681 Culvert City Lethem, Region 9,

Thor Mining Guyana Exploration Inc.

Aremu, Cuyuni Mining District

PROJECT SUMMARY

Document Control Information	
Document Name	Project Summary.
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Date	July, 2023

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1 Project Summary

Treatment and Recycling of Central Mineral Rejects is an important issue in Guyana. The country has a long tradition of mineral exploration and mining, which has driven the growth of cities and regions, created generation opportunities, and strengthened its economy. However, there is a need for investment in the sector to reduce the environmental impacts caused by the current mineral exploration model.

One major issue is the disposal of mineral rejects, which are often left in mountains or spread out in open pits, causing significant environmental problems. To address this issue, Thor Mining Guyana Exploration Inc. has developed an innovative alternative for processing, recovering, treating, and recycling mineral rejects in degraded areas. This gold extraction method uses a chemical process with environmentally friendly products, generating jobs and income while also providing appropriate disposal solutions in Guyana.

Cyanidation of tailings for gold using sodium cyanide is a commonly employed method in gold mining for the extraction of residual gold from mine tailings. Mine tailings are the leftover materials that remain after the primary gold extraction process.

The expenditures to establish a project of the nature will comprise of conglomeration a cost of $ USD 350,000. The proposed gold leaching process encompasses one phase to accommodate the processing of tailings. This will be a single-phase process that will consist of constructing the Heap Leach site that will process 10,000 tons every 6 months.

The Aremu Gold Project processing facility is designed to treat 20,000 tonne per annum. Tests have shown that the tailings are readily amenable to a patented cyanide leaching process. The entire set up is looking to recover over 900 ounces of gold at 1.5 g/t grade. The gold leaching process will use a modified CIL circuit for leaching and recovery to carbon. All of the processing uses industry proven processes.

The single phase process will involve filling up the leaching area with tailings followed by thickening, leaching, CIL, carbon desorption, and eluate electrowinning.

The entire operational process associated with gold project can be divide into the following elements:

a) site preparation- felling of trees and grubbing out their roots, drying out swamps, etc. over the section of the deposit to be worked;

b) de-watering and preventing the inflow of water to the site; establish water ponds

c) Building the Heap Leach Pad – 40m x 7.5m x 2m

d) Setting up CIL vats and laboratory

e) Smelting furnace for gold recovery

In the cyanidation process, sodium cyanide (NaCN) is used as the leaching agent. It reacts with gold particles present in the tailings, forming a soluble complex known as sodium gold cyanide. This complex allows for the dissolution and extraction of gold from the tailings.

After the termination of heap leaching, the next step is to neutralize the sodium cyanide solution. This is achieved by using hypochlorite, which reacts with cyanide to form non-toxic compounds. Before neutralization, a minimal analysis is conducted using silver nitrate and potassium iodide. This analysis helps determine if any residual cyanide is still present in the solution. The goal is to ensure that the cyanide concentration is reduced to 100% absence in the solution. Once the absence of cyanide is confirmed, the solution can be safely discarded. This process is crucial to prevent any potential environmental impact and ensure the responsible management of cyanide solutions in the mining industry.

Overall, this approach will not only reduce the environmental impacts of mineral exploration but also contribute to the sustainable development of Guyana's economy.

The Aremu Project will be the first of many to come where the residual gold is recovered from its tailings and the tailing pond is properly closed and reclaimed. The project creates a heap leach pad of 5 acres to process 10,000 tons with a recovery of 98%.

2 Location & Plant Site Layout

2.1 Location

The Aremu Project will be the first of many to come where the residual gold is recovered from its tailings and the tailing pond is properly closed and reclaimed. The project creates a heap leach pad of 5 acres to process 10,000 tons with a recovery of 98%. The Aremu Tailing Recovery Project is located in the Aremu River area. TMGEI is in a Joint Venture covering 1200 acres, to recover gold from the tailings found on T-12/MP/002.

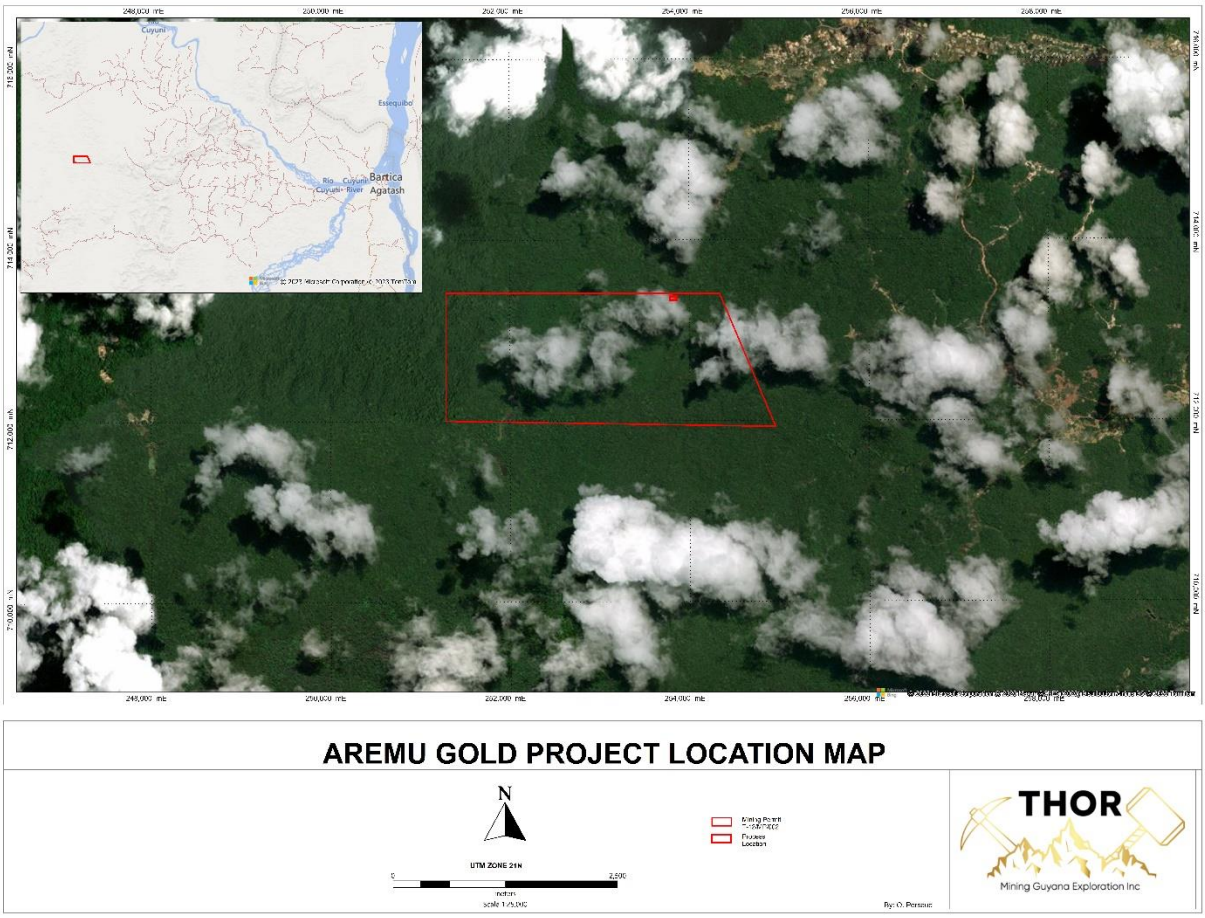

Figure 1. Location & Access map

2.2 Site Layout:

The overall engineering approach was to design a robust process facility that could handle a combination of fresh rock and saprolite under varying operating conditions. The table below shows the key project and ore-specific criteria for the process facility design and operating costs.

Process Design Criteria

Criteria		Units	Design
Head Grade Design		g/t Au	1.5
Gold Recovery	Tailings	%	95
Preleach Thickener Rate (Tailing)		t/m2/h	
Preleach Thickener Underflow Density		% w/w	50
Leach Circuit Type			CIL
Leach Circuit Residence Time		h	24
Leach Stages			2
Carbon Adsorption Stages			4
Detoxification Process			NaClO
Detoxification Target	CN(WAD)	ppm	0.5
Lime Consumption (CaO)		kg/t	7
Caustic Soda Consumption (NaOH)		kg/t	1
Flocculent Consumption	Rock	g/t	50
Ethanol		l/t	1
Silver Nitrate $AgNO_3$		kg/t	0.11
Cyanide (NaCN) (fresh rock - total)		Kg/t	1

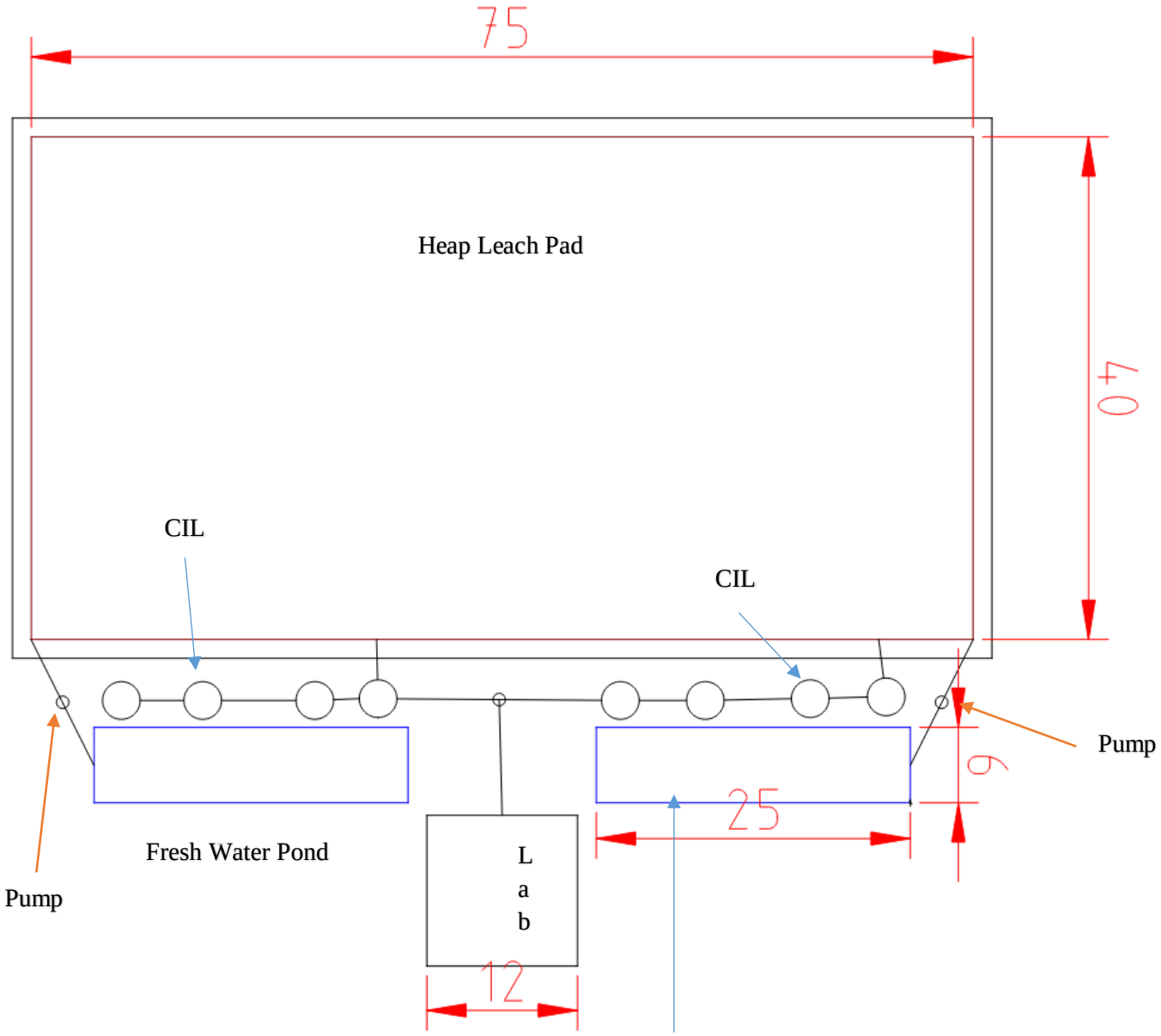

Figure 2. Plant Site Layout

3 Health Safety and the Environment (HSE) Plan

Our Company. will develop and enforce an HSE plan that will comply with Guyana's Occupational Safety and Health Act (Cap 99:06) where it "provides for the registration and regulation of industrial establishments, for occupational safety and health of persons at work and, for purposes connected therewith or material thereto". Moreover, it will observe Section 41 which "prohibits the employment of persons under the age of 15 ("children") in factories."

4 Cyanide Leaching Process

The process facility design is based on a flowsheet with unit process operations that are proven in the minerals processing industries. Material handling of the Saprolite ore can be difficult due to the in-situ moisture, fine particle size, and cohesiveness if not handled properly. To mitigate the risk of downtime when handling this material well known industry engineering practices were incorporated in the design and sizing of equipment. The Aremu Project gold circuit includes the following unit processes:

Tailing Preparation: The tailing is mixed with water and any necessary additives, such as lime, to adjust the pH of the slurry. Lime is often added to maintain alkalinity and promote the stability of the cyanide solution.

Leaching: The prepared ore slurry is then fed into a series of leaching tanks. Cyanide solution, usually in the form of sodium cyanide, is added to the slurry to dissolve the gold particles. The leaching tanks are typically agitated to ensure proper mixing and contact between the cyanide solution and the ore.

Adsorption: After the leaching stage, the gold-bearing solution, known as the pregnant leach solution (PLS), is separated from the remaining solid residue. The PLS is then directed to an adsorption circuit, where it passes through a series of activated carbon columns or tanks. The carbon adsorbs the gold from the solution, forming a loaded carbon.

Carbon Stripping: Once the activated carbon has adsorbed a significant amount of gold, it is removed from the adsorption circuit and sent to a carbon stripping vessel. In the stripping vessel, the gold is desorbed from the carbon using a hot caustic/cyanide solution. The gold-cyanide complex is broken, and the gold is recovered as a concentrated solution.

Electrowinning or Zinc Precipitation: The gold-bearing solution from the carbon stripping process is further treated to recover the gold. Two common methods are electrowinning and zinc precipitation. In electrowinning, an electric current is passed through the solution, causing the gold to be deposited onto cathodes. In zinc precipitation, zinc dust is added to the solution, which reacts with the gold, forming solid gold particles that can be easily separated.

Smelting and Refining: The final step in the process is to further purify the gold to remove impurities and obtain a high-purity gold product. This is typically done through smelting, where the gold is melted and impurities are separated. Refining processes such as electrolysis or chemical treatments may also be used to achieve the desired purity level.

An air/SO2 cyanide detoxification circuit to reduce the weak acid dissociable cyanide (CNWAD) levels in the leach tailings prior to discharge to the TMA;

Tailings Management Area, TMA, for leach residue pumped to the engineered TMA at approximately 50% solids;

In addition to above the process water will be reclaimed from the TMA and recycled to the process operations, with raw water being used as make-up water as required.

Raw water will be reclaimed by a barge from the raw water dam. The raw water is recovered and distributed throughout the site.

Potable water will be generated on-site by the treatment of a fresh water source using multimedia filter, chlorine, ultra-filtration and ultraviolet light. Potable water will then be distributed for use in the process facility and around the site.

Other items included in the process include Process instrumentation, control devices, and process facility and instrument air services including associated infrastructure.

5 Aremu Gold Leaching Processing

The company employs a Patented Method of Cyanidation which recovers 80% of the Lixiviant during the process. The company uses Sodium Cyanide, Sodium Hydroxide and activated Carbon to recover the gold. Heap Leach Pads are set up using impermeable layers. The Heap Pads are constructed, the recovery ponds are made, the specialized lab for processing is made to ensure 0% of free cyanide is made during the process.

Cyanidation of tailings for gold using sodium cyanide is a commonly employed method in gold mining for the extraction of residual gold from mine tailings. Mine tailings are the leftover materials that remain after the primary gold extraction process.

In the cyanidation process, sodium cyanide (NaCN) is used as the leaching agent. It reacts with gold particles present in the tailings, forming a soluble complex known as sodium gold cyanide. This complex allows for the dissolution and extraction of gold from the tailings.

The process typically involves the preparation of a cyanide solution by dissolving sodium cyanide in water. The cyanide solution is then sprayed or poured onto the tailings, allowing it to percolate through the material. As it passes through the tailings, the cyanide solution interacts with the gold particles, leaching them from the tailings.

The gold-cyanide complex that is formed is then separated from the solution. This is often achieved through processes such as carbon adsorption or precipitation. In carbon adsorption, activated carbon is used to adsorb the gold-cyanide complex, which is later desorbed and recovered through further processing. Alternatively, the gold can be precipitated from the solution by adding a suitable reagent, such as zinc or electrolysis.

It is important to note that the use of sodium cyanide in gold cyanidation requires careful handling and adherence to strict safety protocols. Cyanide is a highly toxic substance, and proper measures must be in place to prevent its release into the environment. Mining operations employ various safety measures, such as containment systems and appropriate waste management, to ensure the responsible use and disposal of cyanide solutions.

Cyanidation of tailings using sodium cyanide remains a widely utilized method for gold extraction due to its efficiency and effectiveness in recovering residual gold from mine waste. However, it is crucial for mining operations to prioritize environmental stewardship and implement stringent safety practices to mitigate potential risks associated with the use of cyanide.

After the termination of heap leaching, the next step is to neutralize the sodium cyanide solution. This is achieved by using hypochlorite, which reacts with cyanide to form non-toxic compounds. Before neutralization, a minimal analysis is conducted using silver nitrate and potassium iodide. This analysis helps determine if any residual cyanide is still present in the solution. The goal is to ensure that the cyanide concentration is reduced to 100% absence in the solution. Once the absence of cyanide is confirmed, the solution can be safely discarded. This process is crucial to prevent any potential environmental impact and ensure the responsible management of cyanide solutions in the mining industry.

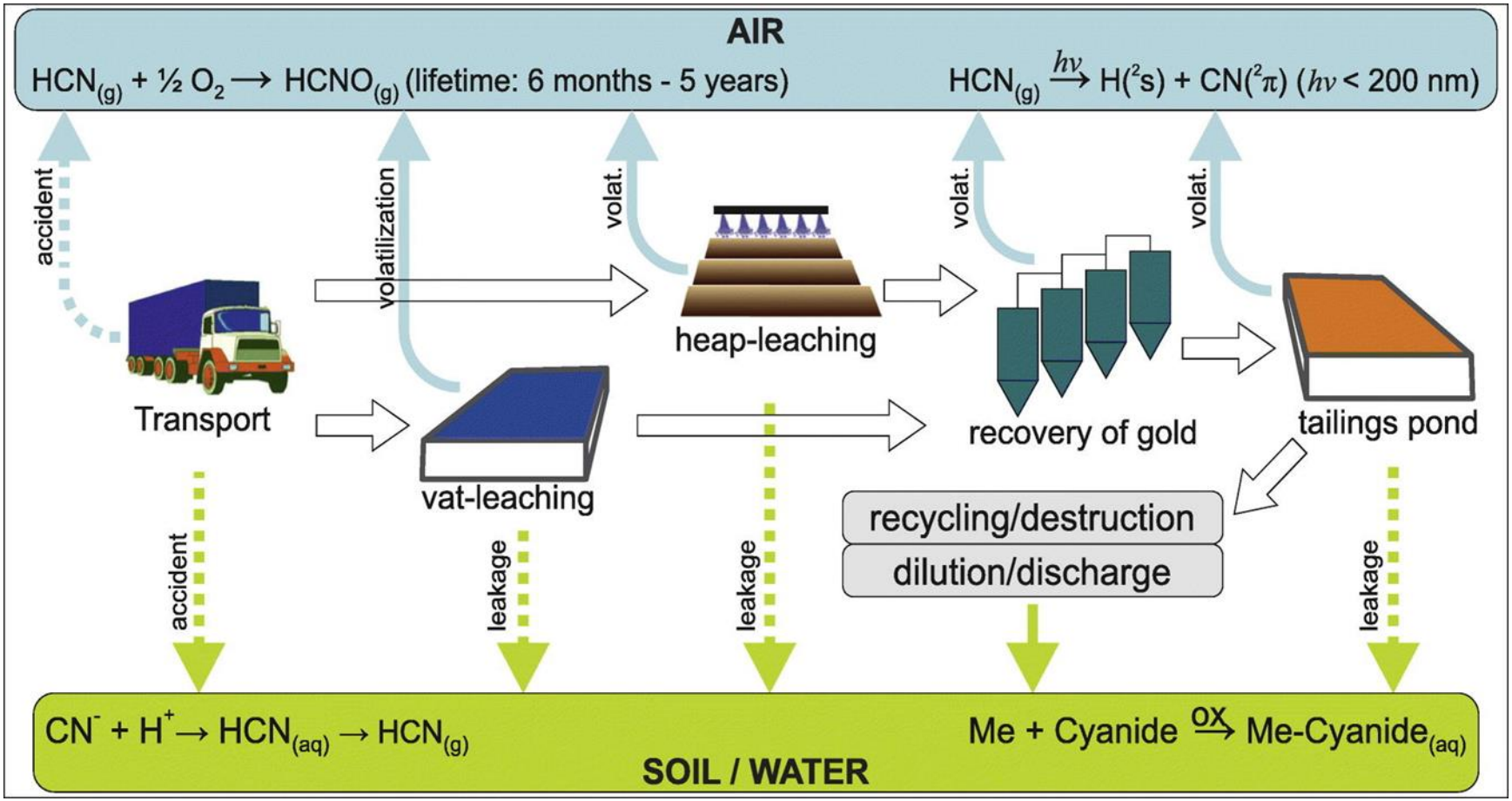

Fig 3. Aremu Gold Ore Processing Flowsheet

6 Equipment List

The Plant and Machinery that will be used to set up the Production Facility will include:

EQUIPMENT LIST (Price Used)	QUANTITY	Unit Cost (GYD)	TOTAL COST	TOTAL COST USD
Haulage Trucks (MAN TGS WW 4x2)	1	$ 5,000,000.00	$ 5,000,000.00	$ 23,809.52
325 Hydraulic Excavators (Caterpillar)	1	$ 30,000,000.00	$ 30,000,000.00	$ 142,857.14
950 Wheel Loader (Caterpillar)	1	$ 15,000,000.00	$ 15,000,000.00	$ 71,428.57
Generator (450KVA.) Caterpillar	1	$ 3,500,000.00	$ 3,500,000.00	$ 16,666.67
ATV	1	$ 3,500,000.00	$ 3,500,000.00	$ 16,666.67
Fuel Pump	1	$ 50,000.00	$ 50,000.00	$ 238.10
Carbon in Leach Vat	1	$ 250,000.00	$ 250,000.00	$ 1,190.48
Tower Light	1	$ 500,000.00	$ 500,000.00	$ 2,380.95
Welding Plant	1	$ 2,500,000.00	$ 2,500,000.00	$ 11,904.76
Rectifier	1	$ 12,000,000.00	$ 12,000,000.00	$ 57,142.86
Electrolysis Machine	1	$ 500,000.00	$ 500,000.00	$ 2,380.95
		Total	$ 72,800,000.00	$ 346,666.67

Table 1. Equipment List

There are no communities, settlement nor any major water way in close proximity to TMGEI gold project.

Communities/Town	Distance/Direction
Bartica	46 km SE
Bartica Airport	41 km SE
Georgetown	225 km
Aremu River	5 km NW
Karrau Amerindian Tille land	32 km SE
Batavia Amerindian Tille land	24 km SE
Cuyuni River	7 km N

The project will also create employment and allow employees to be trained in various vocations. Approximately 80 jobs are expected to be created during construction and 50 jobs during operation. The possible areas for employment are listed below:

Construction Phase	Operational Phase
Labourers	Maintenance Personnel
Electricians	Operators
Engineers	Foremen
Masons	Engineers
Carpenters	Cleaners
Surveyors	Security
Security	Electricians
Drivers	Drivers
Cleaners	Linesmen
Caterers/Cooks	Officer Personnel
Supervisors	Supervisors
Managers	Cooks
H&S Officers	Managers
Logistics	H&S Officers
Accountants	Accountants

7 Implementation Schedule

Task	Years								
	2023	2024	2025	2026	2027	2028	2029	2030	2031
Construction of Dwellings & Admin Structures									
Acquisition and Construction of Process Plant									
Acquisition of Haul Truck & Loader									
Production of Gold									
Monitoring & Reporting Operational Phase									
Rehabilitation Works									
Monitoring & Reporting Post Closure Phase									

8. Description of the physical environment

This section provides a detailed overview of the physical environment within the Project area. To understand the possible environmental impacts that may occur due to the construction and operation of the TMGEI Gold Project, it is essential to generate baseline data of the region to understand the environmental components of the project site. The baseline data generated will give insight into the potential critical impacts, which in turn will help in providing adequate environmental safeguards. In this report, the environmental characteristics of the project area were established through extensive literature research, field sampling/measurements, laboratory analyses, stakeholder consultation and data interpretation. Data from literature research (climate, topography, etc.) were obtained from several existing sources. The environmental data obtained covers the proposed project site and its surroundings.

1. Climate

Guyana is characterized by a Tropical Humid Climate, with high but variable rainfall, humidity, and a small temperature range with two wet and two dry seasons. The majority of the country is covered by dense tropical forest with savannas on the coast and in the southwest. The rainfall pattern is influenced by the movement of the ITCZ (Inter-Tropical Convergence Zone). The tropical heat and humidity are influenced by the north easterly winds blowing from the Atlantic Ocean. Notably, Guyana's climate is also influenced by the effects of the El-Niño (higher temperatures) and La Niña (higher precipitation) phenomenon. Temperatures in Guyana vary geographically, with high altitude regions experiencing cooler temperatures than the coastal, lowland and savannah zones (Government of Guyana, 2013). The climate is tropical with two wet seasons (April to august, and December-February), and two dry seasons (February to April, and August to December). The average temperature is 260C (790F), with an average mean rainfall of 2,124 mm, with major inter – annual variations in rainfall attributable to the 'El Nino/ La Nina' cycle. On the contrary, Guyana's savannah experiences one wet season and a longer dry season with a mean annual precipitation of 1400-1800mm/year (Government of Guyana, 2013). Weather along East bank varies but it falls under the rain belt of Guyana, the following data (Table 3) is available and can be considered as the climate condition of the site.

2. Topography

The Aremu River and Mara-Mara Creek area experience on average 50-177 mm rainfall monthly and temperatures between 24 degrees Celsius – 36 degrees Celsius. The area is covered in tall evergreen flooded riparian forest that is very dense, and the area is hilly.

3. Soils

The soils have been developed on old deltaic and continental deposits with some inclusions developed on crystalline rocks. The majority are red-yellow latosols and sandy regosols with steep, gravelly and truncated phases (Government of Guyana, 2013). The soils have been mapped as:

- 1c Regosols, white quartz phase (Quartzipsamments with Psammaquents, Endoaquepts)
- 2c Red yellow latosols, light textured phase (Ustochrepts with Quartzipsamments, Kanhaplustults)
- 3c Red yellow latosols, steep phase including red, yellow podzolic intergrades to red-yellow latosols (Kanhaplustults with Dystrochrepts, Kandiudults)
- 4c Regosols, laterite gravel phase, including red-yellow latosols, forest and savannah phases (Kanhaplustults with Kandiudults, Eutrochrepts)
- 5c Red yellow latosols, groundwater laterites and lithosols (Kanhaplustults Plinthudults, Kandiudults)
- 6c Groundwater laterites, truncated phase and red-yellow latosols (Plinthustults Plinthaquults, Kanhaplustults)

4. Geology

The area may be divided into three separate lithologies: metasediments and intermediate volcanics, argillaceous sediments, and the Avanavero suite.

The Avanavero suite is part of a Large Igneous Province, known as the PAPA dykes. These regions are typically composed of granitic plutons, dykes, and sills that feature mafic, ultramafic, and gabbroic intrusions. They are predominantly melanocratic rocks with a fine to coarse grained matrix.

The younger granites in Guyana are predominantly composed of granitic rocks, which are coarse-grained and light-colored intrusive igneous rocks. These granites are typically rich in quartz, feldspar (such as

orthoclase and plagioclase), and often contain minor amounts of mica (biotite or muscovite) and other minerals.

Exposures of meta- basic rocks are frequently encountered. These include meta-basalts, dolerites, and meta-gabbros found across the proposed area. These are more prevalent in places with higher laterite-capped hills. A vast area formed primarily of meta-gabbro is considered to be part of a younger unit.

Other work in Guyana (Gibbs & Barron 1993) indicates that these rocks constitute the lowest half of the Barama-Mazaruni Super group's greenstones, with small interbedded siliceous metasediments (e.g., cherts and siltstones) and basaltic tuffs also present. It is believed that these rocks grade upward to additional andesitic volcanics. This could be a component of an ophiolite suite. Meta-diorites have been intruding into this unit locally.

One of the more frequently exposed outcrop types in this area are the Intermediate calc-alkaline andesitic greenstones and basaltic andesites, frequently porphyritic. Some of these rocks are vesicular in appearance and may be pillow basalts. There have been rare interbedded cherty rocks discovered. Coarser rocks include agglomerates and welded breccias, as well as some welded andesitic tuffs.

The Project area can be characterized by (yellow areas) deep well drained brown sandy soils of low fertility, gently sloping to rolling topography. The red areas are predominantly brown sandy clay loams and reddish-brown gravelly clays of low fertility. Hill to steep slopes make cultivation difficult and erosion a serious hazard.

5. Hydrology

The Cuyuni River, like many rivers in Guyana, experiences a pronounced seasonal hydrological regime. It has distinct wet and dry seasons. During the wet season, which generally occurs from May to August, the river's flow increases significantly due to heavy rainfall, resulting in higher water levels and increased discharge. In the dry season, from December to April, the river's flow decreases, and water levels lower.

6. Surface Water

Guyana has an extensive network of rivers and streams that have many rapids and waterfalls, with an absence of naturally occurring lakes. Surface water (which is extracted from shallow reservoirs, streams,

or drainage canals) is primarily used for agricultural and industrial purposes. Only about 10 percent of the country's drinking water comes from surface water. Guyana faces the typical water pollution problems of developing countries in tropical regions. Biological and chemical contamination of surface water varies in magnitude according to location but is increasing with population growth and land use demands.

7. Water Quality

This refers to the biological, chemical and physical characteristic interactions of the water ecosystem (National Oceanic and Atmospheric Administration). Therefore, the environmental quality of the water has a direct influence on aquatic life and human health if point and non-point source pollution are left unchecked. Water quality tests are done to provide information on effluent discharge from a proposed project as well as from the source of activity downstream to assess the quality of the water. The assessment is done to establish baseline conditions of the surrounding environment, and to determine what extent if any, discharge from the operations can affect the aquatic environment.

Water samples were collected and analysed to determine the quality of surface water within, and around the project site. Certificate of Analysis for water samples were issued by the Guyana Water Inc. guided by the World Health Organisation Guidelines. The samples were taken following ISO Standard; ISO 5667 and EPA water quality regulations 2000. The parameters measured were pH, turbidity, total iron, total nitrogen, total dissolved solids (TDS), Phosphate, aluminium, total coliform and E. coli. High occurrences and changes in these parameters will provide an indication of potential of pollution which can affect aquatic life and human health. Furthermore, the results compiled were compared with the thresholds of water quality standards set by the GNBS General Environmental Guideline Values for Effluent Discharge. The water quality tests detected levels above the recommended limits for aluminium and Iron. The samples showed high turbidity and nitrates and contained varying amounts of coliform.

8. Ground Water

About 40 percent of the region, extending from the Atlantic Ocean in the northeast to the border with Venezuela in the west, where large quantities of fresh water are available from the coastal aquifer system. Ground water exploration during military exercises is recommended in this area, but accessibility may be

a problem. Ground water exploration during military exercises is not recommended in the rest of the region, which is in the interior plains (US Army Corps of Engineers, 1998).

When the project is approved, there will be two discharge points. The first allows discharge from the sedimentation pond into the drainage system along the Aremu Creek. The second is provided for discharge from the oil and grease separator adjacent to the workshop. The water quality criteria for discharge from the site is provided in Table 11.

Pollutant	**Concentration Limit**	**Discharge Point**
Non-filterable residue	50 NTUs	Discharge Point 1 & 2
pH	6.5-8.5	Discharge Point 1 & 2
Grease and oil	Visually free	Discharge point 3

Table 1. TMGEI water quality criteria

Monitoring of pH and NTUs is required by GGMC and EPA at Discharge Point 1 & 2, and visual monitoring of grease and oil to ensure that it has been removed at Discharge Point 3. This would allow TMGEI to better manage surface water quality.

9. Noise Quality

Noise pollution is the regular exposure to elevated sound levels that can possibly lead to adverse effects in humans or other living organisms (Environmental Pollution Centers, 2017). As such, the intensity of the sound generated by various activities is key concern to health. Prolonged exposure to sounds louder than 80dB is considered hazardous to hearing (EPA Guyana, 2017) therefore, human hearing is only receptive to certain sound levels. An A-weighting noise assessment provides data on existing noise levels as it

establishes baseline conditions of the surrounding environment and determines to what extent if any, noise from the operations can affect the general environment and the health of staff and community.

Noise measurements were taken at various strategic locations within, and around the proposed project site. The existing sound environment is characterized as an industrial/agricultural zone because of current operational activities. These sample data will be taken according to the ISO Standard 3741, where the acoustics of the environment was well below accepted levels and the data falls within EPA Noise Management Regulations of 2000.

10. Air quality

Air pollution is contamination of the indoor or outdoor environment by any chemical, physical or biological agent that modifies the natural characteristics of the atmosphere (World Health Organization, 2012). This is becoming an increasingly significant problem to growth and development of cities and communities. The air pollutants of major public health concern include particulate matter, carbon monoxide, ozone, nitrogen dioxide and sulphur dioxide and metals, like lead (Hedges 2004, World-Health-Organization 2012).

Particulate Matter (PM) - This is a mixture of solid particles (dust, dirt, soot, and smoke) and liquid droplets suspended in the air. These PM emissions originate from a variety of sources, such as vehicles, factories, industrial sites, construction sites, tilled fields, unpaved roads, stone crushing, and burning of wood (Hedges, 2004). Particulate matter comprises both coarse and fine particles. The coarse particles (PM10) have an aerodynamic diameter between 2.5µm and 10µm and are formed by mechanical disruption (e.g., crushing, grinding, abrasion of surfaces), evaporation of sprays, and suspension of dust. Fine particles have an aerodynamic diameter less than 2.5µm (PM2.5). These particles are formed from gas by chemical reactions; and condensation of high-temperature vapours during combustion (Fierro, 2000).

Total Suspended Particulates (TSP) - This refers to all particles in the atmosphere that are less than 100 micrometres. The amount of PM10 and PM2.5 are related to the amount of total suspended particulates (TSP) in the air (Alias, Hamzah, and Kenn 2007).

Particulate Matter Guidelines and Standards are instituted (Table 6) due to short term and long-term health effects including premature mortality, chronic respiratory disease, acute respiratory systems, decreased

lung functions and aggravated asthma, persistent cough, phlegm, wheezing and physical discomfort (Fierro 2000, Alias, Hamzah and Kenn 2007). These health effects are especially associated with PM10 and PM2.5. The PM10 fraction from TSP can reach the lower regions of the respiratory tract. On the other hand, PM2.5 can absorb more toxic and carcinogenic compounds than larger particles and penetrate more easily deep into the lungs (Alias, Hamzah and Kenn 2007). Additionally, there is increased harm to the environment as PM is a major source of haze that reduces visibility, causes changes to nutrient and chemical balance of the soil and aquatic environment, erosions and staining of structures (residential, commercial, or cultural monuments) (Hedges 2004).

10. Biological Environment

Flora

Areas situated close to the mouth of the Aremu River have lost much of its primary vegetation and natural habitats to infrastructural development and the expansion of mining activities. Several types of modified habitats are associated within the project site which included approximately forty-one (41) plant families with one hundred and eleven species (111) species. The project area is dominated by Mora gonggripi (Morabukea), Pithecellobium jupumba (Hutuasa) and Eschweilera coroiacea (Black Kakaralli). However, large swamps are also located in the project area, mainly resulting from past mineral exploration and influence growth of aquatic plants species, which are of no significance economically.

Fauna

The Cuyuni River in Guyana supports a diverse range of fauna, including both aquatic and terrestrial species. Here are some examples of the fauna found in and around the Cuyuni River:

Fish: The Cuyuni River is home to numerous species of fish, including economically important and ecologically significant ones. Some common fish species found in the river include piranhas, catfish (such as the red-tailed catfish and spotted catfish), arapaima (a large freshwater fish), cichlids, electric eels, and various species of characins.

Reptiles: The river and its surrounding areas provide habitat for several reptile species. This includes caimans, such as the spectacled caiman and black caiman, turtles (including various freshwater turtle

species), and snakes like the green anaconda, boa constrictors, and various venomous species like the bushmaster and lancehead vipers.

Birds: The Cuyuni River and its riparian habitats attract a wide variety of bird species. Some of the notable bird species found in the area include macaws, toucans, herons, kingfishers, jacamars, parrots, eagles, ospreys, and various species of waterfowl.

Mammals: The riparian forests and adjacent habitats along the Cuyuni River provide suitable habitats for several mammal species. Some common mammals in the region include capybaras (the largest rodent in the world), giant river otters, tapirs, various monkey species (such as howler monkeys, spider monkeys, and squirrel monkeys), jaguars, ocelots, and peccaries.

Amphibians: The Cuyuni River and its surrounding areas are home to numerous amphibians, including frogs and toads. Species such as poison dart frogs, tree frogs, and various toad species can be found in the region.

Threatened and endangered species

No species that is listed as endangered has been encountered in the project area.

9. Utilities

Water Consumption

Water requirement will be supplied from either a well or the fresh water may be needed will be obtained from ground wells close to the plant.

Fuel Consumption

A 10,000-gallon fuel tank will be stored on site for power generation at the Plant, Figure 6.

Electricity

The required power of the plant will be provided by the company. Total estimated demand of the plant is around 40 KVA, which would be supplied by high- tension lines. All substations will be indoor type and protected against ingress of dust. Emergency load will be supplied by emergency stand-by- generator.

10. Socioeconomic Conditions and Management Plan

The project can potentially result in influx into the concession and the problems associated therewith due to mine area development. TMGEI will actively discourage influx into the area and not allow outsiders to settle in the periphery of the site.

Guyana population was estimated at approximately 782,000 persons in 1999. About 85 -90 percent of the population is concentrated along a narrow belt which parallels the Atlantic Ocean. The population density of this area is approximately 100 persons per km' compared to an average density of 3.6 persons per km*. Approximately 25% of the country population resides in the capital, Georgetown.

The average household size in the country is 4.7 persons. Nearly 1/3 of all households are headed by women with the trend being more pronounced in urban areas. Approximately 1/3 of the population is younger than 14 years. The ratio of men to women in the population is about 0.97.

The ethnic composition of Guyana includes East Indians (49%), Africans (36%), Amerindians (7%), mixed races (7%) and Chinese, Europeans and others (1%). The Amerindian tribes, including Arawaks, Patomonas,, Caribs and other groups, live mostly in the interior of the country. In the coastal regions, Africans represent 40% of the population, East Indians, 45% and mixed races, 13%, but Amerindians less than 1%.

In the 1991 Census, the national population was about 724,000. The population growth in the intervening years has been very low, often as little as 0.1-0.5% per year. The primary reason for this slow growth is the high levels of emigration from Guyana. The estimated net migration rate for 1999 was —12.2 persons per 1,000.

The major sectors of the economy are agriculture, forestry, fishing, mining, and, manufacturing. Sugar, rice, bauxite and gold account for 75-80% of export earnings. In 1999, the manufacturing sector accounted for 10% of GDP and 12% of employment. Industrial estates are being established to facilitate the further

development of value-added activities (e.g., furniture, textiles and food processing).

Tourism is presently underdeveloped in Guyana although it also represents an integral part of the country economic development strategies. The potential direct and indirect economic benefits of tourism are significant, particularly for tourism products that target the natural and cultural assets of the country. Legislation is pending to create a tourism authority, however substantial efforts will also be required to develop and resource effective marketing strategies and to strengthen the tourism infrastructure.

TMGEI will also train its personnel on site to handle influx sensitively without conflict or security issues. TMGEI will 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 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. Inadequate dissemination of information on the operations can potentially generate animosity between communities in proximity to the operations, the GGMC and TMGEI. The Company will liaise totally with indigenous communities. Company employees would be restricted to the mine site and would have no interaction with the indigenous communities. The operator will give priority to the recruitment of unskilled employees such cleaners and field hands from indigenous communities. The employer will mount training programs and potentially apprenticeships for residents of indigenous communities to boost local labour supply and will provide employment opportunities for motivated individuals from the indigenous village who successfully graduate from the training programs. The intent is to eventually have a significant majority of the unskilled labour pool be represented by individuals from the indigenous communities. 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.

11. Potential Impacts and their significance

1. Air Quality Management

The operation phase of the project will see the generation of dust and combustion emissions from:

- Stripping topsoil and overburden
- Loading and unloading of haul trucks
- Transport/haulage of extracted material from the pit to the processing facility
- 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 loading and unloading of haul trucks, haul roads, crushing and screening 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:

- Minimising drop heights from vehicles
- Limiting vehicle speed
- Employing dust suppression technique such as applying water or non-toxic chemicals
- Maintaining construction equipment according to manufacturer's specifications
- Implementation of these mitigation measures will result in minor impacts (low likelihood, low severity).

2. Geology

During processing, tailing fine sediments will be taken to process site, no new area will be exploited. The

present geologic profile of the area consists of a stratum of alluvial soils overlying residual soil material derived from weathered sedimentary rocks underlain by igneous and intrusive rocks. 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 localised to the site and will not be mitigated.

3. Generation of Solid Wastes Management

The operation of the gold project will generate very minimal 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 odours, attraction of vermin, and creation of human health and safety hazards.

This impact is rated as medium (medium likelihood, low severity). The Project will minimise and mitigate these potential impacts by developing and implementing the respective waste management plans for each type of solid waste anticipated to be generated by the operation phase of the Project. Reuse and recycling would be preferred over disposal to the extent practicable. Under proper management (for cyanide management see its plan), the residual impact associated with solid waste generation is considered to be minor (low likelihood, low severity).

4. Water Management

Several types of potential surface water impacts are attributed to processing activities, including sediment loading and low pH due to acid mine drainage (AMD).

Precipitation may induce leaching of chemicals from waste rock and overburden stockpiles at the Project site. 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 minimise potential impacts to surface water; and,
- Periodic monitoring of the physical integrity of the overburden stockpiles during operations to minimise the potential for discharges due to slope failures.

Implementation of these mitigation measures will result in minor impacts (low likelihood, low severity).
Breaches and overtopping of the water management pond will result in major impacts (high likelihood, high severity) to surface water quality. These impacts will be mitigated by utilisation 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);
- Stormwater runoff from developed areas will be channelled 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 site dewatering operations and slurry from crushing and screening operations. Groundwater from the mine dewatering operations will be discharged to surface water after passing through the water management pond to ensure the attainment of discharge effluent/water quality standards. The extracted groundwater will also be subject to conditions detailed in the Erosion and Sediment Control Plan to minimise sediment discharge to surface water during operations. The potential discharge of groundwater from the pit dewatering activities is considered to be a minor impact (low likelihood, low severity). No mitigation measures are proposed.

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

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

5. Biodiversity Management

Loss of Aquatic Habitats

The operation of the mine and associated infrastructure will impact 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 area, the water management 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 minor impact (low likelihood, low severity). With application of the mitigation measures, for surface waters and groundwater, the residual impact rating will be low (low likelihood, low severity).

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 minimised by implementation of the following:

- Minimisation of the Project footprint;
- Initiating restoration as soon as practicable in temporary work areas.

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

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:

- Minimisation of the Project footprint; and,
- Performance of preclearance surveys.

6. Noise and Vibration Management

During the moving of tailings 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. 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).

In addition to the earthen noise barriers created to minimise impacts, additional mitigation measures, to mitigate 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 minimise 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;
- Conducting regular hearing tests and maintaining records of results for workers exposed to high noise levels.

12. 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 standalone project. This section provides a description and analysis of the potential cumulative impacts of the proposed gold 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.

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. The area is well known for its mining activities and has historically been the lead geographical region in gold 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.

The area is heavily mined out and a lot of tailing materials that can be reprocessed for gold recovery instead of giving out new mining areas. 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 loggers and miners and TMGEI. 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 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 site. At a minimum the committee will conduct periodic stakeholder

and access management reviews. These measures will result in in significant 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 Bartica Sub-Region;
- Guyana Forestry Commission;
- Guyana Geology and Mines Commission;
- Guyana Gold and Diamond Miners Association;
- Local WWF and CI conservation NGO offices;
- Other regional stakeholder organizations.

13. CLOSURE AND DECOMMISSIONING PLANNNING

In the context of this EMP the term 'closure' is taken to encompass decommissioning, demolition and rehabilitation activities prior to closing out activities at the project site. Considering the stage of the project, TMGEI has prepared a Conceptual Closure and Decommissioning Plan which outlines, in conceptual manner, the measures that will be employed during and at the end of mining to allow for proper closure of the project so as to ensure that the site is rehabilitated to an appropriate level. A detailed Closure and Decommissioning Plan will be prepared at a later stage and would be developed in consultation with relevant authorities and stakeholders in advance of closure of the project.

1. Factors that may Cause TMGEI Closure

There are several factors which could result in either the temporary or permanent closure of the TMGEI Project. These include:

- Decrease in market demand for aggregates in Guyana rendering the project not viable.
- Increase in operational costs making the prices for which materials from the TMGEI project are sold uncompetitive in local markets thereby reducing the market share and productive viability.
- Irregular operations not allowing constant production hence irregular supply to markets with consequential loss of market share.
- Exhausting the quantity of commercial aggregates in the project area.
- Mechanical and other problems with machinery and equipment resulting in delayed and reduced supply to market.
- Accident or emergency causing a temporary or permanent closure of operations.

The closure of the project could have wider national implications and could potentially affect the price and demand of gold thereby having an impact on construction and infrastructure developments.

2. Principal Closure and Decommissioning Issues

The principal closure issues related to the TMGEI operation are identified as follows:

- Notification to staff, suppliers, regulatory agencies in accordance with the Laws of Guyana and in particular the Labour Laws.
- Severance Pay to Employees and as required by the Labour Act and Severance Payment Act.
- Payment of Fees and Royalties to the respective Government Institutions/Agencies such as GGMC, EPA, Guyana Revenue Authority and others.
- Decommissioning of all movable plant and machinery.
- Removal of all machinery and equipment from the site.
- Dismantling of all buildings and structures.
- Closeout of haul roads.
- Removal and disposal of waste materials.
- Rehabilitation of mined out areas. This is to be done progressively as the mining activities advance within the project.

3. Objectives of Closure, Decommissioning and Rehabilitation

To assist in ensuring that the closure process is effective, progressive rehabilitation will be done throughout TMGEI project life. Therefore, the objectives of the closure, decommissioning and rehabilitation process are to ensure the:

- Protection of human health and safety.
- Progressive rehabilitation of the site during operations.
- Vegetation is resilient, self-sustaining and comparable to the surrounding areas.
- Project does not compromise the quality and quantity of surface water or groundwater to existing users and water dependent ecosystems.
- Need for long term monitoring and maintenance is reduced through design and construction of heap leach pad platforms that are physically and chemically stable.
- Residual risks and liabilities are identified and can be readily controlled.
- TMGEI closure process and lease relinquishment occur in a cost-effective and efficient manner.
- Recommendations of stakeholders such as the RDC, Town Council, EPA and the GGMC for final use of the site incorporated in closure planning.
- Full cost of decommissioning and rehabilitation is understood and that a mechanism for funding exists.
- Development of an environmental monitoring and reporting programme which is focused towards demonstrating the achievement of closure outcomes.

4. Conceptual Closure and Decommissioning Plan

At this stage of the project, only a conceptual Closure and Decommissioning Plan can be presented. A detailed Plan would be prepared closer to the end of life of the project, and with inputs from the relevant stakeholders to determine potential on the future uses of the site. The key activities included in this conceptual Plan focus on progressive reclamation of the site during the operational phase. These measures are described below. Additional issues related to project closure and all of the decommissioning activities

681 Culvert City Lethem, Region 9, will be addressed in the Detailed Closure and Decommissioning Plan to be prepared at a later stage.