ENVIRONMENTAL IMPACT ASSESSMENT REPORT
MAPLE CREEK PROPERTY
FOR
VANNESSA (GUYANA) INC.
49 EASTERN HIGHWAY
LAMAHA GARDENS
GEORGETOWN, GUYANA

GROUND STRUCTURES ENGINEERING CONSULTANTS INC.
212 D'ANDRADE STREET, NEWTOWN
KITTY, GEORGETOWN
GUYANA
JANUARY, 2002

EXECUTIVE SUMMARY

Vannessa (Guyana) Inc. a subsidiary of Vannessa Ventures Ltd currently exploits a mine at Maple Creek at the confluence of the Potaro and Euwang Rivers for both gold and diamond. The mine operates under a mining permit issued by the Guyana Geology and Mines Commission (GGMC). The firm plans are to expand the operation of the mine. The firm has applied to GGMC for the issuance of a Mining License to supersede the Mining Permit in accordance with the Guyana Geology and Mines Commission (GGMC) regulations. The expanded operation will be operated in accordance with the GGMC Mining License and the Guyana Environmental Protection Agency (EPA) guidelines.

This EIA has been prepared to satisfy both GGMC and EPA mandate and includes an assessment of the potential environmental consequences of the mining operation including impacts on surface water and groundwater quality, geology, noise, odor, dust, aesthetics, air quality, aquatic and terrestrial life, cultural and archaeological resources and socio-economic conditions. 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 assessment also identifies the project-environment interactions during operation and after closure of the mine.

Conventional surface mining methods would be used for mining. The overburden will be cleared and stockpiled for mine reclamation. Ore will be recovered after removal of the overburden and will either be stockpiled or hauled directly to the processing plant. At the plant the ore will be fed unto a hopper and conveyor. The conveyor will feed the ore into a washing circuit. A Dense Media Separator (DMS) Unit will recover diamond. A Spiral Concentrator and a Wiffle Table will recover gold. Tailings from both the wash plant and secondary concentrating plants will be fed into an interconnected network of tailings ponds. The ponds will have adequate capacity to retain all tailings discharged by the process.

The area mined during the process will be reclaimed during the ongoing mining process. Mine pits will be backfilled using overburden material. The coarse and fine fractions of the tailings removed from the ponds will also be mixed and redeposited into the mine cuts.

This EIA also considered alternatives to the proposed action. These alternatives were:

- No Action (Do-Nothing) alternative
- Alternative mining and ore recovery methods
- Alternate mineral recovery methods

This environmental impact statement describes the resources in the environment contiguous to the proposed Maple Creek property, which could be impacted by expansion of the mining operation.

The project and its alternatives will impact the physical, biological and social environments. Mining will result in the depletion of a non-renewable resource, however the area will be made accessible by mining activity and can be converted to agricultural or other uses after closure of the mine. The following sections detail the environmental consequences of the operation of the mine.

Climate: The burning of debris from trees and other vegetation will emit gases and particulate matter. Air quality will also be impacted by emissions from vehicles and engines. These emissions are within acceptable standards and will not have any effect on climatic conditions in the site area or elsewhere. The increased area of surface water bodies will result in increased evaporation and lower temperatures in the site area. The project area will be cleared for mining and lower temperatures will be counteracted by increased exposure.

Geology: The mining and reclamation will result in changes in the topographic height, slope relief intensity, degree of shaping and exposure of the area. The project will also alter the surficial geology within the area mined. The modification of surficial soils will influence the water balance in the area.

Slopes created by the operation will be more stable than those currently occurring at the site and the possibility of slope failures will decrease. Slope failures served as an indirect method of nutrient replenishment to areas down gradient from the slopes. This source of nutrient replenishment will be eliminated.

Water Resources:. Water quality may be impacted by wastewater discharges from the mine 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. Discharge of wastewater into surface water may impair surface water quality by causing changes to its physical, chemical and biological properties.

The introduction of sediment by surface runoff and mine drainage may introduce additional nutrient loads to the streams. The altered nutrient levels can potentially result in eutrophication. Pollution by contaminated surface runoff and mine drainage 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.

Land Use: The project will result in a change in vegetation cover. This may increase soil erosion, soil compaction and nutrient leaching from the surficial soils. The size of forest stand will initially decrease and will alter living conditions for flora and fauna. In addition, the loss of forested areas will expose the cleared area to the full force of prevailing wind. The land reclamation and replanting may result in the introduction of trees not native to the site. Loss of vegetative cover will also alter the factors influencing how the precipitation divides up into evapotranspiration, surface run-off and groundwater recharge.

Vegetation: Clear-cutting of large tracts of tropical rain forest on poor soil, for mining, will make plant regeneration difficult. Burning and leaching deplete the soil of nutrients, and any new vegetation will consist of mostly grass species. During plant regeneration the area may encounter encroachment by particularly aggressive and unwanted plant species (pests) that exist in the area.

Wildlife: Clear cutting for the mine will fragment the area and reduce the size of the tree stands. The installation of plant facilities and roadway construction will form temporary barriers to the movement of animals. People moving along the road may harvest commercially valuable animal and plant species. Species population may decrease due to hunting and trapping.

Socioeconomic Conditions: Amerindians feel that the project will mean the loss of indigenous rights in the area. Hires from outside the communities may lead to a reinforcement of beliefs that development in the area is not meant to benefit residents of Madhia and the surrounding communities. Permanent settlements may develop around the project area based on the access roads constructed to the site. These settlements may lead to further harvesting of timber for housing and fuel and create increased demands for schools and waste disposal. Opportunities for paid employment may also change the traditional division of labour between men and women in the indigenous communities in close proximity to the site. Conflicts may develop between small-scale miners and Vannessa Ventures.

Noise, Odor and Dust: Dust emissions will be produced during the mining operation by vehicles using site roads and from overburden stockpiles onsite. Noise levels above the alert threshold of 86 decibels and hazard threshold of 95 decibels will be produced from heavy-duty machines operation.

Aesthetics: Landscape impacts would result from the clearing of vegetation and from change in the floristic composition of the area. The mine would be screened from external views by the forest hence visual impacts would not arise.

Traffic: The project will introduce some traffic into the area. Construction of a road to the mine site will create a corridor for traffic to move further west. The increased traffic, coupled with the steep terrain in the area may result in some instances of vehicular accidents on the road to the mine site.

Health and Safety: The operation of the mine will provide some health care to residents within the area. In addition, the managements system implemented for the mining operation will ensure no pools of stagnant water and/or waste tailings are on site thereby eliminating fertile breeding grounds for malaria-bearing mosquitoes

Mitigation and monitoring plans have been developed to mitigate the environmental impacts associated with the proposed action. The Mitigation Plan incorporates measures that include protection, mitigation, and enhancement measures. The environmental mitigation measures in this plan include:

- Technology, disposal methods, and engineering designs
- Pollution controls, recycling and conservation of resources, monitoring, special social services or community awareness and education
- Compensatory measures for restoration of altered resources

The Monitoring Plan has been developed to assess the effectiveness of the management plan. Monitoring would be undertaken to evaluate the success or failure of the environmental management plan measures and to reorient that plan, if required. The management plan has been developed to ensure that the impacts that cannot be mitigated are minimized to the maximum extent possible.
The combination of the environmental mitigation plan and the environmental monitoring plan will result in the creation of a mechanism for the effective management of all environmental consequences associated with the project to enable the project to proceed in an environmentally sound manner.

The following would not be impacted by the project:

- **Threatened and Endangered Species**
- **Archaeological & Historical Resources**
- **Paleontology**

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1.0 PURPOSE AND NEED

1.1 Introduction

Vannessa Ventures has several properties on the Potaro River at its confluence with the Euwang River. The properties are all located northeast of the Roraima escarpment near the Kaieteur Gorge where the Potaro River emerges from the plateau. The properties allocated to Vannessa are shown on Figure 1. The specific area being considered by this study lies west of two prominent topographic highs, east of the Euwang River and includes the current drainage of Maple Creek. The area is identified as V-2/MP/000/000 and V-2/MP/000/001 on Figure 1 and its total area of approximately 2100 acres is situated in a small valley between adjacent hills.

1.2 Purpose Of And Need For Action

Vannessa Ventures currently exploits a mine at the site for both gold and diamond. The mine operates under a mining permit issued by the Guyana Geology and Mines Commission (GGMC). Future plans are to expand the operation of the mine after the issuance of a mining license by GGMC. The issuance of a Mining License will qualify the company for all duty free and tax benefits available to an investment of the size being proposed which a Mining License governs.

The purpose of the proposed action is therefore to expand a mine operating under a mining permit in the area identified as Claim Nos. V-2/MP/000/000 and V-2/MP/000/001 on the Survey Department of Guyana, Kaieteur, Sheet No. 43NW in the vicinity of Maple Creek and the Euwang River in the Potaro River basin. To attain the objectives of the proposed action a surface mine will be operated in the area.

The action is needed to recover diamonds and gold confirmed to be present at the location by both Ground Penetrating Radar (GPR) survey and by the excavation and mining of test pits at selected locations within the area. The results of the survey and test pit excavation have convinced Vannessa Ventures to develop the claims identified as V-2/MP/000/000 and V-2/MP/000/001 into an expanded diamond and gold mining operation.

The firm has consequently applied to GGMC for the issuance of a Mining License to supersede the Mining Permit in accordance with the Guyana Geology and Mines Commission (GGMC) regulations. The section of the area initially proposed for development within the area identified will extend from an east-west line on the Euwang River to an east-west line approximately 2 kilometres (km) north of that river. The areal extent of the area to be mined is approximately 2100 acres. The mine will be operated in accordance with the GGMC Mining License and the Guyana Environmental Protection Agency (EPA) guidelines.

1.3 Background

Mining in the Potaro River and more specifically in the Maple Creek watershed has continued since the end of the 19th century. Production and development was limited in the first quarter of the century, but increased significantly from 1924 to 1927. The tributaries of the Euwang River were exploited primarily for diamonds with some focused mining occurring within Maple Creek. The original mining was concentrated on the modern stream system with some limited mining in adjacent creek banks. Early mining methods were labour intensive and employed primarily hand digging and panning to recover product.

Several old test pits riddle the banks of Maple Creek and its tributaries where early miners (porknockers) searched for coarse alluvium. Mining by porknockers was followed by small mining operations performed with tom boxes and larger operations using sluice boxes. The original mining methods were very inefficient and resulted in the waste and burial of potential pay dirt.

Dredging has continued in and around the confluence of the Euwang and Potaro Rivers. Currently, there are approximately three dredges working in the area. Two of these are located downstream of the confluence and one is located upstream of the confluence. These operations are focused primarily on the recovery of gold. The current mining operations, performed by the dredges, consist of washing sediment by hydraulicing, which is followed by utilization of jigs and/or sluices for product concentration. This method allows a large volume of material to be processed in a short period of time, but does not allow the mineral bearing horizon to be identified since columns of soil are washed simultaneously.

Robin Rajkumar of Vannessa Ventures undertook several preliminary exploration projects on the Maple Creek property. These investigations identified the area as a potential diamond resource. Large pit sampling at three locations in the valley successfully produced diamonds. The sampling did not accurately quantify the resource or define the host material for the diamonds. It did, however, spark some interest in the diamond potential of the paleo-channel sediments.
Vannessa Ventures therefore contracted Adrian Hickin to conduct a Ground Penetrating Radar (GPR) Survey of the property in October 1999. The objective of the survey was to delineate and image the previously discovered paleo-channel and to characterize and correlate the stratigraphy of the valley-filled sediments.

The GPR results clearly revealed a buried paleo-channel filled with fluvial sediments. The weathered bedrock-sediment boundary was easily recognizable from the radar profiles based on the contrasting electrical properties. The pattern from the radar imaging appeared to represent sedimentary material and provided evidence of a change in river planform, from a confined channel in the south to a braided system in the north. The GPR profile identified the paleo-channel at an average depth of 10 metres (m) with a maximum depth extending to 16m.

The GPR survey was complemented by an exploration pitting program in February 2000. The objective of the pitting program was to confirm the existence of the sedimentary material and to assess the diamond and gold productivity of the Maple Creek deposits. This program consisted of five pits excavated and mined over a period of two months. The pitting program identified the basal material from the sediment-bedrock interface as a diamond and gold bearing host. Actual production from the pits is summarized in Table 1.

Table 1: Summary of Production during Exploration Pitting

Pit No	Volume of Material Processed (m^3)	Diamonds (carats)	Number of Stones	Gold (grams)
1	305	6.85	18	76.64
2	250	5.05	6	19.87
3	265	4.30	22	30.27
4	1620	179.65	1442	490.19
5	630	4.30	26	27.94

1.4 Scope Of Environmental Impact Assessment

This EIA has been prepared by GSEC to confirm to our proposal of October 31, 2000 to Mr. Erich Rauguth of Vannessa (Guyana) Inc. In accordance with that proposal this report includes an assessment of the potential environmental consequences of the mining operation including impacts on surface water and groundwater quality, geology, noise, odor, dust, aesthetics, air quality, aquatic and terrestrial life, cultural and archaeological resources and socio-economic conditions. 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 assessment also identifies the project-environment interactions during operation and after closure of the mine. The costs associated with mitigation of adverse environmental effects have also been estimated and are presented in this report.

The project area considered by this EIA is an area defined by the mining limits shown on Figure No. 1 and is approximately 2100 acres in area. For the reasons given, the following are not expected to be impacted and are dismissed from the scope of analysis:

Effects on threatened and endangered species and critical habitat: There are no threatened and endangered species and critical habitat in the project area based on field investigations conducted during the period March – April, 2001. No adverse impacts would result from the proposed action.

Effects on archaeological/historical resources: Historical evidence from the Walter Roth Museum indicate there are no cultural or archaeological resources within the study area. Further no items of archaeological significance were unearthed during the exploration pitting program. No adverse impacts would result from the proposed action.

Paleontology: The project would have minimal effect on paleontological resources. Potentially important fossil bearing locales are not known to be present in the area proposed for development into the mine.

2.0 DESCRIPTION OF THE PROPOSED ACTION AND ALTERNATIVES

2.1 Proposed Action

For the purposes of conducting this environmental impact assessment, the proposed action is the operation of a diamond and gold mining operation in an area identified as V-2/MP/000/000 and V-2/MP/000/001 on the Survey Department of Guyana, Kaieteur, Sheet No. 43NW in the Potaro River watershed. The site is located on the west bank of the Potaro approximately 50 kilometres (km) from Madhia and approximately 30 km from Kaieteur. The mine will be operated as a surface mine. Mining will entail removal of overburden from an area of approximately 2100 acres. Several facilities will have to be constructed on the site to support the mining operation. These facilities include personnel housing, equipment repair shops, fuel oil storage facilities and the ore processing facilities themselves. In addition an access roadway will be constructed from a point on the Potaro River opposite Pamela Landing to the mine site. This roadway will end at the Potaro River. A company owned and operated pontoon/barge will be used for crossing the Potaro River. The company will provide transportation across the Potaro for its personnel and facilities only.

The open-pit mining operation will consist of four separate and distinct phases. These phases will be as follows:

- Preliminary works
- Excavating and Transport
- Washing and Classifying
- Heavy Media Separating and Sorting
- Mine Reclamation

The mining operation will be undertaken with typical earthmoving equipment. The equipment will include as follows:

- 1 – Caterpillar D6 Bulldozer
- 1 – Caterpillar 320 Excavator
- 3 - 35 tonnes Dump trucks
- 1 – Caterpillar 245 Excavator
- 1 - Caterpillar 966 Loader

The process plant will consist of a washing circuit, a gold recovery system and a diamond recovery plant. Schematics of the plant and of the gold and diamond recovery circuits are shown as Figures 2 through 4.

2.1.1 Preliminary Works

Preliminary works will consist of the clearing of the forested area for development into a surface mine. The forest will be cleared using conventional methods. Chainsaws will be used for felling large trees. The underbrush will be cleared by hand cutting. The D8 tractor will remove all tree roots and stumps that cannot be cleared by hand or by chainsaws. Clearing will be limited to an area not greater than one acre at any time. Further clearing will occur as the mine progresses and as cleared areas are revegetated.

No timber concessions are known to be present in the area, however, clearing activities will also be coordinated with concessionaires, if determined to be present, to avoid impacting the normal function of their forest operations.

Felled timber will be used for construction purposes on site. Among the facilities to be constructed with timber are the living quarters and office areas for the project. Surplus timber will be stockpiled for use. Timber and other vegetative material not suitable for use as construction material will be burned or buried on site during the mining operation. It is expected that the material to be burnt will not exceed 10 tonnes each month.

2.1.2 Mining

Conventional surface mining methods would be used for this project. Overburden removal and ore recovery would proceed in a sequential manner. The area to be mined will be identified and surveyed. The survey would define the stripping and mining limits in the area and will demarcate the depth of stripping and mining at locations on a grid over the area to be mined. Locations will also be demarcated for stockpiling overburden and ore outside of the mining limits.

The overburden will first be cleared and stockpiled for mine rehabilitation. The ore will be recovered after removal of the overburden. Overburden removal and mining will be conducted with conventional earth moving equipment. The equipment to be utilized will consist of a Caterpillar D8 tractor equipped with a bulldozer and a Caterpillar 320 Excavator. The tractor will be utilized to remove overburden from the area to be mined. The excavator will be utilized for ore recovery. It will also load the ore or overburden into the haul trucks.

The ore will either be stockpiled or hauled directly to the processing plant. Haul roads will be constructed for haulage of ore to either the stockpiles or to the processing plant. Haul roads will be constructed to ensure minimum damage to forested areas and to ensure that streams crossings are kept to only the number absolutely required. Haul roads will also be cleared of all trees and vegetation. During clearing the movement of crews and equipment will be limited to the haul roads to minimize damage to forested areas.

Spoil pile and stockpile areas would be located and arranged in a manner to preserve trees and vegetation to the maximum practicable extent. On abandonment, all materials and debris would be removed from the stockpile locations. The area would be rehabilitated, as required, so that all surfaces drain naturally, blend with the natural terrain, and are left in a condition that will facilitate natural revegetation, provide for proper drainage, and prevent erosion.

During the overburden removal and ore recovery exercises and when weather and ground conditions permit, all deep ruts caused by mining equipment that are hazardous to the movement of equipment would be corrected. Damage to creeks and roads due to mining equipment would also be corrected.

2.1.3 Ore Processing

Transported run of mine ore will be stockpiled and treated at the washing plant by means of scrubbing and classification of the excavated gravel material into two component fractions of the following size:

- -22.00mm + 1.00mm and
- -1.00mm)

Two individual extractive metallurgical processes are characterized by the utilization of the following processes for the extraction of minerals encountered at Maple Creek

- Hydrostatic Separation
- Dense Media Separation

Metallurgical processes used to win the gold and diamond will not utilize reagents that are deleterious to the natural environment in any way.

2.1.3.1 Gold Extraction

The fine fraction from the scrubber/classifying circuit would be treated by primary and secondary jig treatment, whereby the extracted product of the primary jigs are reconcentrated in the secondary jigs thereby upgrading the concentrate quality. Final concentrates will be treated by the Wilfey tables. The product would be smelted by a Luca furnace in the metallurgical laboratory on site producing raw gold ingots.

2.1.3.2 Diamond Extraction

The coarser fraction from the scrubbing/classification unit would then treated by Dense Media Separation (DMS) extracting the diamond component from the gravel. The sink product is then dried, re-classified and treated further and enhanced by utilization of electronic sorting processes (Sortex). The tailings from the process are re-treated further by Oleophobic process capturing any evasive diamonds. Furthermore concentrate yield provided by the DMS plant will be in the 1% of plant feed range. The state of the art processing and recovery provides for strategic controlled security of all diamonds.

2.1.3.3 Tailing Disposal

Tailings product from both processes will be pumped to slime ponds and impounded. Water from the ponds will be recycled for plant process water and will also be utilized in the recovery processes. Preventative measures to be adapted for

integrity of the ponds will include adequate bunding and appropriate geotechnical and architectural design of impoundment area to preclude release of process water into the environment. The dry tailings product resulting from recovery operations will provide gravel ballast for road paving, construction and maintenance of such.

2.1.4 Reclamation

Areas in which mining operations have ceased will be rehabilitated as mining progresses. All mined out areas will be backfilled using a combination of the tailings and excavated overburden material. Backfilled area will be covered with any topsoil previously stripped from the area and leveled, and contoured to attain levels close to original surface and re-vegetated. It is planned that either congapump or cashew trees will be planted in reclaimed areas.

Care will be exercised during rehabilitation to preserve the natural landscape and reclamation operations would be conducted to prevent any unnecessary destruction, scarring, or defacing of the natural surroundings within the mining area. All vegetation would be preserved in the project area except where clearing is required for mining or for temporary access roads. On completion of the mining operation, all work areas would be scarified or left in a condition that will facilitate natural revegetation, provide for proper drainage, and prevent erosion. Temporary accesses that are not required for maintenance operations would be restored to the original contour. The surfaces of such accesses would be scarified as needed to provide a condition that will facilitate natural revegetation, provide for proper drainage, and prevent erosion. The reclaimed mined out areas will be contoured to ensure proper drainage and the area will be planted with cashew and/or congapump.

2.1.5 Support Services

Support services such as equipment maintenance, provision of project housing and other services activities would be performed to reduce accidental spillage of solid matter, contaminants, debris, and other objectionable pollutants and wastes into waterways in the project area. Such pollutants and wastes include, but are not restricted to, refuse, garbage, cement, concrete, oil and grease, and other petroleum products. All water discharges from the area will be done in a manner to ensure minimal discharge of sediments to any waterway. Excavated soil will not be stockpiled or deposited near or on the banks of waterways where they can be washed away by storm runoff. A well will be drilled on site to provide potable water for use by project personnel.

2.2 Alternatives

The alternatives to this project range from doing nothing in the area (No. Action) to action based on alternative land use and includes the following:

- Alternative mining and ore recovery methods
- Alternate mineral recovery methods

2.2.1 No Action Alternative

The No-Action alternative will entail continued operation of the site under the current Mining Permit. The No Action alternative will not preclude porknockers from illegally operating in the area since the company will not expand the current site infrastructure to ensure proper policing of the area.

2.2.2 Alternative Mining and Ore Recovery Methods

The overburden and ore can both be removed by wet-extraction, or dredging operations. In this operation both the overburden and ore are hydraulically extracted and transferred to a processing facility. The entire extraction equipment is normally located on/in the water. Operation of a wet extraction method would require the creation of artificial lakes within the mining area.

Wet extraction of raw materials is a function of site- and mineral-specific factors such as a low degree of soil consolidation, acceptable soil particle size distribution, well-balanced and shallow depth to the ore horizon and adequate quantities of water. These factors are represented by the surficial deposits at this site and the area can be mined by wet extraction. However, since mineral-bearing areas may be quite distant from surface water bodies in some instances water will have to be pumped from existing streams for wet extraction.

Wet extraction will be followed by minimal reclamation since the tailings are highly saturated and contain primarily very fine material. Consequently, soil formation, which is an essential prerequisite for recolonization by plants, is seriously impeded.

2.2.3 Alternate Mineral Recovery Methods

The diamonds and gold present at this site can also be recovered using a Lavador (jig) as was demonstrated during the confirmatory test pitting program. The Lavador is a Dutch invention that functions to concentrate heavy material and to discard the lighter fraction. Slurry pumped by wet extraction methods or created by adding water to dry ore is manipulated by the Lavador to impede the movement of the more dense material as it flows through a circuit of riffles and traps. An agitator, in the form of a diaphragm creates a small pulse in the water column that causes the clastic material to rise and settle repeatedly. Accompanied by a continuous flow of water the light material tends to rise off the mesh and move through the system whereas the more dense material will be unable to negotiate the riffles and would become trapped in the bottom of the holding trays.

3.0 PROJECT SCHEDULE

A road is planned to provide access to the site. After completion the road will link Madhia to the mine site. A barge will be used to cross the Potaro River at its intersection with the access road. The access road, which will be 10 m wide, is expected to be completed by July of 2001. Equipment is currently on order for the expansion of the process plant itself. This equipment which is comprised of a larger wash plant and its ancillary facilities in addition to the dense media separator for diamond recovery is expected to be installed at the mine site by July 2001. An area of approximately one-half hectare (ha.) has been identified for installation of the process equipment. The area will also contain all water management facilities for the plant and diamond recovery operation. Four water and tailing management ponds are to be excavated within the area. A pump will be installed on Maple Creek to withdraw water for the commencement of the processing operation. Sufficient water will be withdrawn to fill one pond in the water management circuit. After this initial withdrawal, water will only be withdrawn on a periodic basis to complement water losses during ore washing and through evaporation.

During operation, approximately 26 persons will work at the mine site. Accommodation will be provided for operation personnel by construction of several housing units on the site. Additional facilities will also be required to support the efficient operations of the mine. The facilities are expected to include the following:

- Power generation equipment
- Oil storage and handling facilities
- Heavy earthmoving equipment workshop
- Waste management facilities

Further expansion is expected after the issuance of the Mining License by GGMC. It is expected that the license will be issued shortly after filing of the necessary documents, which include this Environmental Impact Assessment Report. The mine is expected to have a life of 15-25 years. Mine reclamation will occur concurrent with the ore recovery operation. Initially however, mining will precede reclamation by a period of six months.

Table 2 presents a summary of the commencement and completion dates of the major aspects of the expanded mining operation.

Table 2: Project Schedule

Description	Commencement Date	Completion Date
Access Road: Potaro River to Property	Upon receipt of GGMC Permission	90 days later
Preparation of Site Personnel Facilities	Ongoing	June 2001
Installation of Water Management System	Ongoing	June 2001
Installation of Process & Recovery System	Ongoing	July 2001
Installation of Support Facilities	Completed	
Ore Recovery Operations	Ongoing	25 year after
Mine Reclamation	30 days after completion of mine cut	60 days after start
Plant and Seeding	30 days after reclamation	60 days after start

4.0 EXISTING ENVIRONMENT

4.1 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 results in higher or lower than normal rainfall at specific locations. The El Niño/La Niña is primarily responsible for inter-annual variation in rainfall.

The entire area identified for development into the mine, like the rest of Guyana has a tropical climate and is not subject to extreme variations in temperature and humidity. Data was reviewed for two locations to infer conditions likely to occur at the site. The two locations are as follows:

- Kaieteur
- Omai Gold Mine

The maximum monthly rainfall recorded over the period of record for Kaieteur was 829millimetres (mm). The minimum monthly rainfall recorded was 32mm. The average yearly rainfall over the period was 4726mm. Records for Omai Gold Mine indicate maximum and minimum monthly rainfall of 408 and 105mm respectively. Two corresponding dry periods were noted at both locations;

- February-March and
- September-November.

Rainfall conditions at the mine site are expected to be more similar to those recorded for Kaieteur. No evaporation data is available for Kaieteur. Evaporation data for Omai Gold Mines indicate maximum and minimum daily evaporation of 173 and 121mm respectively. Average daytime temperature is 28 °C. Nighttime temperature is usually about 24 °C.

No records are available for wind speeds 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.

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 the operation of dredges in the vicinity of the mine site. Airborne discharges and particulate matter are not monitored in the area. However, typical guidelines for sulphur 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.

4.2 Geology

4.2.1 Regional Geology

Most of the typical features of granite-greenstone terrains of the better exposed Precambrian shield are found in the Potaro. (Gibbs,1975). The supracrustal rocks are dominantly mafic and intermediate volcanics and immature sediments derived from them. These are metamorphosed to the greenschist grade except for the aureoles of higher grade around the major intrusives. The supracrustal rocks form belts separated by granitoid intrusives.

Several features disrupt and conceal the granite-greenstone belt pattern, including major faults and shear zones. Gabbro and dolerite dikes and sills cross the earlier features. The region was eroded both in the Proterozoic and Tertiary and is now a low relief surface with a few prominent hills over the more mafic rocks. The sands and clays of the Tertiary transgression, which covered most of the region, are now partially eroded.

The supracrustal rocks are apparently the oldest rocks preserved in the area. The basal contacts of the supracrustal section are missing or obscured due to the granitoid intrusives. The volcanics range in composition from basalt to dacites and

rhyodacites. No ultramafic extrusives have been identified. The siliceous volcanics are concentrated in particular areas with associated agglomerates and hypabyssal intrusives.

The sedimentary rocks are predominantly grey graded greywackes and shales. Associated with the greywackes are occasional coarse polymictic conglomerates composed of subangular blocks of diverse intermediate and felsic volcanics. No angular unconformities have been recognized in the greenstone sections. Metamorphosed mafic dikes and sills cut the supracrustal rocks in many places. A 15-20 km. wide belt extending northwest from Madhia contains numerous examples, most of which strike northwest as well.

Several of the granitoid intrusives have aureoles of muscovite-chlorite schist. The Portage Granodiorite is adjacent to and apparently roofed by the Apanachi Schists, which are derived by contact metamorphism of volcaniclastic sediments and some intercalated volcanics.

The development of the Maple Creek Valley can be summarized in four phases. The first phase was the erosion and subsequent incision of a gorge (or paleo-channel) by streams draining the Pakaraima Mountains. At some point conditions changed and the streams running through the valley stopped eroding and began to deposit material. In the Tertiary period, sea level rose submerging the landscape and depositing an extensive blanket of white sand. Presently, streams are eroding through the White Sand and older fluvial sediments, redistributing material in contemporary depositional systems.

4.2.2 Local Geology and Soils

Information obtained from the pits excavated during the exploration program revealed three alluvial facies (Hicken, 1999) paleo-fluvial sand, beach sediment (White Sand), and modern fluvial sediments. The oldest unit (paleo-fluvial sands) is fluvial sand deposited as the paleo-channel filled with sediment. This material is predominantly sand with occasional pebbly sand and gravel beds. The White Sand unit is a Tertiary beach sand that was likely derived from the reworking of older fluvial sediments and the erosion of the Pakaraima escarpment. The White sands are deepest on hills and generally thicken to the north. The youngest unit is a modern fluvial deposits consisting of sediment reworked and redistributed from the initial two units.

The tropical conditions of the study area have produced an environment dominated by chemical weathering. Such an environment is hostile to lithic material, and silica therefore, dominates the sediment composition (quartz). Remnants of lithic materials are in the form of clay clasts and kaolinized sand grains. Generally, bedrock weathers to saprolite, a silty clay material that retains the original bedrock structure.

Two groundwater wells were installed on site during the data acquisition phase. Several soil samples were recovered from the site during the well installation program. The samples were tested to determine both their plasticity characteristics and grain size distribution. The soil samples recovered from the site confirm that the site soils are primarily a white medium to fine sand.

Natural Slopes in the area range from being relatively mild to steep. There is some evidence of slope failure on the sides of roadway accessing the current personnel housing. Most of the slope failure seems to have occurred after saturation of the slopes by heavy rainfall as evidenced by the apparent flow features of the slope failures.

4.3 Water Resources

4.3.1 Groundwater

The site is located within an area defined as the Intermediate Peneplains (Bleackley, 1964) Practically no data is available on groundwater levels in this formation. Two monitoring wells were installed at the site at locations shown on Figure No. 5. Groundwater was encountered at both monitoring wells. The depth to groundwater is approximately 3.4m in the both wells.

4.3.1.1 Flow Conditions

There are several unnamed streams that flow to both the Euwang River and Maple Creek in the area. Most of the streams in the area appear to obtain their base flows from groundwater discharge from aquifers present in the white sands deposits. The base elevations of these streams were used to infer ground water levels. Groundwater elevations in the area were

inferred from the base elevation of the streams to range from 27m to 73m. Local groundwater flow direction appears to be towards individual streams located in the area. Regional groundwater flow is to the Potaro River.

The horizontal flow gradient was inferred by approximating ground surface elevations from topographic maps for the area. The horizontal flow gradients determined from inferred groundwater levels at the monitoring wells is approximately $6.62X10^{-4}$. Groundwater flow is to the south-southwest.

Hydraulic conductivity values were determined by performing a rising head permeability tests in the well adjacent to Maple Creek. The hydraulic conductivity was determined to be approximately $3.5X10^{-3}$cm/sec. While the lateral extent of groundwater is not known, the hydraulic conductivity indicates that the formation may yield water. There are no settlements within close proximity of the proposed mine. Groundwater is therefore not recovered for drinking purposes from within close proximity of the site.

4.3.1.2 Water Quality

Groundwater quality was determined by conducting analytical tests on groundwater samples recovered from both wells. Groundwater samples were tested by Lakefield Research Ltd. of Ontario Canada to determine the presence and concentration of volatile organics, metals, oil and grease, nitrates, sulphates and chlorides. All concentrations except those for total iron are below acceptable drinking water quality. Results of analytical tests on groundwater samples are presented in Tables 3 and 4.

Table 3: Results of Analyses on Groundwater Samples

Maple Creek										
Ground Water										
Final Report										
28.03.01										
	Cl-	NO2 as N	NO3 as N	SO4=	O&G(tot)	O&G a/v	O&G	Hg	Ag	Al
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Analysis Date	04.04.01	03.04.01	03.04.01	04.04.01	05.04.01	09.04.01	09.04.01	03.04.01	11.04.01	11.04.01
Analysis Time	11:03	11:03	11:03	11:03	09:56	08:57	08:57	23:36	19:40	19:40
ODWS Limits	250	1	10	500				0.001		0.01
GW 1 Maple Creek	2	< 0.06	< 0.05	0.7	1	1	< 1	< 0.0001	< 0.01	3.96
GW 2 Maple Creek	3.4	< 0.06	0.1	< 0.5	2	2	< 1	0.0001	< 0.01	7.43
Sample ID	As	Ba	Be	B	Bi	Ca	Cd	Co	Cr	Cu
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Analysis Date	11.04.01	11.04.01	11.04.01	11.04.01	11.04.01	11.04.01	11.04.01	11.04.01	11.04.01	11.04.01
Analysis Time	19:40	19:40	19:41	19:41	19:41	19:41	19:41	19:41	19:41	19:41
ODWS Limits	0.025	1		5			0.005		0.05	1
GW 1 Maple Creek	< 0.05	0.006	< 0.001	< 0.01	< 0.05	0.84	< 0.005	0.02	< 0.02	0.01
GW 2 Maple Creek	< 0.05	0.019	< 0.001	< 0.01	< 0.05	0.5	< 0.005	0.01	0.06	< 0.005
Sample ID	Fe	K	Li	Mg	Mn	Mo	Na	Ni	Pb	Sb
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Analysis Date	11.04.01	11.04.01	11.04.01	11.04.01	11.04.01	11.04.01	11.04.01	11.04.01	11.04.01	11.04.01
Analysis Time	19:41	19:41	19:41	19:41	19:41	19:41	19:41	19:41	19:41	19:41
ODWS Limits	0.3				0.05		200		0.01	
GW 1 Maple Creek	5.45	0.44	< 0.005	6.43	0.22	< 0.02	5.67	< 0.02	< 0.02	< 0.05
GW 2 Maple Creek	7.17	0.64	< 0.005	0.53	0.036	< 0.02	5.03	< 0.02	< 0.02	< 0.05
Sample ID	Se	Sn	Sr	Ti	Tl	U	V	W	Y	Zn
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Analysis Date	11.04.01	11.04.01	11.04.01	11.04.01	11.04.01	11.04.01	11.04.01	11.04.01	11.04.01	11.04.01

Analysis Time	19:41	19:41	19:42	19:42	19:42	19:42	19:42	19:42	19:42	19:42
ODWS Limits	0.01					0.1				
GW 1 Maple Creek	< 0.1	< 0.1	0.0069	0.062	< 0.10	< 0.02	0.008	< 0.05	0.005	0.08
GW 2 Maple Creek	< 0.1	< 0.1	0.0035	0.15	< 0.10	< 0.02	0.019	< 0.05	0.001	0.1

Table 4: Results of Analyses on Groundwater Samples

Samples	Env - Ground Water				
Type	Sample ID	ODWS MAC/	Det Limit	GW 1	GW 2
		IMAC µg/L	µg/L	µg/L	µg/L
	Analysis Date			03.04.01	03.04.01
	Analysis Time			11:35	11:35
	Benzene	5	5	< 5	< 5
	Bromoform		2	< 2	< 2
	Bromomethane		5	< 5	< 5
	Carbon Tetrachloride	5	5	< 5	< 5
	Chlorobenzene		5	< 5	< 5
	Chloroethane		5	< 5	< 5
	Chloroform		2	< 2	< 2
	Chloromethane		5	< 5	< 5
	Dibromochloromethane		2	< 2	< 2
	Bromodichloromethane		2	< 2	< 2
	1,2 Dichlorobenzene	200	5	< 5	< 5
	1,3 Dichlorobenzene		5	< 5	< 5
	1,4 Dichlorobenzene	5	5	< 5	< 5
	1,1 Dichloroethane		5	< 5	< 5
	1,2 Dichloroethane	5	5	< 5	< 5
	1,1 Dichloroethene		5	< 5	< 5
	1,2 Dichloropropane		5	< 5	< 5
	trans-1,2 Dichloroethene		5	< 5	< 5
	cis-1,3 Dichloropropene		5	< 5	< 5
	trans1,3Dichloropropylene		5	< 5	< 5
	trans1,3 Dichloropropene		5	< 5	< 5
	Ethylbenzene	2.4	2.4	< 2.4	< 2.4
	Ethylenedibromide		5	< 5	< 5
	Methylene Chloride		5	< 5	< 5
	Styrene		5	< 5	< 5
	1,1,2,2 Tetrachloroethane		5	< 5	< 5
	Tetrachloroethene		5	< 5	< 5
	Toluene	24	5	< 5	< 5
	Trichloroethene	50	5	< 5	< 5
	Vinyl Chloride	2	2	< 2	< 2
	Trichlorofluoromethane		5	< 5	< 5
	1,1,1 Trichloroethane		5	< 5	< 5
	1,1,2 Trichloroethane		5	< 5	< 5
	O-Xylene		5	< 5	< 5
	M,P,-Xylene		5	< 5	< 5

4.3.2 Surface Water

The area to be developed is drained by the Euwang River and by Maple Creek on the west and east respectively. The Euwang River also passes south of the area and drains the southern part of the site. Maple Creek discharges to the Euwang River as it passes south of the site. The Euwang River discharges to the Potaro River. Figure 1 shows the relationship of the creek and rivers to the site.

At present the forest canopy intercepts most precipitation in the project area. The soils present at ground surface are primarily granular white sands. As a result, precipitation incident on the ground surface quickly infiltrates the ground. Flows in the creek and Euwang River are therefore most probably reflective of groundwater discharge to surface water bodies.

4.3.2.1 Catchment Area & Flow Volumes

The catchment area for Maple Creek was approximated from a 1:50,000 topographic map of the Kaieteur Northwest area to be 20 sq.km. The catchment area for Euwang River approximated from the same map was estimated to be 210 sq.km. No data is available on surface water flows in the either Maple Creek or Euwang 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 the Euwang River and Maple Creek based on the ratio of their catchment area to that of the Kuribrong River.

The minimum and maximum flows are presented in Table 5. The table also summarizes the catchment area of both the Euwang River and Maple Creek.

Table 5: Estimated Flow Volumes in Euwang River and Maple Creek

Location	Catchment Area (km^2)	Estimated Streamflow (m^3/sec)		Month in which Noted	
		Maximum	Minimum	Maximum	Minimum
Euwang River	210	40.0	6.0	June	October
Maple Creek	20	3.8	0.55		

4.3.2.2 Water Quality

Some discoloration was observed in the Potaro River and is probably associated with the operation of dredges on that river. In addition, a significant amount of dredging has occurred at the base of Amatuk Falls on the Potaro River upstream from the site. The dredged spoil from that area is very likely to continue to impact the water quality in the Potaro River into the foreseeable future. Consequently a surface water sample was recovered upstream of the proposed mine site to provide a baseline condition for flow from upstream of the area. Surface water samples were also recovered from Maple Creek near its confluence with Euwang River and from the Euwang River upstream of the area identified for the mine and from the Potaro River upstream of the site. The sample location and numbers are shown on Figure 5. Analytical tests were performed on all surface water samples to determine the presence and concentrations of volatile organics, metals, total suspended solids, sulphates, nitrates, oil and grease and chlorides. The results of the analyses are detailed in Tables 6 and 7. The results indicate that surface water quality is within acceptable limits for most of the compounds. Drinking water standards were exceeded for the following compounds:

- Aluminium
- Cobalt
- Iron
- Antimony

There are no activities in the area that discharges wastewater containing any of the compounds for which drinking water quality standards are exceeded. The concentrations in surface water are reflective of minerals present in soil being leached into solutions.

Table 6: Results of Analyses on Surface Water Samples

Project	Ground Structure					
Samples	Env - Surface Water					
Chemist	Christopher M. Sullivan, B.Sc					
Title	Final Report					
Date	28.03.01					
Type	Sample ID	PWQOLimit	Det Limit	SW 1	SW 2	SW 3
		µg/L	µg/L	µg/L	µg/L	µg/L
	Analysis Date			03.04.01	03.04.01	03.04.01
	Analysis Time			11:33	11:33	11:33
	Benzene	100	5	< 5	< 5	< 5
	Bromoform	60	2	< 2	< 2	< 2
	Bromomethane	0.9	5	< 0.9	< 0.9	< 0.9
	Carbon Tetrachloride	5	5	< 5	< 5	< 5
	Chlorobenzene	15	5	< 5	< 5	< 5
	Chloroethane		5	< 5	< 5	< 5
	Chloroform		2	< 2	< 2	< 2
	Chloromethane	700	5	< 5	< 5	< 5
	Dibromochloromethane		2	< 2	< 2	< 2
	Bromodichloromethane	200	2	< 2	< 2	< 2
	1,2 Dichlorobenzene	2.5	5	< 2.5	< 2.5	< 2.5
	1,3 Dichlorobenzene	2.5	5	< 2.5	< 2.5	< 2.5
	1,4 Dichlorobenzene	4	5	< 4	< 4	< 4
	1,1 Dichloroethane	200	5	< 5	< 5	< 5
	1,2 Dichloroethane	100	5	< 5	< 5	< 5
	1,1 Dichloroethene		5	< 5	< 5	< 5
	1,2 Dichloropropane	0.7	5	< 0.7	< 0.7	< 0.7
	trans-1,2 Dichloroethene		5	< 5	< 5	< 5
	cis-1,3 Dichloropropene		5	< 5	< 5	< 5
	trans1,3Dichloropropylene	7	5	< 5	< 5	< 5
	trans1,3 Dichloropropene		5	< 5	< 5	< 5
	Ethylbenzene	8	2.4	< 2.4	< 2.4	< 2.4
	Ethylenedibromide	5	5	< 5	< 5	< 5
	Methylene Chloride	100	5	< 5	< 5	< 5
	Styrene	4	5	< 4	< 4	< 4
	1,1,2,2 Tetrachloroethane	70	5	< 5	< 5	< 5
	Tetrachloroethene	50	5	< 5	< 5	< 5
	Toluene	0.8	5	< 0.8	< 0.8	< 0.8
	Trichloroethene	50	5	< 5	< 5	< 5
	Vinyl Chloride	400	2	< 2	< 2	< 2
	Trichlorofluoromethane		5	< 5	< 5	< 5
	1,1,1 Trichloroethane	10	5	< 5	< 5	< 5
	1,1,2 Trichloroethane	800	5	< 5	< 5	< 5
	O-Xylene	40	5	< 5	< 5	< 5
	M,P,-Xylene	2	5	< 2	< 2	< 2

Table 7: Results of Analyses on Surface Water Samples

Samples - Surface Water										
Final Report										
28.03.01										
Sample ID	TSS	Cl-	SO4=	NO2 as N	NO3 as N	O&G(tot)	O&G a/v	O&G	Hg	
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	
Analysis Date	04.04.01	02.04.01	02.04.01	31.03.01	31.03.01	05.04.01	09.04.01	09.04.01	03.04.01	
Analysis Time	11:33	14:11	14:11	14:11	14:11	09:55	08:56	08:56	23:33	
PWQO Limits									0.0002	
SW 1 Maple Creek	4	1.8	< 0.5	< 0.06	< 0.05	3	2	1	< 0.0001	
SW 2 Maple Creek	< 2	3.3	< 0.5	< 0.06	0.05	2	2	< 1	< 0.0001	
SW 3 Maple Creek	4	2.2	< 0.5	< 0.06	0.1	1	1	< 1	< 0.0001	
Sample ID	Ag	Al	As	B	Ba	Be	Bi	Ca	Cd	Co
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Analysis Date	10.04.01	11.04.01	10.04.01	11.04.01	11.04.01	11.04.01	11.04.01	11.04.01	10.04.01	10.04.0
Analysis Time	13:33	19:36	13:33	19:36	19:36	19:36	19:36	19:36	13:33	13:33
PWQO Limits	0.0001	0.075	0.005	0.2		0.011			0.0001	0.000
SW 1 Maple Creek	< 0.0001	0.19	< 0.005	< 0.01	< 0.003	< 0.001	< 0.05	0.49	< 0.0001	0.01
SW 2 Maple Creek	< 0.0001	0.2	< 0.005	< 0.01	< 0.003	< 0.001	< 0.05	0.6	< 0.0001	0.008
SW 3 Maple Creek	< 0.0001	0.18	< 0.005	< 0.01	0.003	< 0.001	< 0.05	0.83	< 0.0001	0.008
Sample ID	Cr	Cu	Fe	K	Li	Mg	Mn	Mo	Na	
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	
Analysis Date	11.04.01	10.04.01	11.04.01	11.04.01	11.04.01	12.04.01	11.04.01	10.04.01	12.04.01	
Analysis Time	19:36	13:33	19:37	19:37	19:37	14:26	19:37	13:33	14:26	
PWQO Limits	0.1	0.005	0.3					0.01		
SW 1 Maple Creek	< 0.02	< 0.0008	1.07	1.04	< 0.005	0.41	0.01	< 0.0003	1.13	
SW 2 Maple Creek	< 0.02	< 0.0008	0.24	0.65	< 0.005	1.28	0.006	< 0.0003	7.07	
SW 3 Maple Creek	< 0.02	< 0.0008	0.38	0.62	< 0.005	0.94	0.005	< 0.0003	5.31	
Sample ID	P	Ni	Pb	Sb	Se	Tl	U	V	Zn	
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	
Analysis Date	11.04.01	10.04.01	10.04.01	10.04.01	10.04.01	10.04.01	10.04.01	11.04.01	11.04.01	
Analysis Time	09:14	13:34	13:34	13:34	13:34	13:34	13:34	19:37	19:37	
PWQO Limits	0.02	0.025	0.001	0.02	0.1	0.0003	0.005	0.007	0.02	
SW 1 Maple Creek	0.02	< 0.001	< 0.0002	0.075	< 0.01	< 0.0002	< 0.0002	< 0.002	< 0.01	
SW 2 Maple Creek	0.02	< 0.001	< 0.0002	0.065	< 0.01	< 0.0002	< 0.0002	< 0.002	< 0.01	
SW 3 Maple Creek	0.03	< 0.001	0.0003	0.065	< 0.01	< 0.0002	< 0.0002	< 0.002	< 0.01	

4.3.2.3 Fishes

Fishes in the area were identified by placing seines (15.0m x 2m x 2.5 mm mesh) and gillnets (15.0m x 1.5m x 1.5mm mesh) at several points in the Euwang River both upstream and downstream of the mining concession. Nets were also cast and angling was performed at points approximately 200m from the mouth of the Big Euwang River and upstream and downstream of the Euwang estuary in the Potaro River. Nets were also cast in one shallow pool on the site. The casting was however, impeded by the water depth level and flow and by the presence of obstacles (rocks, logs and fallen trees) beneath the water surface.

Workers on the two (2) dredges operating in the Potaro River, who normally fish in the Potaro, were interviewed on 10th March, 2001 to determine the type of fishes caught. The seine and hook line were set in the Euwang River on the 23rd

March and on the Potaro on the 24th March, 2001 respectively and were kept in place for approximately 21 hours. Both the seine and hook lines were inspected at 9.00am and at 4.00pm. Nets were cast on the afternoon of the 25th March, 2001.

The principal water bodies in the vicinity of the concession are portions of the Potaro River and the Euwang River and its associated tributary creeks and streams. The prime creek is Maple Creek and there are at least two unnamed streams. These water bodies contain representatives of six (6) fish species of which there are tiny aquarium types called Monica locally. The Haimara ((*Hoplias) macro ptbalmus*), Houri ((*Erythrinidae) Hoplias malabricus)*, Tiger fish (*Pymelodidue*), Patwa ((*Cichlidae) cichlasoma bimaculatum)* Tibikuri and catfish (*Horicarlidae*) are eaten by the workers employed by the dredging and gold digging operations in the area.

No indigenous tribe was encountered in the project area. In addition, no large scale commercial exploitation of fish occurs in the area. The edible species mentioned above were caught by single hook lines set by the workers or small seine like nets set at the shoulders of the creeks or streams. Only Monica, Patwa and Tibikuri were actually caught during the study period. These were present in the Uewang, and the Maple Creek and in smaller streams. No fishes were encountered in the excavations. Table 8 is a summary of fishes encountered in the area.

Table 8 Fish Species in Project Area

Scientific Name	Local Name	Scientific Name	Local Name
Hoplias macrophatamus	Haimara	*Erytrinus erytrimus*	Houri
Cichlasoma bimaculatum	Patwa	(Undetermined)	Tibikuri; dury
Pseudoplatystomes vialanti	Tiger fish		

4.4 Terrestrial Resources

Both the flora and fauna surveys were conducted using a similar layout of transects. Transect lines were aligned to follow the baseline and survey lines used during the mineral exploration work. The transect lines were sited at 50 meters centers. Transects were surveyed by two individuals who walked the entire length of each transect and recorded observations. Each individual was equipped with a whistle, torchlight, a tape measure and a cutlass. A 10 m square sub-sector was demarcated at the end of each transect. A definition of vegetation population density of certain species was conducted in each sub-sector.

The floral survey was conducted by two researchers, one of whom was a former officer of the Guyana Forestry Commission. The researchers traversed the transect lines and recorded the plant types encountered one meter either side of the transect line. Trees were identified, their heights noted and the supporting soils observed and noted. The common name and scientific name/family of each type was recorded along with the other feature. The leaves, twigs, flowers and fruits of unknown vegetation were collected and placed between sheets of newspaper for later identification.

Mammals were surveyed in a similar manner as the floral survey. The mammalian researchers walked the transect lines as quietly as possible to present the least disturbance to animals in the area. All mammals were noted, identified and the features recorded in data sheets. At least four animal traps were set and bated with food. These traps were inspected at three hour intervals. Specimens were identified, described, measured and released after features were recorded. Footprints and faecal droppings were also used to identify mammals which were not visually observed.

Specimens of birds, bats, and flying arthropods were identified by setting mists nets at three (3) points along each transect in the area. These were inspected at 3 hour intervals during the nights. Specimens of birds, bats, and flying arthropods caught by the net were inspected, photographed, identified and released. Some arthropods were preserved in alcohol for later identification. The mist nets were also inspected during the daytime. Insect nets were used to catch butterflies, moths, bugs etc. along transect lines and in buildings in the camp at different times of day and night.

Reptiles and amphibians were also identified, described and recorded during the traverse of the transect lines. The locations of the specimens in the transect lines were also noted. Eye spotting exercises were conducted for about three hours each night for at least two nights. The insect nets and the drift nets were the main tools used for catching invertebrates. The insect nets were used on walks along the transect lines and the number of swoops were recorded.

4.4.1 Land Use

There is no established land use plan for the project area. There are no settlements of indigenous people within 30 kilometres of the site. The housing area in nearest proximity to the area is Madhia. Several hydraulic mining operations are sited on the Potaro River both upstream and downstream of the area to be developed into the mine. The area is covered by tropical forest with several commercial species being present. There are, however, no timber concessionaires in the area. The absence may be attributable to difficulty in moving harvested timber from the area to mills and subsequently to the coast. There is some evidence that timber was harvested from this area sometime in the past. This is reflected by evidence of trees having been felled by axe in the area.

There are also several pits containing stagnant water within the project area. The area has therefore been historically exploited for timber and precious minerals. There is no evidence of any agricultural activities in the area. The only housing in the area is that constructed by Vannessa (Guyana) Inc. In the absence of a land use plan the area can therefore be classified as mixed forest and mining lands.

4.4.2 Vegetation

The area of the concession is typical Tropical Rain Forest with warm temperature, high humidity and precipitation. Solar radiation is usually high in this environment. The vegetation thus is luxuriant and the soil types vary slightly with topography making the forest rather diverse.

Fungi are present in a dominant way and almost every plant type utilizes choral root system to access nutrients, which leach rapidly through the soil. These nutrients are mainly and almost exclusively derived from forest litter that is continuously decomposed with the help of abundant fungi and bacteria.

Climax vegetation is typical of steep hill and mountainsides as well as the summits of these rises. However, in areas less inaccessible to humans, secondary forests predominate with shorter trees and shrubs. Where clearings had been made for excavations for mineral recovery, there is evidence that undergrowth had been profuse given the permitted penetration of sunlight there. High canopied and mid level trees are festooned with epiphytes on their trunks and limbs, with aerial roots and vines, some rather thick, hanging and climbing down to the ground.

Ninety (90) tree types were identified among more than seventy (70) species with representatives of all three canopy heights usually encountered in Tropical Rain Forest areas. High canopy trees (over 20 meters) were represented by Greenheart *(clorocardium rodiei)*, Mora *(Mora excelsa)* and three types of Walaba *(Eperua spp.)* while the mid-canopy (six (6) to twenty (20) meters) had representatives such as Baromalli *(Castostemma sp.)* Bulletwood *(Manildara bidentata)* and Kakaralli *(Eschweilera sp.)* and the lower level trees (less than six (6) meters high) had types such as Bartaballi *(Chryophyllum jenmanii)*, Kamadan *(Posoqueria sp.)* and the Kokorite Palm *(Attalea sp.)*. This lowest level understory contained especially in gap areas, ferns and selaginella and mosses as well as lichens which abounded on trunks and limbs. Several tree types in the area are of potential commercial value. A summary of the vegetation encountered in the area is presented in Table 9.

Table 9: Vegetation in Area

Scientific Name	Local Name	Scientific Name	Local Name
Anacardiaceae		**Leguminosae**	
Tapirira marcandii	Duka	*Cassia appoucouita*	Apolouita
Annonaceae		*Clathrotropis brachypetala*	Aromata
Gutteria punctata	Arara	*Andira inermis*	Bat seed
Annona symphyocarpa	Duru	*Pterocarpus officinalis*	Corkwood
Ephedranthus guianensis	Karishiri	*Aldina insignis*	Dakamaballi
Anaxagorea dolchocarpa	Kurihikoyoko	*Enterolobium cyclocarpum*	Devil ear
Xylopia pulcherrima	Kuyama Red	*Pithecellobium jupunba*	Husrusasa
Anaxagorea acuminata	Kurihikoyoko	*Swartzia laevicarpa*	Itikiboroballi
Guatteria atra	Yari Yari	*Scelrolobium guianense*	Kaditiri
		Hymenolobium sp.	Koraroballi
Apocynaceae		*Oromosia coutinhoi*	korokororo
Aspidosperma vargasii	Shibadan	*Mora excelsa*	Mora
Aspidosperma excelsum	Yaruru	*Mora gonggirjppi*	Morabukea
		Pentanclethra macroloba	Trysil

Bignoniaceae *Tabebuia insignis* *Jacarandra copaia* *Tabebuia capitata*	Cedar White Futui Hakia		
Bombacaceae *Catostemma altsonii*	Baromalli		
Boraginaceae *Cordia bicolor*	Table tree	**Linaceae** *Hebepetallum humiriifolium*	Waiaballi
Cecropiaceae *Cecropia sciadophylla*	Congo pump	**Melanostomataceace** *Miconia tomentaza* *Henrietta caudate*	Wakarandan Waramai
Celastraceae *Goupia glabra* *Maytenus planifolia*	Kabukalli Kuiarima	**Meliaceae** *Carapa guianesis*	Crabwood
Chrysobalanaceae *Licania heteromorpha* *Licania laxifolia* *Licania buxifolia*	Kairiballi Kauta Marishiballi	**Myristicaceae** *Virola surinamensis*	Dalli
Combretaceae *Buchenavia fanshawei*	Fukudi	**Myrtaceae** *Marlierea schomburgkiana* *Myrcia rufipila*	Akarako Wild guava
Dichapetalaceae *Tapura guianensis*	Waiaballi	**Palmae** *Atalea Regia* *Jessenia batua*	Kokorite palm Turu palm
Guttiferae *Tovomita brasiliensis* *Vismia guianensis* *Monorobea coccinea*	Awasokule Bloodwood Manniballi	*Quiinaceae* *Quiina albiflora*	Okokonshi
Humiriaceae *Humiria balsamifera*	Tauroniro	**Rubiaceae** *Posoquiria longiflora* *Duroia eriopila*	Kamadan Komaramara
Lauraceae *Chlorocardium rodiaei* *Aniba excelsa* *Aniba hostmanniana* *Aniba guianensis* *Ocotea acutangula* *Aniba hypoglauca*	Greenheart Greenheart gale Kanowaballi Silverballi gingergale, Silverballi, pearleaf Yellow Silverballi,	**Sapindaceae** *Cupania scrobiculata*	Kulishiri
		Sapotaceae *Ecclinusa guianensis* *Macropholis venulasa* *Mailkara bidentata*	Bartaballi Kudibushi Bulletwood
		Simaroubaceae *Quassia simarouba*	Simarupa
		Sterculiaceae *Sterculia rugosa*	Maho

The population density of trees present in the area is detailed in Table 10. Information is only presented for instances where the density exceeds 1 tree/100 m^2.

Table 10: Population Density of Major Plant Species in Mine Area

Common Name	Scientific Name	Family	Density/100m^2
Mora	*Mora excelsa*	Leguminosae	22
Walaba	*Dicymbe altosonii*		11
Greenheart	*Chlorocardium rodiaei*	Lauraceae	1.8
Baromalli	*Catostemma altsonii*	Bombacaceae	1.3

4.4.3 Wildlife

The natural tropical forest setting of the area, influenced by the variable topography of steep and not-so-steep inclines with generally elevated areas of high rainfall and humidity and soil mixtures of sand, and clay loam overlaid with very thick humus provide habitats for various types of arthropods, amphibians, reptiles, birds and mammals.

The arthropods include insects of different types such as moths and butterflies bettles (*coleoptera*) pond flies (*odonate*) grasshoppers (*orthoptera*), bugs and flies (*hemiptera*) wasps and ants; arachids such as spiders (nancy) and millipedes.

The amphibian populations are very scarce and user identified by croaking sounds often attributed to *Buto spp.* by resident workers and tadpoles observed in the Maple Creek crossing a trail to the Main Camp.

Reptiles are represented by species of turtles (one small species of labaria turtle was caught and released in Maple Creek during the study), caiman (one specimen caught in the Big Euwang), snakes (none was seen during the study period) and lizards (two (2) ground types were spotted during the study period). The specimen captured was identified as *Caiman crocodylus* (Spectacled caiman).

4.4.3.1 Invertebrates

Four species of the butterfly family Pieridae, and one each of the family Helicaonidae, Nymphalidea, Lycaenidae, and Rioclinidae were observed along the trails during the daytime. The tiger striped *Helconius sp.* was located around *Heliconia sp*. of plants, while Phoebisarganti, P.trita and Aphrissa satira flew high among the canopy. Caligo sp (Owl butterfly) of the family Brassolidae was caught on the Uewang River late one afternoon.

About eleven (11) species of butterflies and six (6) species of moth were encountered. Along with these there was one type of grasshopper and four different types of bugs. The colors of the bugs were yellow and black, green, brown and blue respectively. Work is in progress at the University of Guyana to identify these bugs. Table 11 presents the Invertebrates encountered in the area.

Table 11: Invertebrates Encountered in Area

Scientific Name	Local Name	Scientific Name	Local Name
Papilionadae		**Lycaenidae**	
Papilio thoas	Butterfly	*Calycopis cerata*	Butterfly
Pieridae		**Riodinidae**	
Phoebis arganti	Butterfly	*Mesosemia sp.*	Butterfly
Phoebis trite	Butterfly	*Ithomiolia sp.*	Butterfly
Aphirssa statira	Butterfly	*Uribia sp.*	Butterfly
Heliconiinae		**Brassolidae**	
Heliconius sara/wallacaei	Tiger striped Butterfly	*Caligo sp.*	Owl Butterfly

4.4.3.2 Herpetofauna

These were not seen except for tadpoles in a very shallow area of Maple Creek that crossed the main trail to the camp. They seem nocturnal because they were not found during a repeat daytime visit in that area.

No arboreal lizard was spotted though two types of lizards (Analis sp. and Ameiva) of the family Iguanidae and Teiidae respectively were seen scuttling on the ground at the camp and along a trail. Only one (1) small sized labaria turtle was caught in the shallow Maple Creek crossing of the camp trail. Workers commented that other turtles had been seen in the area. Table 12 presents a list of herpetafauna encountered in the area.

Table 12: Herpetofauna Encountered in Area

Scientific Name	Local Name	Scientific Name	Local Name
Crocodilae		**Amphibians**	
Caiman crocodilus	Spectacled caiman	*Bufo marinus*	Toad

(Undetermined)	Labaria turtle	*Rana sp.*	Frog
		(Undetermined)	Tadpoles
Pelomedusidae			
Anolis sp.	Lizard		

4.4.3.3 Birds

Eighteen (18) species of birds were observed in the area during the study period between 9th and 25th March, 2001. They were generally flying among the mid and low level canopy while specific types were spotted at particular feeding points. The Blue Crested Heron (*Cochleerius sp*.) was seen one late after noon along the left bank of the Big Uewang River and the King fishers (*Chloroceryle spp*.) were observed flying across the surface of the Potaro River. Parrots (*Amazona spp*.), Macaws (*Ara spp*.) and Parakeets (*Brotogeris sp*) flew in small flocks or in pairs making screaming sounds in the mornings and afternoons. Their foraging ways is known to be fairly extensive in the forest where fruits, nuts and seeds abound. Wood peckers (*Celeus sp.)* were very inconspicuous with only two (2) sightings of solitary birds on high tree trunks. The nest of the Yellow billed oropendola (*Psarocolius sp*.) was spotted while being serviced by the bird. The Powis (*Cras alector*) was seen crossing the trail foraging on the forest floor. This bird moves in pairs in and out of the thick understory. A summary of the birds spotted in the area is detailed in Table 13

Table 13: Birds Observed In Project Area

Scientific Name	Local Name	Scientific Name	Local Name
Alcedenidae		**Picidae**	
Chloroceryle americana	Green kingfisher	*Celeus eleganis*	Chestnut woodpecker
Chloroceryle amazona	Amazon kingfisher	**Psittidae**	
Ardeidae		*Amazona amazona*	Orange winged parrot
Cochlearius sp.	Blue crest heron	*Amazona farynosa*	Mealy parrot
		Ara macao	Scarlet macaw
		Ara sp.	Macaw
Falconidae		**Accipitridae**	
Daptrius americanus	Red throated cara cara	*Buteogallus uru bitinga*	Great black hawk
		Formicidae	
Icteridae		Hypocemis cantator	Warbling ant bird
Psarocolius sp.	Yellow billed oropendpola	**Thrapidae**	
Scaphildura oryzivora	Giant cow bird	*Rhamphocelus carbo*	Silver back tanager
Ramphastidae		**Pipridae**	
Ramphastos culiminatus	Yellow ridge toucan; bill bird	*Pipra pipra*	White crowned manakin

4.4.3.5 Mammals

The principal mammal that was seen during the study was a jaguar (*Panthera onca*), a very large carnivorous cat that feeds on deer, peccaries**,** pacas, and lizards. This animal together with the ocelot (*Felis paradalis*) represent the primary large mammals in the area. Both are listed as vulnerable in the IUCN Red Data Book 1975, and are hunted by humans, no hunting activity was however, noted during the fieldwork. The ocelot was never seen during the study period but faecal remains and paw imprints on the ground confirm its presence in the area. The presence of both deer (*Mazama americana*) and the Tapir (*Tapirus terrestris*) was also confirmed by faecal remains and paw imprints. Visual contact was made of the Red Howler Monkey (*Alouatta seniculus*) in distant trees and of both the Agouti (*Dasyprocta agouti*) and the raccoon (*Procyonidae sp*) which were observed on trails in the concession.

Three species of bats (*Chiroptera*) were caught in the mist nets. These were examined, described, photographed and released. Bats are prevalent in the area. This is not uncommon in tropical and subtropical forests. They have a wide range of eating preferences as some are insectivorous, frugivorous, nectarivorous, carnivorous and even sanguivorous. Bat are generally active at nights over a area ranging from above the tallest canopy to the forest floor. Table 14 is a summary of mammals encountered in the area.

Table 14: Summary of Mammals Encountered in Area

Scientific Name	Local Name	Scientific Name	Local Name
Procoynidae		**Tapiridae**	
Nasua nasua	Racoon	*Tapirus terrestris*	Tapir; bush cow
Felidae		**Cebidae**	
Puma comcolor	Wild cat; ocelot	*Aloutta semiculus*	Red howler monkey; baboon
Cervidae		**Phyllostomidae**	
Mazama americana	Red brocket deer	*Tonatia silvicola*	Bat
Dasyprocta fuliginosa	Agouti		

4.4.4 Threatened and Endangered Species

The study did not encounter any species that is listed as endangered.

4.5 Socioeconomic Conditions

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^2 compared to an average density of 3.6 persons per km^2. 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.

In 1995, the labour force of Guyana numbered 350,000, with an overall participation rate of 62.5% of the population over 15 years of age. Among employed persons, approximately one-third worked in each of the sectors of industry and commerce, agriculture and services. In 1993, the unemployment rate was approximately 11%. However, the combined impact of underemployment along with unemployment is estimated to affect 30% of the labour force.

Among men, the labour force participation rate in 1995 was 86.4%. Women, on the other hand, had a participation rate of 39.2%, with most other women remaining in the home. Employed men tended to work in agriculture (34%), manufacturing (15%), trade (13%) and mining (8%). Over 40% of employed women worked in either trade or commercial services. In 1992, 8% of men were unemployed, compared with 18% of women.

In 1996, the minimum wage was the equivalent of US$ 2.98 per day, a low wage in absolute terms. It was also only two-thirds of the level in 1980, that is, the equivalent of US$ 4.52. The public sector minimum monthly wage in 1996 was G$

7,337; in 1999, it was G$ 15,000. Remittances from overseas Guyanese are a major source of income for many households. Guyana's per capita GDP of approximately US$800 is one of the lowest in the Caribbean region

Life expectancy at birth averages 64.8 years for the total population. For men, it is 61.5 years and for women, 68.2 years. The overall literacy rate for people over 15 years of age is 98.3%, with rates of 98.8% for men and 97.8% for women. The combined gross enrolment ratios for all levels of school are 66% for the entire population and for men and 65% for women.

Although school enrolment rates for women are nearly equal to those for men, women do not appear to have equal access to higher education, or to high technology or other well-paid jobs. The large gender gap noted above in labour force participation rates is, in fact, worse among young adults with 83% of men and only 24% of women who are economically active. In general, the absence of childcare and responsibilities for the elderly tend to limit women's access to formal sector employment. For example, only 34% of female household heads are employed, compared with 84% of male household heads. As a consequence, a large percentage of women work in the informal sector characterized by very low wages and lack of income security.

In recent years, there have been improvements in a number of public health indicators in Guyana. The total fertility rate dropped from 6.1 in 1960 to 2.3 in 1997. The number of births attended by trained medical personnel rose in the 1990's from 88% to nearly 93%. In that same period, infant and child mortality rates also declined. In rural areas, more than 90% of the population has access to safe water and more than 80% to adequate sanitation. In urban areas, nearly 100% of the population has access to both safe water and proper sanitation.

The economic growth in the 1990's resulted in declines in the number of people in Guyana living below the poverty line, from 43% in 1993 to 35% in 1999. The largest decline in poverty levels occurred in the Georgetown area, from 29% to 16%. Nonetheless, approximately 20% of the population of Georgetown live below the poverty level, primarily in squatter settlements.

The major community within close proximity of the project is Mahdia which has a population of 477 persons. However, there are several additional communities likely to be impacted by the project. These communities and their specific characteristics are detailed below.

4.5.1 Madhia

Madhia has a population of approximately 477 persons. The population could be classified into three major groups. These groups are as follows:

- Patamonas
- Coastlanders
- Islanders

The Patamonas are an indigenous Amerindian tribe. The Coastlanders are residents from elsewhere in Guyana who have moved to the Madhia area. The Islanders are the immigrants and their descendants from certain Caribbean Islands, particularly, St Lucia and Dominica. Within recent times there has been an influx of a group that is referred to as "foreigners" by the other residents of the area.

Madhia is regional administrative center. The community has a police station, and schools that provide nursery and primary education. Madhia has a commercial sector which includes dry goods shops, boutiques, a fuel station, two hotels and a brothel. The area is also serviced by several trucks from the coast. These trucks travel to Madhia several times each week and sell vegetables, groceries and other supplies. There is a well in the area which is not functional. Residents consequently collect rainwater for domestic use.

Mining is the main economic activity in this community and as such it responds to and is affected by the economic booms and busts. Madhia is easily accessible through the Bartica/Potaro road and the Konawaruk Road which links Linden to Mabura. It is also accessible by air through Ogle and Timehri airports.

Campbelltown

Campbelltown is north of Madhia. It is an Amerindian community which is managed by the Village Captain (Touchau), a Vice Captain and five councilors. This community has a population of 219 persons comprised of Amerindians and mixed people of part Amerindian descent. The residents of this village are members of the Wapishana, Arawak, Patamona and Carib tribes. There has been some degree of integration between the Amerindians and Afro-Guyanese and the Brazilian miners, but none of these race groups live in the village.

Farming is the main economic activity and subsistence farming is practiced by the residents on farmlands miles away from the village. Some of the Amerindian men are employed as guides, gold miners, labourers and drivers. Some women from this area work at the Regional Office, the schools and some of the stores in the Madhia community. Most of the other residents hunt, fish and farm for their livelihood. The women reported that men live in the mining camps. This has resulted in several families being headed by women.

There are no industries, shops or businesses in this community. There is a community ground and an Amerindian hostel which provides free accommodation for Amerindian miners and families who are intransit.

The community has a well which is powered by a windmill. Residents usually depend on rainwater and creek water whenever the well malfunctions. Campbelltown has no other utility service. This community is accessible by road from Madhia and by trail linked to the Bartica/Potaro road.

Princeville

Princeville is an Amerindian community located some 12 miles away from Madhia along the Potaro River. It has a population of 180 persons comprised only of Amerindians. Most of the Amerindians found here are from the Patamona and Wapishana tribes. There is no indication of racial integration in this village. It is believed that Princeville was established in the late 1980's by a group of Amerindians who felt that it was necessary to create an area to develop their culture and to have access to rich farmlands. This community is managed by the Village Captain, Vice Captain and Councilors of Campbelltown.

Subsistence farming is practiced by the residents. Crops grown are cassava, bananas, plantains, pineapples, cashews and cashew nuts. Men and women are engaged in fishing, farming and hunting activities. The traditional communal lifestyle is maintained in this village where labour and food is shared among the residents. Some men are employed as guides, labourers and miners, but older men remain as father figures in the village. There are no shops, industries or businesses in the area since this is counter to the communal lifestyle. There are no utilities in the area. Princeville has an all age school. A building to house teachers is under construction.

Access to this area is difficult and the area is only accessible to four wheel drive vehicles by trail from the Bartica/Potaro Road.

Tumatumari

Tumatumari is located some 15km upstream of the confluence of the Potaro and Essequibo Rivers. It was initially an Amerindian settlement but is now a mixture of different race groups similar to that of Madhia. The Amerindians found here are from the Arawak tribe. The area was believed to be rich in gold and diamonds and mining was the main economic activity for several years. The fertile agricultural land in the area resulted in the establishment of a Guyana National Service (GNS) centre in the area in 1981. The center concentrated on training young people to develop agricultural and technical skills. Several agro-based industries were established at Tumatumari during the tenure of the GNS. These industries included a pencil factory, a match factory and a tooth-pick factory. Power for the industries was provided by the Tumatumari hydro-electric power station which was established in 1953.

People were not allowed to live around the GNS Centre. The availability of electricity resulted in the establishment of several satellite communities around the area. These communities became known as El Paso, Maicobi and Tumatumari Landing. The total population grew to approximately 450 and electrical appliances were purchased for several homes.The hydro-power station ceased operations in the early 1980s. All factories and industries consequently ceased operations. A number of the residents moved from the area. The area is now totally dependent on mining. The current population is 330 persons.

Tumatumari Landing

Tumatumari Landing is across the Potaro River from Tumatumari near the Konawaruk road. The area has a great degree of racial integration. Persons of African descent who represent approximately one-half of the population, moved to the area from Georgetown and Linden during the 1970s to seek employment and have remained. The Amerindians found here are members of the Arawak and Akaweyo tribes.

Gold mining is the primary source of employment in this area. Several shops line the river bank. These shops sell primarily food and liquor. There are also several small restaurants in the area. The cost of living here is high compared to elsewhere in Guyana with prices practically three times the price of similar commodities in Georgetown.

This area has approximately 20 households. There is a primary school, a health centre and a craft shop. The area is accessible through the Konawaruk road and the Potaro River.

El Paso

El Paso is an Amerindian community to the west of Tumatumari Landing and is populated by Amerindians and mixed races. The Amerindians are members of the Macchusi, Akaweyo and Wapishana tribes. There is some degree of integration with other race groups. There is a primary school and an Anglican Church. Most of the Amerindian have moved away from their traditional culture and have embraced the mainstream culture. There are approximately 40 households in this village.

Maicobi

Maicobi is an Amerindian settlement found on the right bank of the Potaro River near to Tumatumari. This community is populated by Amerindians only and is managed by a Village Captain, a Vice Captain and five councilors. The area has approximately 30 households and subsistence farming is the main economic activity. There is no evidence of racial integration and this group has maintained some aspects of their culture. The people in Maicobi include members of the Macchusi, Carib and Patamona tribes. There are two shops at the entrance to the village, but most of the commercial activity is done at Tumatumari landing. This village has one primary school and is accessed through the Potaro River.

4.5.2 Social Organization

The population of the region can be classified into three major groups. These groups are as follows:

- Amerindians
- Coastlanders
- Islanders

The Amerindian regard themselves as the original residents and have retained their identity spatially and culturally. Amerindian tribes represented in the area include the following:

- Patamonas
- Caribs
- Arawaks
- Wapishana
- Akaweyo
- Macchusi

The Coastlanders are so referred to by the Amerindians and are residents from elsewhere in Guyana who have moved to the area. These people are both permanent and transient residents and are of various ethnic origins, but predominantly of African descent. The Islanders are the immigrants and their descendants from certain Caribbean Islands, particularly St Lucia and Dominica who came in the late 1940's and early 1950's to mine for precious minerals and are mainly of African decent. Within recent times there has been an influx of a group that is referred to as "foreigners" by the other residents of the area.

Within recent times there has been an influx of a group that is referred to as "foreigners" by the other residents of the area. The foreigners are residents of Non-Caribbean states who reside to work in certain institutions as part of aid programmes (for example the hospitals etc.) or as investors.

The exploitation of gold and diamond has always had a direct impact on the viability of the Mahdia community. Times of prosperity in Madhia and its immediate environs are directly related to the successful operation of gold and diamond mines in the area. These times are generally highly correlated to population rises in the area. Population declines are conversely associated with the diminished prospects of gold and diamond mining.

Several of the residents of Madhia and surrounding communities produce tapioca, cassava, farine, potatoes, corn, casareep, and other vegetables. However, the cost of production is high. People consequently prefer to purchase from vendors who travel to the area via the Mahdia–Mabura Hill Road.

There is constant conflict among cultures, particularly from the perspective of the indigenous group, who feel discriminated against. Several foreign mining companies have invested in the area. The firms have, however, sourced their employees from locations outside the area or from other countries. Several Brazilians work in the mining industry in the area. The Brazilians display an acceptable work ethic that has not been emulated by the local workers. Whether this is related to the level of remuneration could not be determined. Businessmen in the area both purchase gold and barter goods for gold with miners in the area. Prior to 1999, upwards of 80 percent of school age teenagers were seeking work as shop assistants, raiding abandoned mines, or were engaged in prostitution.

The introduction of modern technology in the mining sector has led to unemployment and decreased incomes for small-scale miners (pork-knockers) and the associated social disorganization in the family unit due to loss/reduced income levels

4.5.3 Administration

The Ministry of Regional Development through its Regional Administration or Regional Democratic Council administers the area. The Principal Administrator is the Regional Executive Officer. The Regional Democratic Council (RDC) consists of a chairman, who is the political head and councilors from the various political parties that comprise the RDC. The RDC, however, only meet on a quarterly basis because of accessibility problems and councilors often have to be flown to meetings at excessive costs. The Regional Chairman functions under difficult circumstances created by a lack of inadequate staff and limited communications with his subject ministry. In recent times residents of Mahdia have been calling for their own administration to address local issues.

4.5.4 Social Infrastructure

4.5.4.1 Communication

Access to Madhia is either via the Mahdia-Mabura Hill road or by air. Several mining companies working in the area maintain the road and a passenger service is provided by several minibuses which ply the road. By road, Madhia is within six hours of Georgetown. Several private aircraft operators also provide charter flights to Madhia. Madhia is approximately one hour flying time from Georgetown.

4.5.4.2 Utilities

There is no public utility service in the entire community. However, private generators as well as the Regional Administrative Office provide a limited supply of electricity for essential services such as the hospital and police station. No potable water is supplied to the area. Apparently this service existed in the past but has been curtailed since the reservoir in the area has been contaminated. There are no financial services institutions in Madhia and the surrounding communities. Limited financial services are available at the Madhia Post Office.

4.5.4.3 Education

There are primary and nursery schools in the Madhia area. However, secondary education is quite expensive for the approximately 89% of secondary school age children who pass the Secondary School Entrance Examination since the residents of Madhia and surrounding communities have to attend schools in the Paramakatoi area, Georgetown or Bartica. The inadequate facilities for secondary education have led to several factors. These included:

- high drop-out rates from school
- high levels of teenage pregnancies
- 12-15 year old males raiding abandoned/operational mines; an activity referred to locally as "punting"

These developments have implications for the social environment in which girls are socialized. In addition there is no facilities in the area for skill training and the attendant contribution to national development is therefore minimized. The lack of skill training and the attendant ability to contribute to development has resulted in significant levels of prostitution and substance abuse.

4.5.4.4 Other Organizations and Institutions

The Social Impact Amelioration Programme (SIMAP) has carried out certain projects aimed at the poor, particularly the Amerindian communities. There are also religious organisations which are prominent, these include The Full Gospel, Assemblies of God, Roman Catholic, Anglican, Jehovah's Witnesses, Seventh Day Adventist and Indigenous Patamona 'Hallelujah".
The organizations provide the following services:

- Counseling
- Moral upliftment programs
- Collection & distribution of food and clothing to indigent people in area

4.5.4.5 Cost Of Living Issues

Cost of living is very high in Madhia, compared to elsewhere, in spite of the fact that access by road has served to lower the cost of living somewhat. A typical meal at a restaurant in Madhia is approximately $1,000. Flour costs from $4,500 to $5,000 per 100-pound bag and the cost of a daily newspaper is $100.00 as opposed to $25.00 on Guyana's Coast. A list of the prices of various essentials is provided in Table 15.

Table 15: Prices in the Project Area

Item	Unit	Price in $Guy.
Flour	lb	50-60
Sugar	lb	40-60
Salt	lb	40-50
Rice	gallon	320-400
AA Battery	ea.	60-80
Bath Soap	ea.	40-60
Plantains	lb	50-60
Eddoes	lb	60
Sweet Potato	lb	80
Soft Drink	ea.	100-200
Mangoes	ea.	50
Oranges	ea.	50
Ochro	lb	200
Cabbage	lb	140-200
Gasoline	gallon	600
Chicken	lb	250

4.6 Noise, Odor and Dust

The only activity in the site vicinity is the operation of dredges on the Potaro River and the passage of motor boat traffic in the area associated with the dredge operations. No other activity occurs in the project area. Consequently only transient noise currently emanate in the site vicinity, the noise is however not audible over most of the area proposed for development into the mine. There are no odors or dust associated with the activities for which the site is currently utilized.

4.7 Cultural and Archaeological Resources

4.7.1 Existing Landscape

The topography of the proposed site landscape is gentle rolling with small undulating sandy hills that are dissected by creeks and rivers. Immediately to the east and west of the proposed development site, the gently rolling landscape is interrupted by isolated topographic highs that define the valleys of the proposed location. The site is located on topographic forms that have been developed subsequently on white-sand plains of marine sedimentation. The area is covered with an extensive blanket of white sand that forms part of the white sand series (see figure 6).

Figure 6

The vegetation on the site as shown on figure 6 is typical of a mixed tropical rain forest found in Guyana with canopies that are approximately 20–40 meters in height with large climbing plants. A number of buttressed plants can be found growing on the trunks and limbs of large trees. The understorey is covered with shrubs, herbs and a large number of ferns (see figure 7).

Figure 7

Within the study area there are no communities. A few small mining camps are scattered around the forested area on the banks of the Potaro River where several dredge-mining operations are being conducted.

Areas surrounding the Uewang Creek have been disturbed by land dredging operations (see figures 8 and 9). Approximately five percent (5%) of the proposed development site has been disturbed by land dredging operations.

Figure 8

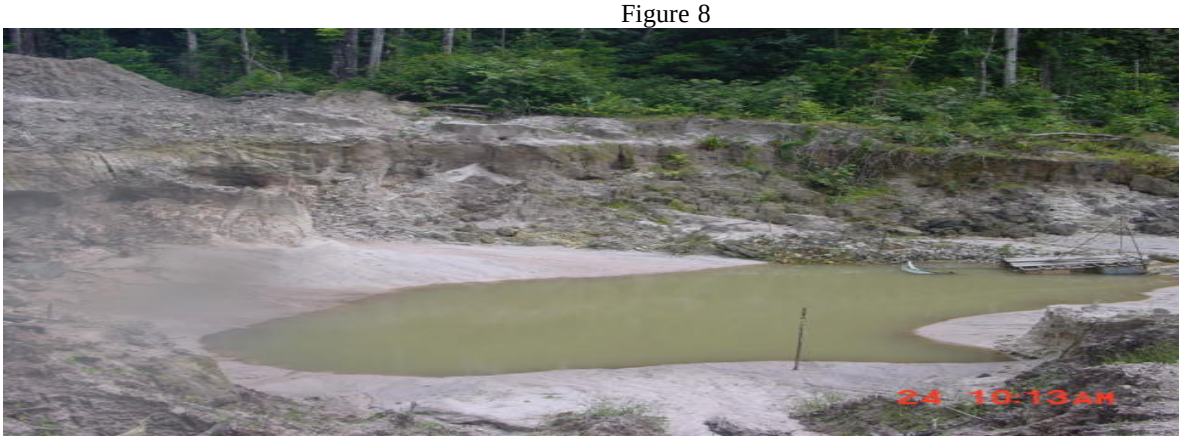

Figure 9

4.7.2 Cultural and Archaeological Resources

In addressing the cultural and archaeological resources of the proposed s ite three aspects were examined:

- Archaeology
- historic resources
- general archaeological potential of the area.

In the study area there are no cultural and archaeological sites that are of historic interest within the zone of visual influence of the proposed development. There are several waterfalls located in the Potaro district where the proposed development will be established. Kaieteur and Amatuk Falls are located two and twenty-five miles respectively upstream of the proposed development. Kaieteur is presently being evaluated as a World Heritage site and it is protected under the Kaieteur National Park Act. However, no permission is required under the Act for working in this area.

Site excavations conducted at points around the site located remains of Old Dutch bottles. These are likely evidence of mining activities that took place during the diamond boom of the years 1923-1930. Some of the largest diamonds ever found in Guyana is reported to have come form the Maple Creek and Little Uewang Creek areas.

Contact was made with the Walter Roth Museum of Anthropology to gather further information on other important or contentious archaeological resource of the area. The investigation revealed that no information was available on the study area.

4.8 Traffic

Vehicular traffic cannot travel farther than Madhia at present. Vannessa has a tractor-trailer on site that is used to move personnel and equipment in the project. There is consequently no traffic in the area.

5.0 POLICY, LEGISLATIVE AND REGULATORY CONSIDERATIONS

5.1 Introduction:

Several pieces of policy, laws and regulations specific to areas of environmental management can affect the mining of minerals at Maple Creek in the Potaro River. As a matter of policy the Environmental Protection Agency requires a Environmental Impact Assessment for projects that would have a significant impact on the environment. The extraction and conversion of mineral resources as a developmental project is listed in the Fourth Schedule as requiring an Environmental Permit. As such there is a statutory requirement for conducting an environmental impact assessment for this project. In addition other existing pieces of International, National and Local level policy statements, legislation and regulations would also have relevance to the development and implementation of this project in areas of environmental concem. In this section, the relevant policies, statutory requirements and guidelines that would impact on the environmental assessment process of this proposed project are outlined.

5.2 International Policy:

In 1992, at the United Nations Conference on Environment and Development (UNCED) held in Rio De Janerio Agenda 21 was adopted as a programme of action for the 21st Century. Twenty-seven (27) environmental principles were outlined at the UNCED conference as an attempt to enshrine a charter for the protection of the Earth. Three principles outlined in Agenda 21 action programme can be applied to the environmental impact assessment process for this development. These are:

- Principle 1, which states that human beings are at the center of concerns for sustainable development and that, they are entitled to a healthy and productive life in harmony with nature.
- Principle 3 which mentioned that the right to development must be fulfilled so as to equitably meet development and environmental needs of present and future generations and;
- Principle 17 which states that environmental impact assessments should be a national instrument, that shall be undertaken for proposed activities that are likely to have a significant adverse impact on the environment and are subject to the decision of a competent national authority.

The above principles outlined in agenda 21 can be seen as mechanisms by which the global community will cooperate to promote sustainable development[1]. Within this context the Government of Guyana has tailored its National Environmental Policy so as to include the principles of Agenda 21 and have included aspects related to the above environmental principles.

5.3 National Policy

In the National Environmental Action Plan (NEAP), 1994, the Government of Guyana has outlined its environmental policy objectives for the sound management of the environment and natural resources. Twelve stated policy objectives were outlined. Those that are applicable to this project are listed below.

- ✓ Ensure prior environmental assessments of proposed activities, which may significantly affect the environment.
- ✓ Ensure that conservation is treated as an integral part of the planning and implementation of development activities.
- ✓ Raise consciousness of the population on the environmental implications of economic and social activities through comprehensive education and public awareness programmes.

One of the policy objectives calls for the Government of Guyana to ensure that environmental assessments of proposed development activities, which may significantly affect the environment, are undertaken. 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

[1] A development that can be maintained indefinitely because it is socially desirable, economically viable and ecologically sustainable (IIED 1996)

Environmental Protection Agency and outlines the legal process for undertaking sustainable and effective management of the environment and its natural resources.

5.4 EPA's Role in EIAs:

With the passing of the Environmental Protection Act, the EPA has four main functions in relation to environmental assessment. These 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 its 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 be 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.

Further, in performing its functions, the Agency is required to implement current principles of environmental management, namely:

- The "polluter pays principle": the polluter should bear the cost of measures to reduce pollution decided upon by public authorities to ensure that the environment is in an acceptable state, and should compensate citizens for the harm they suffer from 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 that 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.

5.5 THE EIA PROCEDURE

In the fourth schedule of the Environmental Protection Act an Environmental Authorisation is required for the extraction and conversion of mineral resources and an environmental impact assessment may be required. This project falls into this category and the agency has indicated that an environmental impact assessment is mandatory prior to the issuance of an environmental authorisation.

Prior to the commencement of an environmental impact assessment process the developer must complete the following:

- Application for an environmental authorization.
- Complete 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.

Upon completion of the above, The Agency publishes in at least one daily newspaper notice of the project and makes available to members of the public the above project summary. Within 28 days of publication members of the public can make written submissions to the Agency, setting out those questions and matters that they require to

be answered or considered in the EIA. During this period the Agency in consultation with the developer and the consultants identified to carry out the EIA will determine the terms and scope of the EIA.

Information required in the Environmental Impact Assessments is clearly outlined in section IV of the Act. The environmental impact assessment process must identify, describe and evaluate the direct and indirect effects of this project on the environment (Section 11(4)(a). Further this project must be assessed with a view to protect and improve human health and living conditions and the need to preserve the stability of ecosystems as well as the diversity of species. Every environmental impact assessment is required to contain the following information:

- A description of the project in which the details are outlined in Section 11(5) (a) (i) – (iv).
- An outline of the main alternative 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 EIA.
- A description of the best available technology.
- A description of any hazard or danger which may arise and a risk assessment of same.
- A description of mitigation measures for any adverse effects
- A statement of the degree of irreversible damage
- An emergency response plan
- A programme for rehabilitation and restoration.

During the environmental impact process the Developers[2] and Consultants [3]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 the reasonable cost, copies of information obtained for the purpose of the EIA.

The Developers and Consultants must submit to the Agency the EIA report along with an Environmental Impact Statement[4] (EIS) for evaluation and recommendations. The decision by the Agency to grant an environmental authorisation for a project shall be subject to conditions, which are reasonably necessary to protect human health and the environment.

5.6 Environmental Impact Assessment Guidelines:

In addition, the Environmental Protection Agency has established guidelines for Conducting and Reviewing Environmental Impact Assessments. The guidelines explain provisions of the Act in relation to the environmental impact assessment procedure and outline the level of detail required in the environmental baseline study, impact assessment and the environmental impact statement.

It is within these basic guidelines that consideration will be given to the information, which is required to enable the full impact assessment on the environment to be evaluated for the proposed Maple Creek mining project.

5.7 ENVIRONMENTAL PROTECTION REGULATIONS:

Regulations on Hazardous Waste Management, Water Quality, Air Quality and Noise Management were established under the Environmental Protection Act. These pollution management regulations were developed to regulate and control the activities of developmental project during construction and operation.

5.7. 1 Hazardous Waste Management Regulations

These regulations outline the rules and procedures for transport, storage, treatment and disposal of hazardous wastes. These regulations will 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. The regulations also

[2] The applicant(s) for the environmental authorization for the project or the state initiating a project.
[3] The persons/firm responsible for carrying out the environmental impact assessment.
[4] A summary of the environmental impact assessment.

established the requirements for the landfill disposal of hazardous waste. Schedule 1 lists the hazardous waste to be controlled under these regulations.

5.7.2 Environmental Protection Water Quality Regulations 2000

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 authorisation, 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. No standards for water quality for mining operations have been proposed. However, for this project the following standards may be applicable.

Table 16: Surface Water Quality Standards - Mining

PARAMETERS	SURINAME STANDARD
Physical Test	
Ph	4.0 – 8.0
Conductivity	300 – 1250mg/l
Total Suspended Solids	100mg/l
Anions	
Alkalinity	nil
Sulphate	250 mg/l
Heavy Metals	
Arsenic	nil
Cadmium	nil
Copper	nil
Iron	1.4mg/l
Lead	nil
Mercury	0.0001mg/
Zinc	nil

5.7.3 Environmental Protection Air Quality Regulations 2000

The requirements for registration and environmental authorisation by persons with facilities that emit air pollution from any process into the atmosphere are outlined in these regulations. Elements related to parameter limits on air contaminants and emission sampling are also stated in the regulations. Schedule 1 outlines provisions for air pollution-monitoring index. The list of air contaminants for which parameter limits are to be set by the Agency are also detailed in the regulations. No air quality standards are established for mining in these regulations. Below are Ambient Air Quality Standards for consideration.

Table17: Air Quality Standards

POLLUTANT	WORLD BANK STD.
Nitrogen Dioxide (NO_2) Maximum 24-hour average	150µg/m^3
Particulate Matter(PM10) 24-hour average	70µg/m^3
Sulphur Dioxide (SO_2) 24-hour average	125µg/m^3

5.7.4 Environmental Protection Noise Management Regulations 2000

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 to be fixed by the EPA were

identified as follows: Residential, Institutional, Educational, Industrial, Commercial, Construction, Transportation and Recreational The EPA has not established noise level standards. However, the ambient noise level that would be considered for this operation for both day and night would be 70 decibels (Industrial and Commercial Standards, World Bank 1998) at the property line.

5.8 Other Sectoral National Policy and Legislation:

5.8.1 The Mining Act

The Guyana Geology and Mines Commission is responsible for the implementation of the Mining Act 1989, which establishes the legal framework for the utilisation 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 with the Minister responsible for mining. The rights of persons in possession of lands grants as well as the privileges of Amerindians in relation to prospecting, mining, quarrying are preserved under this Act. Further regulatory framework under the act makes provisions for the disposal of sanitary waste and the storage of poisonous substances in mining areas.

5.8.2 Mining Regulations

Environmental regulations under the Mining Act are currently being developed for the mining sector. These regulations will require a licence for the use of poisonous substances such as mercury and cyanide and will promote the enforcement of environmental standards in the sector for small and medium scale mining. In general the regulations establish regulatory control in areas of key environmental concerns, some of which will be applicable to the activities of this project. These include:

- 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 exploration and mining
- Submission of environmental management plans in accordance with an environmental code of practice established by the Guyana Geology and Mines Commission.
- Contingency and Response Plans

5.9 Occupational Safety and Health Act 1997

The identification of the health and safety hazards during the operation of the proposed development must be seen as a key element for assessment. The Occupational Safety and Health Act 1997, Section 6 states that any person who intends to erect or cause to be erected a new industrial establishment or any new building appurtenant to any existing industrial establishment shall, before the erection of such industrial establishment or building is commenced, give notice in writing to the Authority of his intention as aforesaid, and shall furnish the Authority with such, drawings, plans or specifications that are required by the Authority. In addition in Section 52 the owner of an industrial establishment that is not a construction site must ensure the following:

(i) health and safety facilities as are prescribed are provided;
(ii) any such facilities prescribed to be provided are maintained as prescribed;
(iii) the industrial establishment complies with the regulations; and

Further, the mining regulations under Mining Act No.20 of 1989, Part XIII (the regulation of mines) 120–126 outline provisions for health and safety working conditions for mines and also mine workers. In keeping with the laws and regulations a description of the established management procedures to monitor and manage occupational health and safety hazards is critical for this project.

5.10 The Forestry Act and Policy:

The Forestry Act (1953) focuses on the utilization and conservation of Guyana's Forests and authorizes the Guyana Forestry Commission to regulate the harvesting, marketing, export and transportation of timber. The Act empowers the Minister responsible for the forestry sector to make regulation governing the harvesting of forestry produce, the operation of sawmills, to restrict the exploitation of certain species and other matters related to the state forest.

5.11 Wild Birds Protection Act:

This Act governs the protection of wildlife in Guyana and focuses on the prohibitions of wounding, killing for sale or export of wild birds. Under this Act the Minister is empowered to make regulations regarding the wildlife trade and the hunting and capture of wild birds. This Act protects over sixty (60) species of birds. In addition, the Species Protection Regulations 1999 was established under the Environmental Protection Act in keeping with legal obligation under the CITES International Convention on Trade in Threatened and Endangered Species. During the environmental assessment process, aspects related to these issues will be considered for the assessment of fauna.

5.12 Kaieteur National Park Act.

This act constitutes a certain area of land in the vicinity of the Kaieteur Falls on the Potaro River in the county of Essequibo as a National Park and provides for the control of the said park and for the preservation of natural scenery, fauna and flora and minerals of the park. In 1999 the park was expanded from its present size of 45 sq. miles to approximately 224 sq. miles. In 2000 the Act was amended to provide the Amerindian families from Chenapau, access and traditional use within the extended park. The Kaieteur National Park is considered one of the crown jewels for nature and eco-tourism plans of the Government of Guyana and is currently being evaluated as a World Heritage site by UNESCO. The park is approximately twenty-five miles upstream of the proposed project and will not be affected by the activities of the project.

6.0 ENVIRONMENTAL IMPACTS

The project and its alternatives will impact the physical, biological and social environments. Mining will result in the depletion of a non-renewable resource. The area will be made accessible by the road constructed to the site to support mining activities. Reclamation and revegetation of the mined out area may create conditions conducive to agricultural development. Revegetation by a commercial plant specie, such as cashew, may create job opportunities for former mine workers after mine closure. Revegetation by a fast growing plant specie, such as congapump, may provide feed for a power generation plant. The proximity of the transmission line for the proposed Amaila Falls Hydropower project may make a power generation plant in the mined out area a very viable option. The following sections detail the environmental consequences of the operation of the mine.

6.1 IMPACTS OF THE PROPOSED ACTION

6.1.1 Climate

The burning of debris from trees and other vegetation will emit gases and particulate matter. The gases that would be released by the open burning of the vegetative mater will be as follows:

- Carbon monoxide
- Methane
- Other volatile organics

During the operational phase of the project a total of approximately 10 tonnes of organic debris will be burnt each month. The quantity of each gas and of particulate matter emitted was estimated based on the USEPA AP-42 Emission Factors. Table 18 presents a summary of the average quantity of emissions that will be generated by open burning on a monthly basis.

Table 18: Estimated Emissions from Open Burning of Organic Material

Constituent	Quantity Emitted (kg/month)
Particulate	180
Carbon Monoxide	1120
Methane	61
Other Volatile Organics	64

Air quality will also be impacted by emissions from vehicles and engines, which are all assumed to be diesel driven. The USEPA AP-42 Emission Factors for mobile sources was used to estimate emissions from vehicles based on all vehicles traveling a cumulative mileage of approximately 300 miles each day, operating at low altitude and with all vehicles being post-1980 models. The estimated emissions are shown in Table 19.

Table 19: Estimated Emissions from Vehicles

Constituent	Quantity Emitted (kg/month)
Hydrocarbon	3.64
Carbon Monoxide	11.2
Nitrates	12.44

Guyana and more particularly the site are not non-attainment areas for greenhouse gases. These emissions are all within acceptable standards and will therefore not have any effect on climatic conditions in the site area or elsewhere.

Several water retention and tailings ponds will be constructed as part of the project facilities. The increased area of surface water bodies will result in increased evaporation in the immediate area of the ponds themselves. The water management area must, however, be cleared for construction of these facilities. The cleared area will not be greater than two acres. Increased exposure of this area, formerly below the forest canopy, will result in a rise in temperatures in this area and will counteract any temperature decrease due to increased evaporation. There will consequently be no impact on the microclimate of the area.

6.1.2 Geology

The mining operation will result in the removal of the soil above the ore horizon. The surficial geology of the area presently consists of white sand overlying brown silty sandy gravel. During removal of soil above the ore horizon, soils will not be segregated by material type. No hardrock mining is proposed for the site. The mining activity will therefore have no impact on bedrock geology or the seismicity of the site.

The mines will be reclaimed at the completion of the ore extraction process. However, the reclamation will be done with a matrix of white sand and brown silty gravel. The reclamation will result in changes in the topographic height, slope relief intensity, degree of shaping and exposure of the area. The project will alter the surficial geology within the area mined and reclaimed. The modification of surficial soils will influence the water balance in the area since the new surficial soils may be less permeable than those current at ground surface and the quantity, physical distribution and time-related recharge of precipitation to groundwater will consequently change.

The post mining reclamation and haul roads will alter the existing ground surface slopes in the area. Since slopes created by the operation 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.

6.1.3 Water Resources

The wastewater produced by the mining operation consists of water from the mine itself and waste water produced from the washing circuit (tailings). The mine water may contain dissolved concentration of metals naturally occurring within the soils present at the site. Water quality will be impacted by wastewater discharges from the mine 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. Discharge of wastewater into surface water may impair surface water quality by causing changes to its physical, chemical and biological properties. The water management facilities will be designed to ensure no uncontrolled discharges to surface waters. These impacts will therefore not be realized during the operations.

Initially surface water will be withdrawn for commencement of the process. This will re-occur when needed. Several un-named tributaries of both Maple Creek and the Euwang River flow through the area to be mined. The mining operation will require diversion of several of these surface water bodies.

Groundwater is encountered within relatively shallow depth of the ground surface. Mining activities will be restricted where possible to above the existing groundwater level. However, mining will intercept groundwater in some instances.

6.1.3.1 Groundwater Flow

Mining activity will entail excavation below the existing groundwater level. This will interfere with the existing groundwater flow regime and may result in the temporary reversal of groundwater flow direction. Groundwater will flow into the excavation during the mining operation. This water must be pumped away from the open-pit for ore recovery. If adequate pumping capacity is not provided groundwater flow into the pit may result in flooding.

After mine closure there may be residual depressions as a result of extraction of the ore and removal of overburden. These depressions may eventually produce groundwater filled ponds on the surface of the reclaimed ground. 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. The ground levels after reclamation will exceed the groundwater levels. This effect on the groundwater flow regime will therefore not be realized.
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 will 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 of the area and subsequent reclamation will result in increased soil compaction. Seepage to groundwater would be reduced and water may accumulate on the ground surface and cause evaporation to increase.

6.1.3.2 Groundwater Quality

Groundwater quality may 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 mineral 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. In addition, no chemical reagents are used in the mining or processing streams. Discharge from the tailings ponds to groundwater will have no impacts on water quality.

6.1.3.3 Surface Water Flow

The project entails the initial withdrawal of water from the Euwang River for the washing and processing circuits. If the quantity of water taken from the Euwang River exceeds the usable supply, vegetation in the vicinity of the Euwang River may die off and streams and springs in its vicinity may run dry. The volume of surface water that will be withdrawn would be restricted to ensure supplies of process water and the demands of vegetation are satisfied and these effects will not occur.

Several small creeks within the area to be mined will be initially impacted by the mining operation. These creeks will be temporarily blocked during the mining operation and will flow through their restored or re-diverted channels after mine reclamation. The creeks all discharge to either Maple Creek or the Euwang River. The temporary interruption of flow in these creeks will results in reduced flows in both Maple Creek and the Euwang River. The reduced flows will be compensated by the increased runoff from site clearing in the short-term. There are no downstream users of water from any of these creeks. The impact of temporary blockage of these creeks will therefore be minimal.

Site clearing will produce increased discharges to surface water flow since interception and evapotranpiration will be reduced. The volume of additional inflow may result in increased surface water levels in both Maple Creek and the Euwang River if large areas of the site are cleared instantaneously. The maximum area cleared at any time during mining shall not exceed one acre.The additional runoff from this area will not result in surface water discharges large enough to alter

seasonal high water levels in either Maple Creek or the Euwang River. This long-term impact will be ameliorated when revegetation occurs at the site.

Surface water flow volumes will also increase if there is indiscriminate discharge of groundwater from the mines to surface water bodies. The hydraulic conductivity and horizontal flow gradients indicate that approximately 0.0052 m^3/s will be added to surface water flow if water is pumped from the mine to surface water.
The project will not affect the regional catchment areas of either Maple Creek or the Euwang River.

6.1.3.4 Surface Water Quality

Groundwater recovered and pumped from the open-pit can introduce sediments and nutrients loads into surface water bodies into which it is discharged. The surface water quality can be impacted by sediment and nutrients in wastewater discharged to surface water. 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. Resistance to specific pollutants will result in these substances being passed onto the food chain.

A surface water quality directly related to erosion is sedimentation. Eroded matter transported by surface runoff to streams and rivers 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. Further, groundwater in the area discharge to surface water. Consequently any dissolved chemicals present in groundwater will be introduced to surface water by groundwater discharge. Surface runoff of water contaminated by waste management facilities on site can also impact surface water quality.

Water management facilities will be maintained during all phases of the operation. No discharges to surface water will occur during mining or processing. These effects will consequently not be realized.

6.1.3.5 Fishes

The operation of the mine itself will have no direct impacts on fishes in the area. The project can, however, result in considerable indirect impact on fishes. The introduction of sediment by surface runoff and mine drainage may introduce additional nutrient loads to the streams. The altered nutrient levels can potentially result in eutrophication. Pollution by contaminated surface runoff and mine drainage 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.

It is not known whether survival of any of the fish species is temperature dependent. Removal of the existing tree cover in the area will result in increased water temperatures and will enhance the existence of species that prefer warmer water. Sediment flow into streams can also retard light penetration and reduce the food producing capability of the area. Increased accessibility may increase chances of fishing by people passing through the area.

6.1.4 Terrestrial Resources

6.1.4.1 Land Use

The project will result in a change in vegetation cover. This may increase soil erosion, soil compaction and nutrient leaching from the surficial soils. Nutrient leaching is, however, expected to be miniscule since most nutrients in tropical forest environment are locked up in living vegetation and relatively little nutrient is present in soil due to the high decomposition rates of dead organic matter in tropical forest environments.

The size of forest stand will initially decrease and will alter living conditions for flora and fauna. In addition, the loss of forested areas will expose the cleared area to the full force of prevailing wind. Trees with shallow root structures will therefore be vulnerable to being toppled. Wind fetch will, however, be limited by the extent of the cleared area which will not exceed one acre. Toppling of trees will therefore be minimal. Loss of forest cover will alter groundwater recharge rate and surface run-off conditions.

The land reclamation and replanting may result in the introduction of trees not native to the site. Loss of vegetative cover will also alter the factors influencing how the precipitation divides up into evapotranspiration, surface run-off and groundwater recharge.

6.1.4.2 Vegetation

Cutting of large tracts of tropical rain forest on poor soil, for mining, will make plant regeneration difficult. This difficulty arises since nutrients, contained in the biomass, either disappear up into the air when organic material is burned, and/or are washed out by rainwater. Burning and leaching deplete the soil of nutrients, and any new vegetation will consist of mostly worthless grass species. The conditions required for regeneration will also disappear with the clear-cutting required for the mine operation. Aggressive grass species and shrubs will effectively prevent seed-bearing plants from finding satisfactory living conditions.

In addition 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. 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. Revegetation of the area with only a few types of trees will alter the diverse nature of the trees present in the area. The areas occupied by the access road, personnel facilities and operational mines will be subtracted from the total area available to flora.

6.1.4.3 Wildlife

Stocks of animals depend on the existence of habitats of a certain size. Clearing for the mine, roadway and personnel facilities 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 roadway construction will form temporary barriers to the movement of animals, including access to water bodies.

The road will provide access to natural domains previously protected from outside influence. People moving along the road may therefore 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.

During operation of the mine, wildlife will 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.

6.1.4.4 Threatened and Endangered Species

No threatened and endangered species are present in the area. There is therefore no impact on threatened and endangered species.

6.1.4.5 Socioeconomic Conditions

The socioeconomic impact assessment was performed by utilizing a participatory approach. The participatory approach identified several focus groups and elite individuals. Each group was interviewed to determine its perspective of the proposed project. The elite individuals consisted of key administrative personnel in the entire area likely to be impacted by the project and included the following individuals:

- Regional Education Officer
- Community leaders
- Councilors and
- Pastors

In addition to the elite individuals, focus groups of between 3-10 persons from each of the communities identified in the baseline area likely to be impacted by the project were also interviewed. These communities are as follows:

- Mahdia
- Campbelltown
- Princeville
- El Paso and Micobie
- Tumatumari
- Tumatumari Landing

The focus groups were further subdivided into the following categories:

- Miners
- Unemployed youths
- Women
- Prospective school leavers
- Health workers
- Pensioners
- Businessmen

The interviews were intended to identify current and projected impacts on human populations resulting from changes to the natural environment in the project and contiguous areas. The interview format consisted of three distinct sections. These sections covered the following:

- Social status of the respondent
- association with the area and perceptions of the project
- proposals to mitigate project impacts

Thirty two (32) respondents were interviewed. This group included 18 males and 14 females. A breakdown in terms of ethnicity is presented in Table 20.

Table 20: Ethnic Breakdown of Socio-economic Sample

Ethnicity	Percentage of Sample
Amerindian Descent	50
African Descent	40
Indian Descent	6
Portuguese Descent	3

This group was further broken down in terms of their origin into the categories identified in Table 21.

Table 21: Breakdown by Origin of Socio-economic Sample

Origin	Percentage of Sample
Guyana's Interior	50
Guyana's Coast	15
Caribbean Islands	19
Madhia Itself	13
Other Countries	3

Knowledge about the project was equally split among the respondents. Approximately 31 percent of the respondents have been involved in various activities in the project area. The activities in which the respondents are involved are:

- gold mining/prospecting
- hunting
- fishing

Sixty percent of those pursuing activities in the area have spent less than a year on their activities. The remaining forty percent who are mainly miners/prospectors and hunters and fishers have frequented the area within a ten – year period.

The Maple Creek/Euwang River area is regarded by residents of the indigenous communities as traditional hunting and fishing areas and residents in the communities surveyed indicated that they fish, hunt and mine in those areas. The operation of the mine may restrict access to the area for hunting and fishing. This may result in loss of revenue/livelihood for the members of the communities who use these areas. The project may therefore result in some social resentment by people in the area if hunters and fishermen lose access to the area.

The operation of the mine will create employment opportunities for residents of the area. In all of the communities surveyed, the residents expressed the desire to work as chain saw operators, laborers and/or drivers or to perform any other unskilled work that is available. If most of the unskilled project employees are hired from outside the communities, it may lead to a reinforcement of beliefs that development in the area is not meant to benefit residents of Madhia and the surrounding communities.

Employment of both skilled and unskilled labour may bring financial benefits to the communities if residents are considered for the jobs. Further employment of people from outside the area will see the repatriation of money away from Madhia itself and the associated lack of development of the area. The project will create a demand for skilled labor. The demand for skills may result in improved education standards and services in the communities.

While there is a limited knowledge base for skilled jobs using heavy-duty equipment, persons surveyed expressed a willingness to be trained in these areas. The project may therefore result in people in the communities acquiring new skills if a training program forms part of the construction activities. Opportunities of paid employment may change the traditional division of labour between men and women in the indigenous communities in close proximity to the mine.

The project would have a total life of approximately 25 years. It can therefore see the creation of permanent settlements on its perimeter based on the access road to be constructed to the site. These settlements may put pressure on arable land and water. In addition, the settlements may lead to further harvesting of timber for housing and fuel and create increased demands for schools and waste disposal.

Given prevailing conditions in Guyana, social unrest, racial tensions and other conflicts may arise among people of different ethnic, social and economic backgrounds moving into the area. Conflicts may also develop between small-scale miners and Vannessa Ventures as the small-scale miners begin to find that areas previously open to extraction are now under the control of the company

The project will introduce completely new technology to Guyana gold and diamond mining industry. It could therefore be used to provide an alternative to the conventional methods for the extraction of gold and diamonds. In addition, the revegetation of the area with cashew trees will provide a potentially long-term, financially viable, asset to any new residents of the area.

6.1.5 Noise, Odor and Dust

Dust emissions will be produced during the mining operation by vehicles using site roads and from overburden stockpiles onsite. The total dust emissions from the stockpiles result from the following:

- Loading and reloading of material unto and from the stockpiles
- Equipment traffic in the storage area
- Wind erosion of the materials in the stockpiles

The dust emitted was estimated using AP-42 Emission Factors for Aggregate and Storage Piles and for Unpaved Roads. The analysis for stockpiles assumed maximum wind speeds of 30kph, soil moisture content of 5% and 10000 tons of stockpiled material. Dust emissions for these conditions are expected to range from 6 to 40 pound per day. The estimate of dust emissions from unpaved roads was based on the surficial soils having a silt content of 5%, average vehicle weight

being 5 tons, and a surficial soil moisture content of 10 percent and based on 300 vehicle miles per day. The dust emitted was computed for different sizes of particulates, PM-2.5, PM-10 and PM-30, where PM-2.5 refers to particulate matter smaller than 2.5 microns. The dust emissions expected from the unpaved roads are detailed in Table 22.

Table 22: Emissions From unpaved Roads

Parameter	Quantity Emitted lbs/day
PM-2.5	21.5
PM-10	147
PM30	402

Noise levels above the alert threshold of 86 decibels and hazard threshold of 95 decibels will be produced from heavy-duty machines operation. During maintenance operations vehicles in maintenance workshops usually generate noise levels in the vicinity of 72-110 decibels. Power generation plant usually generate noise in the range of 90-105 decibels. 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 will occur in close proximity to existing habitats. The mining operation will emit noise. There would have been minimal noise stresses in the project area prior to the project. Continuous noise may therefore 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.

6.1.6 Cultural and Archaeological Resources

Landscape impacts would result from the clearing of vegetation and the disturbance of soil and surficial material during the construction and operation of the mine. Further, there will be a general change in the total floristic composition. This would result in some lost of the existing landscape elements and character within the proposed development area. The proposed mining development would be screened from external views by the forest hence visual impacts would not arise. The cultural and archaeological resources are unlikely to be significantly affected by the construction or operation of the proposed development.

6.1.7 Traffic

The project will introduce some traffic into the area. Moreover the construction of a road to the mine site will create a corridor for traffic to move further west. The traffic will, however be limited to trucks and four wheel drive vehicles. The increased traffic, coupled with the steep terrain in the area may result in some instances of vehicular accidents on the road to the mine site.

6.1.8 Health and Safety

The creation of the water management area may favor the multiplication of waterborne disease vectors such as flies, mosquitoes and other parasites and the introduction of new ones. Outlets from on site detention ponds will create areas of fast flowing water, which are favorable for the development of mosquito vectors responsible for filariasis. Increased occurrences of diseases that may be induced by the presence of the water management ponds include malaria, lymphatic filariasis as well as other diseases such as yellow fever, and dengue. The surface water in the both the Euwang River and Maple Creek is acidic, the possibility of Schistosomiasis (or bilharzia) is consequently unlikely.

The need for people to relocate to the area 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 will 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 access roads may result in the easy spread of diseases since carriers of diseases, both floral and faunal, can gain easy access to wilderness areas along 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.

The company will provide an on site health and emergency response facilities. The operation of the mine will therefore provide some health care to residents within the area. In addition, the managements system implemented for the mining operation will ensure no pools of stagnant water and/or waste tailings are on site thereby eliminating fertile breeding grounds for waterborne disease vectors such as flies, mosquitoes and other parasites. The effects on health and safety shall therefore be minimal.

6.2 IMPACTS OF NO-ACTION ALTERNATIVE

The No-Action alternative will have no impact on climate since only small-scale wildcat mining and or logging will occur at the site. The small-scale mining cannot result in the creation of large bodies of surface water that can affect temperatures in the area. In addition, the remoteness of the area will preclude against large scale timber exploitation since significant logistical problems will be encountered in moving timber from the site to markets on the coast and overseas. Timber exploitation is therefore likely to be too small to cause changes in the site microclimate. The No-Action Alternative will have no impact on geology. Some alteration in ground cover may occur over small areas due to localized operation. This will not impact on the overall geology of the area.

Small-scale mining does not entail the withdrawal of large volumes of water or the discharge of large volumes of tailings. In addition small-scale mining may not occur close to large water bodies. Since small-scale mining is likely to be the only activity that will occur at the site, the impact on water resources is likely to be negligible. The No-Action alternative will not impact land use, vegetation, wildlife or threatened or endangered species in the project area since access will be limited to a very small number of humans. The No-Action alternative will not impact socio-economic conditions, noise, odor, dust, cultural and archaeological resources and will introduce no traffic to the area.

The Potaro/Siparuni Region in which the project is located is experiencing a severe economic recession. This area which is centered on Mahdia was once a prosperous and booming area as a consequence of gold and diamond mining. The area currently experiences only minor gold and diamond recovery since most of the profitable deposits have already been mined. The Amerindian communities nearby, namely Campbelltown and Princeville thrived off of the economic activity in Mahdia in earlier times. These communities are also experiencing the hardships associated with the economic decline of Madhia.

No action will attract no investment in the area. The absence of access would serve as a deterrent to prospective miners. Since the demand for skilled labor will remain stagnant, no-action may lead educated groups to migrate in search of better job opportunities.

6.3 IMPACTS OF WET EXTRACTION

Both the Alternative Mining and Ore Recovery Methods and the Alternate Mineral Recovery Methods are forms of wet extraction. Both alternatives are therefore expected to have the same impact on the environment. These consequences are detailed below.

6.3.1 Climate

Dredging for the removal of overburden and for the recovery of ore will result in practically no aerial emissions from the ore and overburden. Emissions will be limited to that of the hydraulicking equipment. Those emissions are not expected to exceed those of the earthmoving equipment to be used for dry recovery. Wet recovery may, however, entail the creation of large artificial lakes within the project area. Evaporation from those lakes may affect the microclimate of the project area resulting in lowered temperatures.

Wet recovery will also entail the removal of trees and other vegetation in the area. The removal of trees will result in temperature increases in the area and will very likely compensate for any temperature drops due to the creation of lakes for wet extraction.

6.3.2 Geology

During wet extraction the overburden is removed as a slurry. The extraction area will wanders rapidly over the entire mining area. The removal of the overburden will modify the topography of the dry land being exploited. Slurrying also removes a large fraction of the fine grained soils. Dredging therefore will leave soils and other rubble containing large amounts of unclassified soil that is extensively lacking in fine and superfine contents. Consequently, soil formation, as an essential prerequisite for recolonization by plant associations, would be seriously impeded.

In addition, very little soils will be available for reclamation of the area mined. Whatever soil is available for reclamation will be highly saturated with water. Consequently reclamation to original ground level or to just below original ground level that is reflective of the actual paydirt removed will not be possible. Permanent depressions will therefore be present in the area after the completion of the mining operations. The dredging operation will not impact the bedrock geology of the area.

Wet extraction will also entail blasting hillsides with water under high pressure. This will result in scars on the landscape and those areas may take years to develop even the lightest covering of vegetation.

6.3.3 Water Resources

Wet extraction will have a much greater impact on water resources than both the Proposed Action and the Do-Nothing Alternative.

6.3.3.1 Groundwater Flow

Wet extraction will permanently alter groundwater flow conditions in the area both during mining and after the completion of mining. Ground water levels will be lowered in the artificial lakes during the mining operation, consequently groundwater flow will be towards the artificial lakes. After mining is completed, the lakes will not be reclaimed and groundwater flow may be either into the lake or the lake may discharge to groundwater. The lakes will be continually be fed by precipitation. Water levels in the lakes will therefore rise and fall with the wet and dry seasons respectively. The constant fluctuation of the lake levels will result in dis-equilibrium in groundwater flow conditions at the site.

6.3.3.2 Groundwater Quality

Groundwater quality may be impacted by leaching of minerals into solution both from the mine and from the mined out area. Since there may be soluble mineral in the soils at the site, the dis-equilibrium in the groundwater flow regime caused by fluctuating surface water levels in the lakes 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. In addition, groundwater quality may be impacted by spillage of oil and fuel from the dredging equipment directly to surface water, which is discharging to groundwater.

6.3.3.3 Surface Water Flow

Dredging will result in reduced surface water flows since water will have to be withdrawn continuously to support the dredging operation. This water cannot be discharged back to surface water immediately since it would contain a large fraction of sediments.Several small creeks within the area to be mined will eliminated by the mining operation. The area of these creeks would be converted into lakes to support the mining operations. These creeks all contribute flow to the Euwang River and to Maple Creek. The base flow in both Maple Creek and the Euwang River will therefore decrease. The lakes may also serve to trap surface runoff from the cleared areas that would have contributed to flows in both the Euwang and Maple Creek resulting in further decreased flows.

Site dearing will produce increased discharges to surface water flow since interception and evapotranpiration will be reduced. The volume of additional inflow may result in increased surface water levels in both Maple Creek and the Euwang River if large areas of the site are cleared prior to the commencement of mining operations.

This alternative will not affect the regional catchment areas of either Maple Creek or the Euwang River. Flow volumes of both Maple Creek and Euwang River will, however, be decreased due to withdrawal for dredging and due to curtailed flow from several tributaries.

6.3.3.4 Surface water Quality

The discharge of wet-extraction sludge will create sediment plumes that will travel long distances before the clay fraction finally settles out of suspension. The deposition of transported sediment therefore will reduce water quality for significant distances from the site. The rate of nutrient added by transported 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 reduce light penetration. Further, groundwater in the area discharge to surface water. Consequently any dissolved chemicals present in groundwater will be introduced to surface water by groundwater discharge. Surface runoff of water contaminated by waste management facilities on site can also impact surface water quality.

6.3.3.5 Fishes

Wet extraction will introduce large quantities of sediment to streams in the project area. This will result in considerable direct impact on fishes. The discharge of large volumes of sediment will introduce significant nutrient loads to the streams. These additional nutrients will cause eutrophication in the streams. Removal of the existing tree cover in the area will also result in increased water temperatures and will enhance the existence of species that prefer warmer water. Sediment flow into streams will also retard light penetration and reduce the food producing capability of the area.

6.3.4 Terrestrial Resources

6.3.4.1 Land Use

Wet extraction will result in the removal of all surficial soils from the site. The surficial soils will be replaced by a cover of highly saturated fine grained soils. The area actually mined will be altered and wet extraction will completely alter the land use of the area. After mining is completed the area may be classified as abandoned artificial lakes. No forest stands will cover the area for a considerable period of time.

Living conditions for fauna will therefore be altered. In addition, the loss of forested areas will expose the cleared area to the full force of prevailing wind. Trees with shallow root structures immediately adjacent to the areas mined will therefore be vulnerable to being toppled. Loss of forest cover will also alter groundwater recharge rate and surface run-off conditions.

The altered soil present at ground surface may result in the introduction of trees etc. not native to the site. Loss of vegetative cover will also alter the factors influencing how the precipitation divides up into evapotranpiration, surface run-off and groundwater recharge.

6.3.4.2 Vegetation

Since most small-scale miners do not preserve the topsoil removed before excavation begins, this top-soil is often washed away into surface water, carrying with it ecologically valuable seed banks that are necessary for the regeneration of vegetation. In addition, few small-scale miners engage in reclamation or post-mining recovery practices.

6.3.4.3 Wildlife

Stocks of animals depend on the existence of habitats of a certain size. Clear cutting for the mine will fragment the area and reduce the size of the tree stands. In addition, some animal species depend on the existence of other plant and animal species within the habitat for nutrients/food, cover, etc. Clear cutting and encroachments will alter several of the physical conditions including light, humidity and temperature. Discharges to surface water may also contaminate the water available to wildlife in the area.

6.3.4.4 Threatened and Endangered Species

There are no threatened and endangered species in the area. There is consequently no impact on threatened and endangered species.

6.3.5 Socioeconomic Conditions

Wet extraction will create standing bodies of stagnant water in the area after the area is exploited. This may result in increased incidences of water borne diseases such as malaria. People in the area may also develop some social resentment after small-scale miners, hunters and fishermen lose access to the area.

6.3.6 Noise, Odor and Dust

No dust would be emitted by wet extraction. The mining operation will occur in close proximity to existing habitats. The mining operation will emit noise. There would have been minimal noise stresses in the project area prior to the project. Continuous noise may therefore 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.

6.3.7 Cultural and Archaeological Resources

Landscape impacts would result from the clearing of vegetation and the disturbance of soil and surficial material. Further, there will be a general change in the total floristic composition. This would result in some loss of the existing landscape elements and character within the area. The cultural and archaeological resources are unlikely to be significantly affected by the construction or operation of the proposed development. The proposed development will not have any impact on these sites

6.3.8 Traffic

Minimal traffic will be introduced by wet extraction. No environmental impacts are therefore associated with increased/decreased traffic.

6.4 SUMMARY OF IMPACTS

The environmental consequences of the proposed action are classified in terms of their significance in Table 23 below.

Table 23: Significance of Environmental Impacts Associated with Proposed Action

Medium	Impacts	-/+	D/I	P/S	S/M/L	R/IR	T/P	L/RG/N	A/U
Climate	Emission of Gases & Particulates	-	D	P	L	IR	T	L	U
	Lowering of Temperatures	-	I	S	S	IR	T	L	U
Geology	Change of Surficial Soil	NA	D	P	L	IR	P	L	U
	Change of Topography	NA	D	P	L	IR	P	L	U
	Increased Exposure of area	-	D	S	M	R	T	L	U
	Change in area water balance	-	I	S	M	R	T	L	U
	Change in Ground surface slopes	+	D	P	L	IR	P	L	U
	Loss of Soil Nutrients	-	I	S	M	R	T	L	U
Groundwater	Reversal of flow direction	NA	D	P	S	R	T	L	U
	Reduced infiltration recharge	NA	D	P	M	R	T	L	U
	Contamination by metals in soil	-	I	S	M	IR	T	L	A
	Contamination by waste disposal	-	I	S	M	IR	T	L	A
Surface Water	Reduction of Flow Volume	-	D	S	S	R	T	L	A
	Loss of Streamflow in Small creeks	-	D	P	M	R	T	L	A
	Increase surface runoff volumes	-	I	S	M	R	T	L	U
	Increased sediment & Nutrient loads	-	I	S	M	R	T	L	A
	Contamination by heavy metals	-	I	S	M	IR	T	L	A
Fisheries	Loss of spawn areas due to sediment	-	I	S	M	R	T	L	A
	Loss of food due to less light penetration	-	I	S	M	R	T	L	A
	Increased exploitation for food	-	D	P	L	R	T	L	A
	Reduction in number due to denitrification	-	I	S	M	R	T	L	A
Vegetation	Loss of plant communities	-	D	P	L	IR	P	L	U
	Introduction of new species	-	I	P	L	R	T	L	A
	Loss of diversity	-	D	P	L	IR	P	L	U
	Introduction of Commercial plants	+	D	P	L	R	T	L	A

Legend
-/+ :Negative or Positive
D/I: Direct or Indiurect
P/S: Primary or Secondary
S/M/L: Short, medium or Long term
R/IR: Reversible or Irreversible
T/P: Temporary or Permanent
L/RG/N: Local, Regional or National
A/U: Avoidable or Unavoidable
NA- Not Applicable

Medium	Impacts	- /+	D/I	P/S	S/M/L	R/IR	T/P	L/RG/N	A/U
Wildlife	Loss of living area	-	D	P	L	IR	P	L	U
	Increased exploitation by hunting	-	I	S	S	R	T	L	A
Socioeconomic Conditions	Loss of Indigenous rights	-	I	S	L	R	T	L	A
	Increased resentment by small-scale miners	-	I	S	M	R	T	N	A
	Introduction of new technology	+	D	P	L	IR	P	N	U
	Increased Access to area	+	D	P	L	IR	P	N	U
	Increased timber harvesting	+	I	S	L	R	T	N	A
	Increased employment	+	D	P	L	R	T	N	U
Noise, Odor and Dust	Increased dust emissions	-	D	P	L	IR	T	L	U
	Increased Noise emissions	-	D	P	L	IR	T	L	U
Traffic	Increased accidents	-	I	S	L	IR	P	N	A

Legend
-/+ :Negative or Positive
D/I: Direct or Indiurect
P/S: Primary or Secondary
S/M/L: Short, medium or Long term
R/IR: Reversible or Irreversible
T/P: Temporary or Permanent
L/RG/N: Local, Regional or National
A/U: Avoidable or Unavoidable
NA- Not Applicable

7.0 ENVIRONMENTAL MANAGEMENT PLAN

An applicable, relevant and appropriate Environmental Management Plan (EMP) has been developed to mitigate and minimize the environmental consequences identified in Section 6. The EMP incorporates measures that include 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 EMP include:

- Production technology, disposal methods, and engineering designs
- Pollution controls, recycling and conservation of resources, monitoring, special social services or community awareness and education
- 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 EMP if required.

The environmental consequences that can be mitigated are as follows:

- Open-pit excavation Impacts
- Wastewater Impacts
- Stormwater Impacts
- Road Dust Impacts
- Forested Area Impacts

Several other environmental consequences cannot be mitigated. These consequences are as follows:

- Climatic Effects
- Effects on Geology
- Gaseous emissions by equipment
- Vegetation Impacts
- Wildlife Impacts

The management plan has been developed to ensure that the impacts that cannot be mitigated are minimized to the maximum extent possible. In addition, several of the consequences on impacts that cannot be mitigated do not exceed tolerable limits. The 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 area. It is expected that wildlife will return to the area after reclamation and revegetation. The plant type in the reclaimed area will, however, be different from that currently occurring in the area.

7.1 Terrestrial Resources

Planting new vegetation around production facilities, and along access roads and pipelines will mitigate the impact on terrestrial resources. The plant siting will also consider several alternative locations for pipeline routes and plant installations to minimize impact on terrestrial resources. Particular attention will be paid to vulnerable or conservation-worthy plant and animal species that will be affected.

7.2 Openpit Management

The depths in the mining area will not exceed 18m. Mine walls will be designed and sloped to preclude slopes failures and slides. No excavated soil will be stored at the crest of slopes. Sumps will be excavated in mined out area on the floor of the mine and all groundwater flow and precipitation will be channeled into those. Measures will be implemented to prevent surface runoff from entering the open pit and from adding to the volume of groundwater inflow and direct precipitation.

Following ore extraction, all worked-out areas will be drained and graded to eliminate all open bodies of water that could serve as breeding grounds for pathogenic vectors like malaria -transmitting mosquitoes.

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. Equipment will be not generally be serviced in the mine pit. Vehicle 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.

7.3 Overburden Management

Overburden soil removed from above the ore horizon will be stockpiled for land reclamation. To minimize excessive land consumption and the associated clearing of forested areas, all stockpiles will be sited within the mine itself. Further, no stockpile will be sited within 100m of any waterways. Initially overburden material will be stockpiled above ore bearing areas. However, as mining progresses, the overburden would be stored within the open spaces in mined out areas.

Stockpiled soil will be periodically watered to minimize dust emission. In addition, all stockpiles will be surrounded by a soil containment berm to preclude the easy flow of surface runoff and sediment from stockpiles. The containment berms 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 stockpile will be such that foundation and slope failures do not occur.

7.4 Water Management

The volume of water to be withdrawn from Maple Creek will never exceed 20 percent of the low flow in that stream. All ponds that constitute a part of the washing and tailing circuit will be designed to provide minimum capacity of 14 days. Ponds will also be designed to operate with a minimum freeboard of 1.5m and will be surrounded by berms. The berms will prevent discharge by overtopping from the ponds and will also preclude precipitation runoff from entering the ponds. No discharge to surface water would be permitted from any of the ponds that constitute a part of the washing and tailing circuit.

Stormwater runoff and water from the mine pit will both be channeled to a sedimentation pond. That pond will be designed to provide a detention time of 48 hours. Discharge from the sedimentation pond will be via a spillway and will be channeled through a sediment control structure constructed of matrix of stone, sand and grass to remove sediment prior to discharge to surface water bodies in the site area. In some instances water from the sedimentation pond will be discharged to augment water in the washing and tailing circuit.

The mine will be developed to ensure minimum disturbance to streams and creeks in the area. In instances where this cannot be avoided, sediment control structures and practices will be used to prevent the inflow of sediment to surface water. These control practices will include sediment traps or screens to control run-off and sedimentation.

Surface runoff from the workshop and other vehicle service areas will be channeled to an oil/water separator. All water from the oil/water separators will be skimmed prior to discharge. Site clearing operating will progress in a gradual and phased manner to ensure there are no large increases in surface runoff.

7.5 Tailings Management

All tailing ponds will be sited in areas of low soil permeability to ensure minimum discharge to groundwater. In addition, the bottom of all tailings ponds will be above the high groundwater level and tailing ponds will be designed with the minimum surface area required to satisfy capacity constraints. Tailings ponds will also be surrounded by berms to prevent uncontrolled discharges to surface water and to preclude surface runoff from entering the tailings area. Tailings ponds will be sited partly above and partly below existing ground level. The part of the tailings pond above ground level will be designed to prevent slope failure and the associated release of tailings to the environment.

All water discharges from tailings pond will be recycled to the wash plant. The tailings pond area would be patrolled to prevent fauna from straying into the ponds. Tailings ponds will be periodically cleaned and the material recovered from the ponds will be used for both road construction and for the reclamation of mined out areas.

7.6 Hazardous Material Management

All hazardous materials will be located in secure storage facilities on-site to prevent accidental release and 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 the area around the storage facilities will be channeled to the sedimentation 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.

7.7 Waste Management

Solid waste from the operation of the camp will be recycled, composted or disposed of in secure areas. All plastic and glass containers will be recycled and taken of site. All food waste and organic matter will be composted and the composted material will be used as fertilizer for revegetation of the reclaimed 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 by a licensed operator and will be trucked to Georgetown for disposal.

Ashes from burning of vegetation will be added to the overburden soil and will be used for land reclamation. The coarse fraction of the tailing waste will be used in the construction of sediment control structures onsite. The fine fraction of tailings will be used to maintain both site access roads and roads within the mine itself.

7.8 Land Reclamation

All open-pit and stockpile areas will be reclaimed. Special erosion control measures would also be implemented around reclaimed areas to ensure minimum soil loss prior to vegetation taking hold in the reclaimed areas.

Reclamation will consist of grading and compacting the land to bring it as close as possible to the original contours. However, in all instances the final ground level will exceed the depth to groundwater. Efforts will be expended during reclamation to ensure that the soil compaction does not negate against 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. Reclaimed areas will then be covered by humus to allow immediate planting with pioneer species of grass, cashew trees and congapump, a tree native to the area.

All streams that were temporarily diverted during the mining operations will be restored to their channels and cross-sections and measures will be implemented to preclude the easy flow of sediment into the restored waterways.

7.9 Air Quality, Dust & Noise

Water will be sprinkled on roads, other conveying routes and stockpiles to control dust emissions. A dust bonding against such as molasses may also be used if its use reduces the frequency with which the road should be sprinkled with water. The noise emissions would be limited by appropriate soundproofing of individual pieces of equipment. Equipment will be fitted with special exhaust systems (mufflers). Additionally, the miners will be required to wear personal noise-protection gear, e.g., ear protectors.

7.10 Employee Health and Safety

The impacts on health and safety will be mitigated by establishing a program to identify and eliminate all shallow pools and ponds in the area. Pesticides that are non-toxic to humans, fish and livestock will also be used for habitat and vector control. A body will also be established to provide health advisory and support health services and to monitor disease vector and disease incidences.

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.

7.10.1 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.
- Hazard Identification and Control

Table 24 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.

Hazard identification and reporting will not be limited to the initial phases of the operation but 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. The supervisor/manager has the obligation to:

- 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 any injuries and ensure that those instructions are followed
- Provide the necessary safety protective gear when required.

Table 24

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. Reclamation of land for excavation of material: - felling of trees - removal of topsoil & overlying vegetation	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, and gloves
Excavation of sand & transportation to plant	Fugitive dust blown into eyes Inhalation of fugitive dusts High noise levels from working of heave 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	Contract dermatitis skin irritation from exposure to grease High noise levels Fugitive / wind blown dust into eyes	Use of barrier creams & detergents on hands Use of air plugs Use of clear goggles
6. Backfilling of mined out areas	Inhalation of fugitive dust	Use of dust/mist respirators

The employee on the other hand has the obligation to:

- 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.

7.10.2 Hazard Monitoring and Reporting

Monitoring of hazards and work conditions will be the prime responsibility of the safety representative who will be elected from among the workers. He will be responsible for:

- Performing 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 for reporting of these hazards to management.
- Recording of all accidents minor and loss time accidents in a ledger as required by the Ministry of Labour (Table 25 shows the format to be used for recording industrial accidents).
- Remitting of reports of industrial accidents or fatalities to the Ministry of Labour when required

Table 25

ACCCIDENT 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 hazards conditions when detected
- performing work in a safe manner by following the correct work procedure.

7.10.3 Training & Education of Employees

In confirmation with the objectives of safety program the following training programs will be implemented:

- Basic first aid programmes (all employees).
- Advanced first aid programmes (five employees).

- 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 the 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.

7.10.4 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 timers. 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 scene of accident.
- The basic first aider will render first aid care.
- The basic first aider will summon an advanced first aider who will administer further care if necessary and evaluate the necessity for removal to the first aid centre.
- The advanced first aider 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:
    - Make contact with the identified medical Practitioner and Institution and inform them of the time of arrival of the injured employee.
    - Complete the accident form and forward same along with the injured to the medical institution for completion by medical practitioner
    - 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 four wheel drive and will have the following equipment:

1. oxygen cylinder and gas masks resuscitation equipment.
2. a bed and accommodation for a first aid attendant to sit alongside the injured .
3. A flashing light attached to warn other road users.
4. communication equipment

7.10.5 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

7.10.5.1 Dust Exposure

The terrain in which the mining operations will be sited is principally sand (silica). The mining process consists of excavation, transportation, washing and extraction of gold and diamonds from the host material. No blasting or grinding of hard rock is programmed. As a consequence the production process does not result in the dispersion of high concentration of particulate matter into the atmosphere. Any particulate matter dispersed into the atmosphere will be fugitive wind blown dust from the excavation and transportation of sand via the conveyor systems being used. Sampling revealed that more than ninety percent (90%) of the fine crystalline silica particles are more than 2 microns in size. ILO and WHO guidelines state

that the danger from silica particles occur for diameters less than 5 microns and especially those with a diameter between 0.5 and 3 microns since those particles when inhaled can reach the alveoli and lead to lung impregnated disease. Development of respiratory disease due to inhalation of respirable dust has been shown to be in direct proportion to the total load of dust inhaled over a time period. This in turn is a function of:

a) The dust particle size
b) The concentration of particles in the atmosphere.
c) The duration of exposure

The concentration of dust particles in the air is not expected to be consistently above acceptable international standard since it is basically figurative or wind blown dust. The development of respiratory disease due to inhalation of dust is very low and will probably need exposure time far in excess of twenty five years to develop.

Notwithstanding the abovementioned, the following measures will be implemented in order to decrease or eliminate respirable dust inhalation and prevent any adverse effects on workers:

1. Provision of dust respirator with filters to employees exposed during the land reclamation, excavation and transportation phases of the operation
2. Siting of living quarters a convenient distance from the operations site and on the leeward side of same.
3. Minimal denudation of vegetation around campsite.
4. 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.

Employing workers in the excavation and transportation phases of the operations are also 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.

7.10.5.2 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 heavyduty 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
   a. Audiological examination before employment to establish baseline hearing capacity on initiation of employment.
b. Yearly audiological testing of employees exposed to high noise levels.
c. Acquisition of a portable sound level meter
   d. Measurement of sound levels in instances where it is suspected that deviations from the previous levels are occurring.

7.10.5.3 Heat

Only employees who work in the vicinity of the furnaces will be exposed to temperatures above environmental levels. 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

7.11 Fuel Oil Management

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 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 80% of the tank in the event of tank failure. Discharge from fuel storage areas will be channeled to oil-water separator prior to being discharged to surface water.

7.12 Spill Contingency Plan

A spill contingency plan will be developed to respond to any spills of oil and other hazardous substances. The only hazardous material to be used by the mining and processing operations is fuel oil. Contingency plans must, however, also address the likelihood of tailings spills or spills of material transported by pipelines within the plant area. The Spill Contingency Plan will have the following distinct components:

- Hazard identification
- Vulnerability Analysis
- Risk Assessment and
- Response Action

The hazard identification will determine the following:

- Type of material stored and transported through and to the area.
- The points where material is stored in large quantities and the mode of movement of that material from one point to the next
- The location of response equipment and personnel trained to use the equipment

The vulnerability analysis will identify all resources and sensitive receptors that can be impacted by any spills of stored materials. This analysis will not consider any communities since none are within close proximity of the site. This information will be used to identify specific locations, waterways, plants, etc. that are likely to be susceptible to any spills. The risk assessment will then compare the hazard and vulnerability of each media likely to be impacted by any spills. The best method for controlling the spill will be developed after the risk assessment has been completed.

Response actions would be developed to address the risks identified by the risk assessment. The response action will consist of the following:

- Notification of the EPA and GGMC
- Defining the size, position and content of the spill, its direction and speed of movement and its likelihood of affecting sensitive receptors
- Ensuring that all personnel responding to the spill can do so safely
- Stopping the flow of the spilled material and preventing any oil spilled from igniting
- Containing the spilled material to a limited area
- Removal of all the spilled material
- Disposal of the spilled material in a manner acceptable to the EPA and GGMC.

7.13 Socioeconomic Impact Management

The company will develop a public relations program that promotes respects for rights of indigenous peoples. In addition, the company will actively recruit employees from the communities around the area and will encourage the involvement of community residents in environmental monitoring programs to ensure compliance with accepted norms. The communities will also be encouraged to make use of forest resources in the area in so far as that use does not impact the mining operations. The company will also sponsor skills training programs, and scholarships for residents of the area to enhance the skills of the local employment pool.

The company will establish a hiring policy which will not discriminate against residents of surrounding communities. The company will establish policies to enhance capabilities and capacity building through on the job education and training

programs. This will provide a reservoir of skilled workers and a readily available labour force since replacement hires will be sourced easily from locations in close proximity to the site.

The company will also consult with the Department of Lands and Surveys and the Amerindian Lands Commission to demarcate Amerindian communities and traditional lands to ensure that there is minimum impact on these areas. The company will discuss with the Amerindian Council and the Chief Executive Officer of the Ministry of Amerindian Affairs the issue of compensation for loss of access to traditional hunting, farming and fishing areas. Measures will be taken in association with those entities to identify suitable alternative locations for traditional hunting and farming.

7.14 Traffic Management

No restrictions will be placed on traffic flowing through the area that uses the access road constructed to the mine site. Restrictions will be imposed on traffic flows into active mining areas. Project vehicles only will be permitted into mining areas. Signs will be posted along the access road indicating to road users that Vanessa Ventures will not accept liability for accidents on the access road and also indicating that road users are responsible for providing their own insurance cover for accidents on the access road.

SUMMARY OF MITIGATION COSTS

Description	Equipment	Days/ year	Unit Cost $US	Equipment Costs	Man-days /year	Unit cost ($US)	Manpower Costs	Total Mitigation Costs per year
Terrestrial Resources	Nil	-	-	-	96	20.00	1920.00	1920.00
Openpit Management	Pump	60	200.00	12000.00	-	-	-	12000.00
Overburden & Dust Management	Water sprayer	52	100.00	5200.00	52	20.00	1040.00	6240.00
Water Management	-	-	-	-	48	20.00	960.00	960.00
Tailing Management	Trucks	12	2500.00	30000.00	52	20.00	1040.00	91040.00
	Excavator	12	5000.00	60000.00				
Waste Management	Contract Truck	4	1500.00	6000.00	-	-	-	6000.00
Socioeconomic Conditions	-				250	30.00	7500.00	7500.00
Land Reclamation	Trucks	12	2500.00	30000.00	-	-	-	90000.00
	Excavator	12	5000.00	60000.00	-	-	-	
YEARLY MANAGEMENT & MITIGATION COSTS								**215660.00**

8.0 INSTITUTIONAL REQUIREMENTS FOR MANAGEMENT PLAN

The management plan will be executed by a group of professionals hired by the company. These professionals will be qualified in the following disciplines:

- Mining Engineering
- Civil Engineering
- Environmental Sciences

A weather station will also be installed on site to monitor the following variables:

- Daily rainfall
- Daily maximum and minimum temperatures
- Daily evaporation

Contractors will be retained to provide services that are critical to the effective implementation of the environmental management plan. A testing laboratory will be contracted to provide analytical laboratory services. A contractor licensed to haul and dispose that septic waste will collect septic tank waste. A contractor licensed to haul fuel will haul fuel oil to the site.

The mining engineer will be responsible for the design of the open-pit to ensure its slope stability and the associated safety of persons and equipment working in the open pit. He will be supported by the services of a geotechnical testing facility that will provide physical tests to determine soil parameters for design of the pit slopes. The mining engineer will site and design the tailing holding facilities. Factors that will be considered in siting the facilities will include the soil permeability in the area. The geotechnical laboratory will provide services to determine soil permeability. He will also determine the area in which stockpiles will be sited. The civil engineer will determine the design storm for the area based on available data and will design the stormwater detention facilities. He will also size the water management ponds to ensure that adequate storage capacity is provided for the design storm and for process needs. He will also design all facilities for site drainage such as sediment control structures in addition to facilities for fuel oil containment areas. The civil engineer will also design the mine dewatering system for the management of groundwater inflows. The environmental sciences professional will be responsible for the implementation of the environmental monitoring program. Responsibilities of the environmental scientist will consist of the following:

- Management of MSDS
- Monitoring of Solid and Septic Waste disposal
- Installation and sampling of Groundwater monitoring wells
- Sampling of Surface Water
- Management of Weather station data
- Inspection of Tailing Ponds
- Inspection of Fuel Management Facilities
- Coordination of the Company's Health and Safety Program

Effective monitoring will be supported by the company acquisition of equipment for ground and surface water sampling and of a weather station. The company will not have to mount any specific training programs for its personnel since the skills required for implementation of the environmental management plan are all readily available.

9.0 MONITORING PLAN

Vannessa Mining Company Inc.'s environmental monitoring programme for its Maple Creek property will serve as an integral part of the operational activities and is expected to generate the requisite 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 the mitigation measures. The operational monitoring will include those variables important for day-to-day operations such as processing methods and camp facilities.

It is anticipated that monitoring will be conducted during all phases of the project- pre-construction, start-up, operation, closure and post closure. This programme is expected to play a pivotal role in ensuring that the trends for specific parameters are tracked and it will provide information on compliance with legislative norms, set guidelines or desirous operational limits; and form the basis for corrective actions and modification of activities if necessary. The intensity of sampling will depend on the time and location of the development activities and results derived from monitoring data.

9.1 Terrestrial Resources

As part of the reclamation for this property, a record of any spontaneous natural growth after debushing and the associated prevailing conditions will be noted in a logbook. This will be used to determine the parameters necessary for the successful establishment of plant cover after reclamation.

Wildlife monitoring will be conducted concurrently with the vegetation monitoring. Observations will be recorded in a wildlife-sighting logbook and these will be periodically examined to determine if there have been any significant changes in species abundance and/ or distribution. In addition, collisions with wildlife on any project roads will be recorded and the results of these reports can be examined in much the same way as the sighting logbook. Finally, the company's "no hunting" policy will be enforced through checkpoints established at the access points to the concession.

9.2 Overburden Monitoring

The overburden areas will be monitored to determine the integrity of the containment berm around its base since this berm is intended to prevent s ediment flows from the area to surface water bodies. The piles will also be monitored to ensure their height and slopes do not exceed the tolerable limits. Dust emissions from the piles will be visually monitored and corrective action implemented when required.

9.3 Water Monitoring

Water quality standards will be established for all wastewater discharges from the site based on consultation with the Guyana Environmental Protection Agency (EPA) and the Guyana Geology and Mines Commission (GGMC). Samples of wastewater flowing over the spillway will be recovered twice per year and will be analyzed for the parameters identified by the EPA and GGMC.

Samples of surface water will be recovered from Maple Creek, The Euwang River and from the Potaro River twice per year. These samples will be analyzed for the presence and concentration of the following:

- Total dissolved solids (TDS)
- Total suspended solids (TSS)
- Alkalinity
- Potassium
- Sulphates
- Biochemical oxygen demand (BOD)
- Heavy metals
- Nitrogen
- Phosphorus and
- pH
- Total Kledjahl Nitrogen (TKN)

Three permanent groundwater monitoring wells will be installed on the perimeter of the area to be mined. Groundwater samples will be recovered from each well one yearly and will be tested for the presence and concentration of the following:

- Total dissolved solids (TDS)
- Total Kledjahl Nitrogen (TKN)
- Alkalinity
- Potassium
- Sulphates
- Biochemical oxygen demand (BOD)
- Heavy metals
- Nitrogen
- Phosphorus and
- pH

9.4 Tailings Monitoring

The tailing ponds will be monitored to visually determine their structural integrity. The ponds will also be inspected to determine seepage through the sides and to ensure that adequate freeboard exist for their continued use. The monitoring program will determine when the coarse and fine material will be removed from the tailings ponds. The return pipes to the plant from the tailing ponds will be monitored to ensure that there are no leaks in the system.

9.5 Hazardous Material Monitoring

Inventories of hazardous material will be monitored to ensure all material is used for the purposes intended. Waste containment areas will be monitored to ensure that the impervious surface upon which they are sited is not breached. The area will be monitored to determine that incompatible chemicals are not stored together and that stormwater discharges from the area are channeled to the sedimentation pond.

9.6 Solid Waste Monitoring

The solid waste disposal operation will be monitored to determine the effectiveness of the recycling, composting and disposal operation. Manifests will be developed to ensure proper disposal of septic tank waste. The ashes from the firing of vegetative matter will be monitored to ensure it is mixed with the mine overburden material prior to placement in the reclamation area.

Waste from the tailings area will be monitored to ensure that the coarse and fine fractions are used for mine reclamation and road construction within the mining concession only.

9.7 Reclamation Monitoring

The land reclamation area will be monitored to ensure that the final ground surface level is above the ground water level to ensure that water does not pond on the ground surface and lead to the associated non-equilibrium groundwater flow regime. The compaction of the ground surface will also be monitored to ensure that its compaction does not preclude the infiltration of precipitation. The humus from the composting operation will also be monitored to ensure its use in the land reclamation. The growth of trees planted for revegetation will be monitored. Substitute plant types will be identified if the growth rates are unacceptable.

9.8 Air Quality & Dust Monitoring

Equipment will be visually monitored to ensure emissions do not exceed tolerable levels. Roads will be monitored to ensure that excessive dust is not emitted from surface.

10.0 CLOSURE PLAN

The mined out area will be progressively closed as mining progresses. Closure will consist of backfilling of mined areas and planting reclaimed areas. In addition all plants will be dissembled and transported away from the site. The plant area will then be seeded and revegetated.

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Van Andel, T. R. Non-Timber Forest Products of the North West District of Guyana, University of Utrecht, Netherlands, 2000.

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FIGURES

APPENDIX A

Socio-economic evaluation questionnaire

FIELD SURVEY PROGRAM

Review of Project Data

No data was reviewed on climatic data in the Project area since none is available. Rainfall data for Kaieteur was reviewed. Rainfall and evaporation data for Omai Gold Mines Limited was also reviewed. The period of record for both sets of data is, however quite short.

No biological study is known to exist of the area according to the Biodiversity Centre and the EPA Wildlife Section. A telephone contact with the Iwokrama International Centre revealed that wildlife studies had recently been focused on the North and Central Rupununi Area. Attempts are being made to obtain copies of these study reports. The Guyana Forestry Commission indicated that no forest concession exist in the proposed area, however. The Guyana Forestry Commission also indicated that digitized map of the locations of various vegetation types in the Guyana interior is not available.

No data was therefore reviewed for vegetation, wildlife, or cultural or archaeological resources in the area. Discussions with the Guyana Geology and Mines Commission (GGMC) indicate that there are several wet extraction mining operations in progress on both the Potaro River both upstream and downstream of the site.

None of the existing documents indicate population density in the area, however the Potaro/Siparuni area has a population of 5,800 (Statistical Bureau: 1993). The settlements/villages likely to be affected by the Project are as follows:

(a) Mahdia
(b) Campbelltown/Princeville
(c) Micobie/El Paso
(d) Tumatumari

Data from the Ministry of Local Government for each community is shown in Table 1.

Table 1: Data on Amerindian Communities in Project Vicinity

Location	Management Structure	Institutions	Population	Communication	Water supply
Campbelltown/ Princeville	Captain, Village Captain, 5 Councilors	Amerindian Hostel, Primary School, Market	1050		Well
Micobie/El Paso	Captain, Village Captain, 5 Councilors	Primary School, Health Centre, Craft Centre	330	Radio Set	River
Mahdia	Local Government system with Regional Hospital Executive Officers	Primary School	477	Radio Set	Well
Tumatumari	Captain, 5 Councilors	Primary School, Health Centre	221	Radio Set	

FIELD SAMPLE PLANS

Surface Water and Soils

The purpose of this sample plan is to recover samples to:

1. Establish baseline water quality in the Project area
2. Establish baseline level of chemical concentrations in soils, groundwater and surface water in the Project area
3. Determine sediment flow rates in the Potaro and Euwang Rivers upstream and downstream of the area

Data obtained from this phase of the field program will be summarized as depicted in Tables 2 and 3. Field data forms that will be used for data collection are presented in Tables 6 through 9.

Table 2: Summary Sheet of Data obtained from Field Survey- Surface Water

Location	Discharge cfs	Concentration (mg/l)													
		TDS	Ca	Mg	DO	BOD	Na	Cl	Fe	Phosphate	TKN	Nitrate	pH	TSS	Conductivity

Table 3: Summary Sheet of Data obtained from Field Survey- Soils

Location	Concentration (mg/l)											
	Ca	Mg	DO	BOD	Na	Cl	Fe	Phosphate	TKN	Sulfate	Nitrate	pH

Preparation

Thorough preparation before the initiation of a sampling event is the most important step in the sampling process. Equipment lists will be prepared and personnel needs for each sampling event will be projected. If potential obstacles to the timely completion of the job exist, extra personnel will be scheduled.

Sampling preparation will include checking that sampling equipment is in working condition and properly decontaminated. The sampling device will be laboratory cleaned, preferably by the laboratory performing the analysis, then wrapped in aluminum foil and sealed. The sampler will remain in this wrapping until it is needed. Care will be taken so the equipment is not stored or transported in the vehicle used to transport generators/gasoline or decontamination solvents.

Surface Water Sample

A weighted bottle sampler will be used to sample surface water. This sampler will essentially consist of a plastic bottle, a weight sinker, a bottle stopper, and a line that is used to open the bottle and to lower and raise the sampler during sampling.

Procedure

1. Assemble the weighted bottle sampler.
2. Lower the sampling device to the predetermined depth.
3. When the sampler is at the required depth, pull out the bottle stopper with a sharp jerk of the sampler line and allow the bottle to fill completely. (This will be evidenced by the cessation of air bubbles).
4. Retrieve sampler.
5. Follow procedures for preservation and transport.

Table 6: Field Data Sheet for Surface Water Sampling

Location	Date	Time	Depths of Sample Recovery	Volume of Sample	Date delivered to Lab	Received by

Table 7: Field Data Sheet for Soil Sampling

Location	Date	Time	Depths of Sample Recovery	Volume of Sample	Date delivered to Lab	Received by

Table 8: Flow Velocity Determination

Location	Date	Time	Depths as tenths	Duration of observations	Number of revolutions	Constants		Flow Velocity m/s
						a	b	

Soils

Soils will be sampled at the surface or from within 12 inches of the surface. A scoop/trowel will be used to recover soil samples.

Procedure

Small and equal portions of soil samples will be taken from the surface and within 3, 6, 9 and 12 inches below the surface. The samples will be transferred into laboratory cleaned sample bottles and the procedures for preservation and transport will be observed.

Data Collection-Social Impact Assessment

The main economic activity of these communities is mining and to some extent lumbering. Since none of the documents reviewed provided information on employment status, income levels and number of households in these communities the survey will address these issues through the questionnaire.

On the basis of the discussions held to date, it is clear that there is a paucity of communication and information of the proposed Project. This can serve to create suspicion and resistance on the part of the Amerindians and other interest groups.

The methodological design therefore must embrace the participatory approach as well as the dual quantitative and qualitative methods of data collection and analysis. The research design will therefore include focus group discussions, elite interviews and a cross-sectional survey using a pre-coded questionnaire, which will be administered to the respondents via face-to- face interviews.
Elite interviews will be conducted with key persons in each community. These individuals have been identified to be as follows:

(a) Community Health Worker(s)
(b) Regional Chairman
(c) Regional Executive Officer
(d) Regional Health Officer
(e) Police Officer
(f) Mining Wardens
(g) Regional Education Officer

The sample size of each elite group is detailed in Table 10

Table 10: Sample Size of Elite Group

Sample Type	Location	Sample Size
Regional Executive Officer	Mahdia	1
Community Health Worker	Mahdia	1
Regional Chairman	Mahdia Local Government Office	1
Regional Health Officer	Mahdia Hospital	1
Police Officer	Mahdia	1
Mining Wardens	Mahdia Mining Station	1
Regional Education Officer	Mahdia	1

Elite interviews allow for the collection of qualitative data from authoritative sources in the community. The unstructured nature of this method will enable the researcher to probe and corroborate the data collected from other sources. This will be further complemented with the incorporation of the Delphi Technique.

The Focus Group discussions will be held with the following groups.
(a) Businessmen/Business Women
(b) Miners/Pork-knockers
(c) Housewives/farmers/fishermen/women
(d) Members of the Amerindian Council

The sample size of each focus group is detailed in Table 11

Table 11: Focus Group Sample Sizes

Sample Type	Location	Sample Size
Business Community	Princeville/Campbelltown Mahdia Tumatumari	8 - 12 persons
Miners/Pork-knockers	Micobie/El Paso Princeville/Campbelltown Tumatumari	10 - 12 persons
Housewives, farmers, fishermen/women	Princeville/Campbelltown, Tumatumari	10 - 12persons
Amerindian Council	Tumatumari Campbelltown/Princeville Micobie/El Paso	8 - 10 persons

Focus Group discussions are ideal for this particular study, since one homogeneous group can discuss the issues of concern and arrive at a consensus by the end of the session. This approach allows for an evaluation of attitudes, values, perceptions, needs and possible "hidden agendas" coming out of the discussions. This is an appropriate method for these communities given the suspicion and fear of the residents.

The cross-sectional survey will allow for wide collection of data from a large number of respondents in a short period. Open and closed-ended questions will be structured on a continuum that will allow for definite and purposeful answers as well as consensus opinions.

The survey will target 25% of the population in each community. It is intended to provide demographic data, information on income and social status, culture and a range of concrete opinions and perceptions of the proposed Project. The systematic random sampling method will be employed where the researcher will interview respondents using interval method (e.g. every fifth house). This will allow for the representativeness of the population of the communities.

This multi-method approach will facilitate triangulation which will enhance the validity and reliability of the findings.

APPENDIX B

RESUMES OF PROJECT STUDY GROUP

KWESI OSAFO NKOFI

EDUCATION:

Graduate Diploma in International Studies, University of Guyana, 1997.
B.A., (Credit) University of Guyana, 1990.Major: Geography
B.Sc., University of Guyana, 1980. Major Biology
Diploma in Agriculture, Guyana School of Agriculture, 1969.
Post Graduate Training Course on Environmental Impact assessment, Georgetown, 1983.
Participant. CDB Seminar on Environmental Impact Assessment, Barbados, 1988.
Caribbean Workshop on Human Ecology Environmental Management and Education. Georgetown 1991.
I.D.B. Consultative Meeting with Public Agencies responsible for Environmental Protection and Natural resource Conservation. Washington DC. 1987.
5th Commonwealth Conference on development and Human Ecology, Georgetown 1979.
Advanced Management Course conducted by the Training Department of Guymine 1991.

Awards

Bartholomew Atlas Prize - Best Graduating Student in Geography, U.G. – 1990.

EXPERIENCE

1991 – present ***University of Guyana***
Lecturer

Responsible for teaching several courses in both the Faculty of Arts and The Faculty of Natural Sciences including courses on EIA Studies; Geography, and Biogeography for the Bachelor of Arts and the Bachelor of Science programs.

1992 to 1994 ***Agency for Health Sc. Education, Environment and Food Policy Director, Environment Division***

Major duties and responsibilities included supervising the drafting of a national Environmental Policy, supervising the execution of national programmes by Environmental Officers in:

- *Environmental monitoring and control*
- *Environmental Education and public awareness*
- *Coastal Zone Management*
- *Environmental Impacts of activities such as mining, urbanisation, forestry, industrial development, human settlement*
- *Biodiversity studies*
- *Compliance and Enforcement.*

1987 to 1992 ***MMA/ADA Environmental Monitoring and Control Unit***
Manager/Co-ordinator

Directed the development of Environmental Management policies within the MMA, a major agriculture development scheme. Prepared monitoring programmes to assess impacts of construction and agricultural activities on the natural environment. Prepared annual environmental impacts reports for the Inter American Development Bank. Prepared half-yearly reports on water quality for the IDB. Selected, organized, and executed training programs for staff members of the Environmental Unit of the MMA. Coordinated, assessed, and integrated the inputs of specialists in various areas of Environmental Management as they applied to the MMA Area.

Counterpart to Consultant, Commonwealth Science Council – Aquatic Weeds Survey 1992. Counterpart to Consultant, European Community Sponsored Survey of the Mangrove Forest of the Guyana Coast 1991. Participant in Crocodilian Resources Survey of Guyana sponsored by (CITES) the Convention on International Trade in Endangered Species of Wild Fauna and Flora, 1990

1981 to 1986 ***Guyana School of Agriculture (GSA)***
Lecturer

Preparing and presenting lectures in Botany at the GSA Diploma and Certificate in Agriculture Levels. Conducting Laboratory sessions in these disciplines.

OTHER WORK EXPERIENCE*:*

Prepared Environmental Impact Assessment *of Sea Defence Works at Phoenix, West Coast Berbice, for the Caribbean Development Bank (CDB) – 1992.*

Prepared Environmental Impact assessment *of SIMAP Projects in Guyana for the IDB July, 1993.*

Work Attachment at Everglades National Park South Florida, U.S.A*. 1988. IDB sponsored*

Presented paper *at 3rd International Conference on Environmental Enforcement in Oaxaco,* ***Mexico****, April 1994.*

Guyana Representative *in UNEP's Environmental Management Seminar, 1992 in* ***Nairobi, Kenya****. November, 1992.*

Presented Paper *at 4th Project Meeting and Round Table of Commonwealth consultative Group on technology Management.* ***Accra, Ghana****, July-August 1991.*

Presented paper *at 3rd Project Meeting and Roundtable of Commonwealth consultative group on Technology Management Georgetown, 1991.*

PUBLICATIONS:

Nkofi, K.O., Enforcement of Compliance Requirements at OMAI Gold Mines Limited, Guyana. 3rd International Conference on Environmental Enforcement, Oaxaca, Mexico, 1994.

Pastakia, C.M.R. & Nkofi, K.O., Affordable Options for Environmental Monitoring. 4th Project Meeting and Roundtable Workshop of the Commonwealth consultative Group on Technology Management. August, 1991, Ghana.

Earle, T.A. & Nkofi, K.O., The Guyana experience in the Training of Environmental Field Technicians 3rd project Meeting and roundtable of the CommonwealthConsultative Group on technology Management. February, 1991. Guyana.

Nkofi, K.O., Natural downstream affects of Tropical River Impoundments: A study of Water Hyacinth infestation of the Abary River below the Copeman Dam. University of Guyana, 1990.

Nkofi, K.O., (Editor) Proceedings of First National Workshop on Integrated Pest Management. Environmental Monitoring and Control Unit of MMA/ADA, MMA/ADA Guyana, 1990.

Nkofi, K.O., Water Resources Human Development and the Environment Conference on Environment and Development (GAHEF) June 1989.

Nkofi, K.O., Agriculture and the Environment. 4th Seminar on Environmental Considerations in Natural Resources Development. Dept. of Geography, University of Guyana, 1987.

Nkofi, K.O., Environmental compliance and Enforcement in Guyana. Public forum on the National Environmental action Plan, Queen College Georgetown, 1994.

CHARLES P. CERES

EDUCATION:
MS, Drexel University, Philadelphia, PA. 1991 Major: Engineering Geology
B.Sc., Queen's University, Kingston, Ontario, 1979 Major: Civil Engineering
General Technical Diploma, University of Guyana, 1974
40 Hour Health and Training Certification

AFFILIATIONS

Professional Engineer, New Jersey.
Member, American Society of Civil Engineers.
Member, Association of Soil and Foundation Engineers
Member, Guyana Association of Professional Engineers

EXPERIENCE

1993 to Present GROUND STRUCTURES ENGINEERING CONSULTANTS LTD, Guyana
Principal

Established scope and performed geotechnical engineering investigation and analyses for existing tailings dam. Developed hydrogeology of Linmine mining area and examined the impact of mining on groundwater quality and water resources. Performed slope stability and seismic wave propagation analyses for several municipal waste landfills. Coordinated and supervised soils and pavement study for primary and feeder roads in Guyana. Issues examined during this study included pavement structural capacity, design traffic volumes, road embankment stability and soil stabilization options to enhance pavement performance. Supervised geotechnical investigations, performed analyses and prepared engineering reports for several kilometers of Guyana Sea Defences. Developed the scope, supervised geotechnical investigations and presented detailed design reports for several kilometers of Guyana Road Network. Supervised the preparation of asphaltic concrete mix designs for roadway surfaces. Developed the scope, supervised geotechnical investigations and presented design recommendations for several bridges, docking facilities, and multistory buildings in both Guyana Coastal Plains and hinterland. Supervised geotechnical investigations and developed foundation design recommendations for several power generating plants.

1992 to 1993 GOLDER ASSOCIATES, New Jersey, U.S.A
Senior Project Manager

Directed geotechnical field and laboratory investigations of municipal landfill sites. Coordinated slope stability analyses of landfills. Managed and performed several parts of remedial investigations/feasibility studies (RI/FS), and remedial designs (RD), and prepared RCRA Part A and B applications for land-based disposal facilities. Prepared work plans for remedial investigations, treatability testing, and background concentration determination at hazardous waste sites. Modeled contaminant transport in groundwater, determined landfill gas concentration at off-site receptors, defined remedial objectives, identified ARARs, and evaluated remedial alternatives at CERCLA sites. Designed sample plans using geostatistics. Prepared proposals for geotechnical investigations, and RI/FS and RD projects.

1990 to 1992: RAYTHEON ENGINEERS & CONSTRUCTORS, Philadelphia, U.S.A
Project Manager: Environmental Systems and Services Group

Managed geosciences and Phase I Environmental Site Assessments projects. Managed all aspects of geotechnical investigations for fossil fuel, chemical and food processing plants and highways. Performed hydrogeological investigations for wetlands. Managed geotechnical investigations for waste containment facilities and evaluated disposal alternatives for fossil fuel plant waste streams. Designed construction dewatering systems. Performed water resources investigations for power plant siting. Developed coupled surface water and groundwater model for power plant cooling pond to assess impact of suspended solids in plant effluent. Prepared proposals for geotechnical, hydrogeological and contaminated site investigations.

1988 to 1990: SITE ENGINEERS, New Jersey, U.S.A
Project Engineer

Managed geotechnical investigations for low and high-rise buildings. Supervised Phase I and Phase II Environmental Impact Assessments. Supervised quality control field inspectors, laboratory testing and drilling crews. Coordinated closure of RCRA landfill for a major chemical manufacturer. Performed dynamic analyses of foundations for Phalanx Tower for a major defense contractor. Performed multilayer soil deformation analyses for the Pennsylvania Convention Center. Managed groundwater resources investigations for several large office complexes in the Reading, PA. area. Prepared proposals for geotechnical and hydrogeological investigations and for environmental site assessments.

1986 to 1988: ***EFP ASSOCIATES, New Jersey, U.S.A***
Project Engineer

Supervised all geotechnical and hydrogeological investigations for new and expanded municipal waste landfill sites. Supervised site and laboratory investigations and performed slope stability, seepage and deformation analyses for Phase II dam investigations and for several small dams, less than 50 feet high. Analyzed wave and wind records predicted critical wave heights and performed analyses of wave-loaded piles. Created groundwater hydrology group and implemented standardized procedures for pumping and permeability tests. Modeled the impact of landfill leachate on groundwater quality using numerical and analytical groundwater flow and transport models.

1985 to 1986: ***WOODWARD CLYDE CONSULTANTS, New Jersey, U.S.A***
Assistant Project Engineer

Supervised engineers and geologists inspecting foundation excavation and embankment construction for a 260ft. earth and rock fill dam. Reviewed and coordinated shift activities with day shift supervisor.

1983 to 1984: ***GEOTECH ASSOCIATES, Trinidad, W.I.***
Geotechnical Engineer
Supervised geotechnical investigations for multistory buildings, roads and housing developments. Supervised laboratory investigation for lime and cement stabilization of high plasticity clays and supervised field stabilization operations. Developed preloading scheme for embankment constructed over organic clays. Supervised quality control inspection of road construction activities including fill placement and surfacing. Supervised all laboratory soil testing activities.

1979 to 1983: ***GUYANA MINING ENTERPRISE, Guyana, South America***
Project Engineer (1979-1981)
Senior Project Engineer (1981-1983)

Redesigned and supervised construction of mills tailings dams using coarse fraction of tailings for fill and saved $12M. Started and supervised geosciences group two years after graduation. Analyzed slope stability of all open-pit mines and mine waste heaps. Investigated soil competence for mining equipment. Designed preload schemes for soft soils. Determined liquefaction potential of mining waste disposed in ponded water. Supervised mine dewatering investigations. Developed a generic mine drainage plan that coupled groundwater flow and precipitation. Established a soil laboratory, purchased laboratory equipment and trained technicians to perform soil laboratory tests and field quality control tests.

1972 to 1974: ***MINISTRY OF WORKS; Guyana, South America***
Soils and Materials Technician

Performed laboratory tests to determine soils and materials parameters for pavement design and soil laboratory tests to establish parameters for building foundation and earth structure design. Tests performed included CBR, determination of Marshall Stability, Particle Size Distribution, Soil Plasticity tests, soil consolidation tests, direct shear tests, Soil triaxial tests and soil permeability tests. Supervised subsurface investigations.

MICHAEL SCOTT

EDUCATION:

Ph.D. - Social Science and Administration, University of London, England, 1995
M.A. - International Studies - Methods of Analysis, University of Sheffield, England, 1990
B.Soc.Sc. - Sociology (Distinction), University of Guyana, 1984

AFFILIATIONS:

Member of Association of Guyanese Sociologists
Member of the University of Guyana International Relations Association

EXPERIENCE:

1996 - Present ***University of Guyana***

1998 and 1999 ***Graduate School of the Social Sciences and Coordinator***,
Director (Ag.) Postgraduate Diploma in International Studies

1996 - Present ***Graduate School of the Social Sciences and Department of Government and International Affairs***.
Lecturer ll

Developed, Planned, Organised and Conducted seminars and lectures at the undergraduate and post-graduate levels in a number of areas including Diplomacy, International Relations, Research Methodology, Corporate Management, Organizational Analysis, Public Policy Making and Organizational Analysis.

1999 ***Foreign Service Institute of Guyana***

Conducted seminars and lectures on the International System and Research Methods and Techniques in International Relations.

1996 - Present ***Institute of Distance and Continuing Studies, Guyana***
Lecturer

Developed and taught courses in Organizational Behavior and Management; Assisted in the coordination of the Mini-University: Bridging Course for Secondary School Leavers in Entrepreneurship (1997).

SHERANNE DOORGASINGH-WICKHAM

EDUCATION:
M.Sc., University of East Anglia, United Kingdom. Major: Environmental Sciences, 1999
B.Sc., University of Guyana. Major: Agricultural Science, 1992.
Environmental Management, Dalhousie University, Canada, 1998

EMPLOYMENT:

1998 to present Environmental Protection Agency - Office of the President
Special Projects Coordinator

Responsible for coordination of all special projects and activities as defined by Office of the President including the provision of input to other divisions within the Agency on environmental issues. Participate in the planning and implementation of projects or activities. Assist in the formulation of project proposals for major activities.

1996 to 1998 Environmental Protection Agency - Office of the President
Senior Environmental Officer/Officer-in-Charge, EPA

Made recommendations relating to policies and programmes with a view to improving the efficiency and effectiveness of the Agency. Supervised and participated in the preparation and execution of programmes by Environmental Officers and Environmental Field Technicians in Environmental Monitoring and Control, Environmental Education and Public Awareness, and Biodiversity Conservation and Use. Supervised an Environmental Analytical Laboratory. Assisted in the development of linkages with other agencies and international organizations engaged in Environmental Management Programmes. Conducted Environmental Screening on proposed developmental projects. Reviewed Environmental Impact Assessment of developmental projects. Conducted site assessment and analysis of Environmental problems.

1995-1996 Environmental Protection Agency - Office of the President
Environmental Monitoring Officer.

Coordinated Environmental monitoring activities for mining. Reviewed environmental monitoring reports. Conducted investigations and site inspections on possible environmental hazards. Coordinated and organized workshops on Environmental issues including, Regional Workshop on Ecotourism in Protected Areas of the Amazon, Environmental Management for Conventional Gold Mining, Reviewed Environmental Impact Assessment of the following projects, Omai Gold Mining Project Environmental Impact Statement and Addenda, Sapil Project Environmental Impact Statement, Paper Recycling Plant, Docol Project Environmental Impact Statement, Cement Bagging Factory. Monitored and Evaluated mine water discharge and also to set discharge standards.

1993-1995: ***Guyana Agency for Health Science Education, Environment and Food Policy***
Environmental Officer

Planned, organized and carried out research, surveys and inspections into areas relevant to conservation of natural resource and marine pollution in the environment. Collected and maintained databases on specific Environmental issues. Prepared environmental programmes for pollution management. Liaised with local and international environmental personnel and agencies. Supervised Environmental Field Technicians. Monitored and evaluated effluent discharges of several local industries.

1979 -1990 ***Ministry of Education***
Assistant Mistress

Taught Secondary School students concepts of soil, crop and animal production management. Trained students to apply scientific knowledge and skills. Prepared students to write Caribbean Council Examinations in Agriculture Science and Biology. Managed the School's Crops and Livestock farm and implemented agricultural projects.

FIELD EXPERIENCE*:*

Extensive Sampling of surface, sub-surface water and sediments in the Essequibo and Omai Rivers for cyanide and metals.

Sampling and Evaluating Industrial effluents to determine the levels of physical and chemical parameters.

Surveys to determine the socioeconomic impact of the Omai Cyanide Spill.

PUBLICATIONS and REPORTS:

Wickham, S (1994) (Ed), Proceedings on Open Forum on the ***National Environment Action Plan, Guyana***

Wickham, S (1995) Report on ***Water Quality*** *of the* ***Omai and Essequibo Rivers****.*

Harcourt, K and Wickham (1996) A Case Study on ***Omai Aftermath****: Paper presented at Mineral, metal and Environment Conference, Parque, Czech Republic.*

Wickham, S (1997) ***Environmental Policies*** *in* ***Guyana in relation to Environment Protection Act****, Paper presented at a workshop of Environment Management of Mine sites, Guyana.*

STANLEY KENRIQUE MARCUS

EDUCATION

M.D. Higher Institute of Medical Science, Cuba 1985
Advanced Management (Guyana Mining Enterprise) 1989
Community Health Management (PAHO\University of Texas 1992
Hospital Administration (Ministry of Health\PAHO) 1993

EXPERIENCE

1993 to Pres: ***LINMINE***
Director & Medical Officer

Responsible for the management of Linmine Occupational Health and Safety Department and for the administration of Linmine's medical assistance plan.

1985 to 1992 ***MINISTRY OF HEALTH***
Regional Health Officer Region 10

Coordinated the provision of health care services at eighteen Primary Health Care Centres in Region 10. Responsible for the management and administration of the health care services at the Mackenzie, Wismar, Ituni, and Kwakwani Hospitals. Provided medical services to members of the Linden community and to the City of Georgetown and its environs.