CHAPTER 7

POTENTIAL IMPACTS

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CHAPTER 7

7.1 INTRODUCTION

This chapter shall examine the potential impacts that the Project could impose on the surrounding environment, during both its preparation, operation and abandonment stages. It will attempt to identify and assess the equilibrium displacements that could be experienced by specific environmental receptors as a result of the activities that will be carried out during all stages of the Project.

7.2 POTENTIAL IMPACTS

The potential impacts, which the Project could impose on the surrounding environment, during its preparation, operation and abandonment stages, shall be examined in this chapter. Potential displacements are evaluated in terms of the extent and nature of changes induced (i.e. whether there are significant adverse or beneficial implications), and spatial coverage and temporal nature of the displacements. In order to facilitate these analyses, procedures related to the implementation and operations of the Project have been categorised into discrete activities.

Each Project activity will be individually scrutinised for its potential to induce shifts to the various component environmental equilibrium, or to interact with other activities to generate synergistic or antagonistic effects on selected environmental equilibrium. The principal findings generated from an assessment of each activity's potential to impact on a multi-faceted environment, encompassing physical, chemical, biological and human elements, are summarised in the form of an impact matrix. Descriptive details of each impact source, the corresponding nature of impact with or without mitigation measures, and the potential consequences on the environment are discussed and related to one another in the ensuing discussion.

The matrix is used to identify the potential environmental impacts that may occur during the various stages of development. These are summarised in **Table 7-1.** The completed matrix for the present EIA study is shown in **Table 7-2**.

Table 7-1: Categories of Impacts

Symbol	Impact Class
1	Minor adverse environmental impact.
2	Moderate adverse environmental impact.
3	Major adverse impact.
A	Minor positive impact.
B	Major positive impact.
U	Potentially adverse, but insufficient information.
N	Insignificant impact.

Besides the impact assessment, this chapter shall also discuss the specific mitigating or abatement measures that shall be adopted by the Project Proponent in order to minimise or eliminate the potential significant impacts identified. Alternative site options have not been examined. In the case of quarrying, site option does not arise because the site is determined by the location of the available rock reserve.

7.3 IDENTIFICATION AND PREDICTION OF IMPACTS

In general, the potential environmental impacts from the Project may be categorised into and discussed separately under the following stages of development:

- Investigation stage
- Initial site preparation and development stage
- Quarrying and operational stage
- Rehabilitation and abandonment stage

TABLE 7-2 Environmental Impact Assessment Matrix

1	MINOR	ADVERSE IMPACTS
2	MODERATE	ADVERSE IMPACTS
3	MAJOR	ADVERSE IMPACTS
A	MINOR	POSITIVE IMPACTS
B	MAJOR	POSITIVE IMPACTS
U		ADVERSE, BUT INSUFFICIENT INFORMATION.
(BLANK)		INSIGNIFICANT IMPACTS

			PROJECT ACTIVITIES																										
			INVESTIGATION STAGE				DEVELOPMENT STAGE									QUARRY OPERATION									RESTORATION AND ABONDENMENT				
ENVIRONMENTAL COMPONENTS			Project planning	Land acquisition	Environmental Impact Assessment (EIA) study	prospecting and geological investigation	Boundary demarcation and positioning	Mobilization of workforce	Transport of equipment and supplies	Site clearing	Overburden removal	Construction of haulage road and working platform	Improvement to drainage system	Construction of Sediment Basin	Managing wastes at the Project site	Site clearing for quarry face	Overburden removal for quarry face	Blasting operation	Rock excavation operation	Rock crushing operation	Stockpiling	Transportation operations	Upgrading and maintenance of access road	Managing waste generation (Solid, Sewerage,etc.)	Pit Infill & Landscape Restoration	Revegetation Activities	Removal of Infrastructure & Waste		
PHYSICO-CHEMICAL	SOIL	Erosion								2	2	2	1	1		2	2				1		1		A	A			
PHYSICO-CHEMICAL	SOIL	Slope Stability								1	1	2				1	1	2	2		1				A	A			
PHYSICO-CHEMICAL	SOIL	Soil Compaction									1	1					1								A				
PHYSICO-CHEMICAL	SOIL	Loss of Topsoil									2						2								A	A			
PHYSICO-CHEMICAL	SOIL																												
PHYSICO-CHEMICAL	HYDROLOGY & DRAINAGE	Water Yield												A												A			
PHYSICO-CHEMICAL	HYDROLOGY & DRAINAGE	Dry Season Flow								1	1	1	A	1		1	1	1	1						A	A			
PHYSICO-CHEMICAL	HYDROLOGY & DRAINAGE	Fluvial Erosion								1	1			1		1	1								A	A			
PHYSICO-CHEMICAL	HYDROLOGY & DRAINAGE	Stormflow/Flood Response								1	1	1	A	A		1	1									B			
PHYSICO-CHEMICAL	HYDROLOGY & DRAINAGE																												
PHYSICO-CHEMICAL	SURFACE WATER QUALITY	Sediment Load/TSS								2	2	1	1	A		2	2				1		1		B	B			
PHYSICO-CHEMICAL	SURFACE WATER QUALITY	Chemical Quality								1	1	1	1	A	A	1	1				1			A	A	A			
PHYSICO-CHEMICAL	SURFACE WATER QUALITY	Biological Quality								1	1	1	1	A	A	1	1				1			A	A	B			
PHYSICO-CHEMICAL	SURFACE WATER QUALITY																												
PHYSICO-CHEMICAL	GROUND WATER	Water Table Recharge																							B	B			
PHYSICO-CHEMICAL	GROUND WATER	Groundwater Quality								1	1	1		A	A	1	1		1					A	1	B			
PHYSICO-CHEMICAL	GROUND WATER																												
PHYSICO-CHEMICAL	ATMOSPHERE	Local Climate																							A	A			
PHYSICO-CHEMICAL	ATMOSPHERE	Noise							1	1	1	1				1	1	2	1	1	1	1	1		1				
PHYSICO-CHEMICAL	ATMOSPHERE	Air Quality								1	1	1			A	1	1	1	1	2	1	1		A	1	A			
PHYSICO-CHEMICAL	ATMOSPHERE																												
BIOLOGICAL	SPECIES & POPULATIONS	Terrestrial Flora				1	1			3	2	1				3	2									B			
BIOLOGICAL	SPECIES & POPULATIONS	Terrestrial Fauna				1	1			3	2	1				3	2								A	B			
BIOLOGICAL	SPECIES & POPULATIONS	Birds				1	1			2	1	1				2	1									B			
BIOLOGICAL	SPECIES & POPULATIONS	Aquatic Flora								1	1	1		A		1	1								1	A			
BIOLOGICAL	SPECIES & POPULATIONS	Aquatic Fauna								1	1	1		A		1	1								1	A			
BIOLOGICAL	SPECIES & POPULATIONS																												
BIOLOGICAL	HABITATS & COMMUNITIES	Terrestrial Habitats								3	2				A	3	2							A	A	B			
BIOLOGICAL	HABITATS & COMMUNITIES	Terrestrial Communities								3	2					3	2								A	B			
BIOLOGICAL	HABITATS & COMMUNITIES	Aquatic Habitats								1	1			A	A	1	1							A		B			
BIOLOGICAL	HABITATS & COMMUNITIES	Aquatic Communities								1	1			A		1	1									B			
BIOLOGICAL	HABITATS & COMMUNITIES																												
HUMAN	HEALTH & SAFETY	Physical Safety/Health								1	1	1		A		1	1	2	1	1	1	1	A		A	B	B		
HUMAN	HEALTH & SAFETY	Physical Well-being																							A	B			
HUMAN	HEALTH & SAFETY	Communicable Disease																											
HUMAN	HEALTH & SAFETY																												
HUMAN	SOCIAL & ECONOMICS	Business & Employment	A		A	A	A	B	B	A	A	A	A	A	A	A	A	B	A	B	A	A	A	A	A	A	A		
HUMAN	SOCIAL & ECONOMICS	Forest Resources		3						3	1	2				3	1								A	B			
HUMAN	SOCIAL & ECONOMICS	Aquatic Resources												A															
HUMAN	SOCIAL & ECONOMICS	Transport/Infrastructure							1	1	1	1				1	1	1	1			1	A						
HUMAN	SOCIAL & ECONOMICS																												
HUMAN	AESTHETIC & CULTURAL	Landscape								3	3	2	1	A		3	3	2							B	B	A		
HUMAN	AESTHETIC & CULTURAL	Sense of Community								1	1	1		A	A	1	1	2	1			1		A	A	A	B		
HUMAN	AESTHETIC & CULTURAL	Transquility & Peace								1	1	1				1	1	2	1			1				A			
HUMAN	AESTHETIC & CULTURAL	Traditional Lifestyle																								A			
HUMAN	AESTHETIC & CULTURAL																												

7.3.1 Potential Impacts During Investigation Stage

The main activity during the investigation stage is the prospecting and geological exploration study and the Environmental Impact Assessment (EIA). Exploration stage normally requires mobilisation of manpower and equipment involving the movement of vehicles, primarily along the existing roads. During the actual exploration, the main activities are as follows:

- Field reconnaissance
- Surveying and mapping
- Drilling and sampling

Site specific investigation requires limited establishment of access tracks and paths and the stationing of equipment and personnel at locations throughout the study site for limited period of time. All these activities involve the use of light and portable equipment and tools, which can be easily transported to the site. The drilling rig is perhaps the heaviest equipment used. Small clearings and narrow rentises in the primary vegetation are also required for drilling, field reconnaissance and surveying purposes. In a hot and humid climate, it normally takes only a few months for an abandoned clearing to be re-colonised by the vegetation.

Any clearing activities and drilling operations, and the noise and vibration associated with these activities shall not impose disturbance to the wildlife and localised destruction of the floral habitat, particularly in areas of drilling operations. Such impacts are localised as the area concerned is indeed small if compared to the whole proposed area. Thus, no major adverse impact has been identified for this stage of development. On contrary, some minor beneficial impacts such as short-term employment and business opportunities are indicated. Business opportunities for the local community are materialised through the provision of supplies and services to the study teams.

To enhance local participation and socio-economic benefits to the local people, the Proponent shall endeavour to engage local labour for unskilled and semi-skilled jobs, with the aim of developing a core group of employees for the quarrying activities.

7.3.2 Potential Impacts During Initial Site Preparation and Development Stage

Initial Site Preparation and Development Stage shall involve several main activities, which may have potential impacts on the environment. These activities are as follows:

- Boundary demarcation and positioning.
- Mobilization of workforce.
- Transport of equipment and supplies.
- Construction of sediment basin.
- Site clearing.
- Overburden removal.
- Construction of haulage road and working platform.
- Improvement to drainage system.
- Installation of crushers and other facilities.
- Managing wastes at the Project site.

Potential impacts from these activities are:

- Soil erosion and associated sediment pollution of the watercourses - **2**;(Impact Class - see **Section 6.2**) due to the site clearing, construction of haulage road and preparation of working platform. But, no discharge to stream shall occur.
- Loss of topsoil - **2**; loss of topsoil may be due to soil erosion and mixing with the overburden materials during the earthwork activities.
- Air pollution - **1**; in general; the activities are short-term in nature, and no burning of biomass because it may left on-site to biodegrade. Potential pollution from transportation activities, but the site is far from residential areas.

- Loss of fauna - **1**, flora - **3** and habitats - **3**; because quarrying activities have been taking place on area located northern from Project area and the fauna can migrate to other undisturbed neighbouring land.
- Noise pollution - **1**; noise from heavy machinery and chain saws will be restricted to day time and the impact will be short-term and localised and also the site is far from residential areas.
- Vibration - **1;** generated by rock blasting operation shall be localized since the site is far from residential areas.
- Air-blast - **1**; due to rock blasting since the site is far from residential areas.
- Generation of solid and liquid wastes - **1**; these include biomass wastes, solid waste and liquid wastes. Solid wastes and liquid wastes are minimal as all workers shall be commuting daily to the site.
- Aesthetics - **1;** due to the changes to landscape but the modifying of the existing topographical feature shall be able to screen the visibility of quarry operation from adjacent interests.
- Socio-economic impacts – **A**; in terms of employment and business opportunities and upgrading of infrastructure in the area.

7.3.3 Potential Impacts During Quarrying And Operational Stage

As detailed in **Chapter 5**, the main activities during the quarrying operation include the following:

- Clearing of quarry site involving vegetation clearing.
- Overburden stripping and waste disposal involving the stripping, haulage and stockpiling of soil and overburden.
- Rock blasting and extraction.
- Loading and transportation of blasted rock to the processing plant.
- Rock crushing and stockpiling.

Potential impacts from these activities are:

- Soil erosion, and associated sediment pollution and siltation – **2**; (Impact Class - refer to **Section 6.2**) on quarry face slopes, particularly during the initial land clearing and overburden stripping activities.

- Loss of topsoil - **2**; loss of topsoil may be due to soil erosion and mixing with the overburden materials during the stripping and stockpiling activities.
- Loss of fauna, flora, and their habitats – **2**
- Air pollution - **2;** due dust generation and dispersion during earth-moving and quarrying operations.
- Vibration - **1;** (Impact Class - see **Section 6.2**) generated by the rock blasting operations shall be localized.
- Air-blast - **1**; due to rock blasting.
- Noise pollution - **2**; Noise generated mainly by heavy machinery and vehicles shall be localised in nature since the quarry area is quite far from residential area.
- Hydrological changes - **1**; increased runoff due to the clearing of existing vegetation, and changes to groundwater regime.
- Aesthetics - **2;** due to the changes to landscape but the modifying of the existing topographical feature shall be able to screen the visibility of quarry operation from adjacent interests.
- Socio-economic impacts - **B;** due to employment and business opportunities.

7.3.4 Potential Impacts During Rehabilitation and Abandonment Stage

Environmentally, restoration and rehabilitation are perhaps the most important activities of a quarrying Project for the abandonment stage. The main activities involved at this stage are as follows:

- Compaction, levelling, grading and top soiling.
- A forestation by re-vegetate the quarried out area or any identified areas which are not affected by quarrying activities with fast-growing trees and suitable grasses or leguminous cover crops.

The rehabilitation programme of any quarrying operation is designed to restore the disturbed site. The results have to be viewed as being beneficial environmentally. However, some adverse impacts may arise during the process of rehabilitation, or if the quarried-out area are simply abandoned without any restoration. Such potential impacts include:

- Soil erosion, and associated sediment pollution and siltation - **2;** on slopes. However, once the tasks are completed, such adverse impacts will be neutralised.
- Fauna, flora and their habitats – **2;** if the low depression quarried-out area is not rehabilitated, it will eventually be filled with water, thus changing the habitat of the area concerned; **B** if the areas are properly restored and re-vegetated, the forest environment may be re-created and the fauna may return.
- Air quality – **B**; as the absence of dust generation and dispersion when the quarry has been winded down.
- Noise pollution - **1**; noise from heavy machinery and trucks will be control by implementing good maintenance practise, and the impact will be localised. **B**; as the absence of activity when the quarry has been winded down.
- Aesthetics - **2;** if the quarried-out areas are simply abandoned without rehabilitation; **B** if the site is properly restored.
- Socio-economic impacts - **B;** due to employment and business opportunities.

7.4 EVALUATION OF POTENTIALLY SIGNIFICANT IMPACTS

From the identification and study of the resultant impacts during various stages of quarrying, the potentially significant environmental issues are found to be related to:

- Soil erosion and loss of topsoil.
- Stripping of overburden and waste generation.
- Water pollution and degradation of water quality.
- Changes to surface and groundwater regime.
- Slope Stability.
- Air pollution due to generation and dispersion of dust.
- Noise pollution.
- Vibration and air-blast from blasting operation.
- Loss of flora, fauna and habitats.
- Generation of employment or business opportunities.
- Socio economic development.
- Aesthetic, rehabilitation and abandonment.

7.4.1 Soil Erosion and Siltation

Impacts

When land clearing activities are being undertaken, the potential for soil erosion by hydrological forces and subsequent sediment pollution will be greatly increased. These hazards will be most when the vegetative cover has been removed and the exposed soils are further disturbed.

It is expected that initial earthwork activities such as preparation of haulage road will increase both the volume and intensity of rainfall run-off from construction areas as a result of reduced water infiltration, interception and uptake. The Project area experiences moderately heavy rainfall particularly during the wet season (September to November). The rainfall provides significant potential for soil/ exposed subsoil erosion which can result in sedimentation / siltation of off-site areas.

The topography of the Project site is hilly land with slope of about 10° to 40° . Risks of soil erosion for such slope are moderate. Most areas in the Project site are covered with soil that contains elevated organic content and clay fractions, thus soil particles are strongly attached and as such would be expected to be more resistant to erosive action from both water and wind action.

Quantities of soil eroded by wind / mechanical action are likely to be much lower than that caused by rainfall run-off. However, during dry ambient conditions, entrainment of fine particulates (dust) to atmosphere as a result of soil handling, deposit and vehicle movements may be significant. Providing standard erosion mitigation measures are implemented and are effective, it is concluded that risks of soil erosion and concomitant off-site sedimentation effects during development and operational stages can be maintained to within acceptable levels.

Soil Erosion Modelling

Significant advances have been made in our knowledge of the mechanics of soil erosion and the interrelationships between the erosion processes. As a result, some form of soil erosion modelling may predict the anticipated amount of soil erosion. There are a few predictive models that could be used, but the most widely used and perhaps the most reliable method is based on the so-called **Universal Soil Loss Equation (USLE)** (Wischmeier and Smith, 1962). The **USLE** predicts soil loss as a function of six factors, each of which may be calculated and expressed numerically. It is represented by the equation below:

E = R.K.L.S.C.P **(Equation 7-1)**

Where,

E	-	Mean Annual Soil Loss
R	-	Rainfall Erosivity Index
K	-	Soil Erodibility Index
L	-	Slope Length Factor
S	-	Slope Steepness Factor
C	-	Vegetation/Cover Factor
P	-	Soil Conservation Practice Factor

The rainfall erosivity index, R is actually a compound index of rainfall kinetic energy and the maximum 30-minute rainfall intensity. The values for all storm events have to be summed to obtain the annual value. The computation is therefore lengthy and requires comprehensive rainfall records from autographic gauges. Therefore, R factor can be refer to **Figure 1-1:** Rainfall erosivity Map for Terengganu State (*Guideline for Erosion and Sediment Control in Malaysia, DID 2010*). Since this project site is located at Paka, Terengganu, the rainfall erosivity factor is,

R = 19,000 MJ mm/ha/yr

Where,

P (mm)	-	Mean Annual Rainfall
I_{30}	-	Maximum 30-minute rainfall intensity = 75 mm/hr

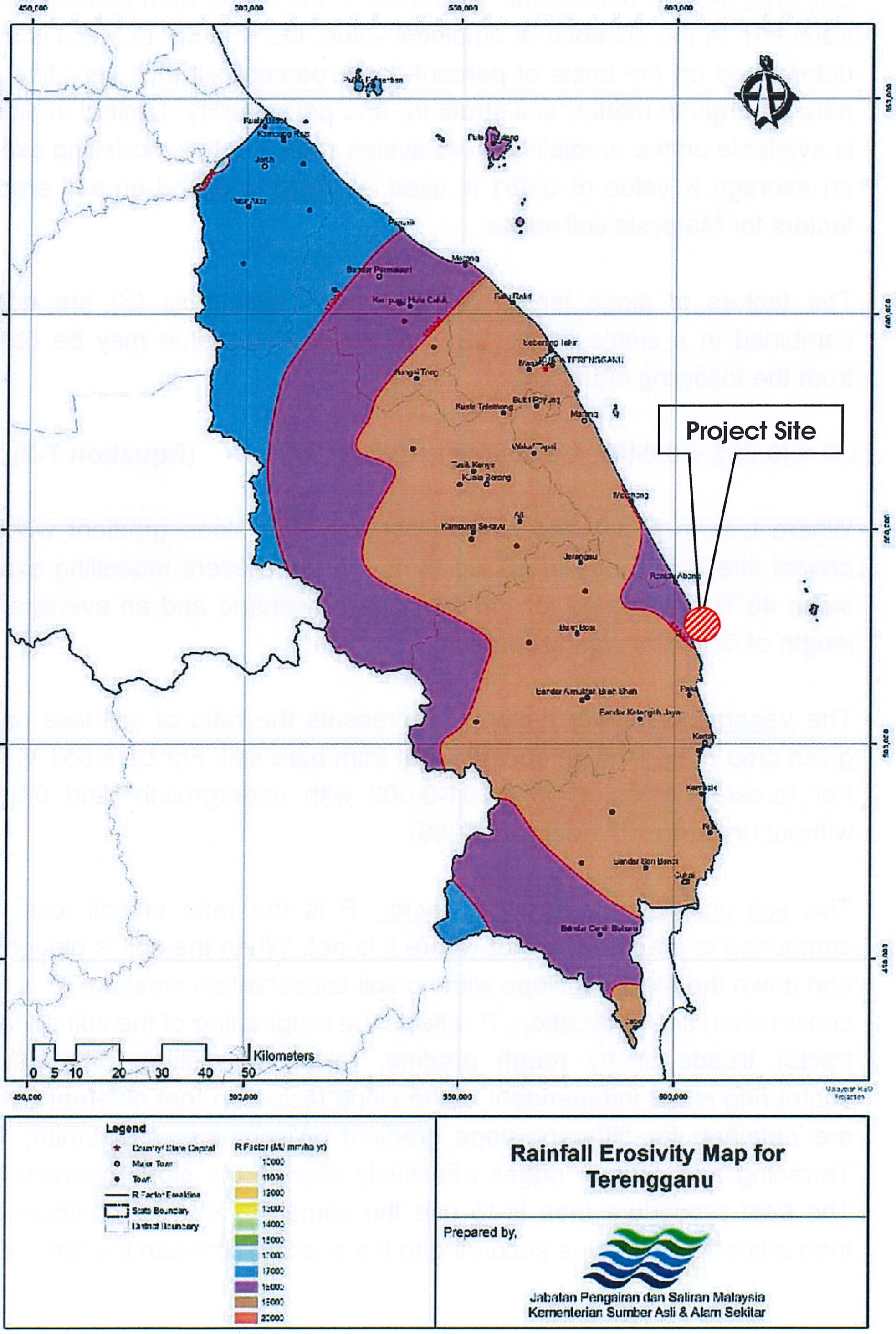

Figure 1-1: Rainfall erosivity Map for Terengganu State

(*Guideline for Erosion and Sediment Control in Malaysia, DID 2010*)

Soil erodibility; K defines the resistance of the soil to both detachment and transport. In the absence of empirical value, the K factor of a soil is usually determined on the basis of percent sand, percent silt plus very fine sand, percent organic matter, soil structure and permeability. Limited information is available on the erodibility of Malaysian soils. For this modelling exercise, an average K value of 0.051 is used. K value is based on soil erodibility factors for Malaysia soil series.

The factors of slope length (L) and slope steepness (S) are normally combined in a single index, LS. The appropriate value may be obtained from the following equation:

$$LS = (0.065 + 0.045S + 0.0065S^2) \times (L/22.13)^n \qquad \textbf{(Equation 7-2)}$$

Where L is in meter and S is in percent. The slope gradient within the project site is in range of 10° up to 40°. In the present modelling exercise, slope 40° is considered for the worst case scenario and an average slope length of 50 meter was assumed.

The vegetation / cover factor, C represents the ratio of soil loss under a given crop or vegetation cover to that from bare soil. For bare soil, C is 1.0. For forested areas, C is 0.001-0.002 with undergrowth, and 0.01-0.10 without undergrowth (Morgan, 1986).

The soil conservation practice factor, P is the ratio of soil loss where contouring is practised to that where it is not. When the soil is ploughed up and down the steepest slope with no soil conservation measure, P is 1.0. In construction site application, P reflects the roughening of the soil surface by tractor treads or by rough grading, raking or disking. The effect of contouring is not independent of the slope factor, so that different P values are obtained for different slope gradient (Wischmeier and Smith, 1978). Terracing and contour ridges effectively change the slope characteristics. The best procedure then is to use the same P value for contouring and then adjust the LS value according to the spacing between the terraces.

Predicted Soil Erosion Risk

The estimated soil loss under different scenario is shown in **Table 7-3**. Based on the worst case scenario where the land is cleared and left bare without any soil conservation measures, the annual soil loss, will be high for all phasing areas. Once the suitable BMPs installed properly, A would be reduced as shown in the table due to each phases.

The soil erosion prediction risk has shown that soil losses from bare slopes could be high even on moderately steep slopes. However, by adopting appropriate soil conversation measures, the estimated soil losses could be drastically reduced to acceptable levels.

At site where the bare soil surface may be compacted and smoothed by grading equipment, the P value of 1.0 usually assigned. In such cases, the risk of soil erosion would be further decreased.

Modified Universal Soil Loss Equation (MUSLE)

The Modified Universal Soil Loss Equation (MUSLE) is perhaps the most frequently used equations for sediment yield estimation. It is developed by Williams (1975) to calculate sediment yields of a catchment as a result of a specific storm event. This empirical relationship is expressed by the following equation for individual storm events:

$$\mathbf{Y = 89.6(VQ_p)^{0.56}\,(K.L.S.C.P)} \qquad \textbf{(Equation 2)}$$

Where,

Y - Sediment yields per storm event (tonnes)

V - Runoff volume in cubic meter

Q_p - Peak discharge in m^3/s

Table 7-3: Estimation of Potential Soil Erosion Using USLE

Condition	Parameters	Phasing Area	
		Phase 1 (5.5407 ha)	Phase 2 7.9455 ha)
Existing	R	19,000	19,000
	K	0.051	0.051
	Slope,L(m)	27	60
	Slope, S(%)	18.50	8.330
	LS	3.449	1.467
	C	0.03	0.03
	P	1.00	1.00
	A (t/ha/yr)	100	43
	E (t/yr)	555	339
Earthwork (Uncontrolled)	R	19,000	19,000
	K	0.051	0.051
	Slope,L(m)	27	60
	Slope, S(%)	18.50	8.330
	LS	3.449	1.467
	C	1.00	1.00
	P	1.00	1.00
	A (t/ha/yr)	3,342	1,421
	E (t/yr)	18,515	11,294
Earthwork (Controlled)	R	19,000	19,000
	K	0.051	0.051
	Slope,L(m)	27	60
	Slope, S(%)	18.50	8.330
	LS	3.449	1.467
	C	0.10	0.10
	P	0.22	0.22
	A (t/ha/yr)	74	31
	E (t/yr)	407	248

R: Rainfall Erosivity Factor;
LS: Slope Length and Steepness Factor;
P: Soil Conservation Practice Factor;
(Table 12.5, MSMA 2012)
Bare soil = 1.00
Sediment containment system (Sediment basin/trap), Check dam & silt fence
= 0.50 x 0.80 x 0.55
= 0.22
E: Mean Annual Soil Loss

A: Annual Soil Loss;
K: Soil Erodibility Factor;
C: Soil Cover Management Factor;
(Table 12.4a-c, MSMA 2012)
Forest 100% cover = 0.03
Bare soil/newly cleared land = 1.0
Grass-seeding & sod 40% cover = 0.10

The approach has seen widespread application, but should be used with caution as it was developed empirically based on limited data for Texas and the southwestern United States. The procedure should only be used on small catchments, and considerable judgement is required in selecting an appropriate slope length when determining the LS topographic factor. The sediment yield estimation using MUSLE is shown in **Table 7-4.**

Design Storm

Phase 1 = 5.5407 ha

Phase 2 = 7.9455 ha

The peak flow and runoff volume for construction area is shown in **Table 7-5**. The peak discharge is related to the rainfall intensity and catchment area via the Rational Method:

$$Q = (C.i.A)/360 \quad \textbf{(Equation 3)}$$

The sediment yield estimation using MUSLE is shown in **Table 7-4**

Condition	Parameters	Phasing	
		Phase 1	**Phase 2**
Post Bulk Grading (Without Mitigation)	Area (ha)	5.5407	7.9455
	V (m^3)	2,193	3,006
	Q_{post} (m^3/s)	1.462	2.505
	K	0.051	0.051
	LS	3.449	1.467
	C	1	1
	P	1	1
	Y (tonnes)	**1,448**	**994**
Post Bulk Grading (With Mitigation)	V (m^3)	4,167	5,711
	Q_{post} (m^3/s)	2.778	4.760
	K	0.051	0.051
	LS	3.449	1.467
	C	0.10	0.10
	P	0.22	0.22
	Y (tonnes)	**65**	**45**

V: Runoff Volume;
P: Soil Conservation Practice Factor; (Table 12.5, MSMA 2012)
Q: Peak Discharge;
Sediment containment system (Sediment basin), Check dam & silt fence
= 0.50 x 0.80 x 0.55
= 0.22

K: Soil Erodibility Factor;
LS: Slope Length and Steepness Factor;
C: Soil Cover Management Factor;
Y: Sediment Yield per Storm Event (Table 12.4a-c, MSMA 2012)
Bare soil = 1.00
Grass-seeding & sod = 0.10
Bare soil = 1.00

The peak flow and runoff volume for construction area is shown in **Table 7-5**

Area	Area (ha)	i (mm/h)	Earthwork (Uncontrolled)				Earthwork (Controlled)			
			tc (min)	C	Q (m^3/s)	V (m^3)	tc (min)	C	Q (m^3/s)	V (m^3)
Phase 1	5.5407	190	25	0.50	1.462	2,193	25	0.95	2.778	4,167
Phase 2	7.9455	227	20	0.50	2.505	3,006	20	0.95	4.760	5,711

Runoff volume using Rational Hydograph Method,

$V = 0.5 \times (2 \times 60 \times t_c) \times Q_p$

Where,

Q - Peak flow (m^3/s)
C - Runoff coefficient
i - Average rainfall intensity (mm/hr)
A - Drainage area (ha)

Summary of Soil Yields

Sedimentation control BMPs trap sediment on the site in selected locations and minimize sediment transfer off the site. Sedimentation controls are generally passive systems that rely on filtering or settling of soil particles out of the water or air. Sediment control BMPs are the last line of defence against erosion and sedimentation before sediment reaches natural water courses.

The estimated sediment yield under different scenario is shown in **Table 7-5**. Based on the worst case scenario where the land is cleared and left bare without any soil conservation measures, the sediment yield will be high for all phasing areas. Once the suitable BMPs installed properly, the sediment yield would be reduced as shown in the table due to each phases.

7.4.2 Impacts of Sedimentation

Impacts

Soil erosion and sedimentation can cause both environmental and economic impacts. Environmental impacts may build up slowly and not produce dramatic result for many years when it will be too late to rectify the problem. Environmental impacts are related to:

- The topsoil is usually the first soil material that is removed by surface erosion. This portion of the soil profile provides the best plant growth medium in terms of both physical and chemical fertility. The remaining subsoil is often more compacted, perhaps rocky, and interfile. As a result, the re-establishment and the growing of vegetation are more difficult.
- Suspended sediment abrades and coats aquatic organisms.
- Excessive sedimentation "paves" the water body floor, blankets the bottom fauna and destroys fish spawning areas.
- Turbidity due to the suspended sediment reduces light penetration and photosynthesis, thus reducing phyto-planktonic growth and food supply to other forms of aquatic life.
- Eroded soil contains nitrogen, phosphorus and other nutrients. When they are introduced into the water system, they could cause eutrophication and trigger alga bloom, which will reduce water clarity, deplete oxygen, and create unpleasant odour and taste.

Once the quarry faces have been developed, the impact will be minimized since runoff from the quarry faces area will flow into series of sediment basins. No water shall discharge from the series of sediment basins during normal day. The operation only requires controlling of runoff along the haulage road and also the dumping area.

Predicted Siltation Risks

It needs to be emphasized here that the quarry extraction shall be carried out in stages i.e. development and operational. The design of the Land-Disturbing Pollution Prevention and Mitigation Measures (LD-P2M2) plan is attached in **Appendix 5-2.** The estimated silt loading calculations are shown in **Table 7-6**.

Table 7-6: Estimation of Siltation From Quarrying Operation

Parameters	Phases	
	Phase 1	Phase 2
Disturbed Area (ha)	5.541	7.946
A (Without Mitigation) (t/ha/yr)	3,342	1,421
Soil Loss (t/yr)	18,517.02	11,290.56
Silt Content of Soil Loss (%)	10.00	10.00
Silt Discharge to River (t/yr)	1,851.70	1,129.06
Silt Discharge to River (mg/s)	58,717.08	35,802.12
Discharge Q (m^3/s)	0.962	1.379
Conc. of Silt Discharge into River (mg/l)	61.04	25.95
A (With Mitigation) (t/ha/yr)	74	31
Soil Loss (t/yr)	410.01	246.31
Silt Content of Soil Loss (%)	10.00	10.00
Silt Loading to Sediment Basin (t/yr)	41.00	24.63
Silt Discharge to River (t/yr)	8.20	4.93
Silt Discharge to River (mg/s)	260.03	156.21
Discharge Q (m^3/s)	1.828	2.621
Conc. of Silt Discharge into River (mg/l)	0.14	0.06

With mitigation measure taken, erosion management technique of terracing the slope will be added the amount of silt going into the proposed sediment basins are 41.00 t/yr (Phase 1) and 24.63 t/yr (Phase 2).

By installing suitable spillway on each sediment basin, about 80% of the silt content can be retained. This means that the silt discharge from the sediment basins to the nearest water bodies are 1,851.70 t/yr (Phase 1) and 1,129.06 t/yr (Phase 2) for worst case scenario. While for a mitigated measure, the silt loading after the sediment basins are 8.20 t/yr (Phase 1) and 4.93 t/yr (Phase 2).

Based on the above, the concentration of silt content in the river is predicted to be 61.04 mg/liter (Phase 1) and 25.59 mg/liter (Phase 2) for unmitigated measure being taken and 0.14 mg/liter (Phase 1) and 0.06 mg/liter (Phase 2) for mitigated measures taken. However, no water shall discharge from the sediment basins during normal day.

7.4.3 Impacts Related to Overburden Stripping

Impacts

Overburden removal accounts for a major portion of the work required for quarrying. This activity will involve utilisation of heavy earth-moving equipment such as hydraulic excavators, pay loaders, backhoes and hauling trucks to prepare the platform and benches in order to expose the rock for extraction.

The excavated overburden materials will be hauled by tipper lorry and temporarily stored in the waste dumping area for future rehabilitation work. The location of dumping area shall be suitably located within an economical distance from the working area. If the stripped soil and overburden were not properly managed, they would be a major source of sediment leaving the quarrying area. The mounds may be unsightly, and more importantly, pose safety hazard to the workers.

7.4.4 Impacts on Hydrological Regime and Water Quality

The potential impact on the hydrological regime is a change in runoff within the catchment. This arises from the increased proportion of lower infiltration rate and shorter retention as a result of land use conversion. The removal of vegetation cover and site clearing at the construction site will increase surface runoff particularly during the rainy season. In view of the flood history in the area, the development may worsen the flood situation if clearing is carried out during monsoon periods. Downstream flash flooding may take place during the course of the site preparation and development stages. The hydrological study impact report is attached in **Appendix 7-2.**

Impacts on Surface Water

The impacts of quarrying activities on water are quite imminent in view of its nature of operation, which cause direct physical disturbance. Surface water is the main sources of domestic water supply and as such any disturbance either physical or chemical on the watercourse will have direct consequences.

Many on-site activities and off-site activities may affect the surface water quality and quantity. The effects of on surface water vary depending on the depth of the quarry face with respect to water table, nature of the strata of the ground and working method. The potential effects of a quarrying operation on surface water regime are summarised as follows:

- It alters the surface over which water flows.
- It changes the pattern and quantity of surface water flows through the clearing and pitting activities, and where required, the diversion of on-site and off-site watercourses.
- It changes the physical and chemical quality of water, particularly with runoff from the stockpiles and working faces, and effluents discharged from settlement ponds and other treatment facilities.
- The surface watercourse may be silted up due to erosion of un-grassed soil and overburden mound and the working faces.

Exposed bare soil on a quarry is easily eroded by rainfall (see **Section 7.4.1**) and so surface run-off from quarrying areas is frequently rich in sediment. These eroded soils often contain adsorbed metals and other trace elements. In addition, when some of the associated minerals are exposed, chemical reactions leading to acidification may occur. The chemistry of the surface water, which comes into contact with these materials, will similarly be affected.

Surface runoff as a result of rain demands much attention when designing quarrying operations. Runoff water can create major problems due to washouts, making provisions of drains and culverts essential. Failure to control storm water on an operational quarrying site can generate serious erosion on exposed soil surface, create boggy areas which impede wet weather working and generate pollution problems in sediment-laden runoff leaving the site. Development of site drainage plan is therefore an essential step that should focus on restricting the amount of extraneous water entering the site, limiting the area disturbed and thus exposed to erosion on the site and managing runoff leaving the site.

With minimum exposed area at any one time, the actual increase in discharge for the whole development is therefore insignificant. More importantly, the exposed area would be excavated or by pit method, and therefore it would collect water rather than shed water. The water collected at the bottom of the pit is likely seepage into the reserve, if not it shall be discharged eventually through pumping and artificial drainage, but it means that the Project will not affect the peak discharge rate and storm-flow significantly.

However, there are some other contributing factors that should be considered such as the quarrying operation shall be carried out in phases where although some areas is being quarried out, other area not affected shall be retained or rehabilitated at the very same time. At each phases of quarry operation, discharge from the storm-water and surface run-off shall be directed to the nearest sediment basins. No water shall discharge from the series of silt trap ponds during normal day. The proposed sediment basins shall be adequate to cater the needs.

Impacts on Groundwater

Ground excavation in quarrying operations inevitably will disrupt the nature of the groundwater in the area. The impacts are quite considerable, as changes in groundwater regime will bear subsequent implication to other factors. Two activities in quarrying operations, which may disrupt the groundwater, are as follows:

- Topsoil removal, overburden and mineral extraction or replacement.
- Surface water diversion.

Some of the effects of quarrying on the groundwater are listed as follows:

- Change in the quality and quantity of aquifer as a result of the alteration of the infiltrating recharge water.
- Affect supply of water as a result of surface water diversion, or a change in the infiltration rate.
- Damage to structures as a result of ground movement or subsidence.
- Effect slope stability.
- Increase in the risk of physical and chemical contamination of groundwater as a result of the removal of natural filter medium.

If the depth of the excavation is lower than the depth of any water table on the site, then water table will be lowered during quarrying and it may be contaminated by the quarry drainage. As many aquifers are interconnected, groundwater levels in the vicinity of a quarry may be lowered. The physical destruction of aquifers may result in water drawdown in the area, thus reducing water supply to nearby streams and other water bodies that depend on groundwater seepage. In the area under study where the rainfall is high, such an impact will not be significant.

7.4.5 Impacts Related to Rock Slope Protection

Impacts

A direct impact for rock slope and soils that may arise from Project development is related to slope stability. It is envisaged that the slope stability can be a problem due to the topographical features of the area and also the nature of bench development to be undertaken. However, a localized slope failure can also happen due to the nature of the soil and earth cutting activities. A fairly common slope failure is the slipping of an embankment or the slides of cutting. It varies in origin and magnitude, and range from near-surface disturbances of weathered zones to deep-seated displacements of rock masses.

Water is frequently associated to be the cause of earth or rock slips, the mechanism of which takes several forms. The most common are by means of eroding the sand stratum, lubricating the shale and increasing the moisture content of clay which ultimately decreases the shear properties of the soil. The failure occurs when the strength of the slope is somewhere exceeded by the stresses within it. Failure often develops as a result of excessive height or steepness of the slope in relation to the soil properties.

There are many factors influencing the stability of slopes. Here, only the common important factors are covered and explained.

- Firstly, the properties of the soil such as friction angle, apparent cohesion and unit weight are important in slope stability. As an illustration, consider these two extremes: The first is a near vertical rock-face with a building on top and is able to do so without much stability concerns. The second is gentle beach at a seaside where the gradient is very gentle and yet it is not stable to build a structure directly on it. These two examples illustrate that stronger soil or rock can support a building/load compared to weaker soil or rock.
- Secondly, slope geometry is also important to be considered. A low and gentle slope is safer than a high and steep slope with similar soil. It is because the latter has more mass on the upslope acting as driving forces (F), compared with that of a gentle slope.

- Thirdly, ground water table profile is an influencing factor in slope stability. The ground water table for hill slopes is generally low and fluctuates with time and rainfall events. High ground water table increases the risk of failure as the shear resistance in the potential failure plane decreases due to increased water pressure between soil particles, as explained earlier. In addition, the ground water table on the upslope acts as additional driving forces. All these factors decrease the FOS of a slope.
- Fourthly, slope maintenance is also an important factor. Poorly maintained slopes can lead to slope failure. These may include, amongst others, damaged/cracked drains, inadequate surface erosion control and clogged drains. Eventually, erosion of the slopes allows the formation of gullies or causes localized landslips which will propagate with time into bigger landslides if erosion control is ignored.

7.4.6 Impacts Related to Blasting Operation

Impacts

Environmental impacts associated with the blasting operations are mainly related to vibration, noise and fly-rock. The magnitude and extent of the disturbances will be dictated by various factors relating to the design and control of the blasting operation. These factors are influenced by the type and quantity of explosive, blast design, method of initiation, degree of confinement, distance to the nearest structures, geology and topography and also the atmospheric conditions of the blasting site.

Blasting Vibration

Vibration, a phenomenon related to noise, is produced by energy that is not capable of fracturing rock. The main component of vibration, termed as peak particle velocity (ppv) and measured in mm/s, is a measure of how fast a particle or passing seismic waves excites structure. The effects of blasting on people and structures depend on individual psychology, the type and nature of the structure and the geology of the area. Experiences show that the main reason for complaints of vibration is not usually actual structural damage but fear of damage and/or nuisance. It is therefore more appropriate to classify vibration levels according to these levels.

The United States Bureau of Mines (USBM) has stipulated that a maximum safe blasting limit adjacent to a structure is 50.8 mm/s ppv with a 95% confidence limit with some adjustment according to the type and nature of the structure. The threshold of perception of vibration is about 0.2-0.5 mm/s ppv and a level of 12 mm/s would cause cosmetic damage.

In Australia, the Australian Standards Association in the Explosive Code AS 2187, Part 2 1983 specifies that ground vibration levels in term of maximum allowable peak particle velocity (PPV) shall be used to compare safe vibration level for blasting operation with nearby building structures. The recommends level is based on the category of structures as follows;

- PPV of 2 mm/s for historical buildings, monuments and building of special significance.
- PPV of 10 mm/s for house and low rise residential building.
- PPV of 25 mm/s for commercial and industrial building or structure of reinforced concrete or steel.

In the United Kingdom, many Mineral Planning Authority (MPA) has specifying ppv limits between 2.5 and 12.5 mm/s with USBM specifying 12-19 mm/s as less than acceptable. British Coal Opencast Executive (BCOE) has variously proposed a maximum of 12 mm/s with 90% below 6 mm/s. However, most specifications are in favour as 6 mm/s as appropriate and acceptable level. It is clear that compliance with these limits will mean that structural damage is very unlikely, although cosmetic damage is possible.

Estimation of Ground Vibration Level

Ground vibration may be estimated using the following attenuation equation:

$$V = K\{RQ^{½}\}^{-B} \quad \textbf{(Equation 7-4)}$$

where,

V	-	ground vibration as peak particle velocity (mm/s)
R	-	distance between charge and point of measurement (meter)
Q	-	effective charge mass per delay or maximum instantaneous charge (kg)
K, B	-	constants related to site and rock properties for estimation purposes

It should be noted that ground vibration depends on the maximum charge weight per delay, and not the total charge weight, provided the delay interval is significant. For a free face average rock blasting, Standards Australia has developed a Scale Distance chart as shown in **Figure 7-1.** The chart has been derived from the above equation by taking **K** as **1140** and **B** as **1.6**.

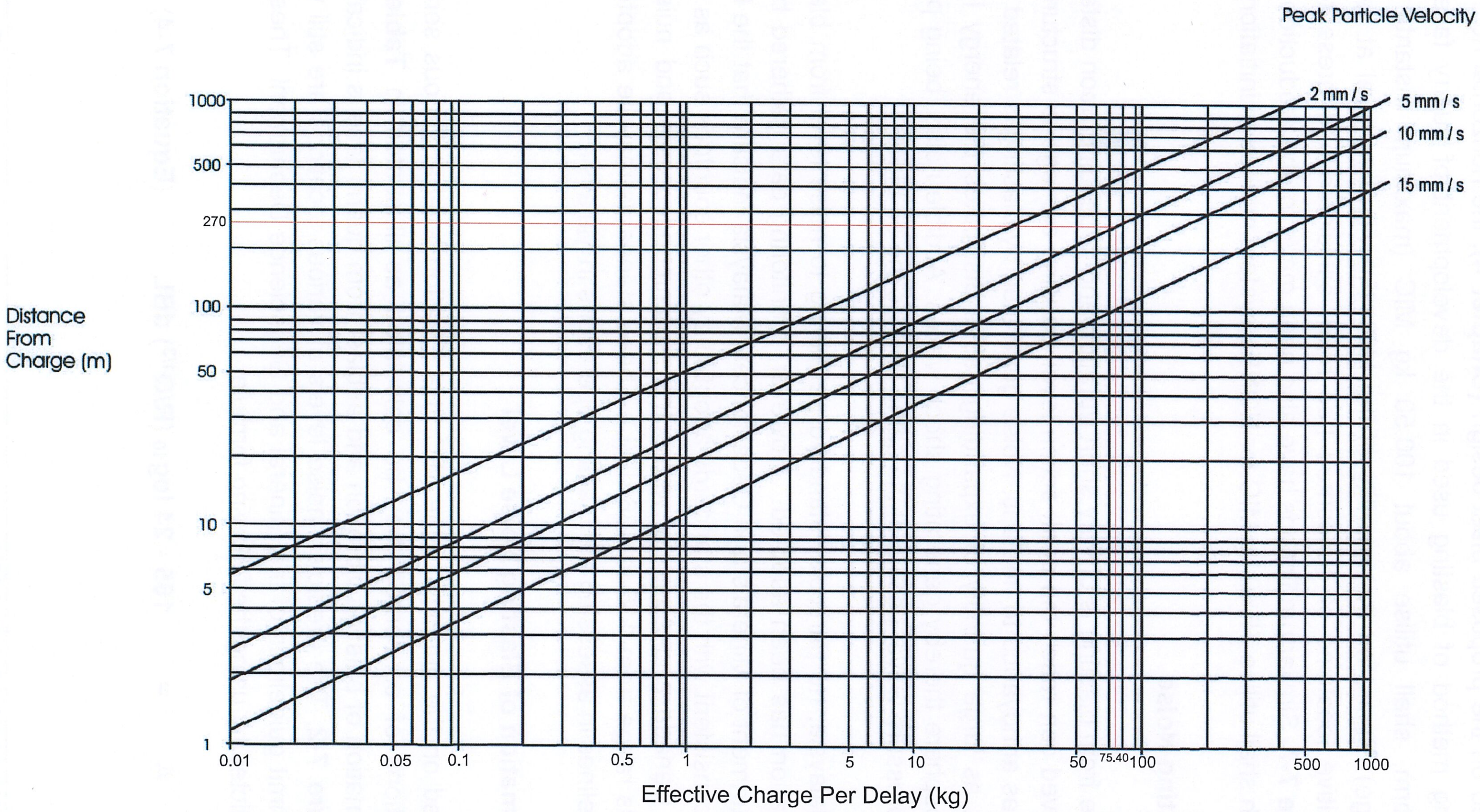

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Figure 7-1

SCALE DISTANCE CHART

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Not to Scale

Based on the proposed blast design **(Chapter 4),** the horizontal hole / fan drilling method of blasting used in the development of quarry face and platform, shall utilise about 100.50 kg MIC (maximum instantaneous charge). Based on the quantity of the MIC, the vibration level at various sensitive locations of concerned has been calculated and presented in **Table 7-7.** Similar predictions have also been made for the production blast which shall utilise 75.40 kg MIC for NONEL system method of initiation.

Blasting Noise

Noise from blasting is of very short duration and depending upon distances involved can reach the peak action level, causing damage to structures as well as annoyance to humans. Noise generated by blasting is related to air blast as large quantity of expanding gases dissipates the energy in the atmosphere thereby generating shock waves. Audible noise, being part of the pressure wave, occurs at the same time as the air blast.

In Malaysia, no particular standard pertaining to noise level from blasting operation has been adopted. However, monitoring data gathered by the Department of Minerals and Geosciences, Malaysia indicate that the levels are consistent with the standards adopted by other countries such as USA, UK, Canada and Australia where the recommended safe and nuisance levels range from 115 to 136 dB(L). These standards may be adopted as guidelines in assessing the blasting operations in Malaysia.

Estimation of Blasting Noise Level

Based on the quantity of the MIC, the vibration level at various sensitive locations of concerned may be calculated as illustrated in **Table 7-7.** Estimation of blasting vibration and airblast from quarry face is indicated in **Figure 7-2**. The predicted noise levels at various locations are still within the limit guidelines of the Mineral and Geoscience Department. These are predicted by using the following formula:

$$A = 165 - 24 \log_{10} (R/Q^{1/3}) \text{ dBL} \qquad \text{(Equation 7-4)}$$

Table 7-7: Estimation of Blasting Vibration and Airblast from Quarry Face

Parameters	Distance from Quarry Face			Limits Guidelines
	Kampung Tebing Tembah	Kampung Kongsi	Kampung Baharu	
	750m	1750m	1750m	
Development Blasting				
K	1140			124 dB(L) 5 mm/s
R (m)	750	1750	1750	
Q (kg)	100.5	100.5	100.5	
B	1.6			
❑ Airblast (dBL)	112.02	103.18	103.18	
❑ Vibration (mm/s)	1.14	0.29	0.29	
Production Blasting (NONEL System)				
K	1140			124 dB(L) 5 mm/s
R (m)	750	1750	1750	
Q (kg)	75.4	75.4	75.4	
B	1.6			
❑ Airblast (dBL)	111.02	102.19	102.19	
❑ Vibration (mm/s)	0.91	0.24	0.24	

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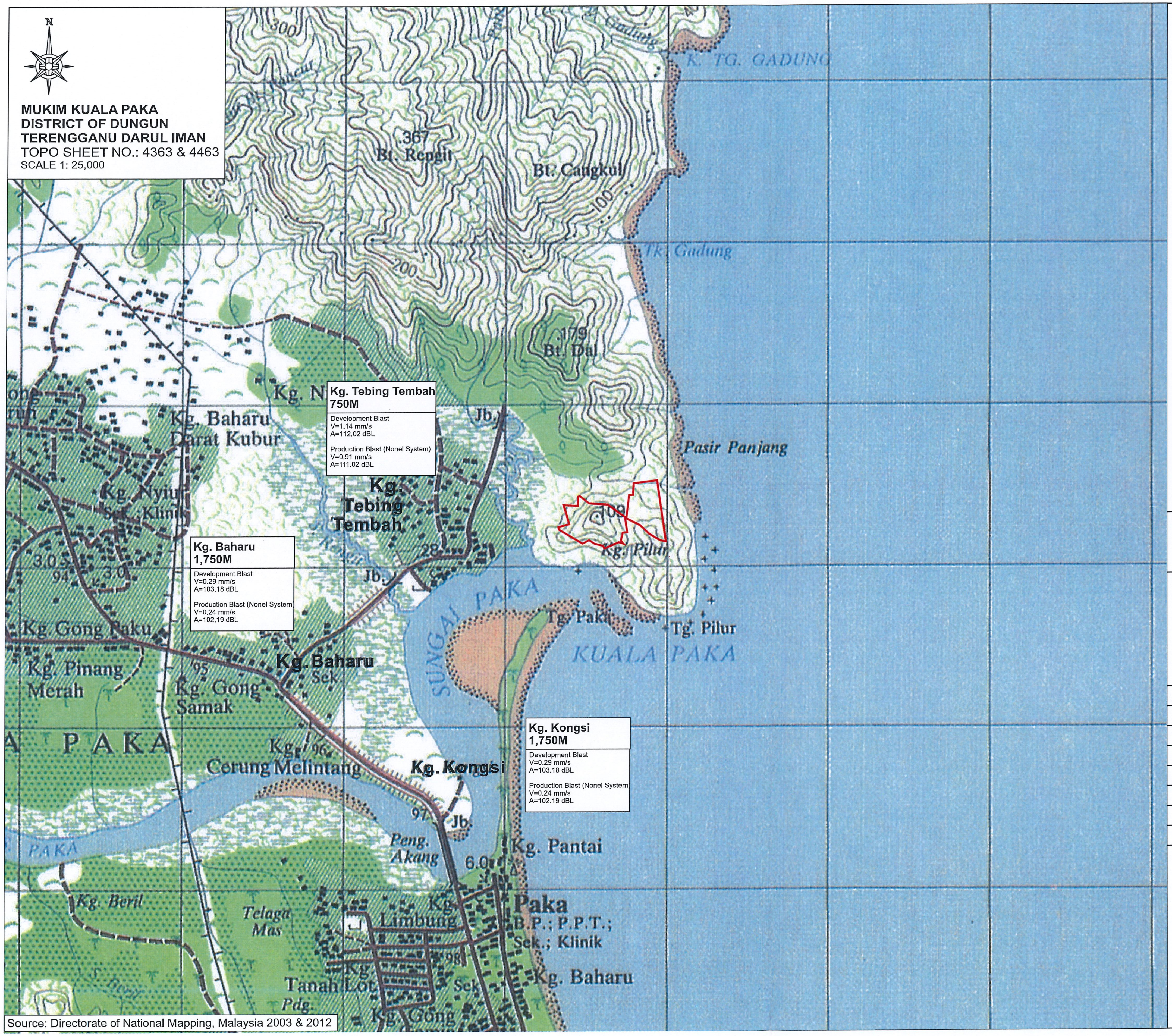

LEGEND

- PROPOSED PROJECT AREA
- RIVER
- CONTOUR
- COCONUT
- *BELUKAR, RIUNG AND HILL PADI*
- RUBBER
- BUILDING IN RURAL AREAS
- ELECTRICITY TRANSMISSION LINE
- UNSEALED SURFACE ROAD

PROJECT PROPONENT

HEXATREND QUARRY SDN. BHD.

DRAWING TITLE

Figure 7-2

ESTIMATION OF BLASTING VIBRATION AND AIRBLAST FROM QUARRY FACE TO SENSITIVE RECEPTORS

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Fly-rock

Geology, rock conditions, improper blasting design, or carelessness are some of the main cause of fly-rock. Fly-rock is produced when there is too much explosive energy for the amount of burden, when stemming is inadequate, or when the explosive energy is too rapidly vented through a zone of weakness.

In bench blasting, two types of throw which are identified are:

1. The forward movement (throw distance) of the rock mass, that is mainly horizontal
2. The flyrock scattered from the rock surface and the front of blast

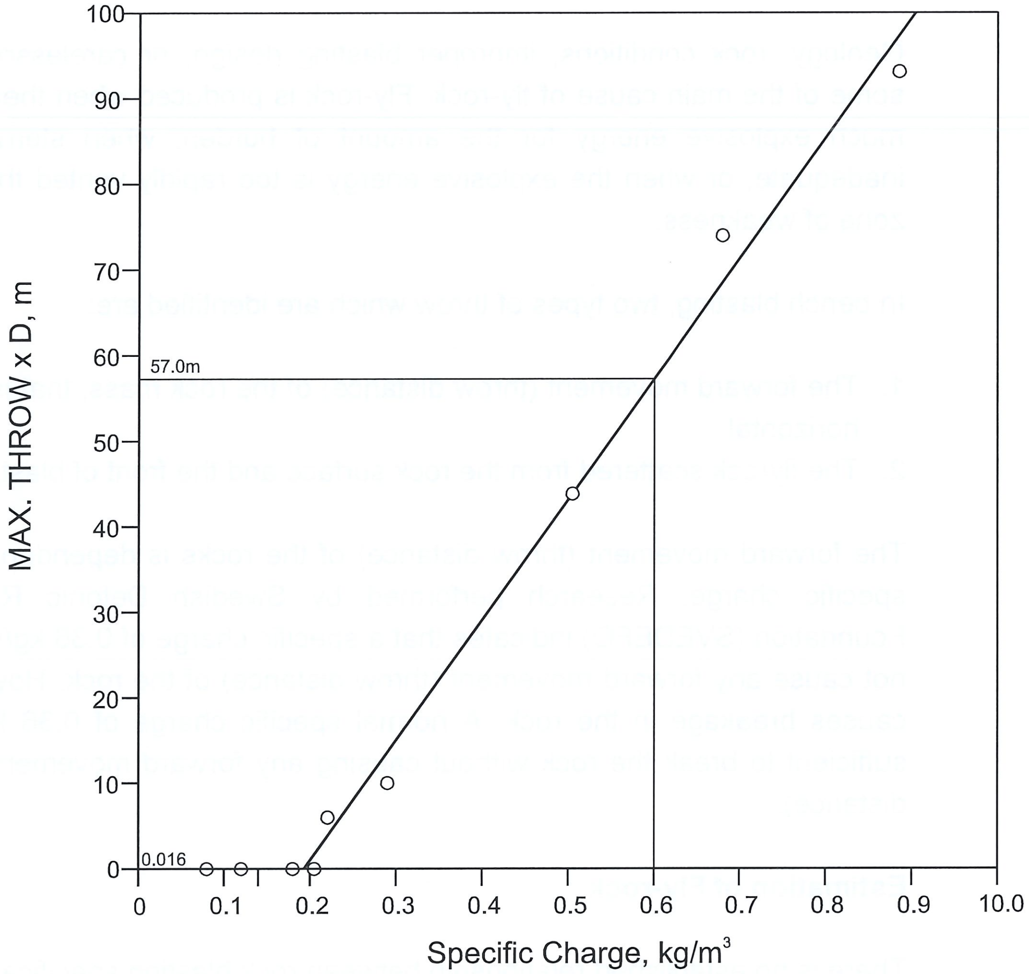
The forward movement (throw distance) of the rocks is dependent on the specific charge. Research performed by Swedish Detonic Research Foundation (SVEDEFO) indicates that a specific charge of 0.36 kg/m^3 does not cause any forward movement (throw distance) of the rock. However, it causes breakage in the rock. A normal specific charge of 0.36 kg/m^3 is sufficient to break the rock without causing any forward movement (throw distance).

Estimation of Fly-rock

There is no established relationship between rock blasting specification and fly-rock. However, the relationship between distance of throw and specific charge rated employed in the blasting operation may be correlated as shown in **Figure 7-3**. **Table 7-8** show that as the maximum specific charge rate for the blast is about 0.40 kg/m^3, the maximum throw distance is estimated to be about 5.073 m.

Table 7-8: Relationship between Distance of Throw and Specific Charge

Design Parameters	Specific Factor/ Powder Factor, kg/m^3	Maximum Throw Distance, m
Proposed Production Blasting	0.60	5.073



Production Blast Design

Specific Charge per Delay	= 0.60 kg/m^3
Diameter of Blast Hole (D)	= 0.089 m
Maximum Throw Distance	= 57.0 x 0.089 m
	= 5.073 m

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Figure 7-3 MAXIMUM THROW LENGTH	Report Ref.: KCS/HQ/472-EIA-0119-2505-R1
	Not to Scale

Flyrock Projection

Figure 7-4 shows the ejection distance of flyrock as a function of blast hole diameter at specific charges for production design. Based on the powder factor quantum, the specific charge of a maximum drill hole diameter is 0.60 kg/m^3 (proposed production blast. Therefore, the maximum flyrock ejected is 470m as shown in **Table 7-9.**

Table 7-9: Length of Ejection of Flyrock as a Function of Blast Hole Diameter at Specific Charges

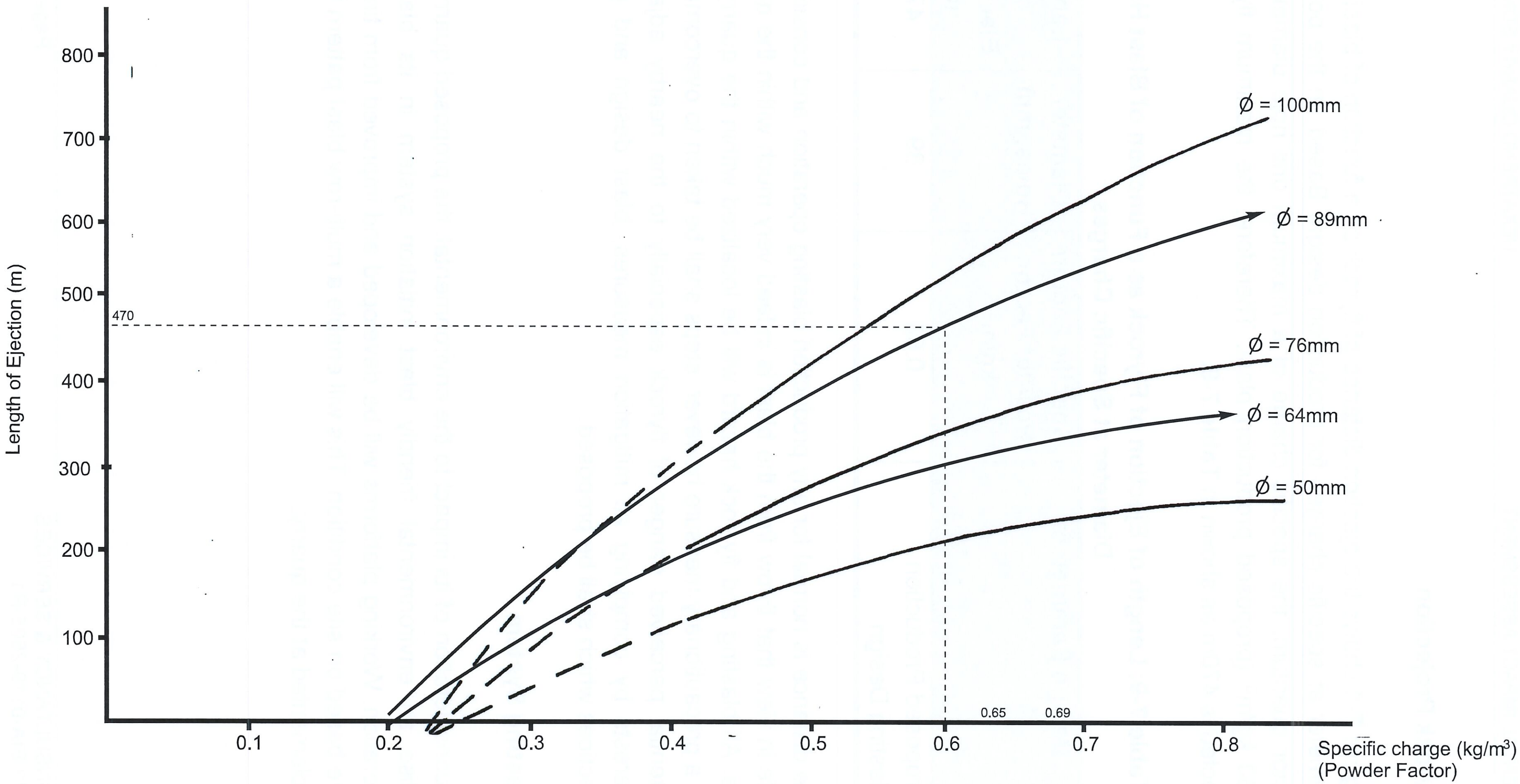
Design Parameters	Specific Factor/ Powder Factor, kg/m^3	Diameter Holes, mm	Length of Ejection, m
Proposed Production Blasting Design	0.60	89	470

The distance is normal for any production blasting operation and considered safe in view that throw from the blast is indeed very much within the quarry site. All blasting and fly rock hazard will be localized within the quarry pit. As a precautionary measure however, steps shall be taken to overcome the potential perceived danger of flyrock especially to the nearby adjacent interests by complying all mitigation measures, blast design and good practices which shall be proposed.

Blasting System

In consideration of its impact to the environmental, the proposed quarry will utilise an environmental friendly blast initiation system in its blasting operation. Working platforms will be developed and improved from time to time based on site condition. This will enable a multi-row blast pattern to be implemented at the quarry.

Maximum Traveling Distance of Flyrock as a Function of Specific Charge (Powder Factor) and Blasthole Diameter



Source: Swedish Detonic Research Foundation

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Figure 7-4 ESTIMATION OF TRAVELLING DISTANCE (FLYROCK)	Report Ref.: KCS/HQ/472-EIA-0119-2505-R1
	Not to Scale

The initiation system recommended for the production blast design is NONEL system with multi row blasting and a delay/hole design. The multi-row blasting design requires a careful selection of the in-the-hole millisecond (ms) delays built in the detonators. The use of millisecond delay intervals between adjacent holes in a single row will minimise ground vibrations, air blast, fly-rock and increase fragmentation. Good fragmentation is achieved when each charge is given sufficient time to break its quota of burden from the rock mass before the next charge detonates; the second and subsequent charges can then shoot to free additional face sequentially.

Multi-row blasting techniques utilising medium diameter borehole will be used at the proposed quarry in order to achieve a desired shot volume. The delay detonators are used in the proposed blast design of the quarry, since it gives the choice of delay firing time thus controlling vibration and air-blast levels.

A NONEL method of the blast initiation system shall be employed at the quarry as it may provide the best choice of suitable millisecond detonators. Electrical system is also available, it is also recommended due to location of quarry face which is very far from electric transmission and other sensitive structure. Electrical initiation can be considered when the quarry floor level is low enough if compared to the surrounding.

In the proposed quarry, multi-row rounds are used in the production blast design of the quarry. Delay interval between 25 ms and 42 ms between adjacent blast-hole in a single row may minimise ground vibration, air blast, and fly-rock, and increase fragmentation. The best fragmentation is achieved when each charge is given sufficient time to break its quota of burden from the rock mass before the next charge detonates; the second and subsequent charges can then shoot to an additional free face. A staggered/rectangular drill pattern, with a hole by hole delay shall be utilised. This pattern is of the symmetric plough formation type. This usually results in a better control of the blast's progression, and thereby the risk for fly-rock. Although fly-rock is an unlikely hazard for the nearby interests, adopting suitable blasting methods is indeed important. Blast pattern which have been chosen are based on the following basis:

- the desired direction of the rock motion
- the delay time in the adjacent blast-hole
- the physical dimensions of burden, spacing and stemming selected to minimise the unwanted side effects of blasting

Quarry Face Direction

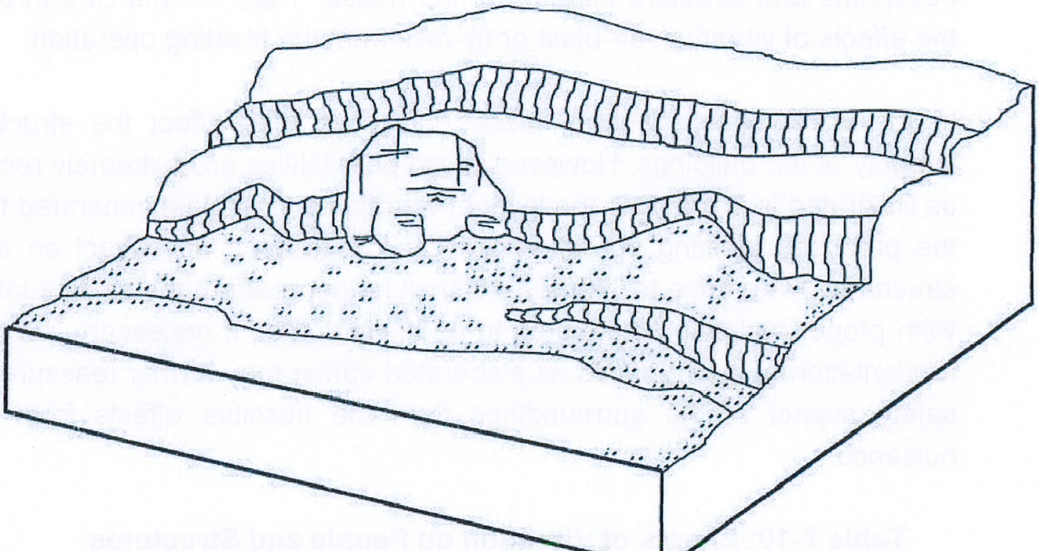
Direction of rock motion as a result of blasting operation will be planned in the proposed quarry in order to ensure that should any fly-rock generated from the blasting operation will not endanger any adjacent interests. In this particular case, attention must be drawn to ensure that the direction of the rock motion or the quarry face must be away from the sensitive areas. The quarry face orientation is as shown in **Figure 7-5**.

Buffer Zone

Ideally, buffer zone need to be created to ensure that there is always sufficient distance between rock excavation activity and other forms of development so that potentially conflicting land uses do not come into close proximity. The need is more demanding when we consider the impact of blasting on the surrounding especially on matters related to fly-rock generated from blasting operation.

However, with the introduction of modern blasting techniques in quarrying industry, the need to have such ideal arrangement may be compensated both through technical approach and good practices now being practices throughout the world. The existing trees and other planted trees within a buffer zone or other reserve may enable the distance between quarrying activities and development to be reduced. Now withstanding of the above, perimeter buffer zones shall be allocated to ensure safety at its maximum.

Proposed Orientation of Quarry



Method of Screening the Working Faces

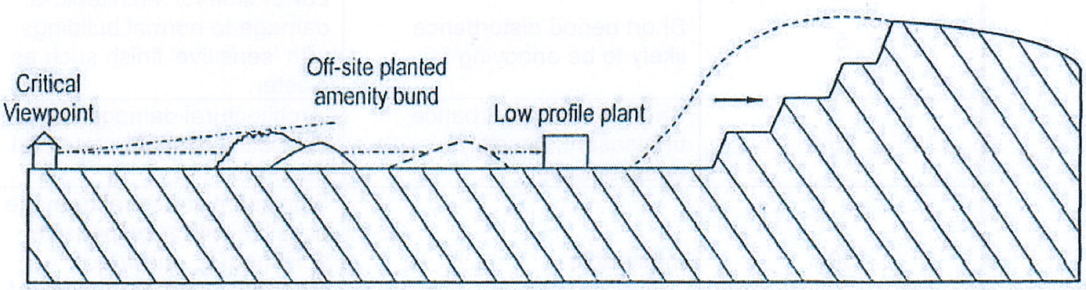


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Figure 7-5 QUARRY FACE ORIENTATION	Report Ref.: KCS/HQ/472-EIA-0119-2505-R1
	Without Scale

Level of Impacts

Evaluations have been made on the possible level of impacts of the above nuisances generated by blasting operations to the structures of concerned. The natures of impacts of blasting to houses are related to safety to the occupants and structure integrity of the house. They are affected through the effects of vibration, air-blast or fly-rock from the blasting operation.

In the worst case scenario, these nuisances may affect the structural integrity of the buildings. However, these possibilities are extremely remote as illustrated in **Table 7-7**, the level of vibration and airblast generated from the proposed blasting operation are too low to have any effect on such structures. Reference to **Table 7-10** shall further reaffirm the said situation. With proper mitigation measures to be implemented if necessary, such as reorientation of quarry faces as elaborated earlier may further reassure the safety aspect of the surroundings from the possible effects from this nuisance.

Table 7-10: Effects of Vibration on People and Structures

Peak Particle Velocity (mm/sec)	Human Response	Damage to Buildings
Less than 0.15	None	None
0.15 - 0.30	Just perceptible	None
2	Perceptible	Upper limit for ancient monuments.
5	Short period disturbance likely to be annoying	Lower limit for 'architectural' damage to normal buildings with 'sensitive' finish such as plaster.
15	Short-period disturbance unpleasant; possibly unacceptable.	'Architectural damage likely; possibility of minor structural damage.
50	Intolerable	Significant structural damage possible with a 'responsive' building (i.e. one which responds at the frequency of the disturbance).

Source: Clark et al, 1981

7.4.7 Impacts Related to Explosive

Impacts

Explosives and all their accessories are safe to handle when they are properly treated. Accidental detonation of the explosives is usually fatal. Therefore, it is prudent for the blaster to adhere to safety rules issued by the explosive manufacturer, existing laws and regulations pertaining to the safe handling, storing and transporting of explosives.

7.4.8 Impacts Related to Rock Crushing Operation

Impacts

Blasted rock will be sent for crushing to produce aggregate of various sizes. The crushing, screening, size classification, material handling and storage operations undertaken can be significant sources of dust emissions if uncontrolled. A substantial portion of these emissions consists of heavy particles that settle out within the plant. As in other operations, crushed stone emission may be categorised as either process sources or fugitive dust sources. Fugitive dust sources generally involve the re-entrainment of settled dust by wind or vehicular movement. Factors affecting emissions from either source category include the type, quantity and surface moisture content of the stone processed; type of equipment and operating practice employed; and topographical and climatic factors.

The proposed quarry, being located in an area characterised by high humidity and rainfall, will encounter lesser amount of dust emissions as compared to quarries located at drier areas. If the dust is not suppressed and controlled, it could lead to reduced visibility around the plant, and cause air pollution and health hazards to the workers.

7.4.9 Impacts Related to Air Pollution

Impacts

The environmental impact of quarrying on air is usually in the form of particulate matter. This problem arises mainly through land clearing activities, handling of overburden, transportation and the movement of vehicles and crushing operations. The severity of the problem will vary according to many factors such as the time of year, moisture in the soil, temperature, humidity and weather.

Airborne dust can cause damage and nuisance, the extent of which depends upon their composition and concentration. Emission points for dust release from quarrying and processing typically include the following:

- Land clearing activities
- Soil or overburden stripping
- Drilling for blast charges
- Blasting Activities
- Loading and unloading of products
- Vehicles Movements
- Fugitive dust loss from lorry
- Dumping into primary crusher
- Primary, secondary, and tertiary crushing
- Screening
- Transfer points on conveyor systems
- Loading onto storage piles from conveyors Discharge Point
- The wind blowing dust from storage piles and open-conveyors

It is likely that air pollution problems will be minimal at the quarry but emission from such facilities as conveyor belts and crushers as well as fugitive dust from material-handling activities may subject the operation to certain statutory requirements under the Environmental Quality Act, 1974 or other relevant laws and regulations pertaining to quarrying.

Gaseous Emissions

In quarrying operations, CO, SO_2, NO_2 and CO_2 are the most concerned gaseous as they give much effect to air quality. Therefore, it is likely that air pollution problem will be minimal at quarrying operation.

- Sulphur Oxides (SO_2) - The burning of fossil fuel which contains some sulphur releases sulphur dioxide. The amount of sulphur dioxide from vehicles is, however, small. Much of it combines with other materials in the air to form sulphate and settle out as particulate matter. Although the amount of SO_2 produced by vehicles is small, when combined with moisture produces sulphuric acid particularly when high temperatures are present. As noted earlier SO_2 also combines with other materials in the atmosphere to form sulphates which eventually settle out as particulate matter. As tropical air is humid and hot the probability of SO_2 combining with moisture to form smog is always high. Any increase in the emission of SO_2 will increase the probability. Acid rain is an effect caused principally by outfall of sulphur oxides, which has led to pollution of surface water bodies and considerable damage to exterior of building, and plants.

- Carbon Dioxide (CO_2) -Carbon dioxide (CO_2) occurs naturally in the atmosphere and consequently increased levels have no significant impact on local air quality. Once again the primary source of CO_2 is from the burning of fossil fuel and from motor vehicle. Although diesel engine is relatively efficient as a mobile power plant, it is far from efficient in terms of energy produced from the energy potential of the fuel and 60% of the heat value leaves the engine as waste heat. One pound of fuel burned generates 0.57 m^3 of carbon dioxide. CO_2 is of concern mainly because of its effects as a greenhouse gas (it is responsible for 56% of the total greenhouse gas effect). It is suggest that by the year 2030 the present greenhouse effect will have doubled leading to a global surface temperature increase of 1.5-5.5°C and an increase in precipitation rate of 3-11%.

- Carbon Monoxide (CO) -Carbon monoxide (CO) is a colourless, odourless gas present naturally in the atmosphere at levels of around 0.23 mg/m^3 (0.2 ppm). Its toxicity to humans as a result from its ability to combine to the oxygen carrier, haemoglobin, in the blood. Haemoglobin has an affinity for CO that is 200 times higher than that for oxygen. When a human is exposed to an atmosphere containing carbon monoxide, the percentage of carboxyl haemoglobin (the percent of the haemoglobin carrying carbon monoxide rather than oxygen) gradually increases with time to an equilibrium value which depends upon the carbon monoxide concentration. Thus, the toxic effects of carbon monoxide are dependent upon both time and concentration. CO is formed during a combustion process as a result of oxygen insufficiency. In a spark-ignition engine cycle CO is formed in large quantities in the early high-temperature portions of the combustion process. Diesel engines emit much less CO compared to petrol powered engines. One pound of the fuel burned generates 0.009 m^3 of carbon monoxide.

- Oxides of Nitrogen (NO_x) - Nitrogen oxides are formed by the reaction of nitrogen and oxygen in the atmosphere at high temperature and pressure such as those that exist in an internal combustion engine. Both nitrite oxide (NO) and nitrogen dioxide (NO_2) are produced, the former much more abundantly. But NO oxidises to NO_2 and the ambient concentration of NO is as a result only twice that of NO_2. Most of all the man-made nitrogen oxides that enter the atmosphere are produced by the combustion of various fuels either from stationary or mobile sources.

Therefore, it can be concluded that heavy machinery and vehicles that burn up various types of fuels would most likely generate potential air pollutants from the Project site in the form of gaseous emissions. The amount release will be relatively small, and can be easily controlled and minimised.

Particles Emissions

Particulate forms a major part of the emissions of air pollutants and come from such diverse anthropogenic sources such as vehicles and land clearing. Particulate matter emitted by vehicle emissions comes from hydrocarbons, and sulphur dioxides. If lead is used with the fuel to control combustion, it forms a major component of the particulate. About 70% of the lead is eventually lost to the air with the exhaust gases. About 30% of the lead particles are large enough to settle rapidly to the ground. About 40% are smaller in size and can remain airborne for sometimes.

Operating conditions play an important role in determining the emission rate of particulate. The composition of the fuel used also influences the rate of particulate formation, for instance, additives, such as lead, increase the amount of particulate emitted.

A quantity of dust is also generated due to gradual wear and tear of rubber tyres, brake linings and clutch plates. In addition, vehicles churn up a lot of dust especially in the dry seasons and this cause a lot of annoyance to pedestrians and nearby residents alike. A more vexing problem is that diesel engines in particular produce carbon particle which they emit as smoke.

Air Quality Assessment

The project site is remotely located more than 0.75km away from sensitive receptors. The nearest receptors are Kampung Tebing Tembah, Kg Baharu and Kampung Kongsi, which is also baseline monitoring site A2, A3 and A4 respectively. PM_{10} concentration at these locations is predicted in the modelling exercise. A detail of air quality assessment is attached in **Appendix 7-1 (Air Quality Assessment)**.

Results of the modelling are presented in incremental Ground Level Concentrations (GLC). Incremental GLC refers to additional concentrations of pollutant at ground level due to the proposed project. In addition to the baseline concentrations, cumulative ambient GLC can be obtained and this will compare with the stipulated ambient air limits.

Air pollutant (PM_{10}) contours during the quarry operations for both scenarios – without mitigating measures; and with mitigating measures are illustrated in **Appendix 7-1 (Air Quality Assessment)**. Based on the modeling results, the effect of flying dust is localized Without control measures, the level of PM10 is estimated more than 400µg/m3 (24 hours) and 35 µg/m3 (1 year) at the receptors (**Table 7-12**). With control measures in place, the incremental GLC of PM10 is lowered to 9 µg/m3 at the surrounding receptors as shown in **Table 7-11**. These levels are low and could hardly pose any significant impact to the surrounding receptors. In addition to the baseline concentrations, the cumulative GLC is estimated below 59 µg/m3 at the receptors with control measures in place. Hence, control measures are essential to be implemented on site at all times to minimize the impact.

$PM_{2.5}$ is a subset of PM_{10}. The ratio of $PM_{2.5}$ to PM_{10} depends on the source of the particulate matter. For instance, combustion process may content $PM_{2.5}$ as high as 80% of total PM. However, for flying dust, content of $PM_{2.5}$ is expected to be lower than 50% of total PM. In view of the PM_{10} modeling results are acceptable with control measures in general, modelling of $PM_{2.5}$ for the proposed project is not necessary in this case.

Table 7-11: Predicted Incremental Ground Level Concentration (GLC) of PM_{10} due to Emissions from the Proposed Project (with Control Measures)

Sensitive/discrete receptor	Existing baseline conc.	Incremental conc.		Cumulative air conc.
		24-hr average	Annual average	24-hr average
Kg Tebing Tembah, A2	46	8.31	1.55	54.31
Kg Baharu, A3	47	8.56	1.25	55.56
Kg Kongsi, A4	50	8.33	0.74	58.33

Note: all units in µg/m^3.

Table 7-12: Predicted Incremental Ground Level Concentration (GLC) of PM_{10} due to Emissions from the Proposed Quarry (without Control Measures)

Sensitive/discrete receptor	Existing baseline conc.	Incremental conc.		Cumulative air conc.
		24-hr average	Annual average	24-hr average
Kg Tebing Tembah, A2	46	415.27	77.57	461.27
Kg Baharu, A3	47	428.04	62.65	475.04
Kg Kongsi, A4	50	416.30	37.19	466.30

Note: all units in $\mu g/m^3$.

7.4.10 Impacts Related to Noise

Impacts

The sources of noise in quarrying operations are numerous and in fact most of the activities generate some form of noise. The general adverse effects of noise are interference with communication, hearing loss, disturbance of sleep, stress and annoyance. The main source of operational noise is mainly from machinery. Typical noise levels of some machinery that are used at the quarry are as shown in **Table 7-13.** The noise levels are measured at 20 meter under normal working conditions.

Table 7-13: Typical Noise Levels Of Quarrying Machinery

Machinery	Noise Levels (dBA) @ 20 meter
12 unit 14 tonnes truck	75-80
1 unit 750 kVA diesel generator	67-72
1 unit small compressor	68-73
1 unit personnel carrier	60-65
2 unit front end load shovel	75-79
1 unit rock breaker	76-81
1 unit Caterpillar D8	75-80

Above 75 dB(A), the possibility of severe health effects such as loss of hearing occurs (USEPA, 1982). Response to such problems varies with receptors; for example schools, offices, and similar receptors where ease of speech is of primary concern will not have the same response to an increase from 55 dB(A) to 60 dB(A) as a busy commercial district. The impact of noise would also be significant in rural areas where the level of existing noise is low. It has been concluded that, in residential areas where the general daytime noise exposure is below 55 dB(A), there will be few people seriously annoyed by noise.

Data from surveys of community noise annoyance lead to the recommendation that general daytime outdoor noise levels of less than 55 dB(A) are desirable to prevent any significant community annoyance. This is consistent with speech communication requirements. At night, a lower level is desirable to meet sleep criteria; depending upon local housing conditions and other factors this would be in the order of 45 dB(A).

Table 7-14 presents the common environmental and ambient noise levels. As indicated the noise level of 80 dB(A), which present typical noise level at the processing plant, would be of moderately loud range which cause communication interference and annoyance.

Table 7-14: Common Environmental Sound Levels

Source/Distance	dB(A)	Subjective Impression
Jet takeoff (nearby)	150	Threshold of pain
Automobile horn (1m)	120	Maximum vocal effort possible
Construction noise (3m)	110	
Discotheque (15m)	110	
Shout (15m)	100	Very annoying
Heavy truck (15m)	90	Constant exposure endangers hearing
Pneumatic drill (15m)	85	Limit for industrial exposure hearing
Train (15m)	80	Annoying
Noisy office with machines	80	
Highway traffic (15m)	70	Telephone use difficult
Conversation (1m)	60	Intrusive
Living room	50	Quiet
Bedroom	40	
Library	30	Very quiet
Broadcast studio	20	
Rustling leaves in breeze	0	Threshold of hearing

Source: EPA, USA (1971)

Noise on the quarry site mainly is due to the mobilization of motor vehicles and machinery. The volume of traffic entering and leaving the Project site will contribute towards the increase to the noise levels of the area. This level will fluctuate with hours of the day and dependent on the numbers and type of vehicles and equipment used at the quarry.

Operators who work on or in the vicinity of noisy machinery could be exposed to a noise level, which, over a period of time, may damage their hearing systems. To the community, the main concern is relating to annoyance or nuisance rather than damage. For general noise criterion level, the significance of the noise impact likely to arise from a quarry is assessed by reference to:

- The difference between baseline and active quarrying noise levels. Complaints are likely to arise from residents if noise levels are 10 dB(A) or more above ambient levels (BS 5228, 1984). Also a 3 dB(A) increase in existing noise levels is the minimum change in environmental L_{eq} which is noticeable (Environmental Resources Limited, 1987).
- Defined criteria. Daytime working noise levels above 65 dB(A) and night time levels above 55 dB(A) are likely to result in a major impact on the surrounding population (Environmental Resources Limited, 1987).

Noise Legislation and Criteria

Noise levels generated at the Project fall within the responsibility of two government departments. Environmental noise levels generated by the plant, and propagated to external areas, are covered by the Department of Environment; whilst protection of site personnel from the effects of excessive exposure to noise comes under the purview of the Department of Occupational, Safety and Health.

The Department of Environment (DOE), in their guidelines for the Sitting and Zoning of Industries, has stated that noise levels at the boundary of the Project, a special category, must not generally exceed the following levels:

Daytime (0700 - 2200)	=	65 dB(A)
Night time (2200 - 0700)	=	55 dB(A)

The Factories and Machinery (Noise Exposure) Regulations, 1989, came into force on 1st February 1989. These Regulations place a number of duties on employers with the overall aim of controlling noise in the workplace.

Prediction of Noise Levels to the Nearest Receptor

Noise level at various distances from the source can be estimated using the equation for noise attenuation in open air, assuming that there is no obstruction and little wind. The relevant equation is as follows:

$$\mathbf{Lr = Lw + 10 \log (1 \div 2\pi r^2)} \qquad \textbf{(Equation 7-5)}$$

where,

Lw - Noise level at the source (dBA)

Lr - Noise level at r meters from the source (dBA)

r - Distance (meters) from the source

Noise level from quarrying area as quoted by USEPA is between 88-102 dB(A) measured from various external sites in general quarry area. However, for the purpose of this estimation, the above noise levels are assumed as the worst case scenario.

In the case of this Project, the nearest receptor of the noise is located about 750m away from the noise source (distance between the quarry boundary and Kampung Tebing Tembah). From such a distance, the noise level may be estimated using the above formula as follows:

$$\begin{aligned} \mathbf{Lr} &= \mathbf{Lw + 10 \log (1 \div 2\pi r^2)} \\ &= 102 + 10 \log [1 \div (2\pi \times 750^2)] \\ &= \mathbf{36.52\ dB(A)} \end{aligned}$$

7.4.11 Impacts Related to Solid and Hazardous Wastes

Impacts

At various stage of the Project development, solid and hazardous waste shall be generated. There are a variety of wastes which can be divided into distinct categories based on their nature and the options for their disposal. Wastes as mentioned below may be generated during development stage or operating stage or both. Thus, mitigation measures that follow shall be applicable for both.

Cut Vegetation

Cut vegetation has the potential to be a fire risk unless properly managed. The preferred disposal route for biomass waste in terms of green vegetation, small branches and other organic materials is to be disposed via mulching / composting in a suitable area within the Project site as the volume involved is relatively small.

Excavated Materials

Excavated materials from site formation, earthworks etc will consist primarily of soils, sand, organic matter and broken rock / gravels. It is expected that the majority of these materials will be reused on the site in forming the elevated site base level. Associated impacts are expected to be negligible.

General Refuse

The storage and handling of general refuse has the potential to give rise to a variety of adverse impacts. These include odour problems if the waste is not collected regularly, windblown litter, water quality impacts if waste enters water courses, visual impacts as well as the attraction of pests, disease vectors and scavenging animals (insects, rodents etc) to the site if waste materials are incorrectly stored / accumulated on-site. The disposal of these types of waste at sites other than approved landfills, can also lead to similar impacts at the disposal sites.

Construction Wastes

The storage, handling, transport and disposal of construction type wastes has the potential to result in visual, water, dust and noise impacts in the event of inappropriate management methods. The disposal of construction waste is unlikely to raise any long-term concerns due to the inert nature of these types of materials.

Hazardous Wastes

In general the waste streams from the Project comprise of dust collected from drilling, crushing and screening, waste oils and lubricants. Some of these hazardous wastes are considered as scheduled wastes. These type of wastes can pose serious environmental and health / safety hazards unless they are handled, stored, transported and disposed of in an appropriate manner at suitable sites (prescribed premises) by competent personnel (contractor) as stipulated under the Environmental Quality (Scheduled Wastes) Regulations, 2005.

Spillages of liquids such as lubricating oils, diesel and hydraulic fluids that is likely to affect surface water quality / aquatic ecology if they enter surrounding water bodies. Provided that any hazardous wastes generated from the development and operational activities are stored, transported and disposed in accordance with regulations and appropriate measures, then associated impacts shall be minor.

7.4.12 Impacts Related to Fuel Oil Storage

Impacts

In view that the Project shall consume diesel in its operation, an area must be dedicated as a fuel oil storage area. Since diesel when it becomes waste it is considered hazardous waste, therefore the impact of this substance is similar to the hazardous waste impact mentioned above.

This substance can pose serious environmental and health / safety hazards unless they are handled, stored, transported and disposed of in an appropriate manner at suitable sites. The spillages are likely to affect surface water quality / aquatic ecology if they enter surrounding water bodies. The potential for environmental damage from improper use of this material is imminent, as leakage from any of the tanks shall pollute the surface and underground water in the area. Due to its flammable nature of the fuel oils, leakage may also lead to fire. Provided that diesel stored, transported and disposed in accordance with regulations and appropriate measures, then associated impacts shall be minor.

7.4.13 Sewerage Discharge

Impacts

Water Quality

Sewage and sanitary effluent may adversely affect the quality of receiving water bodies unless properly treated and managed. It is estimated that the peak workforce of 22 workers would generate about 1.76 m^3 of sewage and sanitary effluents (22 workers x 0.08 m^3 $worker^{-1}$ day^{-1}). The primary contaminants in sanitary effluents will be organic matter, coliform bacteria and suspended solids resulting in decreased dissolved oxygen content, elevated organic and coliform levels in downstream watercourses.

The sewage treatment system will be designed to give an effluent quality which shall comply within the Standard A requirements of the Environmental Quality (Sewage) Regulations 2009. The related effluent will be discharged into individual septic tank and to be frequently disludged by contractor licence by local authority thus the issue of this mitigation measures is irrelevant unless it is not properly maintained.

Odour

One of the potential environmental impacts is nuisance of bad odour if the septic tank not working. Nuisance due to odour is normally caused by the decomposition of organic matter. The impact of odour on human beings is primarily psychological rather than actual physical harm. Offensive odour can cause poor appetite for food, impaired respiration, nausea, vomiting and mental perturbations. In extreme cases, offensive odours can lead to the deterioration of personal and community pride, lower socio-economic status, interference with human relations and discourage capital investment (Sullivan, 1969).

7.4.14 Impacts On Traffic and Transportation

Impacts

Any new development will generate additional trips that will impact prevailing levels of traffic demand. The ingress and egress of vehicles particularly the lorry used to transport equipment, machinery, feedstock material and end products during operational period will increase the traffic volume.

However, the increase is unlikely to cause any significant impact considering the current traffic volume consideration for the vehicles leaving and entering the main road to/from the access road.

As for evaluation reference for the latest status traffic for nearby road, the following assessment is made based on the available data. This assessment enables to evaluate if existing roads can cope with the existing trips, where here it is depend on annual growth rate for the road. If necessary, recommend mitigation measures necessary to satisfy the anticipated levels of demand.

Traffic Impact Assessment

Any new development will generate additional trips that will impact prevailing levels of traffic demand. Traffic impact assessment (TIA) enables one to evaluate if existing roads can cope with this additional trips and if necessary, recommend mitigation measures necessary to satisfy the anticipated levels of demand. Currently, the proposed Project site can be accessed via Tebing Tembah Road. It is approximately 1.0km before reaching the quarry site.

Trip Generation by Project

Trip generation refers to the additional or development traffic as a consequence of the proposed development. Trip generation rates can be generally correlated with land use activities. Like other types of development, the Project will generate trips mainly in the form of lorry transporting building materials, equipment, machinery, waste material, feedstock material and end products. An estimate of trip generation by a variety of developments is available in the February 1997 edition of the Highway Planning Unit (HPU) publication *Trip Generation Manual: Draft Quick Reference.*

Hence, a conservative estimate is made on the basis that 58 trips heavy goods vehicles will be generated during the operating hours 0800 to 1700. The split in trip production and trip attraction is assumed equal. It is also assumed that there is no peak demand. Hence, all trips produced and trip attracted will be equally distributed over 10 hours. The quarry products are mainly destined for consumption of the near or local development. In accordance to JKR Arahan Teknik (Jalan) 8/86, the passenger car equivalent of the quarry vehicles is 3.0 for geometric design purposes. Therefore, the expected number of trips at time when the through traffic is at its peak will be 58/10 or 6.0 vehicle trips or 6.0 x 3.0 that is 18 pcu. Based on the above assumptions, the detailed divisions between trip attraction (IN) and trip production (OUT) are outlined in **Table 7-15.**

Table 7-15: Peak Hour Trip Estimation

Trip Generation	IN (Vehicle)	OUT (Vehicle)	IN (pcu)	OUT (pcu)
Total Trips	6	6	18	18

Environmental Perspective

Other relevant issues of concerned pertaining to traffic and transportation activity of the Project are as follows:

- Potential increased of traffic volumes may cause congestion on the local road network.
- Road damage by heavy vehicle transporting equipment, quarry products to / from Project site.
- Nuisance effects as a result of traffic congestion, increased air and noise emissions.
- Deposition of spoil, wastes and debris on roadways.
- Traffic accidents.

However, there is a public concern for noise, generation of dust, excessive vibrations, inadvertent aggregate spillage, and more importantly the overloading of lorry. The first three factors will adversely impact the environment. Persistent aggregate spillage causes driving nuisance which can culminate into windscreen breakage. This can be a matter of great concern to the travelling public.

The greatest concern from the standpoint of the integrity of the road pavement is lorry overloading. Overloading of lorries transporting aggregates will dramatically increase the potential vehicle damaging power in accordance to the fourth power law on the pavement but is unfortunately difficult ascertain and enforce.

7.4.15 Impacts on Flora

Impacts

Quarrying usually entails the clearing of the entire vegetation cover in each excavation site; the size of the area cleared depending on the amount and extent of the rock reserve. The extent of destruction and damage depends on the number and size of the working areas.

However, as mentioned before, the site-clearing and excavation works shall be minimal and be carried out in stages during drier season to minimise cleared areas. The only concern areas to be affected are along the haulage road to the quarry face and the areas where progressive opening shall be taking place according quarry face development. The flat area to be allocated with quarry infrastructure have relatively cleared, thus no concern shall be placed for this area.

7.4.16 Impacts on Fauna and Their Habitats

The development of the quarry would create a moderate adverse impact to the ecology of the existing habitats. This is because the existing biological environment consists mainly of secondary vegetation.

Quarrying of rock as proposed by this Project will involve spot clearing of existing vegetation and earthworks. Land clearing will eliminate the plants on the site and drive away all the mobile fauna such as birds and mammals to be adjacent area surrounding the Project site. The less mobile animals such as amphibians and reptiles will be affected to a greater degree, thus the adverse impacts expected would be at moderate basis. The creation of canopy gaps will affect some arboreal species such as birds, which depend on the trees to move from one area to another to feed.

Earthworks using of heavy machinery will create noise pollution in the area and this will also frighten away most of the fauna from the Project site. Any uncontrolled soil erosion will cause water pollution and this impact will affect the aquatic fauna in the nearby streams.

Rock aggregates processed from the Project site will be transported out via lorry. Dust and noise from this lorry will not have any severe adverse impact on the ecology and fauna in the area. With the increase in traffic volume on the access road, fewer animals will move nearer to the road corridor because of the noise. The terrestrial fauna will not be seriously affected by the Project, as the quarry is relatively small. The fauna can move into the surrounding forest when work on the site begins.

Though the Project is not expected to clear the whole area at one time, the cost of the Project on the fauna will be mainly in terms of loss of suitable habitats for the various groups of fauna. However, mitigation measures shall be carried out in order to reduce the magnitude of the impacts such as listed.

7.4.17 Occupational Safety and Health

Impacts

Some adverse health impacts that can be associated with labour force are resulted through the provision of on-site workers' accommodation. Normally the quarters are usually built without a proper sanitary and sewerage system, thus encouraging the proliferation of disease vectors. However, for this Project, campsite for workers is not required as the workers shall be commuting daily to the Project site.

Other occupational health and safety issues of relevant to the Project during the development and operation phase are as follows:

- Noise and fugitive dust emissions from machinery and vehicles involved in operation and plant activities.
- Diseases such as asthma and pneumonia, which may be caused by possible increases in air pollutants.
- Accidents from operation and transportation.
- Diseases and accidents related to the operation.
- Psychological impacts arising from concerns about safety risks.

7.4.18 Socio-Economics

Impacts

Employment and Business Opportunities

The potential for the creation of employment and business opportunities represents a significant beneficial impact that would result from the Project. The various stages of Project development will require manpower that shall result in employment opportunities for the communities living in the surrounding areas.

It is expected that the local population will provide the majority of the workforce required, thus minimising or eliminating the need for the use of foreign labourers. Based on preliminary assessment of the Project scale and duration with regard to the operation, up to 35 workers may be employed at any one time and the majority of these positions are expected to be filled by local workers. Numerous workers who worked in the similar industry and many of the skills acquired from their previous work experience will be of relevance.

The implementation of the Project will create business opportunities for the local residents, resulting in an injection of capital into the local economy. Skilled and experienced management and technical staff foreign to the region will be brought in by the Project Proponent to oversee the Project operation. They will create a demand for food, accommodation, transportation and domestic services that the local people can capture as business opportunities. Such beneficial impacts will spill over to the nearby town.

Amenities, Utilities and Infrastructure

Not much impact on the local utilities such as water supply, electricity supply, telecommunication services, etc., is expected from the Project, as these requirements shall be of minimum. Amenities such as medical clinics, schools and public services will not be enhanced, as the scale of operation involved will not have the capacity to induce such a large positive changes.

Nuisance and Public Safety

Although the Project shall widen the employment opportunities towards the residents at the surrounding area, at the same time some problems shall arise. Problem such as inconvenience and nuisance may be arising from possible increase in traffic and dust. Public safety is another aspect that is of concern pertaining to this matter as possibilities of accidents may be increasing. Although the nearby public road users have been exposed to the traffic impact due to transportation of rocks by heavy lorries in and out the quarry areas, relevant mitigation measures such as restricting the speed limit of lorries, material transportation shall be avoided during the peak hours, i.e. 7.00 - 9.00 a.m. and the product limit of lorry shall be strictly controlled and covered with canvas in order to minimize material spillage that may cause accidents.

7.4.19 Impact Related to Aesthetics and Visual Intrusion

Quarries are often located in areas of high aesthetic value. To some extent, this situation is unavoidable because rock can only be quarried where it outcrops and it is the very resistance of many rock types which gives rise to dramatic landscapes such as found in some part of Malaysia.

It is inevitable, therefore, that the visual impact of quarrying receives considerable attention - particularly in view of the long duration of quarrying activities and often permanent re-profiling of the landform. Visual impact can be of an adverse or beneficial nature depending upon the circumstances, however, the visual effect of quarrying tends to be perceived as predominantly negative. The exception to this is when good quarry restoration leads ultimately to the creation of new landscapes, at least equivalent in visual terms, to what existed prior to extraction.

Measurement of visual impact is a subjective process because it involves individuals who have differing perceptions, aesthetic tastes and visual comprehension. A feature that may be considered by one individual to be detrimental to the landscape might be deemed by another to be an asset. However, it is possible to bring objectivity to the assessment and treatment of visual impact by considering the factors which influence it.

Impacts

Site clearing, earthwork and rock extraction will all cause an impact on the general aesthetic of the area. Site clearing and earthworks during the initial stages will create scars in the landscape. Potential sources of visual impact due to quarrying activities are summarized in **Table 7-16**.

Table 7-16: Potential Sources of Visual Impact due to Quarrying

1. Quarry Landforms
❑ Soil and overburden storage mounds
❑ Screen bunds
2. Quarry Landforms
❑ Stockpiles
❑ Waste heaps - including scrap
❑ Quarry faces - active and disused
❑ Haul roads and associated embankments or ramps
❑ Slurry ponds and settlement lagoons
3. Crushing plant
❑ Crushing plant
❑ Internal quarry vehicles
❑ Road vehicles - especially at the main access
4. Built structures
❑ Storage hoppers
❑ Crushing and screening plant
❑ Washing, attrition, dewatering plant
❑ High level walkways and conveyors
5. Miscellaneous sources
❑ Long range indicators of quarrying activity
❑ Air pollution (eg water vapour, dust, vehicle fumes)
❑ Dust deposits (eg on surrounding vegetation)
❑ Mud on roads
❑ Lighting - especially during night time operation
6. Other sources
❑ Long term alteration to the existing landform profile (eg removal of hills and woodlands)
❑ Inappropriate perimeter planting

In the context of the Project, it is brought about by one or a combination of the following three factors:

- Elements which contrast in terms of form, height, mass and colour, thereby creating incongruity in the landscape.
- Perceived negative associations with industrial processes, dereliction and disturbance.
- Long term, and therefore perceived permanent duration.

These factors are affected by:

- Meteorological conditions: rain, fog, haze, mist, strong sunlight, cloud cover;
- Topographic position of the quarry in relation to surrounding relief;
- Observer characteristics: psychology, age, reason for presence;
- Viewpoint characteristics: nature, sensitivity and distance;
- Geology: affects slope angles and method of working, also the presence or absence of exposed rock in the surrounding landscape influences the extent to which the quarry is incongruous;
- Method of working: affects processing, progressive restoration, transportation;

Due to the changing nature of activities throughout the lifetime of the proposed quarry, such as design and planning stage, operation, restoration, sources of visual impact and their extent will certainly vary.

As there is early consideration of visual and aesthetics impact, the Project Proponent shall grabbed the opportunity to undertake advance mitigation measures such as the orientation of quarry working area which shall be reverse direction working in order advance planting, which then provide effective screening at a later date when actually required. Some sources of visual impact, such as structures and plant, only apply during the operational life of the quarry. The actual excavation and some earth structures, however, constitute permanent landscape change. The long term physical and visual modification of the landscape shall therefore also be considered.

Visual Impact Assessment

Visual impact assessment is often regarded as a subjective process. However, landscape architects have developed techniques which ensure that investigations can be undertaken in a systematic, consistent fashion, making the assessment as objective as possible. The primary functions of a visual impact assessment are to identify those localities from which the development will be visible; to evaluate the sensitivity of these critical viewpoints; to assess the impact of visibility; and to modify the quarry design in such a way as to reduce potential impact to a minimum. Typically, the most sensitive locations, and therefore the viewpoints with which the assessor is most concerned, include the following:

- Public footpaths;
- Transport route;
- Residential areas and settlements;
- Individual, isolated properties;
- Recreational and tourist facilities.

Impact has been assessed in relation to the number and characteristics of the observers likely to be affected. It has also been evaluated with reference to the type of viewpoint involved. For instance, visibility from a residential property might be weighted more heavily than from a road or footpath, despite the fact that the latter are likely to involve many more observers. The critical distinction lies in the duration of a view: Visibility from a dwelling will be relatively continuous, whereas from a public right of way it will be discontinuous in both time and space.

7.4.20 Issues Related to Abandonment

Impacts

Failure to obtain the approval from the authority would lead to the cancellation of the Project, thus causing great opportunity and monetary losses particularly to the Proponent, the State Authority and the general public for loss of job opportunities and facilities. If abandonment occurs either during development or operational stage, the structures that have been put up will be left unattended, thus, it would also create unsightly derelicts.

7.5 RESIDUAL IMPACTS

Potential environmental impacts may remain even after all necessary mitigation measures have been adopted and implemented into the project plan. These should be described as residual impacts, which may require further studies and monitoring. Knowledge of these impacts is necessary for the formulation of terms of reference and defining the scope of works for undertaking such studies. Where monitoring and follow-up studies are necessary, the monitoring programme needed should be described.

The lack of concern or an inability to apply the necessary environmental management has resulted in certain quarry operations have in the past failed to achieve adequate standards of environmental performance.

The assessments of the environmental impacts likely to arise from the operation stage have shown that the impacts are within the generally acceptable levels, and that no major long term residual environmental impacts are anticipated provided that appropriate mitigation measures are properly carried out.

However, some residual impacts may remain despite the adoption of the control measures due to factors such as poor management and maintenance of the operations. During the development and operational stages, the main concerns are related to;

- Air pollution, water and noise during site preparation works, plant construction, installation of equipment, quarry operation and transportation operations;
- Vibration, air-blast and possible occurrence of fly-rock from rock blasting operation.

These potential impacts, if uncontrolled, may lead to pollute the receiving water body, increase in concentration of fugitive emission and Total Suspended Particulate (TSP) in the ambient air. They may also endanger the health and safety of the workers and also the surrounding population.

In order to prevent the immediate impacts become as residual impacts, the Project Proponent is recommended to follow all the mitigation aspects mentioned for the friendly impact to the environment. Top management system must ensure that the maintenance and utilisation are carried out in a proper manner with much better procedures. If there are impacts occurred, mitigation should be taken as soon as possible.

During the operational stage, the main concern is the potential increase of air, water and noise pollution due to improper containment of erosion as a result of overburden excavation, lack of maintenance and improper handling of the quarry operation.

On the safety and health aspects, it is recommended that the employees working near the adverse environmental impact areas in the quarry such as the area prone to noise and dust emissions shall be required to use an approved Personal Protection Equipment (PPE) for hearing protection device such as ear muffs or ear plugs and respiratory gears at all times.

Residual impacts can be divided into residual adverse impacts and residual beneficial impacts. Residual adverse impacts are negative impacts, which remain even after mitigation because of circumstances beyond the control of the Proponent or the relevant authorities. Residual beneficial impacts are favourable impacts that do not warrant any mitigation because they contribute positively to enhance the environment.

Impacts Due to Air Quality

Even high care maintenance and controlled is carried out, the results is not totally achieved due to the nature and the efficiency of human made product. The efficiency of the operation can be seen from the impact at the surrounding after a period of time.

Detection of residual impacts by dust can be made by comparison of the previous surrounding area before the plant is installed and the condition after a period when the quarry is fully operated. If there is high dust contaminated on the leaf or trees at the area close-by, this means that, the Project implementation is failure to prepare the environment that should be provided. Furthermore, the health of the workers and the surrounding residence are other aspects that determine that dust emission or other pollutant from the quarry has become residual impacts to the environment.

Impacts Due To Noise

Noise problem is the impact that is really hard to be prevented especially regarding the vehicle movement and plant operation. Complaints from the neighbouring interests will show that it was a residual impact to them. For the workers the impact more related to their health aspect due to their hearing problem. However, noise shall be an issue of concerned as the noise level from the quarry is below the Recommended Noise Level Guideline. Furthermore to avoid any hearing impairment and loss, if the need arise, make it compulsory for workers to wear earplugs when going for inspection around the quarry.

Impacts Due To Water Quality

This impact is not likely to occur if sediment basins and drains constructed within the quarry area are functioning as expected. It is also possible to occur if there is unreasonable attitude such as illegally release of wastewater or solid waste to the drainage and also leakage/spillage of fuel or other hazardous material. If occurred, the impact pretty tremendous because it is not only affected the water bodies nearby but also the downstream activities where the water flows. If dust emission problem occur, it will affect the water quality by the sedimentation of dust in the water, thus it may change the water characteristics.

Occupational Safety and Health Impacts

The impacts shall be controlled from time to time with control measures such as supplying all the workers adequate safety gears (earplugs, safety shoes, respiratory masks, etc.) and its usage made mandatory. Workers exposed for long periods shall be sent for periodic medical check-up. Wastes generated at the quarry site shall be stored, treated or disposed at approved dump site or within the quarry area. Good and safe working procedures shall also be implemented and maintained throughout the quarry operation.

Socio-Economic Impacts

In long term aspect socio-economic is the most beneficial impact in residual impact. The employment provided by the Proponent may increase the life standard of poor residents around that area. This employment opportunities also a contributor to the expected future employment from the structure plan of the area.