

MABURA QUARRY

2022

Background Information Document



WINDSOR TECHNOLOGIES

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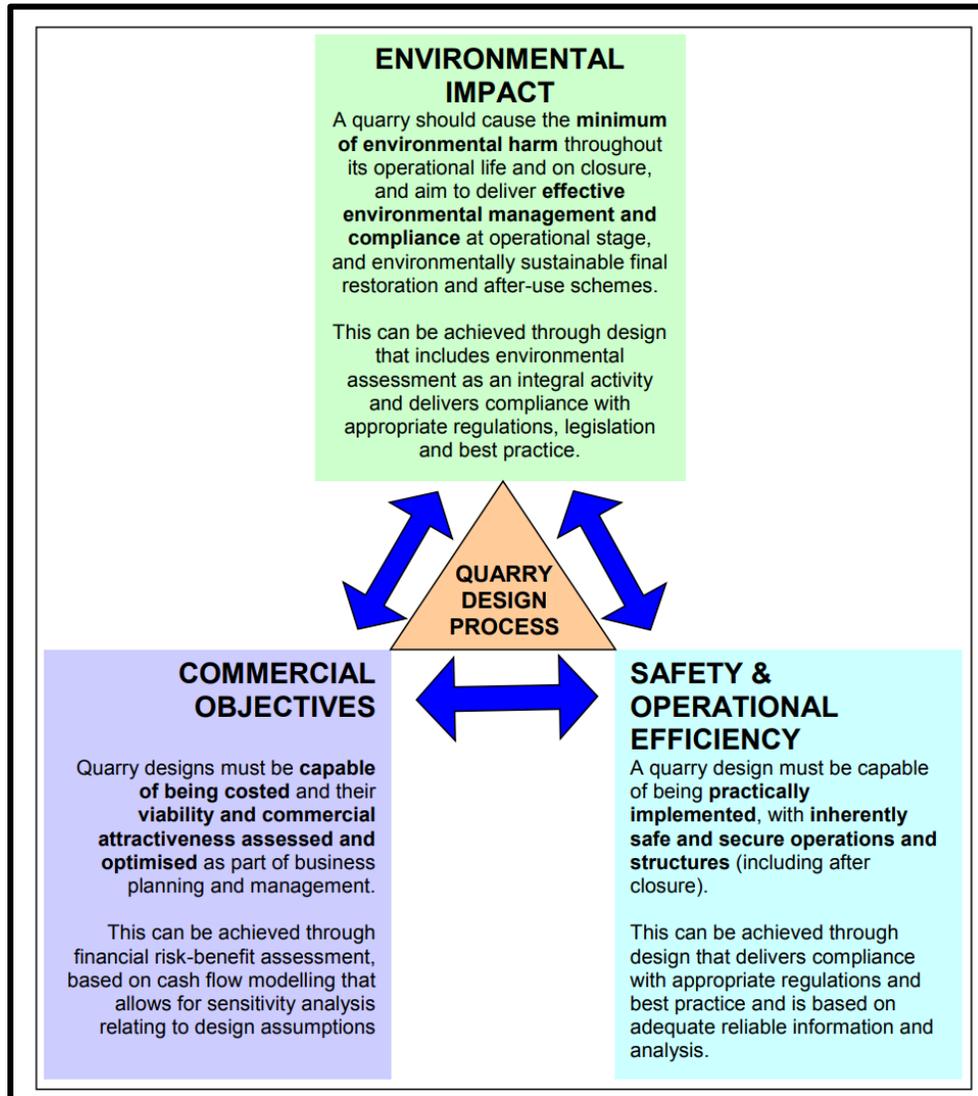
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1.0 Executive Summary

- The primary reason for the opening of this quarry was to satisfy the Ministry of Public Works with boulders for sea defence maintenance and aggregates for road maintenance and other construction works.
- The quarry will produce boulders, crusher-run and aggregates (1" 1½", 2", and 3")
- The Quarry will be owned and operated by:
Windsor Technologies
19 Shamrock Gardens,
Ogle
East Coast Demerara, Guyana
- The area applied for the safe operation of the quarry is approximately 4,187 acres, save and except all lands lawfully held or occupied. The actual operation of the quarry will impact/utilize less than 150 acres.
- The area has approximately 7.4 Mil tonnes of quarry resources
- The proposed quarry will produce approximately 1.7 Mil tonnes of boulders and aggregates in five years. The production rate will fluctuate depending on demand.
- 100 persons will be employed
- Environmental management for the project will be outsourced.

2.0 Introduction

The primary objectives for this quarry plan is to develop a project is safe, efficient and profitable extraction of the maximum usable material from the available land whilst causing the minimum usable environmental disturbance are resultion in beneficial final restoration and land uses. The essentian balance between these objectives are illustrated in the Figure below.



The area selected for development has been identified by the applicant after careful consideration:

- Establishing the minimum land requirements- limits of recovery mineral resources and areas required for association such as processing, stockpiles of finished products, assess and on-site disposal of quarry or process waste,
- Establish the legal context and control of the land.
- Establish the planning context, history, status and planning cycle
- Site description-ground surface contours, geological, geochemical, maps etc

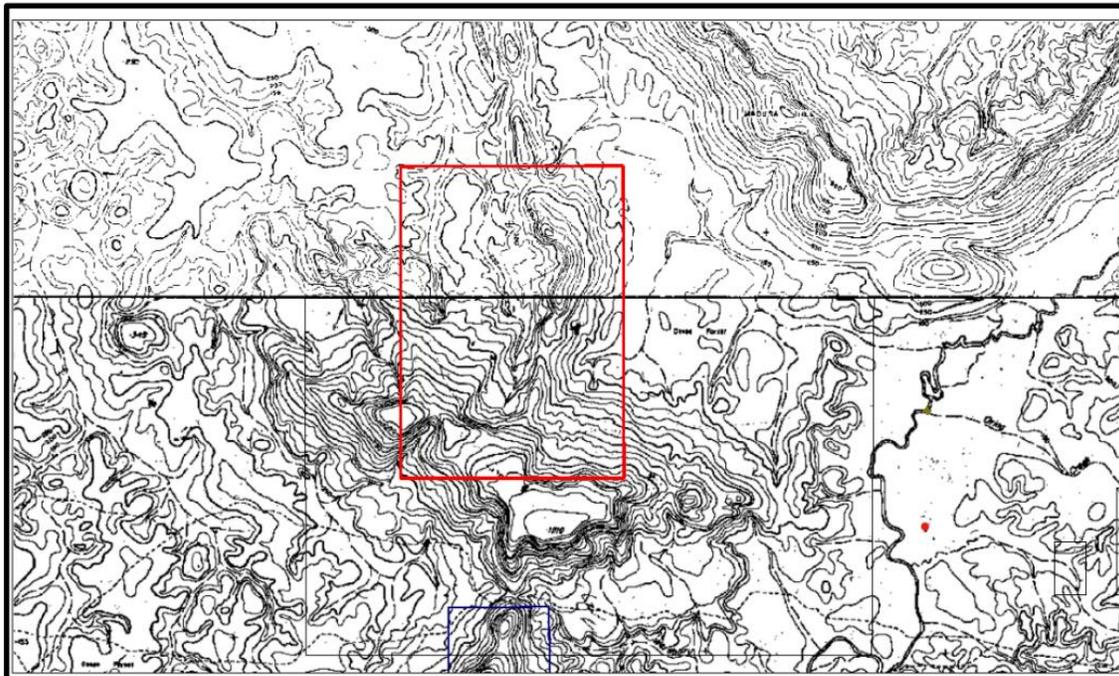
- Identification of environmental drivers- issues that will have a major effect on design, the presence of ecology or archaeology on which there might be an impact, or the presence of sensitive receptors (residence) who may be affected by noise, dust, visual impact or any other nuisance
- Identification of safety drivers, identification of geotechnical or operation settings relevant to the deposit location that influence the creation of inherently safe designs for the workforce and third parties
- Establishing the commercial/financial context- the market competition, establishment costs etc.
- The quarry plan of operation was prepared with the effective identification and interpretation of the primary information obtained for the project. The information is subjected to further reviews as the project evolves.

3.0 Site Selection

The quarry design process commenced with the selection of the site as a prelude to its promotion through the planning and licencing process. The starting points for the site selection was based on the assessment of the active quarry licences, the regional and local geological information, assessment of the land tenure, availability of areas identified and finally the site visit. One of the major criteria, however, was the feasibility of the project, the current demand and supply, prices for commodities, capital and operation expenditure, taxes and royalties etc.

From the pre-feasibility, it was determined that the production cost for one ton is approximately USD\$26.00/ton and the wholesale price was estimated as USD \$50/ton. Hence, a surplus of USD\$24.00/ton. At 150,000 tons per year for the first year, Mabura Quarry will generate a surplus of USD \$3,600,000.

4.0 Property Description



Tract of state land located in the Potaro Mining District No. 2 as shown on Terra Surveys Topographic Map 44NE and 44SE, at scale 1: 50,000 with reference point 'X' located at the confluence of the Demerara River and Oring Creek located with geographical co-ordinates of longitude $-58^{\circ} 33' 36''\text{W}$ and latitude $5^{\circ} 14' 3''\text{N}$ for a distance of 7 miles 1742 yards to Point A, located at geographical coordinates of longitude $-58^{\circ} 41' 3.4''\text{W}$ and latitude $5^{\circ} 16' 6''\text{N}$, thence at true bearing of 90° , for a distance of approximately 2 miles 341 yards, to Point B, located at geographical coordinates of longitude $58^{\circ} 39' 9''\text{W}$ and latitude $5^{\circ} 16' 6''\text{N}$, thence at true bearing of 180° , for a distance of approximately 5 miles 355 yards, to Point C, located at geographical coordinates of longitude $58^{\circ} 39' 9''\text{W}$ and latitude $5^{\circ} 13' 29''\text{N}$, thence at true bearing of 270° , for a distance of approximately 2 miles 341 yards, to Point D, located at geographical coordinates of longitude $58^{\circ} 41' 3.4''\text{W}$ and latitude $5^{\circ} 13' 29''\text{N}$, thence at true bearing of 0° , for a distance of approximately 5 miles 355 yards to the point of commencement at Point A. 3 Thus, enclosing an area of approximately 4,187 acres, save and except all lands lawfully held or occupied.

5.0 Location and Accessibility



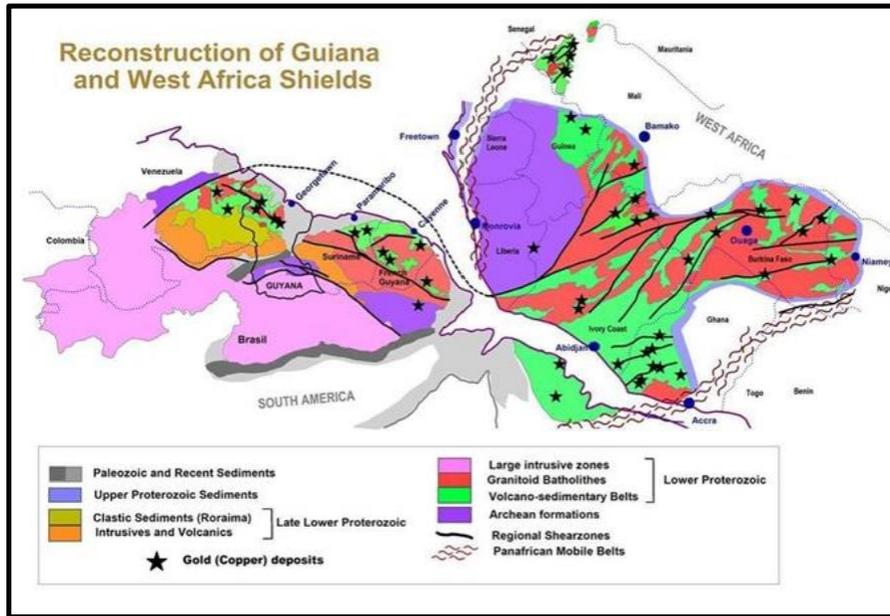
Mabura is a village located **along the Lethem – Linden trail at Region 10, Guyana, South America** – about 127 km from Linden when traveling from Georgetown to Lethem. The village, also known as “Great Falls” village, contains a police outpost which is a checkpoint for passengers traveling along the Lethem – Linden Trail. The proposed quarry is approximately 9-12 km from Mabura.

6.0 Regional and Local Geology

The geology of the area consists of basic and intermediate meta-volcanics / greenstones, intruded by younger granites and then by basic sills and dykes. Superficial quartz sand (White Sand) covers a significant part of the survey area but appears to be at least in some places a locally derived residual deposit, rather than an alluvial sand cover.

Generally, the geology of this area is very similar to that seen in other parts of the greenstone belts of Guyana, with the oldest rocks consisting of the Lower Proterozoic Barama-Mazaruni Supergroup (meta- basic rocks, intermediate meta – volcanics, acid meta – volcanics, meta – sediments and older small granitoid intrusions), which at Omai is known to be intruded by an older granitoid (Voicu et al 1999). The Barama-Mazaruni Supergroup has many of the characteristics of an island arc succession, with marine mafic to felsic meta-volcanics with interstratified tuffaceous and exhalative sediments, tuffaceous graywackes and pelitic sediments, intermediate and acid volcanics. In this district there is no clear evidence for the relative ages of different lithologies, though Gibbs and Barron (1993) report evidence from the Barama area that suggests that the list of lithologies above is in approximate order of age.

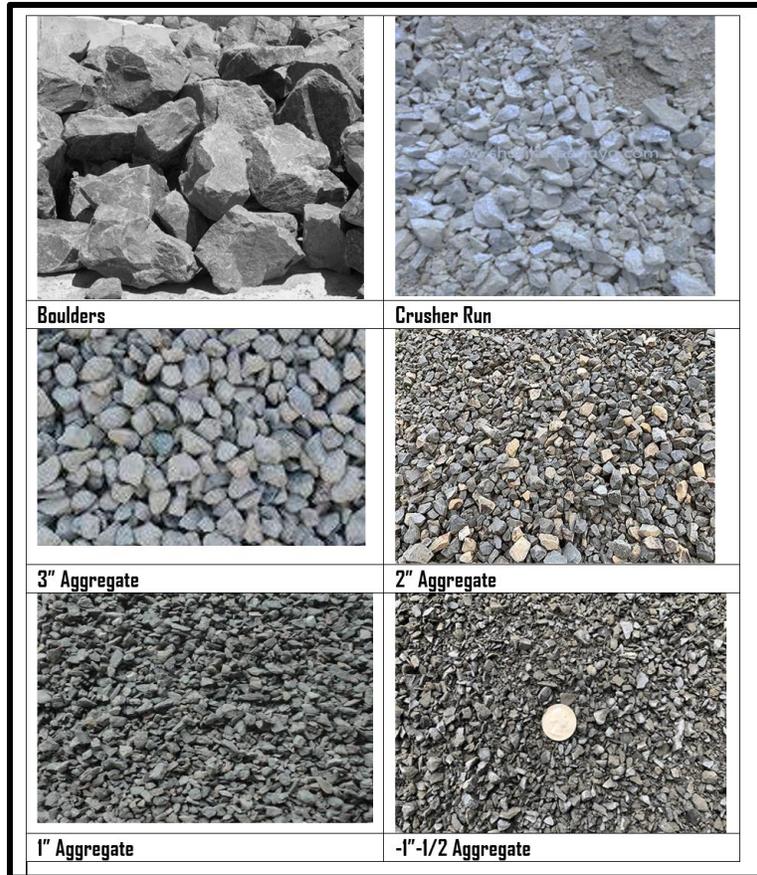
Larger Younger Granites then intrude the older rocks. To the south of the Mabura area, middle proterozoic Burro Burro Group rocks unconformably overly the pre-Cambrian basement. These consist of sandstones of the Muruwa Group, acid volcanics of the Iwokrama Formation and then sediments of the Roraima Formation. The Burro Burro Group (which consists of sandstones and quartzites of the Muruwa Group, acid volcanics of the Iwokrama Formation and sediments of the Roraima Formation) is locally intruded by sub-volcanic granites. It is not known whether small areas of such rocks may occur in the southern part of the Mabura area as well. All older units are then intruded by the Avanavero Suite (Younger Basic) sills and dykes. Two other phases of small Palaeozoic and Mesozoic basalt and dolerite dykes probably also occur in this area, but as lithologies are almost identical, are difficult to differentiate from the Younger Basic (which can be divided into two main groups; large doleritic to gabbroic bodies, and small basaltic to doleritic linear dykes).



The Guiana Shield has been correlated with the Leo-Man Shield of West Africa, and it is generally accepted that prior to the opening of the Atlantic during the Mesozoic the two shields formed contiguous craton. The Archaean Imataca Complex can be correlated with the Archaean Liberian Province, the Central Guyana Granulite Belt with the Dimbroko Zone in Ivory Coast, the BaramaMazaruni greenstones with the Birimian greenstones and the Trans-Amazonian tectono-thermal event with the Eburnean Orogeny.

The project area encompasses and is composed predominantly of Mafic dykes belonging to the Younger Basic Group or Avanavero Suite. (1.78 Ga) The Northern Guyana Metallogenic Province which includes the Barama-Mazaruni Supergroup is the principal metallogenic province of Guyana. The overall distribution of gold occurrences in the Northern Guyana Metallogenic Province is controlled by structural breaks (Walrond, 1985). The mineralization of the area showed values high in copper, nickel and cobalt in 1969 by Banerjee, A.K. and covers the Empresa Hills, Upper Demerara River. The Empresa area rocks shown that pyrite, chalcopyrite, magnetite and pyrrhotite occur in shear zones within amphibolitic meta-basic volcanics. Drilling (Banerjee and Saha) suggested that the potential economic mineralization was limited.

7.0 Commodities



The quarrying industry's role is to provide a reliable supply of construction materials for road making, building construction, and the maintenance of road networks on which other industries depend.

As observed in other industries, successful market leaders are those who provide an efficient and effective service and are mindful of all aspects of their public image. The modern community demands that these premises be managed carefully with consideration of the needs of the environment, neighbours, and employees.

The general objective in planning for the provision of these materials is to ensure that the supply is managed in a sustainable way, so the best balance is obtained between environmental, economic, and social considerations.

The primary reason for the opening of this quarry was to satisfy the Ministry of Public Works with boulders for sea defence maintenance and aggregates for road maintenance and other construction works in Guyana.

8.0 Quarry Operation

A quarry operation is essentially an open pit operation. Extraction of rock from the quarry is carried out by firstly removal and storage of the topsoil for rehabilitation, stripping which is essential removing the overburden, drilling, and loading the drill holes with explosives, blasting (where required) and then removal by excavators. Extracted rock is then delivered to the crushing plant(s)

by loaders or dumpers depending on requirements of the crushing plant(s). It is the duty of the quarry operator or his/her delegated representative to develop and ensure compliance with suitable and sufficient rules covering excavation to ensure the safe construction and operation of excavations.

Such rules shall specify the following matters –

- (1) the manner in which such activities are to be carried out;
- (2) the nature and extent of supervision of such activities; and
- (3) the precautions to be taken during such activities to properly avoid, mitigate or minimise risks to the health and safety of any person and the safety and stability of the excavation.

8.1 Blasting

Primary Fragmentation

The major costs associated with hard rock quarrying are incurred from loading from a rock pile and crushing of broken rock at the processing plant. Two basic techniques are commonly used in primary fragmentation:

- Drilling and blasting; and
- Mechanical breaking (ripping)

The selection of the method used will consider:

- The degree of weathering of the rock mass
- The nature and frequency of discontinuities in the rock mass (fractures, faults, joints, bedding etc)
- The crystallinity, nature, and grain size of the rock mass; and
- The impact strength of the rock mass

The degree of primary fragmentation required is normally geared to producing acceptable sizes for loading and crushing. Primary fragmentation should be designed therefore to optimize the distribution of particle sizes within the rock pile, compatible with the loading and crushing plant. The selection of methods and the degree of fragmentation to be achieved should therefore be assessed against the proposed plant and methods of digging for the operation.

Inappropriate particles size in the rock pile can reduce efficiency of the loading plant, resulting in slow cycle times and increase wear to buckets and teeth of the excavator. When oversize material is delivered to the crushing circuit at the processing plant, additional effort (and energy) is necessary to reduce lump size in the primary crusher. If blocks that are too large are delivered, the system can be temporarily put out of action as the crusher becomes choke, leading to a loss of production increase wear on the crusher plants can also result.

Blast design can be time consuming and expensive if considered for each blast in detail. Consequently, it is common practice to determine a set of rules for a typical blast in different zones of the quarry to satisfy the often-contradictory requirements for production of broken rock and environmental protection. Individual blasts will still require assessment and should be properly recorded.

The degree of fragmentation produced during blasting is determined by two principal factors:

- Explosive energy creating new fracture surface in the rock mass; and
- Exploitation of existing planes of weakness such as joints, fractures etc.

Other factors relating to the choice and the quantity of explosives used, the arrangement of blast holes and the sequencing of detonation will also have an effect. Variations in these aspects can also be used to limit adverse environmental effects or to improve the profile of the blast pile

8.2 Ripping

Mechanical breakage is possible where the rock mass is already fractured extensively (usually by inherent planes of weakness in the rock). Ripping using a doozer fitted with a tooth at the rear, is the most common method.

In most quarries and deposits, ripping techniques may be used only on a limited basis if at all (e.g. in areas in poor ground) they can be effective in short duration excavations (e.g. for construction projects) or in preparation of the upper benches in a quarry (where the ground may already be fairly broken by weathering).

Where applicable, ripping has costs advantages over drilling and blasting and avoids many of environmental impacts associating with blasting.

8.3 Secondary Fragmentation

If the primary fragmentation is inefficient and may not produce a well graded rock pile suitable for immediate loading and crushing. Geological conditions or a need to limit the amount of explosive used in mitigating environmental impacts) may locally produce block sizes that are too great to be handled and, in such circumstances, it is often necessary to undertake secondary fragmentation.

This can be achieved using explosives, but such methods are normally unacceptable on safety grounds as blast can be uncontrolled and result in fly-rock being generated. It also produces environmental impacts (mainly noise). Mechanically methods are generally preferred.

- The use of drop ball
- The use of pneumatic/hydraulic impact breakers (rock pecker)

Drop balls are popular, effective and relatively cheap, but suffers from being slow and therefore inefficient where high production rates are required. Safety is often a hazard arising from flying rock pieces are often associated with this method.

Rock peckers have a number of advantages in secondary breaking applications. They are efficient machines and can be used to accurately reduce block sizes in the rock pile. In addition, they can also be used in other duties in the quarry, principally in scaling faces (to remove large hanging blocks that may pose safety hazards).

8.4 Explosives

When analysing the best explosive for use at a quarry operation, the decision comes down to the environment in which the explosive will be used and what is most cost-effective.

The main environmental consideration is whether the blastholes will be wet or dry. If the boreholes contain water, then the only available explosives are emulsion or a blend that is greater than 60 percent emulsion. In this case, the major decision will be based on the loading capabilities at the site and the cost of blends versus emulsions.

It will be critical in this phase, too, to analyse drilling costs to determine if slightly cheaper blends provide an advantage over the emulsion. The blends may require more drilling cost compared to the emulsion.

Should the boreholes be dry, ANFO is almost always the most economical choice – unless drilling costs are extremely high. In almost all situations, blasting in dry ground will lead to ANFO being the most economical, easiest to load and lowest risk to the mine in the event of misfires or bad product. Therefore, ANFO has taken over 80 percent of the explosives market in recent years.

Consider, too, that different products will result in different fragmentation and throw, and environmental factors and proper testing should always be completed on site to determine the optimal explosive.



1st Topsoil Removal



2nd Topsoil Storage



3rd Stripping Overburden



4th Drilling



5th Blasting



6th Loading Blasted Products



7th Crushing and Screening



8th Rehabilitation and Closure

Stages of the Proposed Quarry Operation

8.5 Production schedule

Products	Year 1	Year 2	Year 3	Year 4	Year 5	TOTAL
Boulders	10,000	50,000	50,000	50,000	50,000	210,000
Aggregate	120,000	300,000	300,000	300,000	300,000	1,320,000
Crusher run	20,000	50,000	50,000	50,000	50,000	210,000
Total	150,000	400,000	400,000	400,000	400,000	1,740,000

8.6 Equipment

Manufacturer	Type	Quantity	Capacity/specifications	Activities
Caterpillar	Haul Trucks	2	40 T	Hauling
Caterpillar	Front-end loader	2	980G	Loading
Caterpillar	Bulldozer	1	D9	Debushing, stripping
Caterpillar	Excavators	2	325 LN	Stripping/removing oversized rocks, loading
Caterpillar	Jumbo drill	1	MD 5075	Drilling blast holes

8.7 Appraisal of Excavations

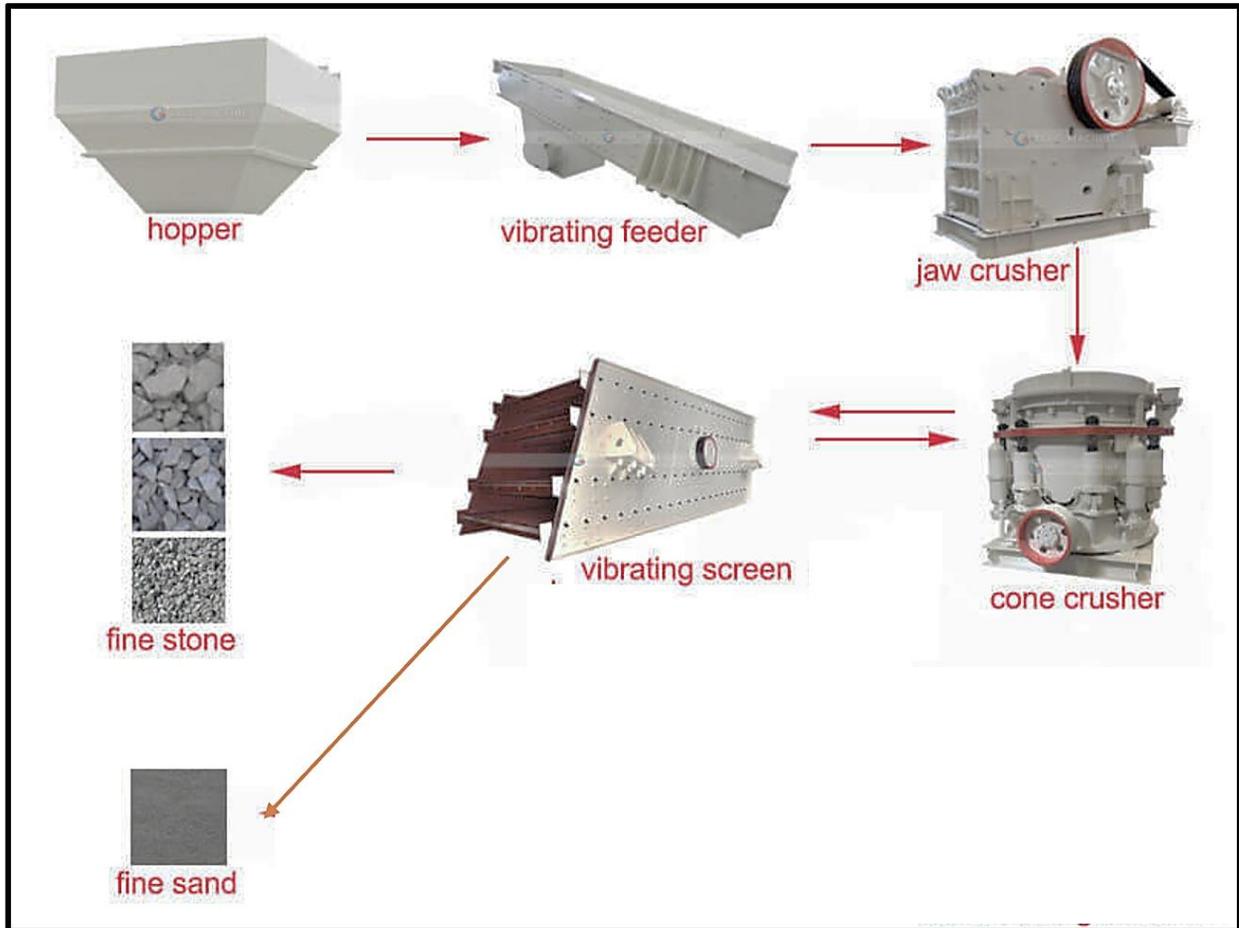
The quarry operator or his/her delegated representative will ensure that a suitable and sufficient appraisal of all proposed or existing excavations at the quarry is undertaken by a competent person to determine whether any such excavation is a significant hazard.

- (1) The quarry operator or his/her delegated representative will ensure that –
 - (a) any significant findings made during an appraisal, any conclusions reached and the reasons for those conclusions are recorded by the competent person undertaking the appraisal.
 - (b) the competent person signs and dates any such record; and
 - (c) the record made in accordance with sub-paragraph (a) is made available to each employer of persons at work at the quarry and to all persons at work at the quarry.
- (2) Where the conclusion reached by the competent person following an appraisal is that the excavation presents no significant hazard then further such appraisals shall be carried out by a competent person –
 - (a) at appropriate intervals.
 - (b) whenever there is any reason to suspect that there has been or will be a significant change to-
 - (i) the matters to which the appraisal relates, or
 - (ii) any neighbouring land which may be affected by movement by or instability of the excavation to which the appraisal relates; and
 - (c) whenever there is any reason to doubt the validity of the conclusion of the current appraisal.
- 3) Where the conclusion reached by the competent person following an appraisal is that the excavation represents a significant hazard, the quarry operator or his/her delegated representative will close the excavations down as soon as is reasonably practicable pending an

assessment of the site and or a geotechnical assessment. The quarry operator or his/her delegated representative will ensure that –

- (a) any significant findings made during an assessment or geotechnical assessment are recorded; and
- (b) any remedial works identified during the assessment are undertaken by the date specified.

8.8 Rock Processing (Crushing, Screening and Washing)



Stages of the Proposed Quarry Process FI

The Table below shows the equipment required to process quarry material.

No.	Name	Type	Qty	Unit	Capacity (kw)
1	Feeder	GZT1148	1	No.	2x5.5
2	Jaw crusher	PE750x1060	1	No.	110
3	Cone crusher	SMH250	1	No.	200
5	Small feeder	GZG125-4	1	No.	2x1.1
6	Heavy vibrate sieve	2YKRH1860	1	No.	18.5

7	Vibrate sieve	3YK2160	1	No.	30
8	Belt conveyor		12	No.	
9	Integrated circuit control system		1	set	
10	Non-standard part and leg of belt conveyor		1	set	

8.8.1 General

This section describes the proposed mode and scope of the quarrying operations to be carried out at the Quarry. Quarry operations will vary over time in accordance with operational requirements and changes in quarrying technology and methods.

8.8.2 Process

The process begins with the loosening of rock by blasting and excavation on the quarry face. This material is then transferred to the crushing plant by front-end loader or dump truck.

8.8.3 Primary Crushing

Aggregate transferred to the primary feed bin passes over a primary scalping screen where oversize material is processed through a Jaw Crusher. Undersized aggregate from the scalping screen bypasses the primary crusher and is transferred to produce by-products. The use of this screen reduces the overall load on the primary crusher. Aggregate is then passed to the main feed belt where it is transferred into the secondary feed bin.

8.8.4 Secondary Crushing

Aggregate from the secondary feed bin passes over a scalping screen, with the undersized bypassing the crusher, again reducing the load on the secondary crusher. The remaining aggregate passes through a cone crusher. Product is then conveyed to a Barmac for shaping before screening and or return to the Barmac for further reduction.

8.8.5 Aggregate Washing

Aggregate is fed to the wash screen where it is washed and graded to the required product size. All products having been processed are then transported to specified storage areas for stockpiling.

8.8.6 Cleaning Sites

Cleanfilling is part of the process of rehabilitating a quarry site through progressive backfilling, using only safe material which can be engineered to fit best practice standards. This ensures the land will be available for other uses in the future and align with any agreed environmental commitment. The quarry operator or his/her delegated representative will ensure that a suitable and sufficient appraisal of all proposed cleanfilling sites at the quarry is undertaken by a competent person to determine whether any such cleanfilling site is a significant hazard.

(1) The quarry operator or his/her delegated representative will ensure that –

(a) any significant findings made during an appraisal, any conclusions and the reasons for those conclusions are recorded by the competent person undertaking the appraisal.

(b) the competent person signs and dates any such record; and

(c) the record made in accordance with sub-paragraph (a) is made available to each employer of persons at work at the Quarry and to all persons at work at the Quarry.

(2) Where the conclusion reached by the competent person following an appraisal is that the cleanfill site presents no significant hazard, then further such appraisals shall be carried out by a competent person.

(a) at appropriate intervals

9.0 Benches and Haul Roads

The quarry operator or his/her delegated representative will ensure that –

(1) Benches and haul roads are investigated, designed, constructed, and monitored by a competent person to allow vehicles and plant to be used and moved upon them safely –

(a) a written report by a competent person that includes the statement that the intended height is safe and water discharge and collection is managed.

(b) each working bench would have separate loading arrangements and of sufficient length and breadth to provide safe working conditions for the vehicles and equipment used on it as determined by a competent person.

(c) working benches will be designed in such a way that no water is discharged over a lower face bench.

(2) The overburden or top of the quarry will be cleared far enough back from the edge of the quarry to provide safe working environment

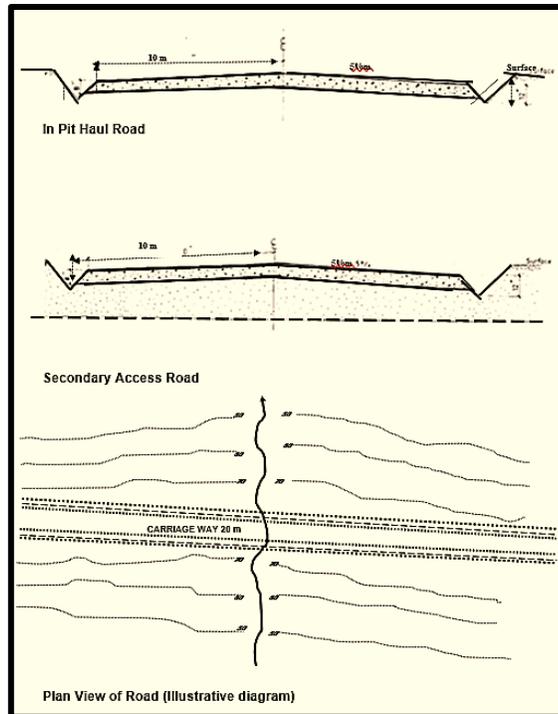
(3) All vehicle access roads within the quarry will be so constructed and maintained that the width and surface of the carriageways are safe for the purpose for which they are to be used. Where access roads to benches are used to transport the quarried product by vehicle down a gradient, then the maximum gradient will be 1 in 10 and in no case shall it exceed a gradient of 1 in 5.

(4) Where necessary, effective precautions will be taken, by the installation of barriers or otherwise, to prevent vehicles or plant accidentally leaving any bench or haul road

In-site roads will generally measure 10-m wide with 0.5-m wide drainage channels, as required, along both sides of the road.

Haul roads will generally be 20 m wide inclusive of safety berms and ditches. Haul trucks will have the right-of-way and all other traffic crossing the haul roads must yield to the haul trucks.

Illustrative road design



9.1 Quarry Operational and Finished Faces

The quarry operator or his/her delegated representative will ensure, so far as is reasonably practicable, that –

- (1) a face would not be worked in a manner that will create an overhang of the face
- (2) where unconsolidated ground is quarried, the face and sides would be battered to prevent collapse
- (3) a face would not be undercut by excavation of a slot at the toe of the face
- (4) where a person is required to work at the toe of a quarry face or on the face itself, the face will be safely scaled of loose rock that could fall on the person
- (5) faces would be left in a safe condition at the end of each day's work
- (6) finished slope of quarry faces will not exceed 55 degrees from the horizontal
- (7) maximum height of finished batters will not exceed 15 meters (excludes working batters).

9.2 Barriers, and/or Fences

The quarry operator or his/her delegated representative will ensure that, where appropriate, a barrier suitable for the purpose of discouraging trespass is placed around the boundary of the quarry and is properly maintained

9.3 Signs

The quarry operator or his/her delegated representative will ensure that signs are positioned throughout the Quarry site providing safety and general site information.

9.4 Escape and Rescue Facilities at the Quarry

The quarry operator or his/her delegated representative will ensure that –

- (1) adequate means of escape and rescue are provided and maintained so as to permit persons in the quarry to leave the quarry promptly and safely in the event of danger;
- (2) adequate means of communication and warning are provided to enable assistance, escape and rescue operations to be launched at once when required;
- (3) written instructions concerning the use of emergency equipment and the action to be taken in the event of an emergency at or near the quarry are prepared;
- (4) persons at work at the quarry are trained in appropriate action to be taken in the event of an emergency; and
- (5) rescue equipment is provided at readily accessible, appropriately sited and clearly signposted places and kept ready for use.

9.5 Safety Drills

The quarry operator or his/her delegated representative will ensure that safety drills are held at regular intervals for persons at work at the quarry, and that the results of the safety drills are recorded. Such safety drills will be for the following purposes –

- (1) to train the persons who work at the quarry in the appropriate actions to be taken in an emergency including, where appropriate, the correct use, handling, or operation of emergency equipment; and
- (2) to train and check the skills of such persons to whom specific duties involving the use, handling or operation of such equipment have been assigned in the event of an emergency.

9.6 Fire and Explosive Hazards

The quarry operator or his/her delegated representative will ensure that –

- (1) No person at work at the quarry uses a naked flame or carries out any work which could give rise to a risk of an unintended explosion or fire unless sufficient measures to prevent such an explosion or fire are taken.
- (2) No person shall smoke in any part of the quarry where there is a risk of fire or explosion.

9.7 Control of Harmful and Explosive Atmosphere

- (1) It is the duty of the quarry operator or his/her delegated representative will ensure that –
 - (a) steps are taken to determine whether potentially explosive substances are present in the atmosphere and, where such substances are present,
 - (b) at any place in the quarry where there is a risk of the occurrence or accumulation of an explosive atmosphere, all necessary measures are taken with a view to –
 - (i) preventing such occurrence and accumulation, or, where this is not practicable,
 - (ii) preventing the ignition of such an atmosphere; and
 - (c) at any place in the quarry where there is a risk of the occurrence or accumulation of a substance harmful to health in the atmosphere, appropriate measures are taken in order to –
 - (i) prevent such occurrence and accumulation, or, where this is not practicable,
 - (ii) extract or disperse that harmful substance, in such a way that persons are not placed at risk.
- (2) Whenever persons at work are present at any place in the quarry where they may be exposed to a substance harmful to health in the atmosphere –
 - (a) appropriate and sufficient breathing and resuscitation equipment shall be made available; and
 - (b) enough persons trained in the use of such equipment shall be present.

(3) The quarry operator or his/her delegated representative will ensure that equipment referred to a paragraph (2) (a) is suitably stored and maintained.

9.8 Danger Areas

The quarry operator or his/her delegated representative will ensure that –

- (1) any danger areas in the quarry are clearly marked;
- (2) equipment or barriers designed to prevent inadvertent entry by any unauthorised person are installed at any danger area in the quarry in which, because of the nature of the work being carried out there or for any other reason there is –
 - (a) risk of a person falling a distance likely to cause personal injury,
 - (b) risk of a person being struck by a falling object likely to cause personal injury, or
 - (c) a significant risk to the health and safety of persons; and
 - (d) where any person at work is authorised to enter a danger area, appropriate measures are taken to protect his/her Health and Safety

10.0 Quarry Management Plans

10.1 Environmental Management

Some of the environmental disturbance created by quarrying is caused directly by engineering activities during aggregate extraction and processing. The most obvious engineering impact of quarrying is a change in geomorphology and conversion of land use, with the associated change in visual scene. This major impact may be accompanied by loss of habitat, noise, dust, vibrations, chemical spills, erosion, sedimentation, and dereliction of the mined site. Some of the impacts are short-lived and most are easy to predict and easy to observe. Most engineering impacts can be controlled, mitigated, kept at tolerable levels, and restricted to the immediate vicinity of the aggregate operation by employing responsible operational practices that use available engineering techniques and technology

10.1.1 Geomorphic Impacts

Quarrying has an associated, often dramatic, visual impact. The principal geomorphic impact of quarrying is the removal of stone, which results in the destruction of habitat. The extent of the geomorphic impact is a function of the size of the quarry and the location of the quarry, especially with respect to the overall landscape and the local landforms. The influence of quarry size on environmental impact is obvious: all other things being equal, the larger the quarry, the larger the geomorphic impact. The size of quarries has increased over time, and so has their impact. The actual size of the proposed quarry is less than 20 acres. However, the areas for the other facilities will be approximately 150 acres and will not alter the geomorphology of the area.

10.1.2 Noise

Sources of noise	Proposed hours of operation		
	Monday to Friday	Saturday, Sunday and Holidays	Declared Public Emergencies
Crushing Plant	7:00 a.m. to 5: p.m.	None	Restrictions suspended
Maintenance Activities	7:00 a.m. to 7:00 p.m.	Two Saturdays and two Sundays per month	Restrictions suspended
Truck access	7:00 a.m. to 5:00 p.m.	No activities on Sundays limited on Saturdays	Restrictions suspended

Blasting	11:30 a.m. to 1:30 p.m. (Once every three months) with potential effected parties given 3 days advance notification	None	Restrictions suspended
Drilling	7:00 a.m. to 5:00 p.m. For two weeks per month	None	Restrictions suspended
Other mining activities, quarrying, debushing, stripping and loading	7:00 a.m. to 5:00 p.m.	None	Restrictions suspended
Office	7:00 a.m. to 5:00 p.m.	None	Not specified

The primary source of noise from extraction of aggregates from earth-moving equipment, processing equipment, and blasting. The truck traffic that often accompanies aggregate mining can be a significant noise source. The impacts of noise are highly dependent on the sound source, the topography, land use, ground cover of the surrounding site, and climatic conditions. The beat, rhythm, pitch of noise, and distance from the noise source affect the impact of the noise on the receiver. Topographic barriers or vegetated areas can shield or absorb noise. Sound travels farther in cold, dense air than in warm air and travels farther when it is focused by atmospheric inversions than when inversions are not present.

An important factor in determining a person's tolerance to a new noise is the ambient (background) noise to which one has adjusted. In general, the more a new noise exceeds the existing background noise level, the less acceptable the new noise will be. In an urban or industrial environment, background noise may mask noise from a quarry operation, whereas the same level of noise in a rural area or quiet, residential neighbourhood may be more noticeable to people. Furthermore, ambient noise generally is an accumulation of noises and does not have a single, identifiable source. If the mining noise is identifiable, the perception of noise probably will be great. For example, the noise from a single backup alarm can often be picked out from an equally loud engine noise.

Crushed stone quarriers are responsible for assuring that the noise emitted from the quarry does not exceed levels set by regulations. The impacts of noise can be mitigated through various engineering techniques. Landscaping, berms, and stockpiles can be constructed to form sound barriers. Noisy equipment (such as crushers) can be located away from populated areas and can be enclosed in sound-deadening structures. Conveyors can be used instead of trucks for in-pit movement of materials. Noisy operations can be scheduled or limited to certain times of the day. The proper location of access roads, the use of acceleration and deceleration lanes, and careful routing of trucks can help reduce truck noise. Workers can be protected from noise using enclosed, air-conditioned cabs on equipment and, where necessary, the use of hearing protectors. Worker safety may include regular health screening. Noise can negatively impact biota (discussed below).

One of the most frequent complaints the public makes to the crushed stone industry situated near population centres is about blasting noise. Blasting may occur daily or as infrequently as once or twice a year. The proposed quarry will have one blast per month which will be enough to satisfy the demands. If the demands increase, the size of the blast will also increase infinitesimal.

Geology, topography, and weather affect the impacts of blasting. Blasting noise generally increases with the amount of explosive, with specific atmospheric conditions, and with proximity

to a blast. The area in front of a blast commonly receives more noise than an area behind a blast. People differ greatly in their response to blasting

When an explosive is detonated enormous amounts of energy are released. Most of the energy of a properly designed blast works to displace rock from the quarry face. The remaining energy is released as vibrations through and along the surface of the earth and through the air. Most of the energy that goes through the earth comes to the surface within a few meters of the detonation and travels as surface waves, which may cause ground shaking. A small amount of the energy is transmitted through the rocks as shear waves, which commonly are insignificant.

When a blast is detonated, some energy will escape into the atmosphere causing a disturbance in the air. Part of this disturbance is subaudible (air concussion) and part can be heard (noise). Air concussion is most noticeable within a structure, particularly when windows and doors are closed. The air concussion creates a pressure differential between the outside and inside the structure causing it to vibrate.

Poorly designed or poorly controlled blasts may cause rocks to be projected long distances from the blast site (flyrock), which can be a serious hazard. Flyrock is not commonly a problem with carefully designed and executed blasting plans but is a situation that deserves careful attention. The pinnacle bedrock in the area can complicate blasting, increasing the risks for flyrock

The technology of rock blasting is highly developed, and when blasting is properly conducted, most environmental impacts would be negligible. By following widely recognized and well-documented limits on ground motion and air concussion, direct impacts from ground shaking and air concussion can be effectively mitigated.

10.1.3 Air Quality

Dust is one of the most visible, invasive, and potentially irritating impacts associated with quarrying, and its visibility often raises concerns that are not directly proportional to its impact on human health and the environment. Dust may occur as fugitive dust from excavation, from haul roads, and from blasting, or can be from point sources, such as drilling, crushing and screening. Site conditions that affect the impact of dust generated during extraction of aggregate include rock properties, moisture, ambient air quality, air currents and prevailing winds, the size of the operation, proximity to population centres, and other nearby sources of dust. Dust concentrations, deposition rates, and potential impacts tend to decrease rapidly away from the source.

A carefully prepared and implemented dust control plan commonly can reduce impacts from dust. Controlling fugitive emissions commonly depends on good housekeeping practices rather than control systems. Techniques include the use of water trucks, sweepers, and chemical applications on haul roads, control of vehicle speed, and construction of windbreaks and plantings. The impacts from plant-generated dust commonly can be mitigated by use of dry or wet control systems. Dry techniques include covers on conveyors, vacuum systems, and bag houses, which remove dust before the air stream is released to the atmosphere. Wet suppression systems consist of pressurized water (or surfactant treated water) sprays located at dust generating sites throughout the plant. Fugitive dust from blasting can be controlled by proper design and execution of blasts. Workers are protected from dust through the use of enclosed, air-conditioned cabs on equipment and, where necessary, the use of respirators. Worker safety may include regular health screening.

In some situations, dust on quarry floors and nearby areas can clog pores in the ground, thus altering recharge rates. In other situations, dust can enter conduits and smaller openings, and can be transported.

Construction works will result in emissions of fugitive dust and products of combustion. Fugitive dust emissions would result from land clearing, loading and unloading of trucks, excavation and grading. Dust generated would be a function of construction activities, soil type, moisture content, wind speed, frequency of precipitation, vehicle traffic and vehicle type. Fugitive emissions would be greater during dry periods.

Combustion emissions would result from chainsaw operations and the use of diesel and/or gasoline fired heavy duty equipment. Products of combustion will include Benzene, PM₁₀, PM_{2.5}, carbon monoxide, NO_x, SO₂, VOCs – a precursor of ozone and Hydrocarbons. These emissions would be short-term and would be in the vicinity of construction operations only. The impacts to air quality would be moderate (low severity; high likelihood).

Operations associated with the quarry will require a substantial supply of electrical energy. It is understood that the onsite power plant will require two 5.8-MW diesel generators for the five years of operation with one as a back-up. The generators will be fuelled by heavy fuel oil, and the heat from the exhaust of the generators will be used to preheat the fuel oil to increase combustion efficiencies. Based on these parameters, an air quality review on generation equipment in similar circumstances was utilized to examine the impacts of the proposed power generating facility. The specifications including physical stack dimensions and exhaust characteristics were estimated based on similar sized diesel generators. It assumed that the exhaust would be combined into a single, 15-meter stack and that the effect of pre-heating the fuel would reduce the exhaust temperature. Scrubbers will be installed in the stacks to reduce particulate matter to the atmosphere and stacks will be cleaned regularly to ensure the prescribed standards are met

Dust would be emitted from the access road surface and from unsurfaced areas within the port facility during operation. Equipment traversing the road will emit products of combustion emission. Equipment passage over the access road will be intermittent. The impacts to air quality would therefore be minor (low severity, medium likelihood). These impacts will be mitigated by employing the following measures:

- Limiting vehicle speed
- Maintaining equipment in accordance with manufacturer's specifications
- Providing facemasks with dust removal filters.
- Covering trucks to minimize particulate emission
- Minimizing drop heights from vehicles
- Employing dust suppression technique such as applying water or non-toxic chemicals
- Conducting periodic medical checks of employees for effects of dust exposure
- Providing goggles and eye wash lotion for dust-induced eye irritation.

Implementation of the mitigation measures will result in minor impacts.

Closure - No impacts will be generated after site closure

10.1.4 Water Resources

10.1.4.1 Surface Water

Construction - Sediment discharge from cleared areas has the potential to reduce water quality

in streams and creeks adjacent to cleared areas. These are moderate impacts (medium severity, medium likelihood). The construction duration is likely to be relatively short. An erosion and sediment control plan will mitigate potential impacts to water quality from erosion. The mitigation measures will result in minor.

The clearing of vegetation will reduce interception and may result in increased discharge to streams and creeks around the construction area and increased water levels in these streams and creeks. These are moderate impacts (low severity, high likelihood). The area is isolated from receptors and the construction period would be relatively short. Increased water levels in the streams and creeks are unlikely to exceed typical wet season levels. These impacts will be mitigated by undertaking most of the construction activities, which may result in increases in stormwater runoff, in the dry season. The mitigation measures will result in minor impacts

Surface water quality may be negatively impacted during construction by accidental discharges of fuels, oils and grease from construction equipment. The potential for accidental spills of fuels, oils and grease and the associated contamination of surface waters will be minimized by implementation of a Spill Prevention and Contingency Plan. That Plan details measures which will be implemented to prevent, and if necessary, contain spills of fuels, oils, or other contaminants. Implementation of these mitigation measures would result in insignificant impacts on surface water quality during construction.

Access road construction will include placing culverts at several stream crossings. Culverts constructed through the service road will modify the natural flow of surface water and concentrate flows at certain points and may increase the speed of surface water flow. These changes may potentially result in flooding, soil erosion, and increased sediment discharge to other streams in the vicinity of the access road. These impacts will be mitigated by designing culvert sizes to pass the natural surface water flows. Culverts shall also be lined with grass and/or, riprap, where necessary. Flow volumes will be determined as part of the hydrological monitoring program to be undertaken during design of the access road. This will result in minor residual impacts.

Surface water quality may potentially be impacted by discharges to surface water of spilled and leaked oils during construction activities. These are moderate impacts. These impact will be mitigated by identifying specific points on the alignment for equipment storage and maintenance. These areas shall have segregated and contained locations with sumps and oil traps. Construction equipment shall be mandated to be provided with leak minimization and drip pans. Oils collected from sumps, segregated areas and leak minimization devices will be stored in drums and would be disposed of at off-site locations. The mitigation measures will effectively remove any potential impacts to surface water quality. The residual impacts will consequently be minor.

Removal of vegetative cover over the access road alignment may potentially increase surface runoff volumes and alter drainage patterns locally in the vicinity of the alignment. These are minor impacts. These impacts will not be mitigated.

Operation - Wastewater during operations will consist mainly of water from quarry dewatering. Water from the quarrying dewatering will only discharge to surface water after passing through the water management pond to ensure the attainment of water quality standards. This water will have no impacts on surface water quality.

Water quality may be potentially impacted by wastewater discharges from the onsite sewerage system, Domestic wastewater or by stormwater run-off from developed areas such as workshops and other equipment storage and service areas. Discharge of wastewater from these areas to surface water may impair surface water quality by causing changes to its physical, chemical, and biological properties.

Potential impacts of discharges from onsite sewerage systems and domestic wastewater will be mitigated by channelling that wastewater to several septic tanks and then through a granular filter bed and by monitoring the “end-of-pipe” water quality before final discharge to surface water. Stormwater runoff from workshops and other equipment storage and service areas will be channelled through several oil- water separators prior to discharge to surface water. The mitigation measures will result in insignificant impacts

Surface water quality may be negatively impacted by accidental discharges of fuels, oils, and grease from equipment and/or the failure of fuel containment facilities. The potential for accidentals spills of fuels, oils and grease and the associated contamination of surface waters will be minimized by implementation of a Spill Prevention and Contingency Plan. That Plan details measures which will be implemented to prevent, and if necessary, contain spills of fuels, oils, or other contaminants. Fuel tanks will be founded impervious bases and will be located within a bermed enclosure designed to hold 110 percent of the contents of tanks. Stormwater discharge from fuel storage areas will be channelled to an oil-water separator prior to being discharged to surface water. Implementation of these mitigation measures would result in insignificant impacts on surface water quality during operation.

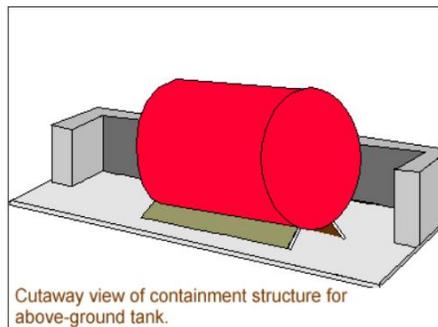


Diagram showing propose set up for fuel tank

Surface water quality may potentially be impacted by spills of fuel and other chemicals while being transported to/from the mine site. These are potentially major impacts (high severity, low likelihood). These impacts would be mitigated by implementation of the Spill Contingency Plan (SPC). Implementation of measures in the SPC will result in minor impacts.

Closure of the access road will have no impacts on surface water

10.1.4.2 Ground Water

Construction - Impermeable liners will be placed over the base of the water management ponds during construction. The impermeable liners will reduce recharge to groundwater. Very little information is available on the hydrogeology of the project area. It can be inferred from the clayey nature of the soils, encountered at the site, that groundwater recharge rates within the area are relatively low with the greater percentage of precipitation reporting as interception and surface runoff. The project area is quite small in comparison to the area available for groundwater recharge. The impacts of reduced groundwater recharge, occasioned by the impermeable liner, would therefore be insignificant.

Wells will be drilled on site to provide water for drinking/cooking. These wells will be located some distance from and at higher elevations than the mining operations and sewerage management facilities. Withdrawals from wells are unlikely to have any impacts on the availability of groundwater since there are no other withdrawals in the area.

Spills of fuel and oils from equipment and from equipment and fuel storage and service areas can flow to the underlying aquifer and potentially impact groundwater quality. This will result in minor impact (medium severity, low likelihood). Potential contamination of the underlying aquifer will be minimized by pans on all equipment, enforcing a program to check for equipment leaks and implementation of a Spill Prevention and Contingency Plan (SPCP). The SPCP will detail plans for utilization of sorbents, biological agents, chemical dispersants, gelling agents etc. All fuel will be stored within containment walls designed to contain 110 percent of the tank contents. Implementation of these mitigation measures will result in insignificant impacts to groundwater quality.

Precipitation can induce leaching of water-soluble substances and/or heavy metals from spoil piles and introduction of these chemicals into the groundwater flow regime through the base of the spoil piles. These are minor impacts (medium severity, low likelihood). These impacts will be mitigated by compacting the base of the spoil piles before commencement of spoil disposal. The weight of the spoil will induce additional compaction of its base further reducing the infiltration potential of the soils. This will result in insignificant impacts.

Operational Infiltration of wastewater from water management ponds, waste management areas and leaching of minerals into solution in the quarry can have potential negative impacts on groundwater quality. These are moderate impacts (high severity, low likelihood). These impacts will be mitigated by providing impervious liners below the water management ponds and waste management areas and directing water from the mine to the water management pond. The mitigation measures will result in insignificant.

Quarrying will entail excavation below existing groundwater levels. This will disrupt the existing groundwater flow regime and result in groundwater flow into the mine in the area surrounding the mine footprint. These are moderate impacts). These impacts will not be mitigated.

Spills of fuel and oils from equipment and fuel storage and service areas can flow to the underlying aquifer and potentially impact groundwater quality. This will result in minor impact (medium severity, low likelihood). Potential contamination of the underlying aquifer will be minimized by

installing drip on all equipment, enforcing a program to check for equipment leaks and implementation of a Spill Prevention and Contingency Plan (SPCP). The SPCP will detail plans for utilization of sorbents, biological agents, chemical dispersants, gelling agents etc. All fuel will be stored within containment walls designed to contain 110 percent of the tank contents. Implementation of these mitigation measures will result in insignificant impacts to groundwater quality.

Closure: After quarry closure several depressions will remain within the footprint of the open pits. These depressions will become groundwater filled ponds. Surface water levels in these ponds will correspond to groundwater levels. Wet period precipitation on the surface of these ponds will result in minor dis- equilibrium of the groundwater flow regime. This is a minor impact.

10.1.5 Biological Resources

10.1.5.1 Vegetation

Construction - Construction works will include clearing areas for the quarry, water management ponds and for other site facilities. The areas occupied by the process facilities, personnel facilities and operational quarry will be subtracted from the total area available to flora. Cutting of large tracts will make plant regeneration difficult. This difficulty arises since nutrients, contained in the biomass can be washed away by rainwater after clearing. In addition, enhanced leaching, occasioned by clearing, can deplete the soil of nutrients. The absence of nutrients may result in any new vegetation consisting mainly of grass species. Aggressive grass species and shrubs will effectively prevent seed-bearing plants from finding satisfactory living conditions. These grasses, similar to the growth currently occurring at various sites within the project, can however serve as a food source for a significant population of birds. The surrounding area is the same ecologically as the cleared area and the area cleared is a very small percentage of the total area. Clearing will consequently result in only minor impacts.

Construction of the new portion of the access road will consume land and will result in the loss of natural habitat. This loss will be restricted to the access road only. The area bordering the access road is the same ecologically and the area lost to the access road is very small in relation to the overall area. This would therefore result in minor impacts.

Construction of the new portion of the access road will cut an existing ecosystem into two parts. The two parts created by the road may potentially have less value than the initial whole ecosystem, since ecosystems are characterized by complex, interdependent relationships between component species and their physical environment. The access road may potentially fragment the area into weaker ecological sub-units and may make the entire area vulnerable to invasion and degradation. This is a direct impact which may be regional and long-term. This impact will be mitigated by minimizing the length and width of the new roadway required. The mitigation measures will result in minor residual impacts.

Operation Traffic on the access road during the operation phase would impact the early succession/edge and secondary forest habitats located along this road by increasing dust, which will settle on vegetation. Dust accumulation on plants has been found to impair biological functions including metabolism and photosynthesis, stunt growth, make them more susceptible to disease, and even cause mortality. Road dust deposits on vegetation up to one km away from the generation site and may contain pollutants or chemicals that can alter the permeability of the

leaves or the pH of the leaves' surfaces. Given the limited geographic scope of this impact, the impact of dust accumulation on plants would be minor. Wetting roads during the dry seasons would reduce this impact to insignificant.

Closure- It is expected that the road will remain in place after site closure. Traffic after closure will be totally for recovery of samples for the continued environmental monitoring program. There would be no impacts on vegetation associated with that infrequent use of the access road after closure.

10.1.5.2 Wildlife

Construction- Clearing for the quarry, ponds, process, and personnel facilities will fragment the area and can potentially impact wildlife since some animal species depend on the existence of other plant and animal species within the habitat for nutrients/food, cover, etc. The area cleared is relatively small in comparison to the available area. Clearing and encroachment will alter several of the physical conditions including light, humidity and temperature. The installation of facilities and other construction works will form temporary barriers to the movement of animals, including access to water bodies. These are minor impacts (low severity, low likelihood). These impacts will be mitigated by minimizing the area cleared for the facilities and by maintaining wildlife corridors within the cleared areas. The implementation of the proposed mitigation measures will result in insignificant residual impacts.

People working on the project may harvest commercially valuable animal and plant species. Species population may therefore decrease due to hunting and trapping. These are potentially moderate impacts. A condition of employment and contractors of the company would be the prohibition of hunting and fishing. In addition, employees and contractors will be forbidden from trading in endangered species. The mitigation measures will result in minor impacts.

The physical disturbance and noise produced by equipment may impose additional stresses upon and may lead to increased migration. While disturbances may be stressful for some wildlife, other species may easily adapt to and thrive successfully in the area owing to the phenomenon of habituation. These are potentially major impacts (high severity, medium likelihood). These impacts will be mitigated by minimizing the extent of the cleared areas and by ensuring that noise levels are at the lowest possible. The mitigation measures will result in moderate impacts.

Operation- Most animal species follow established patterns in their daily and seasonal movements. The areas through which animals travel on their way to and from feeding, breeding, and birthing grounds, and between their seasonal ranges, are known as corridors. If the new access road intersects or blocks wildlife corridors, animals may cease use of the corridor since animals are reluctant to cross open spaces and may be hit by vehicles using the access roads. The access roads may result in potential increase in animal mortality because of collisions with vehicles, or a delay in migration in search of food and for breeding and birthing. These are moderate impacts. These impacts will be mitigated by conducting an assessment after the access road is cleared to identify corridors and signs will be posted notifying drivers of the existence of these corridors and placing speed restrictions on the access road in the vicinity of the corridors. The mitigation measures will result in minor impacts.

Some animals would be attracted to the open spaces created by the access roads for protection from predators, good food supplies and better travel conditions. This may potentially lead to accidental death and poaching. These are moderate impacts (medium severity, medium likelihood). These impacts will be mitigated by constraining the access road to the narrowest width

possible and by lowering the vertical alignment. The access roads will also be designed to minimize cuts and fills and will have relatively flat side slopes with minimal clearing of existing vegetation. The narrower rights-of-way and lower vertical alignment will make crossing easier for animals and will provide longer sight lines for drivers resulting in less frequent collisions with animals. The mitigation measures will result in minor impacts.

During operation of the quarry, wildlife may move away from the area. This displacement will increase competition with wildlife on the periphery of the area. This is a moderate impact. This impact cannot be mitigated.

The physical disturbance and noise produced by equipment may impose additional stresses upon wildlife and may lead to increased migration. While disturbances may be stressful for some wildlife, other species may easily adapt to and thrive successfully in the area owing to the phenomenon of habituation. These are potentially major impacts. These impacts will be mitigated by minimizing the extent of the cleared areas and by ensuring that noise levels are maintained at the lowest possible. The mitigation measures will result in moderate.

Closure- After closure, the only activities will be post closure monitoring. As such the perceived impacts will be infinitesimal. However, the company will be cognisant that the access road can be used by hunters and trappers- activities that predated the quarrying operation.

10.1.5.3 Aquatic Resources

Construction activities will include creation of water management pond impoundments and diversion of some streams for haul roads and other facilities at the site. Erosion and sedimentation from construction activities could transport contaminants from the construction areas into the aquatic systems. The introduction of sediment by surface runoff may introduce additional nutrient loads to the streams. The altered nutrient levels can potentially result in eutrophication. Pollution by contaminated surface runoff can also impact water quality in the streams and may lead to denitrification and increased oxygen consumption resulting in an environment less conducive to the survival of fishes. Contaminants could be ingested by aquatic organisms causing reproductive impairment, stunted growth, and other physiological effects. Also, as contaminants naturally break down, they use dissolved oxygen, sometimes significantly reducing the dissolved oxygen content of the water, which can lower spawning success for many fish species and reduce overall habitat suitability for many aquatic organisms. During construction there could be hydrocarbon contamination of the aquatic systems from accidental spills of lubricants and fuel. Hydrocarbons introduced into aquatic environments may change aquatic plant and animal growth, mortality and communities. These are major impacts.

These impacts will be mitigated by implementation of an Erosion and Sediment Control Plan and by channelling contaminated runoff to oil-water separators prior to discharge to streams/creeks. The mitigation measures will result in insignificant impacts.

Operation- Creation of the Water Management Ponds will encompass several streams containing fishes. The footprint of the open pit is also highly likely to encompass several streams. Surface runoff to the water management pond is unlikely to meet surface water quality standards. Fishes trapped within the impoundment will be impacted by poor water quality. The water quality in the ponds will result in a direct, permanent loss of aquatic habitat within these ponds and loss of aquatic fauna and degradation of aquatic habitats and water quality.

Surface runoff will contain sediments which will result in decreased transparency and a reduction

of light to aquatic plants, a primary food source for aquatic organisms. Further, the suspended sediment will ultimately settle onto instream habitat features (e.g., downed wood, gravel, etc.) or the bottom substrate causing embeddedness, which will decrease the value of instream habitat for macroinvertebrates and fish. Specifically, increases in embeddedness levels decrease the space between substrate particles and limit the available area and cover for small fish, macroinvertebrates, and periphyton.

The adverse effects of increased fine sediments load on fish include increased mortality caused by gill damage; increased predation due to sedimentation of shelter; increased susceptibility to disease; impaired developmental rates; reduction of suitable spawning habitat; reduced spawning success; modification of migration patterns, impairment of visual feeders, and reduction of light penetration, which impedes primary production, reduces food availability, and alters food webs. These are major impacts.

These impacts would be mitigated during the construction phase of the project by constructing the impoundment at a rate slow enough to allow aquatic organisms to relocate outside of the footprint of the ponds. Construction will progress in the flow direction of streams to further enhance this possibility. The mitigation measures will result in moderate impacts.

During operation there could be hydrocarbon contamination of the aquatic systems from accidental spills of lubricants and fuel. Hydrocarbons introduced into aquatic environments may change aquatic plant and animal growth, mortality, and communities. These are major impacts. These potential impacts will be mitigated by implementation of the Spill Contingency Plan and to ensure equipment are adequately maintained according to manufactured specification. The mitigation measures will result in minor impacts.

Several culverts and/or bridges will be built along the access road. Constriction of surface water flows at culverts and other road crossings may potentially create currents too fast for some fish species to survive.

The access road may potentially serve as barriers to movement of some aquatic species, especially where culverts are used. This may potentially restrict the migration of fish. These are moderate impacts. The impacts on aquatic ecosystems will be mitigated by bridging areas of standing water and by designing culverts to enable the passage of migratory aquatic species by incorporating baffles to slow the flow enough to allow fish and others to swim against the current, and by setting culvert bottoms below the level of the stream bed. Culvert gradients will also be designed to ensure that streambed gradients existing prior to construction of the access road are maintained to the extent practicable. This will result in minor residual impacts.

Closure- Discharges to surface water after closure will only occur after attainment of discharge water quality. An Erosion and Sediment Control Plan will be developed and implemented until the area is adequately re-vegetated. Closure will therefore have no impacts on aquatic organisms. No mitigation is required.

10.1.6 Waste Management Activities

10.1.6.1 Solid Waste

Materials that may not be hazardous waste but are not appropriate for disposal on site will be shipped off site for recycling and/or disposal. Materials such as used oil and scrap metal will be shipped to recyclers that can be audited by regulatory agencies. Other materials, such as grease

that may not have available markets for recycling, may need to be disposed onsite rather than recycled.

An area will be identified to establish a facility to dispose solid waste. The facility is planned to cover approximately 500 m² and will be managed using pitting and cover techniques. The facility will be managed for on-site, non-hazardous wastes, and will not accept any off-site wastes from other operators in the area. The primary disposal activities on site will include but may not be limited to the following:

- Demolition and construction debris
- Non-putrescible materials
- Waste from maintenance and operations meeting the definition of inert or non-hazardous such as respirator filters, gloves, boxes, non-recyclable packaging material, air filters, hoses, and piping

10.1.6.2 Hazardous Waste

Materials classified as hazardous waste will be treated onsite by some destruction mechanism before disposal. Materials such as contaminated grease, unused chemicals, paint related materials, and reagent that may be classified as hazardous waste will be treated. The Quarry Project plans to dispose of these materials using the most permanent and practicable disposal method available.

Hazardous wastes that may be generated at the facility include, but may not be limited to, the following:

- Waste paint materials such as thinners
- Chemical wastes such as acetone from the on-site laboratory
- Residue wastes from containers or cans.

Waste will be stored on site and inspected as required by the hazardous waste regulations. As part of these pollution prevention activities, the quarry materials entering the site will be examined to determine if they have the potential to create hazardous waste. If they do, non-hazardous substitutes will be sought. The Project will be examined on an on-going basis to ensure that hazardous substances are eliminated whenever possible. Sound environmental management will be implemented to prevent hazardous materials from causing environmental damage. The following management strategy will:-

- Know which hazardous materials are present on sites.
- Allocate clear responsibility for managing hazardous materials.
- Understand the actual or potential risks and environmental impacts of transporting, storing, using, and disposing of these materials.
- Minimize the use and/or generation of hazardous materials.
- Construct storage facilities that will contain the materials in all foreseen circumstances.
- Dispose of waste materials in a way that eliminates or minimizes environmental impacts.
- Seek alternatives to disposal, such as reuse, recycling and secondary products.
- Implement physical controls and procedural measures to ensure that no materials escape during normal or abnormal operations.
- Have emergency response plans in place to ensure immediate action to minimize environmental impacts should an accidental release occur.

- Monitor any discharges in the environment to detect any escapes of the materials and to measure any subsequent impacts; and
- Keep adequate records and review them regularly so future environmental problems are anticipated and avoided - this also covers duty of care, legal requirements, and public liability.

The above measures allow the Quarry to perform with maximum efficiency and safety for both the workforce and the environment and can build good public relations with the company's stakeholders.

10.1.6.3 Sanitary Waste

Sanitary waste at the Project will be handled by septic systems, with septic tanks located in the vicinity of each building. During the construction phase, and where necessary during operations, portable toilets will be used in various locations throughout the plant and mine sites. Sanitary wastes will be collected periodically by a camp sanitation crew and removed for disposal to a site about 2 km from the quarry site.

10.1.6.4 Specific Waste Management Activities

In general, waste will be managed in dumpsters or other appropriate containers. All containers will be covered or weighted to prevent blowing trash. Trash from office areas will be bagged. A waste disposal crew will be employed to manage wastes other than debris or construction and demolition wastes.

10.1.6.5 Scrap Metal

Scrap metal will be managed to facilitate recycling, with separate storage area located near points of use. Contracts with scrap metal recyclers/dealers will be established for on-going recycling activities. In the event recycling becomes impossible or otherwise impracticable (i.e., scrap prices drop, or scrap prices become so high there are not enough recyclers), scrap metal will be stockpiled near the solid waste facility for bulk recycling.

10.1.6.6 Grease

Grease associated with the hoisting, milling, and other operational equipment will be placed into drums or other bulk containers suitable for recycling. If the grease is not suitable for recycling, the contained waste will be sealed in drums and disposed at a suitable site for to be prepared. While on site, the containers will be managed in an area that will provide secondary containment.

10.1.6.7 Used Oil

Used oil from maintenance activities will be managed in bulk containers with secondary containment to ensure there is no release to the environment. Only oil acceptable for recycling will be placed in the bulk containers. Used oil not acceptable for recycling will be placed in drums for proper disposal.

10.1.6.8 Batteries

Lead acid batteries will be shipped off site to a recycler. While they are stored on site, they will be managed in an area protected from storm water and will have secondary containment. Nickel-

Cadmium (NiCd) batteries will be stored for recycling by a local vendor. While on site, they will be managed in drums or boxes suitable for storage. Lithium batteries will also be stored for recycling in appropriate containers.

10.1.6.9 Tires

The Project plans to bury mining waste tires in an onsite cell. Once placed in the cell, the tires will be covered with a minimum of 0.5 m of material within 50 days of placement. Once the cell is full, at least 1 m of final cover will be placed over the cell within 180 days. The quarry management will also be investigating the potential for reuse of these tires and will seek contracts for beneficial uses of mining tires. As appropriate, tires may also be used for erosion control or structural fill. If alternatives to burial exist, the Project will review them and manage the tires accordingly

10.1.7 Socio-economics impacts

A summary of potential key socio-economic findings and issues/ concerns related to the project is presented here. The project has two components: quarry and access road. There is only one community that is located in proximity to any of these project components and thus the direct impacts on human populace in neighbourhood/village/town is limited. However, there could be potential indirect impacts that create social risks due to the development of the project such as possible influx in the remote areas due to building of access roads. In this section the potential impacts and risks are segregated by project component.

Construction The site is in a remote interior area. The development of the quarry and potential employment opportunities may attract people to the site for work. Most of hiring will be done out of Georgetown, however, opportunities will be granted to Great Falls community residence to apply for suitable jobs. With further development of the quarry if the recruitment process does not continue to be streamlined and widely informed amongst the communities in Guyana, there is potential for people coming to the project site looking for jobs at the site.

As has been the experience in several interior projects, once a worker camp is established in a remote area, it often attracts local people who come to sell goods and services to the workers. There is a possibility that the development of the quarry may attract local vendors, service providers and even prostitutes into the area.

The influx of people may have a variety of impacts. Some of those are:

- Pressure on existing resources - the site is already in a remote area which lacks resources and infrastructure. With the coming in of any local population and increase of workers it may pressurize the already limited shared resources like land, water, forest use, availability of goods and services;
- Security issues - any influx can create security issues and increase crime leading to impacts on
- the workforce.
- Impacts on worker health - the influx of people from outside could possibly create health risks to the quarry workers and vice versa. Very often the introduction of new people into the area is often seen to be accompanied by transmission of contagious and other diseases. Influx of sex workers often leads to rise in HIV and other STD.
- Social interaction with other groups is likely to bring about an increase in alcohol and drug abuse, prostitution, and crime. The circulation of money from wages and salaries would

sustain all of the workers leisure activities. This may increase the demand for alcohol, drugs and sexual services especially for those migrant and expatriate workers. In the mid-term this may bring about an increase in sexually transmitted diseases.

This is adjudged to be a major impact. With appropriate mitigation like planned development or discouraging influx the impact rating will be minor.

10.1.7.1 Expectation of Employment and Economic Opportunities

Owing to the lack of economic opportunities and intrinsic poverty and lack of infrastructure, the villages/local communities expect benefits from any project that develops. They expect the project to promote local benefits such as employment and community development work.

They want benefits and not to be stuck with impacts of quarrying such as deforestation, surface water pollution from erosion or noise from blasting. Informal consultations with residence from Fairview revealed that unemployment and lack of economic opportunities was their primary issue, and the indigenous community expects the project to provide them some benefits.

The company will be able to offer non-technical jobs to the community during construction and for support services during operation. A training program will be initiated for community residence such as welding and fabrication, vehicle servicing and carpentry.

Further, the company plans to work with the community to establish economic activities that can supplement the company. Farming is one of the initiatives that is planned/supported since there would be a need for vegetables, ground provision and poultry. The community could also provide fish.

With appropriate mitigation like discourse with local community to understand their expectations and providing some employment or other opportunities would reduce the impact to minor.

10.7.2 Potential issues with small and medium scale miners

The geology of the area has indicated that there are potential gold deposits. There are several mining permits (medium scale) and small-scale claim license in the vicinity. The building of access roads will open the area for exploitation and possible infringement of the quarry area. This may lead to security risks and potential conflicts.

With patrolling of the perimeter of the concession and consultation with the mineral property owners - this impact would be minor.

10.7.3 Community consultations

In today's mining industry consultation with the community has become very important part of mining operations. Consultation helps people to understand what a mining development will do and how it will affect the community. It enables to identify concerns early, and to take these into account in planning and developing its project. It establishes a relationship between the company and its neighbours which should increase understanding and trust, and to avoid unpleasant surprises.

The Community consultation and involvement is a necessary part of any environment management system-not just because the community is part of the environment affected by an operation, but also because they can add sensitivities and information invaluable to achieving best practice.

The company met with some of the Great Falls villagers and will establish a good working relationship with the people it has to work with. It will try to be a good neighbour and it will try to contribute in the community.

This benefits everyone. The community will understand what the company is doing. It will know what the costs to the community are going to be and what the benefits are going to be, and it can make its judgments accordingly. The initial engagement is to address understandable fears about the effects on the environment can be allayed by knowledge of what those effect will be and how the company will handle/mitigate them.

Consultation is also intrinsically linked to the environmental process in Guyana and has become a legal requirement.

From the community's perspective, such consultation will result in a far better understanding of the proposal and better coverage of environmental issues.

A formal meeting is being planned and should be held by mid-August 2022. The aim is to present the project to the village, hear their concerns and address them, and find ways that the company can provide opportunities for economic development such as vegetable, cattle, and poultry farming to supply the company. By providing sanitary services and security for the camp and other facilities. Another option is to train villagers as equipment operators, welders etc. Other development plans by the company includes providing internet services, support for the educational and recreation facilities. The company will identify a team that will liaise with the community for effective communication.

11.0 CLOSURE CONCEPTS

The reclamation plan proposed for the quarry site has several key components, referred to as initiatives. These initiatives provide the physical and philosophical foundation for the reclamation plan and will remain constant throughout the operational life of the facility. These initiatives include: design of the facilities with closure goals in mind; concurrent reclamation practices; constraining disturbances to a single drainage; minimizing downstream hydrologic disturbances; preparing a comprehensive drainage plan; using modern technology to minimize the generation of impacted water; managing operations to minimize environmental impacts; reclaiming the facilities to blend with surrounding topography; constructing an outer facility shell to reduce visual impacts of the mining operations; salvaging soil resources; performing selective vegetation removal; re-vegetating reclaimed surfaces; and, preparing an estimated closure cost. One of the major initiatives of the Plan will be to facilitate concurrent reclamation of the outer shell of the waste and tailings storage areas and to provide a perimeter buttress to mitigate the visual impact of the Project. It is envisioned that the selection of seedbed preparation, species, and site re-vegetation will be on a research agreement with the University of Guyana where the Project will provide a research grant to the faculty of technology.

11.1 The Closure Planning Process

Ideally a mineral operation, as a temporary use of land, should not impose any permanent constraints on the options for future beneficial use of the site, nor have any permanent effects on the local water resources, biodiversity and overall landscape quality or associated socio-economic development.

This conceptual Closure and Decommissioning Plan (CDP) will be developed for the future operations of Mabura Quarry. The CDP details in conceptual form the measures that will be employed at closure, to ensure that the sites are rehabilitated to an appropriate level and outlines preliminary performance criteria and monitoring requirements. This plan will be developed and finalized in consultation with relevant authorities and stakeholders in advance of closure.

In the context of this Plan, the term 'closure' is taken to encompass decommissioning, demolition, and rehabilitation activities prior to close out of the site. References to 'post closure' relate to the period following termination of closure activities (for example, ongoing monitoring, and after-care

As a part of the legal requirement of Guyana, the company will identify suitable closure and decommissioning methods for the project. The widely accepted 'de facto' standards of the World Bank Group and the corporate standards were used in compiling this preliminary assessment. The minimum standard will dictate that all operations have closure plans that are regularly reviewed and updated and which identify, mitigate where possible, and manage both current and future health, safety, environment, community, and other business risks associated with closure.

Compiling of the CDP is the first stage of closure process. The CDP will address individual closure issues and action required, including details of performance criteria, and monitoring so that the company can prepare financial provisions for the process. A general overview is shown in Figure

More specifically, the objectives of the overall closure planning process, and the specific provisions within that process, are to:

1. Contribute to the management of environmental issues during planning and operational phases as a means of facilitating the effective closure.
2. identify post-closure land use objectives through a process of consultation with stakeholders, communities and landowners.
3. identify suitable best practice measures that are appropriate to the project context and that are able to:
 - satisfy the requirements of existing Guyana legislation, specifically the Environmental Protection Act and the Mining Act;
 - meet the corporate requirements of Mabura Quarry;
 - through consultation, obtain stakeholder acceptance of closure proposals.
 - return land and water resources to pre-quarrying or otherwise agreed conditions.
 - minimize the potential for any negative post-closure impacts and liabilities.
 - minimize the requirement for active management of the post-closure environment, and.
 - maximize the potential for post-closure environmental and socio-economic benefit

11.2 Closure approaches and Actions

11.2.1 Introduction

This section identifies environmental and socio-economic issues that have a bearing on closure and the post-closure phase and identifies conceptual options for effectively managing the closure process for each. Where relevant, preliminary performance targets and monitoring requirements will be identified. Technical investigations will be used to assist in decision making and in the choice of suitable option in specific cases. The items presented are preliminary and will require updating to conform to the final financial commitment.

The principal closure-related issues can be summarised as:

- Final voids (pits) arising from the quarry extraction;
- Waste dumps;
- Surface water management;
- Infrastructure (general, haul roads, bridges and plant)
- Post closure aftercare and monitoring.

Each of these will be described in each sub-section.

11.2.2 Specific Issues and Related Closure Options

11.2.2.1 Final Voids

Evaluation of the shape of the final void will depend on the size and extent, physical constraints and backfilling done during the quarry life. Determining the most appropriate closure for final void is one of the most difficult aspects due to the related technical challenges and economic cost. Options for beneficial uses are a priority where they can be identified and confirmed as being economically viable and sustainable.

Due to the proximity of some of the proposed quarry to creeks, inundation of the pits will occur rapidly once dewatering activities are halted, leading to the creation of pit lakes.

11.2.2.2 Waste dumps and disposal areas

The variety of closure options available for waste dumps and disposal areas are generally linked to the need to create a final landform that is safe, stable, non-erosive, and designed so that it will support the final agreed land use. The most suitable land use for this aspect is to allow natural re-vegetation to create healthy and sustainable ecosystems. Specific options adopted will be determined by the physical and chemical characteristics of the waste and topography of the dump disposal area. However, in general terms, initial preparation is likely to include levelling and re-grading of steep slopes, installation of drainage, limited backfilling of depressions and preparation of ground in a stable state that blends in with the surrounding area.

The best and most site cost-effective erosion prevention method are good site design and the establishment of vegetation. It is generally wise to retain any existing drainage controls

during the initial re-vegetation phase. Deep ripping may improve water infiltration, again reducing flow of surface water flow that causes soil erosion.

From observations in the area, natural re-vegetation will provide good cover within one year once there is some amount of top-soil present. No special measures are likely to be needed to promote the establishment of vegetation although some local amelioration may be required to promote rapid growth where low permeable material are on the surface.

Re-vegetation should establish native plants, particularly as the presence of invasive or non-native vegetation may impact the long-term sustainability of vegetative cover. In some cases, non-weed plants that have shown an aptitude for colonising disturbed sites adjacent to native vegetation, are likely to be useful for rehabilitation.

11.2.2.3 Surface water management

The main issue surrounding the surface water quality during the closure and post closure phase depends on the acceptance of the responsibilities for the management of the haul roads. In the future, the company plan to have discussions with respect to this concern. However, if these roads are accepted, then regular maintenance will be required and will include:

- Culverts should be kept cleared on an on-going basis; and
- Any part of the haul road that potentially impedes drainage and is not taken over by agencies will be removed.

Further, when the operation ceases, there will be no dewatering, or any other activity that will impact surface water quality. The promotion of natural re-vegetation in other areas will prevent or significantly reduce soil erosion. Hazardous materials will be removed and adequately disposed of.

11.2.2.4 Infrastructure

- The first step in the management of infrastructure during closure will be the general clean to and securing of the immediate site area, including:
- Removal of fixed and mobile plant that is no longer required;
- Removal of temporary and permanent structures unless specifically identified as transferable to appropriate creditable government agencies or other bodies;
- Levelling or re-profiling of any bunds and waste piles not specifically addressed in closure plans for waste dumps and disposal areas;
- Removal and safe disposal of non-mineral wastes including hazardous materials;
- Breaking and burial/removal of concrete slabs and foundations;
- Ripping of roads, office sites, and hard standing areas not required or transferred to other agencies;
- Identification and removal of hazardous or contaminated material, weeds or potentially problematic materials; and
- Restrict access to required power supplies and remove non-essential power-related infrastructure (e.g. remove all elevate wires and poles and ground any buried wires).

- Beyond these requirements, generally two broad options exist for infrastructure:
 - ✓ Transfer to, and use by third parties; and
 - ✓ Demolition and/or removal.

It is anticipated that all the roads and associated bridges will be transferred to the relevant authorities in Guyana, and that they will develop these resources according to detailed development management plans that address health, safety, environmental and social issues relating to their presence and use, in particular the potential impacts arising from improved access to the area (e.g. expansion of commercial forestry operations, agriculture and increase hunting).

If the haul roads and bridges and other infrastructure are not transfer to appropriate Guyana authorities, then demolition and safe disposal or reuse/recycle will be required. Demolition usually involves the destruction and removal of physical structures (buildings, plant and roads) and often done in tandem with making the area safe. Demolition of contaminated surface buildings, foundations and plant can be a source of contamination (e.g. dispersion of contaminated solids, dust, wastes and liquids from buildings and therefore this issue must be addresses in planning and implementing demolition work.

11.2.2.5 Stakeholder Engagement

Key stakeholders will be consulted since input from them (local authorities and informed parties) is critical to the identification and successful implementation of closure measures. Following the distribution of this concept report, consultations will be held with the Government Agencies and local communities' part of development of a detailed closure plan. During this program, possible post-closure land use objectives will be discussed.

Opening the above area will have implications for environmental integrity and conservation, and it is therefore critical to develop a strategy regarding control of access and development, while considering productive uses of the land, such as formal development and responsible land management.

It is envisioned that a multi-stakeholder forum will be convened, at which development priorities will be identified and management terms will be agreed. It is anticipated that the following parties and institutions may be invited to participate in this consultation:

- National Government Ministries
- Regional Officers/Committees
- Government Agencies- GFC, GGMC, EPA, GLSC
- International NGO-CI, WWF, Iwokrama
- National NGO-APA, GOIP, local indigenous groups

Following consultations, the suggested post closure land use objectives will be developed and approved to reflect the views of these stakeholders.

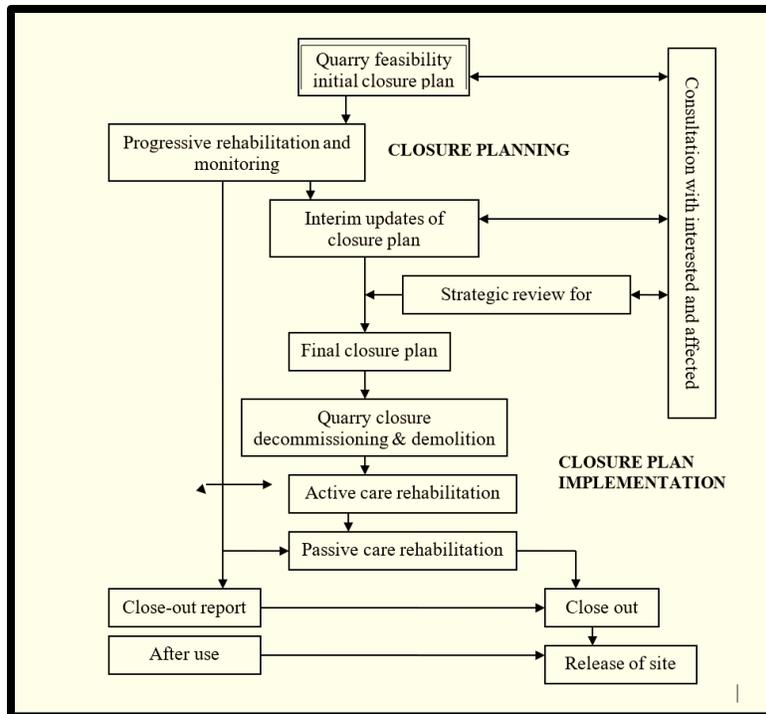
11.3 Summary of Closure Issues

The following summarizes the proposed approach to closure

- Re-profiling of dump area as appropriate;
- Removal or maintenance of surface water management features as appropriate;
- Natural re-vegetation of mine waste facilities, with assistance as necessary;
- Backfilling of pits where practical and economically feasible, replacing topsoil and natural re-vegetation;
- Demolition and removal of all buildings and infrastructure;
- Removal of scrap and rubbish;
- Access roads to be left in place if agreed with the government, otherwise ripped and allowed to re-vegetate naturally, with assistance if necessary; and
- Bridges to be left in place if agreed with the government, otherwise removed and scrapped or sold.
- Retrenched workers adequately compensated and trained to perform other livelihood activities.

From observation of other worked out areas near the property that was mined, it was observed that the waste dumps can rapidly recover to integrate with the existing natural environment. There are no long-term closure issues that cannot be successfully managed by Quarry Operator.

11.4 Closure Planning Process



11.4.1 Principal Closure and Decommissioning Issues

The principal closure related issues relate to existing operations have been identified as:

- Final voids (pits) arising from the material extraction;
- Waste dumps and disposal areas;
- Surface water management
- Infrastructure (general, haul roads, plant, buildings, tank farms etc.); and
- Retrenchment of employees.

Subsequent refinements of the closure plan will be influenced by consultations and will address in more details specific to closure issues and proposed options. It is anticipated that these will address, amongst other items, the following areas:

- **Pits:** details for the rehabilitation of the mined-out areas including the manner in which the actual site of the pit will be restored for future use.
- **Water quality management:** details for post-closure prevention and control of erosion, sedimentation, siltation and leaching to ensure appropriate water quality standards are achieved.
- **Waste management:** description of the type, quantity and quality of overburden and other waste, their disposal, and detailed proposals for utilization and/or stabilization to prevent siltation, erosion, dust generation and maximize integration with surrounding land.
- **Infrastructure:** facilities such as roads, power lines, buildings and structures and their future utilization will be evaluated and where relevant the measures for their maintenance will be described. If decommissioning is proposed, the dismantling and disposal of building structures, support facilities and other infrastructure (such as electric power lines, water pipelines, fuel tanks, transformers etc.) will be discussed in detail.

- **Retrenchment:** description of the socio-economic opportunities in the area, inventory of employees and associated skills, formation of a plan to retrain and re-skill employees and facilitate re-employment to minimize impacts of retrenchment and to ensure facilities and services provided by the Quarry Operator are supported.

In the specific environmental and socio-economical context of the existing site, options for post-closure land use with respect to these issues will be limited due to the potential for long term quarrying activities in the surrounding areas. The priority therefore will be to protect the environment and public health and safety by using safe and responsible closure practices. For each principal component of the project design, a base case for post-closure land use has been identified, considering technical designs, the views of the stakeholders and emphasizing productive end use of each project area following appropriate rehabilitation. The base case for post-closure land use objectives is illustrated in TABLE below:

Project Item	Base Case Post-Closure Land Use Objectives
Quarry pits	Backfill and revegetate
Tailings ponds	Backfill and revegetate
Borrow pits	No feasible use, promote revegetation
Overburden dumps	No feasible use, promote revegetation
General Infrastructure	Remove unless requested to leave in place and transfer to the regional government or government agency. To be discussed and agreed with stakeholders
Haul roads	Leave in situ and transfer to regional government or government agency unless requested to remove. Mechanism to be discussed and agreed with stakeholders

11.4.2 Summaries of Post Closure Objectives

Specific rehabilitation and closure criteria will be fully developed as part of the subsequent consultation process. Components of the rehabilitation criteria will include:

- Land use objectives;
- Physical aspects (e.g. landform stability, resistance to erosion, re-establishment or drainage);
- Biological aspects (e.g. plant choice, canopy cover, fauna return, weed and invasive species control) for areas of re-vegetation; and
- Water quality and soil standards

11.4.3 End-Use Options for Land

In general terms, the proposed post-closure land end-use is a key factor in determining the type of, and the degree of, rehabilitation required to meet the appropriate performance

standards. Total restoration is often perceived as the most appropriate objective without considering the feasibility of such a goal or the potential to generate other beneficial end-uses. Regulatory criteria such as 'restoring the area to pre-mining conditions' may be in conflict with the most sustainable or desirable development options in an area, and long-term land use plans and regulation may need to be adjusted to allow new uses for the land. In addition, restoration to pre-mining conditions may not be technically and ecologically feasible, especially in areas that display high biodiversity prior to quarrying. Further, no baseline study was done prior to the commencement of quarrying activities in the area some 80 years ago.

Consultation meetings will be held with the relevant government agencies, at which the possible post closure land used objectives, will be discussed. These objectives will be amended or confirmed to reflect the views of the stakeholders.

11.4.4 Performance Indicators and Monitoring

For stakeholders to evaluate the success of closure, indicators will be developed to measure and report performance, bearing in mind that what constitutes acceptable performance may vary according to different stakeholder perspectives. Emphasis will be on both socio-economic and environmental issues due to the number of people that will likely be affected by the closure.

The primary function of any post-closure monitoring is to ensure that closure targets and an appropriate level of performance have been achieved. The schedule will be established so that any monitoring programme is simple to operate and will provide data that can be directly understood and utilised by the relevant stakeholders. Development of a detailed post-closure monitoring program will comprise the following activities:

- Identification of the scope of monitoring required and listing of sub-programmes corresponding to each environmental issue;
- Definition of the objectives for each sub-programme;
- Specification of how data or information collected will be used in measuring success against desired performance criteria and targets;
- Definition of the spatial and pathway boundaries for the work and selection, mapping, planning of scales and sites for direct measurement observations or sampling;
- Based on appropriate characterisation studies, selection of key indicator for direct measurement; observation or sampling;
- Definition of how the data will be analysed and interpreted, and how it will be presented in a monitoring report;
- Definition of the precision and accuracy required in the data; and
- Consideration of compatibility of the data to be collected with historical data and with contemporary related data (e.g. from existing studies).

A clear feedback loop will be established between information acquired and the success of closure measures. If reporting indicated that performance is not in line with targets, then the closure process will be modified as appropriate. A post closure and monitoring plan will be developed in conjunction with the final closure plan.

Project Component	Issue	Closure Action	Performance target	Monitoring Requirements
Quarry	Physical			
	Safety	Install fencing to minimize unauthorised human access	No unauthorised access	Physical integrity of fencing
	Final Void	Backfill, re-profile and promote natural re-vegetation	Adequate vegetative cover, development of sustainable ecosystem	Ecosystem health. And species assessment
	Dewatering around pit	Terminate dewatering activities	Restore recharge dynamics	Groundwater flow
	Visual impacts and visual intrusion	Maintain screening vegetation	Sites not visible to casual observers.	Not required
	Biological			
	Removal of the forest cover	Create conditions to promote natural regeneration of alternative and appropriate ecosystems; forest removal should be minimised throughout the remainder of the mining life.	Develop sustainable ecosystem in areas where primary forest has been removed	Ecosystem health, species diversity
	Destruction of habitats important to fauna and avian species with high conservation value.	Create conditions for natural regeneration of suitable host habitats in surrounding areas to facilitate inward migration of relevant species	Return of affected fauna and avian species to regenerated areas	Species diversity, population numbers.
	Poor ground water quality	Backfill above predicted recovered ground water level Maintain water quality during remaining mine life Refill pit with water (from stream or groundwater recovery)		
	Physical			
Stability	Create conditions for re-vegetation to prevent erosion and maximise stability	Maximise slope stability	Stable slopes	
Dust generation	Create conditions for re-vegetation in keeping with surrounding areas, to prevent erosion and dust generation	Eliminate significant windblown dust	Airborne dust concentrations	

Project Component	Issue	Closure Action	Performance target	Monitoring Requirements
Overburden Dumps	Surface run-off and related suspended solids	Install toe drainage where none exist, create conditions for re-vegetation in keeping with surrounding areas	Eliminate adverse impact on water quality or run-off volume	Water quality.
	Visual impacts	Promote re-vegetation of surfaces	Complete vegetative cover	Sustainability of vegetative cover
	Biological			
	Re-vegetation	Promote re-vegetation and sustainable ecosystem development	Effective and sustainable re-vegetation; minimal erosion	Sustainability of vegetative cover
	Destruction of habitats	Create conditions for natural reinstatement and development of suitable host habitats in surrounding areas to facilitate inward migration of relevant species	Presence of fauna and avian species in rehabilitated areas	Species diversity, population numbers.
Physical/chemical				
	Safety	Transfer to Guyana agencies. Otherwise remove and safely dispose of above and below surface items	No safety risks	Risk assessment
	Visual impacts and visual intrusion	Remove and safely dispose of above surface items and create suitable conditions for natural regeneration of vegetation	Maximised land restoration and integration with surrounding areas	Sustainability of vegetative cover
	Local alteration of drainage conditions	Break/remove subsurface and surface items (e.g. foundations) likely to significantly affect drainage	Reestablishment of acceptable surface flow patterns	Surface flow
	Surface and ground water quality	Remove, treat and/or safely dispose of potentially contaminating or hazardous material and items, including contaminated hard-standing material	No impact on water quality	Water quality
Socio-Economic				

Project Component	Issue	Closure Action	Performance target	Monitoring Requirements
General infrastructure	Post transfer impact	Any transfer to Guyana agencies should be subjected to the provisions of a sound development plan for the area	Confirm relevant plans to address potential health, safety, environmental and social impacts and maximise socio-economic benefits are agreed with relevant stakeholders and implemented prior to transfer.	Not required, Guyana agencies will assume responsibility in post transfer phase.
Haul roads	<i>Physical</i>			
	Stability and safety	Re-grade prior to transfer to Guyana agencies; otherwise, re-profile to create conditions for natural re-vegetation	No impact on water quality	Water quality
	Surface water run-off	Transfer to Guyana agencies; otherwise, re-profile and install run-off channels	Transfer to Guyana agencies or effective regeneration of vegetative cover	In the case of transfer, the agencies will assume responsibility, other sustainability of vegetative cover
	Visual impacts and visual intrusion	Transfer to Guyana agencies; otherwise create conditions for natural re-vegetation	Transfer to Guyana agencies or effective regeneration of vegetative cover	In the case of transfer, the agencies will assume responsibility, other sustainability of vegetative cover
	<i>Biological</i>			
	Removal of forest cover	Transfer to Guyana agencies; otherwise create conditions for natural regeneration of alternative and appropriate ecosystems; forest removal should be minimized throughout the remaining mine life	Transfer to Guyana agencies or develop sustainable ecosystems in areas where primary forest has been removed	Eco-system health; species diversity
	Destruction of habitats important to fauna and avian species with high conservation value	Transfer to Guyana agencies; otherwise create conditions for natural regeneration of suitable host habitats to facilitate inward migration of relevant species	Transfer to Guyana agencies or return of regenerated areas	In the case of transfer, the agencies will assume responsibility, other sustainability of vegetative cover

Project Component	Issue	Closure Action	Performance target	Monitoring Requirements
Haul roads	Increases/decreases in swamp water levels and associated dieback of vegetation	Ensure culverts are maintained and cleared prior to transfer to Guyana agencies; in the absent of transfer to agencies, re-profile or remove material and create conditions suitable for natural regeneration of vegetation	Transfer to Guyana agencies or effective regeneration of vegetative cover	In the case of transfer, the agencies will assume responsibility, other sustainability of vegetative cover
	<i>Socio-economic/Cultural</i>			
	Post transfer impacts	Any transfer to Guyana agencies should be subjected to the provisions of a sound development plan for the area	Confirm relevant plans to address potential health, safety, environmental and social impacts and maximise socio-economic benefits resulting from improved access are agreed with relevant stakeholders and implemented prior to transfer, in particular measures to address unplanned migration and its consequences	Not required, Guyana agencies will assume responsibility in post transfer phase
Retrenchment	Socio-economic	Develop closure plan in consultation with potential affected workers; assists where possible with redundancy and retirement; train unskilled workers to become semi-skilled or skilled; retain workers where possible	Worker's acceptance of the termination agreement with appropriate compensation	Not required

12.0 PRELIMINARY FEASIBILITY ASSESSMENT

Operating expenses

Manufacturer	Type	Quantity	Costs	Per day
Caterpillar	Haul Trucks	2	\$70/hr @ 20 per day	\$2,800
Caterpillar	Front-end loader	1	\$50/hr @ 20 per day	\$1,000
Caterpillar	Bulldozer	1	\$50/hr @ 15 per day	\$750
Caterpillar	Excavators	2	\$60/hr @ 10 per day	\$1,200
Caterpillar	Jumbo drill	1	\$50/he @ 2 per day	\$100
Labour 10% Mining Cost				\$585
Total Mining Cost				\$6435

Crushing and screening

No.	Name	Qty	Unit cost	Per day
1	Feeder	1	\$20/hr @ 20 per day	\$400
2	Jaw crusher	1	\$10/hr @ 20 per day	\$200
3	Cone crusher	1	\$10/hr @ 20 per day	\$200
5	Small feeder	1	\$10/hr @ 20 per day	\$200
6	Heavy vibrate sieve	1	\$20/hr @ 20 per day	\$400
7	Vibrate sieve	1	\$15/hr @ 20 per day	\$300
8	Belt conveyor	4	\$5/Hr @ 20 per day	\$320
9	Integrated circuit control system	1	\$4/hr @ 24 per day	\$96
10	Non-standard part and leg of belt conveyor	1	\$4/hr @ 24 per day	\$96
11	Electric Generator	2	\$30@ 12 per day	\$720
Labour 10% Processing				\$293
Total Processing Cost				\$3,225

Other Expenses

Non Mining Labour Cost 2%) Mining and Processing cost	\$193
Administration 2% Mining and Processing Cost	\$193
Security	\$300
Barging (1 trip per week) \$3,000 per trip	\$600
Power generation (Camp)	\$600
Water Supply	\$100
Environmental monitoring	\$200
Miscellaneous 10%	\$219
Total	\$2,405

Annual Production

Products	Year 1	Year 2	Year 3	Year 4	Year 5	TOTAL
Boulders	20,000	20,000	20,000	20,000	20,000	100,000
Aggregate	260,000	260,000	260,000	260,000	260,000	1,300,000
Crusher run	20,000	20,000	20,000	20,000	20,000	100,000
Total	300,000	300,000	300,000	300,000	300,000	1,500,000

INCOME		
Sale of stone	300,000 t @ \$50 per ton	\$15,000,000
EXPENSES		
Mining	\$6,435 x 320	\$2,059,200
Processing	\$3,225 x 320	\$1,032,000
Other Expenses	\$2405 x 320	\$801.280
15% Contingencies		\$583,872
TOTAL EXPENSES		\$4,258,944
PROFIT		\$10,741,056

13.0 FUTURE WORK

1. A drilling program will be initiate to provide the information for the final evaluation of the area and will determine if the prospect is profitable. Prospecting and exploration is the first phase in the life cycle of a mine, followed by development, extraction and finally closure and reclamation. These activities, which often occur simultaneously, involve searching for deposits using a variety of geological methods. During this aspect of the program, baseline environmental information will be collected.
2. Using the data obtained from to quantify the quarry reserve i.e. the quantity of rock available.
3. Using the drill cores to determine rock quality- hardness, abrasiveness, amenability to crushing, blasting characteristics.
4. Selection of equipment
5. Detailed Environmental Management Plan
6. Final Quarry Plan
7. Final feasibility Studies