates rather than deflagrates. Dynamite is chiefly used in construction, mining, demolition, oil well fire-fighting and on the battlefield. Replaced by newer explosives in many applications, dynamite is still used, mainly as bottom charge or in underwater blasting. Dynamite is composed of three parts: nitroglycerin, an adsorbent (diatomaceous earth or nitrocellulose), and a small admixture of sodium carbonate or ketone. The mixture is formed into short sticks and wrapped in paper. Nitroglycerin by itself is a very strong explosive. It is shock-sensitive (physical shock can cause it to explode) in its pure form. It can degrade over time to even more unstable forms, making it highly dangerous to transport or use in its pure form. Absorbed into diatomaceous earth or other adsorbents, nitroglycerin is rendered less shock-sensitive. A priming device is used for initiating dynamite.

Dynamite will "weep" or "sweat" its nitroglycerin content over time. The nitroglycerin "sweat" can pool in the bottom of the box or storage area and crystals will form on the outside of the sticks, creating a hazardous situation. The actual possibility of explosion without a blasting cap however is minimal.

4.1.6.3 Risk of Vehicular and Equipment Accidents

Vehicular and Equipment accidents are medium risk hazards that could result to injuries and possible fatalities, particularly of the vehicle/ equipment drivers and operators at the site and other road users offsite. Contributing factors may include the following: adverse weather conditions, inherently steep slopes, inadequate vehicle/equipment maintenance, unsafe practices, failure to follow protocols/SOPs and traffic accidents, and unsafe road conditions.
Activities that could lead to the risk of vehicular/equipment accidents are shown in *Figure 205*.

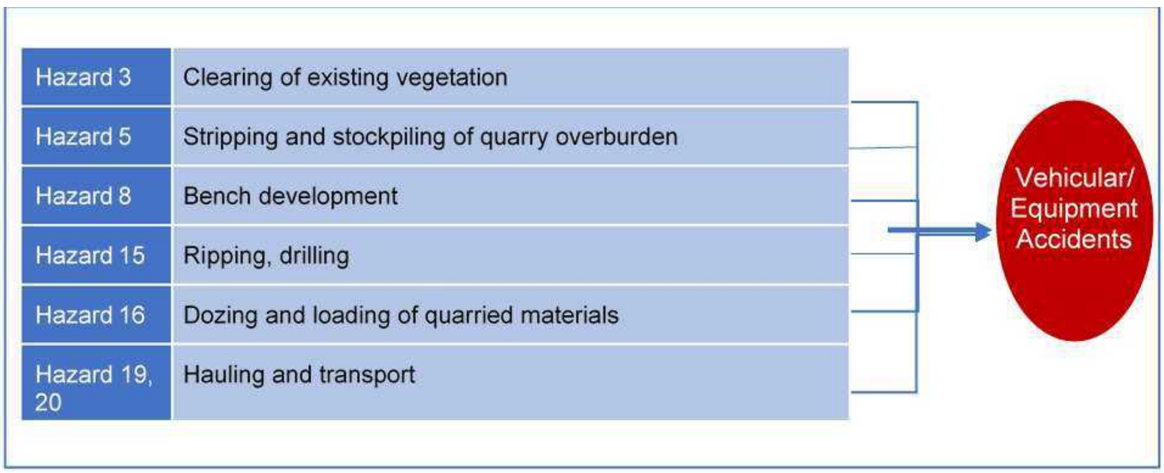


Figure 205 - Activities associated with risks of vehicular/ equipment accidents

4.1.6.4 Occupational Hazards

As shown in ***Table 163***, occupational hazards associated with various project activities include the following: harmful noise levels; repeated exposure to harmful vibration; working at heights; mechanical impacts from falling trees, rocks, etc; possible exposure to blast overpressures; possible contact with moving machinery parts; and ergonomic hazards (heavy lifting, prolonged standing, awkward postures, repetitive movement, etc.).

4.1.6.5 Failure of Siltation ponds Structures

The project will put up settling ponds to mitigate the possible impacts of surface run offs. Failure of siltation ponds structures (walls/containment) can result to flash flooding and mass release of sediments that may be heavily tainted with heavy metals and minerals. Factors which may contribute to structural failure, such as breaching of containment, are natural hazards like strong earthquakes, prolonged heavy rains, strong typhoons, faulty engineering design, and sabotage.

Mass release of sediments and flash flooding can result to injuries, heavy siltation of affected surface water systems, and destruction and contamination (with heavy metals and minerals) of affected terrestrial and aquatic (specifically Conlong River) environments.

Quarrying activities may increase the loads of some heavy metals and other hazardous minerals in the vicinity and at the site through release and exposure of these substances in the process of quarrying. Pertinent activities include excavation, drilling, crushing, stockpiling and transport. Run offs from mine overburden and wastes may scavenge and carry heavy metals and minerals. Surface soil samples from the area showed that some heavy metals and minerals in several sampling stations exceeded the acceptable USEPA limits for soil. These heavy metals include iron and lead.

Lead (Pb). Sources of lead may be geogenic or anthropogenic. Anthropogenic sources include pesticides, agricultural inputs, fuel combustion, coal-fired power plant emissions, waste batteries and paints.

If absorbed into the body, lead can be toxic and has potential for carcinogenicity. With inhalation and ingestion as two routes of exposure, lead accumulates in body organs, which may lead to poisoning or even death. Lead can affect the central nervous system (CNS), the gastrointestinal tract, the bones, and the kidneys. In children, it can lead to risks of impaired development. Lower IQ, shortened attention span, hyperactivity and mental retardation. In adults, lead poisoning may manifest as decreased reaction time, loss of memory, nausea, insomnia, anorexia and joint weakness.

Iron (Fe). Elemental and iron compounds are usual components of mining wastes. Iron is an essential element to human and animal metabolism in trace amounts. In excess, it can exert toxic effects and environmental impacts.

4.1.7 Risk Management

The risk assessment conducted showed that potential inherent (unmitigated) risks from the proposed Quarry Project of Eagle Cement Corp. ranges from medium to high risks. High risks, must be prevented and/or controlled with application of appropriate mitigation measures. These must be reduced to at least Medium Risk before work commences. Medium risks, on the other hand, should be carefully evaluated and reduced to as low as reasonably practicable (ALARP) within a defined period of time. Reasonable in this context means a balance between the benefits of increased safety, environmental protection or lives saved and the costs involved in the process of risk reduction.

4.1.7.1 Risks from Landslides and Rockfalls

Classified as a high-risk hazard, the potential for landslides and rockfalls is primarily due to the nature of activities involved, the steep slopes in some areas, and the susceptibility of the area to natural events that may trigger mass movements of rocks and soil. As earlier discussed, the activities that may trigger landslides or rock falls include earthworks involving unstable and steep slopes, drilling and ripping, and controlled blasting. Natural events that may trigger landslides and rockfalls are earthquakes, heavy and prolonged rains, and intense typhoons. To address these hazards, the Project management plans implement the following measures:

- Strict implementation of a benching design: Bench development involves the construction of access roads and ramps to reach higher grounds and the eventual shaping-up of quarry benches for slope stability. Benches shall be developed according to a specific engineering design oriented towards slope stability and control of erosion;
- Install slope stabilization structures where necessary;
- Construction of a system of drainage canals and settling ponds to control the flow of water that could trigger soil erosion and landslides;
- Grading the topsoil and overburden stockpile to a stable relief;
- Use of quarry wastes and overburden as backfill;
- Progressive rehabilitation and reforestation of inactive and abandoned quarry sites.

The following mitigating measures are recommended:

- Ensure regular inspections and proper maintenance of containment berms; and
- Conduct regular orientation and drills of workers on emergency response in case of landslides and other accidents;
- Particular recommendations are contained in ***Table 163***.

4.1.7.2 Explosives Transport and Blasting Incidents

The management of the proposed Quarry Project of Eagle Cement Corp. has outlined a methodology for the mitigation of any untoward incidents involving the transport and use of explosives at the project site. This methodology is described below.

4.1.7.2.1 General Methodology

The company and the contractor shall conform with DENR Administrative Order (D.A.O) No. 2000 – 98 known as the Mine Safety and Health Standards. Only blasting contractor that has the most advance blasting technology, duly registered and has the necessary license from government agency shall be awarded with the contract.

Non-electric detonation will be use for the initiation of the blasting sequence. This is to minimize the effect of blasting such as air blast, excessive ground vibration and fly rock. To avoid any accident from happening, a strict blasting procedure will be followed in coordination with the contractor and the company.

Blasting operations shall be done using dynamites or boosters as primers and ammonium nitrate as column charge. Full delay system of initiation shall be done using non-electric down line detonators and non-electric surface delay detonators. Starter initiator to be used shall be ordinary blasting cap & safety fuse.

4.1.7.2.2 Fly-Rock, Noise and Vibration Control

- All overlying loose materials and loose rocks shall be removed by bulldozer 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 or community.
- Blaster to prepare drilling layout to ensure the correctness of burden, spacing, and depth of hole
- Protective works, such as the use of blasting mats, shall be done in blast area in very close proximity to vital facilities and community.
- Full delay system of initiation shall be used. Only non-electric down the hole detonators and trunk line delay detonators shall be used. Delay time between adjacent holes shall not be less than 17ms. Firing will be one hole at any given time.
- Stemming materials to be used composed of rock fragments sized 5/8 of hole diameter mixed with drill cuttings and compacted properly.

4.1.7.2.3 Safety Methodology

Only a Licensed Blaster shall supervise the whole blasting activity. All manufacturers' safety guidelines and PNP rules and regulations shall be followed in conducting the blasting operation/activity. The company shall inform the nearby communities as to the time and date of any blasting operation.

4.1.7.2.3.1 Explosives Transport

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

4.1.7.2.3.2 Handling & Charging

- Only the Licensed blaster shall do the charging and priming.
- Primer should be assembled only before charging.
- Stemming height should be greater or equal to the designed burden of the layout. Size of stemming materials shall be 5/8 of the hole diameter mixed with some fine materials and compacted using a tamping stick.
- Only non-conductive materials should be used for charging or tamping. Tamping sticks should be flat at the bottom.
- Tamping of stemming materials should be done carefully not to hit the down line initiator causing it to misfire or initiated prematurely.
- Final connection of loaded holes should only be done when the exact firing time has been confirmed.
- A final inspection of the whole lay out should be made by the blaster, after which he will declare that the area is ready to be blasted.

4.1.7.2.3.3 Clearing & Traffic Control

- Clearing of blasting area shall be done by 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 such as lunch or snack. No blasting will be allowed during night time.
- All possible entries towards the blasting area, at least 200 meters from the blast site, should be barricaded. Also, all equipment and personnel within 200 meters shall be evacuated for safety.
- When all roadblocks are in place, licensed blaster shall conduct final clearing of the area.
- It is only the Drilling and Blasting Supervisor or Project Manager who will give the clearance to fire the starter initiator after ensuring that the area is fully cleared.

4.1.7.2.3.4 Firing

- The licensed blaster will only install the starter initiator (OBC and Safety Fuse) once the area has been declared clear.
- Each fuse should bear a minimum of three (3) minutes period to allow the blaster to seek cover.
- A blasting timer should be made by licensed blaster as a warning shot, which will fire around five (5) to ten (10) seconds prior to the main blast.
- After checking all the connection, the blaster will seek the approval of Drilling and Blasting supervisor to fire the shot.
- Only 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 30 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.
- Only the Drill and Blast Supervisor or Project Manager shall declare that blasting is over and barricades can be lifted. All equipment and personnel can now return and go back to resume their work.

4.1.7.3 Equipment/ Vehicular Accidents

Equipment and vehicular accidents such as fall from steep slopes, being hit by rocks and debris, collisions and others are some of the hazards of the quarry project. These hazards are classified as medium risk. To mitigate these risks, the following measures are proposed:

- Avoid operation during inclement weather.

- Maintain proper security and cordon off hazardous areas.
- Ensure good maintenance and regular testing of equipment and vehicles.
- Adequate training of operators and drivers.
- Provide spotters to guide heavy mining equipment and mobile units in maneuvering and operating within the quarry zones and destination.
- Driver/operator cabs are protected from dusts and heat to reduce stress on operartors.
- Restrict access to vehicles.

4.1.7.4 Failure of Siltation ponds Structures

To mitigate against possible failure of siltation ponds structures and the subsequent flooding and contamination of downstream areas, the following measures will be implemented:

- Construction of a series of strategically placed settling ponds within the project area, with sediments being impounded from the first to the third pond in succession.
- The ponds shall have a capacity of 100,000 m^3, which is capable of handling surface run-off and silt for a twenty-four hours continuous rainfall of 500 mm.
- The silt pond shall comply with applicable water quality standards prior to release to the nearby surface waters.

The following measure is likewise recommended:

- Regular and periodic cleaning/dredging of settling ponds through bailing out the accumulated silt materials as soon as they near critical level.

4.1.7.5 Occupational Hazards

To prevent occupational injuries from accidents and untoward incidents, it is recommended that the management of the Eagle Cement Corp. will both observe and strictly enforce the applicable quarry safety rules and regulations prescribed by the Philippine Mining Laws, particularly those provided for in the DENR Mine Administrative Order No. MRD–51. Workers should be appropriately trained on safe quarrying practices. The following safety precautions should be observed:

- Provision of hard hats, safety shoes and other pertinent PPEs to all quarry workers.
- All overhangs and loose rock masses that have high potential of falling down on pit walls and extraction faces should be scaled down.

- Provide spotters to guide heavy mining equipment and mobile units in maneuvering and operating within the active quarry zones.
- Prohibit quarry workers from working directly below unstable slopes.
- Regular and timely maintenance and servicing of all quarry equipment
- Provide First-Aid kit and assign First Aiders onsite.
- Regular briefing and pep talks to quarry workers on safe operating practices.
- Train workers on proper body mechanics to reduce ergonomic problems.
- Implement job rotation for high risk tasks to reduce worker exposure to hazards such as vibration and high noise levels.

4.1.7.6 Particular Hazards and Mitigation

Particular recommendations to mitigate and manage identified hazards are listed below.

Table 163 – Identified Hazards and Corresponding Recommended Mitigating Measures for the Proposed Quarry Project of Eagle Cement Corp.

SN	Activity/ Condition	Hazard	Recommended Mitigating Measures
A.	**Development Phase**		
1	Clearing of existing vegetation	▪ Being struck by felled trees, debris and equipment part	▪ Adopt and implement the safest methods/ technology. ▪ Ensure that persons doing specialized tasks (eg. Tree felling) are fully trained. ▪ Use of well-maintained equipment. ▪ Ensure use of personal protection gears
2	Clearing of existing vegetation	▪ Vibration and noise from power saws and other equipment	▪ Regular and timely maintece of equipment ▪ Provide ear protection and vibration protective PPEs to workers
3	Clearing of existing vegetation	▪ Vehicular and/or equipment accidents (overturning, fall from heights, etc.)	▪ Use of well-maintained and suitable equipment and vehicles. ▪ Use of properly trained crew and operators, especially drivers of large equipment like bulldozers and backhoes.
4	Stripping and stockpiling of quarry overburden	▪ Landslides and rock falls	▪ Ensure regular inspections and proper maintenance of containment berms. ▪ Batter off final waste dump slope to atmost 20 degrees. ▪ Use wastes and overburden as backfill. ▪ Ensure implementation of rehabilitation plan on waste dumps. ▪ Ensure proper siting of the overburden/waste storage facility.
5	Stripping and stockpiling of quarry overburden	▪ Equipment/vehicular accidents (fall from steep slopes, being hit	▪ Avoid operation during inclement weather. ▪ Maintain proper security and cordon off hazardous areas. ▪ Ensure good maintenance and regular testing of equipment/vehicles.

SN	Activity/ Condition	Hazard	Recommended Mitigating Measures
		by rocks and debris, collisions, etc.)	▪ Adequate training of operators and drivers. ▪ Provide spotters to guide heavy mining equipment and mobile units in maneuvering and operating within the quarry zones and destination; ▪ Driver/operator cabs are protected from dusts and heat. ▪ Restrict access to vehicles
6	Stripping and stockpiling of quarry overburden	▪ Sediment-laden runoffs from overburden stockpiles could contribute to surface water siltation and possible contamination with toxic heavy metals and minerals	▪ Construct and maintain networks of drainage canals and settling ponds ▪ Progressive rehabilitation and reforestation of abandoned quarries, inactive quarries and idle lands ▪ Stabilize overburden stockpiles to a stable relief ▪ Batter off final waste dump slope to atmost 20 degrees and plant with sediment holding vegetation cover
7	Bench Development	▪ Landslides and rock falls	▪ Implement proper design and procedure in bench development ▪ Install slope stabilization structures where necessary (eg. vegetation planting along berms) ▪ Construction and maintenance of a system of drainage canals and settling ponds ▪ Scaling down of all overhangs and loose rock masses that could fall down on pit walls and extraction faces ▪ Use of quarry wastes and overburden as backfill ▪ Progressive rehabilitation and reforestation of inactive and abandoned quarry sites. ▪ Regular orientation and drills of workers on emergency response in case of landslides and other accidents ▪ Proper siting of overburden/waste storage facility

SN	Activity/ Condition	Hazard	Recommended Mitigating Measures
8	Bench development	▪ Equipment/vehicular accidents (fall from steep slopes, being hit by rocks and debris, collisions, etc.)	▪ As in #SN 5
B.	**Production Phase**		
9	Transport to and use of explosives at the site (as per blasting operation only)	▪ Expoosure of people and/or properties to blast overpressures, vibration and high velocity projectiles from accidental detonation	▪ Contract out controlled blasting operations to government and PNP- accredited professional blasters ▪ Implement the Planned Safety Procedures ▪ Strict adherence to protocols such as use of signalling system and communication, cordoning off of affected areas ▪ Proper information dissemination to all workfand/or orce and nearby communities on blasting schedules and protocols
10	Controlled blasting	▪ Exposure of people to harmful blast overpressures that may cause major injuries	▪ Same as above
11	Controlled blasting	▪ Blast overpressures and ground vibration causing damage to nearby infrastructures	▪ Same as above
12	Controlled Blasting	▪ Harmful impact noise causing hearing impairment	▪ Same as above ▪ Ear protective PPE
13	Controlled Blasting	▪ Being struck by high velocity projectiles (fly rocks)	▪ Same as above

SN	Activity/ Condition	Hazard	Recommended Mitigating Measures
14	Controlled blasting	▪ Landslides and rockfalls outside of blasting area due to blast overpressure and vibration	▪ Same as above
15	Ripping	▪ Ripping equipment accidents (fall from steep slopes, being hit by rocks and debris, collisions, etc.)	▪ As in SN#5
16	Dozing and Loading of quarried materials	▪ Equipment (dozers and haul trucks) accident (fall from edge of a bench, being hit by falling rocks, being hit by loading arm)	▪ As in SN#5
17	Hauling and transport of quarried materials	▪ Generation of airborne dusts from dirt roads and from quarried materials being hauled	▪ Regular and adequate water sprinkling of haul dirt roads ▪ Adequate cover over the materials being transported
18	Hauling and transport of quarried materials	▪ Noise from haul trucks could cause disturbance to communities along the haul route	▪ Observance of hauling/transport schedules, whicch takes into account the welfare of the public (eg. no transport during night time)
19	Hauling and transport of quarried materials	▪ Vehicular accidents at the quarry site (fall from edge of bench, collision with other vehicles/equipment or structures, overturning, etc.)	▪ Same as in SN#5

SN	Activity/ Condition	Hazard	Recommended Mitigating Measures
20	Hauling and transport of quarried materials	▪ Traffic accidents (collision with other vehicles, hitting pedestrians and/or animals, others)	▪ Adequate training of drivers ▪ Adequate vehicle maintenance ▪ Regular performance review and implementation of corrective measures
21	Settling ponds	▪ Breaching of siltation ponds could lead to flash floods, siltation and possible contamination with heavy metals and minerals (e.g. Ca, Mg, Zn, Fe, Cd, Pb) of surface waters and nearby lands	▪ Ensure appropriate siting, design and construction of settling ponds and related facilities. ▪ Ensure regular, as well as emergency inspections and monitoring of structures ▪ Ensure proper and regular maintenance of the facility, including sediment dredging when critical levels are reached ▪ Security measures to prevent sabotage of infrastructures.
C.	**Occupational Safety and Health**		
22	Earthworks and other quarry activities	▪ Generation of and exposure of workers to dusts, including respirable particulates that could lead to or predispose to respiratory diseases and eye irritation	▪ Ensure use of appropriate personal protection equipment. ▪ Use of appropriate equipment and vehicles with protective operator cabin. ▪ Pre-employment and free annual medical examination of all workers, including chest X-rays.
23	Equipment operation and blasting	▪ Harmful noise levels could lead to hearing impairment	▪ Ensure good maintenance and regular testing vehicles and equipment. ▪ Provide adequate hearing protective PPEs to workers free of charge
24	Equipment operation (e.g	▪ High impact vibration from equipment can predispose to	▪ Ensure good maintenance and regular testing vehicles and equipment.

SN	Activity/ Condition	Hazard	Recommended Mitigating Measures
	drilling, excavation and ripping activities)	musculoskeletal and nervous system disorders (eg. Hand-Arm vibration Syndrome or HAVS)	▪ Provide vibration protective gears like hand/arm support for critical operations like drilling, ripping . ▪ Job rotation to reduce exposure to vibration.
25	Working at heights	▪ Fall from the edge of a bench	▪ Training ▪ Safety barriers and signages ▪ PPE - hard hats, safety harness
26	Working near unstable or loose soil/ rocks	▪ Being struck by falling rocks/debris at the foot of a face	▪ Prompt scaling down of all overhangs and loose rock masses near pit walls and extraction faces ▪ PPE-hard hats, safety shoes
27	Working near moving equipment parts	▪ Being struck by or caught in a moving part of quarry equipment	▪ Training of workers ▪ Proper selection of equipment, noting presence of guards ▪ Install/replace all guarding mechanism on equipment/ machines
28	Ergonomic issues (heavy lifting, prolonged standing, repetitive movement, awkward postures, etc.)	▪ Ergonomic hazards that may lead to bodily injuries and stress	▪ Training of workers on proper body mechanics in performing various tasks ▪ Job rotation to reduce exposure to very stressful tasks ▪ Provide workers with adequate break times
D.	**Natural Events, Climate Change Factors and Terrorism**		

SN	Activity/ Condition	Hazard	Recommended Mitigating Measures
29	Earthquakes	▪ Landslides and damage to structures and equipment with injuries/fatality to people	▪ Formulate and implement an earthquake response plan that includes the following: monitoring and warning system; system of communication within and outside the mine site; SOPs for all personnel, workers and contractors; and evacuation plan. ▪ Conduct regular and timely orientation and drills of all personnel, workers, contractors, as well as nearby communities, on the earthquake/tsunami emergency response plan and procedures. ▪ Ensure regular and timely inspections and monitoring of all buildings and infrastructures within the mine site.
30	Increased frequency and intensity of tropical cyclones	▪ Landslides and rock falls ▪ Flooding of low lying areas ▪ Damage to buildings and equipment ▪ Injury or fatality from falling trees, debris, rock fragments projectiles, and equipment parts	▪ Regular review of the Project's Emergency Prevention and Response Plan (EPRP) ▪ Implementation of and compliance with the safety and health program, especially the EPRP. ▪ Regular and timely inspections and monitoring of containment dikes, retaining walls, and other retaining structures. ▪ Orient all personnel, workers and contractors of the EPRP ▪ Regular conduct of emergency drills for situations such as fires, flooding and earthquakes. ▪ Education/ information campaigns on climate change, its impacts and appropriate responses to mitigate impacts (tailored to the specific condtion in the area).
31	Torrential rains during rainy season	▪ Same as above	▪ Same as above
32	Drier dry seasons and increased	▪ Increased airborne dusts;	▪ Implement progressive rehabilitation and reforestation program of mined-out areas and other denuded areas.

SN	Activity/ Condition	Hazard	Recommended Mitigating Measures
	ambient temperatures	▪ Drying of nearby water sources could compromise dust suppression efforts	▪ Implement fire prevention and control measures and protocols. ▪ Implement dust suppression measures such as regular and adequate water sprinkling on dirt haul roads, overburden stockpiles ▪ Provide adequate cover over ore stockpiles and during transport ▪ Provide workers with dust protection PPEs such as dust mask/respirators, eye goggles.
33	External Threats/ Terrorism	▪ Terroristic attacks and/or sabotage of quarry facilities	▪ Fencing and security barriers of critical equipment ▪ Proper deployment of security personnel ▪ Monitor for security announcement/advice from government's national/regional/ local security agency ▪ Establish good public relations with the surrounding communities

4.2 Emergency Response Policy and Guidelines

To address the immediate actions required by emergency situations involving the loss of life, damage to property and other resources, a comprehensive system of identifying potential for occurrence of these emergencies and the appropriate response procedures shall be documented, communicated and all personnel trained on the procedures.

The procedures shall include an emergency plan that shall outline the actions to be taken when specific emergency situation arises. The involvement of external parties in emergency planning and response shall be clearly identified and communicated.

Emergency equipment needed shall be identified, acquired and provided in the right quantities. These are alarm systems, emergency lighting and power, means of escape, safe refuge, critical isolation valves, switches and cut-outs, firefighting equipment, first aid equipment and communication facilities.

Periodic emergency drills shall be conducted to test the procedures and measure the readiness of emergency response teams.

4.2.1 Structure and Responsibility

The Emergency Response Team, headed by a full time Safety Engineer reporting directly to the Quarry Manager, will be in-charge of the over-all responsibility of ensuring that the safety and health management system is formulated, implemented, maintained and continually improved. This will ensure strict implementation of Emergency Preparedness and Response Plan.

4.2.2 Emergency Procedures

For each type of emergency, a documented and updated procedure shall automatically govern the response in the shortest possible response time. All procedures are to be subject of intensive training and drill to be conducted regularly.

4.2.2.1 Fire

All necessary fire prevention, warning, suppression and control equipment shall be provided. Fire prevention and firefighting programs shall be established and manned on a constant basis to handle fire emergencies that may occur at fire risk areas in the mining area and nearby communities.

4.2.2.2 Landslides and Land Subsidence

Continuous geotechnical assessments of the mined-out areas and affected sites (haul and access roads, other facilities) shall provide inputs to contingency plans for these types of emergencies. Critical localities near inhabited areas shall be prioritized when responding to these incidents.

During the pre-operation phase, sources of landslides and subsidence should be identified. Early detection of landslides and subsidence occurrences could prevent loss of lives, damage to property and others.

Training of workers on this is very important for them to be responsive and attentive in the application of controls to avoid or minimize the degree of danger.

Aside from attending training, information on landslides and subsidence can be disseminated to workers through posters, leaflets, meetings and other media advertisements.

4.2.2.3 Kidnappings & Unrests

Handling this type of emergency requires the participation of external authorities. It has to be clearly established that there are specific legal and criminal aspects for these events hence, emergency procedures should take this into account.

In general, the Project shall have the policy of not entertaining conditions where ransom payments are imposed.

4.2.2.4 Oil/Fuel Spills

Procedures for handling, transport, storage and use of oil and fuels should incorporate specific steps in controlling the potential and actual occurrences of spillages and leakages. The necessary control and clean up equipment, supplies and personal protective equipment for emergency personnel shall at all times be available in the right quantities.

Good housekeeping practices must be observed in the workplaces. Spills of oil/fuel are to be collected and contained in plastic containers and stored in the designated area.

4.2.2.5 Flooding, Storm and Heavy Rains

Adequate early warning notification and information dissemination shall be ensured for these emergency procedures. Readiness to implement evacuation procedures shall also be ensured. Constant open channels of communication with government agencies on weather condition announcements and disaster response procedures shall be maintained.

The workers should be attentive on this situation to prevent loss of lives, damage to properties and others.

4.2.2.6 Vehicular Accidents

The proper first aid and medical evacuation procedures in handling injured persons involved in vehicular accidents shall form part of these emergency procedures.

Included in the SOPs and WIs are the company policies and guidelines to prevent vehicular accidents within and outside the Project area. The Project contractors and workers are bound to comply with this and necessary penalties are to be applied.

4.2.2.7 Animal Bites

Medical first aid procedures shall be applied immediately. The availability of medicines and specific treatment drugs (i.e. anti-venin serum) must be ensured including properly trained medical personnel.

4.2.2.8 Development Programs

Support systems and programs shall continuously be adopted to ensure that the safety and health performance of the Project be upgraded and improved in the long term.

5.0 SOCIAL DEVELOPMENT PLAN AND IEC FRAMEWORK

5.1 Indicative Social Development and Management Program (SDMP)

The current operation of Eagle Cement provides social/community development assistance to the identified impact communities, Barangays Akle and Talbak. Some of the solutions to community problems identified by the respondents such as employment, livelihood programs, capacity building, scholarship and educational assistance, access to clean water, health programs, solid wastes management program, values formation and other community needs shall be the core programs, projects and activities of the company once it operates.

The participation of the impact communities, specifically the Barangay Councils, Sectoral Organizations, Different Government Institutions, Businesses, and Industries is necessary for the implementation of the indicative social development framework. Eagle Cement will ensure partnership undertakings with the identified stakeholders.

The identified impact of the proposed project, as well as the continuous operation of Eagle Cement to the communities will be addressed and compensated through the continuous implementation of social/community development projects through the Company's CSR Program. The results of the socio-economic assessment, perception survey, and focus group discussion were considered in the development of social development framework. ***Table 164*** presents the indicative social development framework to be implemented in relation to the proposed project of Eagle Cement's operation.

Table 164 - Indicative Social Development Framework

Concerns	*Community Beneficiary*	*Community Member Responsible*	*Government Agency / Non-government Agency and Services*	*Proponent*	*Indicative Timeline*	*Source of Fund*
Livelihood and Employment						
• Gender Responsive Sustainable Livelihood Program (Marginalized Sector: Womens, Youth, Farmers, Senior Citizens, Persons with Disabilities) • Employment Program: Special Program for Employment of Students; Job Fairs • Skills training program: to give local residents of impact barangays the chance to qualify and compete for available employment opportunities during the	• Interested Community Residents – Marginalized Sector	• Barangay Officials • Sectoral Organizations	• LGU Municipal Planning and Development Office • Impact Barangays • Municipal Social Worker Department (MSWD) • Municipal Public Employment Services Ofice • TESDA • Cooperative Development Authority • Local Department of Labor and Employment	• Community Relations Officer	• Pre-construction • Construction • Operation	• LGU – Eagle Cement CSR Program

Concerns	*Community Beneficiary*	*Community Member Responsible*	*Government Agency / Non-government Agency and Services*	*Proponent*	*Indicative Timeline*	*Source of Fund*
implementation of the project or in other areas						
Health Services						
• Provision of Medicines and Medical Tools and Equipment • Support to the improvement of health facilities • Conduct of Medical Mission • Supplemental feeding for malnourished children at barangay including kitchen tools • Provision of Milk and Flu Vaccines	• Impact Barangay • Men, Women, Children, Youth, Senior Citizens, PWDs	• Barangay Officials • Municipal and Barangay Health Workers	• Municipal Health Office (MHO) • Barangay Health Center • Impact Barangay	• Community Relations Officer • Safety and Health Officer	• Pre-construction • Construction • Operation	• LGU – Eagle Cement CSR Program

Concerns	*Community Beneficiary*	*Community Member Responsible*	*Government Agency / Non-government Agency and Services*	*Proponent*	*Indicative Timeline*	*Source of Fund*
• Construction of one unit deepwell • Monitoring of emergence of possible diseases in relation to the presence of the project in the area. Close coordination with Health workers and municipal health officers. • Monitoring of health of community and proper medication thru the MHO and barangay health workers.						
Education Assistance						

Concerns	*Community Beneficiary*	*Community Member Responsible*	*Government Agency / Non-government Agency and Services*	*Proponent*	*Indicative Timeline*	*Source of Fund*
• Adopt-a-School Program • Assistance for development/ improvement of school facilities (day care centers, existing schools) • Provision of scholarship to qualified students • Capacity building of teachers • Brigada Eskwela • Teachers and Pupils Training	• Public Schools within the Impact Barangays • Students, Teachers	• Barangay Officials (specifically the Council Member for Education)	• Department of Education (DepEd) • B/LGU, PTA	• Community Relations Officer	• Pre-construction • Construction • Operation	• LGU – Eagle Cement CSR Program
Public Infrastructure, Environment, and Sanitation						

Concerns	Community Beneficiary	Community Member Responsible	Government Agency / Non-government Agency and Services	Proponent	Indicative Timeline	Source of Fund
• Implementation of Solid Waste Management in compliance with Republic Act 9003 • Infrastructure Development (Cement Donation) for Physical Improvement of the area that will impact on sanitation and safety • Drainage Canal • Church Repair	• Impact Communities	• Barangay Officials (specifically the Council Member for Environment) • Barangay Peace and Security Officers	• Municipal Engineer's Office • Municipal Environment and Natural Resources Office (ENRO) • B/LGU, PPPC	• Community Relations Officer • Environmental Officer/ Pollution Control Officer • Safety Officer	• Pre-construction • Construction • Operation	• LGU – Eagle Cement CSR Program
Road Safety and Protective Services						
• Support for the Peace and Order Program of the Barangay and Municipal LGU	• Barangay/ Sitio Residents • Institutions	• Barangay Officials • Barangay Peace and Security Officers	• Municipal Engineer's Office • Municipal Environment and Natural Resources Office (ENRO)	• Community Relations Officer	• Pre-construction • Construction • Operation	• LGU – Eagle Cement CSR Program

Concerns	Community Beneficiary	Community Member Responsible	Government Agency / Non-government Agency and Services	Proponent	Indicative Timeline	Source of Fund
• Partnership in the implementation of Traffic Management Program • Emergency Response Calamity / Assistance			• Municipal Disaster Risk Reduction and Management Office • Municipal Police	• Mine Environmental Protection and Enhancement Officer / Pollution Control Officer • Safety Officer		• Environmental Management Program • Safety and Health Program
Socio-Cultural Activities						
• Provision of support/ assistance to LGUs in the conduct of activities that strengthens community cohesiveness (Fiestas, Flores de Mayo, Karakol, Christmas Party, Barangay Assemblies)	• Barangay/ Sitio Residents	• Barangay Officials	• Municipal Planning and Development Office • Municipal Social Welfare and Development Office	• Community Relations Officer	• Pre-construction • Construction • Operation	• LGU – Eagle Cement CSR Program

5.2 Information and Education Campaign

Implementation of an intensive and consistent IEC Plan is the key to build a positive rapport with the impact communities and other stakeholders. Through this, an open communication line is established between the Eagle Cement, Barangay and Municipal LGUs, and the residents of Impact Barangays. An open communication ensures accessibility of bringing community concerns to the attention of the company. It is also a way for the company to communicate efforts and activities that addressed community concerns, intervention to avoid or mitigate negative impacts of the operations, as well as to enhance positive impacts through a strong partnership with the impact communities.

Collected information from the community signifies the need to strengthen the IEC implementation of Eagle Cement Corp. A more regular, consistent, and accessible line of the communication will be established between Eagle Cement Corporation and the host barangay. The approach will be two-way, that will ensure feedback mechanism in every communication activity. An open line of communication will be institutionalized that ensures the accessibility of bringing community concerns to the attention of the company. Eagle Cement Corporation, on its part, will communicate all efforts and actions in addressing community concerns, intervention to avoid or mitigate negative impacts of the operations. The monthly IEC activity conducted by the Environment Team will be continued and strengthened by including the Safety and Health Team and most especially the Community Relations Team.

Eagle Cement implements IEC activities to communicate updates on the results of the proposed project and its current operations. Continuing IEC activities will be conducted based on the IEC framework outline in ***Table 165***.

Table 165 - IEC Framework

Target Sector Identified as Needing Project IEC	*Major Topics of Concern in Relation to the Project*	*IEC Schemes / Strategy / Methods*	*Information Medium*	*Indicative Timeline and Frequency*	*Indicative Cost*
• Local Government Units • Households and Business surrounding Eagle Cement • Local Non-Government / Community Organizations • Relevant National Regional Government Agencies • Project affected communities	• Approval of the ECC Amendments and stipulated conditions • Project description (i.e. project components, size/coverage, capacity, among others) • Environmental Performance Report and Management Plan • Concerns on the daily operation of Eagle Cement	• Intensive information dissemination on the approved ECC and EIS • Consultation – Meetings	• Reproduction and Distribution of the approved ECC and EIS to the concerned LGUs • Print materials: Brochure about the approved project • Audio-Visual Presentations • Two-way verbal communication and action report	• Prior to project operation	• Cost of printing the IEC materials • Cost of holding consultation meetings
• Local Government Units • Households and Business surrounding Eagle Cement • Local Non-Government / Community Organizations • Barangay Council and Sangguniang Bayan • Project affected communities	• Presentation of project activities in relation to the operation of proposed project • Discussion on predicted impact and mitigation plan • Gathering of community issues and concerns on the ongoing operation of Eagle Cement	• Printed information about the project updates and posting at impact barangays bulletin board or information centers • Consultation-meetings	• Print materials: Posters or project bulletin • Audio-Visual Presentations • Two-way verbal communication and action report	• During project operation	• Cost of printing the IEC materials • Cost of holding consultation meetings

Target Sector Identified as Needing Project IEC	Major Topics of Concern in Relation to the Project	IEC Schemes / Strategy / Methods	Information Medium	Indicative Timeline and Frequency	Indicative Cost
	• Reporting of results of project and monitoring				
• Local Government Units • Local Non-Government / Community Organizations • Barangay Council and Sangguniang Bayan	• Presentation of project activities in relation to the operations • Gathering of community issues and concerns on the ongoing operation of Eagle Cement • Dissemination of the Corporate Social Responsibility Programs, possible partnership for the implementation and reporting of accomplishments • Dissemination of program implementation and accomplishment on the Environmental Management Plan • Dissemination of program implementation and	• Printed information about the project updates and posting at impact barangays bulletin board or information centers • Consultation-meetings	• Print materials: Posters or project bulletin • Audio-Visual Presentations • Two-way verbal communication and action report	• During operations	• Cost of printing the IEC materials • Cost of holding consultation meetings

Target Sector Identified as Needing Project IEC	***Major Topics of Concern in Relation to the Project***	***IEC Schemes / Strategy / Methods***	***Information Medium***	***Indicative Timeline and Frequency***	***Indicative Cost***
	accomplishment of Occupational Safety and Health • Quarterly reporting of results MMT monitoring				
• Local Government Units • Local Non-Government / Community Organizations • Barangay Council and Sangguniang Bayan • Households and Businesses surrounding Eagle Cement • Relevant National/ Regional Government Agencies • Project affected communities	• Presentation decommissioning and closure plan • Provision of updates on the decommissioning and closure activities • Gathering of community issues and concerns on the decommissioning and closure activities • Reporting of updates on the monitoring of decommissioning and closure activities	• Printed information about the project updates and posting at impact barangays bulletin board or information centers • Consultation-meetings	• Print materials: Posters or project bulletin/newsletter • Audio-Visual Presentations • Two-way verbal communication and action report	• During Decommissioning and Closure Phase	• Cost of printing the IEC materials • Cost of holding consultation meetings

6.0 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 operation.

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 Self-Monitoring Plan

The EQPLs presented below for the Environmental Monitoring Plan is only applicable for Effluent and Emissions regulations.

The salient point of the said table is that Alert and Action EQPLs were only assigned to parameters that can be controlled by the project during construction and operation phases.

Table 166 - Environmental Monitoring Plan

Module	Environmental Sector	Parameters to be monitored	Sampling and Measurement			Lead Person/ Office	Annual Estimated Cost (Php)	EQPL Management Scheme					
								EQPL Range			Management Measure		
			Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
CONSTRUCTION AND OPERATION PHASE													
Terrestrial	Flora Species	Biodiversity, Species Richness, Endemicity, Conservation Status	Quadrat Sampling and Transect Walk	Every two years	Identified Sampling Stations	MEPEO	Part of EPEP cost	▫ Low survival rate (65%)	▫ Low survival rate (60%)	Low survival rate (50%)	Continue monitoring and assessment of Flora	▫ Progressive Rehabilitation	▫ Progressive Rehabilitation
	Fauna Species	▫ Biodiversity, Species Richness, Endemicity, Conservation Status	Sampling (Mist netting, Snap Traps, etc.) and Transect Walk	Every two years	Identified Sampling Stations	MEPEO	Part of EPEP cost	▫ Low sightings (65%) ▫ Low sampling result (65%)	▫ Low sightings (60%) ▫ Low sampling result (60%)	▫ Low sightings (50%) ▫ Low sampling result (50%)	▫ Continue monitoring and assessment of Fauna	▫ Progressive Rehabilitation	▫ Progressive Rehabilitation
Water Quantity	Groundwater Surface water	▫ Deepwell pump operating time ▫ Volume of water extracted ▫ Rate of extraction	Flow meter	Daily monitoring Monthly reporting to NWRB or as required	Deepwell/s to be installed Rivers/Creeks which will be used as water source	Pollution Control Officer / Mining Operations	Part of EPEP cost	▫ 80% of the limit value	▫ 90% of the limit value	▫ Pumping rate limit set by the NWRB in the water permit	▫ Check any additional water uses	▫ Check any additional water uses, ▫ Check the water system for any leakages, ▫ Review the Water Management Plan	▫ Check any additional water uses, ▫ Check the water system for any leakages, ▫ Review the Water Management Plan ▫ Consider other alternative sources of water
	Effluent Class C	▫ pH ▫ Temperature ▫ DO ▫ TSS ▫ COD ▫ Color ▫ Oil and Grease ▫ As, Cd, Cr6+, Pb, Hg	In-situ measurement using hand-held water quality tester (pH, DO, temperature) Grab sampling and laboratory analysis	Monthly	Settling ponds at the quarry area	Pollution Control Officer	Part of EPEP cost	Class C TSS=80-89 mg/l pH: 6.4-6.8 or 9.0-9.2 O&G= 4 - 4.4 mg/l As = 0.032-0.035 mg/l Cd = 0.008-0.0089 mg/l Pb = 0.08-0.089 mg/l Hg = 0.0032-0.0035 mg/l COD=80-89 mg/l Color=120-134 TCU	Class C TSS=90-99 mg/l pH: 6.1-6.3 or 9.3-9.4 O&G= 4.5 – 4.9 mg/l As = 0.036-0.039 mg/l Cd = 0.009-0.0099 mg/l Pb = 0.09-0.099 mg/l Hg = 0.0036-0.0039 mg/l COD=90-99 mg/l Color=135-149 TCU	Class C TSS=100 mg/l pH: 6.0 (min) or 9.5 (max) O&G=5 mg/l As = 0.04 mg/l Cd = 0.01 mg/l Pb = 0.1 mg/l Hg = 0.004 mg/l COD=100 mg/l Color=150 TCU	▫ Investigate the source and identify possible pollutant sources ▫ Conduct corrective actions if needed	▫ Investigate the source to identify possible pollutant sources ▫ If the problem is within the construction/operation area, conduct adjustments/ appropriate corrective action at identified pollutant source.	▫ Investigate the source to identify possible pollutant sources ▫ Provide additional mitigation measures or pollution control facilities ▫ If source is not project construction, inform MMT regarding possible source for the group's investigation and coordination with LGU
	Freshwater / Surface Water	▫ pH ▫ Temperature	In-situ measurement	Monthly	Class C:		Part of EPEP cost	Class C DO: 5.6-6.0 mg/l	Class C DO: 5.1-5.5 mg/l	Class C DO=5 mg/l minimum	▫ Investigate the source		▫ Investigate the source to

Module	Environmental Sector	Parameters to be monitored	Sampling and Measurement			Lead Person/ Office	Annual Estimated Cost (Php)	EQPL Management Scheme					
								EQPL Range			Management Measure		
			Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
	(Ambient)	▫ DO	using hand-held water quality tester		S1 & S2 (control)	Pollution Control Officer		TSS: 64-72 mg/l pH: 7.1-7.4 or 8.8-8.85 O&G: 1.5-1.7 mg/l As:0.015-0.017 mg/l Cd:0.004-0.0044 mg/l Pb:0.04-0.044 mg/l Hg:0.0006-0.0079 mg/l	TSS: 73-79 mg/l pH: 6.6-7.0 or 8.86-8.9 O&G: 1.8-1.9 mg/l As:0.018-0.019 mg/l Cd: 0.0045-0.0049 mg/l Pb:0.045-0.049 mg/l Hg:0.0008-0.0009 mg/l	TSS=80 mg/l pH: 6.5 or 9.0 O&G=2 mg/l As = 0.02 mg/l Cd = 0.005 mg/l Pb = 0.05 mg/l Hg = 0.001 mg/l	and identify possible pollutant sources ▫ Conduct corrective actions if needed	▫ Investigate the source to identify possible pollutant sources ▫ If the problem is within the construction/operation area, conduct adjustments/ appropriate corrective action at identified pollutant source.	identify possible pollutant sources ▫ Provide additional mitigation measures or pollution control facilities ▫ If source is not project construction, inform MMT regarding possible source for the group's investigation and coordination with LGU
		▫ TSS ▫ As, Cd, Pb, Hg, Cr6+ ▫ Oil & Grease	Grab sampling and laboratory analysis										
		▫ TSS ▫ As, Cd, Pb, Hg, Ni, Mn ▫ Oil & Grease ▫ Nitrate ▫ Sulfate ▫ Fecal Coliforms	Grab sampling and laboratory analysis										
	Groundwater	▫ pH ▫ Temperature	In-situ measurement using hand-held water quality tester	Monthly	Deepwell/s to be installed GW1, GW2 & GW3	Pollution Control Officer	Part of EPEP cost	Class A TSS: 30-39 mg/l pH: 7.0-7.3 or 8.1-8.2 O&G: 0.8-0.85 mg/l Chloride:150-119 mg/l As:0.008-0.0085 mg/l Cd:0.0018-0.0023 mg/l Pb:0.006-0.0079 mg/l Hg:0.0006-0.0079 mg/l	Class A TSS: 40-49 mg/l pH: 6.6-7.0 or 8.3-8.4 O&G: 0.86-0.9 mg/l Chloride:200-249 mg/l As:0.0086-0.009 mg/l Cd: 0.0024-0.0029 Pb:0.008-0.009 mg/l Hg:0.0008-0.0009 mg/l	Class A TSS=50 mg/l pH: 6.5 or 8.5 O&G=1 mg/l Chloride=250 mg/l As = 0.01 mg/l Cd = 0.003 mg/l Pb = 0.01 mg/l Hg = 0.001 mg/l	▫ Investigate the source and identify possible pollutant sources ▫ Conduct corrective actions if needed	▫ Investigate the source to identify possible pollutant sources ▫ ▫ If the problem is within the construction/operation area, conduct adjustments/ appropriate corrective action at identified pollutant source.	▫ Investigate the source to identify possible pollutant sources ▫ ▫ Provide additional mitigation measures or pollution control facilities ▫ ▫ If source is not project construction, inform MMT regarding possible source for the group's investigation and coordination with LGU
		▫ TSS ▫ Oil &Grease ▫ As, Cd, Pb, Hg, Cr6+, Cl	Grab sampling and laboratory analysis										
Hydrologic Hazards	Hydrology	▫ Date of occurrence ▫ Frequency in a year	Observation	As needed; Yearly summary	Rivers/creeks within the project area	Pollution Control Officer / Emergency Response Team	Part of EPEP cost	▫ n/a	▫ n/a	▫ n/a	▫ Continuous improvement of the Emergency Response Plan;	▫ Continuous improvement of the Emergency Response Plan; Stream stabilization ▫ Implementation of Progressive rehabilitation	▫ Continuous improvement of the Emergency Response Plan; ▫ Stream stabilization ▫ Implementation of Progressive rehabilitation

Module	Environmental Sector	Parameters to be monitored	Sampling and Measurement			Lead Person/ Office	Annual Estimated Cost (Php)	EQPL Management Scheme					
								EQPL Range			Management Measure		
			Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
Air emissions	Air Quality	PM, SO_X, NO_X, and CO	▫ NOX- U.S.EPA Methods 1 through 4 and Method 7 ▫ CO -U.S.EPA Method 3 or 10 ▫ PM – Methods 1 to 5 ▫ Metals in ambient air – USEPA Methods 1 through 5 or 29	Annual	Generator sets	U.S.EPA Methods	Part of EPEP cost	≥75% of NESSAP Values. EQPL (Alert Minimum in mg/Nm^3) SO_X =525 NO_X = 1500 PM = 112.5 CO = 375 Hg = 3.8 Sb = 7.5 As = 7.5 Cd = 7.5 Pb=-7.5 Others – all other values prescribed in NESSAP	≥90% of NESSAP Values. EQPL (Action Minimum in mg/Nm^3) SO_X =630 NO_X = 1800 PM = 135 CO = 450 Hg = 4.5 Sb = 9 As = 9 Cd = 9 Pb=-9 Others – all other values prescribed in NESSAP	NESSAP Values (in mg/Nm^3) SO_X =700 NO_X = 2000 PM = 150 CO = 500 Hg = 5 Sb = 10 As = 10 Cd = 10 Pb=-10 Others – all other values prescribed in NESSAP	▫ Monitor levels ▫ Check genset operating system	▫ Proponent to correct high levels, as necessary.	▫ Reduce load or suspend operation
Ambient Air	Air Quality	Ambient TSP and PM10	▫ High Volume/ gravimetric	Quarterly or as frequent as necessary	Receptors or ASR's downwind of prevailing winds at the time of monitoring	Project proponent	Part of EPEP cost	▫ EQPLs may not be applicable as laboratory results are known few days or weeks after air sampling ▫ Recommend daily visual inspection of fugitive dust emissions and meteorological monitoring (please see next item below) ▫ Air sampling using High Volume/Gravimetric is intended to check compliance with the NAAQS			Part of environmental mitigation plan/measure is to ensure compliance with the NAAQS set for TSP at 300 $\mu g/Nm^3$ and PM_{10} at 200 $\mu g/Nm^3$		
		Ambient TSP/ Fugitive dust	Visual inspection and meteorological monitoring	Daily during operation during dry condition	Sources of air emissions at the project site	Project proponent and contractor	Part of EPEP cost	Fugitive dust is generated within project area at wind speed of < 5.4 m/s (relatively calm to light wind condition) Note: Wind speed of 5.4 m/s is within Beaufort Scale 3 – leaves and small twigs constantly moving, light flags extended)	Fugitive dust is generated close to residential at winds speed > 5.4 m/s (moderate to strong winds) Note: Wind speed of 5.4 m/s is within Beaufort Scale 3 – leaves and small twigs constantly	Fugitive dust is visually transported outside property boundaries (or at ASRs) during high wind speeds (moderate to strong winds) Note: Wind speed of 5.4 m/s is within Beaufort Scale 3 – leaves and small twigs constantly moving, light flags extended)	▫ Check if regular dust mitigation measures are implemented	▫ Inform equipment operator or contractor on its generated dust emissions ▫ Reduce vehicle travelling speed (e.g., 30 km/hr from 40 km/hr) ▫ Minimise dust generating activities	Suspend operation (i.e., materials handling) until favourable condition is meet (e.g., low wind speed) and/or additional mitigation measures are in placed (e.g., increase wetting frequency)

Module	Environmental Sector	Parameters to be monitored	Sampling and Measurement			Lead Person/ Office	Annual Estimated Cost (Php)	EQPL Management Scheme					
								EQPL Range			Management Measure		
			Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
									moving, light flags extended				
Ambient Noise	Noise Level	Ambient noise (outside periphery of proponent)	▫ Noise	Monthly or as frequent as necessary	Nearest receptor (household)	Project proponent and contractor	Part of EPEP cost	▫ Ambient: 51dBA (daytime)* ▫ Morning/evening- 46 dBA* ▫ Nighttime – 41 dBA* *Add factor of +5 dBA if area (monitoring station) is directly facing two-lane road (Note: Assumes noise sources are from the project only; no other background sources)	▫ Ambient: 53dBA (daytime)* ▫ Morning/evening- 48 dBA* ▫ Nighttime – 43 dBA* *Add factor of +5 dBA if area (monitoring station) is directly facing two-lane road (Note: Assumes noise sources are from the project only; no other background sources)	▫ Ambient: 55dBA (daytime)* ▫ Morning/evening- 50 dBA* ▫ Nighttime – 45 dBA* *Add factor of +5 dBA if area (monitoring station) is directly facing two-lane road (Note: Assumes noise sources are from the project only; no other background sources)	▫ Continue monitoring noise levels ▫ Check background noise levels	Conduct noise assessment to mitigate noise source that contribute to higher noise levels Implement noise attenuation measures	Reduce or suspend activities that attenuate high noise levels exceeding standards especially during nighttime
People	Socio Economic	No. of business established due to the operation	Ocular/Filed Observations Gather secondary data from Barangay/ Municipal LGUs FGDs/ KIIs/ Community Consultations	Annual	Impact Communities	Proponent through CRO		▫ Manifestations/ observations of non-implementation of mitigating measures during monitoring	▫ Incident report on non-implementation of mitigating measures	▫ Complaint received on implementation of mitigating measures	▫ Verify and validate report	Conduct investigation ▫ Take action to address negative impact	Take action to address negative impact ▫ Increase business opportunities
		No. of Community Development Programs/ Projects/ Activities implemented and No. of beneficiaries	Gather secondary data from Barangay/ Municipal LGUs and beneficiaries FGDs/ KIIs/ Community Consultations	Annual	Impact Communities	Proponent through CRO		▫ Manifestations/ observations of non-implementation of mitigating measures during monitoring	▫ Incident report on non-implementation of mitigating measures	▫ Complaint received on implementation of mitigating measures	▫ Verify and validate report	Conduct investigation ▫ Take action to address negative impact	Take action to address negative impact ▫ Improved services and community development potential

Module	Environmental Sector	Parameters to be monitored	Sampling and Measurement			Lead Person/ Office	Annual Estimated Cost (Php)	EQPL Management Scheme					
								EQPL Range			Management Measure		
			Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
		LGU Income aside from IRA	Gather data from Barangay/ Municipal LGUs FGDs/ KIIs/ Community Consultations	Semi-Annual	Impact Communities	Proponent through CRO		▫ Manifestations/ observations of non-implementation of mitigating measures during monitoring	▫ Incident report on non-implementation of mitigating measures	▫ Complaint received on implementation of mitigating measures	▫ Verify and validate report	Conduct investigation ▫ Take action to address negative impact	Take action to address negative impact ▫ Generation of additional revenue for the Local Government
ABANDONMENT PHASE													
• Rehabilitation of mined-out areas	Rehabilitation	Number of hectares rehabilitated	Terrestrial survey	Quarterly	Number of trees and area planted	Proponent through closure team	Part of FMRDP cost	▫ Low survival rate (65%)	▫ Low survival rate (60%)	▫ Low survival rate (50%)	▫ Continue monitoring and assessment of Flora	Replanting and research of other suitable species in the area	▫ Implementation of research and continuous replanting
	Employment	No. of workers employed from the impact communities, including employment from contractors	HR Manpower Monitoring Report FGDs/ KIIs/ Community Consultations	Annual	Quarry/ Impact Communities	Proponent through HR Manager and CRO	Part of FMRDP cost	▫ Manifestations/ observations of non-implementation of mitigating measures during monitoring	▫ Incident report on non-implementation of mitigating measures	▫ Complaint received on implementation of mitigating measures	▫ Verify and validate report ▫ Implement measures to mitigate negative impact	▫ Conduct investigation ▫ Take action to address negative impact	▫ Priority hiring of local residents
	Socio-Economic	No. of business affected due to closure	Ocular/Filed Observations Gather data from Barangay/ Municipal LGUs FGDs/ KIIs/ Community Consultations	Annual	Impact Communities	Proponent through CRO	Part of FMRDP cost	Manifestations/ observations of non-implementation of mitigating measures during monitoring	Incident report on non- implementation of mitigating measures	▫ Complaint received on implementation of mitigating measures	▫ Verify and validate report ▫	Conduct investigation ▫ Take action to address negative impact	Take action to address negative impact Increase business opportunities
		No. of implemented Community Development Programs/ Projects/ Activities continuously managed or sustained by the beneficiaries	Gather secondary data from Barangay/ Municipal LGUs and Beneficiaries FGDs/ KIIs/ Community Consultations	Annual	Impact Communities	Proponent through CRO	Part of FMRDP cost	Manifestations/ observations of non-implementation of mitigating measures during monitoring	Incident report on non- implementation of mitigating measures	▫ Complaint received on implementation of mitigating measures	▫ Verify and validate report ▫	Conduct investigation ▫ Take action to address negative impact	Change in socio/community development benefits

Module	Environmental Sector	Parameters to be monitored	Sampling and Measurement			Lead Person/ Office	Annual Estimated Cost (Php)	EQPL Management Scheme					
								EQPL Range			Management Measure		
			Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
		Monitor decrease in LGU Income	Gather data from Barangay/ Municipal LGUs FGDs/ KIIs/ Community Consultations	Semi-Annual	Impact Communities	Proponent through CRO	Part of FMRDP cost	Manifestations/ observations of non-implementation of mitigating measures during monitoring	Incident report on non- implementation of mitigating measures	▫ Complaint received on implementation of mitigating measures	▫ Verify and validate report ▫	Conduct investigation ▫ Take action to address negative impact	Change in the revenue collection of the Local Government/ Possible decrease in Local Government revenues

6.2 Multi-Sectoral Monitoring Framework

The multi-sectoral monitoring for the project was and shall be based on the guidelines/requirements of the RPM for DAO No. 2003-30 and DAO No. 2017-15.

The Multi-partite Monitoring Team (MMT) shall assess and validate compliance of the Project with the relevant environmental standards. The MMT shall be composed by representatives of the following offices:

- Mines and Geosciences Bureau Regional Office No. III;
- Department of Environment and Natural Resources Regional Office No. No. III;
- Municipal/City Environmental and Natural Resources Office;
- Rural Health Unit (RHU);
- LGU – Barangay and
- LGU accredited Non-Government Organization.

The MMT 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;
- 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
- Fiduciary management of funds allocated for the above purposes.

As stated under the Philippine Environmental Impact Statement System (PEISS), MMTs are organized to encourage public participation, to promote greater stakeholder vigilance and to provide an appropriate check and balance mechanisms in the monitoring of project implementation. The MMT is recommendatory to EMB/MGB. MMTs 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 Contingent Liability and Rehabilitation Fund

CLRF is an environmental guarantee fund mechanism to ensure just and timely compensation for damages and progressive and sustainable rehabilitation for any adverse effect a mining operation or activity may cause.

The CLRF shall be in the form of the Mine Rehabilitation and shall be administered by the CLRF Steering Committee.

6.3.1 Mine Rehabilitation Fund (MRF)

A Mine Rehabilitation Fund (MRF) shall be established and maintained by proponent as a reasonable environmental deposit to ensure availability of funds for the satisfactory compliance with the commitments and performance of the activities stipulated in the EPEP/AEPEP during specific project phase.

The MRF shall be deposited as a Trust Fund in a Government depository bank and shall be used for physical and social rehabilitation of areas and communities effected by mining activities and for research on the social, technical and preventive aspects of rehabilitation.

The MRF shall be in two forms: Monitoring Trust Fund (MTF); and Rehabilitation Cash Fund (RCF).

6.3.2 Monitoring Trust Fund (MTF)

This Fund shall be initiated by Eagle Cement Corporation and shall be deposited in a mutually acceptable Government depository bank for the exclusive use in the monitoring program approved by the MRF Committee.

The MTF shall be in cash and in an amount to be determined by the MRF Committee which shall not be less than the amount of One Hundred Fifty Thousand Pesos (PhP 150,000.00) per quarter to cover maintenance and other operating budget for the transportation and travel expenses, cost of laboratory analysis, cost of supplies and materials, cost of communication services, cost of consultancy work and other reasonable expenses incurred by the monitoring team.

Authorization for the disbursement from the MTF shall only be given by the designated representatives of both the MRF Committee and Eagle Cement Corporation. Replenishment of this amount shall be done monthly to correspond to the expenses incurred by the monitoring team for the month.

6.3.3 Rehabilitation Cash Fund (RCF)

Eagle Cement Corporation shall set up an RCF for a designated amount to ensure compliance with the approved rehabilitation activities and schedules for specific mining project phase, including research programs as defined in the EPEP/AEPEP. It shall be equivalent to ten percent (10%) of the total amount needed to implement the EPEP or Five Million Pesos (P5,000,000.00), whichever is lower. It shall be deposited as a Trust Fund in a mutually agreed Government depository bank in four (4) equal quarterly deposits within fifteen (15) calendars days from the beginning of each quarter of the first year following the approval of the EPEP.

In the event of withdrawals from RCF, the Company shall annually replenish the RCF so as to maintain the minimum required amount.

7.0 DECOMMISSIONING/ ABANDONMENT/REHABILITATION POLICY

Mine closure will greatly affect the host community. The degree will depend on the dependence and involvement of the community to the project. The community may or may not survive without the mining project. The analysis on the failure of these communities is because the community relies on the project as the main source of livelihood and employment. During the operating years, the community as a whole and the company failed to look beyond closure. Hence, the community failed to sustain progress and development after closure.

Mine closure will also result to the following:

Loss/decrease taxes by the National Government. These taxes are Corporate Income Tax, Excise Tax on Minerals, Customs Duties, Value Added Tax, Documentary Stamp Tax and Capital Gains Tax. On the local government level, the following taxes will be affected such as Business Tax, Real Property Tax, Registration Fees, Occupation Fees, Community Tax and other Local Taxes. Other taxes such as Withholding Taxes on Payroll, Interest Income in Banks and Stockholders' Dividends will likewise be affected.

Loss of financial allocations for approved plans/programs such as the Social Development and Management Plan, Environmental Protection and Enhancement Program and Final Rehabilitation and Decommissioning Plan.

Loss of employment. The closure of the project will mean loss of income or business opportunities derived from the project such as the transport sector, the Small-Medium Enterprises like stores, eateries, etc.

Loss of financial support for the company's supported social work projects such as medical missions, outreach programs, support for education, etc.

On the other hand, some believed that mine closure is an advantage due to the operation's foreseen effects on land, air, and water quality.

At the closure of the Project, Eagle Cement Corporation aims to have a minimal area for rehabilitation. Progressive rehabilitation will be implemented during the operating life of the Project. The following are the objectives considered for project closure.

- To establish as early in the life of the project the final land use;

- Consultation with stakeholders;
- Establishment of success indicators for closure;
- Review of the FMRDP;
- Preparation for residual care;
- Building local capacity and avoiding creating a culture of dependency; and
- Facilitate the participation of other development players.

7.1 Final Mine Rehabilitation Plan

7.1.1 Rehabilitation Strategy

The proposed final land uses for each project component will determine the rehabilitation of the Project. The area disturbed will be cleared and revegetated. Involvement of the host community will be the prime strategy to ensure the success of rehabilitation.

The preparation of the area will be done using heavy equipment such as dump trucks, loaders, bulldozers, etc. The final land configuration will incorporate road network to make as many areas accessible as possible with provisions for drainage system.

The community maybe consider as the source of seedlings during the implementation of final mine rehabilitation, this may serve as one of the livelihood programs of the company after close.

The parameters to be considered in the rehabilitation plan to control erosion and sedimentation prior to revegetation are the following:

vi. Stabilization of the quarry areas.
vii. Spreading of top soil on the affected areas.
viii. Introduction of self-sustaining vegetation.
ix. Construction/maintenance of drainage system.
x. Maintenance of nursery to meet the rehabilitation requirements.

7.1.1.1 Final land use for each identified mine component

The 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.

The bases in the selection of the final land use were the following:

1. Hazard in the area that may render it unusable or unfit for other productive land use.
2. Level of environmental and social impacts cause by the operation. (The environmental impacts of the project will not render the area unusable after the life of the project.)
3. The expected post-closure operational use of the land.
4. The productivity of the land surrounding the site. (The surrounding areas are currently non-productive and also cater to other mining projects. The denuded state of the area will change once the revegetation is accomplished.)

The major elements of the plan include the following table:

Table 167 - Final Land Use of Mine Components

Project Component	*Proposed Final Land Use*
Quarry Area	Stable slope and adequately drained
	Planted with endemic tree species
Access road	Retain for future use
Settling ponds	Back-filled/flat and revegetated area

7.2 Mine Closure Criteria and Performance Standards

The completion criteria[8] are a set of indicators which, upon being met, will demonstrate the success of rehabilitation. The completion criteria presented are specific to the project component being rehabilitated or closed.

The guidelines in preparation of Final Mine Rehabilitation and/or Decommissioning Plan (FMRDP), with its prescribed goals for mine closure set by the Mines and Geosciences Bureau are adopted as the general closure criteria for Eagle Cement Corporation. The said goals are as follows:

Physically Stable – The capability of the mine, not pose a hazard to public health and safety as a result of failure or physical deterioration; and continues to perform the function for which it was designed for its design life. It should not erode or move from its intended location under the extreme events or perpetually disruptive to which it will be subjected after closure.

[8] Mine Closure Guidelines for Minerals Operations in Western Australia. The Chamber of Mines of Western Australia, Inc. October 2000

Chemically Stable - The capacity of mine component, to be chemically stable and not to release chemicals (contaminants) into the environment.

Visual Stability – The ability of the mine components or the undisturbed state of the site component to blend with the surroundings. This goal is set with the understanding that the trace of a mine component cannot be completely removed. The visual acceptability and nuisance concerns include abandoned buildings or structures, derelict equipment, odors and smoke, and a scarred landscape.

Productivity or self-sustaining condition – Productivity in a rehabilitated landscape is the ability to generate wood or other marketable products through rehabilitation of the mining areas into agro-forestry, or industrial facilities. Self-sustaining conditions mean that the final land use can be sustained by the natural elements and processes and does not require further human intervention.

The company is aiming for a post land use of revegetated area. Hence, revegetation thru progressive rehabilitation of the affected areas is proposed. Minimum standard includes a stable and revegetated mine area. The provisions by law for the periodic review of the FMRDP every two (2) years will provide the necessary tool to ensure the success of progressive rehabilitation.

Table 168 - Mine Closure Criteria and Performance Standards

Mine Component	***Post Mining Land Use***	***Criteria***
Quarry Area	Revegetated area and source of irrigation.	80% survival rate and self-thriving plants. Stable
Access road	Retained for access	Usable roads
Settling ponds	revegetated area	80% survival rate and self-thriving plants.

8.0 INSTITUTIONAL PLAN FROM IMP IMPLEMENTATION

8.1 Mine Environmental Protection and Enhancement Office (MEPEO)

A Mine Environmental Protection and Enhancement Office (MEPEO) was established by the company for its current operation. The MEPEO is reporting directly to the Quarry Resident Manager and takes lead in implementing the environmental management programs as committed in the Impacts Management Plan (IMP) and the Environmental Monitoring Plan (EMoP) presented in this EIS. The Social Development and Management Plan (SMDP) and Information Education Communication (IEC) Plan shall be competently implemented by the Community Relations Officer (CRO).

As required under DENR Administrative Order 1996-40 and the Revised Procedural Manual for DAO 2003-30, the MEPEO shall also have the following functions:

- Planning and managing the implementation of the approved EPEP/AEPEP;
- Monitoring and police compliance of Contractors on their implementation of provisions of the EPEP and AEPEP;
- Monitoring and evaluating the effectiveness of the mitigating and enhancement measures;
- Planning, proposing and implementing modifications or additional measures deemed necessary to effectively protect the environment;
- Coordinating 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;
- Initiating, planning and implementing 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 ECC conditions and reporting requirements of the DENR-EMB;
- Submission of Compliance Monitoring Report (CMR) in accordance with the specified format in the implementing rules and regulations for Philippine Environmental Impact Statement (PEIS) System; and
- Monitor the actual project impacts vis-à-vis the predicted impacts and management measures presented in the EIS Report.

8.2 Grievance Procedure

Eagle Cement collects grievances through its Community Relations Department. The company conducts and plans for IEC activities to inform the public about their operation. The IEC also serves as a public consultation forum where residents of the communities nearby are able to raise their concerns directly to the Eagle Cement staff. These activities are either conducted with general community members or on a sectoral basis (i.e. youth, farmers, women, etc.).

The community directly or through the barangay officials send their complaints to the Community Relations Officer (CRO). The CRO verifies the complaint by talking with the complainant or ocular inspection. If the complaint is valid, the CRO will coordinate with the appropriate department to address the complaint.

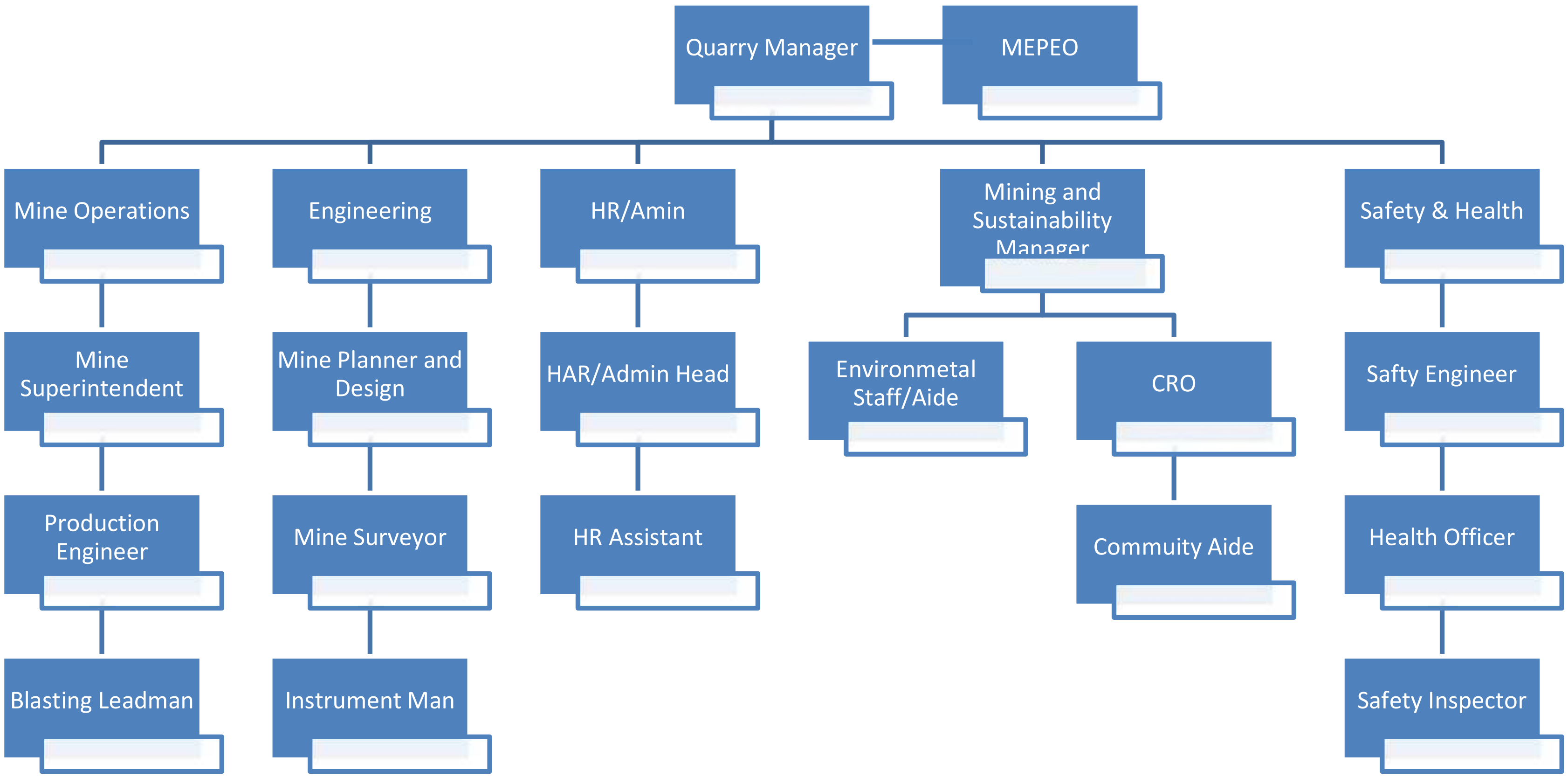


Figure 206 - Organizational Chart

LIST OF ANNEXES

Annex A – MPSA

Annex B – IEC Documentation

Annex C – Initial Perception Survey Result

Annex D – Public Scoping Documentation

Annex E – Final Exploration Report

Annex F – Survey Form Copy

Annex G – FGD and Perception Survey Photo Documentation

Annex H – FGD Documentation

Annex I – FGD Attendance Sheet

Annex J – Accountability Statement

Annex K - PEMAPS

Annex L – Laboratory Result