ATLANTIC ENGINEERING
GUYANA INC.

Agatash Quarry

Project Description

February, 2022

Project Director: Mr. Yannick Van Sluytman

Prepared by: Geenandie Dyal

Contents

List of Figures

List of Tables

1. Executive Summary

Agatash Quarry will be owned and operated by Atlantic Engineering Guyana Inc. Atlantic Engineering Guyana Inc. is a large diversified Guyana Company, involved in the supply and placement of construction and building materials, timber and a variety of other industries. The Agatash Quarry project is intended to provide a long term supply of high quality construction materials and boulders for sea defence in Guyana, regional and local markets. The location and extent of the quarry pit is shown in Figure 1.1, including the locations of overburden and excess product emplacement areas and Project infrastructure. Key infrastructure required for the project includes:

- A crushing and screening plant;
- A port loading and offloading facility;
- A truck loading facility and access road;
- Workshop, office and employees' amenities; and
- An explosive magazine.

2. Project Description

2.1. Physical location

Agatash Quarry is situated at the Left Bank Essequibo River, above Sakarara Point, 3 miles above Bartica on the west bank of the River about 70 miles to Georgetown through waterways and roads. It is centered at grid reference N 060 21' 51.2", W0580 36' 59.04" on 1:50,000 topographic sheet. All grid references used for the remainder of this report are following those on Figure 1, which is adapted from the 1:50,000 sheet 27NE published by the Guyana Geology and Mines Commission (GGMC). The project area is approximately 807 acres. The project area can be defined by the following grid references based on the 1:50,000 topographic map sheet 27NE:

North western Corner- Longitude 580 37' 27" W, Latitude 60 22' 11" N

North eastern Corner- Longitude 580 36' 46" W, Latitude 60 22' 11" N

South western Corner- Longitude 580 37' 27" W, Latitude 60 20' 58" N

South Eastern Corner- Longitude 580 36' 50" W, Latitude 60 20' 58" N

The Agatash Quarry landscape is dominated by the Essequibo River, with the amphibolite Rock Outcrop rising above the water level forming the banks of the Essequibo River and extending inland. It is located approximately 0.5 Km from the Akarakabra Creek in the North, 0.5 Km from the Essequibo River in the East and approximately 2 Km from an Unknown Creek in the South and 2.75 Km the Kurumaikabara Creek in the South. The northern and southern portion of the Agatash Quarry project area slopes to the North West and South West towards the Akarakabra Creek, Unknown Creek and Kurumaikabara Creek. The east of the project area consists of vegetated undulating hills and ridgelines. The west of the project area has rocky outcrops which form the banks of the project area. Vegetation in the east consists of mainly of small shrubs. There are residences within 2 miles of the project area.

The project area has minimal diversity in terms of landforms, vegetation and land uses resulting in small variations in scenic quality. White sand forest dominated by Wallaba trees extend to the east. The area is characterized by low rolling hills and valleys with minor drainage lines. The scenic quality is considered to be low-moderate in areas surrounding the past quarry and moderate-high in surrounding areas primarily unaffected by past quarry sequences and with remnant native vegetation. Vegetation coverage is sparse, with thick shrubs and tree forests, forming a seasonally flooded tropical forest, with scattered marsh and swamps. The dense tropical forests tend to be in the higher elevations. During fauna surveys, the Cingulata (armadillos), Primates, Rodentia (rodents), Chiroptera (bats), Pilosa (sloths) and Carnivora (Carnivorans), were identified in the project area. No threatened or endangered species are present at the quarry site.

It should be noted that this is not the first phase of mining in the project area, and there was a quarry in the immediate project area during an earlier period. The spot heights range from 50 to 100 feet above sea level in the project area.

2.2. Geologic Structure

The rocks quarried at Agatash Quarry are strongly foliated amphibolite (meta-diorite) intruded by minor biotite granite which contains xenoliths of amphibolite with heavy joining and foliation. The estimated reserves of quarriable stone are about 1,000,000 tons with good mass. The total reserve is estimated at over 1,500,000 tons of amphibolite (meta-diorite) with high possibility of extension at depth.

The amphibolite was formed by middle grade regional metamorphism along a convergent plate boundary. The dolerite is intruded by intruded by minor biotite granite which contains xenoliths of amphibolite with heavy joining and foliation. The dykes are oriented in an NNW-SSE direction. The project area is dominated by a major NE-SW trending fault that runs to the eastern section. The main effect of these faults is that movement along them in the past may have caused the amphibolite to be fractured.

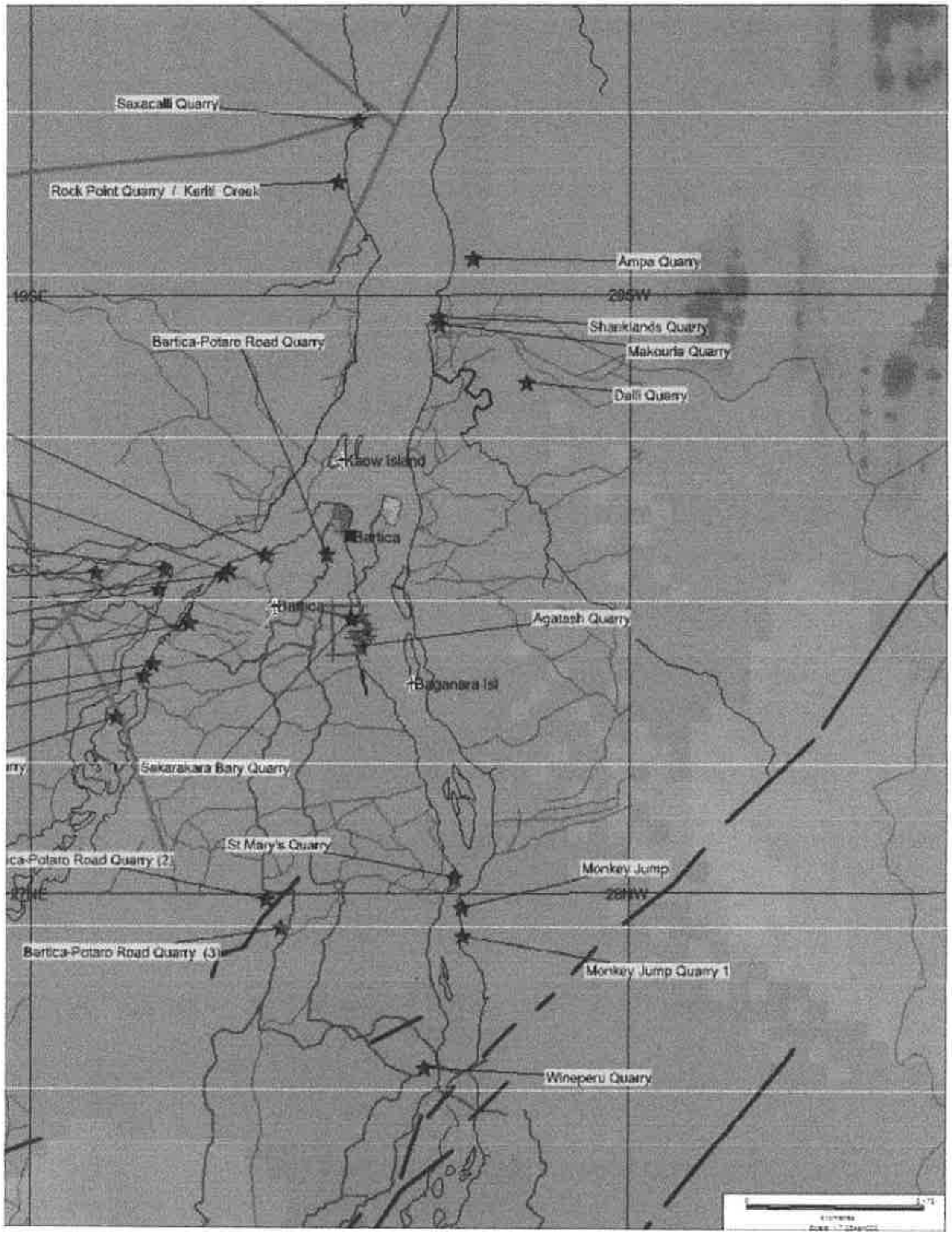

Figure 1: Topographic Map of Agatash Quarry

3. Design of project

The processing plant at Agatash Quarry will consist of a three stage crushing and screening system. It is estimated that the Agatash Quarry has in excess of 1,500,000 metric tons of mineable reserves at a stripping ratio of 0.042:1. Mining operations will continue to meet local aggregate production demands. The quarry will operate 5 days per week at single shifts of 8 hours to produce 352,941 metric tons annually. Typical drill, blast, load and haul cycles will be used. The process plant will operate on 1 eight-hour shift, five days a week.

3.1. Proposed staffing and Infrastructure

The Agatash Quarry will have suitable dwellings to accommodate quarry staff. There will also be a medic with adequate medical supplies on site. Serious medical emergencies will be recommended to the Bartica Hospital, Georgetown Public Hospital or other suitable health care provider. A mini Water treatment plant will be constructed onsite and water from the Essequibo River will be used for domestic purposes and in the crushing and screening plant. Electric power will be sourced from generators onsite. There will be a waste management system in place for all wastes generated by the quarry site. The ancillary facilities will also include an explosive magazine, mobile equipment workshop and fuel storage bay.

The mine will employ 28 persons, but other personnel will be contracted to complete medical and environmental tasks, and for security purposes.

Staff	No. of employees per Year				
	1	2	3	4	5
1. Quarry Foreman	1	1	1	1	1
2. Drill/ Blast Overseer	1	1	1	1	1
3. Driller	2	2	2	2	2
4. Blaster	2	2	2	2	2
5. Haul Truck Operator	1	1	1	1	1
6. Over Road Driver	2	2	2	2	2
7. Loader Operator	1	1	1	1	1
8. Mechanic	2	2	2	2	2
9. Plant Mechanic	2	2	2	2	2
10. Electrician	1	1	1	1	1
11. Plant Foreman	1	1	1	1	1
12. Plant Operator	3	3	3	3	3
13. Plant Laborer	1	1	1	1	1
14. Scale Operator	1	1	1	1	1
15. Site Manager	1	1	1	1	1
16. Engineer	1	1	1	1	1
17. Safety Professional	1	1	1	1	1
18. Environmental Officer	1	1	1	1	1
19. Medic	1	1	1	1	1
20. Cook	2	2	2	2	2

Table 1: List of Staff

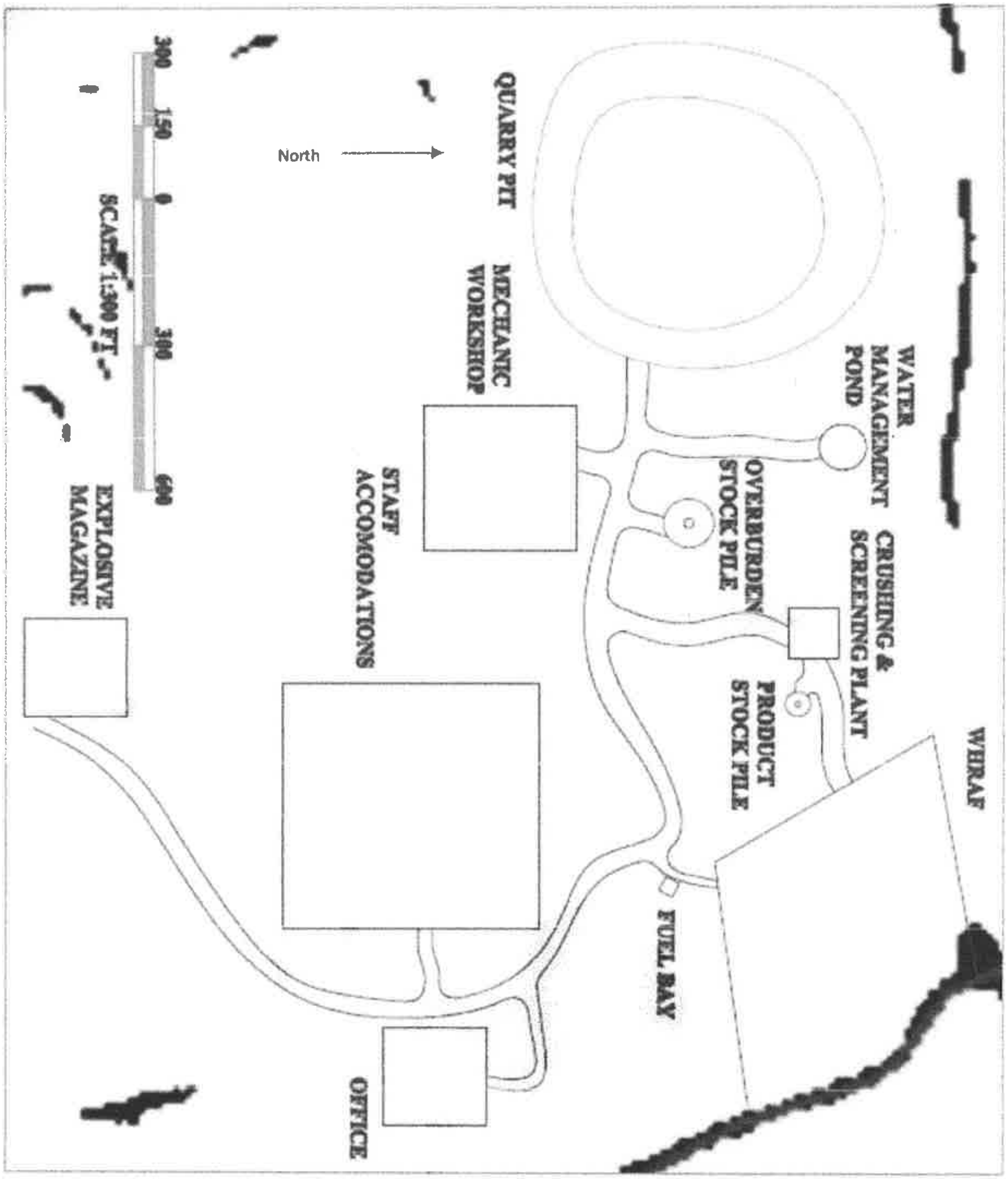

Figure 2: Conceptual 5-year Quarry Plan and Associated Infrastructure

3.2. Description of Project's Activities

3.2.1. Accessibility

The most suitable access to the area of the future quarry and processing site is from Parika or Bartica by Boat, or Bartica by air, then by boat. The most suitable route to transport supplies is from Parika or Bartica by river transport. The quarry development and quarry access road, will start from the processing plant in the North, due to the high probability of low reserves in this area. The placement of the primary crushing and screening technology is at the North-Eastern section of the project area.

3.2.2. Mining Process Description

In order to estimate the total volume of stone reserves in the delineated area and in the area after stone exhaustion, the lowest quarrying level of -13 ft ASL was chosen., which still allows for the quarry floor to be drained by gravity flow into receiving sediment ponds. The final quarry floor of the deposit is proposed to slope slightly by 2.5% from a level of 0 ft ASL in the east towards settlement ponds, then into the natural drainage system. The basis of the quarry benches should be horizontal. In order to estimate the tonnage of stone, raw material density of 4.27 ton/yd3 was used. The level of individual quarry benches, were determined with regard to the bottom, to quarry face heights of 50 ft and to the Geomorphology, and after testing several other options and possibilities, thus, the quarry bench levels in the proposed quarry were chosen as follows: 25 ft, 50 ft ASL. The peripheral areas in the east would drop to -13 ft ASL in the west so as to drain the entire quarry. The quarry will be developed from the existing quarry face.

3.2.3. Overburden Stripping and Pile and Re-utilizing

The volume of overburden is estimated at 19,074 m3. The characteristics of the soil include vegetative cover, top soil, saprolite and clay. The top soil will be stripped and stored for rehabilitation purposes. The overburden will also be stripped and stockpiled for rehabilitation purposes. Berms will be constructed around overburden spoil heaps to prevent run-offs and sedimentation of natural drainage systems. Overburden spoil piles will be located in areas of poor stone reserves.

3.2.4. Drilling and Blasting

Stone will be fragmented by blasting in the form of several standard bench blasts, rock breakers will be utilized in place of secondary blasting.

If adequate quarry development is achieved with a long face, then it may be possible to consider single row bench blasts, which usually consume less explosives. It is assumed that the effect of individual bench blasting will amount to 7,500 metric tons, once to twice per week to meet the annual production capacity of 353,000 metric tons as planned.

3.2.5. Bench Design and Construction

The proposed stone quarrying will involve two horizontal benches, a maximum 50 ft. quarry face height and a 750 slope. The quarry face height is usually based on the technical possibilities of the drilling technology used to prepare for the bench blasting, on requirements regarding the fragmentation of blasted rocks, and on safety instructions for loading of raw materials. The slope of the quarry face is basically based on the angle of the drill holes used to prepare for bench blasting. The quarry faces are proposed to set back at least minimum 33 ft. (working terrace width) for safe operation of loading and hauling equipment.

Proposed Quarry Development- Bench Levels

Bench 2 50 ft. ASL

Bench 1 0-25 ft. ASL

Slopes slightly from 0 m ASL in the West to -13 ft. m ASL in the east.

The proposed quarry floor slopes slightly from 0 ft. ASL in the west to about -13 ft. ASL in the east in order to drain the quarry. It is possible to use temporary surface drains (gutters) if percolation and run off of rainwater from higher benches proves the sloping inadequate.

3.2.6. Haul Road and Haulage

A main haul road is proposed so as to provide access to individual quarry benches, mainly in the western and southern part of the deposit. The main haul road will connect the western and southern areas. It is assumed that the eastern part of quarry would be quarried out first followed by the western area.

The road width will be 33 ft. It is assumed that the blasted rocks will be hauled by high capacity dump trucks. The main haul road should serve for hauling blasted rocks and also any unsuitable layers and overburden. Therefore, a dump for any unusable materials is located near the road. The proposed route of the main haul road is also based on the chosen location of the processing technology section, so as to minimize the length of the haul roads. It is necessary to consider the geomorphology of the terrain when proposing the route, so as to limit road gradient.

3.2.7. Processing Specification and Location

The location of a permanent crushing plant and related processing equipment is proposed at the southern edge of the extraction zone. The feed spout of the preliminary crusher should be located at the edge of this site, with a ramp from above connected to the quarry roads. The processing equipment setup shall enable the following basic specifications of the material input and output.

3.2.8. Mining Equipment and Machinery

The essential quarrying equipment for loosening raw material (drilling equipment, explosives), and for loading and hauling blasted rocks is proposed based on the required production capacity and on local conditions.

- 1 drill rig for preparation of blasting, monitoring of deposit structure, as well as monitoring of groundwater conditions;
- Bulldozer - Overburden work;
- Excavator with bucket-Overburden work, quarrying (loading raw materials);
- Drilling Rigs-Blasting preparation and exploration;
- Wheel Loader-Quarrying (loading raw material);
- High Capacity Dump truck-Hauling raw material to equipment;
- Auxiliary Equipment-Sprinkler truck, 4 x 4 vehicle, Skidsteer, ANFO truck, generator, welding plant

3.2.9. Rock Handling

Transport can be divided into three categories:

- Haulage by quarry machinery inside quarry area
- Haulage of raw materials from quarry to processing plant
- Transport of end products-shipping

3.3. Production Schedule

The quarrying and annual production schedule is set at 353,000 metric tons per annum. It is assumed that a six months' period is necessary for commencement and initial development of production and that production will stabilize at 353,000 metric tons per annum, after development works are completed.

Yearly production Requirements				
Year	Ore Tons	Waste Metric Tons	Total Metric Tons	Blast Holes
1	88,235	5913	88,235	595
2	352,941	5913	352,941	2,380
3	352,942	5913	352,942	2,380
4	352,941	5913	352,941	2,380
5	352,941	5913	352,941	2,380

Table 2: Yearly Production Requirements

3.4. Duration of Project

No.	Project Phases	Duration
1.	Construction of Dwellings and Administrative Structures	21 days
2.	Acquisition and Construction of Processing Plant	88 days
3.	Acquisition of Mining Equipment	88 days
4.	Production of Gabion Rocks & Aggregates	848 days
5.	Monitoring & Reporting – Operational Phase	1140 days
6.	Rehabilitation Works	1304 days
7.	Monitoring & Reporting –Post Closure	1305 days

Table 3: Duration of Project Phases

3.5. Decommissioning Plan

The Rehabilitation and Closure Plan has been prepared for the Agatash Quarry Project to provide the framework for rehabilitation works, direct the implementation of the habitat management area, provide direction for the management of the remnant vegetation, detail the required landscaping measures and minimise the impact of the project on riparian areas.

The facilities will be progressively closed over the duration of the quarry site operations. Progressive closure will reduce the costs of rehabilitation, since closure will be integrated with the production operations. In addition, progressive closure will result in the development of expertise on the most appropriate rehabilitation methods. Progressive closure will be undertaken, however without posing impediments to day-to-day operations of the site. Final closure of the quarry site will be undertaken following completion of all quarrying operations, once treatment of site waters is no longer required, and indications that further quarrying of the property is not warranted.

Final closure of the facility will occur in two stages. The first stage will entail the following activities, if not undertaken during progressive closure phases:

- All fuel, chemicals, waste hydrocarbon products, and any potentially hazardous materials will be removed from this site;
- Pit dewatering will cease; and,
- Water treatment will cease once runoff water no longer requires treatment.

During the second stage of the final closure all equipment, machinery, and storage tanks will be removed for reuse or recycle. Where such uses are not practical, any remaining materials will be disposed of at a suitable storage site. All structures will be removed and/or be demolished. Structures that are suitable for reuse or recycling will be salvaged. Structures not suitable for use will be disposed. The water management pond will be closed and all disturbed areas will be rehabilitated, with the exception of roads needed for access during long term monitoring.

After the major closure activities are complete, a monitoring program will be implemented including the site water quality monitoring and embankment inspections.

Historical information for the site indicates that the site has been the subject of quarrying operations in the past. Those activities have resulted in significant disturbance to the area, including excavations, road building, construction of infrastructure and forest clearing. A large part of the old growth timber was removed during those operations and a large part of the site is covered by secondary growth indicative of former operations at the site.

The conceptual Closure Plan is intended to ensure the "return to nature" of the quarry site. At the conclusion of the closure process, no buildings or supporting infrastructure or facilities will remain at the site. The areas will be fully replaced by a sustainable environment comprised of productive vegetative ecosystems. Spoil piles, stockpiles, borrow areas etc. will be vegetated with general sustainable grass as well as emerging forest (primarily early stages in white sand forest succession are expected to dominate the period immediately following closure). The site will be monitored for success of the closure plan. A few routes will be left for access to points of interest for the monitoring program. These routes will be closed after successful reclamation.

4.Potential Environmental Impacts and their Significance

Potential impacts and risks for the mine site and access roads are detailed below for the construction, operation, and closure phases of the Project. The majority of potential impacts on the physical environment will take place during the construction phase. During operations, potential impacts will be related to water and waste management.

4.1 Construction

4.1.1. Noise

Construction activities are expected to exceed the GNBS and EPA noise emission standards of 90 dBA (decibel) during the day and 75 dBA at nights from heavy earthmoving machinery operations. Maintenance operations in workshops will produce noise levels in the vicinity of 72-110 dBA, while the power generation plant will range from 90-105 dBA. Exposure to noise levels above the tolerable threshold of 72 decibels may result in fatigue, tiredness, low morale, decreased production levels and hearing loss. Primary noise receptors in the area will be individuals involved in construction activities at the site. Additionally, construction phase noise will also have an adverse effect on many species of wildlife that are sensitive to increased noise levels. However, many species may become habituated to frequent noise events or continuous noise levels and may return to the area.

These impacts will be mitigated by implementation of the following:

- Installation of sound suppression devices (such as mufflers) on earthmoving equipment, generators etc.;
- Avoiding unnecessary idling of vehicles and machinery that are used intermittently;
- Employing best available work practices on-site to minimize occupational noise levels; and,
- Provide personal protective equipment (PPE) to employees and contractors, and requiring their usage under the health and safety plan.

Implementation of these measures would result in minor residual impacts (medium likelihood, low severity).

4.1.2. Impacts to Air Quality

Construction activities will result in dust generation from the movement of vehicles and machinery, land clearing, blasting and excavation, and loading and unloading of soil, crushed rocks, etc. Additionally, combustion emissions would result from chainsaw operations, diesel and/or gasoline-fired heavy duty equipment usage and power generation from diesel generators. These emissions would be short-term and elevated only in the vicinity of construction operations. The impacts to air quality would be moderate (high likelihood, low severity).

These impacts will be mitigated by employing the following measures:

- Covering trucks to minimize dust particulate emission;
- Minimizing drop heights from vehicles;
- Scheduling land clearing activities on less windy days;
- Limiting vehicle speed during construction to a maximum 30 km/hr;
- Employing dust suppression techniques such as wetting earthen roads with water or non-toxic chemicals;
- Avoiding open burning of wastes at the construction site; and,
- Maintaining construction equipment according to manufacturer's specifications.

Implementation of the mitigation measures will result in minor residual impacts (low likelihood, low severity).

4.1.3. Impacts to Soil

a) Soil erosion and Sedimentation

Potential impacts such as soil erosion and sedimentation could result from vegetation clearance, landscape grading, and re-contouring to ensure proper drainage, and other construction activities. Significant impacts to soils are expected to occur in steeply sloping areas and where the soils erosion potential is severe. These impacts are considered moderate impacts (high likelihood, low severity).

The likelihood of soil erosion and sedimentation will be minimized or avoided by the implementation of the following mitigation measures:

- Implementation of best management practices in a Storm Water Management Plan for soil erosion, storm water runoff, and sedimentation control (e.g., silt fences);
- Installation of channel control structures;
- Implementation of an Interim Reclamation Plan following clearance activities; and
- Implementation of a long-term Reclamation Plan for disturbed areas.

Implementation of these mitigation measures will result in minor impacts (low likelihood, low severity) on soil.

.b) Rutting and Compaction

Potential impacts resulting from the movement of heavy equipment required to support the planned mining and construction activities may impact the soil resources by causing rutting and compaction of susceptible soils. Given the soils of the Project site, compaction and rutting is not considered a widespread concern, and the impacts to the soil resources are expected to be minor (low likelihood, low severity). Rutting and compaction will be minimized by scheduling the majority of the construction activities, to the extent practicable, to occur in the dry season, by limiting off-road access, and by implementing an awareness education and training program.

c) Topsoil mixing

The construction of roads, access ways, and mine preparation during landscape grading and re-contouring to ensure proper drainage; and during vegetation clearance has the potential to result in topsoil mixing. The mixing of the topsoil with the subsoil from these activities could result in a loss of soil fertility and the loss of viable seeds present (seed banks) in the topsoil. These are moderate impacts (medium likelihood, medium severity).

To prevent mixing of soil horizons, the following mitigation measures will be implemented:

- Segregate topsoil or surface soil from subsurface layers during construction activities;
- Replace topsoil following construction, as applicable;
- Site topsoil storage areas;
- Identify and maintain or salvage topsoil pockets; and
- Replace segregated topsoil as indicated in the Reclamation Plan. Following these mitigation measures, the impact of the proposed Project on soils would be minor (low likelihood, low severity).

d) Contamination by hazardous substances

Soil contamination may occur by accidental release of fuels, oils, grease and other hazardous materials from equipment and/or from the failure of fuel/hazardous material containment areas. These are major impacts (medium likelihood, high severity).

The potential for accidental spills of fuels and other hazardous materials and associated soil contamination will be minimized or avoided by the implementation of a Spill Prevention and Contingency Plan (SPCP). Management measures detailed in the SPCP includes; the siting of fuel containment tanks on impervious bases located within impermeable enclosures designed to hold 110 percent of the contents of the tank, and channeling of storm water discharge from fuel storage areas to an oil-water separator prior to being discharged to surface water.

Implementation of these mitigation measures would result in minor impacts (medium likelihood, low severity) on soil during construction.

4.1.5. Impacts to Surface water

Sediment discharge from cleared areas has the potential to reduce water quality in streams and creeks adjacent to cleared areas. These are major impacts (high likelihood, medium severity). The construction duration is likely to be relatively short. An Erosion and Sediment Control Plan will be implemented to mitigate potential impacts to water quality from erosion. The mitigation measures will result in minor impacts (low likelihood, low severity).

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 (medium likelihood, medium severity). 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 storm water runoff, in the dry season. These mitigation measures will result in minor impacts (low likelihood, low severity).

Surface water quality may be negatively impacted during construction of the mine site by accidental discharges of fuels, oils and grease from construction equipment. These are major impacts (medium likelihood, high severity). 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. This Plan details measures which will be implemented to prevent, and if necessary, contain spills of fuels, oils, or other contaminants. Such measures will include; siting of fuel containment tanks on impervious bases located within an impermeable enclosure designed to hold 120 percent of the contents of the tank and channeling storm water discharge from fuel storage areas to an oil-water separator prior to being discharged to surface water. Implementation of these mitigation measures will effectively remove any potential impacts to surface water quality. The residual impacts will consequently be minor (low likelihood, low severity).

Road construction activities may include placing culverts at several stream crossings. Culverts constructed through the roads 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 streams in the vicinity of roads. These are major (high likelihood, high severity) impacts. These impacts will be mitigated by designing culvert sizes to pass the natural surface water flows. Culverts will 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 works at the site. This will result in minor residual impacts (low likelihood, low severity).

Land clearing and earthmoving activities associated with development of the quarry infrastructure, including the tailings and water management ponds may increase the potential for erosion and the associated increased sediment transport to waterways and sedimentation of these waterways in the Project area. Streams in the Project area have historically been adversely impacted by sedimentation from artisanal miners. Construction activities will pose increased risks of added sediment discharge to these streams. The potential for increased sediment discharge to surface water as a result of construction activities is considered to be major (high likelihood, high severity). The potential for sediment discharge to waterways will be minimized or avoided by the implementation of best management practices such as:

- optimization/minimization of vegetation clearance,
- revegetation of disturbed areas (even if temporary),
- Use of storm runoff retention ponds and silt fences, etc.

Implementation of these mitigation measures will result in minor residual impacts (low likelihood, low severity).

4.1.6. Impacts to Groundwater Quality

Impermeable liners will be placed over the base of the water management pond during construction. The impermeable liners will reduce recharge to groundwater. However, the project foot print 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 minor (low likelihood, low severity).

Spills of fuel and oils from equipment, from equipment and fuel storage and from service areas can flow to the underlying aquifer and potentially impact groundwater quality. This will result in major impacts (high likelihood, high severity) to groundwater quality. Potential contamination of the underlying aquifer will be minimized by installing drip pans on all equipment, enforcing a program to check for equipment leaks and implementation of the SPCP. The SPCP will detail plans for utilization of sorbents, biological agents, chemical dispersants and gelling agents. All fuel will be stored within containment walls designed to contain 120 percent of the tank contents. Implementation of these mitigation measures will result in minor residual impacts (low likelihood, low severity) to groundwater quality.

Groundwater dewatering may be required during construction of foundations for project infrastructure. Surface spills of fuels in the vicinity of foundation excavations may result in localized impacts to shallow groundwater at the project site via runoff into the open excavations. Groundwater dewatering activities will, however, capture any petroleum-related releases to groundwater. The potential impact to groundwater during the construction phase is consequently considered to be minor (low likelihood, low severity). Nevertheless, potential impacts to groundwater quality related to surface spills will be mitigated by the use of secondary containment structures around above ground storage tanks containing fuel oil and the maintenance of spill containment equipment in the vicinity of refueling areas.

4.2. Operation

4.2.1. Impacts to Soil

During operations, additional areas will be cleared, graded, mined, and covered. This will result in expansion of the area of impacted soils. Spills of fuels, lubricants, and other hazardous substances can lead to contamination of soils. In the absence of mitigation, the collective impacts to soils during operations are rated as major (high likelihood, medium severity).

The mitigation measures for soils would include continued implementation of the following:

- Implementation of best management practices for erosion control;
- Topsoil and organic matter stockpiling;
- Re-spreading, de-compaction, and revegetation; and,
- Implementation of the Spill control and Cleanup Plan

Implementation of these measures will result in minor residual impacts (low likelihood, low severity).

4.2.2. Noise

During the quarrying, crushing and screening operations, noise levels above the GNBS/EPA decibel limits of 90 dBA (decibel) during the day and 75 dBA at nights will be emitted from heavy equipment and earthmoving machines and from process equipment such as crushers. Periodic elevated noise levels will also be generated from blasting operations associated with mining operations. Maintenance operations in workshops and the process plant area will generate noise levels in the vicinity of 72-110 dBA. Noise levels from diesel power generation plants will range from 90-105 dBA.

mitigation measures will consist of the following:

- Installation of sound suppression devices (such as mufflers) on earthmoving equipment and generators, as necessary;
- Employing best available work practices on-site to minimize occupational noise levels;
- Isolation of noise source from employees' living area;
- Using acoustic insulating materials such as silencers on exhaust systems;
- Issuing/requiring use of PPE (e.g., ear plugs or ear muffs) especially in high noise locations;
- Posting visible warning signs in areas of high noise levels instructing employees to wear ear protection;
- Periodically monitoring noise levels to ensure compliance with recommended threshold levels and,
- Conducting regular hearing tests and maintaining records of results for workers exposed to high noise levels.

During the operational phase of the project, noise would continue to affect surrounding habitats, but most species remaining would have either become habituated to noise during the construction phase or were otherwise pre-adapted to higher noise levels. Implementation of these measures would result in minor impacts (low likelihood, low severity) related to noise generated.

4.2.3. Impacts to Air Quality

The operation phase of the project will see the generation of dust and combustion emissions from activities such as stripping of topsoil and overburden, drilling and explosive blasting, loading and unloading of haul trucks, transport/haulage of extracted ore from the mine pit to the processing facility, crushing, screening, milling and classifying ore materials, vehicles traversing site roads, wind erosion of stockpiles and operation of heavy duty equipment. This will result in moderate impacts (high likelihood, low severity).

Dust and other emissions from haul roads and other sources will be mitigated by employing the following measures:

- Minimizing drop heights from vehicles
- Limiting vehicle speed
- Employing dust suppression technique such as applying water or non-toxic chemicals
- Maintaining construction equipment according to manufacturer's specifications

Implementation of these mitigation measures will result in minor impacts (low likelihood, low severity).

4.2.4. Geology

During mining, soil and rocks will be excavated from the mine pit area. The present geologic profile of the area consists of a stratum of alluvial soils overlying residual soil material derived from weathered acid crystalline rocks (dolerite and granite associated with pyrite) underlain by igneous and intrusive rocks. Quarrying will not segregate soils based on the depths at which these soils are encountered when the overburden material is disposed in the spoil piles. Quarrying and spoil disposal will result in an alteration of the stratification of the unconsolidated soils at the site. Additionally, several pits will be created by the excavation operation. Spoil disposal and ore stockpiles may result in filling of depressed areas and creation of elevated areas. The pits, spoil and ore stockpiles will alter the topography, slope relief intensity, degree of shaping and exposure of the area. These are moderate impacts (high likelihood, low severity). These impacts would be localized to the quarry site and will not be mitigated.

4.2.5. Generation of Solid Wastes

The operation of the quarry will generate large volumes of solid wastes, including spoils, trash, scrap, rubble, domestic wastes, and hazardous wastes. If not properly managed, these wastes could lead to contamination of soils and water, as well as generation of odors, attraction of vermin, and creation of human health and safety hazards. This impact is rated as major (high likelihood, medium severity). The Project will minimize and mitigate these potential impacts by developing and implementing the respective waste management plans for each type of solid waste anticipated to be generated by the operation phase of the Project. Reuse and recycling would be preferred over disposal to the extent practicable. Under proper management, the residual impact associated with solid waste generation is considered to be minor (low likelihood, low severity).

4.2.6. Impacts to Surface Water

Several types of potential surface water impacts are attributed to quarrying activities, including sediment loading and low pH due to acid mine drainage (AMD). Precipitation may induce leaching of chemicals from waste rock and overburden stockpiles at the Project site. These are considered major impacts (high likelihood, medium severity). Perimeter drainage channels will be installed around waste stockpiles to collect storm water runoff. Storm water from the perimeter drainage system will be discharged to a water management pond before final discharge to surface water. Additional mitigation measures to preclude impacts on surface water quality will include the following:

- Installation of an impermeable liner as part of a leachate collection system to minimize potential impacts to surface water; and,
- Periodic monitoring of the physical integrity of the overburden stockpiles during operations to minimize the potential for discharges due to slope failures.

Implementation of these mitigation measures will result in minor impacts (low likelihood, low severity).

Breaches and overtopping of the water management pond will result in major impacts (high likelihood, high severity) to surface water quality. These impacts will be mitigated by utilization of

Best Management Practices (BMPs) during design, construction and operation of these facilities, including monitoring of dam integrity. Implementation of BMPs will result in minor impacts (low likelihood, low severity).

Water quality may be potentially impacted by wastewater discharges from the onsite sewer system, domestic wastewater, and/or by storm water runoff from developed areas (i.e., workshops, equipment storage and service areas, etc.). These potential wastewater discharges were considered to be major impacts (high likelihood, high severity). Mitigation measures will include the following:

- Proper design, use and maintenance (including regular de-sludging) of plant sewer systems and/or individual septic tank systems (e.g., septic tanks and leach fields consisting of gravel infiltration beds).
- Septic tanks would be designed in accordance with the new Guyanese septic tank standards developed in 2008;
- Proper disposal of sludge (i.e., in a secure landfill); and,
- Storm water runoff from developed areas will be channeled through several oil-water separators prior to discharge to surface water.
- Monitoring of the effluent from the oil-water separators to ensure that the discharged storm water meets effluent discharge/water quality standards prior to discharge into surface water.

Implementation of these mitigation measures will result in minor impacts (low likelihood, low severity).

Wastewater during operations will consist of groundwater extracted from the quarry dewatering operations and slurry from crushing and screening operations. Groundwater from the mine dewatering operations will be discharged to surface water after passing through the water management pond to ensure the attainment of discharge effluent/water quality standards. The extracted groundwater will also be subject to conditions detailed in the Erosion and Sediment Control Plan to minimize sediment discharge to surface water during operations. The potential discharge of groundwater from the pit dewatering activities is considered to be a minor impact (low likelihood, low severity). No mitigation measures are proposed.

Surface spills and releases of fuels, oils and grease from mining equipment and/or the failure of fuel containment facilities (i.e., the tank farm) during the operations phase are considered to be moderate impacts (high likelihood, medium severity). Mitigation measures will include the following:

- Implementation of spill containment, control and prevention measures during transport and refueling operations as well as during all vehicle and mining equipment maintenance and repair; and,
- Channeling storm water discharge from fuel storage areas to an oil-water separator prior to being discharged to surface water.

Implementation of these mitigation measures will result in minor impacts (low likelihood, low severity) on surface water quality during operation.

4.2.7 Fuel Oil Spill

It is assumed that a 15,000 gallons diesel fuel tank would be present onsite. A diesel oil spill into the river may have an effect on shorelines (where staining may coat plants or be ingested by wildlife), on the benthos (where sediments may become contaminated and organisms become physically fouled), on the water surface (where birds and sea creatures may become contaminated by contacting the oil), and in the water column (where aquatic organisms may ingest dissolved hydrocarbons causing narcosis in high concentrations and durations of exposure). If the assumed accidental fuel spill occurred, high concentrations of fuel oil could be present in the Essequibo River. At these concentration levels, humans, fish, invertebrates, mammals, and birds in the river may be at risk. These are considered to be major impacts (medium likelihood, high severity). These impacts will be mitigated by strict adherence to the Environmental Monitoring Plan, specifically to include frequent monitoring and inspection of fuel storage tanks. The Spill Prevention and Cleanup Control and Emergency Response Plans will include aggressive alerts, education, and cleanup activities. In addition, discharges/drainage from these areas would be directed to the tailing ponds, if practical or to a separate emergency containment pond. The emergency containment pond will act as a failsafe mechanism and will complement the Best Management Practice (BMP), Environmental Monitoring Plan (EMP) and the Spill Prevention and Clean-up Control and Emergency Response Plans proposed for implementation to mitigate impacts from spills. Application of these mitigation measures to contain and localize potential spills will result in a rating of minor impact (low likelihood, low severity).

4.3. Mine Closure

4.3.1. Surface Water/Groundwater/Soil

Failure of the water management pond may impact surface water and groundwater quality in the vicinity of the Project area. The potential failure of the water management pond after completion of mining activities is considered to be a potentially low impact (low likelihood, low severity). The following mitigation measures will be implemented to minimize the likelihood of water management pond failure.

- Post-closure monitoring of the stability of the water management pond; and,
- Periodic monitoring of surface and groundwater conditions in the vicinity of the pond. Implementation of these measures will result in minor impacts (low likelihood, low severity).

In addition, the dismantling and cleanup of fuel storage tanks, hazardous waste receptacles, and other accumulated materials during closure could lead to spills which could contaminate surface water and/or groundwater, as well as soils. Potential spills associated with these closure activities are considered to be moderate impacts (high likelihood, medium severity). Mitigation of these potential impacts will be achieved by adhering to a mine closure plan that specifies appropriate and specific procedures for dismantling/decommissioning mining infrastructure.