

**FINAL ENVIRONMENTAL AND SOCIAL IMPACT
ASSESSMENT
KAROUNI GOLD MINES
FOR
TROY RESOURCES GUYANA INC.**

**GROUND STRUCTURES ENGINEERING CONSULTANTS INC.
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SUMMARY

Pharsalus Gold Inc. a wholly owned subsidiary of Azimuth Resources Ltd., which is wholly owned by Troy Resources Limited. has rights to a property centered near the Iron Bridge, crossing over the Main Kaburi River approximately 12 km along the Issano Branch Road and approximately 160 km southwest of Georgetown, Guyana and 37 km northwest of the former Omai Gold Mine. The property consists of several Medium Scale Prospecting and Mining Permits, Small Scale Claim Licenses, two Large Scale Prospecting Licenses and one existing Mining License issued in accordance with the Mining Act, 1989 and the Mining Regulations thereto. The area is located generally in the Karouni area of the Mazaruni Mining District as shown on Terra Survey Topographic Sheets 36SE and 36SW at a 1:50,000 scale.

The Concession and immediately adjacent areas have supported mining activities for over one hundred years. Several of these operations continue within the limits of the Concession and within proximity of the Concession boundaries. Mining operations within the concession has spawned the development of a community; 14 Mile Issano; outside of the boundaries of the contiguous properties.

The Karouni Gold Project will be developed initially as an open pit operation at the Smarts and Hicks Deposits. The total mine life for the pits is three years. Underground mining will be assessed later. The firm proposes to apply to the Guyana Geology and Mines Commission (GGMC) for issuance of a Mining License, to operate an open pit mine in the concession, in accordance with the terms of the PLs. The mine will be focused on the recovery of ore for processing from Smarts and Hicks gold deposits. The maximum mine pit dimensions are expected to be 1,500 m in length by 350 m in width and approximately 180-240 m deep. Saprolite ore represents less than 10% of the total ore. The remaining fresh ore is primarily massive intermediate volcanics with chalcopyrite and gold mineralization.

Mining will commence six months before the processing plant is commissioned. This will enable adequate high grade stocks to be accumulated prior to the commencement of processing. An initial fleet comprising two excavators will commence works at the Smarts and Hicks Deposits. There is sand overburden, up to 30 m thick, covering much of the Smarts Deposit whereas the Hicks Deposit outcrops. Initial ore production will be sourced from the Smarts Deposit with production at the Hicks Deposit commencing in month 5. Ore production will then focus on the higher grade Smarts Deposit. An additional fleet would be mobilized after 5 months to provide additional capacity for the Hicks Deposit. This fleet would then be demobilized in month 30 with a second fleet demobilised in month 29 and open pit mining concluded in month 36.

The Smarts Deposit will be mined as a 4 stage pit. The first two stages will target shallow, higher grade pods with the final two stages amalgamating the pits into a single final pit. Mining will be via conventional backhoe configured excavators loading 30 tonne rigid trucks. Mining will be done on 2.5 m benches over a 5 m high blast. Initial sand overburden removal will be free dig with no blasting required.

Oxidation/weathering is of moderate depth at the Smarts Deposit with average depths to fresh rock of about 50 m below natural surface. Blasting will however be required in the transitional zone and deeper parts of the oxidized profile in order to maintain excavator dig rates. Final vertical depth of the stage 4 Smarts Pit is 140 m. Total volume excavated will be 8,614,000 m³.

Drilling has encountered water accumulating at the base of the sand overburden. It is proposed to divert this water away from the pit crest via drains. Any naturally occurring water courses will also be diverted around the excavation using purpose built drainage channels.

Water in the pit will be pumped out using conventional in-pit sumps excavated as the pit progresses and the water would be pumped to the pit crest for disposal utilizing the surface drainage infrastructure.

The Hicks Deposit will be developed as a series of three discrete pits along the Hicks line of mineralization. Open pit mining will target higher grade, shallow mineralization. The deepest pit, stage 2, will extend to 90 m below natural surface. There is no overburden masking mineralization at the Hicks Deposit. Mining will commence in month 5 after mining has started at the Smarts Deposit with the first two mining fleets.

Conventional truck, shovel and wheel loader surface mining methods will be used in the open pit operations. The sulphide material will be conventionally drilled and blasted before being mined. An independent explosive supplier will be retained to set-up a bulk explosives plant and detonator and explosives magazine on-site.

Mineral processing will consist of handling the saprolite ore and fresh ore by blending the two together and processing singularly. The process will include ore crushing, gravity concentration, CIL leaching and gold recovery and cyanide tailings detoxification. The plant will be designed to enable it to process up to 1.6 million tonnes of ore per annum.

Due to time constraints and the ongoing need to update drilling to convert resources to reserves coupled with the effects of a lower gold price Troy decided to split the Karouni project into an open pit and an underground phase to be addressed later.

This then insured rapid development, ensured sufficient time to conclude reserve drill out and conversion as well as brown fields exploration funded internally. Based on these parameters Troy concluded a further mine optimization study looking at the open pits only. In addition a calculation as to the maximum production capacity achievable without additional major expenditure indicated that a 3 year open pit phase resulted in the maximum return on capital. A series of open pits were designed resulting in various depth pits with the maximum depth being 145 m at the Smarts ore body.

The Preliminary Feasibility Study - NI43-101 - Technical Report, dated 31 July 2014, considers a combination of two open cut mines feeding a conventional carbon-in-leach (CIL) gold plant with a nominal capacity of 1 Mtpa. The study assumes that a total of 2.61 million tonnes of material will be processed with an average grade of 3.84 g/t of gold, with recovered gold production of 303,521 ounces over a 3 year mine life.

This Environmental and Social Impact Assessment (ESIA) and its associated public consultation are parts of the implementation process for design, construction and operation of the mine site. The Environmental and Social Impact Assessment objective is a systematic study, analysis and evaluation of the potential environmental and social impacts related to project execution. The assessment includes an evaluation of the environmental implications of The Project and its alternatives including the no action alternative.

This ESIA is guided by several international policies and local legislation and regulations developed to ensure sound management of the environment. National Policies, Regulations and Legislations which are relevant to the deliberations of this ESIA include the National Environmental Action Plan, The Environmental Protection Air Quality Regulations, The Environmental Protection Water Quality Regulations, The Environmental Protection Noise Management Regulations, The Environmental Protection Hazardous Wastes Management Regulations, The Environmental Protection Authorizations Regulations, The Environmental Impact Assessment Guidelines for Mining, The Mining Guidelines for Water Quality, The Mining (Amendment) Regulations 2005, The Guyana Geology and Mines Commission Act of 1979 and Mining Act of 1989, The Amerindian Act No. 6 of 2006, The Occupational Safety and Health in Mining, The Wild Birds Protection Act Chapter 71:01, The Town and Country Planning Act Chapter 20:01, The National Biodiversity Action Plan, The Public Health Act Cap 145, The Forest Act 2008 and Guyana Forestry Commission Act 2007 and the Code of Practice for Timber Harvesting 2002. The ESIA also identifies the EPA's Role in EIAs.

International policies which are relevant to the preparation of this ESIA include Agenda 21, The Protocol Concerning Pollution from Land-Based Sources and Activities (LBS), The Protocol Concerning Specially Protected Areas and Wildlife (SPA), The Treaty on Cooperation for the Development of the Amazon Basin and The UN Framework Convention on Climate Change (UNFCCC). This ESIA also incorporates the International Finance Corporation Performance Standards (IFC PSs) into consideration of the Project Environmental, Health and Safety.

The assessment of the environmental and social impacts of the proposed project was preceded by a baseline characterization of environmental and social variables in the project areas. The biological baseline characterization focused on examining the biodiversity of the proposed mine site. It was based on field surveys of the mine site area to capture temporal and spatial variations. The biodiversity survey was supplemented by a review of literature on the area biodiversity and the results of that review have also been incorporated into the biological baseline characterization.

The socio-economic and socio-cultural baseline was compiled based both on literature review and on field surveys conducted in communities considered to be within the project area of influence. The definition of the socio-economic and socio-cultural baseline and the identification of potential impacts associated with the project were aided by a public consultation process. Primary stakeholders for this project include groups and individuals directly affected by the project. Secondary stakeholders are the public and/or private sector organizations who may have a role and responsibility in the implementation and/or monitoring of the project. In addition to residents in close proximity to the site, other primary stakeholders include Guyana Geology and Mines Commission (GGMC) and the Region 7 Regional Development Council in which the mine site is located. Secondary stakeholders are regulatory bodies consisting of the Environmental Protection Agency (EPA), the Ministry of Labor, Occupational Safety and Health Department (OSHD), and commercial and industrial enterprises located within close proximity to the site.

Consultations were held with all primary stakeholders. Consultations with state/sectoral agencies and NGOs, based in Georgetown were held in the EPA boardroom. Consultations with residents of communities in proximity to the facility were facilitated by two meetings hosted by the Environmental Protection Agency. All meetings were initiated with a description of the project and its anticipated environmental and social impacts. Stakeholders were subsequently invited to identify issues and concerns for inclusion into the impact assessment and management measures for the facility.

The property lies within the Precambrian Guiana Shield which extends across northern South America from east of the Andes to northeastern Brazil. The regional geology of northern Guyana is situated in the northern part of the Archean-Proterozoic Guiana Shield. This terrain is considered to be the equivalent of the West-African Palaeoproterozoic Birimian Supergroup metasedimentary/greenstone terrains. The soils on the property have developed in place and consist of unconsolidated deposits derived from residual acidic and basic rocks.

Guyana is located in the Equatorial Trough Zone (ETZ) and its weather and climate are influenced primarily by the seasonal shifts of the ETZ and its associated rain-bands called the Inter Tropical Convergence Zone (ITCZ). There are no major industries in the area. Aerial emissions in the Project area are directly related to the emission of gases by rotting trees and other vegetative matter. Airborne discharges and particulate matter are not monitored in the area.

The primary surface water feature within the concession is the Hit or Miss River. Secondary drainage features, within the concession, include McDonald Creek, Blackwater Creek and White Sand Creek. Blackwater Creek has two branches referred to as Blackwater Creek and Blackwater Main. Both branches flow to the Kaburi River.

To capture historical baseline surface water quality in the area, surface water and sediment samples were recovered from exact locations on streams in the concession, at times coincident with the a single wet and a single dry season in Guyana.

Very little data is available on groundwater flow parameters in the concession area. A groundwater hydrology program was undertaken to define the regional groundwater flow regime in the concession area. A single well nest was installed in the concession area in the dry season and four additional well nests were installed in the wet season. Groundwater levels for all wells were assembled with the associated well location data and potentiometric maps were developed for the aquifers at the site.

Groundwater samples, recovered from the wells, were tested to determine the concentrations of constituents mandated by the Guyana Environmental Protection Agency (EPA) in their guidance document titled “Environmental Impact Assessment Guidelines Volume 3 – Mining Version 1, August 2000”.

The Concession lies within the low lying region of the Mazaruni River Basin, entirely within the tropical rainforest ecological zone. The Concession is situated in the Central Guyana Wet Forest national forest region. This wet forest region is characterized by a high abundance of commercial and often near endemic species such as *Swartzia leiocalycina*, *Chlorocardium rodiei*, *Mora excels*, *M. gonggrijpii*, *Alexa imperatricis*, *A. leiopetala* and *Clathrotropis spp* (Steege, 2000). The Concession forms part of the lowland forest ecosystems typical of the lowland forests habitats of the national forest regions and is located within the non-flooded lowland forests in the white sand region and the tall evergreen lowland non-flooded forest in Central Guyana.

The biodiversity surveys indicate that the Concession and the access road have been subject to significant disturbance and habitat degradation. The habitats and biodiversity components within the Concession and access road are consequently classified as largely modified habitats in accordance with the International Finance Corporation Performance Standard 6 (IFC PS 6). Further, neither the concession nor the access road contain habitats with a high biodiversity value and as such are not classified as a Critical Habitat as defined by the IFC PS 6.

The socio-economic baseline study was undertaken to create a profile of the communities in and around the project area. The Mining Concession is located within Administrative Region 7. The socioeconomic baseline was conducted to establish: (i) dominant uses of land and other resources for subsistence and livelihood activities, such as farming, fishing, hunting and mining practices; (ii) presence of infrastructure such as schools, medical facilities, communications network/transport networks and markets; (iii) public health issues in terms of health risks and diseases; (iv) local institutional capabilities; (v) land ownership patterns; (vi) identification and characterization of community cohesion and management; and (vii) identification of existing and proposed development plans for the study area. Consultations and field work was done with the relevant stakeholders to compile the baseline. Socio-cultural and socio-economic data was compiled for Bartica and Itaballi which served as gateways to the mine site. Socio economic and socio cultural data was also compiled for Kaburi Village, 14 Mile Issano and for several mining camps within the concession and within proximity of the concession.

The potential impacts related to construction activities at the mine site and to mining operations include potential impacts to the atmosphere, aquatic and terrestrial resources and to human, socio-economic and cultural resources. An impact rating system was employed to ensure the application of analytical rigor to the assessment of impacts. Impacts were initially rated as direct, indirect or cumulative. Impacts were further categorized according to their seriousness by examining the likelihood and severity of each impact. The impact mitigation measures were then identified and the residual rating of impacts was then classified as to both severity and likelihood.

Potential impacts to soil could result from upgrading of the access road linking the mine site to the Amaila Falls Access Road and from clearance of vegetation over the mine footprint. The likelihood of soil erosion and sedimentation will be minimized or avoided by the implementation of the Best Management Practices (BMP). The movement of heavy equipment during construction and mining may impact soil resources by causing rutting and compaction of susceptible soils. The impacts to the soil resources are expected to be minor (low severity, low likelihood). Topsoil mixing could potentially occur during the project execution. BMP implemented during construction and operation will result in minor impacts.

Construction works will result in emissions of fugitive dust and products of combustion. Impacts to air quality could be moderate. These impacts will be mitigated by scheduling land clearing activities to less windy days, limiting vehicle speed during construction to a maximum 30 km/hr and employing dust suppression technique. Analyses indicated very minor changes in air quality resulting from equipment emissions.

During mining, soil and rock would be excavated from the mine pit area. The present geologic profile of the area consists of a stratum of unconsolidated sandy soils overlying rock in the area to be mined. Mining will not segregate soils based on the depths at which these soils are encountered when the overburden material is disposed in the spoil piles. Mining and spoil disposal will result in an alteration of the stratification of the unconsolidated soils at the site. These are major impacts (low severity, high likelihood), however these impacts would be localized to the mine site.

An erosion and sediment control plan will mitigate potential impacts to water quality from erosion. 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.

Construction of the access road and clearing for the mine footprint will fragment the area. The physical disturbance and noise produced by equipment may impose additional stresses upon wildlife and may lead to increased migration. These impacts will be mitigated by minimizing the area cleared for the facilities and by maintaining wildlife corridors within the cleared areas.

The development of the mine and potential employment opportunities may attract people to the site for work. The uncontrolled influx of people from outside could possibly create health risks for PGI employees and vice versa. The construction and operations phase of the project is likely to increase movement of vehicles such as trucks or other vehicles carrying equipment along the road. The traffic volume due to PGI activities could greatly increase overall traffic movement in this corridor increasing dust, noise, vehicular emissions as well as increase risks of accidents and incidents.

While the Project is likely to be the major development in the Middle Mazaruni region in the short term, the possible increase in small and medium scale mining activities would dramatically increase the scale of effects in the sub-region in the future. The pressure of small and medium scale operations is already a reason for concern by persons in the area with there being claims of minimized water quality. These problems, if not addressed, will be exacerbated by increased mining in the Sub-Region. Cumulative impacts in the area will be managed by institution of a long term, multi-stakeholder regional planning program.

Social & Environmental Management System (SEMS) of the ESIA provides the management framework for the systemic aspects for implementation of the Environmental Management Plan, Social Management Plan and Health, Safety, and Emergency Response Plan. Adoption of the SEMS is critical for the implementation of the SEMP and provides a systemic framework that will be applicable throughout the life of the project.

An Environmental Management Plan was developed to mitigate the potential negative impacts and risks and to enhance the potential positive impacts of the proposed action. Environmental management measures address the environmental impacts and risks to both the physical and socio-cultural environments. A Health and Safety Plan has also been developed to ensure compliance with the regulations of the OHS Act 1997.

A monitoring program is detailed for the proposed operations. The monitoring program will provide data which would serve as the basis to determine the environmental performance of the operation. The facility will be monitored to confirm its adherence to sound environmental management practices and contractually established operational standards. Monitoring will be conducted during the construction and operation phases of the project. The monitoring program is designed to ensure that the trends for specific parameters are tracked. It will also provide information on compliance with legislation, guidelines and contractual requirements for the construction and operation of the facility.

The risk assessment identifies the probability of the operation being compromised by a seismic event, flooding or failure of earth structure and/or containment. Measures to minimize to the identified risks are also identified.

A Conceptual Closure Plan, based on progressive closure, has been developed for the proposed operation. The Closure Plan proposes to ensure the “return to nature” of the mine site. At the conclusion of the closure process, no buildings or supporting infrastructure or facilities would remain at the site. The areas will be fully replaced by a sustainable environment comprised of productive and diverse lake and pond ecosystems. Spoil piles, stockpiles, borrow areas etc. would be vegetated with general sustainable grass as well as emerging forest. 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.

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GLOSSARY OF TERMS

Alloy - A compound of two or more metals.

Assay - A chemical test performed on a sample of ores or minerals to determine the amount of valuable metals contained.

Assay Office - A place that evaluated or chemically tested and analyzed the mineral content of ore to determine the nature and proportion of the ingredients.

Assay Map - Plan view of an area indicating assay values and locations of all samples taken on the property.

Assessment Work - The amount of work specified under mining law that must be performed each year in order to retain legal control of mining claims.

Auriferous - Gold-bearing.

Backfill - Waste material used to fill the void created by mining.

Back Sample - Rock samples collected from an excavated area for the purpose of determining grade.

Barren pond Storage pond for solution from which gold has been extracted.

Base Gold - Gold alloy.

Bund A low embankment often constructed around potential spillage areas to reduce the risk of environmental contamination. It is important these structures can retain the volume of any potential spillage.

Bullion - Unprocessed gold or silver, before coinage or minting. Usually melted into bricks or bars for easy storage.

CIL Carbon-in-leach. A process used to recover gold into activated carbon during the agitation leach process.

CIP Carbon-in-pulp.

Contact - A geological term used to describe the line or plane along which two different rock formations meet.

Cut-off Grade - The grade below which mineralisation is not included in the assessment of ore resources/reserves.

Cyanidation - A method using a weak cyanide solution by which gold or silver grains are extracted from ore.

Decant: The removal of solution from a tailings storage facility after solids have been allowed to settle.

Deposit - A body of rock containing a concentration of minerals.

Development Drilling - Drilling to establish accurate estimates of mineral reserves.

Dilution - The necessary mining of waste rock, along with ore. Measured as the ratio of waste rock to the total amount of rock mined.

Dredging A gold mining method in which a barge or boat equipped with machinery scoops the gold-bearing gravel from the river beds. The gravel is then processed by washing or sluicing.

Dust Minute particles of gold taken by placer mining and used as money.

EPC - engineering, procurement and construction.

EPCM - engineering, procurement and construction management.

Feasibility Study - An economic study assessing whether a mineral deposit can be mined profitably.

Freeboard: The distance between the crest of a pond or impoundment and the level of contained solution.

Free Cyanide: The uncomplexed cyanide ion (CN-) and gaseous or aqueous hydrogen cyanide (HCN).

Gold A heavy yellow metallic chemical element; a precious metal used in coins, jewelry

Gravels A loose mixture of small pebbles and rock fragments like coarse sand that contain gold particles; also called placer deposits.

Gross Value - The theoretical value of ore determined by applying the assessed grade of metal(s) in the ore by the relevant current market price.

HACCP Hazard Analysis at Critical Control Points—a formal procedure designed to identify the hazards associated with particular stages in a given process.

Heap leach To dissolve minerals or metals out of an ore heap using chemicals. During heap leaching gold a cyanide solution percolates through crushed ore heaped on an impervious pad or base pads.

High Grade - Rich ore.

Leaching - A chemical process for the extraction of valuable minerals from ore.

Lixiviants Chemical leaching agents.

Measured Resource - A resource whose size and grade have been estimated from sampling at intervals that are spaced closely enough together so that the deposit's continuity is essentially confirmed.

Metallurgy - The science of separating metals from their ores and preparing them for use by refining, etc., developed from alchemy of the Middle Ages.

Mixing Zone: A predefined area beyond an outfall or discharge point in which the applicable jurisdiction or regulatory agency permits water quality criteria to be exceeded. Beyond the mixing zone boundary, applicable water quality criteria for the protection of aquatic life must be observed.

Ore - Rock containing enough precious metal to make it worth mining.

Open Pit - A mine that is entirely on the surface. Also referred to as open-cut or an open-cast mine.

Overburden - Material, like dirt and rock, covering the gold-bearing veins or gravel that was removed by hydraulicking.

Pay Dirt - Expression describing gold-rich ore, sand, or gravel taken from claims. The claim became "pay dirt" when the miner realized a profit after his expenses had been covered.

pH The measure of acidity (or alkalinity) defined as being the negative log (to base 10) of the free hydrogen ion concentration. The pH scale ranges from 0 to 14; a pH of 7 is neutral, less than 7 acidic and more than 7 alkaline.

Phreatic Surface: The surface between the zone of saturation and the zone of aeration; ground water table.

PPM - Parts per million, also gram/tonne

PPB - Parts per billion.

Primary Deposits - Valuable minerals deposited during the original period of mineralisation, as opposed to those deposited as a result of alteration or weathering.

Probable Reserves - Valuable mineralization that is not yet sampled sufficiently to be proven.

Process Solution: Liquid cyanide received from the supplier, solutions used to leach gold, barren leach solution from heap leaching, mill tailings, tailings return water and carbon stripping solution. However, solutions with concentrations of WAD cyanide below 0.5 mg/l are not considered to be process solutions.

Quartz - A common, hard mineral, often with brilliant crystals, generally found in large masses or veins.

Quicksilver - Mercury (Hg.): a heavy, silver-white metallic chemical element, liquid at ordinary temperatures. Used to help capture gold particles in sluicing when placed at the riffles or ribs in the box.

Reserve - The part of a mineral resource that can be mined profitably.

Riffles - The wooden ribs or slats placed on the bottom of rockers, long toms and sluice boxes to capture the heavy gold particles while the lighter material is washed away.

SAG Mill - Semi-autogenous grinding mill.

Slimes The finest particles suspended in a tailings slurry.

Sparging A procedure designed to minimize operator exposure to cyanide during transfer from transport container to storage facility at a mine site.

Stamp Mill - A mill built to break up and grind gold-bearing ore, saving the gold by amalgamation. A mill could have any number of "stamps".

Stamps - Metal arms at a stamp mill that raised and lowered like battering rams to crush the ore so the gold could be extracted.

Stope - An excavation in a mine from which ore is extracted

Strike Length - The distance and direction along which drilling results have established mineralisation.

Stakeholder: Stakeholders are individuals and groups that have interest in the cyanide-related activities of a mine, or who are or may reasonably be affected by those activities. The term is applied differently depending on the specific nature of the issue to be addressed, and can require considerable flexibility and judgment.

Surface Water(s): Any natural water body occurring on the surface, including but not limited to rivers, creeks, streams, lakes, marshes, and marine waters.

SX/EW - Solvent extraction, electrowinning.

Tailings - Waste material left after gold-bearing ore is processed. Material rejected from a mill after the recoverable valuable minerals have been extracted.

Tailing Storage Facility (TSF): An impoundment used to place mill effluent containing the leached ore in a water slurry that may contain cyanide. The solids remain in the TSF for disposal and the water may be recycled back to the mill for reuse or may be treated and discharged.

Troy Ounce - Based on the ancient unit of measure, the grain, and used to measure gold. The troy ounce contains 480 grains, while the avoirdupois ounce contains 437.5 grains. Therefore, a troy ounce equals 1.097 avoirdupois ounces. Also, a troy ounce equals 20 pennyweight (DWT).

Worked Out - A claim, mine, or area that has been thoroughly mined of all gold that is profitable to mine.

TSF - Tailings storage facility

Volatilization - Release of gaseous phase of a chemical, in this case cyanide.

WAD cyanide - Weak acid dissociable cyanide that is readily released from cyanide-containing complexes when the pH is lowered.

1.0 INTRODUCTION

1.1 Background

This Environmental and Social Impact Assessment (ESIA) report has been prepared for Pharsalus Gold Inc (PGI). Ground Structures Engineering Corporation of Guyana (GSEC) was commissioned to undertake the ESIA by letter dated June 18, 2013. This ESIA has been prepared based on the “Pharsalus Gold Project Confidential Preliminary Scoping Study” and is supported by prior studies, baseline social and environmental field data collection and community engagement, and consultations conducted over the period 2012 – 2013. Several sections of this ESIA report are taken directly from the referenced study. The prefeasibility study for the project is being undertaken concurrently with this ESIA. Certain aspects of the project are consequently still being determined while other aspects are at the conceptual stage and may change after further analyses during the prefeasibility and feasibility stages.

The property is centered near the Iron Bridge, crossing over the Main Kaburi River approximately 12 km along the Issano Branch Road and approximately 160 km southwest of Georgetown, Guyana and 37 km northwest of the former Omai Gold Mine. The property consists of several Medium Scale Prospecting and Mining Permits, Small Scale Claim Licenses, two Large Scale Prospecting Licenses and one existing Mining License issued in accordance with the Mining Act, 1989 and the Mining Regulations thereto. The area is located generally in the Karouni area of the Mazaruni Mining District as shown on Terra Survey Topographic Sheets 36SE and 36SW at a 1:50,000 scale. The extent of the area held by PGI is depicted in Figure 1.

The Concession and immediately adjacent areas have supported mining activities for over one hundred years. These activities have been related primarily to the recovery of gold and diamond by open pit workings of alluvial deposits. Several of these operations continue within the limits of the Concession and within proximity of the Concession boundaries. These operations include White Hole Kaburi, Cornfield, El Dorado, Nine Mile, Smarts, & Milo Camps and Honey Camp. These operations have spawned the development of a community outside the contiguous properties at 14 Mile Issano which predates granting of the mining rights to PGI. 14 Mile Issano has been in existence for 28 years and several individuals reside and operate businesses in the community.

1.2 Purpose of and Need for Action

The firm proposes to apply to the Guyana Geology and Mines Commission (GGMC) for issuance of a Mining License in accordance with the terms of the PLs. The area proposed for development into the mine encompasses the mineralized zones established by the exploration work at the property as indicated by Figure 2. The mine will be operated in accordance with the GGMC Mining License and the Guyana Environmental Protection Agency (EPA) guidelines.

The purpose of the proposed action is therefore to convert the current prospecting operations in the area into a working mine. To attain the objectives of the proposed action a surface mine and mineral processing operation for the recovery of gold will be undertaken at the Pharsalus Mine Site.

The action is needed to recover gold confirmed to be present at the location based on the results of an exploration program undertaken at the property. The results of that investigation have verified that gold is present in adequate quantities and are of reasonable grades to warrant the establishment of a mine and mineral processing operation, to recover gold at the site.

The mine will be focused on the recovery of ore for processing from Smarts and Hicks gold deposits depicted in Figure 2. The area is part of the area acquired by vendor agreements and direct grants to Pharsalus Gold Inc., a wholly owned subsidiary of Azimuth Resources Limited. Project components

Figure 1 - Extent of Areas Held by PGI

Figure 2 - Mineralized Zone Identified for Conversion to Mine

include an open cut mine, processing plant, tailings storage facility, mine site accommodation and additional infrastructure required to recover and to process ore for the recovery of gold.

Construction and operation of mine (The Project) will entail the installation of site infrastructure and amenities. The project has the following major components:

- Mine Site - which will consist of the mine open pits, ore beneficiation facilities, tailings and water management ponds, equipment storage and maintenance facilities, fuel and chemical storage facilities, an airstrip, worker accommodation, site offices and laboratory and supporting facilities;
- A new access road linking the mine site to the Amaila Falls Hydropower Access Road, contingent upon the company being granted permission to use that road.

The second phase of mining at this site may entail the recovery of ore by underground mining methods, if deemed feasible. If underground mining is considered feasible, the company will prepare a separate ESIA and apply for the appropriate permits before commencement of any underground mining.

1.3 Scope of Environmental and Social Impact Assessment

This ESIA has been prepared to conform to guidelines established by the Guyana Environmental Protection Agency and as detailed in the EPA publication titled Environmental Impact Assessment Guidelines, Volume 3 Mining, Version 1, August 2000. In accordance with those guidelines this ESIA is comprised of three components, the Environmental Baseline Study, The Environmental and Social Assessment and the Environmental and Social Impact Management Plan. The baseline detailed herein is a record of the present quality of the physical, biological and socio-economic and socio-cultural variables within the project area of influence. The existing environment is described only for those aspects of the physical, biological, social and economic environment within the study area that are relevant to the project.

The Environmental and Social Assessment identifies and assesses the impacts of the proposed action and its alternatives taking into consideration the measures that are proposed to mitigate and/or enhance the probable impacts. The assessment identifies the project-environment interactions during design, construction and operation and after closure of the operation. The planned implementation schedule, associated with mitigation of environmental effects, is also detailed as part of the ESIA.

The Environmental Management Plan (EMP) has been prepared to conform to the “Guidelines for Preparing Environmental Management Plans” detailed in the referenced document. In accordance with those guidelines, the EMP identifies feasible and cost effective measures to reduce potentially adverse environmental impacts to acceptable levels. It also includes operational procedures to avoid environmental risks during operations as well as emergency and contingency plans in the event of accidents during operations.

This ESIA has also been prepared to be compliant with the IFC standards.

1.4 ESIA Study Team

The Environmental and Social Impact Assessment was undertaken by Ground Structures Engineering Consultants Inc (GSEC). The study team assembled for this assignment consists of individuals who are recognised experts in conducting environmental impact assessments in Guyana and elsewhere. The group of professionals has the necessary range and depth of experience and a thorough understanding of local conditions to conduct the ESIA's to World Bank, IFC, IDB and Guyana EPA Standards.

Charles P. Ceres is the Managing Principal of Ground Structures Engineering Consultants Inc. He served as the Project Director and provided strategic guidance to the team and was responsible for project coordination and logistics. Mr. Ceres oversaw all tasks associated with completion of the ESIA. Mr. Ceres has been responsible for the management and execution of a wide variety of environmental projects in Guyana, the United States and the Caribbean. Mr. Ceres has also managed several ESIA's and EAs in Guyana. He managed the ESIA for the expansion of the Guyana Sugar Corporation Skeldon Estate and has served as a consultant to the Guyana Environmental Protection Agency. Mr. Ceres has supervised several environmental monitoring and remediation projects both in Guyana and overseas. His experience in Guyana includes supervision of the installation of groundwater monitoring equipment at Omai Gold Mines Tank Farm and the environmental audits for the privatization of Linmine and Bermine. His experience in the Northeastern United States includes supervising the installation of equipment for the remediation of soil and groundwater contamination and managing several National Pollution Discharge Elimination Systems (NPDES) installations.

Ms. Ndibi Schwierts is an Environmental Scientist and Forester, and has several years of experience both in the forestry and environmental areas in Guyana. In addition to definition of the regulatory/legislative framework for the project, her responsibilities included developing protocols for baseline definition of forest resources and the development of management and mitigation plans to minimize impacts on these resources. Ms. Schwierts has served in a similar capacity on several other projects in Guyana including the Strategic Environmental Assessment for Guyana's Mining Sector, Aurora Gold Mines Project, Marudi Mountain Alluvial Mining Project and preparation of the Environmental and Social Impact Management Plan for Groundstar Resources oil exploration program in the North Rupununi.

Mr. Hance Thompson is an environmental specialist and biologist, and has several years of experience in regulatory environmental and earth resources management in his previous capacity working with the Guyana EPA. Mr. Thompson was responsible for the development of the bio-physical baseline.

Keith Lowenfield is an accomplished social scientist who has worked on socio-economic baseline studies for Groundstar Resources in the North Rupununi and the Marudi Mountain Alluvial Gold Mine. He also examined the socio-economic impacts associated with the proposed oil exploration program in the North Rupununi and the Marudi Mountain Alluvial Gold Mine. Keith coordinated the activities of individuals working in indigenous communities in proximity to the project to determine the socio-economic impacts of the project and was responsible for development of the management and monitoring plans to mitigate potential impacts.

ESIA Organization

This remainder of this ESIA will be developed in the following sequence:

- Chapter 2 details the approach and methodology
- Chapter 3 outlines the Legal and Institutional Framework for environmental compliance by large scale mining operations.
- Chapter 4 identifies the various phases of the Proposed Action and details of the components of the Proposed Project.
- Chapter 5 identifies and discusses alternatives to the Proposed Action.
- Chapter 6 is a description of the physical environment within the project study area.
- Chapter 7 is a description of the biological environment within the project study area.
- Chapter 8 is a description of the socio-economic and socio-cultural environment within the project study area.
- Chapter 9 presents the impacts on the physical environmental and identifies the risks associated with the proposed action.

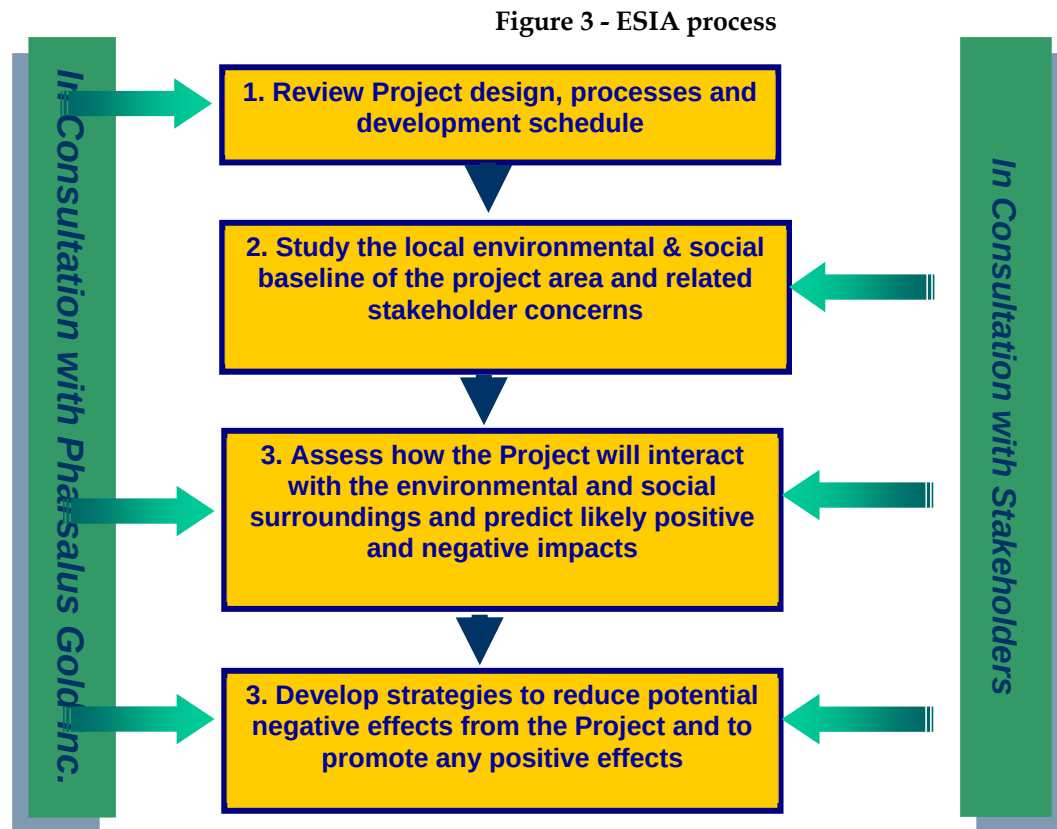
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- Chapter 10 presents the impacts on the ecological environmental and identifies the risks associated with the proposed action.
 - Chapter 11 examines the socio-cultural and socio-economic impacts and risks of the proposed action including impacts and risks related to 14 Mile Issano and to indigenous and other communities within proximity to the project.
 - Chapter 12 outlines the Cumulative Impacts associated with the Proposed Action.
 - Chapter 13 outlines the Social and Environmental Management System for implementation of the Environmental and Social Management Plan.
 - Chapter 14 outlines the Environmental Management Plan (EMP) proposed to mitigate the impacts associated with the project and the implementation schedule for each element of the EMP.
 - Chapter 15 Presents the Employee Health and Safety Plan
 - Chapter 16 presents the Monitoring Plan required to ensure compliance during the various phases of the proposed action.
 - Chapter 17 examines the risks associated with the proposed action and details steps required to minimize those risks.
 - Chapter 18 details a conceptual closure plan for the site and
 - Chapter 19 details the results of discussions with agencies and NGOs.

2.0 APPROACH, METHODOLOGY & LIMITATIONS

2.1 Approach

The primary reports available for this Project are the baseline characterization report and the Preliminary Scoping Report. These reports were prepared over the period 2012 to 2013. The baseline characterization report details the physical, ecological and sociocultural baseline data for the project area and its immediate vicinity. The preliminary scoping report (confidential) presents details on the mine site infrastructure, the process plant and plans for project implementation. The ESIA incorporates both the baseline characterization data and information presented in the preliminary scoping report.

The overall ESIA process followed is depicted in Figure 3 below.



2.2 ESIA Methodology

The methodology incorporated the following tasks which are described in more detail below:

- Review of existing documentation;
- Assessment of Policy, Legislative and Regulatory Framework;
- Evaluation of Historic Baseline Data;
- Determination of Scope of Assessment;
- Public Meetings;
- 2012, 2013 & 2014 Field Activities and Surveys;
- Impact Assessment and Rating;
- Development of Environmental and Social Management Plan;
- Institutional Analyses for Project Implementation;

Development of Monitoring Program;
Preparation of Emergency Response Procedures and
Preparation of Closure Guidelines

2.3 Review of Existing Documentation

The ESIA reviewed available historic data for the mine site and related areas. The review examined data on environmental, economic and social variables which included site geology, hydrogeology, surface water flow, biodiversity, conservation priorities, the proximity of indigenous communities, mining operations now underway and those formerly taking place in the area, and the likely presence of archaeological resources in the area. Examples of documents reviewed include:

- Geological reports for the area;
- Checklists of Plants, Fish, and Terrestrial Fauna of the Guiana Shield Region;
- 2009 IUCN Red List of Threatened Species;
- NatureServe and IUCN species distribution maps and GIS data;
- Alliance for Zero Extinction data;
- Guiana Shield Initiative studies and GIS data;
- Forestry Studies for the area;
- Data on Aquatic Resources of the area;
- Indigenous Groups reports for the mining sector;
- NGO information, including Conservation International (CI) and World Wildlife Fund (WWF);
- World Bank (IFC) guidelines on Baseline Characterization;
- World Bank (IFC) guidelines on Environmental Assessment;
- International Finance Corporation (IFC) Performance Standards and Guidance Notes
- Guyana Environmental Protection Act;
- Guyana Town and Country Planning Act;
- Guyana Forestry Commission Guidelines;
- Guyana EPA Guidelines on Environmental Management Plans.

Guidelines for the mining industry (e.g., ICMM), including those for the management of cyanide and other hazardous chemicals and standards for the construction of roads in mining areas, were also reviewed to determine their relevance to the project.

2.4 Assessment of Policy, Legislative and Regulatory Framework

A review of the applicable Guyanese Regulatory Framework regarding environmental and social requirements of the Project was undertaken. A comparison was made with requirements of the IFC Performance Standards (PSs) and Environmental, Health and Safety (EHS) standards. In those instances where Guyana regulations differed from the levels and measures presented in the IFC EHS guidelines, the more stringent of the two requirements formed the basis of this ESIA.

2.5 Evaluation of Historic Baseline Data

Physical, biological, and socio-cultural baselines were completed for The Project by Ground Structures Engineering Consultants in 2012. The baseline compilation program included biological field surveys, recovery and analyses of surface water samples, visits to communities within proximity of the mine site and compilation of data for the Project area and its vicinity. This ESIA is based on a review of that baseline information and data gathered from additional field programs to fill data gaps and to confirm data acquired by the initial baseline studies.

2.6 Determination of Scope of Assessment

Based on the review and analysis of existing information, the scope of the assessment was determined, including the methodologies to be followed for the additional baseline field studies including hydrogeology, biodiversity, and socio-economic. Scoping identified:

- The appropriate boundaries of the project (e.g., project area of influence);
- Major issues and concerns;
- The information necessary for decision-making;
- The significant effects and factors to be considered; and
- The scope and methodology of the assessment.

2.7 Public Meetings

Several meeting were held to obtain stakeholder comments. All public scoping meetings were chaired by the EPA and the EAB facilitated public hearing into the ESIA. A sectoral meeting was hosted by the EPA on November 15, 2013. Several sectoral agencies including the GGMC, GFC, Ministry of Health and the National Trust were represented at that meeting. GSEC also attended mandatory community stakeholder meetings involving the Environmental Assessment Board under the Guyana EIA legislation. An advertised public meeting was held by the EPA with a presentation of the Project and proposed activities by PGI at Kaburi, the indigenous village in closet proximity to the project on November 16, 2013. A meeting was also held at 14 Mile Issano on December 05, 2013. Concerns and issues raised by attendees at all meetings have been incorporated into the analysis of impacts and development of environmental management and mitigation measures for the project.

2.8 Field Activities and Surveys

The biological baseline was expanded in 2013 to include data for the access road linking the mine site to the Amaila Falls Access Road. The initial baseline ecology was acquired by utilizing various methodologies including field surveys, direct observation, and where appropriate, through interviews and questionnaires. Data collection for the physical environment focused on surface water and groundwater hydrology and quality and soil type. The biological environment data collection was focused on flora and fauna, rare/endangered species, sensitive and critical natural habitats, species of commercial importance, migratory species and the biodiversity of the area.

The project will occur within close proximity of 14 Mile Issano. The socio-economic and socio-cultural baseline was expanded in 2014 to include data generated for 14 Mile Issano.

2.8.1 Hydrogeological Data Acquisition

Five (5) well nests were drilled within the mine site area. Each nest was comprised of three wells, one each in alluvials, saprolite and bedrock. A groundwater monitoring well was installed in each well at each well nest. One borehole was located within the footprint of the area identified for the tailings pond and another within the footprint of the area identified for the process plant. Ground water levels were recorded at each monitoring well to provide data for hydrogeological evaluation.

Groundwater samples were collected from each of the appropriate monitoring well at each well nest after development. Each ground water sample was analyzed for the presence and concentrations of heavy metals, and other constituents to conform to Guyana EPA guidelines. The minimum list of parameters for which all samples were analyzed coincided with those identified by the World Bank for cyanidation operations for the recovery of gold.

2.8.2 Surface Water

Water samples were recovered from several streams in the Project area and tested to determine the concentration of chemical constituents. Snap shots estimates of surface water flows, on major streams/creeks/rivers upstream and downstream of the mine site were measured and coupled with surveyed cross-sections of those streams to develop discharge estimates for surface water modeling. The slope of each stream was also recorded at various locations to provide additional data for surface water modeling. Surface water samples were also recovered from major streams/creeks/rivers upstream and downstream of the mine site. Sediment samples were also recovered from point coincident with surface water sampling points to confirm to Guyana EPA guidelines. Both surface water and sediment samples were analyzed for the presence and concentrations of heavy metals, and other constituents to conform to Guyana EPA guidelines. The minimum list of parameters for which all samples were analyzed coincided with those identified by the World Bank for cyanidation operations for the recovery of gold.

An analytical model was utilized to assess potential impacts to surface water from various discharge, spill, and release scenarios during mine construction and operation. The primary objective for the ESIA was to assess the duration, spatial extent, and dilution of accidental discharges, potentially containing cyanide, to the Kaburi River.

Water volumes for plant processing, potable water and other water uses were determined by performing a mass balance. The mass balance incorporated withdrawals from surface water bodies supplemented by recovery of groundwater from wells drilled within the concession. The project mass balance is presented as Appendix A of this document.

2.8.3 Biological Resources

Two field survey of biological resources for the mine site area and its environs was conducted, one each for a single wet and a single dry season. During the surveys all biological features at the mine site and its environs were sampled. Unknown varieties were sampled, preserved and returned to Georgetown for identification. In addition, a forester prepared estimated quantities of the most dominant species by measuring the breast height, diameters and other data necessary to determine plant biomass.

2.8.4 Socio-Economic Resources

The socio-economic baseline was compiled by both stakeholder mapping and information gathering. Data was compiled on the presence of human communities in the area and agricultural, forest production, fishing and hunting practices. The socio-economic baseline also established resource use patterns in the area and examined land use such as agriculture, forestry and mining. The presence of social infrastructure such as schools, medical facilities, communications/transport networks and markets was established. Data was also compiled on public health and on health risks and diseases in the vicinity of the project.

A fact finding or information seeking exercise was undertaken of small rural communities in the vicinity of the project through consultations. The key objective was to assess the baseline of the communities and identify impacts (if any) that the project could potentially have on the human environment. The main approach therefore was Stakeholder 'consultation' focused and was aimed at participatory engagement of stakeholders in project conception, design and implementation.

An information seeking/research oriented exercise was also undertaken with the communities in the Project Area of Influence to profile the socioeconomic baseline conditions of these communities and the potential impacts (if any) that might arise as a result of the Project. The following activities were carried out in the communities:

- Discussion with community leaders - informal discussion to provide information on the project and to understand community concerns;
- Focus Group Discussions - open ended discussions with groups or sub groups within each communities such as women, youth, elderly people; and
- Community survey forms - these forms were completed in each community to gain basic information on the natural setting, governance, local customs and economy, social development, infrastructure, administrative and economic conditions.

2.9 Impact Assessment and Rating

An impact rating system was developed for the ESIA to enable a systematic ranking of identified environmental and social impacts and presentation of a summary table which can be used by the Project to prioritise mitigations according to ranking. The impacts section presented in this report ranks impacts using the criteria presented in the following sections.

The impact rating is the product of two elements: (1) the severity of the potential impact and (2) the likelihood of the impact or “event” occurring.

2.9.1 Severity and Enhancement Criteria

Firstly, the severity or enhancement of each impact was rated using the criteria identified in Tables 1 thru 4. Note that colours are used to assist the reader in reviewing the impacts and their relative magnitude. As such, they should not be considered definitive.

Table 1: Severity Criteria (Negative Environmental Impacts)

Low	Affects environmental conditions, species, and habitats over a short period of time, is localized and reversible.
Medium	Affects environmental conditions, species and habitats in the short to medium term. Ecosystems integrity will not be adversely affected in the long term, but the effect is likely to be significant in the short or medium term to some species or receptors. The area/region may be able to recover through natural regeneration and restoration.
High	Affects environmental conditions, species and habitats for the long term (i.e., over the life of the Project) may substantially alter the local and regional ecosystem and natural resources, and may affect sustainability. Regeneration to its former state would not occur without intervention. Affects environmental conditions or media over the long term, has local and regional affects and/or is irreversible.

Table 2: Severity Criteria (Negative Social or Health Impacts)

	Duration	Extent	Ability to Adapt	Socio-cultural Outcome	Health Outcome
Low	Short-term <1 year low frequency	Individual / Household	Those affected will be able to adapt to the changes with relative ease, and maintain pre-impact livelihoods, culture, quality of life and health.	Inconvenience with no consequence on long-term livelihoods, quality of life, resources, infrastructure and services.	Event resulting in annoyance, minor injury or illness that does not require hospitalization
Medium	Medium-term 1-6 years Medium or intermittent frequency	Small number of household	Those affected will be able to adapt to change, with some difficulty, and maintain pre-impact livelihoods, culture, quality of life and health but only with a degree of support	Primary and secondary impacts on livelihoods, culture, quality of life, resources, infrastructure and services	Event resulting in moderate injuries or illness, which many require hospitalization
High	Long-term/ Irreversible > 6 years Constant frequency	Large part of/ full settlement	Those affected will not be able to adapt to changes and continue to maintain pre-impact livelihood	Widespread and diverse primary and secondary impacts likely to be impossible to reverse or compensate for.	Catastrophic event resulting in loss of life, severe injuries or chronic illness requiring hospitalization.

Table 3: Enhancement Criteria (Positive Environmental Effects)

	Duration	Extent	Degree of Change	Focus/ Sensitivity
High level of enhancement	Benefits will be sustained over the long term.	Benefits will extend beyond local environment (i.e., linkage of fragmented habitat, e.g., regional corridor)	Direct benefits to species or resources will provide significant opportunities for sustainability.	Benefits will pertain to species, habitats and natural resources that are degraded, or are sensitive, rare, or in need of protection..
Medium level of enhancement	Benefits will be measurable in the short term and possibly longer.	Benefits to species, habitats and natural resources in the local environment and beyond.	Moderate benefits to species, habitat, and natural resources that may provide some opportunities for sustainability.	Benefits will pertain to species, habitats and natural resources that have some level of degradation, sensitivity, or rarity.
Low level of enhancement	Benefits will be short term.	Benefits to a few species, associated habitat, and resources in the local environment only.	Minor benefits to species, habitat, and natural resources that may provide minor opportunities for sustainability.	Benefits will pertain to species, habitats and natural resources that are not , sensitive or rare.

Table 4: Enhancement Criteria (Positive Social and Health Impacts)

	Duration	Extent	Degree of Change	Focus/ Sensitivity
High level of enhancement	Benefits will be lasting and sustained over the long term i.e.: more than 7 years	Benefits throughout the local community and beyond to State/ National level.	Direct benefits to individuals and communities will provide significant opportunities for leveraging secondary benefits and significantly improving livelihoods for themselves and others	Benefits will pertain to vulnerable groups and those that would have otherwise have been 'losers' as a result of the project.
Medium level of enhancement	Benefits will be felt for a medium period of time (1 to 7 years) or be intermittent over the longer term	Benefits to many individuals and households in the local community and beyond	Moderate benefits to individuals and communities which will provide some opportunities for furthering themselves and improving livelihoods	Benefits will possibly pertain to vulnerable groups and those that might have been 'losers' from the project
Low level of enhancement	Benefits will be short-term (up to a year)	Benefits to a few individuals and households either in the local area and/or further afield.	Some benefits to individuals and communities, potentially improving opportunities for furthering themselves and improving livelihoods	Benefits will not pertain to vulnerable groups and will only benefit those that would have otherwise benefited from the project.

2.9.2 Likelihood Criteria

Likelihood categories were divided into the following:

- Low likelihood - Not known in the mining sector;
- Medium likelihood - Has occurred in mining projects; and
- High likelihood - high likelihood of the event occurring in mining projects.

2.9.3 Determining the Rating

The overall rating of the impacts was determined by using the following matrix (Table 5).

Table 5: Rating Matrix

<i>Severity/ Enhancement</i>	<i>Likelihood</i>		
	<i>Low</i>	<i>Medium</i>	<i>High</i>
<i>High level of enhancement</i>	Moderate	Major	Major
<i>Medium level of enhancement</i>	Minor	Moderate	Major
<i>Low level of enhancement</i>	Minor	Minor	Moderate
<i>Low severity</i>	Minor	Minor	Moderate
<i>Medium severity</i>	Minor	Moderate	Major
<i>High severity</i>	Moderate	Major	Major

It should be noted that these matrices act as a guide and there may be situations where their rigid application is inappropriate and where stakeholder perceptions and feedback have a significant role to play. For specific impacts where this is the case, the rating is clearly explained in the evaluation of the impact.

2.10 Limitations of the ESIA Study

The ESIA study has the following limitations:

Timing of the study- the ESIA study was undertaken while the Project pre-feasibility study was being prepared. The Project design details and facility location are expected to evolve and may change during the pre-feasibility study. This ESIA is not consequently based on definitive positions for several of the proposed site facilities including waste disposal and the water management pond.

The analysis and findings of this ESIA are therefore based on the status of the project description as of September 2013. Any changes or additions to the project design and plans subsequent to September 2013 would not necessarily be covered under this ESIA or associated management plans.

3.0 POLICY, LEGISLATIVE AND REGULATORY CONSIDERATIONS

3.1 Introduction

This section examines the policy, legal and administrative framework related to the mining industry in Guyana. The review focuses on the environmental and social aspects of this framework as it pertains to mining and mining activities along with project specific compliance requirements. The review begins with a general description of the national environmental institutional framework and provides an overview of the national policy and legal framework, with particular emphasis on the:

- National Development Strategy
- General National Environmental Legislation
- National Mining Legislation

The review then focuses on the international regulatory framework as it relates to the mining industry of Guyana. First, the review highlights the relevant international treaties, agreements, and conventions to which Guyana is a signatory. These international treaties, agreements, and conventions have influenced the development and implementation of several national policies and legislation related to the mining industry. Second, a detailed review of all applicable project-specific requirements and guidelines set by the International Finance Corporation (IFC) will be provided, with particular reference to:

- Performance Standards on Social and Environmental Sustainability
- Environmental, Health and Safety (EHS) Guidelines

Following the overview of the national and international policy, legal and administrative framework, a description of the required compliance mechanisms for the mining sector is provided. This section provides specific steps the project developer must take in order to comply with the national and international policy, legal, and administrative framework. The two foundational compliance mechanisms considered within this report and required by national legislation are the:

- Prospecting and Mining Licensing Process; and,
- Environmental and Social Impact Assessment Process

The final section provides additional details on specific components of the national and international policy, legal and administrative framework. This information is provided in two comprehensive tables. The first covers national legislation, codes and draft legislation, while the second covers the applicable IFC performance standards and references to EHS guidelines. These tables are provided to supplement the overview provided throughout this chapter and to identify project specific compliance measures prescribed by each legislation, IFC standard, or guideline.

Thus, this policy, legal and administrative framework reviews all applicable national and international policies, legislation, guidelines and standards and recommends specific actions the project developer must implement to ensure full compliance with national law, and IFC Performance Standards and EHS Guidelines.

3.2 National Environmental Institutional Framework

The 1980 Constitution of Guyana provides the foundation for the national environmental institutional and legislative framework, stating that:

“In the interests of the present and future generations, the State will protect and make rational use of its land, mineral and water resources, as well as its fauna and flora, and will take all appropriate measure to conserve and improve the environment”.

Within this constitutional mandate, the Environmental Protection Act of 1996 is the primary environmental legislation in Guyana and establishes the Environmental Protection Agency (EPA) to be the primary governmental agency responsible for the management, conservation, protection and sustainable use of the environment. The Act states that the EPA shall be guided by several key principles upholding the constitutional imperative of protecting and conserving the environment. These principles include strict environmental precautions, penalties, liabilities and avoidance of environmental damage.

The Environmental Protection Act and the EPA form the basis for the environmental institutional framework of Guyana. Within this framework, each sector is administered by its corresponding ministry.

The mining sector is administered jointly by the EPA, the Guyana Geology and Mines Commission (GGMC), and the Minister of Environment and Natural Resources. The GGMC is responsible for the promotion and administration of the mining industry, including permitting, licensing, infrastructure development, and other technical aspects of the industry. The Minister of Environment and Natural Resources manages and collaborates with the GGMC and is responsible for the negotiation of large scale exploration, prospecting and mining agreements.

The following section provides an overview of the relevant national strategies and legislation which make up the policy, legal and administrative framework of the mining sector in Guyana. The overview highlights specific legislation and outlines the administrative permitting and environmental and social impact assessment process. A comprehensive description of all relevant legislation is provided in Table 7, Section 3.9, which provides details on the specific provisions and, where applicable, project specific compliance requirements.

3.3 National Development Strategy

The Guyana National Development Strategy (NDS) 2000 - 2010 represents the highest level of national planning. The NDS reflects the constitutional imperative for the conservation and sustainable use of the country's natural resources, and strongly supports the EPA mandate to manage, conserve, protect and ensure the sustainable use of the environment.

In relation to the mining sector, the NDS recognizes that the mining industry has historically been one of the most significant sectors of the national economy, but also acknowledges significant constraints to the continuing development of the industry, such as an insufficient regulatory regime, lack of a competitive investment and tax system, high cost of transportation and shipping, and poor accessibility to inland services and lack of suitable labor. Within this context, the NDS includes the following goals related to the gold mining industry:

- Restructure the fiscal regime to encourage foreign investment;
- Create a system of licensed and bonded buyers of gold;
- Support environmental initiatives such as a riverbank restoration fund,
- Incentives for regional gold processing mills, and regular regulatory compliance reviews of mining operations;
- Reorganize and restructure the GGMC and the Guyana National Resources Agency (GNRA);
- Increase industry collaboration with the Ministries of Health and Education, specifically in health, education, and malaria control initiatives; and,

-
- Coordinate new road construction by offering compensation or reduction in fees whenever new roads are constructed in accordance with the national road network plan, and meet specific construction and maintenance requirements.

Additionally, the Government of Guyana has published a National Environmental Action Plan (NEAP) to set out the necessary plan of action to ensure that the goals of the national development strategy related to environmental actions are fulfilled. The NEAP seeks to encourage “sustainable development that integrates economic, environmental and social values during planning, and recognizes the need to distribute benefits equitably across socio-economic strata and gender upon implementation.” Specifically, the plan states that Guyana will seek to ensure:

- The preservation and conservation of ecological integrity and the protection of natural habitats and fragile ecosystems;
- The sustainable use of natural resources in conjunction with the proper management and environmental assessments of proposed activities; and,
- The prevention or control of pollution in order to maintain the integrity of the land and the natural purity of the air and water resources.

Therefore, the project will have to seek to contribute to the NDS gold mining industry related goals and the general principles of the NEAP, participate in the economic and social development of the country and carry out all activities in the most sustainable manner possible.

3.4 General National Environmental Legislation

3.4.1 National Environmental Action Plan

The National Environment Action Plan (NEAP) developed in 1994 outlined the Government of Guyana main environmental policy objectives for sound management of the environment and natural resources. The project, if undertaken, must be based on sound environmental management practices.

Twelve policy objectives were outlined. One of the policy objectives calls for the Government of Guyana to require that environmental assessments are undertaken for proposed development activities that may significantly affect the environment. In keeping with this environmental policy objective, the Environmental Protection Act was made law in June 1996 and the legal framework for undertaking an environmental impact assessment was outlined. Further, the Act established the Environmental Protection Agency and outlined the legal process for undertaking sustainable and effective management of the environment and its natural resources.

This plan was updated in 2000 and sets out the environmental development strategy for Guyana for the next five years. It states Guyana’s Policy position as ‘sustainable development that integrates economic, environmental and social values during planning, and recognizes the need to distribute benefits equitably across socio-economic strata and gender upon implementation.’ The main goals of protecting the environment as defined in the plan are:

- The prevention or control of pollution in order to maintain the integrity of the land and the natural purity of the air and water resources;
- The general preservation and conservation of ecological integrity and the protection of natural habitats and fragile ecosystems in particular;
- Ensuring sustainability through best practice of the management and use of natural resources for economic development.

Existing environmental legislation is primarily focused on the exploitation of resources such as precious metals, timber and fisheries. Recent legislation has seen the passage of a Toxic Substances Control Act. This Act is intended to regulate the use and disposal of toxic substances.

Guyana has initiated the development of a national land use policy. Consultations with Ms. Andrea Mohammed of the Guyana Lands and Surveys Commission (GL&SC) have however indicated that this process is still a work in progress and the GL&SC is likely to publish a draft national land use policy document for public review in the short term. The absence of a National Land Use Policy has resulted in conflicting land uses. Land use is presently regulated by the Town and Country Planning Act. This Act regulates the development of Georgetown, Towns and other areas and provides for the public participation in the planning process. The Act however, does not mandate the performance of Environmental Impact Assessments.

3.4.2 Environmental Protection Act 1996

The implementation of the project must be guided by the Environmental Protection Act 1996. The Environmental Protection Act established the Environmental Protection Agency and provides for the management, conservation, protection and improvement of the environment. The act has provisions for the prevention or control of pollution, the assessment of the impact of economic development on the environment and the sustainable use of natural resources. The Act mandates the performance of Environmental Impact Assessments for projects with significant impacts on the environment.

This Act was amended in 2005 and includes a section on record keeping and monitoring requirements. Under this section, the Environmental Protection Agency requires that any person who releases or engages in the handling of hazardous substances or contaminants to:

- Sample and analyze such contaminant or hazardous substances, or material contaminated by same for specific constituents or characteristics;
- Install, use and maintain such monitoring equipment, and implement such environmental audit procedures as may be specified in any environmental authorization issued pursuant to this Act;
- Establish and maintain records regarding such sampling, monitoring, and environmental auditing activities;
- Establish and maintain records regarding pollution control equipment on the premises (including records on control equipment parameters, production variables and other indirect data when direct monitoring is not required);
- Submit reports including compliance reports; and
- Provide such other information as the authority may require.

There are five (5) pieces of legislations governing environmental protection which were enacted in 2000 as a consequence of the Environmental Protection Act. These are:

1. The Environmental Protection Air Quality Regulations
2. The Environmental Protection Water Quality Regulations
3. The Environmental Protection Noise Management Regulations
4. The Environmental Protection Hazardous Wastes Management Regulations
5. The Environmental Protection Authorizations Regulations

3.4.3 Environmental Protection Regulations

Regulations on Hazardous Waste Management, Water Quality, Air Quality and Noise Management were established, in 2000, under the Environmental Protection Act. The project, if implemented, may utilize

cyanide, chemical reagents, fuel oils and greases in its operation. Improper discharges of these substances can impact water quality and wildlife. In addition equipment used for mining and processing will have emissions to air that can potentially impact air quality. Noise from equipment operation may also impair communication. Local and international environmental protection regulations related to these media are therefore applicable to the project. These include Guyana EPA, World Bank and WHO standards detailed below.

3.4.3.1 Environmental Protection Air Quality Regulations 2000

Environmental Protection (air quality) regulations were developed in 2000 under the Environmental Protection Act 1996. In accordance with these regulations anyone who emits any air contaminant in the construction, installation, operation, modification or extension of any facility related to industry, commerce, agriculture or any institution shall apply to the EPA for an environmental authorization and shall submit an application to the EPA at least one hundred and eighty days before the date on which the emission is to commence. In accordance with the regulations the EPA shall establish parameter limits with respect to emission of smoke, solid particles, sulfuric acid mist or sulfuric trioxide, fluoride compounds, hydrogen chloride, chlorine, hydrogen sulfide, nitric acid or oxides of nitrogen and carbon monoxide. No parameters limits have been mandated to date. This project proposes to adhere to a combination of WHO Ambient Air Quality (2007) and World Bank Guidelines. These guidelines (2007) are detailed in Table 6.

Table 6: WHO Air Quality Guidelines

POLLUTANT	AVERAGING PERIODS	GUIDELINE VALUE ($\mu\text{g}/\text{m}^3$)
Nitrogen Dioxide (NO_2)	1-hour average	$200\mu\text{g}/\text{m}^3$
Particulate Matter (PM_{10})	24-hour average	$150\mu\text{g}/\text{m}^3$
Sulphur Dioxide (SO_2)	24-hour average	$125\mu\text{g}/\text{m}^3$

3.4.3.1.1 World Bank Guidelines for Ambient Air

Concentrations of contaminants, measured at the project property boundary, should not exceed the following limits:

Particulate matter (<10 mm)

Annual Arithmetic Mean	$100\text{ mg}/\text{m}^3$
Maximum 24-hour Average	$500\text{ mg}/\text{m}^3$

Nitrogen Oxides as NO_2

Annual Arithmetic Mean	$100\text{ mg}/\text{m}^3$
Maximum 24-hour Average	$200\text{ mg}/\text{m}^3$

Sulphur Dioxide

Annual Arithmetic Mean	$100\text{ mg}/\text{m}^3$
Maximum 24-hour Average	$500\text{ mg}/\text{m}^3$

3.4.3.1.1.1 Workplace Air Quality

Arsenic	$0.05\text{ mg}/\text{m}^3$
Carbon Monoxide	$29\text{ mg}/\text{m}^3$
Copper	$1\text{ mg}/\text{m}^3$
Free Silica	$5\text{ mg}/\text{m}^3$
Hydrogen Cyanide	$11\text{ mg}/\text{m}^3$

Hydrogen Sulphide	14 mg/m ³
Lead, Dust and Fumes, as Pb	0.15 mg/m ³
Nitrogen Dioxide	6 mg/m ³
Particulate (Inert of nuisance dusts)	10 mg/m ³
Sulphur Dioxide	5 mg/m ³

During project design, emission modeling must be conducted to determine whether the most stringent of these air quality standards will be exceeded. If these standards are exceeded mitigation measures must be identified to minimize impacts associated therewith.

3.4.3.2 Hazardous Waste Management Regulations 2000

Gold will be beneficiated by cyanidation. This will entail the utilization of cyanide and other hazardous reagents in the processing operations. Petroleum products will be used for power generation and equipment operation. The chemical reagents and petroleum products will have to be managed in conformance with the EPA Hazardous Waste Management Regulations, 2000.

These regulations outline the rules and procedures for transport, storage, treatment and disposal of hazardous wastes. There are no regulations for the management of hazardous substances. It can be inferred that these regulations will apply to reagents to be used by the project.

These regulations are intended to ensure, through the environmental authorization process, that all operations that generate, transport, treat, store and dispose of hazardous wastes are managed in a manner that protects human health and the environment. The regulations allow for the provision of information on the types of facilities and quantity of hazardous waste generated, treatment standards and efforts to reduce the waste generated. An emergency preparedness plan is required for anyone who operates a hazardous waste facility. For the purposes of that regulation, hazardous material/waste is regarded as the following:

- Explosives
- Flammable liquids
- Flammable solids or waste solids other than explosives which may be readily combustible
- Oxidising substances
- Organic peroxides
- Poisonous substances
- Infectious substances
- Corrosives
- Toxic gases
- Toxic substances which if inhaled or ingested may cause delayed or chronic effects
- Ecotoxic substances which if released may present immediate or delayed adverse impacts to the environment by means of bioaccumulation and/or toxic effects upon systems
- Materials capable, after disposal, of yielding another material which possesses any of the characteristics specified above

3.4.3.3 Environmental Protection Water Quality Regulations 2000

The water quality regulations were promulgated to minimize impacts of discharges on water quality. The project may entail discharges to surface water. If the level of contaminants in effluent discharge from the project exceeds tolerable limits, water quality will be impacted. These regulations require registration and environmental authorization by any person whose construction, installation, operation, modification or extension of any facility cause the discharge of effluents. These regulations cover parameter limits of

effluent discharges, new sources of effluent discharges, fees for registration and environmental authorization, sampling points, records and reports and general provisions for the registration of water effluent, biological integrity, spills or accidental discharges and standard methods of analysis. Guidelines on the discharge of effluents and disposal of sludge are detailed in these regulations.

In accordance with these regulations the EPA was mandated to establish parameter limits for concentration of constituent of effluent which can be discharged into any inland or coastal waters or lands of Guyana for Ammonical Nitrogen, Sulphate, Chloride, Cobalt, Colour, Detergents, Anionic, Fluoride (as F), Molybdenum, Phosphate 9 as P, Polychlorinated Biphenyls, Selenium, Silver, Beryllium, Vanadium, Radioactive Material, Nitrate Nitrogen, Temperature, Pesticides, Fungicides, Herbicides, Insecticides, Rodenticides, Fumigants or any other Biocides or any other Chlorinated Hydrocarbons. Standards were also to be established for any substance that either by itself or in combination with other waste or refuse may give rise to any gas, fume or odour or substance which causes or is likely to cause pollution. The Guyana National Bureau of Standards (GNBS), along with the EPA, have developed interim industrial effluent standards which however are not specific to mining.

3.4.3.4 Environmental Protection Noise Management Regulations 2000

The noise management regulations were developed to ensure effective implementation of health and safety measures during operations and to minimize impacts on receptors in the site vicinity. The project may generate noise. The regulations are consequently applicable to the project.

Under these regulations operations that emit noise in the execution of various activities such as construction, transport, industry, commerce and any institution are required to apply to the Agency for an environmental authorization. The EPA is responsible for the establishment of standards for permissible noise levels in industry, construction and other areas. The categories for which permissible noise levels are fixed by the EPA were identified as follows: Residential, Institutional, Educational, Industrial, Commercial, Construction, Transportation and Recreational.

The Guyana National Bureau of Standards (GNBS) and the EPA together with other relevant agencies developed Guidelines for Noise Emission into the Environment. Under these guidelines, noise emissions from Industrial and Commercial sources for both day (06:00h – 18:00h) and night (18:00h – 06:00h) would be 100 and 80 decibels (Industrial) and 80 and 65 decibels (commercial) respectively at the property boundary or 15 meters from the source.

3.4.3.5 Environmental Protection (Authorizations) Regulations 2000

Before an application for Environmental Authorization is made, an Environmental Impact Assessment or any other relevant document should be submitted to the EPA for approval. Under this regulation, PGI would be mandated to keep records of all environmental monitoring (not less than 3 years), sampling procedures, maintenance and calibration procedures and all problems and malfunctions. These records should be made available to the Environmental Protection Agency. The records should be project specific and shall include:

- Steps PGI would follow to avoid, minimize, mitigate and compensate for impacts
- Records of monitoring information such as date, place and time of measurement etc.
- Proper maintenance of facilities and appropriate quality assurance procedures;
- Establishment of environmental monitoring programme.

3.4.4 EPA's Role in EIAs

The Environmental Protection Act mandated four functions for the EPA which relate to environmental assessment. If the EPA determines that this project is likely to have significant environmental impacts, these four functions of the EPA would be applicable to this project. These four functions are:

- To take such steps as are necessary for the effective management of the natural environment so as to ensure conservation, protection and sustainable use of natural resources;
- To promote the participation of members of the public in the process of integrating environmental concerns in planning for development on a sustainable basis;
- To ensure that any development activity which may cause an adverse effect on the natural environment be assessed before such activity is commenced and that such adverse effect is taken into account in deciding whether or not such activity should be authorized.
- To give development consent, which entitles the developer to proceed with the project.

The Agency is required to implement several principles of environmental management as part of this process. These principles are:

- The “polluter pays principle”: the polluter should bear the cost of measures to reduce pollution
- The “precautionary principle”: where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing measures to prevent environmental degradation.
- The “strict liability” legal principle: any person who contravenes this Act or regulations shall be liable to the penalties prescribed thereafter;
- The “avoidance” principle: it is preferable to avoid environmental damage, as it can be impossible or more expensive to repair rather than prevent damage;
- The “state of technology” principle: measures protecting the environment are restricted by what is technologically feasible and as technology improves, the improved technology should be used to prevent and repair environmental damage.

3.4.5 The EIA Process

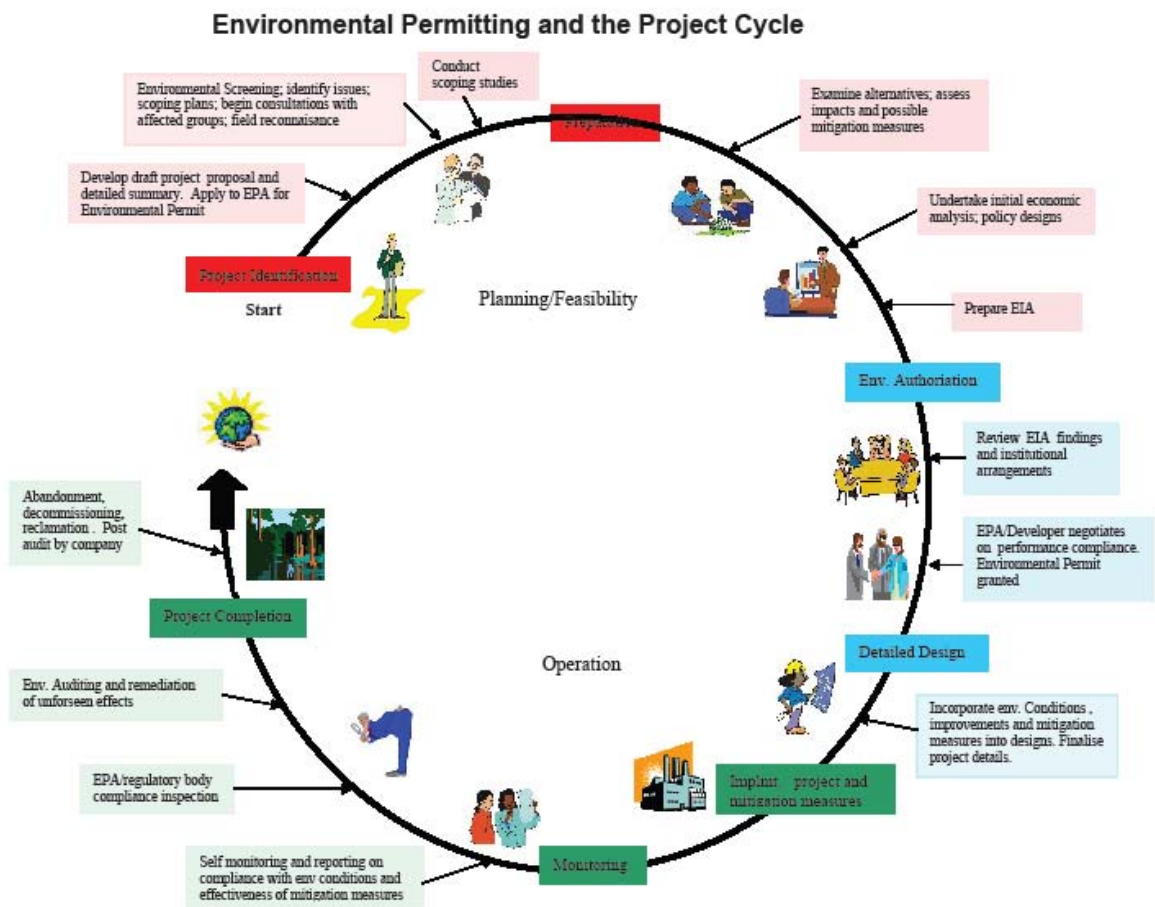
The EPA has developed a guideline for the EIA process, however typically an Environmental and Social Impact Assessment (ESIA) is the product of the EIA process. If an ESIA is undertaken for this project, it must conform to the EIA process established by the Guyana EPA. A summary of that EIA process is detailed below. A schematic representation of the steps in the process is presented as Figure 4.

Commencement of the environmental impact assessment process is preceded by an application for an environmental authorization and a summary of the project including information on the site, design and size of the project, possible effects on the environment and a non-technical explanation of the project. The Environmental Protection Agency would then indicate whether an environmental and social impact assessment is a mandatory requirement for the issuance of an environmental authorization for the operation.

A draft Terms of Reference is prepared and submitted to the EPA. After that submission, the EPA publishes a notice of the project in at least one daily newspaper. A summary of the project is made available to members of the public for a period of 28 days. Within this period the EPA accepts written submissions to the Agency related to the project. These submissions detail questions and matters which members of the public consider relevant to the deliberations of the EIA.

A public consultation meeting is held after this 28 day period. Additional concerns of the public are noted at this forum and the EPA provides comments to the ESIA Consultant for finalization of the Terms of Reference (TOR) of the EIA. This meeting is chaired by the EPA with representatives of the EAB being present. The Environmental Assessment Board (EAB) is a body which provides an independent contribution to the development and finalization of the EIA and makes recommendations which uphold the principles of the EP Act in the context of the interests of the developer, the public and the regulatory agencies. In order to carry out its functions, the EAB is involved in the development of the ESIA from the point of ESIA scoping to establishing conditions for the issuance of an Environmental Permit.

Figure 4 - Schematic of Environmental Permitting Process



During the environmental impact process the Developers and Consultants are required to consult members of the public, interested bodies and organizations and also provide to members of the public on request, and at no more than reasonable cost, copies of information obtained for the purpose of the EIA. The Developer and Consultant must submit to the EPA, the ESIA report along with an Environmental Impact Statement (EIS) for evaluation and recommendations. Every environmental impact assessment is required to contain a description of the project, an outline of the main alternatives studied and reasons for choices, a description of significant effects of the development on the environment, an indication of any difficulties encountered by the developer in compiling information for the ESIA, a description of the best available technology, a description of any hazards or dangers which may arise and a risk assessment of same, a description of mitigation measures for any adverse effects, a monitoring plan and an emergency response/contingency plan and a program for rehabilitation and restoration. The decision by the Agency

to grant an environmental authorization for a project shall be subject to conditions, which are reasonably necessary to protect human health and the environment.

The ESIA must be completed to conform to the TOR and copies submitted to the EPA for review and public comment. The EPA subsequently publishes a notice in at least one daily newspaper notifying the public of the submission of the ESIA. The public has 60 days from the publication date of the notice to make submissions to the EPA and/or the EAB related to the EIA. The EPA, along with relevant sector agencies review the EIA during this sixty day period to ensure that the EIA is in line with any plans, guidelines, regulations or codes of practice developed by the EPA and sector agencies. Copies of the EIA and the findings of the review by EPA and sector agencies are passed to the EAB for review and recommendation.

A public meeting, chaired by the EAB may be held, if considered necessary, at the end of the 60 days period. Additional comments are provided by members of the public at this meeting. The key objectives of public involvement in the EIA process are to:

1. give the public a voice in project planning;
2. obtain local knowledge, information and ideas;
3. provide information to the people on planned activities to stimulate local interest and involvement in the project;
4. ensure early detection of environmental and social impacts arising from the project;
5. initiate and establish mechanisms and procedures to enable local people to participate in all phases of the project.

A final EIA is then prepared to address the comments of the EPA, the sector agencies, the public and the EAB to address issues in the TOR initially agreed to but excluded from the EIA. The EAB will then recommend to the EPA whether the EIA is acceptable and the conditions to be attached to the Environmental Permit, should it be granted.

The EPA takes into account the recommendations of the EAB and sectoral agencies, comments of the public and its own review, and decides whether or not the project should be approved. For approved projects, the EPA issues an Environmental Permit with the terms and conditions necessary to effectively manage the environment. If an Environmental Permit is not granted, the developer can file an appeal within 28 days with the Environmental Appeals Tribunal (EAT). The EAT is a superior court of record and has, in addition to the jurisdiction and powers conferred by the EP Act, all the powers inherent in such a court. The Tribunal has the power to enforce its own orders and judgments and the same power to punish contempt as the High Court of Justice. The EAT has the jurisdiction to hear and determine appeals against:

1. The refusal of an Environmental Permit;
2. The requirement of an Environmental Permit;
3. Cancellation or suspension of an Environmental Permit.

3.4.6 Amerindian Act No. 6 of 2006

The access road to this concession passes close to the Amerindian Titled Community of Kaburi. Several provisions of the Amerindian Act are therefore applicable to the Project.

The Amerindian Act of 2006 was assented to by the President on 14th March, 2006 and came into operation in April 2006. The Act provides for the recognition and protection of the collective rights of Amerindian Villages and Communities, mechanisms for good governance within Amerindian Villages and Communities and the granting of land to these Villages and Communities. The act allows for granting of Amerindian Village and Village land status to an Amerindian Community on Application, if

it has been in existence for at least twenty five (25) years and if at the time of application and for five (5) years immediately preceding its application, it consisted of at least one hundred and fifty (150) persons. The Village lands may not be disposed of except as provided in the Act. An existing Amerindian Village may have its Village lands extended on application in writing in accordance with the provisions of the Act.

Part V of the Act deals extensively with mining and matters related to mining including, environmental issues relating to lands within the boundaries of Amerindian Villages and proximate thereto. This Part provides for allocation of lands to residents and for lease of lands within the Villages.

Mining is allowed in any river, creek, stream or other source of water within the boundaries of any village subject to prescribed conditions. One of the conditions is that a miner must enter into a written agreement with the Village Council. That agreement must be based on the consent of individuals present at a village council meeting. The agreement must relate to issues such as:

- The offer of employment to residents of the Village at market rates once residents with the required skills are available.
- The purchase of food and materials from the Village once available and at competitive prices
- Compliance by the miner and employees with rules made by the Village council
- The obligation of miners to take all necessary steps to avoid
 - o damage to the environment
 - o pollution of ground water and surface water
 - o interference with agriculture
 - o damage or disruption of flora and fauna
 - o disruption of residents normal activities

The Village and mine operator may also exercise an option to expressly cater for the following in their written agreement:

- An environmental protection program
- A waste disposal plan
- A mechanism for identifying and resolving conflict
- A health program providing medical supplies to health workers for use in the Villages
- An education program

If a large scale miner, involved in either prospecting or mining, is refused consent by the Village he may still be able to prospect or mine for minerals provided the Minister with responsibility for mining and the Minister of Amerindian Affairs declare that the mining activities proposed are in the public interest.

The act mandates the payment of tribute by a miner to the Village for any minerals obtained from Village lands. The Guyana Geology and Mines Commission is mandated to make transfers into a fund for that purpose, a prescribed percentage of royalties obtained from mining activities on Village lands. The Guyana Geology and Mines Commission is obligated to notify the Village and be satisfied that the impact of mining on the Village will not be harmful before issuing any permit, licence, concession or permission over or in:

- any part of Village lands
- any land contiguous with Village lands
- any rivers, creeks or water way which pass through Village lands or any lands contiguous with Village lands.

The provisions that impose obligations on the Guyana Geology and Mines Commission before the issue of any licence, permit or concession may be interpreted as being operative in relation to permits, concessions and licences to be issued after the coming into operation of the Act. The Act does not inform whether Amerindian Villages are to be considered private lands for the purposes of the Mining Act of 1989.

3.4.7 Wild Birds Protection Act Chapter 71:01

The Act stipulates for the protection of certain wild birds. Wild birds are defined in the schedule of the Act. Certain wild birds are protected absolutely. It is an offence to wound, kill, expose for sale, and offer for sale or export wild birds that are absolutely prohibited. However, there are some wild birds that are not so protected; they receive protection only during a prescribed closed season. However, it is not an offence to wound or kill any wild bird for the purpose of procuring food and if done ten miles or more from a plantation. There are no provisions for the protection of wild birds relative to mining operations, however, conservation of biological resources is applicable to the project. PGI will therefore need to conform to the provisions of this act.

3.4.8 Town and Country Planning Act Chapter 20:01

Provisions are made in this Act for the orderly and progressive development of land (which is specifically defined), Cities, Towns and other areas be they urban or rural, for their preservation and improvement and for other related matters. The prescribed authority responsible for effecting the provisions of the Act is the Central Housing and Planning Authority established under the Housing Act Chapter 36:20. This act would regulate any new settlement associated with the operations. The Central Housing and Planning Authority will consequently be required to provide consent for the development and regulation of any new settlement associated with operations.

3.4.9 Pesticides and Toxic Chemicals Control Act No. 13 of 2000

This project may entail the importation of cyanide and other chemicals reagents for use in beneficiation, some of which can be classified as toxic chemicals. The Pesticides and Toxic Chemicals Control Act No. 13 of 2000 regulates the manufacture, importation, transportation, storage, sale, use and disposal of pesticides and toxic chemicals. The act also resulted in the establishment of the Pesticides and Toxic Chemicals Control Board. This act would be applicable to the reagents to be used during project execution.

In accordance with the act regulations should be developed to include as follows:

- Regulations for the health and safety of workers against the risk of poisoning by controlled products when working in connection with the use of controlled products or when working on land or in any premises on or in which controlled products have been or are being used, stored or manufactured
- Regulations imposing duties on the employers of workers, on the workers themselves and on others using controlled products and controlling and prohibiting sale, use, disposal and transportation of any toxic chemical or pesticide.

A 'controlled product' is defined in the Act as 'any pesticide or toxic chemical'. 'Toxic chemical' is defined as 'any disinfectant or any other substance known to be poisonous, corrosive, irritating, capable of causing a sensitive reaction or sensitive to man or animal that is used in agriculture, the art, commerce or industry or for any domestic or other purpose ...'

In accordance with the act, the following is mandated:

-
- Registration of toxic chemicals and pesticides;
 - Licensing of persons wishing to import, manufacture and sell pesticides or toxic chemicals.

Analysts, Inspectors and Medical examiners may be appointed to support and enforce provisions of the Act.

The functions of the of Pesticides and Toxic Chemicals Control Board include

- The registration of Pesticides and Toxic Chemicals
- The issuance of licence to persons to import or manufacture registered pesticides and toxic chemicals.
- Consideration and determination of applications relevant to the Act and dealing with all aspects of the importation, manufacture, storage, transportation, sale, preparation for sale, use and disposal of pesticides and toxic chemicals.

3.4.10 National Biodiversity Action Plan

The National Biodiversity Action Plan (NBAP) was prepared in 1999 to integrate the implementation of the Convention on Biological Diversity into national development. The overall goal of the NBAP was “to promote and achieve the conservation of Guyana’s biodiversity, to use its components in a sustainable way, and to encourage the fair and equitable sharing of benefits arising out of the use of Guyana’s biodiversity”. The stated objectives of the plan were to:

- Evaluate the state of capacity nationally to achieve the above goal;
- Identify gaps and needs relating to achieving the above goal;
- Propose actions to achieve this goal and close the gaps;
- Develop activities in a number of priority areas relating to the overall goal;
- Identify the roles and responsibilities of the various stakeholder groups in the implementation of the plan; and
- Increase public awareness of biodiversity.

The plan included a number of program areas partitioned under two phases with various actions for execution. Phase 1 identified foundation programs that are essential for sustainable biodiversity planning and management. This included Human Resources and Institutional Capacity Building. Phase 2 on the other hand, consolidated phase 1 and initiated additional interventions for the second cycle of the plan. The program area for the additional interventions included Planning a Biodiversity Action Plan.

This plan entered its second cycle in 2007 to focus mainly on conservation and sustainable use of biodiversity and sharing of benefits. It retained, as its cornerstone, the goal and seven objectives from the previous plan. Four thematic natural resource areas are listed as requiring attention. These are:

- Forests
- Agriculture
- Coastal resources
- Marine resources

The operation and access roads will be located in forested areas and impinges on biological diversity. Therefore, according to NBAP 1, consideration must be given to the adoption of the four approaches stated below when planning for management of biodiversity.

The Participatory Approach

This approach recognizes that conservation and responsible use of biodiversity requires commitment and collaboration from agencies, individuals etc. that impact/use biodiversity through their activities.

The Cyclical/adaptive Planning Approach

This approach is cyclic in nature and adaptive to change in circumstances and national policy.

The Ecosystem Approach

The ecosystem approach to biodiversity planning and management is based on the linking of the social, economic and environmental aspects of biodiversity management.

The Precautionary Principle

The precautionary principle according to the Convention on Biological Diversity is “where there is a threat of significant reduction or loss of biological diversity, lack of full scientific certainty should not be used as a reason for postponing measures to avoid or minimize such a threat.” This principle has been incorporated into the Environmental Protection Act.

3.4.11 Public Health Act Cap 145

The provisions of the Public Health Act must be factored into the employee health and safety plan for the site operations. Section 2 of the Public Health Act Chap. 145 states that mining districts under the Public Health Act are understood to include mining districts established under section 4 of the Mining Act. Under Section 147, the Minister responsible for Health is enabled to make regulations generally for the sanitary control of mining districts or parts thereof, and the health and welfare of the inhabitants. Revisions to the Public Health Act including draft regulations for mining have been made but not yet promulgated.

3.4.12 Forest Act 2008

The project area is located in a State Forest and is subject to conditions prescribed by the Guyana Forestry Commission. The Forest Act 2008, consolidates and amends the law on forests. It governs all activities that are carried out in the forest including mining and associated activities. Under this Act, no person shall engage in the following unless a mineral prospecting or mining licence has been granted under the Mining Act 1989:

- Enter and occupy state forest;
- Cut, damage or take any forest produce or carry on any kind of forest operation;
- Carry out any kind of exploratory operation in a state forest

The Guyana Forestry Commission with the approval of the Minister is vested with the power for carrying out the purposes of the Act.

3.4.13 Guyana Forestry Commission Act 2007

The Guyana Forestry Commission Act 1979 was repealed and was replaced the Guyana Forestry Commission Act 2007. The functions of the Commission as defined in the latter act include:

- To provide advice on various forest related issues and on formulation of forest policy;

-
- To prepare plans, codes of practice, and guidelines for the conservation and management of forests;
 - To research, collate, analyse, prepare and disseminate data, statistics and other information about forests and all aspects of forestry including forest ecology and the use of forest produce;
 - To inspect, certify and accredit services for quality control of forest produce.

The project may entail management and reclamation of forest resources and this act must therefore be adhered to.

3.4.14 Code of Practice for Timber Harvesting 2002

The Code of Practice for Timber Harvesting was developed by the Guyana Forestry Commission (GFC). It provides guidelines and standards on what constitutes satisfactory road building and other related forestry activities. One important component of this project may be the construction of roads on the property. All roads will at a minimum have to conform to GFC Road Planning guide as outlined in the Code of practice for Timber Harvesting.

3.4.15 Low Carbon Development Strategy

The Low Carbon Development Strategy (LCDS) is outlined in the document “Transforming Guyana’s Economy While Combating Climate Change” dated June 2009 from the Office of the President, Republic of Guyana. The LCDS aims to build “on previous reforms to further stimulate investment, economic growth and job creation as well as to improve security and social services, protect vulnerable sections of society, and deal with increased climate change induced flooding”. It recognizes that the majority of Guyana’s 15 million hectares is suitable for timber extraction and places an annual value of US \$580.0 million on that resource.

The LCDS recognizes the need for “continuing the modernization of the traditional economic sectors which have generated Guyana’s historical growth and employment”. The document further “prioritizes the modernization of four traditional sectors: sugar, rice, forestry and mining”.

The LCDS is focused primarily on the consequences of deforestation and avoided deforestation. The intent is to ensure a carbon neutral position results from forestry operations. It has very little discussion on the mining sector and proposes “to align all land-use policies with the LCDS - most importantly forestry and mining policies”. It was recently proposed by the GGMC, as a consequence of the LCDS, that the use of mercury in mining be curtailed entirely. A two year period has been identified for enactment of the mercury ban.

3.5 National Mining Legislation

3.5.1 Mining Regulations

The regulations contain provisions for the sanitary management of human waste and for burial of animals and any person who expires at the mine. Detailed provisions are outlined for the Regulation of Mines. These regulations include prohibition against the hiring of females, and underage boys in addition to restriction on persons permitted to work underground. These regulations also mandate requirements for ventilation of shafts and for the use of explosives in mining operations and in general details provisions for underground mines.

Procedures for the use of poisonous substances including cyanide and mercury are also outlined in these regulations with restrictions being placed on the discharge of poisonous effluent to the environment and on the exposure of individuals to mercury fumes.

The royalty payable on gold, silver and precious stones are detailed in the regulations in addition to the rights and expectations of lessees and tributors. The regulations places restrictions on individuals eligible to be employed as laborers in mining districts and mandate that each person, who is not an Amerindian, who works as an employee in a mining district shall be registered. The employer at a mine site is mandated by regulations to keep medicines and medical supplies for the use of mine employees and in instances where the number of employees exceed 50 the employer is compelled to employ a sicknurse or dispenser and prohibits employers from punishing employees.

The regulations further mandate provisions for the keeping of record of gold, valuable minerals and precious stones, payment of royalty on gold, valuable minerals and precious stones, sale and purchase, of gold valuable minerals and precious stones and on the export of precious Stones.

Part XXII of the regulations applies to the rights, privileges and restriction on Amerindians and the miscellaneous provisions provide for disposal of forfeited gold, valuable minerals and precious stones.

3.5.1.1 Environmental Provisions

The environmental provisions of Cap 65:01 as inferred from those regulations relate to the management of mine operation effluents. The provisions for construction of dams can be interpreted as being related to the construction of tailings, detention and sediment control structures.

In accordance with Part VIII 60 (a) a dam can be constructed on state land as part of a mining operation. There is also a mandate that no one shall deposit any earth, stone, gravel, debris or tailings on a claim held by another person without their consent. This regulation also mandate that any area of water containing poisonous or injurious chemical solutions used in the treatment of gold or other minerals must be fenced to prevent inadvertent access thereto, and notice boards shall be erected in suitable places warning persons from making use of such water. In addition, in no case shall water containing any poisonous or injurious chemical solutions be permitted by a claim holder or his agents to knowingly escape or enter any river, creek, race, lake, reservoir, or any stagnant water without having been previously rendered innocuous. The stipulations of these regulations are applicable to the siting of tailings ponds and the management of effluent discharge from ponds.

Additional provisions of the regulations which are inferred to relate to the utilization and impacts on water resources stipulate that a person may hold at the same time on any water-course which is not navigable, claims extending from the point where such water-course ceases to be navigable to its source and no claim other than a dredging concession or river location shall include the bed of a navigable river or water-course. In addition, no person holding a claim on either bank of a navigable water-course shall prevent free navigation and passage thereon and every holder of a claim shall be entitled to the free use of water naturally flowing through or past his claim, and not already lawfully appropriated in such manner as may, in the opinion of the commissioner or of the mines officer, subject to the approval of the Commissioner, be necessary for the proper working thereof.

Additional regulations related to water resources is a mandate that no person shall back up the water of any river, creek or water-course upon any claim or cause any claim to be flooded, either willfully or by neglect through the construction of any dam or stop-off, or in any other way and permits the Minister to grant to any person a licence, with such terms and conditions as he may think proper to take direct and use any water from any river, creek, tributary, stream, lake or pool, situated upon or flowing through any State lands for the purpose of supplying with water any machine or any engine or machinery employed and for mining purposes provided that such works shall not interfere with existing rights. Every water-race shall have a point to be specified by the commissioner or mines officer at which water shall be taken from the river, creek, or other source, but in no case shall such river, creek, or other source be included in or form part of any water-race or pipe for or the conveyance of water.

The final water resources provision states that in case any holder of a licence under this regulation fails to make a reasonable use of the advantages allowed to him by his licence or if he takes water in excess of a reasonable quantity or if he wastes water or if he fails to comply with the condition under which his licence was granted the Minister may cancel his licence and every person who willfully or negligently causes the water of any well or reservoir on or near any claim, or of any creek used for drinking purposes and set apart by the mines officer for that purpose, to become contaminated shall be guilty of a breach of the regulations.

Limits on effluent disposal are covered by the requirement that in no case shall water containing any poisonous or injurious chemical solution be permitted to escape or enter any river, creek, race, lake, reservoir, or any stagnant water without having been previously rendered innocuous.

3.5.1.2 Safety Provisions

Health and safety regulations are not explicitly detailed in Cap 65:01. However, the provisions of Part XIII, Regulation of Mines can be interpreted as relating to regulating conditions in mines to ensure health and safety. The Mines Regulations details requirements for the employment of a mine manager and places restrictions on persons appointed manager of a mine. In addition, duration of work restrictions are detailed for underground work in addition to the age of employees delegated to perform certain functions such as the lander or bracedman over any shaft and persons in charge of steam or other machinery used in connection with any mine, or for the treatment of any products of any mine. A mines officer is also empowered by these regulations to authorize in writing the entry of any surveyor, assessor, inspector or other person into and upon any mine or site for the purpose of measuring the depth of any shaft, dip, or inclination or the length of any tunnel or drive, or for any other purpose.

The regulations include requirements for the provision of an adequate amount of ventilation to be constantly produced in a mine to such an extent that the shafts, winches, sumps, levels and working places of the mine, and the traveling road to and from such working places, shall be in a fit state for working and passing therein.

The regulations permit the use of gunpowder or other explosive or inflammable substance provided that specific conditions are adhered to. These include the storage in a chamber or magazine of the mine, at a distance of not less than two hundred feet from where any blasting operations are being carried on and restrict these materials from being taken for use into the workings of the mine except if in a securely covered case or canister containing not more than eight pounds of gunpowder, or more than five pounds of nitro-glycerine compounds. In addition detonators for blasting are required to be kept on the surface of the ground in a covered box placed in a magazine and at least fifty feet from the nitroglycerine compounds. Notification is required when blasting operations are being carried on and procedures are detailed for dealing with missed charges.

The safety regulations dictate that the top and all entrances between the top and bottom of every working or pumping shaft shall be properly and securely fenced or securely covered and that all abandoned or disused shafts shall be fenced or securely covered and its position indicated on the surface. The safety provisions details requirements for use of shafts, methods of signaling, covering of underground braces and the use of chains for lowering or raising persons in shaft or plane.

3.5.2 The Mining (Amendment) Regulations 2005

The GGMC amended its mining regulations in 2005. These amended regulations together with the Mining Act 1989 are applicable to this project. If an ESIA satisfies both the EPA and GGMC, a mining

licence would be issued for the mining operations on the property. GGMC would be responsible for enforcing the provisions in this regulation.

Environmental provisions applicable to current mining operations are detailed in the Mining (Amendment) Regulations 2005. The Mining (Amendment) regulations 2005 contain mandates for the following:

- Use of Poisonous Substances
- Requirements for Environmental Management for Large and Medium Scale Mining
- Requirements for Environmental Management for Small Scale Mining
- General Requirements
- Protected Areas
- Pollution Control
- Offences and Penalties

3.5.2.1 Use of Poisonous Substances

The poisonous substances regulations are applicable primarily to the use of mercury and cyanide in gold mining and stipulate that no person shall use elemental mercury or any form of mercury. Contravention of the regulations results in a Cease Work Order being placed on the operations on the claim or area until clean-up is done to the satisfaction of the Commissioner.

These regulations present mandates for the use of cyanide and require that no operation in which cyanide or any preparation containing cyanide is used in the treatment of gold or other minerals may be commenced until the necessary buildings, structures, rooms, appliances and other arrangements to carry on these operations have been inspected and approved by a mines officer. In addition, at every mine or other place where cyanide is used an approved cyanide antidote shall be kept in a conspicuous and convenient place in a box labeled cyanide antidote. Explicit directions for the use of such antidote shall be affixed inside the lid of the box and the mines manager shall ensure that all persons working in any place where the cyanide is used, familiarize themselves with the location of the box and the directions for use of the antidote.

The Commission is required to keep registers which shall contain information related to cyanide permits issued with information in the register to include:

- the name of the person to whom the cyanide permit is granted;
- the date that the permit was granted, expiration and renewal dates;
- the date and reason for revocation and suspension of the licence or permit and in respect of suspension the period thereof;
- the number of the licence or permit;
- the amount of cyanide purchased and any relevant remarks.

The register shall be open for inspection by the public at the office of the Commission during office hours, free of charge, and the Commission shall, on payment of the prescribed fee, cause to be made copies of any entry in any such register.

The regulations stipulate that any area of water containing poisonous or injurious chemical solutions used in the treatment of gold or other minerals must be fenced in any effective form to prevent inadvertent access thereto, and notice boards shall be erected in suitable places warning persons from making use of such water and in no case shall water containing any poisonous or injurious chemical

solutions be permitted by a claim holder or his agents to knowingly escape or enter any river, creek, race, lake, reservoir, or any stagnant water without having been previously rendered innocuous.

The owner or manager of any claim or mine, in which cyanide or any preparation containing cyanide or any other poisonous substance is used for any purpose is mandated to enter or cause to be entered in a register to be kept for that purpose, the quantities of cyanide and other poisonous substances received and issued. The record of each poisonous substance shall be kept separately and shall show the date of receipt, the date of issue, quantities received or issued and the balance of stock on hand, and the signature of the receiver or issuer, as the case may be. The owner or manager of any claim or mine shall have the said register available at all times for inspection by a mines officer. All vessels or plants used for the treatment of zinc or lime with acid or for the cyanide process shall be fitted with mechanical agitators and hoods or other appliances of such a nature that the fumes generated in such vessels shall be carried directly to the external air at a distance approved by the Commissioner from time to time. All facilities shall be located downwind or in any other wind of all residences so that such residences are not unduly disturbed.

The regulations provide for an adequate supply of wholesome drinking water to be provided in each premises or place where cyanide or any preparation containing cyanide is used, and this supply shall be distinctly labeled Drinking Water.

Cyanide or other poisonous substances used in any mining or milling process are required to be kept in a separate compartment specially set aside for the storage of such poisonous substances with the compartment being locked and in the care of a person duly authorized by the manager and no person is authorized to remove from a claim or mine any cyanide or other poisonous substances without having obtained the written permission of the manager. Further all holders of licences and permits as granted under the Mining Act, shall adhere to the provisions of the Code of Practice on Use and Handling of Poisonous Chemicals as published jointly by the Commission and Environmental Protection Agency, and updated from time to time.

3.5.3 Guyana Geology and Mines Commission Act of 1979 and Mining Act of 1989

The Guyana Geology and Mines Commission established by the GGMC Act 1979 is responsible for the implementation of the Mining Act 1989, which establishes the legal framework for the utilization of mineral resources in Guyana. The Act makes provision for a system of mineral agreements and licences for regulating prospecting. It gives the Commission the responsibility for establishing regulations for mining and quarrying operations. A mining licence is required in order to mine any mineral and is issued at the discretion of the Commissioner of Guyana Geology and Mines Commission with the Minister responsible for mining. In addition, the act makes provisions for the disposal of sanitary waste and the storage of poisonous substances in mining areas.

Sections 76 and 77 of the Mining Act of 1989 details provisions for regulations related to safety in mines or quarries or in prospecting, mining or quarrying operations and the welfare of workers. The Guyana Geology and Mines Commission is currently developing a document on Occupational Health and Safety in Mines. The provisions of this act are superseded by the Mining Act 1989 if inconsistencies prevail.

3.5.4 Occupational Safety and Health in Mining

The Occupational Health and Safety Act 1997 contain provisions applicable to the regulation of health and safety in mines. In 2002, a draft Mining Occupational Safety and Health Regulation was proposed by the Ministry of Labour, Human Services and Social Security with the assistance of the International Labor Organization (ILO). If a mine becomes operational at the site it will be required to operate in accordance with the Occupational Health and Safety Act 1997.

The draft OSH Regulation covers duties of employers and self-employed persons, owners of mines, manufacturers and workers. Reporting of dangerous situations and occurrences, administrative requirements such as the preparation, checking and maintenance of mine development plans in advance of mine development, as well as those for mine operations, inspections by mine operators, minimum age of workers and the maximum duration of work shifts, testing of shaft ropes and notice of death or injury are also covered. Other general areas included in the regulation are competency requirements for the supervision of workers at a mine, training for the performance of mining operations, the supervision of work done by competent workers, safe access to and egress from workplaces such as mine openings, ladders, stairways, platforms and open pit workings and general safety for working alone, protective equipment and clothing, protection from falling objects, the prohibition of substance abuse in mines, and the use of pressurized systems.

Safety requirements are also prescribed for surface operations and underground operations. Emergency procedures and fire prevention and control strategies are outlined. The draft Regulation also addresses working environment conditions such as ventilation, records and control of specific contaminants, noise and dust limits, vibration and heat stress, ergonomics, sanitary facilities and precautions against exposure to radon and radiation. The safe handling, storage, operation, and transport of explosives are also dealt with. Basic safety procedures for electrical safety in mines, safety requirements for machinery and plant equipment, and the operation of hoisting equipment are detailed as well as miscellaneous provisions regarding the resolution of health and safety issues and the refusal of a worker to work in particular instances.

This extensive draft Regulation has not yet been given legal effect by the Ministry of Labour, Human Services and Social Security.

3.6 INTERNATIONAL AND REGIONAL POLICY

3.6.1 Rio Declaration

The Rio Declaration on Environment and Development was one of five (5) documents that resulted from the Earth Summit in Rio de Janeiro in 1992. The other documents that are applicable to this project are:

- Agenda 21
- United Nations Framework Convention on Climate Change
- United Nations Convention on Biological Diversity

The Rio Declaration consisted of 27 principles intended to guide future sustainable development around the world. It confirms the responsibilities of all countries including Guyana to among other principles:

- Use the precautionary approach to prevent environmental degradation (Principle 15)
- Prepare environmental impact assessments with full public participation (Principle 10)
- Include Indigenous People and their communities in development projects (Principle 22)

Guyana ratified the Rio Declaration and developed and implemented guidelines for conducting Environmental Impact Assessments, which will guide implementation of this project.

3.6.2 Agenda 21

Agenda 21 arises from the United Nations Conference on Environment and Development (UNCED) held in Rio De Janeiro in 1992 and outlines a number of environmental policy and management issues for a more sustainable pattern of development in the 21st century. Four major areas of political action were

identified in Agenda 21, the social and economic development, natural resources, fragile ecosystems, major organizations and groups of people and means of implementation (Selman, 1996). Further, twenty-seven (27) environmental principles for the protection of environmental resources were outlined as the Agenda 21 action programmes. One of its principles which states that environmental impact assessment should be a national instrument, and shall be undertaken for proposed activities that are likely to have a significant adverse impact on the environment and are subject to a decision of a competent national authority will be applicable to implementation of this project (Principle 17). This global principle guided the development of a national policy on environmental impact assessment.

The UNCED Conference also initiated global statements on key environmental issues. These included the Framework Convention on Climate Change and the Convention on Biological Diversity which Guyana has ratified. In light of this, Guyana must consider these global agreements during environmental impact assessment for developmental projects.

3.6.3 Convention on Biological Diversity

If implemented, this project may potentially impact the biodiversity of the area to be exploited. The project must consequently be executed to satisfy the objectives of the Convention to conserve biological diversity. Guyana ratified the Convention on August 12, 1992, and it was entered into force on November 12, 1997. The National Focal Point is the Office of the President and the Implementing Agency is the Environmental Protection Agency. The objectives of the Convention include: the conservation of biological diversity (defined as the variability among living organisms from all sources including inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexities of which they are a part including diversity within species, between species and of ecosystems), the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources.

The provisions of the Convention apply to areas within the limits of national jurisdiction of contracting parties and as regards the effects of processes and activities, both within and beyond the limits of national jurisdiction. Contracting parties are required under Article 7 of the Convention, to identify processes and activities which have or are likely to have significant adverse impacts on the conservation and sustainable use of biological diversity and to monitor their effects through sampling and other techniques. Parties are, also as far as is possible and as appropriate, required to establish protected areas or areas where special measures need to be taken to conserve biological diversity. In areas adjacent to these protected areas environmentally sound and sustainable development should also be promoted. Article 8 requires that degraded ecosystems be rehabilitated and restored and the recovery of threatened species be done through the development and implementation of plans or management strategies. Contracting parties are also required to regulate or manage relevant processes or activities where a significant adverse effect on biological diversity has been determined.

Article 10 of the Convention supports the integration of conservation and sustainable use of biological resources in national decision-making, and also supports local populations to develop and implement remedial action in degraded areas where biological diversity has been reduced. The avoidance or minimizing of adverse transboundary effects is also considered important and should be addressed by the introduction of environmental impact assessments of proposed projects that are likely to have significant adverse impacts on biological diversity, the exchange of information and consultation on activities likely to significantly adversely affect the biological diversity of other States and notification to such States of imminent or grave danger to biological diversity within areas under the jurisdiction of States.

In observance of the Convention, Guyana established the Environmental Protection Agency in 1996, to coordinate and implement a program for the conservation of biological diversity. A National Biodiversity Action Plan was also developed with stakeholders.

3.6.4 Protocol Concerning Pollution from Land-Based Sources and Activities (LBS)

The Protocol requires contracting parties to develop and implement programs, plans and measures as effective means of preventing reducing or controlling pollution of the Convention area from land-based sources and activities. Parties are required to address the source categories, activities and pollutants of concern listed in Annex 1 to the Convention. Extractive industries and mining are identified as priority source categories and activities, while heavy metals and compounds, cyanides and fluorides are listed as primary pollutants of concern. Annex II identifies factors to be used to determine effluent and emission limitations and/or management practices.

If the project is implemented, possible landbased sources of pollution at the property will include fuel storage tanks, chemical reagent holding facilities and leaks from mining equipment. In accordance with this protocol, the project will be required to develop and implement programs, plans and measures to prevent, reduce and/or control pollution of the project area from land-based sources and activities.

3.6.5 Basel Convention on the Transboundary Movement of Hazardous Waste and their Disposal

The Basel Convention aims to protect human health and the environment against the adverse effects resulting from the generation, management, transboundary movements and disposal of hazardous and other wastes. Guyana is a party to this convention which came into force in 1992. It was designed specifically to prevent transfer of hazardous waste from developed to less developed countries (LDCs). The Convention is also intended to minimize the amount and toxicity of wastes generated. This ensures that toxic waste is managed as closely as possible to the source of generation. Examples of hazardous waste as defined by the convention are:

- Wastes from the manufacture, formulation and use of wood preserving chemicals
- Waste pharmaceuticals, drugs and medicines
- Wastes from the production, formulation and use of organic solvents
- Waste mineral oils unfit for their originally intended use
- Waste oils/water, hydrocarbons/water mixtures, emulsions
- Wastes from production, formulation and use of inks, dyes, pigments, paints, lacquers and varnish

Consequent to this convention Guyana developed regulations on environmental protection. One of these regulations focuses on the management of hazardous wastes.

3.6.6 Protocol Concerning Specially Protected Areas and Wildlife (SPA)

The SPAW Protocol which is used as a means of regionalizing global conventions such as the CBD, utilizes an ecosystem approach to conservation by protecting rare and fragile ecosystems and the endangered species it houses. Through its Caribbean Regional Coordinating Unit, assistance is given in the establishment of protected areas, as one of the objectives of the SPAW Programme is to significantly increase the number and improve the management of national protected areas and species in the region and assist the Governments of the region, on request, in developing guidelines for the establishment and management of such areas.

The Protocol extends to the Convention Areas as well as water courses extending up to the fresh water limit or watersheds designated by the parties. It urges when necessary, the establishment of protected areas in instances where it is necessary to protect:

- representative types of coastal and marine ecosystems of adequate size to ensure their long-term viability and to maintain biological and genetic diversity;
- habitats and their associated ecosystems critical to the survival and recovery of endangered, threatened or endemic species of flora or fauna;
- the productivity of ecosystems and natural resources that provide economic or social benefits and upon which the welfare of local inhabitants is dependent; and
- areas of special biological, ecological, educational, scientific, historic, cultural, recreational, archaeological, aesthetic, or economic value, including in particular, areas whose ecological and biological processes are essential to the functioning of the Wider Caribbean ecosystems.

In the application of protection measures, each party is urged to progressively take such measures in accordance with its national laws and international law as are appropriate for:

- the regulation or prohibition of the dumping or discharge of wastes and other substances that may endanger protected areas;
- the regulation or prohibition of coastal disposal or discharges causing pollution, emanating from coastal establishments and developments, outfall structures or any other sources within their territories;
- the regulation or prohibition of fishing, hunting, taking or harvesting of endangered or threatened species of fauna and flora and their parts or products;
- the prohibition of activities that result in the destruction of endangered or threatened species of fauna or flora and their parts and products, and the regulation of any other activity likely to harm or disturb such species, their habitats or associated ecosystems;
- the regulation or prohibition of any activity involving a modification of the profile of the soil that could affect watersheds, denudation and other forms of degradation of watersheds, or the exploration or exploitation of the subsoil of the land part of a marine protected area;
- the regulation or prohibition of industrial activities and of other activities which are not compatible with the uses that have been envisaged for the area by national measures and/or environmental impact assessments pursuant to Article 13;
- any other measure aimed at conserving, protecting or restoring natural processes, ecosystems or populations for which the protected areas were established.

If any rare or fragile ecosystems are encountered within the area being considered for development, the ecosystem approach to conservation would have to be utilized to manage that rare or fragile ecosystem.

3.6.7 Treaty on Cooperation for the Development of the Amazon Basin

The area proposed for the development of this project is considered part of the Amazon Basin and this treaty would be applicable to the development. The Treaty on cooperation for the Development of the Amazon Basin was established in 1978 to promote the harmonious development of the Amazon Region and to undertake joint action and efforts to promote the harmonious development of the Amazonian territories in such a way that joint actions produce equitable and mutually beneficial results and also achieves the preservation of the environment, conservation and rational utilization of the natural resources.

Six sub-committees were set up to initiate, implement and address issues as relates to the implementation of the Amazonian Treaty. These include the following: Health, Transportation, Education, Infrastructure, Tourism, Environment, Science and Technology and Indigenous Affairs.

The area proposed for the development of this project is considered part of the Amazon Basin. The aforementioned environmental conditions and agreements place emphasis on the Government of Guyana as a signatory to these treaties to put specific measures in place for compliance. The enactment of the Environmental Protection Act and its regulations have established the institutional and regulatory measures for the implementation of the treaty some of which forms part of the environmental impact assessment requirements.

3.6.8 Convention on International Trade of Endangered Species

This convention was established in 1972 to control international trade of live and dead animals and plants through the issuing of permits/certificates for such trade. Requirements for the establishment of Scientific and Management authorities; regulation of trade in specific species via permits and certificates; records of trade are detailed in the convention. The legal obligation under this convention was established in the Species Protection Regulations of 1999 under the Environmental Protection Act.

3.6.9 UN Framework Convention on Climate Change (UNFCCC)

CO₂ emitted by equipment during both exploration and mining phases is a greenhouse gas. In addition, clearing of forested areas for mine site development and for drill pad construction will reduce the sequestration ability of the forests impacted by that clearing. These quantities of greenhouse gases emitted and the reduction in sequestration must be quantified in the ESIA.

UNFCCC entered into force in 1994 to achieve stabilization of greenhouse gas concentrations at a level that would prevent dangerous anthropogenic interference with the climate system. Further, acceptable levels of greenhouse gas (GHG) should be achieved within a time frame that is sufficient to allow ecosystems to adapt naturally to climate change.

In keeping with the provisions of the Convention, a national climate change committee was established and a national inventory of Greenhouses Gases was prepared for base-year 1994. Aspects related to technology transfer, capacity building requirements, vulnerability assessment and adaptation measures were compiled.

3.7 International Finance Corporation Requirements

In addition to the international treaties, agreements and conventions listed above, projects receiving financing from the IFC must comply with an additional set of performance standards and EHS guidelines. A brief description of these standards and guidelines is now outlined. Where appropriate, references to detailed compliance parameters are provided to technical requirements of the EHS guidelines for the mining industry. A comprehensive description of all relevant IFC standards and EHS guidelines and project specific compliance recommendations is provided in Table 8.

The IFC has developed eight (8) performance standards for environmental and social impact assessment (Performance Standards on Social and Environmental Sustainability 2006). These standards guide the management of social and environmental risks and impacts of projects. In addition to the standards and requirements set by the national policy, legal and administrative framework, the project developer may be expected to consistently meet these IFC standards throughout the life of the project as part of Best management Practices (BMP) for its operation.

The performance standards that may be applicable to project implementation are:

- Performance Standard 1: Social and Environmental Assessment and Management Systems
- Performance Standard 2: Labor and Working Conditions
- Performance Standard 3: Pollution Prevention and Abatement
- Performance Standard 4: Community Health, Safety and Security
- Performance Standard 5: Land Acquisition and Involuntary Resettlement
- Performance Standard 6: Biodiversity Conservation and Sustainable Natural Resource Management
- Performance Standard 7: Indigenous Peoples
- Performance Standard 8: Cultural Heritage

The following section provides a brief description of each applicable standard and notes specific compliance actions necessary to meet each standard.

3.7.1 PS 1: Social and Environmental Assessment and Management Systems

This performance standard focuses on the importance of managing social and environmental performance throughout the life of a project. It entails the thorough assessment of potential social and environmental impacts and risks from the early stages of project development, and provides order and consistency for mitigating and managing these on an ongoing basis.

The IFC mandates that a social and environmental management system appropriate to the nature and scale of the project be established and maintained. The management system shall incorporate the following elements:

- Social and Environmental Assessment - The social and environmental assessment should consider the potential social and environmental (including labor, health and safety) risks and impacts of the project. It should also include a description of the project and an appropriate social and environmental baseline data.
- Management Program - The management program should take into consideration the findings of the social and environmental assessment and consultation with affected communities. The program shall include mitigation and performance improvement measures and actions that address identified social and environmental risks and impacts.
- Organizational Capacity and Training - An organizational structure that defines roles, responsibilities and authority to implement the management program shall be developed. Employees and contractors with responsibility for social and environmental performance shall be trained in the requirements of the Performance Standards, Guyana's regulatory requirements and actions required under the management program.
- Community Engagement - The purpose of community engagement is to build and maintain constructive relationships with local communities that may be affected by risks from this project. This shall be an ongoing process which involves:
 - o The disclosure of information on the risks, impacts and opportunities of the project;
 - o A process of consultation so that affected communities can express their views on project risks, impacts and mitigation measures and have their concerns addressed.
 - o Establishing a grievance mechanism if ongoing risks or adverse impacts are anticipated. The grievance mechanism receives and facilitates resolution of the concerns of the affected communities. The affected communities should be informed of the grievance mechanism during the engagement process.

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- Monitoring and Reporting - The plan shall include procedures to monitor and measure the effectiveness of the management program. Mechanisms such as inspections and audits shall be used to verify compliance toward the desired outcome.
 - Compliance with all IFC EHS General Guidelines and Mining Sector Guidelines

3.7.2 PS 2: Labor and Working Conditions

This performance standard recognizes that the pursuit of economic growth through employment creation and income generation should be balanced with protection for basic rights of workers. Failure to establish and foster a sound worker-management relationship may undermine worker commitment and retention, and can jeopardize a project. The specific actions required by this performance standard include the following elements:

- Working Conditions and Management of Worker Relationship – The project would be mandated to adopt a human resources policy that sets out the company’s approach to managing employees consistent with this Performance Standard. This PS mandates that upon employment, employees shall be provided with information regarding their working conditions and terms of employment and their rights to wages and benefits.
- Protecting the Workforce - No child below the age of 18 years will be employed in a manner that is economically exploitative and/or interferes with his/her education, health, physical, mental, moral or social development. Forced labor, which is any work or service not voluntarily performed, will not be employed.
- Occupational Health and Safety – A safe and healthy work environment shall be provided for workers. This considers physical, chemical, biological and radiological hazards in the various work areas.
- Compliance with IFC EHS General Guidelines and Mining Sector Guidelines.

3.7.3 PS 3: Pollution Prevention and Abatement

This performance standard recognizes that increased industrial activity generates increased levels of pollution to air, water and land that may threaten people and the environment. Thus, the objectives of the pollution prevention and abatement performance standard are to avoid or minimize adverse impacts on human health and the environment by avoiding or minimizing pollution from project activities and to promote the reduction of emissions that contribute to climate change. The specific actions required by this performance standard include the following elements:

- General Requirements on Pollution Prevention and Abatement - During the life-cycle of the project, pollution prevention and control technologies to avoid or minimize adverse impacts to human health and the environment shall be considered within the realm of technical and financial feasibility.¹

⁽¹⁾ Technical feasibility is based on whether the proposed measures and actions can be implemented with commercially available skills, equipment and materials, taking into consideration local factors such as climate, geography, demography, infrastructure, security, capacity and operational reliability. Financial feasibility is based on commercial considerations including the magnitude of the incremental cost of adopting such measures and actions compared to the project’s investment, operating and maintenance cost and whether this incremental cost could make the project non viable.

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- Ambient Considerations - To address adverse project impacts on existing ambient conditions (i.e., air, soil, surface and groundwater), specific consideration will be given to existing and future land use, existing ambient conditions, and project proximity to ecologically sensitive areas.
 - Promotion of strategies that avoid, minimize or reduce the release of pollutants.
 - Greenhouse Gas Emissions - The reduction of project-related Green House Gas (GHG) emissions shall be promoted. Cost-effective options to reduce or offset project-related GHG emissions include carbon financing, use of renewable energy sources, emissions offsets, etc. Quantification and monitoring of GHG emissions shall be conducted annually in accordance with internationally recognized methodologies.
 - Compliance with IFC EHS General Guidelines and Mining Sector Guidelines.

3.7.4 PS 4: Community Health, Safety and Security

This performance standard mandates responsibility to avoid or minimize the risks and impacts from project activities to community health, safety and security. The objectives of PS 4 are to avoid or minimize risks to and impacts on the health and safety of the local community during the project life cycle from both routine and non routine circumstances and to ensure that the safeguarding of personnel and property is carried out in a legitimate manner that avoids or minimizes risks to the community's safety and security. The specific actions required by this performance standard include the following elements:

- Community Health and Safety Requirements - During the life of the project, the risks and impacts to health and safety of affected community shall be evaluated and measures shall be developed to prevent or avoid risks and minimize impacts. Workers, their families and the community shall be protected from hazardous materials that may be released by the project. Adverse impacts from project activities on soil, water and other natural resources used by affected communities shall be minimized. Hazards that stem from the risks and impacts from project activities shall be communicated to affected communities. Risks of security arrangements within and outside the project site will be assessed.
- Compliance with IFC EHS General Guidelines and Mining Sector Guidelines

3.7.5 PS 6: Biodiversity Conservation and Sustainable Natural Resource Management

This performance standard addresses how to avoid or mitigate threats to biodiversity² and manage renewable natural resources. The objectives of PS 6 are to protect and conserve biodiversity and to promote the sustainable management and use of natural resources through the adoption of practices that integrate conservation needs and development priorities.

The requirements of this PS are applied to all habitats whether or not they are legally protected or have been previously disturbed. The specific actions required by this performance standard include the following elements:

- Protection and Conservation of Biodiversity -To avoid or minimize adverse impacts to biodiversity in the project area of influence, the following shall be done:

⁽²⁾ Biodiversity refers to the variety of life in all its forms, including genetic, species and ecosystem diversity. The components of biodiversity include ecosystems and habitats, species and communities, and genes and genomes all of which have social, economic, cultural and scientific importance.

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- o Assess the significance of impacts on all levels of biodiversity. This should include the different values attached to biodiversity by stakeholders and the impacts on ecosystem services.
 - o Assess the major threats to biodiversity including habitat destruction and invasive alien species.
 - Natural habitats shall not be significantly converted or degraded unless conversions are appropriately mitigated.
 - The project shall not be implemented in a critical habitat unless impacts are mitigated and there is no reduction in the population of any recognized critically endangered or endangered species as defined by IUCN or national legislation.
 - Compliance with IFC EHS General Guidelines and Mining Sector Guidelines.

3.7.6 PS 7: Indigenous Peoples

This performance standard recognizes that indigenous peoples may play a role in sustainable development by promoting and managing activities as partners in development. The objectives of PS 7 are:

- To ensure that the development process fosters full respect for the dignity, human rights, aspirations, cultures and natural resource-based livelihoods of indigenous peoples;
- To avoid adverse impacts of the project on communities of indigenous peoples, or when avoidance is not feasible, to minimize, mitigate or compensate for such impacts, and to provide opportunities for development benefits in a culturally appropriate way;
- To establish and maintain an ongoing relationship with the affected indigenous peoples throughout the life of the project; and,
- To respect and preserve the culture, knowledge and practices of indigenous peoples.

The specific actions required by this performance standard include the following elements:

- Avoidance of Adverse Impacts and Information Disclosure, Consultation and Informed Participation - All indigenous communities within the project's area of influence that may be affected by the project shall be identified. The nature and degree of expected social, cultural and environmental impacts shall also be identified. Where avoidance is not feasible, the project shall minimize, mitigate or compensate for these impacts. Their actions will be developed with full participation of affected Indigenous Peoples.
- Development Benefits- Opportunities for culturally appropriate development benefits for affected communities shall be identified through consultation. This shall be documented and provided in a timely manner.

3.7.7 PS 8: Cultural Heritage

This performance standard seeks to reduce project impacts to material cultural heritage and promote its preservation. Cultural heritage includes historic monuments and buildings, archaeological sites, shrines and other sites of religious significance.

3.8 Legislative Requirements for the Mining Sector

The national and international policy, legal and regulatory framework suggests and describes the project-specific actions the project developer will have to undertake to comply with all applicable regulations,

codes, and guidelines. As described above, Guyanese legislation mandates two general compliance mechanisms to ensure that all projects meet Guyanese national regulations, codes and guidelines. These mechanisms involve:

- Prospecting and Mining Licenses; and,
- Environmental and Social Impact Assessments.

These two mechanisms ensure, through application, review, approval, and monitoring, that all phases of prospecting, design, construction, operations, and closure of mining projects meet all relevant national regulations, codes and guidelines. Furthermore, by incorporating the applicable IFC Performance Standards and EHS Guidelines into these compliance mechanisms, the project developer will ensure that all activities also comply with the applicable international standards and IFC financing requirements. Although these activities form part of the same environmental permitting and authorization process prescribed and administered under Guyanese National Legislation, they are described here separately to provide an overview of the project-specific requirements of each compliance mechanism.

3.8.1 Prospecting and Mining Licensing Process

The first mechanism for ensuring compliance with the legislative framework for the mining industry in Guyana is the prospecting and mining licensing process. In Guyana, all mineral rights are owned by the State and administered by the GGMC in accordance with the Mining Act. The Act prescribes two levels of permitting for the mining industry: prospecting and mining. Prospecting licenses are required in order to begin prospecting activities. Conditions of the prospecting license include allowing for the application of a mining license at any time during its tenure. Mining licenses are required prior to the initiation of any mining operations.

The Mining Act divides prospecting and mining licenses into three groups based on the size of the concession. Small-scale claims of up to 1500ft x 800ft are granted to Guyanese citizens and may be located on any state land with no previous concessions. Medium-scale licenses and permits are granted for areas between 150 and 1,200 acres which can be grouped together with additional licenses or claims to form larger continuous blocks. Medium-scale licenses and claims are only granted to entities registered in Guyana, but can be transferred under private contract to other entities. Large-scale claims for areas between 500 and 12,800 acres may be granted to any entity, including companies of any nationality.

The application process for prospecting and mining licenses is administered by the GGMC, as described in the Mining Act. The project developer must apply for and acquire the appropriate prospecting or mining license in order to comply with the national legislative framework describe above. This process ensures that all prospecting and monitoring operations are fully authorized by the Guyana EPA and GGMC.

3.8.2 Requirements for Environmental Management for Large Scale Mining

There are specific requirements for environmental management of large scale mining operations. Every person who proposes to use cyanide at the final stages of processing, and which entails disposal of effluent is required before commencing any action related thereto, to apply either personally or in writing to the Commission for a cyanide permit and shall submit with such application, the prescribed fee and a description in summary of the activities in respect of which cyanide is to be used including information on:

- the site, design or process and amount of Cyanide to be used; site characteristics and layout; distance to water bodies; ground water regime and mode of tailings disposal;
- possible effects on the environment;
- a simplified description of the activity; and

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- activities for minimizing the use of cyanide in the long-term.

Where the Commission is satisfied with regard to an application for a cyanide permit for the use of cyanide that the proposed use does not significantly affect the environment and that the requirements of these Regulations have been complied with, together with the requirements of the Environmental Protection Act 1996 and the recommendations of the EPA it shall grant the permit applied for on such terms and conditions and in such form as the Commission may from time to time determine.

The Commission may refuse to grant a cyanide permit under this regulation where it has reason to believe that the application is based on false or misleading information; or after consultation with the EPA, it is satisfied that the preservation and character of the environment, including flora and fauna will be adversely affected. If the Commission, after consultation with the EPA is satisfied that there has been material changes in the circumstances that existed at the time the cyanide permit was granted, the Commission shall convey this in writing to the permit holder and advise that a new permit must be applied for and the current permit will remain valid only up to a stipulated date.

A person to whom a cyanide permit has been granted in accordance with this regulation can apply to the Commission to vary or modify the cyanide permit stating clearly the reasons and the Commission may issue a written warning to the cyanide permit holder and manager of the operation for any breach of provisions of these Regulations or any term and condition subject to which the permit is granted. The Commission may however, suspend a cyanide permit for a breach of any provision of these Regulations or for any term or condition subject to which the permit is granted.

The Commission is required, on suspending a cyanide permit to notify the holder in writing stating the breach that gave rise to the suspension, requiring the holder of the cyanide permit to remedy the breach, stating the time within which the breach is to be remedied and stating whether the cyanide permit is to be returned within a specific time to the Commission.

Where the Commission cancels a cyanide permit, the Commission is required as soon as practicable thereafter to notify in writing the person to whom the permit or certificate was granted of the cancellation and the notice shall state the reason for the cancellation, and such cancellation shall take effect on receipt of the notice by the addressee and any person who is aggrieved by a decision of the Commission shall within twenty-eight days of the decision, appeal in writing against such decision to the Minister. The Minister after examining all relevant information on the matter appealed shall issue an appropriate order. A cyanide permit is mandated not to be transferable except with the permission of the Commissioner and where the Commissioner authorizes the transfer of such a permit, he may vary the conditions already imposed on the cyanide permit or he may impose such other conditions as he may consider appropriate. The Commission, EPA, the mining associations and educational training institutions shall in accordance with the curricula approved by the Commission jointly or singularly provide training and certification courses for miners on the proper use of mercury and cyanide and environmental hazards associated with such use in mining activities. The Commission is also mandated by the regulations to prepare a Code of Practice that will provide further guidance on practices involving mercury use, cyanide use and disposal of effluent which shall form part of these Regulations.

Every holder of a Mining licence, Prospecting Permit or Mining Permit is also mandated to lodge an Environmental Bond in favor of the Commission, for an amount to be determined by the commissioner. The Environmental Bond or part thereof, shall be used by the Commission to restore the environment where restoration of the said area was not done to the satisfaction of the Commissioner provided that the Commission shall retain no third party to carry out such restoration before the miner has been given three months from the date restoration becomes due to restore the area.

The regulations also mandate preparation of a closure plan before any new prospecting or mining licence is issued by the Commission and the closure plan must be approved by the Commission and before a new prospecting or mining licence, is issued by the Commission to an operator, the mining guidelines should be seen to have been adhered to in the previous mining operation the applicant may have had.

The reclamation and closure plan is required to include measures for the backfilling of placer mine pits, where applicable, the sealing or capping of shafts at closed mines in accordance with the Code of Practice or the directions of an appropriate authority at the Commission, as appropriate, the stripping and stockpiling of topsoil for use in reclamation, the replacement of topsoil and vegetation of disturbed lands and the restoration of water courses, where appropriate. Holders of Prospecting and Mining Licences are required to prepare a contingency and response plan in accordance with the Code of Practice. The contingency and emergency response plan must set out provisions for hazards in mining operations including practical mechanisms for responding to cyanide and fuel spills and spills of other poisonous or hazardous substances and breaches of tailings ponds. Any person who contravenes this regulation commits an offence and holders of prospecting and mining licences and medium scale permits are required to ensure that all relevant information of the contingency and emergency response plan are communicated to employees and independent contractors, and shall include information on first person response, notification procedures, location of clean-up equipment, an analysis of potential accidents and responses and materials safety data sheets for all materials which could be spilled.

3.8.2.1 General Requirements

The general requirements of the regulations stipulate that the Commissioner shall determine the number of dredges or mining operations which shall be permitted to dredge or mine in any area which may already be or likely to be affected by tailings discharge and to also direct the method of mining permissible in the areas affected or likely to be affected by tailings discharge if necessary. The basis for the commissioner determination is the percentage of clay content found in the overburden or deposit or the total load of clay which may be released in the tailings and shall be made from results of sampling and tests done by officers of the Commission. The regulations also permit the The Nephelometric Turbidity Units (NTU) value at the affected area to be stipulated by the Commissioner from time to time and operators of land operations are mandated to discharge tailings into a tailings pond or into a river, creek or stream where the critical turbidity has not exceeded 30 NTU. In addition, operators of river operations are required to discharge tailings into a tailings pond on land or to a river, creek or stream where the critical turbidity has not exceeded 30 NTU or in any other manner as approved by the Commissioner.

Operators are also required to ensure that discharges from tailings ponds or dredges into any river or creek shall not exceed either 100 mg/l of total suspended solids (TSS) or 50 Nephelometric Turbidity Units (NTU). The Commissioner is authorized to stipulate the limits for chemical contamination from time to time. Discharges from tailings ponds and river dredges are required to be released underwater through a conduit at a minimum depth specified by the Commissioner. Where any operation exceeds either of the stipulated limits, the operator shall be cited for such breach and be given twenty-four hours within which to rectify same and operators are required to keep a daily record of the readings of the total suspended solids or Nephelometric Turbidity Units (NTU) readings in the grab sample of the discharge and such readings of the daily record shall be approximately twenty four hours after the previous reading.

Where settling ponds are used as parts of the mine drainage system, channels discharging into the river are required to be culverted, and where necessary the slopes must be protected from erosion. Approved devices, chemical procedures or ponds are required to be used to remove settleable solids from tailings discharges from on-land mines and every settling pond is required to have a minimum water residence time equivalent to the aggregate volume of slurry processed or water used in each sluice box or mine

processing device in any continuous two hour period with discharge being in accordance with the effluent limits. Operators are also restricted from disposing of petroleum products or any matter containing tars, oil, grease or any poisonous substances directly on the surface of the land or in a river or creek.

The regulations require that all hazardous waste earmarked for disposal whether recovered from prior workings or from the current operations shall be sealed in barrels which are made of or lined with plastic, marked and sealed and conveyed to an area set aside or facility set up for the disposal of hazardous waste. The accumulated waste shall be brought to the Commissioner's attention for treatment as appropriate and where facilities for disposal are not available, a miner shall burn all waste products including batteries using fuel such as kerosene or similar substances of high flash point in an area set aside for such purposes or, where appropriate shall use the said waste products.

Prior to the commencement of mining in any area a miner is required, if the miner considers that the area has been environmentally damaged, to request in writing an inspection of such areas by the Commissioner or an officer appointed in writing by the Commissioner.

The regulations require that information in relation to the disposal of effluent shall be provided by the applicant to the Commission on the following, the site of the disposal, the amount of the disposal and the possible effects on the environment provided that in the case of small scale miners there shall be the option of applying for a cyanide permit as a syndicate or individually. In, such cases the requirements shall be provided by the small scale miner by completion of a questionnaire provided by the Commission.

Among the requirements of the general requirements is that tailings dam or water retaining dams higher than 16 feet or six metres shall be inspected annually by a qualified civil, mining or geotechnical engineer registered with the Commission and approved by a recognized engineering body. The reports of such inspection are required to be kept on file and be available for review by inspectors of the Commission and every tailings pond shall be equipped with emergency spillways that pass the flows from the probable maximum flood so as to prevent overtopping of dams under extreme rainfall or runoff rainfall.

The regulations stipulate that no compensation shall be paid to a holder of a permit where the decision to cancel the permit was necessary for the purposes of protecting and conserving the environment, any animal or plant or by reason of an unforeseeable change in circumstances on the basis of which the permit was granted.

3.8.2.2 Protected Areas

The regulations mandate that no person shall conduct mining and quarrying activities in the areas within 20 metres of the low water mark of a river bank except for access of dredges from the river or in specified nature reserves and parks where resource extraction is prohibited or in buffer areas without the express approval of the Commission and the notification of parties likely to be affected by the activity. In addition, no dry mining or excavation shall be conducted in any watershed without prior permission from the Commissioner.

3.8.2.3 Pollution Control

Environmental effects monitoring shall be conducted for every mine including new mines. Each environmental effects monitoring program shall be required to be submitted to the Commission for approval as part of the Environmental Management Plan.

3.8.2.4 Mining Guidelines for Water Quality

In addition to the mandates for effluent discharge to the environment, the EPA has established guidelines for water quality associated with mining. These guidelines mandate that both surface and groundwater associated with mining operations be analyzed for pH, TDS, TSS, turbidity, conductivity, organic compounds (phenol and oil and grease), major anions (Ca, Mg, Na, K), nutrients (TKN, total ammonia, phosphate, nitrate + nitrite), trace metals (Al, As, Cd, Co, Cr, Cu, Fe, Hg, Mn, Mo, Ni, Pb, Se, Sb, Zn). The EPA further dictates that concentration levels of these substances shall not exceed levels of environmental concern (normally set as levels to protect aquatic species). The EPA also reserves the right to request analyses to determine bacteriological levels (coliforms, fecal coliforms and standard plate counts), rare earth elements, radioactive elements and other trace metals.

3.8.2.4.1 World Bank Water Quality Standards

Tolerable limits have not been established by the EPA for water quality for construction or mining operations. However, for this project, the 2007 IFC EHS guidelines for the mining and milling industries are considered applicable. These guidelines for liquid effluents, residual heavy metals and cyanide are detailed below.

The following guidelines for liquid effluent discharged to receiving waters from tailings impoundment, mine drainage, sedimentation basins, sewage systems and storm water drainage are applicable to this project.

pH	6 to 9
BOD5	50 mg/l
Oil and Grease	10 mg/l
Total Suspended Solids	50 mg/l
Temperature-at the edge of a designated mixing zone of receiving waters, Max 3°C if receiving waters >28°C	Max 5°C above ambient temperature of

The target guidelines for residual heavy metals expected to pose no risk for significant adverse impact to aquatic biota or human use are applicable to this project.

Arsenic	0.1 mg/l
Cadmium	0.05 mg/l
Chromium, Hexavalent	0.10 mg/l
Copper	0.3 mg/l
Iron, Total	2 mg/l
Lead	0.2 mg/l
Mercury	0.002 mg/l
Nickel	0.5 mg/l
Zinc	1.0 mg/l

If natural concentrations exceed these levels, the discharge may contain concentrations up to natural background levels. Concentrations up to 110% of natural background are acceptable if no significant adverse impact can be demonstrated.

The tolerable limits for discharge of cyanide to the environment are:

Free Cyanide	0.1 mg/l
Total Cyanide	1.0 mg/l
Weak Acid Dissociable	0.5 mg/l

In no case should the concentration in the receiving water outside of a designated mixing zone exceed 0.022 mg/l.

Effluent discharged from the property during all operational phases must adhere to the most stringent of the water quality standards detailed above.

3.8.3 Environmental Impact Assessment Guidelines

The Environmental Protection Agency (EPA) in collaboration with the Environmental Assessment Board (EAB) has produced guidelines for conducting Environmental Impact Assessments (EIA) for Mining Projects in Guyana. The guidelines are intended to complement those in Section IV of the Environmental Protection Act, 1996 (EP Act).

If this project is implemented, the ESIA must be conducted in accordance with guidelines established by the EPA for the mining sector. In accordance with the guidelines, EIA for the mining sector shall consist of three components; Environmental Baseline Study, Environmental Assessment and Environmental Impact Statement. The Environmental Baseline Study records the quality of the environment within the area of influence before the project is implemented. The data is analyzed in the environmental assessment and is used to predict and quantify impacts. The Environmental Assessment (EA) is the identification and assessment of impacts of the proposed project and of its alternatives. The EA considers mitigation measures to offset negative impacts and assesses the impact of implementing these measures on the environment. The Environmental Impact Statement is a summary of the findings of the Environmental Baseline Study and the Environmental Assessment and includes an Environmental Management Plan.

3.9 Regulatory Review

In conclusion, the following section provides additional details on specific components of the national and international policy, legal and administrative framework. Table 7 provides a comprehensive review of all national legislation, codes, guidelines, and draft legislation applicable to the mining industry of Guyana. This table is provided to supplement the overview of national legislation provided above. The table also includes project-specific compliance recommendations.

Table 8 provides a comprehensive description of the applicable IFC performance standards and references to EHS guidelines. This table is provided to supplement the overview of the IFC standards and guidelines provided above in relation to specific actions and compliance parameters.

Table 7: National Legislative Framework and Checklist for Compliance

Legislation / Policy		Responsible Authority	Specific Provisions / Citations	Checklist for Compliance
Relevant National Legislation				
1	<i>Environmental Protection Act, 1994 (amended in 2000)</i>	Central Government/ relevant State Government	The Act establishes the Environmental Protection Agency and provides the administrative and legislative basis for: • Requirement of environmental impact assessments, approval or rejection of projects, environmental permitting, regulations and authorizations; • Prevention and control of pollution, including permitting, enforcement and prohibitions; • Establishment and jurisdiction of environmental appeals tribunal; • Procedures for investigations, prosecutions and civil proceedings; • Environmental trust fund finances; and, • Other administrative activities of the EPA.	Submit comprehensive environmental impact assessment to the EPA. Secure authorization prior to undertaking project development. Prepare and follow pollution prevention plan to ensure compliance with EPA pollution regulations. Provide appropriate financial assurance, if necessary.
2	<i>Environmental Protection (Air Quality) Regulations 2000</i>	Environmental Protection Agency	Outlines administrative and technical regulations related to air quality, including control of air emissions, national ambient air quality standards, permitting, and penalties. The regulations include the following list of contaminants for which specific emissions parameters will be set: • Smoke • Solid particles • Sulfuric acid mist or sulfuric trioxide • Fluoride compounds • Hydrogen chloride • Chlorine • Hydrogen sulfide • Nitric acid or oxides of nitrogen • Carbon monoxide	Submit application for authorization from EPA. Prepare and follow pollution prevention plan to ensure compliance with EPA air quality regulations.

	Legislation / Policy	Responsible Authority	Specific Provisions / Citations	Checklist for Compliance
3	<i>Environmental Protection (Hazardous Wastes Management) Regulations 2000</i>	Environmental Protection Agency	These regulations outline the rules, procedures and authorization process which apply to all operations that generate, transport, treat, store and dispose of hazardous wastes. The regulations include the following hazardous materials/wastes: • Explosives • Flammable liquids • Flammable solids or waste solids other than explosives which may be readily combustible • Oxidizing substances • Organic peroxides • Poisonous substances • Infectious substances • Corrosives • Toxic gases • Toxic substances which if inhaled or ingested may cause delayed or chronic effects • Ecotoxic substances which if released may present immediate or delayed adverse impacts to the environment by means of bioaccumulation and/or toxic effects upon systems • Materials capable, after disposal, of yielding another material which possesses any of the characteristics specified above	Submit application for authorization from EPA. Prepare and follow emergency preparedness plan. Submit Waste Analysis Plan, if necessary.
4	<i>Environmental Protection (Water Quality) Regulations 2000</i>	Environmental Protection Agency	These regulations require registration and environmental authorization of any project which may cause the discharge of effluents. These regulations cover parameter limits of effluent discharges, new sources of effluent discharges, fees for registration and environmental authorization, sampling points, records and reports and general provisions for the registration of water effluent, biological integrity, spills or accidental discharges and standard methods of analysis. The EPA was mandated to establish specific parameter limits for the concentration of the following effluents: Ammonical Nitrogen, Sulfate, Chloride, Cobalt, Color, Detergents, Anionic, Fluoride (as F), Molybdenum, Phosphate 9 as P, Polychlorinated Biphenyls, Selenium, Silver, Beryllium, Vanadium, Radioactive Material, Nitrate Nitrogen, Temperature, Pesticides, Fungicides, Herbicides, Insecticides, Rodenticides, Fumigants or any other Biocides, any other chlorinated hydrocarbons, and any substance that either by itself or in combination with other waste or refuse may give rise to any gas, fume, odor or substance which causes or is likely to cause pollution.	Submit application for authorization from EPA. Prepare and follow emergency preparedness plan.

Legislation / Policy		Responsible Authority	Specific Provisions / Citations	Checklist for Compliance
5	<i>Environmental Protection (Authorizations) Regulations 2000</i>	Environmental Protection Agency	These regulations further define the authorization process for all projects potentially having environmental impacts. The regulations define all administrative, design, licensing, monitoring, evaluation and documentation requirements.	Submit necessary applications for authorization from EPA.
6	<i>Environmental Protection (Noise Management) Regulations 2000</i>	Environmental Protection Agency	These regulations apply to operations that emit noise during construction, operations, transport, or other phases and require that all such activities be approved by the EPA. The EPA has published a draft standard on Noise Emissions which defines permissible noise levels for the following sectors: Residential, Institutional, Educational, Industrial, Commercial, Construction, Transportation and Recreational.	Submit application for authorization from EPA. Adhere to EPA's permissible noise parameters in all operations.
7	<i>Forest Act 2008</i>	Guyana Forestry Commission	The Act consolidates and amends the law on forests, and governs all activities that are carried out in state forests including mining and associated activities. Under this Act, no person shall engage in the following unless a mineral prospecting or mining license has been granted under the Mining Act 1989: • Enter and occupy state forest; • Cut, damage or take any forest produce or carry on any kind of forest operation; and, • Carry out any kind of exploratory operation in a state forest.	Apply for and obtain prospecting and mining license.
8	<i>Amerindian Act No 6 of 2006</i>	Ministry of Amerindian Affairs	The Act allows for mining on Amerindian Lands provided the following: • The offer of employment to residents of the Village at market rates once residents with the required skills are available. • The purchase of food and materials from the Village once available and at competitive prices • Compliance by the miner and employees with rules made by the Village council • The obligation of miners to take all necessary steps to avoid - o damage to the environment - o pollution of ground water and surface water - o interference with agriculture - o damage or disruption of flora and fauna - o disruption of residents normal activities	Written agreement with the Village Council based on consent of individuals present at a village council meeting.
9	<i>Wild Birds Protection Act Chapter 71:01</i>	Environmental Protection Agency	The Act pertains to hunting regulations for certain species of wild birds, including protection status, hunting season, sale of birds, etc.	There are no provisions for the protection of wild birds relative to mining operations.
10	<i>Pesticides and Toxic Chemicals Control Act No. 13</i>		The Act regulates the manufacture, importation, transportation, storage, sale, use and disposal of pesticides and toxic chemicals, and requires that regulations be developed to:	Register all toxic chemicals. Apply for and obtain license for import, manufacture or sale of toxic chemicals.

Legislation / Policy		Responsible Authority	Specific Provisions / Citations	Checklist for Compliance
			- Ensure the health and safety of works as well as mitigate risks associated with controlled products; and, - Impose duties or other fees related toxic chemicals. The Act resulted in the establishment of the Pesticides and Toxic Chemicals Control Board, whose functions include: - The registration of Pesticides and Toxic Chemicals; - The issuance of licenses to persons to import or manufacture registered pesticides and toxic chemicals; and, - All aspects of the importation, manufacture, storage, transportation, sale, preparation for sale, use and disposal of pesticides and toxic chemicals.	
11	<i>Public Health Act Cap 145</i>	Ministry of Health	The Act includes a clause which enables the Minister of Health to make regulations pertaining to sanitation, health and welfare of inhabitants of mining districts. Revisions to the Public Health Act including draft regulations for mining have been made but not yet promulgated.	Prepare and implement appropriate OSH management plan.
12	<i>Code of Practice for Timber Harvesting 2002</i>	Guyana Forestry Commission (GFC)	This code provides guidelines and standards on sustainable forestry, forest harvesting practices, health and safety of forestry workers and other forestry related activities.	Comply with code of practice for timber harvesting in any removal or clearing of forested areas during mining operations.
13	<i>Town and Country Planning Act 20:01</i>	Central Housing and Planning Authority	The Act establishes provisions for the orderly and progressive development of land, cities, towns and other areas for their preservation and improvement and for other related matters. This act would regulate any new settlement associated with operations.	Where possible, coordinate with regional development plans, especially in the construction and use of roads and other infrastructure.
National Mining Sector Legislation				
1	<i>The Mining Act</i>	Guyana Geology and Mines Commission (GGMC)	The Mining Act establishes the legal framework for the utilization of mineral resources in Guyana. Specifically, the Act makes provisions regarding: - Rights to and guardianship of minerals; - Large, medium and small scale prospecting and mining - Prospecting licenses - Mining licenses - Royalties, penalties and other financial information - Mine safety, health and labor standards - Special provisions relating to Amerindians - And other requirements, provisions and information In addition, the Act makes provisions for the disposal of sanitary waste and the storage of poisonous substance in mining areas. The GGMC is also currently developing an additional document on occupational health and safety in mines.	Apply for and secure prospecting license prior to conducting any prospecting activities. Apply for and secure mining license prior to implementing all mining operations. Comply with all financial regulations and settle all accounts over royalties, taxes, fees or other transactions. Develop and implement environmental, health and safety management plans. Respect Amerindian clause (see below).

	Legislation / Policy	Responsible Authority	Specific Provisions / Citations	Checklist for Compliance
2	<i>Amerindian Clause (Mining Act, Part VII)</i>	GGMC	Sec. 111 of the Mining Act states that “for the purposes of this Act, all land occupied or used by Amerindian communities and all land necessary for the quiet enjoyment by the Amerindians of any Amerindian settlements, shall be deemed to be lawfully occupied by them.”	Ensure that Amerindian communities in the vicinity of the project are in no way negatively impacted by the project.
3	<i>The Mining (Amendment) Regulations 2005</i>	GGMC	This amendment to the Mining Act establishes increased regulatory control of poisonous substances such as cyanide and mercury in areas of key environmental concern, including: • Terms and agreement for mercury and cyanide use; • Management of tailings and mining waste; • Water quality; • Use and disposal of poisonous substances; • Closure and reclamation; • Management of the natural environment for restoration and mining; • Submission of environmental management plan in accordance with an environmental code of practice established by the GGMC; and, • Contingency and response plans.	Submit and implement environmental management plan in accordance with code of practice. Prepare and implement contingency and response plans. Plan in advance for closure and reclamation.
4	<i>Gold Board Act 1981</i>	Guyana Gold Board	The Act established the Guyana Gold Board (GGB) and required that all gold produced in Guyana be purchased by and sold through the GGB to ensure the capture of mining royalties owed to the Guyanese Government.	Declare and sell all gold to the GGB.
5	<i>Mining Guidelines for Water Quality</i>	Environmental Protection Agency	The EPA has established guidelines requiring that water quality associated with both surface and groundwater associated with mining operations be analysed for pH, TDS, TSS, turbidity, conductivity, organic compounds (phenol and oil and grease), major anions (Ca, Mg, Na, K), nutrients (TKN, total ammonia, phosphate, nitrate + nitrite), and trace metals (Al, As, Cd, Co, Cr, Cu, Fe, Hg, Mn, Mo, Ni, Pb, Se, Sb, Zn). The EPA further dictates that concentration levels of these substances shall not exceed levels of environmental concern (normally set as levels to protect aquatic species) and reserves the right to request analyses to determine bacteriological levels (i.e., coliforms, fecal coliforms and standard plate counts), rare earth elements, radioactive elements and other trace metals.	Submit application for authorization from EPA. Prepare and follow emergency preparedness plan.
6	<i>Draft Mining Occupational Safety and Health Regulation 2002</i> <i>and</i> <i>Occupational</i>	Ministry of Labour, Human Services and Social Security	The Occupational Health and Safety Act 1997 contains provisions applicable to the regulation of health and safety in mines, which may be expanded by the OSH draft regulations of 2002 specifying duties of employers and self-employed persons, owners of mines, manufacturers and workers, including: • Reporting of hazardous situations • Administration of monitoring and evaluation • Labor restrictions, minimum age, and duration of work shifts	Prepare and implement OSH management plan. Prepare and implement emergency preparedness plan. Carry out all necessary employee training requirements. Provide protective equipment and ensure proper handling of explosive or hazardous

Legislation / Policy	Responsible Authority	Specific Provisions / Citations	Checklist for Compliance
Health and Safety Act 1997		- Health and Safety procedures for mine operation - Employee training requirements - Provision of protective equipment - Emergency preparedness and fire prevention - Handling of explosive materials <u>Note:</u> the extensive draft regulation has not yet been given legal effect by the Ministry of Labour, Human Services and Social Security.	materials, as defined in the OSH management plan.

Table 8: IFC Performance Standards, Provisions, and Related National Legislation

IFC Performance Standard	Objectives	Specific Provisions	Applicable National Legislation
1	The objectives of the social and environmental assessment and management systems are: - To identify and assess social and environment impacts, both adverse and beneficial, in the project's area of influence; - To avoid, or where avoidance is not possible, minimize, mitigate, or compensate for adverse impacts on workers, affected communities, and the environment; - To ensure that affected communities are appropriately engaged on issues that could potentially affect them; and, - To promote improved social and environment performance of companies through the effective use of management systems.	- Social and Environmental Impact Assessment - Management Program - Organizational Capacity and Training - Community Engagement - Monitoring and Reporting - Use IFC EHS General Guidelines and Mining Sector guidelines in project development and Social and Environmental Impact Assessment	- Environmental Protection Act 1994 (amended in 2000) - Environmental Protection (Air Quality) Regulations 2000 - Environmental Protection (Hazardous Waste) Regulations 2000 - Environmental Protection (Water Quality) Regulations 2000 - Environmental Protection (Authorizations) Regulations 2000 - Environmental Protection (Noise Management) Regulations 2000 - Pesticides and Toxic Chemicals Control Act No. 13 - Public Health Act Cap 145 - Code of Practice for Timber Harvesting 2002 - Wildlife Management and Conservation Regulations (Draft) - Town and Country Planning Act 20:01 - The Mining Act - The Mining (Amendment) Regulations 2005 - Mining Guidelines for Water Quality
2	The objectives of the labor and working conditions performance standard are: - To establish, maintain and improve the worker-management relationship; - To promote the fair treatment, non-	- Human Resources Policy and Training - Grievance Mechanism - Protection of Workforce - Occupational Health and Safety Plan, including identification of hazards,	- Environmental Protection Act 1994 (amended in 2000) - Pesticides and Toxic Chemicals Control Act No. 13 - Public Health Act Cap 145 - The Mining Act - The Mining (Amendment) Regulations 2005

IFC Performance Standard	Objectives	Specific Provisions	Applicable National Legislation
	discrimination and equal opportunity of workers, and compliance with national labor and employment laws; - To protect the workforce by addressing child labor and forced labour; and, - To promote safe and healthy working conditions, and to protect and promote the health of workers.	provision of protective and preventive measures, training, documentation and reporting of occupational accidents, diseases and incidents, and emergency prevention, preparedness and response arrangement Use IFC EHS General Guideline on Occupational Health and Safety	- Mining Guidelines for Water Quality - Occupational Health and Safety Act 1997 - Draft Mining Occupational Safety and Health Regulation 2002
3	The objectives of the pollution prevention and abatement performance standard are: - To avoid or minimize adverse impacts on human health and the environment by avoiding or minimizing pollution from project activities; and, - To promote the reduction of emissions that contribute to climate change.	- Use IFC EHS General Guidelines and Mining Sector guidelines to evaluate and select pollution prevention and control techniques - An emergency preparedness and response plan that addresses training, responsibilities, communication, and procedures - Consideration of existing and future land use, ambient conditions and proximity to ecologically sensitive areas - Promote reduction in GHG emissions and quantify and monitor GHG emissions annually	- Environmental Protection Act 1994 (amended in 2000) - Environmental Protection (Air Quality) Regulations 2000 - Environmental Protection (Hazardous Waste) Regulations 2000 - Environmental Protection (Water Quality) Regulations 2000 - Environmental Protection (Authorizations) Regulations 2000 - Environmental Protection (Noise Management) Regulations 2000 - Pesticides and Toxic Chemicals Control Act No. 13 - Public Health Act Cap 145 - The Mining Act - The Mining (Amendment) Regulations 2005 - Mining Guidelines for Water Quality
4	The objectives of the community health, safety and security performance standard are: - To avoid or minimize risks to and impacts on the health and safety of the local community during the project life cycle from both routine and non routine circumstances; and, - To ensure that the safeguarding of personnel and property is carried out in a legitimate manner that avoids or minimizes risks to the community's safety and security.	- Use IFC EHS General Guidelines and Mining Sector Guidelines to evaluate and mitigate project related Community Health and Safety impacts - Public disclosure of hazards, risks, or negative impacts of the project - Adherence to IFC Security Personnel Requirements	- Environmental Protection Act 1994 (amended in 2000) - Environmental Protection (Air Quality) Regulations 2000 - Environmental Protection (Hazardous Waste) Regulations 2000 - Environmental Protection (Water Quality) Regulations 2000 - Environmental Protection (Authorizations) Regulations 2000 - Environmental Protection (Noise Management) Regulations 2000 - Pesticides and Toxic Chemicals Control Act No. 13 - Public Health Act Cap 145 - The Mining Act

IFC Performance Standard	Objectives	Specific Provisions	Applicable National Legislation
			• The Mining (Amendment) Regulations 2005 • Mining Guidelines for Water Quality • Occupational Health and Safety Act 1997 • Draft Mining Occupational Safety and Health Regulation 2002
5	The objectives of the Land Acquisition and Involuntary Resettlement Standard are: • To avoid or at least minimize involuntary resettlement wherever feasible by exploring alternative project designs • To mitigate adverse social and economic impacts from land acquisition or restrictions on affected persons' use of land by: (i) providing compensation for loss of assets at replacement cost; and (ii) ensuring that resettlement activities are implemented with appropriate disclosure of information, consultation, and the informed participation of those affected • To improve or at least restore the livelihoods and standards of living of displaced persons • To improve living conditions among displaced persons through provision of adequate housing with security of tenure at resettlement sites	• Conducting a census to identify persons who will be displaced by the project, to determine eligibility for compensation and assistance, and to discourage inflow of people who are ineligible for benefits • Setting a cut-off date for eligibility and dissemination and documentation of the cut-off date throughout the project area • Consulting with and ensuring informed participation of affected persons and communities in the decisionmaking processes related to resettlement including consultation during implementation, monitoring, and evaluation of compensation payment and resettlement to achieve desired outcomes • Establishment of a grievance mechanism to receive and address specific concerns about compensation and relocation raised by displaced persons or members of host communities designed to resolve disputes in an impartial manner	• Town and Country Planning Act 20:01
6	The objectives of the biodiversity conservation and sustainable natural resources management performance standard are:	• Environmental Impact Assessment • Implement mitigation measures such as post operation restoration of habitats,	• Environmental Protection Act 1994 (amended in 2000) • Environmental Protection (Air Quality) Regulations 2000 • Environmental Protection (Hazardous Waste) Regulations

IFC Performance Standard	Objectives	Specific Provisions	Applicable National Legislation
	- To protect and conserve biodiversity - To promote the sustainable management and use of natural resources through the adoption of practices that integrate conservation needs and development priorities	- offsetting of ecological and biodiversity losses, - Compensate direct users of biodiversity and respect ongoing usage of biodiversity by indigenous peoples or traditional communities - No reduction in population of IUCN critically endangered or endangered species - No introduction of new alien species - Use IFC General Guidelines and Mining Sector Guidelines to avoid or mitigate environmental impacts	2000 - Environmental Protection (Water Quality) Regulations 2000 - Environmental Protection (Authorizations) Regulations 2000 - Environmental Protection (Noise Management) Regulations 2000 - Wild Birds Protection Act Chapter 71:01 - Pesticides and Toxic Chemicals Control Act No. 13 - Code of Practice for Timber Harvesting 2002 - Wildlife Management and Conservation Regulations (Draft) - Town and Country Planning Act 20:01 - The Mining Act - The Mining (Amendment) Regulations 2005 - Mining Guidelines for Water Quality - Forest Act 2008
7	The objectives of the performance standard on indigenous peoples are: - To ensure that the development process fosters full respect for the dignity, human rights, aspirations, cultures and natural resource-based livelihoods of indigenous peoples; - To avoid adverse impacts of the project on communities of indigenous peoples, or when avoidance is not feasible, to minimize, mitigate or compensate for such impacts, and to provide opportunities for development benefits in a culturally appropriate way; - To establish and maintain an ongoing relationship with the affected indigenous peoples throughout the life of the project; and, - To respect and preserve the culture, knowledge and practices of indigenous	- Identify indigenous communities within the project area of influence and avoid or mitigate adverse impacts - Disclosure, consultation and informed participation of indigenous peoples	- The Mining Act - Amerindian Clause (Mining Act, Part VII) - The Mining (Amendment) Regulations 2005 - Mining Guidelines for Water Quality - Forest Act 2008

IFC Performance Standard	Objectives	Specific Provisions	Applicable National Legislation
	peoples.		

4.0 DESCRIPTION OF PROPOSED ACTION

The mine will be focused on the recovery of ore for processing from Smarts and Hicks gold deposits depicted in Figure 5. The area is part of the area acquired by vendor agreements and direct grants to Pharsalus Gold Inc., a wholly owned subsidiary of Azimuth Resources Limited, which in turn is a wholly owned subsidiary of Troy Resources Ltd. Project components include an open cut mine, processing plant, tailings storage facility, mine site accommodation and additional infrastructure required to recover and to process ore for the recovery of gold.

Development and operation of the mine site will involve several distinct phases. These phases will include the following:

- Construction of mine site infrastructure and upgrade of mine site access road
- Construction of a process plant
- Staged construction of tailings storage facility

The mine site will be accessed by crossing the Essequibo River at either Butakari or at Mango Landing. The Butakari crossing was developed as part of the Amaila Falls Access road infrastructure while Mango Landing was created for access to the former Omai Gold Mines. Use of either of these crossings currently provides access along existing roads to 14 Miles Issano, located immediately outside the PGI concession.

Electricity for mine site operations will be provided by a series of diesel-fired duty generators plus back up units to enable start up and allow for units off line for maintenance and repairs, each of which will be modular complete with acoustic enclosures and cooling systems. Diesel will be used on site as the primary source of fuel and heating. Diesel will be used for the smelting furnace, elution heater and the carbon regeneration kiln, as well as fuel for site vehicles. Diesel will be transported to site, via the site access road, by tankers and will be stored in diesel storage tanks. The fuel and re-fuelling areas will have a number of 20,000 litres storage tanks mounted within a bunded area which will have the capacity to hold 20,000 l in case of a total tank failure. Diesel will be pumped from these tanks to the location at which it is required.

Diesel will also be dispensed by two fuel bowzers. One fuel bowser will be equipped with a light vehicle pump to fuel the smaller site vehicles. A fast fill bowser equipped with a mobile equipment plant pump will pump diesel into the larger equipment such as the mining fleet or fleet service vehicle. The refuelling area for trucks and light vehicles will be constructed in line with commercial fuel stations, i.e. a concrete apron surrounded by channelling leading any spillage into an underground holding tank equipped with a pump to allow emptying.

Subject to final installed plant requirements, the power station is expected to operate with up to 10 generator sets, with 1 available for operation on standby and 1 under maintenance. A tank farm will be constructed onsite to serve as the primary fuel storage facility and fuel will be transferred to a day tank for electricity generation when required.

The mine site infrastructure will be enclosed within appropriate security fencing. Site infrastructure buildings within the security fence will include the following:

- Food servery and messhall
 - Process plant office
-

Figure 5 - Location of Smarts and Hicks Deposits in Relation to PGI Concession

-
- Plant workshop and laboratory

Warehouse, spare parts storage areas and plant consumables storage facilities

- Process control room
- Electrical switchrooms
- Gold room

Site infrastructure buildings will include the following:

- Administration office
- Kitchen and messhall
- First aid building
- Security, laundry and change room

Elements of the project will be constructed concurrently. During all phases of project development, construction and in the future operation, workers will be housed in on-site accommodation. Medical and other facilities will be provided at the mine site for the efficient functioning of the workforce. These facilities will include fresh water and drinking water sources, and water treatment and waste management facilities. The schematic layout of the mine site is shown as Figure 6.

Most of the site infrastructure buildings are expected to be located within appropriate security fencing, with the tailings dam embankment located in the valley adjacent to the plant site, 20 m below plant level. Any water courses flowing across the mine pit footprint will be diverted around the mine pit.

Raw water for the process plant will be supplied from raw water wells and wells used to dewater the mine pits. Raw water is natural water found in the environment, such as rainwater, ground water, and water from bodies like lakes and rivers. Water in this form is considered raw, as opposed to water which has been treated before consumption, such as drinking water or water which has been used in an industrial process, such as waste water. (Wikipedia, 2014). The raw water will be stored in a lined raw water dam located adjacent to the process plant. Process water will be delivered to a lined process water dam constructed adjacent to the plant site. Process water will come from the following sources:

- Overflow from the raw water pond
- Tailings Storage Facility decant return water
- Clarified thickener overflow

Potable water will be obtained from groundwater wells and will pass through a filtration plant for purification. Potable water is water safe enough to be consumed by humans or used with low risk of immediate or long term harm. In most developed countries, the water supplied to households, commerce and industry meets drinking water standards, even though only a very small proportion is actually consumed or used in food preparation. Typical uses (for other than potable purposes) include toilet flushing, washing, and landscape irrigation. The word potable came into English from the Late Latin *potabilis*, meaning drinkable. (Wikipedia, 2014). Potable water, stored in a potable water tank will be pumped to the:

- Process plant
- Camp storage tank
- Mining Contractor's area

Figure 6 - Conceptual Mine Site Layout

A sewage treatment system will be installed to service the plant buildings and another would be installed at the camp to service the workers accommodation village. All sewerage water will be treated to the appropriate standards to facilitate discharge to receiving waters.

The Tailings Storage Facility (TSF) will be located approximately 600 meters to the south of the process plant and will be a valley storage facility with the containment embankment at the eastern end of the valley. The TSF will be constructed in a staged fashion with stage 1 being sufficient to store a minimum of 2 years volume of process tailings and rainfall runoff.

A new access road will be constructed to connect the mine site to the Amaila Falls Access road, if the Government agrees to the use of that road. The access road will be 9 m wide and approximately 8 km length and will consist of two 3.5 m carriageways plus 1 m shoulders as well as associated drainage ditches alongside the road. A 1 km section of road will be constructed to provide access from the site access road to the airstrip which will service the mine site. That road will be 6 m wide and will consist of two 3 m carriageways, plus associated drainage ditches alongside the road.

The airstrip, to service the proposed mining operation, has already been constructed and granted approval for operation by the Guyana Civil Aviation Authority. The airstrip is located about 1.4 km south of the process plant and has been designed for the Cessna Caravan which is a class B1 to B2 aircraft.

PGI will transport the project components, including mills and large construction items, directly to Linden from where the items will be trans-shipped to the mine site. PGI may also establish a bus station and a customs office at Linden specifically for this project. PGI will also source fuel from Linden.

4.1 Preliminary Works

Initial mine site construction activities will focus on preparation of construction camp facilities, kitchen, construction site offices and workshops. The capacity of the communications system will be expanded along with the on-site administration and management areas. Sewer and water services will be expanded to meet the needs of the expanded camp.

The preliminary works will include the following not necessarily in the order listed:

- Improvement of the existing site access road
- Brushing and grubbing of areas for process plant and other site facilities
- Increasing the fuel and lubricant storage capacities
- Construction of workshops and offices
- Construction of medical facilities
- Improvements to the communications system
- Construction of materials storage areas
- Installation of sewer, water and power for the construction phase
- Construction of worker accommodations, kitchen and office
- Construction of buildings and shelters for repair and maintenance, power generators, water pumps, etc.
- Construction of hard rock crushing facilities, concrete batch plant, sawmill, and other ancillary support for construction activities
- Pre-stripping of the open pit mining areas

The access road will be upgraded to handle the higher traffic volumes. The upgrade will entail clearing the vegetation on the sides of the road and cut and fill to widen it. The access road will be surfaced using lateritic or other suitable material available along the roadway.

Brushing and grubbing will be carried out to encompass construction sites. Brushing and grubbing would be controlled by survey to ensure that the required designed footprint of the operations is managed. Laydown areas will be developed. Access to a rock or aggregate source, necessary for the batching of concrete for construction purposes, will be developed. Survey control and site layout activities will commence.

PGI was granted a construction permit, by the EPA, to commence some preliminary works at the mine site. The permit authorizes construction works on the following:

- Erection of a security fence around the plant and camp site
- Upgrading of internal roads
- The construction of a Government of Guyana outpost facility adjacent to the New Issano Bypass Road
- Plant Site trenching and laying of underground piping and electrical cabling
- Pouring of structural concrete foundations and piers
- Design and construction of effluent disposal systems

4.1.1 Plant Site Trenching and Laying of Underground Piping and Electrical Cabling

At the plant site initial preparatory works including the clearing and burning of trees have been completed along with the removal of organics to abandoned sand pits. As such, the site is currently an exposed white sand area. To begin construction of the plant, the foundation trenching has to be dug. The total perimeter of trenching required is approximately 2000 m, each of varying widths and depths. The widths range from 0.9 m to 0.5 m; whilst depths range from 0.8 m to 0.4 m, giving an average volume of 840 m³ of sand to be removed. This excavated material will be stockpiled at an appropriate location on site to be used for construction purposes. In addition to the foundations trenching, trenching for underground piping and electrical cables have to be dug. These pipes will be laid at design elevations that will range from 1 m to 0.5 m below ground level and the excavated material will be used as backfill.

A summary of some of pipes to be laid at the plant and camp site is presented in Table 9.

Fluid	Pipe Size (mm)	Pipe Specs	Pipe Length (m)	Total Length (m)
Potable Water	42	Schedule 40	5	2220
	90	PE100-PN6.3	210	
	110	PE100-PN6.3	2000	
	150	Schedule 40	5	
Raw Water	32	Schedule 40	310	1229
	50	Schedule 40	20	
	150	Schedule 40	899	
Process Water	32	Schedule 40	254	334
	50	Schedule 40	20	
	150	Schedule 40	60	
Sewage	100	Schedule 40	440	600
	150	Schedule 40	160	
Gray water	100	Schedule 40	440	600
	150	Schedule 40	160	

Table 9: Summary of underground pipes

Electrical cables will also be laid at an average depth of 1.5 m below ground level and will be encased in appropriate conduit.

4.1.2 Pouring of Structural Concrete Foundations and Piers

Pouring of concrete foundations at the plant and camp site will occur after the appropriate reinforcements are in place. The total volume of concrete expected to be poured is approximately 1600 m³ and will be mixed on site using ransoms. To achieve this mix, water from creeks will be utilized along with sand from excavation activities or burrow pits. Stone will be imported from nearby quarries and stockpiled. There will be no pile driving activities. However, a few of the structures at the plant will be elevated and they will be supported by steel piers of varying heights. All of the housing at the camp site will be prefab in nature amounting to a total of sixty two structures. The main waste that will be generated from this pouring activity is the accumulation of cement bags and structurally compromised form boards. These will be disposed of by burning in a designated location subject to GGMC approval.

4.1.3 Erection of Security Fence around Plant and Camp Site

In order to provide a sense of safety in the environment and secure the company's assets, fences will be erected around the plant and camp site. The security fences will be very simplistic in nature consisting of wooden posts driven approximately 0.6 m below ground level and secured with a 0.4 m square concrete base. These posts will be sourced from land clearing activities (land stripping) and prepared at the company's saw mill. The fence will consists of 5 feet chain link material fitted with razor wire at its peak. The total length of fence required is 2031 m with the camp site contribution 815 m, and the plant site the remaining 1216 m. The camp and plant site fencing will secure areas of 29,784 m² and 67,513 m² respectively. Figure 7 depicts the fence layout for the camp site and Figure 8 depicts the fence layout for the plant site.

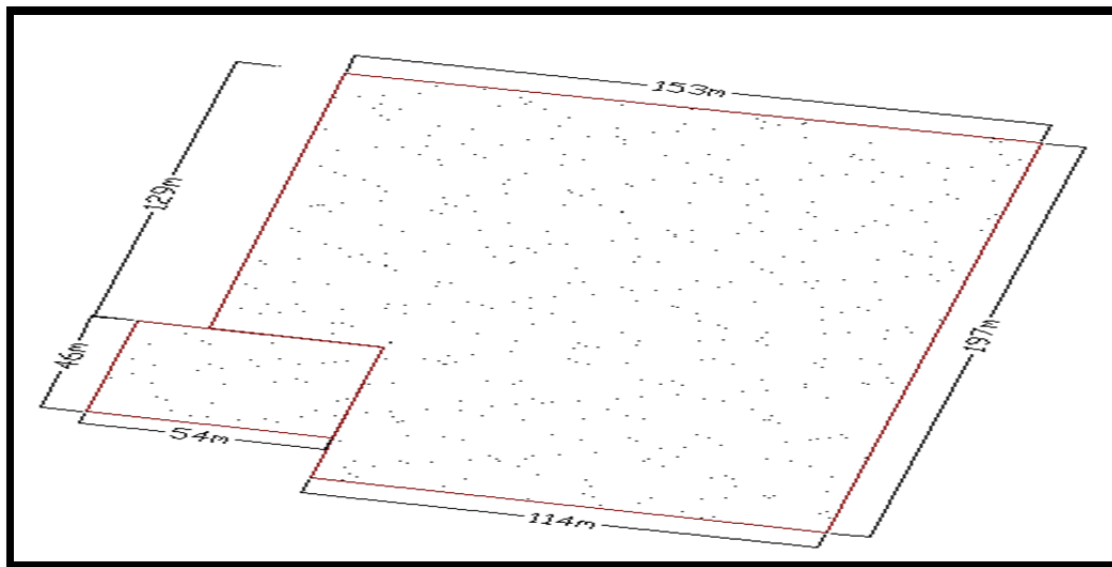


Figure 7 - Layout of proposed security fence for Camp Site

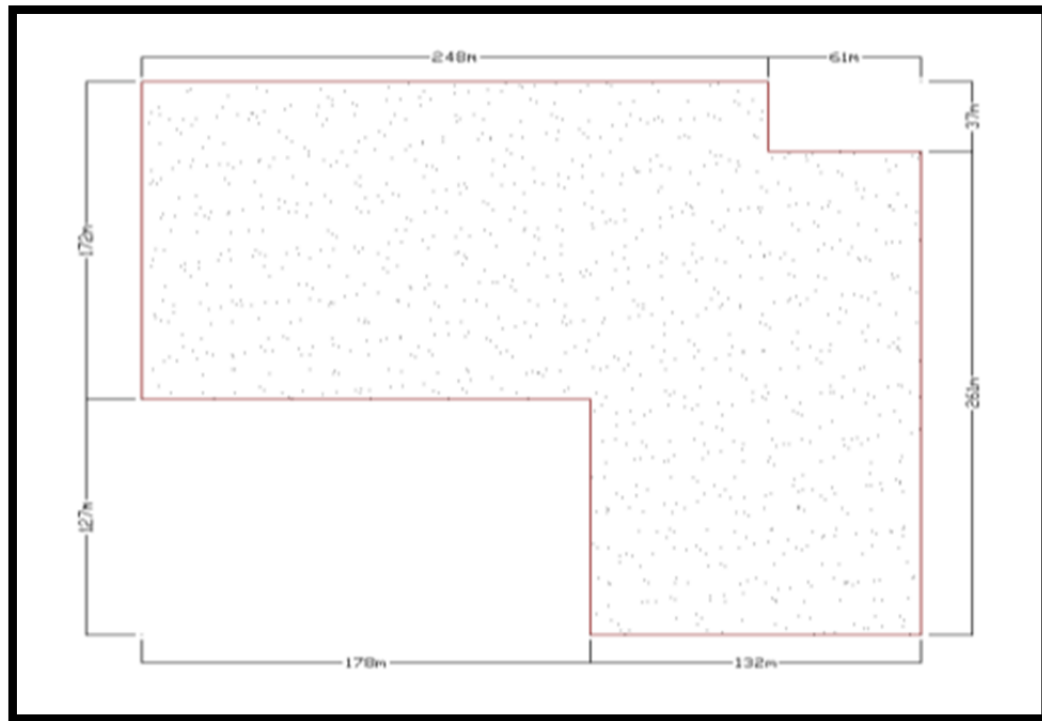


Figure 8 - Layout of proposed security fence for Plant Site

4.1.4 Upgrading of Internal Roads

Troy's internal road network currently comprises of approximately 30 km of roads of various widths. The main access and haul roads are 12 m wide and the secondary roads are 7 m wide. Of this 30 km, 16 km are all weather (laterite) roads with the remaining 14 km having a white sand base. This 14 km stretch is currently being upgraded to all weather roads with the placement of a 6 inch laterite finish. The laterite is being retrieved from a burrow pit in close proximity to the working area. In some areas the main access road has to be widened from a current 8 m to 12 m. This will be done through the use of bulldozers and excavators and the fallen vegetation will be managed in accordance with EPA & GFC guidelines. Any trees which have beneficial value will be transported to the saw mill for processing as permitted by GGMC. Surplus logs will be stockpiled for delivery to Vaitarna and Toolsie Persaud, the authorized forestry concession holders in the area of the mine site. Used oils and lubricants are stored in a defined secure area for future offsite removal to an approved licenced reprocessing or treatment facility as may be available.

4.1.5 Construction of Government Outpost Facility Adjacent to the New Issano Bypass Road

Troy's mine entrance will mainly be populated by the company's security team where stringent access measures will be in place. However, a single building external to the mine site will be dedicated to accommodating Government officials and it will have dimensions of approximately 7 m x 9 m. It will be a wooden structure provided with basic amenities such as power, potable water, showers and toilets. Electricity will be provided from Troy's main generation plant and potable water, along with volumes required for daily activities, will be harvested from rainfall and stored in tanks. Filters will be fitted onto the pipes designated for potable water to ensure acceptable water quality.

4.1.6 Design of Effluent Disposal Systems

All effluent from various locations at the Karouni Project site will be processed through four tank treatment system.

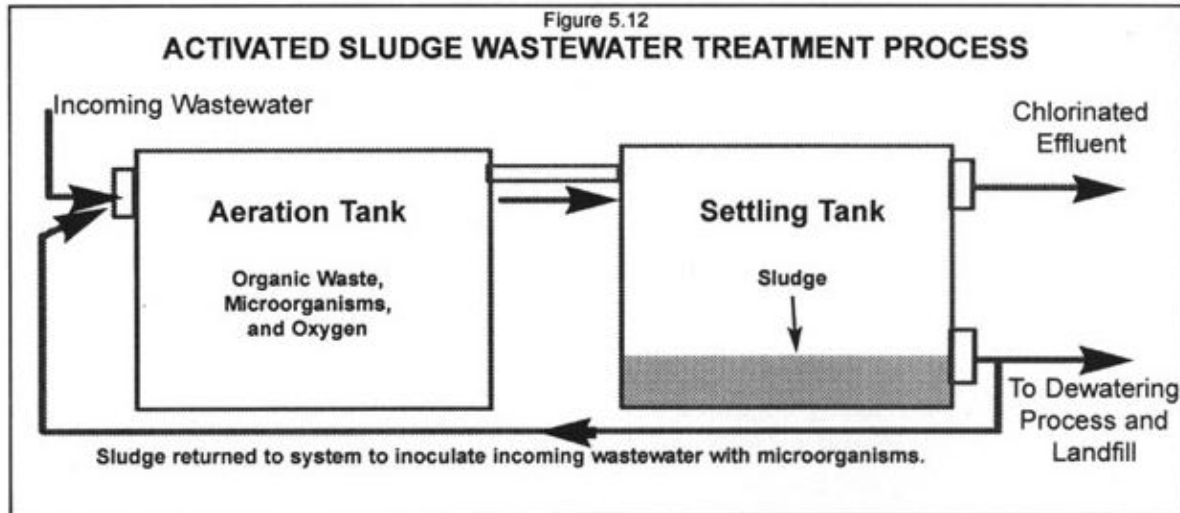


Figure 9 - Layout of Effluent Treatment Process

All the liquid waste from the toilet, bathroom, laundry and sink goes into pipes which carry it to a septic tank. The effluent from the tank is then disposed of through effluent disposal drains often referred to as a sand gravel filter. All soiled waste will be processed and taken to the appropriate land fill.

4.1.7 Additional Works

Technical work such as additional in-fill drilling in the pit, exploration drilling, geotechnical investigations and testing, and surveying will continue to be carried out during this phase. Drainage management will be laid out and detailed in the field for construction.

Material for permanent camp construction and fuel storage and tank fabrication will arrive and these activities will be undertaken. The construction equipment fleet will be expanded to start the facilities construction.

Quarry equipment and starter aggregate crushing operations will start to produce limited quantities of concrete for camp construction. Permanent camp sewage, water treatment, solid waste equipment, and power services will be installed.

An airstrip has already been constructed and permitted by the Guyana Civil Aviation Authority. This ESIA does not address the environmental impact of the airstrip since an environmental management plan would have been a prerequisite to it being granted an operational permit.

Several elements of the preliminary work may occur during the period over which this ESIA is being conducted. The EPA will be accordingly advised of these works and the appropriate authorization and permits will be obtained prior to commencement of work on any of the the project preliminary elements detailed herein.

Figure 10 - Mine Site Layout Identifying Smart and Hicks Open Pits

When the facilities to support a construction workforce are completed and land has been cleared and surveyed, construction of site infrastructure will be undertaken.

The initial development of the open pit, stripping and stockpiling of saprolite and the initial construction of the saprolite/sulphide ore processing facilities will commence during the preliminary work phase. The construction and mining equipment fleet, repair shops, fuel, lubricant and materials storage areas will also be expanded. Initial stripping of sand and saprolite overburden will commence and the on-site workforce will be increased. In addition, off-site facility construction including materials consolidation and transfer facilities, port development, and access road upgrade/improvement will be undertaken.

The next preparatory stage will consist of stripping and stockpiling of saprolite overburden material to expose the fresh rock for eventual mining. Any saprolite material not suitable for processing will be disposed to the waste rock dump. Saprolite ore will be stockpiled for eventual blending with the hard rock sulphide ore. Final process plant design is dependent upon positive results from ongoing metallurgical testing and successful development of an economically feasible saprolite-sulphide metallurgical process as part of the feasibility analysis being conducted for the project.

4.2 Mining operations

Due to time constraints and the ongoing need to update drilling to convert resources to reserves, coupled with the effects of a lower gold price, Troy decided to split the Karouni project into an open pit and an underground phase to be addressed later.

This then ensured rapid development, allowed sufficient time to conclude reserve drill out and conversion as well as brown fields exploration funded internally. Based on these parameters Troy concluded a further mine optimization study looking at the open pits only.

In addition a calculation as to the maximum production capacity achievable without additional major expenditure indicated that a 3 year open pit phase resulted in the maximum return on capital. A series of open pits were designed resulting in various depth pits with the maximum depth being approximately 120 m at the Smarts ore body. Mining operations will commence at the Smarts deposit with ore being mined using conventional open pit mining methods potentially to be followed by underground mining in the later years of operation. The Hicks deposit will be mined by open pit methods only which will supplement the Smarts operation.

The company will carry out owner mining to ensure the highest levels of safety and productive efficiency. The maintenance operations will include a heavy equipment maintenance and service facility/tyre shop, as well as a separate light vehicle maintenance garage, office, fuel farm and workshop. The mining operations will conform to all requirements of the environmental permit granted to the company.

Ore initially will be mined using conventional open pit mining methods. Equipment to be utilized for the open pit mining operation will include blast hole drills, excavators and wheel loaders, haulage trucks, bulldozers, graders, service trucks, pick-up vehicles and pit dewatering pumps and portable lighting sets.

A fully permitted, security fenced enclosed explosives storage facility will be constructed at a site located a safe distance outside the maximum blasting buffer zone from open pit operations.

Exploration work at the mine site has established the presence of viable grades of ore in the area identified for the open pit mine in Figure 4. The maximum mine pit dimensions are expected to be 1,500 m in length by 350 m in width and approximately 110-120 m deep. Saprolite ore represents less

than 10% of the total ore and is positioned in approximately the upper 70 metres of the pit. The remaining fresh ore is primarily massive intermediate volcanics with chalcopyrite and gold mineralization. The saprolite ore is a chemically weathered rock, mostly soft or friable. The saprolites contain predominantly quartz and a high percentage of kaolinite with other clay minerals which are formed by chemical decomposition of primary minerals, mainly feldspars. The saprolite material would be mined using loaders and excavators. The hard rock (fresh material) will be drilled and blasted to fracture the rock for mining by conventional truck and excavator operations.

The mine pit will be developed in “phases” or “push-backs”. The saprolite will be stripped and either processed, stockpiled for processing or disposed in the waste dump if of inadequate grade. The hard rock will be mined after enough saprolite ore has been mined to provide adequate working faces for the hard rock mining to begin. Each phase will be mined to ensure that safety, working area requirements, mine access and service requirements are taken into consideration.

Mineral processing will consist of combining small parcels of the saprolite ore and fresh ore by blending the two together and processing singularly. The softness and clay content will make processing of the saprolite more challenging with conventional conveyance method. The saprolite ore would therefore be blended at a very low rate to address the potential material handling problems.

The ore exploitation rate will result in a minimum mine life of 3 years or more depending on the final processing rate and the potential future identification of additional economic reserves within the proposed mining lease.

4.3 Ore Processing Facility Construction

The construction of the processing facilities is expected to take 9 - 12 months and will include:

- ore storage, crushing, conveying, grinding, mineral processing, product storage and load-out facilities,
- gold recovery facilities,
- maintenance, storage, laydown yard, laboratory, office and administration areas, and
- construction of tailings, waste and water management ponds, electrical power generation, transmission, and other infrastructure facilities.

The development of the open pit will be timed so that the pit can begin to supply ore to the processing facility once it is constructed.

4.4 Mining and Mineral Processing

4.4.1 Open Pit Operation

Conventional truck, shovel and wheel loader surface mining methods will be used in the open pit operations. Sixty to eighty (60 – 80) tonne type class haul trucks are expected to be used during the excavation of the saprolite material, and larger haul trucks, shovels and wheel loaders may be used during the mining of the sulphide zone, with capacity being dependent on the mining rate and constraints of the pit design. The sulphide material will be conventionally drilled and blasted before being mined. An independent explosive supplier will be retained to set-up a bulk explosives plant and detonator and explosives magazine on-site.

When the pit is in operation, materials to be mined will be sampled at the face to determine whether they are waste or ore, and the boundary between the materials marked by flags and pickets before their excavation. The materials will be loaded into mining trucks. Ore would be hauled to the processing

plant and waste materials to the waste rock dump. The mine roads and the working surfaces on the waste dumps would be maintained using graders, bulldozers and wheel dozers. It is expected that an ore stockpile would be maintained at the processing plant to provide up to 5 - 7 days of run-of-mine (ROM) ore storage capacity. Mining and processing will take place 24 hours per day, 7 days per week and 365 days per year. Low grade material that would otherwise be disposed as waste rock will be temporarily stockpiled and reclaimed and processed after the pit is mined-out. The ultimate limits of the open pit will be defined by the open pit design which is being developed. Waste materials will be disposed in the waste rock dumps.

The project will be designed and operated in accordance with environmental protection requirements and guidelines. As an example, the project footprint and land clearing limits will be monitored and controlled over the life of the project. The footprint design will aim to reduce disturbance to the small area of forested areas remaining in the planned open pit mine footprint.

4.4.2 Mineral Processing

Mineral processing will occur in the following stages:

- Crushing Circuit
- Grinding Circuit
- Leaching and Detox Circuit
- Stripping and Gold Room Circuit
- Water and Tailings
- Reagents and Services

4.4.2.1 Crushing Circuit

Ore would be transported from the pit to the Run of Mine (ROM) pad by haul truck. A front-end loader will feed ore from the stockpiles into the ROM bin. A static grizzly positioned above the ROM bin will separate the +600mm ore for separate size reduction by a mobile rock breaker. Broken oversize would be blended back into the feed ore.

Ore would pass from the ROM bin onto a variable speed apron feeder at a nominal controlled flow rate of 154 tonnes per hour. The ore would be fed into a jaw crusher. Spillage from the apron feeder will be directed via the apron feeder dribble chute to the jaw crusher discharge conveyor

The jaw crusher will operate in an open circuit configuration with a closed side setting (CSS) of 70 mm. It will accept ore with a top size of up to 600 mm and will operate for approximately 6500 hours each year. This will allow for scheduled maintenance to be performed on the crushing circuit as well as for operational downtime. The jaw crusher will reduce the material to a particle with 80 percent (P80) being less than 82.2 mm, which will then be discharged to the jaw crusher discharge conveyor.

If the jaw crusher becomes choked a fixed rock breaker would be used to break up the large rocks allowing them to pass into the crushing chamber. A dust collector will be installed to collect the dust coming from the jaw crusher discharge chute.

The crusher tramp magnet will collect tramp metal from the crushed product belt and will dump it into the crusher tramp metal bunker. The primary screen would be fed by the jaw crusher discharge conveyor. A metal detector would be situated on the jaw crusher discharge conveyor and should metal be detected this will raise an alarm and halt the conveyor so the item can be removed. This will prevent damage to the secondary crusher and primary screen.

The primary double deck screen has an aperture of 25 mm on the top deck and 15 mm on the bottom deck. The +25 mm material would be fed directly into the cone crusher feed bin. This material would be drawn at a constant rate of 274 tonnes per hour (tph), and includes a recirculating load of 178% by the cone crusher vibrating feeder and would be fed into a Nordberg HP 500 cone crusher. The cone crusher has a Closed Size Setting (CSS) of 20mm and will reduce 80 percent of the material to a 22.3 mm size. The cone crusher dust collector will be used to minimize dust emissions from the cone crusher area. The crushed material would be discharged onto the cone crusher product conveyor which will return the material to the jaw crusher product conveyor to be re-screened on the primary screen.

The undersize of the primary screen, with 80 percent of materials less than 10.3 mm (P80, 10.3 mm), will pass onto the stockpile feed conveyor, which will transfer the crushed material to the covered crushed ore stockpile. The stockpile will have a nominal 24 hour total capacity, with a live storage of 3692 tonnes. The stockpile will ensure that the processing plant can run independently of the crushing plant.

The under stockpile belt feeder, to be located under the stockpile, will draw material out of the pile to be fed into a grinding circuit via a conveyor.

Dust suppression sprays will be located at the ROM static grizzly to minimize dust emissions. Raw water would be used for this operation. A maintenance hoist would be located above the jaw crusher, with another maintenance hoist being available above the cone crusher for maintenance. During shut down, the maintenance hoist would be used to remove worn parts from both pieces of equipment.

A safety shower and eyewash stations will be located in this area as part of the general safety requirements for personnel.

4.4.2.2 Grinding Circuit

The grinding circuit would be fed with P80, 10.3mm ore from the crushed ore stockpile onto the ball mill feed conveyor at 125 tph. An emergency feed hopper will be in place to allow feeding of the plant via a front end load (FEL) should an issue arise with the under stockpile feeder. This will transport the material to the ball mill transfer conveyor which will feed the ball mill. The ball mill feed conveyor will also be fed lime from the lime ring main. Lime feed will be used to maintain pH at 10-10.5 in the leaching circuit downstream to prevent the volatilization of cyanide (HCN).

In addition to the fresh feed from the ball mill transfer conveyor, the ball mill will also be fed with process water, cyclone underflow, intensive leach tailings and will be able to receive new balls from the ball mill charging kibble. The ball mill is a 5 m diameter, 7.32 m long mill. Using a ball charge of 40% and a slurry density of 74% solids the mill will draw 3.1 kW with a recirculating load of 210%.

The overflow ball mill would be equipped with a trommel and associated water sprays. The undersize of the trommel will discharge into the mill discharge hopper where process water will be added as required to condition the feed to 55% solids prior to pumping to the hydrocyclone cluster. The oversize (scats) will be collected in the mill scats bunker and will be periodically returned to the mill feed via FEL or if grades are low they will be discarded. The cyclones in this cluster will be used to split the slurry into cyclone overflow (34% solids) and cyclone underflow (approx. 66% solids).

The cyclone underflow will be fed into the cyclone underflow splitter box which will be used to direct feed between return to the mill and feed to the gravity concentration circuit. Should the underflow be returned to the mill from the cyclone underflow splitter box, the slurry will gravitate

down to the ball mill as recycled feed via the gravity tails return hopper. Slurry not returned to the mill will gravitate to the gravity concentrator distribution boxes that will be used to control the feed onto gravity screens. These screens with an aperture of 2.0mm will be used to screen out oversized material from the gravity concentrators' feed. The oversized material will form part of the combined gravity tailings return that will gravitate back to the mill feed point via the gravity tails return hopper. Both screens will be assisted with water sprayers which will help screen the material and condition the feed to the gravity concentrators to improve efficiencies. The underflow from the gravity screens will gravitate to their respective gravity concentrator.

The Knelson XC30 gravity concentrators will be used to recover gold by the gravity before processing through the intensive leach reactor. This will reduce the gold loading in the leaching circuit, as well as assist in the prevention of gold short circuiting and it being lost to tailings. The tailings from the gravity concentrators will be combined with the gravity screen oversized slurry and will gravitate to the ball mill feed.

The material from the gravity concentrators will be dumped every two hours into the Intensive Leach Reactor (ILR). This unit will have a feed hopper that will retain the gravity concentrate between leaches, with the intensive leach lasting 24 hours. The concentrate will be fed into the ILR and mixed with a leach solution that contains 2.5% NaCN added NaOH to maintain pH. Following the leaching period the leach solution will be pumped to the electrowinning area, while the leach tailings will be returned to the ball mill feed.

The cyclone overflow material, at a P80 of 63 micron and approximately 34% solids will gravitate down to the pre-leach thickener via the trash screen and thickener feed collection tank which will reduce the kinetic energy of the feed prior to entering the thickener. A trash screen underflow box will be installed to accept a bypass to allow operation to continue when the screen decks are being replaced. The trash screen will have water sprayers to assist with the screening process, and will remove trash material from the thickener and downstream processing feed. The trash will be collected in the trash screen bunker and periodically removed by an FEL or similar machinery.

Flocculant and process water will be added in the thickener feedwell to assist with the thickening operation. The 25 m diameter thickener will increase the slurry density to 50% solids in the thickener underflow, with the underflow being pumped to leach tank 1 at a rate of 171 m³/h. The overflow will gravitate back to the process water dam for use throughout the process water plant.

To assist with the safe operation of this area, ancillaries will be installed. These include the two sumps with sump pumps, one being the ball mill sump pump and the cyanidation leach sump pump. These will be used to remove overflow and spillages from this area. The ball mill sump will be able to return slurry to the ball mill feed or the ball mill discharge hopper depending on the cause of the spillage. The cyanidation leach pump will be able to return spillages from the first leach tank.

A ball mill charging hoist would be included for the filling of the ball mill charging kibble and other maintenance requirements. Additionally, a cyclone maintenance hoist will be available for servicing of the cyclone cluster. There will be safety shower and eyewash stations throughout the area that will be used in case of emergency.

4.4.2.3 Leaching and Detoxification Circuit

The feed to the leach tank will contain 50% solids, and will be agitated with added cyanide. The cyanide would be added to form a solution to approximately 250ppm cyanide and will act to begin the leaching process. The residence time would be nominally 4 hours in the leach tank prior to the

slurry gravitating via launders into Carbon in Leach (CIL) tank 1. The leaching circuit will be contained within bunding to ensure that overflow and spillages are contained and not able to enter the environment.

CIL tank 1 is the first of the tanks that will contain activated carbon and will operate in a counter current flow of carbon to slurry. In order for this to be achieved each of the 6 CIL tanks will feature intertank screens to prevent the carbon flowing downstream and carbon pumps to move the carbon up stream. This counter-current method will allow for the greatest difference in gold concentration in the leach solution and on the carbon, and hence the greatest driving force for gold recovery onto the activated carbon. In this way the carbon will enter the circuit in CIL tank 6 and will be removed from the circuit at CIL tank 1. The carbon concentration in the slurry will be approximately 12 g/l. Each CIL tank has a residence time of 3.52 hours and a working volume of 600 m³. Slurry will pass through the circuit at a nominal rate of 171 m³/h.

All of the leach tanks will also feature agitators to keep the solids suspended in the slurry during the leaching time. The tank arrangement will allow for gravity transfer of slurry between the tanks through open launders, with the launder arrangement allowing for the ability to bypass a tank for maintenance as required.

In CIL tank 1 the carbon would be removed and will be pumped to loaded carbon screens which will be equipped with water sprayers. These screens will have a 1 mm aperture deck and will wash the carbon prior to elution. The screen underflow slurry will pass back into leach tank 1 via a launder, while the loaded carbon will pass as screen oversize and gravitate into the feed hopper for the elution circuit.

The stripped and regenerated carbon from the elution circuit will be returned to CIL tank 6 via the regenerated carbon dewatering screen. The water fed with the carbon to this screen will pass through as undersize screen and will be sent to the detoxification circuit. New carbon will be manually added by way of the site crane into CIL tank 6.

The leached slurry in CIL tank 6 will pass from the final launder into the detoxification (detox) circuit, at detoxification tank 1 for cyanide destruction. The detox circuit contains three agitated tanks, and will be bunded separately to the CIL tanks and operate in series. This will provide three stages of detox to ensure that the cyanide is completely removed through the 7.5 hours total residence time. As with the CIL circuit the detox tanks will be able to have a tank bypassed as required for maintenance. The detox tanks will all be dosed with sodium metabisulphite (SMBS), while detox tank 1 will also receive a feed of copper sulphate (CuSO₄) to maintain a minimum 50 ppm Cu²⁺ as part of the detoxification process. Spent hydrochloric acid (HCl) and acid wash water from the elution circuit will also be pumped into detox tank 3. The detox tanks will be highly agitated and be air sparged to drive the reaction which will destroy the cyanide. The slurry will gravitate between the tanks in this circuit. Discharge from the final detox tank will gravitate through the fine carbon screen feed box and onto the fine carbon screen. This screen will have an aperture of 850 micron and will be used to capture and retain any carbon that has passed the final carbon screen in CIL tank 6. The carbon will pass as oversize and be collected in fine carbon bags for gold recovery on a periodical basis. The screen undersize once separated through the use of the screen and the fine carbon screen and water from the water sprayers will gravitate via the launder to the tailings feed hopper. From the hopper the detoxified slurry will be pumped to the tailings storage facility. Safety shower and eyewash stations will be made available throughout the area.

Maintenance gantry cranes, located on monorails, will be installed over the leach and CIL circuit for use in the removal of intertank screens as required for cleaning and maintenance. The removal of agitators in the detoxification circuit will be achieved by a crane.

Two sumps will be installed with pumps within the leaching circuit for the collection of spillage, the slurry will be returned to the pre-leach tank or detox tank 1 as required from these sumps. Additional sumps with pumps will be included within the detox circuit for spillage collection, these sumps will pump the slurry collected back to detox tank 1.

In order to reduce the consumption of cyanide and detoxification reagents, online cyanide analysers will be installed throughout both the leach and detox circuit to monitor the level of free cyanide within the slurry solution.

4.4.2.4 Stripping and Gold Room Circuit

The carbon stripping and gold production units will be housed in a distinct area. The area will include the elution circuit, gold recovery and production and carbon regeneration. The following description covers these areas.

4.4.2.4.1 Elution

The process will use two columns, one for the acid wash and one for the elution stage. The acid wash column will be fed from the oversize from the loaded carbon screen. 3% HCl will be used for the acid soaking stage. Acid will be allowed to contact the carbon for a specified time to remove inorganics such as silicates and carbonates which the carbon has picked up from the slurry in the tanks. Acid from the acid soak stage will be sent to the detox tank prior to disposal in the Tailing Storage Facility (TSF).

Following the acid soak, raw water will be pumped through the column. This stage would be used to wash out the acid remaining on the carbon, and to prevent chlorides entering the eluate. The acid wash water would be sent to the detoxification tank following its pass through the column. Following the washing stage with acid, water will be pumped through the column to wash out the acid that remains. The washed carbon would then be transferred via fluidization water into the elution column.

The elution column would be filled with carbon at the start of the elution cycle. The elution cycle will generally take 10-14 hours and broken down into the following stages:

- Loading
- Elution
- Cooling and unloading

Once loaded from the acid wash column, the activated carbon will be stripped. The eluate stripping solution will be made up from NaOH and cyanide in the eluate mix tank (0.1% NaCN, 1% NaOH). The eluate solution will be preheated through a heat exchanger setup that will have a heater and heat recovery to maintain the heat for the stripping cycle, around 140 degrees C.

The primary heat exchanger will be heated by glycol thermal oil which would be heated by a diesel fired heater. The glycol loop features the diesel fired glycol heater and a glycol expansion tank. The secondary heat exchanger will recover heat from the eluate from the elution column as it passes

through to the pregnant liquor tank and electrowinning, reducing the heating requirement of the glycol heater.

The returning eluate from the column will pass through eluate strainers to ensure the feed for the electrowinning is free of solids. These strainers will be periodically changed out to prevent blockages.

The elution cycle will pass the elution solution through the column at a rate of around 2 bed volumes per hour. This solution will pass from the elution column, through the electrowinning cells and back to the elution column continuously until the gold tenors in solution drop below a defined level (5-10ppm). At this point the gold loading on the carbon will be approximately 20 - 50 ppm. The column can then be emptied and the carbon taken for return to leach circuit.

4.4.2.4.2 Gold Recovery and Production

The gold recovery circuit will take solution from two sources, the intensive leach location and the eluate. These sources will be handled and accounted for separately so that track can be kept on whether gold has been generated by gravity or by leaching.

The pregnant leach solution will be fed into the intensive cyanidation pregnant liquor tank, which will act as a holding and recirculation tank during gravity electrowinning. The solution will be pumped through the intensive cyanidation electrowinning cell and back through to the storage tank until the gold tenors within the solution drop to approximately 5-10ppm. At this point the now barren solution will be pumped to the leach tank so any gold present can be recovered and the cyanide can be utilized in the leaching process. Electrowinning of the gravity recovered gold will take place as required.

The pregnant eluate solution containing the gold from the carbon stripping would be processed as indicated above, with the solution passing from the column, through the electrowinning cells, and back through the column. This solution would be recycled through either of the two CIL electrowinning cells as required during the electrowinning process. This will continue until a barren level of approximately 5-10 ppm is reached. The solution will then be discharged to the leach tank as per the gravity electrowinning barren solution.

Following the electrowinning progress (both for the gravity and leach circuit gold) the cells which contain steel wool on the cathodes will be removed by hand and the recovered electrowon sludge would be taken for filtration or calcination.

Depending on the final process method chosen the cathodes will either be mild steel wool or stainless steel cathodes. Should stainless steel cathodes be used the sludge will be pressure washed off and then filtered. Should steel wool be used this would be directly calcined. Should filtration of the sludge washed off stainless steel cathodes be undertaken, filtration will be conducted using a pressure filter press to remove water prior to calcination and smelting. The dried gold sludge will be passed through the calcine oven, to remove additional water and to volatile impurities from the furnace feed.

The material from the calcine oven would then be loaded into the diesel fired furnace, where various fluxes would be added. The flux mixture would be made up of nitre, silica, borax and soda ash. The flux mixture would be used to remove impurities such as base metals like iron etc. from the bullion as a slag. Then molten gold would be poured from the furnace into bullion moulds. Once cooled the bullion would be removed from the moulds and cleaned. The cleaned and cooled bullion would then be loaded into the gold safe where it will be stored until collection.

4.4.2.4.3 Carbon Regeneration

The carbon from the elution cycle, once barren, will be sent to the carbon regeneration kiln. The carbon regeneration kiln will be used to reactivate the carbon and remove organic impurities such as oils etc. which are not removed during the acid wash, prior to the carbon being returned to the CIL circuit.

A venturi and process water will be used to transfer the carbon from the elution column to the regeneration kiln feed screen. The regeneration kiln feed screen will have an aperture of approximately 850mm. Water sprayers will be used to assist with the screening of the regeneration feed. The screen underflow will be predominantly water, with this water being pumped back to the process water dam for reuse throughout the process. The screen oversize will be deposited into the feed hopper as part of the horizontal carbon regeneration kiln package. The diesel fired kiln will be fed with carbon as required. The regeneration kiln will operate at 650 degrees C, and be fed with carbon at a throughput rate of approx. 250kg/h.

Upon exit from the regeneration kiln the carbon will be deposited into the carbon quench tank containing raw water to both cool the carbon and provide a means of returning the carbon to the leaching circuit. From the carbon quench tank the carbon will be transferred using a venturi and process water to the dewatering screen and into the CIL circuit.

4.4.2.5 Area Ancillaries

Additional equipment would be provided within the area to assist with the maintenance and safety. These include safety shower and eyewash stations at key locations within the area and within the elution/regeneration area, within the electrowinning area, the gold room and the general area.

Sumps and sump pumps will be installed for the catchment of spillage and rainfall, contained within the bunded areas. One set will be installed within the gold room. Material collected in this sump will be returned to the mill feed hopper. An additional sump will be installed within the elution bunding. Depending on the material collected within this sump there will be the option to return this to the leach tank should there be gold and or cyanide present within the liquor or fed through to detoxification circuit should this material require direct disposal to tailings.

4.4.2.6 Water and Tailings

The water and tailings area of the plant will be used to provide the water required throughout the process plant and to store the tailings resulting from the leaching process. In addition run-off water collected around the process plant and TSF, or from mine dewatering activities, will be handled in stilling ponds prior to discharge into the river system. This will ensure the water released is treated and hence suitable for release.

Water will be fed to both the raw water dam and the water purification feed tank from the river or wellfield. The source of the water for the process plant is to be confirmed at a later date following a trade-off and evaluation study. The raw water dam will provide water to be used as both feed throughout certain areas of the process plant (elution circuit, gravity fluidization and reagents), and for top up water for the process water dam.

The water purification tank will be used as a holding tank for the water purification plant. This will be used as a method of cleaning the water from the river or wells in order to make it suitable for human consumption and other potable water use. The discharge from the water purification plant will be minimal due to the high quality of the feed water. As such the concentrated impurities will be disposed

of on an as required basis, to the process water dam. The treated potable water will be stored in the potable water tank until required at the process plant.

The tailings storage facility (TSF) would be used to hold the tailings pumped from the detoxification circuit. As the tailings settle recoverable water will be pumped back to the process water dam, with excess water following rains being transferred to the stilling ponds.

The stilling ponds will be used to remove solids from excess water prior to discharge to the river system. The stilling ponds will also be used as pre-discharge treatment point for excess water collected from other locations throughout the process plant. This water will include water collected from select sumps during periods of high rain.

The stilling ponds will also be equipped with pontoon pumps to pump between the ponds, empty ponds during the clean-up of deposited solids, and to enable water to be returned to the process water dam as required.

4.4.2.7 Reagents and Services

The reagents and services area of the process plant will be used for both reagent preparation and storage prior to distribution throughout the process plant. In addition to the reagents for the process key services (fuel and air) will also be stored and prepared within this area.

The reagents will be mixed in a bunded area in covered tanks to prevent heavy rain damaging or causing losses to the reagents. Bunding will be placed around key areas to prevent losses, and also provide additional levels of separation between reactive reagents.

Safety shower and eye wash stations will be installed throughout this area. These include the cyanide circuit safety shower and eyewash station, acid safety shower and eyewash station, caustic safety shower and eyewash station, and the general reagents safety shower and eyewash station. Sumps will be included for containment, based on the bunding used. The sumps will include sumps with associated pumps.

4.4.2.7.1 Cyanide

Cyanide would be used for gold extraction and recovery through the leach circuit, ILR and during elution. The cyanide would be delivered to site in 1,000 kg bags inside a wooden box. The CN bricks within the bags will be loaded into the bag breaker on the cyanide mixing tank. These would be mixed with caustic and raw water by the cyanide mixing tank agitator to form a 20% solution. Sodium hydroxide would be added into tank to achieve a pH of 10-10.5 to prevent formation of hydrogen cyanide gas (HCN) by volatilization.

The mixed solution would be transferred to the cyanide distribution tank where it will be stored and pumped as required to the leach circuit, ILR and elution circuit via a ring main.

The separate bunded area that complies to the International Cyanide Code will keep the cyanide away from other reagents, and HCN monitors will be worn by operators or installed around the plant for the safety of personnel.

4.4.2.7.2 Hydrochloric Acid

Hydrochloric acid would be used during the acid washing stage of the elution cycle. Hydrochloric acid will be delivered to site at 30% HCl. The HCl will be transferred into the 30% hydrochloric acid tote. The acid will be made up to the required concentration as needed within the elution circuit.

4.4.2.7.3 Sodium Hydroxide

Sodium hydroxide (NaOH) will be used for the pre-soak cycle for the elution cycle, as well as emergency pH control through the leach circuit, the ILR and in the cyanide mixing tank. It will be delivered to site as solid pellets in 25 kg bags and transferred into the NaOH distribution tank. The NaOH would be pumped throughout the process plant using the installed distribution pumps.

4.4.2.7.4 Sodium Metabisulphite

Sodium Metabisulphite (SMBS) is one of two reagents which will be used for cyanide destruction and detoxification of the tailings. The SMBS will arrive on site in bulky bags. These would be broken with the bag breaker and mixed via agitator in the SMBS mixing tank. The solution would be pumped to the SMBS distribution tank and when required SMBS would be pumped to the detoxification circuit from the SMBS distribution tank.

4.4.2.8 Water Management

Due to the high level of rainfall expected at the Karouni gold project plant location, many allowances and design considerations have been undertaken in order to manage the high level of water expected around the plant, and prevent the release of any potentially contaminated water into the environment from the process plant.

The plant area is situated in a cleared elevated area underlain by 30 – 40 m of sand cover with very high permeability. No surface water run off has been detected even during very high rainfalls. The plant itself is based on a closed loop for water management with process water being returned from the TFS to a raw process water dam. Because of the need for good access around the plant a saprolite covering would be placed around the plant structure to minimize infiltration of rain water. In order to deal with the potential run off issue the area of ground will be graded to channel any rainwater to a primary stilling water dam which will be followed by a secondary stilling dam to allow time for settling of any solids. The water in the final settling dam will be regularly tested for contaminants prior to release of any water into the surrounding streams. The final settling dam will be equipped with pumps to recover as much water as possible for the plant. Such water will be pumped back to the process water dam.

The water balance of the project indicates the need for an additional 70 m³ per hr after recovery from tailings and parts of the new flow will come from the settling ponds if available.

4.4.2.8.1 Measuring Water Flows

Measuring of water flows into and out of the plant area will be undertaken as part of the operating procedures using density and flow meters for tails and flow meters for incoming fresh water. Since the plant area will have numerous structures with roofs, a system of rain water collection will be implemented to augment water from other sources. All areas containing stores and areas used for workshops will have special parking areas underlain with geo membranes to avoid contamination of the ground in line with the plan to have the project accredited under ISO 14001 E. Nearby streams will be monitored for clarity and contaminants as per appended schedule. It should be noted that the pH of most streams in the area has a current pH of approximately 4.5 – 6.

4.4.2.8.2 Wash Bays

All vehicle wash bays and service areas will be equipped with oil and grease separators with any oil and grease being removed from site by contractors for disposal in Georgetown. Water will be recycled via settling tanks.

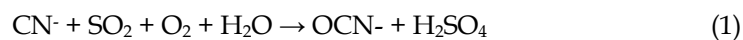
4.4.2.9 Cyanide Destruction Process

The INCO SO₂AIR cyanide destruction process uses a combination of SO₂ and O₂, in the presence of soluble copper, to oxidize cyanide. Both free cyanide (CN⁻) and cyanide weakly complexed with metals such as copper, zinc and nickel are oxidized to form cyanate (OCN⁻), which is less toxic by two orders of magnitude. During the process, the ferro cyanide complexes are removed as insoluble ferrocyanide salts. In addition, a small amount of thiocyanate (SCN⁻) is oxidized.

The slurry to be treated is contacted with the reagents in a simple continuous stirred tank reactor operating at ambient temperatures. Depending upon the composition of the slurry or solution being treated, the retention time may vary; generally, it ranges from 1 to 3 hours. Gaseous or liquid SO₂, soluble sulphite or bisulphite may be used to supply the SO₂ required. The oxygen is normally supplied with the addition of compressed air, or, on occasion, pure oxygen is used. If cyanidation does not leach sufficient copper into solution, copper sulphate is added to catalyse the reaction. The reaction is operated at a controlled pH.

In order to maintain the desired pH, lime is added to neutralize sulphuric acid generated during the process. The operating pH will be dependent upon the individual slurry or solution characteristics and effluent requirements. Typically, the pH is maintained in the range of 8.0 to 9.5.

Sodium cyanide and other alkaline cyanides are extensively used to extract gold and silver from a variety of ores. Dissolution of these precious metals in alkaline cyanide solution to form stable complex cyanide anions depends on excess cyanide in solution. The oxidation of this free cyanide to cyanate in the INCO Process can be represented by the equation:

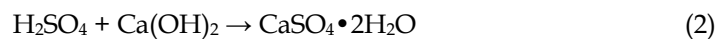


Reaction (1) requires dissolved copper to act as a catalyst. As a result of the cyanidation leaching process, sufficient soluble copper, in the form of a copper cyanide complex, is frequently available in the tailings solution, eliminating the need to add it as a copper sulphate. The theoretical SO₂ requirement, according to reaction (1) above, is 2.46 parts by weight to one part of cyanide; however, the SO₂ dosage is greater due to its consumption by other side reactions.

Oxygen for reaction (1) is provided by bubbling compressed air through the INCO reactor. Due to its low solubility and the low mass transfer rate between the gaseous and liquid phases, only a small fraction of the oxygen is removed from the air as it is bubbled through the reactor; however, once in solution, oxygen readily reacts with the SO₂ to oxidize cyanide. Insufficient oxygen transfer will limit the performance of the reactor.

Temperature has little effect on the cyanide oxidation reaction, but the type of effluent, solution or slurry, can have a large effect on the reaction (usually determined in laboratory test work).

During the test work campaign, it was found that a pH of 9.5 was preferred in the treatment of the Goias Vehlo solution. Normally, the pH is maintained with the addition of lime. Sulphuric acid generated during cyanide oxidation and other oxidation reactions is neutralized with lime in the reactor to form gypsum, as follows:

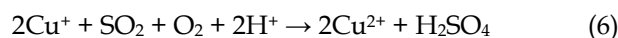


In addition to gold and silver, variable amounts of other metals such as copper, zinc, nickel and iron are leached during the cyanidation process. Generally, metals dissolve only slightly, or their dissolution can be minimized by additional treatment. Reactive sulphides such as pyrrhotite can also react with cyanide to form thiocyanate or produce partially oxidised species such as thiosulphate.

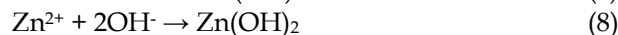
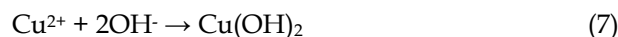
Weakly complexed cyanides of copper, zinc and nickel are dissociated as follows:



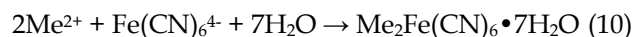
Cuprous copper in solution is oxidised in the INCO Process to the cupric ion, as follows:



Sulphite and thiocyanate will maintain some of the residual Cu^+ in solution as CuSO_3^- or $\text{Cu}(\text{SCN})_2^-$. The liberated metal ions precipitate as metal hydroxides (below) as the liberated cyanide is oxidised to cyanate, according to the equation (1):

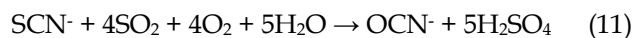


The strongly complexed iron cyanides are not decomposed in the INCO Process, but are removed as insoluble metallo ferrocyanide precipitates, as follows:



Often the feed contains sufficient base metals (Cu^{2+} , Zn^{2+} or Ni^{2+}) for complete and simultaneous precipitation of the ferrocyanide ion. If this is not the case, cupric ions (Cu^{2+}) are usually added to supplement the base metals already present and complete the precipitation.

Generally, less than 10 per cent of the thiocyanate (SCN^-) is oxidised. The reaction is as follows:



The cyanate ion (OCN^-) that is produced is unstable, and hydrolyses to ammonium and carbonate ions, as follows:



This reaction is accelerated at low pH. The carbonate ion precipitates as calcium carbonate. A small amount of the ammonium (NH_4) ion is found to form ammonia (NH_3) and eventually escapes the mill solutions as NH_3 gas; the remainder reports to the solid phases present.

The treated effluent reclaim water becomes saturated with sulphates. These sulphates precipitate with calcium as gypsum whenever the pH is raised. To minimise gypsum scaling in the lines and equipment, reclaim water should only be added where the precipitating gypsum will be predominantly deposited on solid surfaces where it can be worn off by grinding and normal abrasion. Anti-scaling chemicals are frequently added in gold mill circuits to prevent this problem.

Tailings will be pumped continuously to the cyanide destruction circuit. A baffled tank feed will be used to evenly distribute the solution stream within the first reactor and then overflow into the SMBS tank which is series.

The slurry will enter each reactor via down-comer and this is important to prevent short circuiting. Agitation will be used to contact the solution stream with SO₂ and O₂, in order to oxidise the weak-acid dissociable cyanide (CNWAD) contained in the feed. In this case, a solution of sodium metabisulphite, will be used to provide the SO₂ required, and compressed air will be used to supply the O₂. The pH will be maintained with the addition of lime.

Each reactor will be subject to different process upsets and must be controlled separately. It is not sufficient to add the required reagents to the downcomer; reagents should be metered to each process reactor and controlled on an individual basis. It is usual to have greater agitation in these tanks than typical CIP tanks because they are reactors and mixing controls the reaction rate along with time, mass of reactants and flow rate.

Additional rates of Na₂S₂O₅ will be determined by the cyanide load entering the reactor and the recommended dosage of SO₂, as determined by the laboratory test work and optimisation performed during commissioning. Generally, the sodium metabisulphite is added at the top of the reactor, into the vortex of the agitator. The solution is drawn down, by the downward pumping action of the upper axial flow impeller, into the stirred volume of the tank, where it is contacted with the feed stream.

The air will be sparged in at a fixed rate. Generally, 3 to 6 open ended point spargers are used to deliver the air to each reactor. To ensure rapid dispersion and maximise oxygen transfer rates, it will be introduced at the bottom of each reactor, below the lower impeller of the agitator. In order to ensure that sufficient air will be available at all times, a dedicated process air compressor is recommended.

The testwork indicated that the reaction worked most effectively at a pH of 9.5. The treatment pH is very important in this process, and lime must be made available for pH control. During normal operation, lime is added to the inlet downcomer, and when batching is required, it is added to the stirred volume of the tank. Lime would be delivered to the reactors through a distribution loop from the stock tank. A pH probe installed in each reactor will be used to maintain the set point using automatic lime addition via a pinch valve.

4.4.3 Process Water Balance

As an integral part of the design for the Karouni Gold Project, the mass and water balance for the process was determined. This document served to assist with not only the sizing of the plant equipment but also to indicate the water demand required for the plant. The water in the process plant is broken down into the five types below.

- Raw Water indicative of water directly from the wellfield or river to be used as direct plant feed, a feed source for treatment for potable water and a top up source for the process water dam
- Process Water which indicates water to be used or recycled from the process plant. This water would be contained within the process circuit
- Tailings Return Water which represents water that has been collected from the tailings storage facility, both through settling of tailings and collection of rain water
- Potable Water which is water used for personal consumption, ablution and specific process requirements
- Discharge Water which identifies water will only come from excess tailings storage facility return water after passing through the stilling ponds. All water from the tailings storage facility would pass through the detoxification circuit or be collected as rainwater at the tailings storage facility.

This water if available will also be used for dust suppression on the main haulage road as required.

The following assumptions and design parameters were made as part of the process water balance:

- Water would be sourced from the river and/or wellfield
- A pre-leach thickener would be used to both recover water prior to leaching and also maintain slurry density
- The plant would be fed both raw and process water, from their respective water dams
- Raw water would be used for dust suppression in non-bunded areas, process water would be used for wash down in bunded areas, allowing collection and return of this water to the process water dam
- Rainwater collected in bunded is not included as run-off and will be returned to the pre-leach thickener feedwell to be recovered as process water.
- Forty five percent of water discharges to and collected from the tailings storage facility will be returned to the process plant, the remainder will remain in the TSF.
- A net rainfall rate of 2.7 m of rain a year for determining rain water collection. This is based on 4 m of rainfall with 1.3 m of evaporation.
- Potable water would be sourced from a bleed from the raw water for the plant, due to the expected high water quality it is envisioned that only minor treatment will be required (chlorination and filtering). This implies no reverse osmosis is required, and hence no brine will be generated. Should an RO plant be installed, the brine will be returned to the process water dam.
- All material and water sent to the tailings storage facility would be passed through the detoxification circuit
- Excess return water from the tailings storage facility (in excess of the requirements of the process water dam top up) will be passed through stilling ponds to settle out any solids prior to discharge from the plant area
- There will be no external plant discharge of water without this first passing through the detoxification circuit and tailings storage facility

The summary water balance as depicted in Figure 11 below.

Figure 11 - Summary Project Water Balance

5.0 DESCRIPTION OF ALTERNATIVES

This section reviews the factors leading to the decisions regarding the selection of the primary alternatives for the development of mining operations at the PGI Property, including the “No Project” alternative. The physical and ecological environmental and socio-economic impacts associated with the selected alternative will be detailed separately in respective sections of this ESIA.

5.1 No Project Alternative

The “No Project” alternative is not considered viable to PGI, as it would result in the foregoing of economic benefits to Guyana derived from the revenues of the gold production and creation of direct and indirect employment by the project. This alternative would also lead to the necessity of further exploration in other concessions and would not leverage the findings of the exploration and prospecting carried out in this Property to date, thus resulting in greater environmental impacts in areas presently not subject to such activities.

5.2 Mine and Infrastructure Location

The mineral resources within the PGI concessions were first discovered in the early 1900s and have been explored and partially developed since the 1980s by various individuals. The proposed mine location was selected based on the exploration studies performed by PGI. These studies have identified and delimited the resource. There is no alternative location for the mining activities due to absence of other significant findings within the Property. The siting of the tailings dam, the water management area, the mine waste disposal area, and other facilities have been guided by topography and the principles of minimizing the affected area and concentrating the impacts to a single zone within the concession, as well as the IFC/World Bank Group Environment, Health, and Safety Guidelines for Mining.

5.3 Mining and Beneficiation Processes

The resources to be mined consist of both unconsolidated soils and hard rock. The hard rock portion of the deposit can be recovered solely by drilling and blasting. The unconsolidated soils can be removed by wet-extraction and/or dredging operations where both the overburden and ore are hydraulically extracted and transferred to a processing facility. Operation of a wet extraction method would require the creation of artificial lakes within the mining area and will create tailings that are highly saturated and that contain primarily very fine material. Gold can be recovered from the alluvial deposits at the site by mercury amalgamation. Similarly gold can also be recovered from rock by mercury amalgamation after the rock is crushed to a fine pulp.

Pharsalus Gold Inc. will utilize international best practice for all mining and beneficiation processes and will incorporate the IFC/World Bank Group Environment, Health, and Safety Guidelines for Mining in the final design of all facilities and processes. The International Cyanide Management Code for the Manufacture, Transport and Use of Cyanide in the Production of Gold (the Cyanide Code) will be applied to the cyanide management and destruction processes. Wet extraction and mercury amalgamation techniques do not conform to Best Management Practices in the gold mining industry. The cyanidation alternative adopted for the project will result in almost 100% gold recovery.

6.0 EXISTING PHYSICAL ENVIRONMENT

Data collection for the physical environment focused on geology, surface water and groundwater hydrology, topography, soils, benthic sediment, climate and meteorology, ambient air quality, and water quality. The desktop studies included review of data held by the Guyana Geology and Mines Commission (GGMC), The Guyana Environmental Protection Agency, (EPA), and the Guyana Forestry Commission (GFC). Additional data provided by PGI have been incorporated into the definition of physical baseline conditions for the concession.

6.1 Geology, Soils and Topography

The property lies within the Precambrian Guiana Shield which extends across northern South America from east of the Andes to northeastern Brazil. The regional geology of northern Guyana is situated in the northern part of the Archean-Proterozoic Guiana Shield, comprised of a Palaeoproterozoic granite-greenstone terrain with an over-all E-W to NE-SW structural grain. This terrain is considered to be the equivalent of the West-African Palaeoproterozoic Birimian Supergroup metasedimentary/greenstone terrains, which in northern Guyana was originally mapped as being part of the Lower Proterozoic Barama-Mazaruni Supergroup ca. (2200-2000 Ma.). The Barama-Mazaruni Supergroup consists of metasedimentary/greenstone terrains intercalated with Archean-Proterozoic gneisses and intruded by Transamazonian granites and mafic-ultramafics (McConnell and Williams, 1969).

The regional geology is similar to that of other areas within the Bartica-Potaro-Tiboku Triangle. There is however greater development of the lower members of the White Sand Series and coarse volcanic agglomerates present. The strike is prevalently East-Southeast (E.S.E.) with a local variation to east at some locations.

In the East Kaburi area the white sand series surface falls from approximately 120 m above sea level to under 105 m where the white sand is thinner. Yellow and brown sands are well represented in areas where the white sand is thinner. Massive lateritic ironstone covers much of the property. This ironstone is derived from both doleritic and volcanic rocks. No real margin is discernible between the laterite and laterized surface of the volcanic rocks. At lower elevations, usually about 105 m, the laterite sheets thin to only a few centimetres thick and are usually broken up and no longer mappable as a massive ironstone.

The granite which occurs in the area is normally a biotite-feldspar granite. In areas above and below the East Kaburi bridge, it becomes hornblende. In this area it also appears to be auriferous, as gold workings occur entirely in it.

Exposures of solid volcanic rocks are rare in the area. Slightly-sandy, decomposed schists are encountered at some locations. In some locations the thickness of residual material cover is as much as 16 m. Porphyritic felsites with a structure like bostonite, oligoclase-quartz-porphyry, porphyritic rhyolite, and micro-syenite are also present at some locations within the property. Many are well foliated, and probably the most sheared have decomposed to the schistose clay varieties which are only slightly foliated.

A large number of minor dolerite dykes cross the area. A number of them from widely separated localities can be referred to a single magma, and have crystallized as a non-ophitic type with interstitial micropegmatite. Others are typical ophitic dolerites.

The soils on the property have developed in place and consist of unconsolidated deposits derived from residual acidic and basic rocks. (Braun and Derting, 1964).

Figure 12 - Soils Map of the Proposed Project Area and Its Immediate Surroundings



There are three soil map units within the property boundaries, As, La and Qr, classified as Class III, Class III and Class IV respectively as shown on Figure 8. Soil Unit As is an association of deep dominantly well drained yellow and brown sandy clay loam and clay soils with excessively drained deep sand and shallow sandy loam soils occurring at some locations. These soils are encountered on gently rolling to steep dissected white plateaus with crystalline rock exposure and are the result of stratified unconsolidated sandy deposits and weathering of residual acidic materials.

Soil Unit La is an association of deep well and somewhat excessively drained, brown very gravelly sandy loam and gravelly silt loam soils which occurs on sloping, hilly and steep dissected pediments. This soil resulted from the deposition of unconsolidated very gravelly materials derived from laterite concretions and from the weathering of residual acidic and basic rocks.

Soil Unit Qr is a deep excessively and poorly drained white sand soils occurring on gently sloping white sand plateaus and terraces. This soil resulted from deposition of stratified unconsolidated deposits of white quartz sand.

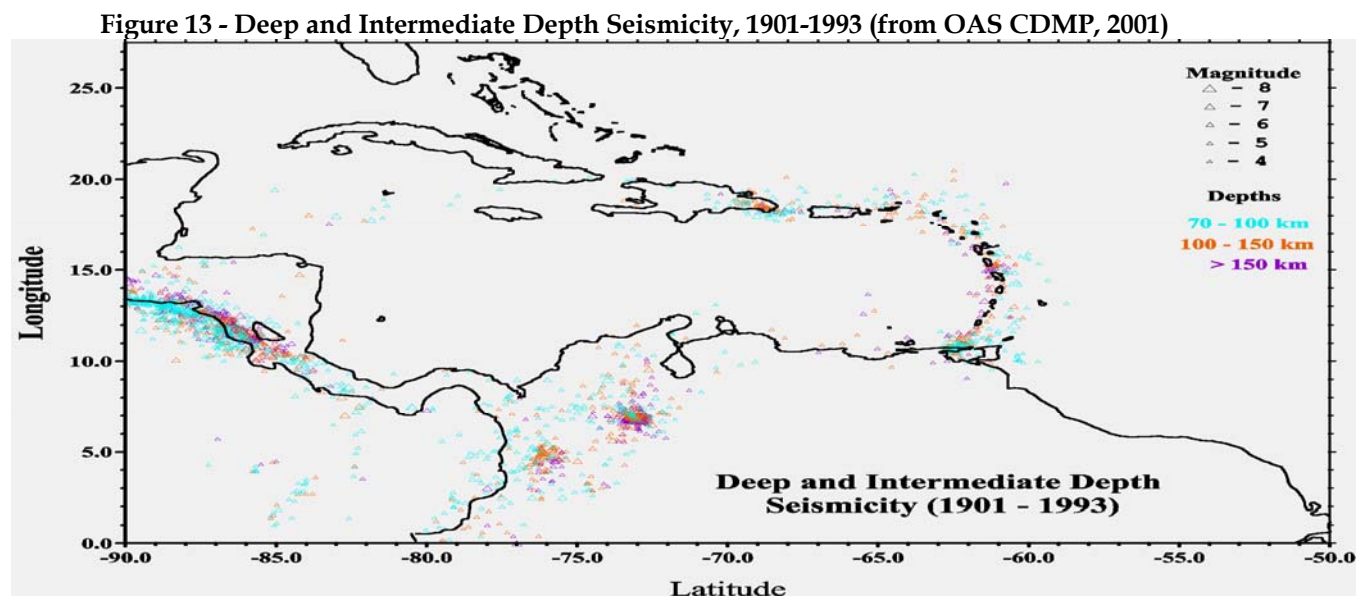
6.2 Natural Hazards

6.2.1 Seismic Activity

Seismicity in the northern part of the South America continent is largely controlled by plate boundary events occurring along the southern rim of the Caribbean Basin. Major earthquakes frequently occur along the plate boundary between the South American and Caribbean Plates. Figures 13 and 14 respectively show the distribution of historical deep seated and shallow earthquakes occurring around the Caribbean Basin. These figures demonstrate that earthquake activity is concentrated in a circular pattern around the perimeter of the Caribbean tectonic plate.

Guyana is located within the South American tectonic plate. The project site is located more than 200 km from the Caribbean and South American plate boundary and is located in an area of low seismic activity.

A search was conducted of the National Oceanic and Atmospheric Administration Earthquake database, which includes data on a half-million earthquakes dating back to 2100 B.C. The results of that search are shown as Figure 15.



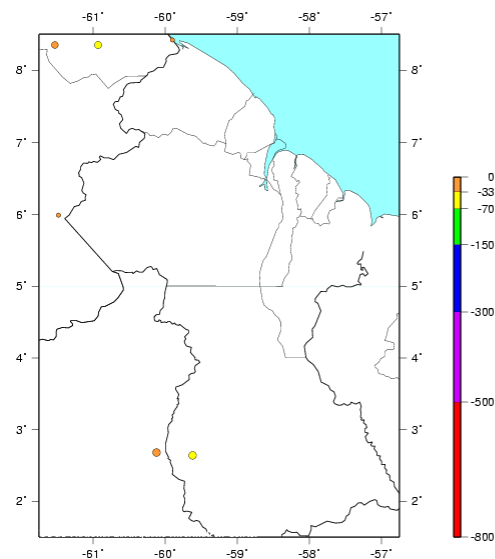
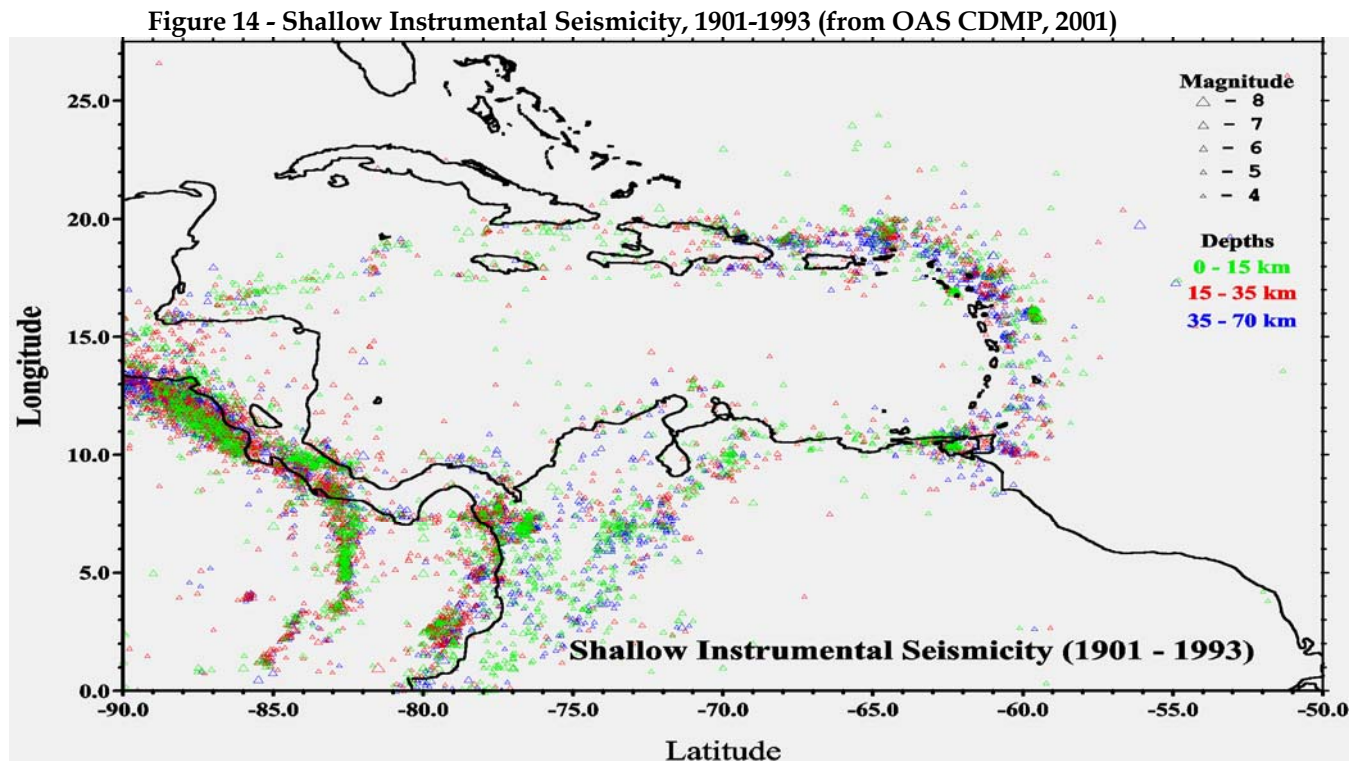


Figure 15 - Earthquake Location within and around Guyana

That search revealed that five events have occurred within recorded history within 300 km of the property. One of these events occurred in Guyana, in 1964, at a point defined by 2.64° North and 59.62° West at a depth of 50 km and with a magnitude of 4.50. The second event occurred almost immediately west of that point in Brazil at a point defined by 2.68° North and 60.12° West. The depth of that event was not recorded. The magnitude of that event was reported as being 4.90. The earthquake occurrence closest

to the site occurred in Venezuela at a point defined by 5.99° North and 61.48° West. The depth and magnitude of that event were not reported.

6.3 Climate and Air Quality

Guyana is located in the Equatorial Trough Zone (ETZ) and its weather and climate are influenced primarily by the seasonal shifts of the ETZ and its associated rain-bands called the Inter Tropical Convergence Zone (ITCZ). Secondary influences on the climate are of Pacific origin. Formation of El Niño and La Niña can disturb the regular location of ITCZ and thus result in higher or lower than normal rainfall at specific locations. The El Niño/La Niña is primarily responsible for inter-annual variations in rainfall. This concession, like the rest of Guyana has a tropical climate and is not subject to extreme variations in temperature and humidity.

There are no major industries in the area. Aerial emissions in the project area are directly related to the emission of gases by rotting trees and other vegetative matter. Some aerial emissions are also related to mining operations in the vicinity of the property. Airborne discharges and particulate matter are not monitored in the area. However, typical guidelines for sulfur emissions specify two levels of allowable emissions. If the region is unpolluted the maximum allowable emissions should not exceed 500 tonnes per day (tpd). If the region is polluted the maximum allowable emissions should not exceed 100 tpd. This criterion is not expected to be exceeded by current aerial emissions.

Rainfall and temperature data has been periodically collected for several locations within the property commencing in 1994. Temperature and rainfall data are available for the Hicks Camp and East Kaburi area. The data is detailed in Appendix A. The available data indicates temperatures within the concession range from a low of 23°C to a high of 43°C. The record also indicates that average weekly precipitation ranges from 0 mm during the period late January-early February to in excess of 60 mm in June. The maximum recorded rainfall over the period of record was in excess of 60 mm and occurred in August 1995. The limited climate data confirms that the dry seasons occur over the periods of Mid-August to Mid-November and Mid-February to Mid-May. The intervening periods are reflective of the occurrence of the wet seasons.

The sole climatic information in the public domain for the project vicinity is rainfall data for Madhia. The Ministry of Agriculture, Hydrometeorological Service (HMS) has maintained a meteorological station at Madhia which is approximately 45 km from the concession. Collection of monthly rainfall data at Madhia commenced in January 1946. The collection of data ceased in February 1992. The record is not continuous but the absence of a few data points does not compromise the quality of the data. The record, depicted as Figure 16 and presented in detail in Appendix B, confirms that two wet and two dry seasons are typically experienced in the project vicinity. The wet periods are between May and August and between November and February. The quantity of monthly rainfall, however, appears to be less in the November-February period. Annual rainfall, based on the existing data, is estimated at about 3660 mm. The maximum and minimum yearly rainfall over the period of record is 6225 and 2432 mm respectively.

No records are available for wind speeds and evaporation in the area. Winds are monitored in the Botanic Gardens in Georgetown. A review of those records reveals that the winds blow primarily from the northeast and east. Winds speeds are highest in March and lowest in July. The average of the higher wind speeds is 7.7 knots. The average of the lower wind speeds is 4.8 knots.

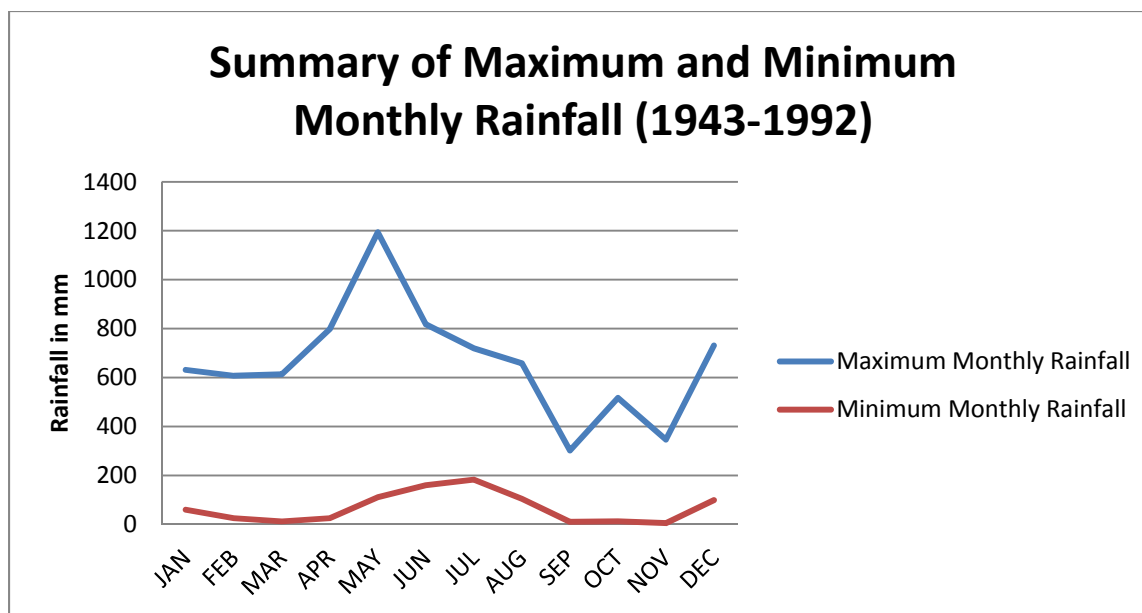


Figure 16 - Summary of Minimum and Maximum Monthly Rainfall at Madhia over the Period of Record

6.4 Surface Water

The southern, northwest-southeast trending boundary of the concession sits approximately on a surface water divide. The primary surface water feature within the concession is the Hit or Miss River. The Kaburi River passes just beyond the northern, northwest-southeast trending boundary of the concession. Secondary drainage features, within the concession, include McDonald Creek, Blackwater Creek and White Sand Creek. McDonald Creek is a tributary of Blackwater Creek which is itself a tributary of the Kaburi River. Blackwater Creek has two branches referred to as Blackwater Creek and Blackwater Main. Both branches flow to the Kaburi River. The location of the tributaries, Hit or Miss and Kaburi Rivers are shown on Figure 17. Both Hit or Miss River and the creek referred to as Blackwater Main run across the entire concession and serve as the ultimate conduit for all precipitation incident on the concession. The Issano Branch Road passing through the concession serves as a surface water divide between the catchments of the Hit or Miss River and Blackwater Main Creek.

The soil present at ground surface is primarily granular material. It is highly likely that most of the precipitation incident on the ground surface infiltrates the ground. Flows in the streams and creeks within the property therefore are probably reflective of groundwater discharge to surface water bodies.

6.4.1 Catchment Area & Flow Volumes

There is very little data available on surface water flow volumes within the concession. The catchment areas for flows in both Blackwater Main and Hit and Miss River, within the concession were approximated from the 1:50,000 topographic map of Figure 17. The catchment areas were respectively approximated to be 3.8 and 3.1 sq.km. No data is available for surface water flows for either Blackwater Main and Hit and Miss River, neither is there any flow data available for the Potaro River.

The nearest location for which hydrologic data streamflow data is available is the Kuribrong River. That data was accumulated during 1982 and is presented in the report titled "Guyana Power Study, Interim Report No. 2". Hydrologic conditions are similar at both Kuribrong River and at the site since both areas are within the watershed of the Potaro River. Consequently surface water flows were approximated for both Blackwater Main and Hit and Miss River based on the ratio of their catchment area to that of the

Kuribrong River. The approximate minimum and maximum flows inferred from flows in the Kuribrong River are presented in Table 10 which also summarizes the catchment area of both Blackwater Main and Hit and Miss River within the concession.

Table 10: Estimated Flow Volumes in Blackwater Main and Hit and Miss Rivers at boundary of Concession

Location	Catchment Area (km ²)	Estimated Streamflow (m ³ /sec)		Month in which Observed	
		Maximum	Minimum	Maximum	Minimum
Blackwater Main	3.8	0.72	0.105	June	October
Hit or Miss River	3.1	0.59	0.086		

Current velocity measurements were recorded for several streams in the concession in both the wet and dry seasons. The points at which the current velocities were recorded are shown on Figure 18. The cross-sections of the streams were simultaneously determined at the points at which the current velocity was recorded. The current velocity measurements were coupled with the cross-section data for each location and the stream flow was estimated for that location. The coordinates of the points and the corresponding stream flow data for the dry and wet seasons are detailed in Table 11. The flows at all points upstream of the concession boundary and within the concession are generally within the range of the flows inferred from the Kuribrong data. The point, PGISW5, is downstream of the concession and flow at that location is reflective of cumulative discharge from points within the concession.

Table 11: Location of Surface water Samples

Date	Point ID	Coordinates		Ground Elevation (m)	Average Depth (m)	Width (m)	Average Velocity (m/s)	Flow (m ³ /s)	Bed Slope
		Northing	Easting						
Sep 25, 2012	PGISW1	622561	274202	86	0.36	6.09	0.30	0.66	0.059
July 1, 2013					1.20	4.00	0.70	3.36	
Sep 25, 2012	PGISW2	622935	265130	84	0.56	2.74	0.05	0.08	0.034
June 28, 2013					0.40	4.55	0.20	0.36	
Sep 25, 2012	PGISW3	625770	267372	72	0.36	7.01	0.16	0.40	0.012
June 28, 2013					1.50	13.00	0.60	11.70	
Sep 25, 2012	PGISW4	620122	273750	69	0.91	4.75	0.16	0.69	0.030
July 1, 2013					0.75	4.00	0.30	0.90	
Sep 25, 2012	PGISW5	622265	276612	58	2.02	18.29	0.11	4.06	0.018
June 28, 2013					3.00	27.00	0.40	32.40	

6.4.2 Surface Water Quality

Surface water samples were recovered from each stream at points coincident with the centerline of the cross-section at which the current velocity were measured during both the dry and the wet season coincident with times at which the flow measurements were made. All surface water samples were tested by Exova Laboratories. The results of analytical tests on surface water samples are shown on Table 12 and 13 for the dry season and wet season respectively. The IFC effluent guidelines are also tabulated in the last column of that table for comparison.

Figure 17 - Surface Water Hydrology Map of Property

Figure 18 - Location of Surface Water Measurements and Samples

Table 12: Results of Analytical Tests on Surface Water Samples Recovered during Dry Season

LAB ID:								IFC Effluent Guidelines
Sample Date:			25-09-2012	25-09-2012	25-09-2012	25-09-2012	25-09-2012	
Sample ID:			PGISW1	PGISW2	PGISW3	PGISW4	PGISW5	
PARAMETER	UNITS	MRL						
Conductivity	uS/cm	5	22	33	19	22	25	
Cyanide (free)	mg/L	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.1
Cyanide (total)	mg/L	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	1
N-NH3 (Ammonia)	mg/L	0.02	0.06	0.08	0.05	0.05	0.04	
N-NO2 (Nitrite)	mg/L	0.1	<0.10	<0.10	<0.10	<0.10	<0.10	
N-NO3 (Nitrate)	mg/L	0.1	0.14	0.21	0.17	0.25	0.14	
pH			4.64	4.17	4.96	4.53	4.41	6-9
Phenols	mg/L	0.001	<0.005	<0.001	<0.001	<0.001	<0.001	0.5
Total Dissolved Solids (COND - CALC)	mg/L	1	14	21	12	14	16	
Total Suspended Solids	mg/L	2	106	<2	142	7	11	50
Turbidity	NTU	0.1	0.4	277	29.0	427	50.7	
Calcium	mg/L	1	<1	<1	<1	<1	<1	
Magnesium	mg/L	1	<1	<1	<1	<1	<1	
Potassium	mg/L	1	<1	<1	<1	<1	<1	
Sodium	mg/L	2	<2	<2	<2	<2	<2	
Aluminum	mg/L	0.01	5.3	0.24	4.3	3.6	1.2	
Antimony	mg/L	0.0005	<0.01	<0.0005	<0.01	<0.01	<0.01	
Arsenic	mg/L	0.001	<0.05	<0.001	<0.05	<0.05	<0.05	0.1
Barium	mg/L	0.01	0.01	<0.01	<0.01	<0.01	<0.01	
Beryllium	mg/L	0.0005	<0.01	<0.0005	<0.01	<0.01	<0.01	
Boron	mg/L	0.01	<0.1	<0.01	<0.1	<0.1	<0.1	
Cadmium	mg/L	0.0001	<0.01	<0.0001	<0.01	<0.01	<0.01	0.05
Chromium	mg/L	0.001	<0.05	<0.001	<0.05	<0.05	<0.05	0.1
Cobalt	mg/L	0.0002	<0.01	<0.0002	<0.01	<0.01	<0.01	
Copper	mg/L	0.001	0.02	<0.001	<0.01	<0.01	<0.01	0.3
Iron	mg/L	0.03	4.0	0.14	5.9	2.1	1.3	2.0
Lead	mg/L	0.001	<0.01	<0.001	<0.01	<0.01	<0.01	0.2
Manganese	mg/L	0.01	0.04	<0.01	0.02	0.02	<0.01	
Mercury	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.002
Molybdenum	mg/L	0.005	<0.01	<0.005	<0.01	<0.01	<0.01	
Nickel	mg/L	0.005	<0.01	<0.005	<0.01	<0.01	<0.01	0.5
Selenium	mg/L	0.001	<0.05	<0.001	<0.05	<0.05	<0.05	
Silicon	mg/L	0.1	2.6	1.2	2.8	2.0	3.5	
Silver	mg/L	0.0001	<0.01	<0.0001	<0.01	<0.01	<0.01	
Strontium	mg/L	0.001	<0.05	0.001	<0.05	<0.05	<0.05	
Thallium	mg/L	0.0001	<0.01	<0.0001	<0.01	<0.01	<0.01	
Titanium	mg/L	0.01	<0.1	<0.01	<0.1	<0.1	<0.1	
Vanadium	mg/L	0.001	<0.05	<0.001	<0.05	<0.05	<0.05	
Zinc	mg/L	0.01	<0.05	<0.01	<0.05	<0.05	<0.05	0.5
Oil & Grease - Mineral	mg/L	1	<1	<1	<1	<1	<1	10
Oil & Grease - Non-mineral	mg/L	1	<1	<1	<1	<1	<1	
Oil & Grease - Total	mg/L	1	<1	<1	<1	<1	<1	

MRL = Method Reporting Limit

Table 13: Results of Analytical Tests on Sediment Samples Recovered in the Dry Season

LAB ID:			989119	989120	989121	989122
Sample Date:			25-09-2012	25-09-2012	25-09-2012	25-09-2012
Sample ID:			PGISW1	PGISW2	PGISW3	PGISW5
PARAMETER	UNITS	MRL				
Cyanide (free)	ug/g	0.3	<2	<0.3	<2	<3
Cyanide (total)	ug/g	0.3	<2	<0.3	<2	<3
Loss on Ignition (@550C)	%	0.1	1.1	0.2	2.5	4.5
Total Organic Carbon	%	0.01	0.43	0.19	0.55	0.39
Calcium	ug/g	100	200	<100	200	100
Magnesium	ug/g	100	100	<100	100	<100
Potassium	ug/g	100	<100	<100	100	<100
Sodium	ug/g	100	100	<100	<100	<100
Aluminum	ug/g	5	3020	67	5570	12400
Antimony	ug/g	1	<1	<1	<1	<1
Arsenic	ug/g	1	<1	<1	<1	2
Cadmium	ug/g	0.5	<0.5	<0.5	<0.5	<0.5
Chromium	ug/g	1	5	<1	25	270
Cobalt	ug/g	1	<1	<1	<1	1
Copper	ug/g	1	4	<1	6	15
Iron	ug/g	5	1430	35	5370	53700
Lead	ug/g	1	1	<1	2	2
Manganese	ug/g	1	10	<1	20	27
Mercury	ug/g	0.1	<0.1	<0.1	<0.1	<0.1
Molybdenum	ug/g	1	<1	<1	<1	1
Nickel	ug/g	1	3	<1	5	8
Selenium	ug/g	1	<1	<1	<1	1
Zinc	ug/g	2	5	<2	6	10

The results of the surface water quality analyses returned elevated levels of iron and suspended solids. The pH values were also lower than the IFC guideline range. Values outside of the guideline ranges are shown in yellow on Tables 11 and 12. The elevated levels of iron are probably reflective of metals dissolution by the low pH water. The elevated levels of sediments, recorded during the dry season cannot be reflective of sediment in rainfall runoff. It is highly likely representative of discharges from artisanal mining operations within proximity of the concession.

Sediment samples were also recovered from locations where surface water samples were recovered to conform to EPA guidelines. Samples were recovered from the bed of the creeks/ rivers exactly below the points at which surface water samples were recovered. The sediment samples were analyzed for the parameters mandated by the EPA. Results of analyses on sediment samples are detailed in Tables 13 and 14. No results are shown for PGISW4, for the dry season, since the bottles containing that sample broke during transit to the laboratory.

6.5 Groundwater Resources

Very little data is available on groundwater flow parameters in the concession area. A groundwater hydrology program was undertaken to define the regional groundwater flow regime in the concession area. A single well nest was installed in the concession area in the dry season and four additional well nests were installed in the wet season. The location of each well nest is shown on Figure 19.

Figure 19 - Location of Groundwater Well Nests

One well nest was located within the footprint of the area identified for the tailings pond and another within the footprint of the area identified for the process plant. Wells were screened in alluvials, saprolite and bedrock at each location. The hydraulic conductivity of the alluvial, saprolite and bedrock were determined by conducting rising head hydraulic conductivity (Slug) tests in alluvials and saprolite and packer tests in the bedrock. The slug test consisted of displacing the water in the well and monitoring the return of the water level to its pretest level over time. The Packer Test consisted of isolating a section of the borehole using inflatable packers and injecting water into the isolated section and recording the water losses into the rock over time.

Groundwater levels were recorded at all wells at the same time to provide data on vertical and horizontal flow gradients. Groundwater levels in wells were reduced to elevation values based on the ground surface elevations obtained by GPS.

The stratigraphic profile within the concession generally consists of a zone of alluvial soil which has been completely weathered to soil with no remaining structure of the rocks from which the soils were formed being visible. The alluvials are underlain by Saprolite. The saprolite is representative of a portion of the weathered profile which has retained the original fabric and structure of the parent rock. Saprolite differs from weathered rock in degree of alteration. It is material that is sufficiently broken down that it can be augered through or dug with a shovel yet it retains the original rock structure (Anderson & Anderson, 2010). The retention of the rock structure implies that the saprolite has undergone no strain. The saprolite is underlain by weathered rock or Saprock which constitutes the transition zone between saprolite and bedrock. In this zone intact rock material is present in a discontinuous framework separated by soil-like material. Typically saprock is defined by having a rock content of 50 % or more. The rock material can be present in various states of weathering from highly weathered to fresh. Significant zones of soil like material can be encountered within a saprock zone due to preferential local weathering. The saprock is underlain by a stratum of intact rock with no indication of weathering.

6.6 Flow Gradients

The groundwater elevations in the wells were recorded simultaneously during the wet season. No groundwater was encountered during the wet season in the wells screened in the alluvial deposits at Smarts and Hick Pits, however, groundwater levels recorded elsewhere in the alluvials were generally in excess of the groundwater levels recorded in the saprolite deposit at the same well nest. This is indicative of a downward flow gradient from the alluvial deposit into the saprolite. No discernible confining layer was encountered at the interface between the alluvials and saprolite. The variation in groundwater levels between these two formations is highly likely a reflection of the saprolite itself acting as a confining layer.

Groundwater levels in the saprolite were in excess of the groundwater level recorded in the bedrock. Similarly no discernible confining layer was encountered at the interface between the saprolite and bedrock. The variation in groundwater levels between these two formations is highly likely a reflection of the bedrock itself acting as a confining layer.

Groundwater levels for all wells in alluvials were assembled with the associated well location data and a potentiometric map was developed for the alluvial stratum. The data used for the alluvial stratum is detailed in Table 16 and the associated map of the potentiometric surface is depicted as Figure 20. The potentiometric levels were developed by extrapolation between points where groundwater elevations were recorded. It should be established that the data may not be exactly accurate because of the distance between ground water level measurements and the relatively low number of values.

Table 14: Results of Analytical Tests on Surface Water Samples Recovered during Wet Season

			1056266	1056267	1056268	1056269	1056270	IFC Effluent Guidelines
Sample Date			2013-09-01	2013-09-01	2013-09-01	2013-09-01	2013-09-01	
Parameter	Units	MRL	PG1SW1	PG1SW3	PG1SW2	PG1SW4	PG1SW5	
Conductivity	uS/cm	5	21	18	35	18	22	
Cyanide (free)	mg/L	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.1
Cyanide (total)	mg/L	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	1.0
N-NH3 (Ammonia)	mg/L	0.02	0.06	0.07	<0.02	0.03	<0.02	
N-NO2 (Nitrite)	mg/L	0.1	<0.10	<0.10	<0.10	<0.10	<0.10	
N-NO3 (Nitrate)	mg/L	0.1	0.2	0.13	0.12	0.19	0.1	
pH		1	4.92	4.94	4.05	4.88	4.54	6-9
Phenols	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.5
Total Dissolved Solids (COND - CALC)	mg/L	1	14	12	23	12	14	
Total Suspended Solids	mg/L	2	306	76	<2	10	22	50
Turbidity	NTU	0.1	>100	>100	9	86.6	62.4	
Calcium	mg/L	1	<1	<1	<1	2	<1	
Magnesium	mg/L	1	<1	<1	<1	<1	<1	
Potassium	mg/L	1	<1	<1	<1	<1	<1	
Sodium	mg/L	2	<2	<2	<2	<2	<2	
Aluminum	mg/L	0.1	5.7	6.5	0.3	2.4	1.6	
Antimony	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
Arsenic	mg/L	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.1
Barium	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
Beryllium	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	
Boron	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
Cadmium	mg/L	0.008	<0.008	<0.008	<0.008	<0.008	<0.008	0.05
Chromium	mg/L	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.1
Cobalt	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
Copper	mg/L	0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.3
Iron	mg/L	0.1	4.6	9.1	0.1	3.1	1.8	2
Lead	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.2
Manganese	mg/L	0.01	0.02	0.04	<0.01	0.02	0.01	
Mercury	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.002
Molybdenum	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
Nickel	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.5
Selenium	mg/L	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	
Silicon	mg/L	0.1	2.6	1.2	2.8	2	3.5	
Silver	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	
Strontium	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	
Thallium	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	
Titanium	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	

Vanadium	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	
Zinc	mg/L	0.04	<0.04	<0.04	<0.04	<0.04	<0.04	0.5
Oil & Grease - Mineral	mg/L	1	<1	<1		<1	<1	
Oil & Grease - Non-mineral	mg/L	1	<1	<1		<1	<1	
Oil & Grease - Total	mg/L	1	<1	<1		<1	<1	10
Acidity as CaCO3	mg/L	5	23	21	20	20	22	
Alkalinity as CaCO3	mg/L	5	<5	<5	<5	<5	<5	
Chlorine	mg/L	1	2	2	1	2	2	
Flouride	mg/L	0.1	<0.10	<0.10	<0.10	<0.10	<0.10	
HCO3 as CaCO3	mg/L	1	<1	<1	<1	<1	<1	
Total Kjeldahl Nitrogen	mg/L	0.1	1.09	1.03	0.67	0.6	0.55	

Table 15: Results of Analytical Tests on Sediment Samples Recovered in the Wet Season

Sample Date			2013-09-01	2013-09-01	2013-09-01	2013-09-01	2013-09-01
Analyte	Units	MRL	PG1SW1	PG1SW2	PG1SW3	PG1SW4	PG1SW5
Cyanide (free)	ug/g	0.05	<0.05	<0.05	<0.05	<0.05	0.1
Cyanide (total)	ug/g	0.05	0.05	0.05	<0.05	0.05	0.1
Loss on Ignition (@550C)	%	0.1	0.7	2.3	0.4	0.8	13
Total Organic Carbon	%	0.01	0.11	0.35	0.18	0.2	1.71
Calcium	ug/g	1	<0.1	<0.1	<0.1	<0.1	<0.1
Magnesium	ug/g	1	<0.1	<0.1	<0.1	<0.1	<0.1
Potassium	ug/g	1	<0.1	<0.1	<0.1	<0.1	<0.1
Sodium	ug/g	1	<0.1	<0.1	<0.1	<0.1	<0.1
Aluminum	ug/g	5	1220	6410	549	894	25700
Antimony	ug/g	1	<1	<1	<1	<1	<1
Arsenic	ug/g	1	<1	<1	<1	<1	2
Cadmium	ug/g	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chromium	ug/g	1	20	25	2	4	154
Cobalt	ug/g	1	<1	2	<1	<1	3
Copper	ug/g	1	2	8	6	2	41
Iron	ug/g	5	1260	2520	3050	936	87300
Lead	ug/g	1	<1	2	<1	<1	5
Manganese	ug/g	1	8	21	3	5	77
Mercury	ug/g	0.1	<0.1	<0.1	<0.1	<0.1	0.2
Molybdenum	ug/g	1	<1	<1	<1	<1	1
Nickel	ug/g	1	9	14	<1	1	9
Zinc	ug/g	2	<2	7	<2	2	17
Selenium	ug/g	1	<1	<1	<1	<1	1

Table 16: Groundwater Elevations in Alluvial Deposit

Location	Monitoring Well ID	Coordinates		Response Zone	Ground Elevation (m)	Groundwater Elevation (m)
		Northing(m)	Easting(m)			
Processing Plant	Plant A	271540	620800	Alluvials	118.00	96.9
Tailings Management Area	Tailings A	272285	619930	Alluvials	78	76.1
Smarts Pit	Smarts A	270300	621875	Alluvials	109.00	Not Encountered
Hicks Pit	Hicks A	273875	619440	Alluvials	70	Not Encountered
	PGIGW1C	268814	619449	Alluvials	102	86

Similarly data was used to develop potentiometric maps for the saprolite stratum and bedrock at the site. The data used for the saprolite stratum and bedrock are presented in Tables 17 and 18 respectively. The potentiometric maps developed based on the information in Tables 17 and 18 are shown depicted on Figure 21 and 22 respectively. All potentiometric level maps were developed by extrapolation between points where groundwater elevations were recorded. It should be established that the data may not be exactly accurate because of the distance between ground water level measurements and the relatively low number of values.

Table 17: Summary of Groundwater Elevations in Saprolite

Location	Monitoring Well ID	Coordinates		Response Zone	Ground Elevation (m)	Groundwater Elevation (m)
		Northing (m)	Easting (m)			
Processing Plant	Plant B	271540	620800	Saprolite	118	91.7
Tailings Management Area	Tailings B	272285	619930	Saprolite	79	75.3
Smarts Pit	Smarts B	270300	621875	Saprolite	111	81.9
Hicks Pit	Hicks B	273875	619440	Saprolite	72	59.2
	PGIGW1B	268790	619454	Saprolite	103	86.6

Table 18: Summary of Groundwater Elevations in the Bedrock

Location	Monitoring Well ID	Coordinates		Response Zone	Ground Elevation (m)	Groundwater Elevation (m)
		Northing (m)	Easting (m)			
Processing Plant	Plant C	271540	620800	Bedrock	119	90.5
Tailings Management Area	Tailings C	272285	619930	Bedrock	78	74.5
Smarts Pit	Smarts C	270300	621875	Bedrock	120	100.0
Hicks Pit	Hicks C	273875	619440	Bedrock	71	58.6
	PGIGW1A	268800	619435	Bedrock	Not Recorded: Bees Present at Location	

Since the groundwater elevations differed at each well nest, the formations are very likely hydraulically isolated with leakage between the formations. The horizontal flow gradients were computed by identifying potentiometric lines that were farthest and closest apart. Since horizontal flow occur perpendicular to the potentiometric lines, maximum and minimum hydraulic gradients respectively will be perpendicular to the closest and farthest spaced potentiometric lines. The maximum and minimum horizontal flow gradient equate to approximately 0.0004 and 0.00008.

Figure 20 - Potentiometric Map for Alluvial Zone at Pharsalus Gold Mine Site

Figure 21 - Potentiometric Map for Saprolite Zone at Pharsalus Gold Mine Site

Figure 22 - Potentiometric Map for Bedrock Zone at Pharsalus Gold Mine Site

The potentiometric maps in all instances indicate groundwater flow primarily towards the northwest, however there appears to be some indication of a localized peak in groundwater elevation in the saprolite aquifer in the south central part of the concession. The data is inadequate to determine interconnection between groundwater flow and the surface water bodies flowing through the concession.

The difference in groundwater elevations at each well nest is indicative of the existence of vertical flow between the hydrologic formations at the site. The vertical flow gradient between the alluvial and saprolite deposit ranged from -0.0316 to 0.274. The vertical flow gradient between the saprolite deposit and bedrock ranged from -2.463 to 0.11.

Hydraulic conductivity values for the alluvials, saprolite and bedrock are summarized in Tables 19 thru 21 respectively.

Table 19: Summary of Hydraulic Conductivity of Alluvial Stratum

Location	Monitoring Well ID	Measured Coordinates		Response Zone	Hydraulic Conductivity (cm/sec)
		Northing (m)	Easting(m)		
Processing Plant	Plant A	271540	620800	Alluvials	4.86E-05
Tailings Management Area	Tailings A	272285	619930	Alluvials	3.61E-05
Smarts Pit	Smarts A	270300	621875	Alluvials	2.00E-05
Hicks Pit	Hicks A	273875	619440	Alluvials	2.05E-04
	PGIGW1C	268814	619449	Alluvials	2.57E-04

The hydraulic conductivity of the alluvial soils at the site is therefore equated to approximately 10^{-5} cm/sec.

Table 20: Summary of Hydraulic Conductivity of Saprolite Stratum

Location	Monitoring Well ID	Measured Coordinates		Response Zone	Hydraulic Conductivity (cm/sec)
		Northing (m)	Easting (m)		
Processing Plant	Plant A	271540	620800	Saprolite	3.64E-05
Tailings Management Area	Tailings A	272285	619930	Saprolite	1.55E-04
Smarts Pit	Smarts A	270300	621875	Saprolite	5.31E-05
Hicks Pit	Hicks A	273875	619440	Saprolite	8.91E-05
	PGIGW1B	268790	619454	Saprolite	1.07E-05

The hydraulic conductivity of the saprolite stratum at the site is therefore equated to approximately 10^{-5} cm/sec.

Table 21: Summary of Hydraulic Conductivity of Bedrock

Location	Borehole/Monitoring Well ID	Measured Coordinates		Response Zone	Hydraulic Conductivity (cm/sec)
		Northing (m)	Easting (m)		
Processing Plant	Plant C	271540	620800	Bedrock	2.80E-05
Tailings Management Area	Tailings C	272285	619930	Bedrock	2.69E-04
Smarts Pit	Smarts C	270300	621875	Bedrock	1.51E-04

Hicks Pit	Hicks C	273875	619440	Bedrock	No Take
	PGIGW1A	268800	619435	Bedrock	2.57E-05

The hydraulic conductivity of the bedrock at the site is therefore equates to approximately 10^{-4} cm/sec.

6.7 Groundwater Quality

The vertical hydraulic flow gradients were used to determine the well sampled at each well nest. The groundwater samples were tested for parameters mandated by the Guyana Environmental Protection Agency (EPA) for mine site operations. These guidelines mandate that groundwater associated with mining operations must be analyzed for pH, TDS, TSS, turbidity, conductivity, organic compounds (phenol and oil and grease), major anions (Ca, Mg, Na, K), nutrients (TKN, total ammonia, phosphate, nitrate + nitrite), trace metals (Al, As, Cd, Co, Cr, Cu, Fe, Hg, Mn, Mo, Ni, Pb, Se, Sb, Zn). The parameters encompass the parameters mandated by the IFC in Table 1, "Effluent Guidelines, Environmental, Health and Safety Guidelines for Mining". The list of parameters was expanded to include tests for cyanide (both free and total). The results of analytical tests on groundwater samples recovered during the wet season are detailed in Table 22.

Table 22: Results of Analytical Tests on Groundwater Samples

Sample Date			2013-09-01	2013-09-01	2013-09-01	2013-09-01	IFC Effluent Guidelines
Parameter	Units	MRL	PG1PA1	PG1TA1	PG1SP1	PG1HP1	
Acidity as CaCO ₃	mg/L	5	<5	<5	<5	<5	
Al	mg/L	0.1	92.3	19.8	13.8	17.9	
Alkalinity as CaCO ₃	mg/L	5	32	171	61	22	
As	mg/L	0.02	<0.02	<0.02	<0.02	<0.02	0.1
Ca	mg/L	1	13	19	24	10	
Cd	mg/L	0.008	<0.008	<0.008	<0.008	<0.008	0.05
Cl	mg/L	1	2	30	2	2	
Co	mg/L	0.01	0.06	<0.01	<0.01	<0.01	
Conductivity	uS/cm	5	81	1470	131	52	
Cr	mg/L	0.05	0.18	<0.05	0.13	0.09	0.10
Cu	mg/L	0.01	0.16	0.03	0.05	0.03	0.3
Cyanide (free)	mg/L	0.005	<0.005	<0.005	<0.005	<0.005	0.1
Cyanide (total)	mg/L	0.005	<0.005	<0.005	<0.005	<0.005	1.0
F	mg/L	0.1	<0.10	0.38	<0.10	<0.10	
Fe	mg/L	0.1	151	12.6	24.9	40.9	2.0
HCO ₃ as CaCO ₃	mg/L	1	32	171	61	22	
Hg	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.002
K	mg/L	1	2	3	<1	<1	
Mg	mg/L	1	2	6	<1	<1	
Mn	mg/L	0.01	1.98	0.33	0.17	0.1	
Mo	mg/L	0.01	<0.01	0.02	<0.01	<0.01	
Na	mg/L	2	11	276	4	<2	
Ni	mg/L	0.01	0.1	0.02	0.02	0.01	0.5
N-NH ₃	mg/L	0.02	0.17	<0.02	0.31	0.08	
N-NO ₂	mg/L	0.1	<0.10	<0.10	<0.10	<0.10	

N-NO3	mg/L	0.1	0.9	<0.10	0.36	0.31	
Oil & Grease – Mineral	mg/L	1		<1		<1	
Oil & Grease - Non-mineral	mg/L	1		<1		2	
Oil & Grease – Total	mg/L	1		<1		2	10
Pb	mg/L	0.01	0.02	0.04	0.01	<0.01	0.2
pH		1	6.98	7.71	7.13	6.6	6-9
Phenols	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	0.5
PO4	mg/L	0.09	<0.09	0.44	<0.09	<0.09	
Sb	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	
Se	mg/L	0.02	<0.02	<0.02	<0.02	<0.02	
SO4	mg/L	3	3	388	<3	<3	
TDS (COND - CALC)	mg/L	1	53	1030	85	34	
Total Kjeldahl Nitrogen	mg/L	0.5	3.88	2.36	4.8	1.86	
Total Suspended Solids	mg/L	2	465	91	560	503	50
Turbidity	NTU	0.1	>100	>100	>100	78.1	
Zn	mg/L	0.04	1.68	0.09	0.36	0.09	0.5

6.8 Archaeological Resources

Some artisanal mining activities are occurring and have occurred in the concession in the past. The site itself is located in the Middle Mazaruni area. Colchester et. al., 2002 details the settlement pattern of the indigenous Akawaio since colonial times. The mine site would have been encompassed by former Akawaio settlements and is contained within the Mazaruni Amerindian Reserve demarcated in 1904. This demarcation was reduced to the Upper Mazaruni Amerindian District in 1959. There are no records of any immigrant activity in the area. There is no evidence above ground surface of historical buildings or sites left over from settlements formerly in the area and there do not appear to be any heritage issues local to the proposed mine site.

6.9 Odor, Noise and Dust

Noise levels were recorded at several locations within the concession. A summary of noise levels and the locations recorded are detailed in Table 23. Noise levels within the concession range from a low of 5dB to a high of 91dB with the higher levels being indicative of noise associated with the exploration drilling operation.

Table 23: Summary of Recorded Noise Levels

Point ID	Coordinates		Noise Level(dB)	Time	Date	Description of Location
	Northing	Easting				
PGISW1	622561	274202	52	12:30pm	25-09-2012	Trees, Bushes and Stream
PGISW2	622935	265130	58	7:10am	25-09-2012	Trees, Bushes and Stream
PGISW3	625770	267372	52	8:35am	25-09-2012	Trees, Bushes and Stream
PGISW4	620122	273750	52	4:30pm	25-09-2012	Trees, Bushes and Stream
PGISW5	622265	276612	51	10:15am	25-09-2012	Trees, Bushes and Stream
14 Mile Landing	622555	270110	77	9:25am	25-09-2012	Accommodations, Restaurants, Grocery Shops, Beer Gardens and Internet Cafe
PGI Camp Site	619223	273724	56	2:20pm	25-09-2012	Accommodations, Kitchen, Offices, Coreshed and Mechanic Shop

RC Drill Rig	619810	273002	85	1:35pm	25-09-2012	Reverse circulation drill rig surrounded by trees and bushes
Diamond Drill Rig	619059	273720	91	5:10pm	25-09-2012	Orbit hydraulic diamond rig surrounded by trees and bushes

Some odors may be generated by food waste and kitchen scraps from the camp kitchen. Kitchen waste is however disposed in a pit at the mine site. The pit is covered at the end of every day to preclude animals from scavenging the waste. This provides effective control of odors emitted at the mine site.

There is one main road at the mine site and several service roads which were built to access exploration locations. Dust is emitted from the road surfaces during the dry periods.

7.0 BIOLOGICAL RESOURCES

The biodiversity baseline compilation was designed to track both spatial and temporal trends in the biodiversity of the Concession in periods corresponding to a single wet and a single dry season in Guyana. The primary mechanism utilized for development of the biodiversity baseline consisted of field surveys of the area to capture both spatial and temporal variations. Spatial variations in biodiversity were captured by the establishment of discrete sample squares in areas based on topography, forest/vegetation ecosystem types present in the area, and the level of disturbance. Temporal variations were captured by sampling the exact locations during both a single wet and a single dry season.

The purpose of the biodiversity study was to determine whether there are any rare, threatened/endangered species or critical habitats within the Concession. The study expanded on the biodiversity baseline previously done for the Karouni Area in 1996 by Micheal Bradley for the then owners of the Concession, Cathedral Gold Corporation. The area of focus of the biodiversity surveys is depicted in Figure 23 below.

The biodiversity study was designed to conform to the Guyana Environmental Protection Agency (EPA) guidelines and to the IFC Performance Standards (PS) 6; Biodiversity Conservation and Sustainable Management of Living Natural Resources. The objectives of the biodiversity survey were as follows:

- to compile an inventory of species within and around the Concession;
- to identify endemic plants and animals, rare and endangered species;
- to identify the use of terrestrial and aquatic plants and animals by people ; and
- to identify sensitive/critical ecological habitats.

Using baseline data gathered from the Concession, critical habitat was determined by the presence of habitat with high biodiversity value as described in the IFC PS 6. The following IFC PS 6 criteria were used to determine high biodiversity value:

- habitats required for the survival of critically endangered or endangered species (as defined by the International Union for the Conservation of Nature (IUCN) Red List of Threatened Species or National Legislation);
- areas having special significance for endemic or restricted-range species;
- sites that are critical for the survival of migratory species;
- areas supporting globally significant concentrations or numbers of congregatory species; and
- areas with unique assemblages of species or which are associated with key evolutionary processes.

The conformance to PS-6 objectives was determined by comparing species recorded by the field surveys to a list maintained by the IUCN. The Convention on the International Trade of Endangered Species (CITES) was used to determine and classify species which are rare or endangered and are prohibited from international trade.

The IUCN defines species according to their likelihood of extinction and produces a Red List, which includes internationally recognized flora and fauna. CITES produces a list of threatened or endangered animals listed in three Appendices based on level of threat. The criteria for the IUCN and CITES classifications are provided in Table 24.

Figure 23 - Area of Focus of the Biodiversity Baseline Study (Bordered in Yellow)

Table 24: IUCN and CITES Classifications

IUCN	CITES
Extinct (E) - A taxon is Extinct when there is no reasonable doubt that the last individual has died. A taxon is presumed Extinct when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual.	CITES Appendix 1: Includes all species in danger of extinction that are, or that can be affected by trade. The commercial trade of these species is subject to very strict regulations, in order not to endanger survival of the species, and is only authorized under exceptional circumstances.
Extinct in the Wild (EW) - A taxon is Extinct in the Wild when it is known only to survive in cultivation, in captivity or as a naturalized population (or populations) well outside the past range. A taxon is presumed Extinct in the Wild when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual.	CITES Appendix 11: Includes those species that are not currently in danger of extinction, but may become so in the future if their commercial trade is not strictly regulated. Other species not affected by trade are also subject to regulations, in order to allow the effective control of the trade of the species mentioned above.
Critically Endangered (CR) - A taxon is Critically Endangered when the best available evidence indicates that it meets any of the criteria A to E for Critically Endangered (see 2001 IUCN Redlist Categories and Criteria Version 3.1), and it is therefore considered to be facing an extremely high risk of extinction in the wild.	CITES Appendix 111: Includes species that are subject to jurisdictional regulations anywhere, with the objective of preventing or restricting their exploitation, and requires the cooperation of all districts to control the trade.
Endangered (EN): A taxon is Endangered when the best available evidence indicates that it meets any of the criteria A to E for Endangered (see 2001 IUCN Redlist Categories and Criteria Version 3.1), and it is therefore considered to be facing a very high risk of extinction in the wild.	
Vulnerable (VU): A taxon is Vulnerable when the best available evidence indicates that it meets any of the criteria A to E for Vulnerable (see 2001 IUCN Redlist Categories and Criteria Version 3.1), and it is therefore considered to be facing a high risk of extinction in the wild.	
Near Threatened (NT): A taxon is Near Threatened when it has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future.	
Least Concern (LC): A taxon is Least Concern when it has been evaluated against the criteria and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened. Widespread and abundant taxa are included in this category.	
Data Deficient (DD): A taxon is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. A taxon in this category may be well studied, and its biology well known, but appropriate data on abundance and/or distribution are lacking. Data Deficient is therefore not a category of threat.	
Not Evaluated (NE): A taxon is Not Evaluated when it is has not yet been evaluated against the criteria.	

The field surveys focused on the acquisition of biodiversity data for both a single wet season and a single dry season. The wet season survey was undertaken over the period of May 28 to June 10, 2012. The dry

season survey was undertaken over the period of October 22 to November 02, 2012. Data acquired by the surveys undertaken at different periods were analyzed to document temporal trends in the area biodiversity.

7.1 Background

7.1.1 Areas of Recognized Global, National and Local Importance to Biodiversity

The IFC biodiversity guidelines require consideration of areas of recognized global, national or local importance to biodiversity, such as legally protected areas, World Heritage Sites, Ramsar Sites, Important Bird Areas, Key Biodiversity Areas, Community reserves, and natural reserves, as well as ecoregional planning areas.

The Concession has not been identified by the Government of Guyana (GOG) as a priority area for conservation interest. The conservation initiatives in Guyana are largely focused on the larger forested landscapes of Central and Southern Guyana or on the Rupununi Savannas region.

According to the National Protected Areas Act, 2011, the Kaieteur National Park and the Iwokrama International Forest Reserve are the only legally protected areas in Guyana. The GOG officially proposed a protected areas system for Guyana in the National Forestry Action Plan (NFAP) in 1989. In 1999, a national workshop was held by the Environmental Protection Agency (EPA). That workshop which was sponsored by the Global Environmental Facility (GEF), on the implementation of the National Biodiversity Action Plan (NBAP) was focused on protected areas. This workshop identified five additional priority sites for conservation and inclusion in the protected area system of Guyana, in addition to the Kaieteur National Park and Iwokrama Forest Reserve which were initially proposed by the GOG. The five additional areas identified for immediate action and labeled Phase I sites were:

- Shell Beach
- Orinduik
- Mount Roraima
- Kanuku Mountains Protected Areas
- Konashen Community Owned Conservation Area
- Southern Guyana Region

A 2005 GEF proposal for the Guyana Protected Areas System, Project Phase I identified the Upper Cuyuni River basin as an area of conservation interest. The proposal characterized the area as having evidence of unique flora and fauna that are poorly studied. None of the five priority sites including areas that are legally protected are within the Concession as is depicted on Figure 24.

Eco-regional planning was done at the level of the Guiana Shield Region in April 2002 through the “Guiana Shield Conservation Priority-setting Workshop” co-sponsored by Conservation International (CI), the Guiana Shield Initiative of the Netherlands Committee for the IUCN, the Caribbean Sub-regional resource Facility of the United Nations Development Programme (UNDP), UNDP Suriname, and UNDP Guyana.

The workshop identified a series of priority areas for biodiversity and conservation within the Guiana Shield Region. The workshop identified the Lower Essequibo area as a biological and conservation priority area, with the area being included for its importance for plant ecology, invertebrates, fishes and freshwater ecology. The North Central Guyana area of the Lower Essequibo priority area was identified for plant ecology included for plant endemism. The workshop established that plant ecology priority areas are relatively well distributed throughout the Guiana Shield region and because plant ecology areas

Figure 24 - Proposed Protected Areas of Guyana with respect to the Concession

are quite large, they need not be protected in their entirety to preserve and sustain the region's biodiversity (Steege 2003).

The Savanna Belt of Guyana and Suriname of the Lower Essequibo priority area were identified for invertebrate species richness. This area is situated far north and remote from the Lower Essequibo priority area. The Central and Lower Essequibo areas were identified for fishes and freshwater ecology and were included for species richness and areas of ecological phenomena.

The biodiversity and conservation priority areas were not bio-geographically defined by the workshop. The workshop, however, developed a schematic map which identified the Guiana Shield Conservation Priority Areas in Guyana. That map, depicted as Figure 25, indicates that the Concession falls within the area classified as the "Lower Essequibo" Biological and Conservation Priority Area. Other priority areas in Guyana include the White Sand Belt, the Eastern Upland and Tepui area and the Rupununi Wetlands. None of these areas are within the concession.

Figure 26 identifies Zero Extinction Sites in northern South America, Mesoamerica and the Caribbean including Guyana. None of these sites fall within Guyana or within close proximity of the Concession. The Rio Tacutu site in Brazil near the Guyana border is a savanna ecosystem designated for the endangered hoary-throated spinetail (bird).

Guyana is not a signatory of the Ramsar Convention and has no proposed or listed Ramsar Wetland Sites.

There are no officially designated areas in Guyana identified as Important Bird Areas (IBAs). However, Birdlife International has proposed a total of 10 Important Bird Areas for Guyana with an area of more than 366,600 ha or 1.7% of the country's land area. Figure 27 identifies the proposed IBAs for Guyana. None of the IBAs proposed for Guyana are located near or within the Concession.

7.1.2 Biodiversity of the Area

Consistent with the IFC's interpretative guidance on PS 6 (2012), this baseline incorporates biodiversity at four levels of scale, listed and discussed below in increasing order of detail:

- Regions/Biogeographic Provinces ;
- Landscapes and Ecosystems ;
- Area of Direct Influence/Habitats ;
- and Species

7.1.2.1 Regions and Biogeographic Context

The Food and Agricultural Organization (FAO) of the United Nations has identified three global ecological zones within Guyana. These ecological zones are:

- The tropical rainforest zone which occurs extensively within Guyana's central zone;
- The tropical moist deciduous forest located along the country's coast and on the border with Brazil; and
- The tropical montane forest ecological zone centered around the uplands of the Pakaraima Mountains.

Figure 28 identifies the FAO global ecological zones within Guyana. The Concession exists within the tropical rainforests ecological zone, approximately 160 km southwest of Georgetown, Guyana.

Figure 25 - Concession with respect to the Guiana Shield Conservation Priority Areas in Guyana.

Figure 26 - Alliance for Zero Extinction Sites in Northern South America, Mesoamerica, and the Caribbean.

Figure 27 - Location of proposed Important Bird Areas in Guyana

Figure 28 - FAO Global Ecological Zone Map-Guyana

Four main geographical regions can be distinguished within the ecological zones in Guyana (FAO³). These are:

- The northern coastal belt, consisting of low-lying alluvium with a varying width up to a maximum of 65 km in land (in the east);
- The lowland region of undulating forest land covering most of the northern and central parts of the country, generally with an elevation below 150 m;
- The Pakaraima mountain region in the west, an elevated table land of sandstone escarpments between 300 and 1200 m in elevation; and
- The southern uplands consisting of a vast area mostly over 150 m in elevation covered with undulating forest land.

Based on the FAO's definition of the geographical regions in Guyana, the Concession forms part of the lowland region of undulating forest land generally with an elevation below 150 m, within the Central Guyana District. The Concession lies within the low lying region of the Mazaruni River Basin, entirely within the tropical rainforest ecological zone.

The lowland region of the Mazaruni Basin and the Concession are considered part of the Guiana Shield region as defined by recent regional studies (Huber and Foster, 2003; Hollowell and Reynolds, 2005). The Guiana Shield is situated in northeastern South America. It includes the large mountain systems that form the watershed between the Amazon and Orinoco Rivers. It covers 2.5 million km² and is bounded roughly by the Amazon River to the south, the Japaura'- Caqueta' River to the southwest, the Sierra de Chiribiquete to the west, the Orinoco and Guaviare Rivers to the northwest and north and the Atlantic Ocean to the East. Figure 32 shows the location of Guyana and the concession in relation to the Guiana Shield Region.

The Guiana Shield accounts for more than 25 % of the world's remaining tropical rain forest. Its diverse landscapes have been recognized for their biological endemism, unique ecosystems, pristine forests and cultural diversity. Table 25 provides the estimated diversity and endemism of Guiana Shield flora and fauna.

Table 25: Estimated diversity and endemism of Guiana Shield flora and fauna

Flora/fauna	Number of species	Number of endemic species	Percentage of total species that are endemic
Vascular Plants	20,000	7,000	35%
Birds	975	150	15%
Mammals	282	27	10%
Reptiles	280	76	27%
Amphibians	272	127	47%
Freshwater Fish	2,200	700	32%

Table taken from Conservation Priorities for the Guyana Shield Consensus Report of 2002

The lowland eco-regions of the Guiana Shield are biogeographically distinct from the Guiana Shield highlands which include the Tepui formations characterized by relatively high levels of endemisms. Biogeographically, the lowlands of the Guiana Shield are much more closely related to the forested lowlands of the Amazon Basin. The lowland rainforests on brown sandy soils, loams, or laterites is the major vegetation type of the Amazon Valley and the Guiana Shield (Steege, 2003).

³ <http://www.fao.org/forestry/country/18310/en/guy/>. Downloaded in November 2012

The lowland tropical rainforests of the Guiana Shield and Amazon Basin are characterized by flat-topped hills, ridges and valleys with an elevation between 50 to 300 m. The vertebrate faunal diversity of the Guiana Shield lowlands is comprised largely of widespread species found across the lowlands humid forests of the Amazon Basin. Guiana vertebrate endemics are generally restricted to the highlands of the Guiana Shield or to the savanna and dry forest ecosystems.

During the period 1966 to 1973, the United Nations Development Programme (UNDP) and the FAO co-funded a large scale Forest Industries Development Survey (FIDS) in most of the forested areas of Guyana. The purpose of the survey was to assist the GOG in determining the extent and composition of accessible forest. The valuation and reconnaissance surveys were conducted throughout the near-coastal areas, inland in the Bartica Triangle, and along the Bartica/Potaro road. Field work for the FIDS surveys was carried out in the following areas identified by the respective numbers in Figure 31.

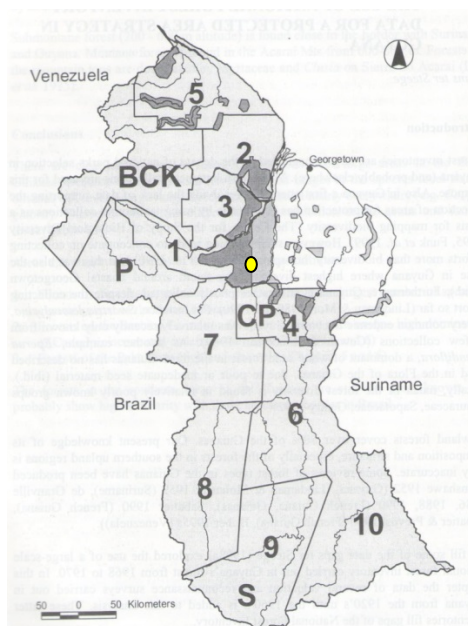
1. 1966 : Barama, Cuyuni and Kako rivers drainage
2. 1968 : Lumidpau to Akarai mountains
3. 1968 – to May 1969 : ‘Accessible’ forests
4. 1969 – 1970 : ‘Inaccessible’ Southern forests (zone 6 to 10)
5. 1971 and 1973 : Pakaraima Mountains (zone P)
6. 1973 : Carl Persaud lease (zone CP)

The study identified five national forest regions as depicted in Figure 32. These regions are as follows:

- The Southern Wet Forest, south of the Cuyuni River to east of the New River,
- The Southern Dry Forests,
- The Pakaraima Mts. Wet Forest,
- The Central Guyana Wet Forest, situated on the sandy Berbice formation and
- The Northwest Guyana Wet Forest.

Figure 30 - Map of the Guiana Shield Region

Figure 31 - Guyana Base Map Showing Inventory Zones of the FIDS Survey (FIDS Light Grey Areas)
 Map sourced from; *Plant Diversity of Guyana; Tropenbos Series 18; Edited by Steege (2000)*



Legend

1-5: Accessible' forest zones;

6-10 Inaccessible' forest zones;

BCK: Barama, Cuyuni and Kako river drainage

S: South, Lumidpau to Akarai mountains

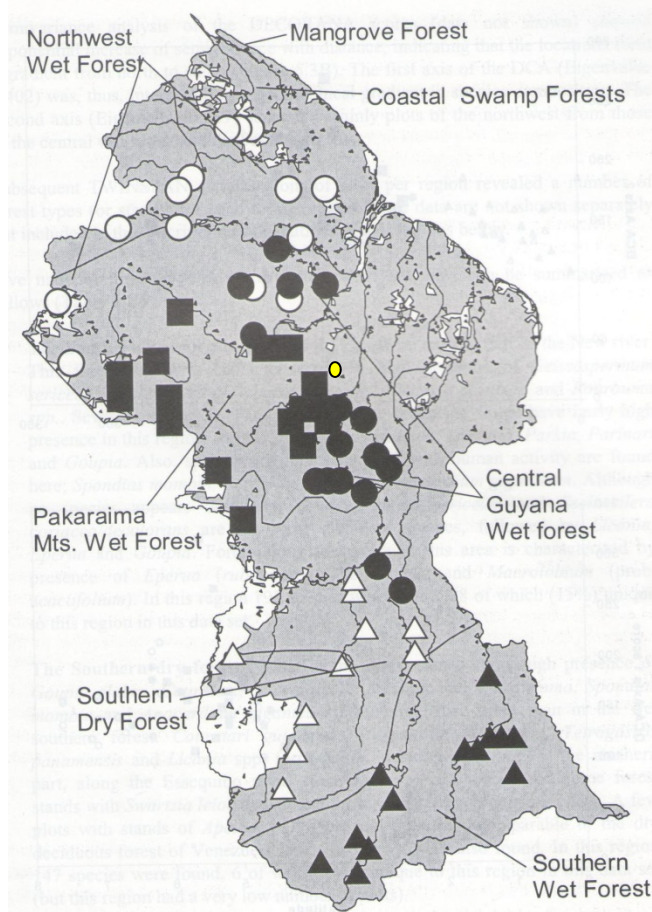
P: Pakaraima Mountains

CP: Carl Persaud Lease; Valuation and Reconnaissance surveys areas are in medium grey.

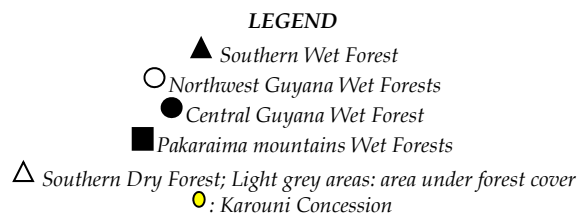
Overlapping zones (FIDS and Valuation and Reconnaissance Surveys) are in dark grey.

● : Karouni Concession

Figure 32 - Guyana Base Map showing the Five National Forest Regions



Map sourced from; Plant Diversity of Guyana; Tropenbos Series 18; Edited by Steege (2000)



The Concession is situated in the Central Guyana Wet Forest national forest region. This wet forest region is characterized by a high abundance of commercial and often near endemic species such as *Swartzia leiocalycina*, *Chlorocardium rodiei*, *Mora excels*, *M. gonggrijpii*, *Alexa imperatricis*, *A. leiopetala* and *Clathrotropis spp* (Steege, 2000).

The Concession forms part of the lowland forest ecosystems typical of the lowland forests habitats of the national forest regions. Inspection of the Vegetation Map of Guyana depicted in Figure 33 reveals that the Concession is located within the non-flooded lowland forests in the white sand region and the tall evergreen lowland non-flooded forest in Central Guyana. Even though these lowland forest ecosystems may have heterogeneity in the nature of soils, they are shared across the lowlands of the national forest regions. Consequently, the lowland forest habitats of the Concession are characterized by biota that is widespread throughout the lowlands of Guyana's national forest regions and by extension the Guiana Shield and Amazonia lowlands.

Figure 33 - Vegetation Map of Guyana.
(Map sourced from the Centre of the Study of Biological Diversity, University of Guyana (1995))

7.1.2.2 Landscapes and Ecosystems

The Mazaruni River Basin, in which the Concession is located, occupies approximately 36,600 km², and is situated almost entirely within Guyana. In Guyana, the Mazaruni Basin area is subdivided into the Upper, Middle and Lower Mazaruni District. The Mazaruni Districts, known for timber and mineral resources, consist of active mining communities at Bartica, Issano, Imbaimadai, and Isseneru. Historical and current human activities related to logging and mining may have significantly affected the environmental quality of the Mazaruni Basin. Human activities have resulted in the fragmentation of natural habitats through road construction, construction of mining camps, extraction of timber and mineral resources and the creation of communities. The Mazaruni River Basin is the landscape region applicable to the compilation of this biodiversity baseline.

The Mazaruni River Basin is part of the Essequibo River Freshwater ecoregion (Abell et al., 2008). The Essequibo drainage is seasonally linked to the Amazon drainage when the flooded savannas of the Rupununi form a continuous expanse of water between the tributaries of the Rio Branco and the Rupununi River (Watkins et al., 2004). The Essequibo River and the seasonally flooded Rupununi Savannas of southwestern Guyana serve as biological corridors for aquatic biota, directly linking the Amazon Basin and the Watersheds north of the Guiana Shield. The Mazaruni River flows into the Essequibo River and therefore forms a biological corridor to the Amazon aquatic ecosystems via the Rupununi savannas.

According to a classification of Forest of the Guiana Shield region by Steege and Zondervan (2000), there are five divisions of the Guiana forest:

1. Forest of the Coastal Plain (Venezuela-Guyana-Suriname-French Guiana)
2. Forest of the Northwest District of Guyana and Lowland Venezuelan Guayana
3. Forest of the White Sands Formation (Guyana-Suriname-French Guiana)
4. Forests of the Pakaraima-Central Guayana Upland Region (Guyana-Venezuela-Brazil)
5. Forest of the Southern peneplain (Guyana-Suriname-French Guiana-Brazil)

The Middle Mazaruni Basin and the Concession fall within the Guiana forest division broadly described as Forests on the White Sand Formation of Guyana. The natural forest composition of the White Sand Formation of Guyana is characterized (Steege and Zondervan, 2000) mainly by:

- Mixed lowland rainforests on pleistocene brown sands.
- Clump wallaba and the dry evergreen wallaba forests on excessively drained white sand in Central Guyana.

The mixed lowland rainforests on pleistocene brown sands, and the clump wallaba and the dry evergreen wallaba forests on excessively drained white sand in Central Guyana are shown in the National Vegetation Map depicted in Figure 34. The forest types of the Concession are depicted in the Guyana Forestry Commission (GFC) Vegetation Map in Figure 35. Descriptions of each forest type follow.

- Rain forests on Pleistocene brown sands in central Guyana; Forests on the brown sands of the Berbice formation are almost invariably characterised by species of *Eschweilera* and *Licania*. Species, which may be locally dominant, are *Eschweilera sagotiana*, *E. decolorans*, *E. confertiflora*, *Licania alba*, *L. majuscula*, *L. laxiflora*, *Chlorocardium rodiei*, *Mora gonggrijpii*, *Alexa imperatricis*, *Swartzia schomburgkii*, *S. leiocalycina*, *Catostemma commune*, *Eperua falcata*, *Pouteria guianensis*, *P. cladantha*, *Aspidosperma excelsum* and *Pentaclethra macroloba*. Mono-dominance is common in forests on brown sands in central Guyana.

Figure 34 - National Vegetation Map of Guyana, after Steege (2001)

Figure 35 - GFC Vegetation Map

- Dry evergreen forest on white sands; Occurring on the bleached white sands (albic Arenosols) of Central Guyana are Clump Wallaba and Dry evergreen forests (Wallaba forests). In the Dry evergreen forests *Eperua falcata* and *E. grandiflora* are strongly dominant and may form, alone or together, more than 60% of the canopy individuals. Other common species in the canopy layer are *Catostemma fragrans*, *C. altsonii*, *Licania buxifolia*, *Talisia squarrosa*, *Ormosia coutinhoi*, *Eschweilera corrugata*, *Aspidosperma excelsum*, *Terminalia amazonia*, *Chamaecrista adiantifolia*, *Chamaecrista apocouita*, *Swartzia* spp., *Dicymbe altsonii* (west Guyana only), *D. corymbosa* (ibid.), *Manilkara bidentata* (Pomeroon-Waini waterdivide) and *Pouteria*. Clump wallaba forest, dominated by *Dicymbe altsonii* (endemic to Guyana) and *D. corymbosa* with co-dominance of *Eperua*, *Catostemma* and *Hyeronima* is found on excessively drained white sand ridges in the Mazaruni Basin.

The forest ecosystems of the Mazaruni Basin are dominated by dense forests which are interlocked among aquatic environments in the form of rivers and creeks. Forest ecosystems along the rivers and in the creek valleys are seasonally flooded and provide the habitats for aquatic biota during the wet season. The valleys' slopes, hillslopes, and ridgetops support forests that are not seasonally flooded. The forest river ecosystems of the Mazaruni Basin are integrated through surface and groundwater hydrological processes. The surface waters of the region are generally considered "blackwaters", with low pH, high contents of tannins and organic acids from the breakdown of leaf litter. These forest ecosystems support a large diversity of widespread humid forest fauna typical of the neotropics generally, the Guiana Shield and Amazonia lowlands, and the lowlands of the national forest regions of Guyana.

7.1.2.3 Area of Direct Influence/Habitat and Species

Guyana has a rich diversity of species of flora and fauna. Guyana is home to 429 species of fresh water fish (Funk and Kelloff, 2009). There are 222 species of mammals, 120 species of amphibians and 168 species of reptiles that are known to occur in Guyana (Hollowell and Reynolds, 2005). Over 850 species of birds are known to exist in Guyana. Guyana has an estimated 5989 species of flowering plant, which are found in 1673 genera and 198 families (Steege, 2000).

Wildlife observation surveys within the Concession were first conducted in the period 1995-1996 by Micheal D. Bradley for Cathedral Gold Corporation. The surveys were carried out by providing observation forms to staff of Cathedral Gold Inc. Observations of animal sightings were recorded and reported. Flora and fauna recorded by the Micheal Bradley survey were typical of species and habitats associated with the forested lowland ecosystems of the Mazaruni Basin, Guiana Shield and the Amazon Basin. Some of the fauna recorded in Micheal Bradley's work included jaguars, peccaries, lowland tapirs, howler monkeys and the black curassows. Detailed findings of Micheal Bradley's work are provided in the Micheal Bradley's 1996 Report on Baseline Environmental Evaluations of Hicks, Tallman and East Kaburi Properties.

Several biodiversity studies were conducted in areas with similar habitat characteristics to that of the Concession. These studies were evaluated to develop background information for the Concession before the actual field work was done. In general, data from areas which are within lowland non-flooded forests, mixed forests, clump wallaba and wallaba forests ecosystems were examined to develop background information for the field surveys.

Biodiversity surveys were performed, by GSEC and Klohn Crippen Burger (KCBL), for the Tassawini Concession, in 2011 and 2007 respectively. The Tassawini Concession is located at Chinese Landing Northwest District within the non-flooded lowland tall evergreen forest region shared with the Concession.

The data acquired by that survey is considered appropriate for incorporation as background information for the Concession given their ecological similarity. The KCBL study compiled data for flora and fauna

over a complete yearly seasonal cycle. The GSEC study compiled data for flora and fauna for the short dry season in March of 2011.

Another area considered ecologically similar to the Concession is the Amaila Falls Hydro Project area. Sections of the Indirect Area of Influence (IAI) and Direct Area of Influence (DAI) of the Amaila Falls project are in close proximity to the Concession. These areas, with the exception of the IAI and DAI areas that fall within the Montane Forest ecosystems (Pakaraima Mountains), are situated in non-flooded lowland forests that are ecologically similar to the Concession. Findings of the studies used to develop background information for the Concession follow.

7.1.2.3.1 Mammals (Non-Volant)

The Amaila Falls Hydro Project biodiversity survey (2010) within the IAI of the project recorded a total of 116 individuals of 17 species of medium and large non-volant mammals belonging to 7 orders and 12 families. The survey of medium and large-sized non-volant mammals in the DAI recorded 22 species belonging to 7 orders and 13 families.

The Tassawini baseline biodiversity survey recorded a total of 7 non-volant mammal species in 2007 and a total of 19 non-volant mammalian species in 2011. Documented non-volant mammal species of international conservation concern in the Tassawini surveys included *Panthera onca* (IUCN listed as Near Threatened), *Puma concolor* (IUCN listed as Near Threatened), *Tapirus terrestris* (IUCN listed as Vulnerable), and *Alouatta seniculus* (IUCN listed as Least Concern).

7.1.2.3.2 Bats

The Tassawini Concession survey of 2007 recorded a total of four genera with one genera being identified to species level (*Saccopteryx bilineata*). The genera recorded included the *Corollia*, *Artibeus*, *Tonatia* and *Saccopteryx*. The Tassawini Concession survey of 2011 recorded a total of 9 species of bats within 2 families; 8 species of Phyllostomines and 1 species of Emballonuridae. The conservation status of the bats recorded during the surveys was assessed as least concern by the IUCN.

Biodiversity baseline studies on bat species abundance and presence which were done in areas ecologically similar to the Concession are provided in Table 26 below.

Table 26: Bat Species Identified in areas Ecologically Similar to the Concession

Project	Location/Habitat Characteristics	Bat Species Recorded
Peter's Mine Concession	Puruni River approximately 80 miles southwest of Bartica, Region 7; lowland, tall, evergreen non-flooded forest, flooded riparian forest	One (1) species recorded from the Phyllostomidae family
Garner Forest Logging Concession	Kartabu- Puruni Road, Region 7; tall, evergreen, lowland non-flooded forest	13 species of bats from 2 families; 12 species of Phyllostomidae; and 1 species of Vespertilionidae
Jaling Forest Logging Concession	East of the Venezuelan border, north of the Baramita Amerindian Reserves, and west of Whana and Whannamaparu Rivers, Region 7; Flooded riparian forest and lowland non-flooded tall, evergreen forests	11 species of bats within 2 families; 10 species of Phyllostomidae; and 1 species of Vespertilionidae

7.1.2.3.3 Birds

The Amaila Falls 2010 biodiversity study recorded 412 species of birds. Frugivores accounted for 57 species, Insectivores accounted for 108 species, Omnivores accounted for 57 species, Nectarivores accounted for 18 species, and Carnivores accounted for 50 species. The 2007 Tassawini survey recorded a total of 263 species of birds. Bird species of international concern recorded in the 2007 Tassawini survey were Scarlet macaw (*Ara macao*), CITES I; and the Red-and-green macaw (*Ara chloroptera*), CITES II. In the 2011 Tassawini survey, a total of one hundred and twelve (112) species of birds from thirty (30) families were recorded. No endangered or critically endangered species were recorded during the survey.

7.1.2.3.4 Herpetofauna (Reptiles and Amphibians)

The Amaila Falls biodiversity study of 2010 recorded amphibians and reptiles at points along the Amalia Falls Transmission Road, at Kaburi Community, at Powis Landing, at Butakari and on watersheds of the Amaila and Kuribrong Rivers upstream of the confluence of the Kuribrong and Potaro Rivers. This study documented 36 species of amphibians (33 anurans and 3 caecilians), 39 species of squamate reptiles (18 lizards and 21 snakes), one species of crocodilian, and three species of chelonians, totaling 79 species. Among these, 14 species were considered endemic, with eight species being endemic to the Guiana Shield, while six were exclusive to Guyana. None of the species registered by the Amaila Falls baseline survey were listed as threatened by IUCN Red List.

The 2011 Tassawini survey recorded a total of 84 individuals representing 30 species of reptiles and 107 individuals representing 26 species of amphibians. Similar herpetofauna diversity was recorded in Tassawini during the 2007 survey, with 26 species of amphibians and 20 species of reptiles. No endangered or critically endangered herpetofauna species were recorded during the Tassawini surveys.

7.1.2.3.5 Macro-invertebrates

Data on macro-invertebrates in Guyana is extremely limited. The studies that were done did not place emphasis on the broad spectrum of macro-invertebrates but were rather focused or limited to insects. Terrestrial macro-invertebrates recorded in the Tassawini surveys were classified to the family taxon, due to the difficulty of identifying and classifying invertebrates to the species level. The 2007 survey recorded 52 families of macro invertebrates from 15 orders, while the 2011 survey recorded 37 families of macro invertebrates from 13 orders.

7.1.2.3.6 Fish

The Amalia Falls 2010 biodiversity study recorded fifty three (53) species of fishes. The 2007 Tassawini survey recorded a total of sixty-nine (69) species of fish belonging to 22 families and 7 orders. The 2011 Tassawini survey documented a total of two hundred and forty-four (244) individuals making up a total of 37 species from 19 families. No endangered or critically endangered species were recorded during the surveys.

7.2 Biodiversity of the Project Area

Biodiversity surveys were conducted of both the project area and the new site access road using a system of sample plots and transects. The detailed survey methodology is provided in Appendix C. Details of the surveys indicating observations by transects and/or sample plot for both the wet and dry seasons for the project area are presented in Appendix D. A similar methodology was employed for the new access road. The locations of the sample plots within the project area are shown on Figure 36.

Figure 36 - Location of Terrestrial and Aquatic Sample Plots in Project Area

Table 27: General Habitat Descriptions of Terrestrial Sample Plots

ation	Habitat Description
	Mixed lowland forests on slightly undulating terrain. The soil type was fine brown sand. Elevation of the area ranged between 85 - 117 m. The forest canopy was high and irregular. Canopy height varied between 15 – 35 m. Canopy species included <i>Eschweilera sagotiana</i> and <i>Dicymbe corymbosa</i>, <i>Catostemma commune</i>, <i>Carapa guianensis</i>, <i>Chlorocardium rodiei</i> and <i>Mora gonggrijpii</i>. Dominant understory species were <i>Licania heteromorpha</i> and <i>Oxandra asbeckii</i>. Young canopy trees; <i>Mora gonggrijpii</i> and <i>Dicymbe corymbosa</i> were also dominant in the understory. The herb layer was well developed with <i>Ischnosiphon arouma</i> and <i>Panicum pilosum</i>. Lianas were occasional and epiphytes were frequent. Leaf litter was medium during the wet season and thick during the dry season. The road with the area was used as part of the faunal transect. The remainder of the faunal transect was situated within the forest.
	Predominantly primary soft wallaba forests on fine white sand. The area was slightly undulating with the highest elevation recorded at 133 m. The area is characterized by a high forest canopy that is irregular and relatively closed. Canopy height varied between 20 – 35 m. Frequently occurring species of the canopy layer was the <i>Eperua falcate</i>; species that occurred occasionally were <i>Eperua grandiflora</i> and <i>Catostemma commune</i>. The understory layer was dense and dominated by <i>Chamaecrista apoucouita</i>, <i>Pouteria Trigonosperma</i>, <i>Ecclinusa guianensis</i> and <i>Tovomita schomburgkii</i>. Young canopy trees; <i>Catostemma commune</i>, <i>Eperua falcate</i> and <i>Eperua grandiflora</i> were also dominant in the understory layer. The herb layer was sparsely developed with <i>Ischnosiphon arouma</i>. Lianas were rare and epiphytes abundant. No evidence of human alteration was noted within the floristic sample plot, however, the Issano road was located parallel to the floristic sample plot. The Issano road within the area was used as part of the faunal transect. The remainder of the faunal transect transitioned from a predominately flat non-flooded forested area and terminated in a swamp. A small artisanal mined pit was situated within the faunal transect area. Natural tree fall was frequent along sections of the faunal transect forming small gaps. The forest floor of the area was moist except on slopes where it was much drier with an open understory.
	Predominantly primary mixed forests on fine brown sandy loam soil; forest area slightly undulating with the highest elevation recorded at 133 m. The area is characterized by a high forest canopy that is irregular and relatively closed. Canopy height varied between 20 – 35 m. Canopy species that occurred occasionally were <i>Eschweilera sagotiana</i>, <i>Licania densiflora</i>, <i>Dicymbe corymbosa</i> and an emergent species <i>Eschweilera potaroensis</i> (Potaro Kakaralli – endemic to Central Guyana). The understory layer was dense and dominated by young canopy species; <i>Chlorocardium rodiei</i>, <i>Mora gonggrijpii</i>, <i>Dicymbe corymbosa</i>, and <i>Alexa imperatricis</i>. Understory species that were abundant to frequent included <i>Licania heteromorpha</i> and <i>Oxandra asbeckii</i>. The herb layer was sparsely developed with <i>Ischnosiphon arouma</i>. Lianas and shrubs were occasional and epiphytes were rare. Evidence of human alteration in the area consisted of inactive artisanal mines and secondary access roads. A seasonal flooded creek meandered through the ravines of this sample area. Part of the faunal transect was on an access road on slightly undulating terrain and the remainder situated within the forest. The faunal transect transitioned from white sand wallaba forest to a brown sand mixed forests. The faunal transect was bisected by small creeks at three points. Natural tree fall was few within the area.

	E 0624705	elevation recorded at 179 m. The area is characterized by a high forest canopy that is regular and relatively closed. Canopy height varies between 15 - 30 m. The canopy layer was dominated by <i>Dicymbe altsonii</i> . Frequently occurring species of the canopy layer were the <i>Eperua grandiflora</i> , <i>Catostemma fragrans</i> and <i>Catostemma commune</i> . The understory layer was sparsely populated and dominated by <i>Ecclinusa guianensis</i> and by Young canopy trees; <i>Dicymbe corymbosa</i> and <i>Licania densiflora</i> . Frequently occurring species of the understory layer was the <i>Conomorpha Peruviana</i> . Lianas were rare. Epiphytes and palms were occasional. The leaf litter layer was thin during the wet season and thick during the dry season. No evidences of human alteration was noted within the floristic sample plot, however, an active road was located parallel to the sample floristic plot. There was one active and one abandoned mine in the transect area. Cecropia, solanaceae, sedges and grasses were common at the mined areas. Small scale logging was ongoing during the wet season survey within this sample area. Part of the faunal transect was situated along a road within the area. The remainder of the faunal transect was within the forest. The faunal transect traversed a dry forested area, then to a swamp, and terminated in a non-flooded forested area with a thick understory. The forest floor of the area was moist and leaf litter medium during the wet season survey.
TE 5	N 0266002 E 0623623	Predominantly primary soft wallaba forests on fine white sand; forest area slightly undulating with the highest elevation recorded at 148 m. The area is characterized by a high forest canopy that is irregular and relatively closed. Canopy height varied between 20 – 35 m. <i>Eperua falcate</i> was dominant within the canopy layer. Occasional species recorded were <i>Eperua grandiflora</i> , <i>Catostemma commune</i> , <i>Catostemma fragrans</i> and <i>Pouteria trigonosperma</i> . The understory layer was dense and dominated by <i>Oxandra asbeckii</i> , <i>Anaxagorea spp.</i> and <i>Tovomita schomburgkii</i> and young canopy trees; <i>Catostemma commune</i> , <i>Eperua falcate</i> and <i>Pouteria trigonosperma</i> . Lianas were rare and epiphytes were abundant. No evidence of human alteration was noted within the floristic sample plot, however, a very active road was located parallel to the floristic sample plot. Part of the road in the area was used as the faunal transect. The remainder of the faunal transect was situated within the forest. The faunal transect was bisected by a small creek. There was one active artisanal mine close to this area.

Table 28: Site and habitat descriptions of Aquatic Sampling Locations

Transect ID	Coordinates	Transect Location	Description of locality
AQ 1a	N 273895 E619016	White water creek located at the second bridge south east of Pharsalus Hicks camp.	Natural aquatic habitat surrounded by mixed forest on brown sand. The stream depth remained wadeable in both the wet to dry season surveys with minor overtopping of the banks seen in the wet season. Stream bed consisted mainly of brown sand and leaf litter. The forest canopy cover in the area of the creek sampled was about 80%. Stream flow was characterized by runs and pools.
AQ1b	N 273771 E 620113	Upstream Kaburi creek. First bridge south east of Pharsalus camp.	Natural black water creek meandering through mixed forest on brown sand. The area had a significant amount of fallen trees. No significant change in the water level in the creek was noted in the wet to dry season surveys. The creek had about 30% forest canopy cover within the area sampled. Stream flow was characterized by riffle and runs with no pool areas within area sampled.
AQ 2	N 276610 E 622334	Kuburi Creek at Iron bridge.	Natural aquatic habitat. Area sampled found on mixed forest on brown sand. Significant overtopping of the banks of the creek was noted during the rainy season. A significant amount of woody debris and fallen dead wood were found within area sampled.
AQ 3	N 271067 E 621567	Mc Donald creek at the roadway in the area.	Wadeable natural black water creek surrounded by secondary mixed forest on brown sand and wallaba forest on white sand. No instream vegetation or fallen trees were noted within this sample area. There was no forest canopy cover of the stream within the area sampled. No significant change in water level was noted in the wet to dry season surveys. Stream flow was characterized by riffle and runs.
AQ4	N 267782 E 627067	This site was inaccessible and was replaced by AQ7.	
AQ 5a	N 272658 E 620268	Upstream of white sand creek at the roadway in the area.	Wadeable natural black water creek surrounded by secondary mixed forest growth on brown sand. No visible instream vegetation and no forest canopy cover of the creek were noted in the area sampled. Stream flow was characterized by runs and riffles.

AQ5b	N 273777 E 620104	Downstream of the white sand creek at the newly constructed bridge in the area.	Natural aquatic system surrounded by mixed forest on brown sands. No visible instream vegetation and no forest canopy cover were noted in the area sampled. Stream flow was characterized by runs and pools.
AQ6	N 273789 E 619224	Blackwater creek at a deserted mining camp.	Modified aquatic habitat as a result of artisanal mining. The creek meandered through a vast open area cleared as a result of artisanal mining. The sampled area had a high occurrence of algae due to stagnation in the dry season survey. No instream vegetation or forest canopy cover of the creek were noted in the area sampled. This site was only surveyed during the wet season survey. This area was not sampled in the dry season survey since it appeared devoid of life (dead).
AQ7	N 265731 E 623963	Hit and miss/mad man creek.	Natural aquatic system surrounded by primary soft wallaba forest on white sand. Tree fall was prevalent with a number of fallen trees and branches in the creek. The forest canopy cover of the area of the stream sampled was about 80%. The area sampled was relocated about 300 m upstream in the dry season survey due to the presence of artisanal mining in the area sampled during the wet season survey.

A general habitat description of the terrestrial sample plots within the Concession is provided in Table 27. The identification of aquatic sample sites and aquatic habitat descriptions are presented in Table 28.

7.2.1 Biodiversity of the Concession

The biodiversity surveys indicate that the Concession and the access road have been subject to significant disturbance and habitat degradation. The habitats and biodiversity components within the Concession and access road are consequently classified as largely modified habitats in accordance with the International Finance Corporation Performance Standard 6 (IFC PS 6). Further, neither contain habitats with a high biodiversity value and as such are not classified as a Critical Habitat as defined by the IFC PS 6 (2012).

The wet season survey of the Concession recorded a total of 23 non-volant mammalian species representing 6 families; 13 species of bats representing 4 families; 123 species of birds representing 35 families; 20 species of amphibians representing 6 families; 23 species of reptiles representing 11 families; 18 orders of terrestrial macro-invertebrate; 32 species of fish from fourteen (14) families; and 14 orders of aquatic macro-invertebrates.

The dry season survey of the Concession recorded a total of a total of 27 non-volant mammalian species representing 7 families; 13 species of bats representing 2 families; 95 species of birds representing 28 families; 22 species of amphibians representing 6 families; 33 species of reptiles representing 12 families; 18 orders of terrestrial macro-invertebrates; 39 species of fish representing 17 families; and 7 orders of aquatic macro-invertebrates.

These findings generally confirm with the finding of surveys conducted in areas ecologically similar to the Concession, and the lowland habitats of the Guiana Shield and Amazon Basin.

The surveys recorded no critically endangered or endangered fauna. Endemic species recorded by the surveys were two Guyana endemic fish species, *Hyphessobrycon minimus* and *Aequidens potaroensis*; two Guyana endemic amphibian species, *Stefania evansi* and *Adenomera lutzi*; a Guyana-Venezuelan endemic amphibian; *Rhaebo nasicus*; two Guiana Shield endemic amphibians; *Hyalinobatrachium taylori* and *Pipa aspera*; and fourteen Guiana Shield endemic birds; *Gypopsitta caica*, *Pteroglossus viridis*, *Xiphorhynchus pardalotus*, *Hypocnemis cantator*, *Pithys albifrons*, *Gymnopathys rufigula*, *Myrmotherula guttata*, *Herpsilochmus stictocephalus*, *Perissocephalus tricolor*, *Phoenicircus carnifex*, *Corapipo gutturalis*, *Lepidothrix* spp., *Pionus fuscus* and *Cyanocorax cayanus*. No migratory species was recorded.

Information gathered from the floral surveys confirmed that the Concession is characterized by forests broadly classified as Forest on the White Sands Formation.

The wet and dry season surveys recorded no difference in the floral composition of the Concession. Both surveys documented 130 plant species belonging to 49 families. The thickness of forest litter, as reflected by the thickness of fallen leaves and twigs on the forest floor, differs significantly between seasons. During the wet season, the litter depth was generally fine to medium. A significant increase by 27% in litter depth was recorded during the dry season. Several plant species were recorded to have both fruits and flowers during both surveys. There was, however, an increased level of flowering and fruiting during the wet season survey. There was an increase in tree biomass recorded between the two surveys with the dry season survey yielding a slightly greater biomass likely due to some growth during the intervening period.

None of the forest types encountered within the Concession are geographically restricted within the greater landscape region/Mazaruni Basin. Species identified were common to fairly common to the Concession and the white sand and brown sand biogeographic provinces of Guyana. None of the floral

species recorded in the Concession are known to be endangered. Endemic floral species recorded in the Concession were the *Chlorocardium rodiei*, *Dicymbe corymbosa*, *Swartzia leiocalycina*, *Licania capera*, *Licania boxiflora*, *Catostemma commune*, *Dicymbe altsonii*, *Eschweilera potaroensis*, and *Mora gonggripii*. These species are widely distributed in the national forest regions of Guyana particularly in the Northwestern and Central Guyana national forest zones.

7.2.1.1 Flora

Information gathered from the survey conformed to the findings of Steege (2000). The Concession and access road alignment are dominated by forest broadly classified as Forest of the White Sand Formation. The natural forest composition of the Concession is as follows:

- rainforests on pleistocene brown sands, almost invariably characterised by species of *Eschweilera* and *Licania* associations; and
- dry evergreen forest on white sands characterized by clump wallaba and dry evergreen wallaba forests.

The wet and dry season surveys recorded no difference in the floral composition of the Concession. Both surveys documented 130 plant species belonging to 49 families. The surveys indicated that forests within the Concession are dominated by species of the Caesalpiniaceae family. *Mora gonggripii*, *Dicymbe corymbosa*, *D. altsonii*, and *Eperua falcata* with a combined total of 53 stems, accounted for 30% of the trees recorded within the canopy by the surveys. Species of the Lecythidaceae family with *Eschweilera* spp. accounted for approximately 25% of the recorded trees with a total of 44 stems. Approximately, 80% (104) of the recorded plants species were trees. Shrubs constituted 6.2% of the plant species, herbs, 3.1%, epiphytes, 3.8%, lianas, 5.4% and palms 1.5% of the plant species recorded by the surveys.

The dry evergreen forests on white sands within the Concession were dominated by *Eperua falcate* and *E. grandiflora* of the Caesalpiniaceae family with these species accounting for 60% of the trees recorded within the canopy with a combined total of 108 stems. The Clump Wallaba forest on white sand was dominated by *Dicymbe altsonii* with 69 stems while *Eperua grandiflora* was abundant with 37 stems. Species of the Caesalpiniaceae family accounted for 75.5% of the trees within the canopy. Other species common in the canopy layer of both the dry evergreen and clump wallaba forests were *Catostemma* spp., *Chamaecrista apoucouita*, *Pouteria Trigonosperma*, *Licania boxiflora* and *Talisia squarrosa*.

The brown sand mixed forests of the Concession are characterized by common occurrences of commercial and endemic species such as *Chlorocardium rodiei*, *Catostemma commune*, *Dicymbe corymbosa*, *Dicymbe altsonii*, *Swartzia leiocalycina*, *Eschweilera potaroensis*, *Mora gonggripii*, *Licania capera* and *L. boxiflora* (Steege, 2000).

The thickness of forest litter, as reflected by the thickness of fallen leaves and twigs on the forest floor, differs significantly between seasons. During the wet season, the litter depth was generally fine to medium. A significant increase by 27% in litter depth was recorded during the dry season. This thickness was continuously distributed over the forest floor.

A summary of floral species recorded in the wet and dry season for the Project area is detailed in Table 29.

Table 29: Floral Species recorded in Concession

Common Name	Scientific Name	Family	Uses
Adebero	<i>Paypayrola longifolia</i>	VIOLACEAE	-
Ants bush	<i>Cordia nodosa</i>	BORGINACEAE	Medicinal use to remedy high blood pressure; relieve headache; back pain and whooping cough.
Antswood	<i>Tachigali paniculata</i>	LEGUMINOSAE-CAESALP	Subsistence use of wood for boards and house construction
Apokuita	<i>Chamaecrista apoucouita</i>	LEGUMINOSAE	-
Arara broad leaf	<i>Unonopsis spp.</i>	ANNONACEAE	Subsistence use of wood for board
Arara fine leaf	<i>Bocageopsis multiflora</i>	ANNONACEAE	Subsistence use of wood for board
Aromata	<i>Clathrotropis brachypetala</i>	LEGUMINOSAE-CAESALP	Commercial timber - Heavy Construction; Boat Building
Aruadan	<i>Sloanea trichosticha</i>	ELAEOCARPACEAE	Subsistence use of wood to carved paddles from the plank roots
Asashi	<i>Rheedia acuminata</i>	GUTTIFERAE	-
Asepokoballi	<i>Pouteria jenmanii</i>	SAPOTACEAE	Subsistence use of fruits
Awasokule	<i>Tovomita schomburgkii</i>	GUTTIFERAE	Subsistence use of straight trunks for housing boards and firewood; the stilt roots served as whips or bows
Awati	<i>Maprounea guianensis</i>	EUPHORBIACEAE	Medicinal use of leaves for sores and itching skin
Barabara	<i>Diospyros ierensis</i>	EBENACEAE	Subsistence use of fruit
Baradan	<i>Ocotea tomentella</i>	LAURACEAE	Commercial timber use for boards, canoes, coffins, floors and furniture
Baromalli	<i>Catostemma altsonii</i>	BOMBACACEAE	Commercial timber – Plywood
Baromalli	<i>Scleronema guianense</i>	BOMBACACEAE	Commercial timber – Plywood
Baromalli sand	<i>Catostemma fragrans</i>	BOMBACACEAE	Commercial timber – Plywood
Bartaballi	<i>Pouteria durlandii</i>	SAPOTACEAE	Subsistence use of the sweet and edible fruit and the buttresses for carved axe handles and paddles
Bauwaua	<i>Astronium ulri</i>	ANACARDIACEAE	-
Black Heart	<i>Acosmium praeclara</i>	LEGUMINOSAE-PAPIL	Commercial timber – Construction
Black Kakaralli	<i>Eschweilera sagotiana</i>	LECYTHIDACEAE	Commercial timber – Construction
Black Maho	<i>Rollinia exsucca</i>	ANNONACEAE	Commercial timber - Plywood; Interior Joinery
Black yari yari	<i>Guatteria punctate</i>	ANNONACEAE	Medicinally used to treat snakebite (particularly labaria snake)
Bokobokotokon	<i>Hirtella racemosa</i>	CHRYSOBALANACEAE	Subsistence use for house construction
Brown sliverballi	<i>Licaria canella</i>	LAURACEAE	Commercial use of wood for board, furniture and canoes
Bullet wood	<i>Manilkara bidentata</i>	SAPOTACEAE	Commercial timber - Heavy Construction
Bultatakobia	<i>Schlegelia violacea</i>	BIGNONIACEAE	Medicinal use of clear water from stem to drip into sore eyes
Burada	<i>Exellodendron barbatum</i>	CHRYSOBALANACEAE	Minor commercial timber use for firewood
Clammy cherry	<i>Cordia sercicalyx</i>	BIGNONIACEAE	Subsistence use of sticky fruit pulp as glue.

			The pulp can be eaten as well.
Common Baromalli	<i>Catostemma commune</i>	BOMBACACEAE	Commercial timber – Plywood
Crabwood	<i>Carapa guianensis</i>	MELIACEAE	Commercial timber - Interior Joinery; Carpentry
Dalli hill	<i>Virola sebifera</i>	MYRISTICACEAE	Subsistence use of wood for house construction and medicinal use of sap to rubbed on mouth sores
Dalli swamp	<i>Iryanthera juruensis</i>	MYRISTICACEAE	Subsistence use of wood for boards, canoes and music instruments
Devildoer	<i>Strychnos mitscherlichii</i>	LOGANIACEAE	Subsistence used of sweet and edible fruit
Devildoer tree	<i>Glycydendron amazonicum</i>	EUPHORBIACEAE	Subsistence use of sweet and edible fruit
Dog Seed	<i>Tabernaemontana undulate</i>	APOCYNACEAE	Medicinal use of latex for sore eyes and munuri bites and the sap for headaches
Duka	<i>Tapirira obtuse</i>	ANACARDIACEAE	Subsistence use of the wood for firewood
Face the East	<i>Philodendron scanden</i>	ARACEAE	Medicinal use of leaf to treat snake bites
Fat poke	<i>Chrysobalanus icaco</i>	CHRYSOBALANACEAE	Subsistence use of sweet and edible fruit
Fern (small leaf baboon tail)	<i>Polybotrya caudate</i>	DRYOPTERIDACEAE	Medicinal use of the rhizome to treat whooping cough
Fern tree	<i>Touroulia guianensis</i>	QUINACEAE	-
Fine Bamboo	<i>Panicum pilosum</i>	GRAMINEAE	-
Fine leaf black kakaralli	<i>Eschweilera wachenheinii</i>	LECYTHIDACEAE	Subsistence use of wood for house frames, poles, post, axe handles, etc.
Fukadai	<i>Buchenavia fanshawei</i>	COMBRETACEAE	Subsistence use of wood for floor scantling, uprights, rafters and other housing materials.
Ginger silverballi	<i>Aniba guianensis</i>	LAURACEAE	Subsistence use of poisonous wood for boards and canoes
Greenheart	<i>Chlorocardium rodiei</i>	LAURACEAE	Commercial timber - Heavy Construction
Greenheart gale	<i>Aniba excels</i>	LAURACEAE	Cultural
Hachiballi	<i>Pera ferruginea</i>	EUPHORBIACEAE	Subsistence use of wood as sawn boards
Haiariballi	<i>Alexa imperatricis</i>	LEGUMINOSAE-PAPIL	Commercial Timber and plywood
Haiawa	<i>Protium guianensis</i>	BURSERACEAE	Spiritual use of resin from bark as incense to invite good spirits while chasing away the bad ones. Subsistence use of wood to make boards and canoes.
Haiawballi	<i>Protium tenuifolium</i>	BURSERACEAE	Commercial Timber- boards, furniture, canoes and firewood
Hakiaballi	<i>Vitex schomburgkiana</i>	VERBENACEAE	Subsistence use of wood for tool handles, bows and firewood.
Hakiaballi Rope	<i>Arrabidaea candicans</i>	BIGNONIACEAE	-
Hanaquablar	<i>Philodendron brevispathum</i>	ARACEAE	Medicinal use of shoots for scorpion bites
Hikuribianda	<i>Quassia cedron</i>	SIMAROUBACEAE	-
Iron Mary	<i>Chamaecrista adiantifolia</i>	LEGUMINOSAE-CAESALP	-
Itikiboroballi	<i>Swartzia benthamiana</i>	PAPILIONACEAE	Subsistence use of wood for house posts and firewood

Kaditiri	<i>Sclerolobium micropetalum</i>	LEGUMINOSAE-CAESALP	Subsistence used of stinging ants that inhabit this tree to make dogs hunt better
Kaiarima	<i>Maytenus planifolia</i>	CELASTRACEAE	Medicinal use of bark for fire burns
Kairiballi	<i>Licania heteromorpha</i>	CHRYSOBALANACEAE	Cultural
kakaralli smooth leaf	<i>Eschweilera decolorans</i>	LECYTHIDACEAE	Subsistence use of wood for house frames, poles, post, axe handles etc.
Kamahora medium leaf	<i>Pouteria Trigonosperma</i>	SAPOTACEAE	Subsistence use of edible sweet fruit
Kamoro	<i>Pleonotoma albiflora</i>	BIGNONIACEAE	Subsistence use of flexible stem as sturdy fishing line.
Kapadula	<i>Tetracera volubillis</i>	DILLENIACEAE	Medicinal use of the wood in aphrodisiacs as a builder, stimulating sexual activities and curing impotence.
Karakara	<i>Souroubea guianensis</i>	MARCGRAVIACEAE	Medicinal use of branch to prepare remedy for venereal diseases and wood to treat diarrhea and vomiting
Karishiri	<i>Oxandra asbeckii</i>	ANNONACEAE	Subsistence use of young trunks for wicker kitchen walls and house frames.
Kauta	<i>Licania guianensis</i>	CHRYSOBALANACEAE	Subsistence use of wood as firewood
Kautaballi	<i>Licania alba</i>	CHRYSOBALANACEAE	Subsistence use as firewood
Kereti (White silverballi)	<i>Ocotea cannliculata</i>	LAURACEAE	Commercial timber - Interior Joinery
Kibihidan	<i>Ryania speciosa</i>	FLACOUTIACEAE	Subsistence use of wood for firewood and traditional Arawak kitchen walls
Kokoritiballi	<i>Pouteria dura</i>	SAPOTACEAE	Subsistence use of edible sweet fruit and the wood for house posts and boards
Komaramara	<i>Duroia eriopila</i>	RUBIACEAE	Subsistence use of fruit pulp
Konoko	<i>Licania cuprea</i>	CHRYSOBALANACEAE	Subsistence use of wood as firewood
Korokororo	<i>Ormosia coutinhoi</i>	PAPILIONACEAE	Commercial timber - General Construction
Kufa (Black)	<i>Clusia palmicida</i>	GUTTIFERAE	Medicinal use of the root cortex for malaria; the latex applied as plaster on mosquito worms
Kulishiri black	<i>Cupania hirsute</i>	SAPINDACEAE	Subsistence use of trunk for wicker kitchen walls and of wood for firewood
Kurihikoyoko	<i>Anaxagorea spp.</i>	ANNONACEAE	Subsistence use of wood for rafters, runners and flooring beams
Kurokai	<i>Protium heptaphyllum</i>	BURSERACEAE	Subsistence use of wood for house construction and canoes
Kwako	<i>Marlierea Montana</i>	MYRTACEAE	-
Lanaballi	<i>Gustavia hexapetala</i>	LECYTHIDACEAE	-
Mabwa	<i>Himatanthus articulatus</i>	APOCYNACEAE	Subsistence use of long lasting wood for canoes
Maho	<i>Sterculia pruriens</i>	STERULIACEAE	Commercial Timber - Plywood; Interior Joinery
Mamudan	<i>Neea cauliflora</i>	NYCTAGINACEAE	Subsistence use of wood for firewood
Mamuriballi	<i>Mouriri tetragona</i>	MELASTOMATACEAE	Subsistence use of wood for house post
Manobodin	<i>Emmotum fagifolium</i>	ICACINACEAE	-
Marishiballi	<i>Licania boxiflora</i>	CHRYSOBALANACEAE	Subsistence use as firewood

Marishiballi	<i>Licania mollis</i>	CHRYSOBALANACEAE	Subsistence use as firewood
Matora	<i>Coccoloba uvifera</i>	POLYGONACEAE	-
Mokru	<i>Ischnosiphon arouma</i>	MARANTACEAE	Subsistence use of the stem for the manufacture of household equipment
Monkey ladder	<i>Bauhinia scala-simiae</i>	LEGUMINOSAE-CAESALP	Medicinal use of root for diarrhea; of wood for malaria, to bitter the blood and to stop hemorrhage
Mora	<i>Mora excels</i>	CAESALPINIACEAE	Commercial timber - Sleepers; Heavy construction
Morabukea	<i>Mora gonggrijpii</i>	CAESALPINIACEAE	Commercial timber - Sleepers; Heavy construction
Moroballi	<i>Talisia sqarrosa</i>	SAPINDACEAE	Subsistence use of wood as fish poison
Munuridan	<i>Siparuna guianensis</i>	MONIMIACEAE	Medicinal use of bark for ants bites; leaves or bark for skin rash and sap for cuts and bee stings.
Nibi	<i>Heteropsis flexuosa</i>	ARACEAE	Commercial NTFP - used of root
Okokonshi	<i>Quiina indigofera</i>	QUIINACEAE	Subsistence use of the wood for house construction, warishi frames and arrow sockets
Parakusan	<i>Swartzia polyphylla</i>	PALIONACEAE	Subsistence use of plank roots to carve paddles.
Potaro Kakaralli	<i>Eschweilera potaroensis</i>	LECYTHIDACEAE	Subsistence use of wood
Quackoo	<i>Marliera Montana</i>	MYRTACEAE	Subsistence use of edible fruit; wood for firewood
Rose of the mountain	<i>Brownea latifolia</i>	LEGUMINOSAE-CAESALP	Medicinal use of the bark for stomach ache, diabetes and vomiting of blood
Ruri	<i>Chaetocarpus stipularis</i>	EUPHORBIACEAE	Subsistence used of the wood to make canoes, boards, house frames and firewood; the bark to get rid of evil spirits
Ruri red skin	<i>Chaetocarpus schomburgkianus</i>	EUPHORBIACEAE	Subsistence used of the wood to make canoes, boards, house frames and firewood; spiritual use of the bark to get rid of evil spirits
Saka Purpleheart	<i>Peltogyne paniculata</i>	LEGUMINOSAE-CAESALP	Commercial timber - Heavy construction; Cabinet work
Serebedan	<i>Swartzia arborescens</i>	LEGUMINOSAE-PAPIL	-
Shibidan	<i>Aspidosperma desmanthum</i>	APOCYNACEAE	Commercial timber - Interior Joinery
Solider's cap	<i>Psychotria poeppigiana</i>	RUBIACEAE	Medicinal use of leaves and flowers for cold, cough, tuberculosis and to stop menstrual bleeding
Suya	<i>Pouteria speciosa</i>	SAPOTACEAE	Commercial timber
Swizzlestick	<i>Mabea speciosa</i>	EUPHORBIACEAE	Subsistence use of wood as round wood in house construction.
Teterumaballi	<i>Conomorpha peruviana</i>	MYRSINACEAE	-
Trysil	<i>Pentaclethra macroloba</i>	LEGUMINOSAE-MIMOS	Subsistence use as a disinfectant for skin wounds and as fire wood
Turtle cherry	<i>Eugenia patrisii</i>	MYRTACEAE	Subsistence use of fruit and wood for

			making cotton spindles
Turu	<i>Jessenia bataua</i>	PALMAE	Subsistence use of fruit to make drinks, etc.
Wadara	<i>Couratari guianensis</i>	LECYNTHIDACEAE	Commercial timber - plywood
Waiaballi	<i>Tapura guianensis</i>	DICHPETALACEAE	Subsistence use of wood for house post
Wallaba Clump	<i>Dicymbe altsonii</i>	CAESALPINIACEAE	-
Wallaba Clump	<i>Dicymbe corymbosa</i>	CAESALPINIACEAE	-
Wallaba Ituri	<i>Eperua grandiflora</i>	LEGUMINOSAE-CAESALP	Commercial timber - Heavy construction
Wallaba soft	<i>Eperua falcate</i>	LEGUMINOSAE-CAESALP	Commercial timber - Heavy construction
Wamara	<i>Swartzia leiocalycina</i>	LEGUMINOSAE-PAPIL	Commercial timber - Inlay; Cabinet work
Wanania	<i>Minquartia guianensis</i>	OLACACEAE	-
Waraia	<i>Miconia prasina</i>	MELASTOMATACEAE	Subsistence use of edible fruit
Warakabakoromukru	<i>Ischnosiphon gracilis</i>	MARANTACEAE	Subsistence use of the stem for the manufacture of household equipment
Warakosa	<i>Inga jenmanii</i>	LEGUMINOSAE-MIMOS	Subsistence use of fruit and as firewood
White Yari Yari	<i>Duguetia pycnastera</i>	ANNONACEAE	Subsistence use of wood for fishing rods and bows
Whitey	<i>Inga jenmanii</i>	LEGUMINOSAE-MIMOS	Commercial timber - Utility plywood (interior piles)
wild guava	<i>Calycolpus goetheanus</i>	MYRTACEAE	Subsistence use of fruit
Wina Kakaralli	<i>Lecythis corrugate</i>	LECYNTHIDACEAE	Commercial timber - Heavy Carpentry
Yarula (Black)	<i>Aspidosperma excelsum</i>	APOCYNACEAE	Subsistence use of wood for paddles. Medicinal use of bark for malaria
Yekoro	<i>Licaria vernicosa</i>	LAURACEAE	Subsistence use of wood for boards, walls, furniture, coffins, canoes and firewood.
Yuruwe	<i>Bactris humilis</i>	PALMAE	Subsistence use of leaves for thatch roof

Several plant species were recorded to have both fruits and flowers during both surveys. There was, however, an increased level of flowering during the wet season survey. Plants generally produce fruits at the beginning of the wet season to facilitate the germination process. This accounts for the greater number of species observed fruiting in the wet season. Plant species flowering and fruiting in the wet and dry season surveys are presented in the Table 30.

Table 30: Plant Species Flowering and Fruiting

Vernacular Name	Observed during Wet Season Survey		Observed during Dry Season Survey	
	Flowering	Fruiting	Flowering	Fruiting
Baromalli				<i>Catostemma spp.</i>
Baromalli		<i>Scleronema guianense</i>		
Bullet Wood		<i>Manilkara bidentata</i>		
Devildoer			<i>Strychnos mitscherlichii</i>	<i>Strychnos mitscherlichii</i>
Greenheart		<i>Chlorocardium rodiei</i>		
Iron Mary			<i>Chamaecrista adiantifolia</i>	
Kakaralli spp.			<i>Eschweilera spp.</i>	
Kamahora medium leaf		<i>Pouteria Trigonosperma</i>		
Kufa (Black)	<i>Clusia palmicida</i>			
Suya		<i>Pouteria speciosa</i>		
Wallaba Clump		<i>Dicymbe spp.</i>		

Wallaba Ituri		<i>Eperua grandiflora</i>		
Wallaba Soft			<i>Eperua falcate</i>	

The average floristic composition of all transects surveyed during the wet and dry season surveys is provided in Table 30. The table indicates significant variation between the wet and dry seasons for the tree layer with Diameter at Breast Height (DBH) less than 20 cm for both the mixed forests and Wallaba/Dry Evergreen Forests present in the Concession. DBH of less than 20 cm is generally reflective of seedlings. The decreased seedling density in the dry season results from increased mortality rate of seedlings during the dry season, after the germination period of the wet season. The average number of individuals, species and families recorded for the other floristic composition indicated no significant temporal differences.

Table 31: Floristic Composition of Transects Surveyed

Floristic Composition	Mixed Forest		Wallaba/Dry Evergreen Forest	
	Wet	Dry	Wet	Dry
Tree layer with Diameter at Breast Height (DBH) greater than 20 cm				
No. of individuals in 0.5 ha	89	89	91	111
No. of species in 0.5 ha	27	25	16	16
No. of families in 0.5 ha	15	15	11	11
Mean diameter trees >20cm DBH	37.6cm	38.85cm	38.37cm	37.4cm
Tree layer with DBH less than 20 cm (saplings and seedlings)				
No. of individuals in 0.1 ha	758	484	919	732
No. of species on 0.1 ha	50	39	39	35
No. of families in 0.1 ha	26	23	23	21
Shrub layer with DBH less than 10cm diameter				
No. of individuals in 0.1 ha	16	21	15	15
No. of species in 0.1 ha	4	5	4	2
No. of families in 0.1 ha	4	5	4	2
Herb layer with DBH less than 1.5m				
No. of individuals in 0.1 ha	16	16	4	5
No. of species in 0.1 ha	2	2	1	1
No. of families in 0.1 ha	2	2	1	1
Palm Layer with DBH less than 20cm diameter				
No. of individuals in 0.1 ha	20	20	7	6
No. of species in 0.1 ha	2	2	1	1
No. of families in 0.1ha	1	1	1	1
Epiphytes, Hemi-epiphytes and Lianas >10cm diameter				
No. of individuals in 0.5ha	29	27	34	30
No. of species in 0.5 ha	5	7	5	4
No. of families in 0.5 ha	4	5	4	3

Analyses of timber species volume revealed insignificant variation between volumes recorded in the wet and dry season. The volumes of commercial timber computed for the wet and dry season surveys are detailed in Table 32.

Approximately 80% of the recorded vegetation is trees of which 17% (22) is utilized as commercial timber. Plants utilized for subsistence and medicinal purposes account for 49% and 13% respectively of the total recorded vegetation. The total standing volume of trees recorded for the area of 2.5 hectares (ha), directly sampled within the concession, ranged from 954.6 m³ to 913.2 m³ for the wet and dry season respectively.

Table 32: Commercial Volume of Timber Species in Areas Surveyed by Season

Commercial Volume		Wet Season		Dry Season	
Vernacular Name	Scientific Name	Total Volume (m ³)	Marketable Volume (m ³)	Total Volume (m ³)	Marketable Volume (m ³)
MIXED FOREST					
Aromata	<i>Clathrotropis brachypetala</i>	1.49	0.00	1.02	0.00
Asepoko	<i>Pouteria guianensis</i>	2.57	0.58	2.78	0.54
Baromalli	<i>Catostemma spp.</i>	7.28	1.74	7.55	2.63
Black Kakaralli	<i>Eschweilera sagotiana</i>	47.37	15.27	42.34	15.63
Bullet Wood	<i>Manilkara bidentata</i>	9.26	4.63	11.06	5.32
Burada	<i>Exellodendron barbatum</i>	5.60	2.80	5.60	2.80
Crabwood	<i>Carapa guianensis</i>	24.51	6.95	16.64	8.32
Greenheart	<i>Chlorocardium rodiei</i>	46.22	18.21	37.31	9.78
Haiawaballi	<i>Tetragastris altissima</i>	1.03	0.00	0.73	0.00
Potaro Kakaralli	<i>Eschweilera potaroensis</i>	10.59	3.11	24.48	8.98
Mora	<i>Mora excels</i>	5.28	0.00	0.00	0.00
Morabukea	<i>Mora gonggrijpii</i>	30.50	2.16	28.74	5.43
Smooth Leaf Black Kakaralli	<i>Eschweilera decolorans</i>	0.57	0.00	0.00	0.00
Suya	<i>Pouteria speciosa</i>	14.74	6.07	9.49	0.00
Wallaba Soft	<i>Eperua falcate</i>	1.54	0.00	3.86	1.93
Wamara	<i>Swartzia leiocalycina</i>	2.22	1.11	2.30	0.00
Whitey	<i>Inga jenmanii</i>	2.52	1.26	2.43	1.03
Wina Kakaralli	<i>Lecythis corrugate</i>	1.36	0.00	1.13	0.00
WALLABA/DRY EVERGREEN FOREST					
Baromalli	<i>Catostemma spp.</i>	54.00	17.38	58.02	20.21
Saka Purpleheart	<i>Peltogyne paniculata</i>	3.89	0.00	2.18	0.00
Black Kakaralli	<i>Eschweilera sagotiana</i>	0.47	0.00	0.53	0.00
Potaro Kakaralli	<i>Eschweilera potaroensis</i>	0.00	0.00	0.73	0.00
Korokororo	<i>Ormosia coutinhoi</i>	10.60	4.15	10.47	4.03
Wallaba Ituri	<i>Eperua grandiflora</i>	171.28	68.57	189.22	65.49
Wallaba Soft	<i>Eperua falcate</i>	166.44	49.21	173.66	62.57
Wina Kakaralli	<i>Lecythis corrugate</i>	1.75	0.00	1.43	0.00
Ulu	<i>Trattinickia rhoifolia</i>	0.00	0.00	0.73	0.00
TOTAL		623.08	203.2	634.43	214.69

The volume of marketable timber recorded, for the sampled area, for the wet and dry season surveys were respectively 63.89 m³ and 62.39 m³ for the mixed forests area and 139.31 m³ and 152.30 m³ for the wallaba forests area. The Total Standing Volume of commercial timber estimated to be present within the mixed forest range from 214.65 m³ to 197.46 m³. The Total Standing Volume of commercial timber estimated to be present within the wallaba forest ranged from 408.43 m³ to 436.97 m³. Marketability was assessed based on risk class (sound and straight) and diameter at breast height (DBH) of 35 cm and above. The volume of marketable timber, recorded by species, in the area sampled for the two seasons is also detailed in Table 31.

The volume recorded by the wet and dry season surveys were respectively 331.52 m³ and 278.78 m³ for species that are utilized for non-commercial purposes (subsistence and medicinal purposes) within the areas sampled. These results are detailed in Table 33.

Table 33: Total Volume of Species Utilized for Subsistence and Medicinal Purposes

Vernacular Name	Scientific Name	Wet Season Total Volume (m ³)	Dry Season Total Volume (m ³)
Apokuita	<i>Chamaecrista apoucouita</i>	5.96	7.85
Asepokoballi	<i>Pouteria jenmanii</i>	1.50	0.00
Awasokule	<i>Tovomita schomburgkii</i>	0.25	0.45
Barabara	<i>Diospyros dichroa</i>	0.56	0.72
Bauwaua	<i>Astronium ulei</i>	1.66	2.80
Black Heart	<i>Acosmium praeclara</i>	1.02	0.68
Clammy cherry	<i>Cordia sercicalyx</i>	0.84	0.00
Dalli swamp	<i>Virola surinamensis</i>	3.56	1.96
Duka	<i>Tapirira marchandii</i>	4.11	7.08
Fine Leaf Black Kakaralli	<i>Eschweilera wachenheinii</i>	0.28	0.31
Hachiballi	<i>Pera schomburgkiana</i>	1.60	2.34
Iron Mary	<i>Chamaecrista adiantifolia</i>	0.00	0.48
Itikiboroballi	<i>Swartzia benthamiana</i>	0.20	1.14
Kairiballi	<i>Licania heteromorpha</i>	1.23	0.42
Kamahora medium leaf	<i>Pouteria Trigonosperma</i>	40.51	44.10
Kautaballi	<i>Licania alba</i>	8.49	3.38
Kokoritiballi	<i>Pouteria cuspidate</i>	2.53	0.72
Komaramara	<i>Duroia eriopila</i>	1.13	0.00
Konoko	<i>Licania cuprea</i>	2.04	2.87
Kulishiri black	<i>Cupania hirsute</i>	0.36	0.24
Manobodin	<i>Emmotum fagifolium</i>	1.89	1.62
Marishiballi	<i>Licania densiflora</i>	14.32	20.46
Moroballi	<i>Talisia squarrosa</i>	21.52	15.75
Parakusan	<i>Swartzia polyphylla</i>	2.65	3.46
Ruri red skin	<i>Chaetocarpus schomburgkianus</i>	3.95	3.50
Serebedan	<i>Swartzia arborescens</i>	0.59	0.57
Teterumaballi	<i>Conomorpha peruviana</i>	0.29	0.00
Trysil	<i>Pentaclethra macroloba</i>	1.30	0.41
Waiaballi	<i>Tapura guianensis</i>	1.48	0.00
Wallaba Clump	<i>Dicymbe altsonii</i>	138.85	75.05
Wallaba Clump	<i>Dicymbe corymbosa</i>	52.94	64.44
Wanania	<i>Minquartia guianensis</i>	5.73	4.02
Warakosa	<i>Inga thibaudiana</i>	1.23	2.88
Wirimiri	<i>Lecythis confertiflora</i>	0.00	0.25
Yarula (Black)	<i>Aspidosperma excelsum</i>	6.95	8.83
TOTAL		331.52	278.78

Species are classified by the GFC as Special Class (SC) Category, Class I, Class II and Class III based on their market value and durability. Species ranked highest in economic value and durability is SC timber. Lower ranked species are placed in Class I, Class II and Class III respectively, according to their market value and durability. A total of 22 species of commercial timber with 20cm DBH and above were identified during the surveys. Three of the identified species are of the Special Class Category, seven species are of Class 1, two species are of Class II and ten species are of Class III. Table 34 depicts the Special Class Category Species as well as Class I, II and III Timber species recorded by the surveys.

Table 34: Species Classification for Timber Species within concession

Vernacular Name	Scientific Name	GFC Royalty Category	Average Total Marketable Volume (m ³)/ha
Bullet Wood	<i>Manilkara bidentata</i>	Special Category	2.00
Greenheart	<i>Chlorocardium rodiei</i>	Special Category	5.60
Saka Purpleheart	<i>Peltogyne paniculata</i>	Special Category	2.42
Aromata	<i>Clathrotropis brachypetala</i>	Class 1	0.00
Crabwood	<i>Carapa guianensis</i>	Class 1	3.06
Mora	<i>Mora excels</i>	Class 1	0.00
Morabukea	<i>Mora gonggrijpii</i>	Class 1	1.52
Suya	<i>Pouteria speciosa</i>	Class 1	2.43
Ulu	<i>Trattinickia rhoifolia</i>	Class 1	0.00
Wamara	<i>Swartzia leiocalycina</i>	Class 1	0.44
Baromalli	<i>Catostemma spp.</i>	Class 2	8.40
Wallaba Soft	<i>Eperua falcate</i>	Class 2	23.13
Asepoko	<i>Pouteria guianensis</i>	Class 3	0.22
Black Kakaralli	<i>Eschweilera sagotiana</i>	Class 3	6.18
Burada	<i>Exellodendron barbatum</i>	Class 3	1.12
Haiawaballi	<i>Tetragastris altissima</i>	Class 3	0.00
Korokororo	<i>Ormosia coutinhoi</i>	Class 3	1.64
Potaro Kakaralli	<i>Eschweilera potaroensis</i>	Class 3	2.42
Smooth Leaf Black Kakaralli	<i>Eschweilera decolorans</i>	Class 3	0.00
Wallaba Ituri	<i>Eperua grandiflora</i>	Class 3	26.81
Whitey	<i>Inga jenmanii</i>	Class 3	0.46
Wina Kakaralli	<i>Lecythis corrugate</i>	Class 3	0.00

Both the above ground and below ground (roots) tree biomass, within the concession, were determined for both surveys. There was an increase in tree biomass recorded between the two surveys with the second survey yielding a slightly greater biomass likely due to some growth during the intervening period. The mean tree biomass per hectare including roots and saplings was determined to be 740.32 tonnes carbon per hectare (t C/ha) and 752.3 (t C/ha) for the wet and dry season respectively. The volumes of biomass are detailed in Table 35.

Table 35: Biomass per Hectare for Areas Sampled

	Wet Season						Dry Season					
	(tonne Carbon/hectare)					Total Carbon Dioxide Equivalent	(tonne Carbon/hectare)					
Parameter	Above Ground Biomass	Below Ground Biomass	Saplings Biomass	Dead wood and Litter Biomass	Total Carbon Pool			Above Ground Biomass	Below Ground Biomass	Saplings Biomass.	Dead wood and Litter Biomass	Total Carbon pools
Mean	478.95	111.76	99	50.61	740.32	2714.51	485.01	113.38	99	54.91	752.3	2758.43

7.2.1.2 Fauna

Both faunal surveys documented terrestrial and aquatic species within the Concession. All transect areas surveyed exhibited evidence of human disturbance. Low levels of natural disturbances associated with tree falls were also observed in all transects surveyed. The areas sampled were moderately to highly altered and are classifiable as a modified habitat as defined by the IFC PS 6.

7.2.1.2.1 Mammals

A total of twenty three (23) species of non-volant mammals representing seven (7) families and thirteen (13) orders were recorded during the wet season survey. Fifteen (15) species were recorded in the five transects surveyed during the wet season, while eight (8) were confirmed by interviews. There were no opportunistic encounters with non-volant mammals during the wet season survey. The most abundant families recorded during the wet season were Cebidae and Felidae which were represented by five (5) and four (4) species respectively. The least abundant families recorded during the wet season were the Mustelidae, Canidae, Tapiridae, Agoutidae, Dasypodidae and Hydrochaeridae with only one species of each family being recorded.

Mazama americana, (Red-brocket deer), *Dasypodidae leoprina* (Red-rumped agouti) and *Agouti paca* (Labba) were recorded at all survey sites during the wet season survey. *Dasypus* sp (Armadillo) was recorded at four of the survey sites during the wet season survey while *Didelphis marsupialis* (common opossum) and *Tapirus terrestris* (Tapir) were recorded at three sites during the wet season survey. Species recorded at a single site during the wet season survey were *Cebus olivaceus* (Wedge-capped capuchin), *Samari scureus* (Squirrel monkey), *Leopardus pardalis* (Ocelot) and *Didelphis albiventris* (White-eared opossum).

A total of twenty seven (27) species of non-volant mammals representing seven (7) families and fifteen (15) orders were recorded during the dry season survey. Fifteen (15) species were recorded in the five transects surveyed during the dry season while ten (10) were only confirmed by interviews. There was an opportunistic encounter with one species, *Dasypus novemcinctus*. The most abundant families recorded by the dry season survey were Cebidae, Felidae and Didelphidae with five (5), four (4) and three (3) species respectively.

The least abundant families recorded during the dry season were the Mustelidae, Canidae, Callitrichidae, Tapiridae, Erethizontidae, Agoutidae, Dasypodidae and Hydrochaeridae with only one species of each family being recorded.

Mazama americana, (Red-brocket deer), *Aloutta seniculus* (Red-howler monkey), *Tapirus terrestris* (Tapir) and *Dasypodidae leoprina* (Red-rumped agouti) were recorded at all sites during the dry season survey. *Agouti paca* (Labba) and *Cebus olivaceus* (Wedge capped capuchin) were recorded at three sites. Species recorded at a single site during the dry season survey were *Panthera onca* (Jaguar) and *Marmosops parvidens* (mouse opossum).

A total of twenty eight (28) species of non-volant mammals were documented by the wet and dry season surveys. Twenty two (22) species were registered during both surveys. The red brocket deer (*Mazama Americana*), labba (*Agouti paca*), tapir (*Tapirus terrestris*), great long-nosed armadillo (*Dasypus Kappleri*) and red-rumped agouti (*Dasypodidae leoprina*) were registered at three (3) or more sites during both the wet and dry season surveys. The red brocket deer, labba, tapir and red-rumped agouti are herbivorous. Therefore, their presence at more than sixty percent of the sites surveyed may be attributed to their ability to utilize a variety of plants as food.

Didelphis albiventris (White-eared opossum) was documented only during the wet season survey, while five (5) species of non-volant mammal namely, *Sagunus midas* (golden-handed tamarind), *Coendou sp* (Porcupine), *Marmosops parvidens* (mouse opossum), *Dasypus novemcinctus* (nine-banded armadillo) and *Mazama gouazoupira* (Grey brocket deer) were documented during the dry season survey only. Three of the fifteen opossum species known to exist in Guyana were recorded during both surveys. These species were the *Didelphis marsupialis*, *Didelphis albiventris* and *Marmosops parvidens*.

Table 36: Mammals Species Documented within the Concession

ORDER	FAMILY	SPECIES RECORDED BY		COMMON NAME
		WET SEASON SURVEY	DRY SEASON SURVEY	
CARNIVORA	Canidae	<i>Cerydocon thous*</i>	<i>Cerydocon thous*</i>	Savannah Fox
	Felidae	<i>Leopardus Pardalis</i>	<i>Leopardus Pardalis</i>	Ocelot
	Mustelidae	<i>Lontra longicaudis*</i>	<i>Lontra longicaudis*</i>	Neotropical Otter
	Procyonidae	<i>Nasua Nasua*</i>	<i>Nasua Nasua*</i>	Kibihee
	Felidae	<i>Panthera Onca</i>	<i>Panthera onca</i>	Jaguar
	Procyonidae	<i>Potos Flavus</i>	<i>Potos Flavos</i>	Kinkajou
	Felidae	<i>Puma Concolor</i>	<i>Puma Concolor</i>	Puma
	Felidae	<i>Herpailurus yagouaroundi*</i>	<i>Herpailurus yagouaroundi*</i>	Jaguarundi
ARTIODACTYLA	Cervidea	<i>Mazama Americana</i>	<i>Mazama Americana</i>	Red Brocket Deer
	Cervidae		<i>Mazama gouazoupira</i>	Grey Brocket Deer
	Tayassuidae	<i>Pecari Tajacu*</i>	<i>Pecari Tajacu*</i>	Collared Peccary
	Tayassuidae	<i>Tayassu Pecari*</i>	<i>Tayassu Pecari*</i>	White-lipped Peccary
CINGULATA	Dasypodidae	<i>Dasypus Kappleri</i>	<i>Dasypus Kappleri</i>	Great Long-nosed Armadillo
	Dasypodidae		<i>Dasypus novencintus</i>	Nine-banded Armadillo
DIDELPHIMORPHIA	Didelphidae	<i>Didelphis marsupialis</i>	<i>Didelphis marsupialis</i>	Common Opossum
	Didelphidea	<i>Didelphis albiventris</i>		White eared opposum
	Didelphidea		<i>Marmosops parvidens</i>	Delicate mouse opossum
PERISSODACTYLA	Tapiridae	<i>Tapirus Terrestris</i>	<i>Tapirus Terrestris</i>	Brazilian Tapir
PRIMATES	Cebidae	<i>Alouatta Seniculus</i>	<i>Alouatta Seniculus</i>	Red Howler Monkey
	Cebidae	<i>Ateles Paniscus*</i>	<i>Ateles paniscus*</i>	Black Spider Monkey
	Cebidae	<i>Cebus Olivaceus</i>	<i>Cebus Olivaceus</i>	Wedge-capped Capuchin
	Cebidae	<i>Cebus paella*</i>	<i>Cebus paella*</i>	Brown capuchin
	Cebidae	<i>Saimiri Sciureus</i>	<i>Saimiri Sciureus*</i>	Squirrel Monkey
	Callitrichidae		<i>Sagunus midas</i>	Golden handed tamarind
RODENTIA	Erethizontidae		<i>Coendou sp</i>	Porcupine
	Agoutidae	<i>Agouti Paca</i>	<i>Agouti Paca</i>	Labba
	Dasyproctidae	<i>Dasyprocta Leporina</i>	<i>Dasyprocta Leporina</i>	Agouti
	Hydrochaeridae	<i>Hydrochoerus hydrochaeris*</i>	<i>Hydrochoerus hydrochaeris*</i>	Capybara

The mammals recorded within the Concession are widely distributed within the lowlands of Guyana, and the Guiana Shield. No critically endangered mammalian species was recorded by either survey.

7.2.1.2.2 Bats

The wet season survey recorded a total of 39 individuals representing 13 species and 4 families; Phyllostomines with 10 species, Mormoopidae with 1 species, Emballonuridae with 1 species, and Molossidae with 1 species. The most abundant species recorded in the wet season survey was the

Rhinophylla pumilio with 11 individuals, followed by the species *Carollia brevicauda* with 5 individuals. The wet season survey also recorded the species *Pteronotus parnelli*, *Carollia perspicillata* and *Phyllostomus hastatus*, each with 4 individuals; the *Tonatia bidens* with 3 individuals; *Glossophaga soricina* with 2 individuals; and the *Saccopteryx bilineata*, *Eumops aripendulous*, *Vampyressa bidens*, *Lophostoma schulzi*, *Uroderma bilobatum* and *Artibeus spp*, each with 1 individual.

The dry season survey recorded a total of 29 individuals representing 13 species and 2 families; Phyllostomines with 12 species, and Mormoopidae with 1 species. The most abundant species recorded in the dry season survey were the species *Rhinophylla pumilio* and *Glossophaga soricina*, each with 5 individuals recorded. The dry season survey also recorded the species *Pteronotus parnelli*, *Tonatia silvicola*, *Trachops cirrhosus* each with 3 individuals; *Chrotoperus auritus*, *Mimon crenulatum* and *Artibeus gnomus* each with 2 individuals; and *Artibeus obscurus*, *Carollia perspicillata*, *Carollia brevicauda*, *Mesopylla macconnelli* and *Phylloderma stenops* each with 1 individual recorded. Table 37 documents the species recorded by the surveys in both seasons.

Table 37: Bat species recorded within the Concession

COMMON NAMES	FAMILY	SPECIES RECORDED BY	
		WET SEASON SURVEY	DRY SEASON SURVEY
Parnell's Mustached Bat	Mormoopidae	<i>Pteronotus parnelli</i>	<i>Pteronotus parnelli</i>
White-lined sac wing bat	Emballonuridae	<i>Saccopteryx bilineata</i>	
Free Tailed bat	Molossidae	<i>Eumops aripendulous</i>	
Dwarf Little fruit bat	Phyllostomidae	<i>Rhinophylla pumilio</i>	<i>Rhinophylla pumilio</i>
Dark fruit eating bat			<i>Artibeus obscurus</i>
Woolly false vampire bat			<i>Chrotoperus auritus</i>
Hairy nosed bat			<i>Mimon crenulatum</i>
Fringe-lipped bat			<i>Trachops cirrhosus</i>
Common long tongued bats		<i>Glossophaga soricina</i>	<i>Glossophaga soricina</i>
White throated rounded eared bat			<i>Tonatia silvicola</i>
Gnome fruit eating bat			<i>Artibeus gnomus</i>
Silky Short-tailed bat		<i>Carollia brevicauda</i>	<i>Carollia brevicauda</i>
Seba's short-tailed bat		<i>Carollia perspicillata</i>	<i>Carollia perspicillata</i>
Macconnelli's bat			<i>Mesopylla macconnelli</i>
Pale-faced Bat			<i>Phylloderma stenops</i>
Greater spear-nosed bat		<i>Phyllostomus hastatus</i>	
Bedentate Yellow-eared Bat		<i>Vampyressa bidens</i>	
Schulz' round-eared bat		<i>Lophostoma schulzi</i>	
Common Tent Making Bat		<i>Uroderma bilobatum</i>	
Greater Round Eared Bat		<i>Tonatia bidens</i>	
		<i>Artibeus spp.</i>	

Rhinophylla pumilio was the most abundant species recorded in both wet and dry season surveys. Eight species recorded during the wet season survey were not recorded during the dry season survey. However, the dry season survey recorded 8 species which were not recorded in the wet season survey. The species *Rhinophylla pumilio*, *Pteronotus parnelli* and *Glossophaga soricina* were recorded during both wet and dry seasons surveys.

The 8 species not recorded during the dry season survey include 6 species from the Phyllostomidea family; *Phyllostomus hastatus*, *Vampyressa bidens*, *Lophostoma schulzi*, *Uroderma bilobatum*, *Tonatia bidens*, and *Artibeus spp*; 1 species from the Emballonuridae family; *Saccopteryx bilineata*; and 1 species from the Molossidae family; *Eumops aripendulous*. The 8 additional species recorded in the dry season survey are all of the Phyllostomidea family. These species include; *Mesopylla macconnelli*, *Phylloderma stenops*, *Tonatia*

silvicola, *Artibeus gnomos*, *Artibeus obscurus*, *Chrotopterus auritus*, *Mimon crenulatum*, and *Trachops cirrhosus*. Overall, the wet and dry season surveys recorded a total of 21 species of bats at the Concession representing 4 families; Phyllostomidae, Mormoopidae, Molossidae and Emballonuridae.

The Concession recorded a significantly higher number of bat species (21 species) when compared with the Tassawini concession area where a total of four species were recorded for both the 2007 and 2011 surveys. The number of bat species recorded at the Concession was also higher when compared with areas ecologically similar to the concession such as the Garner Forest Logging Concession with 13 species recorded and the Jaling Forest Logging Concession with 11 species recorded. Species richness of the Concession may be due to the presence of abundant foraging sites in the form of disturbed forest areas, and nesting sites such as the roof of camp houses.

Bats recorded within the Concession are widely distributed throughout the lowland habitats of Guyana, and the Guiana Shield. None of the species recorded within the Concession are restricted range species or endangered species.

7.2.1.2.3 Birds

The wet season survey recorded one hundred and twenty three (123) species of birds from thirty five (35) families. One hundred and fourteen (114) species were recorded in the transects surveyed and nine (9) species were recorded as opportunistic sightings. The *Thamnophilidae* family (antbirds, antshrikes and antwrens) was the most abundant family recorded by the wet season survey with twenty three (23) species of that family being recorded during the wet season survey. The next most abundant species recorded by the wet season survey were from the *Tyrannidae* family (flycatchers), and *Psittacidae* family (parrots & macaws) with fifteen (15) and ten (10) species respectively of each of these families being recorded by the wet season survey. The *Poliophtilidae* (gnatwren), *Momotidae* (motmots), *Alcedinidae* (kingfishers) families, each represented by one species, were the least abundant families recorded during the wet season survey.

The Wedge-billed Woodcreeper, (*Glyphorhynchus spirurus*) was the most common species recorded during the wet season survey with thirty-eight (38) individuals of that species being recorded. There were limited sightings of birds of prey during the wet season survey. Birds of prey recorded by the wet season survey were the Roadside Hawk (*Buteo magnirostris*), the Plumbeous Kite (*Ictinia plumbea*) and the White Hawk (*Leucopternis albicollis*).

The dry season survey recorded ninety five (95) species from twenty eight (28) families. Ninety four (94) species were recorded in the transects surveyed, while one species was recorded as an opportunistic sighting. The *Thamnophilidae* family (antbirds, antshrikes and antwrens) was also the most abundant family recorded by the dry season survey with sixteen (16) species of that family being recorded during the dry season survey. The next most abundant species recorded by the dry season survey were from the *Psittacidae* family (macaws and parrots) and *Tyrannidae* family (flycatchers) with fifteen (11) and nine (9) species respectively of each family being recorded by the dry season survey. The *Accipitridae* (hawks), *Apodidae* (swifts) and *Bucconidae* (puffbirds) families, each represented by one species were the least abundant families recorded during the dry season survey.

The Wedge-billed Woodcreeper, (*Glyphorhynchus spirurus*) was recorded as the most common species encountered during the dry season survey with thirty (30) individuals. Fewer birds of prey were recorded during the dry season as compared to the wet season survey with the Roadside Hawk (*Buteo magnirostris*) being the only bird of prey recorded by the dry season survey.

Less bird species were recorded during the dry season survey (95 species) compared to the wet season survey which recorded 123 species. Eleven (11) species of birds recorded during the dry season survey

were not recorded during the wet season surveys and 39 species of birds recorded during the wet season were not recorded during the dry season survey. No migrant species was recorded during either surveys.

Change in seasons can affect availability of food and may result in movement of birds to areas with more abundant food. The lower incidences of tree fruiting coupled with the greater thicknesses of leaf litter during the dry season survey may have affected the presence of some birds in the concession in the dry season.

Table 38 documents the species recorded by the surveys in both seasons. Avian species encountered during the surveys are common and are widely distributed within the lowland habitats of Guyana, and the Guiana Shield. No endangered or migratory species were recorded during the surveys.

Table 38: Birds Recorded within the Concession

Common Name	Family	Species Recorded by	
		Wet Season Survey	Dry Season Survey
Harpy Eagle	Accipitridae	<i>Hapria hapryja</i>	-
Plumbeous Kite	Accipitridae	<i>Ictinia plumbea</i>	<i>Ictinia plumbea</i>
Roadside Hawk	Accipitridae	<i>Buteo magnirostris</i>	-
White Hawk	Accipitridae	<i>Leucopternis albicollis</i>	-
American Pygmy Kingfisher	Alcedinidae	<i>Chloroceryle aenea</i>	-
Band-rumped Swift	Apodidae	<i>Chaetura spinicaudus</i>	<i>Chaetura spinicaudus</i>
Swallow-winged Puffbird	Bucconidae	<i>Bucco spp.</i>	<i>Bucco spp.</i>
Short-tailed Nighthawk	Caprimulgidae	<i>Lurocalis semitorquatus</i>	<i>Lurocalis semitorquatus</i>
Red-and-Black Grosbeak	Cardinalidae	<i>Periporphyrus erythromelas</i>	<i>Periporphyrus erythromelas</i>
Yellow-green Grosbeak	Cardinalidae	<i>Caryothraustes canadensis</i>	<i>Caryothraustes canadensis</i>
Turkey Vulture	Cathartidae	<i>Cathartes aura</i>	<i>Cathartes aura</i>
Pale-vented Pigeon	Columbidae	<i>Patagioenas cayennensis</i>	<i>Patagioenas cayennensis</i>
Plumbeous Pigeon	Columbidae	<i>Columba plumbea</i>	<i>Columba plumbea</i>
Ruddy Ground-dove	Columbidae	<i>Columbina talpacoti</i>	<i>Columbina talpacoti</i>
Cayenne Jay	Corvidae	<i>Cyanocorax cayanus</i>	-
Capuchin Bird	Cotingidae	<i>Perissocephalus tricolor</i>	<i>Perissocephalus tricolor</i>
Guianan Red-Cotinga	Cotingidae	<i>Phoenicircus carnifex</i>	-
Screaming Piha	Cotingidae	<i>Lipaugus vociferans</i>	<i>Lipaugus vociferans</i>
Black Curassow	Cracidae	<i>Crax alector</i>	-
Marail Guan	Cracidae	<i>Penelope marail</i>	-
Spix's Guan	Cracidae	<i>Penelope jacquacu</i>	-
Black-bellied Cuckoo	Cuculidae	<i>Piaya melanogaster</i>	<i>Piaya melanogaster</i>
Smooth-billed Ani	Cuculidae	<i>Crotophaga ani</i>	<i>Crotophaga ani</i>
Buff-throated Woodcreeper	Dendrocolaptidae	-	<i>Xiphorhynchus guttatus</i>
Chestnut-rumped Woodcreeper	Dendrocolaptidae	<i>Xiphorhynchus pardalotus</i>	<i>Xiphorhynchus pardalotus</i>
Plain-brown Woodcreeper	Dendrocolaptidae	<i>Dendrocincla fuliginosa</i>	-
Wedge-billed Woodcreeper	Dendrocolaptidae	<i>Glyphorhynchus spirurus</i>	<i>Glyphorhynchus spirurus</i>
Red-throated Caracara	Falconidae	<i>Ibycter americanus</i>	<i>Ibycter americanus</i>
Slaty-backed Forest Falcon	Falconidae	<i>Micrastur mirandollei</i>	<i>Micrastur mirandollei</i>
Black-faced Antthrush	Formicariidae	<i>Formicarius analis</i>	<i>Formicarius analis</i>
Spotted Antpitta	Formicariidae	<i>Hylopezus macularis</i>	<i>Hylopezus macularis</i>
Thrush-like Antpitta	Formicariidae	<i>Myrmothera campanisona</i>	<i>Myrmothera campanisona</i>
Plain Xenops	Furniriidae	<i>Xenops minutus</i>	<i>Xenops minutus</i>

Great Jacamar	Galbulidae	<i>Jacamerops aureus</i>	-
Yellow-billed Jacamar	Galbulidae	<i>Galbula albirostris</i>	<i>Galbula albirostris</i>
Grey-breasted Martin	Hirundinidae	<i>Progne chalybea</i>	-
Green Oropendula	Icteridae	<i>Psarocolius viridis</i>	<i>Psarocolius viridis</i>
Blue-crowned Motmot	Momotidae	<i>Momotus momota</i>	-
Chestnut Woodpecker	Picidae	<i>Celeus elegans</i>	-
Lineated Woodpecker	Picidae	<i>Dryocopus lineatus</i>	<i>Dryocopus lineatus</i>
Red-necked Woodpecker	Picidae	<i>Campephilus rubricollis</i>	-
Waved Woodpecker	Picidae	<i>Celeus undatus</i>	<i>Celeus undatus</i>
Yellow-throated Woodpecker	Picidae	<i>Piculus flavigula</i>	<i>Piculus flavigula</i>
Yellow-tufted Woodpecker	Picidae	-	<i>Melanerpes cruentatus</i>
Manakin (female)	Pipridae	<i>Lepidothrix spp</i>	-
Saffron-crested Tyrant-Manakin	Pipridae	<i>Neopelma chrysocephalum</i>	-
Thrush-like Shiffornis	Pipridae	<i>Schiffornis turdina</i>	<i>Schiffornis turdina</i>
White-crowned Manakin	Pipridae	<i>Pipra pipra</i>	-
White-fronted Manakin	Pipridae	-	<i>Pipra serena</i>
White-throated Manakin	Pipridae	<i>Corapipo gutturalis</i>	<i>Corapipo gutturalis</i>
Long-billed Gnatwren	Poliophtidae	<i>Ramphocaenus melanurus</i>	<i>Ramphocaenus melanurus</i>
Black-headed Parrot	Psittacidae	<i>Pionites melanocephalus</i>	<i>Pionites melanocephalus</i>
Blue and Yellow Macaw	Psittacidae	-	<i>Ara ararauna</i>
Blue-cheeked Parrot	Psittacidae	<i>Amazona dufresniana</i>	<i>Amazona dufresniana</i>
Blue-headed Parrot	Psittacidae	<i>Pionus menstruus</i>	-
Caica Parrot	Psittacidae	<i>Gypopsitta caica</i>	<i>Gypopsitta caica</i>
Chestnut - fronted Macaw	Psittacidae	-	<i>Ara severus</i>
Dusky capped Flycatcher	Psittacidae	-	<i>Myiarrchus tuberculifer</i>
Dusky Parrot	Psittacidae	<i>Pionus fuscus</i>	-
Golden- winged Parakeet	Psittacidae	<i>Brotoyeris chrysoptera</i>	<i>Brotoyeris chrysoptera</i>
Mealy Parrot	Psittacidae	<i>Amazona farinosa</i>	<i>Amazona farinosa</i>
Orange-winged Parrot	Psittacidae	<i>Amazona amazonica</i>	-
Red-and-Green Macaw	Psittacidae	<i>Ara chloropterus</i>	<i>Ara chloropterus</i>
Red-fan Parrot	Psittacidae	<i>Derophtus accipitrinus</i>	<i>Derophtus accipitrinus</i>
Scarlet macaw	Psittacidae	-	<i>Ara macao</i>
Grey-winged Trumpeter	Psophiidae	<i>Psophia crepitans</i>	-
Black-necked Aracari	Ramphastidae	<i>Pteroglossus aracari</i>	<i>Pteroglossus aracari</i>
Channel-billed Toucan	Ramphastidae	<i>Ramphastos vitellinus</i>	<i>Ramphastos vitellinus</i>
Red-billed Toucan	Ramphastidae	<i>Ramphastos tucanus</i>	<i>Ramphastos tucanus</i>
Spectacled Owl	Strigidae	<i>Pulsatrix perspicillata</i>	<i>Pulsatrix perspicillata</i>
Antwren species	Thamnophilidae	<i>Myrmotherula spp.</i>	-
Bay-headed Tanager	Thamnophilidae	<i>Tangara gyrola</i>	-
Black - Chined Antbird	Thamnophilidae	-	<i>Hypocnemoides melanopogon</i>
Black throated Antbird	Thamnophilidae	-	<i>Myrmeciza atrothorax</i>
Brown-bellied Antwren	Thamnophilidae	<i>Myrmotherula gutturalis</i>	<i>Myrmotherula gutturalis</i>
Cinereous Antshrike	Thamnophilidae	<i>Thamnomanes caesi</i>	<i>Thamnomanes caesi</i>
Dusky Antbird	Thamnophilidae	<i>Cercomacra tyrannina</i>	<i>Cercomacra tyrannina</i>
Dusky-throated Antshrike	Thamnophilidae	<i>Thamnomanes ardesiacus</i>	<i>Thamnomanes ardesiacus</i>
Fasciated Antshrike	Thamnophilidae	<i>Cymbilaimus lineatus</i>	<i>Cymbilaimus lineatus</i>
Ferruginous-back Antbird	Thamnophilidae	<i>Myrmeciza ferruginea</i>	<i>Myrmeciza ferruginea</i>
Gray Antbird	Thamnophilidae	<i>Cercomacra cinerascens</i>	-

Gray Antwren	Thamnophilidae	<i>Myrmotherula menetriesii</i>	<i>Myrmotherula menetriesii</i>
Guianan Warbling Antbird	Thamnophilidae	<i>Hypocnemis cantator</i>	-
Long-winged Antwren	Thamnophilidae	<i>Myrmotherula longipennis</i>	<i>Myrmotherula longipennis</i>
Mouse-coloured Antshrike	Thamnophilidae	<i>Thamnophilus murinus</i>	<i>Thamnophilus murinus</i>
Plain-winged Antwren	Thamnophilidae	<i>Myrmotherula behni</i>	<i>Myrmotherula behni</i>
Pygmy Antwren	Thamnophilidae	<i>Myrmotherula brachyura</i>	<i>Myrmotherula brachyura</i>
Rufous-bellied Antwren	Thamnophilidae	<i>Myrmotherula guttata</i>	<i>Myrmotherula guttata</i>
Rufous-throated Antbird	Thamnophilidae	<i>Gymnopathys rufigula</i>	-
Scaled-backed Antbird	Thamnophilidae	<i>Hylophylax poecilinotus</i>	-
Silvered Antbird	Thamnophilidae	<i>Sclateria naevia</i>	<i>Sclateria naevia</i>
Spot-tailed Antwren	Thamnophilidae	<i>Herpsilochmus sticturus</i>	-
Spot-Wing Antwren	Thamnophilidae	<i>Myrmotherula schisticolor</i>	-
Todd's Antwren	Thamnophilidae	<i>Herpsilochmus stictocephalus</i>	<i>Herpsilochmus stictocephalus</i>
White-plumed Antbird	Thamnophilidae	<i>Pithys albifrons</i>	<i>Pithys albifrons</i>
Bananaquit	Thraupidae	<i>Coereba flaveola</i>	-
Blue Dacnis	Thraupidae	<i>Dacnis cayana</i>	-
Fulvous-crested Tanager	Thraupidae	<i>Tachyphonus surinamus</i>	<i>Tachyphonus surinamus</i>
Opal-rumped Tanager	Thraupidae	<i>Tangara velia</i>	<i>Tangara velia</i>
Purple Honeycreeper	Thraupidae	<i>Cyanerpes caeruleus</i>	<i>Cyanerpes caeruleus</i>
Silver-beaked Tanager	Thraupidae	<i>Ramphocelus carbo</i>	<i>Ramphocelus carbo</i>
Cinereous Tinamou	Tinamidae	<i>Crypturellus cinereus</i>	<i>Crypturellus cinereus</i>
Great Tinamou	Tinamidae	<i>Tinamus major</i>	<i>Tinamus major</i>
Undulated Tinamou	Tinamidae	<i>Crypturellus undulatus</i>	<i>Crypturellus undulatus</i>
Variegated Tinamou	Tinamidae	<i>Crypturellus variegatus</i>	<i>Crypturellus variegatus</i>
Amazilia Species	Trochilidae	<i>Amazilia spp</i>	<i>Amazilia spp</i>
Blue-tailed Emerald	Trochilidae	<i>Chlorostilbon mellisugus</i>	-
Eastern Long-tailed Hermit	Trochilidae	<i>Phaethornis superciliosus</i>	<i>Phaethornis superciliosus</i>
Fork-tailed Woodnymph	Trochilidae	<i>Thalurania furcata</i>	<i>Thalurania furcata</i>
Gray-breasted Sabrewing	Trochilidae	<i>Campylopterus largipennis</i>	-
Reddish Hermit	Trochilidae	<i>Phaethornis ruber</i>	<i>Phaethornis ruber</i>
Muscian Wren	Troglodytidae	-	<i>Cyphorhinus arada</i>
White-breasted Wood-wren	Troglodytidae	<i>Henicorhina leucosticta</i>	<i>Henicorhina leucosticta</i>
Black-throated Trogon	Trogonidae	<i>Trogon rufus</i>	<i>Trogon rufus</i>
Violaceous Trogon	Trogonidae	<i>Trogon violaceus</i>	<i>Trogon violaceus</i>
White-tailed Trogon	Trogonidae	<i>Trogon viridis</i>	<i>Trogon viridis</i>
Cinnamon-crested Spadebill	Tyrannidae	<i>Platyrrhynchus saturatus</i>	<i>Platyrrhynchus saturatus</i>
Golden-crowned Spadebill	Tyrannidae	<i>Platyrrhynchus coronatus</i>	-
Gray Elaenia	Tyrannidae	<i>Myiopagis caniceps</i>	<i>Myiopagis caniceps</i>
Helmeted Pygmy-Tyrant	Tyrannidae	<i>Lophotriccus galeatus</i>	<i>Lophotriccus galeatus</i>
Mc Connell's Flycatcher	Tyrannidae	<i>Mionectes macconnelli</i>	<i>Mionectes macconnelli</i>
Ochre-bellied Flycatcher	Tyrannidae	<i>Mionectes oleagineus</i>	-
Olivaceous Flatbill	Tyrannidae	<i>Rhynchocyclus olivaceus</i>	-
Rufous-crowned Elaenia	Tyrannidae	-	<i>Elaenia ruficeps</i>
Short-tailed Pygmy-Tyrant	Tyrannidae	<i>Myiornis ecaudatus</i>	<i>Myiornis ecaudatus</i>
Spadebill	Tyrannidae	<i>Platyrrhynchus spp.</i>	<i>Platyrrhynchus spp.</i>
Tody-Flycatcher	Tyrannidae	<i>Todirostrum spp.</i>	<i>Todirostrum spp.</i>
Tropical Kingbird	Tyrannidae	<i>Tyrannus melancholicus</i>	-
Whiskered Flycatcher	Tyrannidae	<i>Myiobius barbatus</i>	<i>Myiobius barbatus</i>

Yellow-bellied Elaenia	Tyrannidae	<i>Elaenia flavogaster</i>	<i>Elaenia flavogaster</i>
Yellow-throated Flycatcher	Tyrannidae	<i>Conopias parva</i>	<i>Conopias parva</i>
Zimmer's Flycatcher	Tyrannidae	<i>Tolmomyias assimilis</i>	<i>Tolmomyias assimilis</i>
Buff-cheeked Greenlet	Vireonidae	<i>Hylophilus muscicapinus</i>	<i>Hylophilus muscicapinus</i>
Slaty-capped Shrike-Vireo	Vireonidae	<i>Vireolanius leucotis</i>	-

7.2.1.2.4 Herpetofauna

Twenty eight (28) species from one amphibian order – Anura (frogs and toads) representing seven (7) families (Bufonidae, Dendrobatidae, Hylidae, Leptodactylidae, Pipidae, Hemiphractidae and Centrolenidae) were recorded by the surveys of the Concession.

Twenty (20) species from six (6) families were encountered during the wet season survey, while twenty two (22) species from six (6) families were encountered during the dry season survey. A study conducted in a seasonal Amazonian forest, (Duellman, 1995) found that increased anuran activity is closely correlated to the occurrence of heavy rainfall and not to total rainfall. There were three such periods of heavy rainfall during the dry season survey which may account for the larger number of species encountered during the dry season survey.

The Hylidae family yielded the greatest species diversity in both the wet and dry season surveys. Eleven (11) species of hylidae were recorded during the wet season survey and twelve (12) species were recorded during the dry season survey. Species from the families of Leptodactylidae, Bufonidae, Hemiphractidae and Dendrobatidae were recorded during both the wet and dry season surveys. The family, Pipidae, represented by *Pipa aspera* was recorded in the dry season but was not recorded during the wet season. The family Centrolenidae represented by a single species, *Hyalinobatrachium taylori*, in the dry season survey, was not recorded by the wet season survey.

The wet season survey recorded a total of two hundred and forty nine (249) individuals. The dominant species recorded during the wet season survey were *Osteocephalus oophagus* (50 individuals), *Scinax rubra* (42 individuals) and *Trachycephalus resinifictrix* (34 individuals), all of the family Hylidae.

The dry season survey recorded a total of two hundred and sixty six (266) individuals. The dominant species recorded during the dry season surveys were *Rhinella marina* (51 individuals), *Pseudis paradoxa* (41 individuals), *Scinax rubra* (26 individuals) and *Hypsiboas boans* (21 individuals).

The increased occurrence of *Rhinella marina* and *Hypsiboas boans* during the dry season as compared to the wet season surveys stems from their reproductive strategy. Aichenger (1987) documented the increased presence of these two species during the dry season, when they would use the exposed water edges/banks for breeding. Increased activity of *Hypsiboas boans* during the dry season on sandy or muddy edges of slow moving water bodies is also documented (Rodriguez and Duellman, 1994). Most of the encounters of this species during the dry season survey were on sandy banks of water bodies, and abandoned mining pits.

The decrease in observations of *Osteocephalus oophagus* in the dry season as compared to the wet season is linked to the behavioral ecology of the species. There is a decreased frequency of male calls for female after the breeding season which coincides with the wet season.

The wet season survey recorded one species of Centrolenidae (Glass Frog); *Hyalinobatrachium taylori*. This species was not recorded in the dry season survey. *Hypsiboas crepitans*, *Phyllomedusa tomopterna*, *Stefani evansi* and *Colostethus sp.* were also recorded in the wet season survey but not in the dry season survey.

The dry season survey recorded one species of Pipidae (Surinam Toad), *Pipa aspera*. This species was not recorded during the wet season survey. *Stefania scalae*, *Hypsiboas calcaratus*, *Hypsiboas multifasciatus*, *Osteocephalus leprieurii*, *Rhaebo guttatus*, and *Adenomera lutzi* were also recorded only in the dry season survey and not in the wet season survey.

The amphibian species assemblage encountered within the Concession is typical of Guyana and the wider Guiana Shield and Amazonian region.

Three endemic amphibian species were identified in the Concession during the wet season survey; *Stefania evansi*, *Hyalinobatrachium* cf. *taylori* and *Rhaebo nasiscus*. The dry season survey also identified endemic amphibian species; *Adenomera lutzi*, *Rhaebo nasiscus*, and *Pipa aspera*.

Table 39: Amphibians Recorded within the Concession

ORDER	FAMILY	SPECIES RECORDED BY		COMMON NAME
		WET SEASON SURVEY	DRY SEASON SURVEY	
ANURA	Bufonidae	-	<i>Rhaebo guttatus</i>	Spotted Toad
	Bufonidae	<i>Rhaebo nasiscus</i>	<i>Rhaebo nasiscus</i>	Werner's Toad
	Bufonidae	<i>Rhinella marina</i>	<i>Rhinella marina</i>	Neotropical Giant Toad
	Bufonidae	<i>Atelopus hoogmoedi</i>	<i>Atelopus hoogmoedi</i>	Hoogmoed Harlequin Toad
	Dendrobatidae	<i>Ameerga hahneli</i>	<i>Ameerga hahneli</i>	Pale Striped Amazon Poison Frog
	Dendrobatidae	<i>Colostethus</i> sp.	-	Rocket Frog
	Hylidae	<i>Dendropsophus minutus</i>	<i>Dendropsophus minutus</i>	Lesser Treefrog
	Hylidae	<i>Hypsiboas boans</i>	<i>Hypsiboas boans</i>	Giant Gladiator Treefrog
	Hylidae	-	<i>Hypsiboas calcaratus</i>	Troschel's Treefrog/Blue-Flanked Treefrog
	Hylidae	-	<i>Hypsiboas multifasciatus</i>	Many Banded Treefrog
	Hylidae	<i>Hypsiboas crepitans</i>	-	Emerald Eyed Treefrog
	Hylidae	<i>Trachycephalus resinifictrix</i>	<i>Trachycephalus resinifictrix</i>	Amazon Milk Frog
	Hylidae	<i>Dendropsophus marmoratus</i>	<i>Dendropsophus marmoratus</i>	Marbled Treefrog
	Hylidae	<i>Osteocephalus oophagus</i>	<i>Osteocephalus oophagus</i>	Oophagus Slender-Legged Treefrog
	Hylidae	<i>Osteocephalus taurinus</i>	<i>Osteocephalus taurinus</i>	Manaus Slender-Legged Treefrog
	Hylidae	-	<i>Osteocephalus leprieurii</i>	Cayenne Slender-Legged Treefrog
	Hylidae	<i>Phyllomedusa bicolor</i>	<i>Phyllomedusa bicolor</i>	Giant Leaf Frog
	Hylidae	<i>Phyllomedusa tomopterna</i>	-	Tiger Leg Monkey Treefrog
	Hylidae	<i>Pseudis paradoxa</i>	<i>Pseudis paradoxa</i>	Paradoxical Frog/Shrinking Frog
	Hylidae	<i>Scinax rubra</i>	<i>Scinax ruber</i>	Red Snouted Treefrog
	Leptodactylidae	-	<i>Adenomera lutzi</i> *	Lutz's Thin-Toed Frog
	Leptodactylidae	<i>Leptodactylus petersii</i>	<i>Leptodactylus petersii</i>	Peter's Thin-Toed Frog
	Leptodactylidae	<i>Leptodactylus knudseni</i>	<i>Leptodactylus knudseni</i>	Knudsen's Thin-Toed Frog
	Pipidae	-	<i>Pipa aspera</i>	Albina Surinam Toad
	Hemiphractidae	-	<i>Stefania scalae</i>	Rana Stefania De La Escalera

	Hemiphractidae	<i>Stefania evansi</i>	-	Groete Creek Carrying Frog
	Centrolenidae	<i>Hyalinobatrachium taylori</i>	-	Taylor's Glass Frog

*Previously *Leptodactylus lutzi*

Forty two (42) species from three reptilian orders; Squamata (lizards and snakes), Testudines (turtles and tortoises) and Crocodylia (Caimans, alligators and crocodiles) representing fifteen families; Gymnophthalmidae, Polychrotidae, Gekkonidae, Teiidae, Scincidae, Boidae, Colubridae, Dipsadidae, Elapidae, Viperidae, Anomalepididae, Amphisbaenidae, Testudinidae, and Alligatoridae were recorded during the herpetofaunal surveys conducted at the Concession.

Twenty three (23) species from eleven (11) families were encountered during the wet season survey, while thirty three (33) species from twelve (12) families were encountered during the dry season survey. The increase in species diversity and abundance during the dry season survey may be as a direct consequence of the changes in environmental variables such as temperature, moisture, and sunlight intensity.

In both the dry and wet season surveys, the order Squamata exhibited the greatest species diversity as well as family diversity. The family from this order which exhibited greatest species diversity throughout the survey was Colubridae with eight (8) species being recorded in the wet season and seven (7) species being recorded during the dry season surveys. Species from the families of Alligatoridae, Colubridae, Viperidae, Tropiduridae, Teiidae, Gekkonidae, Polychrotidae and Gymnophthalmidae were observed in both the wet and dry seasons. The families of Boidae, Elapidae, and Scincidae were encountered only in the wet season survey with each being represented by one species *Eunectes murinus* (Boidae), *Micrurus hemprichii* (Elapidae), and *Mabuya nigropunctata* (Scincidae).

Three families recorded by the dry season survey were not recorded by the wet session survey. These were the family Amphisbaenidae represented by the species *Amphisbaena fuliginosa*, the family Anomalepididae represented by the species *Typhlops minuisquamus*, and the family Dipsadidae represented by the species *Siphlophis compressus* and *Pseudoboa coronata*.

The wet season survey recorded a total of eighty-four (84) individuals. The most commonly encountered reptilian species, during the wet season survey were the *Ameiva ameiva* and *Kentropyx calcarata*. These species were commonly encountered near campsites and on transects, basking in sunlit patches in the forest floor. *Anolis fuscuaauratus* was the only species registered at all sites during the wet season srurvey.

The dry season survey recorded a total of one hundred and forty one (141) individuals. The dominant species recorded during the dry season survey was *Kentropyx calcarata* (41 individuals), followed by *Ameiva ameiva* (28 individuals).

Interviews with local miners and PGI staff confirmed the presence of *Leptotyphlops tenella*, *Anilius scytale*, *Boa constrictor*, *Corallus caninus*, *Epicrates cenchria*, *Micrurus surinamensis*, *Tantila melanocephala*, *Chironius fuscus*, *Spilotes pullatus*, *Bothrops brazili* and *Leptophis ahaetulla*. None of these species were actually recorded by any of the surveys.

The reptilian species assemblage encountered within the Concession is typical of Guyana and the wider Guiana Shield and Amazonian region. None of the reptilian species recorded within the Concession are endangered or restricted range species

Table 40: Reptiles Recorded in the Concession

ORDER	FAMILY	SPECIES RECORDED BY		COMMON NAME
		WET SEASON SURVEY	DRY SEASON SURVEY	
SQUAMATA - Lacertilia	Gymnophthalmidae	-	<i>Iphisa elegans</i>	Glossy Shade Lizard
	Gymnophthalmidae	<i>Leposoma percarinatum</i>	<i>Leposoma percarinatum</i>	Striped Root Lizard
	Gymnophthalmidae	<i>Prionodactylus oshaughnessyi</i>	-	White-Striped Eyed Lizard
	Gymnophthalmidae	-	<i>Bachia flavescens</i>	-
	Polychrotidae	<i>Anolis chrysolepis</i>	<i>Anolis chrysolepis</i>	Goldenscale Anole
	Polychrotidae	<i>Anolis fuscoauratus</i>	<i>Anolis fuscoauratus</i>	Slender Anole
	Polychrotidae	<i>Anolis nitens nitens</i>	<i>Anolis nitens nitens</i>	Yellow-Tongued Anole
	Polychrotidae	-	<i>Anolis planiceps</i>	Tree-trunk Anole
	Gekkonidae	<i>Gonatodes annularis</i>	<i>Gonatodes annularis</i>	Annulated Gecko
	Gekkonidae	<i>Gonatodes humeralis</i>	<i>Gonatodes humeralis</i>	Bridled Forest Gecko
	Gekkonidae	-	<i>Gonatodes alexandermendesi</i>	Mendes' Gecko
	Gekkonidae	<i>Thecadactylus rapicauda</i>	<i>Thecadactylus rapicauda</i>	Turnip-Tailed Gecko
	Gekkonidae	-	<i>Coleodactylus amazonicus</i>	Brazilian pygmy gecko
	Gekkonidae	-	<i>Pseudogonatodes guianensis</i>	Amazon pygmy gecko
	Gekkonidae	<i>Hemidactylus mabuya</i>	-	Common Leaf- Toed Gecko)
	Teiidae	<i>Ameiva ameiva</i>	<i>Ameiva ameiva</i>	Amazon Race Runner
	Teiidae	<i>Kentropyx calcarata</i>	<i>Kentropyx calcarata</i>	Striped Forest Whiptail
	Teiidae	-	<i>Cnemidophorus sp.</i>	Whiptail Lizard
	Tropiduridae	<i>Plica plica</i>	<i>Plica plica</i>	Neotropical Tree Agama
	Tropiduridae	-	<i>Plica umbra</i>	South American 'Chameleon'
	Scincidae	<i>Mabuya nigropunctata</i>	-	Black Spotted Skink
SQUAMATA - Serpentes	Boidae	<i>Eunectes murinus</i>	-	Green Anaconda
	Colubridae	<i>Drymoluber dichrous</i>	-	Common Glossy Racer
	Colubridae	<i>Oxyrhopus formosas</i>	<i>Oxyrhopus formosas</i>	Formosa False Coral Snake
	Colubridae	<i>Pseustes sulphureus</i>	-	Amazon Puffing Snake
	Colubridae	<i>Oxybelis aeneus</i>	-	Brown Vine Snake
	Colubridae	-	<i>Erythrolamprus miliaris</i>	

	Colubridae	<i>Erythrolamprus aesculapii</i>	<i>Erythrolamprus aesculapii</i>	Aesculapian False Coral Snake
	Colubridae	<i>Liophis typhlus</i>	<i>Liophis typhlus</i>	Velvet Swampsnake
	Colubridae	<i>Leptodeira annulata</i>	-	Cat-Eyed Night Snake
	Colubridae	<i>Oxybelis fulgidus</i>	<i>Oxybelis fulgidus</i>	Green Vine Snake
	Colubridae	-	<i>Atractus favae</i>	Filippi's Ground Snake
	Colubridae	-	<i>Chironius fuscus</i>	Brown Sipo
	Dipsadidae	-	<i>Siphlophis compressus</i>	Tropical Flat Snake
	Dipsadidae	-	<i>Pseudoboa coronate</i>	Crowned False Boa
	Elapidae	<i>Micrurus hemprichii</i>	-	South American Coral Snake
	Viperidae	<i>Bothrops atrox</i>	<i>Bothrops atrox</i>	South American Lancehead
	Anomalepididae	-	<i>Typhlops minuisquamus</i>	Basin Worm Snake
SQUAMATA - Lacertilia	Amphisbaenidae	-	<i>Amphisbaena fuliginosa</i>	
TESTUDINES	Testudinidae	-	<i>Chelonoidis denticulate</i>	Yellow footed tortoise
CROCODYLIA	Alligatoridae	-	<i>Paleosuchus trigonatus</i>	Schneider's Smooth Fronted Caiman
		<i>Caiman crocodilus</i>	<i>Caiman crocodilus</i>	Spectacled Caiman

7.2.1.2.5 Terrestrial Macro-invertebrates

Terrestrial-macro invertebrates recorded in the surveys were classified to the Order taxon, due to the difficulty of identifying and classify invertebrates to lower taxa.

The wet season survey recorded 18 orders of terrestrial macro-invertebrates. The orders Diptera, Isoptera, Acari, and Blattidea were assessed the most abundant terrestrial macro-invertebrates during the wet season. Orders such as Lepidoptera, Odonata, Hymenoptera and Araneae were also fairly common in the wet season survey. The orders Lithobiomorpha, Haplotaenidia, Scorpiones, Hemiptera and Mantodea were the least abundant/common in the wet season.

All 18 orders of terrestrial macro-invertebrates recorded in the wet season survey were recorded during the dry season survey. During the dry season survey, the orders Hymenoptera, Isoptera, Callipodida, Araneae, Blattidea, Hemiptera and Acari were the most abundant in areas surveyed. Orders such as Lepidoptera, Odonata, and Orthoptera were fairly common to common in the dry season survey. The orders Lithobiomorpha, Haplotaenidia, Scorpiones, and Mantodea were the least abundant/common in the dry season. The orders Hemiptera, Coleoptera, Odonata and Araneae were more prevalent during the dry season when compared to the wet season.

Insects were fairly common to abundant at all areas surveyed during the surveys. However, they were more plentiful along the access roads and open/cleared areas. The abundance of insects may be related to the number of plants that were either fruiting or flowering during the surveys.

Similar findings were recorded in the Tassawini Concession survey with 15 and 13 orders recorded in the 2007 and 2011 surveys respectively.

Table 41: Terrestrial macro-invertebrates recorded within the Concession

Vernacular Name	ORDER RECORDED BY	
	Wet Season Survey	Dry Season Survey
Mites and Ticks	Acari	Acari
Segmented Worms	Annelida	Annelida
Spiders	Araneae	Araneae
Cockroaches	Blattidea	Blattidea
Centipedes	Lithobiomorpha	Lithobiomorpha
Beetles	Coleoptera	Coleoptera
Millipedes	Callipodida	Callipodida
True Flies	Diptera	Diptera
True Bugs	Hemiptera	Hemiptera
Bees, Wasp and Ants	Hymenoptera	Hymenoptera
Termites	Isoptera	Isoptera
Butterflies, moths and skippers	Lepidoptera	Lepidoptera
Praying Mantis	Mantodea	Mantodea
Dragon and Damselflies	Odonata	Odonata
Grasshoppers, locusts, crickets and katydids	Orthoptera	Orthoptera
Stick Insects	Phasmidae	Phasmidae
Scorpions	Scorpiones	Scorpiones
Aqua worms, earth worms	Haplotaxida	Haplotaxida

7.2.1.2.6 Fish

The wet season survey of the ichthyofauna of the concession recorded one hundred and fifty- one (151) individuals of thirty two (32) species from fourteen (14) families. The family Characidae recorded the highest number of individuals during the wet season survey with fifty-four (54) individuals and accounted for nine (9) of the thirty two (32) species recorded by the wet season survey. The least abundant families recorded by the wet season survey were Acestrorhynchidae, Anostomidae and Gymnotidae with only one individual of each family being recorded.

The most common species recorded for the wet season was *Hoplias malabaricus* which was recorded at at every sample site except the Kaburi creek at the Iron Bridge. *Aequidens potaroensis* was recorded at four sample sites during the wet season. The least common species recorded during the wet season survey were *Eigenmannia virescens*, *Electrophorus electricus*, *Rhamdia quelen*, *Brachyrhamdia heteropleura*, *Hoplias aimara*, *Acaronia sp.*, *Apistogramma sp.*, *Crenichla saxatallis*, *Acestrorhynchus falcirostris* and *Leporinus arcus*. Each of these species was represented by only one individual during the wet season.

The dry season survey of the ichthyofauna of the concession recorded two hundred and nine (209) individuals of thirty-nine (39) species from seventeen (17) families. The family Engraulidae recorded the highest number of individuals during the dry season with forty-six (46) individuals from two (2) species. The family Characidae was the second most abundant recorded by the dry season survey with thirty one individuals from eight species.

The least abundant families recorded during the dry season survey were Rhamphichthyidae, Lebiasinidae, Cetopsidae, Anostomidae and Auchenipteridae with only one individual of each family being recorded by the dry season survey.

Brycon falcatus and *Hoplias malabaricus* were the most common species recorded during the dry season survey with individuals of both species being recorded at four of the survey sites.

Table 42: Fish Species Recorded within the Concession

Common Name	FAMILY	RECORDED BY	
		Wet Season Survey	Dry season Survey
Dag fish	Acestrorhynchidae	<i>Acestrorhynchus falcistrostris</i>	<i>Acestrorhynchus falcistrostris</i>
Orange tail	Alestidae	-	<i>Chalceus macrolepidotus</i>
	Alestidae	-	<i>Triportheus brachypomus</i>
Kabushi	Anostomidae	<i>Leporinus arcus</i>	<i>Leporinus arcus</i>
Dawalloo	Auchenipteridae	-	<i>Ageneiosus inermis</i>
Boots	Auchenipteridae	<i>Trachycorystes trachycorystes</i>	<i>Trachycorystes trachycorystes</i>
Lock man	Auchenipteridae	-	<i>Trachycorystes galeatus</i>
	Cetopsidae	<i>Helogenes marmoratus</i>	<i>Helogenes marmoratus</i>
Celebe	Characidae	<i>Astyanax fasciatus</i>	<i>Astyanax fasciatus</i>
Silva	Characidae	<i>Brycon falcatus</i>	<i>Brycon falcatus</i>
	Characidae	<i>Hemigrammus schmardae</i>	-
	Characidae	<i>Hemigrammus stictus</i>	-
	Characidae	<i>Hyphessobrycon minimus</i>	-
	Characidae	<i>Moenkhausia collettii</i>	<i>Moenkhausia collettii</i>
	Characidae	<i>Moenkhausia sp.</i>	-
	Characidae	<i>Phenacogaster microstictus</i>	-
	Characidae	<i>Poptella longipinnis</i>	<i>Poptella longipinnis</i>
	Characidae	-	<i>Charax gibbosus</i>
	Characidae	-	<i>Myleus asterias</i>
Patwa	Cichlidae	<i>Aequidens potaroensis</i>	<i>Aequidens potaroensis</i>
Sunfish	Cichlidae	<i>Crenichla saxatallis</i>	<i>Crenichla saxatallis</i>
Patwa	Cichlidae	<i>Cichlasoma bimaculatum</i>	<i>Cichlasoma bimaculatum</i>
Patwa	Cichlidae	<i>Acaronia nasso</i>	<i>Acaronia nasso</i>
	Cichlidae	<i>Acaronia sp.</i>	-
	Cichlidae	<i>Apistogramma sp.</i>	<i>Apistogramma sp.</i>
	Engraulidae	<i>Anchoviella sp. 1</i>	-
	Engraulidae	<i>Anchoviella sp. 2</i>	-
	Engraulidae	<i>Anchoviella guianensis</i>	<i>Anchoviella guianensis</i>
Kataback	Erythrinidae	-	<i>Prosomyleus rhombeus</i>
Huri	Erythrinidae	<i>Hoplias malabaricus</i>	<i>Hoplias malabaricus</i>
Himari	Erythrinidae	<i>Hoplias aimara</i>	<i>Hoplias aimara</i>
Yarrow	Erythrinidae	-	<i>Hoplerythrinus unitaeniatus</i>
Shocking eel	Gymnotidae	<i>Electrophorus electricus</i>	<i>Electrophorus electricus</i>
Kassie	Heptapteridae	<i>Rhamdia quelen</i>	<i>Rhamdia quelen</i>
	Heptapteridae	<i>Brachyrhamdia heteropleura</i>	<i>Brachyrhamdia heteropleura</i>
Patwa	Lebiasinidae	<i>Nannostomus marginatus</i>	-
Smoke hassar	Loricariidae	<i>Hypostomus watwata</i>	<i>Hypostomus watwata</i>
	Pimelodidae	<i>Pimelodus blochii</i>	<i>Pimelodus blochii</i>
	Pimelodidae	-	<i>Pimelodus ornatus</i>
	Pimelodidae	-	<i>Pseudoplatystoma fasciatum</i>
	Rhamphichthyidae	-	<i>Rhamphichthys rostratus</i>
	Rivulidae	-	<i>Rivulus waimacui</i>
Luga luga	Sternopygidae	<i>Eigenmannia virescens</i>	<i>Eigenmannia virescens</i>
Luga luga	Sternopygidae	<i>Eigenmannia sp.</i>	-
Luga luga	Sternopygidae	-	<i>Sternopygus macrurus</i>

A total of forty-five (45) species of fishes from seventeen (17) families were recorded by both wet and dry season surveys. Ten (10) species recorded during the wet season were not recorded during the dry season while thirteen (13) species of fish recorded during the dry season were not recorded during the wet season.

The variability in the species recorded is probably indicative of short range migrations of some species in response to food availability, spawning and changes in environmental conditions. The Characidae family was recorded as the most abundant family during both the wet and dry season surveys. This family feeds on a wide range of plants, animals and other materials including planktonic, crustaceans, insects, some higher plant material, detritus and even fish scales. Their feeding habits probably account for their abundance in the Concession.

Two endemics were recorded by the surveys. These were the cichlid *Aequidens potaroensis* recorded during both the wet and dry season surveys and *Hyphessobrycon minimus* which was recorded by the wet season survey.

7.2.1.2.7 Aquatic/Benthic Macro-invertebrates

Aquatic macro-invertebrates recorded during both surveys were classified to the Order taxon, due to the difficulty of identifying and classifying invertebrates to the lower taxa. The methodology employed and details on how the information acquired was analyzed are presented in Appendix D.

The wet season survey recorded fourteen (14) orders of aquatic macro-invertebrates. The orders Decapoda, Amphipoda, Hemiptera, and Nepomorpha were assessed as the most abundant aquatic macro-invertebrates during the wet season. The least encountered orders during the wet season were Gastropoda, Diptera and Trichoptera.

The dry season survey recorded seven (7) orders of aquatic macro-invertebrates. The Orders of Diptera Decapoda and Odonata were the most abundant in the dry season survey. The least encountered order during the dry season was Araneae.

The orders Adephaga, Amphipoda, Decapoda (crabs), Isopoda, Nepomorpha, Coleoptera, Trichoptera, Polydesmida and Hirudinea were not recorded in the dry season survey. The absence of these orders during the dry season was mostly likely due to the absence of the habitats (water puddles) where the organisms were previously observed.

Table 43: Aquatic macro-invertebrates recorded in the concession

COMMON NAME	ORDER RECORDED BY	
	WET SEASON SURVEY	DRY SEASON SURVEY
Diving water beetle	Adephaga	-
Semi aquatic spider	Araneae	Araneae
Scud	Amphipoda	-
Shrimp	Decapoda	Decapoda
Crab	Decapoda	-
Cray fish	Decapoda	Decapoda
Sand flies	Diptera	Diptera
Mosquito	Diptera	Diptera
Snail	Gastropoda	Gastropoda

Water strider	Hemiptera	Hemiptera
Semiaquatic woodlouse	Isopoda	-
Water boatman	Nepomorpha	-
Water stick	Nepomorpha	Nepomorpha
Water scorpion	-	
Dragonfly	Odonata	Odonata
Water beetle	Coleoptera	-
May fly larva	-	-
Caddisflies	Trichoptera	-
Water Millipede	Polydesmida	-
Leech	Hirudinea	-

7.2.2 Biodiversity of the New Site Access Road

A similar methodology to that detailed in Appendix C was used to conduct the biodiversity survey of the new access road. This survey was however conducted once only in the wet season over the period of July 11 – 15, 2013. A general habitat description of the terrestrial sample plots is provided in Table 44. The identification of aquatic sample sites and aquatic habitat descriptions are presented in Table 45. The locations of sample plots for the access road survey are shown on Figure 37.

7.2.2.1 Flora

The floral survey documented three forest types along the access road; clump wallaba forest, Morabukea Forest and Mixed Wallaba Forest. The Clump Wallaba Forest, occurring on fine white sand was dominated by the Caesalpiniaceae family. *Dicymbe corymbosa* with 68 stems accounted for 45.6% of the data collected. *Eperua falcate* and *E. grandiflora* of the Leguminosae – Caesalp family were abundant with a combine total of 47stems accounting for 31.5% of the data collected. *Pouteria Trigonosperma* of the Sapotaceae family with 14 stems (9.4%) was occasional. The Morabukea Forest, occurring on brown sandy loam, was characterized by the common occurrence of emergent and endemic species such as *Chlorocardium rodiei* (Green heart), *Peltogyne venosa* (Purple heart), *Manilkara bidentata* (Bullet wood) and *Eschweilera potaroensis* (Potaro Kakaralli). However, based on the data collected, species of the Caesalpiniaceae and Lecythidaceae families were abundant. *Mora gonggrijpii* of the Caesalpiniaceae family with a total of 31 stems accounted for 30% of the data collected. Similarly, the Lecythidaceae family with *Eschweilera sagotiana* and *Eschweilera potaroensis* accounted for 30% with a combine total of 31 stems. Species of the Leguminosae – Caesalp family were abundant within the Mixed Wallaba Forest on fine white sand. *Eperua falcate* and *E. grandiflora* with a combine total of 46 stems accounted for 41.4% of data collected. *Licania mollis* and *Licania alba* of the Chrysobalanaceae family occurred occasionally with a combine total of 14 stems accounting for 12.6% of data collected. *Catostemma alstonii* of the Bombacaceae family also occurred occasionally, with 14 stems accounting for 12.6% of data collected.

The occurrence of endemic species along the road is consistent with that of Central Guyana. True Guyana endemics Greenheart (*Chlorocardium rodiei*); Wamara (*Swartzia leiocalycina*); Marishiballi (*Licania buxifolia*); and Potaro Kakaralli (*Eschweilera potaroensis*) were common in the mixed forests. Guiana shield endemics Common Baromalli (*Catostemma commune*) and Black Kakaralli (*Eschweilera sagotiana*) were frequent.

Figure 37 - Location of Terrestrial and Aquatic Sample Points for Access Road Survey

Table 44: General Habitat Descriptions of Terrestrial Sample Plots Surveyed on Access Road Alignment

Transect ID	GPS Location	Habitat Description
RT 1	N 0267939 E 0611868	Predominantly, primary Clump Wallaba forest on fine white sand. The forest area occurs on slightly undulating terrains. Elevation of the area ranged between 113-121 m. Characteristically, a high forest with an irregular and moderately closed canopy. Canopy height varies between 20-35 meters. The canopy layer was dominated by <i>Dicymbe corymbosa</i> and frequent by <i>Eperua grandiflora</i> . Other species that occurred occasionally within the canopy layer were <i>Eperua falcate</i> and <i>Pouteria Trigonosperma</i> . The understory layer was sparsely populated with species <i>Tovomita schomburgkii</i> , <i>Dugueta pycnastera</i> and <i>Duroia eriopila</i> occurring frequently. Lianas, epiphytes and palms were occasional. The litter depth was predominantly fine.
RT 2	N 0270118 E 0613878	Predominantly, primary Morabukea mixed forest on brown sandy loam soil. The forest area occurred on slightly undulating terrains with flat areas occasionally water logged. Elevation of the area varies between 121-132 meters. Characteristically, high forest with an irregular and relatively closed canopy. Canopy height varies between 20 – 35 meters. <i>Mora gonggrijpii</i> occurred abundantly within the canopy layer. Canopy species <i>Eschweilera sagotiana</i> occurred occasionally and emergent species <i>Eschweilera potaroensis</i> (Potaro Kakaralli – endemic to Central Guyana) rarely occurred. The understory layer was medium to densely populated with a diversity of understory species occasionally occurring. Understory species such as <i>Licania heteromorpha</i> , <i>Dugueta pycnastera</i> and <i>Oxandra asbeckii</i> . Lianas species <i>Strychnos mitscherlichii</i> was abundant while epiphytes were rare. The litter depth was fine to medium.
RT 3	N 0267992 E 0615604	Primary Marsh forest on pegasse soil, bordered by transitional mixed forest on fine brown sandy soil. Forest area relatively flat with elevation varying between 89-105 meters. Twenty five meters east from the sample area, a creek flows in the southern direction. Characteristically a medium forest with open canopy. Canopy height varies between 15-25 meters. Canopy species that occurred occasionally were <i>Eperua grandiflora</i> , <i>Peltogyne paniculata</i> and <i>Catostemma alstonii</i> . Other occurring canopy species common in marsh forest were <i>Symphonia globulifera</i> , <i>Humiriastrum obovatum</i> , <i>Jessenia bataua</i> and <i>Pradosia schomburgkiana</i> . The understory layer was densely populated with palm species <i>Jessenia bataua</i> and shrub species <i>Ischnosiphon gracilis</i> . Epiphytes were frequent while lianas were rare. Predominantly thick litter depth.
RT 4	N0269424 E 0617792	Predominantly, primary mixed Wallaba forest on fine white sand. Forest area slightly undulating, with elevation varying between 108-127 meters. Characteristically, a high forest with moderately closed canopy. Canopy height varies between 25-35 meters. <i>Eperua falcate</i> occurred abundantly within the canopy layer with <i>Eperua grandiflora</i> , <i>Licania mollis</i> and <i>Catostemma alstonii</i> occasionally occurring. Densely populated understory layer dominated by <i>Dugueta pycnastera</i> , <i>Oxandra asbeckii</i> and <i>Tovomita schomburgkii</i> . Epiphytes were occasional, whereas lianas and palms were rare. Leaf litter layer was thin to medium. Human alteration noted and included a surveyor's transect of 3 meters wide through sample area.

Table 45: General Habitat Descriptions of Aquatic Sampling Locations Likely Influenced by Access Road

Transect ID	GPS Location	Description of locality
RA1	N0268281 E 0612275	Natural freshwater habitat occurring within, primary Morabukea mixed forest on brown sandy loam soil. The forest area occurred on slightly undulating terrains with flat areas occasionally water logged. Elevation of the area varies between 121-132 meters. The major plant species present was <i>Mora gonggripii</i> . Other species present included <i>Licania heteromorpha</i> , <i>Dugueti pycnastera</i> and <i>Oxandra asbeckii</i> . Lianas species <i>Strychnos mitscherlichii</i> was abundant while epiphytes were rare within the understory. 20% to 30% fallen trees in-stream. Stream width ranged from 0.5m to 3m. Stream flow characterized by runs with a few pool areas. No visible assemblages, odours or surface oils.
RA2	N 0268242 E 0611837	Natural freshwater habitat occurring within, primary Morabukea mixed forest on brown sandy loam soil. The forest area occurred on slightly undulating terrains with flat areas occasionally water logged. Elevation of the area varies between 121-132 meters. The major plant species present was <i>Mora gonggripii</i> . Other species present included <i>Licania heteromorpha</i> , <i>Dugueti pycnastera</i> and <i>Oxandra asbeckii</i> . Lianas species <i>Strychnos mitscherlichii</i> was abundant while epiphytes were rare within the understory. 20% to 30% fallen trees in-stream. Stream width ranged from 0.5m to 3m. Stream flow characterized by runs with a few pool areas. No visible assemblages, odours or surface oils.
RA3	N 0269209 E 0612875	Natural freshwater habitat surrounded by predominantly, primary Clump Wallaba forest on fine white sand. Elevation of the area ranged between 113-121 m. The canopy layer was dominated by <i>Dicymbe corymbosa</i> and frequent by <i>Eperua grandiflora</i> . The understory layer was sparsely populated with species <i>Tovomita schomburgkii</i> , <i>Dugueti pycnastera</i> and <i>Duroia eriopila</i> occurring frequently. Lianas, epiphytes and palms were occasional. 30% to 40% fallen trees in-stream. Stream width ranged from 1m to 4m. Stream characterized by runs and riffles. Many mora roots found in-stream. Assemblages of water strider and saucer beetle seen.
RA4	N 0269016 E 0613034	Natural freshwater habitat surrounded by predominantly, primary Clump Wallaba forest on fine white sand. Elevation of the area ranged between 113-121 m. The canopy layer was dominated by <i>Dicymbe corymbosa</i> and frequent by <i>Eperua grandiflora</i> . The understory layer was sparsely populated with species <i>Tovomita schomburgkii</i> , <i>Dugueti pycnastera</i> and <i>Duroia eriopila</i> occurring frequently. Lianas, epiphytes and palms were occasional. 30% to 40% fallen trees in-stream. Stream width ranged from 1m to 4m. Stream characterized by runs and riffles. Many mora roots found in-stream. Assemblages of water strider and saucer beetle seen.

Table 46: Floral Species Recorded Along Access Road

Vernacular Name	Scientific Name	Family	Uses
Aiomorakushi	<i>Pouteria cladantha</i>	SAPOTACEAE	Subsistence use of sweet edible fruit
Apokuita	<i>Chamaecrista apoucouita</i>	LEGUMINOSAE	Cultural
Arara broad leaf	<i>Unonopsis spp.</i>	ANNONACEAE	Subsistence use of wood for b
Arara fine leaf	<i>Bocageopsis multiflora</i>	ANNONACEAE	Subsistence use of wood for b
Aruadan	<i>Sloanea trichosticha</i>	ELAEocarpaceae	Subsistence use of wood to ca paddles from the plank roots
Asashi	<i>Rheedia acuminata</i>	GUTTIFERAE	Cultural
Asepoko	<i>Pouteria guianensis</i>	SAPOTACEAE	Subsistence use of fruits
Awasokule	<i>Tovomita schomburgkii</i>	GUTTIFERAE	Subsistence use of straight tr for housing boards and firew the stilt roots served as whi bows
Barabara	<i>Diospyros dichroa</i>	EBENACEAE	Subsistence use of fruit
Baririkuti	<i>Mabea piriri</i>	EUPHORBIACEAE	Subsistence use of latex for eyes and wood for round-wo
Baromalli	<i>Catostemma alstonii</i>	BOMBACACEAE	Commercial timber - Plywood
Bartaballi	<i>Ecclinusa guianensis</i>	SAPOTACEAE	Subsistence use of the sweet edible fruit and the buttresse carved axe handles and paddl
Black Heart	<i>Acosmium praeclara</i>	LEGUMINOSAE-PAPIL	Commercial timber - Construc
Black Kakaralli	<i>Eschweilera sagotiana</i>	LECYTHIDACEAE	Commercial timber - Construc
Buba	<i>Socratea exorrhiza</i>	PALMAE	Subsistence use of leaves to t forest camps and as hat
Bullet Wood	<i>Manilkara bidentata</i>	SAPOTACEAE	Commercial timber - H Construction
Dalli swamp	<i>Iryanthera juruensis</i>	MYRISTICACEAE	Subsistence use of wood boards, canoes and r instruments
Devildoer	<i>Strychnos mitscherlichii</i>	LOGANIACEAE	Subsistence used of sweet edible fruit
Dog Seed	<i>Tabernaemontana undulate</i>	APOCYNACEAE	Medicinal use of latex for sore and munuri bites and the sa headaches
Duka	<i>Tapirira marchandii</i>	ANACARDIACEAE	Subsistence use of the wood firewood
Dukali	<i>Parahancornia fasciculata</i>	APOCYNACEAE	Subsistence use of latex as the wood for boards and cano
Duru	<i>Apeiba echinata</i>	TILIACEAE	Subsistence use of the wood firewood
Futui	<i>Jacaranda copaia</i>	BIGNONIACEAE	Commercial timber
Granny Backbone	<i>Serjania paucidentata</i>	SAPINDACEAE	Medicinal use of stem creek/pond to poison fish, to male impotence (weak back) of the leaves to treat thrush
Greenheart	<i>Chlorocardium rodiei</i>	LAURACEAE	Commercial timber - Heavy Construction
Hachiballi	<i>Pera schomburgkiana</i>	EUPHORBIACEAE	Subsistence use of wood as boards
Haiawaballi	<i>Protium tenuifolium</i>	BURSERACEAE	Commercial Timber- bo furniture, canoes and firewood
Haihaia	<i>Sapium paucinervium</i>	EUPHORBIACEAE	Subsistence used as Rubbery l

Hanaquablar	<i>Philodendron brevispatum</i>	ARACEAE	Medicinal use of shoots for scorpion bites
Haudan (Potaro Kakaralli)	<i>Chytroma praeclara</i>	LECYTHIDACEAE	Subsistence use of wood
Hurihi	<i>Humiristrum obovatum</i>	HUMIRICEAE	Cultural
Itikiboroballi	<i>Swartzia benthamiana</i>	PAPILIONACEAE	Subsistence use of wood for house posts and firewood
Kaditiri	<i>Sclerolobium micropetalum</i>	LEGUMINOSAE-CAESALP	Subsistence used of stinging ants that inhabit this tree to make dogs hunt better
Kairiballi	<i>Licania heteromorpha</i>	CHRYSOBALANACEAE	Cultural
Kakarua	<i>Pradosia schomburgkiana</i>	SAPOTACEAE	Cultural
Kamahora medium leaf	<i>Pouteria Trigonosperma</i>	SAPOTACEAE	Subsistence used of edible sweet fruit
Kapadula	<i>Tetracera volubillis</i>	DILLENACEAE	Medicinal use of the wood in aphrodisiacs as a builder, stimulating sexual activities and curing impotence.
Karishiri	<i>Oxandra asbeckii</i>	ANNONACEAE	Subsistence use of young trunks for wicker kitchen walls and house frames.
Kauta	<i>Licania guianensis</i>	CHRYSOBALANACEAE	Subsistence used of wood as firewood
Kautaballi	<i>Licania alba</i>	CHRYSOBALANACEAE	Subsistence used as firewood
Kereti (White silverballi)	<i>Ocotea canaliculata</i>	LAURACEAE	Commercial timber - Interior Joinery
Kibihidan	<i>Ryania speciosa</i>	FLACOURTIACEAE	Subsistence used of wood for firewood and traditional Arawak kitchen walls
Kirikaua	<i>Iryanthera lancifolia</i>	MYRISTICACEAE	Cultural
Kokoritiballi	<i>Pouteria cuspidata</i>	SAPOTACEAE	Subsistence used of edible sweet fruit and the wood for house posts and boards
Komaramara	<i>Duroia eriopila</i>	RUBIACEAE	Subsistence used of fruit pulp
Konoko	<i>Pouteria engleri</i>	SAPOTACEAE	Subsistence use of wood as firewood
Korokororo	<i>Ormosia coutinhoi</i>	PAPILIONACEAE	Commercial timber - General Construction
Koyechi	<i>Rollinia exsucca</i>	ANNONACEAE	Medicinal use of bark to treat fever and to prevent miscarriage. Subsistence used for firewood
Koyechiballi	<i>Lueheopsis rugosa</i>	TILIACEAE	Medicinal use of bark to treat fever and to prevent miscarriage. Subsistence used for firewood
Kufa (Black)	<i>Clusia palmicida</i>	GUTTIFERAE	Medicinal use of the root cortex for malaria; the latex applied as plaster on mosquito worms
Kulishiri black	<i>Cupania hirsuta</i>	SAPINDACEAE	Subsistence used of trunk for wicker kitchen walls and of wood for firewood
Kurihikoyoko	<i>Anaxagorea spp.</i>	ANNONACEAE	Subsistence used of wood for rafters, runners and flooring beams
Kuruati	<i>Renealmia floribunda</i>	ZINGIBERACEAE	Cultural
Maho	<i>Sterculia pruriens</i>	STERCULIACEAE	Commercial Timber - Plywood; Interior Joinery

Manariballi	<i>Pithecellobium corymbosum</i>	LEGUMINOSAE-MIMOS	Subsistence used of latex as karaman wax
Manni	<i>Symphonia globulifera</i>	GUTTIFERAE	Subsistence used of latex as karaman wax
Marishiballi	<i>Licania densiflora</i>	CHRYSOBALANACEAE	Subsistence used as firewood
Monkey Pot	<i>Lecythis zabucajo</i>	LECYTHIDACEAE	Commercial timber - Heavy Construction
Morabukea	<i>Mora gonggrijpii</i>	CAESALPINIACEAE	Commercial timber - Sleepers; Heavy construction
Moroballi	<i>Talisia squarrosa</i>	CAESALPINIACEAE	Subsistence used of wood as fish poison
Okokonshi	<i>Quiina indigofera</i>	QUIINACEAE	Subsistence used of the wood for house construction, warishi frames and arrow sockets
Purple Heart	<i>Peltogyne venosa</i>	LEGUMINOSAE-CAESALP	Heavy construction; Cabinet work
Quackoo	<i>Marliera montana</i>	MYRTACEAE	Subsistence used of edible fruit; wood for firewood
Saka Purpleheart	<i>Peltogyne paniculata</i>	LEGUMINOSAE-CAESALP	Commercial timber - Heavy construction; Cabinet work
Scraping Nibi	<i>Thoracocarpus bissectus</i>	CYCLANTHACEAE	Subsistence used to make warishis and quakes
Serebedan	<i>Swartzia arborescens</i>	LEGUMINOSAE-PAPIL	Cultural
Shibidan	<i>Aspidosperma desmanthum</i>	APOCYNACEAE	Commercial timber - Interior Joinery
Solider's cap	<i>Psychotria poeppigiana</i>	RUBIACEAE	Medicinal use of leaves and flowers for cold, cough, tuberculosis and to stop menstrual bleeding
Teterumaballi	<i>Conomorpha peruviana</i>	MYRSINACEAE	Cultural
Tonka bean	<i>Dipterxy odorata</i>	LEGUMINOSAE-PAPIL	Subsistence use of wood as house construction
Turu	<i>Jessenia bataua</i>	PALMAE	Subsistence used of fruit to make drinks, etc.
Wadara	<i>Couratari guianensis</i>	LECYTHIDACEAE	Commercial timber - plywood
Waiaballi	<i>Tapura guianensis</i>	DICHAPETALACEAE	Subsistence used of wood for house post
Wallaba Clump	<i>Dicymbe corymbosa</i>	CAESALPINIACEAE	Cultural
Wallaba Ituri	<i>Eperua grandiflora</i>	LEGUMINOSAE-CAESALP	Commercial timber - Heavy construction
Wallaba Soft	<i>Eperua falcata</i>	LEGUMINOSAE-CAESALP	Commercial timber - Heavy construction
Waraia	<i>Miconia punctata</i>	MELASTOMATACEAE	Subsistence used of edible fruit
Warakabakoromukru	<i>Ischnosiphon gracilis</i>	MARANTACEAE	Subsistence used of the stem for the manufacture of household equipment
Warakosa	<i>Inga edulis</i>	LEGUMINOSAE-MIMOS	Subsistence used of fruit and as firewood
White Cedar	<i>Tabebuia insignis</i>	BIGNONIACEAE	Commercial timber
White Yari Yari	<i>Dugueti pycnastera</i>	ANNONACEAE	Subsistence use of wood for fishing rods and bows
Whitey	<i>Inga jenmanii</i>	LEGUMINOSAE-MIMOS	Commercial timber - Utility plywood (interior piles)
Wild guava	<i>Eschweilera alata</i>	LECYTHIDACEAE	Subsistence used of fruit
Wina Kakaralli	<i>Lecythis corrugata</i>	LECYTHIDACEAE	Commercial timber - Heavy Carpentry

Yarula (Black)	<i>Aspidosperma excelsum</i>	APOCYNACEAE	Subsistence use of wood for paddles. Medicinal use of bark for malaria
Yuruwe	<i>Bactris humilis</i>	PALMAE	Subsistence use of leaves for thatch roof

A summary of the floral species recorded for the road survey is detailed in the Table 46. The survey recorded 86 plant species of 38 families. Plant species flowering and fruiting, were rarely observed during the road survey. Table 47 identifies plant species observed to be flowering and fruiting during the survey.

Table 47: Plant Species Flowering and Fruting

Vernacular Name	Flowering	Fruiting
Devildoer (Red)		<i>Strychnos mitscherlichii</i>
Morabukea		<i>Mora gonggripii</i>
Wallaba Ituri	<i>Eperua grandiflora</i>	

The floristic composition surveyed along the road is provided in Table 48. The survey recorded a very dense sapling and seedling stratum. This is as a result of the present germination period of the floristic reproductive cycle.

Table 48: Floristic Composition on Access Road Alignment

Floristic Composition	Wallaba Forest	Morabukea/Mixed Forest	Marsh/Transitional Mixed Forest	Mixed/Wallaba Forest
Tree layer >20cm DBH				
# of individuals in 0.5 ha	150	111	103	111
# of species in 0.5 ha	17	25	27	21
# of families in 0.5 ha	10	13	19	14
Mean diameter trees >20cm DBH	37.7cm	36.7cm	30.9cm	34.5cm
Tree layer <20cm Diameter (saplings and seedlings)				
# of individuals in 0.1 ha	1243	768	441	854
# of species on 0.1 ha	35	34	32	36
# of families in 0.1 ha	22	18	22	21
Shrub layer <10cm diameter				
# of individuals in 0.1 ha	6	12	69	15
# of species in 0.1 ha	1	2	3	2
# of families in 0.1 ha	1	2	3	2
Herb layer <1.5m				
# of individuals in 0.1 ha	0	0	0	5
# of species in 0.1 ha	0	0	0	1
# of families in 0.1 ha	0	0	0	1
Palm <20cm diameter				
# of individuals in 0.1 ha	17	6	157	6
# of species in 0.1 ha	1	1	2	2
# of families in 0.1ha	1	1	1	1
Epiphytes, Hemi-epiphytes and Lianas >10cm diameter				
# of individuals in 0.5ha	17	45	27	22
# of species in 0.5 ha	4	2	4	4
# of families in 0.5 ha	3	2	4	3

Approximately 24.4% (21) of the recorded vegetation is utilized as commercial timber. Plants utilized for subsistence and medicinal purposes account for 65.1% and 10.5% respectively of the total recorded vegetation. The total standing volume of trees recorded for the area directly sampled along the 8 km road is 476.23 m³.

Table 49: Total and Marketable Volume of Timber along Access Road

Commercial Timber		All Sample Areas (2 Ha.) along 8km Road	
Vernacular Name	Scientific Name	Total Volume (m3)	Marketable Volume (m3)
Asepoko	<i>Pouteria guianensis</i>	0.42	0.00
Baromalli	<i>Catostemma alstonii</i>	37.04	16.49
Black Kakaralli	<i>Eschweilera sagotiana</i>	17.40	7.12
Bullet Wood	<i>Manilkara bidentata</i>	15.27	7.86
Futui	<i>Jacaranda copaia</i>	1.32	1.01
Greenheart	<i>Chlorocardium rodiei</i>	2.28	2.28
Haiawaballi	<i>Tetragastris altissima</i>	0.75	0.00
Potaro Kakaralli	<i>Eschweilera potaroensis</i>	17.03	14.13
Kereti (White Sliverballi)	<i>Mora excelsa</i>	1.90	0.00
Korokororo	<i>Ormosia coutinhoi</i>	3.16	1.74
Monkey Pot	<i>Lecythis zabucajo</i>	3.02	0.00
Morabukea	<i>Mora gonggripii</i>	46.06	22.63
Purple Heart	<i>Peltogyne venosa</i>	6.54	6.54
Saka Purple Heart	<i>Peltogyne paniculata</i>	14.04	7.56
Shibidan	<i>Aspidosperma desmanthum</i>	2.83	0.00
Wadara	<i>Couratari guianensis</i>	0.19	0.00
Wallaba Ituri	<i>Eperua grandiflora</i>	27.52	13.48
Wallaba Soft	<i>Eperua falcata</i>	59.96	38.04
White Cedar	<i>Tabebuia insignis</i>	1.97	0.00
Wina Kakaralli	<i>Lecythis corrugata</i>	0.87	0.00
TOTAL		259.57	138.88

The volumes of commercial timber computed for the access road are detailed in Table 49. The total standing volume of commercial timber recorded during the road survey is 259.57 m³ of which 53.5% (138.88m³) is marketable. Marketability was assessed based on risk class (sound and straight) and diameter at breast height (DBH) of 35 cm and above. The volume of marketable timber, recorded by species, in the area (2 ha) sampled is also detailed in Table 49.

The volume recorded for species that are utilized for non-commercial purposes (subsistence and medicinal purposes) within the areas sampled is 216.66 m³. These results are detailed in Table 50.

Table 50: Volume of Timber Species on Access Road Alignmentr Used for Subsistence and Medicinal Purposes

Vernacular Name	Scientific Name	Total Volume (m ³)
Aiomorakushi	<i>Pouteria cladantha</i>	0.69
Apokuita	<i>Chamaecrista apoucouita</i>	1.60
Awasokule	<i>Tovomita schomburgkii</i>	1.15
Dalli swamp	<i>Virola surinamensis</i>	0.49
Duka	<i>Tapirira marchandii</i>	6.34
Dukali	<i>Parahancornia fasciculata</i>	0.59
Duru	<i>Apeiba echinata</i>	1.20
Hachiballi	<i>Pera schomburgkiana</i>	1.99
Haihaia	<i>Sapium paucinervium</i>	0.32

Hurihi	<i>Humiriastrum obovatum</i>	8.18
Itikiboroballi	<i>Swartzia benthamiana</i>	1.85
Kaditiri	<i>Sclerolobium micropetalum</i>	2.95
Kairiballi	<i>Licania heteromorpha</i>	2.13
Kakarua	<i>Pradosia schomburgkiana</i>	1.92
Kamahora medium leaf	<i>Pouteria Trigonosperma</i>	38.55
Kautaballi	<i>Licania alba</i>	7.65
Kirikaua	<i>Iryanthera lancifolia</i>	2.48
Kokoritiballi	<i>Pouteria cuspidate</i>	4.43
Konoko	<i>Licania cuprea</i>	1.88
Koyechi	<i>Rollinia exsucca</i>	1.74
Koyechiballi	<i>Lueheopsis rugosa</i>	0.88
Manariballi	<i>Pithecellobium corymbosum</i>	3.68
Manni	<i>Symphonia globulifera</i>	5.88
Marishiballi	<i>Licania densiflora</i>	19.52
Moroballi	<i>Talisia squarrosa</i>	20.28
Serebedan	<i>Swartzia arborescens</i>	1.29
Tonka Bean	<i>Dipterxy odorata</i>	10.60
Turu	<i>Jessenia bataua</i>	2.91
Wallaba Clump	<i>Dicymbe corymbosa</i>	59.72
Yarula (Black)	<i>Aspidosperma excelsum</i>	3.77
TOTAL		216.66

Both the above ground and below ground (roots) tree biomass were determined for the road survey. The mean tree biomass per hectare including roots and saplings was determined to be 301.37 tonnes carbon per hectare (t C/ha). The volumes of biomass are detailed in Table 51.

Table 51: Biomass per Hectare for Access Road Alignment

Parameter	tonne Carbon/hectare					Total Carbon Dioxide Equivalent
	Above Ground Biomass	Below Ground Biomass	Saplings Biomass	Dead Wood and Litter Biomass	Total Carbon Pool	
Mean	213.64	50.21	1.15	18.37	301.37	1105.02

7.2.2.2 Fauna

7.2.2.2.1 Mammals

A total of eleven (11) species representing six (6) orders and eleven (11) families were recorded on the access road alignment. Eight species were recorded in the four transects surveyed while seven (7) species were encountered along the access road alignment itself. Each family recorded, was represented by a single species. The most abundant order was Carnivora which was represented by four (4) species, while the orders Artiodactyla and Rodentia were represented by two (2) species respectively. One species was recorded for the orders Cingulata, Didelphimorphia, Perissodactyla and Primates.

Dasyprocta leporine (Red rumped agouti) was the lone species recorded along all four transects. *Mazama American* (red brocket deer), *Dasypus sp* (armadillo) and *Pecari tajacu* (collared peccary) were recorded along three transects. *Agouti paca* (labba) was recorded along two transects. Species recorded at a single transect were *Panthera onca* (Jaguar) and *Lontra longicaudis* (Neotropical otter). *Tapirus terrestris* (tapir), *Potos flavus* (kinkajou), *Didelphis marsupialis* (common opossum), and *Aloutta seniculus* (red howler monkey) were documented along the proposed alignment. Table 52 identifies mammals recorded on the access road alignment.

Table 52: Mammals Identified on the Access Road Alignment

ORDER	FAMILY	Scientific Name	Common Name
CARNIVORA			
	Mustelidae	<i>Lontra longicaudis</i>	Neotropical otter
	Felidae	<i>Panthera onca</i>	Jaguar
	Procyonidae	<i>Potos Flavus</i>	Kinkajou
ARTIODACTYLA	Cervidae	<i>Mazama americana</i>	Red brocket deer
	Tayassuidae	<i>Pecari Tajacu</i>	Collared peccary
CINGULATA	Dasypodidae	<i>Dasypus kappleri</i>	Great long-nosed Armadillo
DIDELPHIMORPHIA	Didelphidae	<i>Didelphis marsupialis</i>	Common opossum
	Tapiridae	<i>Tapirus terrestris</i>	Brazilian tapir
PERISSODACTYLA			
PRIMATES	Cebidae	<i>Alouatta Seniculus</i>	Red howler monkey
	Agoutidae	<i>Agouti Paca</i>	Labba
	Dasyproctidae	<i>Dasyprocta Leporina</i>	Agouti

7.2.2.2.2 Bats

The access road survey documented a total of five (5) individuals, representing 5 species belonging to one family, Phyllostomidae; 2 species of the sub-family Phyllostominae, 2 species of the sub-family Stenodermatinae and 1 species of the sub-family Glossophaginae. Table 53 summarizes the observations on the access road alignment.

Table 53: Chiropterans Documented on the Access Road Alignment

Family	Sub-family	Taxon	Vernacular Name
Phyllostomidae	Phyllostominae	<i>Lophostoma brasiliensis</i>	Pygmy round-eared bat
		<i>Chrotopterus auritus</i>	Wooly false vampire bat
	Stenodermatinae	<i>Uroderma bilobatum</i>	Common tent-making bat
		<i>Artibeus obscurus</i>	Sooty fruit-eating bat
	Glossophaginae	<i>Lonchophylla thomasi</i>	Thomas nectar bat

7.2.2.2.3 Birds

The survey of the access road alignment recorded fifty five (55) species, from twenty five (25) families. The family with the greatest recorded species diversity of sixteen (16) species was Thamnophilidae (antbirds, antshrikes and antwrens). Tyrannidae (flycatchers) was the next most diverse family (9 species) recorded during the survey. Psittacidae and Falconidae were both represented by three (3) species each, while the families of Trogonidae, Cotingidae, Columbidae, Trochilidae and Picidae were represented by two (2) species each. The families of Accipitridae, Cuculidae, Furniriidae, Dendrocolaptidae, Apodidae, Icteridae, Pipridae, Psophiidae, Polioptilidae, Rhamphastidae, Strigidae, Thraupidae, Troglodytidae, and Vireonidae, were the least represented families each with one (1) species.

The most abundant species recorded of the three hundred and sixty three (366) individuals were *Psophia crepitans* (Gray-winged Trumpeteer) with 30 individuals being recorded. The species with the lowest number of individuals recorded were *Buteo magnirostris* (Roadside Hawk) and *Camptostoma obsoletum* (Southern Bearded Tyrannulet), each with one (1) individual being recorded.

Members of the fruit/nut-eating guild; including members from the families Thraupidae, and Psittacidae were notably absent. That absence may be a direct consequence of no flowering and extremely limited fruiting within the area during the survey period, resulting in the movement of birds to areas with more abundant food sources. All of the species recorded are relatively common and widely distributed within the lowland habitats of Guyana and the wider Guiana Shield. There were no records of endangered or migratory birds during the surveys. Table 54 documents birds recorded on the access road alignment.

Table 54: Birds Recorded on the Access Road Alignment

Common Name	FAMILY	Scientific Name
Roadside Hawk	Accipitridae	<i>Buteo magnirostris</i>
Plumbeous Pigeon	Columbridae	<i>Columba plumbea</i>
Pale-vented Pigeon	Columbridae	<i>Patagioenas cayennensis</i>
Screaming Piha	Cotingidae	<i>Lipaugus vociferans</i>
Thrush-like Schiffornis	Cotingidae	<i>Schiffornis turdina</i>
Black-bellied Cuckoo	Cuculidae	<i>Piaya melanogaster</i>
Wedge-billed Woodcreeper	Dendrocolapitidae	<i>Glyphorhynchus spirurus</i>
Bat Falcon	Falconidae	<i>Falcon ruficularis</i>
Red Throated Caracara	Falconidae	<i>Ibycter americanus</i>
Plain-crowned Spinetail	Furnariidae	<i>Synallaxis gujanensis</i>
Band-rumped Swift	Apodidae	<i>Chaetura spinicaudus</i>
Green Oropendula	Icteridae	<i>Psarocolius viridis</i>
Blue-crowned Motmot	Momotidae	<i>Momotus momota</i>
Red-necked Woodpecker	Picidae	<i>Campephilus rubricollis</i>
Chestnut Woodpecker	Picidae	<i>Celeus elegans</i>
Saffron-crested Tyrant-Manakin	Pipridae	<i>Neopelma chrysocephalum</i>
Long-billed Gnatwren	Poliioptilidae	<i>Ramphocaenus melanurus</i>
Orange-Wing Parrot	Psittacidae	<i>Amazona amazonica</i>
Blue-headed Parrot	Psittacidae	<i>Pionus menstruus</i>
Golden-winged Parakeet	Psittacidae	<i>Brotogeris chrysoptera</i>
Gray- Winged Trumpeteer	Psophiidae	<i>Psophia crepitans</i>
Red-billed Toucan	Ramphastidae	<i>Ramphastos tucanus</i>
Spectacled Owl	Strigidae	<i>Pulsatrix perspicillata</i>
Gray Antbird	Thamnophilidae	<i>Cercomacra cinerascens</i>
White Browed Antbird	Thamnophilidae	<i>Myrmoborus leucophrys</i>
Warbling Antbird	Thamnophilidae	<i>Hypocnemis cantator</i>
Black Chinned Antbird	Thamnophilidae	<i>Hypocnemoides melanopogon</i>
White Plumed Antbird	Thamnophilidae	<i>Pithys albifrons</i>
White Bellied Antbird	Thamnophilidae	<i>Myrmeciza longipes</i>
Wing Banded Antbird	Thamnophilidae	<i>Myrmornis torquata</i>
Short Tailed Anthrush	Thamnophilidae	<i>Chamaeza campanisona</i>
Slate Crowned Antpitta	Thamnophilidae	<i>Grallaricula nana</i>
Ferruginous Back Antbird	Thamnophilidae	<i>Myrmeciza ferruginea</i>
Cinereous Antshrike	Thamnophilidae	<i>Thamnomanes caesi</i>

Dusky Antbird	Thamnophilidae	<i>Cercomacra tyrannina</i>
Rufous-throated Antbird	Thamnophilidae	<i>Gymnopithys rufigula</i>
Scale-backed Antbird	Thamnophilidae	<i>Willisornis poecilinotus</i>
Banded Antwren	Thamnophilidae	<i>Dichrozona cinta</i>
Black-throated Antbird	Thamnophilidae	<i>Myrmeciza atrothorax</i>
Amazonian Antshrike	Thamnophilidae	<i>Thamnophilus amazonicus</i>
Purple Honeycreeper	Thraupidae	<i>Cyanerpes caeruleus</i>
Reddish Hermit	Trochilidae	<i>Phaethornis ruber</i>
Fork-tailed Woodnymph	Trochilidae	<i>Thalurania furcata</i>
White-breasted Woodwren	Troglodytidae	<i>Henicorhina leucosticta</i>
White-tailed Trogon	Trogonidae	<i>Trogon viridis</i>
Black-throated Trogon	Trogonidae	<i>Trogon rufus</i>
Helmeted Pygmy-Tyrant	Tyrannidae	<i>Lophotriccus galeatus</i>
Zimmer's Flycatcher	Tyrannidae	<i>Tolmomyias assimilis</i>
Olivaceous Flatbill	Tyrannidae	<i>Rhynchocyclus olivaceus</i>
Whiskered Flycatcher	Tyrannidae	<i>Myiobius barbatus</i>
McConnell's Flycatcher	Tyrannidae	<i>Mionectes macconnelli</i>
White-throated Spadebill	Tyrannidae	<i>Platyrinchus mystaceus</i>
Golden Crowned Spadebill	Tyrannidae	<i>Platyrinchus gumia</i>
Yellow-throated Flycatcher	Tyrannidae	<i>Conopias parva</i>
Southern Beardless-Tyrannulet	Tyrannidae	<i>Camptostoma obsoletum</i>
Buff-cheeked Greenlet	Vireonidae	<i>Hylophilus muscicapinus</i>

7.2.2.2.4 Herpetofauna

7.2.2.2.4.1 Amphibians

One hundred and fifty (150) individuals from six (6) species of amphibians were documented on the access road alignment. One order, Anura (frogs and toads) representing three (3) families (Hylidae, Bufonidae and Dendrobatidae) was recorded. The dominant anurans were *Ameerega hahneli* (47 individuals), *Osteocephalus oophagus* (41 individuals) and *Allobates femoralis* (34 individuals).

The positive correlation between amphibian activity patterns and rainfall has been demonstrated repeatedly (see Duellman, 1995; Gottsberger and Gruber, 2004; Born et al, 2010), with increase anuran activity related to pattern and timing of rainfall events, as opposed to total rainfall (see Walls et al, 2013). Therefore, increase activity is directly associated with heavy rainfall. Three brief, sporadic rainfall events occurred during the survey, which may account for the decrease in species sightings.

Several seasonal wetland areas were observed along sections of RT1, RT3 and RT4, which indicates seasonal presence of different families and species. Typically male frogs establish short-term territories for reproductive purposes while foraging elsewhere (Wells, 1977). However, families such as Bufonidae, Dendrobatidae and Hylidae (some species only) tend to establish longterm territoriality (see Born et al, 2010), based on sites which offer protection from predators, soil moisture availability, and availability of water and food. In this regard, temporal patterns in calling activity varied significantly among families. For example, taxa with embryonic development on vegetation (several species within the Family Hylidae) are active from middle to late wet season (see Gottsberger and Gruber, 2004). Males of the *O.*

oophagus and *T. resinifictrix* were heard calling at night, utilizing canopy bromeliads which offer predatory protection and is a vital source of water during dry periods. On the other hand, Dendrobatids with terrestrial oviposition and subsequent parental tadpole transportation such as *A. femoralis* and *A. hahneli*, were continuously active throughout the wet season (see Gottsberger and Gruber, 2004), while egg-laying species (Families Leptodactylidae, Pipidae, Hemiphractidae and several species of Hylidae) are often seen at the start of the rainy season.

No endangered, rare or threatened species of amphibians were documented. Table 55 summarizes amphibians recorded on the access road alignment.

Table 55: Amphibians Recorded on the Access Road Alignment

Scientific Name	Common Name
Hylidae	
<i>Osteocephalus oophagus</i>	Oophagous slender-legged Treefrog
<i>Tracycephalus resinifictrix</i>	Casque-headed Treefrog
<i>Hypsiboas boans</i>	Giant Gladiator Treefrog
Bufonidae	
<i>Rhinella marinus</i>	Giant Toad
Dendrobatidae	
<i>Ameerega hahneli</i>	Pale Striped Amazone Poison frog
<i>Allobates femoralis</i>	Brilliant-thighed poison frog

7.2.2.2.4.2 Reptiles

Twenty nine (29) individuals of nine species of reptiles, representing seven families; Testudinidae, Gymnophthalmidae, Teiidae, Scincidae, Polychrotidae, Tropiduridae, and Gekkonidae were recorded on the access road alignment. The most frequently encountered reptilian species were *Anolis nitens nitens* (7 individuals), *Ameiva ameiva* (5 individuals) and *Kentropyx calcarata* (5 individuals). These lizards were commonly encountered in transects basking in sunlit patches in the forest floor, and/or along the forested edge of the road. Individuals of *Uranoscodon superciliosus* and *Chelonoidis denticulata* were opportunistically documented.

No species of snakes were encountered on the access road alignment, despite the notable prey presence such as lizards and frogs. The presence of numerous Collared Peccaries (*Pecari tajacu*) within the area may be a deterring factor, as indicated by disturbances along sections of RT1, RT3 and RT4. Peccaries are known to eat indiscriminately, and their presence often warrants prey migration from the area (see Sowls, 1997). Additionally, no caimans (Family Alligatoridae) were encountered during this survey due to the lack of large water bodies within surveyed areas. Table 56 summarizes reptiles recorded on the access road alignment.

Table 56: Reptiles Documented on the Access Road Alignment

Scientific Name	Common Name
Testudinidae	
<i>Chelonoidis denticulata</i>	Yellow-footed Tortoise
<i>Leposoma percarinatum</i>	Striped Root Lizard
Teiidae	
<i>Kentropyx calcarata</i>	Striped Forest Lizard
<i>Ameiva ameiva</i>	Great Ameiva

Scincidae	
<i>Mabuya nigropunctata</i>	Black Spotted Skink
Polychrotidae	
<i>Anolis fuscusauratus</i>	Slender Anole
<i>Anolis nitens nitens</i>	Yellow-tongued Anole
Tropiduridae	
<i>Uranoscodon superciliosus</i>	Brown tree climber Lizard
Gekkonidae	
<i>Thecadactylus rapicauda</i>	Turnip tailed Gecko

7.2.2.2.5 Terrestrial Macro-Invertebrates

The access road alignment survey recorded a total 15 orders of macro invertebrates. The most abundant order recorded was the Hymenoptera, Diptera and Isoptera as indicated by their presence at all four of the sample sites. The Acari order had the second greatest macro-invertebrates abundance followed by the Lepidoptera, Araneae and Blattidea. Orthopterans were fairly common at all of the sample sites followed by Scorpiones and Coleoptera respectively. The Annelida and Lithobiomorpha were uncommon at sample sites 1 and 2. The Odonata and Amblypygi were fairly common at sample site 1 only and the Hemiptera at sample site 2.

Table 57: List of the Macro-Invertebrates orders on Access Road Alignment

Vernacular Name	Order
Mites and Ticks	Acari
Segmented Worms	Annelida
Spiders	Araneae
Cockroaches	Blattidea
Centipedes	Lithobiomorpha
Beetles	Coleoptera
True Flies	Diptera
True Bugs	Hemiptera
Bees, Wasp and Ants	Hymenoptera
Termites	Isoptera
Butterflies, moths and skippers	Lepidoptera
Dragon and Damselflies	Odonata
Grasshoppers, locusts, crickets and katydids	Orthoptera
Scorpions	Scorpiones
Whip scorpion	Amblypygi

7.2.2.2.6 Fish

The survey of fishes was focused on creeks which would probably be influenced by runoff from the access road. A total number of sixty-one (61) individuals from thirteen (13) species and nine families were encountered during the survey. The family Cichlidae recorded the highest number of individuals with a total of nineteen (19) individuals. Sternopygidae was the least abundant family with only two (2) individuals recorded. The most common family was Cetopsidae with a minimum of two (2) individuals

recorded at each site. The least common families were Engraulidae, Crenuchidae and Calichthyidae recording individuals at only one site each. An endemic specie, *Aequidens potaroensis*, was recorded during the survey. The results of the survey are detailed in Table 58.

Table 58: Fishes Encountered in Creeks Probably Influenced by Access Road

FAMILY	SPECIES	Common Name
Alestidae	<i>Triportheus brachypomus</i>	
Cetopsidae	<i>Helogenes marmoratus</i>	
Characidae	<i>Astyanax fasciatus</i>	Celebe
Cichlidae	<i>Aequidens potaroensis</i>	Patwa
Cichlidae	<i>Crenichla alta</i>	Sunfish
Cichlidae	<i>Cichlasoma bimaculatum</i>	Patwa
Cichlidae	<i>Acaronia nasso</i>	Patwa
Engraulidae	<i>Anchoviella guianensis</i>	
Crenuchidae	<i>Pecilocharax bovallii</i>	
Calichthyidae	<i>Hoplosternum littorale</i>	Hassar
Erythrinidae	<i>Hoplias malabaricus</i>	Huri
Erythrinidae	<i>Hoplerythrinus unitaeniatus</i>	Yarrow
Sternopygidae	<i>Eigenmannia virescens</i>	Luga luga

7.2.2.2.7 Aquatic/Benthic Macro-invertebrates

The survey of the creeks most likely impacted by activities on the access road revealed nine (9) orders of aquatic macro-invertebrates. The methodology employed and details on how the information acquired was analyzed are presented in Appendix D. The orders Araneae, Diptera and Hemiptera were most common with individuals recorded at every site. The least common orders were Adephaga, Ephemeroptera and Hirudinea with individuals only observed at a single location. Table 59 summarises aquatic macro invertebrates encountered by the survey.

Table 59: Aquatic macro-invertebrates in Creeks Probably Influenced by Access Road

ORDER	COMMON NAME
Adephaga	Diving water beetle
Araneae	Semi aquatic spider
Coleoptera	Water beetle
Coleoptera	Saucer beetle
Decapoda	Shrimp
Decapoda	Crayfish
Decapoda	Crab
Diptera	Mosquito
Ephemeroptera	Mayfly
Hemiptera	Water strider
Hirudinea	Leech
Odonata	Dragonfly
Odonata	Damsel fly
Odonata	Damsel fly larvae

7.3 Human Impacts on the Landscape and Ecosystems of the Concession

The IFC requires the delineating of the project site in terms of modified or natural habitat. The determination provided below was made based on the human-induced disturbances and the biodiversity value of the Concession and the greater landscape (Mazaruni River Basin) in which the Concession is located.

Forest habitats within the transect areas surveyed of the Concession as well as the general Concession area showed signs of environmental degradation as a result of historical human activities, including logging and artisanal mining. Human disturbance within/in the vicinity of transects consisted of the following evidence depicted in Table 60.

Table 60: Human disturbance observed within/in the vicinity of transects surveyed

Transect	Human disturbance/habitat alternation observed
TE 1	Secondary Access Roads
TE 2	Issano Road and old artisanal mining ground, 14 Miles Issano Landing
TE 3	Active secondary road, logging
TE 4	Active Artisanal Mining and secondary access road
TE 5	Old artisanal mining ground, Logging, Exploration drill pads access road, secondary access roads

The greater forest landscape of the Mazaruni Basin has historically been affected by mining and logging activities. The Mazaruni Basin is well known for its gold mining activities. The third largest open-pit mine in South America, the Omai Gold Mines, was operational until 2005/06 in this region. Subsistence farming, fishing, hunting, and employment in logging and mining industries are the main sources of livelihoods in the Mazaruni River Basin. The construction of roads, and the creation of mining and logging areas within the Mazaruni Basin has lead to increased human activity. This may have resulted in the possible degradation of the forest ecosystems through habitat fragmentation and the possible contamination and degradation of water quality of rivers systems from discharges associated with human activity.

Given that the Concession and the forest ecosystems of the Mazaruni River Basin have historically been subjected to significant disturbance and degradation from human activities, the biodiversity components of the Concession and the greater Mazaruni River Basin landscape are largely modified habitats.

7.4 Identification of Potentially Critical Habitat within the Concession

Biodiversity baseline data gathered from the Concession was used to identify potentially sensitive or Critical Habitat within the Concession area. The biodiversity baseline compiled from infield consultations and desktop research, and infield data collection and surveys were examined to assess applicability of the IFC PS6 (2012) critical habitat criteria.

The IFC PS 6 (2012) identifies five criteria for the assessment of whether a given modified (or natural) habitat may be considered a critical habitat. These are as follows:

- Criterion 1: areas that meet the criteria of the IUCN classification, including habitats required for the survival of critically endangered and/or endangered species (as defined by the IUCN Red List of Threatened Species or National Legislation);
- Criterion 2: areas having special significance for endemic and/or restricted-range species;
- Criterion 3: sites that are critical for the survival of migratory and/or congregatory species;
- Criterion 4: areas with highly threatened and/or unique ecosystems; and

- Criterion 5: areas associated with key evolutionary processes.

For the first three critical habitat criteria numerical thresholds were defined by the IFC to facilitate decision making. The thresholds form the basis of a tiered approach, in that numerical thresholds are used to assign Criteria 1 through 3 to a Tier 1 or a Tier 2 critical habitat designation. A summary of the tiers with respect to the thresholds for each criterion is provided in Table 61.

Table 61: Quantitative Thresholds for Tiers 1 and 2 of Critical Habitat Criteria 1 through 3

CRITERIA	Tier 1	Tier 2
1. Critically Endangered (CR)/Endangered (EN) Species	(a). Habitat required to sustain ≥ 10 percent of the global population of CR or EN species/subspecies where there are known, regular occurrences of the species and where the habitat could be considered a discrete management unit for that species. (b). Habitat with known, regular occurrences of CR or EN species where the habitat is one of 10 or fewer discrete management sites globally for that species	(c). Habitat that supports the regular occurrence of a single individual of CR species and/or habitat containing regionally-important concentrations of a Red-listed EN species where that habitat could be considered a discrete management unit for that species/subspecies. (d). Habitat of significant importance to CR/EN species that are wide ranging and/or whose population distribution is not well understood and where the loss of such habitat could potentially impact the long term survivability of the species. (e). As appropriate, habitat containing nationally/regionally important concentrations of an EN, CR or equivalent national/regional listing.
2. Endemic/Restricted Range Species	(a). Habitat known to sustain ≥ 95 percent of the global population of endemic or restricted range species where that habitat could be considered a discrete management unit for that species.	(b). Habitat known to sustain ≥ 1 percent but < 95 percent of the global population of an endemic or restricted-range species where that habitat could be considered a discrete management unit for that species, where data are available and/or based on expert judgment.
3. Migratory/Congregatory Species	(a). Habitat known to sustain, on a cyclical or otherwise regular basis, ≥ 95 percent of the global population of a migratory or congregatory species' lifecycle where that habitat could be considered a discrete management unit for that species.	(b). Habitat known to sustain, on a cyclical or otherwise regular basis, ≥ 1 percent but < 95 percent of the global population of a migratory or congregatory species at any point of the species' lifecycle and where that habitat could be considered a discrete management unit for the species, where adequate data are available and/or based on expert judgement. (c). For birds, habitat that meets BirdLife International's Criterion A4 for

		congregations and/or Ramsar Criteria 5 or 6 for identifying Wetlands of International importance. (d). For species with large but clumped distributions, a provisional threshold is set at ≥ 5 percent of the global population for both terrestrial and marine species. (e). Source sites that contribute ≥ 1 percent of the global population recruits.

Information and analyses on the status, trends and threats to species of international conservation concern recorded in the Concession was taken from the IUCN Redlist website: <http://www.iucnredlist.org>.

7.4.1 Critically Endangered (CR)/Endangered Species (EN)

The local conservation status of the threatened faunal species recorded by the surveys is not known. Guyana has no proposed or adopted list of threatened or endangered species. As a consequence, the IUCN Red List of Threatened Species was used for this assessment to conform to the requirements of the IFC PS 6 (2012).

Review of the IUCN Red List of Endangered Species revealed no listed plant or animal species recorded in the Concession Area as endangered or critically endangered. Table 62 provides a summary of the species of international concern recorded by the surveys within the Concession:

Table 62: Species of International Concern Recorded within the Concession

SPECIES	COMMON NAMES	IUCN Classification	CITES Classification
<i>Panthera onca</i>	Jaguar	Near Threatened	I: Species in danger of extinction that are, or that can be affected by trade
<i>Puma concolor</i>	Puma	Least Concern	II: species that are not currently in danger of extinction, but may become so in the future.
<i>Tapirus terrestris</i>	Brazilian Tapir	Vulnerable	II: species that are not currently in danger of extinction, but may become so in the future.
<i>Alouatta macconnelli</i>	Guianan Red Howler Monkey	Least Concern	II: species that are not currently in danger of extinction, but may become so in the future.
<i>Ateles paniscus</i>	Black Spider Monkey	Near Threatened	II: species that are not currently in danger of extinction, but may become so in the future.
<i>Harpia harpyja</i>	Harpy Eagle	Near Threatened	I: Species in danger of extinction that are, or that can be affected by trade
<i>Amazona dufresniana</i>	Blue Cheeked Parrot	Near Threatened	I: Species in danger of extinction that are, or that can be affected by trade
<i>Ara macao</i>	Scarlet Macaw	Least Concern	I: Species in danger of extinction that are, or that can be affected by trade

The only endangered or critically endangered plant species listed by the IUCN for Guyana are: *Trichilia surumuensis*, *Aniba rosaedora*, *Virola surinmensis*, and *Vouacapoua Americana*. These species are widespread in forested lands in Guyana. *Trichilia surumuensis* is restricted to the Roraima Highlands; the *Aniba* genera occurs widely in Wallaba forest and in mixed forest on white and brown sand; the *Vouacapoua*

genera is locally common in mixed forest in the near interior growing in reefs on rocky hills or sandy clay, and in swamp forest on alluvial flats in southeastern Guyana; *Virola surinamensis* are widely distributed and are abundant to frequent in marsh forest, Mora forest and swamp forest. None of these species were recorded in the Concession.

No critically endangered mammals are known to occur in Guyana. The only endangered mammal listed by the IUCN for Guyana is the giant otter (*Pteronura brasiliensis*). This species was not recorded in the Concession. No mammal species recorded at the Concession were listed as endangered or critically endangered.

Panthera onca (Jaguar) is the largest cat of the Americas, and the only living representative of the genus *Panthera* found in the New World. The jaguar is considered to be Near Threatened due to habitat loss, poaching of prey and fragmentation of populations across portions of its range. Much of the jaguar's remaining habitat is the rainforest of the Amazon basin. The jaguar is still an abundant species, but is threatened by habitat loss and persecution.

The geographic range of the puma (*Puma concolor*) is the largest of any terrestrial mammal in the Western Hemisphere (Sunquist and Sunquist 2002), from Canada through the US, Central and South America to the southern tip of Chile. The puma is an adaptable cat found in every major habitat type of the Americas, including the high Andes (5,800 m in southern Peru). The Puma is native to Argentina; Belize; Bolivia, Plurinational States of; Brazil; Canada; Chile; Colombia; Costa Rica; Ecuador; El Salvador; French Guiana; Guatemala; Guyana; Honduras; Mexico; Nicaragua; Panama; Paraguay; Peru; Suriname; United States; and Venezuela. The Puma is listed as Least Concern as it is a widespread species.

Tapirus terrestris is found in lowland regions of northern and central South America, from Argentina, Bolivia, Brazil, Colombia, Ecuador, French Guiana, Guyana, Paraguay, Peru, Suriname, and Venezuela. This species is considered to be Vulnerable due to an ongoing population reduction as a result of habitat loss, illegal hunting and competition with livestock. Lowland tapir populations seem unlikely to persist anywhere humans occur at densities any greater than 1/km². Even where habitat remains, populations are reduced and dispersed due to the effects of hunting. This is greatly amplified around increasing human populations and settlements within its habitat range.

Ateles pansicus occurs north of the Rio Amazon, east of the Rios Negro and Branco. In Guyana, it is known from the far south and from the east of the River Essequibo (Sussmann and Phillips-Conroy 1995), and east from there through Suriname and French Guiana, excluding the lowland coastal plains, but throughout adequate habitat and into the states of Amapá, Pará (north of the Rio Amazonas), and Amazonas, Brazil. *Ateles pansicus* is listed as Vulnerable as there is reason to believe the species has declined by at least 30% over the past 45 years (three generations) due primarily to habitat loss in Brazil as well as hunting across its range, which is taking place even within protected areas.

The IUCN conservation status of the bat species identified by the surveys is listed as least concern (LC) or Data Deficient.

Guyana has no listed critically endangered or endangered terrestrial or freshwater invertebrates. The only fish and non-avian reptiles listed as endangered or critically endangered by the IUCN for Guyana are marine species that are not present in the Concession. No endangered or critically endangered amphibians are known to occur in Guyana.

The only endangered birds species listed in Guyana are: Sun parakeet (*Aratinga solstitialis*); Hoary-throated spinetail (*Synallaxis kollari*); and the Red siskin (*Carduelis cucullata*). All of these birds are associated primarily with savanna or dry forest landscapes (i.e., Rupununi and Sipalawini savannas within Guyana). None of these birds were recorded in the Concession.

The *Harpia harpyja* (Harpy Eagle) and *Amazona dufresniana* (Blue Cheeked Parrot) are listed as Near-Threatened, and the *Ara macao* (Scarlet Macaw) as Least Concern in the IUCN Red list. The *Harpia harpyja* is sparsely distributed and generally rare throughout its extensive range in south Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica, Panama, Colombia, Venezuela, Guyana, Suriname, French Guiana, Ecuador, Peru, Bolivia, Brazil, Paraguay and north-east Argentina. The *Harpia harpyja* species is classified as Near Threatened because it is suspected to be declining moderately rapidly owing to hunting and habitat loss. The *Amazona dufresniana* is wide ranging and occurs in south-east Venezuela, north Guyana, north-east Suriname and north-east French Guiana. This species is classified as Near Threatened because it has a moderately small population which is suspected to be declining significantly owing to habitat loss and possibly trade.

The *Ara macao* (Scarlet Macaw) has an extremely large range, and hence does not approach the thresholds for Vulnerable under the range size criterion (Extent of Occurrence <20,000 km²). The *Ara macao* (Scarlet Macaw) is native to Belize; Bolivia, Plurinational States of; Brazil; Colombia; Costa Rica; Ecuador; French Guiana; Guatemala; Guyana; Honduras; Mexico; Nicaragua; Panama; Peru; Suriname; Trinidad and Tobago; and Venezuela. The population size may be moderately small to large through its range, but it is not believed to approach the thresholds for Vulnerable under the population size criterion (<10,000 mature individuals with a continuing decline estimated to be >10% in ten years or three generations). For these reasons the species is evaluated as Least Concern by the IUCN Red list.

Despite their IUCN listing internationally, evidence supported by several surveys suggests that the threatened species recorded within the concession are found in healthy populations throughout their ranges in Guyana. In 2009, the Zoological Society of London conducted a biodiversity assessment of the Head of the Rewa River in southern Guyana. Their survey documented a high density of the threatened faunal species reported in the Concession within the Rewa area. Similarly, in 1998, studies conducted within the Iwokrama Forest of central Guyana by Lim et al, (1999) indicate that the Iwokrama forest supports healthy populations of the threatened faunal species recorded within the concession. These threatened faunal species were also recorded in the biodiversity baseline surveys of Tassawini in Northwest Guyana, Aurora on the Cuyuni River, and at Toroparu in the upper Puruni River, central Guyana.

7.4.2 Endemic/Restricted Range Species

There is no clear picture of endemism in Guyana. Guyana is no phytogeographic entity in itself but part of the Guiana Shield area. Local plant endemism is often associated with such habitats as white sands, serpentine rock, swamps, igapo, verzea, rock outcrops and cloud forest (Gentry, 1992). As such, concentrations of endemics in Guyana can be expected in the white sands area and the Pakaraima Highlands (Steege, 2000). Species endemic to the three Guianas are, in Guyana, especially abundant in the central and northwest national forest regions, where they usually account for more than 50% of all individuals in the forest (Steege, 2000). Typical Guiana lowland genera such as *Licania* and *Swartzia* are common throughout the lowland forest of Guyana (Steege, 2000).

The surveys recorded the following endemic flora species; the *Chlorocardium rodiei*, *Swartzia leiocalycina*; *Licania capera*; *Licania boxiflora*; *Catostemma commune*; *Mora gonggrijpii*; *Eschweilera potaroensis*; and *Dicymbe altsonii*. None of the endemic flora species recorded in the concession is listed as threatened based on the IUCN Red List.

The *Chlorocardium rodiei* has a fairly wide distribution in the central and north-western portions of the country, and is associated with the sandy soils of the Berbice formation. *Chlorocardium rodiei* is reef forming and dominant in greenheart forest on light sandy loams soils. It is occasional to frequent in other types of mixed forest, occasional in mora forest and rare in Wallaba Forest. *Chlorocardium rodiei* is widely distributed, but rare in Northwest District (Rohwer et al. 1991; Steege 1990).

Typical Guianan lowland genera such as *Licania*, *Swartzia* are common throughout the lowland of Guyana (Steege, 1998). *Swartzia* is more common in central to east Guyana (Steege, 1998). *Dicymbe*, which is almost entirely a Guiana Shield genus, spreads eastwards into central Guyana. *C. commune* is frequent to abundant in mixed forest and mora forest and occurs principally in the Essequibo and Cuyuni River Basins (Steyermark, 1987). *C. commune* is found abundantly in almost every dry land forest type in the Northwest District region of Guyana (Huber 1995).

Mora gonggrijpii, a Guiana Shield endemic, is locally abundant, forming almost pure stands (Morabukea forest) or in mixed forest with greenheart and black kakaralli on laterite soil or loam, generally in the near interior, but rare in the Northwest District (Polak, 1992). *Eschweilera potaroensis* is abundant in the west-central Guyana and prevalent to the area surrounding the confluence of the Potaro and Essequibo Rivers of the Mazaruni Basin (Steege, 2000). According to Berry et al. (1995) most of the genera endemic to Guyana and the Guiana Shield have a fairly wide altitudinal distribution.

Under the IFC PS 6 (2012), the Tier 1 sub-criteria for Critical Habitat for endemic or restricted range species is that the habitat is known to sustain at least 95% of the global population of the species in question. None of the species recorded qualify the concession as a Tier 1 Critical Habitat under Criterion 2.

The Tier 2 Critical Habitat sub-criterion for endemic species is that the habitat includes at least 1 percent of the global population of the species in question. The Concession area is approximately 126 km², which would require that the extent of occurrence of the endemic species recorded in the area does not exceed 12,600 km². Based on available information, the distribution of these species is likely to be far greater than 36,600 km². These species therefore does not qualify the Concession as Tier 2 Critical Habitat for endemic plants. For comparison the Mazaruni Basin alone has an area of approximately 36,600 km².

The Guiana Shield has a variety of landscapes scattered throughout the region and includes sandstone tepuis, granite inselbergs, white sands, seasonally flooded tropical savannas, lowlands with numerous rivers, isolated mountain ranges, and coastal swamps, each supporting a characteristic vegetation (Huber et al., 1995, Huber, 1995b). The highlands of the Shield have flora and fauna with numerous endemic species. Some tepui endemic species occur as low as 300 m in elevation, with increasing numbers by 1500 to 1800 m, and fully developed communities occurring by 2000 m (Funk and Berry, in press).

The Concession is located in the tropical lowland moist forest of central Guyana. The lowland rain forest on brown sandy soils, loams, or laterites is the major vegetation type of the Amazon Valley and the Guiana Shield (Steege, 2003). This low land eco-region is biogeographically distinct from the Guiana Shield Highland centers of endemism. The Guiana Shield Lowland forest fauna is largely shared with other lowland eco-regions of the Amazonia Basin.

According to an updated List of freshwater fish species endemic to Guyana by Vari *et al*, (2009), a total of eighty four (84) freshwater fish species are endemic to Guyana. The majority of the listed species are found in the highlands of the Guyana Shield, especially in the Potaro river basin, or in the Rupununi Savannas Region. Review of this list against the fish species recorded at the Concession revealed two Guyana endemics; *Hyphessobrycon minimus* and *Aequidens potaroensis*. These species are widely distributed within the Essequibo River Basin. The two endemic species were not yet assessed in the IUCN Red List species. Under PS 6, restricted range freshwater fish species are those with an extent of occurrence of 20,000 km². The *Hyphessobrycon minimus* and *Aequidens potaroensis* species do not have ranges that can be considered restricted based on their widespread distribution within the Essequibo River Basin. For comparison, the Mazaruni River Basin which forms part of the Essequibo Freshwater ecoregion occupies approximately 36,600 km².

The biodiversity of the invertebrate communities of the Guiana Shield region is extremely poorly known (Lavelle, 2003). The invertebrate Orders Hymenoptera (Family-Formicidae, ants); Lepidoptera (butterflies); and Opisthopora (earthworms) are estimated to have high endemisms within the Guiana Shield Region (Lavelle, 2003).

Most of the Guianas endemic amphibians are largely restricted to the Guiana Shield Highlands, generally closely associated with the Tepui formations (Senaris and Mac Culloch, 2005). Some amphibian endemic species occur at relatively low elevations, and these tend to have wider distributions than do highland endemics.

Amphibians species endemic to the Guyana Lowlands recorded in the surveys are:

- *Stefania evansi* - this species is known from the lowlands of west-central Guyana, including the base of Mount Wokomung 680-698 m. In the Pakaraima Mountains it has been recorded up to 1,400 m above sea level. This species is abundant in suitable habitat at lower. This species is listed as Least Concern by the IUCN Red List;
- *Anomaloglossus kaiei*- endemic to Guyana at 150-900 m elevation. *Anomaloglossus kaiei* is known from Kaieteur National Park and the Pakaraima Mountains, Guyana, where it is known to occur in primary and disturbed forest (Kok et al., 2006). The species can also be found along the Guyana-Brazil border and is also possibly present in Brazil. It occurs between 150-900 m elevations. This species is listed as least concern by the IUCN Red List ; and
- *Adenomera lutzi* - This species was originally known from the Mazaruni-Potaro District, Guyana. Additional specimens were collected on Mount Ayanaganna in the Pakaraima Mountains, also in Potaro-Mazaruni District, Guyana, the Chenapowu River on the upper Potaro River, the Kaieteur National Park, Mount Ayanganna, Mount Wokomung and the Merume Mountains in the Pakaraima Mountains region of Guyana. This species is listed as Data Deficient by the IUCN Red list.

The Guyana-Venezuelan endemic amphibian *Rhaebo nasicus* and two Guiana Shield endemic amphibians, *Hyalinobatrachium taylori* and *Pipa aspera*, were also recorded with the concession.

As it the case for most vertebrate fauna, most of the endemic reptiles are restricted to highland areas (Senaris and Mac Culloch, 2005). The only known Guiana Shield Region reptilian endemic occurring in the lowland forest of the North West District of Guyana is the *Echinosaura sulcarostrum*, known only from Baramita at elevation of 100 m (Avila-Pires, 2005). This species was not recorded in the Concession. The species is not yet evaluated by the IUCN Red List.

Based on migration and endemism descriptions of Birds of Guyana (Braun, 2000) fourteen of the species recorded at the Concession are Guiana Shield endemics, namely *Gypopsitta caica*, *Pteroglossus viridis*, *Xiphorhynchus pardalotus*, *Hypocnemis cantator*, *Pithys albifrons*, *Gymnopithys rufigula*, *Myrmotherula guttata*, *Herpsilochmus stictocephalus*, *Perissocephalus tricolor*, *Phoenicircus carnifex*, *Corapipo gutturalis*, *Lepidothrix spp.*, *Pionus fuscus* and *Cyanocorax cayanus*. These species are widely distributed within the Guiana Shield and are listed as least concern by the IUCN Red List.

According to Lim et al (2005), there are fifteen mammalian lowland endemic species of the Guiana Shield Region, five of which have restricted distribution occurring in areas outside of Guyana. The others are found throughout the Guiana Shield and include: *Didelphis imperfect*, *Monodelphis brevicaudata*, *Lophostoma schulzi*, *Neacomys guianae*, *Lasiurus atratus*, *Neacomys paracou*, *Oecomys auyantepui*, *Ateles paniscus*, *Oecomys rex*, *Oecomys rutitus*, *Sphiggurus melanura*, *Proechimys hoplomysoides*, *Isothrix sinnanmariensis*, *Pithecia pithecia*. None of these species were recorded within the Concession.

Under PS 6, restricted terrestrial vertebrates are species with an extent of occurrence of 50,000 km² or less. While there are a number of terrestrial vertebrate species that are broadly endemic to the Guiana Shield region, none of the Guiana Shield endemics or the Guyana lowland endemics known to occur in the Concession have ranges that can be considered restricted.

7.4.3 Migratory and Congregatory Species

The interior lowlands of central Guyana are not known to be critical habitats for migratory or congregatory species. Unlike the Atlantic Coastline of the North West District of Guyana (Shell Beach Area), which supports the nesting, foraging grounds of migratory sea turtles and birds such as the Scarlet Ibis (*Eudocimus ruber*), the Concession does not include any significant habitat areas known to assemble congregatory or migratory species.

The Essequibo drainage is seasonally linked to the Amazon drainage when the flooded savannahas of the Rupununi form a continuous expanse of water between the tributaries of the Rio Branco and the Rupununi River (Watkins et al, 2004). The Cuyuni, Mazaruni, Potaro, and the Siparuni River basins, all part of the Essequibo Freshwater eco-region connect the Amazonia aquatic systems via the Essequibo River, thereby serving as biological corridors linking to the Amazon Basin. The Kaburi River which forms the main drainage basins for the Concession area drains into the Mazaruni River. The Mazaruni River Basin connects to the Essequibo drainage, and may be part of the migratory pathway for fish species and aquatic biota, however, no migratory fish species were recorded in the Concession.

7.4.4 Unique Assemblage of Species and Key Evolutionary Processes

The Concession forms part of the lowland forest ecosystems typical of the lowland forests habitats of the national forest regions, and by far the lowland forests of the Guiana Shield Region and the Amazon Basin. Even though these lowland forested areas may have heterogeneity in the nature of soils, they are present across the lowland forests of the national forest regions and therefore do not have significant transitional habitats that may have potential importance for key evolutionary processes such as speciation.

Unlike the Guiana Shield Highlands centres of endemism occurring at elevations of 1500 m or more, the Lowland forests habitat of the Concession are characterized by biota that is widespread throughout the Guiana Shield and Amazonia Lowlands. As a result, there are no ecological features/functions or ecosystem services characteristic of the Concession which are not replicated across the Guiana Shield and Amazonia lowlands.

8.0 DESCRIPTION OF THE SOCIAL ENVIRONMENT

A zone of influence or study area for the Concession was determined taking into consideration all possible interactions and probable impacts which may be experienced even if they are to relatively far away communities if a project is developed at the site. The zone of influence has been thus defined as the physical radius to which the project footprints or impacts may potentially extend.

The Concession extends over an area of approximately 1600 ha and encompasses several areas historically worked by small and medium scale miners. These areas are depicted on Figure 38. PGI operational base is centered at the former Hicks mine site. The Concession is east of and approximately 30 km from the Amerindian titled Village of Kaburi. This indigenous village is the primary indigenous community in close proximity to the Concession. A community is located at 14 Mile Issano immediately outside the Concession boundaries and precedes the acquisition of the concession by PGI. There are several other small/medium scale mining communities located within 10 km of the Concession.

In addition there are certain areas which can provide employees and logistics support to operations at this property. These towns occur in Regions 7 and 10. The property is however located in Region 7, the socioeconomic and sociocultural baseline was consequently focused on sourcing logistical and other resources from Region 7. The zone of indirect influence for the socio-economic and sociocultural baseline study was determined using this logic. Hence, Itaballi and Bartica were considered to be in the area of indirect influence since employees may be drawn from and benefits may potentially accrue to these communities. The socio-economic baseline study was consequently undertaken to create a profile of these communities.

The Concession is located within the Cuyuni-Mazaruni, Administrative Region 7. The area of influence considered appropriate for this baseline compilation is depicted on Figure 38.

The socioeconomic baseline was conducted to establish: (i) dominant uses of land and other resources for subsistence and livelihood activities, such as farming, fishing, hunting and mining practices; (ii) the presence of infrastructure such as schools, medical facilities, communications network/transport networks and markets; (iii) public health issues in terms of health risks and diseases; (iv) local institutional capabilities; (v) land ownership patterns; (vi) identification and characterization of community cohesion and management; and (vii) identification of existing and proposed development plans for the study area. Stakeholder consultations was integrated into compilation of this sociocultural and socioeconomic baseline.

The following data collection methods were employed:

- review and update of secondary data (reports, legislation, etc.);
- visit and consultations with the communities/Kaburi Village, 14 Miles Issano and with residents of the several mining camps within the area of influence.

Figure 38 - Area of Influence Map

8.1 Property Area

There are no indigenous and/or traditional villages within the Concession. 14 Mile Issano is located just outside the concession boundaries. No information is available to indicate the time the settlement started, however anecdotal information indicates that the area was settled in 1978. PGI has a camp within the concession which is the basis for work related to development of the property, including exploration drilling and project feasibility studies. Small and medium scale miners, working further west frequently pass through 14 Mile Issano area.

8.2 Access Road and Property Roads

The roads within the Concession boundaries area were constructed during previous mining/exploration operations. The property is currently accessed by road from Linden and Bartica. A new access road will be constructed to provide access to the mine site for project implementation. That access road will link the mine site to the Amaila Falls Access road, contingent upon the company being granted access to the Amaila Falls Access Road by the Government of Guyana. The new access road and other roads both within and external to the property are shown on Figure 39.

The first part of the socioeconomic baseline provides an overview of Amerindians in Guyana and of Region 7 (Cuyuni-Mazaruni) which is the administrative Region in which the Concession is located. The second part provides the socio-economic profile of the communities and villages within the project area of influence.

8.3 Amerindians in Guyana

Anthropologists and administrators often classify Amerindians as coastal and interior tribes. Coastal Amerindians, who inhabit areas in close proximity to the Atlantic Coast and more particularly, the Pomeroon and Corentyne Rivers, are identified as the Carib, Arawak and Warau. Their names originated from three large families of Guyana's Amerindians (World Bank 2001). The seven interior tribes are the Akawaio, Arekuna, Barama River Carib, Makushi, Patamona, Waiwai and Wapisiana. The Barama River Caribs, Akawaio, Arekuna, and Patamona reside in river valleys located in the western part of Guyana.

Amerindians are the fourth largest ethnic group in Guyana and account for 9.2 per cent of the 751,223 persons in Guyana (Guyana Census Report, 2002). Between 1980 and 2002, the Amerindian population grew from 40,343 to 68,819. This represents a significant increase of 70.6 per cent. Approximately 70 percent of the Amerindian population is found in Regions 1, 2, 8 and 9. Specifically, Amerindians account for more than three-quarters of the populations of Regions 8 and 9 (75.9 and 89.2 percent respectively) and more than two-thirds of the population of Region 1 (62.2 percent). The highest rate of growth occurred in Region 8 (104 %), followed by Region 9 (31%) and Region 1 (27%) (Guyana Census Report, 2002).

Like other indigenous peoples of the Amazon, Amerindians' subsistence lifestyles are based predominantly on agriculture. Amerindian poverty is characterized by high levels of unemployment, low income, lack of local capacity building, poor social infrastructure, lack of or inadequate access to markets, credit facilities, high transportation costs, low educational level and poor nutrition.

The 1999 Guyana Survey of Living Conditions (GSLC) records 78.4 per cent absolute poverty in the rural interior. The extraordinarily high level of poverty found among Amerindian communities is the result of a combination of historical, political, socio-economic and spatial factors (Bynoe, 2005). For example, their geographic isolation; the dispersed settlement pattern and difficult terrain they occupy; the high administrative costs of projects in these areas; lack of technical, human and financial resources; exorbitantly high transportation costs and related effects on accessibility, mobility and markets.

Figure 39 - Alignment of Mine Site Access Road

The staple diet of the Amerindians consists of cassava, which supplies carbohydrates. Protein generally comes from fish or meat, which are either hunted or bought from the more successful fishermen or hunters. Sometimes these protein sources have to be bought from interior shops owned by people from the coast (Coastlanders).

Access to potable water is very limited in the majority of Amerindian communities. Traditional sources of pure water, namely creeks and rivers, have increasingly come under threat of pollution due to the rapid growth of resource extractive industries in the interior beginning from the early 1980s.

8.4 Profile of Region 7 Cuyuni-Mazaruni

Guyana has ten administrative regions (Figure 40). Each of Guyana's ten administrative regions has a Regional Democratic Council (RDC) and a regional chairman. This system of local government is designed to decentralize government functions and to provide each region with administrative responsibilities to serve the interest of that region. In Region 7, the RDC is located in Bartica, which is not easily accessible by most indigenous communities. As a result, the RDC has three sub-regions; Upper, Middle and Lower Mazaruni Sub-regions. The Concession area of influence straddles the Middle and Lower Mazaruni Sub-regions.

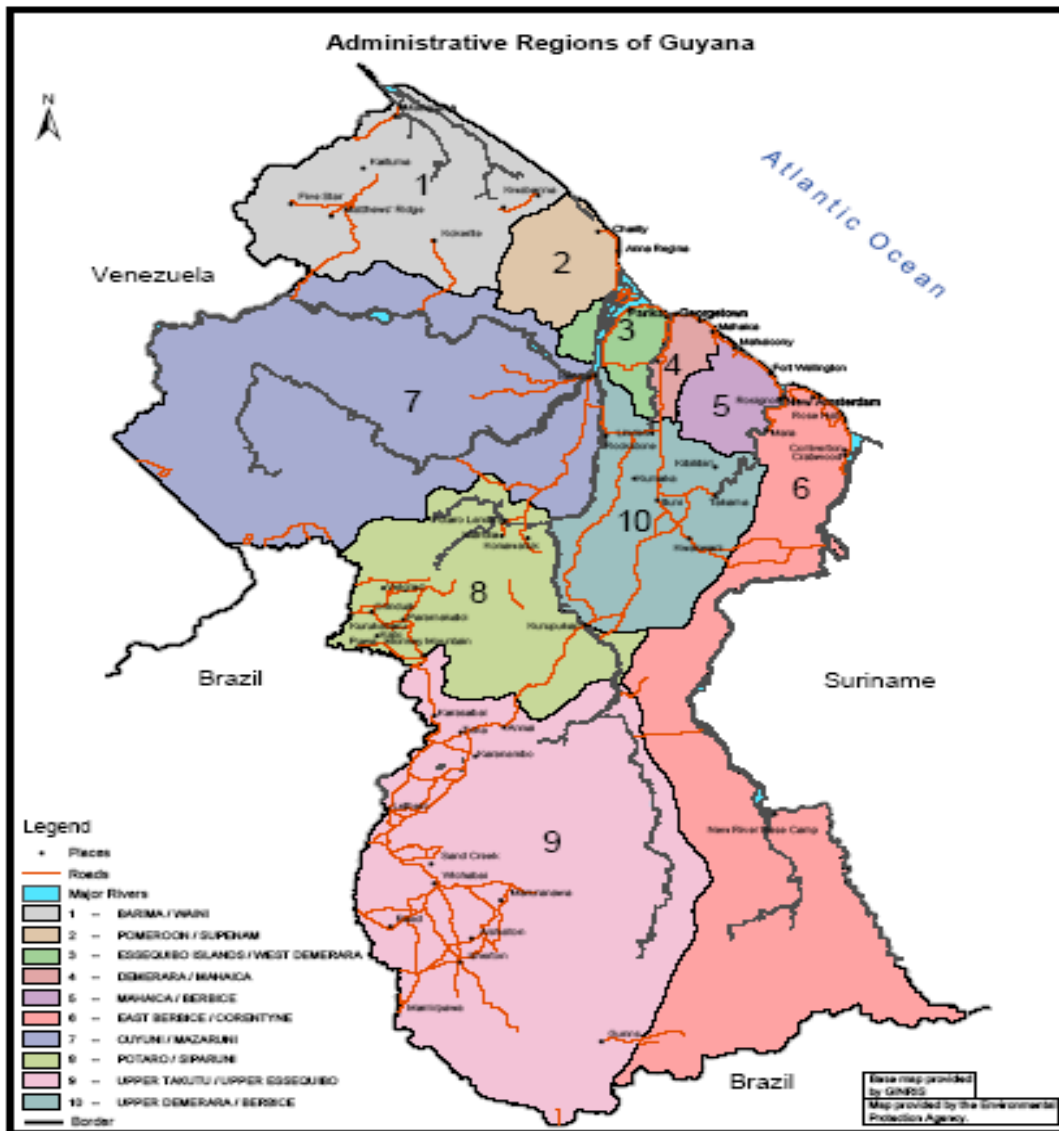
The Concession is located within the Middle Mazaruni Sub-region with a District Administrative Centre located at Kamarang. One of the objectives of the body is to address the problems faced by Amerindians in an organized manner (Colchester, La Rose, and James, 2002). At the local level, Village Councils, as required by law, administer each community.

Amerindian communities are governed by Village Councils made up of Toshaos and Councillors. Elections are held every two years, and are supervised by Officers of the Regional Democratic Council. The Amerindian Act (2005) gives elected village officials similar powers to that of their counterparts in the local government structure in non-Amerindian areas. The functions of the Village Council are set out in the Amerindian Act (2005) as:

- represent the Community;
- act in the best interest of the Community;
- provide advice and strategic direction to the Community; hold for the benefit and use of the Community all rights, titles and interests in or over Community lands;
- manage and regulate the use and occupation of Community lands;
- promote the sustainable use, protection and conservation of Community lands and the resources on those lands;
- encourage the preservation and growth of Amerindian culture;
- ensure that places and artifacts which hold sacred or cultural values to the Community are protected and cared for;
- protect and preserve the Community's intellectual property and traditional knowledge;
- nominate Councilors or other members of the Community to accompany the Toshao to meetings of the Regional Democratic Council, or to attend meetings on behalf of the Community; and
- ensure that proper accounts and financial records are kept.

Most Amerindian leaders have identified the need for leadership and other training as a priority for their development (National Development Strategy 2001-2010). General constraints faced by Amerindians include access to land, lack of physical and social infrastructure, income poverty, limited sustainable livelihood alternatives, low literacy level, and lack of capacity to monitor activities taking place adjacent to their communities.

Figure 40 - Administrative Regions of Guyana



The poverty levels in Amerindian Communities are high. This is due to among other factors, high levels of unemployment. There is also a breakdown in the education system since teachers are required to teach more than one class, resulting in some children being left unattended (Renshaw, 2006)⁴.

The most prevalent health risks are related to diarrhoeal-related diseases, malnutrition, HIV/AIDS, dental problems, malaria, gastroenteritis and bronchi-pneumonia. There is one hospital in Bartica⁵ which has modest facilities. Many patients must, consequently travel to Georgetown which is accessible by speedboat or ferry from Parika or by air, from Ogle.

⁴ Renshaw, J. (2006) Access to Social services in Guyana. Draft Final Report (Version 2). Commissioned by the IADB under Technical Cooperation GY-T1010.

⁵ Bartica is the centre of small-scale and gold and diamond mining.

Region 7 is well known for its gold mining activities. Gold mining has always been an economic pillar for Guyana, even though Region 7 has seen little of this gold wealth re-distributed in local communities. As such, subsistence farming, fishing, hunting, and employment in logging and mining businesses are the main sources of livelihoods in the Region. Generally, the cost of living in this Region is extraordinarily high, and is estimated to be almost one and a half times that on the coast. One of the root causes of the high cost of living is the high freight costs associated with the relative geographic isolation of the area, compounded by the difficulty in traversing the terrain. This high cost of living has negatively impacted the availability of government officers (teachers, health workers, nurses, etc.). Most government employees are not adequately compensated to remain for long periods in the area.

Generally, Amerindian subsistence economies are gradually integrated into cash economies through mining and logging activities.

8.5 Demographic and Population Information

The total population of Region 7 is approximately 19,000 people (an 8% increase from the 2002 Census Report), and accounts for 2.3% of the total population in Guyana. Amerindians are the fourth largest ethnic group in Guyana and make up about 10% of the total Guyanese population. Amerindians account for 41.7 per cent of the Region 7 population.

Between 1980 and 2002, the Amerindian population grew from 40,343 to 68,819. This represents a increase of 70.6 per cent. The population of Region 7 rose modestly by 1.53 per cent between 1980 and 2002. The population density is estimated at 0.4 persons per square kilometer, compared to the national average of approximately 3 to 3.5 persons per square kilometer. (Guyana Census Report, 2002).

There are twenty-three (23) Amerindian communities (mainly Akawaios and Arecuna) in Region 7. These communities are scattered throughout the three sub-regions of Upper, Middle and Lower Mazaruni. The communities are identified in Table 63 below, which provides additional information on the estimated population of each community.

8.6 Health Issues in Region 7

Malaria continues to dominate the list of reported illnesses contracted within Region 7. In 2008, eight thousand, two hundred and fifty three (8,253) cases were reported. This decreased to 7,853 in 2010 and has since escalated to 10,639 in 2011 and 11,763 cases in 2012 (representing a 39% of all cases reported within the country and a 49% increase in cases reported in 2010). Other ailments reported in the Region during the period January to September, 2013 include, Diabetics (350 cases), certain infectious and parasitic diseases (299 cases), skin disorders (150 cases), acute respiratory diseases (120 cases), Hypertension (520 cases).

Table 63: Amerindian Communities in Region 7

VILLAGE	SUB-REGION	POPULATION IN 2008	POPULATION IN 2011	REMARKS
ARAU	Upper Mazaruni	140	300	
CHINOWENG	" "	540	600	
JAWALLA	" "	1,200	1,500	
KAMBARU	" "	219	280	Satellite Villages of Jawalla
QUEBANANG	" "	-	-	
KAIKAN	" "	296	400	
KAKO	" "	511	500	
KURUTUKU	" "	127	100	

PARUIMA	" "	730	600	
PHILLIPAI	" "	1,098	800	
WARAMADONG	" "	875	700	
WARAWATTA/KAMA RANG	" "	594	650	
ISSENERU	Middle Mazaruni	260	-	
TASSARENE	" "	230	-	
KABURI/72 MILES	" "	295	300	
KANGARUMA/FALLS TOP	" "	-	280	Satellite of Issano
BATAVIA	Lower Mazaruni	132	400	
DOGG POINT	" "	-	180	
FALMOUTH	" "	-	240	
GOSHEN/RIVERS VIEW	" "	330	370	
KARRAU	" "	276	300	
KARATABO	" "	300	300	
ROCKSTONE	" "	375	-	

Source: Ministry of Amerindian Affairs and Regional Administration Region 7

8.7 Education

Education in the Region is supervised by the Regional Democratic Council (RDC) of Region 7 through the Regional Department of Education. Nursery and Primary education are provided in all communities. Secondary education has to be accessed at either Waramadong or Bartica.

The Regional Administration has one dormitory at Waramadong and two dormitories at Bartica which provides accommodation for secondary school students from Region 7. The facilities at Bartica are complimented by a daily speed boat service, for Primary and Secondary school students, which ferries students to/from the Lower Cuyuni/Mazaruni communities to Bartica.

The Regional Education Department has piloted a school feeding program through the BEAMS Project and its Education for All/Fast Track Initiative (EFA/FTI) program which provides daily meals for most schools within the Region.

8.8 Communities in the Area of Influence

The communities in the Concession area of influence are:

- Kaburi Village which is the indigenous village in closest proximity to the property. This village may also potentially serve as a source of labor for operations on the property.
- Bartica and Itaballi which are major hubs for providing services for the interior related to mining and mineral exploration operations. Bartica is also the home of the Regional Democratic Council, responsible for carrying out legislative and community services to Region 7. Itaballi is located approximately six miles from Bartica on the West Bank of the Mazaruni River.
- 14 Mile Issano and several small and medium scale mines within the concession.

Figure 41 - Map Showing Communities within Project Area of Influence

8.8.1 Kaburi Village

Kaburi village, a titled Amerindian Community, is located 72 miles from Bartica, the administrative capital for Region 7. The location of Kaburi Village relative to the proposed mine site is depicted on Figure 42.

In 2011, the village reported a total population in excess of 300 persons. Many of the residents of Kaburi Village move from one location to another in search of employment or other resources. These residents however always return to Kaburi village during periods of inactivity. The village is connected by road to Bartica, Madhia, Sherima Landing and Issano Landing. Passage of the access road to Madhia and Issano through the village has resulted in the establishment of shops along an approximate 1.5 km long stretch of the road. These shops offer services to both villagers and to commuters.

Households in the community are interconnected by white sand trails. A wooden bridge over the Kaburi River connects the two sections of the community. Water is recovered from the Kaburi River for both potable and sanitary use. The river therefore forms an important component of existence in the village as a place where residents gather and interact as they wash themselves and their clothes.

The village is governed by Village a Council consisting of a Toshao and councilors who are all elected by the villagers to serve the community for a period of two years. The Village Council makes decisions, particularly in relation to the utilization of communal lands. The Village Council is responsible for property location, distribution and maintenance.

Women in Kaburi Village are organized into a group referred to as The Mothers' Union. The Mothers' Union is focused primarily on the welfare of women in the Kaburi area and meet monthly to address issues affecting women in the community. The Union also offers cooking, sewing and embroidery classes to women in the community.

Discussions with members of the community revealed that there are several plans to be implemented in this year by the newly elected Toshao and Village Council. These plans include as follows:

- construction of a new playground and pavilion for youths of the community
- development of the 1 mile bridge as a eco-tourism site
- Commencement of poultry and pig rearing by community members
- Development of a sawmill in the community
- Development of a housing scheme geared towards young adults of the community
- Installation of telecommunication tower
- Purchasing of a bus for school children

A community census performed by the residents in 2013 yielded the total population of Kaburi village as being 350 persons distributed among some 80 households. The number reflects the inclusion of persons who reside in Kaburi Village solely for economic purposes in addition to persons who periodically enter Kaburi Village from nearby areas. The distribution of population by different areas designated within Kaburi Village is illustrated on Figure 43.

Figure 42 - Location of Kaburi Village Relative to Proposed Mine Site

Social infrastructure in Kaburi Village consists of the following:

- A school
- A health centre
- Two churches (Full Gospel and Anglican)
- A village office
- A community centre (Benab)

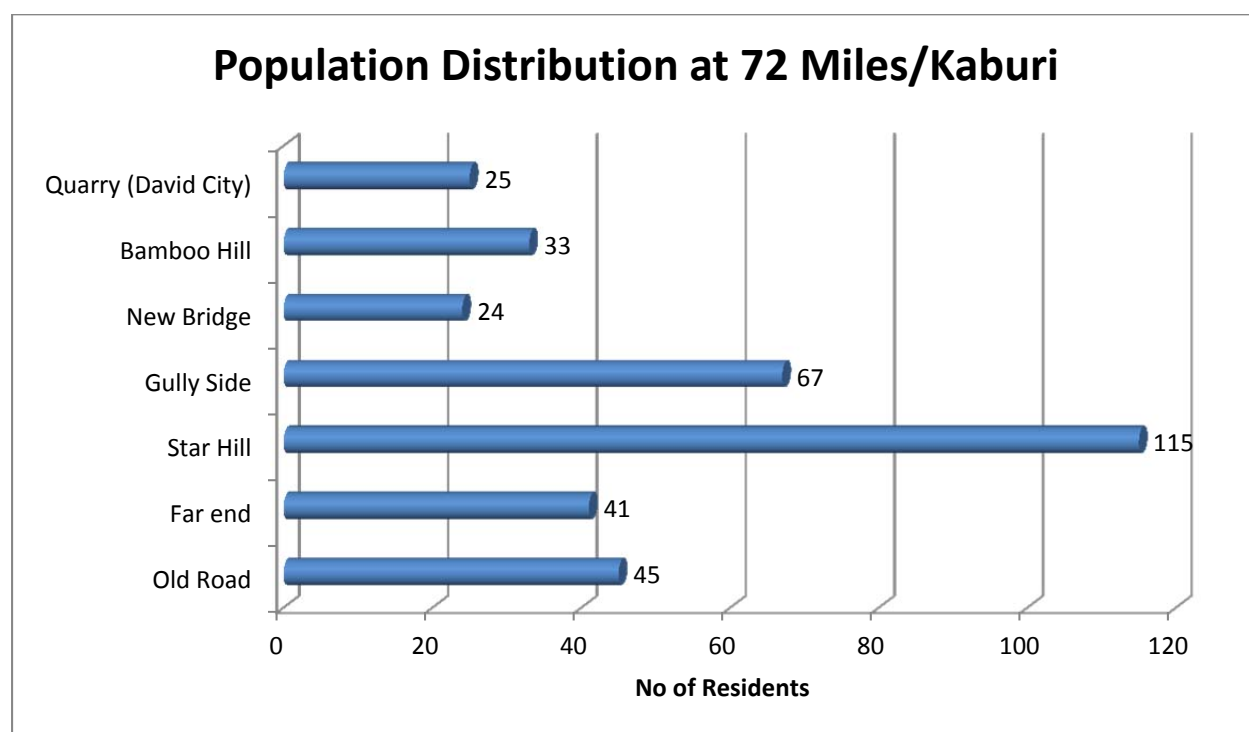


Figure 43 - Kaburi Village Population (2013 Community Census)

8.8.1.1 Education

There is a single school in Kaburi Village referred to as the 72 Miles Primary School. The school offers instructions to children between the ages of 5 and 16. The school which has a total student roll of 66 is staffed by 5 teachers. Four of the teachers were trained at the Cyril Potter College of Education in Georgetown. There are no private educational facilities or training institutions in Kaburi Village.

Instructions at the school go beyond the instructional levels typically associated with primary schools in Guyana. The school operates under a system in Guyana referred to as primary tops where some secondary school level instructions are provided to students. Children older than 12 years also have the option of attending secondary school in Bartica. Since this is relatively expensive only a few students exercise this option. Some parents also now opt to send their children for secondary education either at Bartica or in Georgetown via the scholarship programmes offered by both the Regional Administration and the Ministry of Amerindian Affairs.

The majority of adults in Kaburi Village have attended primary school. A few residents of the village have graduated from secondary school in Bartica.

8.8.1.2 Illness

The incidences of various illnesses in Kaburi Village over the period of January to September 2013 are summarized in Table 64. The table indicates cases of cold, fevers and diarrhoea occur with higher levels of frequency in the community. Malaria occurs with a lesser level of frequency than cold, fevers and worms but presents some cause for concern nevertheless. The table also indicates the number of births and deaths recorded within the community during the corresponding period.

Several of the residents of the village practice traditional medicine. Local medicines obtained from the plants and other sources in the surrounding forest are used by the village medicine man to treat residents for skin infections, diarrhoea, malaria, and cancer.

Table 64: Summary of Incidences of Various Illnesses in Kaburi Village

Illness	No. of Cases
Cold, Cough & fever	120
Red Eyes	10
Accidents	4
Malaria	28
Diarrhoea	100
Burn Patient	1 (Referred to Bartica Hospital)
Births for the period	4
Deaths in the community	0

(72 Miles/Kaburi Health Post Jan –Sept 2013)

8.8.1.3 Religion

The community is predominantly Christian. Residents are primarily members of the Anglican and Full Gospel churches. Both churches have worship services on Sundays and during the week. The churches provide an important part of the social infrastructure of the village administration and culture since the churches have replaced traditional spiritual practices. Anecdotal information reveals that the last spiritual elder (P-I man) of the village died sometime ago and was never succeeded. The churches also serve as points for dissemination of information about community activities in addition to performing its traditional functions of marriages, dedications, thanksgiving and funerals.

8.8.1.4 Economic Activity

The primary economic activities in Kaburi Village are mining and logging. Farming is done on a very small scale by individuals as subsistence for their families. While hunting, like farming, is primarily for personal subsistence, some individuals in the village also sell meat obtained from hunting.

There are several local shops in the village which sells basic foodstuff and other items. Rice, wheat flour, sugar, beverages (alcoholic and non-alcoholic) cooked food, snacks, medication, clothing, sanitary napkins and other products are among the items stocked by the shops. The majority of shops offer an alcohol based service with beverages being the main item sold in addition to other goods. These shops function as night spots within the community for locals and commuters.

Villagers not involved in gold mining and timber harvesting find work as traders and contractual employment with the State. Five villagers own their own gold hydraulicking operations and together hire upwards of 60 persons. The mining operations are all located outside of Kaburi village. Timber harvesting, which occurs within the titled area, is currently on the increase with greenheart timber being the most sought after species.

8.8.1.5 Security

Disputes in the community are arbitrated by the Toshao alone and/or in some instances with input of village councilors. The Toshao is also designated as a rural constable and has the powers of arrest. Major cases, beyond the authority of the Toshao, such as those involving grievous bodily harm or assault are referred to the Bartica Police Station, which is the nearest to the village. Residents of Kaburi indicated during discussion that there is a constant police presence in the area due to mining activities. This presence, however was not substantiated by visual observations during compilation of the baseline study or by other individuals, including miners who pass through the area.

8.8.1.6 Utilities

Each household in the Kaburi area has been provided with solar panels from the Government of Guyana and this serves as the primary source of electricity in the community. Some residents however supplement the solar panels source with generators. Generally, residents catch rain water and store them in both tanks and plastic drums for cooking and bathing, however, the main source of water in the community is derived from the Kaburi creek; serving almost all those in village.

The most readily available means of communication is the village radio set which is available for the use of the villagers. In some households however, there are personal radio sets which residents use to make contact with the immediate regions as well as Georgetown. Internet service are provided by shop owners and a cellular signal can be received at several points on the Amaila Falls Access Road which passes just outside the boundary of Kaburi Village.

8.8.1.7 Main Environmental and Social Concerns

Many members of the community are aware of the presence of the Pharsalus Gold Inc. and of activities associated with PGI operations. The majority of residents of Kaburi with whom discussions were held expressed no objections to the project in proximity to their village; any misgivings were primarily related to the absence of benefits to the community associated with this and other projects.

During consultations, resident of Kaburi Village identified the source of the Kaburi River as being within the property. Since water from that river is critical to the continued existence of the village, pollution of the river was identified as a significant concern for residents. Pollution of the river in addition to resulting in a loss of potable and sanitary water will also increase the range of villagers who fish in the river within the titled area.

Kaburi River itself does not extend into the concession. Main Creek, which serves as a collector of discharge from several creeks within the concession, discharges to the Kaburi River outside of the concession limits. Main Creek itself is fed by Blackwater, White Sand and several other unnamed creeks within the concession.

8.8.2 Bartica

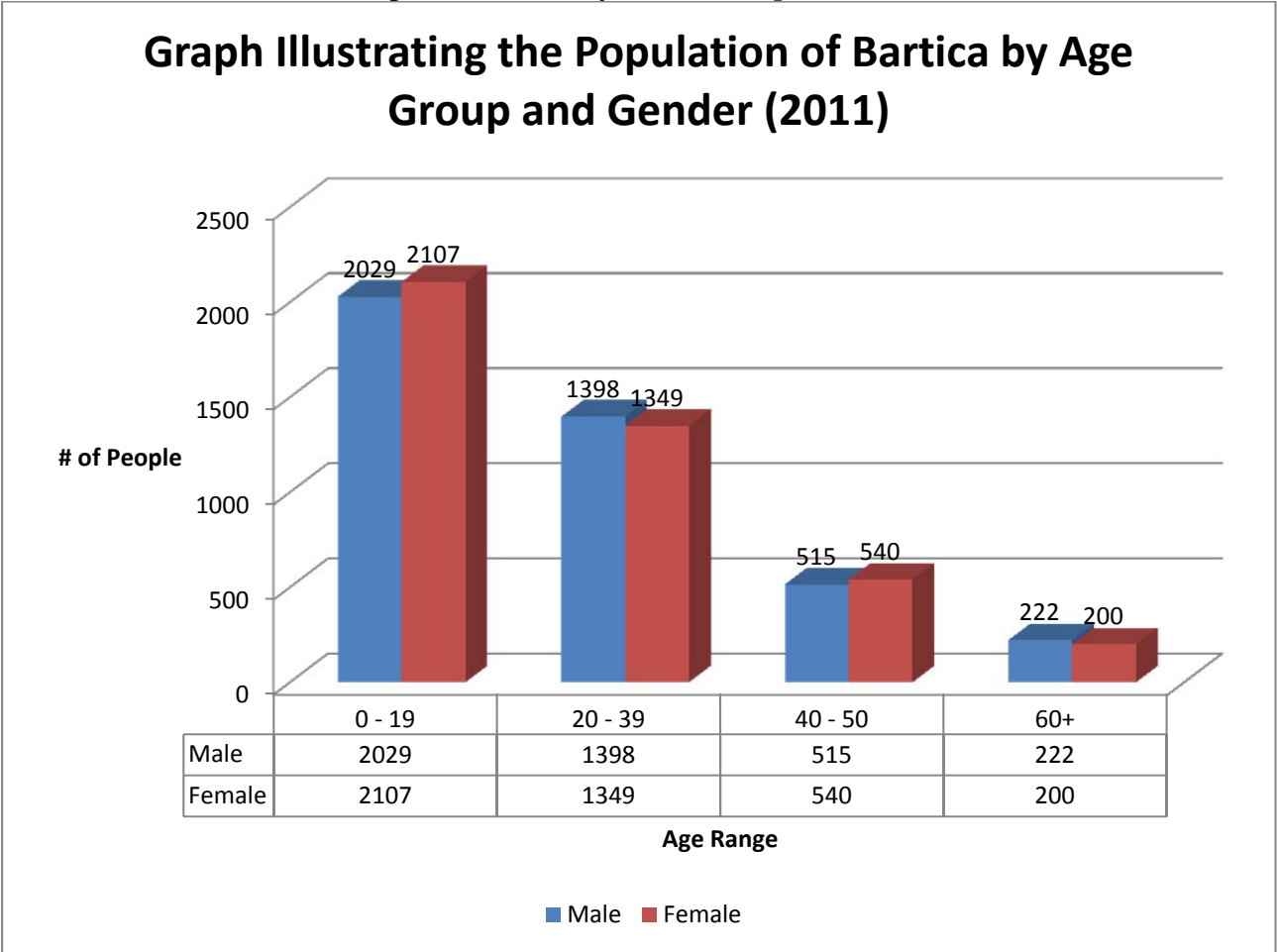
Bartica sits on the site of the old “Vryheid” Dutch Plantation that was established in 1678 by the Dutch West India Company. The first permanent structure to be established there in 1829 by the Church Missionary Society to carry out missionary work among the Amerindians, housed the Bartica Mission Station. However, due to the soil’s unsuitability for agriculture, the mission moved eastwards for about a mile to a place called Bartica Grove (the current site of Bartica), at the confluence of the Essequibo, Mazaruni and Cuyuni Rivers.

In 1887, the land was repossessed with permission from the Court of Policy to lay the foundation for a future town in the hinterland and several lots were laid out and sold at a public auction. However, it was the rise of the gold industry in the 1880's which really give impetus to the development and growth of Bartica as it was an ideal location in terms of accessibility to Georgetown, as well as the gold fields and the timber grants. Bartica also served as a major recruitment point for laborers and a number of service oriented businesses sprang up in the town to cater for the needs of the miners and woodcutters. Finally government departments were established to monitor and control the gold industry.

8.8.2.1 Population

The population of Bartica has increased by approximately 12% from the 2002 Population census indicator, with a population growth from 7,458 in 2002 to 8,360 in 2011 and from 1,421 households in 2002 to approximately 1,510 plus households in 2011. According to the regional administration, this increase is attributable to increases in mining/commercial activities in the region. The relatively young population of Bartica account for 82% of the residents below the age of 40 years old and approximately 95% of residents below the age of 60 years old.

Figure 44 - Summary of Bartica Population



Source: 2002 Population Census and the Regional Administration, Region 7

Figure 45 - Bartica Population by Age Group

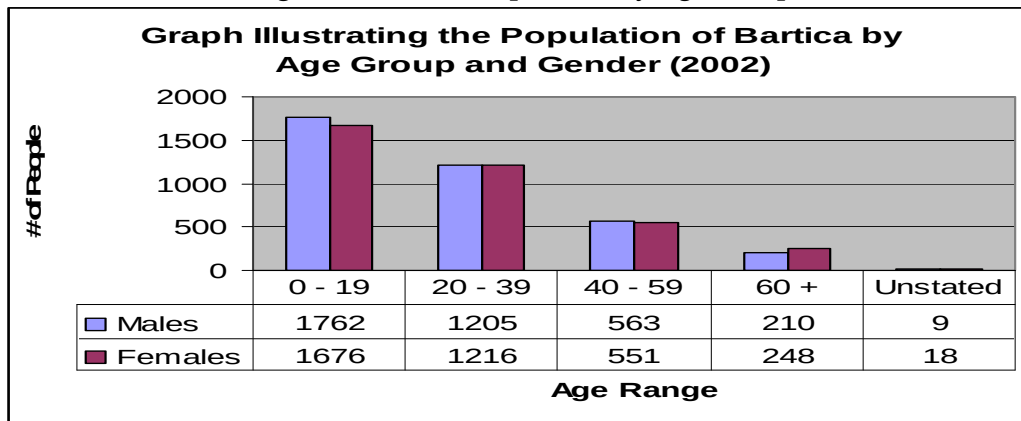
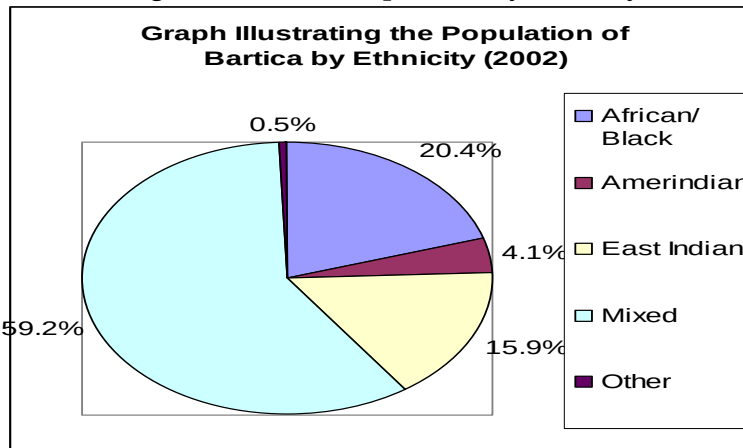
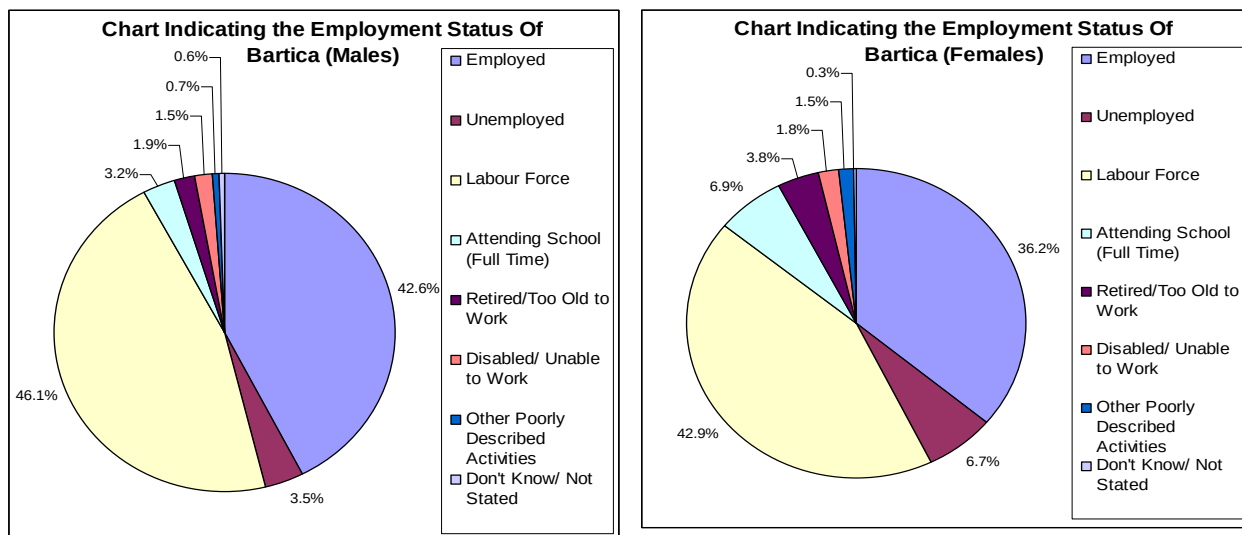


Figure 46 - Bartica Population by Ethnicity



The unemployment rate in Bartica is approximately 7.6 % for males and 15.6 % for females.

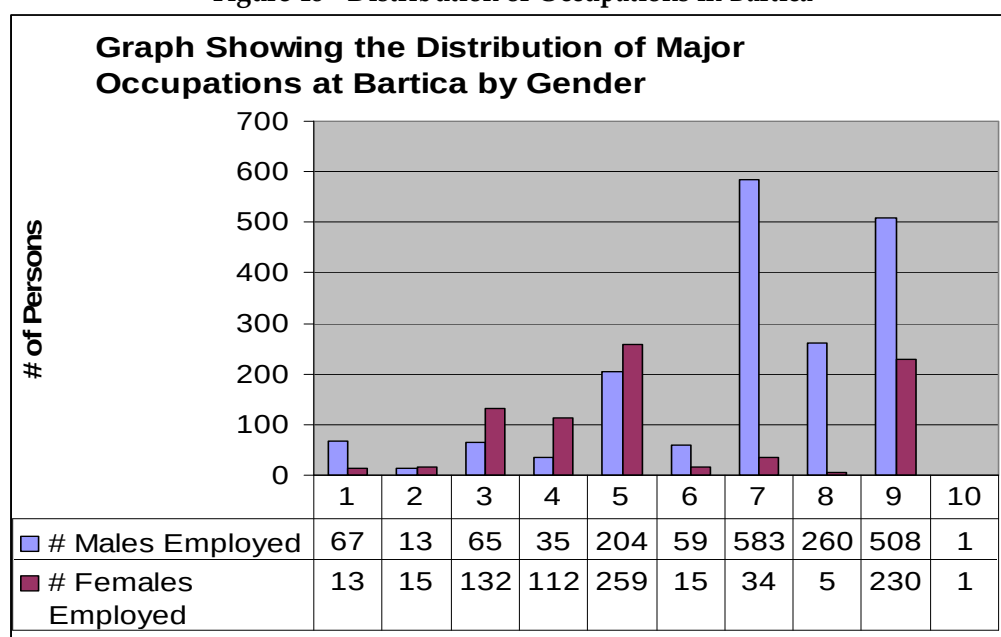
Figure 47 - Employment Levels in Bartica by Gender



8.8.2.2 Economic Activities

The dominant economic activities for males in Bartica are related to craft and related trades, elementary occupation, plant and machine operators and assemblers, and service and market sales workers and shops, respectively. On the other hand, most females are engaged in economic activities in areas such as service and market sales, workers and shops, elementary occupation, technicians and associate professionals, and clerks (Figure 48).

Figure 48 - Distribution of Occupations in Bartica



Occupation Key

Number	Occupation
1	Legislators, Senior Officials & Managers
2	Professionals
3	Technicians & Associate Professionals
4	Clerks
5	Service & Market Sales Workers & Shops
6	Skilled Agricultural & Fishery Workers/Farmers
7	Craft and Related Trades Workers
8	Plant & Machine Operators & Assemblers
9	Elementary Occupation
10	Not Stated

8.8.2.3 Health Issues in Bartica

Figure 49 provides information on ailments and their occurrences in Bartica. It may be inferred that the principal ailments are related to typhoid and paratyphoid fevers, asthma, and sexually transmitted diseases. It is noted that while there was a marked decrease in typhoid and paratyphoid fevers between mid 2003 and 2005, occurrences of asthma and sexually transmitted diseases have increased by at least 400 percent between 2003 and 2005.

For the period, January – September 2013, the leading reported health cases continue to be that of Malaria with 1350 cases reported and treated. This has decreased somewhat in comparison to 2011 – 1473 cases,

within the Region 7 area. Other ailments reported in the area for the period include acute respiratory (120 cases), hypertension (520 cases), diabetes (350 cases), viral infections (299 cases) and skin infection had a reported (150 cases) reported and treated.

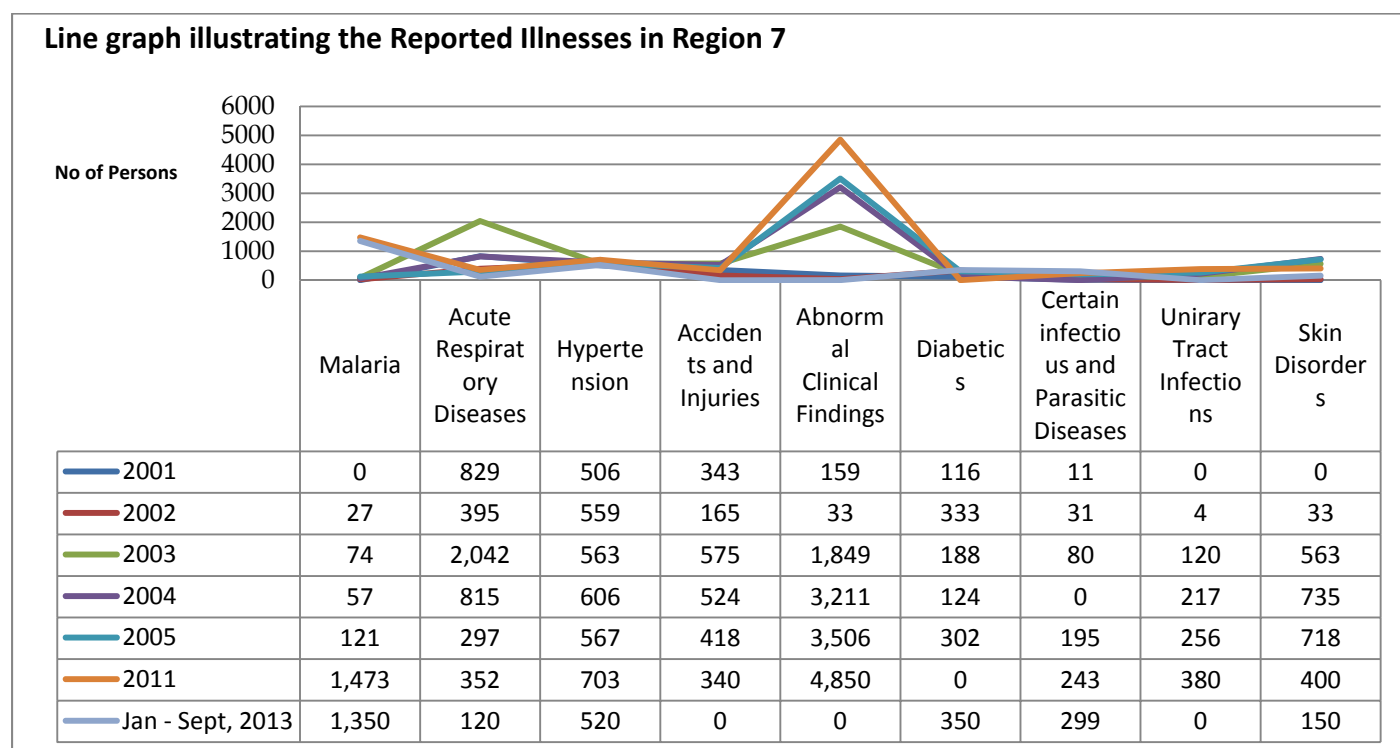


Figure 49 - Health Statistics for Bartica

8.8.2.4 Social Issues⁶

Bartica has the following social amenities:

- one secondary school;
- six primary schools;
- several nursery schools;
- a community centre;
- a police station;
- a library; and
- a hospital

Others social amenities include:

- a regional transportation workshop;
- the office of the Regional Democratic Council of Region 7;
- two commercial banks; and,
- several places of worship

⁶ Information provided by Ms. Audrey Jones, Education Officer, Regional Democratic Council)

The Hope Foundation, an HIV/AIDS NGO operates in Bartica and provides education and public awareness on HIV/AIDS and related issues.

Brazilians who reside at Bartica are allowed to operate a number of establishments (shops and restaurants). The Brazilian culture has been adopted by many of the youths of Bartica and this has led to both positive and negative changes in the local culture.

8.8.3 Itaballi

Itaballi is located on the West Bank of the Mazaruni River, approximately six miles from Bartica. The population is estimated to be 300, accounting for approximately 84 households. (2005/2006). Information documented by Dr. Mark Bynoe⁷ indicates that in 2004 over 68.9 % of the population of Itaballi were within the age range of 20-39. Approximately 41% of the respondents⁸ were of mixed descent, approximately 4% were of other, approximately 14% were of Indian-Guyanese descent, and about 31% were of African-Guyanese descent. There seems to have been a gradual increase in the population in more recent years and this is likely attributable to the growth of the mining/logging industry in the past few years and the associated development of the area.

Itaballi has the following social infrastructure:

- a community centre;
- a library;
- a primary school;
- a recently constructed health centre/post;
- two churches; and
- a play field and pavilion.

Itaballi has no secondary school, however, children from the community can and have, over the years, accessed secondary education in Bartica. A recently constructed health facility provides the community with basic health services, such as medical supplies, medical checks and testing for hypertension. Malaria smears are sent to be analyzed at the Bartica Regional Hospital.

There are a number of shops which cater to the needs of miners. There are also a number of fuel depots which supply fuel to vehicles heading to the interior. In 2003, a security check-point was established at Itaballi with the aim of reducing the high incidence of crime at interior locations. Two officers of the Guyana Police Force and two GGMC mining officers are stationed at the check-point. These officers monitor persons and vehicles entering and leaving the mining district.

8.8.3.1 Economic Activity

Itaballi is primarily a farming community, with bananas, pears, and ground provisions being the main produce. Subsistence farming appears to be the main non-income household activity, while the major economic activities are gold/diamond mining, shop keeping, logging and farming. Figure 50 indicates

⁷ Information was obtained from the social assessment aspect of an Environmental and Social Impact Assessment for the Garner Forest Industries Inc. Sustainable Logging Operation in the Cuyuni -Mazaruni District, Guyana conducted in December 2004 by Dr. Mark Bynoe.

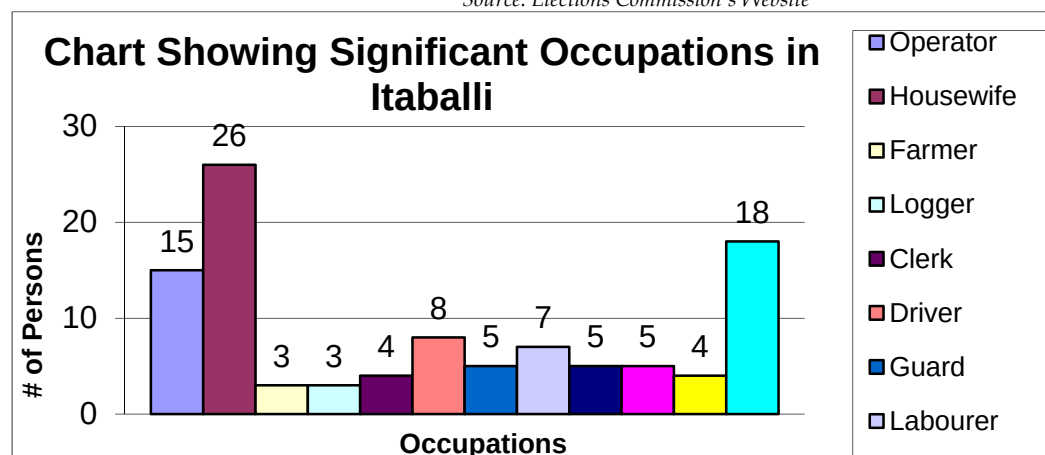
⁸ Approximately 73 percent (29) of these 40 households in Itaballi were surveyed.

that there has been an increase in the number of occupations⁹ not related directly to mining/logging which may perhaps be an indicator of development of the village. Other forms of income generation are:

- Cash crop farming;
- Small scale gold processing;
- Selling timber; and
- Wildlife trappers and sellers

Figure 50 - Occupations in Itaballi

Source: Elections Commission's Website



8.8.3.2 Main Social and Environmental Concerns

Residents of Itaballi identified the main social and environmental concerns as:

- high unemployment, especially among young people;
- absence of technical training facilities for youths and limited opportunities for self actualization and improved self esteem;
- poor health care system;
- poor water supply;
- land erosion and destruction of forests and vegetation;
- discrimination among different races/lack of social cohesion;
- drug and alcohol abuse;
- strangers entering the community and being involved in crime;
- a high prevalence of malaria among residents;
- a high incidence of diarrhea, typhoid and vomiting due to unsanitary conditions and the domestic use of contaminated water from nearby rivers, and
- the influence of alcohol in the community: shops in the area appear to market the substance and it is claimed that alcohol is a major cause of spousal abuse and the lack of social cohesion within homes.

Itaballi has a larger percentage of males to females, due to the nature of employment being mining/logging oriented.

⁹ This information was obtained from the Elections Commission Web and only applies to persons 18 years and over.

8.8.4 Mining Camps

The Concession and immediately adjacent areas have supported mining activities for over one hundred years. These activities have been related primarily to the recovery of gold and diamond by open pit workings of alluvial deposits. Several of these operations continue within the limits of the Concession and within proximity of the Concession boundaries. These operations are as follows:

- White Hole Kaburi
- Cornfield
- El Dorado
- Nine Mile
- Smarts, & Milo Camps
- Honey Camp

White Hole Kaburi, owned by Mr. Patrick Harding, has been solely mined by him continuously over the past nine years. PGI and Mr. Harding have an agreement which facilitates operations by both entities in this area. In addition, other dredge owners are allowed to work within the Concession based on mutually satisfactory arrangements. The primary mining method in this area is hydraulicking. There are four dredges currently in the area. Two of these are operational and provide employment for 25 persons all of whom are from Guyana coastal areas. There is a preference for people from the coast since, it is claimed, persons from the areas within close proximity of the operations are not reliable workers and often abandon the worksite and head home in the middle of the operations placing the crew under additional pressure.

Cornfield is operated by various individuals who control individual block(s). There are currently five operational claims in the area. The area has been in operation since 1996. PGI has a financial arrangement to conduct exploratory drilling in this area. A single dredge is currently operational in this area and provides employment for a total of eight crew members all of whom are from coastal locations.

El Dorado is another historic mine site as is reflected by the presence of antiquated mining equipment, rumored to belong to a Chinese company, on the property. The area now falls under the control of PGI through an arrangement with the mine operator, Mr. Mohamed, on the property. A single dredge is operated by a 16 crew members who are all either from the Essequibo Coast or Bartica.

Nine Mile Kaburi is located beyond the boundaries of the Concession. It has been acquired by PGI in a private transaction. Three dredges are currently operational in the area based on financial arrangements with the property owner. One dredge, owned by Mr. Hall, has a crew of seven men, all from the coast. The second dredge, owned by Mr. Israel, has a crew of twenty five persons operating two dredges simultaneously in a single location. Israel's workers are from coastland locations. However these workers are quite mobile and move to other locations if there is a perception that production is low.

The Smarts operations currently employ seventy five men. The operations consist of eight work crews supported by four excavators. Smarts entered into a financial agreement with PGI to allow PGI to conduct exploratory drilling on its properties. Monies from this agreement were invested in the operations including the acquisition of four excavators. Smarts has a rigid organizational structure and only employs individuals from his village of Mahaica on the East Coast. This operation has identified security as a serious issue in the area, however the twice weekly police patrols in the area has alleviated some of these fears. This operations plans to relocate to 11 miles Issano since the area is almost mined out. Workers at this camp expressed concerns over larger companies taking over the property. In addition, some workers verbally expressed disquiet over the treatment of local miners as opposed to expatriates who were reportedly taking over the industry and operating illegally. The persons expressing these

views, however, could not identify specific instances to validate their concerns. It was therefore concluded that the disquiet expressed is primarily related to local perception and cannot be validated by factual evidence.

The area operated by Milo has been mined commencing in the 1930's. Milo himself has no operations in the area, however, several dredges are operational on the property based on agreements between Milo and the operators. Milo has been asked by PGI to have GGMC verify his claims in order to enter into a financial agreement allowing PGI to explore the area.

Honey Camp operated by Pereira Mining Co. has been in operation since the 1930s. In September 2012 PGI entered into an option agreement with Pereira Mining Co. to potentially take ownership of these tenements. There are currently four persons managing two camps at 9 mile and Honey Camp. Workers for these operations are all from Buxton, Plaisance or Mahaicony.

8.8.4.1 Social Infrastructure

All living accommodations in the mining camps are constructed primarily of wood from the surrounding forest and have either plastic or tarpaulin roofs. The furniture in the camp consists only of sleeping facilities which are either wooden bunk beds with mattresses or hammocks equipped with insect nets.

The camps all recover rain water for drinking and cooking. Small quantities of potable water are bought in 5 gallon plastic containers from Bartica. Each camp disposes of waste in pits at the camps. These pits are occasionally set alight to burn garbage in the pits and to eliminate vermin and vectors.

Food for the operations is sourced from either Georgetown or Bartica. A few of the mining operations supplement their food by cultivating vegetables and fruits. The mining operations hunt very little since it would require travel of several miles. Some fishing is done in nearby creeks and mined out pits for Himara, pakoo and tilapia.

Equipment is moved to/from the mining operations by truck/pickup, many of which traverse the area on a daily basis. The individuals working on the operations get around the area primarily by foot, however, the more affluent miners have access to 4-wheel drive pickups and All-Terrain Vehicles.

Social entertainment for miners on these operations is centered at 14 Mile Landing. Miners frequent 14 Mile Landing in the evenings and weekends and make use of the services offered.

All camps are equipped with radio sets for communication and/or satellite phones. The area is patrolled twice weekly by police from Bartica and the camps maintain good relations with each other to provide an added sense of security which is essential for survival in these areas. The frequency of police patrols of the area is too sparse to provide an overall sense of security for the area.

All camps reportedly take precautions against all types of diseases with special emphasis on the control of malaria. Extreme cases of infected persons are referred to the Bartica Hospital except for Pereira Mining which is closer to the Issano medical post.

8.8.5 14 Miles Landing

14 Miles Landing serves as a way station to and from operations in the area. The area consists of a series of shops catering to the need of both commuters and residents of mining camps within its proximity. The shops extend over approximately 400 m of roadway passing through the area. The shops vary in size, service offered and staff complement. The area is relatively quiet during the days but transforms into a hive of activity at night providing entertainment for miners.

The Guyana Geology and Mines Commission conducted a survey of the 14 Mile Landing area in 2012 and developed an inventory of shop owners and residential properties within 14 Mile Issano. The entire list of these individuals, recorded by the GGMC, to be present at 14 Mile Landing, in 2012, is as follows:

1. Vickram Singh
2. Simon Ferrel
3. Alberta Edwards
4. Lenny Wilson
5. Raymond Barker
6. Troy Smartt
7. Michelle Wishart
8. Ann Fraser
9. Darol London
10. Shaksla Glsynn
11. Royer Yuen
12. Troy Noble
13. Donna Wilson
14. Monique Ben
15. Morris Sheperd
16. Troy Richards
17. Orin Whitehead
18. F. Razack

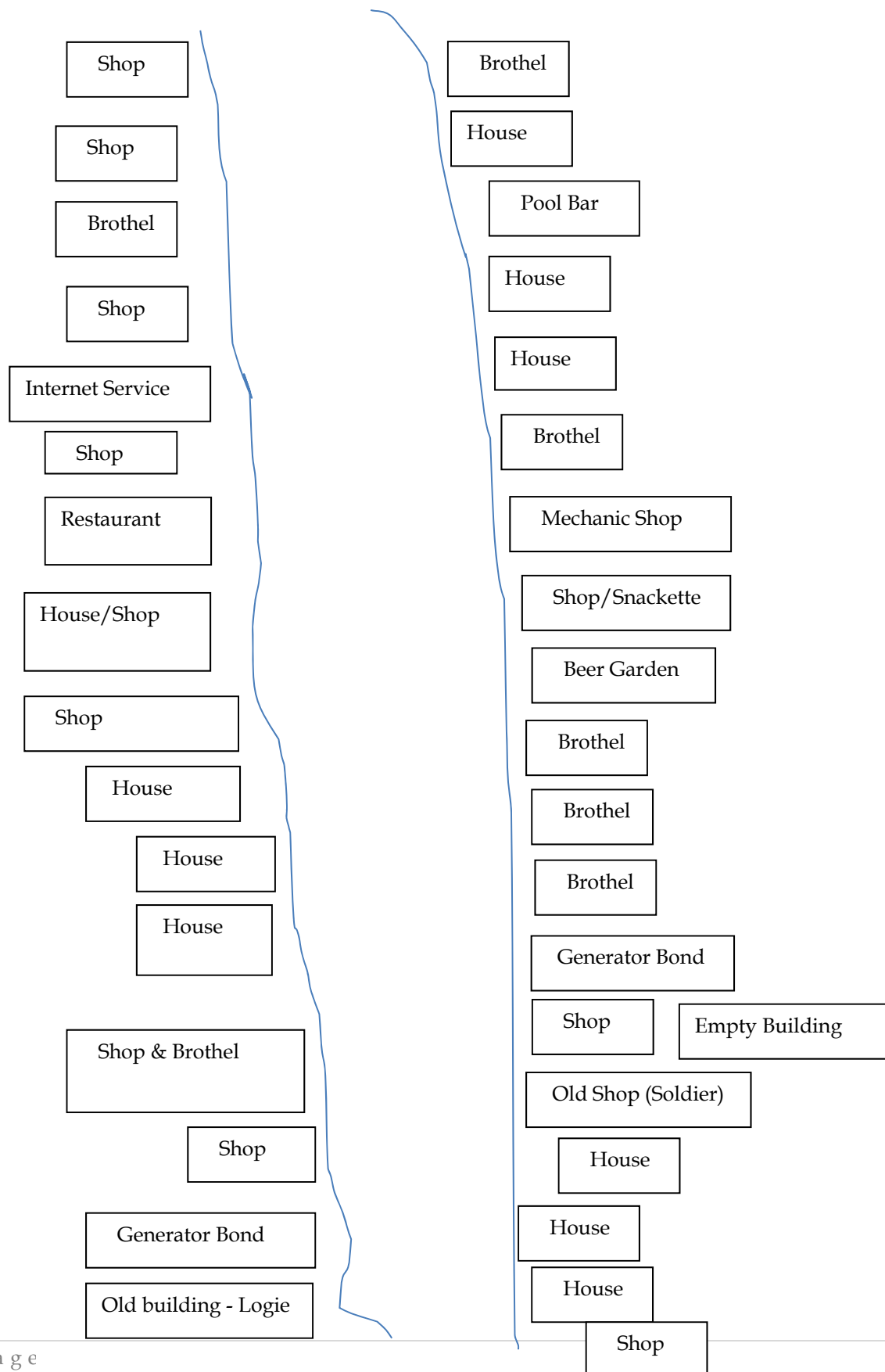
Informal discussions with the GGMC revealed that 14 Mile Landing is not recognized and does not factor into GGMC plans for the development of the area. GGMC has however recognized that there are individuals and businesses in the area and are in the process of formulating a plan to respond to the presence of these individuals.

This baseline survey identified 42 buildings at 14 Mile Landing. Seventeen of the 42 buildings recorded during the baseline surveys are shops. These shops provide a variety of services and the staff complement in each shop is indicative of the level of service offered. Facilities and services available include pool halls and Beer Gardens, brothels (Kaimus), communication (internet) services, grocery/supply shops and gold purchasing. A schematic of the layout of the structures is depicted on Figure 51.

Buildings at 14 Miles Landing are constructed primarily of timber sourced from the surrounding forest and are covered with zinc roof. There is a creek two miles from the 14 mile landing that is the main water source for those residing on the landing. Since the area is remote from any surface water facility, the availability of potable and sanitary water is highly dependent on the rainfall in the area. Rainwater is collected and stored in polyethylene tanks and steel drums. Several shops in the area sell water in the dry season.

Sanitary facilities consist of pit latrines. Garbage and waste is disposed either by burial or by burning in pits. Several shops own electrical generators which provide power for refrigeration and other needs. Fuel is imported from Bartica or Georgetown. Communication facilities in the area include two internet cafes both of which provide internet calling services. Several persons also operate short wave radios and offer services which patch these radios through to telephone services.

Figure 51 - Schematic Layout of Structures at 14 Miles Landing



8.8.5.1 Economic Activities

At night, 14 Mile Landing becomes a community of primarily male transient/artisanal miners. The population at night is approximately 75% male and 25% female, while the population during the day is 25% male and 75% female. Very little farming occurs in the community with a few individuals cultivating cash crops and rearing livestock for personal use. The majority of people in the community purchase goods and supplies at expensive rates since the goods and supplies are brought in from Georgetown.

There are seventeen operational businesses in 14 Mile Landing, two of which offer internet call services, six wholesale and retail food and drinks stores and nine shops offering entertainment in the form of alcoholic drinks and service workers.

The women at 14 Miles Landing are mostly service workers, some women however, are assisting in selling and operating shops with their partners. Petty trade also exists among the residents of the community. Service workers operate in small buildings referred to as Kaimus, which are owned by several shop owners in the area. In addition, one business offers rooms for rent to travelers passing through the area or visiting for entertainment.

Approximately six vehicles pass through 14 mile landing each day. These vehicles are mostly cargo trucks but also serve as passenger trucks going to the Karouni area and to points further west and north.

8.8.5.2 Social and Environmental Concerns

Many of those working and residing at 14 Miles Landing believe that large scale operators will force persons out of business and destroy their livelihoods. Further they strongly believe that removal of small miners from the area will lead to increases in violent crimes. Many also believe and are saddened by the belief that small scale miners (pork knockers) who have worked the area all their lives may have to move to new lands since they have no legal rights to the area.

There is a request for the government to deal fairly with the community at 14 Miles Landing by regularizing the area, and by allocating workable mining blocks to members of the community.

9.0 KEY POTENTIAL PHYSICAL ENVIRONMENTAL IMPACTS AND RISKS

The key potential physical environmental impacts and risks related to the Project are detailed in this section. Potential impacts and risks for the mine site and access road are detailed for the construction, operation, and closure phases of the Project.

The primary intent of this assessment is to identify the potential impacts and risks that will require protective management and mitigation actions during each project phase. The protective measures and mitigations actions are expanded in the Environmental Management Plan. This assessment considers “impacts” as consequences likely to occur during normal operations. “Risks” are considered to be unlikely adverse consequences resulting from system failure or accidents.

It is important to emphasize the physical context of the Project Area of Direct Influence prior to the identification of impacts. The environment in the area of the Pharsalus Gold Mine Project has been the location of historical mineral exploration and mining activities which has impacted the area as evidenced by the information presented in the baseline section of this document. Some of the mining operations have been in the form of small scale mining which has impacted the physical environment of the area. The project now proposed may result in additional environmental impacts.

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 tailings management with there being potential risks related to spills and failure of the tailings containment area. The potential impacts and risks are segregated by project component and phase in the section which follows. The potential impacts are rated in accordance with the rating criteria as presented in Tables 1 Thru 4, Section 2.

9.1 Construction Impacts

9.1.1 Noise and Odors

Construction activities will produce noise levels above the WHO industrial/commercial noise level guideline value of 70 decibels (dBA) from heavy earthmoving machinery operation. Maintenance operations in workshops will generate noise levels in the vicinity of 72-110 dBA. Noise levels from the power generation plant will range from 90-105 dBA. Exposure to noise levels above 90 dBA can cause noise-induced hearing loss. Noise levels above the tolerable threshold of 72 decibels may result in fatigue, tiredness, low morale and decreased production levels. Tired workers are prone to accidents which may contribute to an increase in work-related accidents. These are major impacts (high likelihood, high severity).

Primary noise receptors in the area will be individuals involved in construction activities at the site. 14 Mile Issano is within close proximity of the project boundaries. The community may experience elevated noise levels associated with construction activities. It should however be noted that the highest ambient noise level of 77 dB was recorded for 14 Mile Issano during the baseline survey. Construction noise levels are consequently not expected to exceed noise levels typical for 14 Mile Issano.

Construction phase noise will 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. The more sensitive fauna have likely long abandoned the project area where there is frequent disturbance from noise associated with artisanal mining and exploration.

These impacts will be mitigated by implementation of the following:

-
- Installation of soil berms as noise barriers to mitigate noise impacts on 14 Mile Issano Community;
 - 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).

Construction activities would be localized to the project area and are unlikely to generate any significant odours. The short construction duration coupled with the absence of odour generating activities will require no mitigation measures.

9.1.2 Air Quality

Construction activities will result in an increase in dust generation from the movement of vehicles and machinery, and the generation of atmospheric emissions from vehicles, machinery, and electrical generators. Fugitive dust emissions will result from land clearing, vehicle movements on earthen roads, excavation, grading and loading and unloading of soil, crushed rock, etc. Dust generation, transport and deposition 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, diesel and/or gasoline-fired heavy duty equipment usage and power generation from diesel generators. 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 elevated only in the vicinity of construction operations. Burning of waste would also generate emissions.

Uncontrolled fugitive dust and emissions to air from burning of waste may impact the residents of 14 Mile Issano since the community is located immediately beyond the boundaries of the concession.

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 i.e material likely to emit dust will be discharged from trucks, front end loaders, excavators etc. when the receptacle containing the material is very close to the ground ;
- Scheduling land clearing activities on less windy days as would be indicated by the weather forecast;
- 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, such as molasses provided its cost is less than that of water;
- Avoiding open burning of wastes at the construction site; and,
- Maintaining construction equipment according to manufacturer's specifications.
- Maintaining a vegetated buffer zone on the boundary of the concession immediately bordering 14 Mile Issano.

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

9.1.3 Impacts on Soils

Construction of the mine site and the site roads could result in potential impacts to soil. Potential impacts could result from vegetation clearance, landscape grading, and re-contouring to ensure proper drainage, and other construction activities. Soil erosion and sedimentation impacts may result from vegetation clearance and other construction activities. Significant impacts to soils are expected to occur in steeply sloping areas and where the soils erosion potential is severe or very severe. Short-term impacts are expected to occur in areas where the soils have a severe or very severe erosion potential and where slopes are steep. These are 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.

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.

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;
- Establish 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).

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 bermed impermeable enclosures designed to hold 110 percent of the contents of the tank and channeling of stormwater 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.

9.1.4 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 stormwater 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 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. 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 a bermed impermeable enclosure designed to hold 110 percent of the contents of the tank and channeling stormwater 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 mine 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).

9.1.5 Groundwater Quality

Impermeable liners may be placed over the base of the tailings 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).

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. This coupled with the increased infiltration potential as a result of increased area of exposed ground cover to rainfall will facilitate ground water recharge and minimize potential impacts on groundwater quantity. This would therefore result in minor impacts (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 110 percent of the tank contents. Implementation of these mitigation measures will result in minor residual impacts (low likelihood, low severity) to groundwater quality.

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. 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.

9.1.6 Traffic

Traffic flow within the mine site area will increase during construction activities. Increased traffic will increase the risk of vehicular accidents. This will result in moderate impacts (low likelihood, medium severity). Speed limits will be imposed for vehicles during construction activities and in the mine production phase. Construction equipment will be equipped with manufacturer specified equipment to minimize the likelihood of accidents on site roads. Traffic impacts during construction will therefore be minor (low likelihood, low severity).

9.1.7 Generation of Solid Wastes

Construction of the mine site and its ancillary facilities will generate solid wastes, including soil, paper, metal, 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 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).

9.2 Operation Impacts

9.2.1 Soils

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;
- Respreading, decompaction, 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).

9.2.2 Noise

During the mining and mineral processing operations, noise levels above the WHO industrial/commercial noise level guideline value of 70 dBA will be emitted from heavy equipment and earthmoving machines operation and from process equipment such as crushers and grinders. 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. Exposure to noise levels above 90 dBA can cause noise induced hearing loss. Noise levels above the tolerable threshold of 72 dBA may result in fatigue, tiredness, low morale and decreased production levels. Tired workers are prone to accidents which may contribute to an increase in work-related accidents. These are major impacts (high likelihood, medium severity).

Primary noise receptors in the area will be individuals involved in operation activities. The 14 Mile Issano community may also experience elevated noise levels associated with site operations. This may result in the development of tension between PGI and the residents of 14 Mile Issano. Ambient noise levels above 75dB were recorded for 14 Mile Issano during the baseline survey. Elevated noise levels at 14 Mile Issano will be specifically responded to by creation of a earthen berm, on the boundaries of the concession immediately adjacent to 14 Mile Issano, using soil excavated from the mine pit to mitigate noise impacts on the 14Mile Issano community. In addition to the earthen noise barriers created to minimize impacts on the community, additional mitigation measures, to mitigate noise impacts to both the community and the mine site employees, 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 and dining 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.
 - Developing a program to liaise with the 14 Mile Issano community to respond to issues related to elevated noise levels related to PGI operations.

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.

9.2.3 Air Quality

The operation phase of the project will see the generation of dust and combustion emissions from:

- Stripping topsoil and overburden
- Drilling and Explosive Blasting
- Loading and unloading of haul trucks
- Transport/hauling 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 spoil piles
- Operation of heavy duty equipment

Stripping topsoil and overburden will generate dust when undertaken in the dry season. Dust emissions from blasting, loading and unloading of haul trucks, haul roads, milling equipment, material stock piles and other fugitive dust generating operations would occur over the duration of the operation. 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

The impacts of generation of dust and combustion emissions on 14 Mile Issano will be mitigated by maintaining a vegetated buffer zone on the concession boundaries immediately adjacent to the community.

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

9.2.4 Power Generation Facility

Electrical energy will be required for implementation of the project. A power plant will be installed onsite and will generate peak power of approximately 8.0 MW using generators. The generators will be fueled by diesel and/or heavy fuel oil, and the heat from the exhaust of the generators will be used to preheat the fuel oil to increase combustion efficiencies. An air quality screening model, Screening Air Dispersion Model, Screen 3, was used to estimate emission associated with operation of these generators. Physical stack dimensions and exhaust characteristics were estimated based on utilization of eight 1.0 MW diesel generators. It was also assumed that the exhaust would be combined into a single, 30-meter stack and that the effect of pre-heating the fuel would reduce the exhaust temperature from 717 Kelvin (K) to 321 K. Stack characteristics for the single stack, for the eight units required for a peak generation of 8.0 MW are shown in Table 65.

Table 65: Estimated Stack Parameters for Generators

Description	Height (m)	Inner Diameter (m)	Exhaust Velocity (m/s)	Exhaust Flow (m³/s)	Exhaust Flow (acfm)	Exhaust Temperature (K)	Heat Input (MMBTU/hr)
8 Units	30.00	1.0	9.26	7.273	15394	321.0	27.96

This assessment was conducted assuming that the power generation units would comply with the air quality sections of the IFC Environmental, Health, and Safety General Guidelines (dated 30 April 2007). In accordance with the general guidelines, it was assumed that the stack would be constructed in accordance with Good International Industry Practice (GIIP) guidelines and would therefore not be subject to aerodynamic downwash from nearby buildings and structures. Emission rates were calculated based on the general guideline recommendations (as specified in Table 1.1.2 of the IFC Environmental, Health, and Safety General Guidelines, dated 30 April 2007). This table contains a range of emissions limits and modeling was conducted for both ends of the ranges. Emissions calculated for SO₂, NO_x, and PM, for the low and high range of the IFC guidelines, are shown in Table 66.

Table 66: Modeled Emission Rates for Generators

Description	Exhaust Flow (m³/s)	Units	PM Low	PM High	NO _x Low	NO _x High	SO ₂ Low	SO ₂ High
8 Units	7.273	ugm³/s	0.18	0.43	8.6	9.3	11.3	25.12

The modeling was conducted using the U.S. EPA screening model SCREEN3, which has been used widely in the U.S. as a conservative estimate of the maximum impacts of air pollution sources. Receptors were placed out to 50 km from the mine site, and maximum concentrations were identified for comparison to IFC standards. The IFC general guidelines defer to "...national legislated standards, or in their absence, the current WHO Air Quality Guidelines or other internationally recognized sources". For the purpose of this assessment, modeled impacts were compared to the WHO Air Quality Guidelines; additionally, all PM emissions were assumed to be PM_{2.5}. Due to the remote nature of this facility, no background concentrations were added to the modeled impacts. Additional emissions will come from non-stationary sources such as vehicles, machinery, and portable pumps and generators.

Table 67 presents the results of the modeling and demonstrates that the maximum impacts of the power generating units meet all of the WHO guideline values except for SO₂, 24-hour averages. However, modeled impacts do comply with the SO₂ 24-hour average interim guideline. Compliance with the interim guideline is generally considered acceptable. It should be noted that equipment specifications and emission rates will need to match the specifications used in the modeling in order to support these conclusions.

Table 67: Model Results-- Emission Rates for Generators

SO₂

Avg. Period (8 Units)	Description	Model Prediction (ug/m ³)	WHO Guidelines (mg/m ³)	WHO Interim Target
1-hr	Low	132.2	350	-
	High	318.0		
24-hr	Low	10.58	20	125
	High	25.44		

NO₂

Avg. Period (8 Units)	Description	Model Prediction (ug/m ³)	WHO Guidelines (mg/m ³)
1-hr	Low	111.35	200
	High	149.42	
Annual	Low	8.908	40
	High	11.94	

PM

Avg. Period (8 Units)	Description	Model Prediction (ug/m ³)	WHO Guidelines (mg/m ³)	WHO Interim Target (mg/m ³)
24-hr	Low	2.11	50	25
	High	5.29		
Annual	Low	0.18	20	10
	High	0.42		

9.2.5 Geology

During mining, soil and rock 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 (granite, schist, dolerite, granodiorite, and phyllite) underlain by metamorphic and intrusive rocks. Mining will not segregate soils based on the depths at which these soils are encountered when the overburden material is disposed in the spoil piles. Mining 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 mine site and will not be mitigated.

9.2.6 Generation of Solid Wastes

The operation of the mine 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 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).

9.2.7 Water Resources

9.2.7.1 Impacts to Surface Water

Several types of potential surface water impacts are attributed to gold mining activities, including sediment loading and low pH due to acid mine drainage (AMD). Chemicals such as cyanide, chlorine and other caustic chemicals will be typically used during the mining operations and can impact surface water bodies via accidental spills, releases, or leachate associated with waste rock stockpiles from the gold processing operations.

Several chemicals including cyanide and lime will be used during mineral processing. Potential spills or discharges of cyanide and other chemicals used in the mineral processing operations may result in major impacts to surface water (high likelihood, medium severity). Best Management Practices (BMPs) during the transportation, handling, storage, use of and destruction/safe disposal of these chemicals would be implemented during mine operations to minimize these potential impacts. Implementation of these mitigation measures (i.e., BMPs) will result in minor impacts (low likelihood, low severity) to surface water.

Precipitation may induce leaching of chemicals from waste rock and saprolite stockpiles at the Project site. In the event of significant storm events, these stockpiles may become saturated, causing slope failures. Stormwater discharge from stockpiles containing water-soluble chemicals and/or heavy metals and sediment discharge to surface water from slope failures can potentially result in degradation of surface water quality. These are considered major impacts (high likelihood, medium severity). Perimeter drainage channels will be installed around waste stockpiles to collect stormwater runoff. Stormwater 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 waste rock and saprolite 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).

Several creeks are located in the vicinity of the proposed mine pit and tailings pond. Flow into creeks downstream of the mine pit and tailing ponds will be altered and/or reduced after these facilities become operational, resulting in reduced flows in the downstream section of these creeks. The modification of hydrologic flow patterns in creeks is considered a major impact (high likelihood, medium severity). Mitigation of this impact may be achieved by directing discharge from the tailings pond, assuming that they meet effluent discharge limits and water quality standards, to the section of the creeks downstream of the tailings pond. Mitigation measures will result in minor impacts (low likelihood, low severity).

Breaches and overtopping of the tailings pond will result in major impacts (high likelihood, high severity) to surface water quality. These impacts will be mitigated by utilization of 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 stormwater runoff from developed areas (i.e., workshops, equipment storage and service areas, etc.). Discharge of wastewater from these areas to surface water may impair surface water quality by causing changes to physical, chemical and biological properties within the receiving waters. 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,
- Stormwater 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 stormwater 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 mine dewatering operations and slurry/tailings from the mineral processing 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.

Wastewater from the gold processing operations (i.e., slurry/tailings) will be transferred to the tailings pond. The tailings pond will be constructed with an impermeable liner system to minimize potential leakage to surface or groundwater. Potential release of tailings water is considered to be a minor impact (low likelihood, low severity).

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 refuelling operations as well as during all vehicle and mining equipment maintenance and repair; and,
- Channeling stormwater 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.

9.2.7.2 Fuel and Cyanide Spill Modeling

Two hypothetical accidental spills into the Blackwater Creek, the tributary of the Kaburi River were modeled to assess the potential impacts of utilizing and storing these materials at the mine site. The two

materials evaluated were fuel oil (diesel) and cyanide. Detailed data on surface flow parameters does not exist for the area. Surface water flows were measured during the field sampling exercise using a current meter. The flow velocities were combined with the cross-section of the both Blackwater Creek and the Kaburi River to determine mean flow conditions. The dispersion coefficients were obtained by comparison of flow velocity and river bottom slope to rivers for which these parameters have been measured and an analytical model was used to estimate the spread of the chemicals spilled into the river. The analytical model defines concentration, C, at time t, after the discharge by the following relationship:

$$\frac{M}{2\pi(2E_x t)^{1/2}(2E_y t)^{1/2}} \exp \left[-\frac{1}{2} \left\{ \frac{(x-u_x t)^2}{2E_x t} + \frac{(y-u_y t)^2}{2E_y t} \right\} \right]$$

Where

M= mass of contaminant

E_x and E_y = longitudinal & lateral dispersion coefficient respectively

u_x and u_y = mean stream velocity in x and y directions

x and y = distances in x and y direction from discharge

and t = time since discharge

9.2.7.2.1 Fuel Oil Spill

The model of the fuel oil assumed that the spill resulted from rupture and total loss of the contents of a 50,000 gallons diesel fuel tank stored immediately adjacent to Blackwater Creek. The accidental spill scenario assumed that the diesel fuel breached the containment facility and all 50,000 gallons spilled over the bank into the creek in one hour. The diesel was modeled as a both conservative substance (no decay or evaporation) and based on degradation due to evaporation and biological decay. A typical decay rate of 50%/day was used in the decay model.

The model examined the impact of the spill over time at points 250, 500 and 1000 m from the point the spill entered the creek. Figure 52 depicts diesel concentrations (mg/m³), at distances of 250, 500 and 1000 m, from the location of the spill based on no decay or evaporation. The results of the modeling indicate the occurrence of diesel at below trace concentrations at distances ranging from 250 to 1000 m from the spill, 1 hour after the spill. The rapid decrease in fuel oil concentration is due primarily to the high velocity and steepness of the river in the vicinity of the mine site. The high velocity and elevated slopes accelerates the movement of the plume downriver.

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, Blackwater Creek would experience concentrations as high as 993 mg/l at the initial spill location and 1.7 g/l at a location 1.2 km downstream. 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 fail safe 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).

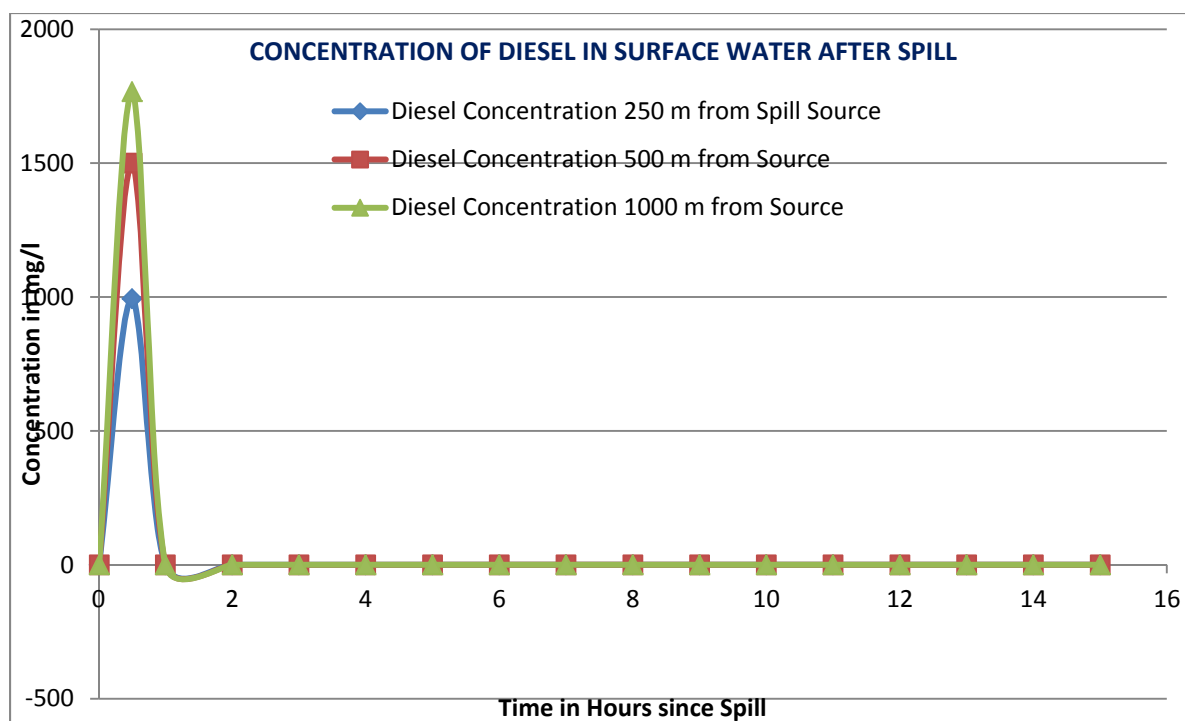


Figure 52 - Variation of Diesel Concentration over Time at Points in Blackwater Creek (Conservative Solute)

9.2.7.2.2 Cyanide Spill

Cyanide has the potential to be present on the mine site at several locations such as in the process tanks, storage tanks and mine tailings pond. The worst-case cyanide spill source was postulated as deriving from two 500 m³ vat tanks. Cyanide in the tanks is assumed to have a concentration of 1.0 g/l (1000,000 ug/l). The accidental spill assumed that the cyanide breached the containment facility and that 1000 m³ of solution spilled into Blackwater Creek in 3 hours. The model of the cyanide spill incorporated a rapid decay rate reflective of cyanide degradation in tropical environments. The analytical model indicated that a cyanide spill of 1000 m³ over 3 hours produced a maximum concentration of 2.14 g/l at a location 10 m downstream from the spill site. The analytical model results of peak concentrations of free cyanide for the hypothetical spill with distance downstream of the spill is shown in Figure 53.

Cyanide is acutely toxic to humans. Liquid and gaseous cyanide can enter the body via inhalation, ingestion, or absorption through the skin, especially cut, abraded, or moist skin. Lethal dose standards (50% lethality) provided by the International Cyanide Management Institute are shown in Table 68. Contact with free cyanide at a concentration of 1 mg/l (or 1 part per million or 1000 ug/l) would be lethal to a 100 kg man. Cyanide has low persistence in the environment and does not accumulate or biomagnify, so chronic exposure to sub-lethal concentrations does not result in acute toxicity. Chronic cyanide poisoning has been observed and is a potential risk to those with continuous exposure, but this analysis is based on a single, acute, accidental cyanide spill event.

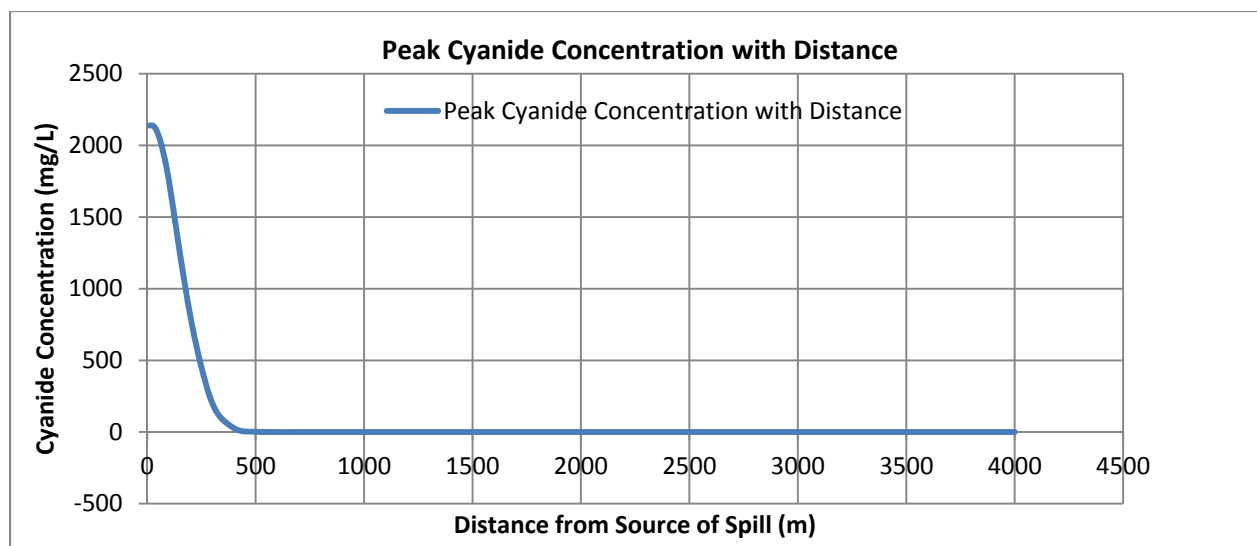


Figure 53 - Maximum Cyanide Concentration in Barama River downstream of mine site after hypothetical spill of 1000m³ of 800 mg/l cyanide

Fish and aquatic invertebrates are also very sensitive to cyanide exposure. Adverse effects are observed at concentrations of 5 ug/l, with death of many species at 20 to 76 ug/l of free cyanide. At levels exceeding 200 ug/l, free cyanide is rapidly toxic to most species of fish. Birds and mammals are also susceptible to cyanide toxicity at concentrations from 0.8 to 11.1 mg /kg of body weight. These values, shown in Table 68, are provided by the International Cyanide Management Institute (www.cyanidecode.org).

If the assumed cyanide spill occurred, Blackwater Creek would experience free cyanide concentrations as high as 2.14 g/l at the initial spill location and 89µg/l at a location 800 m downstream. At these concentration levels, humans, fish, invertebrates, mammals, and birds in the river would be in danger for at least one kilometer downstream of the mine site. These impacts merit the rating of major (medium likelihood, high severity). These impacts will be mitigated by strict adherence to the Environmental Monitoring Plan, specifically to include frequent monitoring of cyanide in the tailings and water management ponds, cyanide storage tank integrity, and containment of cyanide in ore processing and mining operations. The Spill Prevention and Cleanup Control and Emergency Response Plans would include aggressive alerts, education, and cleanup activities. The application of the proposed mitigation measures will contain and localize potential impacts, and result in a minor impact rating (low likelihood, low severity).

Table 68: Surface Water Cyanide Standards – International Cyanide Management Institute

Parameter	Value
LD50 for human ingestion	50 – 200 mg or 1 – 3 mg / kg of body weight
LD50 for human contact	100 mg / kg of body weight
LD50 for fish	200 ug/l
LD50 for invertebrates	20 to 76 ug/l
LD50 for birds via ingestion	0.8 to 11.1 mg / kg of body weight
LD50 for mammals via ingestion	2 to 10 mg / kg of body weight

9.2.8 Groundwater Contamination

Precipitation may induce leaching of chemicals from waste rock and saprolite stockpiles at the project site. Leaching of the waste rock and saprolite stockpiles can potentially result in degradation of groundwater quality if no impermeable liner is installed below these facilities. The presence of

groundwater at shallow depths, potential leaching of contaminants into groundwater is considered a major impact (high likelihood, high severity). This potential impact will be mitigated by installation of an impermeable barrier under the waste rock and saprolite stockpiles. These mitigation measures will result in minor impacts (low likelihood, low severity).

Infiltration of wastewater from the tailings and waste management areas along with leaching of minerals into solution in the mine can have potential negative impacts on groundwater quality. These are considered to be major impacts (high likelihood, high severity). Mitigation of these potential impacts will be achieved by installing impervious liners below the tailings pond and waste management areas and by directing water from the mine to a water management pond. Implementation of these mitigation measures will result in minor impacts (low likelihood, low severity).

Extensive groundwater dewatering will be required to facilitate mine pit operations. This will disrupt the existing groundwater flow regime and result in groundwater flow into the mine from areas surrounding the mine footprint. This may also include surface water from the Blackwater Creek and creeks in the areas because these may be hydraulically connected to shallow groundwater in the vicinity of the open pit mine. Based on the remote location of the project site and lack of any known water supply wells, the groundwater dewatering is considered to be a moderate impact (high likelihood, low severity). No mitigation measures are proposed.

Several chemicals including cyanide and lime will be used during mineral processing. Potential spills or discharges of cyanide and other chemicals used in the mineral processing operations may result in major impacts to groundwater (high likelihood, high severity). Best Management Practices (BMPs) during the transportation, handling, storage, and use of these chemicals will be implemented during mine operations to minimize these potential impacts. Implementation of these mitigation measures (i.e., BMPs) will result in minor impacts (low likelihood, low severity) to groundwater.

9.2.9 Explosive Detonation

The operational phase of the project will mandate blasting of rock. Rock blasting operations while unlikely to produce damaging vibrations may produce other effects that are disconcerting and alarming to persons who feel vibration and hear the blast. Additional effects of explosive detonation on 14 Mile Issano are likely to include:

- Vibration of walls and floors and generation of noise therefrom
- Rattling of pipes and duct work
- Rattling of loose objects, plates, etc
- Sliding of objects over tables or shelves
- Falling of objects from tables and shelves
- Swaying of hanging objects
- Rippling and oscillation of open water bodies
- Amplification of noise levels inside a structure above outside noise levels
- Disturbing vibration to occupants of buildings within proximity of the blast

If vibrations are felt by the residents of 14 Mile Issano, they may react with curiosity, concern, and even fear. Since human response is a highly subjective phenomenon the response will vary among individuals. Vibration, however, is a fact of daily life which one regularly experiences but is seldom aware of. This type of vibration has been designated cultural vibration. Generally, it elicits no reaction from the person affected. Other vibration that contrasts sharply, because it is not part of the daily experience but is unusual, has been designated as acultural. It surprises a person, is disturbing, and causes an acute

awareness. Blasting is definitely acultural for the average person. The annoyance and fear associated with it begin at levels much lower than the damage level for structures.

Explosive detonation will also generate air blasts. Air blast is an atmospheric pressure wave transmitted from the blast outward into the surrounding area. Air blast is produced by the combination of an atmospheric temperature inversion and wind. Air blast is generated by the explosive gases being vented to the atmosphere as the rock ruptures, by stemming blow out, by displacement of the rock face, by displacement around the borehole and by ground vibration. Various combinations of these may exist for any given blast. This pressure wave consists of audible sound that can be heard, and concussion or subaudible sound which cannot be heard. If the pressure of this wave, termed overpressure, is sufficient it can cause damage. Air blast can create an annoyance problem but does not cause damage. Air blast effects coupled to vibration if felt by the residents of 14 Mile Issano, it may result in the development of an adversarial position between the residents of that community and the PGI. These are major impacts (high likelihood, high severity).

The effects of airblast will be mitigated by ensuring there is no explosive detonation place if there is an atmospheric inversion. Since radiation inversions commonly exist in the mornings, but normally disappear by noon, rock blasting will occur after noon when the inversion has dissipated. The wind information from the onsite weather station will also be consulted and explosive detonation will be conducted when the wind flow is away from 14 Mile Issano. The vibration generated by explosive detonation will be attenuated by designing all blast to ensure the peak particle velocity established by the US Office of Surface Mining detailed in Table 69 are not exceeded.

Table 69: Office Of Surface Mining, Required Ground Vibration Limits

DISTANCE FROM THE BLASTING SITE (ft)	MAXIMUM ALLOWABLE PEAK PARTICLE VELOCITY (in/s)
0 to 300	1.25
301 to 5000	1.00
5001 and beyond	0.75

Table 69 combines the effects of distance and frequency. At short distances, high frequency vibration predominates. At larger distances, the high frequency vibration has attenuated or died out and low frequency vibration predominates. Therefore, at large distances a lower peak particle velocity, 0.75 in/s, are mandated. At the shorter distances, a higher peak particle velocity, 1.25 in/s, is permitted. If vibration levels remain too high and it becomes desirable and even necessary to reduce them, the following options will be exercised:

- The maximum charge per delay will be reduced by decreasing the number of holes per delay. If the number of holes per delay cannot be reduced then each hole will be deck loaded and fired with two or more delays.
- The vibration level will be reduced by redesigning the blast so that less energy per hole is necessary to fragment the rock. This will be achieved by changing the hole spacing, the burden, even the hole size and/or the explosive may be helpful also.

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

9.3 Mine Closure

9.3.1 Surface Water/Groundwater/Soil

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

- Post-closure monitoring of the stability of the tailings 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.

Table 70: Summary of Physical Environmental Impacts

Source of Impact and Existing Vulnerability	Impact Rating Prior to Mitigation or Prior Implementation of EMP	Recommended Mitigation Measures -Proposed Environmental Management Plan	Impact Rating After Mitigation or After Implementation of EMP
Source Construction of roads Vegetation clearance Vulnerability Steep areas High erosion potential soils Potential surface water contamination by introduction of sediments	Moderate (Severity - Low; Likelihood - Medium)	1. Best management practices for Storm Water Management; 2. Channel control structures; 3. Interim Reclamation Plan following clearance activities; 4. Long-term Reclamation Plan	Minor (Severity - medium; Likelihood - low)
Source Operation of construction equipment Vulnerability Highly compressibility soils Wet and poorly drained soils	Minor (Severity - Low; Likelihood - medium)	1. Scheduling Construction activities in dry season 2. Limiting off-road access 3. Implementation of awareness education and training program	Insignificant (Severity - low; Likelihood -Low)
Source During the construction of roads, access ways, and mine preparation During landscape grading and re-contouring for proper drainage During vegetation clearance and landscape grading. Vulnerability loss of soil fertility loss of viable seeds present (topsoil seedbank) in the topsoil.	Moderate Severity - medium; Likelihood - medium)	1. Segregate topsoil from subsurface layers during construction activities 2. Replace topsoil following construction, as applicable; 3. Create topsoil storage areas; 4. Identify, maintain or salvage topsoil pockets 5. Replace segregated topsoil as in the Reclamation Plan	Minor (Severity- low; likelihood - medium).
Source Clearing of areas within mine footprint Extension of roads to access mine, tailings and water management ponds and stockpiles Vulnerability High erosion potential soils Potential surface water contamination by introduction of sediments	Moderate (Severity - medium; Likelihood - medium).	1. Implementation of best management practices for soil erosion and storm water runoff 2. sedimentation control (e.g., silt fences, re-vegetation	Insignificant (Severity - low; Likelihood - low).

Construction	Increased emissions of fugitive dust and products of combustion	<i>Source</i> - Land clearing - loading and unloading of trucks - excavation and grading - Construction of roads, tailings and water management ponds and stockpiles - Emissions from chainsaws - Use of diesel and/or gasoline fired heavy duty equipment <i>Vulnerability</i> - Vegetation in proximity to work - Workmen at the site	moderate (Severity - low; Likelihood - high)	- Cover trucks to minimize particulate emission - Minimize drop heights from vehicles - Scheduling land clearing activities to less windy days - Limiting vehicle speed to a maximum 30 km/hr - Employing dust suppression technique - Avoiding open burning of wastes - Maintaining construction equipment according to manufacturer's specifications.	Minor (Severity - low; likelihood - low)
Operation	Increases in dust and combustion emissions	<i>Source</i> - Vehicles traversing site roads - Wind erosion of stockpiles and spoil piles - The operation of heavy duty equipment <i>Vulnerability</i> - Vegetation in proximity to work - Workmen at the site	Minor (Severity - low, likelihood - medium)	Cover trucks to minimize particulate emission Minimize drop heights from vehicles Limiting vehicle speed to a maximum 30 km/hr Employing dust suppression technique Maintaining construction equipment according to manufacturer's specifications Providing facemasks with dust removal filters Conducting periodic medical checks of employees Providing goggles and eye wash lotion	Minor (Severity - low Likelihood - low).
Geology					
Construction	Removal and alteration of surficial soils	<i>Source</i> - Construction of camp, fuel and lubricant containment and storage areas, installation of sewer, water and power services, construction of site accommodation etc, <i>Vulnerability</i> - Soil at depths of less than 2 m at site	Insignificant (Severity - low; Likelihood - high)	None Required	Insignificant (Severity - low; Likelihood - high)
Operation	Alteration in stratigraphic profile	<i>Source</i> - Excavation and removal of overburden and ore to 100+ m <i>Vulnerability</i> - Mine footprint	Major (Severity - low; Likelihood - high)	None provided	Major (Severity - low; Likelihood - high)
Water Resources - Surface Water					
Construction	Reduced water quality	<i>Source</i> - Sediment discharge from cleared areas <i>Vulnerability</i> - Streams and creeks adjacent to cleared areas - Kaburi River - Aquatic life	Moderate (Severity - medium; Likelihood - medium)	Implementation of erosion and sediment control plan	Minor (Severity - low; Likelihood - low)

Construction	Increased runoff to streams/ creeks - higher surface water levels	<i>Source</i> - Clearing of vegetation and reduced interception <i>Vulnerability</i> - Creeks and streams in area - Kaburi River - Aquatic Life	Moderate (Severity - low; Likelihood - High)	1. Schedule major clearing operation for dry periods	minor impacts (low severity, low likelihood)
Construction	Potential Contamination	<i>Source</i> - accidental discharges of fuels, oils and grease from equipment <i>Vulnerability</i> - Creeks and streams in area - Kaburi and Hit and Miss Rivers - Aquatic Life	Moderate (Severity - medium; Likelihood - medium)	1. Implementation of a Spill Prevention and Contingency Plan.	Insignificant (Severity - low; Likelihood - low)
Operation	Potential Contamination	<i>Source</i> - discharges from sewerage system - domestic wastewater discharge - stormwater run-off from developed areas <i>Vulnerability</i> - Creeks and streams in area - Kaburi and Hit and Miss Rivers - Aquatic Life	Moderate (Severity - Medium; Likelihood - medium)	1. Utilization of septic tanks and granular filter beds 2. Monitoring the "end-of-pipe" water quality 3. Use of oil-water separators	Insignificant Severity - low Likelihood - Low)
Operation	Potential Contamination	<i>Source</i> - accidental discharges of fuels, oils and grease from equipment - spills of cyanide and other process chemicals - failure of fuel containment facilities - discharge of process wastewater <i>Vulnerability</i> - Creeks and streams in area - Kaburi and Hit and Miss Rivers - Aquatic Life	Major (Severity - high; Likelihood - medium)	1. Implementation of a Spill Prevention and Contingency Plan. 2. Founding fuel tanks on impervious bases and within bermed enclosures 3. Use of oil-water separator prior to discharge 4. Implementation of Best Management Practices (BMP) during transportation, handling and storage and use of these chemicals	Insignificant (Severity - low Likelihood - low)
Closure	Potential Contamination	<i>Source</i> - Acid Mine drainage <i>Vulnerability</i> - Creeks and streams in area - Kaburi and Hit and Miss Rivers - Aquatic Life - Soil containing heavy metals	Major (Severity - high; Likelihood - medium).	1. Assessment of the ARD/ML potential 2. Covering AMD areas with 60 cm impervious soils	Minor (Severity - low; Likelihood - low)

Water Resources – Groundwater					
Design	Groundwater Contamination	<i>Source:</i> - Fuels and oils from drill rigs. <i>Vulnerability:</i> - Potential groundwater quality degradation.	Moderate (Severity – Medium; Likelihood – Medium)	1. Equipping rigs with drip pans to catch spills of fuels and oils. 2. Casing boreholes to isolate the holes from surrounding geological formation.	Insignificant (Severity –Low; Likelihood – Low)
Construction	Reduced recharge	<i>Source</i> - Impermeable liners on base of tailings and water management ponds. <i>Vulnerability</i> - Reduced quantity of available groundwater	Insignificant (Severity – low; likelihood – low).	1. None provided	Insignificant (Severity – low; likelihood – low).
Construction	Contamination	<i>Source</i> - Fuel and oils spills and discharge <i>Vulnerability</i> - Underlying aquifer	Minor (severity – medium; Likelihood - low).	1. Installation of drip pans on all equipment 2. Program to checks for equipment leaks 3. Implementation of a Spill Prevention and Contingency Plan	Insignificant (Severity - low; likelihood - low)
Operation	Contamination	<i>Source</i> - Water soluble compounds in excavated materials - Infiltration from tailings and water management ponds <i>Vulnerability</i> - Groundwater quality in underlying aquifer	Moderate (Severity – high; Likelihood - low)	1. Compacting spoil pile base 2. Impervious liner for tailings and Water Management Ponds	Insignificant (Severity – low; Likelihood -low)
Operation	Contamination	<i>Source</i> - Fuel and oils spills from equipment - Spills from fuel storage and service areas <i>Vulnerability</i> - Groundwater quality in underlying aquifer	Minor (severity – medium; likelihood - low)	1. Installation of drip pans on equipment 2. program to checks for equipment leaks 3. Implementation of a Spill Prevention and Contingency Plan (SPCP)	Insignificant (Severity - low; Likelihood - low)
Noise					
Construction	Increased Noise Levels	<i>Source</i> - Heavy-duty and earthmoving machines operation. - Maintenance operations in workshops - Power generation plant <i>Vulnerability</i> - Wildlife receptors around area - Workers	Moderate (Severity – medium; Likelihood - medium).	1. Installation of sound suppression devices 2. Avoiding unnecessary idling of vehicles 3. Best Available Work Practices 4. Provide employees with noise reduction equipment	Minor (Severity - low; Likelihood – medium)

Operation	Increased Noise levels	<i>Source</i> - Heavy-duty and earthmoving equipment operation - Process equipment such as crushers and grinders - Maintenance operations in workshops and process plant - Fossil fuel plant <i>Vulnerability</i> - Wildlife receptors around area - Workers	Moderate (Severity - medium; Likelihood - medium).	- Installation of sound suppression devices - Best Available Work Practices to minimize noise levels - Isolation of noise sources from employees' living and dining area - Installation of acoustic insulating materials - Provide noise suppression equipment to employees - Periodically monitoring noise levels - Warning signs in areas of high noise levels - Periodic medical hearing checks of workers	Minor (Severity - low; Likelihood - medium)
Rock Blasting					
Operation	Airblast Flyrock and Vibrations	<i>Source</i> - Explosive detonation <i>Vulnerability</i> - Workers - Equipment - Wildlife	Major (Severity - high; Likelihood - medium)	- Correct design of blasting rounds, - Avoiding detonation of large unconfined charges - Consideration of atmospheric conditions - Establishment of danger zones around blast sites - Minimum stand-off distance during blasting - Appropriate delay intervals for charge ignition - Utilization of appropriate blast patterns - Confinement of the charge	Minor (Severity - low; Likelihood - medium)
Traffic					
Operation	Increase accidents in	<i>Source</i> - Access roads, vehicle and equipment use <i>Vulnerability</i> - Workers - Wildlife	Moderate (Severity - Medium; Likelihood - medium)	- Build haul roads to standard widths for mining operations - Post signs along roadways - Restrict speed to 50 km/hour on access roads	Minor (Severity - low; Likelihood - medium)
Closure	Habitat Degradation	<i>Source</i> - Encroachment by aggressive and unwanted plant species (pests) - Acid Mine Drainage <i>Vulnerability</i> - Native vegetation species and natural ecosystem - Historical fire regimes, - Soil nutrient regimes, - Increased soil erosion - Elimination/ alteration of natural vegetative strata.	Moderate (Severity - low, Likelihood - high)	- Implementation of weed management program - Determination of acid generating potential - Placing acid generating material above the water table to isolate the material from contact with water - Capping acid generating materials with clay or other materials to reduce permeability	Insignificant (Severity - low; likelihood - low).

10.0 KEY POTENTIAL ECOLOGICAL ENVIRONMENTAL IMPACTS AND RISKS

The key potential ecological impacts and risks related to the Project are detailed in this section. Potential impacts and risks for the mine site and access road are detailed for the construction, operation, and closure phases of the Project.

The primary intent of this assessment is to identify the potential impacts and risks that will require protective management and mitigation actions during each project phase. The protective measures and mitigations actions are expanded in the Environmental Management Plan. This assessment considers “impacts” as consequences likely to occur during normal operations. “Risks” are considered to be unlikely adverse consequences resulting from system failure or accidents. Given this consideration, loss of habitat resulting from clearing for construction is an impact, while a spill of fuel resulting from a tanker truck accident is a risk.

It is important to emphasize the biological context of the Project Area of Direct Influence prior to the identification of impacts. The environment in the area of the Pharsalus Gold Mine Project has been the location of historical mineral exploration and mining activities which has impacted the area as evidenced by the information presented in the baseline section of this document. Some of the mining operations have been in the form of small scale mining which has impacted the ecology of the area. The project now proposed may result in additional ecological impacts.

The majority of potential impacts on the biological environment will take place during the construction phase. The potential impacts and risks are segregated by project component and phase in the section which follows. The potential impacts are rated in accordance with the rating criteria as presented in Tables 1 Thru 4, Section 2.

10.1 Construction Impacts

10.1.1 Loss of Aquatic Habitats

The construction of the mine and associated infrastructure will result in the loss of various stream and swamp habitats within the concession area. Several of these habitats have already been affected by historical exploration and mining activities at the site as well as by ASM activities in the area. Surveys have not identified any of the aquatic habitats to be critical habitats based on the criteria of IFC PS6. Similar aquatic habitats are common in the region. Loss of aquatic habitats in the open pit area, tailings pond, and other areas where major conversion of the land surface is required will be unavoidable due to the nature of the activities.

Upstream and downstream segments of streams will be affected and flow may be curtailed in some segments due to development of the mine pit, tailings pond and other mine facilities. During construction, diversion channels will be provided for stormwater runoff. These channels will discharge to existing surface waters. The diversion channels will receive runoff from soil waste piles and will discharge to the tributaries of Blackwater Creek and Hit and Miss River, the largest surface flow conduits in the concession. Retention ponds and other detention storage/sedimentation facilities will be installed to ensure that stormwater discharges do not degrade the water quality and habitat structure of the receiving bodies. None of the aquatic fauna identified in the streams or creeks within the Area of Direct Influence is known to be threatened or restricted-range endemic.

The loss of aquatic habitat in the concession area is considered to be a potentially major impact (high likelihood, medium severity). These impacts will be mitigated by minimizing the extent of areas cleared for diversion channels and by the installation of bypass structures, where possible, to facilitate flow in the

downstream section of streams which have been diverted. Application of these mitigation measures will result in minor residual impacts (low likelihood, low severity) on aquatic habitats.

10.1.2 Loss of Terrestrial Habitat and Flora

It is estimated that approximately 400 ha of land will be cleared for the mine site and associated infrastructure. The loss of terrestrial habitats and flora is unavoidable within the project footprint area. Activities related to exploration and artisanal mining has resulted in large tracts of the project footprint area being secondary growth areas.

None of the terrestrial habitats in the Area of Direct Influence have been identified as critical habitat per the criteria of IFC PS6. None of the plant species known to be present in the Area of Direct Influence are known to be threatened locally or to be restricted-range endemic. The loss of terrestrial habitats in the Area of Direct Influence is considered to be a major impact (medium likelihood, high severity). With appropriate mitigations such as strict minimization of clearing and progressive restoration, the impact rating is considered to be minor (low likelihood, low severity).

10.1.3 Loss of Terrestrial Fauna

Some loss of small and/or slow-moving fauna will inevitably occur during land clearing and earthmoving activity. None of the invertebrate, amphibian, non-avian reptile or small mammal species determined to be present in the Area of Direct Influence is known to be threatened or endemic. More mobile fauna including large mammals and adult birds will very likely flee the area well in advance of any land clearing operations. The surrounding area is large enough to absorb fauna fleeing cleared areas. The loss of terrestrial fauna in the Area of Direct Influence is estimated to be a moderate impact (high likelihood, medium severity) since the area has been disturbed by prior mining and exploration activities. This impact will be mitigated by minimization of the areas cleared. The residual impact will consequently be minor (low likelihood, low severity).

10.1.4 Increased Human Population and Activity in the Area of Influence

The construction works will lead to increased human population and increased levels of general activity in the area. The increased human presence has the potential to lead to increased impacts on flora and fauna through harvesting, collecting, hunting, fishing, disturbance, and other activities by construction workers. This impact is considered major (high likelihood, high severity). The company will enforce a policy of no hunting and fishing by its employees and will also implement measures to ensure that no flora and/or fauna are harvested from the area or brought into the area. Implementation of these measures will result in minor residual impacts (low likelihood, low severity).

10.2 Operation Impacts

10.2.1 Loss of Aquatic Habitats

The operation of the mine and associated infrastructure will impact various stream and swamp habitats within the concession area. These habitats will have already been affected by construction phase activities, but the initiation of mining operations will bring additional impacts to these affected aquatic habitats.

Impacts to aquatic habitats associated with the operation of the open pit area, the tailings pond and other areas where major conversion of the land surface occurs will be unavoidable due to the nature of the activities. Upstream and downstream segments of streams will be affected. Water discharged from the

diversion channels surrounding the waste stockpile areas will affect downstream receiving bodies and their aquatic fauna.

The loss of aquatic habitats in the concession area is considered to be a major impact (high likelihood, high severity). With application of the mitigation measures, outlined in Chapter 9, for surface waters and groundwater, the residual impact rating will be minor (low likelihood, low severity).

10.2.2 Loss of Terrestrial Habitats and Flora

During operation, the additional loss of habitats and flora will not affect any threatened or restricted-range endemic species of flora and fauna. Much of the fauna will have likely already left the affected habitats due to disturbance during the construction phase. This impact is rated as moderate (medium likelihood, medium severity). These impacts will be minimized by implementation of the following:

- Minimization of the Project footprint; and,
- Initiating restoration as soon as practicable in temporary work areas.

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

10.2.3 Loss of Terrestrial Fauna

During the operation of the mine, most of the larger animals would have already abandoned the area during the construction phase. Only small fauna accustomed to disturbed environments are likely to remain in or enter mining areas and other work sites. It is likely that small numbers of small animals such as amphibians and snakes will experience mortality due to equipment and vehicle use.

The loss of terrestrial fauna during the mining operations phase is rated as moderate (high likelihood, low severity). These impacts will be mitigated by implementation of the following:

- Minimization of the Project footprint; and,
- Performance of preclearance surveys.

10.2.4 Introduction or Promotion of Alien Invasive Species

The movement of people, equipment, and materials to the mine has the potential to cause the introduction of alien invasive species of both plants and animals. The disturbance and clearing of natural habitats can also promote the growth or colonization of alien invasive species. This impact is rated as moderate (high likelihood, low severity). These impacts will be mitigated by implementation of the following mitigation measures:

- Monitoring of biodiversity; and,
- Control of invasive species.

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

10.2.5 Loss of Aquatic Habitats

The operation of the mine and associated infrastructure will impact various stream and swamp habitats within the concession area. These habitats will have already been affected by construction phase activities, but the initiation of mining operations will bring additional impacts to these affected aquatic habitats.

Impacts to aquatic habitats associated with the operation of the open pit area, the tailings pond and other areas where major conversion of the land surface occurs will be unavoidable due to the nature of the activities. Upstream and downstream segments of streams will be affected. Water discharged from the diversion channels surrounding the waste stockpile areas will affect downstream receiving bodies and their aquatic fauna.

The loss of aquatic habitats in the concession area is considered to be a major impact (high likelihood, high severity). With application of the mitigation measures, outlined in Chapter 9, for surface waters and groundwater, the residual impact rating will be minor (low likelihood, low severity).

10.2.6 Loss of Terrestrial Habitats and Flora

During operation, the additional loss of habitats and flora will not affect any threatened or restricted-range endemic species of flora and fauna. Much of the fauna will have likely already left the affected habitats due to disturbance during the construction phase. This impact is rated as moderate (medium likelihood, medium severity). These impacts will be minimized by implementation of the following:

- Minimization of the Project footprint; and,
- Initiating restoration as soon as practicable in temporary work areas.

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

10.2.7 Loss of Terrestrial Fauna

During the operation of the mine, most of the larger animals would have already abandoned the area during the construction phase. Only small fauna accustomed to disturbed environments are likely to remain in or enter mining areas and other work sites. It is likely that small numbers of small animals such as amphibians and snakes will experience mortality due to equipment and vehicle use.

The loss of terrestrial fauna during the mining operations phase is rated as moderate (high likelihood, low severity). These impacts will be mitigated by implementation of the following:

- Minimization of the Project footprint; and,
- Performance of preclearance surveys.

10.2.8 Introduction or Promotion of Alien Invasive Species

The movement of people, equipment, and materials to the mine has the potential to cause the introduction of alien invasive species of both plants and animals. The disturbance and clearing of natural habitats can also promote the growth or colonization of alien invasive species. This impact is rated as moderate (high likelihood, low severity). These impacts will be mitigated by implementation of the following mitigation measures:

- Monitoring of biodiversity; and,
- Control of invasive species.

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

Table 71: Summary of Ecological Impacts

<i>Source</i> Clearing for the open pit, tailings and water management ponds and other site facilities Clearing for access road Clearing for wharf <i>Vulnerability</i> Displacement of wildlife Nutrients in Biomass and Soil Mortality and injuries of wildlife due to interaction with vehicles Mortality and injuries of wildlife due to increased interaction with vehicles	Minor (Severity – low; Likelihood – medium)	1. None Provided. The surrounding area is exactly the same ecologically as the cleared area and the area cleared is a very small percentage of the total area.	Minor (Severity – low; Likelihood – medium)
<i>Source</i> Traffic resulting in dust covered vegetation. Fragmentation caused by roads <i>Vulnerability</i> Vegetation in access road vicinity Displacement of wildlife. Mortality and injuries of wildlife due to interaction with vehicles.	Moderate (Severity – medium; Likelihood – medium)	1. Wet roads during the dry seasons. 2. Minimize road width 3. Limit speeds on roads 4. Implementation of a weed management program to control the spread of invasive and exotic species	Insignificant (Severity - low; Likelihood - low)
<i>Source</i> Site preparation and construction of Roads, Tailings and Water Management Ponds. Vegetation clearing for Site access and for construction. <i>Vulnerability:</i> Disruption of nutrient cycles and destruction of soils. Formation of gullies and increased sediment loads to aquatic systems. Pollution of surface waters due to erosion.	Moderate (Severity – Medium; Likelihood – Medium)	1. Implementation of Best Management Practices	Minor (Severity – Low; Likelihood – Medium)

Construction	Mortality and Disturbance of Wildlife	<i>Source:</i> • Site preparation and construction of • Roads, Tailings and Water Management Ponds. • More workers on site and noise from equipment. • Hunting by workers <i>Vulnerability:</i> • Displacement of wildlife. • Higher mortality and injuries of wildlife due to increased interaction with vehicles and hunting.	Moderate (Severity - medium, Likelihood - medium).	1. Minimizing cleared areas 2. Slow and phased clearing to enable migration of wildlife 3. Maintenance of wildlife corridors in cleared areas 4. Ban on hunting and fishing by company employees 5. Controlled access of non-indigenous persons to mining concession 6. Minimization of noise emissions	Minor (Severity - low; Likelihood - medium)
Operation	Habitat degradation	<i>Source</i> • Dust accumulation on plants • Physical disturbance and noise from equipment operation • Blockage/intersection of wildlife corridors • Traffic on roads <i>Vulnerability</i> • Early succession/edge and secondary forest habitats located along roads • Displacement of wildlife and increased competition with wildlife on the perimeter of project area • Increased migration of wildlife • Animals on their way to and from feeding, breeding and birthing grounds, and between seasonal ranges • Animals attracted to access roads open spaces for protection from predators, food supplies and better travel conditions • Higher mortality and injuries of wildlife due to increased interaction with vehicles and hunting	Moderate (Severity - medium; Likelihood - medium)	• Wetting roads during the dry seasons • Minimize extent of the cleared areas • Utilise Best Working Practices for noise • Identification and flagging of migration corridors • Posting signs notifying drivers of the existence of these corridors • Speed restrictions on the access road in the vicinity of the corridors • Constrain width of access road • Lowered the vertical alignment to maximize line of sight. • Design access roads to minimize cuts and fills and with flat side slopes. • Hunting and fishing ban for employees	Minor (Severity - low; Likelihood - medium)
Closure	Habitat Degradation	<i>Source</i> • Encroachment by aggressive and unwanted plant species (pests) • Acid Mine Drainage <i>Vulnerability</i> • Native vegetation species and natural ecosystem • Historical fire regimes, • Soil nutrient regimes, • Increased soil erosion • Elimination/alteration of natural vegetative strata.	Moderate (Severity - low, Likelihood - high)	5. Implementation of weed management program 6. Determination of acid generating potential 7. Placing acid generating material above the water table to isolate the material from contact with water 8. Capping acid generating materials with clay or other materials to reduce permeability	Insignificant (Severity - low; likelihood - low).

Biological Resources – Aquatic					
Construction	Loss of aquatic habitat and fauna	<i>Source</i> • Diversion/drainage of streams for haul roads • Impoundment of Tailings and Water management ponds • Constriction of surface water flows at culverts and other road crossings may create currents too fast for some fish species to survive. • Culverts on access road may act as barriers to movement of some aquatic species • Restricted migration of fish • Sediment discharge to waterways • Accidental spills of lubricants and fuel <i>Vulnerability</i> • Fish breeding areas. • Dissolved oxygen levels. • Nutrient loads to waterways. • Reproductive impairment, stunted growth, and other physiological effects. • Spawning success for fish species • Reduction of habitat suitability for many aquatic organisms	Major (Severity – high; Likelihood - medium)	1. Implementation of Erosion and Sediment Control Plan 2. Channelling contaminated runoff to oil-water separators prior to discharge to streams/creeks 3. Bridging areas of standing water 4. Designing culverts to enable the passage of migratory aquatic species by incorporating baffles to slow flows 5. Setting culvert bottoms below the level of the stream bed. 6. Designing culvert gradients to ensure that streambed gradients existing prior to construction are maintained to the maximum extent practicable	Minor (Severity – low; Likelihood - medium).

Operation	Degradation of aquatic habitat and water quality	<i>Source</i> - Absorption of creeks/streams within tailings and water management ponds - Process discharge to tailings and water management ponds - Sediment discharged in process wastewater - Hydrocarbon contamination of aquatic environment from accidental spills of lubricants and fuel <i>Vulnerability</i> - Fishes and other aquatic organisms trapped within tailings and water management ponds. - Decreased transparency and reduction of light available to aquatic plants. - Suspended sediment settlement onto instream habitat features (e.g., downed wood, gravel, etc.) or bottom substrate. - Reduction in available area and cover for small fish, macroinvertebrates, and periphyton. - 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 and reduced spawning success. - Modification of migration patterns. Impairment of visual feeders. - Reduction of light penetration.	Major (Severity - high, Likelihood- medium)	- Construction of impoundment at a rate slow enough and in direction of stream flow to allow aquatic organisms to relocate outside of the footprint of the ponds. - Implementation of the Spill Contingency Plan - Implementation of Erosion and Sediment Control Plan	Moderate (medium Severity - medium; Likelihood - medium)

11.0 KEY SOCIOCULTURAL AND SOCIOECONOMIC IMPACTS AND RISKS

As highlighted in the socio-economic baseline, there is a single permanent community, 14 Mile Issano located immediately outside the boundaries of the project concession. There are also several small and medium scale mining operations within proximity of the proposed mine site. The indigenous community, Kaburi Village is located approximately 30 km from the project. Consequently there would be direct impacts on 14 Mile Issano, Kaburi Village and small and medium scale mining operations within proximity of the proposed mine site.

The social impact assessment also considered an indirect area of influence (IAI). The IAI incorporates areas beyond the operational boundaries of the project. It includes areas providing good and services, including labor, to the project and logistical corridors to be used for effective implementation of the project. The IAI also incorporates communities indirectly affected by interaction with the project in spite of their physical distance from the project site.

Several of the social issues, detailed in this document, are in fact risks associated with project implementation. Enhanced access to the project site may increase the likelihood of greater artisanal and small scale mining (ASM) and timber extraction. These are identifiable risks which PGI will have to address in association with the relevant regulatory agency.

The social impacts and risks, likely to be associated with the project, are detailed in the following sections. The impacts and risk are identified and segregated by project component and phase.

11.1 Construction Impacts

The construction phase of the project is projected to extend over 2 years. During the construction period, the project is likely to have a positive impact on economic conditions of the entire country. Impacts of the project on overall socio-economic conditions of the country will include generation of employment and increased demand for some goods and services.

It is expected that at the peak of construction activities, the project will provide work for approximately 400 individuals. These will be direct hires by the PGI and its sub-contractors. This will represent a significant increase in regional jobs. It is expected that during the construction phase, PGI will be one of, if not, the primary employer in Region 7. The workforce will likely be sourced locally since there is a large skill pool available after the closure of the Omai Gold Mine Limited (OGML). PGI will centralize its recruitment in Georgetown. Candidates from all over the country will consequently be eligible for employment. Some areas of Guyana are likely to benefit more than others. For example, Linden is the home of a large percentage of workers of the former OGML and would be the most likely source of skilled workers for the project construction phase.

The construction phase will also demand goods, services and logistics. These will include transportation services, construction materials and construction equipment. Logistics contractors including truckers and security companies will directly benefit. Suppliers of building materials and construction equipment will also directly benefit from increased demand. Construction companies could also potentially benefit if some of the construction work is farmed out to sub-contractors.

The project will also enhance the economic conditions in the country thru payment of taxes and royalties to the Government.

The overall impact on the national socio-economic conditions during the construction phase is considered to be a major beneficial impact with high level of enhancement and medium likelihood.

The mine site is located in an interior area with a small and dispersed population. During construction, the project will be construed as a potential employment opportunity and may attract people to the site in search of work. Development of the mine may also attract local vendors and service providers including sex workers to the area. The increased influx of individuals to the site could have adverse social and environmental effects.

The mine site area lacks infrastructure and social services. Rapid development of informal settlements in the vicinity of the mine site can potentially result in degradation of surface water quality. In addition harvesting of resources such as timber for buildings and thru hunting and fishing for protein, may have adverse effects on biodiversity in the area. Increased influx could also potentially result in increased alcohol and substance abuse, prostitution and crime. Influx of individuals could also expose PGI employees to health risks since introduction of new people into the area is often accompanied by transmission of contagious and other diseases. Influx of sex workers often leads to increased incidences of HIV and other STD. In addition increased criminal activity may occur because of increased influx.

This is a major potential impact with medium likelihood and high severity. PGI will develop and implement a focused influx management plan to mitigate these potential impacts. The post mitigation impact is rated to have a minor likelihood and low severity.

Consultations revealed that unemployment and lack of economic opportunities are primary concerns. There is an expectation that the Project will provide both employment opportunities and economic benefits. As currently configured, the project will centralize hiring in Georgetown. Further the range of skills required may not be available in Region 7. If employment and economic benefits do not accrue to Region 7, disappointing this expectation may engender antipathy towards the project and this may be manifested in the form of sabotage or other criminal acts.

This is a moderate impact with medium likelihood and medium severity. PGI will undertake an aggressive outreach and engagement program to identify means to satisfy some of the expectations. The post mitigation impact is rated to have a minor likelihood and low severity.

Artisanal and small scale miners (ASM) are active in the area with some operating illegally within the PGI concession. These include miners operating with permits from the GGMC as well as illegal miners from Brazil and possibly Venezuela. There are environmental, health and safety impacts typically associated with ASM. These impacts include mercury contamination, increased turbidity in streams, the creation of stagnant pools of water which serve as breeding places for mosquitoes, alteration of river channels from hydraulic mining of alluvial sediments, tailings heaps, deforestation, destruction of habitat, and land degradation. Typical social issues associated with ASM are impacts on Amerindian communities, influx of sex workers, increase in crime, and increase of HIV/AIDS and STDs.

The existence of the Amaila Falls Access Road will potentially provide access for artisanal miners to new areas including areas of the concession bordering that road. Encroachment by ASM on the concession could lead to security risks and possible conflicts. Activities related to the influx of ASM around the project will increase the likelihood of environmental pollution caused by ASM. Activities associated with ASM may pollute rivers and/or negatively impact biodiversity or surrounding environment and may be wrongly attributed to PGI. PGI therefore would be exposed to reputational risks and environmental liability issues. This would be exacerbated if international NGOs are involved.

This is a major impact with high severity and medium likelihood. PGI will engage with the GGMC and together with the GGMC will implement an ASM management plan and will actively patrol the concession boundaries. The post mitigation impact is rated to have a minor likelihood and low severity.

11.2 Operation Impacts

Mining projects create a 'boom and bust' economic cycle. The demand for labor, goods and services will be high during the construction period. This demand will decrease significantly during the project operational phase. Workers and subcontractors sourced from Linden and elsewhere may become economically vulnerable during the project operational phase. Some areas may thus be more affected economically than others and there may be widespread and sudden unemployment, loss of supply and contracts and assured sources of income.

There is likely to be a decline in the demand for construction workers as the project shifts into the operation phase. The demand for skilled mining workers will however increase. It is expected that the number of skilled mining workers will be less than the number required for the construction phase.

The requirements for service providers and contractors such as construction companies are also likely to decline significantly once construction is complete. Similarly, the sourcing of goods such as food, electrical goods, camp equipment, etc. from Georgetown is likely to decline, impacting the livelihoods and incomes of many who had benefited from the construction boom.

This is judged to be a major impact with medium likelihood and high severity. Careful planning will be required to manage the 'boom and bust' cycle and mitigate the potential secondary negative impacts. Measures such as diversifying workforce skills (so that they can work in other industries) or targeting the worker's families for income generation projects can be successful mitigation measures to reduce these impacts.

Although the exact traffic estimates are not known, the construction and operations phase of the mine is likely to significantly increase movement of vehicles such as big trucks or other vehicles carrying equipment, materials and workforce along the road. It is anticipated that fuel in large quantities will be transported to meet the energy requirements of the mine. Similarly, the operation of the mine will require significant transport of cyanide on these roads..

As the road is a public road, it is likely that other companies and ASMs, will also use the improved and new roads. The traffic volume due to the mine site activities could greatly increase overall traffic movement in this corridor increasing dust, noise, and vehicular emissions as well as increase risks of accidents and incidents.

This is rated to be a moderate impact with medium likelihood and medium severity. The enforcement of a traffic management plan in partnership with the Government and other users will reduce the impact to minor.

11.3 Blast Vibration and Airblast Impacts

This project will induce a wide range of human response to blasting and blast effects. This will range from persons who recognize that some benefit will result from the blasting operation. The other end of the spectrum would be represented by persons who do not want any blasting, regardless of the consequences to occur. The latter group of individuals will continually identify blast vibrations and airblast as having ill effects on both themselves and on their property. These are moderate impacts with high likelihood and medium severity.

Attempts have been made to quantify human response to both blast vibration and airblast in technical terms. Researchers have however found that, while data can be gathered on humans respond to sonic booms, ground vibration, earthquakes, etc., the subject of human response to

blast vibrations and airblast is an elusive target. This is because there are many factors, physiological, technical and political, that can skew the results.

The main contribution of typical human response to blast effects is that it increases the perception that some damage was either possible or likely to have occurred from blasting. Most humans are quite sensitive to motion and sound. They can perceive levels of both motion and sound that are far below, by a factor of 100 to 1000 or more, levels that may cause damage to the average structure. The factors that have an impact on human response to blast vibrations and airblast include:

- health of the individual
- orientation of the individual – i.e. in a standing position, more responsive to vertical motion; lying down, more sensitive to motion from side to side
- location of the individual
 - indoors, more receptive to structure noises
 - outdoors, blast effects are not as noticeable and may be masked by ambient noise and vibration
- activity of the individual, persons at rest are more sensitive than those actively engaged in some physical activity
- whether the individual is pre-warned or not (the startle factor), persons expecting a blast will usually not consider the effects to be as severe as those who are not warned
- quality and type of construction for persons since blasting will induce structural noises and rattling of windows and doors
- ambient noise or vibration levels since blast effects are not perceived to be as severe when other ambient noise and vibration are present

PGI will establish a mechanism to inform the 14 Mile Issano Community of impending blasts. Both Pre- and post-blast surveys, would be considered and blast vibration and airblast will be monitored to assist in the evaluation of claims for damages. Implementation of these measures will result in minor impacts (low likelihood, low severity).

11.4 Closure Impacts

The Project as currently envisaged has a projected total life of 3 years from the start of production. Closures of projects of such scale typically have significant impacts on the national socio-economic conditions.

Depending on the scale of total employment provided by the project over its lifecycle, there could be a dramatic decrease in employment due to project closure. This may disproportionately affect one area of the country over another. For example, if the bulk of the mine operation workforce is sourced from Linden, the incomes and livelihoods of this town could be severely affected by the closure of the project.

All of the service providers and suppliers to the project could be severely impacted, especially if the bulk of their business came from the project. The closure of the project will also result in decreased revenues to the Government in the form of taxes and royalties. This in turn may negatively impact the GDP of the country.

The impacts of closure are therefore considered to be potentially major. The project proponents in partnership with the Government and its workforce along with suppliers/contractors need to carefully plan for eventual closure. A carefully formulated forward looking closure plan should be commissioned to address the socio-economic impacts of closure.

11.5 Landscape and Visual Resources

The project will alter the vertical dimensions of the landscape and the materials present therein. In addition, the color, reflectivity and visible emissions will be changed slightly from current levels since the operations will be shielded by surrounding vegetation. Landscape and visual impacts will result from creation of the access road from the mine site to the Amaila Falls Access Road and the flow of traffic over this road. These impacts will be minor (low severity, low likelihood). These impacts will not be mitigated. Additional landscape and visual impacts will result from clearing of greenery, mining and for facility construction. The scale of the area to be cleared is however relatively small in comparison to the overall area and would be shielded and adsorbed by the adjacent forest. The impacts of clearing will be minor (low severity, low likelihood). These impacts will not be mitigated.

11.6 Heritage

Removal and destruction of artifacts currently in the project area will compromise the quality of these artifacts. In additions, if artifacts exist below ground in the project area, removal of the ground cover may alter the pressure required to maintain the integrity of these artifacts. Changes in water conditions may also compromise the quality of any artifacts located below ground in the project area. If artifacts are present in the area their quality may be compromised. These are moderate impacts (medium severity, low likelihood). These impacts will be mitigated by preparing an archaeological watching brief for implementation during earth moving, excavation and blasting. Archaeological evidence would be recorded and artifacts should be removed or preserved in place after consultations with the Guyana National Trust. The mitigation measures will result in insignificant impacts (low severity, low likelihood).

11.7 Land Use

The primary land use activities in the area are mining and forestry. The land will be initially used for mining and will be reconverted to forestry after mine closure. The project will result in no impacts on land use. These impacts will not be mitigated.

11.8 Low Carbon Development Strategy

One of the participants of the Sectoral meeting expressed concerns about the impacts of the project on the proposed Low Carbon Development Strategy (LCDS). Approximately 150 ha of tropical forest will be cleared for the mines, widened roadway and related facilities. The total life of mine is approximately 15 years. Deforestation rates will therefore approximate to 10 ha per year over the life of the mine. The Guyana Forestry Commission document "Terms of Reference for Developing Capacity for a National Monitoring, Reporting and Verification System to Support REDD+ Participation of Guyana" indicates that Guyana has approximately 16 million ha of land area covered by forest. Further deforestation rates in Guyana are relatively low at 0.1 to 0.3% per year. Nationally that rate equates to 16,000 to 48,000 ha per year. The deforestation rate of this project will add a total of 10 ha/year to those values which equates to less than 10^{-4} % increase in the national deforestation rate. This increase is very tiny and would have no impacts on national deforestation rates.

The MOU with Norway will pay US \$30 million per year for a total forest cover of 16 million hectares. This equates to approximately, US\$1.88 per ha. The total cost of deforestation, based on the MOU with Norway, associated with this project consequently equates to US \$18.80 per year. Average estimates of royalty payments for the project exceed US \$10,000,000.00 per year based on recovery of 100,000 ounces of gold, at US \$1300 and payment of an eight percent royalty. This project consequently adds a significantly greater amount per hectare than that provided by the payments by Norway for avoided deforestation.

The greater value of the deforested would not be restored by reclamation of the mined out areas. The sole area not be reclaimed will be encompassed by lakes created by the tailings pond and open pit mine. The impacts of the project on the LCDS are consequently minor (low likelihood, low severity). No mitigation is necessary.

12.0 CUMULATIVE IMPACTS ASSOCIATED WITH PROPOSED ACTION

Cumulative impacts are defined as the combination of multiple impacts from existing projects, the proposed project, and/or anticipated future projects that may result in significant adverse and/or beneficial impacts that would not be expected in the case of a stand alone project. This section provides a description and analysis of the potential cumulative impacts of the proposed gold mining project and past and/or future actions/projects on the natural and socio-economic environment.

Determining the cumulative environmental consequences of the proposed action requires delineating the cause-effect relationships between the multiple actions and the resources, ecosystems, and human communities of concern. This cumulative impact study was constrained by the lack of existing data detailing environmental impacts of existing and proposed actions within the area of influence of the project. The sole project within the area of influence of the project for which a detailed Environmental and Social Impact Assessment is available is the Amaila Falls Hydropower Project. The assessment of cumulative impacts was evaluated considering both the Amaila Falls Hydropower Project and the limited abstract issues associated with typical existing and proposed actions in the project area of influence.

12.1 Potential Cumulative Impacts

The poverty levels in Guyana are relatively high. However Guyana is a natural resource rich country and there are approximately 100,000 persons who work directly or indirectly in gold and other mineral resources exploitation. Region 7 is well known for its gold mining activities and has historically been the lead geographical region in gold and other mineral resources exploitation. Evidence from communities within the project's area of influence indicates employment in mining and logging in addition to other subsistence livelihood activities are the main sources of livelihood in the Region.

Further evidence from communities within the project area of influence indicates significantly increased level of small and medium scale mining activities in the area. This can be attributed to significant increases in the price of gold. Upgrading the road to the mine site may result in more small and medium miners being able to access the area. In addition, the presence of a foreign company in the area will induce talks of a major gold strike in the area. This will result in more small and medium scale operators moving into the area. This could potentially result in a gold rush effect in the region which could have significant adverse effects on the natural environment, social and economic conditions, and community health.

In conformance with the Low Carbon Development Strategy, the Government of Guyana proposes to enforce regulations for management of the mining sector. Enforcement of these regulations will minimize any potential impacts related to small and medium scale mining operations. These regulations will further enhance the participation of stakeholders in the economic and social development of the country by supporting and encouraging sustainable development in Region 7.

There are several small and medium scale operators in the project area. These operators all recover gold totally by mercury amalgamation. Mercury amalgamation will contribute to increased mercury levels both in soil and water in the project area. The project will expose miners to alternative, mercury free, beneficiation methods and will indirectly support the GoG efforts to eradicate mercury amalgamation in the gold mining industry.

The project will upgrade and maintain the access road from to the mine site. Small and medium-scale operators will utilize this road. While this will increase traffic volumes on the road, the presence of a primary artery to points west of 14 Mile Issano will eliminate the need for miners to develop alternate routes and this will minimize likely loss of flora and fauna associated with clearing other access roads to point west of the mine site.

While the Project is likely to be the major development in the Middle Mazaruni region in the short term, the possible increase in small and medium scale mining activities would dramatically increase the scale of effects in the sub-region in the future. The pressure of small and medium scale operations is already a reason for concern by persons in the area with there being claims of minimized water quality. These problems, if not addressed, will be exacerbated by increased mining in the Sub-Region. The Government of Guyana is supportive of development in the region in order to benefit the national economy and has developed an appropriate and well structured regulatory framework to address and mitigate these concerns. However, enforcement of these regulations is weak due to limited capacity and resources.

The creation of a reservoir for the proposed Amaila Falls Hydropower Plant, once operational, will result in regulated flows into the Kuribrong River downstream of the plant site. This will in turn result in more regulated flows in streams and tributaries in the project area. Incidences of very low flows will consequently be reduced.

An all weather road, created to provide access to the hydropower plant site, passes within close proximity of the project boundaries. Vegetation was cleared for the road alignment and would also be cleared for the transmission line alignment within the project area of influence.

The proposed gold mining project is one of several long term mining projects proposed for Region 7 (the Aurora Gold Mine Project and The Toroparu Gold and Copper Mine Project being the others). Additionally, as depicted on Figure 54, there are a number of large scale (TSAs) logging projects within the region including two; Vitarna and Toolsie Persaud (Interior Forest Investment) with parts which are located within the concession. Discussions between PGI and both forest product concessionaires have indicated that there are no exploitable forest resources within the concession.

This project together with the Toroparu Mine Project, the Aurora Mine project and logging operations around the concession will provide significant sources of employment, training, and revenue for the region. If the Amaila Falls Hydropower Project is constructed that would add to the level of employment, training and revenue for Region 7. The success of this project and the other mining projects identified above will encourage the development of additional mining concessions by PGI or other mining companies which could lead to greater levels of employment and extend the duration of the increased employment as well.

The new access road to Amaila Falls will provide a conduit for economic success of many large scale investment projects as well as other economic development activities within the Region in that it will provide access to exploitable natural resources such as timber and minerals. Currently, the road is utilised by a number of major stakeholders including TSAs holders and many small and medium scale miners and other persons accessing the area. Maintenance of the Amaila Falls Access Road would be critical for benefits to accrue from the proposed project and other extractive resource industries in the area and the region.

The creation of the Amaila Falls access road may lead to migration of people to the project area to access and exploit resources to support their livelihood activities. Improved access to the project area may consequently result in increased mining, logging, agriculture and other livelihood activities such as subsistence farming, fishing, and hunting. The presence of foreign companies in the area may result in rumors of major gold finds in the area. This may potentially lead to further proliferation of artisanal mining activities in the area, both illegal and legal operations and an increase in the number of businesses associated therewith such as shops, hotels, and brothels and the creation of other communities similar to that at 14 Mile Issano.

Figure 54 - Proposed Mine Site and Surrounding Timber Concessions.

An upsurge in uncontrolled resource extraction activity and other knock on activities may have significant adverse effects on the natural environment, social and economic conditions, the overall health of the area and Region. These are major impacts (major severity, medium likelihood). These impacts will be managed by implementation of a Multi-Stakeholder Influx Management Committee. This committee will be comprised of representatives of any established community, GGMC, GFC, major stakeholders such as loggers and miners and PGI. The committee will provide an ongoing mechanism to manage and respond to attempts by unauthorized persons to access the areas adjoining the access road and mine site to exploit resources construed to be present in those areas. This committee will meet quarterly or with greater frequency if circumstances dictate, to discuss access issues and concerns related to development of the access road and mine site. At a minimum the committee will conduct periodic stakeholder and access management reviews. These measures will result in insignificant impacts (low severity, low likelihood).

The cumulative impacts in the area will be managed by institution of a long term, multi-stakeholder regional planning program. Such planning would be done by building consensus, collaboration and partnerships between the affected and responsible parties. Key stakeholders who would be included in the process are:

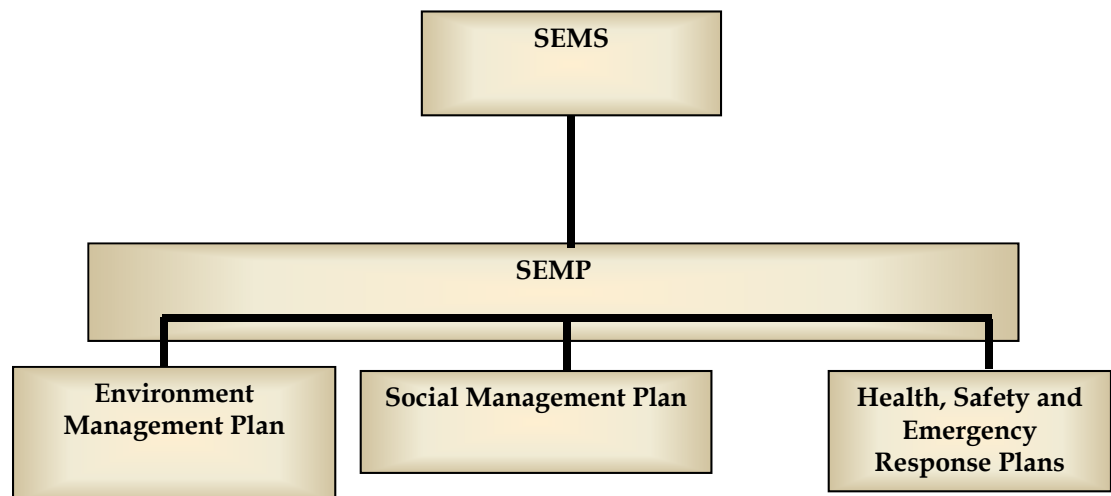
- Government of Guyana through authorities in the Middle Mazaruni Sub-Region;
- Residents of the Kaburi Village and 14 Mile Issano;
- Guyana Forestry Commission;
- Guyana Geology and Mines Commission;
- Guyana Gold and Diamond Miners Association;
- Local WWF and CI conservation NGO offices; and
- Other regional stakeholder organizations.

13.0 SOCIAL AND ENVIRONMENTAL MANAGEMENT SYSTEMS

The Social & Environmental Management System (SEMS) provides the management framework for the systemic aspects for implementation of the Environmental Management Plan, Social Management Plan and Health, Safety, and Emergency Response Plan. This SEMS is the backbone of the SEMP and the adoption of this SEMS is critical for the implementation of the SEMP presented in this report. The SEMS is a systemic framework that will be applicable throughout the life of the project and to every phase from feasibility and construction to operation and closure.

While the SEMP are mainly plans and/or mitigation measures to address specific impacts identified by this ESIA, the SEMS goes beyond the SEMP and forms an independent and adaptive system of checks and balances that ensures that all possible environmental & social risks/impacts of the project are identified and managed beyond the scope of this ESIA and through the project life cycle. The SEMS has the following components:

1. Policy framework;
2. Organizational Structure and Responsibilities for the implementation of the SEMP;
3. Monitoring and Audits Process;
4. Change Management; and
5. Reporting and Disclosure.



13.1 Policy framework

Pharsalus Gold Inc Corporation and its contractors will adhere to all applicable laws, regulations, and codes of practice of Guyana, the applicable IFC Performance Standards on Social and Environmental Sustainability, and the applicable IFC EHS Guidelines. In the event that Pharsalus Gold Inc Corporation deems full compliance with a particular standard or guideline not to be technically or economically feasible, the MNRE, EPA, and GGMC would be consulted proactively such that alternative standards or practices may be developed.

A policy framework would form an integral part of a management system. The company will develop written policies on environmental, social and health & safety issues. The policies would clearly outline the mission, vision and aims of the company and the standard operating procedures (SOP) that detail how these policies will be implemented throughout the Project.

A code of conduct will be an integral part of the policy framework. The code of conduct will ensure that the intent of the policies of the company and SOPs percolate to all levels like the employees, contractors and subcontractors of the Project.

13.2 Written Management Policies

Although Pharsalus Gold Inc has not yet adopted a set of formal policies, it would adhere to the entire environment, social, health and safety and labor legislation and regulatory framework of Guyana as well as the applicable IFC Performance Standards and EHS Guidelines. Each of these compliance requirements have been discussed in Section 3 of this ESIA report.

Pharsalus Gold Inc will develop written policies for each of the applicable IFC PS discussed in Section 3. This will ensure that all issues that may arise during the project lifecycle can be predicted, analyzed and managed by a robust management system geared to continuous improvement.

These written policies will be designed to:

- Document principles that are compatible with social and environmental protection while allowing the operation of the facility at competitive costs;
- Facilitate SOPs through the project lifecycle that will ensure compliance to its environmental and social, health & safety goals;
- Promote awareness to its employees and to the general public regarding social and environmental protection.

13.3 Pharsalus Gold Inc Code of Conduct

All Pharsalus Gold Inc employees, contractors, and site visitors will be required to comply with a Company Code of Conduct. The code of conduct will ensure that all the company's employees, contractors and sub contractors are in alignment with the company's basic mission, vision, policies, and goals. This will enhance implementation of the company's written SOPs and ensure that the main message percolates to all levels and individuals associated with the project.

The code of conduct will have the following objectives:

- To ensure that all company and project personnel adopt a respectful manner towards local communities, their resources and the environment; and
- To avoid and minimize adverse impacts that the behavior of company and project personnel may have on local communities and/or their resources and the environment. Such adverse impacts include social conflicts, depletion of natural resources, and impacts on native flora and fauna.

Pharsalus Gold Inc will develop their own code of conduct to reflect their own vision and objectives.

13.4 Organizational structure and Responsibilities

Pharsalus Gold Inc is currently organizationally structured for exploration activities. The ESIA consultations within the company revealed the following:

- There is lack of dedicated resources to manage environment and community/social aspects. By virtue of being a small exploration unit Pharsalus Gold Inc functions in a skeletal capacity with managers and staff taking on multiple functions;

- Personnel who can take management decisions are based in primarily in Australia and Georgetown and a number of functions like hiring, HR, pay process, logistics etc. are centralized in the Georgetown office;
- Stakeholder interactions are managed by various personnel mostly located in the Georgetown office. Some staff are responsible for liaising with Government departments while others interact with communities. However these duties/functions are not formalized and there is no documentation of stakeholder engagements, issues, or grievances.

To ensure effective implementation of the SEMP of this ESIA, Pharsalus Gold Inc will develop a team of trained individuals and dedicate specific resources to that team. The primary responsibility of this team of trained individuals will be to oversee the implementation of the SEMP and take ownership of the systems and processes of this SEMS.

Figure 55 depicts the organizational structure and personnel required for the implementation of the SEMP. The organization structure also depicts the specific sub-structures showing the divisions between social and environment teams that will manage and implement the SEMP.

The overall implementation will be done by placing both environmental and community managers at the site. This will ensure division of the tasks related to implementation of the ESMP amongst qualified personnel. The larger responsibility of the ESMP will rest with the Director of Sustainability and the Senior Management team while the sub teams will perform the field functions. Pharsalus Gold Inc will hire or place specialists who have experience in environmental and social issues and implementing management plans for each of the proposed positions in Figure 55.

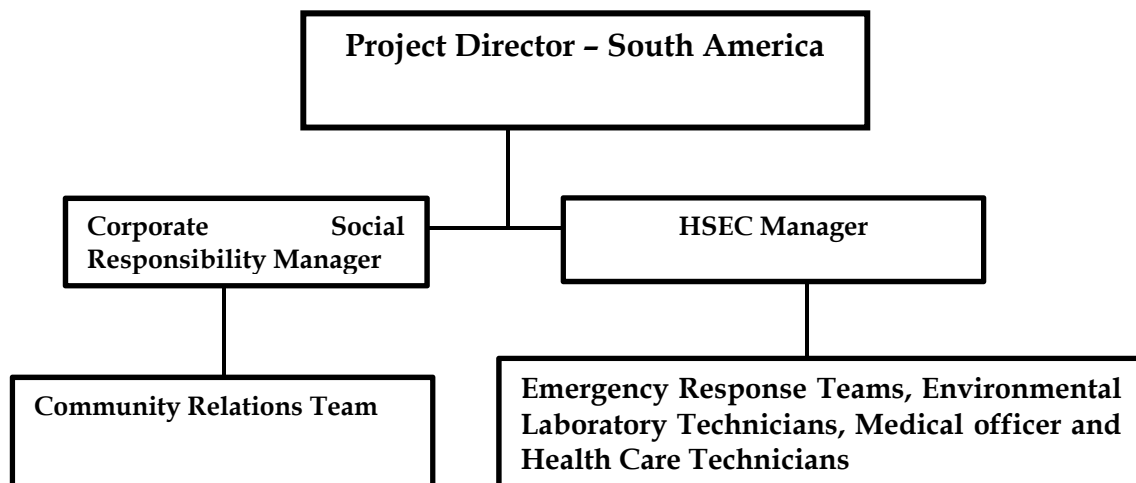


Figure 55 - Proposed Organization & Implementation Structure for the ESMP

13.4.1 Project Director - South America

The Project Director - South America will be responsible for all sustainability matters and will be tasked with the implementation of the ESMP. The Director will manage and lead the Environment and Social/Community teams and ensure that the ESMP implementation occurs properly. The Health, Safety, Environment and Community Manager (HSEC Manager) will have direct responsibility for social/community aspects of the ESMP and will report directly to the Director until mining operations commence, at which time the Mines Manager - Guyana will assume the role and then report directly to the Project Director - South America.

The Project Director – South America will be the conduit of information and will advise and direct the senior management team of Pharsalus Gold Inc. The Senior Management team is likely to include all senior staff in Georgetown, at the Corporate office and Project Managers and other staff as appropriate. The Director will regularly report to the Senior Management on the implementation issues of the ESMP, information on arising social and environmental issues and management of the Social and Environmental Management System (SEMS). The Director will have powers to take organizational and resourcing decisions at the country level which are necessary for maintaining a robust SEMS. Drafting of codes of conduct, written policies, managing subcontractors and ensuring compliance to all Project policies and commitments through the Project lifecycle and in cases beyond the scope of the ESMP will be the responsibility of this Director.

The Director will be responsible for compiling yearly reports on the status of the ESMP implementation and to manage the internal monitoring activities. The Director will be responsive to the environmental and social issues arising (if any) and will be proactive in identifying risks and managing these issues through the lifecycle of the project.

13.4.2 Health, Safety, Environment and Community (HSEC) Manager

A Health, Safety, Environment and Community (HSEC) Manager shall be assigned to full-time onsite duty at the Site. The HSEC Manager will report directly to the Project Director – South America during the project build phase and will have direct responsibility for all HSEC aspects of the construction and operations, including emergency response, and will be the primary authority for day-to-day enforcement of the Environmental Management Plan (EMP) and Health, Safety, and Emergency Response Plan (HSERP).

Once Mining operations commences, the Mine Manager – Guyana will direct and support the HSEC Manager by providing additional expertise and resources on an as needed basis to satisfy operational, maintenance and emergency response needs. If necessary, Pharsalus Gold Inc may retain a qualified firm to provide support to the HSEC Manager to assist with specialized training and emergency response expertise and will provide additional technical resources for operational and emergency response needs. It is anticipated that the MNRE, EPA and GGMC will review plans prepared by the operations to ensure that all concerns are appropriately addressed.

The HSEC Manager will manage all environmental and health and safety related activities and will provide training to employees and will identify equipment and resources needed to satisfactorily perform their duties and responsibilities. The EHS Manager will also provide onsite training and internal auditing of EMP and HSERP effectiveness.

13.4.3 Environmental Staff

The EHS Department will have 3 technicians whose primary duties will be to inspect the local environmental monitoring stations for water, air and soil and to collect grab samples for routine checks. They also work with the EPA and other authorities to report and assure that discharges are within guidelines.

An environmental laboratory staffed by a complement of three individuals will be located at the Project site. Individuals working in the laboratory will analyze samples of air, surface and groundwater and will serve as response team advisors in the event of emergencies. The environmental laboratory will be responsible for the analyses of samples to assess environmental compliance. The laboratory will also be responsible for collecting and packing samples for off site quality assurance tests by an independent laboratory approved by the EPA.

13.4.4 Health, Safety, and Emergency Response Staff

Medical Officers will be assigned to the Mine Site to oversee the onsite health facilities that will be equipped to attend to the needs of site residents, workers, and visitors. Two full time Health Care Technicians will be provided at the mine site to attend to minor injuries and basic first aid. Emergency Response Teams, at the site, will be comprised of employees who have been specially trained to handle potential incidents. These employees will also be responsible for maintaining the operational effectiveness of the emergency response equipment.

13.5 Monitoring and Audit process

Social and environmental monitoring programs will be implemented to address all activities that have been identified to have potentially significant impacts on social and the environmental resources during construction, normal operations, and unexpected conditions. Social and environmental monitoring activities will be based on direct and indirect indicators of emissions, effluents, and other potential sources of impacts associated with the project under a risk-based, targeted approach that addresses key indicators that are most reflective of potential impacts and risks. Monitoring will extend for a minimum period of three years after closure. Monitoring frequency for each parameter will be sufficient to provide representative data for the parameter being monitored.

Monitoring will be conducted by trained individuals following monitoring and record-keeping procedures and using properly calibrated and maintained equipment. Monitoring data will be analyzed and reviewed/compared against operating standards so that any necessary corrective actions can be taken.

The monitoring program will implement applicable sampling and analytical methods for emissions and effluents as provided in the IFC General EHS Guidelines.

The environmental monitoring program for the mine will serve as an integral part of the operation and would be implemented to generate information for environmental management and environmental information dissemination. Monitoring will be conducted during all phases of the project; specifically, the design, construction, operation and closure phases. The monitoring program will play a pivotal role in ensuring that the trends for specific parameters are tracked and will provide information on compliance with legislative norms, set guidelines or desirable operational limits. Review of the monitoring data will provide a basis for corrective actions and modification of activities if necessary. Sampling intensity during monitoring will depend on the time and location of the development activities and results derived from monitoring data. Pharsalus Gold Inc will conduct regular internal audits of the EMP and the Monitoring Program and will contract an independent expert firm to provide an annual external audit.

The Social Monitoring program will also have a system of internal and external monitoring. The internal monitoring would be done in house by the Community Relations Team led by the CSR Manager. Quarterly monitoring will be done of the implementation of the ESMP and of all community projects being funded by the company. External third party monitoring and/or audits will be facilitated by the company to ensure that the ESMP and its activities are meeting indicators. All issues and corrective actions raised by third party audits would be implemented.

13.6 Reporting and Disclosure

Pharsalus Gold Inc senior management will receive periodic assessments of the effectiveness of the ESMP, based on systematic data collection and analysis resulting from the monitoring and auditing programs.

Pharsalus Gold Inc will also report externally on the implementation, monitoring, and auditing of the ESMP. The ESMP, monitoring reports, and external auditing reports will be disclosed to any interested party requesting a copy. In addition, these will be posted on the Pharsalus Gold Inc website.

13.7 Change Management

Pharsalus Gold Inc recognizes that the Project design, specifications, procedures, operation parameters, and other elements will be subject to change throughout the lifetime of the Project in response to issues encountered and and/or new policies. Change Management Procedures will be developed to ensure that changes are properly reviewed and approved by persons with the required expertise prior to implementation, to eliminate workplace hazards that could lead to injuries, equipment damage, production losses, project reputational impact or environmental impact. Also, the procedures will establish accountability for proper change implementation.

Change Management review procedures will address both permanent and temporary changes. Temporary change reviews and approvals will specify the duration of the change and will require review if an extension is required. Temporary changes will be considered in the same manner as permanent changes.

The ESMP will be reviewed and updated not less than annually and whenever the need for improvement is identified during its implementation. A complete review of the effectiveness of the ESMP and the need for modification in light of final Project design will be performed not less than 90 days before the start of operations.

Changes will be communicated to affected personnel via training and updates to digital and printed versions of the ESMP.

14.0 SOCIAL AND ENVIRONMENTAL MANAGEMENT PLAN

An Environmental and Social Management Plan (ESMP) has been developed to mitigate and minimize the environmental consequences identified in Sections 9, 11 and 11. The ESMP incorporates protection, mitigation, and enhancement measures. A separate monitoring plan has been developed to assess the effectiveness of the management plan. The environmental mitigation measures in this ESMP include:

- Production technology, disposal methods, and engineering designs;
- Pollution controls, recycling and conservation of resources, monitoring, special social services or community awareness and education and
- Compensatory measures for restoration of altered resources.

Monitoring would be undertaken to evaluate the success or failure of the environmental management plan measures and to reorient the ESMP if required.

The ESMP is intended to ensure that impacts which cannot be mitigated are minimized to the maximum extent possible and that positive impacts are enhanced. The ESMP will ensure that impacts which cannot be mitigated do not exceed tolerable limits. Wildlife and vegetation impacts are not exactly mitigated by the provisions of the management plan, however, there is a relative abundance of similar vegetation and wildlife in the surrounding area. The open bodies of water left after completion of the mining operations will present a more diverse ecological system in the area and may result in habitation by aquatic species.

It is expected that wildlife will return to the area after completion of the mining operations and site closure. Regrowth may result in the growth of some plant types not initially present in the area.

14.1 Noise and Vibrations

The Guyana National Bureau of Standards (GNBS), along with the EPA and other relevant agencies, has developed standards on Noise Emissions into the Environment. This standard is applied to regulate noise emissions into the environment.

Good practice in the prevention and control of noise sources will be established based on prevailing land use and the proximity of noise receptors such as communities or community use areas. Noise management strategies will include:

- Noise levels at the nearest sensitive receptor will meet the noise guidelines in the General EHS Guidelines;
- Implementation of enclosure and cladding of processing plants;
- Installation of proper sound barriers and /or noise containments, with enclosures and curtains at or near the source equipment (e.g. crushers, grinders, and screens);
- Installation of natural barriers at facility boundaries, such as vegetation curtains or soil berms and
- Optimization of internal traffic routing, particularly to minimize vehicle reversing needs (reducing noise from reversing alarms) and to maximize distances to the closest sensitive receptors.
- Installation of soil berms on the concession boundary with 14 Mile Issano

Noise emissions will be limited by appropriate soundproofing of individual pieces of equipment. Equipment exhaust systems will be fitted with mufflers. The electrical generators will be housed in closed structures with acoustic insulation that would reduce external noise levels. Additionally, all workers

with potential chronic or acute noise exposures will be required to wear appropriate personal noise-protection gear.

The most significant vibrations are usually associated with blasting activities. However vibrations may also be generated by many types of equipment. The mines will minimize significant sources of vibration by implementation of best management practices such as through adequate design of crusher foundations. Blasting-related emissions such as vibrations, airblast, overpressure, and/or fly rock) will be minimized by the following:

- Mechanical ripping where possible, to avoid or minimize the use of explosives;
- Use of specific blasting plans, correct charging procedures and blasting ratios, delayed/microdelayed or electronic detonators, and specific in-situ blasting tests (the use of downhole initiation with short-delay detonators improves fragmentation and reduces ground vibrations);
- Development of blast design, including a blasting-surfaces survey, to avoid overconfined charges, and a drill-hole survey to check for deviation and consequent blasting recalculations;
- Implementation of ground vibration and overpressure control with appropriate drilling grids; and
- Adequately designing the foundations of primary crushers and other significant sources of vibrations.

In addition, PGI will conduct preblast inspections, with the agreement of residents, of all structures located in 14 Mile Issano. The purpose of the preblast inspections would be to document the condition of each structure prior to its exposure to vibration from blasting. The documentation, generated by the preblast inspection will be used to verify or refute claims of damage resulting from vibrations.

The inspection procedure will document name of the structure owner the address, date and time. This would be followed by a description of the structure, 1 floor, 2 floors, frame, painted or masonry construction, porches and foundations. Gutters and downspouts and drainage would be noted. Any low unusual ground and soil conditions would also be noted and will include lots on 1 in 3 slope, slope failures, retaining walls inclined due to soil pressure, drainage problems and pooling of water.

The interior inspection would be conducted room by room with each room designated and described. Each wall would be inspected, noting the number of windows, doors, wall corners and ceiling corners. Window, floor and ceiling moldings would be checked for openings in mitered joints, straight joints and for separations from wall, floor or ceiling. Glass panes would be examined for cracks.

Floors would be examined for openings between boards, loose, or squeaky boards, discoloration and general wear of wood. Ceilings should be examined for cracked, loose or hanging plaster, water discoloration and holes. Foundations would be checked for cracks, holes, settling and condition of mortar, if any. Gutter and downspouts will be checked for general condition and drainage. Photographs would be made of any unusual conditions that are more severe than ordinary.

A preblast survey report would be prepared for each structure with a complete description of what the inspection was able to document. It would be clearly written so that an independent examiner can readily understand what was observed.

14.2 Atmospheric Emissions and Dust

Fugitive dust emissions from dry surfaces of construction sites, roadways, work areas, tailings facilities, waste dumps, stockpiles and other exposed areas will be minimized by the following:

- Dust suppression techniques (e.g. wetting down, use of all-weather surfaces, use of agglomeration additives) for roads and work areas, optimization of traffic patterns, and reduction of travel speeds;
- Revegetating or covering exposed soils and other erodible materials promptly;
- Clearing and opening up new areas only when absolutely necessary;
- Enclosing dusty materials storage areas by installing efficient dust suppression equipment in these areas.
- Loading, transfer, and discharge of materials will take place with a minimum height of fall, and will be shielded against the wind, and
- Conveyor systems for dusty materials will be covered and equipped with measures for cleaning return belts.
- Maintaining a vegetated buffer zone on the project boundary immediately adjacent to 14 Mile Issano

Water will be periodically sprinkled on roads, other conveying routes, stock piles and spoil piles to control dust emissions.

Other emissions to air should include NO_x, CO, VOCs, SO₂, PM₁₀, PM_{2.5}, and hazardous air pollutants (HAPs) from the operation of gasoline- and diesel-fired equipment. These emissions would be reduced to minimum levels by following the protocols of the manufacturer for equipment use and maintenance.

Recommended emissions reduction and control strategies for stationary power generation activities from sources with a capacity equal to or lower than 50 Megawatt thermal (MWth) and from mobile sources are addressed in the General Environment, Health and Safety (EHS) Guidelines. General recommendations related to smelting and refining may also be found in the EHS Guidelines for Base Metal Smelting and Refining. There are, however, a few issues which are specific to the roasting and smelting of precious metals. Recommended management strategies include:

- Operations at controlled temperature (higher temperature roasters generally cause more problems of contaminant control); and
- Inclusion of an appropriate gas scrubbing system.

14.3 Soils Management

Soils will be protected from contamination and erosion during all Project activities. Soil erosion measures are detailed in the Erosion and Sediment Control Plan. Soil will not be allowed to become a contaminant itself by entrainment in runoff or wind. Topsoil and organic matter will be separated from subsoils and will not be intermixed. Topsoil and organic matter will be stockpiled and protected from rainfall and sunlight. Stockpiled materials will be reutilized in progressive restoration works as soon as practicable to avoid losses of organic matter through oxidation. No topsoil will be removed from any area outside the mining limits unless approved by the EPA.

Soils in temporary work areas will be decompacted by disking, plowing, ripping, or other mechanical means. Soils will be protected from contamination as detailed in the Spill Prevention and Control Plan. Contaminated soil will be remediated by in situ or ex situ means as appropriate.

14.4 Acid Mine Drainage

Acid mine drainage (AMD) forms when sulfide minerals are exposed to oxidizing conditions in metal mining operations. Acid Mine Drainage is a function of the acid-producing (sulfide) and alkaline (carbonate) minerals contained soils excavated at the mine site. In general, sulfide-rich and carbonate-

poor materials produce acidic drainage. In contrast, alkaline-rich materials, even with significant sulfide concentrations, often produce alkaline conditions in water.

A series of geochemical tests will be conducted on soils and rocks to be excavated during the mine site operation. These will be both static and kinetic tests and are designed to determine the acid generating capacity of the soils and rocks to be excavated. Static testing is comprised a range of simple, relatively fast and inexpensive screening tests designed to assess the potential for acid mine drainage in samples by evaluating the acid generating and acid neutralising processes. Kinetic tests are used to confirm the findings of static testing, to evaluate the rate of sulphide oxidation, predict acid drainage characteristics, and to assess potential management techniques. Samples will be continuously recovered over the duration of the mine life to determine the likelihood of acid drainage material being uncovered during mining. The number of samples recovered for testing will depend on:

- the geological variability and complexity of rock types and
- the level of confidence in predictive ability

A combination of strategies for both hydrological and oxidation controls, throughout all stages of the mine site operation, will be used to minimize and retard the risk of acid mine drainage. Control strategies will entail measures to eliminate exposure of acid generating material to both oxygen and water. If this cannot be accomplished, all acid generating material will be chemically treated to reduce its acid generating potential. Acid Mine drainage will be minimized by control of water percolation through the material to inhibit migration or transport of oxidation products from the source.

The primary approach to control AMD would be to keep water away from pyritic material. Once overburden materials have been identified and classified based on geochemical analyses, the overburden handling and placement plan for the material will be carefully followed. All potentially acid generating material will be segregated and placed above the water table on top of a 1 to 2 m thick layer of non-acid generating soil and will be further covered with a clay cap to reduce surface water infiltration into this material. The area will also be contoured to divert surface water above the site to decrease the amount of water entering the area.

14.5 Erosion and Sediment Control Plan

Mining will be undertaken with long-term erosion and sediment control as a primary consideration. Mining operations conducted during the rainy season will be clearly demonstrated, to the satisfaction of the EPA, that at no stage of the operations will there be any substantial risk of increased sediment discharge from the site. When mining occurs in the rainy season, the smallest practicable area of erodible land will be exposed during mining operations and the time of exposure shall be minimized. Natural features, including vegetation, terrain, watercourses and similar resources shall be preserved wherever possible. Limits of mining shall be clearly defined and marked to prevent damage by mining equipment.

Site clearing operations will progress in a gradual and phased manner to ensure there are no large increases in sediment discharge. Sediment control structures will be used to prevent the inflow of sediment to surface water. These control practices will include sediment traps and screens to control runoff and sedimentation from active mining and developed areas.

Permanent vegetation and structures for erosion and sediment control shall be installed as soon as possible. Adequate provision shall be made for long-term maintenance of permanent erosion and sediment control structures and vegetation. No topsoil shall be removed from the area outside the mining limits unless approved by the EPA. Topsoil overburden shall be stockpiled and redistributed to provide a suitable base for seeding and planting. Runoff from the stockpiled area shall be controlled to prevent

erosion and resultant sedimentation of receiving waters. Runoff shall not be discharged from the site in quantities or at velocities substantially above those which occurred before grading.

Waste rock and soil from the mining and mineral processing operations will be disposed in spoil piles located in the mined out areas. All spoilpiles would be surrounded by a soil containment berm to preclude the easy flow of surface runoff and sediment from stockpiles. The containment berms would be constructed of soil pervious enough to enable the passage of surface runoff water while trapping sediment contained in that runoff. The height and slope of each spoilpile would be such that foundation and slope failures do not occur.

Stormwater runoff and water from the mining operations would both be channeled to temporary sedimentation ponds. Those ponds would be designed to provide a detention time of 48 hours. Discharge from the sedimentation pond would be via a spillway and would be channeled through a sediment control structure constructed of a matrix of stone, sand and grass to remove sediment prior to discharge to surface water bodies in the site area.

Mining would proceed in such a manner as to minimize disturbance to streams in the area. In instances where this cannot be avoided, sediment control structures and practices would be used to prevent the inflow of sediment to surface water. These control practices would include sediment traps or screens to control run-off and sedimentation. Surface runoff from maintenance workshops and other vehicle service areas would be channeled to an oil/water separator. All water from the oil/water separators would be skimmed prior to discharge. Discharges from the oil/water separators will meet effluent discharge limitations.

Sumps would be excavated on the floor of the mine and all groundwater flow and precipitation would be channeled into sumps. Measures would be implemented to prevent surface runoff from entering the open pit and from adding to the volume of groundwater inflow and direct precipitation.

Erosion control operations would be performed under favorable weather conditions. When excessive moisture or other unsatisfactory conditions prevail, the work would be stopped. Erosion control materials will not be applied in adverse weather conditions which could affect their performance. Erosion control will be accomplished by using one of the following:

- Erosion control blankets
- Geotextile fabric
- Seeding

Before placing the erosion control blankets the subgrade will be graded smooth with no depressions or void areas and would be free from obstructions, such as tree roots, projecting stones or other foreign matter. No vehicles will be permitted directly on the blankets. Before geotextile fabric is placed the subgrade shall be compacted and graded level with no depressions, voids, soft or uncompacted areas and shall be free from obstructions, such as tree roots, projecting stones or other foreign matter. Seeding shall then be applied to the areas.

14.5.1 Stormwater Management

Stormwater runoff will be managed by a combination of the following:

- Slope Drain
- Energy Dissipators
- Diversion of Run-on

- Temporary Diversion Dike
- Grass-lined Channel
- Trench Drain
- Drop Inlet
- In-Stream Diversion Techniques
- In-Stream Isolation Techniques

Slope drains will be used to intercept and direct surface runoff or groundwater into a stabilized watercourse, trapping device, or stabilized area. Slope drains will be constructed with pipes or lined channels that convey surface runoff down slopes without causing erosion. Subsurface drains will be constructed from tile, pipe, or tubing and will be used to improve drainage and stabilize slopes in areas with saturated soils.

Energy Dissipators consisting of outlet protection and velocity dissipation devices such as rock riprap, stone, or concrete flow spreaders will be placed at the outlet of drainage culverts and channels to reduce the velocity and/or energy of water exiting at those points.

Diversion channels, drainage swales, and lined ditches are all structures designed to intercept, divert, and convey surface runoff to prevent erosion and reduce pollutant loading. These structures will be used to convey runoff down sloping land or divert runoff away from a sensitive area to avoid erosion. These structures will be used to direct runoff to a stabilized watercourse, drainage pipe, channel, or sediment-trapping device.

Drainage swales and lined ditches are drainage channels lined with grass, riprap, asphalt, concrete, or other materials. Drainage swales will be designed to convey runoff without causing erosion.

A temporary diversion dike is a low berm or ridge of compacted soil that channels water away from a steep slope or embankment and toward a desired location. Earth dikes will be stabilized with vegetation.

Grass lined channel will be designed to provide protection to resist channel and streambank erosion and will be used when channel soils may subside or shift after installation.

Trench drains construction with or without perforated pipe and filter fabric will be installed to intercept and divert shallow seepage away from the face of a streambank or divert surface runoff in a situation where a drainage swale or temporary diversion dike is not appropriate.

Drop inlets will be used to convey concentrated overbank runoff to the toe of slope by installing a drop inlet at the top of slope that daylight at the toe of slope. This practice would be used for large amounts of surface runoff (typically up to 200 cfs) across a steep, high slope/embankment. Small amounts of runoff flowing across a relative intact slope would be handled with a diversion dike and slope drains.

In stream diversion would be used as a temporary bypass through a pipe, flume, or excavated channel to channel water flow around work areas. Stream diversion would commonly be used during culvert installation or replacement. Where possible, a stream diversion would be the first choice to control erosion and sediment during the construction of culverts or other in-stream structures.

In-stream isolation would consist of a temporary structure built in a waterway to enclose a construction area and reduce sediment pollution from construction work in or adjacent to water. The structures may be made of rock, sand bags, wood or water-filled geotextiles (aqua barriers). During construction in a watercourse, these structures are designed to reduce turbidity and sediment discharge.

14.6 Overburden Management

Improper management of overburden spoils could increase sediment discharge to surface water and result in acid mine drainage after closure.

To minimize excessive land consumption and the associated clearing of forested areas, spoil piles will be located in mined out areas in the open pit. Initially spoils will be disposed in above ground areas determined to be free of economic grade ore. However, as mining progresses, spoils will be disposed in mined out areas as part of the progressive reclamation. Spoil piles will be periodically watered to minimize dust emission. In addition, all spoil piles will be surrounded by a soil containment berm to preclude the easy flow of surface runoff and sediment. The containment berm will be constructed of soil pervious enough to enable the passage of surface runoff water while trapping sediment contained in that runoff. The height and slopes of each spoil pile will be such that foundation and slope failures do not occur. Spoil piles will be seeded and revegetated after closure. The locations of the spoil piles are shown on Figure 56 and are located to minimize encroachment on water courses.

14.7 Terrestrial Resources

Temporary and permanent alteration of terrestrial habitats will be minimized to the extent feasible and be consistent with the requirement to protect and preserve critical habitat. Recommended management strategies will include:

- Siting site roads and facilities in locations that avoid impacts to critical terrestrial habitat, and planning exploration and construction activities to avoid sensitive times of the year;
- Minimizing disturbance to vegetation and soils;
- Implementation of mitigation measures appropriate for the type of habitat and potential impacts including, for example, post-operation restoration (which may include baseline inventories, evaluations, and eventual rescue of species), offset of losses, or compensation of direct users;
- Avoiding or minimizing the creation of barriers to wildlife movement, or threats to migratory species (such as birds) and providing alternative migration routes when the creation of barriers cannot be avoided;
- Planning and avoiding sensitive areas and implementing buffer zones;
- Conducting activities such that the risk of landslides, debris or mud flows, and bank or alluvial fan destabilization is minimized;
- Implementing soil conservation measures (e.g. segregation, proper placement and stockpiling of clean soils and overburden material for existing site remediation); key factors such as placement, location, design, duration, coverage, reuse, and single handling will be considered;
- Where topsoil is pre-stripped, it will be stored for future site rehabilitation activities. Topsoil management will include maintenance of soil integrity in readiness for future use. Storage areas will be temporarily protected or vegetated to prevent erosion;

Figure 56 - Location of Spoil Piles and Tailings Pond

- Conserving the quality and composition of growth medium for use (e.g. for capping) during site reclamation and closure activities;
- Ensuring that the growth medium is sufficient to support native plant species appropriate for the local climate and consistent with proposed future land uses. Overall thickness of the growth medium will be consistent with surrounding undisturbed areas and future land use; and
- Managed vegetation growth along site roads and at permanent above-ground facilities. Removal of invasive plant species and replanting of native species. Vegetation control will employ biological, mechanical and thermal vegetation control measures and avoid the use of chemical herbicides as much as possible.

If it is demonstrated that the use of herbicides is required to control vegetation growth along site roads or at facilities, then personnel will be trained in their use.

The Project footprint would optimize the use of areas which were previously cleared for earlier exploration and mining operations and clearing would be minimized to the extent practicable.

The area will be revegetated with indigenous species or any other species that may be approved in writing by the Guyana Forestry Commission after completion of mining as part of the Closure Plan. Primary and secondary site roads will be identified and site roads no longer needed would be closed to employees. The revegetation program will be tested on these closed roads to develop an appropriate revegetation program. The company will enact a policy to ensure no plants or wildlife is removed from the mine site. In addition employees will not be permitted to bring plants and wildlife from other areas to the mine site.

New vegetation will be planted around production facilities and along site roads to mitigate the impact on terrestrial resources. Vegetated corridors will be maintained and gradually removed during construction to enable wildlife present in the area to relocate to adjacent areas. Construction rates will be monitored in relation to the time it will take for animals to move away from construction areas and construction works will be programmed, based on the results of that monitoring, to occur in a manner slow enough to ensure that animals can move to other locations. Construction of the tailings ponds will progress in the direction of stream flow to enable aquatic organisms to vacate the area. Process plant and other buildings and facilities will be sited within areas which were previously cleared for earlier mining operations. The footprint of areas identified for the tailings ponds and the open pit together with the site roads will be minimized.

Particular attention will be paid to vulnerable or conservation-worthy plant and animal species that will be affected and conservation measures will be enforced in consultation with the EPA Biodiversity Unit. Wildlife will be restricted access to cyanide-solution ponds, by erecting fences at strategic locations, if monitoring indicates significant occurrences of deaths associated with ingestion of water from the tailing pond and related water management facilities. In addition, all discharges from these facilities will be monitored to ascertain that discharges are safe for fish, as well as people. The company will restrict hunting for wildlife in the project area of influence by non-indigenous peoples. Access to the concession by non-indigenous persons, not employed by the project, will be restricted and the workforce will be educated about the consequences of hunting. Pharsalus Gold Inc will also establish a reporting mechanism for hunting incidents within the concession.

14.8 Openpit Management

Improper design of the mine pit coupled with improper mine operation may result in slope failure and pose threats to workers health and safety and equipment.

Mine walls will be designed based on the results of detailed geotechnical and geohydrological investigation with slopes to preclude slopes failures and slides. Excavated soil will not be stored at the crest of slopes. Ramps into the mine pit and roads within the pit will be wide enough to allow for the passage of two vehicles with slopes generally acceptable for the operation of those vehicles.

Discharge of contaminated water through the floor of the mine can result in groundwater contamination. Equipment will not generally be serviced in the mine pit. Vehicle and equipment servicing will be restricted to emergency repairs only. In the event of emergency repairs, work will be undertaken to ensure there are no oil and/or fuel spills in the pit.

Groundwater inflow and precipitation can result in mine flooding.

Sumps will be excavated in mined out areas on the floor of the mine and all groundwater flow and precipitation will be channeled into the sumps. Pumps will be provided for mine dewatering based on the results of the hydrological analyses undertaken for the project. Berms will be maintained at the edge of open mine pits to prevent surface runoff from entering the open pit and from adding to the volume of groundwater inflow and direct precipitation.

14.9 Surface Water Management

Improper management of surface water can result in discharge of contaminated water and sediments to surface water and overtopping of the tailings and water management ponds.

All contaminated water will be directed to a water management pond. Liquid-based process wastewater will be channeled to the tailings pond. All water retention facilities will be provided with adequate capacity to contain the design rainfall event and to eliminate the likelihood and frequency of spills that may impact on downstream waters and on groundwater quality.

Site clearing operations will progress in a gradual and phased manner to ensure there are no large increases in sediment discharge. Sediment control structures will be used to prevent the inflow of sediment to surface water. These control practices will include sediment traps and screens to control runoff and sedimentation. Surface runoff from the workshop and other vehicle service areas will be channeled to oil/water separators. All water from the oil/water separators will be skimmed prior to discharge. The operations will monitor discharges to surface water upgradient and down gradient of the site.

The Tailings pond will be designed for the critical rainfall event. The top of the tailings pond will sit above surrounding ground level and will preclude runoff from the surrounding area from entering the pond. The pond would be provided with a minimum operating freeboard of 3 m which will allow for adequate containment of precipitation associated with the design rainfall event.

Water can exit the tailings pond as seepage through its embankment. Seepage controls will be provided in the design to maintain embankment stability, to decrease water losses and maintain water-quality at the site. Drains will be provided for seepage collection and all seepage collected in these drains will be pumped back into the process stream.

Precipitation data, topographic maps and stream flow measurements will be used during the design of the ponds to prepare hydrographs and frequency curves for use in estimating volumes of precipitation. Precipitation data from wet and dry years will be used to provide minimum, average, and maximum precipitation volumes to determine storage capacity for the ponds. The design of the ponds will include capacity to store precipitation incident on the ponds during rainfall. Surface runoff from other areas of the site will be channeled away from the tailings pond.

All storm water runoff will be channeled to the water management pond. Discharge from the water management pond will be via a spillway and will be channeled through a sediment control structure to remove sediment prior to discharge to surface water bodies in the site area. In some instances water from the water management pond will be discharged to augment water in the process circuit.

Openpit and water management and tailings ponds locations will eliminate flow in some streams/creeks.

The mine will be developed to ensure minimum disturbance to streams and creeks in the area. In instances where this cannot be avoided, these streams/creek will be diverted to ensure flow to downstream sections.

Infiltration through the base of the tailings and/or water management pond can negatively impact groundwater quality.

The tailings and water management ponds will both be provided with impervious liners. No direct discharge to surface water would be permitted from any of the ponds that constitute a part of the process circuit.

14.10 Domestic and Industrial Wastewater

The Mining Regulations stipulate that any area of water containing poisonous or injurious chemical solutions used in the treatment of gold must be fenced in any effective form to prevent inadvertent access thereto, and notice boards should be erected in suitable places warning persons from making use of such water and in no case should water containing any poisonous or injurious chemical solutions be permitted by a claim holder or his agents to knowingly escape or enter any river, creek, race, lake, reservoir, or any stagnant water without having been previously rendered innocuous.

The design of the onsite sewage treatment facilities will be in compliance with the applicable requirements of the 2008 Guyanese septic tank standards.

Although not specific to mining, the GNBS and EPA have jointly developed interim industrial effluent standard which will be met by the Project.

14.11 Tailings Pond Management

Improper design, construction and management of the tailing and water management ponds can lead to embankment failure and the discharge of contaminated water to the environment.

The World Bank OP 4.37 – Safety of Dams Requirements for Design and Review would be applied to the design, construction, operation, instrumentation and monitoring of the tailings dams. The tailings ponds will be designed to ensure stability of its embankment. Stability analysis will be performed of the embankment cross-section to optimize the structure with respect to cost and other objectives while maintaining reliability. Flow nets or an appropriate numerical method will be used to estimate seepage direction and volume and pore pressures at points within the embankment. A flow net is a graphical solution of Darcy's law to show steady flow through porous media and is used to show ground water flow. Finite-element and other analysis are also appropriate for predicting seepage direction and volume.

The analyses of the tailings pond embankment stability will consider the following failure modes:

- rotational slide
- overtopping
- foundation failure

- erosion
- piping
- liquefaction

Data for the analyses will be generated by conducting a detailed geotechnical investigation in the area proposed for the tailings pond and on materials identified for use as fill for tailings pond construction. The objective of the investigation will be to determine the geotechnical and hydrogeological conditions and characteristics of the subsurface soil and rock units as they affect the design of the structure.

The investigations will include the installation of vertical boreholes through overburden units and bedrock, soil sampling, rock coring, field testing of soil and rock samples, and laboratory testing of the recovered soil and rock samples.

The initial design of the tailings dam and other earth structures will be submitted to the EPA for review. The final design of the tailings pond will be submitted to both GGMC and the EPA for approval of these structures prior to project start up and the use of these facilities.

Monitoring and preventive maintenance would be undertaken to assure optimal performance of the tailings and water management ponds. Monitoring will consist of visual observation of the tailings embankment, and the monitoring of piezometers and other instrumentation installed to assess the performance of these facilities. Preventive maintenance will be undertaken at all potential trouble spots observed during visual inspection. The preventative maintenance will be geared primarily to ensure the stability of the structure and to control seepage through the embankment cross-section. A beach will also be maintained immediately adjacent to the upstream slope of the embankments to increase the length of the seepage path and the stability of the embankment slope.

Measurements and monitoring will be made after the occurrence of unusual conditions such as heavy surface runoff or peak floods. If the characteristics of the tailings and the construction method change substantially over the time the pond is in use, these changes may alter the conditions governing the stability of the embankment. Changes could occur in crest levels, water levels, embankment slopes, cross-section geometry, seepage conditions, and material characteristics. A continuous program of inspection and maintenance would therefore be undertaken from the beginning of deposition throughout the life of the pond. Through careful monitoring, areas of concern will be noted and quickly repaired, thereby preventing failure.

Visual monitoring will be done to identify typical distress signals associated with tailings pond operation, such as cracking, wet spots on the downstream face, and critical settlement. The visual observations will be supplemented by instrumentation to enable an accurate interpretation of the extent of any problem likely to occur. The instrumentation inclusive of piezometers, settlement plates and inclinometers will be used to show developing trends in the behavior of the tailings and water management ponds.

The instrumentation would be installed in the embankment and its foundation to monitor changes which are critical to the embankment stability, and to predict unstable conditions. Instruments will be installed to measure pore water pressures, seepage flows, embankment movements, and total pressures. Pore water pressure in soils will be measured with piezometers. Seepage flow emerging downstream from the embankment will be collected and directed to a weir for flow measurements. Seepage flows will be used to indicate when significant changes occur and to permit an evaluation of potential problems from piping.

Markers will be installed on the embankment surface and would be aligned in a straight line-of-sight to permit rapid detection of horizontal movement during surveys. In instances where cracks are visible on

the embankment surface, successive measurements between two stakes spaced either side of the crack will indicate any widening and acceleration in separation rate.

Slope indicators will also be used to measure horizontal movement of the embankment. The slope indicators works by telescoping cylindrical casing into the embankment during construction. A sensing element is lowered down grooves inside the casing and measures the slope of the casing in two directions at right angles. From the measured slopes, the horizontal movements occurring over the length of the casing can be calculated. Settlement will be measured by leveling of temporary benchmarks.

The frequency of monitoring will depend on previous observations and on the critical nature of the parameters. The frequency of monitoring will be more pronounced during and immediately after construction. When records indicate that conditions are relatively stable, the frequency of monitoring will be extended.

14.12 Tailings Management Guidelines and Recommendations

A recognized expert firm with extensive experience and a positive track record in tailings management would undertake the geotechnical investigation and design the tailing and water management ponds prior to the commencement of construction activities at the site. In addition, a recognized expert firm would provide quality control/quality assurance (QA/QC) services to Pharsalus Gold Inc during the construction phase and supervise the installation of embankment and foundation monitoring instrumentation.

Pharsalus Gold Inc will develop a site-specific Tailings Management Plan as part of the final design phase of the Project. The tailings management strategies will consider how tailings are to be handled and disposed of during operation, in addition to permanent storage after decommissioning. Strategies will be developed in full consideration of the site topography, downstream receptors and the physical nature of tailings (e.g. projected volume, grain size distribution, density, water content, among other issues).

In particular, the Tailing Management Plan (TMP) development will explicitly include review and consideration of the lessons learned from the Omai Mines incident due to the high sensitivity of many stakeholders to this issue. The TMP would include a synthesis of these lessons and the steps to be taken to mitigate and where possible avoid identified weaknesses of the Omai management system.

The TMP will include details on the management organization and roles, as well as the required qualifications and competencies for tailings operators and a training plan. The TMP will include an Operating Manual and Contingency Plan, both written in clear and concise language.

Recommended tailings management strategies will include:

- Design, operation, and maintenance of structures according to specifications of ICOLD3 and ANCOLD4, or other internationally recognized standards based on a risk assessment strategy.
- Appropriate independent review will be undertaken at design and construction stages with ongoing monitoring of both the physical structure and water quality, during operation and decommissioning;
- Where structures are located in areas where there is a risk of high seismic loadings, the independent review will include a check on the maximum design earthquake assumptions and the stability of the structure to ensure that the design is such that during seismic events there should be no uncontrolled release of tailings;
- Design of tailings storage facilities will take into account the specific risks/hazards associated with geotechnical stability or hydraulic failure and the associated risks to downstream economic assets, ecosystems and human health and safety.

- Environmental considerations will also consider emergency preparedness and response planning and containment/mitigation measures in case of catastrophic release of tailings or supernatant waters;
- Any diversion drains, ditches, and stream channels to divert water from surrounding catchment areas away from the tailings structure will be built to the flood event recurrence interval standards outlined elsewhere in this Section;
- Seepage management and related stability analysis will be a key consideration in design and operation of tailings storage facilities. This is likely to require a specific piezometer based monitoring system for seepage water levels within the structure wall and downstream of it, which will be maintained throughout its life cycle;
- Consideration of zero discharge tailings facilities and completion of a full water balance and risk assessment for the mine process circuit including storage reservoirs and tailings dams.
- Consideration of use of natural or synthetic liners to minimize risks;
- Design specification will take into consideration the probable maximum flood event and the required freeboard to safely contain it (depending on site specific risks) across the planned life of the tailings dam, including its decommissioned phase;
- Where potential liquefaction risks exist, including risks associated with seismic behavior, the design specification will take into consideration the maximum design earthquake;
- On-land disposal in a system that can isolate acid leachate-generating material from oxidation or percolating water, such as a tailings impoundment with dam and subsequent dewatering and capping. On-land disposal alternatives will be designed, constructed and operated according to internationally recognized geotechnical safety standards; and
- Riverine (e.g. rivers, lakes, and lagoons) disposal is not considered good international industry practice and will not be considered by the Project.

In order to reduce the use of the TMA by wildlife, the following criteria will be applied (after Donato et al., 2007):

- Reduce supernatant area;
- Thicken tailings to prevent supernatant formation;
- Screen decant ponds;
- Line dam walls with steep-sloping high-density polyethylene;
- Remove nearby vegetation surrounding or overhanging water;
- Remove standing trees and logs within TMA;
- Avoid supernatant resting against dam walls;
- Avoid uneven dam floors that form islands; and
- Avoid the formation of shallow flats.

The TMA will be designed for the critical rainfall event. The top of the TMA would be situated above surrounding ground level to prohibit runoff from the surrounding area from entering the pond. The TMA would be provided with a minimum operating freeboard of 3 m which should allow for adequate containment of precipitation associated with the design rainfall event.

14.13 Hazardous Material Management

Improper handling of hazardous materials could result in discharge to the environment. Hazardous materials at the mine site are expected to include cyanide, tailings with various percentages of cyanide, waste oils and grease from work shop operations and from vehicle. Hazardous materials will be located in secure storage facilities on-site to prevent accidental release and to protect against rainfall that may result in contaminated run-off and leaching. All storage areas for hazardous material will be concreted to provide an impervious surface and to prevent uncontrolled discharges to groundwater. Material Safety

Data Sheets (MSDS) will be kept on site and all measures to contain spills of hazardous materials shall be in accordance with the procedures therein. No rainfall would be allowed to percolate through areas where hazardous materials are stored and no uncontrolled run-off will be permitted from these areas. Stormwater from areas around storage facilities will be channeled to the water management pond.

Incompatible substances that can react upon mixing to generate heat, fire, gas, explosion, or violent polymerization will not be located within proximity of each other. Hazardous material will be disposed of in accordance with guidelines established by the EPA. Cyanide and cyanide waste will be managed in accordance with the cyanide management plan detailed below.

14.14 Explosives Management

Explosives will be stored in a magazine manufactured to conform to U.S. Government specifications. The Explosive Storage magazine would be designed to be bullet, fire, weather and theft resistant. It would be manufactured from high quality heavy gauge steel with plywood or hardwood lined interiors and would be properly ventilated.

Placards will be posted on or near each magazine door, specifying explosive and personnel limits and general safety precautions that would be observed during work in the magazine. Vegetation around the magazine would be controlled to minimize potential damage. At least two fire extinguishers would be provided and maintained for immediate use by personnel working around the magazine. The purpose of these extinguishers would be to fight small external fires or magazine fires that do not involve explosives.

Explosives would be stored on shelves in the magazine. Explosives and explosives containers in storage would be positioned safely and securely. If explosives containers are stacked, they will be placed in stable arrays. Load limits will be established for shelves in the magazine. Materials will not be left suspended by booms, cranes, or hoists in the magazine.

Stored explosives will be segregated by lot designation. Stacks of explosives would be arranged so that air freely circulates to all parts of the stack. To prevent moisture accumulation, pallets would be used to ensure that containers are not stacked directly on the magazine floor. Aisles shall be wide enough to accommodate inspection, inventory, sampling, and materials handling operations in the magazine. Unobstructed aisles will be maintained to permit rapid exit of personnel.

The magazine will be locked at all times except when permissible operations are in progress or when opened for ventilation. Personnel will be present whenever the magazine is open for ventilation. All exit doors will be unlocked and open when personnel are working in the magazine.

The explosive magazine will be inventoried annually to determine the total weight of explosives present and to remove and destroy materials that are not properly identified or labeled.

Empty containers, tools, conveyors, lift trucks, skids, etc. would not be stored in the magazine. Combustible materials such as packing materials and boxes will not be stored in the magazine. Flammable liquids will not be stored or used in the magazine unless the liquid is an explosive or is needed as an explosives-wetting agent, or is an integral part of an explosives device.

Operations in and around the magazine will be prohibited when an electrical storm is in progress and minimized when it is evident that such a storm is approaching. Explosives handling operations will not be performed when magazine entranceways do not provide adequate footing. No operation involving hazardous materials will be permitted in the magazine. Only one container of explosives will be opened at one time in a magazine.

14.15 Cyanide Management

PGI will follow the International cyanide code as much as possible. Differences will however occur where facilities are inadequate in Guyana to support the full code. PGI is a fully owned subsidiary of Troy Resources which is an ISO 14001 accredited operator in Argentina and a voluntary member of the Australian Code of Environmental management.

PGI will monitor both free and Weak Dissociable (WAD) Cyanide in tailings. Automatic cyanide samplers will be installed in a minimum of 2 tanks in the leach train. The amount of cyanide solution entering the leach system will be monitored both manually and automatically every 2 hour, both for strength and flow rate which will be adjusted to maintain the required level of cyanide through the leach tanks to maximize economic recovery. This will allow for quick calculation of the total cyanide in the system at any time. The gravity circuit will be part of the plant and will assist in lowering the overall amount of cyanide used.

The pulp in the leach system will be sampled on a 2 hourly basis to check density which then also will give the actual amount of solution in the circuit. The overall feed rate or discharge rate of pulp into the plant or out to the tailings dam will be measured using a Nucleonic device giving flow rate and density.

Since the plant is being built to incorporate an INCO/Air detoxification circuit, tailings will pass via tanks where Sodium Metabisulphate (SMBS) and a small amount of copper sulphate would be added to the tailings. The copper sulphate will act as a catalyst to lower the cyanide level in the tailings to at or below permissible for discharge. The normal process would be to fill one tank and to add the chemicals while a second tank is being agitated and given time for the reaction to complete. Final cyanide levels in the tailings will be measured before release to the tailings dam.

The transportation, storage, use and disposal of cyanide at the mine can be hazardous both to human health and the environment. Cyanide use would be consistent with the principles and standards of practice of the International Cyanide Management Code. The Cyanide Code includes principles and standards applicable to several aspects of cyanide use including its purchase (sourcing), transport, handling and storage, operational use, facilities decommissioning, worker safety, emergency response, training, and public consultation and disclosure. The Code is a voluntary industry program developed through multi-stakeholder dialogue under the auspices of the United Nations Environment Programme and administered by the International Cyanide Management Institute.

Best Management Practice (BMP) techniques will be adopted to minimize the risk of environmental damage from accidental cyanide release. The main goals of the BMP will be to:

- Minimize the amounts of cyanide required for gold recovery;
- monitor all operations, discharges and the environment to detect any escape of cyanide and subsequent impacts of that release;
- ensure a full understanding of the actual and potential hazards and environmental impacts of cyanide use;
- maximize the recovery of cyanide or to ensure its destruction;
- construct physical containment facilities to control spills or leaks of cyanide;
- to dispose of cyanide in a way that minimizes environmental impacts; and
- to keep adequate records of cyanide use.

Clear responsibility will be established for all phases of cyanide use, including transportation, storage, use and disposal. Cyanide levels in the tailings will be reduced by passage through an agitated cyanide destruction tank. In this tank the residual cyanide content would be reduced below permissible levels through oxidation, using SO₂-air process.

The Mining Regulations also specify the following requirements for use of cyanide:

- All vessels or plants used for the cyanide process should be fitted with mechanical agitators and hoods or other appliances of such a nature that the fumes generated in such vessels should be carried directly to the external air at a distance approved by the GGMC;
- Cyanide facilities should be located downwind or in any other wind of all residences so that such residences are not unduly disturbed;
- An adequate supply of wholesome drinking water is to be provided in each premises or place where cyanide or any preparation containing cyanide is used, and this supply should be distinctly labeled Drinking Water; and
- Cyanide used in any mining or milling process is required to be kept in a separate compartment specially set aside for the storage of cyanide with the compartment being locked and in the care of a person duly authorized by the manager and no person is authorized to remove from a claim or mine any cyanide without having obtained the written permission of the manager.

14.15.1 Acquisition

Cyanide shall be purchased only from manufacturers employing appropriate practices and procedures to limit exposure of their workforce to cyanide and to prevent releases of cyanide to the environment.

14.15.2 Transport

The transport of cyanide will be performed to ensure protection of all communities and the environment during transport. Clear lines of responsibility will be established for all aspects of transport including the safety, security, release prevention, personnel training and emergency response procedures in event of unplanned releases. The mines manager will identify personnel responsible for each aspect of cyanide transport. The transport aspects will include as follows:

- packaging & labeling
- storage and security at port of entry,
- transport to the operation,
- unloading at the operation,
- safety training
- security during transport,
- emergency response during transport.

The Emergency Response Plan addresses spill response scenario during transport to the site. All personnel involved in cyanide transport would be trained prior to the commencement of operations and would also be given periodic refresher training in the use of the equipment and in the implementation of the Emergency Response Plan.

Warning signs will be posted on all transport equipment alerting workers of the presence of cyanide and that smoking, open flames, eating and drinking are prohibited. In addition, workers will be required to wear cyanide-specific personal protective equipment. Security measures, such as lockouts on valves and fenced and locked storage of solids, would be provided at all transshipment points and at interim storage sites.

Storage of both solid and liquid cyanide would be separate from incompatible materials such as acids, strong oxidizers and explosives. All contact with low and neutral pH water would be prevented during shipping. Storage facilities will have spill containment capacity at least equal to 120% of the capacity of

the storage area and personal protective equipment and clean-up materials appropriate for the type and amount of cyanide stored would be provided at all storage locations.

High-risk sections of the route to the site, such as river and stream crossing and areas of highly pervious soil, would be identified and evaluated to determine the need for special precautions in these areas. Communities in the area will be consulted and all applicable governmental/EPA transportation related and emergency response procedures would be considered to prevent and respond to any releases during cyanide transport.

The company road safety program for all cyanide transport vehicles will include, but not be limited to, vehicle and tire inspections, preventive maintenance, limitations on drivers hours, tie-down procedures for solids, and procedures by which transportation can be suspended if severe weather conditions are encountered. Vehicle operators will retain records to document that these activities have been conducted. The company will also implement inventory and/or chain of custody documentation procedures to identify the loss of any cyanide material during transport.

All transport vehicles will be provided with emergency communications capability to ensure timely communication. Any spills/releases will be immediately reported to the Mines Manager who will immediately inform all potentially impacted communities, relevant government agencies and the company's designated emergency response team.

14.15.3 Handling and Storage

The company will design and construct unloading, storage and mixing facilities consistent with sound and accepted engineering practice and will employ quality control/quality assurance procedures and spill prevention and containment measures to protect workers and the environment during cyanide handling and storage.

To the extent practicable, all unloading and storage areas for liquid and solid cyanide would be located away from people and surface waters. Where this is not practicable, the potential for release to surface water and/or human exposure associated with the storage location would be evaluated and the operation would implement protective measures to prevent or minimize these potentials. The protective measures will include automatic sensors and alarms for hydrogen cyanide gas, additional containment structures, and specific emergency procedures for evacuation and response.

Unloading of all cyanide would be done on a concrete surface that can prevent leaks from coming in contact with the environment. An automatic level indicator, high-level alarm, or integrated tank and tanker valve-shutdown device will be provided on all cyanide storage tanks to prevent overfilling. Direct observation of tank levels or use of a manual gauging rod would not be done to prevent overfilling of cyanide storage tanks.

Storage areas for cyanide would be well ventilated to prevent the build-up of hydrogen cyanide gas. Measures would be put in place to minimize the potential for contact of cyanide with water. These measures will include storage in covered enclosures and off the ground or in secure containers.

The public and workers not directly involved in cyanide operations will be prohibited from accessing cyanide storage areas by a fenced boundary or by storing cyanide within a separate fenced and locked area of the plant. Cyanide would be stored separately from incompatible materials such as acids, strong oxidizers and explosives with berms, bunds, walls or other barriers that will prevent mixing.

Cyanide storage and mixing tanks would be located on a concrete surface to prevent seepage to the subsurface. Secondary containment would be employed to contain releases from these tanks as well as any precipitation that may come in contact with cyanide. The secondary containment will allow for

recovery and return to the cyanidation process or proper disposal. Secondary containments used for this purpose would be constructed of concrete, plastic or other materials demonstrated to provide a competent barrier to leakage. All containments will be sized to hold 120 % of the volume of the largest tank within the containment and any piping that drains back into the containment.

Cyanide storage and mixing tanks and related pipeline would be constructed or coated with materials that are compatible with cyanide and high pH conditions. Tanks and pipelines would be clearly identified as containing cyanide. The direction of flow would also be indicated on pipelines. Cyanide-specific first aid and emergency response equipment would be readily available for use at unloading, storage and mixing locations, including high-pH water for decontamination of exposed workers, oxygen and a resuscitator and appropriate personal protective equipment. An antidote for cyanide poisoning will also be available. Workers involved with unloading, storage and mixing of cyanide would be trained in the use of emergency rescue equipment and in the first aid procedures for responding to cyanide exposures.

Spill neutralization and clean-up equipment would be available for use at unloading, storage and mixing locations. This will include water for cleaning spills of liquid cyanide, shovels for cleaning up spills of solid cyanide, and chemicals to treat or neutralize cyanide and cyanide-contaminated soils, as well as cyanide-specific personal protective equipment. Personnel engaged in unloading, storage and mixing activities would be trained in the operation's procedures to respond to cyanide spills, including notifications, clean up and detoxification.

Storage areas, pipelines, pumps, valves and tanks would be inspected at least once monthly for evidence of leakage, presence of solution in secondary containments and integrity of the containment. Deficiencies would be noted and records would be retained documenting the inspection and the implementation of necessary corrective measures.

Empty cyanide containers would not be reused on or off the mine site for any purpose other than holding cyanide. Prior to their disposal or reuse, cyanide drums would be rinsed with high-pH water three times, and the rinse water would be added to the cyanidation process. The rinsed drum would then be crushed and placed in the onsite landfill. Plastic bags and liners would also be triple-rinsed prior to disposal. Wooden containers would be burned or disposed of in the spoil pile area.

14.15.4 Operations

All cyanide related facilities would be inspected on an established frequency sufficient to assure and document that they are functioning within design parameters. Tanks holding process solutions would be inspected for structural integrity and signs of corrosion and leakage. Secondary containments would be inspected for their integrity, the presence of fluids and their available capacity, and to assure that drains are closed and, if necessary, locked, to prevent accidental releases to the environment. Leak detection and collection systems at ponds would be inspected as required. Pipelines, pumps and valves would be inspected for deterioration and leakage. Ponds would be periodically inspected to ensure available freeboard and the integrity of embankment.

Facility inspections would be documented on inspection forms and in log books and would include the date of the inspection, the name of the inspector, and any observed deficiencies. The nature and date of corrective actions also would be documented.

Preventive maintenance programs would be implemented to assure the continuous functioning of equipment and devices that are necessary for cyanide management. Pumps, pipelines, and cyanide treatment, destruction and regeneration equipment would be regularly maintained so that failures do not

result in worker exposure or releases to the environment. Preventive maintenance activities would be documented.

The operations would have a source of emergency power for pumps and other equipment when their primary power supply is interrupted to prevent unintentional cyanide releases and worker exposures. Back-up power generating equipment would be maintained and tested to ensure its availability if needed. The operations will use bottle roll or another test procedure to determine the optimal rate of cyanide addition for the process. The rate of addition would be reevaluated and adjusted as necessary when changes in ore type or processing plant practices occur that effect cyanide requirements.

Unintentional releases will be prevented by maintaining adequate freeboard in tailings storage facilities. All facilities will be inspected and monitored to determine the accuracy of the water balance and to assure the facilities operates as designed. This will prevent an over-accumulation of water that can result in overtopping, unplanned discharge into the environment, and potential structural failure of the facility.

Tanks holding process solutions such as leaching vessels, CIL tanks and cyanide tanks associated with cyanide regeneration activities would be located on concrete to restrict seepage of spilled solution or leakage to the subsurface. Secondary containment would be provided for a potential failure of cyanide process solution tanks, with provisions for recovery of released solution such that adverse impacts on surface or ground water are prevented.

Spill prevention or containment measures would be provided for pipelines transporting process solution. These measures will include secondary containment ditches, differential pressure sensing with alarms and/or automatic shutoff systems, or preventive maintenance programs with pipe thickness measurements. Cyanide process tanks and pipelines would be constructed or coated with materials that are compatible with cyanide and high pH conditions. Tanks and pipelines would be clearly identified as containing cyanide. The direction of flow would be indicated on pipelines.

Facilities for the management of cyanide would be constructed according to accepted engineering standards and specifications. Quality control and quality assurance programs would be implemented during construction of new facilities and modifications to existing facilities to assure their structural integrity and their ability to safely contain process solutions and solids.

The quality control and quality assurance program would address the suitability of the materials of construction and the adequacy of soil compaction for earthworks such as tank foundations and earthen liners. Quality control and quality assurance procedures would also be implemented for installation of synthetic membrane liners used in ponds, for pipes, pipe fittings, for welds and bolts on cyanide storage and process tanks, and for any other equipment containing cyanide. Records would be retained to document that the specified quality control and quality assurance procedures have been followed.

Holding facilities and compounds will be designed and maintained to ensure the storage areas are adequately ventilated to disperse any build up of hydrogen cyanide gas to minimize the possibility of contact with water. In addition all storage areas will be bunded and will be located well away from natural drainage channels. Cyanide will be stored separately from corrosive, acidic and explosive materials. The storage area will be fenced and locked to prevent accidental entry or access by unauthorized individuals. The storage area will also be designed to be fire resistant and will be provided with adequate fire fighting capability. In addition, all vegetation will be cleared from the storage area to decrease the likelihood of fires.

An inventory will be maintained of all quantities stored and any loss will be immediately reported to the mines manager and to GGMC.

The company will deploy a system to enable rapid determination of cyanide concentration in any waste water discharged from the site. One of the following systems will be deployed.

- Cyanide Ion Specific Electrode
- Canfield Cyanide Testing System
- Basic Color-Disc Field-Test Kits

14.15.5 Worker Safety

Operators undertaking operations involving cyanide use will wear appropriate protective clothing. For respirable forms of cyanide, a full face respirator would be worn. Since cyanide can be absorbed through skin, for liquid cyanides, worker would wear disposable coveralls, PVC gloves and waterproof boots. Workers will wash their hands before eating, drinking or smoking. Contaminated protective gear and clothing would be securely discarded, or washed before being stored and re-used. Operators will be protected through a monitoring and sampling program for airborne contaminants in confined spaces. Sampling for hydrogen cyanide gas will either be undertaken continuously, using electronic detection equipment, or batch sampling will be done using air pumps and sampling tubes.

Operators will work in pairs with one acting as a 'sentry' during all operations. The role of a sentry will be clearly defined and will be primarily to act as a passive observer of any cyanide handling process. The sentry will participate in the handling process only in the event of an emergency. Cyanide handling operations will include the following:

- opening storage containers;
- dissolving sodium cyanide pellets; and
- cleaning-up cyanide spillages.

Should an operator be exposed to cyanide, effective and timely medical care will be provided. All personnel would be required to be familiar with the treatment procedures for personnel affected by cyanide exposure presented in the box below. The treatment of cyanide poisoning will fall into two categories.

1. Patients who are conscious
2. Patients who are unconscious

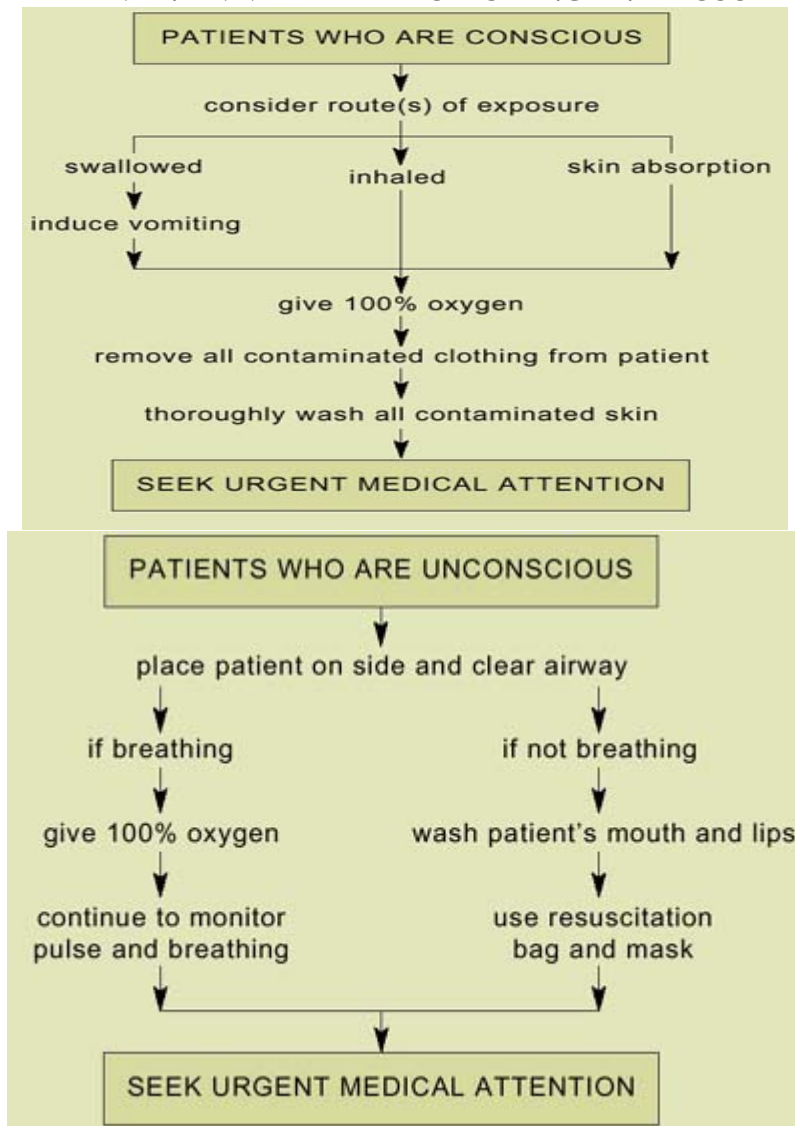
Treatment for both categories will be undertaken swiftly and efficiently by well trained and properly equipped personnel.

14.15.6 Emergency Response

Detailed emergency response plans for potential cyanide releases are presented in Section 14.19. The plans detail the involvement of site personnel and stakeholders in the planning process. It identifies and designates the appropriate personnel, equipment and resources to be mobilized in the event of a cyanide spill and details the procedures for internal and external emergency notification and reporting.

The emergency response plans also incorporate monitoring elements and remediation measures that account for the additional hazards of using cyanide treatment chemicals and entails periodic evaluation and revision of response procedures and capabilities, if required.

FIRST AID TREATMENT IMMEDIATELY FOLLOWING AN EXPOSURE INCIDENT



14.15.7 Worker Training

All workers involved in cyanide handling would be trained to understand the hazards associated with cyanide use. Workers will also be trained to operate the facility according to systems and procedures that protect human health, the community and the environment. Training will also be provided to workers to respond to both worker exposures and environmental releases of cyanide.

14.15.8 Decommissioning

All cyanide handling facilities will be decommissioned in accordance with the Closure Plan (Section 18). All cyanide handling facilities will be effectively decommissioned to ensure protection of human health and the environment and wildlife. PGI will also establish an assurance mechanism capable of fully funding cyanide-related decommissioning activities.

14.16 Waste Management

Improper disposal of waste could result in releases to the environment and the presence of vectors and vermin at the site. Non-hazardous solid wastes such as household and non-process related industrial waste would be managed according to the recommendations presented in the IFC General EHS Guidelines. Non-hazardous solid waste should be collected for recycling or disposal at an approved sanitary landfill constructed onsite. No other solid wastes or liquid wastes would be mixed or disposed of together with waste rock or overburden.

The following waste will be generated by the project:

- overburden during mining
- tailings from the processing operation
- solid waste, including food waste from the camp operations
- septic waste from the camp operations

Overburden will be placed in spoil piles in the mined out area. All tailings and other process waste will be placed in the tailings pond. The coarse fraction of the tailing waste, recovered from the gravity circuit, will be used as hard capping for access roads.

Solid waste from the operation of the camp would be disposed of in secure areas designed in accordance with guidelines provided by the Guyana EPA. All food waste and organic matter will be composted and the composted material will be used as fertilizer for revegetation of the spoil piles after closure. Food waste would be stored so as not to attract vermin or generate odors that affect work or residential areas.

Septic waste will be managed by a series of septic tanks on site. Discharge from the septic tanks will be channeled through a granular filter bed prior to discharge. Septic tanks contents will be emptied as dictated by capacity constraints, and will be disposed in accordance with EPA guidelines.

14.17 Mine Waste Geochemical Characterization

The Mining operations will prepare and implement ore and waste geochemical characterization methods for proper routing of Potentially Acid Generating (PAG) materials and Acid Reduction Detection (ARD) management programs that include the following elements:

- Conducting a comprehensive series of accelerated leaching tests from feasibility study stage onwards, to evaluate the potential for ARD in all formations foreseen to be disturbed or otherwise exposed by the mine according to internationally recognized methodologies;
- Conducting comprehensive ARD/metals leaching (ML) testing/mapping on an ongoing basis with decreasing block size as formations are transferred from long to medium and short term mining plans;
- Implementation of ARD and ML preventive actions to minimize ARD including:
 - Limiting exposure of PAG materials by phasing of development and construction, together with covering, and/or segregating runoff for treatment; and
 - Implementation of water management techniques such as diverting clean runoff away from PAG materials, and segregating “dirty” runoff from PAG materials for subsequent treatment; grading PAG material piles to avoid ponding and infiltration; and removing pit water promptly to minimize acid generation.

- Controlled placement of PAG materials (including wastes) to provide permanent conditions that avoid contact with oxygen or water including:
 - Submerging and/or flooding of PAG materials by placing PAG materials in an anoxic (oxygen free) environment, typically below a water cover;
 - Isolating PAG materials above the water table with an impermeable cover to limit infiltration and exposure to air. Covers are typically less of a concern in arid climates where there is limited precipitation, and should be appropriate for local climate and vegetation (if any); and
 - Blending of PAG materials with non-PAG or alkaline materials will also be employed to neutralize acid generation, as appropriate. Blending would be based on full characterization of each of the blended materials, the ratio of alkaline materials to acid generating materials, the case histories of failed operations, and the need for static and long- term kinetic tests.

14.18 Land Reclamation

Land reclamation will reduce negative perceptions and impacts associated with open pit mining. All open-pit and spoil pile areas will be regraded to fit into the surrounding topography. Erosion controls would be applied around regraded areas to minimize soil loss prior to vegetation taking hold. Minimum compactive effort will be exercised during regrading to ensure that the soil compaction does not prevent stormwater infiltration. This will ensure the soil would be able to fulfill its diverse functions as a water reservoir, a biotope for plants and animals, and a basis of agricultural production. Regraded areas will be covered by humus to enhance conditions for revegetation. All streams that were temporarily diverted during the mining operations will be restored to their channels and cross-sections and berms will be provided adjacent to the reclaimed channels to preclude the easy flow of sediment into the restored waterways.

14.19 Fuel Oil Management

Spills of fuel oil could result in soil, surface and groundwater contamination. Fuel oil storage areas will be located well away from areas of fire hazard such as where welding operations will be performed. All fuel will be barged and/or trucked to site by secure fuel trucks and transferred into fuel storage tanks that are founded on impervious concrete surfaces. The fuel tanks will be housed within bermed enclosures. The enclosures will be sized to retain the contents of 120% of the tank in the event of tank failure. Discharge from fuel storage areas will be channeled to oil-water separators prior to being discharged to surface water.

Indiscriminate dumping of waste oil will not be permitted under any circumstances. Waste oil will be stored in suitable containers at designated points located around the Project site. All locations will be selected based on factors such as proximity to water, migration routes, fire risks and access. All waste oil storage areas will be provided with secondary containment to deal effectively with any leakage or spillage. All liquids, spent oils, fuels and lubricants will be collected and returned in drums to oil companies and/or to Bosai for fueling of their calcination operations.

14.20 Spill Contingency Plan

The spill contingency plan prepared for the project consists of two distinct plans; the Emergency Response Plan (ERP) and the Spill Prevention and Cleanup Control (SPCC) Plan. The elements of each plan are detailed below.

14.20.1 Emergency Response Plans

The objective of the Emergency Response Plan (ERP) is the protection of the communities and the environment in the project area of influence through the development of emergency response strategies and capabilities. This Emergency Response Plan details measures to respond to potential releases of tailings, process chemicals, process wastewater, fuel oils and/or other hazardous material. In addition it details emergency response procedures for potential release of hazardous material which is being transported to the site.

Examination of the proposed project has identified several possible scenarios which may require the activation of emergency response procedure. Emergency response actions will be needed for the following:

- Spills of fuel oil, cyanide or other hazardous material during road transport to the site;
- Releases of fuel oil, cyanide or other hazardous material during unloading and mixing;
- Releases of fuel oil, cyanide or other hazardous material during fires and explosions,
- Release of fuel oil, cyanide or other hazardous material due to pipe, valve and tank ruptures,
- Overtopping of tailings and water management ponds,
- Failure of embankment of the tailings and/or water management pond,
- Power outages and pump failures,
- Uncontrolled seepage through the embankment of tailings and/or water management pond.

This ERP describes specific response actions, as appropriate for each emergency situations identified above. The response actions include clearing site personnel and potentially affected communities from the area of exposure, notification to operational, management and response personnel, use of antidotes and first aid measures for chemical exposure, control of releases at their source, containment of releases, assessment of the release and mitigation, procedures to examine the cause of the release, and implementation of measures to prevent reoccurrence of releases.

The company will maintain an Emergency Response Center at the site. A primary and alternate Emergency Response Coordinator will be located at the site. The coordinators will have explicit authority to commit the resources necessary to implement the ERP. Emergency response teams would be identified and would be appropriately trained and prepared. After the commencement of construction, this ERP shall be extended to include call-out procedures and 24-hour contact information for the coordinators and response team members.

All personnel involved in mineral processing and process chemical management would be trained to recognize and respond to situations which can result in releases to the environment. The training will include identification of procedures to be followed if a chemical release is discovered, including notification of the appropriate site personnel, measures to assure worker safety, and methods to stop or contain the release, if possible.

The following list of equipment and supplies will be provided for response to emergencies.

- Earthmoving Equipment
- Mobile Generators
- Sand and Gravel
- Sand Bags
- Pumps
- Pipes
- Booms

- Absorbents

If there is a slowly developing emergency or unusual situation, where an emergency is not imminent, but could occur if no action is taken, (e.g prolonged and unseasonal rainfall and possible overtopping of the tailings/water management pond) the EPA, GGMC and Ministry of Natural Resources and the Environment (MNRE) will be notified. The Regional Democratic Council of Region 7, Kaburi Village and the relocated 14 Mile Issano community will be notified of the potential problem and will be kept advised of the situation. During these contacts, the agencies will be requested to indicate if there are any immediate actions that can be taken to reduce the risk of the emergency and if necessary, preventative actions will be implemented. An Emergency Response Coordinator will be assigned the task to continuously monitor the situation and to coordinate emergency action if required.

If an emergency is imminent, but has not yet begun, (e.g. failure of the outer section of tailings/water management pond embankment, but no releases) media houses in Region 7 and nationally would be alerted to inform residents of surrounding area and steps will be initiated to immediately advise communities and persons in the vicinity of the emergency to evacuate due to the potential release. The EPA, GGMC and MNRE will be notified. A single Emergency Response Coordinator will be tasked with responding to the potential release to minimize disparate utilization of resources. Equipment and personnel will be deployed to the maximum extent necessary to prevent the potential release to the environment.

If there is a release of fuel oil, cyanide or other hazardous material, all persons and communities downstream and downwind from that release will be notified immediately and efforts will be coordinated with others to reduce impacts associated with the release. The EPA, the GGMC and MNRE will be immediately notified. If a spill of fuel oil, cyanide or other hazardous material/waste enters waters adjacent to the access/haul roads, Kaburi Village, the relocated 14 Mile Issano and Guyana Water Inc. (GWI) will be added to the entities notified. An alternate water source will be provided to the Kaburi Village and to the relocated 14 Mile Issano community until analytical tests confirm that the water has again attained potable water quality standards.

All transport vehicles will be fitted with absorbent material and vehicle operators will be provided with a radio to maintain contact with the emergency response center. If there is a spill/leak of fuel oil, cyanide or other hazardous material onto roadways during transportation to/from the site prompt action will be taken to contain the leakage or spillage. All combustibles/ignition sources such as running engine, likely to result in fires will be removed from the vicinity of the spill and anyone in the area will be advised to stay upwind of the spill. Absorbent material in the transport vehicle will be used to cover small spills. The vehicle operator will immediately notify the Emergency Response Center which will assign an Emergency Response Coordinator to respond to the emergency.

A berm will be constructed around the spill area to control runoff to surface water. All soils impacted by the spills will be excavated from the spill area and disposed in accordance with the hazardous waste management procedures. In the events of spills to surface waters, fauna will be trapped and will be relocated to areas within close proximity of the site, which are the same ecologically as the spill area. Fishes will be trapped with nets and animals will be snared in traps designed to ensure that animals are not injured during trapping. The relocation of fauna impacted by accidental spills is expected to be a very infrequent occurrence and will have insignificant impacts on the areas to which the fauna is relocated. Spills of fuel oil will be responded to by the addition of surfactants and by retrievals with skimmers. Other chemicals, which cannot be recovered manually, chemically or by mechanical means will be allowed to naturally degrade by dilution and dispersion. During the degradation process water quality would be monitored in the spilled area. After monitoring determines that water quality has attained acceptable standards, sensitive fauna will be allowed to naturally reenter the area.

If an earthquake is felt in the vicinity, visual inspections shall be conducted of the tailings and water management facilities, process vessels and pipe network, containment facilities for chemicals and fuel, and sewerage management facilities immediately after. If damage has occurred, but is judged not serious enough to cause failure of any facility, the nature, location, and extent of the damage, as well as the potential for failure will be quickly observed. The EPA, GGMC and MNRE will be contacted and a description of damage, including the location, extent and rate and the associated effects on adjoining structures, prevailing weather conditions, and other pertinent facts will be provided.

If any of these facilities is damaged to the extent that a potential release to the environment is possible, the emergency imminent procedures will be immediately implemented. A close watch will be kept on the facilities for the next two to four weeks as some damage may not show up immediately after the quake. If there is overtopping of ponds, power outages and pump failures, uncontrolled seepage from the tailings or water management pond, and/or leaks from process vessels, all persons and communities downstream from the site will be notified immediately and efforts will be coordinated with others downstream to try and reduce impacts, if applicable. The EPA, the GGMC and MNRE will be immediately notified. The Emergency Response Center will assign an Emergency Response Coordinator to respond to the emergency. Emergency response procedures will replicate those for a spill during transportation of fuel oil, cyanide or other hazardous materials to the site.

Any time levels in the water management ponds exceed the design levels, these facilities will be inspected daily. If the water surface level rises to within 0.25 m of the crest of the facility the following will be immediately implemented:

- contact EPA, GGMC and MNRE
- discharge excess water from these facilities to surface water through sediment control structure
- monitor the receiving surface water body for sediment and chemical contamination
- notify downstream residents of the discharge, and perform the discharge in stages to reduce sediment and chemical inflows
- provide water to residents downstream of the discharge until water quality in the receiving waters returns to an acceptable standard.

14.20.2 Spill Prevention and Cleanup Contingency Plan

This Spill Prevention and Cleanup Contingency (SPCC) Plan will become effective coincident with the commencement of construction activities at the mine. Emergency Response Coordinators will have authority to expend funds and recruit employees to implement the Spill Prevention and Cleanup Contingency Plan. The SPCC Plan addresses the following:

- Operating procedures to prevent oil spills;
- Control measures which will be installed to prevent a spill from reaching navigable waters; and
- Countermeasures to contain, clean up, and mitigate the effects of any spill which discharges to surface or ground water.

This SPCCP also sets out an organized, planned, and coordinated course of action to be followed in case of a fire, explosion, or release of hazardous material which could threaten human health or the environment. The SPCC Plan would be implemented for on-site, as well as off-site releases that could threaten human health and the environment, even if the Emergency Response Coordinator does not believe that the spill will leave the site. The Plan deals with threats to facility personnel, as well as with threats to people outside the facility.

After the completion of construction works at the site, a site plan detailing the physical layout and a facility diagram will be appended to this SPCCP. The appended information shall include contact list and phone numbers for the Emergency Response Coordinator(s), the EPA, cleanup contractors, and other appropriate national and local agencies who will be contacted in case of a discharge. The SPCCP shall also be expanded to include a prediction of the direction, rate of flow, and total quantity of fuel oil/cyanide/hazardous material which may be discharged after a Hazard Assessment has been conducted for the process equipment failure.

An internal communication or alarm system capable of providing emergency instructions shall be maintained at the mine site together with a device capable of summoning external assistance (telephone or two-way radio). Portable fire extinguishers, fire control equipment, spill control equipment, and decontamination equipment will also be maintained at this location.

All fuel storage areas shall be founded on impervious surface and be sited in containment facilities designed to retain 120% of the tank contents. The containment may be either dikes, berms, retaining walls or curbs. Discharge from the containment area shall be directed into gutters which flow to oil-water separators prior to release to the environment. End-of-pipe water quality shall be monitored to ensure adherence to water quality. If there is a discharge from the fuel storage area to the environment, an Emergency Response Coordinator shall respond to that discharge and an alternate source of water will be provided to persons located downstream of the discharge.

Spills of fuel oils will be cleaned by mechanical methods, chemical dispersants, gelling agent or biological agents. The specific method to be used will depend on the quantity and location of the spill. Mechanical cleanup, using booms and skimmers, will be used to recover spills to surface water. Containment booms would be used to control the spread of spilled product and to concentrate the product in thicker surface layers to make recovery easier. In addition, booms will be used to divert and channel oil slicks along desired paths, making them easier to remove from the surface of the water. Skimmers would be used to recover spilled oil from the surface of the water. Skimmers will be either self-propelled or operated from the bank of streams/creeks. Chemical dispersants will be used to accelerate the breakup of fuel oil and refined product spills to surface water. Dispersants would be applied immediately following a spill, before the lightest materials in the oil have evaporated. The use of dispersants in freshwater would be authorized by the Emergency Response Coordinator only if it does not pose any threat to human health or the environment. Gelling agent will be used to respond to small spills of fuel oil. Gelling agents will be applied by hand to small spills and would be left to mix on their own. The gelled oil would be removed from surface water using skimmers. Biological agents will be used to mitigate the impacts of spills of crude oil and refined products to surface water and to soils.

Surface water and soil samples will be recovered from the impacted areas after cleanup to ensure that residual levels of hydrocarbons and other fuel oil constituents do not exceed tolerable limits. If these limits are exceeded in soil, additional soil will be removed from the spill area until the residual levels fall below tolerable limits. The soil excavated from the area shall be disposed in accordance with the Hazardous Waste Management protocol. If surface water quality has not been attained, monitoring will be continued. Persons downstream of the spill will continue to be provided with clean water until water in the affected area again attains acceptable water quality.

If the discharge of fuel oil results in contamination of the aquifer, a detailed investigation will be conducted to define the contaminant plume. A plan to clean-up the aquifer will be prepared after the delineation of the plume. The contaminated groundwater will be treated and would be re-injected into the aquifer. Treatment will cease when analyses of groundwater samples indicate acceptable groundwater quality.

If there is a fire which results in release of toxic fumes and if the fire spreads and is likely to ignite materials at other locations at the site or can cause heat-induced explosions, water and/or chemical fire suppressant shall be used as fire suppressant. In addition to fires, if an explosion has occurred which poses an imminent danger that can result in a safety hazard due to flying fragments or shock waves or if an imminent danger exists that an explosion could result in release of toxic material The EPA, the GGMC and MNRE will be immediately notified. The Emergency Response Center will assign an Emergency Response Coordinator (ERC) to respond to the emergency. The ERC shall determine whether the situation warrants evacuation of employees and persons within proximity of the fire or explosion. If evacuation is required, all employees shall be picked up from designated assembly points and will be evacuated along pre-planned evacuation routes. Previously identified alternate evacuation routes shall be used if primary exit routes are blocked by releases of toxic substances or fires.

During the emergency control phase, the emergency coordinator will take all reasonable steps necessary to ensure that explosions and releases do not occur, recur, or spread to other areas. These steps will include, where applicable, stopping operations. The emergency coordinator would monitor for leaks, pressure buildup, gas generation, or ruptures in valves, pipes, or other equipment, wherever appropriate. Details would be provided to emergency personnel concerning the types of on-site emergency equipment to be used and the need for personnel protection equipment.

Immediately after an emergency, the emergency coordinator would provide for treating, storing, or disposing of recovered waste, contaminated soil or surface water, or any other material. The recovered material would be handled as a hazardous waste unless it is a characteristic hazardous waste only, which is analyzed and determined not to be hazardous. The emergency coordinator would ensure that in the affected areas, no waste which may be incompatible with the released material is treated, stored, or disposed of until cleanup procedures are completed. All emergency equipment would be cleaned and made fit for its intended use before operations are resumed.

The SPCC Plan will be reviewed, and be immediately amended whenever the following situations apply:

- applicable regulations are revised
- the plan fails in an emergency
- the facility changes its design, construction, operation, maintenance, or other circumstances in a way that materially increases the potential for fires, explosions, or releases
- the list of emergency coordinators changes
- the list of emergency equipment changes.

14.21 Catchment Area Management

The concession will be managed to ensure minimal impacts to the watershed. The objective of the catchment management plan will be to maintain as closely as possible the pre-project hydrological runoff characteristics of the watershed in which the project is located. The catchment management plan addresses the protection and conservation of the local natural resources and contains measures for safeguarding water for future development. The plan will also ensure that water quality and security of water supply is provided to transient people and communities who use the waters of Blackwater Creek and Hit and Miss River, their tributaries and their receiving waters.

All forest cover outside of the area cleared for the mine site operation will be maintained to control run-off, to limit erosion, to minimize sediment and nutrient supplies, to maximize infiltration and to maintain pre-project rates of evapotranspiration. The adoption of sound catchment management practices for the area will reduce the inflow of debris and other material from both point and diffuse sources into the

waters of Blackwater Creek and Hit and Miss River and their tributaries, thereby ensuring the maintenance of water quality both upstream and downstream of the project.

Both Vitarna and Interior Forest Products have identified the absence of exploitable forest resources within the concession. Pharsalus Gold Inc, however, will provide the EPA and GFC with information on any logging operations within the concession Area. The responsible national statutory authority will undertake to ensure that a formal Environmental Impact Assessment is conducted where any new forestry exploitation project is proposed. If PGI determines that uncontrolled logging is occurring in the area covered by this ESIA report, both the EPA and GFC will be informed. If new timber concessions are granted within this concession by the responsible national statutory authority during the life of the mine the developer will review the draft ESIA report prepared for logging in the area to ensure implementation of the following:

- appropriate use and choice of cutting implements and machinery
- selective felling
- establishment of buffer areas around the mine
- road construction in accordance with sustainable practices
- closure of roads after completion of logging activities.
- regular monitoring of the logging areas to ensure no encroachment.

Pharsalus Gold Inc will also report to the EPA instances of clearing for small scale agriculture along access routes and within forested areas that could prove detrimental to the environment if left uncontrolled. The developer will develop in consultation with the responsible national statutory authority, methods to curb or mitigate these problems.

Since Pharsalus Gold Inc has no legal authority, the responsible national statutory authority will be required to establish clear demarcation between the areas of different land-use potential and promote awareness of the consequences of encroachment within areas identified for specific land use. The responsible national statutory authority will also provide training on environment friendly methods of agriculture such as selective clearing instead of slash and burn; terracing, mulching, crop rotation or strip cropping and on adopting proper land tenure procedures. The responsible national statutory authority will further be required to ensure that any type of land development meets all relevant legal requirements and be in accordance with any land use plan drawn up by the local authorities.

In those instances where Pharsalus Gold Inc has legal authority, travel along access roads by the public will be controlled. Where this is not the case, the developer will report to the responsible national statutory authority, levels of use and incidents of encroachment.

14.22 Social Management Plan

The project can potentially result in influx into the concession and the problems associated therewith due to mine area development.

PGI will actively discourage influx into the area and not allow outsiders to settle in the periphery of the camp. PGI will also train its personnel on site to handle influx sensitively without conflict or security issues. PGI would also promote and run health awareness campaigns especially on HIV, STD and malaria amongst the workers as well as local communities upstream and downstream of the project site. The project will increase expectations of employment and economic opportunities.

The company will dialogue with the local community to understand their expectations and create strategies to generate local employment. The company will also promote community development

projects that enhance local benefits and which create skills, capacities, improve education, health and infrastructure of the local community. The developer will also take practical measures to ensure that residents do not abandon their current livelihoods.

The project may result in potential issues with artisanal miners.

PGI will consult and engage with artisanal miners who come into the concession and patrol the concession boundaries. PGI will inform the GGMC and EPA of the presence of illegal activities within its concession and will work with the GGMC to evict these miners.

The project can potentially result in reduced employment and other induced economic benefits after closure of the operation.

The company will train and build capacity of the workers and service providers to find economic opportunities with other industries in Guyana.

The construction of the Amaila Falls Hydropower access road may result in increased traffic and safety risks. PGI will estimate the volume of traffic likely during construction and operations phases and will partner with government and the GGMC to promote safety and reduce risks. The company will conduct driver safety training programs, identify zones of high risks on roads and will coordinate movement of traffic with other road users to minimize risks.

Inadequate dissemination of information on the operations can potentially generate animosity between communities in proximity to the operations, the GGMC and PGI.

The Company will liaise totally with indigenous community. Company employees would be restricted to the mine site and would have no interaction with the indigenous community, Kaburi Village, except for employees who are members of that community. A committee comprised of representatives of Kaburi Village, the GGMC and PGI will be established to provide an ongoing management mechanism to respond to concerns that arise in Kaburi Village related to the mine site operation. This committee will meet quarterly or with greater frequency if circumstances dictate, to discuss issues and concerns related to the interaction of the mine and the community. At a minimum the committee will conduct periodic stakeholder and mine management reviews. The stakeholder review will entail continuous monitoring and review of the mining operations to identify new or evolving issues. Kaburi Village will be encouraged to report instances of infractions of the norms of indigenous society by mine site personnel and to sensitize mine site personnel to these norms. Results of environmental monitoring will be made available for review by members of the Kaburi Village. Members of Kaburi Village will also be informed of all incidents during operations that do not conform to sound environmental practice and specified operational environmental standards as set forth in the management, mitigation, emergency and Health and Safety plans, and of mitigation and management measures implemented to prevent or remedy such occurrences and to counter their reoccurrence. Reports will be issued quarterly or upon occurrence of a violation and will be made publicly and easily available by PGI upon request.

The operator will give priority to the recruitment of unskilled employees such cleaners and field hands from Kaburi Village. The employer will mount training programs and potentially apprenticeships for residents of Kaburi Village to boost local labor supply and will provide employment opportunities for motivated individuals from the village who successfully graduate from the training programs. The intent is to eventually have a significant majority of the unskilled labor pool be represented by individuals from the indigenous community at Kaburi.

The Project will have open days for local suppliers and will maintain a register of local suppliers and the goods these suppliers provide. The developer will source provisions for its canteen and kitchen from local residents to boost and sustain current indigenous farm practices.

Once the operations are well established PGI will promote a controlled program of tourism visits to the site and will aid these visitors in the interpretation of the environmental soundness of the operations. The developer will work with Kaburi Village to develop an appropriate area package to stem the impact of boom-bust effects related to diminished employment rates after mining at the site ceases.

The company recognizes the absence of skills appropriate to the mining sector in Guyana. In this regard PGI will join with the Guyana Mining School to develop courses specific to the mining sector including courses in mineral processing.

PGI is dedicated to ensuring that the project will provide benefits to Kaburi Village and will work with the Village to identify projects that will benefit both the village and the company. PGI will work with the Guyana Forestry Commission (GFC), to establish a nursery for hardwood timber and other species, in Kaburi Village, that the GFC would wish the Company to use for remediation of waste dumps and other mine out areas at the end of open pit operations. Troy Resources, the parent company of PGI has successfully implemented this venture around the world and will utilize the same model in Guyana.

Since effective functioning of a mine site operation requires mandatory ability to read signs, write reports and understand mining operations, PGI will work with Kaburi Village and more particularly with persons coming through the education system to improve reading, writing and knowledge of mine operation standards. PGI will partner with the Government of Guyana to offer these facilities to Kaburi Village.

PGI will also take steps to address potable water and health issues in Kaburi Village by extending its medical facilities to provide services to Kaburi Village. PGI will also assist in the maintenance of Kaburi Village access roads.

15.0 EMPLOYEE HEALTH AND SAFETY PLAN

During the operation of the facility, emphasis will be placed on providing a safe and healthy environment for the workers. A health and safety plan will be implemented to ensure compliance with the regulations of the OHS Act 1997. Occupational Safety & Health plans will be implemented in the following areas:

- Industrial Accident prevention and management
- Occupational Hygiene.
- Illness & Infectious disease prevention and management.
- Sewage and Waste Disposal.

15.1 Industrial Accident Prevention and Management

Industrial accident prevention and management will be effected via the company safety program. This will commence during the construction phase of the new facility and last through the operating phase until the cessation of operations. The program will include the following:

- Hazard identification and control;
- Monitoring and reporting of industrial accidents;
- Training or education of employees in industrial first aid;
- Industrial Accident Protocol;
- Fire Safety & Preparation and
- Hazard Identification and Control

Table 72 lists the potential hazards in different phases of the operations of the facility and the preventative and remedial activities necessary for their elimination and control. In addressing these hazards, the first priority will be their elimination via modification in the design of equipment or process. If this is not possible or feasible and the hazard cannot be eliminated, then the employees will be provided with the necessary safety protective gear to prevent any injuries during the work process.

Table 72: Potential Hazards

Phase	Potential hazard	Protective & preventative Safety measures
1.Clearing of Site & Construction of Living Quarters: felling trees removal of topsoil & overlying vegetation assembly of building assembly of generating plant	Insect Bites Snake Bites Minor Trauma to Extremities Lacerations from use of sharp tools	Use of insect repellants Provision of snake bite kits Use of safety shoes & gloves
2.Excavation of Ore	Fugitive dust blown into eyes Inhalation of fugitive dusts High noise levels from working of heavy duty vehicles - trucks, tractors etc.	Use of clear goggles Use of dust/mist respirators Use of air plugs
3. Smelting of ore in furnaces	High temperatures	Use of heat resistant aprons/

	Minor burns to extremities	overalls Use of heat resistant gloves
4. Operation of Power generating plant	High noise levels High noise levels	Use of air muffs, Wearing of air plugs
5. Maintenance shop operations	Contact dermatitis skin irritation from exposure to grease High noise levels	Use of barrier creams & detergents on hands Use of air plugs
6. Cyanide Exposure	Inhalation of Cyanide Gas Ingestion	Use of respirators, clear goggles, protective gloves, coveralls, cyanide gas monitoring, washing before eating, drinking or smoking.
7. Onsite and Offsite Spill	Discharge to Groundwater Discharge to Surface water	Containment around storage areas Monitoring discharges Communication with impacted areas

Hazard identification and reporting will constitute an ongoing activity in which the employees' participation will be considered an integral part of his work functions. The OHS Act 1997 clearly stipulates the responsibilities of employees and supervisor/management in this regard. In accordance with those regulations the supervisor/manager will do the following:

- Inspect all machines and equipment for the existence of potential hazards and ensure that they are in working order.
- Inform the worker of any hazards present.
- Instruct the employee in the correct safe work procedure to prevent injuries and ensure that those instructions are followed
- Provide the necessary safety protective gear when required.

In accordance with OSH Act 1997 employees will be authorized to do the following:

- Cease work once a hazard is perceived.
- Report the hazard to the supervisor who will in company with the safety representative inspect the condition or circumstance and determine its validity.
- Obey the instruction to perform alternative work or cease work completely as directed by the supervisor.
- Return to the workstation or proceed once the hazard has been adequately dealt with or eliminated.

15.2 Hazard Monitoring and Reporting

The Safety Representative, elected from among the workers, will monitor hazards and work conditions. He will do the following:

- Perform Safety Inspections on and off the operations site on a regular and programmed basis (at least once per month) for the detection of unsafe conditions or any potential hazards and report these hazards to management.
- Record all minor and loss time accidents in a ledger as required by the Ministry of Labor (Table 73 shows the format to be used for recording industrial accidents).
- Remit reports of industrial accidents or fatalities to the Ministry of Labor when required.

Table 73: Accident Report Format

Personal injury	Equipment damage
Name of person involved	Dept/ Area
Name of injury	
Place of injury	
Description of accident	
Type of accident:	Loss Time Minor
Foreman Signature.....	
Diagnosis.....	
Remarks.....	

In addition to the abovementioned, all employees will be educated about their responsibility to participate in the creation of a healthy and safe environment by:

- reporting unsafe and hazardous conditions when detected
- performing work in a safe manner by following the correct work procedure.

15.3 Training & Education of Employees

The company will run periodic training program in:

- Basic first aid programs (all employees).
- Advanced first aid programs
- Accident investigation & reporting seminars (supervisory personnel & safety reps.)

The basic first aid program will be extended to all employees and would be geared to ensure that in the event of an accident or injury, someone with first aid knowledge will always be present to render initial assistance until further medical attention can be made available. Qualified personnel will run seminars to impart the necessary theoretical as well as practical skills required. These courses will be scheduled depending on employee strength and attrition.

The advanced first aid program will constitute an upgrading course from the basic first aid program in which selected employees including supervisors and the Safety representative will be exposed to advanced first aid knowledge and techniques which will enable them to participate in the recognition and the initial management of serious injuries and illnesses e.g. Fractures, Spinal Injuries, Malaria, Typhoid fever etc.

15.4 Industrial Accident Protocol

Serious injuries will be referred to a medical practitioner and medical institution. The medical institution and practitioner will preferably be chosen from the nearest Town/Village to the operations and contact will be maintained by radio/radiophone at all times. In the event of an industrial accident the following protocol will be followed:

- A basic first aider will be summoned if not already present at the scene of accident.
- The basic first aider will render first aid care.
- The basic first aider will summon an certified medex who will administer further care if necessary and evaluate the necessity for removal to the first aid centre.
- The certified medex will summon the vehicle specifically identified for this purpose and supervise the removal of the injured to the first aid station.
- The employee's immediate supervisor will be informed. He will:
 - o Make contact with the identified medical Practitioner and Institution and inform them of the time of arrival of the injured employee.
 - o Complete the accident form and forward same along with the injured to the medical institution for completion by medical practitioner
 - o Inform the Safety representative who will record the accident in the Industrial accident register.

A vehicle will be available at all times to respond to accidents. That vehicle will be equipped with a four wheel drive and will have the following equipment:

- oxygen cylinder and gas masks resuscitation equipment,
- a bed and accommodation for a first aid attendant to sit alongside the injured,
- a flashing light attached to warn other road users,
- communication equipment.

15.5 Occupational Hygiene

The main environmental occupational hazards to which employees will be exposed during the operations phase of the mining entity are:

Dust.
Noise.
Heat
Fumes

15.5.1 Dust Exposure

The following measures will be implemented in order to decrease or eliminate respirable dust inhalation and prevent any adverse effects on workers:

- Provision of dust respirator with filters to employees exposed during the excavation and transportation of ore
- Siting of living quarters a convenient distance from the operations site and on the leeward side of same.
- Minimal denudation of vegetation around campsite.
- Chest X-Rays of all employees once yearly in order to detect any incipient pulmonary disease such as persistent coughing and/or shortness of breath.

These measures will assist in elimination or reduce further the very low risk of the development of lung impregnated disease by employees exposed to dust.

Workers in the excavation and transportation phases of the operations would be exposed to wind blown/fugitive dust being blown into the eyes and causing eye irritation and conjunctivitis. These

employees will be provided with clear goggles and eye wash lotion will at all times be available for washing the affected eyes.

15.5.2 Noise

The following measures will be implemented to address worker health and safety related to noise associated with the operation:

1. Control of noise levels at source via installation of silencers on exhaust system of power generating plant.
2. Provision of hearing protection to employees exposed to high noise levels: ear muffs for employees in the maintenance shops and generating plant areas.
3. Earplugs for employees who operate heavy-duty machines.
4. Siting of power generating plant and mining operations in location away from the living quarters of employees.
5. Warning signs in areas of high noise levels instructing employees to wear earmuffs or earplugs as required.
6. Hearing conservation program for employees exposed to noise. This will consist of:
 - Audiological examination before employment to establish baseline hearing capacity on initiation of employment.
 - Yearly audiological testing of employees exposed to high noise levels.
 - Acquisition of a portable sound level meter
 - Measurement of sound levels in instances where it is suspected that deviations from the previous levels are occurring.

15.5.3 Heat

Measures to decrease the effect of increased exposure to heat will include:

- Measurement of ambient temperature levels in vicinity of generating plant
- Provision of heat shields - coating of surface of generating plant by high reflective material such as polished aluminum.

15.5.4 Cyanide Exposure

Job functions and tasks would be evaluated to determine possible exposure scenarios and pathways. Process changes or engineering controls would be developed and implemented to eliminate these exposures where practicable and to reduce or control them when they cannot be eliminated. The operations would develop and document procedures for performing cyanide related tasks such as unloading, mixing, plant operations, entry into confined spaces, and equipment decontamination prior to maintenance in a manner that minimizes worker exposures.

These procedures would address the use of cyanide-specific personal protective equipment such as respirators, eye protection and protective gloves, coveralls or suits, pre-work inspections, emergency response, cyanide monitoring and communications and documentation. Personnel involved in cyanide management would be trained in handling cyanide in a manner that protects their safety and the safety of their co-workers. Training would also include the proper use of personal protective equipment, emergency rescue equipment, and cyanide first aid equipment.

The plant would implement procedures to review process and operational changes and modifications for their potential impacts on worker health and safety, and to incorporate the necessary worker protection

measures. Worker input through safety meetings, suggestion boxes, or other methods would be factored into the development and evaluation of health and safety procedures.

Process changes and engineering or administrative controls would be used to limit worker exposure to hydrogen cyanide gas and sodium and potassium cyanide to the American Conference of Governmental Industrial Hygienists (ACGIH) Ceiling Limit Value of 4.7 parts per million (5 mg/m³) as cyanide. Where the potential exists for significant worker exposure to hydrogen cyanide gas or sodium or potassium cyanide dust, the operation would monitor hydrogen cyanide concentrations with ambient and/or personal monitoring devices and evaluate the results to confirm that controls are adequate.

Cyanide monitoring equipment would be maintained, tested and calibrated as directed by the manufacturer, and records would be retained for at least one year. Warning signs would be placed where cyanide is used and would alert workers that cyanide is present, that smoking, open flames, eating and drinking are not allowed and that the necessary cyanide-specific personal protective equipment must be worn. Showers, low-pressure eye wash stations and dry powder or non-acidic sodium bicarbonate fire extinguishers would be located at strategic locations throughout the operation where cyanide is present. This equipment would be maintained and be inspected or tested on a regular basis, and records would be retained, to assure that it is in good working order if and when needed. Tanks and piping containing cyanide would be identified by color code, signs, labels, tags, decals or other means to alert workers of their contents. The direction of cyanide flow in pipes would also be labeled, marked or otherwise designated.

Cyanide first aid equipment including medical oxygen and a resuscitator will be provided and will be inspected regularly to assure that it is available when needed. Antidotes for cyanide poisoning would be available. Antidotes will be stored and/or tested as directed by their manufacturer and replaced on a schedule that assures their effectiveness. In general, the procedures for responding to inhalation of cyanide gas or skin contact with liquid or gaseous cyanide would include the following elements:

- Activate alarm or call for help to notify the appropriate site personnel (through alarms, radio, telephone) so that medical assistance is available as soon as possible.
- Call for assistance before responding to the emergency ("buddy-system"). Never try to rescue a cyanide victim on your own.
- The responder must put on the personal protective equipment necessary to safely enter the area and come in contact with the exposed individual.
- If possible, the responder must move the exposed individual to a safe area away from continued exposure. If removing the exposed individual from the area is not possible, the responder must attempt to prevent further exposure to the victim or seek assistance in moving the victim from the area of exposure.
- All contaminated clothing must be removed from the exposed individual, and the exposed individual should be decontaminated by washing with water. Safety shower and eye wash station using low pressure water are recommended.
- Oxygen must be administered, and medical help must be sought. If authorized by the applicable jurisdiction, treatment with amyl nitrite is recommended along with oxygen. A resuscitator should be used if the exposed individual is not breathing.

If cyanide is ingested the response to such exposure should include the following elements:

- Notify the appropriate site personnel and put on personal protective equipment, as above.
- An exposed individual who is conscious should spit or be made to vomit, and the mouth should be rinsed with water.

- Continue with decontamination and administration of oxygen and amyl nitrite if permitted, or if the exposed individual is not breathing, a resuscitator should be used.
- An exposed individual that is not conscious, or has impaired consciousness should be treated with oxygen and amyl nitrite if permitted.

Workers who may be called upon to respond to cyanide exposures will be trained in the operation's response procedures and will take part in routine drills to test and improve their response skills. The operations will develop its own on-site capability to provide first aid or medical assistance to workers exposed to cyanide.

Formalized arrangements would be made with local hospitals so health workers are aware of the potential need to treat patients for cyanide exposure. In making these arrangements, the operation will ensure that the medical facility has adequate qualified staff, equipment and expertise to be able to respond effectively. The operation will assist local medical providers with training and equipment to enhance its capabilities.

Mock emergency drills based on likely release/exposure scenarios would be conducted periodically to test response procedures. Lessons learned from the drills would be incorporated into response planning.

15.6 Food and Water Safety

Food and water will be provided by the mine site operator to employees. No sales of food, beverages will be permitted by vendors etc. within the mine site. A condition of employment will forbid purchasing of food, beverages etc from vendors. All food including both raw and refrigerated foods will be stored in accordance with guidelines provided by the Environmental Health Unit of the Ministry of Health. Redundancy will be provided for storage of refrigerated goods to ensure capacity exists in the event of damage or loss of any unit. All waste generated by the operation will be disposed in accordance with the Waste Management Plan.

A vector control program will implemented over the duration of the project. Should an outbreak of flies occur, an insect exterminator would be used to control the flies at the source. Uncovered and available food wastes will not be permitted, to minimize the development of any rodent populations. Should an outbreak of rodents or other vermin occur within the area, the vermin will be exterminated by a licenced exterminator in a manner that is appropriate for the vermin in question.

All water for drinking purposes will be imported to the site from acceptable and certified drinking water sources. If groundwater is utilized for drinking water, it would be treated by chlorination and filtration to acceptable quality for potable water use. Samples of drinking water will be tested at the Government Analyst Department to ensure it conforms to drinking water standards.

15.7 Vector Control

Water in tailing and water management ponds may favor the multiplication of waterborne disease vectors such as flies, mosquitoes and other parasites and the introduction of new ones.

Pesticides that are non-toxic to humans, fish and livestock will be used for habitat and vector control. A body will be established to provide health advisory and support health services and to monitor disease vector and disease incidences.

16.0 ENVIRONMENTAL MONITORING

16.1 General Monitoring Requirements

The Mining Regulations require that “environmental effects monitoring” should be conducted for every mine, including new mines. An “environmental effects monitoring program” is required to be submitted to the GGMC for approval as part of the Environmental Management Plan.

The IFC recommends that environmental monitoring programs should be implemented to address all activities that have been identified to have potentially significant impacts on society and the environment, during both normal operations and unexpected conditions. Social and environmental monitoring activities would be based on direct and indirect indicators of emissions, effluents, and other potential sources of impacts associated with the project. IFC guidelines recommend that monitoring should extend for a minimum period of five years after closure.

Monitoring frequency for each parameter would be sufficient to provide representative data for the parameter being monitored. Specific monitoring frequencies are specified in the following sections.

Monitoring would be conducted by trained individuals following monitoring and record-keeping procedures and using properly calibrated and maintained equipment. Monitoring data would be analyzed and reviewed/compared against operating standards so that any necessary corrective actions can be taken.

The environmental monitoring program for the mine would serve as an integral part of the operation and would be implemented to generate information for environmental management and environmental information dissemination. The monitoring plans described in this chapter encompass two distinct categories, environmental and operational. The environmental aspect is structured to monitor the physical, biological and socioeconomic changes in the environment, if any, and includes the mitigation measures. The operational monitoring would include those variables important for day-to-day operations such as processing methods and camp facilities.

Monitoring would be conducted during all phases of the project; specifically, the design, construction, operation and closure phases. The monitoring program would play a pivotal role in ensuring that the trends for specific parameters are tracked and would provide information on compliance with legislative norms, set guidelines or desirable operational limits. Review of the monitoring data would provide a basis for corrective actions and modification of activities if necessary. Sampling intensity during monitoring would depend on the time and location of the development activities and results derived from monitoring data.

16.2 Noise Monitoring

In accordance with IFC General EHS Guidelines, the noise monitoring program would be designed and conducted by trained specialists. Monitoring periods would be sufficient for statistical analysis and may last 48 hours with the use of noise monitors that would be capable of logging data continuously over this time period, or hourly, or more frequently, as appropriate (or else cover differing time periods within several days, including weekday and weekend workdays). The type of acoustic indices recorded depends on the type of noise being monitored, as established by a noise expert. Monitors would be located approximately 1.5 m above the ground and no closer than 3 m to any reflecting surface (e.g., wall). In general, the noise level limit is represented by the background or ambient noise levels that would be present in the absence of the facility or noise source(s) under investigation.

16.3 Air Quality & Dust Monitoring

Vehicles and non-stationary equipment would be visually monitored to identify any vehicles or equipment with visible particulate emissions that should be inspected to identify need for repair or maintenance.

Emissions from the generator house stack would be tested annually for NO_x and PM, with fuel testing for SO₂, to ensure IFC emissions guidelines are met. After three years, the testing frequency may be relaxed to every 2-3 years if the annual testing produces consistent results.

Roads and roadside vegetation would be monitored to ensure that excessive dust is not emitted by vehicle traffic, construction, and maintenance activities.

In addition, Pharsalus Gold Inc would establish an automated meteorological station to measure rainfall, temperature (maximum and minimum), humidity, evaporation, wind speed and direction, and hours of sunshine.

16.4 Soils Monitoring

The removal, storage, and reutilization of topsoil and organic matter would be registered and documented. The removal, storage, treatment, and final disposition of contaminated soils would also be registered and documented.

16.5 Water Quality Monitoring

Sampling of discharge points downstream of the tailings and water management ponds would be conducted weekly for the first year of operation and twice per month after that time. The sampling results would be used to determine the effectiveness of the cyanide destruction circuit.

Effluent from the sewage treatment systems would be sampled weekly at the discharge point(s) and tested for total coliform bacteria, BOD₅, COD, pH, total N, total P, oil & grease, and TSS and these will be compared against IFC General EHS Guidelines indicator values for treated sewage discharges. Monitoring of effluent from oil-water separators would also be conducted weekly to ensure that discharged stormwater meets effluent discharge/water quality standards prior to discharge into surface water.

Surface water samples would be collected in streams/creeks in proximity of the operations on a quarterly basis (i.e., four times each year). Statistical evaluation of the data would be performed to determine if sampling should be conducted at more frequent intervals. Stream flow data would be collected at each surface water sampling event as part of the sampling protocol. Surface water monitoring data would be compared to the IFC/World Bank Standards (IFC/World Bank Environmental, Health and Safety Guidelines for Mining, December 10, 2007) to assess for potential impacts from the mining operations. These levels should be achieved, without dilution, at least 95 percent of the time that the plant or unit is operating, to be calculated as a proportion of annual operating hours.

Groundwater monitoring wells would be installed both up-gradient and down-gradient of the tailings and water management pond. Samples would be collected from these wells on a monthly basis and analyzed for the presence of heavy metals and cyanide. Three additional permanent groundwater monitoring wells would be installed on the perimeter of the operations area. Groundwater sampling would be conducted at each perimeter well on a yearly basis and samples would be analyzed for the presence and concentration of parameters of the World Health Organization (WHO) guideline values provided in Guidelines for Drinking-water Quality Incorporating First and Second Addenda to Third

Edition, Volume 1, Recommendations, 2006 to assess for potential impacts from the mining operations. For cases where the baseline conditions exceed IFC/World Bank or WHO standards, the surface water and groundwater parameters should not show a statistically significant increase over the baseline levels.

16.6 Tailings and Water Management Dam Integrity Monitoring

Monitoring and preventive maintenance would be undertaken to assure optimal performance of the tailings and water management ponds. Monitoring would consist of visual observation of the tailings embankment, and the monitoring of piezometers and other instrumentation installed to assess the performance of these facilities. Pharsalus Gold Inc would retain an independent expert firm to monitor the performance of the Tailings pond during the project operation phase.

The tailings and water management ponds would be monitored on a weekly basis, at a minimum, or as dictated by the EPA/GGMC to visually determine their structural integrity. The ponds would also be inspected to determine seepage through embankment cross-sections and to ensure that adequate freeboard exist for their continued use. This is likely to require a specific piezometer-based monitoring system for seepage water levels within the dams and downstream of them, which would be maintained throughout their life cycle.

Visual inspections and monitoring of dam embankment structural stability using settlement plates, slope inclinometers and pore water pressure measurements would be conducted to assess the stability of the dams. Soil strength gains associated with consolidation of the fill and the widened cross-section of the embankments due to tailings deposition should also be factored into the periodic evaluation of the impoundment stability.

Preventive maintenance would be undertaken at all potential trouble spots observed during visual inspection. The preventative maintenance would be geared primarily to ensure the stability of the structure and to control seepage through the embankment cross-section. A beach would also be maintained immediately adjacent to the upstream slope of the embankments to increase the length of the seepage path and the stability of the embankment slope.

Measurements and monitoring would be made after the occurrence of unusual conditions such as heavy surface runoff or peak floods. If the characteristics of the tailings and the construction method change substantially over the time the Tailings pond is in use, these changes may alter the conditions governing the stability of the embankment. Changes could occur in crest levels, water levels, embankment slopes, cross-section geometry, seepage conditions, and material characteristics. A continuous program of inspection and maintenance would therefore be undertaken from the beginning of deposition throughout the life of the dam. Through careful monitoring, areas of concern would be noted and quickly repaired, thereby preventing failure.

Visual monitoring would be done to identify typical distress signals associated with tailings dam operation, such as cracking, wet spots on the downstream face, and critical settlement. The visual observations would be supplemented by instrumentation to enable an accurate interpretation of the extent of any problem likely to occur. The instrumentation inclusive of piezometers, settlement plates and inclinometers would be used to show developing trends in the behavior of the tailings and water management ponds.

The instrumentation would be installed in the embankment and its foundation to monitor changes which are critical to the embankment stability, and to predict unstable conditions. Instruments would be installed to measure pore water pressures, seepage flows, embankment movements, and total pressures. Pore water pressure in soils would be measured with piezometers. Seepage flow emerging downstream from the embankment, would be collected and directed to a weir for flow measurements. Seepage flows

would be used to indicate when significant changes occur and to permit an evaluation of potential problems from piping.

Markers would be installed on the embankment surface and would be aligned in a straight line-of-sight to permit rapid detection of horizontal movement during surveys. In instances where cracks are visible on the embankment surface, successive measurements between two stakes spaced either side of the crack should indicate any widening and acceleration in separation rate.

Slope indicators would also be used to measure horizontal movement of the embankment. The slope indicators work by telescoping cylindrical casing into the embankment during construction. A sensing element is lowered down grooves inside the casing and measures the slope of the casing in two directions at right angles. From the measured slopes, the horizontal movements occurring over the length of the casing can be calculated. Settlement would be measured by leveling of temporary benchmarks.

The frequency of monitoring would depend on previous observations and on the critical nature of the parameters. The frequency of monitoring would be more pronounced during and immediately after construction. When records indicate that conditions are relatively stable, the frequency of monitoring would be extended. Monitoring auditing would include water balance, freeboard, and deposition plans.

16.7 Mine Waste Stockpiles Monitoring

The waste rock stockpiles would be monitored on a weekly basis to determine the integrity of the containment berm around the perimeter of the stockpiles. The monitoring events would include an evaluation of the height and slopes of the stockpiles to ensure that they do not exceed the tolerable limits.

Potential geotechnical changes in the stockpiles would be monitored to assess potential changes that can significantly decrease the stability of the stockpiles. In accordance with the IFC EHS Guidelines for Mining, modern topographical 3D deformation measurements and related specific processing and evaluation software would be the standard method for stability monitoring.

Dust emissions from the stockpiles would be visually monitored and corrective action implemented, if required. Corrective actions may include wetting down or covering the stockpiles to reduce dust emissions.

Runoff from the stockpiles would be monitored for water quality. Samples would be collected from the leachate collection/perimeter drainage system and analyzed for the presence and concentration of appropriate parameters to assess whether the leachate can be discharged directly into the diversion channel system or whether it must be pumped to the water management pond for treatment prior to discharge to surface water.

Potential changes in geotechnical properties due to chemical or biologically catalyzed weathering would be considered and monitored as these can reduce the geotechnical stability of the stockpiles.

16.8 Hazardous Material Monitoring

Inventories of hazardous material would be monitored to ensure all material is used for the purposes intended. Waste containment areas would be monitored to ensure that the impervious surface upon which they are sited is not breached. The area would be monitored to determine that incompatible chemicals are not stored together and that stormwater discharges from the area are channeled to the water management pond.

Hazardous material inventory data, including cyanide-containing substances, would be reported to the GGMC and made available to interested stakeholders.

16.9 Solid Waste Monitoring

The solid waste disposal operation would be monitored to determine the effectiveness of the recycling, composting and disposal operations. Manifests would be developed to ensure proper disposal of septic tank waste.

16.10 Aquatic Ecology Monitoring

In addition to the monitoring of the physical and chemical quality of water in streams and rivers, Pharsalus Gold Inc would perform periodic sampling to assess trends in the abundance and diversity of the aquatic biota in all of the streams affected by the Project. Special attention should be given to the detection of invasive alien species.

16.11 Terrestrial Ecology Monitoring

Pharsalus Gold Inc would contract a firm to develop and implement a Biodiversity Monitoring Plan. This plan would identify the appropriate indicators, protocols, and frequencies to be followed. The results of the Biodiversity Monitoring would be reported to all interested stakeholders.

Monitoring would begin during the pre-construction phase and will continue throughout construction, operations, and abandonment until site closure has been achieved. The pre-construction phase monitoring would provide additional baseline data for comparison against monitoring results from later project phases.

Wildlife monitoring would be conducted concurrently with the vegetation monitoring. Observations would be recorded in a wildlife-sighting logbook and these would be periodically examined to determine if there have been any significant changes in species abundance and/or distribution. All collisions with wildlife on haul and site roads would be recorded. The record would note the proximity to cleared areas, the animal involved in the collision and the time of that collision etc. These records would be used to evaluate the success of the measures outlined in the Management Plan.

In the event that endangered species are observed at any time during construction or operations, special monitoring plans would be developed to track these occurrences.

A record would be maintained of all animal mortality associated with Tailings and Water Management Ponds. The location of the fatality, the time of day and the process discharge at that time would be among the parameters recorded. Additional fencing around the ponds would be installed as needed based on the results of this monitoring.

Special attention should be given to the detection of invasive alien species in order to preemptively identify areas where control measures are required.

16.12 Progressive Reclamation Monitoring

As part of the reclamation program, a record would be maintained of all spontaneous and natural regrowth after clearing and the conditions contributing to that regrowth. The record would note plant species, soil type, weather conditions during the period, drainage conditions etc. The records would be used to examine parameters considered necessary for the successful establishment of plant cover after reclamation.

Land reclamation areas would be monitored to ensure that compaction of the ground surface does not preclude the infiltration of precipitation. The humus from the composting operation would also be monitored to ensure its use in the land reclamation. The growth of any trees planted for revegetation would be monitored. Substitute plant types would be identified if the growth rates are unacceptable.

16.13 Post-Closure Monitoring

Post closure monitoring of the Tailings Pond would be conducted to ensure the integrity of the embankment cross-section and to verify that surface water and groundwater are not being impacted by releases from the Tailings Pond. The cyanide concentration and water content of tailings would be monitored to determine when these parameters are within acceptable limits (<0.1 mg/L for free cyanide, <0.5 mg/for WAD cyanide).

Post closure monitoring of the Tailings Pond would also include the collection of surface water and groundwater samples from locations in the vicinity of the Tailings Pond on a quarterly basis. Both surface and groundwater samples will be analyzed for parameters mandated by the EPA and will include both free and total cyanide. Minimum parameters for which both surface and groundwater will be analyzed are detailed in Table 74. Sampling would be conducted for a period of five years after mine closure, at a minimum. Additional monitoring beyond five years may be required depending on the results of a risk analysis.

Table 74: IFC effluent guideline values for the mining sector.

Pollutant	Units	IFC Guideline Value
Total Suspended Solids	mg/L	50
pH	S.U.	6-9
COD	mg/L	150
BOD5	mg/L	50
Oil and Grease	mg/L	10
Arsenic	mg/L	0.1
Cadmium	mg/L	0.05
Chromium (VI)	mg/L	0.1
Copper	mg/L	0.3
Cyanide	mg/L	1
Cyanide, Free	mg/L	0.1
Cyanide, Weak Acid Dissociable	mg/L	0.5
Iron (total)	mg/L	2.0
Lead	mg/L	0.2
Mercury	mg/L	0.002
Nickel	mg/L	0.5
Phenols	mg/L	0.5
Zinc	mg/L	0.5
Temperature	°C	<3 degree differential
<i>Note: Metals concentration represent total metals.</i>		

Monitoring of the tailings would be discontinued only after both cyanide concentrations and tailings moisture content are within acceptable limits and only after the safety factor of embankment cross-section is determined to exceed 1.5. This safety factor is based on the soil strength gains over time due to compaction and the widened embankment footprint based on deposition of the coarse fraction of the tailings adjacent to the dam.

Closed facilities will be inspected and annual reports provided to evaluate the success of progressive reclamation. Reclamation monitoring would be coordinated with the EPA and GFC. Reclamation success will be evaluated both in terms of vegetation and erosion. The existing monitoring programs for surface and groundwater will continue in accordance with the proposed monitoring plans. Monitoring would be modified to address progressive reclamation as it proceeds.

17.0 RISK ASSESSMENT

17.1 Landslide Risk Assessment

The landslide risk assessment was conducted based on the qualitative terminology depicted in Table 75 (Lee & Jones, 2004).

Table 75: Landslide Risk Assessment – Qualitative Terminology

Qualitative Measures of Likelihood						
Level	Descriptor	Description	Indicative Annual Probability			
A	Almost Certain	The event is expected to occur	>= 10 ⁻¹			
B	Likely	The event will probably occur under adverse circumstances	=10 ⁻²			
C	Possible	The event could occur under adverse circumstances	=10 ⁻³			
D	Unlikely	The event might occur under adverse circumstances	=10 ⁻⁴			
E	Rare	The event is conceivable but only under exceptional circumstances	=10 ⁻⁵			
F	Not Credible	The event is inconceivable or fanciful	=10 ⁻⁶			
Qualitative Measures of Consequences to Property						
Level	Descriptor	Description				
1	Catastrophic	Structure completely destroyed or large scale damage requiring major engineering works for stabilization				
2	Major	Extensive damage to most of structure or extending beyond site boundaries and requiring significant stabilization works				
3	Medium	Moderate damage to some of structure or significant part of site requiring large stabilization works				
4	Minor	Limited damage to part of structure or part of site requiring some reinstatement/stabilization works				
5	Insignificant	Little damage				
Qualitative Risk Analyses Matrix - Level of Risk to Property						
Likelihood		Consequences to Property				
		Catastrophic	Major	Medium	Minor	Insignificant
A - Almost Certain		VH	VH	H	H	M
B - Likely		VH	H	H	M	M - L
C - Possible		H	H	M	L - M	VL - L
D - Unlikely		M - H	M	L - M	VL - L	VL
E - Rare		M - L	L - M	VL - L	VL	VL
F - Not Credible		VL	VL	VL	VL	VL
Risk Level Implications						
Risk Level		Implications				
VH	Very High Risk	Extensive detailed investigation and research, planning and implementation of treatment options essential to reduce risks to acceptable levels, may be too expensive and not practical				
H	High Risk	Detailed investigation, planning and implementation of treatment options required to reduce risks to acceptable levels				
M	Moderate Risk	Tolerable provided treatment plan is implemented to maintain or reduce risks. May be accepted. May require investigation and planning of treatment options				
L	Low Risk	Usually accepted. Treatment requirements and responsibility to be defined to maintain or reduce risks.				

VL	Very Low Risk	Acceptable, manage by normal slope maintenance procedures

The factors which will contribute to high risks of slope failure are as follows:

- Pronounced increases in porewater pressures in the foundation soils of the tailings ponds,
- Unsustainably steep slopes in the mine and ramp access and on the site and haul roads,
- Development of highly saturated soil conditions on the slopes of the spoil piles and stock piles.

Slope stability failure can be triggered by one or a combination of these factors. If the proximity of the slope to the access road and/or haul road is small, slope failure may have an impact on the efficient functioning of those facilities. Slope failure in the mine could result in a shutdown of the mine site operations. Slope failure of the tailings pond can result in the release of contaminants to the environment.

Risks of slope failure of the open pit slopes, mine access ramp and tailings pond will be reduced by undertaking geotechnical investigations and analyses for design of these facilities. The geotechnical investigations will generate data which will be used to design the open pit slopes, mine access ramp and tailings pond. Slope stability analysis will consider the likelihood of slopes being saturated during the wet season.

Analyses of conceptual cross-sections for the tailings ponds will consider the following failure modes:

- rotational and block failures of the slopes
- foundation failure of embankment
- piping failure of the embankment

The analyses will examine both short and long-term load conditions. Flow nets or an appropriate numerical method will be used to estimate seepage direction and volumes and pore pressures at points within the cross-section.

Analyses for the mine access ramp and sections of the haul roads, considered likely to be endangered by slope failure, will examine rotational and block failures of the slopes. The assessment of ramp stability will incorporate consequences associated with soil unloading. Allowances will also be made during the analyses for rises in groundwater levels in the slopes associated with flooded conditions at the base of the slope.

An extensive program of rock coring will be undertaken for development of the mine pits. The coring and the associated laboratory testing programs will develop data on rock parameters for design of that section of the open pit founded in rock. Geologic mapping will be conducted during excavation of the open pit in rock. The open pit will be designed to prevent failure planes from 'daylighting' into the cut, thus reducing the likelihood of wedge failures in the open pit.

Geotechnical investigations and analyses will also be conducted in areas identified as ore stock piles and for spoil pile locations, if outside the open pit footprint. The parameters generated by the geotechnical investigations will be used to assess the foundation stability and slope stability for these facilities. The analyses will consider both short and long-term load conditions.

Monitoring and preventive maintenance would be undertaken to identify potential slope instability areas. Through careful monitoring, areas of concern will be noted and would be quickly repaired, to prevent slope failure. Monitoring will consist of visual observation of the slopes and the monitoring of piezometers, slope indicators and other instrumentation installed to assess the performance of these facilities.

Monitoring will also be made after the occurrence of unusual conditions such as heavy surface runoff or peak floods. The frequency of monitoring will be more pronounced during and immediately after construction and during the wet seasons. Preventive maintenance will be undertaken at all potential trouble spots observed during visual inspection. Preventative maintenance will consist of work on critical slope areas to reduce the forces which will result in slope instability.

Visual monitoring will be done to identify typical distress signals associated with slope failure, such as cracks at the crest of the slope, devegetation of the slope, wet spots on the downstream face of the slope, and critical settlement inwards of the slope crest. The visual observations will be supplemented by instrumentation to enable an accurate interpretation of the extent of any problems likely to be occurring. Instrumentation inclusive of piezometers, settlement plates and inclinometers will be used to show developing trends in the slopes and embankments.

Instrumentation would be installed in the tailing and water management ponds embankment and foundation to monitor changes which are critical to the structures stability, and to predict unstable conditions. Instruments will be installed to measure pore water pressures, seepage flows and embankment movements. Pore water pressure in soils will be measured with piezometers. Seepage flow emerging downstream from the embankment will be collected and directed to a weir for flow measurements. Seepage flows will be used to indicate when significant changes occur and to permit an evaluation of potential problems from piping.

Markers will be installed on the embankment crest and would be aligned in a straight line-of-sight to permit rapid detection of horizontal movement during surveys. In instances where cracks are visible on the embankment surface, successive measurements between two stakes spaced either side of the crack will indicate any widening and acceleration in separation rate.

Slope indicators will also be used to measure horizontal movement of the embankment. Settlement will be measured by leveling of temporary benchmarks.

Implementation of the design and monitoring program detailed above will ensure that slope instability is unlikely to develop, with slope instability problems likely to develop only under adverse conditions. If slope instability does develop, damage would be minor and would be limited to small areas. The slope instability would be easily corrected by the utilization of available construction techniques. The risk of slope instability would therefore be low and the design and monitoring program outlined would be adequate to manage that risk.

17.2 Seismic Risk Assessment

Geological features indicating the likelihood of a seismic event include the following (Kramer, 1996):

- Fracture surfaces and indicators of fracturing directly evident at ground surface inclusive of disruption of the ground surface and evidence of the movement and grinding of the two sides of a fault (slickensides, fault gouge, and fault breccia).
- Geologically mappable indicators including juxtaposition of dissimilar materials, missing or repeated strata and the truncation of strata or structures.
- Topographic and geomorphic indicators including topographic scarps or triangular facets on ridges, offset streams or drainage, tilting or changes in elevation of terraces or shorelines, sag ponds and anomalous stream gradients.
- Secondary geologic features inclusive of abrupt changes in groundwater levels, gradients, and chemical composition, alignment of springs or volcanic vents and the presence of hot springs.

- Geophysical indicators of subsurface faulting such as steep linear gravity or magnetic gradients, differences in seismic wave velocities, and offset of seismic reflection horizons.
- Geodetic indicators such as fault movement appearing in geodetic surveys as tilting and changes in the distance between fixed points.

Fieldwork for the mine site area was done primarily to determine the biodiversity of the area. While a detailed examination was not conducted to discern the features detailed above, fieldwork has not detected the occurrence of any of the features indicative of the likelihood of a seismic event.

As was indicated in Section 6, an earthquake event was recorded for Guyana, in 1964, at a point defined by 2.64° North and 59.62° West at a depth of 50 km and with a magnitude of 4.50. Additionally as can be inferred from Figure 12 an earthquake of unknown magnitude occurred at a point defined by 5.99° North and 61.48° West in Venezuela in 1975. Strong ground motion information for Guyana from the Caribbean Disaster Management Program has also indicated the possible occurrence of horizontal ground acceleration of 45 - 70 cm/sec² due to an earthquake event elsewhere.

This acceleration, while quite low can result in liquefaction of the sands present at shallow depths at the project site. The integrity of structures can be compromised if the sand liquefies during an earthquake event. The geotechnical analyses will consequently examine the liquefaction susceptibility of sands at the project site. If the probability of liquefaction is estimated to be unacceptable, a program of work will be undertaken to either increase the density of the sand or to provide a mechanism for rapid drainage during a likely earthquake event.

Based on the information above the risk of a seismic event occurring within 200 km of the site is very low.

17.3 Flood Risk Assessment

The project is located in a tropical area with high annual precipitation and intense rainfall events. Various elements of the proposed mine infrastructure will be subjected to flooding risks. However the open pit and the tailings ponds are of special concern.

17.3.1 Open Pit

Flood risks associated with the proposed Open Pit will be mainly generated from severe runoff resulting from extreme rainfall event(s) in the pit and the surrounding watershed. Flooding of the open pit could be disastrous and would impact the operation in a very significant way. The pit dewatering system will be designed to handle a significant hydrological event and a surface runoff control/diversion system will be provided to minimize surface runoff from reporting into the pit area. The runoff control/diversion system will be designed to be sufficient for the extreme hydrological event.

17.3.2 Tailing Management Area

The Tailings Pond will contain tailings generated from the processing plant. Extreme floods that exceed the design criteria and intensive internal erosion can cause failure of the structure. A discharge resulting from the tailings pond failure would generate significant environmental impacts. The embankments for the tailings pond have been classified as "extreme" in terms of failure consequences and have been designed accordingly. The embankments and associated spillway(s) will be designed to handle the extreme floods without overtopping of the embankments. A regular inspection/monitoring program will be established during operations and closure to ensure that the embankments are stable in the long term.

18.0 CONCEPTUAL CLOSURE PLAN

The sole precedent for closure of a mine site operation in Guyana is closure of Omai Gold Mines. (OGML, 2007). This conceptual closure plan draws from that closure plan since the operation now proposed is similar to that undertaken by Omai Gold Mines

The proposed Project will likely include the following components:

- Open pit mine;
- Ore processing plant;
- Administration, warehouse, maintenance and outbuildings;
- Stockpiles (ore and mine rock);
- Spoilpiles (overburden)
- Tailings Management Area(TMA);
- Laydown and materials storage facilities;
- Onsite air strip and haul roads ;
- Onsite power infrastructure and fuel storage facilities;
- Domestic and industrial waste handling facilities;
- Water management facilities and drainage works;
- Offsite power infrastructure upgrades and
- Port facilities.

The facilities will be progressively closed over the duration of the mine site operations. Progressive closure will reduce the costs of reclamation since closure will be integrated with the production operations. In addition progressive closure will result in the development of expertise on the most appropriate reclamation methods. Progressive closure will be undertaken, however without posing impediments to day-to-day operations of the site. Final closure of the mine site will be undertaken following completion of all mining operations, once treatment of site waters is no longer required, and indications that further mining 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 such 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 Tailing Pond and other water management ponds will be closed and all disturbed areas will be reclaimed, with the exception of roads needed for access during long term monitoring.

After the major closure activities are complete, a monitoring program may 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 mining and mineral exploration for close to 80 years. 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 mine site. At the conclusion of the closure process, no buildings or supporting infrastructure or facilities would remain at the site. The areas will be fully replaced by a sustainable environment comprised of productive and diverse lake and pond ecosystems. Spoil piles, stockpiles, borrow areas etc would be vegetated with general sustainable grass as well as emerging forest (primarily early stages in rainforest 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.

18.1 Closure Objectives

The objectives of the Closure Plan are to:

1. Prevent, reduce or mitigate the adverse environmental effects associated with the Project;
2. Provide for the reclamation of all affected sites and landscapes to a stable and safe condition;
3. Provide for the return of all affected ecosystems to healthy and sustainable functioning;
4. Reduce the need for long-term monitoring and maintenance by designing for closure and instituting progressive reclamation;
5. Provide for long-term monitoring and maintenance of the sites affected by the Project as required;
6. Provide for mine closure using the most current available proven technologies in a manner consistent with sustainable development.

The overall intent of the closure plan is to achieve Pharsalus Gold Inc objective for restoring the site and aquatic environment to a high ecological value. In addition closure will result in the establishment of conditions that support public safety through physical stability (**Physical Stability**), it would encourage productive end land use by promotion of revegetation and promote conditions for biological stability (**Biological Stability**) in addition to ensuring that mechanism are in place to protect water resources and the receiving environment thereby providing chemical stability (**Chemical Stability**).

Criteria/performance standards, which would function as measures of accomplishment of the closure objectives, are:

- **Physical Stability** - Preservation of protective safety measures (in a state in which the measures can be effective) throughout the post-closure monitoring period, once there has been no external human influence.
- **Biological Stability** - Effective revegetation and restoration evidenced by vegetative proliferation on 70% of the site areas intended for revegetation by the end of the post-closure monitoring period.
- **Chemical Stability** - Water quality similar or improved when compared with historic data at the end of the post-closure monitoring period, once there has been no human or related influence.

The conceptual closure plan incorporates the use of storm-water management practices and soil and wildlife conservation. The storm-water management practices will provide systems that minimize environmental damage by:

- Maximising retention time within the system by use of detention ponds
- Minimising increases in surface runoff flow and volume

- Channelling and diverting runoff
- Use of bench terraces

Soil conservation techniques to be employed to ensure closure success include

- Modifying the soil slope
- Maintaining and establishing natural vegetative cover
- Securing favorable soil conditions to facilitate vegetative growth.

Wildlife conservation techniques will include:

- Providing food resources through establishment of vegetation
- Providing habitats for wildlife through encouragement of vegetative proliferation, as well as creation of aquatic habitats
- Providing surface water and soils of good quality for wildlife consumption and use.

The mine site reclamation will be coordinated with the GGMC and the GFC.

18.2 Reforestation and Reclamation

The objectives of reforestation are to protect the soil against erosion and to restore biodiversity. The intent of the reclamation program is to develop reconstituted habitats which are ecologically functional and which are able to evolve naturally to the initial situation. Site rehabilitation will occur as mining proceeds so that on completion of the mining process reclamation will be substantially completed. Where possible, excavations will be reforested immediately after ore recovery to minimize loss of botanical or animal biodiversity. The reforestation process will mimic the natural closure of forest gaps by pioneer trees. The reclamation plan is developed on the basis of careful planning and respect of basic rules related to fast reforestation which will provide a new forest cover rich in biodiversity.

The reforestation process proposed to be applied is based on the use of heliophilic species to mimic the mechanisms that close the treefall gaps during forest regeneration cycles in pristine forests. Studies of plant succession, vegetation pattern, tree growth and biomass, performed in natural pristine forests in French Guyana and Amazonian forests show that fauna recolonization and fauna succession are key mechanisms for biodiversity conservation. The reforestation process will be based on these mechanisms.

The reforestation program will commence before mining and its associated soil excavation begins at the site. Before the forest cover is removed, all useful seeds and seedlings will be collected and would be stored in a plant nursery in the mine site area. The forest cover will then be cut and all the useful biomass would be collected, processed and stored to produce compost. Large wood stumps and trunks will also be inoculated with mushrooms. The topsoil would be removed before work commences and would be collected and stored separately. Seeds which are in the top-soil would be collected with the topsoil and stored.

A nursery would be established, at low cost, close to the mine site, by collecting material in the wild. The nursery would be established along creek flats inside forested areas close to the bottom of the slope. The nursery will contain young trees of the species already present in the impacted habitat, and hosting efficient indigenous ectomycorrhizal and endomycorrhizal fungi present in forest humus and nursery.

Many species of pioneer trees are sensitive to diseases and pests and as a result, many cuttings may be lost (sometimes up to 70%). The nursery would therefore be sized to overcome this problem particularly since no pesticides will be used in the nursery.

The reforestation process will begin immediately after the first area has been mined and recontoured and will be implemented by a crew specifically delegated reclamation responsibility which will start the soil rehabilitation and the revegetation process. This action will be taken to avoid soil erosion and compaction.

Borrow pits used to source material for embankment construction will be profiled and partially vegetated. Rehabilitation will commence with re-shaping of the material previously re-deposited into the mined out areas. The water retention in surficial soil will vary from none in highly porous areas to very high in clay soils areas. The soils will therefore be intermixed to ensure uniformity of its water retention capacity. The area will then be contoured to fit into its original topography. A thick layer of the topsoil, initially stored, would then be spread over the contoured area. Micro-topography artefacts will be added, if necessary, depending on the habitat, to provide traps for floating seeds and micro-habitats for fauna. Compost will then be added to the topsoil during the revegetation and seeding process. The area will then be revegetated using seedlings and plants from the nursery.

The reclamation program will be undertaken using seedling and planting rates which are designed to establish a minimum of one leguminous plant (nitrogen source) per square metre and one non-legume plant per square metre. Nutrients will be provided by using small amounts of lime fertilizers and compost. Large cuttings from leguminous trees will be used in order to establish a shade cover in five to eight month. After two to three years, these short lived plant species will contribute to the development of a litter layer. It is expected that they will age after five years and will be replaced by other species.

Stumps and logs, previously inoculated with mushrooms and stored under the canopy would be located at strategic points to provide long term sources of organic matter and micro habitats. These stumps and logs will form fertility islets to provide organic nutrients to the top-soil for years. This would be particularly important in this remote area since the transportation of mineral fertilisers would be costly. The decaying wood would release fertility in the same way as in the natural treefall gaps and this kind of fertilizer is less prone to washing out by rain and flooding than the mineral fertilisers.

A containment berm will be constructed around the perimeter of each spoil pile to control erosion and the migration of solids. The spoil pile will then be graded to blend with the natural topography. A layer of saprolite will be applied to selected areas of the dump face where waste rock only is exposed. Soil will then be applied over the spoil piles and vegetated 'islands' will be planted and observed. If the "islands" indicate that the soils are adequately fertile to develop a diverse community of plants, no additional action will be taken and the vegetation will be allowed to naturally spread. If observations of the "island" indicate very little development and spreading of vegetation, seedlings from the nursery plot will be transplanted into the spoil pile.

The mine pit will be provided with a spillway to enable discharge to surface water features around the pits. The discharge spillway will be sloped and will be covered with geotextile and rip rap (waste rock) to minimize the possibility of erosion. All power and water line will be disconnected and will be removed from the site.

All stockpile areas will be excavated back to original ground level, profiled and covered with natural organic-rich soils. Vegetated 'islands' will be planted over stockpile areas and will be observed. If the "islands" indicate that the soils are adequately fertile to develop a diverse community of plants, no additional action will be taken and the vegetation will be allowed to naturally spread. If observations of the "island" indicate very little development and spreading of vegetation, seedlings from the nursery plot will be transplanted into the spoil pile.

The water management pond will be breached to reduce the pond to one-half of its designed height and a spillway will link the pond to nearby surface water features. The spillway will be covered with geotextile and rip rap (waste rock) to minimize the possibility of erosion.

All haul and access roads will be regraded, reclaimed, and closed except for agreed upon access routes. To match adjacent slopes and roads, material will be pulled from the fill portions of the roads and placed in the cut portions to aid in regrading. All exploration roads at the mine site will be reclaimed in a similar manner to haul roads. This will include all areas outside the active mining area.

The process plant and its associated treatment facilities will be removed from the site. Concrete slabs and footings will be broken up and placed into open facilities such as ponds or will be placed on waste rock dumps in such a manner that the concrete will be incorporated into anticipated reclamation. Facility sites will be graded to blend in with existing topography, and compacted areas will be ripped and the whole area will be covered with topsoil and revegetated as detailed above. All topsoil areas will be regraded and revegetated. The primary materials to be used would be cover soil, subsoils, and non-acid generating (NAG) and acid neutralizing materials such as gravels and selected waste rock. Impervious ground covers will be installed using clays excavated from the mine pits.

The remaining areas not constructed on or of potentially AMD generating materials such as workshops, topsoil stockpiles, and some haul roads, will be covered with 12 inches of topsoil and up to an additional 12 inches of subsoil to provide a suitable substrate for vegetative growth. The subsoil will increase water storage capacity and provide a good substrate for rooting and maximize the likelihood of long-term vegetative success.

The closure plan will lead to the re-establishment of ecological processes that will allow for the development of appropriate habitats on the areas previously disturbed by mining. Where needed to provide slope and soil stabilization, permanent seed mixtures will include native species appropriate for the area. Non-invasive introduced vegetation species will be considered for their benefits to add organic matter to soils.

Closed facilities will be inspected and annual reports provided to evaluate the success of progressive reclamation. Reclamation monitoring would be coordinated with the EPA and GFC. Reclamation success will be evaluated both in terms of vegetation and erosion. The existing monitoring programs for surface and groundwater will continue in accordance with the proposed monitoring plans. Monitoring would be modified to address progressive reclamation as it proceeds.

Post closure monitoring of the tailings pond will be continued to ensure the integrity of the embankment cross-section. The cyanide concentration and water content of tailings will also be monitored to determine when these parameters fall within acceptable limits. Monitoring will only cease after both cyanide concentrations and tailings moisture content are within acceptable limits and only after the safety factor of embankment cross-section is determined to exceed 1.5 based on the soil strength gains over time and the widened embankment footprint based on deposition of the coarse fraction of the tailings adjacent to the dam itself.

19.0 RESULTS OF SECTORAL AGENCIES AND NGO MEETINGS

A meeting was held with various NGOs and sectoral agencies under the auspices of the Guyana Environmental Protection Agency. A single meeting was also held with the indigenous community of Kaburi Village and with residents of 14 Mile Issano.

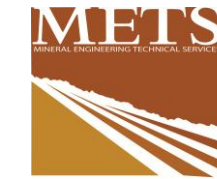
The objectives of the meetings were as follows:

1. To determine whether the organisation has any legislations or regulations that would impact on the proposed development;
2. To discuss the organisation's position on the proposed development;
3. To discuss areas of concern as it relates to the environment in the project area;
4. To collect all information or data on the environment within the project vicinity.

The minutes of all meetings are presented in Appendix E. The organisations present and their representatives at each meeting are also identified.

APPENDIX A: PROJECT MASS BALANCE

APPENDIX B: HISTORIC WEATHER DATA



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MASS BALANCE

1,000,000 tpa

Troy Resources Ltd

West Omai Gold Project

J962-MB-000-001

10/01/2014

COVER SHEET

0	29/08/2014	Client Issue	BF	IDR		
A	10/01/2014	First Revision	BF	PS		
Rev	Date	Description of Revision	By	Chkd	App	Client

Client:

Troy Resources Ltd

Project:

West Omai Gold Project

1,000,000 tpa

Operating Parameters	Unit	Crusher	Grinding	CIL	Reference
Operating days per year	days	365	365	365	Input
Operating hours per day	hours	24	24	24	Input
Operating utilisation	%	74.2	91.3	91.3	Calculation
Operating hours per year	hours	6,500	8,000	8,000	From Design Criteria
Plant feed PA	dtph	1,000,000	1,000,000	1,000,000	From Design Criteria
Hourly ore feed rate (input)	dtph	153.8	125.0	125.0	Calculation

Mass Balance Summary	Unit	Crusher	Grinding	CIL	Reference
Mass in	dtph	153.8	125.2	125.4	Calculation
Total mass in per year	dtph	1,000,000	1,001,500	1,002,820	Calculation
Total mass out per year	dtph	1,000,000	1,001,500	1,002,820	Calculation
Balance	dtph	0	0	0	Calculation

Assumptions and Inputs	Unit	Value	
Feed			
Water SG	t/m ³	1.00	PDC
ROM ore solids SG	t/m ³	2.70	PDC
ROM ore moisture content (operating)	%	8.00	PDC
ROM ore feed to plant per year	tpa	1,000,000	PDC
ROM ore feed to primary crusher	dtph	153.85	Calculation
Vibrating Grizzly Split to O/S	%	100	Bruno
Secondary Crusher Recirculating Load	%	178	Bruno

Grinding			
Ball mill trommel split to O/S	%	0.177	J462
Ball mill trommel O/S % solids	%	100	J462
Ball mill feed density	%	74	
Cyclone feed solids density	%	55	PDC
Cyclone o/f solids density	%	34	Assumption
Cyclone U/F solids density (JK)	%	76.5	
Ball Mill Recirculating Load	%	209.77	

Gravity Circuit			
Gravity concentrate solids density	%	50	PDC
Gravity concetrates feed % (of Cyclone U/F)	%	80	0.000232
Gravity concentrate mass pull of feed	%	0.03	
Gravity Concentrator Fluidisation Water	m3/h	17.00	
Number Gravity Concentrators	#	2.00	
Gravity Screen O/S Density	%	80.00	

Leaching

CIL Feed mass recovery to residue	%	100			Assumption
CIL Cyanide Addition (kg/t of leach feed)	kg/t	0.32			PDC
CIL Hydrated Lime Addition (kg/t of leach feed)	kg/t	1.50	ASSUMED		PDC
Hydrated lime - detox	kg/t	0.95			
Strips per Week	#	7.00	ASSUMED		PDC
Carbon SG	-	0.45			
Carbon per Strip	t	3.00			PDC

Elution

Carbon % solids going to elution circuit	%	80			Assumption
Carbon transfer water	m3/h	1.67	scaled to hourly, 40m3/h at 60 minute transfer time, once a day		Assumption
Dewatered carbon % solids	%	80			Assumption
Carbon loss to attrition	%	0.01			Assumption
Carbon loss % solids	%	80			Assumption
Wash solution	m3/h	0.5	Scaled to hourly, 12m3/h at 60 minute transfer time, once a day		
Eluate	m3/h	0.5	Scaled to hourly, 12m3/h at 60 minute transfer time, once a day		
Electrowinning	m3/h	0.5	Scaled to hourly, 12m3/h at 60 minute transfer time, once a day		
ILR Total Soln Feed	m3/h	0.33	Based on 8 m3 from Gekko communication, 4 leach soln, 4 wash water, once per day (assume raw water)		

Pre-leach Thickener and Water

Pre-leach Thickener U/F density	%	50			
Flocculant Dilution Water	m3/h	7.5			
Tailings dam water return	%	45			Assumption
Site Personal (per swing)	#	250			

Reagent Water Demand

Cyanide		0.82	m3/h	Process	From Reagent Tank Calculation Sheet
HCl		0.10	m3/h	Raw	From Reagent Tank Calculation Sheet
NaOH					
SMBS		0.37	m3/h	Process	From Reagent Tank Calculation Sheet
Flocculant		5.67	m3/h	Raw	From Reagent Tank Calculation Sheet
CuSO4		1.95	m3/h	Process	From Reagent Tank Calculation Sheet
Lime - mill feed		0.60	m3/h	Process	From Reagent Tank Calculation Sheet, agitation factor removed
Lime - detox feed		0.04	m3/h	Process	From Reagent Tank Calculation Sheet, agitation factor removed

Rainfall

Area of TSF	m2	80000.00			
Rainfall PA	m	4.00			
Evaporation PA	m	1.30			
Net rainfall PA	m	2.70			
Net rainfall into TSF per hour	m3/h	27.00			

Plant bunded area	m2	50.00			
Plant bunded water return per hour (rainfall)	m3/h	0.02			
General Purpose Outlet Water	m3/h	21.60		(3.6*60*10%)	

MINERAL ENGINEERING TECHNICAL SERVICES

Mass Balance

Client: Troy Resources Ltd

1,000,000 tpa

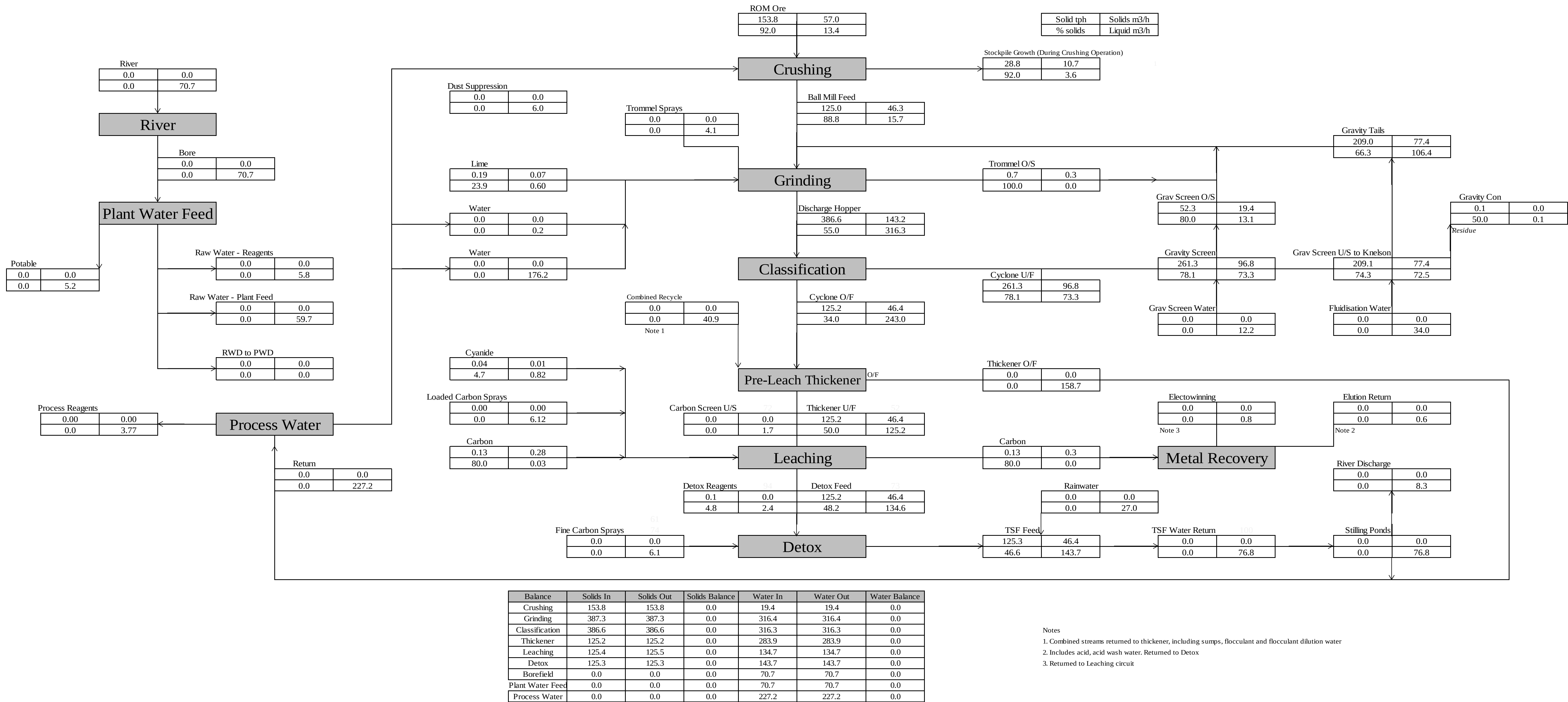
Project: West Omai Gold Project

Stream Number	Stream Name	Solids t/h	Liquid t/h	Total t/h	Solids % w/w	Solids m³/h	Liquid m³/h	Total m³/h	Solids SG	Slurry SG	Reference
Crushing and Grinding											
1	ROM ore feed to crushing	153.85	13.38	167.22	92.00	57	13	70	2.70	2.38	Calculation
2	Dust suppression water Crushing	0.00	6.00	6.00	0.00	0	6	6	2.70	1.00	Input
3	Primary crusher discharge	153.85	19.38	173.22	88.81	57	19	76	2.70	2.27	Calculation
4	Combined Primary Feed to Secondary Circuit	153.85	19.38								
5											
6	Combined Screen Feed	427.69	53.87	481.56	88.81	158	54	212	2.70	2.27	Calculation
7	Screen O/S, Secondary Crusher Feed	273.85	34.49	308.34	88.81	101	34	136	2.70	2.27	Calculation
8	Secondary Crusher Discharge	273.85	34.49	308.34	88.81	101	34	136	2.70	2.27	Calculation
9	Screen U/S	153.85	19.38	173.22	88.81	57	19	76	2.70	2.27	Calculation
10	Secondary Crusher calculated recirculating load		178%								
11											
12	Stockpile Feed	153.85	19.38	173.22	88.81	57	19	76	2.70	2.27	Calculation
13	Stockpile Discharge	125.00	15.74	140.74	88.81	46	16	62	2.70	2.27	Calculation
14											
15	Ball mill fresh feed	125.00	15.74	140.74	88.81	46	15.74	62.04	2.70	2.27	Calculation
16	Ball mill quick lime addition	0.19	0.60	0.78	23.89	0.07	1	1	2.70	1.18	Calculation
17	Ball mill recycled water from dam	0.00	0.18	0.18	0.00	0.00	0	0	2.70	1.00	Calculation
18	Combined Gravity / Cyclone U/F Recycle	261.34	119.53	380.87	68.62	97	120	216	2.70	1.76	Calculation
19	Total Ball mill feed	387.21	136.05	523.26	74.00	143	136	279	2.70	1.87	Input
20	Ball mill calculated recirculated load		210%								Calculation Check
21	Trommel Water Sprays	0.00	4.08	4.08	0.00	0	4	4	2.70	1.00	Calculation
22	Ball mill trommel O/S	0.68	0.00	0.68	100.00	0	0	0	2.70	2.70	Input
23	Trommel O/S Recycle	0.68	0.00	0.68	100.00	0	0	0	2.70	2.70	Calculation
24	Ball mill trommel U/S	386.53	140.13	526.66	73.39	143	140	283	2.70	1.86	Calculation
25											
26	Ball Mill discharge hopper process water addition	0.00	176.17	176.17	0.00	0	176	176	2.70	1.00	Calculation
27	Ball Mill discharge hopper	386.59	316.30	702.89	55.00	143	316	459	2.70	1.53	Input
28											Calculation
29	Cyclone feed	386.59	316.30	702.89	55.00	143	316	459	2.70	1.53	Input
30	Cyclone U/F - Total	261.34	73.29	334.63	78.10	97	73	170	2.70	1.97	Calculation
32	Cyclone O/F	125.19	243.01	368.20	34.00	46	243	289	2.70	1.27	Input
33											
34	Gravity Circuit										
35	Split from Cyclone U/F recycle to gravity circuit	80%									
36	Gravity screen O/S Return	52.27	13.07	65.34	80.00	19	13	32	2.70	2.01	Calculation
37	Gravity Screen Wash Water	0.00	12.24	12.24	0.00	0	12	12	2.70	1.00	Calculation

38	Total Gravity Feed	209.07	72.46	281.54	74.26	77	72	150	2.70	1.88	Calculation
39	Knelson Fluidisation Water	0.00	34.00	34.00	0.00	0	34	34	2.70	1.00	Calculation
40	Centrifugal gravity concentrator concentrate	0.06	0.06	0.12	50.00	0	0	0	2.70	1.46	Input
41	Centrifugal gravity concentrator tails (return to ball mill)	209.01	106.40	315.41	66.27	77	106	184	2.70	1.72	Calculation
42	Trash Screen Water Sprays	0.00	6.12	6.12	0.00	0	6	6	2.70	1.00	Calculation
43	Feed to Pre-Leach Thickener (Cyclone O/F)	125.19	243.01	368.20	34.00	46	243	289	2.70	1.27	Calculation
44											
45	Pre-Leach Thickener										
46	Pre-LeachThickener Floc Dilution Water	0.00	7.50	7.50	0.00	0	7	7	2.70	1.00	Calculation
47	Combined General purpose bunded sump return	0.00	21.62	21.62	0.00	0	22	22	2.70	1.00	Calculation
48	Flocculant addition	0.00	5.67	5.67	0.00	0	6	6	2.70	1.00	Calculation
49	Combined Recycle Streams To Thickener	0.00	40.91	40.91	0.00	0	41	41	2.70	1.00	Calculation
50	Pre-LeachThickener Feed	125.19	283.92	409.11	30.60	46	284	330	2.70	1.24	Calculation
51	Pre-Leach Thickener O/F	0.00	158.74	158.74	0.00	0	159	159	2.70	1.00	Calculation
52	Pre-Leach Thickener U/F	125.19	125.19	250.38	50.00	46	125	172	2.70	1.46	Calculation
53	Carbon In Leach Circuit Feed	125.19	125.19	250.38	50.00	46	125	172	2.70	1.46	Calculation
54											
55	Carbon In Leach Circuit										
57	Cyanide addition	0.04	0.82	0.86	4.65	0.01	0.82	0.84	2.70	1.03	Input
59	Carbon flowrate (hourly average basis)	0.13	0.031	0.16	80.00	0	0	0	0.45	0.51	Calculation
61	Spent electrowinning solution	0.00	0.83	0.83	0.00	0	1	1	2.70	1.00	Calculation
62	Loaded Carbon Screen Water Sprays	0.00	6.12	6.12	0.00	0	6	6	2.70	1.00	Calculation
63											
64	Total CIL circuit slurry feed	125.35	132.99	258.35	48.52	46	133	179	2.70	1.44	Calculation
65	Spent ore to Detox tank / Tailings feed	125.23	132.96	258.19	48.50	46	133	179	2.70	1.44	Calculation
66											
67	Elution Circuit - Data calculated in PDC										
68	Elution Circuit feed (loaded carbon)	0.13	0.03	0.16	80.00	0	0	0	0.45	0.51	Calculation
69	Elution Circuit - carbon transport water	0.00	1.67	1.67	0.00	0	2	2	3.00	1.00	Calculation
70	Carbon Regeneration Dewatering Screen Feed	0.13	1.70	1.82	6.86	0	2	2	0.45	0.92	Calculation
71	Carbon Regeneration Dewatering Screen O/S	0.13	0.03	0.16	80.00	0	0	0	0.45	0.51	Calculation
72	Carbon Regeneration Dewatering Screen U/S	0.00	1.67	1.67	0.00	0	2	2	0.45	1.00	Calculation
73	Fine Carbon Screen Feed	125.23	134.63	259.86	48.19	46	135	181	2.70	1.44	Calculation
74	Fine Carbon Screen Sprays	0.00	6.12	6.12	0.00	0	6	6	2.70	1.00	Calculation
75	Total Fine Carbon Screen Feed	125.23	140.75	265.98	47.08	46	141	187	2.70	1.42	Calculation
76	Fine carbon screen O/S	0.01	0.003	0.02	80.00	0	0	0	0.45	0.51	Calculation
77	Fine carbon screen U/S	125.22	140.75	265.96	47.08	46	141	187	2.70	1.42	Calculation
78	HCl	0.00	0.10	0.10	0.00	0	0	0	2.70	1.00	Calculation
79	Wash Solution (raw water)	0.00	0.50	0.50	0.00	0	1	1	2.70	1.00	Calculation
80	Combined HCl / Wash Soln	0.00	0.60	0.60	0.00	0	1	1	2.70	1.00	Calculation
81	Elution Solution	0.00	0.50	0.50	0.00	0	1	1	2.70	1.00	Calculation
82											
83	ILR and Electrowinning										
84	ILR gravity concentrate feed	0.06	0.06	0.12	50.00	0	0	0	2.70	1.46	Calculation
85	ILR leach reagent feed	0.00	0.33	0.33	0.00	0	0	0	2.70	1.00	Calculation
86	ILR residue	0.06	0.06	0.12	50.00	0	0	0	2.70	1.46	Calculation

87	ILR leach solution to electrowinning	0.00	0.33	0.33	0.00	0	0	0	2.70	1.00	Calculation
88	Elution Electrowinning Feed	0.00	0.50	0.50	0.00	0	1	1	2.70	1.00	Calculation
89	Combined Electrowinning return	0.00	0.83	0.83	0.00	0	1	1	2.70	1.00	Calculation
90											
91	Detox Tank										
92	Detox Lime Addition	0.12	0.04	0.16	74.89	0	0	0	2.70	1.89	Calculation
93	Detox Tank Feed	125.22	141.34	266.56	46.97	46	141	188	2.70	1.42	Calculation
94	Reagents	0.12	2.35	2.47	4.81	0	2	2	2.70	1.03	Input - PDC
95											
96	Tailings										
97	Tailings storage rainwater collection	0.00	27.00	27.00	0.00	0	27	27	2.70	1.00	Calculation
98	Tailings storage feed - Plant	125.33	143.69	269.03	46.59	46	144	190	2.70	1.42	Calculation
99	Tailings storage feed	125.33	170.69	296.03	42.34	46	171	217	2.70	1.36	Calculation
100	Wet tailings storage water return	0.00	76.81	76.81	0.00	0	77	77	2.70	1.00	Calculation
101	TSF growth	125.33	94.26	219.59	57.08	46	94	141	2.70	1.56	Calculation
102	PWD Return Water	0.00	227.20	227.20	0.00	0	227	227	2.70	1.00	Calculation
103											
104	Stilling Ponds										
105	Stilling Ponds Feed	0.00	76.81	76.81	0.00	0	77	77	2.70	1.00	Calculation
106	Discharged to River	0.00	8.34	8.34	0.00	0	8	8	2.70	1.00	Calculation
107	Returned to PWD	0.00	68.47	68.47	0.00	0	68	68	2.70	1.00	Calculation
108											
109	Process Water Dam										
110	Process Water Dam - Plant Feed Total	0.00	227.20	227.20	0.00	0	227	227	2.70	1.00	Calculation
111	Reagents - Process Water	0.00	3.77	3.77	0.00	0	4	4	2.70	1.00	Calculation
112											
113	Raw Water										
114	River	0.00	70.67	70.67	0.00	0	71	71	2.70	1.00	Calculation
115	Purification	0.00	5.21	5.21	0.00	0	5	5	2.70	1.00	Calculation
116	Reagents - Raw Water	0.00	5.77	5.77	0.00	0	6	6	2.70	1.00	Calculation
117	Raw Water Plant Feed	0.00	59.69	59.69	0.00	0	60	60	2.70	1.00	Calculation
118	Raw water top-up water required (-ve is Water Disposal Requirement)	0.00	0.00	0.00	#DIV/0!	0	0	0	2.70	#DIV/0!	Calculation
119	Potable water (Total)	0.00	5.21	5.21	0.00	0	5	5	2.70	1.00	Input
120	Strips per week		7.00								
121	Other water losses		0.38								
122	Water Balance										
123	Litres from river per hour		70,674.94	L/hr							
124	Liters from river per year		565,399,552.08	L/yr							
125	Megalitres per year required from river		565.40	ML/yr							

Troy Resources Ltd Mass Balance
Block Flow Diagram



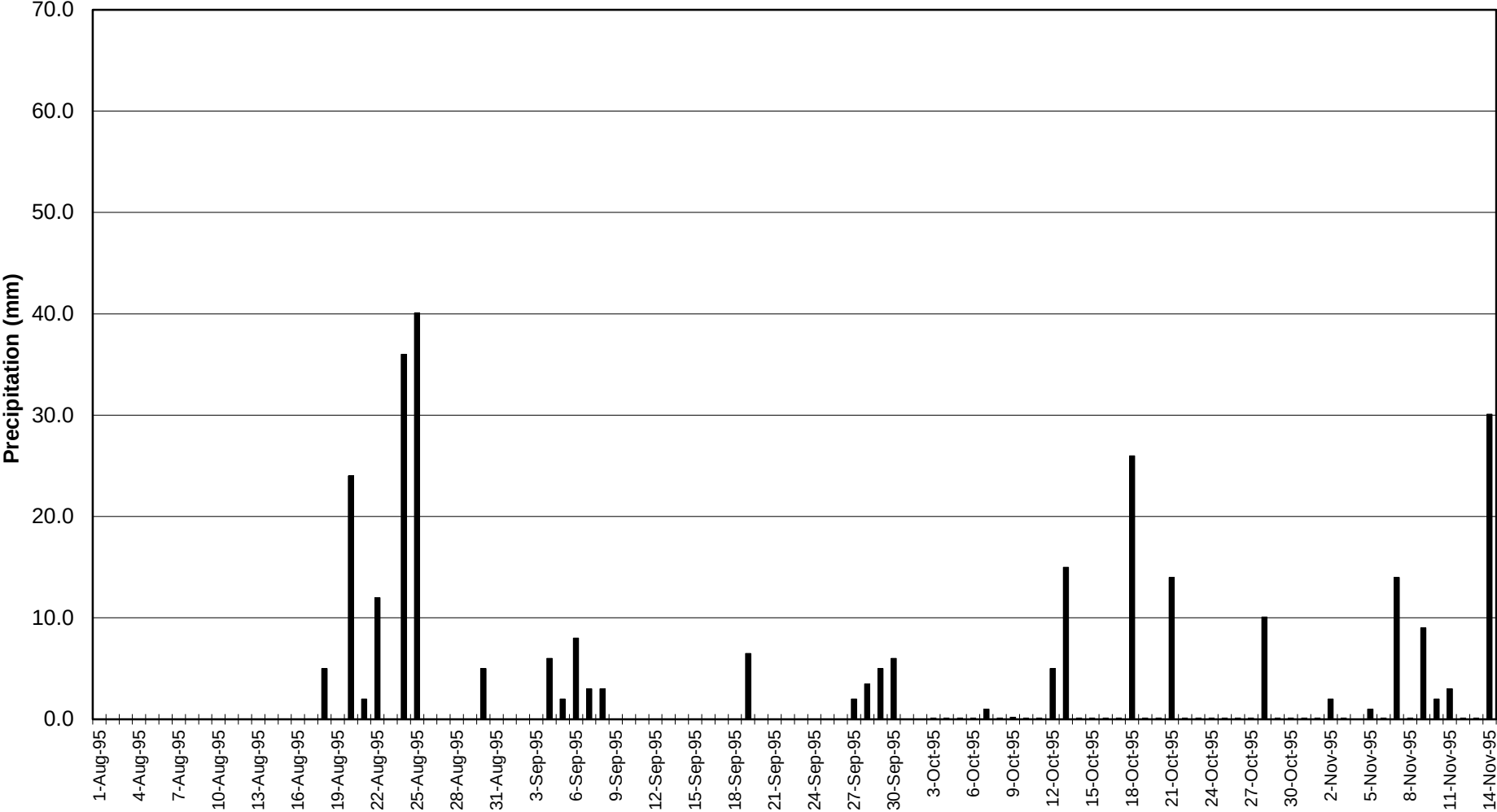
APPENDIX B: HISTORIC WEATHER DATA

CATHERAL GOLD CORPORATION								
KABURI-ELDORADO PROJECT								
Weather/Stream Gauge								
PROPERTY: Tallman Property								
Weather Station Log								
			TEMPERATURE (°C)			Rainfall		STREAM GAUGE
Date	Observer	Time	Max	Min	Current	(mm)	General Weather Conditions and Other Comments	AM (m)
1-Aug-95	F. Andersen		Hot	Hot		Sprinkle	Sunny, some cloud.	0.450
2-Aug-95	F. Andersen		Hot	Hot		Shower in pm	Some cloud.	0.400
3-Aug-95	F. Andersen		Hot	Hot		Shower in pm	Rain at 3:30 pm, last 2 days.	0.425
4-Aug-95	F. Andersen		Hot	Hot		Intermittent	Some cloud.	0.425
5-Aug-95	F. Andersen		Hot	Hot		Rainstorm am/pm	Very muggy. No rain at 3:30 pm.	0.470
6-Aug-95	F. Andersen		Hot	Hot		Rainstorm pm	Heavy morning rain.	0.465
7-Aug-95	F. Andersen		Hot	Hot		No rain	Sunny, no cloud.	0.465
8-Aug-95	F. Andersen		Hot	Hot		No rain	Sunny, no cloud.	0.425
9-Aug-95	F. Andersen		Hot	Hot		Heavy rain	Rain from 2-3 pm.	0.400
10-Aug-95	F. Andersen		Hot	Hot		Light rain	Showers in pm.	0.400
11-Aug-95	F. Andersen		Hot	Hot		Rain/sun	Heavy rain at night/intermittent rain all day.	0.415
12-Aug-95	F. Andersen		Hot	Hot		Lots	Rain all night and late pm - big storm in pm.	0.415
13-Aug-95	F. Andersen		Hot	Hot				0.450
14-Aug-95	F. Andersen		Hot	Hot			Entered to August 14 am.	0.450
15-Aug-95	F. Andersen		Hot	Hot		Light rain	-P-Ohio/Enviro/Weather	
16-Aug-95	F. Andersen		Hot	Hot		Rain in night		0.410
17-Aug-95	F. Andersen		Very hot (38°)			Heavy rain in early am	Muggy, overcast, arrive at 5 pm, thermo-rain gauge installed 7:19 pm.	0.430
18-Aug-95	F. Andersen		38	24		5	Hard rain early am.	0.430
19-Aug-95	F. Andersen		40	26		Trace	Very hot.	0.430
20-Aug-95	F. Andersen		40	24		24	Very heavy rain in midday, pm.	0.410
21-Aug-95	F. Andersen		41	22		2	Even hotter.	0.470
22-Aug-95	F. Andersen		42	21		12	Hot.	0.460
23-Aug-95	F. Andersen		42	22		Trace		0.460
24-Aug-95	F. Andersen		39	23		36	Heavy rain in early am.	0.500
25-Aug-95	F. Andersen		41	24		40		0.500
26-Aug-95	F. Andersen		38	24		0		0.530
27-Aug-95	F. Andersen		40	23		0		0.450
28-Aug-95	F. Andersen		41	24		Trace		0.450
29-Aug-95	F. Andersen		40	24		0		0.450
30-Aug-95	F. Andersen		38	25		5		0.440
31-Aug-95	F. Andersen		39	24		0		0.430
1-Sep-95	F. Andersen		38	23		0		0.420
2-Sep-95	F. Andersen		39	23		Trace		0.400
3-Sep-95	F. Andersen		40	24		0		0.400
4-Sep-95	F. Andersen		40	22		6		0.400
5-Sep-95	F. Andersen		41	23		2		0.400
6-Sep-95	F. Andersen		40.5	23		8	Heavy storm early pm.	0.411
7-Sep-95	G. Charles		40.5	23		3	Heavy storm 6 pm.	0.420
8-Sep-95	G. Charles		39	24		3	Heavy storm.	0.425
9-Sep-95	G. Charles		41	23		AM 10	Heavy storm 5:30 pm.	0.425

CATHERAL GOLD CORPORATION								
KABURI-ELDORADO PROJECT								
Weather/Stream Gauge								
PROPERTY: Tallman Property								
Weather Station Log								
			TEMPERATURE (°C)			Rainfall		STREAM GAUGE
Date	Observer	Time	Max	Min	Current	(mm)	General Weather Conditions and Other Comments	AM (m)
10-Sep-95	M. Bradley		41.5	22.5		0.5	Light rain in early morning.	0.405
11-Sep-95	M. Bradley		40.5	22.5		Trace	Cloudy with few afternoon sunny periods.	0.400
12-Sep-95	M. Bradley		43	22		0	Sunny with few cloudy periods.	0.400
13-Sep-95	M. Bradley		44.5	22		0	Sunny, cloudy periods to mid-afternoon, overcast, then clear.	0.390
14-Sep-95	M. Bradley		43	23.5		0.5	Light rain at 5:30 am; cloudy with sunny breaks.	0.375
15-Sep-95	M. Bradley		44	25		0	Overcast with afternoon sunny periods.	0.375
16-Sep-95	M. Bradley		44	21		0	Sunny with cloudy periods.	0.365
17-Sep-95	M. Bradley		42	23		0	Sunny morning, cloudy periods becoming overcast afternoon.	0.365
18-Sep-95	M. Bradley		42.5	22		0	Cloudy with sunny periods.	0.360
19-Sep-95	M. Bradley		42	23		6.5	6.5 mm in 15 minutes starting 2 pm, then sunny.	0.360
20-Sep-95	M. Bradley		43	21.5		0	Sunny, cloudy periods.	0.360
21-Sep-95	M. Bradley		44.5	23.5		0	Sunny, few cloudy periods in afternoon.	0.360
22-Sep-95	M. Bradley		41	24		Trace	Overcast, few sunny breaks at noon, thunder and rain 2-4:30.	0.368
23-Sep-95	M. Bradley		40.5	23		Trace	Overcast to noon, sunny with cloudy periods, thunder and rain 5-5:30.	0.375
24-Sep-95	M. Bradley		42	23		Trace	Overcast to 10, sunny with cloudy, 1 light shower.	0.355
25-Sep-95	M. Bradley		42.5	24		0	Overcast morning; sunny with cloudy periods in afternoon.	0.350
26-Sep-95	M. Bradley		44.5	24		0	Cloudy with sunny periods; sunny afternoon.	0.350
27-Sep-95	M. Bradley		44	24		2	Cloudy with sunny periods; light rain 3:30-4:30 am, 2-3 pm.	0.350
28-Sep-95	M. Bradley		44	24		3.5	Cloudy with sunny periods; lightening, light rain 9:30-11 pm.	0.365
29-Sep-95	M. Bradley		37	24		5	Overcast most all day, thunder storms around.	0.370
30-Sep-95	M. Bradley		40	24		6	Overcast morning after overnight rains; afternoon sunny with cloudy periods.	0.375
1-Oct-95	M. Bradley		40	24		0	Overcast until 11; cloudy with sunny periods.	0.370
2-Oct-95	M. Bradley		41	24		0	Overcast to 9:30, sunny with cloudy periods.	0.370
3-Oct-95	H. Arthur		39	23		0	Sunny with cloudy periods.	0.350
4-Oct-95	H. Arthur		40	26		0	Sunny with cloudy periods. Overcast until 10:00 am.	0.330
5-Oct-95	H. Arthur		40	22		0	Cloudy with sunny periods.	0.330
6-Oct-95	H. Arthur		39	24		0	Cloudy with sunny periods, overcast to 1 pm.	0.325
7-Oct-95	H. Arthur		40	24		1	Cloudy with sunny periods, overcast all day.	0.325
8-Oct-95	H. Arthur		41	23		0	Cloudy with sunny periods, overcast until noon.	0.290
9-Oct-95	H. Arthur		40	23		Trace	Sunny with cloudy periods, overcast until 11:00 am.	0.280
10-Oct-95	H. Arthur		41	25		0	Cloudy with sunny periods, overcast until 2 pm.	0.270
11-Oct-95	H. Arthur		41	22		0	Cloudy with sunny periods.	0.270
12-Oct-95	H. Arthur		38	23		5	Cloudy with sunny periods, rain.	0.290
13-Oct-95	H. Arthur		38	22		15	Cloudy with sunny periods.	0.290
14-Oct-95	H. Arthur		40	23		0	Cloudy with sunny periods, overcast to 11:00 am.	0.280
15-Oct-95	H. Arthur		39	24		0	Cloudy with sunny periods, overcast to noon.	0.275
16-Oct-95	H. Arthur		40	22		0	Sunny with cloudy periods, overcast to 8:00 am.	0.270
17-Oct-95	H. Arthur		40	23		0	Sunny with cloudy periods, overcast to 9:00 am.	0.270
18-Oct-95	H. Arthur		40	22		26	Sunny with cloudy periods, overcast to 9:00 am.	0.290
19-Oct-95	H. Arthur		40	22		0	Sunny with cloudy periods.	0.270

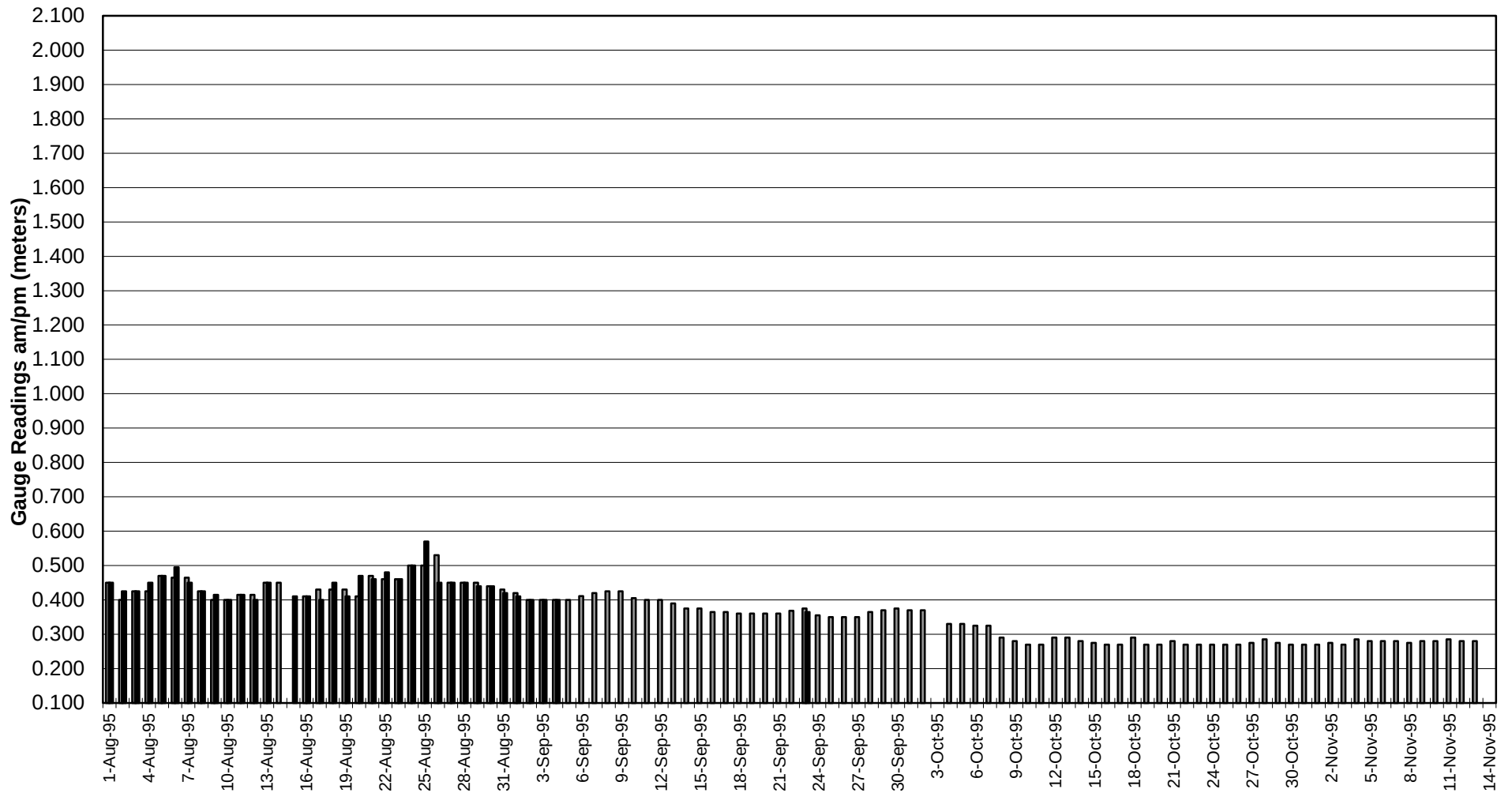
CATHERAL GOLD CORPORATION								
KABURI-ELDORADO PROJECT								
Weather/Stream Gauge								
PROPERTY: Tallman Property								
Weather Station Log								
			TEMPERATURE (°C)			Rainfall		STREAM GAUGE
Date	Observer	Time	Max	Min	Current	(mm)	General Weather Conditions and Other Comments	AM (m)
20-Oct-95	H. Arthur		41	22		0	Cloudy with sunny periods, overcast to 10:00 am.	0.270
21-Oct-95	H. Arthur		39	23		14	Cloudy with sunny periods, overcast to noon.	0.280
22-Oct-95	H. Arthur		40	22		0	Cloudy with sunny periods, overcast all day.	0.270
23-Oct-95	H. Arthur		39	22		0	Cloudy with sunny periods, overcast to noon.	0.270
24-Oct-95	H. Arthur		38	24		0	Cloudy with slight drizzle, overcast all day.	0.270
25-Oct-95	H. Arthur		40	22		0	Cloudy with sunny periods.	0.270
26-Oct-95	H. Arthur		39	24		0	Sunny with cloudy periods.	0.270
27-Oct-95	H. Arthur		40	23		0	Sunny with cloudy periods, shower at 2 pm.	0.275
28-Oct-95	H. Arthur		38.5	24		10	Sunny with cloudy periods, drizzle at 3:00 pm.	0.285
29-Oct-95	H. Arthur		40	23		0	Cloudy with sunny periods.	0.275
30-Oct-95	H. Arthur		40.5	23		0	Cloudy with sunny periods, rain at 5:00 pm.	0.270
31-Oct-95	H. Arthur		39	22		0	Cloudy with sunny periods, overcast to 10:00 pm.	0.270
1-Nov-95	H. Arthur		36	23.5		0	Cloudy with sunny periods, rain at 1:00 pm.	0.270
2-Nov-95	H. Arthur		39	22		2	Sunny with cloudy periods, slightly overcast.	0.275
3-Nov-95	H. Arthur		38	24		0	Sunny with cloudy periods, rain at 3:00 pm.	0.270
4-Nov-95	H. Arthur		36.5	23		30.5	Cloudy with sunny periods, rain at 4:00 pm.	0.285
5-Nov-95	H. Arthur		38	23		1	Cloudy with sunny periods, drizzle at 10:00 pm.	0.280
6-Nov-95	H. Arthur		39.5	22.5		0	Cloudy with sunny periods, rain at 5:00 pm.	0.280
7-Nov-95	H. Arthur		38	24		14	Cloudy with sunny periods, overcast to N/W.	0.280
8-Nov-95	H. Arthur		39	24		0	Cloudy with sunny periods, drizzle at 2:00 pm.	0.275
9-Nov-95	H. Arthur		35	24		9	Cloudy with sunny periods, drizzle at 6:30 am.	0.280
10-Nov-95	H. Arthur		38	24		2	Cloudy with sunny periods, rain at 1:00 pm.	0.280
11-Nov-95	H. Arthur		38	22.5		3	Cloudy with sunny periods, overcast until 9:00 am.	0.285
12-Nov-95	H. Arthur		38	22		0	Cloudy with sunny periods, overcast until 9:00 am.	0.280
13-Nov-95	H. Arthur		38	24.5		0	Sunny with cloudy periods.	0.280
14-Nov-95	H. Arthur		37	23.5		30	Cloudy with sunny periods, rain at 3 am.	0.290

Tallman Property - Daily 24 Hour Precipitation Readings

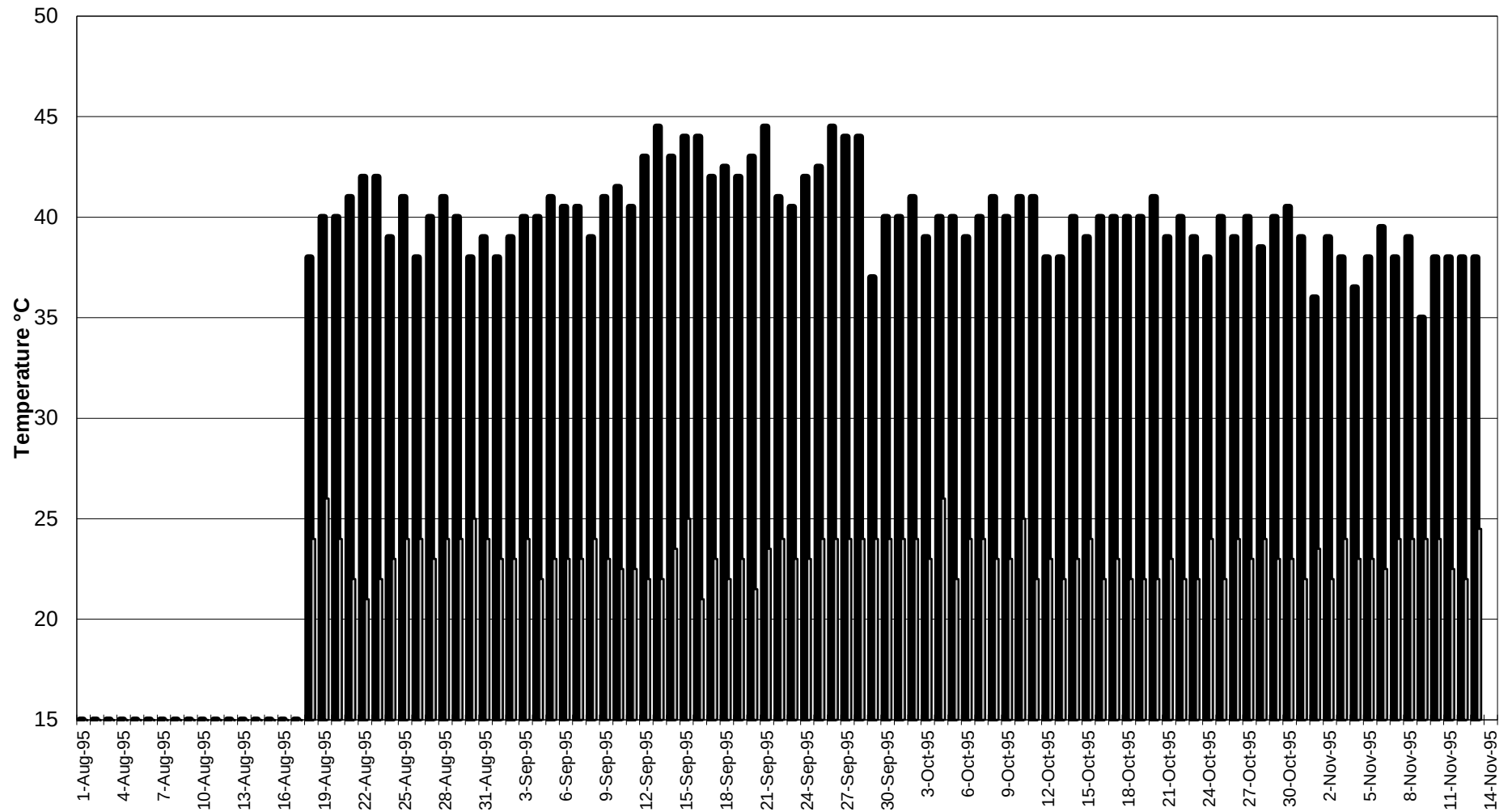


Note: For Illustration 0 mm precipitation = 0.1 mm (graph), Trace = 0.2 mm

Tallman Property: Stream Gauge Readings, L60N, 49E

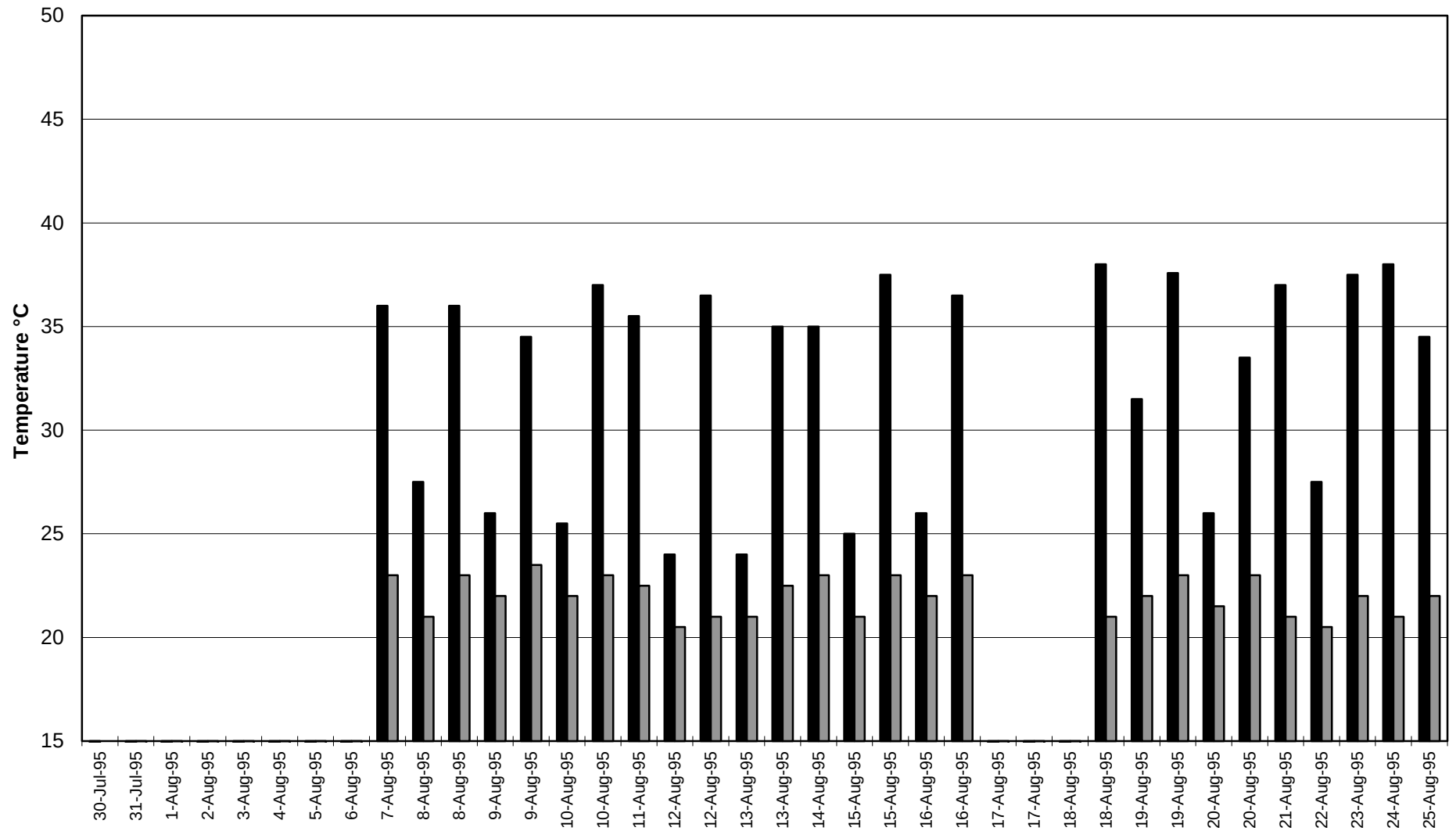


Tallman Property - DailyTemperature Readings (Max/Min)

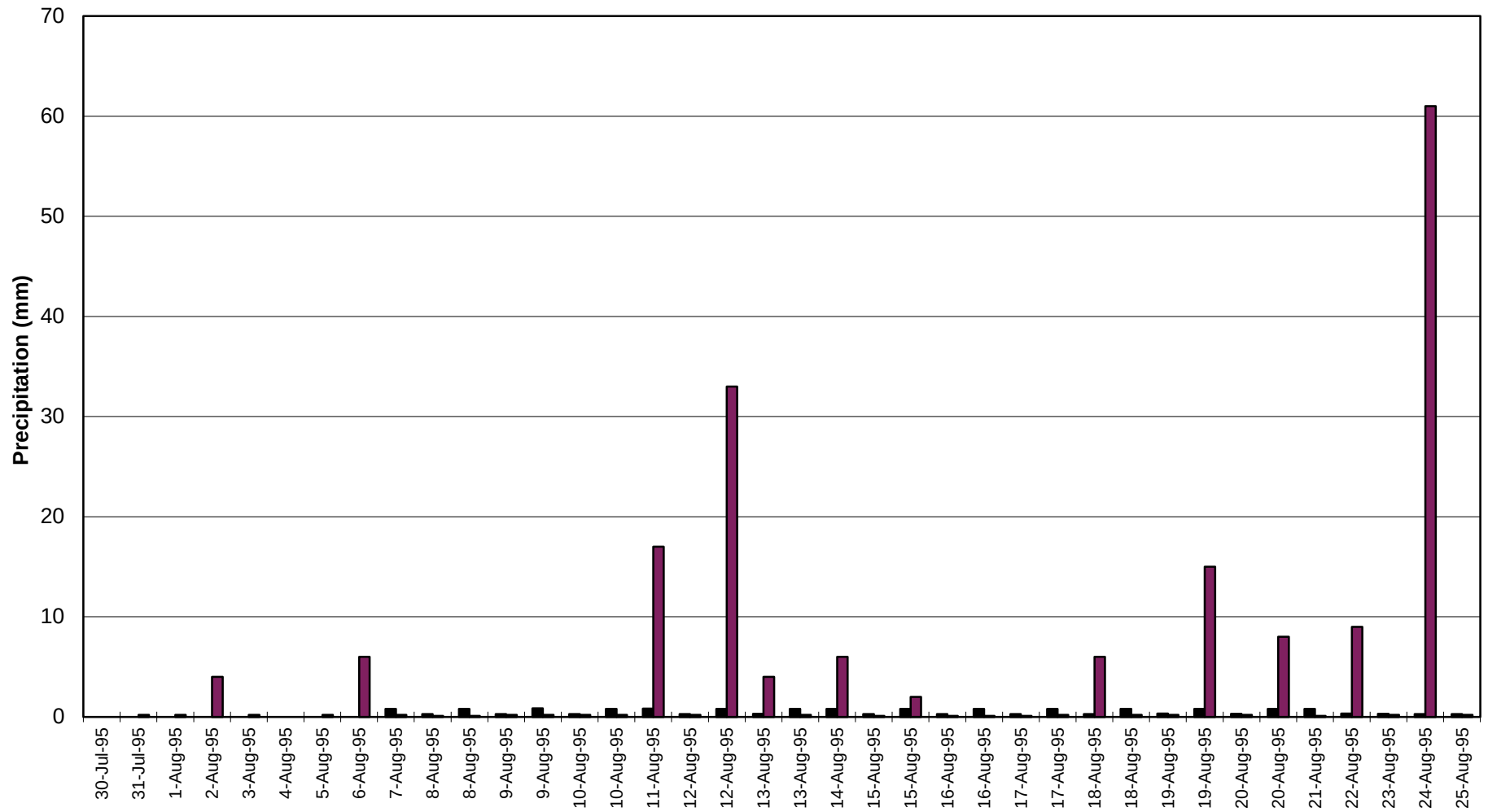


CATHERAL GOLD CORPORATION									
KABURI-ELDORADO PROJECT									
Weather and Hydrology Record Log									
PROPERTY: East Kaburi Prospecting Licence - 5 Miles Camp									
Weather Station Log									
			Temperature (°C)			Rainfall		STREAM LEVEL	
Date	Observer	Time	Max	Min	Current	(mm)	General Weather Conditions and Other Comments	DAY (m)	NIGHT (m)
30-Jul-95	CR		21-35						
31-Jul-95	CR		21-35	21-24.5		Trace			
1-Aug-95	CR		21-36	20-5.25		Trace			0.3
2-Aug-95	CR		21-36.5	20.5-25		4		0.3	0.3
3-Aug-95	CR		21-37.5	21-25		Trace		0.3	0.3
4-Aug-95	CR		21-37	20.5-27				0.3	0.3
5-Aug-95	CR		21-33	21.5-26.5		Trace		0.3	0.35
6-Aug-95	CR		21-33	21-27		6		0.35	
7-Aug-95	CR	7:00 PM	36	23		Trace		0.33	
8-Aug-95	CR	7:00 AM	27.5	21		None		0.33	
8-Aug-95	CR	7:00 PM	36	23		None		0.33	
9-Aug-95	CR	7:00 AM	26	22		Trace		0.33	
9-Aug-95	CR	8:45 PM	34.5	23.5		Trace		0.33	
10-Aug-95	CR	7:00 AM	25.5	22		Trace		0.33	
10-Aug-95	CR	7:00 PM	37	23		Trace		0.32	
11-Aug-95	CR	8:00 PM	35.5	22.5		17	Reports previous 25 hrs; 0.43 m at 3 pm.	0.38	
12-Aug-95	CR	7:00 AM	24	20.5		Trace		0.33	
12-Aug-95	CR	7:00 PM	36.5	21		33	Stream 0.33 m before ~6 pm rain.	0.52	
13-Aug-95	CR	7:45 AM	24	21		4		0.39	
13-Aug-95	CR	7:15 PM	35	22.5		Trace		0.35	
14-Aug-95	CR	7:00 PM	35	23		6	Reports previous 24 hrs.	NR	
15-Aug-95	CR	7:00 AM	25	21		None		NR	
15-Aug-95	CR	7:00 PM	37.5	23		2		0.33	
16-Aug-95	CR	7:00 AM	26	22		None		0.33	
16-Aug-95	CR	7:00 PM	36.5	23		None		0.33	
17-Aug-95	CR	7:00 AM	NR	NR		None	Moved thermometer to new location, no readings	0.33	
17-Aug-95	CR	7:00 PM	NR	NR		Trace	Moved thermometer to new location, no readings	0.33	
18-Aug-95	CR	7:00 AM				6	Minor mishap with thermometer	0.35	
18-Aug-95	CR	7:00 PM	38	21		Trace		0.33	
19-Aug-95	CR	8:15 AM	31.5	22		Trace		0.33	
19-Aug-95	CR	7:00 PM	37.58	23		15	Creek looks higher than it reads	0.35	
20-Aug-95	CR	7:30 AM	26	21.5		Trace		0.33	
20-Aug-95	CR	7:30 PM	33.5	23		8		0.39	
21-Aug-95	CR	7:00 PM	37	21		None	24 hrs.	0.33	
22-Aug-95	CR	8:00 AM	27.5	20.5		9		0.33	
23-Aug-95	CR	7:30 AM	37.5	22		Trace		0.33	
24-Aug-95	CR	7:00 AM	38	21		61	Rains overnights	0.6	
25-Aug-95	CR	7:00 AM	34.5	22		Trace	Previous 24 hrs.	0.35	

East Kaburi - Daily Temperature Readings (Max/Min)

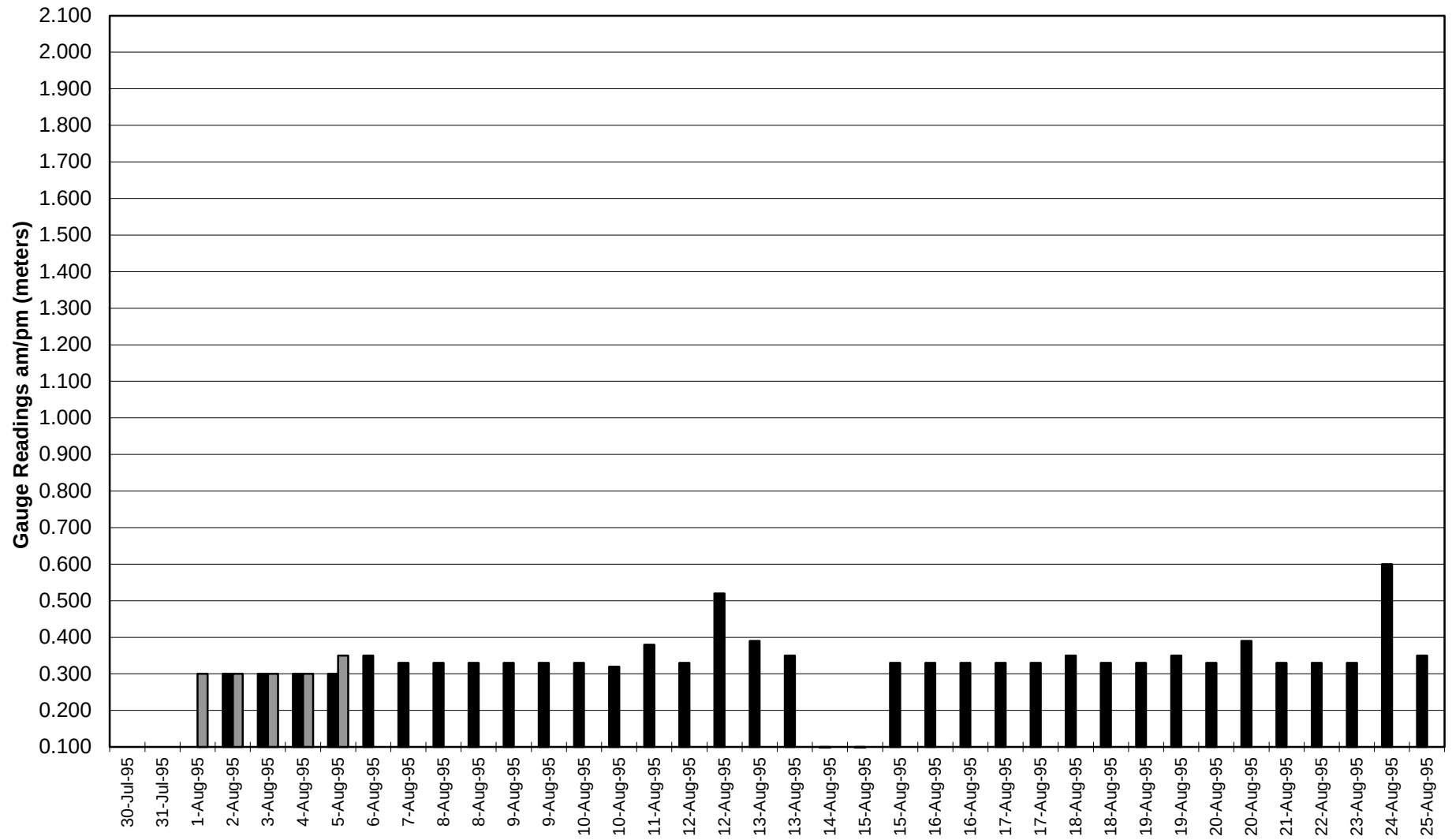


East Kaburi - Daily 24 Hours Precipitation Readings



Note: For Illustration 0 mm precipitation = 0.1 mm, Trace = 0.2 mm

East Kaburi - Stream Gauge Readings, L60N, 49E



Hicks Camp

Rainfall Registration Chart

Date	Jan	Feb	March	April	May	June	July	Aug
	mm	mm	mm	mm	mm	mm	mm	mm
1	1.5	2	3.5	21	0	4	0	63
2	9.5	4	2.5	0	10.5	58.5	0	0
3	25.5	0	1	6	1	26	0	0
4	14.5	0	2.5	1	9.5	5	9.5	0.5
5	35.5	0	8.5	0	2	7	3.7	0
6	16.5	4.5	3	8	3.5	12	0	0
7	7	0	0.5	1	2	3	25.3	15
8	9	1.3	22	0	13	4.5	0	0.5
9	7.5	4.5	1	0	71.5	11	15	0
10	5	4	61	13	12.5	12.5	175	26
11	4	13	20	3.5	2	11	10.5	13.5
12	4	0	12.5	1.5	7	20	0	7
13	3	35.5	59	0	1	5	14	0
14	1	4.5	12.5	0	6.5	0	6.75	21.5
15	17.5	0	52	0	44.5	4.5	26	1.5
16	0	0	5.5	0	0.5	9.5	25	3.5
17	1	75	0.5	0	22	7.5	23.5	4
18	5.5	35	36	0	5	8	1.5	5.5
19	0	9.5	7.5	0	15.5	7.5	0.75	0
20	0	26.5	12	0	0.5	25.5	0	58.5
21	0	88	0.5	1	16	15	2	9
22	0	4	0	0	1	9	21.5	0
23	0	20	16.5	0	2	49	7.5	0.5
24	0	1.5	11.5	0	2	5	7	15
25	0	6	1.5	2	12	5	63.5	24
26	0	2.5	0	0	12.5	1	7.5	5.5
27	0	3	1	0	15	7.5	2.5	1.5
28	0	8.5	0	0	11	4	23	4
29	0		6	0	9	17.5	7	12.5
30	2		0	0	84.5	3.5	51	0
31	13		27		7.5		7	0
TOTALS	182.5	352.8	387	58	402.5	358.5	536	292
# rain days								
	since Jan 1	2 months	3 months	4 months	5 months	6 months	7 months	8 months
TOTALS								
2011								
rain days								
months totals								

year 2011

Sept	Oct	Nov	Dec	Date
mm	mm	mm	mm	
0	0.5	54	14.5	1
0	0	6.5	6	2
0	0.5	2	37	3
0	8	4	0	4
9	0	3	0	5
0	0	0.5	0	6
0	0	4	0	7
0	0	3	5	8
0	0	4.5	12	9
2	9	7	14	10
0	0	1.5	1.5	11
7.7	0	0.5	0	12
0	3	3	32.5	13
0.5	3.5	1	0	14
18	0	0.5	0	15
17.5	0	0	65	16
0	0	0	0	17
26	3	18	0	18
3.5	11	10	0	19
0	70	7	0	20
1	2	1.5		21
0.5	0	19.5		22
0	2	2.5		23
0	0	1.5		24
19.5	2.5	12		25
3.5	0	1		26
0	20.5	0.5		27
0	2.5	0		28
0	16.5	0		29
0	14.5	12		30
	1			31
108.7	170	180.5	187.5	
9 months	10 months	11 months	12 months	

Hicks Camp

Rainfall Registration Chart

Date	Jan	Feb	March	April	May	June	July	Aug
	mm	mm	mm	mm	mm	mm	mm	mm
1		8.5	9	0	25.75	8.5		
2		12	2	2.5	1.5	12.75		
3		8	0.5	9.5	102.5	0.5		
4	15	32.5	0	2.75	4.5			
5	22	47.5	9.5	7	0			
6	4	22	0	41	85			
7	26	37	2	2	23			
8	16.5	0.5	1.5	9.5	4.5			
9	12	0.25	5.5	0.5	42			
10	11.5	0.25	14	0	9			
11	6.5	0.5	5.5	20.5	7			
12	8	0	1	1	0			
13	6	10	0	21	2			
14	9	4.5	0	0	26			
15	11	4.5	1.5	3.5	2.5			
16	6.5	4.5	0	0	0.5			
17	5	7.5	0	1	26.5			
18	10.5	1.75	24	2.5	7			
19	5	0	10	4.5	8			
20	8	19	11	1	28.5			
21	10	13	0	1	1			
22	11.5	1.5	16	0.5	0			
23	4.5	12.5	0	0	0.75			
24	0	11	3	0	6			
25	1.5	0.5	14.5	8	4.5			
26	4	13	1	9	32			
27	4.5	38	12.5	30	10			
28	21	30	2.5	24	50			
29	40	35.5	0	3	4.5			
30	14.5	0	4.5	3.5	8.5			
31	25	0	0.5	0	16.5			
TOTALS	319	375.75	151.5	208.75	539.5			
# rain days	27	27	22	24	28			
	since Jan 1	2 months	3 months	4 months	5 months	6 months	7 months	8 months
TOTALS	27	54	76	100	128			
2011								
rain days								
months totals								

year 2012

Sept	Oct	Nov	Dec	Date
mm	mm	mm	mm	
				1
				2
				3
				4
				5
				6
				7
				8
				9
				10
				11
				12
				13
				14
				15
				16
				17
				18
				19
				20
				21
				22
				23
				24
				25
				26
				27
				28
				29
				30
				31
9 months	10 months	11 months	12 months	

APPENDIX C: HYDROMETEOROLOGICAL DATA FOR MADHIA

DAILY RAINFALL																																
Year	Month	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
1943	01	6.1	5.1	14.2	54.4	0.3	6.6	9.1	8.4	28.2	12.7	14	15.2	51.3	15.5	8.1	0	3	5.3	0	2.3	4.8	5.1	31.2	8.4	12.7	2.8	22.4	82.3	8.6	5.8	31.8
1943	02	14.2	8.6	1.5	2.5	39.9	46.5	2.3	1.3	2.8	23.6	9.4	0	6.9	34.5	1.8	9.1	0	11.2	1	0.3	2.5	5.6	10.4	14.2	29.2	0.8	22.4	7.6			
1943	03	3.6	1	12.4	6.9	4.3	0	76.2	0	0	0	0	12.7	0	18.3	2.3	31.5	46.7	97.8	8.4	25.4	14.7	2.8	9.9	7.1	32.5	42.7	31	7.6	0.3	0.5	1.3
1943	04	14.5	6.9	0	0	8.9	7.6	3.3	0.5	18.8	0	10.2	12.7	16	0	0	0.3	27.9	21.6	63.2	25.4	0.8	34.5	42.2	20.1	4.8	2.5	7.1	0	0	0.8	
1943	05	11.7	59.2	2.3	59.4	14	6.4	37.6	1.3	12.2	28.2	20.1	19.6	15.2	15.7	10.2	23.4	1.3	3.8	8.6	30	5.3	5.3	90.9	10.2	7.9	17.5	5.6	4.6	5.8	43.7	41.9
1943	06	37.3	45.2	31	0.8	0	5.3	27.7	7.9	4.8	42.9	28.2	77.5	1.3	35.8	2.3	0.3	42.4	1.8	50.8	57.2	0	6.4	5.6	0	19.8	28.2	2.5	0	0.5		
1943	07	15.7	5.1	57.4	64.8	5.3	18.5	0	25.7	13.5	10.2	9.7	19.8	0.8	3	0	1.3	5.1	8.4	15.2	34.3	1.5	0	20.3	11.2	9.7	9.7	37.3	0	22.1	0	44.2
1943	08	0	0	0	66	23.1	27.7	15.5	25.9	19.8	26.7	1.3	9.7	8.1	1.3	17.3	0	27.9	16.5	41.1	0	6.6	21.3	36.8	15.2	9.7	9.7	37.3	0	22.1	0	44.2
1943	09	9.1	1.3	6.1	15.7	47.2	9.7	4.3	26.2	0	0	0	2.8	8.9	2.5	0	0	0	0	0	0	0.3	2.5	0	0	22.1	0.5	0.3	26.4	0	0	
1943	10	0	1	0	0	0	0	0	0	0	2.3	11.7	0	0	0	0	0	0	0	0	0	0	0	0.3	1.3	2.3	0	5.1	2.8	0	0	8.4
1943	11	0	0	0	0	0	13	2.3	16	1.5	0	0	0	0	2.5	17.8	0.8	0.3	0	13.2	0	0	0.5	53.8	14.2	13.7	35.6	8.4	2.3	0.3	0	
1943	12	12.4	47	30.5	0	7.6	1.5	0	0.3	15	0	0	16.5	11.7	10.9	0.5	2	5.6	12.2	5.1	66.5	21.6	11.9	8.9	0	38.1	9.1	10.4	41.9	0	2.5	18.8
1944	01	14.7	16.8	43.9	3.3	23.1	9.4	3.3	22.9	0	4.8	7.9	0	0	0	2.3	20.3	26.4	0.3	0	0	0	2.3	1.5	0.3	1	8.4	8.9	0	2	10.2	36.1
1944	02	16.8	0.5	0.5	1.5	8.1	0.8	12.7	10.7	0	0	8.4	14.7	12.7	16.5	5.1	12.2	2.8	23.6	17.3	0	0	6.6	4.6	1	22.9	2.3	3.8	1	40.9		
1944	03	3.8	54.6	6.4	43.9	1.3	6.4	0	0.5	0.8	0	0.5	0	0	0	85.6	10.9	7.9	1.5	8.6	31.2	20.3	13	0	2.5	10.4	9.4	51.8	0	0.8	27.9	22.4
1944	04	3	20.8	12.4	26.7	1	21.8	0.3	7.9	2.8	0	20.3	8.4	4.1	29.2	9.1	6.1	18	26.4	20.3	22.1	48.3	0	0	0	21.3	52.1	91.2	10.4	30.5	6.4	
1944	05	6.1	0	0	15	48	22.1	7.1	0	4.8	0	0	0	34.8	0.5	80	29.5	14.2	2.3	48.3	15.2	36.1	36.3	13.2	60.7	0	14	27.7	9.1	31	7.9	35.3
1944	06	13.2	26.4	23.4	12.4	11.7	31.8	20.6	62.2	8.1	8.6	23.1	24.9	87.9	13.5	4.1	2.5	0	6.1	53.8	4.6	38.1	17.8	17.3	8.9	4.3	1.8	3.3	1.5	25.9	5.1	
1944	07	17.3	11.4	10.7	9.7	32.5	12.2	22.9	38.6	28.4	6.6	5.8	0	0.3	12.7	59.9	16	1	13.2	1	0	0.8	0.3	5.8	0	0.3	5.1	56.6	4.3	0.8	0	1
1944	08	4.6	0	32.3	11.4	0	13.7	6.1	47.2	3.8	10.2	3.6	12.4	38.4	16.8	1.5	0	32.3	16.8	14	10.4	0	0	0.3	30.7	0.3	2.8	22.9	0	5.6	7.4	5.3
1944	09	0.3	0	0.3	0.8	2.5	12.7	0	1.3	0	0	21.1	25.1	0.3	3.6	0	1.8	0	0.5	0.8	4.1	0	15.2	11.7	0.8	0.5	4.8	4.1	0	0	0	
1944	10	0	0	0	0	0	3	0	0	1.5	1.3	0	4.1	2.5	3	8.1	39.9	10.7	0	0	0	0	0	0	0	0	0	0	0	0	0	0.5
1944	11	0	0	0	14	35.1	0.5	0	0	0	0	0	0.8	0	0	0	0	5.6	0	11.9	0	1.3	9.4	3.6	10.7	14.7	0.3	9.7	2.5	2.5	5.1	
1944	12	2	0	7.1	38.6	0	2.3	0.8	0.3	2.3	1.3	8.4	24.9	11.4	26.2	1.8	16.3	24.4	38.1	1.3	45	18	0	0	24.9	10.9	2.8	5.1	0	0	0	17
1945	01	2.3	0	1	8.4	0.3	3.6	3.3	14.5	0.8	0	0	0	0	0	0	4.1	22.9	4.8	16	8.1	17.8	0	43.4	47.5	8.1	30.5	37.3	1	21.3	2.5	2.3

1945	02	0	0	0	2	20.6	2	2.3	0.8	3	1.3	27.7	23.4	16	29.7	0	5.3	22.6	81	30.5	41.9	6.1	0	1.3	31.2	12.2	5.8	5.8	16.3				
1945	03	18	21.1	9.9	4.8	0.8	12.2	0	28.4	11.2	0.8	2	0	0	1.3	2.5	0	0	1	7.9	2.3	1.8	0.5	1	10.4	6.9	29.2	52.8	7.6	0.3	8.6	10.2	
1945	04	0.3	0.5	0	82	1.5	0	0	0	0	0	49	8.4	19.3	19.1	29.5	9.1	1	6.1	1	2.3	5.3	14.5	0	1	0.8	3	0	8.4	3.3	14.7		
1945	05	0	0	0	10.4	1.8	0.8	0	2	2.5	4.8	10.4	43.2	5.1	56.6	19.6	10.9	24.1	34.5	6.1	4.3	1.5	4.6	10.4	9.1	0.8	5.3	38.1	109	5.1	4.3	78.7	
1945	06	12.2	1	23.9	6.4	2.5	32	3	13	2.8	6.9	14	13.7	4.6	52.8	7.4	17.8	6.9	11.7	88.4	37.6	1.3	4.1	1.3	1.3	28.4	1.8	26.7	5.1	0.8	8.1		
1945	07	2.5	13	12.2	10.7	10.4	1.3	13	9.9	39.4	2.8	33.5	10.7	40.6	0	2.5	9.7	9.9	27.4	18	7.6	2.8	0.5	3.6	14	24.1	15	24.1	0.8	0.3	1	4.1	
1945	08	0	28.7	23.9	0	8.9	13.5	14.5	13.5	4.3	11.9	5.3	15.2	16.3	18.5	0.5	0.3	15	2.3	3.3	104	27.7	14.7	0	101	7.9	1.3	0	4.6	0	0	0	
1945	09	0	1	0.3	3.8	0	0	0.5	1	6.1	0	0.8	0	3.8	0.3	0	0	7.9	0	0	4.3	1.3	0	0	0	0	0	0	0	0.8	0		
1945	10	0	0	0.3	0	0	0	0	0	5.6	6.4	0	1	23.9	0	0	39.4	0	0	0	4.3	5.1	1.5	2.5	0	0	0.8	7.6	0	0	0	2.5	
1945	11	0	0	0	4.6	38.9	5.6	1	0	0	6.9	0.8	0	14.5	1.8	17	18.5	14.2	26.9	72.9	1.8	19.1	1.5	8.1	0	3.3	0	20.6	0	0.3	1.5		
1945	12	0.3	0.8	8.1	6.9	34	7.9	2.5	8.9	1.5	5.1	2.8	0.3	10.9	11.2	53.8	36.3	6.4	14.7	9.9	22.9	5.1	8.1	16.5	4.6	16	2.5	4.8	0	0.8	2.5	0	
1946	01	4.6	6.4	6.4	0	0	0.5	0	0.8	9.1	5.6	3.8	2.8	6.6	8.9	46.7	8.4	0	0.5	0.5	12.4	4.8	7.4	15	3.6	0	0.8	8.4	8.4	13.5	12.7	30.5	
1946	02	34.3	43.2	10.4	34.3	28.4	0.3	12.7	8.4	2	10.4	10.2	2.8	0	1.3	6.1	0	4.6	0	2.8	17.3	1.3	0	2.3	3.8	2.3	0	0.3	0				
1946	03	4.8	3	0	12.7	5.3	32.3	7.1	26.7	15.7	1.3	28.4	9.9	0	6.4	1.8	12.2	0.8	8.4	23.4	0.8	1.5	0	12.4	0	3.3	42.9	1.3	0	2.3	0	0	
1946	04	22.4	36.1	5.3	7.4	0	0.5	2	1.5	27.7	44.7	27.9	6.9	47.2	58.4	3	1	3.3	1.8	40.1	10.9	9.9	1.8	22.4	9.7	4.1	2	0.3	6.9	28.2	40.9		
1946	05	38.4	11.4	7.6	16.3	2	43.2	3.8	7.4	5.1	14	40.6	34	21.3	51.3	43.7	15.5	27.9	5.1	13.5	7.9	0	43.7	1.8	4.3	2.5	35.3	11.4	7.4	38.6	7.1	13.5	
1946	06	30.2	6.6	6.9	5.1	29.7	0	23.1	2.3	2	0.8	21.1	24.6	8.1	10.9	1.8	0	20.1	0	3.3	6.1	5.6	2.3	3.3	0	22.9	3	15.7	2.8	22.9	32		
1946	07	0.3	14	17.5	0	0	2.5	3	6.1	24.6	1	5.6	22.1	12.4	5.3	0	3.6	7.4	62.5	24.6	6.9	3.8	116	2.5	9.9	6.4	2.5	0.5	0.8	2.3	9.9	12.4	
1946	08	18.8	2	4.3	11.7	7.1	1.8	10.7	42.4	0.3	46.2	54.1	0.8	23.6	2.8	0	9.7	0.3	4.8	7.4	8.9	0	4.8	25.1	60.5	8.9	16	0	6.4	0.3	1.5	0	
1946	09	38.1	7.6	1.8	4.1	2.8	2.3	1.3	17.5	2.5	13.5	3.6	0.3	0	0.3	0	0	21.1	17.5	0	0	0	0	0	0	0	0.8	0.5	0	14	11.4		
1946	10	3.6	21.3	2.3	6.6	0.3	0.3	0	27.2	0	0	0	0	0	0	0	0	0	1	0.3	0	18.8	5.3	8.1	2.3	0	0	0	0.5	0	0	0	
1946	11	36.8	0.8	14.2	4.6	8.6	0	0	3	0	3	0	0	0	0	18.3	0.3	0	0	46	2	6.1	1	5.8	2	5.3	7.6	0.3	0	0	0		
1946	12	0	0.5	5.3	1	5.1	1.3	1.5	2.5	19.6	5.8	0	1.3	49.5	0	3.8	0	2.5	2	0	0	0	0	0	36.6	38.9	0	9.7	3.8	7.1	1.3	0.5	
1947	01	6.1	2	0	6.6	8.1	14.5	25.7	16.5	14.7	8.4	7.6	18.5	1.3	2.8	1.3	9.9	33.8	15.5	7.9	1.3	132	3.8	5.3	4.3	1.8	1.5	0	0	0	1.8	8.1	
1947	02	2.5	0.8	8.6	10.9	4.8	0	2.3	0	6.6	3.3	0	0	14	2.5	6.4	2	0	0	0	0	0.5	0	0	19.3	1	0	0	0				
1947	03	0	0	0	0.3	0	0	0	1.8	0	2	0.5	0.8	0	0	0	0	0	1.8	0	0	0	1	0	0	0	0	0	0	4.6	0	0	
1947	04	0	0.3	0	2.3	0	1.5	0	0.5	2.5	0	12.7	0.8	0	2	0	2.5	18.8	16.8	0.8	14.2	11.9	11.2	3.3	22.9	14	32.3	0.8	9.4	0	0		
1947	05	1.8	0.8	19.1	29.2	5.1	0	1.3	7.4	36.8	9.9	5.8	1.8	68.1	14.5	40.4	3.8	0	24.9	60.2	53.3	21.3	0.3	18.3	26.4	10.2	52.8	131	7.9	62	0.3	8.4	

1947	06	23.4	4.6	10.9	14.7	40.6	26.7	0	48.5	10.9	20.6	13.5	0	2.3	24.9	12.4	10.9	27.2	18	11.7	38.1	0	0	0	68.8	50	4.3	13.5	41.4	84.6	7.4	
1947	07	10.4	48	9.9	1.3	7.6	14	3.3	5.3	34	0.8	6.4	16.3	1.3	3	35.8	27.2	4.3	62.2	14.7	39.4	4.6	3.6	36.1	38.6	44.2	11.9	19.3	5.8	1.3	33.8	33.3
1947	08	9.1	2.8	17	2.5	2.3	21.8	2.5	1.5	3.3	0	21.6	0	9.1	2	5.3	0.5	3.8	4.8	3.3	5.3	3	27.4	11.2	16	6.4	0	19.1	0	1	0	0
1947	09	0	1.3	0	0	0	67.3	2	16.5	1.3	4.1	0	13.5	4.6	23.1	25.4	0	0	0	0	0	1.8	0	0	0	0	0	0	0	14.5	3.6	
1947	10	5.6	0	0	26.7	0	0	0	0	0	9.4	8.9	1.8	0	12.2	3.6	6.6	0	0	16.5	0	0	0	0	7.1	22.9	0	0	0	0	0	0
1947	11	0	4.1	0	0	0	0	0	13	3.6	20.3	5.8	3.3	7.4	2.3	6.1	8.4	9.9	6.9	13.2	0	25.9	3.8	11.2	0	0	0	0	0	30	25.9	
1947	12	21.8	16	11.7	2.3	13.2	0	20.6	22.9	25.1	29	8.6	53.1	15	5.8	0.3	6.6	1.5	0	0	0	0	16.5	7.6	0	2.3	3.3	1.8	5.1	4.1	0	13.5
1948	01	7.6	31.8	11.4	17.8	7.6	1.3	2	2.3	1.5	15.2	16.5	4.8	3.3	0.5	0	0	0	16.5	6.4	0	1.3	0	1.5	22.9	4.3	6.6	16.3	1.3	27.9	0	22.6
1948	02	0	0	0	1.3	22.4	0	0	0	7.6	0	0	0	0	12.7	0	0	6.6	0	0	0	0	6.1	3.6	75.4	34.5	3.8	25.9	7.6	90.9		
1948	03	15.7	1.3	4.1	2.3	8.6	1.5	7.6	3.8	16	0.3	0	2.3	0	0	0	25.4	0.3	1.5	37.3	54.6	8.9	6.9	42.7	54.1	0	9.7	27.7	20.8	26.4	0.8	5.1
1948	04	8.9	13.2	10.2	5.1	3.8	5.8	20.3	37.6	23.4	5.6	22.1	6.6	6.1	39.4	5.8	2.8	1.8	14.5	17	0	0	0	15	10.4	12.4	17.3	0	0	0	0	
1948	05	0	0	10.2	10.2	14	7.1	42.7	20.6	19.8	20.1	19.1	25.1	29.7	25.4	28.4	18.5	53.3	20.3	68.3	0	20.1	21.1	42.9	5.8	14	8.1	1	23.9	27.9	5.3	77.7
1948	06	11.2	1.8	21.1	8.9	2.3	5.1	11.2	3.6	2.3	5.3	5.1	0.8	8.1	0	3.3	23.1	6.9	20.3	4.3	5.1	17.5	12.7	11.2	1.8	93.2	4.8	23.6	2.8	15.7	7.4	
1948	07	0.3	5.8	1.3	51.6	0	10.4	35.6	9.7	36.6	2.3	17.8	0.3	26.4	2.8	53.3	5.1	24.1	0.5	0.3	0.3	0	3	2.5	0	37.3	0	8.1	19.1	1.3	0.5	1.5
1948	08	6.4	6.4	4.1	3	10.7	6.9	30	2	4.8	0	0	2	0.8	13.7	0	0	1.5	0	12.2	6.6	2	0.8	0	0	0	0	0.8	0	23.1	0	2.5
1948	09	5.8	17.3	0	0	2	0.3	10.9	2	0	0	0	11.2	24.4	0	4.6	0	0	0	0	0	18.3	24.1	0	1.8	0	0	1	0	1.3	3.8	
1948	10	0	0.3	0	7.9	0	7.4	0	0	2.5	6.4	3.8	2.5	3.6	0	4.6	0	0	0	0	0	18	14.2	22.4	0.8	0	0.3	0	0	0	22.9	9.4
1948	11	0	0.5	0	0	0	0	9.7	5.6	0.5	21.3	30.7	5.1	9.7	38.1	0.3	0	7.6	19.8	0	2.5	0.3	0	3.3	14	1	13.5	6.1	29.7	5.1	6.6	
1948	12	1.3	7.6	16.5	0.5	7.6	3.3	20.3	31.8	0.5	1.8	8.9	1.3	32.3	9.7	0	32.8	34	1	0	0	0.8	14.2	16.3	7.4	11.4	36.3	36.6	6.4	15.7	0	29.2
1949	01	22.4	7.9	7.6	0	0	2.5	22.9	4.6	53.8	4.8	43.9	28.2	0.3	1.3	19.8	19.1	4.6	31.5	14.7	14	0.3	7.6	5.3	9.9	0	0	10.2	7.6	0.5	48.3	21.1
1949	02	0.3	0.8	2.8	1.3	11.7	23.6	34.3	24.9	4.8	0	17.3	31	43.9	5.6	12.4	18.5	54.4	2.3	11.9	27.9	11.7	19.1	16.5	23.9	7.9	17.3	30	54.6			
1949	03	3.6	3.6	0	0	0.5	2.5	0	1.8	1	0.3	17.3	35.6	0	7.4	27.7	1.3	20.1	14.5	0.5	10.4	9.7	41.9	14.2	14.5	0.8	2.3	15	6.1	7.4	41.1	40.1
1949	04	13.7	0	28.4	3.8	54.6	4.6	4.6	1.3	4.1	0	3.8	0	13.2	26.7	4.3	26.2	14.7	5.3	24.1	10.2	7.1	2.8	61.7	7.1	17	7.6	0	0	0	10.2	
1949	05	61	22.9	27.9	11.2	24.4	5.6	67.8	14.2	2.3	0	1.3	2.3	0	15.2	13.5	0	13	11.4	0.5	35.1	32.8	18.8	65.8	9.9	47	12.7	34.8	32.8	45.5	21.6	18.5
1949	06	7.9	1	45	6.6	2.8	21.1	19.8	78.7	42.7	4.3	27.2	3.8	50.8	4.3	30.7	2.5	4.8	34.8	6.4	2.3	19.1	35.6	1.5	0.8	59.9	10.9	5.1	4.1	34.3	26.4	
1949	07	0.5	16.8	6.4	17	8.1	6.9	7.4	22.4	1.3	2.3	9.4	38.4	4.6	0.3	21.1	1.8	2.3	0	32	8.1	34.3	2.5	0	12.2	1.8	0	26.7	0	2.3	2.8	12.4
1949	08	15.7	1.3	17.8	8.4	13	2.3	2.5	3	1	0	30.5	16	8.4	2.8	13.5	2.3	11.9	1.8	3	0	10.9	0.8	15.5	3.6	6.6	0	24.6	18.3	0.5	0	0
1949	09	0	0	0	0	0	24.9	14.7	0.8	21.1	6.4	0	55.6	0.8	0.5	0	3.3	0.8	0	0	0.8	31	42.2	23.6	0	0.3	0	3.6	1	16.5	0	

1949	10	6.4	0	0.8	0	22.9	0.5	1.5	0	0	11.9	7.4	1	0	0	9.7	0.8	8.9	4.8	20.3	3	2.5	0	0	0	0	5.8	0	0.3	0	0.3	2.3
1949	11	2	16.5	0	2.3	0	20.6	0.3	27.9	8.1	6.9	0	0	7.1	20.3	8.9	1.5	26.9	3.3	0	1.3	0	15.2	0	1.5	15.7	0	21.6	71.1	4.1	4.6	
1949	12	5.6	1.5	0	5.6	16.8	9.1	0.8	1	4.6	0	4.3	22.6	7.4	30.2	14.2	107	0	25.4	0.3	15.2	12.4	15.2	25.9	2.5	4.6	2.5	20.8	26.9	1.3	9.7	11.4
1950	01	6.6	9.7	6.9	2.3	68.6	4.1	0	6.1	15.7	5.6	1	2.8	15.2	2	31.8	50.3	25.4	2.8	45	70.4	32.8	26.7	17.3	38.1	44.2	33.3	11.2	0	3	8.1	8.1
1950	02	29.2	1.3	9.1	7.6	23.9	18	33	17.8	9.1	22.6	0	0.8	17	15.2	9.9	13.2	30	6.9	7.6	0	0	0.8	4.1	5.6	2.5	1.8	0.3	2			
1950	03	1.3	13.5	1.3	0	0	4.3	0.3	14.2	27.2	12.4	14.5	8.4	16.5	17.3	8.6	8.9	11.9	5.1	4.6	0.3	2.3	0	4.6	5.8	0.3	0	0.5	0.5	7.4	2.3	1.5
1950	04	0	0.8	0	4.1	9.1	10.9	10.2	3	1	29.2	1	1.8	0.5	14	13.2	0.8	0.5	0.3	2.8	0	0	4.6	0	0	3	4.6	3.8	18.5	0	9.1	
1950	05	4.8	7.1	0	0	9.1	2.5	36.8	44.5	41.1	7.6	5.6	1.3	0.5	68.8	1.5	2	56.1	19.8	5.1	14	17.3	38.1	9.9	7.6	45.2	13.2	0.3	0.5	10.9	24.9	18.5
1950	06	12.7	109	18	28.4	8.1	18	4.3	63.5	1.8	1.5	19.3	13	53.8	0.8	57.4	13.7	45.7	0	58.4	5.3	14.5	6.1	2.8	2	37.6	33	2.5	0.3	0.5	1	
1950	08	2.3	75.9	0.5	2.8	0	0	0	4.6	23.4	8.4	0	46.5	36.3	23.9	12.7	1.5	18	0	0	0	0	0	0	0	1.3	73.7	0	46.7	8.9	0	0
1950	09	10.2	14.2	0	18.3	8.6	1.8	0	0	0	0	0.8	0	0	1.5	0.3	0	3.3	0	2.8	0	0	0	0	3	0	0.8	8.6	0	0	0	
1950	10	5.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0.3	0	50.8	29	13.5	0	1.8	2	2	0	0	0	0	0	0	2	9.9
1950	11	1.8	0.5	31.2	2.3	0	0	5.6	0	0	0	1.8	0	12.7	0	4.3	5.3	0	0	0	0	0	2.3	0.3	2	0	0	0	0	22.6	11.9	
1950	12	3	0	7.1	7.6	3.8	41.9	4.3	34.3	14.7	7.9	0.5	2.5	6.4	14.7	17.3	0	0	0	0	0	0	10.2	10.2	0	0	0	61	5.3	9.7	0.3	8.4
1951	01	43.9	54.4	21.8	2	17	12.4	1	48.3	11.4	6.1	11.9	6.4	0	6.9	2	1	39.9	21.6	12.7	39.4	24.1	7.1	8.1	4.8	0.5	31.8	2.3	1.3	0.3	19.6	9.7
1951	02	41.9	11.4	54.9	15.7	141	0.3	5.1	22.4	16	12.7	17.3	20.3	24.1	2.5	16.8	18.5	2.3	4.6	1	0	69.9	5.8	0.3	20.3	21.3	1	14	6.9			
1951	03	17.3	0.8	0	0.8	4.6	2.5	26.7	27.9	3	33	10.7	0.8	21.3	5.3	0	0.8	0	8.9	36.8	0.3	2	0	0	8.4	9.1	4.3	0	6.1	2.5	0	24.1
1951	04	5.8	0.8	6.6	3	0	0	0	0	2	21.1	0.3	3.8	1.3	0	0.5	0	1.5	10.9	25.4	34	12.7	51.6	0	11.2	10.2	14	36.8	5.1	12.7	0	
1951	05	18.5	41.9	20.3	7.9	0.5	2.8	23.1	52.3	2.5	107	5.6	19.3	63.2	2.3	55.1	0	0	5.1	4.6	13.2	40.6	0	0	20.3	1	2.5	23.6	32.8	5.6	0	29.7
1951	06	1.5	54.9	7.6	9.1	43.9	3.3	23.4	31.2	10.9	9.7	16	3.8	93.2	9.1	24.4	23.6	16.5	31.2	2.5	3.3	12.7	17.5	25.9	58.4	43.2	18.3	17.3	8.1	105	92.7	
1951	07	28.7	18.3	65.3	2.5	14.7	9.9	21.1	2.8	0	43.9	6.6	34.3	116	4.8	6.4	4.1	26.4	2.3	11.2	26.2	2	13.5	1.3	9.4	44.5	6.1	9.7	0	1	1.5	12.7
1951	08	11.2	0	7.9	0	1.3	22.1	0	5.8	12.7	10.9	7.9	12.7	62.7	1	0	13.5	0	2.3	0	3	1.8	5.1	2.5	0	0	11.7	0	0	2.8	29.2	1.3
1951	09	0	0	0	2.3	3.6	0.5	0	0	0	5.3	3	0	0	0	0	0	1.5	12.4	1.8	3.6	21.8	0	0	0	0	1	0	0	0.5		
1951	10	38.9	40.1	0	0	0	0	3.8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	27.9	1	2.3	0	0	0	0.5	0
1951	11	0	12.2	0	0	12.7	0.8	0	0	7.6	0.8	2.5	0	0	0	0	0	2.3	0	0	0	0	0	10.4	1.3	2.8	0	0.3	0	3	6.4	
1951	12	1.3	0.5	7.6	4.1	7.6	0.5	1.3	0	3.8	6.6	1.8	1.8	0.8	0	0	0	15.2	0	7.6	0.5	1	2.3	20.3	17.8	21.6	1.8	10.2	10.2	1.3	31	12.7
1952	01	5.1	0	48.3	7.1	22.9	4.6	2.5	6.1	0.3	0	4.1	15.2	20.8	0.3	0.5	1	0	19.1	33	12.7	0.5	2	45.7	3.3	0	9.1	4.6	18.3	9.1	5.6	2

1952	02	17.8	19.3	0.5	0	0	33	12.7	48.3	29.2	38.1	1	2.5	0	17.8	0.8	1.3	1	11.2	1.3	0.5	4.1	0.8	4.8	10.2	18.3	11.7	24.1	22.9	2.8					
1952	03	14.7	2	5.1	0	0	0	0	0	0	4.6	15.2	0	2	2.8	0.5	0	0.8	20.6	0	9.1	0	0	0	0	0	27.9	10.7	0	7.6	13.7				
1952	04	0	0.8	6.4	7.4	7.9	0	13.5	0	0	13.5	11.4	23.1	1.3	0.8	0	0	0	0	0	0	11.7	0	0	0	22.9	17.3	0	0	0.3					
1952	05	4.8	0	28.7	37.8	1.8	10.7	3.8	14.2	0	0	3.3	6.9	1.3	16	5.8	24.1	11.2	2.8	7.1	2.8	1	8.9	14	33	25.4	37.1	6.6	0	38.1	20.3	36.8			
1952	06	0	17.3	20.8	0	20.1	18	15.2	7.6	13.5	0	6.9	0	38.9	22.6	0.8	0	17.8	17.8	0	0	76.2	53.3	21.8	10.4	2.5	17.5	0	0	5.1	9.4				
1952	07	6.6	3	22.9	1	6.4	12.7	27.2	17.8	13	0	18	24.1	26.7	0	16.8	1	0	3.6	2	0	0	7.6	0	4.6	1.5	0	11.4	21.6	14.5	49	63.5			
1952	08	7.6	0	8.1	38.1	16.8	13.5	1.5	0.3	26.4	3.6	3	5.8	0	0.3	22.9	24.4	4.8	0	0	54.4	0	27.9	8.1	2.5	0	6.4	0	16	0	10.2	0			
1952	09	20.8	4.1	0	0	0	0	0	5.3	0	0	0.5	0	20.3	0	26.7	0	0	0	31	0	72.4	0	2	0	0	27.7	0	18.5	0	0				
1952	10	0	0	0	3.3	34	0	0	0	15.2	0	0	0	0	0	0	0	1.8	0	0	0	0	0	0	0	38.4	5.3	0	0	2	0	0			
1952	11	0	0	0	0	0	0	0	54.1	0	39.6	25.4	35.1	12.4	27.9	16.3	4.3	15.7	21.1	0	0	0	0	0	35.3	0	0	1.8	24.4	18.3	0				
1952	12	0	0	0	0	33.5	0	36.8	0	0	0	50.8	29.7	0	0	38.1	0	0	0	0	0	25.9	32	0	0	25.4	0	14.7	10.7	0	0	0			
1953	01	17	0	0	27.7	38.1	5.6	0	31	0	0	0	0	0	29.5	24.4	0	0	38.1	50.8	9.1	22.9	27.2	5.6	19.3	0	20.6	0	7.9	25.9	0	11.4			
1953	02	34.3	58.4	0	0	17.8	0	0	12.7	38.1	48.3	25.4	30	26.9	35.6	0	0	38.1	27.9	16	0	26.7	0	31.8	0	18.5	25.9	43.2	52.1						
1953	03	12.7	0	0	28.2	0	6.1	38.1	0	102	0	0	31.8	29.5	25.4	0	3.8	0	37.1	63.5	25.4	24.1	0	21.6	25.4	0	12.7	25.4	0	18.8	23.6	0			
1953	04	0	0	0	50.8	25.4	0	0	0	0	25.4	22.9	0	22.4	7.6	0	0	0	0	33	5.3	10.2	26.9	23.9	0	0	50.8	0	9.9	12.7	25.4				
1953	05	59.7	25.4	16.5	25.4	18.5	0	0	11.7	0	41.4	35.6	0	19.1	17.8	3.8	21.1	14.7	0	25.4	0	15.7	15.2	0	16.5	2.8	25.4	0	25.4	12.7	6.4	0			
1953	06	0	12.7	12.2	50.8	24.1	50.8	12.7	3.6	38.1	30.7	0	13.2	25.4	25.7	0	27.4	44.5	9.1	8.6	1.8	7.6	14.2	49	0	37.6	0	6.4	31	11.2	23.9				
1953	07	36.1	7.4	14.7	12.2	13.7	5.1	22.6	1	0	0	0	43.4	24.1	16.5	66	2.3	0	22.1	45.5	11.4	13.7	0	0	36.1	1.5	11.7	10.2	37.6	9.4	1.5	0			
1953	08	0	0	31.8	8.9	8.9	2.5	0	0	9.9	0	0	0	18	11.4	0	2.8	2.8	0	0	0	2.3	0	0	3.3	39.6	2.5	1.3	0	0	0	8.9			
1953	09	0	63.5	8.4	0	0	0	0	0	0	0	0	0	8.4	17.5	0	0	0	0	0	6.1	2	0.5	0	10.9	6.4	0	0	0	0	0				
1953	10	7.1	1.3	0	0	0	0	0	0	0	0	0	0	0	1.5	0	5.1	17.8	0	0	0	0	14.2	0	2.8	0	2.8	1	9.9	0	4.8	6.9			
1953	11	22.6	0	0	7.9	0	0	0	0	0	0	0	0	7.6	0	0	33.8	7.4	2.5	33	0	0	0	0	0	0	0	17	8.6	11.4	0				
1953	12	0	6.1	4.1	41.9	24.1	6.1	5.1	0	0	0	18.3	0	0	0	0	0	0	33.5	0	67.3	15.2	30.5	7.6	0	0	0	9.7	15.7	10.4	29	30.5			
1954	01	29.5	48.8	17.3	10.7	9.7	32.5	61.5	7.6	5.1	11.7	0	38.1	29.5	5.1	5.1	9.7	0	20.1	0	0	0	0	7.6	14.7	46.2	18.3	0	0	17.8	16	24.1			
1954	02	6.4	0	11.4	2.3	38.4	0	0	0	0	10.9	25.7	0	0	0	0	0	3.6	7.6	0	0	0	15.2	10.7	8.9	16	7.1	8.6	37.8						
1954	03	0	0	5.8	0	23.6	49.5	9.4	0	2.8	7.1	28.2	0	0	3.8	0	5.8	2.8	0	0	0	0	0	25.4	30.5	5.1	21.1	17.8	0	0	0	33			
1954	04	29.2	33.8	0	3.8	3	38.9	7.6	5.1	0	5.1	94	13.5	16.8	13.2	15.2	6.4	5.1	5.6	23.4	27.9	8.9	5.1	13.5	28.4	40.6	33	6.4	5.8	63.5	9.7				
1954	05	2.5	2	3.8	7.6	28.7	3.3	16	3.3	3.8	5.1	35.6	6.4	17.8	73.7	3.8	66	39.4	48.3	68.6	18.5	5.1	18	0	9.7	17.3	10.7	0	3.8	0	0	8.9			

1954	06	0	3.8	0	16.5	11.4	28.2	8.9	21.6	11.2	11.4	0	0	8.4	10.2	36.8	12.2	13	4.3	0	7.4	9.1	10.2	17.8	6.4	7.6	0	3.8	9.7	14	8.9	
1954	07	5.1	0	8.1	26.7	9.7	7.6	0	22.4	22.1	72.4	21.6	0	26.7	0	5.6	3.8	52.1	0	43.2	5.1	16.5	0	7.6	0	5.1	41.9	3.8	2.5	27.9	10.2	17.8
1954	08	5.1	7.6	28.7	40.1	53.3	15.2	48.3	11.7	15.2	13.2	33	11.4	0	7.6	0	0	7.1	52.1	0	45.7	7.1	10.2	5.1	19.1	26.7	3.8	21.3	0	11.4	19.8	13.7
1954	09	0	0	43.2	15.2	0	0	0	2.5	0	0	8.9	0	0	0	5.1	19.1	0	0	12.2	0	0	0	0	5.1	0	0.8	0	0	35.6	1.3	
1954	10	0	0	12.2	0	20.3	0	2	0	0	0	0	0	0	2.5	0	0	1.3	0	20.3	0	1	39.1	57.2	30.5	2.5	0	2.3	1.5	13.7	28.2	3.3
1954	11	2.5	1.3	3	78.7	1.5	8.9	1.3	16.3	10.2	5.1	24.4	11.4	0	0	0	0	0	0	0	0	16.5	39.4	8.9	0	24.1	11.4	0	2.5	31	43.2	
1954	12	13.7	0	0	0	10.2	0	0	13.2	0	1.5	0	0	0	2.5	8.1	8.9	12.7	0	5.1	40.6	7.6	12.7	0	0	10.2	15.7	13.7	17.8	10.2	0	5.1
1955	01	0	5.1	8.9	0	21.6	50	19.1	13.5	38.1	15.2	16	0	23.4	0	5.1	8.9	21.6	0	12.7	0	3.8	0	8.9	0	2.5	0	0	0	5.1	35.6	7.6
1955	02	7.6	30.5	24.1	7.6	5.1	7.6	5.1	27.9	2.5	0	2.5	7.6	17.8	10.2	0	0	13.2	0	2.5	27.9	3.8	2	1.5	0	2	2.5	0	0			
1955	03	26.7	0	40.6	20.3	0	10.2	5.1	68.6	33	15.2	25.4	27.9	15.2	13.7	53.3	40.6	35.6	10.2	13	18.8	2.5	0	11.7	30.5	48.3	5.1	17.8	1.3	0	17.8	5.1
1955	04	2.5	0	15.2	8.9	6.6	2.5	45.7	43.2	26.7	16.5	10.9	7.1	4.1	8.9	13.7	15.7	21.3	11.7	10.2	13.2	0	0	0	0	10.2	0	5.1	7.6	0	0	
1955	05	0	7.6	30.5	33	30.5	66	30.5	10.2	12.7	3.8	0	6.4	21.6	7.6	10.2	58.4	61	31.2	17	7.1	8.1	35.6	33.5	2.5	8.9	38.1	0	12.7	7.6	10.9	8.9
1955	06	19.8	0	27.9	35.6	81.3	0	0	2.5	1.3	0	30.5	7.6	17.8	27.9	35.6	20.3	48.3	3.8	10.2	4.6	1.5	2.5	0	6.1	2.5	1.5	3.8	8.9	2.5	22.9	
1955	07	2.5	3	7.6	2	14.7	0	0	27.9	10.2	17.8	30.5	38.1	17.8	48.3	5.1	8.9	12.7	8.9	4.6	17.8	5.1	12.7	34.3	58.4	10.7	18.8	2.5	0	15.7	0	0
1955	08	2.5	3	7.6	2	14.7	0	0	27.9	10.2	17.8	30.5	38.1	17.8	48.3	5.1	8.9	12.7	8.9	4.6	17.8	5.1	12.7	34.3	58.4	10.7	18.8	2.5	0	15.7	0	0
1955	09	61	25.4	61	0	0	0	0	1.3	0	0	0	0	0	22.9	0	0	0	0	0	0	2.3	0	0	12.7	0	0	0	0	0	0	
1955	12	1.3	6.9	25.9	43.4	33.5	4.3	20.8	8.1	30.7	1	3.8	8.1	25.4	36.6	15.5	8.9	5.1	21.3	7.6	10.2	48.8	8.4	5.1	1.3	3.8	24.1	29.2	23.1	42.9	11.4	0.8
1956	01	40.4	4.1	127	7.4	0	0	1.3	11.4	7.6	2	53.3	23.1	10.7	3.8	2.5	5.1	7.6	11.4	0	12.7	4.3	34	6.1	31.2	17.5	14.2	23.9	50.8	19.8	49	1.5
1956	02	16	1.3	0	1.3	2.5	4.8	13.5	0	30.7	0	0.8	2.8	0	30.2	3.8	10.9	19.8	23.4	2.8	10.4	14	17	18.5	0	2.5	0	5.8	1	17		
1956	03	6.4	12.7	22.1	20.3	5.1	0	0.5	0	3.8	23.9	0	26.7	26.2	1.3	25.4	0	33.8	9.1	12.2	25.9	30.7	35.6	0	1.5	0	0	0	12.7	7.4	0	0
1956	04	0	1.3	5.1	0	40.4	0	13.5	30.5	8.9	5.6	12.7	36.6	2.8	3.8	0	0	0	0	9.4	17.8	0	0	0	11.9	8.9	6.4	2	0	32.8	34.3	
1956	05	2.3	5.1	1.3	63.5	12.4	26.9	17.3	25.9	6.9	27.4	66.8	52.3	25.4	19.1	21.8	15	6.4	7.6	4.8	26.4	55.1	28.7	8.1	15	17	11.4	8.1	25.4	21.8	52.1	27.9
1956	06	26.7	50.8	113	24.1	20.3	48.8	27.9	44.2	2.5	7.4	9.9	3	2	10.9	27.7	40.6	35.6	2.5	5.6	6.1	14.2	21.3	49.3	41.1	17.8	3	0.5	25.4	5.1	68.6	
1956	07	10.2	15.5	83.8	15.2	0	30.5	5.1	76.2	18.8	4.6	10.2	0	25.9	12.7	13.5	39.1	6.6	22.9	0	12.7	30.5	14.2	14.5	2	13.5	0.5	0	15.5	0	14.7	0
1956	08	1.3	4.6	4.8	0	6.9	12.7	0	8.6	57.4	10.2	20.3	0	15.7	49.3	0	6.4	4.6	12.7	21.6	53.3	0.5	31.2	0.3	6.4	5.1	5.8	0	0	0.8	0	16
1956	09	0	0	10.2	20.6	0.3	0	6.4	68.1	1.8	6.9	5.1	0	0	0	0	0	0.3	14.5	27.7	0	0	7.6	14.2	21.3	10.4	0	0	11.4	0	5.1	
1956	10	0	22.9	0	1.3	1.8	0	0	12.7	0	10.7	0	14.2	0	15.2	0	0	13	0	5.3	0	28.7	27.7	11.4	0	0	9.4	0	0	3.3	0	0
1956	11	0	0	0	15.2	0	0	0	0	0	3.3	0	38.1	45.7	6.6	7.9	18	74.2	0	1.3	0	0	0	1	0	0	0	0	0	0	26.7	

1956	12	0	25.9	0	20.3	0	9.7	0	25.4	109	0	0	0	17.8	27.9	20.3	59.7	8.9	6.4	7.6	26.7	22.9	26.7	33	27.9	19.3	13.7	10.2	13.7	8.9	15.2	11.4
1957	01	14.5	11.4	7.6	13.2	5.8	3.8	6.4	0	23.4	11.2	1.3	0	3.8	16.8	3.8	14.2	22.4	8.9	19.1	4.6	10.9	9.4	20.3	13.7	16.8	23.9	3.8	10.9	11.2	13.2	22.9
1957	02	19.6	1.8	5.3	7.6	11.4	14	8.1	6.4	19.1	30.5	13.7	0	0	0	0	22.9	24.1	19.1	13.5	3.8	0	0	0	0	0.8	10.2	2.5	0			
1957	03	0	0	0	18.8	10.2	0	0	0	1	1.8	0	11.2	15	2.5	0	0	0.8	0	0	21.3	0	3.8	9.7	2.3	0	0	0	0	0	0	3.8
1957	04	0	14	0	0	0	0	0	0	0	11.2	0	3.3	0	0	0	0	0	2.5	0	0	1	0	0	22.1	5.1	0	0	2.8	0	4.1	
1957	05	10.2	15.7	21.1	0	0	5.3	4.3	22.9	2.8	4.8	53.6	10.2	18	14.2	24.1	7.9	7.6	15	15.2	45.7	55.9	3.6	2	1.3	0.8	10.2	24.1	21.8	24.6	92.7	34.3
1957	06	60.2	2	19.8	24.4	11.9	10.4	38.1	17	2.5	1.3	2.3	6.6	7.9	21.6	22.1	7.6	27.2	38.1	22.1	17.8	11.7	9.4	7.1	9.4	9.1	43.7	6.4	11.7	12.7	13.7	
1957	07	2.5	6.6	5.1	17.3	15	12.7	64	47.8	11.4	3.6	27.9	16.5	11.9	2.5	3	5.8	6.9	17.8	22.4	0	9.4	8.6	24.1	0	0	0	25.7	1.8	10.9	0	29
1957	08	0	9.4	0	0	7.6	7.9	0	28.2	17.3	5.1	0	6.1	5.1	2.5	1.5	8.4	3.8	0	5.8	1.8	0	0	7.1	0.5	0.5	0	6.1	13.2	2.5	0	8.6
1957	09	4.8	20.3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	12.7	72.9	0	0	5.1	0	6.4	0	0	9.4	0	0	0	0	
1957	10	0	0	0	0	8.6	1.3	0	3.8	0	1.5	0	0	0	3.8	0	7.6	11.4	0	0	0	0	0	0	0	0	0	0	38.1	4.1	0	0
1957	11	0	0	0	0	0	0.5	0.8	0	0	0	0	0	0	0	0	7.4	6.4	0	0	7.4	0	0	0.3	0	5.8	17.5	3.8	11.2	5.1	3.8	
1957	12	10.4	0	34.3	11.2	44.7	24.4	12.4	0	0	0	12.7	20.3	8.9	4.6	25.7	5.3	2.8	0	4.1	0	4.3	37.8	22.9	32	4.6	2	14	4.6	6.4	17.5	1.3
1958	01	0	3.8	7.6	1.3	0.8	11.7	0.5	17.3	9.4	0	0	2	4.3	0	0	0	6.9	0.5	0	2.3	0	20.3	43.9	7.1	0.5	0	4.6	40.1	11.9	3.8	0
1958	02	0	2	4.1	1.8	0	13.5	4.6	15.2	1.8	2.3	25.4	8.1	1	5.6	2.3	10.2	1.8	3	1.8	20.3	5.3	0	0	1.3	10.7	4.6	8.1	0.5			
1958	03	0	13.5	5.8	15.2	5.6	0	0.8	4.6	0	14.2	2.3	0	1.5	0.3	4.6	8.9	0	0	0	0	5.3	10.9	5.8	5.1	1.3	6.6	13.5	26.9	6.6	2	9.7
1958	04	9.7	30.5	20.3	21.6	31.2	13	16.5	30	15.2	3.6	0	0	24.9	11.2	4.3	1.8	21.6	6.6	26.7	9.1	27.9	25.4	63.5	29	63.5	38.1	6.9	23.4	36.8	58.4	
1958	05	22.1	41.1	31.5	12.4	6.1	0	2.5	2.5	15	8.4	3.6	19.3	8.6	7.9	6.4	3.8	3	5.1	33.8	5.8	35.1	5.1	5.6	0	0	20.6	17	14.7	0	1	11.4
1958	06	0	3	0	0	11.4	20.8	0	5.6	25.4	27.9	25.4	10.2	25.4	0	13.7	0	28.2	0	40.6	83.8	0	0	0	23.4	25.4	35.6	27.9	12.7	0	25.4	
1958	07	27.9	25.4	0	0	0	0	0	10.2	0	5.1	10.2	10.2	0	0	22.4	0	0	1.3	3.6	20.6	38.1	1.3	0	0	6.1	0	0	25.4	18.5	0	0
1958	08	0	0	0	0	102	0	37.6	37.1	0	0	20.1	9.7	0	15.5	0	8.9	0	0	0	0	0	0	0	0	0	0	50.8	0	0	36.3	0
1958	09	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10.7	0	0	0	0	0	0	0	0	0	0	
1958	10	0	3.8	0	0	0	0	0	23.4	0	0	0	0	25.4	0	0	2.3	0	0	0	25.4	0	0	27.9	0	0	0	0	0	12.7	7.6	27.9
1958	11	0	0	0	0	0	0	0	0	0	0	0	0	0	2.5	1	0	0	0	4.6	1.5	0	0	0	5.1	15.2	6.1	25.4	0	10.2	27.9	
1958	12	12.7	1.3	0.3	1.3	14	8.1	0	0	0	4.3	10.4	3.6	9.9	15.7	7.6	1.8	2.3	3	19.3	11.7	2	3	15	4.6	2.3	4.3	12.2	4.8	0	6.1	11.7
1959	01	0	7.9	6.1	0	35.6	25.4	22.4	0	0	0	19.6	0	0	9.9	0	0	0	0	23.1	0	0	46.2	0	0	0	0	25.4	28.7	25.4	29.2	27.9
1959	02	0	0	0	0	0	0	0	27.9	0	36.6	0	0	0	0	0	0	0	30.5	0	0	0	0	34.3	25.4	0	0	7.6	19.1			

1959	03	0	0	12.7	2.8	0	0	0	0	5.1	12.7	25.4	27.9	5.1	9.9	0	10.2	15.2	0	10.2	14.2	0	5.1	0	0	10.2	9.7	0	0	0	5.1	6.9
1959	04	0	0	0	0	5.1	10.2	12.7	0	6.6	25.4	27.9	22.4	13.2	25.4	43.9	6.9	16	0	12.2	24.4	30	11.4	0	1.3	0	0	0	6.1	3	12.7	
1959	05	0	0	0	49.3	0	0	0	0	0	0	0	6.4	0	0	0	4.3	0	0	22.6	3.8	34	46.5	8.6	0	7.4	10.7	4.3	0	0	0	0
1959	06	0	7.1	16.5	16.5	39.4	5.3	42.9	51.8	0	17.3	26.7	18.8	16.5	5.1	1.8	17.3	0	22.9	25.4	48	0	7.6	16.5	35.6	46.7	43.2	5.8	0	6.1	3.3	
1959	07	0	10.2	16	74.7	33	14.5	11.9	0	12.7	26.7	8.6	21.3	47.8	33.8	17	19.8	37.3	17	48	37.3	0.5	24.1	7.9	3.3	6.6	4.3	0	18.8	17.8	4.1	3.3
1959	08	0	35.6	7.4	0	0	0	0	0	0	22.9	51.6	1	0.8	0	24.4	2	0	0	0	0	8.1	23.6	7.9	0	7.9	11.2	13.2	0	17.3	0	23.4
1959	09	0	0	0	0	0	0	12.7	10.2	26.4	18.3	0	0	0	0	0	32.8	0	0	1	0	0	0	43.2	0	0	0	0	0	0	0	0
1959	10	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	3	70.4	7.4	0	6.6	0	0	1.8	4.3	0	0	0	20.3	0.8	33	0
1959	11	0	13.2	1.8	11.9	0	8.6	0	12.4	6.4	0	3.6	1	12.7	15.2	3.8	0	0	0	8.9	10.2	10.4	2.5	4.1	0	0	10.2	29.2	35.6	15.2	11.2	
1959	12	2.5	28.4	1.5	0	1.5	9.9	4.1	1.5	9.1	25.1	23.9	21.8	11.4	13.7	10.2	1	19.3	0	34	0	0	3.6	0	22.6	8.6	0	6.1	0	2	0	0
1960	01	0	0	0	0	6.6	0	1.3	6.9	12.4	4.6	0	19.3	26.7	28.7	32.5	18.3	30.7	66	1	0	13.2	30.2	7.4	0	1	1.5	2.5	9.4	4.1	0	0
1960	02	0	0	1.3	0	0	0	0	0.5	0	0	16.8	11.2	39.4	0	12.2	66.5	0	10.7	33.5	1	4.3	0	0	4.6	7.6	32	13	0	6.1		
1960	03	1.3	15	6.4	0	0	0	1.3	0	0	0	0	3.8	0	0	0	0	0	0	0	0	0	3.8	1.3	0	0	0	4.6	0	0	0	0
1960	04	0	6.1	0	20.1	23.4	50	36.3	34	1	2.8	0	0	0	0	0	38.1	14.2	3.8	4.8	24.9	31	3.8	0.8	57.2	0	0	2.5	4.1	3.8	5.6	
1960	05	24.9	7.9	1.8	0	26.4	6.1	47.2	18.8	2	34.5	7.6	33.5	0	0	22.9	50.5	69.6	11.9	32.3	0	7.1	1.5	24.9	3.3	1	10.2	85.6	4.8	6.6	0	23.1
1960	06	16.8	6.1	27.9	7.1	0	8.1	12.2	7.6	26.7	23.9	0	6.6	74.9	8.9	2.3	0.5	0.5	0	39.9	5.1	4.6	22.9	2.5	10.4	4.6	23.4	12.2	11.7	6.6	31.5	
1960	07	55.9	31.2	0	0	36.8	32	31	1.3	29.2	5.8	0	0	25.9	7.9	9.7	3	0	0	6.1	0	3.6	1	76.7	3	0	16	0	0	1.8	0	16
1960	08	16	2.3	8.1	13.5	10.2	4.8	5.1	9.1	35.6	7.9	14.2	0	21.8	0	0	19.3	11.4	0	0	0	0	0	0	0	0.8	29.2	2	0	0	0	2.3
1960	09	0	0	0	0	0	0	0	0	0	0	0	0	7.6	12.7	10.7	0	0	0	2.5	0	0	0	0	0	0	5.6	0	8.1	0	0	
1960	10	0	0	0	0	0	0	0	4.6	19.8	6.9	8.9	0	0	0	0	19.3	1.8	0.3	0	0.3	2.3	4.1	1.5	5.6	0	11.7	0.8	28.4	1.3	4.3	28.4
1960	11	0	0	12.2	2.5	13.7	4.8	11.2	0	38.9	40.6	20.8	9.7	0.8	0	0	1.3	0.8	0	0.8	0	0	6.9	23.1	13.5	2.8	2.8	0.8	21.1	9.1	0	
1960	12	0.5	2	52.8	13.5	18.5	0	0	0	22.9	5.6	2	2.5	5.1	18.5	6.4	9.7	14	3.3	3.6	2.3	6.4	4.6	31	6.1	9.7	1.3	0	0	5.1	42.4	6.6
1961	01	6.9	27.9	7.4	6.4	7.6	26.7	15.2	7.4	1.5	26.9	49.3	2.5	0.3	29	2	1.5	28.2	8.6	1.5	0	1.3	0.3	2	0	4.1	4.6	0	7.1	0.3	2.3	1.3
1961	02	19.1	0	0	43.2	15.2	0	2.5	18.3	17.3	0	0	0	0	0	0	2	1.3	11.2	1.3	6.6	5.6	1.8	0.5	2.3	15	14.2	3.6	3.3			
1961	03	2.8	0.3	6.6	0.8	1	0.5	0.5	4.6	4.1	1.3	0.5	0	11.4	0	0	0	0	0.3	0	0	3.6	0	2.3	0.5	0	0	0	5.1	0.5	0	1
1961	04	0	0	9.7	0	0	0	1.5	0	0	0.3	0	0	0	0	0	4.8	2.3	0	0.5	0.3	0	3.6	0.5	1.5	0	0.3	0	0	0	0	
1961	05	3.8	0	2	0	5.1	3.8	14	11.2	7.6	4.1	0.5	0	0	4.1	0	8.6	47.8	16	0	0	25.1	5.3	41.7	20.1	10.9	32.5	16.3	1.8	19.6	19.1	
1961	06	28.7	59.2	9.1	19.1	9.7	15.7	5.1	23.6	20.8	2.3	15.7	81.8	13.5	16.3	22.1	34.3	29	29.7	24.9	111	2	4.1	5.1	0.5	10.2	1	36.3	2.5	20.1	20.8	

1961	07	1.5	49	24.1	38.1	31.5	55.9	2.8	0.8	1	10.2	19.8	9.4	6.1	0	29.2	4.3	8.1	2	0.5	2.5	3.6	0	1.5	2.5	25.9	13.7	4.6	0.5	2.8	0	0.8
1961	08	13.2	52.3	3.6	0	61.5	17	7.6	7.6	11.9	12.4	4.6	1.5	1	5.6	9.9	19.8	0	4.1	1	1.8	0.8	12.2	0	0	0	0	0	24.4	0	2.5	1
1961	09	0	13.2	0	8.4	3.3	0	0	5.6	16.5	40.6	43.2	0	0.5	0.5	0.8	0	2.3	0.8	9.4	2	10.4	10.7	0	0	0	2.5	24.1	0	0	0	
1961	10	0	0	0	0	2.3	0	0	0	0.8	0.8	7.1	1	0.8	0	4.3	0	1	1	9.7	3	2.5	6.9	15.2	0	0	0.5	0.8	3	0	0	0
1961	11	0	11.4	1.3	1.8	0	0	0	1.5	42.2	3.8	8.4	2.3	0	0	0	4.1	1.8	0	7.4	4.1	22.9	1.3	0	13.7	14	0	3.3	0	2.8	0.3	
1961	12	17.3	14.7	0.8	2.5	1	6.1	12.7	36.1	1	2.8	25.7	5.6	5.1	6.1	0	0	19.8	20.3	14.5	16.5	13.7	21.3	20.8	0	2.5	0.5	7.6	3.6	35.6	0.5	0
1962	01	0.8	14.7	15	1.8	4.8	0.5	5.3	0	0	29	7.1	5.3	9.9	19.1	0	0	0	19.1	24.1	11.4	0	3.8	4.3	15.7	1.8	3.3	5.3	1	3.6	3.3	10.7
1962	02	0	0	3	7.6	11.7	0	17.5	6.6	0	0	0	31.8	0	0	8.1	0	2	45.7	19.8	5.6	23.6	24.4	15	0.5	1.5	2.5	0.5	4.3			
1962	03	5.1	2.5	0	26.7	2.5	47.2	35.6	0	0	0.8	0.5	2.3	3.3	0.3	2.3	0	0	0	1	0	0	0	2.5	0	0	0	0	0	0	18.8	0
1962	04	0	0	0	0	0	23.4	0.5	0	0	0	0	11.7	3	20.8	7.1	1.8	2.5	9.4	2	1	2	0	0	0	0	33.3	0	0	0	0.3	
1962	05	4.1	0	6.6	28.2	4.8	3.6	0.5	7.9	0	0	13.7	47.5	9.7	4.3	1.3	0	45.2	33	18	46.5	19.6	0.5	18.8	13.2	25.7	20.1	0	46.2	16	12.2	14
1962	06	0	6.1	9.7	5.3	14.5	17	13.2	34.3	1.5	7.6	15.2	31	99.6	4.8	11.9	1	6.4	16.5	0	4.1	0.5	50.8	16	5.6	14.7	3.6	47.8	7.6	50	11.2	
1962	07	1	2	23.4	4.1	11.7	0.3	0	0.3	11.7	2.3	0.8	9.4	3.3	1	3	62.7	4.8	2.8	26.9	32.5	2.5	11.4	34.8	17	1.8	10.2	0	0	7.6	0.3	0
1962	08	12.7	26.9	4.3	7.9	0.8	17	0	0	43.9	23.4	39.1	6.4	32.8	2.3	0	4.1	12.4	6.4	1.3	0.3	22.1	0	7.4	9.4	0.3	18.8	1.3	0	45.5	0	0
1962	09	0	0	0	5.6	0.3	0.5	4.6	0	8.4	0.8	0	11.2	4.8	20.6	0	4.8	13	1	3.8	4.6	0	0	0	0	2.5	0	0.8	0	0	20.6	
1962	10	16.8	1.3	1	1.3	0	0	0	0	0	1	0	10.4	0	0	0	0	1	0	0	6.9	0	1	0.3	0	0	1.8	0	0	0.5	3	0
1962	11	0	0	0	0.5	6.6	0	0	5.1	0	0	8.6	0	7.6	0	0.5	0	0	0	1	6.6	0	32.5	40.1	0	16.8	0.5	34	24.4	0	1	
1962	12	2	0.3	2.5	0.5	0	5.8	1.8	7.4	16	5.1	0.3	0	0	0	0	0	0	33.5	27.4	4.6	0	0	8.9	4.3	18.8	0.5	13.2	22.1	1.3	1.5	5.3
1963	01	1.5	35.1	0.8	1.8	2.5	1	16.3	54.1	9.4	1.8	14	2	0	0	0	2.3	23.1	36.1	25.1	10.9	24.1	1.3	2.3	50.3	12.7	11.9	35.8	20.8	6.9	33.8	0.5
1963	02	3.8	0	0	16.5	7.4	0.8	1.8	19.6	7.6	13.2	0.5	0	9.7	47.2	16.3	4.1	3.8	22.6	19.3	10.7	3.3	0	0	2	0	0	0	4.8			
1963	03	0	0	13	6.1	1.3	53.1	32.3	20.6	17.8	19.6	12.4	4.8	0.5	0	5.3	31.2	12.2	0	0	5.6	0	0	0	1.3	11.4	0	0	11.4	3.3	0	0.8
1963	04	8.1	20.8	7.6	0	4.6	0	0	0	24.1	0	22.6	0.5	0	52.3	22.9	0.3	0	0	0	0	46.5	0.5	0.8	9.7	29.2	7.6	1.5	0	0	0	
1963	05	0	0	29	4.1	55.1	8.9	17	57.9	30	45.7	0	17.8	0.8	27.9	27.2	26.4	32.5	46	14	22.1	21.8	4.6	9.4	19.1	25.9	4.6	26.7	55.9	140	5.6	12.4
1963	06	14.5	10.7	0	19.3	75.2	50	9.1	3.8	12.4	7.1	3	1	24.1	30	21.3	3.6	26.7	5.1	37.6	34.8	62.7	5.1	22.1	6.1	2.3	63.5	7.1	17.3	20.6	15	
1963	07	0.5	0	0	9.4	0	0	0	17.8	8.4	6.9	8.4	0	20.1	11.2	2.3	0.3	23.4	2.3	0	2	37.3	12.7	10.2	9.9	7.1	0.3	13.7	0	9.9	0	6.4
1963	08	25.1	6.6	0	0	1.8	5.1	26.2	0.5	4.8	0.8	2.3	0	3	2	0.8	8.9	1.8	0	0.5	4.3	0.5	0	0	0	28.2	11.4	0	14.2	0	0	28.4
1963	09	10.4	0	0.3	1	1	6.9	0	4.3	0	0	0.8	0	3.3	0	1.3	0	0	0	5.6	0	0	0	0	0	0.8	0	0	0	3.3	0	
1963	10	0	0	0	4.8	0	0	0	0	0	0	0	0	1.5	0	0	2.3	0	0	0	0	0	0	0	4.6	5.3	0	0	0	0	0	0

1963	11	0	0	0.5	8.9	0	0	0	0	0	0	0	0	0	0	8.9	6.9	10.2	2.5	0.8	5.3	4.3	0	2	1.3	20.8	0	0	0	0	0	
1963	12	27.2	23.4	17.5	5.1	1.5	9.7	8.4	17	8.1	11.9	1.5	0	0	0	5.3	23.1	0.5	1	1.5	0	5.1	1.5	0	0	0	0	0.5	0	0	0.3	0
1964	01	2.5	0	0	0	0	0	2	5.3	3.6	0	0	12.7	7.6	0.8	0	5.1	0	0	3.8	0	0	0	0	0	0	12.7	0	2	8.9	0	1.8
1964	02	0	0	9.7	0	4.3	0	0.5	0.3	0.5	0	0	0	0	0	7.1	13	5.3	5.3	18.5	37.6	0	0	0.8	0	0	20.8	0	0			
1964	03	0	0	0	0.8	0	10.7	0	0	2.5	18	2	19.3	10.9	13.5	15	2.5	2.3	1.8	0.8	13	3.3	0	0	0	0	29.2	6.9	2.8	0	2	0
1964	04	0	0	11.2	7.4	3.3	0	3.6	1.5	4.1	2.8	5.3	2.3	5.8	4.3	4.8	7.4	1.8	10.9	16.3	0	0	0	5.3	0	0	0	5.1	14.2	1	0	
1964	05	0	0	0	0	0	0	0	0	0	0	0	0	0	2.8	36.8	0	11.7	1.8	0.5	10.4	25.7	11.4	11.7	0.8	5.3	2	15.7	4.8	0.5	1.5	0.3
1964	06	0	20.3	45.7	30.2	30	10.7	10.4	4.8	28.2	5.3	26.4	65	0	7.6	18	9.1	28.4	6.6	11.2	19.3	0	0.5	0	56.6	19.8	0	0.5	0	0	2.5	
1964	07	21.6	3	2.5	27.4	5.1	36.8	0	0.8	0	5.6	12.4	13.7	26.7	5.8	18.3	1.5	2.3	1.8	4.1	43.2	50	7.6	2.5	2.3	10.9	7.1	0	1.3	2.8	4.6	8.9
1964	08	0	14.7	6.1	6.9	5.8	2.5	0.8	0	14.7	2	13.2	24.1	2.5	0	7.6	6.4	0	1	0	0	0	0	0	11.4	3	0.8	0	33.8	0.8	2.5	9.4
1964	09	1.3	0	0	0	4.6	4.1	0.3	0	0	10.4	0	0	17.8	5.1	28.7	0	0	0	0	12.7	0	0	0	0	0	0	49.5	0	2	0	
1964	10	0	0.5	0	0	1.8	0	0	0	0	0	0	11.4	0	1.8	5.8	0	0	0	0	0	11.7	0	0	0	3	0	8.1	22.9	0	0	0
1964	11	0	0	0	10.7	0	0	5.8	0	0	3	6.9	0	1	0	9.9	13	0	9.4	4.1	2.5	0	16.3	0	0	43.7	44.5	2.5	25.7	0	0	
1964	12	0	8.9	3.6	0	0	12.7	8.6	34.3	0	8.9	10.2	52.1	59.7	36.8	64.5	2.8	8.6	19.3	0	6.9	0.5	0	26.7	6.4	3.8	2.5	43.7	25.9	8.4	3.8	0
1965	01	3.8	0	2.5	0	0	28.4	0	0	18.8	0	15	15.5	2	16.8	15.7	19.8	21.1	3.6	11.9	25.7	9.1	55.1	5.1	12.7	8.1	0.5	2.5	4.6	2.5	2.3	4.8
1965	02	4.3	5.3	13.7	0	2.5	0	0	0	0	16	15.7	0	0	23.1	24.6	4.8	0	0.3	0	0	33.5	7.6	0	0	0	0	0	0			
1965	03	21.6	9.4	3	0	20.3	6.9	0	3.6	2.3	36.1	0	17.8	8.9	26.7	0	2.5	0	5.1	11.4	2.5	2.5	30.5	0	0	0	0	2.5	0	0	7.6	26.7
1965	04	0	0	0	0	0	0	0	26.2	17.5	0	0	0	13.5	30.2	9.1	0	0	0	31.8	34	10.4	3.3	0	0	4.3	5.3	2.8	7.4	10.9	7.9	
1965	05	4.6	9.4	7.4	10.4	8.9	10.2	10.4	30.5	36.8	15.2	15.2	16.5	62.2	6.4	6.4	3.8	2.5	15.2	26.7	12.7	12.7	53.3	15.2	25.4	0	15.2	2.5	25.9	8.9	12.7	30.5
1965	06	53.3	2.5	5.1	12.7	68.6	5.1	10.2	35.6	7.6	17.8	53.3	20.3	20.3	40.6	15.2	2.5	1.3	2.5	0	8.9	2.5	10.2	6.4	3.8	3.8	12.7	0	10.2	17.8	7.6	
1965	07	10.2	5.1	53.3	5.1	20.3	0	15.2	40.6	2.5	26.7	0	0	0	27.9	53.3	10.2	2.5	12.7	0	10.2	35.6	7.6	0	0	2.5	0	0	25.4	7.6	31.8	17.8
1965	08	26.7	6.4	2.5	12.7	1.3	2.5	3.8	0	11.4	10.2	27.9	35.6	45.7	1	2.5	12.7	5.1	17.8	0	61	1.3	5.8	0	6.4	25.7	11.9	0	0	30.2	6.9	0
1965	09	0	0	0	52.1	3.8	0	0	0	9.4	0	0	0	0	1.5	7.1	0	0	0	0	0	0	2.8	0	0	0.3	2.5	0	0	0	0	
1965	10	0	0	0	0	0	2.5	0	5.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2.5	0	0	0	12.7	0	0	0
1965	11	0	0	9.9	0	9.9	0	0	0.8	1.3	3.8	0.5	15	16.8	2.8	3	0	5.8	3.3	6.6	26.7	3.8	7.6	27.9	29.2	0	0	0	0	2.5	0	
1965	12	0	5.1	17.8	2.5	5.1	4.3	0	17.8	12.7	7.6	35.6	26.7	22.9	29.7	33	54.6	15.2	30.5	19.1	1.3	0.5	26.2	3	3	35.1	0	0	1.3	4.3	0.5	1.3
1966	01	17	36.6	11.7	4.3	9.7	12.7	9.4	9.7	10.2	3.8	0	0	0	1.8	15.2	0	18.5	5.8	0	5.3	11.7	15.2	0	2	0.5	11.9	0.5	0.8	0	0	0

1966	02	0	0	0	0	0	0	0	0	0	0	0	0	1.3	0	0	0	0	5.3	11.7	29.5	13	3	0	2.5	0.8	9.7	2	5.1			
1966	03	13.5	9.7	1.5	0	0	1.3	0	0	0	0	0	0	0	27.9	0	0	0	0	0.5	7.6	8.9	15.2	12.7	4.3	7.4	49.5	9.1	19.3	2.5	14.5	0.8
1966	04	0.8	1.5	0	0	0	0	0	0	0	1	15.5	0	0	1.3	2.8	0	0	25.7	80	3.8	19.1	0	2	8.1	15.5	12.7	11.4	7.6	11.7	0.8	
1966	05	0	0	0	0	0	0	44.7	2.5	0	1	14.2	95.3	0	31.8	6.9	7.6	6.1	0	0	11.4	10.2	14	16.5	7.6	9.9	0	0	0	26.7	26.9	15.2
1966	06	13.2	9.9	67.3	3.8	5.1	10.2	8.9	25.1	15.2	0	10.2	44.5	15.7	0	61.5	0	2.5	12.2	5.1	12.7	0	30.5	0	43.2	16.5	24.1	34.3	11.4	6.4	3.8	
1966	07	11.4	12.7	36.8	55.9	11.4	16.5	17.8	12.2	17.8	10.2	7.6	20.3	0	0	0	30.5	0	0	0	0	0	11.2	2.8	0	19.6	24.6	15	0	1.5	5.8	0
1966	08	0	0	6.1	8.9	2.8	0	6.4	17.5	0	23.6	26.4	0	9.1	41.7	5.1	1.8	5.3	0	0	0	0	0	15	2	0	39.9	2.3	12.7	3.6	1.3	12.7
1966	09	7.9	0.5	18.3	19.6	4.8	2.3	6.9	0	1	11.4	10.9	27.4	0.5	0	27.9	31.2	0	0	0	0	0	6.4	0	0	0	16.5	0	0	0	0	
1966	10	0	0	0	30.5	0	0	0	7.4	0	0	0	0	0	0	0	17	0	0	4.1	21.6	0	0	0	0	0	0	0	0	0	0	4.6
1966	11	0	0	0	0	0	0	8.4	0	4.6	20.3	0	0	0	17.8	19.1	8.9	0	0	0	0	0	0	23.4	0	0	0	5.8	7.1	28.7	4.3	
1966	12	69.6	39.1	0	0.8	0	0	40.1	3.3	17.3	0.8	0	0	10.7	16.8	1.5	3.8	5.6	5.1	15	25.4	0	17.8	56.4	0	43.2	29.2	40.1	43.7	19.1	5.8	9.7
1967	01	0	3.8	1.8	0.8	2	0	5.1	0	31.5	11.4	24.1	33	8.9	12.7	4.3	25.4	0	5.8	0	2.3	24.4	58.4	11.4	1.3	3.8	5.1	15.2	22.9	7.6	15.2	12.7
1967	02	17.8	0	0	0	12.7	5.1	2.5	0	6.4	0	0	1.5	7.1	2	0	2.5	0	18	0	7.9	0	0	0	0	0	18.3	10.7	0.8			
1967	03	0	0	0	0.5	3.8	0	0	21.6	0	39.4	0	13.2	0	2.3	4.1	0.5	1.3	1.3	0	2.8	8.1	0	1.3	5.6	27.9	1.3	10.2	2.5	0	3.8	2.5
1967	04	0	0	0	0	0	2.5	7.6	0	3.3	28.4	2.8	12.4	7.1	38.1	20.3	0	7.6	43.2	6.4	39.4	52.1	8.9	108	31.8	0	0	0	0	0	61.5	
1967	05	0	17.8	8.9	58.4	26.7	0	11.4	3.8	0	0	0	50.8	0.5	0.5	14.7	23.6	4.6	5.1	7.6	25.9	10.2	9.1	13.2	9.9	15.2	30.5	14	10.7	16	9.4	12.4
1967	06	6.6	11.9	27.9	15.2	18.8	20.8	30.5	4.3	33	10.2	3	8.1	22.1	23.4	34.5	29.2	22.1	27.7	56.9	11.2	39.4	12.4	12.7	11.9	10.4	0.5	41.1	10.9	6.6	20.8	
1967	07	50.8	25.4	20.8	14.2	11.7	1.3	6.1	18.3	19.3	7.6	11.7	0	18.3	2	6.1	0	9.4	2.5	3.8	10.7	0	4.3	3	58.4	4.6	0	2.5	1.8	14.7	7.1	19.1
1967	08	15.2	27.9	21.6	2.5	14.2	5.3	44.5	10.2	9.4	0	38.1	13.2	53.3	1.8	0	0	12.7	0	7.6	0	0	10.2	15.2	0	0	2.5	0	0	3	0	0
1967	09	2.5	0	1	0	1.3	0	0	8.9	0	0	0	0	0	0	0	0	16.5	0	0	0	0	0	30.5	0	13.7	31	0	1.3	10.9	0	
1967	10	0	0	0	0	0	0	0	3.6	0	0	0	0	0	0	0	0	0	0	0	0	4.3	26.7	3.6	33	0	0	0	0	0	0	0.3
1967	11	40.6	0	41.7	0	0	5.6	0	0	0	0	0	0	0	0	0	16.5	0	0	22.9	6.9	0.5	85.1	0	0	26.7	36.6	23.4	9.4	14	16.5	
1967	12	0	0	0	0	0	1.3	0	0	0	5.1	21.1	7.9	4.8	0	0	0	0	0	39.9	36.1	0	39.1	89.9	0	45.7	10.2	5.1	0	0	0	0
1968	01	0	2.3	30.2	58.4	20.3	43.2	41.7	30.5	36.8	43.2	7.1	0	12.7	0	5.6	0	6.4	19.1	15.2	0	0	30.7	23.1	0	0	0	47.8	0	0	0	23.4
1968	02	19.3	0	0	30	0	25.1	14	0.5	0	0	0	0	0	0	0	0	0	12.2	7.4	0	0	0	0	0	0	0	25.4	22.4	13.5		
1968	03	0	0	0	0	0	41.9	0	15.5	0	0	0	24.1	0	0	0	38.1	41.9	8.9	0	0	0	5.1	0	0	0	0	0	0	0	57.2	19.8
1968	04	0	0	8.1	0	23.9	0	0	10.4	16.5	9.9	0	17.8	26.2	9.4	38.1	12.7	0	0	0.8	0	0	0	54.6	0	7.6	13.5	0	0	0	0	
1968	05	0	0	0	0	25.4	0	0	0	0	0	0	14	0	0	33	30.5	0	0	7.6	5.1	32.3	0	0	7.6	0	0	30.5	0	12.7	0	0

1968	06	0	33	7.6	30.5	58.4	10.2	7.1	23.4	30.5	8.1	0	9.1	15.2	21.3	31.2	27.9	12.7	29.2	47.5	7.1	34.3	14.7	20.3	30	17.3	10.2	43.2	23.4	5.8	23.4	
1968	07	8.9	14	10.2	34.3	12.7	14.7	7.1	23.4	19.1	11.7	9.7	22.9	10.2	0	0	0	33	0	0	22.9	0	14	0	20.3	19.1	30.5	15.2	15.2	2.5	2.5	6.1
1968	08	0	7.6	6.1	11.4	2.8	2.5	0	21.1	9.1	25.4	27.9	11.7	11.4	45.7	15.2	6.6	7.6	5.3	9.1	11.4	6.6	0	0	17.5	0	43.2	3.6	12.7	12.7	26.2	3.3
1968	09	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	27.9	3.6	12.7	12.7	26.2	3.3	
1968	10	14.5	0	0	0	0	4.3	0	0	0	0	0	0	1.3	13.5	1.8	0	0	0	0	0	0	57.2	0	0	0	0	13.5	1.8	0	0	0
1968	11	8.9	0	2.3	0	0	0	0	9.9	0	0	0	0	11.7	24.1	0	21.6	7.9	0	22.1	27.7	11.9	0.5	0	22.1	10.2	59.7	4.3	21.3	12.4	0	
1968	12	34.3	19.1	0	13.5	1.3	0	0	48.3	25.9	0	0	9.9	7.4	27.4	0	0	0	0	0	19.8	0	6.4	14.7	0.8	16.8	8.1	17.8	11.4	0	14.5	0
1969	01	34.3	44.5	57.2	20.1	19.1	31.8	0	0	15.7	14.5	0	35.6	22.9	43.9	13.5	13.2	0	0	9.1	6.9	20.8	30.5	13	0	0	48.3	11.7	5.3	112	0.5	7.1
1969	02	10.2	15.7	19.3	14.7	20.1	11.7	2.3	0	0	0	0	0	7.1	0	0	0	0	0	0	23.6	13	0	14.2	0	6.4	14	14.2	37.3			
1969	03	0	19.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	29.2	0	0	0	39.4	0	19.6	7.9	0	19.3	18.8	22.9
1969	04	25.4	2	0	4.3	0	12.7	11.2	0	25.4	3	7.1	9.7	3.8	5.1	9.1	17	0	0	6.9	9.7	8.1	2.8	20.3	2.8	0	0	4.1	0	17	0	
1969	05	0	40.9	21.8	19.1	0	0	11.4	31.8	0	80	24.1	19.6	16.8	29.2	15.5	30	0	9.4	15.5	11.4	3.8	29.2	19.1	0	9.7	3.8	18.5	9.9	23.9	0	0
1969	06	55.4	34.3	2.3	71.1	13.7	38.9	0	11.4	14	0	0	12.7	0	31.5	7.6	18	59.2	36.6	28.7	14	4.6	7.6	48.8	39.1	12.4	21.3	0	0	0	0	
1969	07	7.1	13.2	9.1	5.3	5.1	50.8	7.1	2	15.2	11.4	17.3	0	0	9.7	11.9	5.3	1.5	0	0	0	0	18.5	0	34.8	0.5	0	17.5	4.6	2	13	5.6
1969	08	0	0	0	0	25.9	30	4.8	28.2	2	47.5	0.2	0	0	0	38.9	0	0	20.6	20.3	69.9	12.2	0	0	11.9	4.8	0	15.7	0	0	0	3.8
1969	09	0	0	8.9	3.3	0	0	0	0	0	0	0	0	0	6.4	0	0	0	0	0	0	0	0	0	0	7.1	0	0	0	0	9.9	
1969	10	18.3	0	0	0	0	0	0	0	0	68.6	0	6.4	3.8	0	6.6	32	0	0	0	0	0	7.1	0	0	0	1.8	2	0	0	9.7	0
1969	11	0	0	0	0	0	0	0	0	0	0	0	0	0.3	0	0	2.8	0	0	0	0	0	0	7.4	10.2	0	0	0	0	24.6	0	
1969	12	0	6.6	0	20.6	0.5	0	1.5	0	0	0	0	0	0	45.7	39.1	8.6	0	9.4	5.3	0	4.8	0	0	0	0	0	0	55.1	11.9	0	0
1970	01	0	30.7	24.9	8.9	16.5	19.1	10.7	41.9	0	0	21.6	19.3	0	0	7.6	0	0	2.5	15.2	14	5.1	0	0	11.4	19.6	0	0	6.4	14.5	10.9	21.1
1970	02	35.8	0	17.8	25.4	0	16.8	8.4	20.1	30.5	3	6.1	17	0	12.7	50.8	3.8	18.8	8.6	7.1	0	56.1	0	0	0	1	0	2.3	0			
1970	03	0	0	0	13.5	18.8	34.5	6.9	7.6	0	0	0	0	0	0	0	0	0	0	11.2	0	26.7	5.6	13.7	26.7	18	20.1	24.6	7.6	0.8	0	0
1970	04	5.3	12.7	9.1	12.4	11.4	29.7	22.4	85.1	0	0	31.8	9.7	25.4	4.1	2.8	0	0	31.8	5.8	7.9	0	0	49	15	0	25.4	1.3	0	0	22.1	
1970	05	0	0	11.4	0	0	72.4	0	55.9	0	27.2	0	25.4	25.4	37.6	4.6	0	23.1	0	0	0	16.8	1.8	30	2.3	66.8	1.8	2.5	7.6	29.7	0	3
1970	06	19.1	10.9	43.2	14.5	14	9.4	12.7	23.6	0	26.4	21.6	0	0	0	0	7.4	9.1	0	0	0	27.9	47	2.3	68.6	29.2	1	53.3	0	8.9	3	
1970	07	41.1	0	23.1	32	11.2	34.8	7.4	0	0	4.6	0	11.4	25.4	0	0	0	32.5	0	57.2	0	43.4	0	0	0	0	0	36.1	0	0	0	0
1970	08	0	0	0	0	29.2	25.4	19.1	23.4	32.8	68.3	65.8	0	0	0	12.7	19.1	5.1	0	1.8	0	25.4	32	78	1.3	0	0	0	6.9	0	0	47.2
1970	09	6.1	5.8	2	0	0	15.5	5.3	0	0	0	0	0	0	0	0	0	0	0	0	54.4	0	0	0	0	11.4	0	0	0	0	0	

1973	01	12.7	2.5	27.9	0	2.5	12.7	3.8	0	0	0	5.1	3.8	0	27.9	0	2.5	0	0	0	0	12.7	2.5	0	3.8	12.7	0	0	2.5	12.7	2.5	1.3
1973	02	62.2	2.5	3.8	0	0	0	54.6	2.5	0	0	26.7	0	0	0	0	31.8	0	12.7	0	26.7	0	0	0	0	0	0	0	2.5			
1973	03	2.5	0	0	0	12.7	0	0	0	0	0	0	0	29.2	0	0	2.5	0	0	0	0	0	31.8	2.5	1.3	3.8	173	0	0	0	6.4	17.8
1973	04	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17.8	0	1.3	0	17.8	14	0	53.3	23.4	7.1	0	10.9	1.3	0	
1973	05	0	0	59.9	0	0	0	0	0	0	33.3	5.1	50.8	0	0	4.6	50.8	69.9	0	28.2	0	0	39.1	3.3	22.6	0	0	0	38.1	2.5	0	6.4
1973	06	31.8	2.5	0	0	12.7	1.3	0	0	2.5	1.3	12.7	0	0	39.4	2.5	0	19.1	6.4	38.1	1.3	0	0	0	64.8	0	2.5	1.3	27.9	0	38.1	
1973	07	31.8	2.5	0	0	12.7	1.3	0	0	0	27.9	0	3.8	5.1	1.3	6.4	0	0	0	64.8	2.5	3.8	26.7	0	53.3	6.4	0	0	0	26.7	6.4	12.7
1973	08	31.8	0	2.5	1.3	0	3.8	3.8	0	0	1.3	0	0	64.8	2.5	0	0	0	0	0	0	31.8	1.3	2.5	1.3	0	3.8	0	3.8	14	0	12.7
1973	09	1.3	0	2.5	0	0	0	0	0	31.8	0	0	0	0	0	0	0	12.7	0	0	0	1.3	0	0	3.8	0	0	0	30.5	0	0	
1973	10	31.8	0	1.3	2.5	0	0	0	0	31.8	0	2.5	1.3	0	0	27.9	0	0	0	39.4	1.3	2.5	0	3.8	0	6.4	0	27.9	1.3	3.8	2.5	2.5
1973	11	0	33	0	1.3	41.7	8.9	26.7	3.8	6.4	3	0	1.3	0	1.8	0	0	0	0	0	0	0	0	0	0	12.7	10.2	34.3	2.5	0	0	
1973	12	1.3	6.6	11.4	30.2	11.4	11.4	12.7	0	0	0	27.2	0	0	40.6	0	2.5	12.4	26.4	0	19.1	3.6	11.7	9.7	7.9	6.4	3.8	58.4	59.7	88.9	7.1	19.1
1974	01	36.8	5.3	15.2	9.7	27.4	25.4	29.2	12.7	37.1	27.1	16.5	27.9	12.7	6.4	15.2	9.1	11.4	3.8	0	0	1	1.8	21.8	89.4	42.2	21.6	1	0	0	0	8.6
1974	02	7.6	0	0	7.1	1.5	20.1	5.3	0	0	5.1	7.4	3	34.5	40.6	16.3	0	0	17.8	0.8	1.3	0	0	10.9	1.8	1.8	12.6	5.3	3.8			
1974	03	0	3.3	0	1.8	17.5	0	0	0	0	1.3	0.5	33	11.4	4.6	5.6	11.4	9.7	1.3	0	7.9	8.1	0.5	5.1	5.1	88.9	11.7	58.9	11.4	1.3	22.6	12.7
1974	04	25.9	17.3	8.1	1.3	18.3	21.6	13	20.6	5.6	9.1	10.9	4.1	33	6.1	0.8	1.3	0	12.7	11.7	1.8	0	0.8	8.4	9.6	0	0	7.6	7.9	4.8	0	
1974	05	0	0	0	0	0	0	0	1.5	0	0	0	4.3	2	0.8	1	3	2.5	5.1	5.3	0	0	0	0	0.8	0	11.9	0.8	4.1	6.6	30	31.7
1974	06	12.7	20.3	13.2	14.7	22.3	5.1	6.1	7.6	1.8	16.5	3	1.8	1.5	0	0	0	0.5	0	55.9	66	2.3	25.9	30.5	17.8	27.4	25.4	0	5.3	4.1	9.7	
1974	07	29.7	69.6	5.1	12.4	20.3	5.6	4.1	29.2	69.9	53.6	3.6	5.1	10.4	15.2	16.5	5.1	33	53.3	19	2.5	47	68.6	2.8	3	53.3	2.8	27.9	0	3.8	3	44.5
1974	08	54.6	0	27.9	29.2	26.7	27.9	74.9	26.7	27.9	52.1	33	11.4	5.1	9.7	41.7	17.8	20.8	0.8	2.5	1.3	0	0	2.5	12.7	3.8	25.4	12.7	3.8	6.3	5.1	50.8
1974	09	0.5	0	0	0	0	1.3	0.8	0	0	1.8	0	0	0	0	0	25.4	14	5.1	0	0	0	0	0	52.1	29.2	0	0	22.9	31	0	
1974	10	0	0	0	0	0	1	0	0	0	2.5	1.3	0.5	0	0	0	0	0	1.8	0.5	1.3	0	0	0	0	3.8	0	0	0	0	0	0
1974	11	0	0	0.5	0	0	0	1.3	0	0	0.3	0	0	0	0	0	0	0	1.8	0	0.5	0	0	0.3	0	0	0	0.5	0	0	0	
1974	12	2.5	0.8	1.8	3.8	0.5	0.3	0.3	0	0	1	0.3	0	1.8	50.8	25.4	12.7	5.1	1.3	0.8	0.3	0.5	1.3	2.3	53.6	0.3	0	0	2.3	26.2	4.3	38.1
1975	01	38.1	19	25.9	2.5	20.8	50.8	27.9	0.5	1.3	1.8	3	3.8	0.8	1.3	5.1	25.4	0	1.3	3.8	0	1.3	5.1	2.8	2	3.8	0.8	0.5	0	1.3	5.6	20.3
1975	02	0.3	0	1	2.5	1.8	0.5	0	0	0	0	0	0.5	0.5	0	0	1.3	0.8	0	2.5	1.8	2.3	25.4	76.2	12.7	5.1	0	1.3	0			
1975	03	0.5	0.3	0	0	0	0	1.3	0.3	0	0	0	1.8	1	0.5	0	0	0	0	0.3	0.3	0.5	26.7	12.7	1.8	0	0	2.5	1.3	12.7	14	0
1975	04	0	0	0	0	0	0	1.3	0.8	0	26.7	0	0	0	0.5	0	0	0	1.3	0.5	0	0	0	0	0	1	0.5	1.5	21.1	26.9	0.5	

1975	05	0	0	1.3	0.8	0	0.8	0	2.5	0	0	0	0.5	2.5	5.1	17.8	26.7	12.7	19	2.5	3.8	17.8	26.7	13.2	5.1	25.9	2.5	12.7	39.9	5.1	3.8	19
1975	06	1.3	2.8	25.9	27.1	1	0.5	5.1	35.6	0.8	5.8	0	0	6.3	3	17.8	2.5	1.3	20.3	4.3	0.5	31.8	8.9	16.5	29.2	50.8	8.9	38.1	8.9	27.9	19	
1975	07	1.3	3	0.8	0	1.8	6.6	20.3	3.8	26.7	11.4	30.4	50.8	20.3	3.8	17.8	0.8	0	8.6	2	0	25.4	0	44.4	12.7	0	1.3	0	3	0.5	0	0
1975	08	0	5.1	76.2	38.9	19	6.1	12.7	0	0	0	0	0	8.9	10.2	61.5	0	0	0	38.1	76.2	53.3	31.8	1.3	3	15.2	6.4	9.1	0.8	1.8	0	0
1975	09	0	0	3.8	246	5.1	0	0	0	0	0	2.5	0	0	0	0	1.3	25.9	0	0	12.7	0	0	0	2.5	1.3	0	0.5	0	0	0	
1975	10	0	0	0	0	1.3	0	0	0	3	1.8	0	0	0	19	5.1	1.5	0	0	0	4.1	1.3	0	0	0	0	0	3.6	0	0.5	0	0
1975	11	0	0	0	0	0	0	1	0.5	0	0	8.9	0.8	0	5.6	2.5	0	0	1	1.5	0	1.3	0	15.2	6.9	3.8	11.7	14	1	0.8	38.1	
1975	12	119	5.1	0	0	0	0	16.5	3.8	2.3	0	25.4	1.5	0	0	0	0	0	0	0	0	0	0	45.2	40.6	5.1	3.8	0	0	2.5	0	0
1976	01	0	0	38.1	96	54.6	5.1	35.6	27.9	22.3	0	0	0	0	0	82.5	1.3	8.4	10.7	9.9	2.3	0	35.3	4.1	0	0	31	51.3	26.7	10.2	1.3	0
1976	02	0	0	0	14	3.6	2	30.5	25.4	8.9	25.9	10.7	4.3	19.6	30	18.5	53.8	52.1	59.4	8.1	3.8	30.5	14	25.4	31.7	26.2	21.3	16.5	18.3	12.7		
1976	03	42.4	0	0	0	0	0	0	0	0	0	0	184	17.8	33	13.2	3.3	25.4	14	5.1	2.5	1.3	2.5	11.4	0	3.8	30.5	22.9	19	25.9	25.4	35.6
1976	04	11.4	20.8	29.2	35.6	15.2	3	30.5	23.4	5.1	0	0	0	0	0	0	0	130	39.4	37.6	0.5	29.2	32.5	30.5	12.7	50.8	38.1	7.6	30.5	33	5.6	
1976	05	1.3	3	0	0	0	0	0	0	135	13.2	0.5	19.1	51.6	25.9	27.1	8.1	1.3	8.9	0.5	1.3	3.8	48.3	20.3	8.6	24.1	29.2	32.3	43.2	3	20.8	5.3
1976	06	2	1.3	5.1	21.6	21.1	38.1	14.5	13.2	7.6	6.6	11.9	3.8	3	61	8.9	12.7	30.5	22.9	2.5	4.6	7.6	30.5	14	17	4.3	30.5	12.7	8.4	18.3	4.6	
1976	07	11.4	27.9	7.1	4.3	8.9	3.8	2	4.3	14	12.2	9.1	2	3.6	4.6	31	0.8	5.1	0.5	3.6	8.9	0	0.8	42.4	0	18.3	50.8	40.9	49.5	52.6	1.3	3.6
1976	08	0	0	0	0	0	64.8	0	0	0	0	0	15.7	0	0	0	39.4	0	0	0	0	10.7	27.2	45	2	0	0	0	1.5	3	2	0
1976	09	0	0	0	0	0	0	0	0	0	29.2	19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	78.7	31	0	
1976	10	15.2	0	0	0	0	0	0	0	0	0	0	0	0	17.5	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
1976	11	0	0	3.8	0	0	0	0	0	0	1.3	0	0	0	0	0	6.6	0	0	0	2.5	29.2	0	5.8	0	0	6.6	4.3	25.9	2.5	13.2	
1976	12	0	4.6	26.7	0	3.8	0	13.2	25.4	1.3	3	8.4	2	5.6	20.3	14.7	23.4	21.6	20.3	28.4	11.2	25.9	2.5	0	0	1.3	3.8	27.2	20.8	12.7	16	15.2
1977	01	1.3	2.5	0	20.3	0	0	0	2	0	0.5	0	0	13.5	0	0	3	0	0	0	0	0	0	0	1.3	2	0	3.6	0	0	10.2	0
1977	02	0	0	3.8	3	2	0	0.8	1.5	0	0	127	0	0	0	0	7.9	48.3	54.6	17.8	13.5	8.1	3	1.3	0.5	5.3	14	23.4	15.2			
1977	03	8.9	9.4	38.1	21.6	10.7	0	0	1.3	0.5	0	0	0	5.1	0	18.5	20.8	15.2	6.6	0	0	0	2	3	0	0	0	0	0	0	0	0
1977	04	0	0	0	5.8	15.7	29.2	30.5	20.3	0	0	10.7	7.6	2	0	3	5.6	3.8	2	3.8	20.8	26.2	28.4	7.6	25.9	7.1	3.8	4.1	12.7	0.5	0	
1977	05	0	5.3	3	1.3	0	0	4.6	1.5	2.5	1	6.3	2.3	2	5.1	48.3	20.3	11.2	5.1	4.1	1.3	25.4	41.9	28.4	11.4	61.5	34.5	27.2	14	27.9	10.7	14
1977	06	3	5.8	3.8	25.9	21.6	25.6	14.5	33.5	113	19	20.8	25.9	17	13.2	30.5	7.1	9.1	29.2	19.6	5.1	2.8	3	0.5	0	27.4	25.7	24.6	26.2	78.7	2.5	
1977	07	25.7	11.4	21.1	30.5	26.7	20.6	16.8	23.6	14.7	18.5	11.2	1.3	24.1	30	53.8	27.9	17	5.1	27.7	10.2	8.1	5.1	14.7	16	10.7	25.7	22.9	19.3	16.3	7.6	13.2
1977	08	7.1	5.6	10.9	13.7	2.5	0	0	0	0	0	0	0	3.8	3	0	0	8.1	5.8	0	0	4.1	26.7	0	10.2	0	2	0	0	0	0	1.3

1977	09	0.5	0	0	0.5	1.8	0	0	0	0	0	1.5	0	1.3	0	0	0	0	0	0	5.6	0	3.8	0	0	0	0	1	3	0	0		
1977	10	0	2.3	0	0	0	4.1	0	0.8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6.6	1.3	0	0	0	0	
1977	11	0	0	0	0	0	0	0	0	0	4.1	1.8	0	0	0	0	2.5	0	0	0	0	0	5.6	8.9	3.6	0	6.6	0	0	1	0		
1977	12	0	0	0	0	0	2	0	0	0	3	1.8	2.3	0	3.8	1.3	2.8	6.6	1.3	2	0.5	1.8	24.1	25.9	13.2	5.8	0	0	0	0	0	1.3	
1978	01	0	0	0	0	0	0	1.3	0	0	5.1	3	0	0	2.3	0	4.6	3	0	0	0	0	0	0	5.6	24.9	14.5	17.3	25.9	20.3	18.3	2	
1978	02	0	0	0	0	0	0	0	0	0	3.8	15	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	2.3	1.3				
1978	03	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17.8	0	8.1	0	0	0	0	0	0	0	3.8	0	0	0	0	0	0	
1978	04	0	2	0.8	0	0	0	0	0	4.6	3.6	1.8	0	0	0	0	0	0	0	3	0	0	0	0	0	0	17.3	9.1	10.9	13.5	14.5		
1978	06	15.2	13.7	8.1	25.9	9.7	6.6	0	2.5	2	3.6	0.5	5.6	4.1	3.6	2	0	17	1.3	0.8	0	0.5	0	7.1	8.1	6.6	5.8	5.6	1	2	1.3		
1978	07	5.8	31	16.3	51.8	18	6.1	1.5	1	7.8	11.9	20.1	9.4	13	2.3	2	1.3	2.5	3.6	8.4	0.5	3.8	12.7	14	3.3	0.3	0.5	0	0	9.9	0.3	0	
1978	08	55.9	53.6	26.7	66.8	61	40.6	29.2	27.2	25.1	21.6	33.8	0	7.4	24.1	0	0.8	2.5	0	35	2.5	29.2	2.3	8.4	38.1	6.3	38.6	1	6.6	2.5	10.4	1	
1978	09	10.7	0	0	0	8.4	5.1	9.6	19.8	4.3	0	0	0	0.8	0.5	0.5	14	0	38.3	2	3.6	26.9	0	0	0	0	0	0.5	1	0	0.8		
1978	10	0	0	0.5	0.8	1	11.9	0	6.6	1	0	0	0.8	1.3	0	0	4.3	0	1.3	6.6	38.1	5.6	0.3	0	0	0	0	1.3	0	14.5	0	9.4	
1978	11	0	0	0	0	0	9.4	14	2	10.7	0	0	0.8	0	0.5	0	0	0	2	14.5	0	0	0	0	3.8	1.3	13	32.5	9.4	15.2	21.8		
1978	12	2.8	44.4	2.5	15.2	6.6	40.6	57.4	7.6	6.6	1.3	5.1	3	2	4.3	4.3	0	0	0	0	89.7	5.1	5.8	0	0	1.3	0	4.3	1.8	12.7	40.6	31.7	
1979	01	13.5	29.2	2.8	1.8	0	0.8	0	0	0	0	0	0	2.5	6.3	19	3.3	1.3	5.1	1.5	7.6	17.8	30.5	38.1	29.2	8.4	0	0	0	8.9	26.7	16.5	
1979	02	0	0.5	0	0	3.8	3.3	4.6	5.1	0.8	1	5.6	4.1	8.6	1	0	0.8	0.5	0.8	0.5	1.3	0.8	1.3	4.3	3.3	3.8	0	0	0				
1979	03	34.3	26.7	26.2	27.4	25.9	30.5	34.8	36.3	10.9	3.8	5.1	21.6	36.3	11.2	1.8	7.1	8.1	13	18.8	7.6	19.8	59.7	5.1	54.6	0	0	0.8	0.5	1.3	1.8	0	
1979	04	31.8	22.9	21.6	33	17.8	11.4	5.1	3.8	4.3	6.6	1.3	4.1	4.8	2	1.8	8.9	22.9	13.7	15.7	19.6	7.4	21.6	2	0	0	37.6	21.6	36.8	19	14.7		
1979	05	1.5	0.8	7.1	0	0	0.5	14.5	14.7	0	0.5	0.8	1.3	0.5	1.5	0	0	0	33	24.1	30.5	16.5	6.3	14	12.7	0	16	0	6.4	1.8	19.6	3.3	
1979	06	1	30	13.7	35.8	29	19	2.8	40.1	84.3	26.2	19.3	2.8	42.4	13	1.5	1	0.5	1.5	2	1.8	4.1	3	4.8	6.4	9.6	26.7	29.5	9.6	14	15.2		
1979	07	11.7	9.6	11.4	33.5	30	31.7	40.6	21.6	16.5	12.7	4.6	8.9	5.1	4.6	5.6	6.6	3.6															
1982	02	31.8	4.1	0	0	30	2.3	54.4	12.2	17.8	14	0	0	0	0	0	0	0	64.8	9.7	11.2	14.2	8.4	2.5	2.3	0	0	1.3					
1982	03	0	1.3	2.5	1	0	0	0	0	6.1	4.1	9.1	27.4	10.2	43.2	39.4	82.6	11.4	71.1	3.8	3.1	2.5	12.7	21.6	0	24.4	0	0	30.5	46.5	22.9	5.1	
1982	04	3.8	0	36.8	35.6	25.4	24.1	30.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	155	19.1	27.7	7.9	12.7	0	2.5		
1989	01											11	2	30.5	0	0	1.5	9	11	0	0	0	6	8	3.2	5	1	0	0	0	0	1	

1989	02	0.2	0.5	0.6	12	0.3	20	0	0	0.1	0.7	23.3	0.4	0	0	24	10	30	40	0.3	10	0.6	1.2	0.2	1.3	0.2	0	0	0			
1989	03	3.1	0.1	0	0	0	0	0	0	0	22.5	0	3	2	2.9	3.4	0	1.6	0	0	2.3	0	25.4	0	0	1.6	0	27.2	20.7	52.7	52.7	2.7
1989	04	4.6	0	0	0	22.6	27.8	9.4	0	16	0	0	6.4	5.9	0	46.3	1.2	6	0	0	4.3	0	0	0	0	0	0	0	11.6	10.4	8.1	
1989	12	0	10.3	39.4	27.9	12	20.1	5.9	11.6	17.2	40.1	27	10.3	12.7	14	16.7	22	0	0	19.5	17	12.1	13.4	15	15.6	0	0	2.1	4.6	0	29.1	0
1990	01	24.3	13	39.1	17.2	6	19.1	24.8	37	18.7	35	0	16.3	0	12.4	21	7.1	3	0	29.8	32	4.6	21.9	22.1	31	27.9	11.3	11	14.3	16	24.1	30.4
1990	02	25.7	26.5	36.9	10.2	23.2	10	15.5	5.1	26.5	2.3	0	2.7	17.5	11.2	0	0	0	0	0	22.5	20	0	0	0	0	0	11.3	3			
1990	03	6.5	6.1	0	0	0	0	18.3	49.9	20.3	3.1	14.5	7.8	1.2	4	26.4	11	13.8	0	0	12.1	25.3	50.9	22	19.6	10.3	27.2	22	33.4	15.8	12.6	28.4
1990	04	29.3	36.1	21.9	12.3	33	91.6	11.3	13.6	16.3	10.9	7.1	22	17.4	11.8	15.3	25.1	14	0	28.5	41	14.5	12.6	36.3	21.1	29.8	50.3	50.9	60.3	40.5	23.8	
1990	05	50.3	29.6	13.8	33.1	40.3	29	50.4	44.9	66.1	73	10.9	25.6	80.3	70.5	33.9	22	14.9	31.2	50.3	70	54.3	67.9	40.8	34.3	23.8	50.1	31.4	11	21.8	15	3.5
1990	06	40.3	28.1	12.8	50.3	22.3	50.1	30	17.8	13.9	27	0	16.4	19.3	36.1	40.8	50	70.1	31	18.3	14	12.6	22.9	15	6.1	11.4	28.3	21.6	20	15.7	13.3	
1990	07	60.4	50.3	14.9	28.6	30.1	12	15.9	24.6	12.9	7.2	0	31	12.6	0	42.8	17.1	14.9	50	37.1	0	0	22.3	25	41.3	11.1	9.2	2.1	15.3	13	20.1	11
1990	08	14	19.5	0	11	45.6	15.3	0	39.1	9.4	3.5	0	1.2	4.7	0	0	14	0	3	11.6	1	0	39.1	17.3	0	12	3.1	3.9	0	6.5	15.5	0
1990	09	0	0	24	14	1.2	0	30.1	0	0	1.4	0	17.5	14	0	0	0	10.3	2.1	0.4	0	16	13	0	0	0	11.6	0	0	10.7	0	
1990	10	1.3	0	4.5	0	0	0	12.1	0	0	0.5	0	20	14	0	0	0	0.6	0	13	6.1	7.2	0	0	0	5	0	0	0	0	18	0
1990	11	5.1	0	13.2	7	0	0	0	14	0	8.1	12.5	9	25.6	33.1	3.8	0	1.2	0	6	10	5.9	3.1	8.3	12	16	7	20.3	5.5	7.1	18.3	
1990	12	59.5	11.3	4.1	9	1	21.5	12	17.3	54.6	17	12.8	5	12.4	14	21	13.1	41	30.1	18	36.4	22.7	0	19.5	26.5	41.3	39.4	19	20.8	48.2	53.1	29.4
1991	01	22.1	15.3	40.1	3.1	54	25.4	33.6	19.2	20.2	17.8	60.1	77.2	10.9	21	12	31.5	14	0	0	19.2	14	34.1	11	2.1	5.3	0	7.1	0	15.2	18.3	16
1991	02	2.3	14	17.3	3.4	6.1	0	22.7	24.5	11	0	50.1	19	0	0	11	10	6.2	0	8.2	4	25.8	44.1	54.2	6.5	7.3	0	4.3	24.5			
1991	03	14.3	21	0	8.5	11.9	9.2	0	0	13.6	24.2	3.9	4.5	16.7	33.4	36.5	17.3	11	6.5	0	0	0	0	20.5	15.3	18.5	22.6	44	19.5	10.8	4.5	8.2
1991	04	1.2	29	1.3	1	72.6	33.1	16	0	2.1	17.8	0	14.2	19	27	22.2	13.8	11	12.9	44.1	12.4	0	25.4	33.1	50.9	24	22.3	43	19.4	20.1	27	
1991	05	14.3	10.4	2.6	11	8.1	3	0	4.1	13.6	0	0	0	0	9.5	3.1	9.5	41	33.6	11.1	10	17	7	31.7	14.9	12.1	0	0.3	8.3	15.4	11.4	19.5
1991	06	22.5	21	33.4	7.8	9.4	11.5	14.3	41.6	12	15.8	19.9	0	0	43.6	50.8	31.2	0	0	25.7	21.4	20.8	18.5	17	11.9	25.4	21	12.4	33	14.5	11	
1991	07	10.9	15	0	2.1	4.6	22.7	20.8	14	19.5	0	16.4	11	8.1	9.4	0	0	2.6	5	0.2	0.3	8	0	0.6	0.9	0	0.1	0.5	0	0.4	10	
1991	08	15.8	18.3	1.5	2	0	0	0	22.5	34.5	17.9	12.3	4	7	9.5	13.6	22.9	44	16.5	0	0	0	0	31.8	27.5	32	11	12.6	0	0	0	0
1991	09	11	0	19.1	0	33	0	0	0	16.5	20.9	11.8	13.2	22.5	6.9	0	33.4	17.8	0	12.5	6.5	10.3	12.5	0	0	14.9	18.5	15	0	0	0	
1991	10	9.1	11	0	0	3.1	0	0	0	4.5	0	0	0	0	0	7.3	0	11	8.5	2	0	0	1	6.5	13.5	0	10.5	2.4	0	0	4.2	0
1991	11	9.5	4.3	0	0	0	10	0	0	0	0	11.5	4	6.3	0	0	12.1	5	0	1.5	0	0	0	0	8.5	3	0	0	2	0	0	
1991	12	66	23.1	20.5	0	17.5	14.3	0.8	10.1	0	11	3	12.1	17.2	0	0	0	0	14.2	33.2	21.9	10.5	21.8	33.1	0.9	11.6	0	0.2	0.7	16.5	11	14

[illegible]

APPENDIX D: ECOLOGICAL SURVEY METHODOLOGY

1.0 BIODIVERSITY BASELINE METHODOLOGY

The Concession is typically lowland forest and undulating hills, criss-crossed with creeks. The Concession area was observed to be divided into the following landscapes or ecosystems:

- undisturbed and disturbed areas on elevated gradients (hills); and
- undisturbed and disturbed areas on flats/low gradients.

The primary mechanism utilized for development of the biodiversity baseline consisted of field surveys of the area to capture both spatial and temporal variations. Spatial variations in biodiversity were captured by the establishment of discrete sample squares in areas based on topography, forest/vegetation ecosystem types present in the area, and the level of disturbance. Temporal variations were captured by sampling the exact locations during both a single wet and a single dry season.

1.1 Flora

Sample plots locations for the floral survey were determined by utilization of the Guyana Forestry Commission (GFC) Vegetation Map and a Guyana Geology and Mines Commission (GGMC) topographic map as reference sources. The vegetation types within the Concession were determined from the Vegetation Map while elevation differences were established from the GGMC 1:50,000 topographic map. Figure 1 shows a schematic map of sample plot locations. Terrestrial survey plots are designated as TE, and aquatic survey plots as AQ on the map. The UTM Coordinates for each plot are as detailed in Table 1.

Table 1: UTM Coordinates of Sample Plots

Transect No	UTM Coordinates
TE 1	N273114, E619188
TE 2	N268682, E622204
TE 3	N275055, E617364
TE 4	N270076, E624705
TE 5	N266002, E623623
Q 1a	N273895, E619016
AQ1b	N273771, E620113
AQ 2	N276610, E622334
AQ 3	N271067, E621567
AQ4	N267782, E 627067
AQ 5a	N 272658, E 620268
AQ5b	N 273777, E 620104
AQ6	N 273789, E 619224
AQ7	N 265731, E 623963

The floral survey methodology utilised in this survey was adopted from the Alder and van Kuijk (2009) baseline assessment of forest carbon in Guyana conducted for the GFC. The floral survey consisted of both a terrestrial forest inventory (FI) of trees within the Concession and a floristic survey. Vascular plants species such as shrubs, herbs, and lianas (Pteridophytes and Angiosperms) not included in the FI were recorded during the floristic survey. The floristic survey was conducted in the plots set up for the FI.

Figure 1 - Schematic map of sample plots locations

Five survey plots were established for the floral survey. A cluster of five circular plots were established in each survey plot. The circles were established in the pattern shown in Figure 2. The center to center distance of each of the larger circle was set at 100 m. Each circle or the main plot had a radius of 18 m. A smaller inner circle with a radius of 8 m was established concentric with the larger circle as depicted in Figure 3.

Figure 2 - Cluster of Circular Sample plots

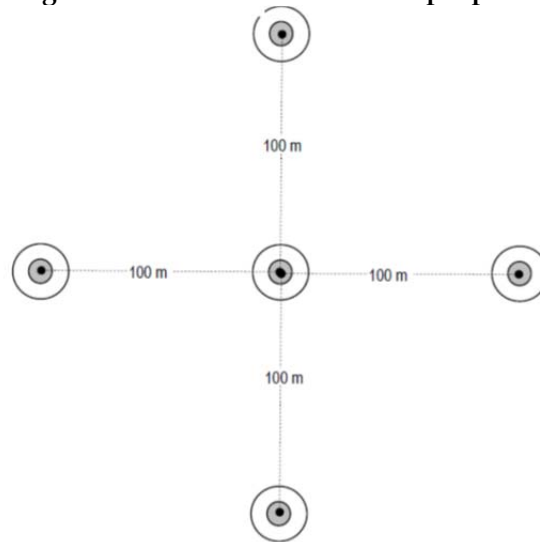
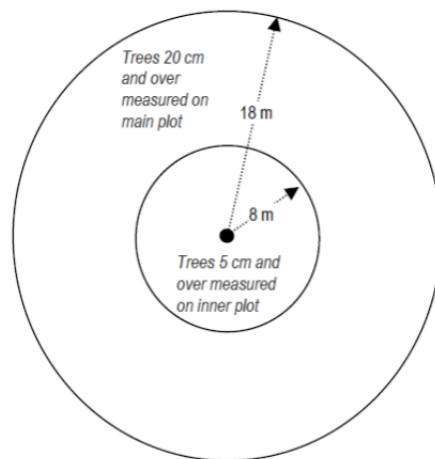


Figure 3 - Main circle plot design



All trees (including standing dead trees) of 20 cm DBH and above were recorded over the main circle plot. Within the inner circle plots all trees 5cm DBH and above were recorded to estimate total biomass. The clusters of circular plots were randomly placed along discernible environmental gradients/ecotones (slope, soil type, vegetation type, exploited and unexploited forest). Data recorded for the inner circle included both below ground-roots and above-ground tree biomass. Estimated quantities of plant biomass were prepared by measuring the DBH of climax canopy trees, saplings and seedlings.

Floral information recorded per plot included:

- Location (UTM Coordinate (Easting and Northing) of each sample plot and site elevation.
- Type of environment and physiographic position of subplot and soil type
- Plant species scientific name and common name.
- Estimated commercial height for timber, considering sample diameters above 35 cm DBH. Volume estimates within each plot of mature stems above 35 cm DBH were extrapolated to determine volume estimates of commercial and cultural use timber.
- Percent Canopy openness was used to define the degree and extent of forest disturbance from a canopy perspective, assuming the ground dimension of the existing canopy opening to be approximated by an ellipsoid.

Data was collected and analysed using the DAFOR raking system. This method of evaluation involves assigning species as dominant, abundant, frequent, occasional or rare.

Plants in each survey plot were determined as belonging to one of three strata. These strata were respectively A, B and C stratum (all mature trees greater than and equal to 20 cm DBH); Understory Layer (Smaller Woody Stems); and the Ground/Herbaceous Layer (Seedlings/herbaceous stems).

Data was recorded on data sheets. Information recorded on the data sheets included plot composition (plot number, species diameter at breast height (DBH)), plot attributes (including location and soil type), and taxa specific and tree attributes. Unknown varieties were sampled, preserved and returned to Georgetown for identification.

Each plot was classified as primary or secondary growth to allow inferences to be drawn about the degree of disturbance within each plot. The volume of commercial and cultural use timber reported reflects the volumes computed over the transect area only. These volumes were extrapolated over the plot to determine the volume of wood available within each plot.

The biomass quantities determined in the survey plots were extrapolated to determine the total biomass within the PGI concession. This information was subsequently used to estimate carbon stock within the area. Forest carbon stocks estimates were developed to conform to requirements of the GFC and the Guyana Low Carbon Development Strategy (LCDS).

For the biomass estimations, field data was recorded using data sheets and analyzed using Microsoft Excel. Timber volume estimates were determined using the following formula (Adopted from the GFC Metrification Manual for Timber Species, 1999):

- Timber Volume (m^3) = $0.7854 \cdot D^2 \cdot L \cdot 0.0001$

Where D = Diameter at Breast Height (DBH)
 L = log length

Biomass estimates were developed based on the pan-tropical biomass equation of Chave et al (2005). The Chave et al (2005) biomass allometric model was validated as applicable for use in the Guyana context in Alder and van Kuijk (2009) baseline assessment of forest carbon in Guyana. Biomass estimates were calculated strictly for trees with DBH greater than 5 cm and for saplings with BDH less than 5 cm. Carbon accounting estimates were expressed either in tonnes carbon per ha, ($tC\ ha^{-1}$) or tonnes of carbon dioxide-equivalent per ha, ($tCO_2-e\ ha^{-1}$). The IPCC (2006) recommended conversion factor of 0.5 for biomass to carbon was used. To determine CO_2 -equivalent, tonnes of carbon was multiplied by the ratio of 44/12, which is the ratio of the atomic weights of Carbon Dioxide (CO_2) to Carbon (C).

The Chave et al (2005) model is as follows:

- $AGB = \text{wood density (g/cm}^3) \times \exp(-1.499 + 2.148\ln(\text{DBH}) + 0.207(\ln(\text{DBH}))^2 - 0.0281(\ln(\text{DBH}))^3)$

Wood densities were derived species by species from the database of Zanne et al (2009). These are available for 134 Guyanese species, including all common forest trees. For species with unknown wood density a weighted average wood density of 0.66 g/cm³ was utilized as recommended by Steege (2001).

Below ground tree (root) biomass was calculated as a root:shoot (R:S) ratio relative to above ground biomass. This method is implicit in the IPCC (2006) equations for forest biomass calculations. The following root:shoot ratios adopted from Steege (2001) were utilized for the forest types encountered within the Concession:

- Mixed Forest R:S ratio = 0.220
- Wallaba Forest R:S ratio = 0.487

Necro-mass (dead wood and litter) was approximately estimated using an expansion factor of 8.6 % relative to tree biomass (Steege, 2001).

1.2 Fauna

Five terrestrial/wildlife sampling plots were established for the faunal surveys in the general vicinity of the floral plots. A standard sampling design consisting of 2km transects was employed at each plot. Different terrestrial vertebrate groups were sampled at separate intervals of each transect, so as to avoid or minimize interference between methodologies and sampling of different terrestrial vertebrate groups.

1.2.1 Mammals (Non-Volant)

Nineteen Duke heavy duty large cage traps (30 cm x12 cm x 12 cm), thirty five large Sherman folding traps (4cm x 4.5cm x15cm), and twenty small Sherman folding traps (3cm x 3.5cm x 9cm) were installed along 1km of the transect at each site. Duke heavy cage traps were used to target species such as *Didelphis sp.*, *Agouti paca*, *Dasyprocta leporine* and *Dasypus species*. Sherman folding traps were used to target rats and small opossums.

Traps were placed in pairs at least 15 m off the main transect and were installed both at ground and above ground levels. Traps to sample arboreal (tree dwelling) mammals were positioned approximately 3-5m above the ground. This was done to ensure that both ground dwelling and arboreal species were targeted. At ground levels traps were placed at sites that appeared to be frequented by mammals including the sides of fallen logs, near to boulders or holes near base of tree trunks. Additionally, traps were placed along the banks of creeks and in seasonally flooded areas to target aquatic species. Traps were baited with sunflower seeds, ripe plantains, cassava, sweet potatoes, fish or a mixture of fish, flour and peanut butter. Sardines were used to attract carnivorous and insectivorous species. Traps were checked daily and re-baited between 7:00 am and 10:00am daily.

Transect searches were also conducted and were used to target medium and large nocturnal and otherwise cryptic mammal species. Indirect evidence used to detect non-volant mammals included tracks, trails, scat, burrows, feeding ground, prey remains and other cues such as scratches on trees. Transect searches were conducted twice per day once in the morning between 9: 00 am and 11:00 am and then at nights between 6:30 pm and 8:30 pm. During nocturnal surveys mammals were detected by their eye shine.

At each site camera traps were installed at areas suspected to be frequented by mammals. Cameras were left for two nights at each site in the initial wet season survey. For the dry season survey cameras were left for five nights at each survey site.

Non-volant mammals that were spotted opportunistically were also recorded. Opportunistic encounters of non-volant mammals by other member of the survey team were also recorded.

Interviews were used to canvass secondary data on non-volant mammalian diversity. During interviews information was gleaned on past and current use of mammalian wildlife. A total of 9 individuals were interviewed during the wet season survey and included 1 individual attached to an active small scale mining operation, 6 persons from 14 mile landing, and 3 employees of PGI. Interviews with PGI staff were conducted in the dry season survey. Interviews were informal and guided. Respondents were asked a standard set of questions that gleaned information on the diversity of non-volant mammals in the area. Interviewees were guided by photographs to eliminate misidentification of species. Guides used during the interview included: A Field Guide of Neo-tropical Rainforest Mammals; and A pocket identification guide of Monkeys of the Guianas.

1.2.2 Bats and Birds

Mist nets were installed for capturing both birds and bats. For bats a total of sixteen understory mist nets (dimensions 12 x 2.5 m, mesh size 36mm with four pockets) were installed along the 2 km transect in each of the five wildlife survey plots. Nets were established in sets of two placed perpendicular to each other to optimize sampling effort. Bat mist nets were opened between 17:00 hrs to 22:00 hrs daily for a total of 2 days per transect. Mist nets placement were determined based on the forest structure of individual sites, openness of the understory, forest type, potential roosting site, accessibility and possible bat foraging sites. Captured specimens were identified, marked, recorded and released. Unidentified specimens were placed in individual cloth bags and transported to the camp 'laboratory' to facilitate identification. Species identification was aided via the use taxonomic identification keys.

Birds were mist-netted at the same locations used for mist-netting bats. Four methods were used to sample birds; mist-netting; visual encounter survey (VES)/audio encounter survey (AES); point counts along transects; and opportunistic sightings. Birds observed via VES and or by their vocalizations were recorded along the established transects. Each transect was walked once in the early morning at 06:30 hrs and again in the late afternoon at 15:00 hrs daily. Each transect typically took two hours to walk. Eight (8) mist-nets were set to sample understory birds at selected netting spots established within each transect. Mist nets placement were determined based on the forest structure of individual sites, openness of the understory, forest type, potential roosting site, accessibility and possible foraging sites. Nets were left open for 8 hours, typically between 06:00 and 12:30 hours (5.5 hours) and again from 15:00 to 17:30 hours (2.5 hours). Birds were photographed and identified to species using taxonomic checklists and field guides. All birds were released unharmed within 30 minutes of capture following species identification.

1.2.3 Herpetofauna (Amphibians and Reptiles)

Visual Encounter Surveys (VES) and Auditory Encounter Surveys (AES) were conducted along the 2km transect at each survey plot to determine herpetofaunal species presence, distribution and relative abundance. Patch sampling of habitats was conducted in the morning and evening. Patch sampling involved the random sampling of microhabitats or habitat patches where concentrations of reptile and amphibian densities are the highest e.g. along creeks, fallen dead trees, etc. Surveys lasted approximately 2-3 hours, commencing at 10:00 hrs and at 18:00 hrs. Mag-lights were used to spotlight reptiles and amphibians for night VES. During the nightly surveys species were often encountered by their vocalization or eye-shine. General searches for amphibians and reptiles around the campsites were also conducted and opportunistic observations were recorded along old trails and roads. Additional

information on species presence was gleaned through interviews with miners from the 14 Mile Landing and PGI staff.

1.2.4 Terrestrial Macro-invertebrates

Encounters of macro-invertebrates were recorded in all transects. Macro-invertebrates were classified to the taxon- Order due to the difficulty of identifying and classifying them to the species level. Leaf litter searches along the transects and open trails and roads were used to sample terrestrial macro-invertebrates.

1.2.5 Aquatic Fauna (Fish and Aquatic/Benthic Macro-invertebrates)

Six aquatic fauna survey locations were established. Some of the survey areas, depicted in Figure 1, were further divided in the sub-sites based on the need to ensure all habitats within the Concession were investigated. Sampling was done both diurnally and nocturnally, so as to capture species that were active at both times of the day. Sampling methods employed were:

1. Cast-net – At sample areas that allowed for the use of the castnet (lack of woody debris, adequate depth), there were two cast netting sessions; one at 10:00hrs and the other at 17:00hrs. Each netting session consisted of 8 throws and lasted an average of 10 minutes.
2. Gill nets – At each site, three lengths (net lengths varied depending on width of waterbody) with eye sizes of 1, 2 and 3 inch were placed at areas with low stream flow. If a site consisted of two sample points, 1 gill net of each of the above mentioned eye size was placed at each sample point. These were checked for netted species at the following times : 06:00-07:00hrs; 12:00 hrs-13:00hrs; and 18:00hrs-19:00hrs for a duration of two days.
3. Hook and line – Hook and line was used to sample small-medium sized fishes within all the sites. Different baits were used to ensure that there was minimal bias in the species that were targeted and caught. Hook and line was done between 04:00hrs-07:00hrs, 10:00hrs-12:00hrs, and 16:00hrs-19:00hrs daily.
4. Hand net – A dip net was used to sample the edges and shallow areas found within the sample sites. This was particularly useful for the smaller species, such as *Moenkhausia colleti*, small characins and benthic organisms.
5. Night-Shining – At sites where the water is clear and shallow, a torch light was used to search for fishes. These were then caught using a dip-net. This method was usually employed between 20:00hrs and 22:00hrs.
6. Interviews – Photographic plates with images of fishes that are expected to be found based on the literature review were prepared. These were then used to conduct semi-formal interviews with members of staff of PGI, as well as members of the 14 Miles Issano community.

APPENDIX E: TRANSECT SPECIFIC DATA COMPILED FOR CONCESSION

Table 2: TRANSECT SPECIFIC RECORD OF MAMMALS WITHIN CONCESSION

[illegible]

Didelphimorpha											
<i>Didelphis albiventris</i>	White eared opossum	X									
<i>Didelphis marsupialis</i>	Common opossum		X	x	X		x				x
<i>Marmops parvidens</i>	Delicate mouse opossum						x				
Artiodactyla											
<i>Mazama Americana</i>	Red brocket deer	X	X	x	X	x	x	x	x	x	x
<i>Mazama gouazipura</i>	Grey brocket deer						x			x	
<i>Tayassu pacari</i>	white- lipped peccary*										
<i>Pecari tajacu</i>	Collard peccary*										
Perissodactyla											
<i>Tapirus terrestris</i>	Brazillian tapir		X	x	X		x	x	x	x	x
Total		6	9	9	7	5	12	6	9	8	10

*Species recorded by interviews

COMMON NAME	SCIENTIFIC NAME	FAMILY	WET SEASON						DRY SEASON							
Screaming Piha	<i>Lipaugus vociferans</i>	Cotingidae	3	2	4	2			7	6						
Capuchin Bird	<i>Perissocephalus tricolor</i>	Cotingidae		1										1		
Guianan Red-Cotinga	<i>Phoenicircus carnifex</i>	Cotingidae				1										
Black Currasow	<i>Crax alector</i>	Cracidae					2			1					AMN	
Marail Guan	<i>Penelope marail</i>	Cracidae	2													
Spix's Guan	<i>Penelope jacquacu</i>	Cracidae	2													
Black-bellied Cuckoo	<i>Piaya melanogaster</i>	Cuculidae			1	1	1						4			
Smooth-billed Ani	<i>Crotophaga ani</i>	Cuculidae						9		12						
Chestnut-rumped Woodcreeper	<i>Xiphorhynchus pardalotus</i>	Dendrocolaptidae	3		3	4						3				
Wedge-billed Woodcreeper	<i>Glyphorhynchus spirurus</i>	Dendrocolaptidae	3	5	10	10	6	4		4		14	12			
Plain-brown Woodcreeper	<i>Dendrocincla fuliginosa</i>	Dendrocolaptidae			1											
Buff-throated Woodcreeper	<i>Xiphorhynchus guttatus</i>	Dendrocolaptidae							2		1					
Slaty-backed Forest Falcon	<i>Micrastur mirandollei</i>	Falconidae			1						1					CITES II
Red-throated Caracara	<i>Ibycter americanus</i>	Falconidae		4		3						1				CITES II
Spotted Antpitta	<i>Hylopezus macularis</i>	Formicariidae		2	1	1	1			1			1			
Thrush-like Antpitta	<i>Myrmothera campanisona</i>	Formicariidae					1					1	1			
Black-faced Antthrush	<i>Formicarius analis</i>	Formicariidae			3	1						1				
Plain Xenops	<i>Xenops minutus</i>	Furniriidae				1				1						

[illegible]

COMMON NAME	SCIENTIFIC NAME	FAMILY	WET SEASON						DRY SEASON							
Trumpeter																
Channel-billed Toucan	<i>Ramphastos vitellinus</i>	Ramphastidae			1						5					CITES II
Red-billed Toucan	<i>Ramphastos tucanus</i>	Ramphastidae			4	2	1		2							CITES II
Black-necked Aracari	<i>Pteroglossus aracari</i>	Ramphastidae	5								3					CITES II
Spectacled Owl	<i>Pulsatrix perspicillata</i>	Strigidae					1		2							
Mouse-coloured Antshrike	<i>Thamnophilus murinus</i>	Thamnophilidae	2	3	4		4			3						
Dusky-throated Antshrike	<i>Thamnomanes ardesiacus</i>	Thamnophilidae	4	1	1	4	2			2	1	3				
Fasciated Antshrike	<i>Cymbilaimus lineatus</i>	Thamnophilidae					2		1							
Cinereous Antshrike	<i>Thamnomanes caesi</i>	Thamnophilidae	2			5			1			5				
Spot-tailed Antwren	<i>Herpsilochmus sticturus</i>	Thamnophilidae		2											AMN	
Rufous-bellied Antwren	<i>Myrmotherula guttata</i>	Thamnophilidae	2	2	1		3				1				GUI	
Brown-bellied Antwren	<i>Myrmotherula gutturalis</i>	Thamnophilidae	2						2						GUI	
Todd's Antwren	<i>Herpsilochmus stictocephalus</i>	Thamnophilidae	4		5	8					4					
Pygmy Antwren	<i>Myrmotherula brachyuran</i>	Thamnophilidae			2						2	7				
Gray Antwren	<i>Myrmotherula menetriesii</i>	Thamnophilidae	2	2		4	4		1			2				
Spot-Wing Antwren	<i>Myrmotherula schisticolor</i>	Thamnophilidae	1				1									
Plain-winged	<i>Myrmotherula</i>	Thamnophilidae	2	1	4						7					

COMMON NAME	SCIENTIFIC NAME	FAMILY	WET SEASON						DRY SEASON							
Antwren	<i>behni</i>															
Long-winged Antwren	<i>Myrmotherula longipennis</i>	Thamnophilidae	2		2	2			2		1					
Antwren species	<i>Myrmotherula spp.</i>	Thamnophilidae	1		2	1										
White-plumed Antbird	<i>Pithys albifrons</i>	Thamnophilidae	2	1	9		1		5		7				GUI	
Rufous-throated Antbird	<i>Gymnopithys rufigula</i>	Thamnophilidae			6										GUI	
Scaled-backed Antbird	<i>Hylophylax poecilinotus</i>	Thamnophilidae		1		1										
Silvered Antbird	<i>Sclateria naevia</i>	Thamnophilidae						2	2							
Dusky Antbird	<i>Cercomacra tyrannina</i>	Thamnophilidae						2								
Gray Antbird	<i>Cercomacra cinerascens</i>	Thamnophilidae					2									
Ferruginous-back Antbird	<i>Myrmeciza ferruginea</i>	Thamnophilidae		2	2		2		1		2					
Guianan Warbling Antbird	<i>Hypocnemis cantator</i>	Thamnophilidae			6		4									
Bay-headed Tanager	<i>Tangara gyrola</i>	Thamnophilidae			2											
Black - Chined Antbird	<i>Hypocnemoides melanopogon</i>	Thamnophilidae							1		1	2				
Black throated Antbird	<i>Myrmeciza atrothorax</i>	Thamnophilidae							1					1		
Silver-beaked Tanager	<i>Ramphocelus carbo</i>	Thraupidae					4	8			1					
Fulvous-crested Tanager	<i>Tachyphonus surinamus</i>	Thraupidae			3						5				AMN	

COMMON NAME	SCIENTIFIC NAME	FAMILY	WET SEASON						DRY SEASON							
Opal-rumped Tanager	<i>Tangara velia</i>	Thraupidae	2		5				4		3					
Purple Honeycreeper	<i>Cyanerpes caeruleus</i>	Thraupidae			10						7					
Blue Dacnis	<i>Dacnis cayana</i>	Thraupidae			1											
Bananaquit	<i>Coereba flaveola</i>	Thraupidae	1													
Great Tinamou	<i>Tinamus major</i>	Tinamidae			1		1				1					
Variegated Tinamou	<i>Crypturellus variegates</i>	Tinamidae	1	3	1					2	1					
Cinereous Tinamou	<i>Crypturellus cinereus</i>	Tinamidae		1						1						
Undulated Tinamou	<i>Crypturellus undulates</i>	Tinamidae		3						7						
Gray-breasted Sabrewing	<i>Campylopterus largipennis</i>	Trochilidae		2												
Reddish Hermit	<i>Phaethornis ruber</i>	Trochilidae	8		1	3	2		8		1	4				
Eastern Long-tailed Hermit	<i>Phaethornis superciliosus</i>	Trochilidae		3	2		2				1					
Amazilia Species	<i>Amazilia spp</i>	Trochilidae			1						1					
Fork-tailed Woodnymph	<i>Thalurania furcate</i>	Trochilidae	2			2			1							
Blue-tailed Emerald	<i>Chlorostilbon mellisugus</i>	Trochilidae	1													
White-breasted Wood-wren	<i>Henicorhina leucosticte</i>	Troglodytidae	1	3	1	1	2	2			4	1				
Muscian Wren	<i>Cyphorhinus arada</i>	Troglodytidae									1					
White-tailed Trogon	<i>Trogon viridis</i>	Trogonidae	1		1	1	1		1		1	1				
Violaceous	<i>Trogon violaceus</i>	Trogonidae	1						1							

COMMON NAME	SCIENTIFIC NAME	FAMILY	WET SEASON						DRY SEASON							
Trogon																
Black-throated Trogon	<i>Trogon rufus</i>	Trogonidae	1		3					3	1					
Helmeted Pygmy-Tyrant	<i>Lophotriccus galeatus</i>	Tyrannidae	1	2	3	1	1		1	2						
Short-tailed Pygmy-Tyrant	<i>Myiornis ecaudatus</i>	Tyrannidae			1					1	1					
Zimmer's Flycatcher	<i>Tolmomyias assimilis</i>	Tyrannidae	5		2	4	4		5	4						
Olivaceous Flatbill	<i>Rhynchocyclus olivaceus</i>	Tyrannidae					2									
Yellow-bellied Elaenia	<i>Elaenia flavogaster</i>	Tyrannidae						2								
Tropical Kingbird	<i>Tyrannus melanocholicus</i>	Tyrannidae		2												
Whiskered Flycatcher	<i>Myiobius barbatus</i>	Tyrannidae		2	1	1					1					
Ochre-bellied Flycatcher	<i>Mionectes oleaginous</i>	Tyrannidae	1			1										
Cinnamon-crested Spadebill	<i>Platyrrinchus saturates</i>	Tyrannidae			3						1					
Golden-crowned Spadebill	<i>Platyrrinchus coronatus</i>	Tyrannidae		1												
Mc Connell's Flycatcher	<i>Mionectes macconnelli</i>	Tyrannidae				1										
Gray Elaenia	<i>Myiopagis caniceps</i>	Tyrannidae			2						4					
Yellow-throated Flycatcher	<i>Conopias parva</i>	Tyrannidae						2	2							
Tody-Flycatcher	<i>Todirostrum spp.</i>	Tyrannidae			3				3							

COMMON NAME	SCIENTIFIC NAME	FAMILY	WET SEASON						DRY SEASON							
Spadebill	<i>Platyrinchus spp.</i>	Tyrannidae	2		1				1		3					
Roufous-crowned Elaenia	<i>Elaenia ruficeps</i>	Tyrannidae										1				
Buff-cheeked Greenlet	<i>Hylophilus muscicapinus</i>	Vireonidae	6	2	2	2	2				2					
Slaty-capped Shrike-Vireo	<i>Vireolanius leucotis</i>	Vireonidae			2											
Total # of birds encountered in Wet Season							123									
Total # of birds encountered in Dry Season							95									
Total # of birds encountered (Both Seasons)							134									

KEY

TE – Terrestrial Transect

Op – Opportunistic Sighting

NT- Near Threatened (IUCN)

LC – Least Concern (IUCN)

V – Vulnerable (IUCN)

EN/MI – Endemism and Migrations Codes

GUI- restricted to the Guianas and adjacent Venezuela and Brazil

AMN – Restricted to Amazonian (and Guianan) lowlands north of the Amazon.

Table 4: TRANSECT SPECIFIC RECORD OF BATS IN CONCESSION

COMMON NAMES	SPECIES	WET SEASON							DRY SEASON					
		TRANSECT LOCATION							TRANSECT LOCATION					
		T1	T2	T3	T4	T5	PGI Base Camp	Total	T1	T2	T3	T4	T5	Total
Parnell's Mustached Bat	<i>Pteronotus parnelli</i>	1		1	1	1		4		1	1	2		3
White-lined sac wing bat	<i>Saccopteryx bilineata</i>						1	1						
Free Tailed bat	<i>Eumops auripendulous</i>						1	1						
Dwarf Little fruit bat	<i>Rhinophylla pumilio</i>	1	5			5		11	1	2	1		1	5
	<i>Artibeus obscurus</i>								1					1
Woolly false vampire bat	<i>Chrotopterus auritus</i>								1		1			2
Hairy nosed bat	<i>Mimon crenulatum</i>								1	1				2
Fringe-lipped bat	<i>Trachops cirrhosis</i>										1		2	3
Common long tongued bats	<i>Glossophaga soricina</i>	1			1			2		1	3			5
White throated rounded eared bat	<i>Tonatia silvicola</i>								1	1	1			3
Gnome fruit eating bat	<i>Artibeus gnomos</i>									1	1			2
Silky Short-tailed bat	<i>Carollia brevicauda</i>	2		1	2			5		1				1
Seba's short-tailed bat	<i>Carollia perspicillata</i>		1		2	1		4		1				1
Macconnelli's	<i>Mesopylla</i>									1				1

bat	<i>macconnelli</i>													
Pale-faced Bat	<i>Phylloderma stenops</i>												1	1
Greater spear-nosed bat	<i>Phyllostomus hastatus</i>	2		2				4						
Bedentate Yellow-eared Bat	<i>Vampyressa bidens</i>	1			1			2						
Schulz' round-eared bat	<i>Lophostoma schulzi</i>				1			1						
Common Tent Making Bat	<i>Uroderma bilobatum</i>		1					1						
Greater Round Eared Bat	<i>Tonatia bidens</i>		2					2						
	<i>Artibeus spp.</i>					1		1						
Total Number of Individuals		8	9	4	8	8	2	39	5	10	9	1	4	29

Table 5: TRANSECT SPECIFIC RECORD OF AMPHIBIANS IN THE CONCESSION

COMMON NAMES	SPECIES	WET SEASON							DRY SEASON						
		TRANSECT LOCATION							TRANSECT LOCATION						
		T1	T2	T3	T4	T5	OPS	Total	T1	T2	T3	T4	T5	OPS	Total
Spotted Toad	<i>Rhaebo guttatus</i>	-	-	-	-	-	-	-	1	-	-	5	3	-	9
Werner's Toad	<i>Rhaebo nasicus</i>	11	1	-	2	3	-	17	2	-	-	-	-	-	2
Neotropical Giant Toad	<i>Rhinella marina</i>	5	-	-	2	-	-	7	6	5	4	15	13	8	51
Hoogmoed Harlequin Toad	<i>Atelopus hoogmoedi</i>	1	-	15	2	-	-	18	2	1	4	2	-	2	11
Pale Striped Amazon Poison Frog	<i>Ameerga hahneli</i>	2	-	4	-	-	-	6	1	-	2	1	-	-	4
Rocket Frog	<i>Colostethus sp.</i>	11	-	2	-	-	-	13	-	-	-	-	-	-	-
Lesser Treefrog	<i>Dendropsophus minutus</i>	-	-	-	1	-	-	1	-	-	-	-	-	-	-
Marbled Treefrog	<i>Dendropsophus marmoratus</i>	-	-	-	-	-	2	2	-	-	-	-	2	1	3
Giant Gladiator Treefrog	<i>Hypsiboas boans</i>	13	3	-	-	-	-	16	2	5	3	8	3	-	21
Troschel's Treefrog/Blue-Flanked Treefrog	<i>Hypsiboas calcaratus</i>	-	-	-	-	-	-	-	-	6	2	1	-	-	9
Many Banded Treefrog	<i>Hypsiboas multifasciatus</i>	-	-	-	-	-	-	-	-	3	4	2	4	-	13
Emerald Eyed Treefrog	<i>Hypsiboas crepitans</i>	-	2	-	-	-	-	2	-	-	-	-	-	-	-
Amazon Milk Frog	<i>Trachycephalus resinifictrix</i>	5	13	8	5	3	-	34	7	-	2	-	-	-	9
Oophagus Slender-Legged Treefrog	<i>Osteocephalus oophagus</i>	7	20	5	12	6	-	50	3	3	4	3	2	-	15
Manaus Slender-Legged Treefrog	<i>Osteocephalus taurinus</i>	1	-	-	3	-	-	4	2	-	2	1	2	-	7
Cayenne Slender-Legged Treefrog	<i>Osteocephalus leprieurii</i>	-	-	-	-	-	-	-	-	-	3	-	-	1	4
Giant Leaf Frog	<i>Phyllomedusa bicolor</i>	-	-	-	-	7	-	7	3	-	1	-	-	-	4
Tiger Leg Monkey Treefrog	<i>Phyllomedusa tomopterna</i>	-	-	-	-	3	-	3	-	2	2	3	1	-	8
Paradoxical Frog/Shrinking Frog	<i>Pseudis paradoxa</i>	-	-	2	-	16	-	18	3	6	14	1	17	-	41
Red Snouted Treefrog	<i>Scinax rubra</i>	10	25	4	3	-	-	42	3	10	2	4	7	-	26
Lutz's Thin-Toed Frog	<i>Adenomera lutzii</i> *	-	-	-	-	-	-	-	-	3	2	2	-	-	7
Peter's Thin-Toed Frog	<i>Leptodactylus petersii</i>	-	-	1	-	-	-	1	-	-	2	1	-	1	4
Knudsen's Thin-Toed Frog	<i>Leptodactylus knudseni</i>	-	-	-	-	3	-	3	-	-	2	2	1	-	5
Albina Surinam Toad	<i>Pipa aspera</i>	-	-	-	-	-	-	-	-	-	8	-	-	2	11
Rana Stefania De La Escalera	<i>Stefania scalae</i>	-	-	-	-	-	-	-	-	-	2	-	-	1	2

Groete Creek Carrying Frog	<i>Stefania evansi</i>	-	-	2	-	-	-	2	-	-	-	-	-	-	
Taylor's Glass Frog	<i>Hyalinobatrachium taylori</i>	3	-	-	-	-	-	3	-	-	-	-	-	-	
Total Number of Individuals		69	64	43	30	41	2	249	41	44	65	51	55	16	266
Species Richness		11	6	9	8	7	1	20	14	8	19	14	11	7	22

Table 6: TRANSECT SPECIFIC RECORD OF REPTILES IN THE CONCESSION

COMMON NAME	SPECIES	T1	T2	T3	T4	T5	OPS	Total	T1	T2	T3	T4	T5	OPS	Total
Glossy Shade Lizard	<i>Iphisa elegans</i>								1	1		1			3
Striped Root Lizard	<i>Leposoma percarinatum</i>	1				1		2	1	1	1				3
White-Striped Eyed Lizard	<i>Prionodactylus oshaughnessyi</i>	1						1							
-	<i>Bachia flavescens</i>									1					
Goldenscale Anole	<i>Anolis chrysolepis</i>								1		3	2	1	1	8
Slender Anole	<i>Anolis fuscoauratus</i>	2	3	1	2	1		9	2		2		1		5
Yellow-Tongued Anole	<i>Anolis nitens nitens</i>	1						1		1		1			2
Tree-trunk Anole	<i>Anolis planiceps</i>								1		1	2			4
Annulated Gecko	<i>Gonatodes annularis</i>									1	1				2
Bridled Forest Gecko	<i>Gonatodes humeralis</i>	1		1				2				1			1
Mendes' Gecko	<i>Gonatodes alexandermendesi</i>										2				2
Turnip-Tailed Gecko	<i>Thecadactylus rapicauda</i>		1					1				1			1
Brazilian pygmy gecko	<i>Coleodactylus amazonicus</i>												1		1
Amazon pygmy gecko	<i>Pseudogonatodes guianensis</i>										1				1
Common Leaf- Toed Gecko)	<i>Hemidactylus mabuya</i>			1				1							
Amazon Race Runner	<i>Ameiva ameiva</i>	7			3	20	5	35	2	3		2	17	4	28
Striped Forest Whiptail	<i>Kentropyx calcarata</i>	8	1	5				14	8	7	3	8	6	9	41
Whiptail Lizard	<i>Cnemidophorus sp.</i>									1					1
Neotropical Tree Agama	<i>Plica plica</i>	1		2				3	2			1			3
South American 'Chameleon'	<i>Plica umbra</i>								1			2	1	1	5
Black Spotted Skink	<i>Mabuya nigropunctata</i>					1		1							

Green Anaconda	<i>Eunectes murinus</i>						1	1							
Common Glossy Racer	<i>Drymoluber dichrous</i>		1					1							
Formosa False Coral Snake	<i>Oxyrhopus formosus</i>				1			1				1			1
Amazon Puffing Snake	<i>Pseustes sulphureus</i>					1		1							
Brown Vine Snake	<i>Oxybelis aeneus</i>					1		1					1		1
	<i>Erythrolamprus miliaris</i>								1						1
Aesculapian False Coral Snake	<i>Erythrolamprus aesculapii</i>					1		1		1					1
Velvet Swampsnake	<i>Liophis typhlus</i>					1		1		1					1
Cat-Eyed Night Snake	<i>Leptodeira annulata</i>							1							
Green Vine Snake	<i>Oxybelis fulgidus</i>							1					1		1
Filippi's Ground Snake	<i>Atractus favae</i>													1	1
Brown Sipo	<i>Chironius fuscus</i>									1					1
Tropical Flat Snake	<i>Siphlophis compressus</i>								1		1				2
Crowned False Boa	<i>Pseudoboa coronata</i>								1						1
South American Coral Snake	<i>Micrurus hemprichii</i>			1				1							
South American Lancehead	<i>Bothrops atrox</i>			1				1		1	2	1			4
Basin Worm Snake	<i>Typhlops minuisquamus</i>									1					1
	<i>Amphisbaena fuliginosa</i>													1	1
Yellow footed tortoise	<i>Chelonoidis denticulata</i>								1	1		1		1	4
Schneider's Smooth Fronted Caiman	<i>Paleosuchus trigonatus</i>									1	1	1			3
Spectacled Caiman	<i>Caiman crocodilus</i>	1	1	1				3		1	2	3			6
TOTAL		23	7	13	6	27	6	84	23	24	20	28	29	18	141
SPECIES RICHNESS		9	5	8	3	8	2		13	14	12	15	8	7	

Table 7: TRANSECT SPECIFIC RECORD OF TERRESTRIAL MACRO-INVERTEBRATES IN THE CONCESSION

U – Small numbers recorded, but not observed daily (uncommon)

F - Less than 5 individuals recorded daily (fairly common)

C - Observed between one to ten individuals daily (common)

A - Observed more than ten individuals daily (abundant)

[illegible]

Table 8: TRANSECT SPECIFIC RECORD OF FISH IN THE CONCESSION

FAMILY	SPECIES	COMMON NAME	WET SEASON						DRY SEASON						Total
			AQ 1	AQ 2	AQ 3	AQ 5	AQ 6	AQ 7	AQ 1	AQ 2	AQ 3	AQ 5	A Q6	AQ 7	
Acestrorhynchidae	<i>Acestrorhynchus falcirostris</i>	Dag fish	1	-	-	-	-	-	1	-	-	-	-	-	2
Alestidae	<i>Chalceus macrolepidotus</i>	Orange tail	-	-	-	-	-	-	-	-	-	1	-	-	1
Alestidae	<i>Triportheus brachypomus</i>		-	-	-	-	-	-	4	-	21	-	-	-	25
Anostomidae	<i>Leporinus arcus</i>	Kabushi	1	-	-	-	-	-	1	-	-	-	-	-	2
Auchenipteridae	<i>Ageneiosus inermis</i>	Dawalloo	-	-	-	-	-	-	-	1	-	-	-	-	1
Auchenipteridae	<i>Trachycorystes trachycorystes</i>	Boots	-	1	-	1	-	-	3	7	-	7	-	-	19
Auchenipteridae	<i>Trachycorystes galeatus</i>	Lock man	-	-	-	-	-	-	-	-	-	3	-	-	3
Cetopsidae	<i>Helogenes marmoratus</i>		1	-	-	-	1	-	-	-	-	-	-	-	2
Characidae	<i>Astyanax fasciatus</i>	Celebe	-	-	-	-	-	4	1	-	-	-	-	-	5
Characidae	<i>Brycon falcatus</i>	Silva	-	-	-	-	-	6	4	-	4	2	-	4	20
Characidae	<i>Hemigrammus schmardae</i>		-	-	-	4	-	-	-	-	-	2	-	-	6
Characidae	<i>Hemigrammus stictus</i>		7	-	-	-	-	-	-	-	-	-	-	-	7
Characidae	<i>Hyphessobrycon minimus</i>		8	-	-	-	-	-	-	-	-	-	-	-	8
Characidae	<i>Moenkhausia collettii</i>		4	-	8	-	-	-	2	-	3	-	-	-	17
Characidae	<i>Moenkhausia sp.</i>		-	-	-	4	-	-	-	-	-	-	-	-	4
Characidae	<i>Phenacogaster microstictus</i>		-	-	-	6	-	-	-	-	-	6	-	-	12
Characidae	<i>Poptella longipinnis</i>		-	-	-	2	2	-	-	-	-	2	-	-	6
Characidae	<i>Charax gibbosus</i>		-	-	-	-	-	-	-	1					1
Characidae	<i>Myleus asterias</i>		-	-	-	-	-	-	-	-	-	1	-	-	1
Cichlidae	<i>Aequidens potaroensis</i>	Patwa	6	-	7	6	6	11	7	-	7	-	-	2	52
Cichlidae	<i>Crenichla saxatallis</i>	Sunfish	-	-	-	-	1	-	3	1	-	-	-	-	5

Cichlidae	<i>Cichlasoma bimaculatum</i>	Patwa	-	-	-	-	-	2	-	1	-	-	-	2	5
Cichlidae	<i>Acaronia nasso</i>	Patwa	-	-	-	-	5	8	1	-	-	-	-	1	15
Cichlidae	<i>Acaronia sp.</i>		-	-	1	-	-	-	-	-	1	-	-	-	2
Cichlidae	<i>Apistogramma sp.</i>		-	-	1	-	-	-	1	-	1	-	-	-	3
Engraulidae	<i>Anchoviella sp. 1</i>		-	4	-	-	-	-	-	4	-	-	-	-	8
Engraulidae	<i>Anchoviella sp. 2</i>		-	-	-	5	-	-	-	-	-	-	-	-	5
Engraulidae	<i>Anchoviella guianensis</i>		-	-	-	8	-	-	14	22	6	-	-	-	50
Erythrinidae	<i>Hoplias malabaricus</i>	Huri	2	-	1	4	-	2	10	-	1	4	-	2	26
Erythrinidae	<i>Hoplias aimara</i>	Himari	1	-	-	-	-	-	1	-	-	-	-	-	2
Erythrinidae	<i>Hoplerythrinus unitaeniatus</i>	Yarrow	-	-	-	-	-	-	2	-	-	-	-	-	2
Erythrinidae	<i>Prosomyleus rhombeus</i>	Kataback	-	-	-	-	-	-	3	-	-	-	-	-	3
Gymnotidae	<i>Electrophorus electricus</i>	Shocking eel	-	-	-	-	1	-	-	-	2	2	-	-	5
Heptapteridae	<i>Rhamdia quelen</i>	Kassie	-	-	-	1	-	-	-	-	-	1	-	-	2
Heptapteridae	<i>Brachyramdia heteropleura</i>		-	1	-	-	-	-	1	1	-	1	-	-	4
Lebiasinidae	<i>Nannostomus marginatus</i>	Patwa	-	-	-	-	-	4	-	-	-	-	-	1	5
Loricariidae	<i>Hypostomus watwata</i>	Smoke hassar	-	-	-	6	-	-	3	-	-	4	-	-	13
Pimelodidae	<i>Pimelodus blochii</i>		-	-	-	-	-	2	-	-	-	-	-	0	2
Pimelodidae	<i>Pimelodus ornatus</i>		-	-	-	-	-	-	-	1	-	-	-	-	1
Pimelodidae	<i>Pseudoplatystoma fasciatum</i>		-	-	-	-	-	-	-	1	-	-	-	-	1
Rhamphichthyidae	<i>Rhamphichthys rostratus</i>		-	-	-	-	-	-	-	2	-	-	-	-	2
Rivulidae	<i>Rivulus waimacui</i>		-	-	-	-	-	-	2	-	1	-	-	-	3
Sternopygidae	<i>Eigenmannia virescens</i>	Luga luga	-	-	-	1	-	-	-	3	-	1	-	-	5
Sternopygidae	<i>Eigenmannia sp.</i>		-	-	-	-	1	-	-	-	-	-	-	-	1
Sternopygidae	<i>Sternopygus macrurus</i>		-	-	-	-	-	-	1	2	-	-	-	-	3

Number of individuals	31	6	18	42	15	39	66	47	47	37	-	12	360
Number of family	9	3	5	11	6	8	21	13	10	14	-	7	45

Table 9: TRANSECT SPECIFIC RECORD OF AQUATIC MACRO-INVERTEBRATES IN THE CONCESSION

U - Small numbers recorded, but not observed daily (uncommon)

F - Less than 5 individuals recorded daily (fairly common)

C - Observed between one to ten individuals daily (common)

A - Observed more than ten individuals daily (abundant)

VERNACULAR NAME	ORDER	TRANSECT/ABUNDANCE STATUS WET SEASON						TRANSECT/ABUNDANCE STATUS DRY SEASON					
		AQ1	AQ2	AQ3	AQ5	AQ6	AQ7	AQ1	AQ2	AQ3	AQ5	AQ6	AQ7
Diving water beetle	Adephaga	C	C	C	A	F	U	-	-	-	-	-	-
Semi aquatic spider	Araneae	F	F	F	C	C	C	C	C	A	F	-	C
Scud	Amphipoda	U	U	F	F	C	C	-	-	-	-	-	-
Shrimp	Decapoda	A	A	A	F	U	C	A	A	A	A	-	-
Crab	Decapoda	F	F	F	F	-	C	-	-	-	-	-	-
Cray fish	Decapoda	-	-	A	-	-	-	A	U	U	-	-	-
Sand flies	Diptera	U	U	F	C	A	A	A	A	F	A	-	A
Mosquito	Diptera	U	U	F	C	A	A	A	A	C	A	-	A
Snail	Gastropoda	U	U	C	U	C	C	F	-	-	-	-	-
Water strider	Hemiptera	C	C	A	C	F	C	A	A	C	A	-	C
Semiaquatic woodlouse	Isopoda	-	-	-	-	F	U	-	-	-	-	-	-
Water boatman	Nepomorpha	C	F	A	C	U	C	-	-	-	-	-	-
Water stick	Nepomorpha	U	U	U	U	U	F	-	F	-	-	-	-
Water scorpion	Nepomorpha	-	-	-	-	-	-	-	F	-	-	-	-
Dragonfly	Odonata	U	U	F	U	U	U	A	C	C	C	-	A
Water beetle	Coleoptera	C	A	A	C	C	A	-	-	-	-	-	-
May fly larva	Ephemeroptera	-	-	-	-	-	-	-	-	-	-	-	-
Caddisflies	Trichoptera	U	U	F	C	U	U	-	-	-	-	-	-
Water Millipede	Polydesmida	F	U	C	F	U	U	-	-	-	-	-	-
Leech	Hirudinea	-	-	C	-	F	-	-	-	-	-	-	-

APPENDIX E: MINUTES OF MEETINGS

Date: November 15, 2013

Time: 10:30 h

Venue: EPA Boardroom, Ganges Street, Sophia, Georgetown.

Objective: To hold a sector scoping exercise for the Environmental Impact Assessment of the above-mentioned project, and to provide Sector Agencies with the opportunity to highlight concerns/comments/issues they may have regarding the project to be incorporated into the final Terms of Reference (TOR) for the ESIA Study.

EPA Representatives:

- Mrs. Teijvarti Persaud – SEO (M&F), Environmental Management Permitting Division
- Ms. Savitri Itwaru – EO 11 (M&F), Environmental Management Permitting Division
- Ms. Nalissa Persaud – EO 11 (M&F), Environmental Management Permitting Division
- Ms. Saudia Sadloo – EO 1 (M&F), Environmental Management Permitting Division
- Ms. Sharmin Joseph – EO 1 (M&F), Environmental Management Permitting Division
- Mr. Andrew Gupta – EO 1 (IIE), Environmental Management Permitting Division
- Dustin Roache – Intern (M&F), Environmental Management Permitting Division

Environmental Assessment Board (EAB) Representatives:

- Mr. Veetal Rajkumar – Chairman
- Ms. Bendita Lachmansingh – Member
- Ms. Denise Simmons - Member
- Mr. Omkar Lochan - Member

Representative from Pharsalus Gold Inc.:

- Mr. Ian Christie (Resident Manager)
- Mr. Michael O'Kelly – Representative from Troy Resources
- Jamie Altmann - Finance Manager

Representatives from ESIA Consultant Team from the Environmental Management Consultants:

- Charles Ceres – ESIA Lead Consultant

Representatives of Sector Agencies:

- Ryan Smith – Guyana Geology and Mines Commission
- Ndibi Schwieters - Ministry of Natural Resources and the Environment
- Steve Chichester - Ministry of Health
- Jagdesh Singh – Guyana Forestry Commission

Representatives of Non- Governmental Organisation:

- Colin Klautky – Guyanese Organisation of Indigenous People (GOIP)
- Peter Persaud – The Amerindian Action Movement Of Guyana (TAMOG)
- Laura George – Amerindian People Association (APA)

Minutes

The Sector Agency Scoping Meeting for Pharsalus Gold Inc. Proposed Gold Mining project was held in the EPA Boardroom located in Ganges Street, Sophia, Georgetown. The meeting commenced at 10:35 h.

The Chairperson, Mrs. Persaud began the Sector Scoping Meeting by giving her opening remarks, welcoming and thanking all the Sector Agencies and Non Governmental Organizations for attending the Sector Scoping Meeting for Pharsalus Gold Inc. proposed Gold Mining project. She explained the mandate of the Agency and the role in authorizing projects by stating that the

Company is required to conduct an Environmental Impact Assessment (EIA) and as such this meeting is a part of the EIA process as stipulated in the Environmental Protection Act.

She proceeded to give a brief background on the project, and the stages it had completed in the Authorization process. She indicated the purpose of the meeting was to provide an opportunity to hear the issues/comments /concerns the Sector Agencies and Non Governmental Organisations would like to see incorporated into the Draft Terms of Reference (ToR) for the study.

The Chairperson introduced the members of the Head Table and proceeded to invite Mr. Christie to give a brief outline of the proposed project. Mr. Christie thanked Mrs. Persaud and began by acknowledging the presence of his two colleagues, Mr. Michael O'Kelly who was appointed Project Manager for the development of the **cabinet** phase of the project and Mr. Jamie Actmann newly appointed Finance Manager present in Guyana.

He indicated that Pharsalus has been in existence for nearly five (5) years. Over this period of time, it was supported by an Australian listed Company called Azimuth Resources Ltd. and up to the end of 2013 the Company spent nearly USD 45 million for a detailed expedition in the Black Water Creek Kaburi concession area. At this time Troy Resources expressed its interest. Troy has a long history in Australia and more recently in South America for more than a decade. In South America, they have three mine operations, two in Brazil, one of which is closed and the other is still in operation at the Arenas Para State, and a new mine which has recently developed in Argentina near San Wain, a very successful underground mine and growing in scope. Mr. Christie concluded by extending his appreciation for the opportunity to speak to Sector Agencies and NGO's present.

Before proceeding, the Chairperson acknowledged the presence of the Environmental Assessment Board (EAB) members, Mr. Veetal Rajkumar (Chairman), Ms. Denise Simmons, Ms. Benita Latchmansingh and Mr. Omkar Lochan, and highlighted the Board as an independent body established under the EP Act, 1996, to oversee the EIA process. They are responsible for reviewing the EIA documents separately from the EPA and to provide their recommendations to the Agency on whether the document is acceptable or not and whether the Agency can proceed to grant Authorisation. If acceptable, they would recommend conditions to be included in the Environmental Authorisation.

The Chairperson invited Mr. Ceres, the lead consultant, to present the strategies or approaches his team will take to commence the ESIA Study. He thanked, Mrs. Persaud and proceeded to explain that the environmental issues cannot be discussed in a vacuum since the assessment was not conducted and requested that Mr. Christie elaborate on the project description for the benefit of all before he proceeded to highlight the Environmental Impacts.

Mr. Christie then gave a brief description of the proposed mining project in relation to the location, lifetime, projected production of the project and number of staff that will be employed, Mr. Christie expanded his presentation to include the preliminary work, mining operation and components, stages in ore extraction and processing facility, mineral processing, gold refinery and tailings. Subsequently, Mr. Ceres proceeded to present the approach his team will take to conduct the ESIA. He highlighted that the ESIA will be done in accordance with the EPA guidelines for mining projects, such as how data will be collected, the legislative and regulatory framework that will guide and govern this project along with several national and international guidelines that will also be adopted. He proceeded to explain some of the potential impacts and possible mitigation measures that will be identified in the Environmental Management Plan document and the manner in which the study will be undertaken and compiled.

The Chairperson thanked Mr. Ceres for his presentation then proceeded to invite representatives from various sector Agencies to make any suggestions and comments on the project, as well as any issues or concerns they may have.

Questions/Comments/Suggestions

1. Colin Klautky elected spokesman for Guyanese Organisation of Indigenous Peoples stated that the reforestation plan is credible because this concept is till new to indigenous Communities in Guyana. However, for Region 7, he indicated that the Chairman, Mr. Bradford, would be the best person to give a general overview of the roads. He indicated that the road between the airport and Bartica is unusable, only tractor can get there, so he is assuming that Pharsalus will have incorporated responsibilities for maintenance. Most of time there is little obligation from Companies regarding the maintenance of the roads.

Mr. Christie – Resident Manager Pharsalus responded to this statement by stating that it is unlikely that the road will be used at Bartica. The Company would more than likely consider the Sharima crossing through Linden or the old Omai mine crossing. The interaction with Bartica on a long-term basis will exist; however, he indicated the Company will work with in collaboration with the Ministry of Transport and other entities regarding the Access Road. Mr. Christie

further elaborated that the Company's strategy for the importation of the project components including mills and large construction items, has been directly transported to Linden and trans-shipped from there. It will be easier for the boat men to operate and maybe at this stage the Company can have similar importation with a bus station and a customs officer at Linden specifically for this project. He indicated that the Company currently uses small fuel tanks from Bartica, but this will change in the future because of plans to source fuel from Linden.

2. **Peter Persaud - Amerindian Action Movement of Guyana** extended well wishes to the Company and stated the Company's name is not clear to him because the name Pharsalus and Troy is used in the document. He would like the Company to specify its name in the Document.

He further queried, how this project will affect the Guyana's Low Carbon Development Strategy (LCDS) in terms of deforestation? Also in terms of the preliminary work, the Amerindian Act was mentioned, this Act he stressed is a legal and very important document that governs the Amerindian people and Communities, however, his position on this is that the Company should respect the Act at all times.

Additionally, he indicated that the summary pointed out that during the construction phase, 420 persons will be employed and the number will increase at the other phases. He further pointed out that it is important to note that the mine is 30 km from the Kaburi Village and what will occur is that employees will move into the villages. In this regard, it is important for the Company to have strict rules and regulations for employees to have respect for village rules, its members, ways of life and the Amerindian Act.

In terms of water quality, customary and cultural activities of the people also should be respected. He highlighted that the Community depends on the Kaburi River and queried if mining affects the waters and, if so, regular testing should be done for sedimentation and other qualities to ensure that the Kaburi people are safe.

Also it was mentioned in the document that there are no archaeological sites, however, during the Company's continued exploration should any archaeological sites be encountered the Walter Roth Museum should be contacted. He further queried if the Company made contact with the museum to find out if studies were done regarding this site.

In terms of building Community relationships, he humbly suggested regular meetings with the Company and Village Council and Community so as to hear how the project is affecting the people of that Community. He further suggested that the Company highlight its plans or programme in terms of assistance for the Village. Additionally, he added that since there is a scholarship programme, the Amerindian Village not far away from the mine should be the focus.

3. **Amrita Thomas - Regional Vice Chairperson, Region 7** stated that she is in support of the first speaker in terms of the positive impact and appreciate these types of development.

She indicated that it is good that this EIA will be done before the project begins. However, she appealed to those working on the assessment, that at the end of the assessment, both the positive and the negative impacts on the environment should be presented. If the negative impacts outweigh the positives ones, there is no way this project should be given the go ahead. She indicated that she wants to see the assessment and to weigh the positives and negatives, if it balances the project can go ahead.

She further highlighted that it was mentioned in the document that the mine site is not located far from the Community and that the place is not suitable for agriculture however, even though it is not suitable for agriculture, this is the way of life of the people and it is different from the coastal area. The people use the area as hunting grounds, fishing grounds and agricultural purposes and also depend on the forest for medicinal plants.

Additionally, she indicated that the consultant mentioned that corridors would be created for the animals and was unaware if animals can listen and determine whether to not go there or go there. She stressed for this to be considered and the risk management and how possible this can be. She also recalled the Omai spill and queried what was done about it and if the country is currently capable and prepared to deal with a spill if one should occur.

She stressed that she wanted to hear from the people of Kaburi if they agree and that she is happy for the scholarship programmes that are being promised. There is the need to upgrade the people. She further informed the meeting that

Indigenous peoples have their ways of assessing their lands; their land use policy is different from the Government's land use policy. There should be a mechanism where both can teach the other how to use the land.

She further expressed gratitude for being part of the discussion and requested further that the Community be visited. She informed the meeting that an assessment should be done at Kaikan Arau area since it's heart breaking that miners Guyanese, Venezuelan and Brazilians have established their businesses and the social and environmental impacts are terrible especially coming down the banks of the river. The people living there are dumping their garbage in the river and this water is used for drinking and cooking purposes. She also indicated that they are also dumping human waste into the water and requested a visit be conducted by the relevant agencies and can work along together.

4. Mr. Rajkumar – Chairman of EAB, stated that mention was made of the access road and what to know what would be the length of the Access road.

Mr. Christie – Resident Manager Pharsalus responded if the Company is able to gain access to the Amaila Falls project access road and then connect pieces from the mine site, it would be an average about 8-9 km.

Mr. Rajkumar - Chairman EAB questioned in relation to the Amaila road, if access is not granted by the Government of Guyana what will be the Company's secondary plan?

Mr. Christie – Resident Manager Pharsalus responded that the Company plans to rehabilitate the old Omai crossing road, and to use a section of the Amaila falls road highway which is an upgrade of the old Amaila access road. If they are not granted access, the parallel access that already exists will be the project's road which would be total loss of infrastructure. The Company hopes to have a negotiation with the Government to financially assist with the maintenance of the said road or perhaps the Company can maintain the turn off point of the road up to the mine at no cost of the government.

Mr. Rajkumar - Chairman EAB enquired how the discussions are going with the Government.

Mr. Christie – Resident Manager Pharsalus responded it has been very difficult given the number of Agencies involved.

Mr. Rajkumar - Chairman EAB also requested elaboration on the Community Compensation package as was mentioned on page 17 in the Draft Terms of Reference (ToR).

Mr. Ceres - ESIA Consultant indicated mention was never made of this and would have an Emergency Response Compensation plan or a spill Contingency Plan to put in place to compensate the community for any spill. Compensation would only be offered in an event of a spill.

Mr. Rajkumar - Chairman EAB thanked Mr. Christie and Mr. Ceres for their corrections on this matter and proceeded to enquire other than the nursery was there any consideration for other benefits to the Community?

5. Mr. Christie – Resident Manager Pharsalus mentioned that the focus of the Company is to support the local Communities with medical facilities, education and improve lifestyle. What the Company would have been delighted for is if the members of the two communities had skills that would be of benefit to the Company, but it is recognized that this is not the case. Clearly, mining requires basic literacy skills, knowledge to deal with machinery, chemicals, safety issues; be able to read signs, in this regard, education is important. That is where the Company would hope to work along with the Communities to make sure they get educated so they would have the potential to be employees at the operation. The Company will also like employees to operate in a safe manner so it will be assisting the Community by engaging with them with basic needs such health and water quality and electricity.
6. Mr. Rajkumar - Chairman EAB enquired for clarity if the Community is 30 km or 80 km away from the mine site. Mr. Ceres responded that it is 30 km.

Mr. Rajkumar - Chairman EAB further enquired if anyone knows the population of this Village.

Mr. Christie – Resident Manager Pharsalus responded he this it is an average about two hundred (200) people.

Mr. Ceres responded that his team is currently collecting social economic data from the Community and will go into each settlement to compile the data and issues affecting the population for the ESIA study.

Mr. Rajkumar – Chairman EAB wanted to advocate interaction with the Mining School since it was recently established and curriculum is currently being developed.

Mr. Christie - Resident Manager Pharsalus responded certainly there will be persons from different backgrounds attending the school, so training will offer employment and ideas of mineral processing and specifically mine exposure. The Company is working along with two other mining Companies; Guyana Gold Fields and Sand Spring Resources, so as to ensure there is no duplication of efforts at the school. The Company would also like for the training to reflect personnel needs in the fields, so when a student comes onboard, students graduates have a practical understating of programme and what happens on the mine site.

7. Mr. Jagdesh Singh - Guyana Forestry Commission indicated he was pleased that the Company is considering an alternative access road if they are not granted permission to use the Amaila Road by the Government. He highlighted that the GFC was interested to see a reforestation plan in the ESIA and most importantly the species commonly used is the Acacia for mined out site.

In this regard, since the Company's license overlaps two large concessionaries Vitarna and Toolsie Persaud (Interior Forest Investment) in terms of the operation, the GFC would like to see in the ESIA a complete plan of how clearing of the concession will be done in collaboration with GFC.

8. Dr. Latchmansingh - EAB Member queried about the Company's Plans in terms of First Aid.

Mr. Christie – Resident Manager Pharsalus responded that the Company plans to have a trained paramedic on a 24 hour basis.

Dr. Latchmansingh – EAB Member further enquired about the Company's plans for medical evacuation and how will this be done?

Mr. Christie- Resident Manager Pharsalus responded by indicating evacuation will be done by helicopter; it would take 15 minutes to Timehri with the helicopter and with approval of the airstrip by the Government, that is also another alternative way of emergency or medical evacuation.

Dr. Latchmansingh - EAB Member also inquired whether medical supplies would be provided to the Community.

Mr. Christie Resident Manager Pharsalus responded that protocol would have to be established and put in place to deal with such emergencies for the Kaburi Village.

- 12 Ms. Simmons - EAB Member, thanked EPA for the session and highlighted that they would usually receive Terms of Reference which are general and these sessions bring out a lot of information. She reviewed the study area and notes that page 18 of the ToR indicates the area at 14 Miles, Issano to be a transient Community. She queried how this issue will be dealt with.

Mr. Christie – Resident Manager Pharsalus responded that for the logging concessions, they have indicated to GFC and they have already provided the names of the concessionaries owners. The Company has engaged them and they already have indicated that there are no commercial timbers available to be felled in the area; this will be communicated to GFC.

In terms of 14 Miles, Issano, GGMC has to deal with this matter, this is their responsibility. The Company is engaged in a number of discussions about how to micro-manage the operation and how the area can be made available to the Company and will assist in whatever way possible.

Ms. Simmons – EAB Member also highlighted that the ESIA would require some details on the assessment of the impacts of the construction and operation of the airstrip and also an assessment of an emergency should an accident occur.

She also informed the meeting that there was also a biological survey that was done in 2012, that indicated the number of commercial species existing in that area. An assessment would also be required to give an overview if there were species of importance in that area since there are indigenous people living in that area. In addition, she thinks that the areas that need to be visited should be agreed upon in conjunction with the scoping to be held the following day at Kaburi.

15. Steve Chichester – Ministry of Health indicated that the Ministry's concern is the monitoring of water quality. He recommended that the Company should have regular testing of water quality in rivers for domestic purposes so as to determine if there are any releases of chemicals in the water and to share the information with the Agency.

Mr. Ceres – ESIA Consultant mentioned that this will be covered in the ESIA for water quality testing on site.

16. Mr. Christie – Resident Manager Pharsalus mentioned for clarity that Kurakaburi River is not part of the mining license, however, Black Water Creek flows through the area of the project, and part of the extensive EMP, the Company will test all water flows emanating from the mine including pit water and monitoring will be done 24/7 throughout the mine life.
17. Mrs. Persaud – Chairperson also indicated to the gathering that if the project is approved and a Permit is issued to the Company, they will be required to conduct a monitoring regime to be submitted to the Agency for review and scrutiny.
18. Laura George – Amerindian People Association recommended two consultations points:
 - She encouraged the Company, the EPA and other companies to have Community consultations with the Community to present both the positive and the negative impacts of this project on the environment, since only the positives are presented on strongly. In addition, many of the Communities are blinded by the positives because these are stressed on more than the negatives in terms of long term effects on the environment.
 - A power point presentation where similar work that was done can be highlighted. Indicate what were the impacts and effects on the environment and mitigation plans for the impacts so that other Communities can have a better understanding of the process and its effect on the environment. She recommended that the Company should sponsor a site visit showing the entire operation process so there is more informed awareness to make decisions.

She further enquired how the project is going to impact the small and medium scale miners in the area. Since pressure is on the small scale miners especially Guyanese not to use mercury and is given minimal support by the Government. Therefore large-scale mining projects are more economically friendly and better than small and medium scale mining. She stated that there is a rush to utilize the country's resources looking at the conventions and protocols that Guyana is a signatory of and still there is no strategy to deal with small, medium and large-scale mining, be it legal or illegal and the impacts.

In addition, she informed that Guyana is one out of the five countries in the world to have fresh water resources and speak of these impacts on the environment, water pollution and soil, so she expressed her concern as to why the Country was still authorizing large projects. There is need to look at the benefits on native and non-native Communities.

19. Mr. Smith – Guyana Geology and Mines Commission enquired on the potential impacts on surface water; could the Company say how comprehensive would the water quality variance and related parameters be? He also enquired of plans for top soil preservation?

20. Mr. Rajkumar – Chairman EAB had two recommendations to be included in the ESIA :

- A reforestation plan in the ESIA; and
- A compensation package for the Community directly from the developer.

Mr. Ceres - ESIA Consultant responded that compensation would only be rewarded in an event of a spill.

Mr. Rajkumar – Chairman EAB responded that he is not speaking directly of environmental implications but some sort of benefit sharing.

21. Dr. Latchmansingh – EAB Member enquired what plans are in place for sewage treatment.

Mr. Ceres – ESIA Consultant responded that the ToR mentioned the sewage treatment plan but the ESIA document will explain how sewage would be treated and also solid waste management.

22. Steven Chichester- Ministry of Health enquired if the Agency ever conducted water testing?

Mrs. Persaud - Chairperson responded that yes there is a requirement for Companies to do water testing within specific reporting periods and that there is a list of parameters that is very detailed.

Mr. Ceres – ESIA Consultant also indicated EPA has ground and surface water parameter, but it does not include cyanide but will use international standards to capture this parameter.

There being no further issues and concerns raised, the Chairperson expressed gratitude to the gathering for attending the Sector Scoping Meeting and concluded by updating on the preceding activities in the ESIA process as it relates to the project. The meeting concluded at 13:40 h.

Pictures



Picture 1 and 2: Members of the Sector Agencies and NGO's at the Sector Scoping meeting.

Date: November 16, 2013

Time: 11:30 h

Venue: Kaburi Benab, Kaburi Village, Region 7.

Objectives:

1. To hold a scoping exercise for the Environmental and Social Impact Assessment (ESIA) for the above-mentioned project.
2. To provide stakeholders the opportunity to highlight concerns regarding the project to allow for the incorporation into the final Terms of Reference for the ESIA study.

Environmental Protection Agency's (EPA) Representatives:

- Ms. Teijvarti Persaud, SEO (M&F), Environmental Management Permitting Division
- Ms. Nalissa Persaud - EO II (M&F), Environmental Management Permitting Division
- Ms. Saudia Sadloo-EOI I (M&F), Environmental Management Permitting Division

Environmental Assessment Board (EAB) Representative:

- Mr. Veetal Rajkumar – Chairperson, Environmental Assessment Board
- Mr. Omkar Lochan – Member, Environmental Assessment Board

Guyana Geology and Mines Commission (GG&MC):

- Trevor Hurry – Mining Engineer
- Shevon Duguid – GIS Officer

Representative from Pharsalus Gold Inc.:

- Mr. Ian Christie – Resident Manager -Guyana.
- Mr. Michael Okelly – Representative of Troy Resources Inc.

Representatives from ESIA Consultant Team – Ground Structures Engineering Inc. (GSEC):

- Mr. Charles P. Ceres – ESIA Coordinator, Technical Team Leader

Attached list of Attendees from respective Communities:

Minutes

The Public Scoping Meeting for Pharsalus Gold Inc. proposed Gold Mining project held at the Kaburi Benab, Kaburi Village, Region 7, commenced at 11:30 h.

The Chairperson, Ms. Teijvarti Persaud welcomed and thanked members of the public for attending the meeting and remarked on the interest shown by the people in the activities surrounding the Village. She then proceeded to introduce the project and outline the steps for the project in the Authorisation process and indicated the current stage

of the project. She further defined what the ESIA study was about and what it is expected to be achieved in the study particularly to mitigate the impacts resulting from the project. She then introduced the members of the Head Table and indicated what their respective role in the proceedings relating to the project.

The Chairperson then invited Mr. Ian Christie to give a brief presentation on the Company background and proposed operation. Mr. Christie indicated that project was conducting exploration in the area particularly around the Hicks and Smarts area during the last five years and has proved the existence of a resource of approximately 1.6 million ounces of gold in the hard rock below ground. He further added that more recently, the parent Company of Pharsalus Gold Inc., an Australian Company called Azimuth Resources, has been taken over by another Australian Company called Troy Resources which are long-term gold miners starting in Australian and more recently focusing in South America and have existing mines in Brazil, Para State- Andorinhas, and San Juan Argentina called Casposa. He added that Troy Resources saw an opportunity to move into Guyana through the takeover of Azimuth Resources and has now moved to the permitting stage of the project. He highlighted the experience of the Company (Troy Resources) in Gold mining and working alongside Communities such as Kaburi and expects the corporate focus of the Company on local communities would not change and would be part of the development of the mine here.

Development of the project (what it entails)

He indicated that that the Company intends to import plant and equipment to establish a processing operation which would treat approximately 600, 000 tons of ore per year as stage 1. The expectance at this stage of the project would be in excess of 100, 000 ounces of gold per year. He further added that the initial project life is estimated at around 15 years, however, he expects that with further exploration within the immediate area considerable years could be added to the mine life.

He indicated the operation itself was fairly straight forward and entails the establishment of a number of shallow open pits as the Company initially plans to go to a depth of about 130 m; taking the hard rock from the small pits where the high grade gold sits at the moment. However, he indicated that in a few years the Company would be looking at more deep drilling to establish where the ore continues at depth and at that time they would explore the possibility of establishing an underground mining operation. However, the open pit operation is the present focus. He outlined the process and listed some equipment that would be used.

Construction phase

He indicated that the construction phase of the project is expected to commence in 2014, and involves the construction of the mine site infrastructure, upgrade of the access road, processing plant with ancillary processing plants, power house, dams for raw water and tailings, mess hall, camp facilities for up to 400 persons, workshops, electric switch room, gold room for smelting, offices, first aid building, on site laboratory for testing, security stations, and airstrip. He added that it expected that the project, from the time all approvals are completed, would take approximately 12 months to set up, as such, he hopes to commence operation in 2015. A sewage treatment plant would be established. Also the Company would work out with the Government of Guyana to use part of the Amaila Hydro Project access road to bring heavy duty equipment, consumables, and fuel to site. He indicated other upgrades that would be necessary for the operation and that mining itself would be carried out either by the parent Company, trained personnel or by contractors depending on what area are the best options. He added that there would be ongoing exploration on site to increase longevity of mine.

He outlined the mineral processing which is called carbon in leech and outlined what would entail especially as it relates to the use of cyanide. He also described the proposed plant to be established from ore to the pouring of the duray gold bars and the highest level of technology to be used in cyanide destruction. He added that the plant design is very simple and is used in hundreds of operations around the world and the technology is well proven and safe once the personnel are trained to the highest level.

He added that the gold would be shipped offshore for further processing while the government of Guyana would receive its 8 percent royalty agreement from the operation, i.e. using current gold price would be \$ 1300 US dollar per ounce as such, over the 15 year mine life the Government should receive approximately \$ 10, 000, 000 yearly. He outlined the employment situation which would include direct and indirect employment, contractors, etc. and that the Company would be joining with the New Guyana Mining School to develop specific curriculum courses such as mineral processing.

With regards to the Community, he highlighted that it is hoped that they could work on projects that would be of benefit to the Community and the Company. He added that the Company hopes to work with the Guyana Forestry Commission (GFC), to establish a nursery for hardwood timber and other species that the GFC would wish the Company to use for remediation of waste dumps and mine surfaces at the end of open pit operations; this has been a successful Community venture around the world and it is expected to work here. Another community project would be in the area of education since in mining literacy is necessary to read signs, write reports and understand operations, etc. The Company wishes to work with the Community, particularly with persons coming through the education system to improve its standards. The Company recognizes that it would have to partner with the government in this regard and also in the area of water and health issues as the Company hopes to extend its medical facilities to the Community. Other projects include assisting in the maintenance of the Community access road as part of the benefits that the Company can commit to it this point in time.

Mr. Shevon Duguid of the GG&MC was then invited by the Chair to outline the mining licence process of the Guyana Geology and Mines Commission and the Commission's role and responsibility in monitoring such operations after the licence would have been issued.

The Chair further requested of Mr. Christie to explain the site plan presented to which he gave a brief explanation. He noted the responsibility of the Company to report to the EPA on varying indicators.

The Chair then invited Mr. Charles Ceres, the ESIA Consultant to give an outline of the approach the study would take.

Mr. Ceres thanked the Toshao and Village for hosting the meeting and proceeded to outline the approach of the team in conducting the study. He indicated that the ESIA study would be done in accordance with guidelines established by the EPA of which there are several as such, the one that would be utilized would be the guidelines for mining. He added that there are three primary components of an ESIA: the environmental baseline characterization, the environmental impact assessment and the environmental impact assessment statement, which includes the environmental management plan and a plan to monitor the identified impacts, etc. He provided more details on each component and indicated that collection of such data inclusive of water quality, flora, fauna including fishes, air quality data, soils, slopes and topography began since 2012. He further indicated that collection of social data has already begun and would continue. He outlined the legislative framework that the project would have to comply with

both local and international. He then listed and explained some of the potential impacts that are expected by the project and some of the possible mitigation measures that may have to be employed by the Company especially for reclamation and that a risk assessment would form part of the study. The compilation would be a comprehensive document where the Community would have an opportunity to determine whether their issues were addressed.

The Chair then opened the floor to the Community for them to identify any other area they would like to be covered in the study.

Questions/Comments/Suggestions

The Chair then invited the attendees to raise any additional concerns they may have that should be included in the final terms of reference

1. Mr. Orin Whitehead – Businessman, 14 - Mile Issano – enquired as to what benefits the Company intends to provide to 14 Mile Community which is closer to the Company apart from benefits provided to the Kaburi Village.
2. Mr. I. Christie – Country Manager- Pharsalus Gold Inc. – Indicated that the 14 Mile Community is under the control of the GG&MC and that the Company has been in discussions with the GG&MC in the past six months regarding options that exist for the Community. At this point, the Chair interjected that the purpose of this session is to raise concerns/issues that can be studied and incorporated into the ToR for the study and that this concern is noted and would be included.
3. Ms. Patricia Chang-Yen – 14 Mile Issano – enquired as to whether the boundaries of the mining concession included the 14 Mile, Issano area.
4. Mr. I. Chrisite – Resident Manager- Pharsalus Gold Inc – indicated that the wider area that the Company applied for included the Smarts Area and the Hicks Area and the existing 14 Mile area and that the Issano Road would have to be realigned outside of the boundary Mining licence however, this is being addressed by the GG&MC as part of the processing for issuing of the Mining license.
5. Mr. Christopher Edwards – Representative – Kaburi Village – enquired as to whether the Company was a member of ICMM - International Council of Mining and Metals. Further, he added that there was mention of the project following the guidelines of the EPA and enquired as to whether the project would also be following the guidelines of Convention on Biological Diversity (CBD).
6. Mr. I. Christie – Resident Manager- Pharsalus Gold Inc, – indicated not to his knowledge however, that Troy's other operations are ISO 14001 certified as such is subscribing to other certifying bodies that are recognized world wide.

7. Mr. C. Ceres – also indicated that the operation would be IFC compliant which was missed in his presentation. He also added that the CDB was only one of the guidelines that the project would be following among others. He also added that the Social Scientist would be coming around to the Community to capture concerns.
8. At this point members of the 14- mile Issano Community enquired as to whether they would be going to 14 – Mile to conduct the same assessment and also requested that a meeting be held at 14 Mile Issano.
9. Mr. Reynold David (Toshao, Kaburi) – requested that the Company leave a map that clearly identify boundaries since there are residents of the Community who are involved in mining and are not sure if they are operating within their boundaries.
10. Mr. I. Christie – Resident Manager- Pharsalus Gold Inc. – indicated that he did not have the exact map however, would have the a map delivered.
11. Mr. Michael Wishart – Indicated that he visited the 14 Mile area after ten years and observed that there was a creek 12 km from Kaburi that now looks like a lake by the steel bridge where miners are working. He added that this would damage the forest along the creeks and enquired whether there was anything that could be done by the EPA since these areas forms part of their fishing and hunting grounds, to which the Chair indicated that further discussions on this issue can take place after the meeting however; focus should now be on concerns for the project.
12. Ms. Patricia Chang-Yen – 14 Mile Issano – enquired whether the project would include the whole Kaburi Creek and tributaries to it.
13. Mr. I. Christie – Resident Manager- Pharsalus Gold Inc. – indicated that the Kaburi Creek would be outside the boundaries of the concession and that the significant water body would be the Blackwater Creek apart from some minor water ways.
14. Mr. Reynold David (Toshao, Kaburi) - indicated that the Blackwater Creek flows back into the Kaburi. He added that the Kaburi is also known as the Mc Donald Creek which flows to west Kaburi, which forms part of the fishing ground and hunting ground as such, the Community would be affected. Further, he enquired whether the Company would extend their power supply to the Community once operational.
15. Mr. I. Christie – Resident Manager- Pharsalus Gold Inc – indicated that the Company would have to assess the potential and would work in collaboration with government and other agencies to provide either an independent power source or a line to hook the Community up. However, in his experience, this community is too far for a hook up as such the Company would work in collaboration with government to provide an independent source after a study is done. He committed to conducting a study of the situation.
16. Ms. Jennifer Edwards – Resident, 14 Mile Issano – enquired as to what would be the benefits for persons of the 14 Mile community once the project would have been approved especially since there are persons living there for over 20 + years and have businesses there. She enquired whether they would be relocated by the Company to an area where they can earn on the same scale. She added that the 14 Mile is a gazetted landing and that persons depend on their businesses to support their families. Further, she

enquired if the miners at 14 Mile would have access to the road to access their mining blocks. The Chair indicated that these questions would not be answered at this point but would be noted to be addressed.

17. **Mr. Gregory Charles – Agatash** – noted that during the time of Omai Gold Mines, there was no such meeting conducted. He further enquired as to what systems could be put in place for hiring to take place at Kaburi.
18. **Mr. I. Christie – Resident Manager- Pharsalus Gold Inc** — reiterated the need for education as was previously mentioned and the Company's support for the Local Government to enhance the educational system. He reiterated that modern mining requires a certain level of education and that the Company was willing to support the Community in bringing persons to that level before being eligible for employment in the mining industry. He added that preference would be given to persons at the entry level position whether for the operational or construction phase, once it is identified that they are certified tradesman. He pointed out that artisanal mining in Guyana has incurred many deaths due to unsafe mining practices and this would not be practiced in the Company. He also indicated that the Company would be employing a Community relations Officer in an effort to work with the Toshao and other senior members of the Community to facilitate the interactions and determine the protocols for working with the Community. Further, he outlined that the Social Scientists should be in a position to inform on the existing skill sets within the Community once the study is completed and provide that information however, the Company will not be hiring persons unless they have a basic level of literacy.
19. **Mr. Henk Wilkinson – Villager 14 Mile Issano** – enquired as to the possibility of hosting a meeting at the 14 Mile Issano area. The Chair indicated that such a meeting was not possible on the said day. However, it would be considered since the meeting was publicized which was further reiterated by Mr. Duguid of the GG&MC.
20. **Ms. Patricia Chang-Yen** – enquired as to what was the duration of the mine and would they be left in the state that Omai left the environment in. Mr. Christie indicated that one of the purpose of the meeting was to indicate awareness of the project and its plans.
21. **Mr. Gordon Bradford Region 7, Chairman** – welcomed the gathering and highlighted that during the experience with Omai, Bartica was in the forefront in that when the event unfolded there were no measures in place especially for safe drinking water. He further added that persons were not that educated and enquired as to how equipped the EPA is to handle such situations. He further stated that the Communities are dependent on the EPA for the testing of the water in an effort to protect them and ensure sustainability of the resources. He also pointed out the willingness of the region to collaborate with the EPA and GG&MC especially as it relates to water quality monitoring. He further implored the EPA to host a meeting at the 14 Mile Landing.

There being no further issues and concerns raised, Ms. Persaud expressed thanks to the gathering for attending the Public Scoping Meeting and concluded by updating the audience on the preceding activities in the ESIA process as it relates to the project including the role of the EAB. The meeting concluded at 13:30 h.

Pictures



Figure 1: shows a section of the Meeting at Kaburi



Figure 2 :Shows the Head Table

Date: December 05, 2013

Time: 11:30 h

Venue: 14 Miles, Issano Landing

Objective:

3. To hold a second scoping exercise for the Environmental and Social Impact Assessment (ESIA) for the above-mentioned project.
4. To provide stakeholders the opportunity to highlight concerns regarding the project to allow for the incorporation into the final Terms of Reference for the ESIA study.

EPA Representatives:

- Mrs. Teijvarti Persaud – SEO (M&F), Environmental Management Permitting Division
- Mrs. Sonia Gumbs – Luke – SEO (IIE), Environmental Management Permitting Division
- Ms. Saudia Sadloo – EO 1 (M&F), Environmental Management Permitting Division

Environmental Assessment Board (EAB) Representative:

- Mr. Veetal Rajkumar – Chairman
- Mr. Omkar Lochan - Member

Representative from Pharsalus Gold Inc.:

- Mr. Ian Christie (Resident Manager)
- Mr. Michael O'Kelly – Representative from Troy Resources.

Representatives from ESIA Consultant Team from the Environmental Management Consultants:

- Mr. Dexter Patterson
- Ms. Kean Chase

Representatives of Sector Agencies:

- Mr. Shevon Duguid – Guyana Geology and Mines Commission
- Mr. Vernon Underwood - Guyana Geology and Mines Commission

Minutes

The Second Public Scoping Meeting was facilitated at a Community Shop in 14 Miles, Issano Landing, on November 16, 2013. The meeting commenced at 11:30 hours with the Chairperson, Ms. Persaud, welcoming the members of the Community, thanking them for their presence and apologizing for rescheduling the meeting due to the weather and logistical arrangement that could not have been met.

The Chairperson proceeded by introducing the members of the Head Table. She further went on to highlight the mandate of the Agency, the purpose of the meeting, and informed attendees that the main focus of the gathering was to hear the concerns and issues that they may have on the proposed project. She proceeded to give a brief background on the project, and the stages it has completed in the Authorization process. The Chairperson further stated that concerns and issues identified at this meeting would assist in finalizing the Terms of Reference (ToR) for the Environmental Social Impact Assessment (ESIA) study.

Also, based on the previous meeting held at Kaburi Village Benab on November 16, 2013, one of the main requests arising from that meeting was for a meeting to also be held at 14 Miles, Issano.

Ms. Persaud then invited Mr. Duguid, GGMC Lands Management Officer, to present the steps involved to acquire a mining license from the Guyana Geology and Mines Commission (GGMC). Mr. Duguid stressed during his presentation that projects such as this one would not be issued with a mining license without the approval of the ESIA and issuance of an Environmental Permit by the EPA.

Mr. Christie was then invited by the Chairperson to provide a summary of the proposed project. He gave the history of Pharsalus and a brief description of the proposed mining project. In addition to the location, lifetime, projected production of the project and number of staff that will be employed, Mr. Christie expanded his presentation to include the preliminary work, mining operation and components, stages in ore extraction and processing facility, mineral processing, gold refinery and tailings. He thanked the persons for hosting the meeting at the shop and for coming out to raise concerns and issues that they may have regarding this project.

Ms. Persaud then invited Mr. Patterson (GSEC social consultant) to deliver his presentation on the overview of the ESIA study as it pertains to the project, and the manner in which it would be undertaken and compiled.

Subsequent to Mr. Patterson's presentation, the Chairperson invited the public to make enquiries, suggestions and comments on the project they may have.

Questions/Comments/Suggestions

1. **Mr. Sherwood Mc Calmon** made the statement that Cyanide is not an environmentally friendly substance for human health and the environment. He suggested that the Company should consider using an alternative method for the trapping of the gold because of his previous experience when the Omai spill occurred in 1996, in the Essequibo River, Demerara, and Potaro River; he was one of the persons affected.

He indicated that if cyanide is going to be utilized, he would appreciate if careful monitoring especially regarding the health of people could be conducted and systems put in place to prevent spills from occurring. He also questioned in the event of a spill what measures would be in place in order to mitigate the effects on the environment and how will persons affected be compensated?

2. **Philbert Alphs** indicated that he was speaking on behalf of the people at 14 Miles, Issano. He posed many questions he wanted to be addressed as follows:
 - What are the plans in place for the miners and shop keepers and people settling at this Landing?
 - How will the Community fish and hunt for food if the boundaries will be secured by Pharsalus Gold Inc.
 - What are the plans set aside for the Community?

He stressed that their concern was survival during the mining at Hick and Smart and their future existence in the area.

3. **Victor Manjat** stated that he was an old porkknocker and founder of the Issano village. He further stated that himself and others are prohibited from walking on the road, since the wardens from GGMC would stop them, from going to the Hicks/Smart project boundary. He stressed that this was their land and he is worried about the livelihood of his people, their survival and the environment. He gave an example of how the cyanide has made the lives of people impotent to produce children and would like the Regulatory Agencies and Company to look in to the welfare of the health of the people. He indicated that this could not have been done in other countries and be tolerated. He further queried when the Community will be able to use the access road?

He also wants to ensure that proper measures are in place once the Company is granted a license as it relates to the health and safety of the Community.

4. **Orin Whitehead** stated that he would like the shop keepers and the people living here remain to develop the 14 Miles, Issano Village. He stressed that they will remain here and will not relocate.
5. **Walston Bhoothoo** informed the gathering that the Community of 14 Miles are business people and there are many dredge owners and miners around the Community that depended on them as the Community depended on their business. He indicated that they have been doing business peacefully in this place for a number of years and was requesting the Company to consider benefit sharing between the Company and the community.

6. Rex Bumbury indicated that the Company was about to use Cyanide and queried about its safety rather than experiencing another spill like Omai to realize the consequences?

He indicated that lessons should be learnt from the Omai spill and that the ESIA should answer such questions and further suggested some techniques that could be implemented to curb the impacts. He stated that the technologies are always present however, persons responsible cannot guarantee health and safety, as failure is seen in every area of the Country. He further enquired should a spill occur, who takes the responsibility to represent the people and ensure that the effects are not as wide spread as was seen with Omai?

7. Simon Pharell highlighted that the Company was at the prospecting stage as such, does not have a licence and enquired whether the Community would be relocated once the Company is granted the licence. He also enquired as to whether the Community can have the issuance of the license to this Company revoked. Further, he enquired as to what were the Company's future plans. He highlighted that the proposed plant species to be used for the restoration process results in famine and El Niño. He added that the plant was used in Africa, Brazil and depletes the land, in addition, the shedding of its leaves results in fire and requested that more information be provided on this plant species.

Mr. Pharell informed the gathering that some of the members of the Community had lived there their entire lives, and queried as to the length of time it will take for the licence to be published or become valid. Further should embark on an underground operation, additional years will have to be added to the 15 years Permit. He asked how this was fair.

He indicated that the people of the Community did not want compensation and stressed that is not what they are looking for, and queried:

- What rights do they have over their lands?
- Relocation? Where will they have to move, where will they go?
- What will become of their lives when this is all they know of?

8. Patricia Chang Yuen queried if the project boundary includes 14 Miles. She indicated that the draft ToR states that 14 Miles is a transition Community and this is not true. She stressed that the Community has been in existence for 28 years and more, and development had occurred due to the persons residing here and requested to get the concept of a transition Community changed from the Project summary because this is not the case.

She further indicated that the project summary stated that a total of 300 persons will be employed. Of the 300, she queried what percentage are Guyanese and members of the local communities?

She informed the gathering that there were over 30 shops with families and employees, and queried the following:

- How do you intend to move us and where?
- What will happen? Many persons will be unemployed. These shops are their livelihood and the EPA needs to take this into consideration since our livelihood can be taken away from us.

She queried who was paying for the ESIA study. She indicated that if the Company was, then the Consultants are being controlled by the Company, then the ESIA will be tailored for the Company to get approval for the ESIA. She queried whether anyone has the Communities interest at hand. If this government wants this investment, you (EPA) are a part of the government, if they say yes, where do we the people stand regarding this decision?

Mrs. Persaud responded to her comment by stating that the Company is paying for the ESIA Study, however, despite this, the ESIA study has to be approved by the EPA. The Agency has to review the document as the Community along with the EAB. The approval of the document is not based on Pharsalus, it depends on whether the study complied with the Terms of Reference and EPA/International guidelines. Thus the importance of this meeting is to garner what it is that the Community thinks should be included in the draft ToR, before it could be finalised.

Mrs. Persaud stressed that when the study is completed and submitted to the Agency, it has to be reviewed by other experts. She further stated that the EAB has specialists on their team and that they are a body that was established

under the Environmental Protection Act to independently oversee the EIA process and review the document. In addition, the EPA developed guidelines of how the EIA should be conducted and how it should be prepared. The Agency is responsible for reviewing the document to ensure that it meets local standards and guidelines and where standards that have not yet been developed locally, international standards from the IDB or World Bank are adopted.

She further informed the gathering that the document will also be provided to the Community for review so that if there are any concerns or issues that were not addressed it can be addressed, in addition, the document goes through a series of review, it goes to GFC, GGMC, etc. At this point, Mr. Rajkumar indicated that the Community is one of the stakeholders that will be given the opportunity to review the document within 60 days to provide its comments and concerns to the Agency. The comments received during this period will be sent to the consultants for them to address in the revised document.

Mrs. Persaud further indicated that the EAB can hold a similar hearing to this one with the Community to garner issues/comments/concerns that were not addressed or captured in the document and have it addressed in the revised.

Mr. Rajkumar also shared that it comes back to the stakeholders involved. The persons who will be reviewing and commenting on the document are not only government officials and NGOs but the Community is involved. So it is not only the government perspective or approval that will be given but the multitude of stakeholders involved in the process. Mrs. Persaud indicated that the EPA cannot issue a Permit before an EIA study is conducted and approved because the EP Act, 1996, does not allow this to occur.

9. Henk Wilkinson stated that he is a resident and shop owner at 14 Miles and if the mine becomes operational they will have to relocate the landing because it is in the Company's interest. He requested the EPA to conduct an analysis on the Community of 14 Miles on this matter and to produce the report to the Community. He further indicated his reason for this request was based on the fact that the Community generates income, provides employment, and has a network with Bartica. The Company and the Government in considering relocation should provide the Community with strategies to benefit themselves and their dependents to ensure sustainability of livelihoods.
10. Goslyn Edwards stated that on behalf of everyone from the Community, they were all well aware that they will have to be relocated sometime or the other because of the drilling, the blasting and noise. However, they cannot be relocated to a non productive area given the Company's consideration for an additional 15 years of the mine life.

She indicated that office work did not pay as much thus the reason why the people are so concerned about the plans that Pharsalus has in place for their relocation. She further highlighted that the people understand that Pharsalus has all right to invest after their studies have been completed. The Community is not against the development for the Country however, the concern is related to the sustainability of their livelihoods particularly income. Many persons moved here years ago to invest and earn money at this Landing, as such it is requested that the Company conducts an analysis of the Community's investment in the area. labour, time invested while living here and take these into their consideration for this Community's relocation.

11. Henk Wilkinson queried if the Consultant team would be conducting an assessment of the 14 Miles, Issano Community? If yes when?
He further queried what measures would they have to undergo to make sure that a Community like this is not affected?
12. Philbert Aplhs queried should a license be granted, would it be a must for the people in the Community, around 14 miles, dredges, etc. be removed?
He recommended that if this is the case, the GGMC should take note of the dredge owners of this Community and provide alternative mining lands to work that will be viable.
13. Patricia Chang Yen queried if the road will be diverted from 9 Miles or will there be no road through this area or will a new access road be created?
She further indicated that the type of species (eucalyptus) that will be used to reclaim the area in Guyana is not the best choice.

Mr. Lochan responded by stating that before the species can be planted approval has to be granted by the Guyana Forestry Commission (GFC) and they are in the process of conducting a study of the species that are suitable when rehabilitating mine sites. Confirmation has to be granted by GFC for the type of species. Mrs. Persaud and Mr. Rajkumar also added that not only Guyana Forestry Commission grants approval also a Land Reclamation Committee that has been recently established would also have to give approval to the type of species. Mr. Rajkumar added that these are some of the things that will have to be revised and thanked her for highlighting the issue.

14. Allison Edwards stated that she is currently pursuing her studies in CAT and ACCA and is requesting that should the landing be relocated the Company should make arrangements to facilitate internet service for the Community especially for those that are dependent on the service.

There being no other questions or concerns raised, EPA thanked the members of the public for attending the meeting and outlined the next steps of the project. The meeting concluded at 13:45 hours.

Pictures



Picture 1: shows the members of the Head Table at 14, Miles Issano



Picture 2 and 3 shows the Head Table and the members of the communities at 14 Miles, Issano.

FINAL TERMS OF REFERENCE

**FINAL TERMS OF REFERENCE
ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT
PHARSALUS GOLD MINE
FOR
PHARSALUS GOLD INC**

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1.0 INTRODUCTION

Pharsalus Gold Inc. (PGI) holds gold mining rights to several contiguous properties, acquired by vendor agreements and direct grants, totaling approximately 1100 km². The property is centered near the Iron Bridge, crossing over the Main Kaburi River approximately 12 km along the Issano Branch Road and approximately 160 km southwest of Georgetown, Guyana and 37 km northwest of the former Omai Gold Mine. The property consists of several Medium Scale Prospecting and Mining Permits, Small Scale Claim Licenses, Large Scale Prospecting Licenses and existing Mining Licences issued under the Mining Act, 1989 and the Mining Regulations thereto. The area is located generally in the Karouni area of Mining District No. 3 as shown on Terra Survey Topographic Sheets 36SE and 36SW at a 1:50,000 scale. The extent of the area held by PGI is depicted in Figure 1.

The Concession and immediately adjacent areas have supported mining activities for over one hundred years. These activities have been related primarily to the recovery of gold and diamond by open pit workings of alluvial deposits. Several of these operations continue within the limits of the Concession and within proximity of the Concession boundaries. These operations include White Hole Kaburi, Cornfield, El Dorado, Nine Mile, Smarts, & Milo Camps and Honey Camp. These operations have spawned the development of a community within the contiguous properties at 14 Mile Issano which predates granting of the mining rights to PGI. 14 Mile Issano has been in existence for 28 years and several individuals reside and operate businesses in the community.

In order to develop and operate the Mine Project, PGI will require a new Mining License issued by the Guyana Geology and Mines Commission (GGMC). A mandatory requirement for the issuance of the Mining License is the conduct and submission of a feasibility study for approval by the GGMC. By law governing mining and environmental protection, the GGMC mandates that the feasibility study must include an Environmental and Social Impact Assessment (ESIA) which must be developed in accordance with the Guyana Environmental Protection Agency (EPA) Environmental Permitting and EIA Process.

The EPA's environmental permitting and EIA process has several steps. The first step is the submission of an EIA application to the EPA. The second step is the submission of the Terms of Reference (TOR) detailing the extent of the ESIA study and the likely environmental and social impacts associated with the proposed action.

Subsequent to the submission of the draft TOR, the EPA will facilitate a Public Consultation Process to inform the general public of the project and to hear their views and concerns regarding project development and implementation. Concerns and issues raised at this process will be incorporated into the final TOR to be approved by the EPA. The ESIA study conducted will reflect the requirements of the approved/final TOR.

Following the submission of the draft ESIA study, the EPA will facilitate a public review of the study document. During this time the Environmental Assessment Board (EAB), a statutory board established under the Environmental Protection Act, 1996, to manage and oversee the EIA Process, will determine whether or not a public hearing on the draft ESIA study is required. Subsequent to the public review, the EPA will determine whether or not to grant Environmental Permission for the project to proceed.

The Final TOR, detailed herein, has been prepared to identify the principal environmental and socio-economic concerns and other matters related to the operation of the Pharsalus Gold Mine. This TOR which details the proposed methodology for performing the ESIA study also has been modified to be responsive to comments received from both the Environmental Protection Agency and the Environmental Assessment Board. Additionally the final TOR is responsive to issues identified at sectoral and public scoping meetings.

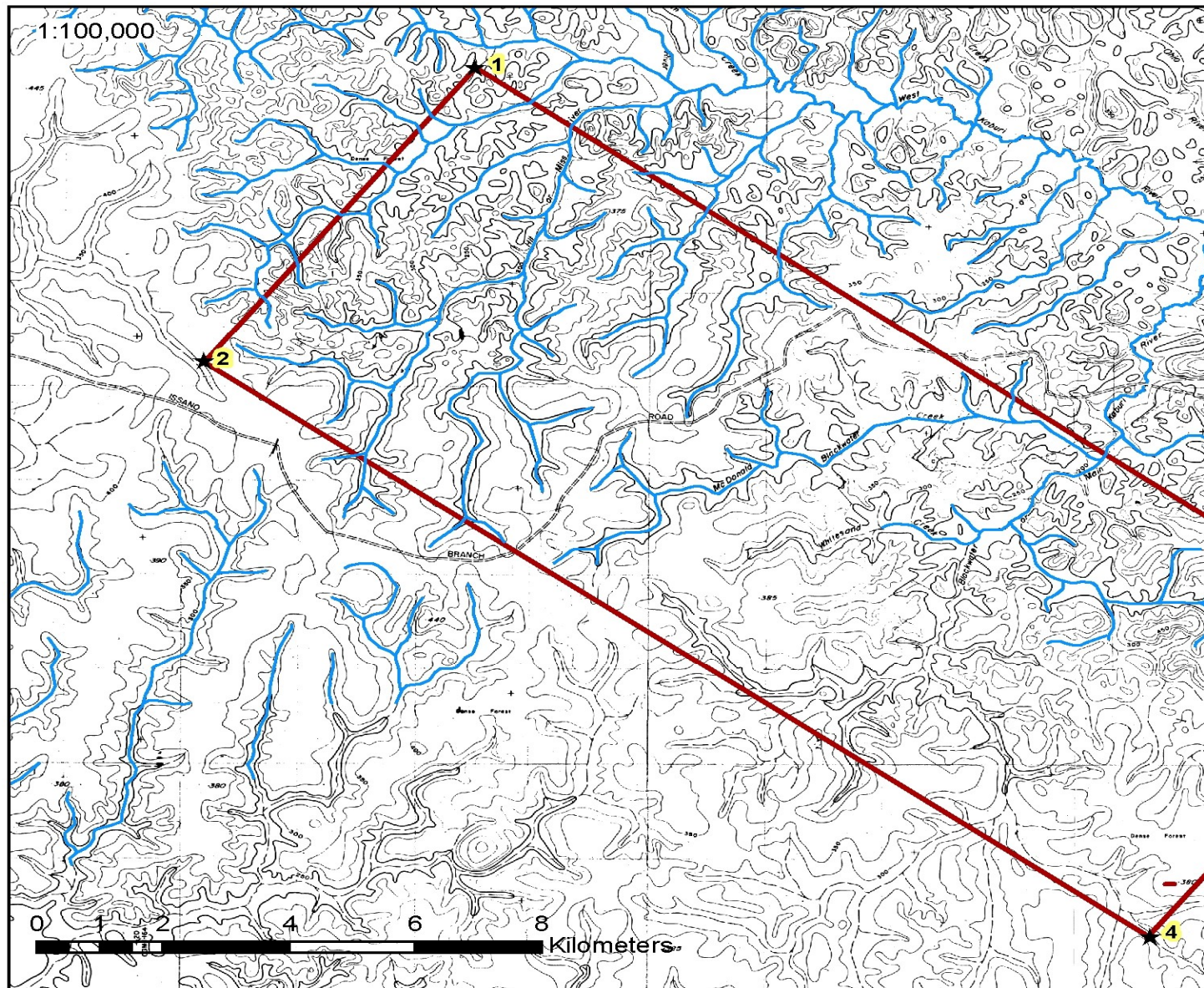


Figure 1 - Extent of Area for Proposed new Mining Licence for Pharsalus Gold Inc.

2.0 DESCRIPTION OF PROPOSED OPERATION

The mine will be focused on the recovery of ore for processing from Smarts and Hicks gold deposits depicted in Figure 2. The area is part of the area acquired by vendor agreements and direct grants to Pharsalus Gold Inc., a wholly owned subsidiary of Azimuth Resources Limited, which in turn is a wholly owned subsidiary of Troy Resources Ltd. Project components include an open cut mine, processing plant, tailings storage facility, mine site accommodation and additional infrastructure required to recover and to process ore for the recovery of gold.

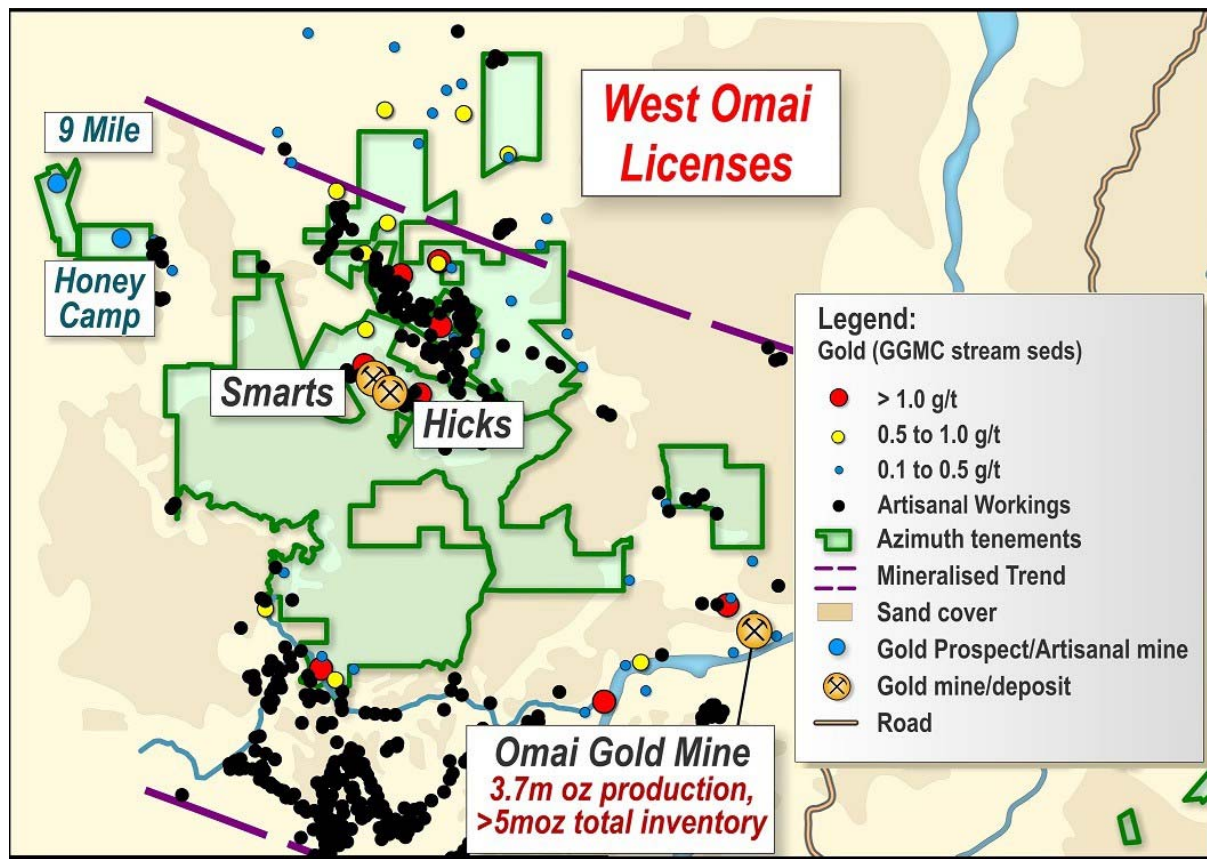


Figure 2 - Location of Smarts and Hicks Deposits in Relation to PGI Concession

Development and operation of the mine site will involve several distinct phases. These phases will include the following:

- Relocation and resettlement of the community at 14 Mile Issano
- Construction of mine site infrastructure and upgrade of mine site access road
- Construction of a process plant
- Staged construction of tailings storage facility

The mine site will be accessed by crossing the Essequibo River at either Butakari or at Mango Landing. The Butakari crossing was developed as part of the Amaila Falls Access road infrastructure while Mango Landing was created for access to the former Omai Gold Mines. Use of either of these crossing will provide access along existing roads to 14 Miles Issano, located within the PGI concession. The 14 Mile Issano itself is located within the footprint of the operational mine site and must be relocated for work to commence on mine site infrastructure installation.

Electricity for mine site operations will be provided by a series of diesel-fired duty generators plus back up units to enable start up and allow for units off line for maintenance and repairs, each of which will be modular complete with acoustic enclosures and cooling systems. Subject to final installed plant requirements, the power station is expected to operate with 7 generator sets, with 1 available for operation on standby and 1 under maintenance. A tank farm will be constructed onsite to serve as the primary fuel storage facility and fuel will be transferred to a day tank for electricity generation when required.

The mine site infrastructure will be enclosed within appropriate security fencing. Site infrastructure buildings within the security fence will include the following:

- Food servery and messhall
- Process plant office
- Plant workshop and laboratory
- Warehouse, spare parts storage areas and plant consumables storage facilities
- Process control room
- Electrical switchrooms
- Gold room

Site infrastructure buildings will include the following:

- Administration office
- Kitchen and messhall
- First aid building
- Security, laundry and change room

Elements of the project will be constructed concurrently. During all phases of project development, construction and in the future operation, workers will be housed in on-site accommodation. Medical and other facilities will be provided at the mine site for the efficient functioning of the workforce. These facilities will include fresh water and drinking water sources, and water treatment and waste management facilities. The schematic layout of the mine site is shown as Figure 3.

Most of the site infrastructure buildings are expected to be located within appropriate security fencing, with the tailings dam embankment located in the valley adjacent to the plant site, 20 m below plant level. Any water courses flowing across the mine pit footprint will be diverted around the mine pit.

Raw water for the process plant will be supplied from raw water wells and wells used to dewater the mine pits. The raw water will be stored in a lined raw water dam located adjacent to the process plant. Process water will be delivered to a lined process water dam constructed adjacent to the plant site. Process water will come from the following sources:

- Overflow from the raw water pond
- Tailings Storage Facility decant return water
- Clarified thickener overflow

Potable water will be obtained from groundwater wells and will pass through a filtration plant for purification. Potable water, stored in a potable water tank, will be pumped to the:

- Process plant
- Camp storage tank
- Mining Contractor's area

A sewage treatment system will be installed to service the plant buildings and another would be installed at the camp to service the workers accommodation village. All sewerage water will be treated to the minimum standard required to ensure compliance with local discharge regulations.

The Tailings Storage Facility (TSF) will be located approximately 600 meters to the south of the process plant and will be a valley storage facility with the containment embankment at the eastern end of the valley. The TSF will be constructed in a staged fashion with stage 1 being sufficient to store 2 years volume of process tailings and rainfall runoff.

The mine site will be serviced by road and air. Road access will be along currently existing roads. The Essequibo River will be crossed either at Butakari or at Mango Landing. Butakari Crossing is a component of the Amaila Falls Access Road infrastructure. The Company will hold discussions with the Ministry of Transport and other entities to determine if it would be allowed to use the Butakari Crossing and Amaila Falls Access Road. Alternatively, PGI will rehabilitate the old Omai crossing at Mango Landing and upgrade the section of the existing roadway linking that crossing to the Amaila Falls Access road and then use a section of the Amaila Falls road to intersect a new road which will provide access to the mine site.

If PGI is not denied access to the Amaila Falls road, PGI will upgrade and utilize a roadway which currently provides the mine site. If access is granted to the Amaila Falls Access Road, PGI will negotiate with the Government to financially assist with the maintenance of the Amaila Falls Road.

A new access road will be constructed to connect the mine site to the Amaila Falls Hydropower service road, if the Government agrees to the use of that road. The access road will be 9 m wide and approximately 8 km length and will consist of two 3.5 m carriageways plus 1 m shoulders as well as associated drainage ditches alongside the road. A 1 km section of road will be constructed to provide access from the site access road to the airstrip which will service the mine site. That road will be 6 m wide and will consist of two 3 m carriageways, plus associated drainage ditches alongside the road.

The airstrip, to service the proposed mining operation, has already been constructed and granted approval for operation by the Guyana Civil Aviation Authority. The airstrip is located about 1.4 km south of the process plant and has been designed for the Cessna Caravan which is a class B1 to B2 aircraft.

PGI will transport the project components, including mills and large construction items, directly to Linden from where the items will be trans-shipped to the mine site. PGI may also establish a bus station and a customs office at Linden specifically for this project. PGI will also source fuel from Linden.

2.1 Preliminary Works

The first phase of the work will entail construction of an area for the resettlement of the residents of 14 Mile Issano. This will be followed by initial construction activities for the mine site. Initial mine site construction activities will focus on preparation of construction camp facilities, kitchen, construction site offices and workshops. The capacity of the communications system will be expanded along with the on-site administration and management areas. Sewer and water services will be expanded to meet the needs of the expanded camp.

The preliminary works will include the following not necessarily in the order listed:

- Improvement of the existing site access road
- Brushing and grubbing of areas for process plant and other site facilities
- Increasing the fuel and lubricant storage capacities

- Construction of workshops and offices
- Construction of medical facilities
- Improvements to the communications system
- Construction of materials storage areas
- Construction of new airstrip
- Installation of sewer, water and power for the construction phase
- Construction of worker accommodations, kitchen and office
- Construction of buildings and shelters for repair and maintenance, power generators, water pumps, etc.
- Construction of hard rock crushing facilities, sawmill, and other ancillary support for construction activities
- Pre-stripping of the open pit mining areas

The access road will be upgraded to handle higher traffic volumes. The upgrade will entail clearing the vegetation on the sides of the road and cut and fill to widen it. The access road will be surfaced using lateritic or other suitable material available along the roadway.

Brushing and grubbing will be carried out to encompass construction sites. Brushing and grubbing would be controlled by survey to ensure that the required designed footprint of the operations is minimized. Laydown areas will be developed. Access to a rock or aggregate source, necessary for the batching of concrete for construction purposes, will be developed. Survey control and site layout activities will commence.

Technical work such as additional in-fill drilling in the pit, exploration drilling, geotechnical investigations and testing, and surveying will continue to be carried out during this phase. Drainage management will be laid out and detailed in the field for construction.

Material for permanent camp construction and fuel storage and tank fabrication will arrive and these activities will be undertaken. The construction equipment fleet will be expanded to start the facilities construction.

Quarry equipment and starter aggregate crushing operations will start to produce limited quantities of concrete for camp construction. Permanent camp sewage, water treatment, solid waste equipment, and power services will be installed.

The airstrip will be upgraded if required and a security and terminal building constructed.

When the facilities to support a construction workforce are completed and land has been cleared and surveyed, construction of site infrastructure will be undertaken.

The initial development of the open pit, stripping and stockpiling of saprolite and the initial construction of the saprolite/sulphide ore processing facilities will commence during the preliminary work phase. The construction and mining equipment fleet, repair shops, fuel, lubricant and materials storage areas will also be expanded. Initial stripping of sand saprolite overburden will commence and the on-site workforce will be increased.

The next preparatory stage will consist of stripping and stockpiling of saprolite overburden material to expose the fresh rock for eventual mining. Any saprolite material not suitable for processing will be disposed to the waste rock dump. Saprolite ore will be stockpiled for eventual blending with the hard rock sulphide ore. Final process plant design is dependent upon positive results from ongoing

metallurgical testing. Successful development of an economically feasible saprolite-sulphide metallurgical process is part of the feasibility analysis being conducted for the project.

2.2 Mining operations

Exploration work at the mine site has established the presence of viable grades of ore in the area identified for the open pit mine in Figure 4. The maximum mine pit dimensions are expected to be 1,500m in length by 350m in width and approximately 180-240 m deep.

Saprolite ore represents less than 10% of the total ore and is positioned in approximately the upper 70 m of the pit. The remaining fresh ore is primarily massive intermediate volcanics with chalcopyrite and gold mineralization. The saprolite ore is a chemically weathered rock, mostly soft or friable. The saprolites contain predominantly quartz and a high percentage of kaolinite with other clay minerals which are formed by chemical decomposition of primary minerals, mainly feldspars. The saprolite material would be mined using loaders and shovels. The hard rock (fresh material) will be drilled and blasted to fracture the rock for mining by conventional truck and shovel operations. Mining operations will commence at the Smarts deposit with ore being mined using conventional open pit mining methods. The Hicks deposit will be mined by open pit methods.

The company may hire an experienced mining contractor to undertake the mining operation or alternatively, carry out owner mining should safety, efficiency, and economic circumstances dictate. A mixture of both modes of mining operations is also possible across the various open pits to be developed. In the case of Contract Mining, the Contractor would be responsible for establishing all facilities required to support the mining operation and to maintain all mining equipment. The maintenance operations will include a light vehicle maintenance garage, office, fuel farm and workshop. The company will provide access to an area located adjacent to the plant site for the Contractor's exclusive use in addition to raw water, power and communications. The contractor will be mandated to conform to all requirements of the environmental permit granted to the company.

Ore initially will be mined using conventional open pit mining methods. Equipment to be utilized for the open pit mining operation will include blast hole drills, shovels and wheel loaders, haulage trucks, bulldozers, graders, service trucks, pick-up vehicles and pit dewatering pumps and portable lighting sets.

A fully permitted, security fenced enclosed explosives storage facility will be constructed at a site located a safe distance outside the maximum blasting buffer zone from open pit operations.

The mine pit will be developed in "phases" or "push-backs". The saprolite will be stripped and either processed, stockpiled for processing or disposed in the waste dump if of inadequate grade. The hard rock will be mined after enough saprolite ore has been mined to provide adequate working faces for the hard rock mining to begin. Each phase will be mined to ensure that safety, working area requirements, mine access and service requirements are taken into consideration.

Mineral processing will consist of handling the saprolite ore and fresh ore by blending the two together and processing singularly. The softness and clay content will make processing of the saprolite more challenging with conventional conveyance method. The saprolite ore would therefore be blended at a very low rate to address the potential material handling problems.

The ore exploitation rate will result in a mine life of 15 years or more depending on the final processing rate.

2.3 Ore Processing Facility Construction

The construction of the processing facilities is expected to take 9 - 12 months and will include:

- ore storage, crushing, conveying, grinding, mineral processing, product storage and load-out facilities,
- old recovery facilities,
- maintenance, storage, laydown yard, laboratory, office and administration areas, and
- construction of tailings, waste and water management ponds, electrical power generation, transmission, and other infrastructure facilities.

The development of the open pit will be timed so that the pit can begin to supply ore to the processing facility once it is constructed.

2.4 Mining and Mineral Processing

2.4.1 Open pit operation

Conventional truck, shovel and wheel loader surface mining methods will be used in the open pit operations. Sixty to eighty (60-80) tonne type class haul trucks will be used during the excavation of the saprolite material, and larger haul trucks, shovels and wheel loaders will be used during the mining of the sulphide zone, with capacity being dependent on the mining rate and constraints of the pit design. The sulphide material will be conventionally drilled and blasted before being mined. An independent explosive supplier will be retained to set-up a bulk explosives plant and detonator and explosives magazine on-site.

When the pit is in operation, materials to be mined will be sampled at the face to determine whether they are waste or ore, and the boundary between the materials marked by flags and pickets before their excavation. The materials will be loaded into mining trucks. Ore would be hauled to the processing plant and waste materials to the waste rock dump. The mine roads and the working surfaces on the waste dumps would be maintained using graders, bulldozers and wheel dozers. It is expected that an ore stockpile would be maintained at the processing plant to provide up to 5 - 7 days of run-of-mine ore storage capacity. Mining and processing will take place 24 hours per day, 7 days per week and 365 days per year. Low grade material that would otherwise be disposed as waste rock will be temporarily stockpiled and reclaimed and processed after the pit is mined-out. The ultimate limits of the open pit will be defined by the open pit design which is being developed. Waste materials will be disposed in the waste rock dumps.

The project will be designed and operated in accordance with environmental protection requirements and guidelines. As an example, the project footprint and land clearing limits will be monitored and controlled over the life of the project. The footprint design will aim to reduce disturbance to the small area of forested areas remaining in the planned open pit mine footprint.

2.4.2 Mineral Processing

The process plant will consist of the following process stages (with the design potential for a future staged capacity increase to up to 1.6 million tonnes per annum):

- Ore crushing
- Stockpile reclaim, milling and classification
- Gravity concentration and intensive leach recovery

- CIL leaching and gold recovery via carbon elution
- Cyanide detoxification and tailings storage

The initial stage 1 process plant is expected to have a nominal capacity of an estimated 600,000-750,000 tonnes of ore per annum, designed to produce up to 110,000 ounces of gold per annum based on an average overall minimum recovery of a 92%.

The plant Run of Mill (ROM) pad and primary crusher will be located on a ridge approximately 650 m southwest of the Smarts pit in order to avoid fly-rock and will be close enough to minimize mine haulage costs. The remainder of the treatment plant will be approximately 800 m from the mining operations along the same ridge as the ROM pad.

Mill feed ore will be introduced into the treatment plant from a 3,000 tonne live capacity open air stockpile at a design rate of 94 tonnes per hour. The treatment plant will operate 24 hours per day, 365 days per year at a nominal availability of 91.3% for a total of 8,000 operating hours per year.

The mineral processing units include:

- Run-of-mine saprolite ore feed preparation, sizing and washing
- Run-of-mine ore primary crushing, ore handling and storage
- Screening and conveying, grinding and cycloning
- Gravity circuits to extract up to 50% of contained gold in mill feed
- Cyanidation – leach – adsorption circuits (CIL)
- Gold precipitation and recovery, dore shipping for further processing
- Cyanide destruction process
- Process water recycling
- Final effluent treatment

2.4.3 Hard Rock (Primary) Ore & Blended Material Process Circuit

2.4.3.1 Leach

To improve the cyanidation kinetics the thickener underflow would be fed to a pre-aeration tank before the leach tanks. Leach tanks will be designed and sized for a pulp density of 45% solids and 24-36 hour residence time. Pulp density will be monitored by several Nucleonic Density Gauges attached to the process pipes. The leach circuit will consist of the nominal six agitated tanks. Sodium cyanide would be metered into the first and second leach tank to maintain a nominal 0.5-0.8 g/L concentration. Air will be supplied to all tanks and a provision made for the by passing of any one tank.

2.4.3.2 Carbon Circuits

The slurry from the leach tanks will be pumped to the carbon in leach (CIL) circuit, which conceptually would be a train of six agitated tanks. Each tank will be equipped with an inter-stage screen for carbon retention. Loaded carbon will be directed to the carbon stripping circuit. Stripped carbon from the carbon elution and activation kiln will be delivered to the last CIL tank. Slurry from the last CIL tank would be screened to ensure that no carbon is inadvertently lost. Loaded carbon from CIL would be transferred to a pressure vessel where gold would be eluted with weak caustic-cyanide solution at an elevated temperature. Stripped carbon will be screened and reactivated in a horizontal kiln.

2.4.3.3 Gold Refinery

Pregnant strip solution from the elution process would be accumulated in the pregnant solution tanks and would be fed continuously to the electrowinning cells for gold recovery. The electrowinning (EW) will be divided in two sections, with one handling the pregnant solution coming from the ICU and the other dealing with the eluate from the carbon stripping vessel. Cathode gold would be periodically removed under tight security, refined to doré in a furnace and cast into bars for shipment and sale.

2.4.3.4 Tailings

Tailings from the last CIL tank would be discharged to a cyanide destruction plant. The leach circuit tailings will report to a carbon safety screen, from which they will pass through a sampler for collection of metallurgical accounting sample before entering the agitated cyanide destruction tank. In this tank the residual cyanide content would be reduced below permissible levels through oxidation, using a SO₂-air process before discharge to the tailings pond.

3.0 REGULATORY FRAMEWORK

3.1 Applicable Regulatory Framework

The environmental compliance element of the project will be regulated under several statutes. These statutes outline measures that must be implemented to ensure compliance with policy guidelines and legislation. A review and assessment of the effect the relevant legislation have on project implementation will be done. Legislation and policies in Guyana that are applicable to the project include:

- The Environmental Protection Act, 1996
- The Wild Birds Protection Act, 1973
- The Aquatic Wildlife Control Regulation, 1996
- The Forest Act, 2008
- Guyana Forestry commission Act, 2007
- The Amerindian Act
- Code of Practice for Timber Harvesting, 2002
- The Guyana Geology and Mines Commission Act, 1979
- Mining Act, 1989
- The Mining (Amendment) Regulations, 2005
- The Environmental Protection Water Quality Regulations, 2000
- The Environmental Protection Air Quality Regulations, 2000
- The Environmental Protection Noise Management Regulations, 2000
- The Environmental Protection Hazardous Waste Regulations, 2000
- The Environmental Protection Authorization Regulations, 2000
- Pesticides and Toxic Chemicals Control Act, 2000
- Occupational Safety and Health Act, 1997
- The National Environmental Action Plan, 2000
- National Biodiversity Action Plan, 2007
- Wildlife Conservation Regulation (draft), 2000
- Public Health Ordinance, 1953
- National Trust Act,
- The Town and Country Planning Act,
- The Drainage and Irrigation Act

Guyana is signatory to a number of international and regional conventions and protocols aimed at addressing environmental concerns. Some of these which are applicable to the project, and which will be included in the international and regional conventions to be considered, are:

- Convention on International Trade in Endangered Species of Fauna and Flora (CITES), 1973;
- Convention on Biological Diversity, UNCED, 1992;
- Treaty on Cooperation for the Development of the Amazon Basin, Brasilia, 1978;
- United Nations Framework Convention on Climate Change, UNCED, 1992;
- Convention on the Protection of the World Cultural and National Heritage, 1972; and
- Agenda 21;
- Protocol Concerning Pollution from Land-based Sources and Activities, (LBS)

Additionally, Guyana has recently embarked on a low carbon development pathway and has developed its own Low Carbon Development Strategy (LCDS). The LCDS sets out Guyana's strategy to forge a new low carbon economy over the coming decades. The strategy is currently in its third draft. An assessment on the effect of the strategy (and an identification of relevant principles of the third draft applicable to the project) on project implementation and the vice versa will be conducted.

The above listed environmental laws, conventions and protocols provide legal authority for institutions in the country to implement mitigation measures, monitoring and technical supervision, thereby promoting the effective involvement of various concerned groups in development actions. These regulations will be reviewed and their relevance to this project will be established.

4.0 OBJECTIVES

The ESIA for the gold mine will be prepared to identify and evaluate the environmental, socio-economic, health and safety consequences of the proposed project. The ESIA will outline plans to mitigate any possible negative environmental, socio-economic and health impacts and to enhance the positive environmental, socio-economic and health impacts. A monitoring plan will also be prepared to monitor the effectiveness of the mitigation management plan and to re-orient that plan if necessary.

The socio-economic impact assessment will be carried out using methods such as focused consultations. Wherever possible, information will be gathered on the communities living close to the site by administering semi-structured questionnaires or conducting focused consultations. Meetings will be held with representatives of Indigenous Groups in Guyana. Environmental and social impact management plans and guidelines for closure plans for the facilities will be prepared to conform to Guyana Environmental Protection Agency (EPA) guidelines and regulations promulgated by the Guyana Geology and Mines Commission.

A census will be developed and administered in the 14 Mile Issano community. The facts to be captured by the census will include

- Tabular list of people likely to be relocated,
- Existing markets
- Land Ownership and Common land ownership
- Seasonal employment
- Income Sources
- Utilization of Natural Resources
- Social Community Fabric
- Formal and informal Leadership Structure
- Communication Channels
- Conflict Resolution Mechanism

The results of the study shall include the following:

- Discussion of the proposed project and a description of alternatives to the proposed project including the do-nothing alternative;
- Description of the technology to be utilized for ore recovery and for mineral processing;
- Definition of baseline physical, biological and socio-economic conditions in the area likely to be impacted by the project;
- Identification of the environmental and socio-economic consequences associated with the proposed project;
- Plan for mitigation of environmental impacts;
- Resettlement Plan for 14 Mile Kaburi
- Plan for monitoring the effectiveness of the mitigation management plan;
- Emergency Response and Contingency Plan/Community Compensation Plan; and
- Closure plan developed based on consultation with the GFC detailing plans for reforestation using appropriate species.

The Community Compensation Plan would apply only in the event of the PGI needs to respond to an emergency created directly by its operation.

5.0 STUDY AREA

The mine site is centered near the Iron Bridge, crossing over the Main Kaburi River approximately 12 km along the Issano Branch Road and approximately 160 km southwest of Georgetown, Guyana and 37 km northwest of the former Omai Gold Mine. The property consists of several Medium Scale Prospecting and Mining Permits, Small Scale Claim Licenses and Large Scale Prospecting Licenses issued under the Mining Act, 1989 and the Mining Regulations thereto. The project is located generally in the Karouni area of Mining District No. 3 as shown on Terra Survey Topographic Sheets 36SE and 36SW at a 1:50,000 scale. The boundaries of the Property are detailed in Table 1.

Table 10: Boundaries of Properties Held by PGI

Easting	Northing
262208	623561
266492	629320
281447	617980
277169	612347

A zone of influence or study area for the Concession was determined taking into consideration all possible interactions and probable impacts which may be experienced even if they are to relatively far away communities if a project is developed at the site. The zone of influence has been thus defined as the physical radius to which the project footprints or impacts may potentially extend.

The mine site encompasses several areas historically worked by small and medium scale miners. These areas which are depicted on Figure 2 include a community at 14 Miles Issano and Hicks Mine. The existence of the 14 Mile Issano predates the award of the Prospecting License to PGI. PGI operational base is centered at the former Hicks mine site. The Concession is west of and approximately 30 km from the Amerindian titled Village of Kaburi (72 Mile). This indigenous village is the primary community in close proximity to the proposed mine. A medium sized community is located at 14 Miles Issano within the proposed mine site and precedes acquisition of the property by PGI. There are several other small/medium scale mining communities located within 10 km of the Concession.

There are certain areas which can provide employees and logistics support to operations at this property. These areas occur in Regions 7 and 10. The property is however located in Region 7, the socioeconomic and sociocultural baseline was consequently focused on sourcing logistical and other resources from Region 7. The zone of indirect influence for the socio-economic and sociocultural baseline study was determined using this logic. Hence, Itaballi and Bartica were considered to be in the area of indirect influence since employees may be drawn from and benefits may potentially accrue to these communities. The socio-economic baseline study will consequently be undertaken to create a profile of the communities of Bartica and Itaballi in addition to the communities within close proximity of the mine site, i.e. 14 Mile Issano, Kaburi Village and the small and medium scale mining operations.

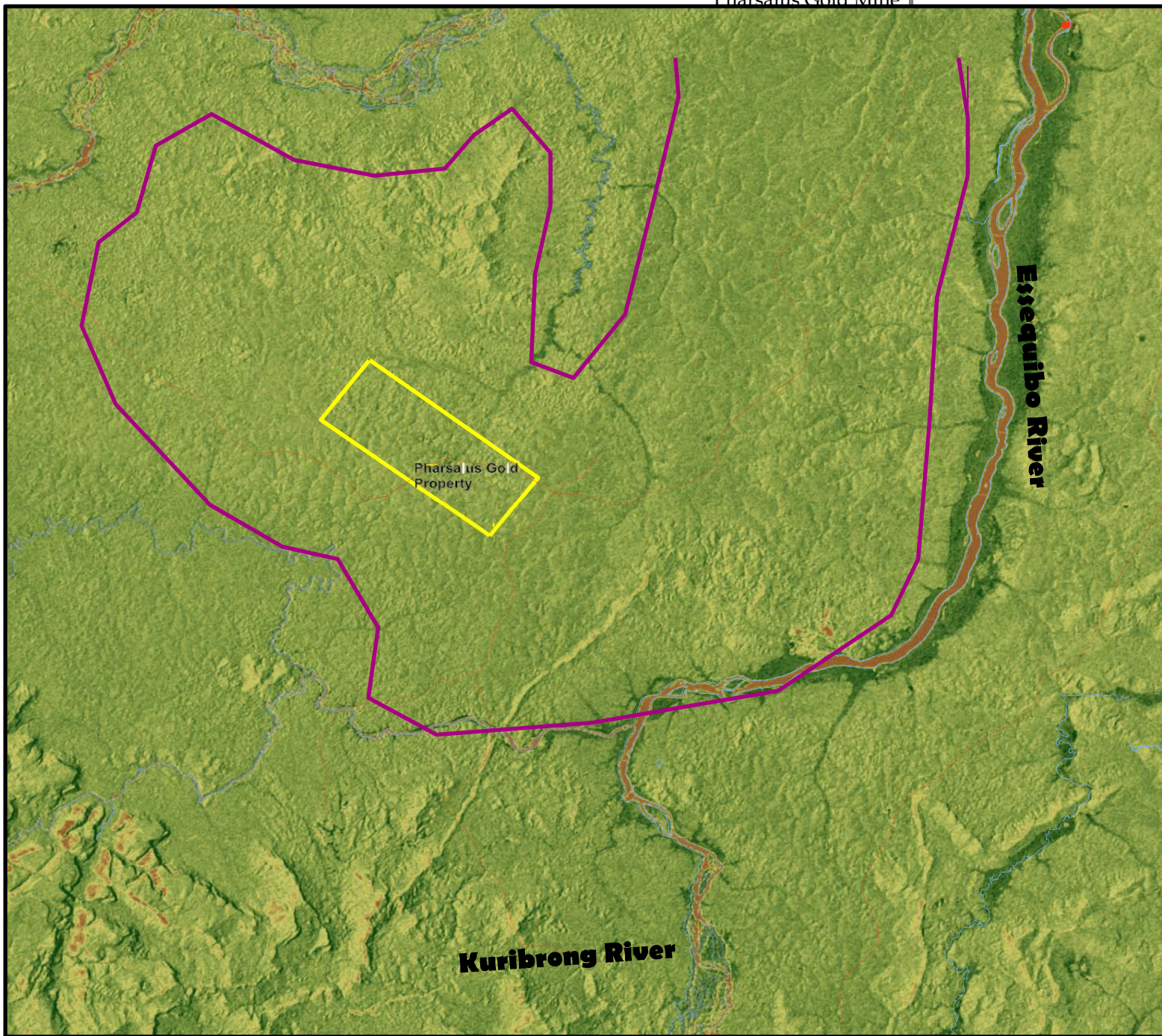


Figure 3 - Project Area of Influence

6.0 ANTICIPATED IMPACTS

This section documents the impacts anticipated to be associated with the proposed project. Several of these impacts are unlikely to be realized due to the implementation of an Environmental Management Plan. These impacts are, however, detailed in this section to inform stakeholders of potential impacts to be considered during the performance of the ESIA.

Although the ESIA investigation is in the preliminary stages, there is sufficient information on the project to begin to determine the likely impacts, and the assignment of resources to adequately investigate and characterize those impacts.

Possible impacts to the physical environment are likely to include the following:

- Air quality, noise, dust and emissions
- Degradation of aesthetics
- Soil erosion
- Impacts from excavation and disposal of excavated materials
- Impacts on geology, hydrogeology
- Impacts on water resources

Potential impacts to the biological environment may include:

- Reduction of forested lands
- Alteration to dissolved oxygen levels in creeks
- Increase in nutrient levels in creeks leading to algae blooms
- Changes to wetland areas
- Impacts to the ecosystems food chains
- Loss of Wildlife habitats

Potential impacts to the social and economic structure of the area:

- Economic opportunities during construction
- Economic opportunities after project completion
- Increase in water-related diseases, contagious diseases or pest outbreaks
- Migration of people into the area in search of job
- Trauma, social unrest, conflict and impoverishment due to relocation and resettlement
- Possible rise in the cost of living due to inflation
- Pressure on existing resources and infrastructure

6.1 Air Quality

During mining operations, gaseous exhaust (consisting primarily of carbon monoxide and unburned hydrocarbons) would be emitted from mining equipment. Fugitive dust would be emitted from the surface of the site access roads. Dust emissions would be short-term, sporadic, and localized to the access roads. Off-site impacts to ambient air quality would not result. To minimize fugitive dust, access roads can be regularly sprayed with water or another dust suppressant.

Clearing for the Mine Site and other related facilities will require the clearing of vegetation. If any of that cleared vegetation is burned, gases and particulate matter will be emitted. Burning of cleared vegetation will be minimized to reduce emissions associated with that activity.

Additionally, air quality may be impacted by emissions from passenger vehicles and engines. Vehicles will be equipped with emission controls to reduce these to acceptable levels.

6.2 Climate

Several water management ponds in addition to a tailings pond may exist at the site during the mining operation. The increased area of surface water bodies will result in increased evaporation in the immediate area of the ponds themselves. This may impact the microclimate of the project area by lowering temperatures in the site area.

6.3 Geology and Soils

The mining operation will result in the excavation of the soil and rock present at the site. The surficial geology of the area presently consists of a zone of white sand and saprolite (sandy silty clay) overlying rock in the area to be mined. During mining, soils will not be segregated by material type. Mining will consequently result in an alteration of the surficial soils present at the site. The excavation and spoil disposal will result in changes in the topographic height, slope relief intensity, degree of shaping and exposure of the area. The mining operation will therefore alter the surficial geology within the area mined.

The haul roads and access road will alter the existing ground surface slopes in the area. Since roadway slopes must be safe for the passage of equipment and personnel, the new slopes will be less unstable than the natural slopes at the site. Further, surface water management will preclude saturation of slopes within the area. The slopes created by the operation will therefore be more stable than those currently occurring at the site and the possibility of slope failures will be significantly decreased. However, slope failures may have served as an indirect method of nutrient replenishment to areas down gradient from the slopes. This source of nutrient replenishment will be eliminated by enhanced slope stability in the area.

6.4 Water Resources

6.4.1 Surface Water

Site clearing for construction would produce increased discharges to surface water since interception and evapotranspiration would be reduced. The volume of additional inflow may result in increased surface water levels during construction if large areas are cleared rapidly.

While unlikely, water quality in the Kaburi River and Blackwater may be impacted by the mine operations. Water quality may be impacted by wastewater discharges from the mining and processing operations coupled with discharges from the onsite sewerage system, domestic wastewater or by rainwater run-off from developed areas such as workshops and other onsite facilities.

The wastewater produced by the mining operation will consist of water from the mine itself and wastewater from the mineral processing circuit. No water from the mining operation will be discharged to surface water. All water from the processing circuit will be fed to the tailings pond. Since no water will be discharged from the process stream, processing water will have no impacts on water quality. Any impacts on water quality due to process discharge are probable impacts which will be addressed by the Environmental Management Plan.

Waste material from both the mining and mineral processing phases will be placed in spoil piles in the mining area. Precipitation can induce leaching of chemicals from these spoil piles. Surface runoff from mining and mineral processing waste containing large amounts of water-soluble substances or heavy

metals can result in degradation of surface water quality. In the event of extreme amounts of rainfall, waste dumps may erode and landslides may result and cause sediment to spread over large areas. There is a very remote risk that breaches in the tailings storage facility may also occur during such conditions.

The surface water quality can also be impacted by sediment and nutrients in wastewater discharged to surface water from workshops and other service area. Changes in natural water quality may affect the organisms found in aquatic systems, e.g. bacteria, algae and water plants by causing changes in dissolved oxygen content and temperature. The behavior, reproduction and physiology of organisms may all be affected. If bacteria, algae and water plants develop resistance to these pollutants and fish feed on the bacteria, algae and water plants these substances may be passed onto the food chain if eaten.

Surface runoff from onsite areas, such as site access roads, can introduce sediments and nutrients loads into surface water bodies into which it is discharged. Eroded matter transported by surface runoff to creeks in the site vicinity may reduce water quality and cause undesirable deposition and sedimentation in the water source. The rate of nutrient added by eroded material may exceed the natural rate and contribute to eutrophication in water resources. As a consequence spawning areas for fish may be damaged. Sediments in surface water may also lead to reduced light penetration.

6.4.2 Groundwater

The modification of surficial soils will influence the water balance in the area since the new surficial soils may be less permeable than those currently at ground surface and the quantity, physical distribution and time-related recharge of precipitation to groundwater will consequently change. In addition, clearing of the area will change the vegetation cover and may alter groundwater recharge and runoff conditions.

Mining operations will intercept groundwater. Mining activity will entail excavation below the existing groundwater level. This will interfere with the existing groundwater flow regime and will result in the temporary reversal of groundwater flow direction. This impact will be localized to the pit itself. The pits are very small in comparison to the surrounding area and there will be no impacts on groundwater availability to nearby communities. Groundwater will flow into the excavation during the mining operation. If adequate pumping capacity is not provided groundwater flow into the pit may result in flooding.

After mine closure there will be residual depressions as a result of extraction of the ore and removal of overburden. These depressions may eventually produce groundwater filled ponds in the mined out area. The surface water levels in these ponds will correspond to the new groundwater levels and surface water in the ponds would be fed by groundwater. This will result in dis-equilibrium of the groundwater flow regime. Groundwater flow may not return to equilibrium for a considerable period of time.

Clearing of the area for mining will change the vegetation cover and will alter groundwater recharge and runoff conditions. The change in groundwater recharge and any falls in groundwater levels may lead to the loss of some specific plant communities that depend on shallow depths to groundwater for survival. The lower recharge and lowered groundwater depths may also result in less discharge of groundwater to surface water. This loss will, however, be compensated for by increased surface runoff from cleared areas.

Mining and mineral processing waste containing large amounts of water-soluble substances or heavy metals can jeopardize groundwater, unless the soil under the dump is sufficiently impermeable. All mining and mineral processing waste will be located in low permeability areas to ensure no impact on groundwater quality.

Groundwater quality may also be impacted by infiltration of wastewater from the tailings management area and by leaching of minerals into solution from the mine itself. In addition, groundwater quality may be impacted by seepage from waste management facilities on the site.

Since there may be soluble minerals in soils at the site, the dis-equilibrium in the groundwater flow regime caused by gradient reversals during mining may impact groundwater quality by periodically introducing dissolved minerals into the groundwater flow regime. The presence of dissolved minerals in the groundwater can change the pH of groundwater in the area. The minerals present in the soils constitute a part of the geochemistry of the area. The impact of their dissolution will consequently be minimal.

6.5 Vegetation

The loss of vegetation and deforestation would constitute the main impact on terrestrial resources in the mine area. The access road would create a continuous line through the landscape which connects several geographical areas. The location of the site is relatively remote. Consequently movement of animals across the roadway would only be affected during construction operations. Thereafter the road should not impede movement and communication between animals.

Clear-cutting of large tracts of tropical rain forest on poor soil, for mining, may make plant regeneration difficult. The conditions required for regeneration will also disappear with the clear-cutting required for the mine operation. Aggressive grass species and shrubs may effectively prevent seed-bearing plants from finding satisfactory living conditions.

During plant regeneration the area may encounter encroachment by particularly aggressive and unwanted plant species (pests) that exist in the area. These pests may result in the loss of some vegetation and animal species. Regrowth in the area will alter the diverse nature of the trees present in the area. The areas occupied by the process facilities, personnel facilities and operational mine will be subtracted from the total area available to flora.

6.6 Wildlife

Stocks of animals depend on the existence of habitats of a certain size. Clearing for the power plant, mine, process and personnel facilities and access roads will fragment the area. In addition, some animal species depend on the existence of other plant and animal species within the habitat for nutrients/food, cover, etc. 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. People working on the project may harvest commercially valuable animal and plant species. Species population may therefore decrease due to hunting and trapping.

Persistent acid mine drainage and discharges to surface water may also contaminate the water available to wildlife in the area. The acid runoff further dissolves heavy metals such as copper, lead and mercury into ground or surface water.

During operations, some wildlife species are expected to move away from the affected area. This displacement will increase competition with wildlife on the periphery of the area. The physical disturbance and noise produced by mining activities 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 affected zones owing to the phenomenon of habituation.

Animals tend to follow established patterns in their daily and seasonal movements. If the access road intersects or blocks wildlife corridors, it may result in cessation of use of the corridor because animals are reluctant to cross the road and/or an increase in mortality because of collisions with vehicles, or a delay in migration which may result in the weakening or disappearance of an entire generation of the population. In addition, some animals are attracted to roads for various reasons, including protection from predators, good food supplies and better travel conditions. This may lead to accidental death.

6.6.1 Birds

Many species of migratory birds including waterfowl and waders will be attracted to open bodies of water represented by the tailings pond and water management ponds in the area. These birds may be harvested by people in the project area. Many tree species are unisexual and are pollinated with the help of birds. Clearing causes birds to find other habitat. Consequently, pollination and dissemination of seeds by birds no longer occur.

6.6.2 Fishes

The operation of the mine itself will have no direct impacts on fishes in the area. The mining operation can, however, result in indirect impact on fishes. 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 that may lead to denitrification and increased oxygen consumption resulting in an environment less conducive to the survival of fishes. No discharges to surface water will occur during mining or processing. The effects on fishes will therefore be minimal.

6.7 Land Use

The Project is unlikely to generate long term effects on existing and future land uses. Historically primary land use in the area has been mining and forestry. This land use will continue over the project life. The mine would be operated in accordance with regulations applicable to mining permits. The relocation of the 14 Mile Issano community will alter land use in an area contiguous to the proposed mine site. The relocation of the 14 Mile Issano may also impose stresses on the environment since effective management of the relocated community will demand utility services such as potable water and solid waste management.

6.8 Noise, Odor and Dust

Dust emissions would be produced during the construction and operations phase by vehicles using the site roads, from material stockpiles onsite and from mining operations. Noise levels above the alert threshold of 86 decibels and hazard threshold of 95 decibels would be produced from mining equipment.

Noise levels above the alert threshold of 86 decibels and hazard threshold of 95 decibels would be produced from heavy-duty machines operation. Exposure to noise levels above the internationally accepted level of 90 decibels can cause noise induced hearing loss. Noise levels above the tolerable threshold of 72 decibels can cause/result in fatigue, tiredness, low morale and decreased production levels and productivity. Tired workers are also prone to accidents and this can contribute to an increase in accidents in the working environment.

The mining operation would occur in close proximity to existing wildlife habitat. The operation would emit noise. There would have been some noise stresses in the area prior to the project associated with exploration drilling. Continuous noise during the project may however disrupt acoustic communication between fauna and may lead to changes in behavior as it relates to mating, food gathering, warning

signals and brood care in areas near the emission sources. Further individual noises, which may sometime occur in conjunction with visual signals, may give rise to panic reactions during territory-seeking or brood care and may lead to habitats being permanently abandoned.

6.9 Health and Safety

The need for people to relocate to the site for construction may see the introduction of behavioral diseases due to increases in population densities. The arrival of workers and migrant settlers from various localities and regions with diverse cultural and social backgrounds would increase the concentration of people in a formerly isolated rural area and may result in increases in sexually transmissible diseases, the spread of locally prevalent contagious diseases and the introduction of new diseases as yet unknown in the area of the Project.

The enhanced access road may result in the easy spread of pests or diseases because floral and faunal vectors can gain easy access to areas on the new road corridor. Transportation of plant products, such as fruit, along the roadway and from the Project site may also aid in the spread of diseases.

Without proper controls and employee education, prostitution, HIV/Aids, other sexually transmitted disease, alcohol & drug abuse, and malaria may be aggravated by the project.

Public health and safety would not be threatened by the proposed action because hazardous emissions and effluents would be reduced to acceptable levels at receptor locations in close proximity to the site. Facility workers would be exposed to standard industrial hazards associated with the operation of heavy equipment and machinery. The proposed action would not present any unique hazards to occupational health and safety.

6.10 Socioeconomic Conditions

The construction and operation of the mine could provide employment opportunities for the nearest Amerindian community, thus increasing their sources of income and living conditions. However in the short term, the Project would result in the transfer to the Project site of a number of construction workers. This work force would diminish rapidly after construction and would be replaced by a small number of operation and maintenance personnel. The Project may therefore lead to the creation of a “boom town” associated with construction activities and related to the arrival of a migrant population and the development of a new community around the mine site. The temporary increase in population may result in increased stress on local services and infrastructure.

The Project would create some employment opportunities for residents of the study area. Employment of both skilled and unskilled labor may bring financial benefits to the community if residents are considered for the jobs. The Project would also create a demand for technical skills. The demand for skills may result in improved education standards and services in communities within the study area.

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 migrant and expatriate workers. In the mid-term this may bring about an increase in sexually transmitted diseases.

Amerindians in the area who practice traditional farming generally use “slash and burn” agricultural practices. The road may provide access to areas where these farming practices may be used.

PGI will support the Kaburi community with medical facilities, education and improved lifestyles. PGI will also work along with the Kaburi community to enable its members to be educated to become potential employees of the operation by identifying motivated individuals from that community and awarding those individuals with scholarships to attend the Mining School.

The 14 Mile Issano community is located within the footprint of the proposed open pit. This community would have to be relocated and resettled to make this project a reality. Resettlement, if not properly implemented may lead to trauma, social unrest, conflict and impoverishment and the associated disruption of social patterns. These consequences may haunt the operation over the duration of the project life. Resettlement will also exert pressures on existing social system with both direct and indirect impacts. Indirect social impacts will occur in this instance since the change process will leave 14 Mile Issano residents with no other option but to move.

Resettlement may also entail loss of both physical and non-physical assets, including homes, productive land, income earning assets and sources, substance, resource, social networks and ties, cultural identify and mutual help mechanisms.

The socioeconomic impact management plan will identify a mechanism for promoting good community partnership and development of partnership will communities directly impacted by the project. A negotiated Resettlement Plan will also be developed for the 14 Mile Issano community based on consultations between PGI, The GGMC, the EPA and residents of 14 Mile Issano. The plan will include fair and appropriate non-monetary compensation, plus other incentives and benefits to affected individuals and will include measures to ensure the restoration of the livelihood activities of affected persons.

PGI will work with the newly operational mining school to provide training to enable graduates to satisfy its personnel needs in the fields and to have a practical understanding of mine site activities.

6.11 Cultural and Archaeological Resources

There are no known archaeological resources in the area. This will however be further investigated by field survey teams and confirmed by interviews during update of the socio cultural baseline. A protocol will also be outlined in the ESIA in the event there are any chance discoveries of archaeological resources during construction, operation or closure of the mine site.

6.12 Traffic

The project will introduce some traffic into the area. The traffic will, however be limited to trucks and four wheel drive vehicles. The increased traffic may result in some instances of vehicular accidents on the road to the mine site. The impacts associated with the use of heavy machines will also be considered.

6.13 Access Road

Creation of the access road and/or upgrade of existing roads will result in impacts to both flora and fauna on the roadway alignment. Impacts associated with the creation and/or upgrades to roadways will be considered.

6.14 Cumulative Impacts

The ESIA report will contain a topographic map which identifies all existing mining and forestry concessions within both PGI's concession and within close proximity of the concession. The topographic map will be used to identify existing and potential activities/developments within the project area of

influence and their associated environmental and socio-economic impacts. The cumulative impacts of the proposed project and of existing and planned developments within the project area of influence will also be examined and detailed in the ESIA based on activities/developments likely to occur within close proximity of the project.

7.0 STUDY METHODOLOGY

The study will be undertaken to confirm with the Guyana EPA standards and will be undertaken in the following distinct phases:

- Public consultations and scoping meetings
- Data collection
- Characterization of the baseline conditions
- Identification and characterization of potential impacts
- Identification of impact mitigation measures and enhancement of benefits
- Preparation of an Environmental Management Plan
- Preparation of Emergency Response Plan
- Preparation of Closure Plan

7.1 Public Consultation and Scoping Meetings

Public consultation meetings were held at locations identified by the EPA; Georgetown, Kaburi Village and 14 Miles Issano. The Developer's Representative presented the proposed project and the Consultant identified the physical, biological and social issues of concern that will be investigated during the ESIA process. An open discussion followed where members of the public voiced their concerns over the proposed project and its impacts. Members of the public were also invited to discuss issues they considered as relevant which were not assumed to be issues of concern by the consultants.

Based on the findings of the initial public consultation, meetings will also be held with the GGMC, EPA and the MNRE to develop an appropriate Resettlement Plan for 14 Mile Issano.

7.2 Data Review

The Study Team will assemble and evaluate relevant baseline data related to the physical environment, biological environment and socio-cultural environment. The baseline data to be assembled and evaluated will include:

- topography of the areas;
- baseline data on climate and weather
- local general geological structure, classification, composition and distribution of superficial deposits;
- the existence and movement of groundwater;
- determination of hydrogeological data;
- determination of hydraulic data
- physical, chemical and geotechnical properties of the surficial soil;
- background contamination of the surficial soil, surface water and/or groundwater;
- the risk of natural hazards (e.g. flooding) and subsidence;
- local meteorological data; and
- biological data.

The physical baseline data will include a topographic map identifying the mining concession boundaries in relation to 14 Mile Issano, the indigenous community at Kaburi and all existing mining and forestry concessions within proximity of the mine site.

7.3 Field Surveys

Ecological field surveys were undertaken in both a single wet and a single dry season in 2012. Field surveys were also conducted to acquire socioeconomic baseline data for the project area and areas likely to be impacted by the project. The socioeconomic data compilation included an inventorization of the residents of 14 Mile Issano. The GPS coordinates of every structure at 14 Mile Issano was also established by that socioeconomic survey. An ecological field survey will be conducted to acquire baseline data for the new road proposed to link the mine site to the Amaila Falls Access road.

Surface water samples were recovered from creeks in close proximity to the project area and from points upstream and downstream of the area to be mined for a single dry season in 2012. Sediment samples were also recovered from these points to conform to guidelines established by the EPA. A single groundwater sample was recovered from a well nest drilled within the project area for a dry season in 2012. Additional surface water and sediment samples will be recovered from the exact points sampled during the 2012 dry season to ensure water and sediment quality data is available for at least a wet and a dry season. Four additional groundwater monitoring well nests will be installed within the footprint of the proposed mine.

Water elevations in the wells will be recorded to assist with the hydrogeological evaluation. All water samples will be analyzed to determine the presence and concentration of substances as mandated in the Guyana EPA, Environmental Impact Assessment Guidelines, Volume 3 Mining, Version 1, (2000).

7.4 Natural and Socio-Economic Environment

During the consultation respondents will be educated about the project and its likely impacts on the social environment. A socio-economic baseline will be presented for each distinct community in the project area. The baseline will include population distribution in the area, skills available, existing economic activities, educational facilities, current school dropout rate, industries in the area and the skills used by those industries, any social inequalities currently existing in the project area, adequacy and costs of transportation, and current and projected labor supply and wage levels.

The socioeconomic baseline will include a schematic plan of PGI concession identifying the 14 Mile Issano community and the operational mining camps within that concession. The social infrastructure, economic activity and social and environmental concerns of the camps and community will be detailed in that baseline. The GPS location of all buildings and the name of residents occupying each building will also be outlined in the baseline. All information on land tenure of residents and artisanal miners shall be captured by the baseline data.

Additionally, the social scientist will note the location of residents, communities and institutional features. The socioeconomic impact assessment will include a discussion of the health, education and social infrastructure available in each community. The socio-economic assessment will include both the positive and negative impacts on communities to be impacted by the project. This information will be summarized for inclusion in the ESIA report.

The Social Scientist will compile a list of persons likely to be affected by the resettlement of 14 Mile Issano. Information compiled will include land ownership, land use and other rights to land and will include an inventory of all potential resettlement losses. The data will also document people who have historically resided in the area as opposed to people who have moved into the area to benefit from any resettlement plan and will verify the nature and existence of both traditional and non-traditional income generating activities.

The socio-economic baseline will include characterization of both the indigenous community at Kaburi and the 14 Mile Issano community. It will also document information on the various mining camps located within proximity of the proposed mine site development.

7.5 Biological Environment

An inventory of terrestrial and aquatic resources has been prepared for the area based on field surveys conducted in 2012. The field data acquisition phase included determination of the type and density of commercial species present in the area. The distribution and density of flora and fauna was determined, habitats were identified and the ecological interaction of species was studied. The species of vegetation and the prospects for the use of those of commercial value was explored. The survey also identified all species of both medicinal and cultural importance to indigenous people living in that area.

7.6 Impact Assessment of Project

The Study Team will assess the environmental and socio-economic impacts for each element of the project. The “elements” to be assessed will include:

- Site Clearing operations ;
- Mining Operations;
- Processing Operations;
- Site Access Road
- Pure Water Management;
- Waste Water Management;
- Complementary installations including site buildings and equipment maintenance yard;
- Description of the quantities and types of waste to be generated during operation of the mine;
- Resettlement of 14 Mile Issano
- Waste management plan for operational phase;
- Spill contingency plan for the operational phase;
- Pollution prevention and abatement methods envisaged
- Impacts associated with construction of the airstrip.

The impact assessment will include an evaluation of limitations/constraints. Impacts will be assessed for the preoperational, operational and maintenance phases of the project.

The ESIA report will contain a detailed resettlement plan developed to conform to the International Finance Corporation (IFC) Performance Standard 5 (PS5). The objectives of that plan shall be as follows:

- To minimize involuntary resettlement wherever feasible by exploring alternative project designs
- To mitigate adverse social and economic impacts from land acquisition or restrictions on affected persons’ use of land by: (i) providing compensation for loss of assets at replacement cost; and (ii) ensuring that resettlement activities are implemented with appropriate disclosure of information, consultation, and the informed participation of those affected
- To improve or at least restore the livelihoods and standards of living of displaced persons
- To improve living conditions among displaced persons through provision of adequate housing with security of tenure at resettlement sites

The ESIA report will identify the project boundaries and present justification for the boundaries identified. All existing operations in the project vicinity that are likely to contribute to cumulative environmental impacts in the project area will be identified. The cumulative impacts on both surface and

ground water will be assessed based on baseline water quality established during the field sampling program.

Economic impacts with regards to income generation for the community and national economy will be identified and issues such as on site residence, electricity supply and domestic water supply to mine workers will be addressed.

The ESIA report will include a discussion of the impacts related to ancillary facilities such as the road, air strip and camp site. It will delineate the area of influence of the project and examine cumulative impacts related to other projects and developments in that area. The ESIA report will also discuss alternatives to the project.

The ESIA report will include a topographic map highlighting the mining concession relative to 14 Mile Issano and Kaburi communities. The map will also depict surrounding logging concessions and mining claims/licenses. Mining claims with PGI PL area will also be identified.

The environmental, socioeconomic and health impacts of the project components will be assessed separately as well as cumulatively.

8.0 MANAGEMENT PLAN

A Management Plan will be developed to minimize identified potential/acute environmental impacts on the site due to site activities using the following steps:

- Through evaluation of environmental impacts, identify site activities whose impacts can be reduced or eliminated by mitigation
- Summarize site activities requiring mitigation or restoration and categorize into common types, where feasible;
- Identify and estimate the impacts which cannot be mitigated.

The management plan will include proposals for the use/disposal of vegetation cleared from the site and for the management of solid waste. The management plan will also address issues related to employees and residents' health and safety including vector borne diseases. The management plan will also examine the need for the developer to cultivate partnership(s) with adjacent communities and to explore options for enhancing positive benefits to these communities.

The management plan will contain measures to reduce impacts to both surface and groundwater including impacts to both Blackwater Creek and Kaburi Creek.

Included in the Management Plan would be a plan for resettlement of 14 Mile Issano. That plan will be designed to mitigate negative impacts of displacement and will identify development opportunities. It will establish the entitlements of all categories of affected persons. It will also include a mechanism to document all transactions to acquire land rights, as well as compensation measures and relocation activities. The plan will also establish procedures to monitor and to evaluate the implementation of the Resettlement plan and to take corrective action if necessary.

The EMP will also detail procedures for ensuring that Cyanide is managed in accordance with the International Cyanide Code to minimize impacts to health, safety and the environment.

The ESIA will contain details of a reclamation plan. That plan will include a revegetation plan for impacted area to minimize the proliferation of invasive species. PGI area overlaps two large concessionaries, Vitarna and Toolsie Persaud (Interior Forest Investment), the ESIA will also contain detail of collaboration between PGI, these concessionaries and the Guyana Forestry Commission (GFC) during clearing of the mine site.

Other elements of the management plan will include options for public use of the airstrip, and options for the use and development of roads outside of the PGI Prospecting License area. The management plan will also contain a community relations plan to respond to project concerns raised by communities within proximity of the mine site and to provide responses to health emergencies. The community relations plan will detail protocols to enable PGI to provide medical and education benefits to Kaburi Village and to improve the community lifestyle. It will also detail the mechanism for identifying individuals to be awarded scholarships to attend the mining school. Plans for engagement with Kaburi to satisfy basic community needs such as potable water and electricity will also be detailed in the Community Relations Plan.

9.0 MONITORING PROGRAMME

The Study Team will develop a follow-up and Monitoring Program based on the results of the ESIA and the Management Plan. This Monitoring Program will be designed to evaluate the suitability and effectiveness of the proposed mitigation measures, as well as to verify the prediction of impacts during development and operation. The Monitoring Plan will identify parameters to be monitored and the frequency of monitoring. Services such as analytical laboratory equipment, weather stations equipment and sampling equipment necessary for effective monitoring will also be identified in the ESIA report. The monitoring plan will identify the monitoring to be done and the training requirements for monitoring staff.

The monitoring plan will include plans for regular testing of water quality to determine if there are any releases of chemicals. The data would be provided to the EPA for dissemination to the relevant sectoral agencies.

10.0 RISK ASSESSMENT

The ESIA will examine the risks associated with project implementation. These risks are expected to include the following:

- Tailings Storage/Water management facility embankment failure
- Modified Mercalli Event at the site

Measures to reduce/eliminate the likelihood of catastrophic failure will be detailed in the ESIA.

11.0 CLOSURE PLAN

A conceptual closure plan will be prepared for the mine site operation. The GFC will be consulted during the preparation of the closure plan and the Closure Plan will incorporate suggestions and recommendations made by GFC.

12.0 PREPARATION OF EIA REPORT

The Study Team will prepare the EIA and supporting documentation, as required. The assessment document will include the following items:

- Executive Summary;
- Policy, Legal and Administrative Framework;
- Description of the Project;
- Analysis of Alternatives;
- Description of the Environment;
- Significant Environmental Impacts;
- Environmental Management and Mitigation Plan including plans for the use, management and disposal of fuels/oils, and for the management of solid waste and sewage and for watershed management, access management and Site security and Resettlement of 14 Mile Issano;
- Community Relations Plan for Kaburi Village
- Monitoring Program;
- Emergency response/Contingency Plans
- Closure Plan;
- Inter-Agency and Public/NGO Involvement
- List of References; and
- Appendices
- Records of Inter-Agency and Public/NGO Communication
- Data and Unpublished Reference Documents
- Terms of Reference
- Relevant Notices
- Minutes of Scoping Meetings

The report will be prepared using matrices, tables, figures, etc. as much as possible to ensure readability and conciseness. The format will be determined in consultation with EPA, GGMC and other appropriate authorities. Six to eight copies of the draft EIA report will be submitted to the EPA along with an electronic version of the document in PDF format.

13.0 ESIA STUDY TEAM

The Environmental and Social Impact Assessment would be undertaken by the firm of Ground Structures Engineering Consultants Inc. (GSEC). The study team assembled for this assignment consists of individuals who are recognized experts in conducting environmental impact assessments in Guyana. The group of professionals, assembled to conduct the ESIA, all have the necessary range and depth of experience and a thorough understanding of local conditions to conduct the ESIA to World Bank and Guyana EPA Standards.

Charles P. Ceres, GSEC Project Director, is the Managing Principal of Ground Structures Engineering Consultants Ltd. of Guyana. He will be the Project Director and will provide strategic guidance to the team and will be responsible for project co-ordination and logistics. Mr. Ceres will oversee the fieldwork and baseline studies. Mr. Ceres has been responsible for the management and execution of a wide variety of environmental projects in Guyana, the United States and the Caribbean. Mr. Ceres has also managed several EIAs and EAs in Guyana. He managed the EIA for the expansion of the Guyana Sugar Corporation Skeldon Estate and has served as a consultant to the Guyana Environmental Protection Agency. Mr. Ceres has supervised several environmental monitoring and remediation projects both in Guyana and overseas. His experience in Guyana includes supervision of the installation of groundwater monitoring equipment at Omai Gold Mines Tank Farm and the environmental audits for the privatization of Linmine and Bermine. His experience in the Northeastern United States includes supervising the installation of equipment for the remediation of soil and groundwater contamination and managing several National Pollution Discharge Elimination Systems (NPDES) installations.

Ms. Ndibi Schwiers is an Environmental Scientist and Forester, and has several years of experience both in the forestry and environmental areas in Guyana. Ms. Schwiers was responsible for developing protocols for baseline definition of forest resources. Ms. Schwiers has served in a similar capacity on several other projects in Guyana including the Strategic Environmental Assessment for Guyana's Mining Sector and the Aurora Gold Mines Project.

Mr. Hance Thompson is an environmental specialist and biologist, and has years of experience in regulatory environmental and earth resources management in his previous capacity working with the Guyana EPA. Mr. Thompson was responsible for the development of the bio-physical baseline. Hance will also spearhead the team responsible for compilation of data for the relocation of 14 Mile Issano.

Keith Lowenfield, Social Scientist is an accomplished social scientist who has worked on socio-economic baseline studies for ETK Toroparu and Groundstar Resources in the North Rupununi. He also examined the socio-economic impacts associated with the proposed oil exploration program in the North Rupununi. Keith will coordinate the activities of individuals working in communities in proximity to the project to determine the socio-economic impacts of the project and would be responsible for development of the management and monitoring plans to mitigate potential impacts.