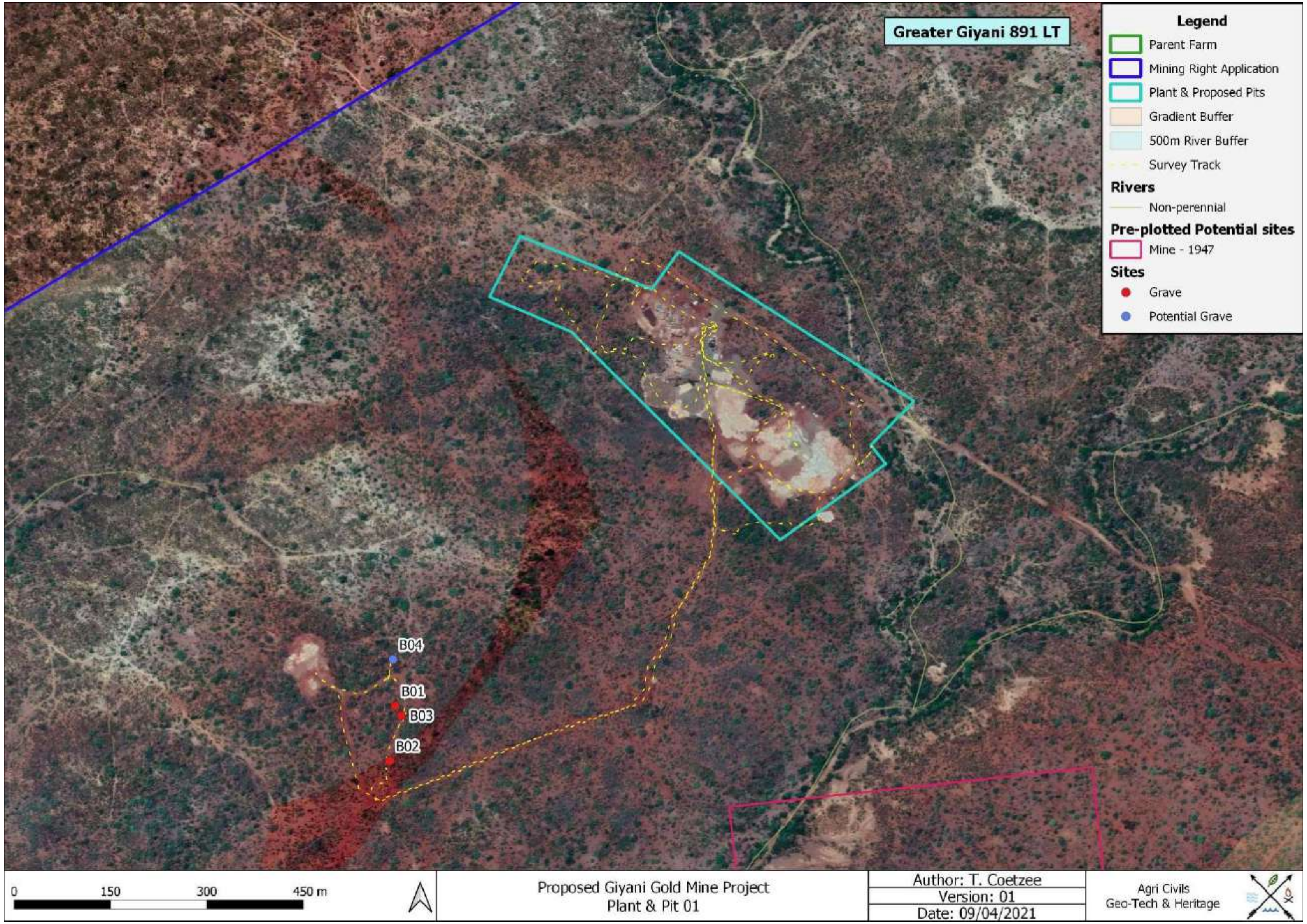

Figure 37: Plant and Pit 01 superimposed on a 2020 aerial backdrop.

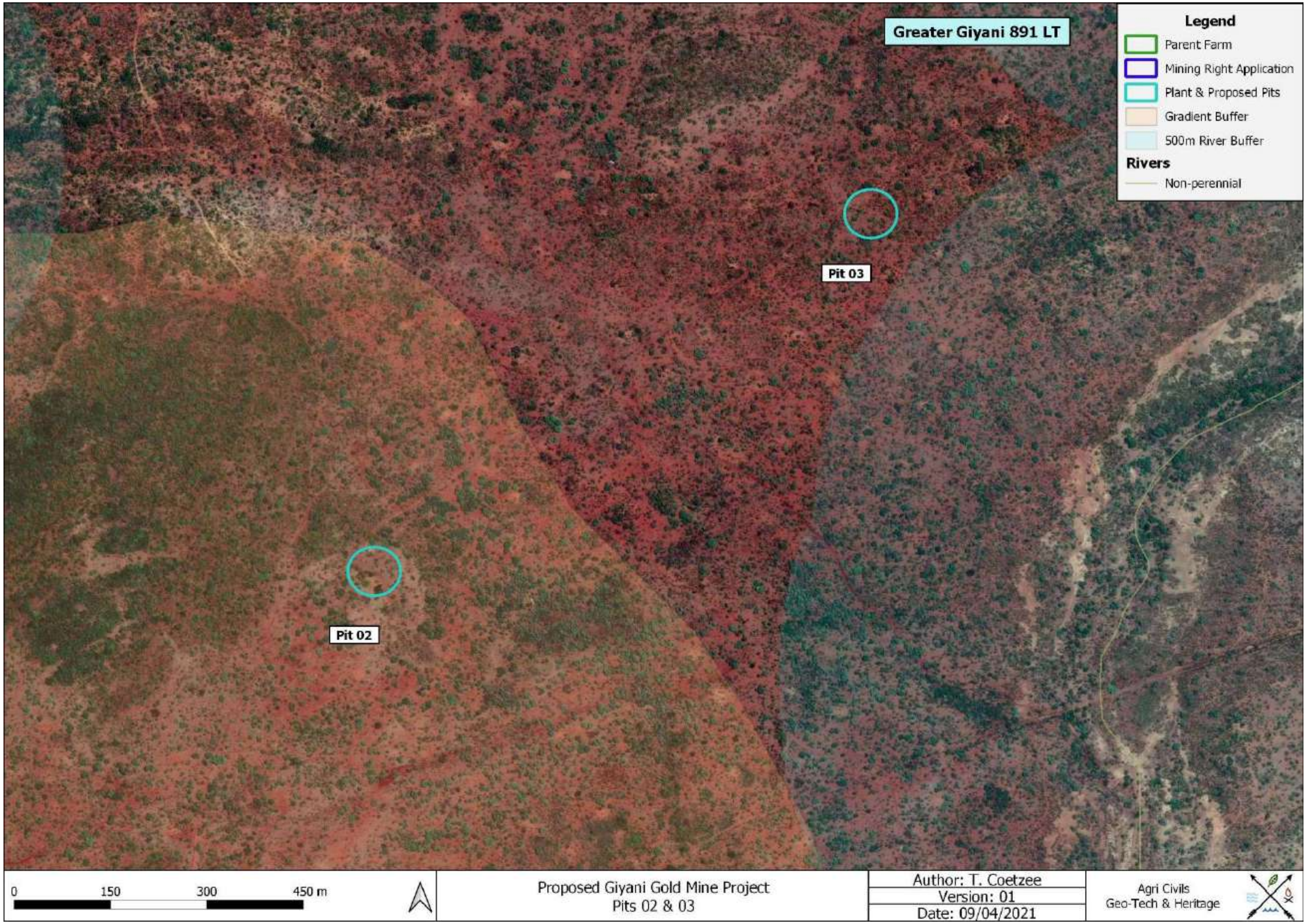

Figure 38: Proposed Pits 02 & 03 superimposed on a 2020 aerial backdrop.

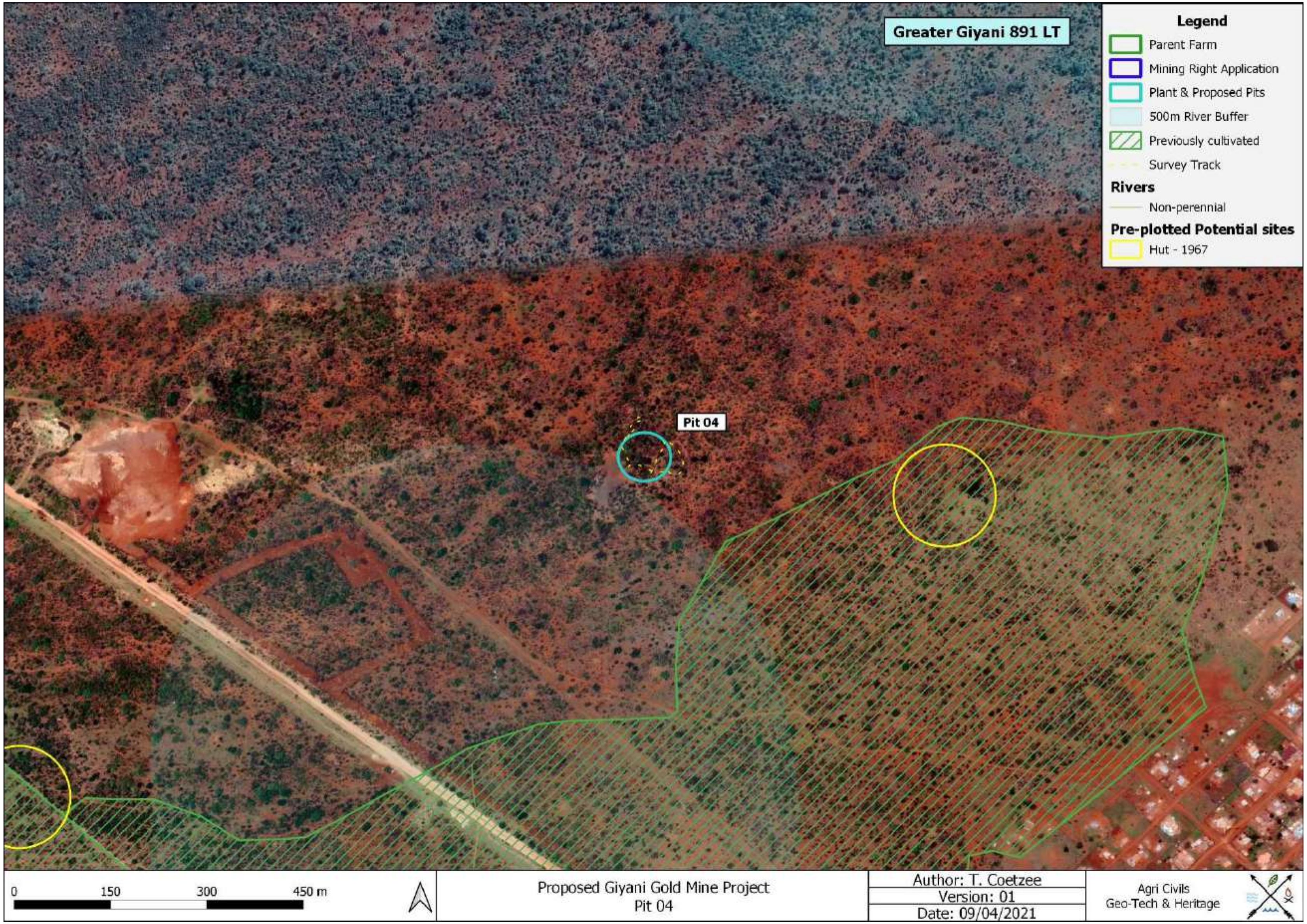

Figure 39: Proposed Pit 04 superimposed on a 2020 aerial backdrop.

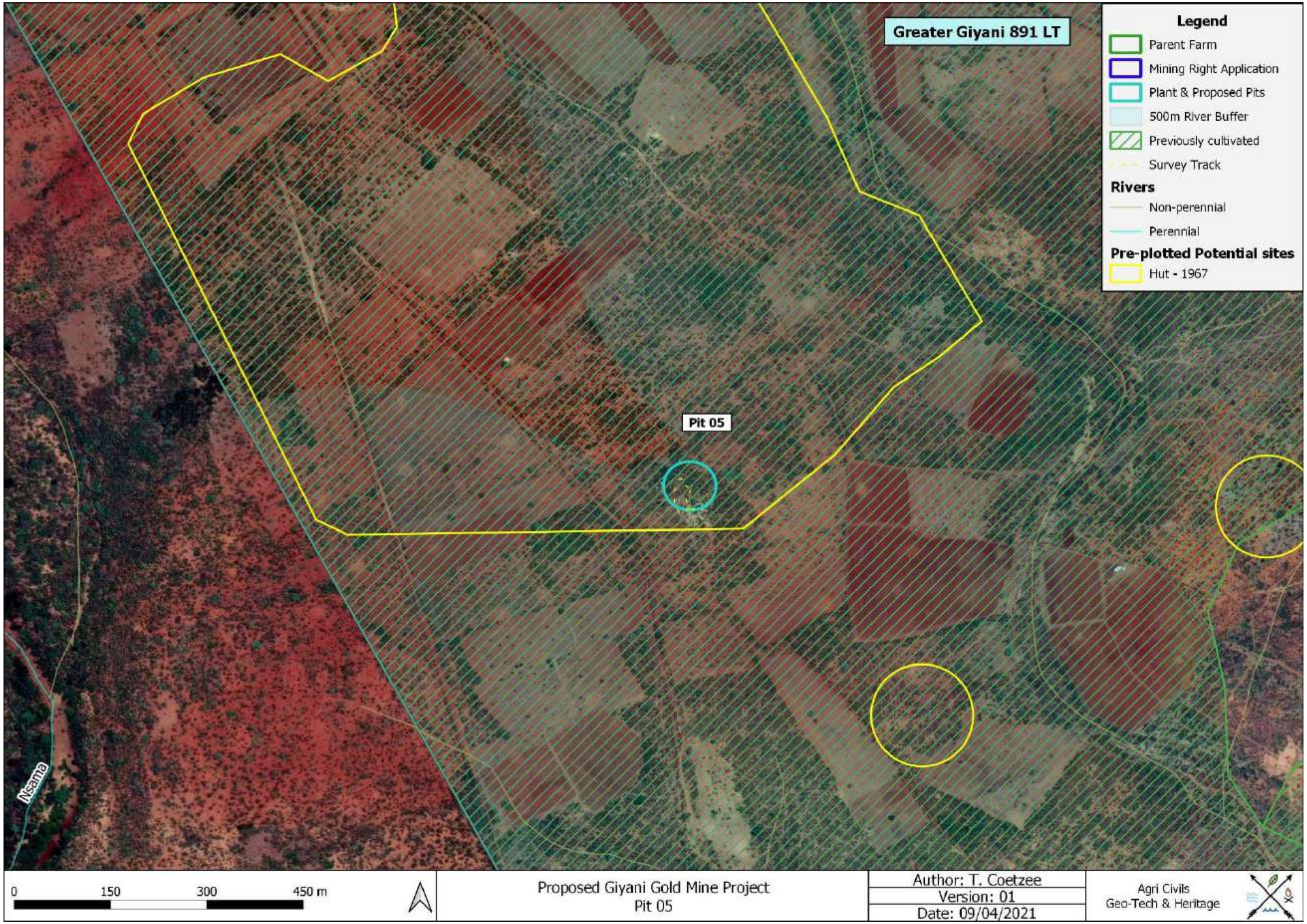

Figure 40: Proposed Pit 05 superimposed on a 2020 aerial backdrop.

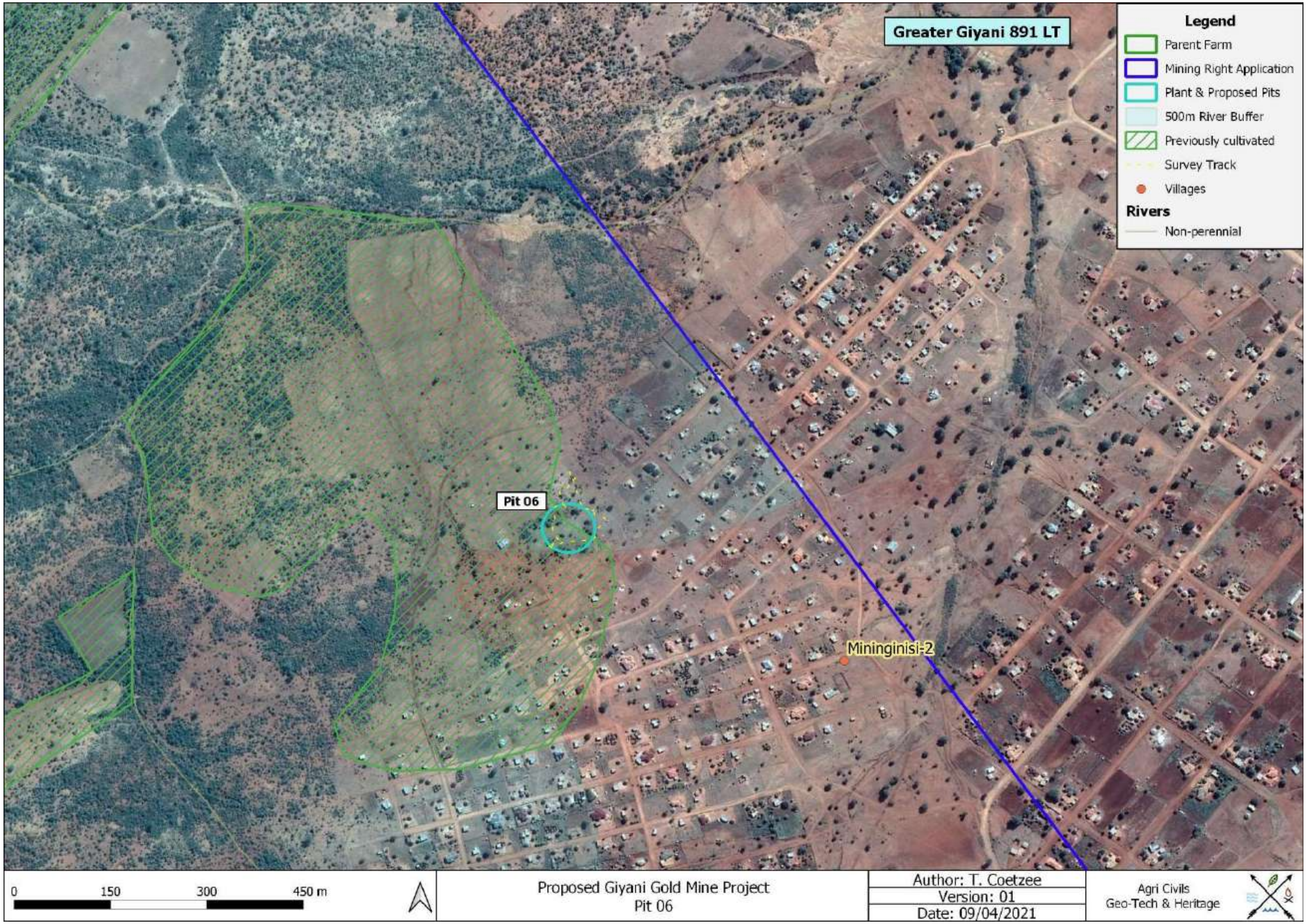

Figure 41: Proposed Pit 06 superimposed on a 2020 aerial backdrop.

7.2 Recommendations

The following recommendations are made in terms with the National Heritage Resources Act (25 of 1999) in order to avoid the destruction of heritage remains associated with the areas demarcated for development:

Plant and Pit 01

- The area demarcated for the expansion of the plant and Pit 01 has to a large extent been disturbed by contemporary mining activity and no sites of heritage significance were noted within the demarcated boundary. No further action is required.

Proposed Pits 02 & 03

- Pits 02 & 03 could not be accessed due to dense vegetation cover. Because the Giyani Gold Mining Project is based on the location of previous mining activity, a strong possibility exists that proposed Pits 02 & 03 are associated with historical mining activity. Therefore, it is recommended that the vegetation at these sites be cleared and a qualified archaeologist inspect the areas prior to any development to prevent the accidental damage and destruction of heritage resources. Care, however, must be exercised not to disturb any potential shafts, structures or any other archaeological features when clearing the vegetation.

Proposed Pit 04

- Due to the potential archaeological significance of the mining activity at proposed Pit 04, it is recommended that the vegetation hampering visibility and access to the trenches be cleared and that a qualified archaeologist document and map the site prior to any development. Care must be exercised not to disturb the trenches or any other archaeological features when clearing the vegetation.

Proposed Pit 05

- The historical mining activity associated with proposed Pit 05 is significant from an archaeological perspective since the site is associated with infrastructure that date to at least 1947. Dense vegetation, however, hampered determining the extent and location of all the features and structures. Therefore, it is recommended that the vegetation hampering access and visibility be cleared and that a qualified archaeologist document and map the site prior to any development. Care must be exercised not to disturb the shafts, structures or any other archaeological features when clearing the vegetation. It is also recommended that the historical mining structures associated with this site be fenced-off and avoided by development. The mine's ECO should inspect the structures during the proposed mining development and should any impact be observed, or if impact cannot be avoided, a destruction permit will have to be obtained from the relevant heritage authority.

Pit 06

- Although the rehabilitated mining shafts associated with proposed Pit 06 might date to the 1980s, the associated buildings and structures likely date to earlier times and are considered significant from an archaeological perspective. Due to the rehabilitated and disturbed nature of the site, the recording done during this study is regarded as sufficient. However, it is also recommended that the historical mining structures associated with this site be fenced-off and avoided by development. The mine's ECO should inspect the structures during the proposed mining development and should any impact be observed, or if impact cannot be avoided, a destruction permit will have to be obtained from the relevant heritage authority.

Graves

- Grave sites 2330BB-B01 – B04 are located approximately 600 m southwest of the pant and Pit 01 area. No impact is envisaged and no further action is required.

General Recommendations

- The recommendations made are based on the specific project activities, as well as surface boundaries as indicated in this report. Should the proposed surface impact areas be altered, a qualified archaeologist must survey the altered areas and amend the report accordingly.

- Because archaeological artefacts generally occur below surface, the possibility exists that culturally significant material may be exposed during the development and construction phases, in which case all activities must be suspended pending further archaeological investigations by a qualified archaeologist. Also, should skeletal remains be exposed during development and construction phases, all activities must be suspended and the relevant heritage resources authority contacted (See National Heritage Resources Act, 25 of 1999 section 36 (6)).

- From a heritage point of view, development may proceed on the demarcated areas, subject to the abovementioned conditions, recommendations and approval by the South African Heritage Resources Agency.

8. Addendum: Terminology

Archaeology:

The study of the human past through its material remains.

Artefact:

Any portable object used, modified, or made by humans; e.g. pottery and metal objects.

Assemblage:

A group of artefacts occurring together at a particular time and place, and representing the sum of human activities.

Context:

An artefact's context usually consist of its immediate *matrix* (the material surrounding it e.g. gravel, clay or sand), its *provenience* (horizontal and vertical position within the matrix), and its *association* with other artefacts (occurrence together with other archaeological remains, usually in the same matrix).

Cultural Resource Management (CRM):

The safeguarding of the archaeological heritage through the protection of sites and through selvage archaeology (rescue archaeology), generally within the framework of legislation designed to safeguard the past.

Excavation:

The principal method of data acquisition in archaeology, involving the systematic uncovering of archaeological remains through the removal of the deposits of soil and other material covering and accompanying it.

Feature:

An irremovable artefact; e.g. hearths or architectural elements.

Ground Reconnaissance:

A collective name for a wide variety of methods for identifying individual archaeological sites, including consultation of documentary sources, place-name evidence, local folklore, and legend, but primarily actual fieldwork.

Matrix:

The physical material within which artefacts is embedded or supported, i.e. the material surrounding it e.g. gravel, clay or sand.

Phase 1 Assessments:

Scoping surveys to establish the presence of and to evaluate heritage resources in a given area.

Phase 2 Assessments:

In-depth culture resources management studies which could include major archaeological excavations, detailed site surveys and mapping / plans of sites, including historical / architectural structures and features. Alternatively, the sampling of sites by collecting material, small test pit excavations or auger sampling is required.

Sensitive:

Often refers to graves and burial sites although not necessarily a heritage place, as well as ideologically significant sites such as ritual / religious places. *Sensitive* may also refer to an entire landscape / area known for its significant heritage remains.

Site:

A distinct spatial clustering of artefacts, features, structures, and organic and environmental remains, as the residue of human activity.

Surface survey:

There are two kinds: (1) unsystematic and (2) systematic. The former involves field walking, i.e. scanning the ground along one's path and recording the location of artefacts and surface features. A systematic survey by comparison is less subjective and involves a grid system, such that the survey area is divided into sectors and these are walked ally, thus making the recording of finds more accurate.

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Human Tissue Act No. 65 of 1983, Government Gazette, Cape Town

National Heritage Resource Act No.25 of 1999, Government Gazette, Cape Town

Removal of Graves and Dead Bodies Ordinance No. 7 of 1925, Government Gazette, Cape Town

Appendix A: Historical Aerial Imagery & Topographical Maps

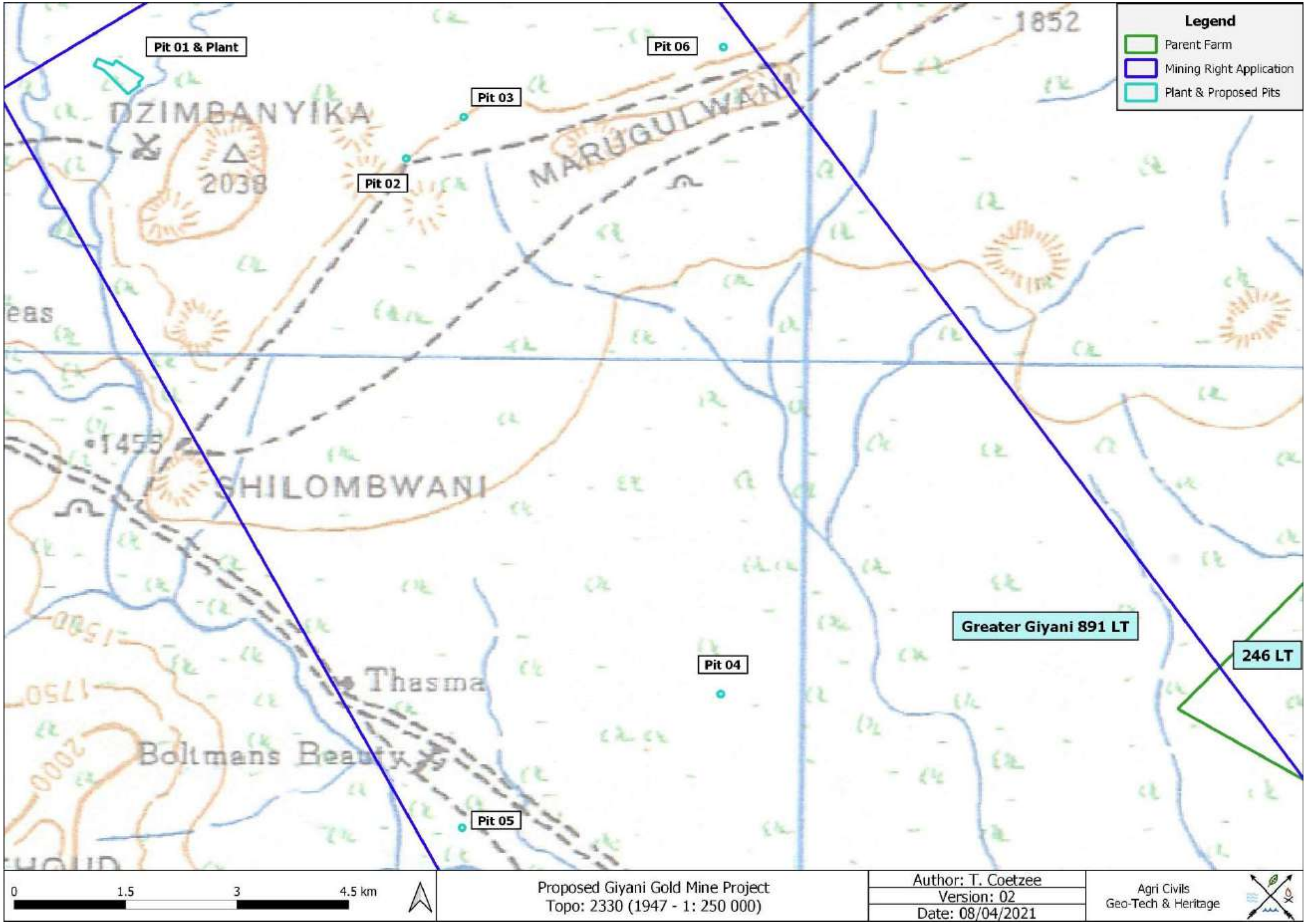

Figure 42: Segment of 1947 SA 1: 250 000 2330 indicating the demarcated study areas.

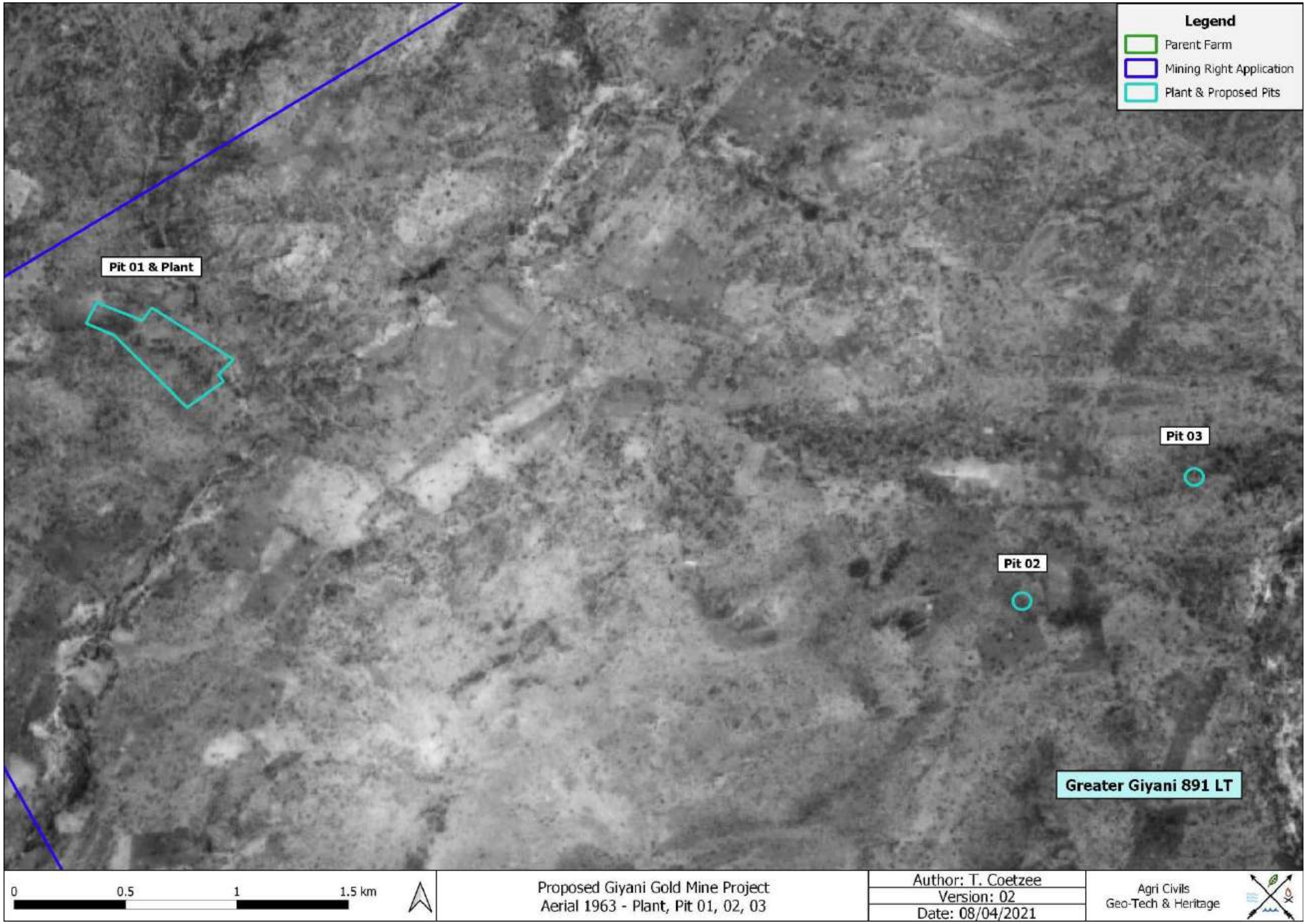

Figure 43: Proposed plant expansion, Pits 01, 02 and 03 on a 1963 aerial backdrop.

Figure 44: Proposed Pits 04 & 05 on a 1963 aerial backdrop.

Figure 45: Proposed Pit 06 on a 1963 aerial backdrop.

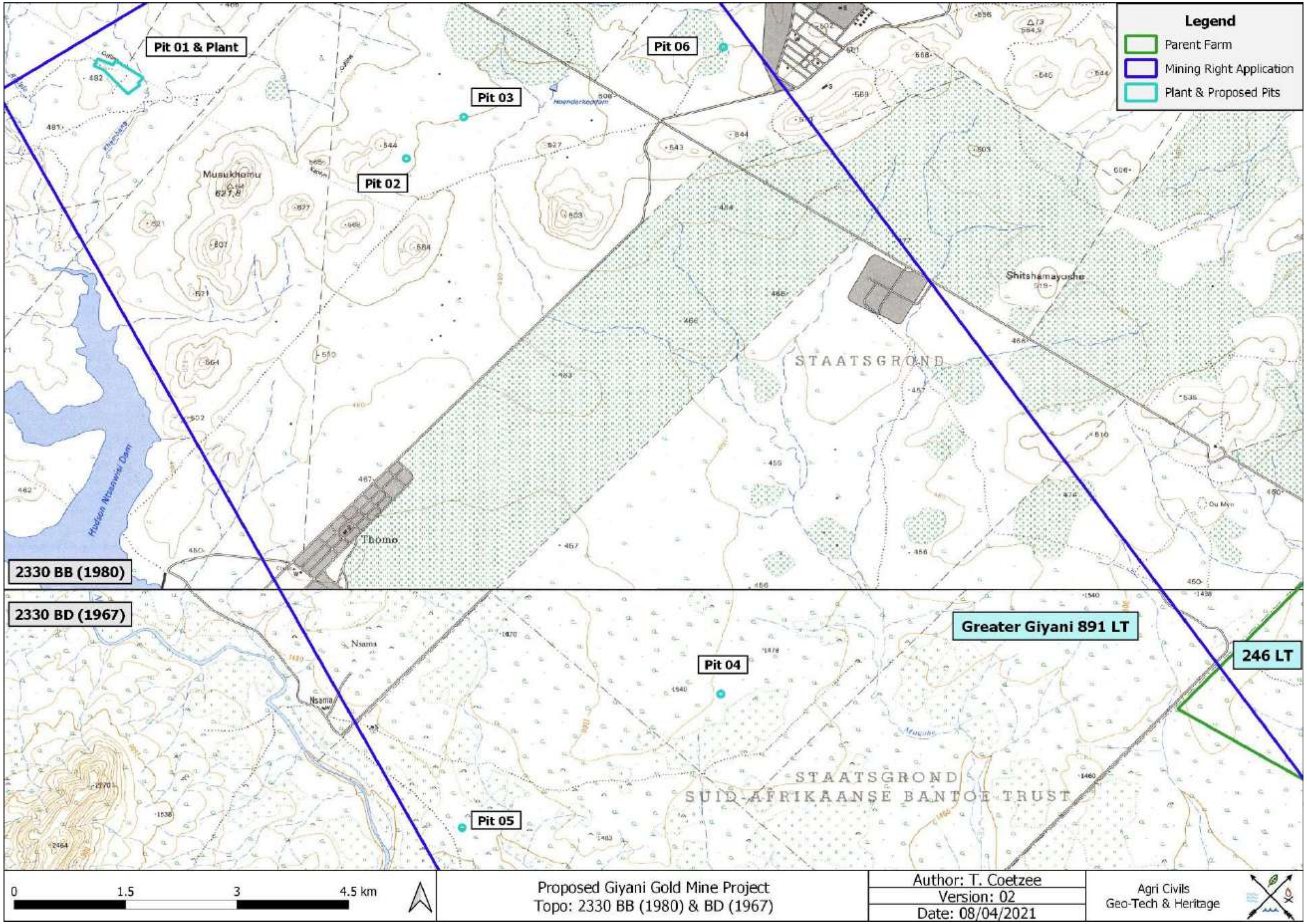

Figure 46: Segments of 1967 & 1980 SA 1: 50 000 2330 BB & BD indicating the study areas.

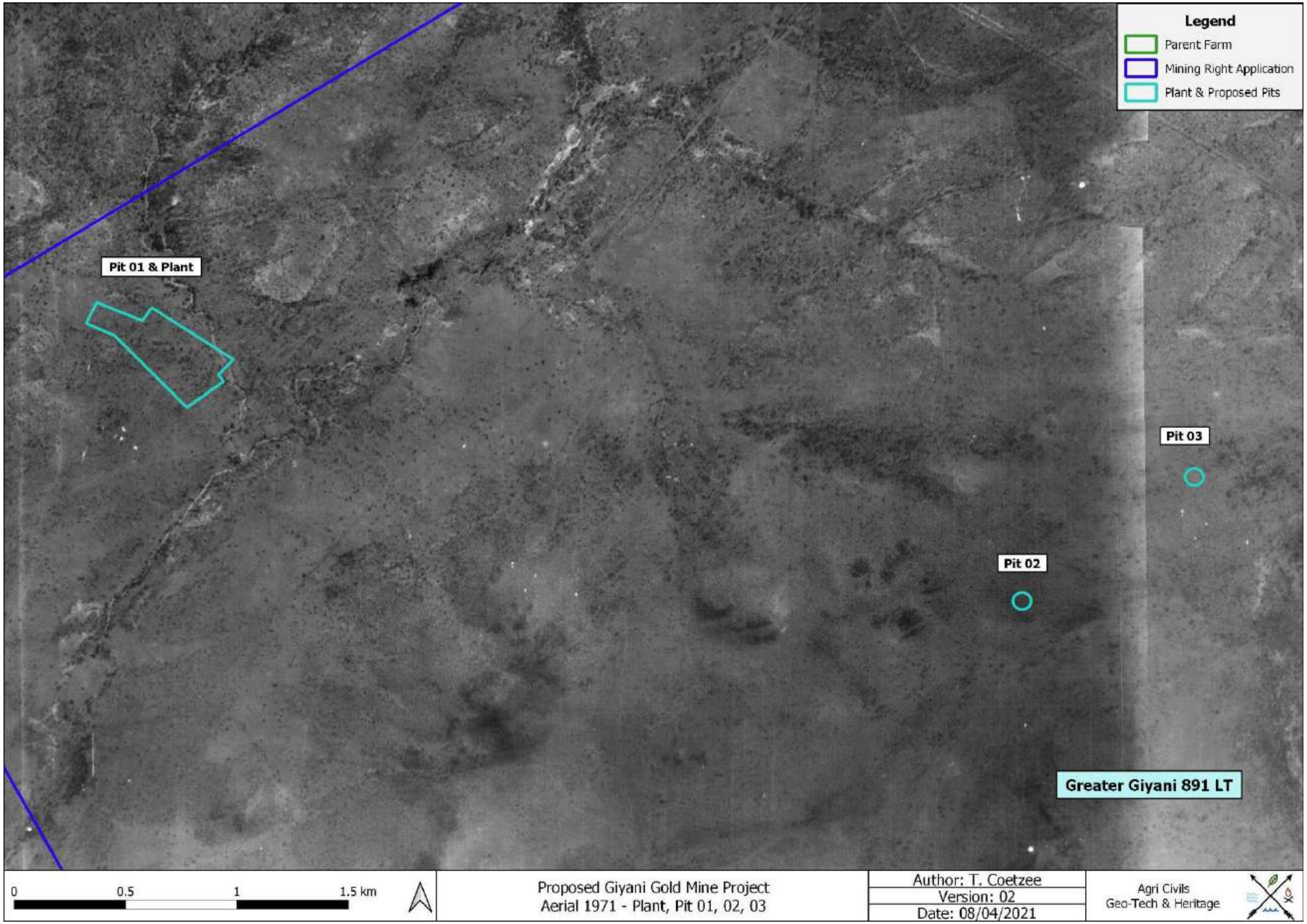

Figure 47: Proposed plant, Pit 01, 02 and 03 on a 1971 aerial backdrop.

Figure 48: Proposed Pits 04 & 05 on a 1971 aerial backdrop.

Figure 49: Proposed Pit 06 on a 1971 aerial backdrop.

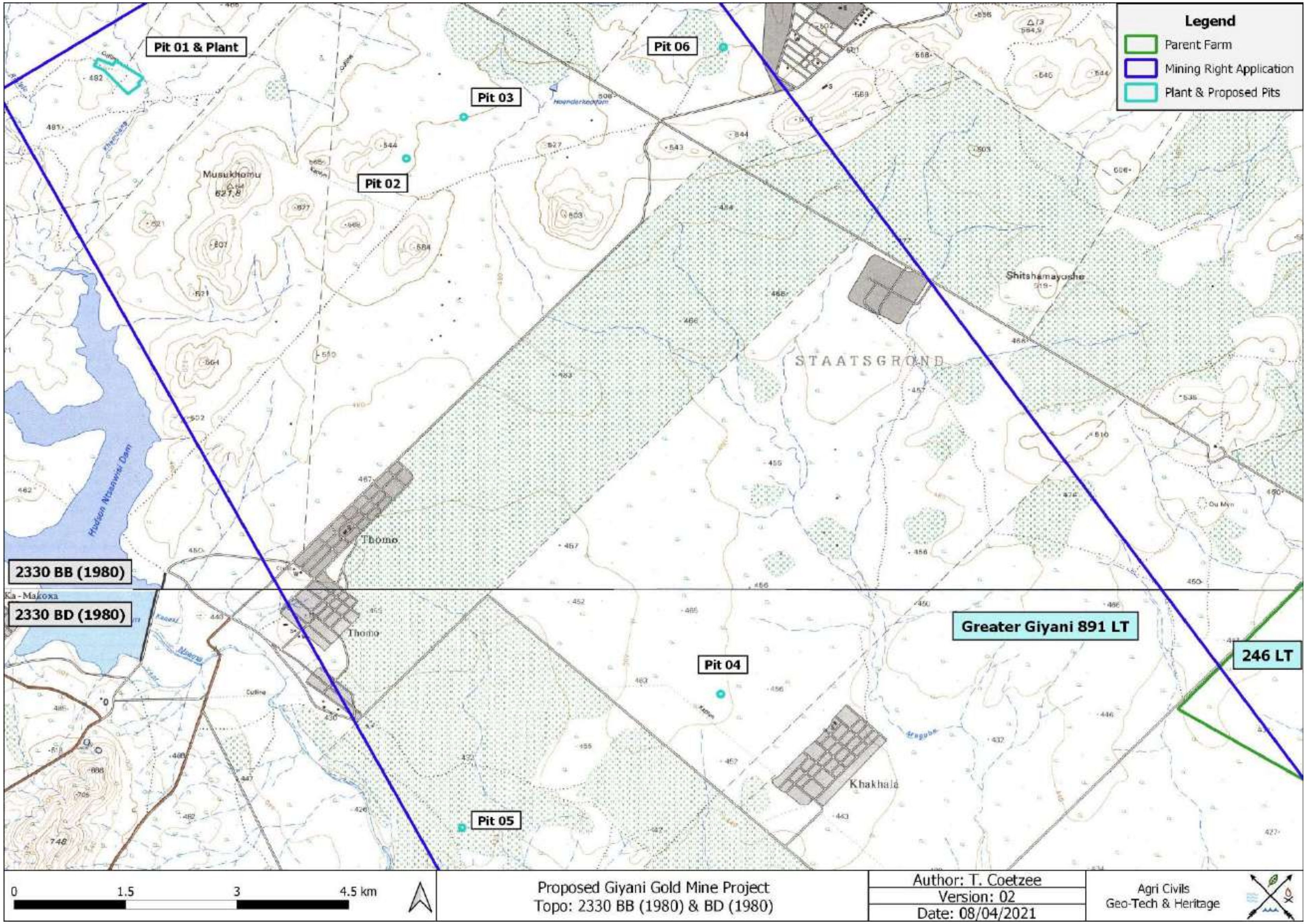

Figure 50: Segments of 1980 SA 1: 50 000 2330 BB & BD indicating the study area.

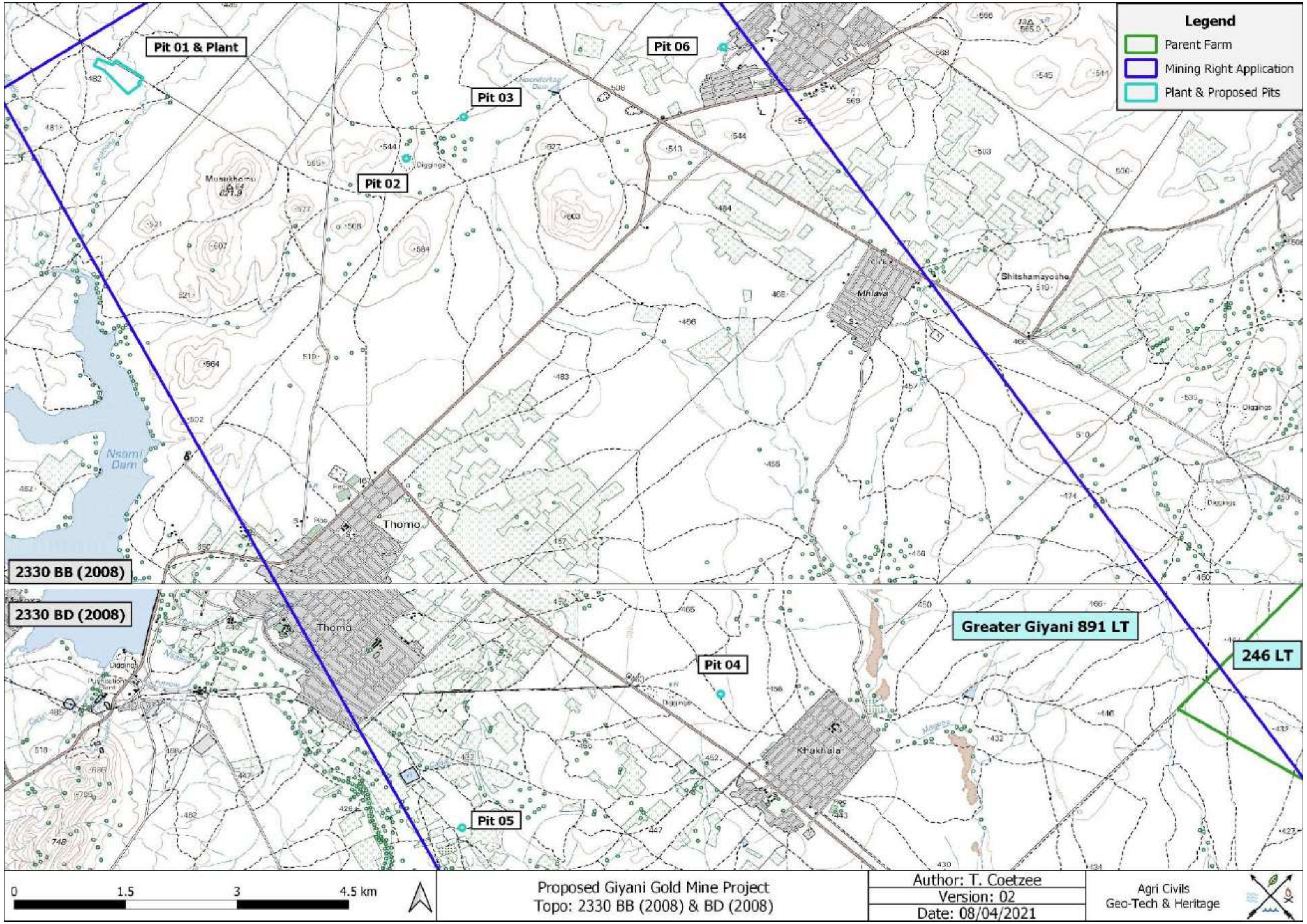

Figure 51: Segments of 2008 SA 1: 50 000 2330 BB & BD indicating the study area.

ANNEXURE 6 - SOIL AND LAND CAPABILITY ASSESSMENT

SOIL ASSESSMENT AND LAND CAPABILITY FOR THE PROPOSED GIYANI GOLD MINE PROJECT, LOCATED IN GIYANI IN THE LIMPOPO PROVINCE

Commissioned by

KUSILE INVEST 133 (PTY) LTD

Date: 22 April 2021

REPORT INFORMATION

Report Title:	Soil Assessment and Land Capability for the mining right application on Un-Surveyed State land of Greater Giyani 891 LT and a portion of portion 0 of the farm 246 located in the Greater Giyani Municipality, within Mopani District Municipality in Limpopo Province.	
Report Reference:	SLCR - (GGMv. D01)/2022	
Report Status:	Draft	
Prepared By:	Archean Resources Pty Ltd	
Authored by	Yvonne Gutoona	BSc Geology and BSc Geography

STATEMENT OF INDEPENDANCE AND PROFESSIONAL AFFILIATION

I, Yvonne Gutoona, hereby declare that I:-

- Act as an independent consultant;
- Do not have any financial interest in the undertaking of this project, other than remuneration for the work performed in terms of the National Environmental Management Act EIA Regulations Amendment of April 2017
- Have and will not have vested interest in the proposed activity nor will I engage myself in any conflicting interest associated with this project
- I undertake to disclose and provide to the competent authority any material or information at my disposal regarding this project as required in terms of National Environmental Management Act (EIA regulations of April 2017);
- Based on the information provided to me by the client and in addition to information obtained during the course of this study, I have presented the results and conclusion with regard to this project to the best of my professional ability;

Y. Gutoona

Signed at: Pretoria

EXECUTIVE SUMMARY

Kusile Invest 133 (Pty) Ltd has appointed Archean Resources (Pty) Ltd, an independent consulting company, to conduct an Environmental Impact Assessment (EIA) process to evaluate the potential environmental and social impacts of the proposed project. The project is referred to as the Giyani Gold Mine Project. The applicant Kusile Invest has lodged a mining right on Un-Surveyed State land of Greater Giyani 891 LT and a portion of portion 0 of the farm 246 located within the town of Giyani, Limpopo Province. and intends to establish an underground and open cast mine. The mine development activities will commence by establishing and installing the required mining infrastructure such as pit establishment, shaft headgear and winders, service water, compressed air and power supply, processing plant and installation of surface ventilations fans. The type and size of the mining infrastructure to be installed will be designed to support the proposed Life of Mine (LOM) production rate of 12 000 tons per month of Run of Mine material (ROM) for 30 (thirty) years.

As part of the application process a Soil and Land capability assessment has been undertaken. The objectives of the investigation included a soil survey and mapping of study area, measurement of the effective depth of the soil(s), assessment of agriculture potential of soils, assessment of the erodibility and misuse of soils, mapping of land use & land capability, formulation of a soil stripping guide and plan, determination of chemical, mineralogical and physical properties of representative soil forms, assessment of suitability of soils for rehabilitation purposes and an impact assessment of topsoil stripping on soils with recommendations to mitigate negative impacts.

From the investigation it is conclusive the dominant soils according to the Taxonomical Soil Classification System of South Africa include;

- **Glenrosa and/or Mispah forms (other soils may occur**).
- **Red-yellow apedal, freely drained soils**
    - Ae - Red, high base status, >300mm deep (no dunes)

The soil have structure favouring arable land use if climate permits and soils with structure favouring arable land use scarce or absent.

The soil association map shows:

The application area has Red, massive or weakly structured soils with high base status (association of well drained Lixisols, Cambisols, Luvisols) and Soils with minimal development, usually shallow on hard or weathering rock, with or without intermittent diverse soils with (association of Leptosols, Regosols, Calcisols and Durisols. In addition one or more of Cambisols, Luvisols.

PRESENT LAND USE

The proposed mining area has le than 10% of low to moderate and more than 85% of medium to high agricultural land use capability. The area is mostly used for Subsistence Farming Annual Crop Cultivation / Planted Pastures Rotation, most notably maize is the commonly planted crop. Mining activities will irreversibly impact the land capability of the soil hence proper management measures need to be implemented during construction, operations and decommissioning to prevent soil loss due to contamination.

PROBLEM STATEMENT AND STUDY OBJECTIVE

The soils occurring on the proposed area will be disturbed in the construction and operation phase. Any medium to long-term impacts after construction needs to be limited. The purpose of this study is to identify the present soil forms as well as their physical and chemical characteristics and how they will react to any disturbance. Due to the change in primary use of the land from mainly natural bushveld areas to mining, there will be an impact in the medium term to long term.

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Glossary

Term	Definition
Ae	Red-yellow apedal, freely drained soil. Red, High base status, > 300mm deep, no dunes
Ag	Red-yellow apedal, freely drained soil. Red, high base status, < 300mm deep.
Ah	Red-yellow apedal, freely drained soil. Red and Yellow, high base status, usually <15% clay
AGIS	Agricultural Geo-Referenced Information System
GPS	Global Positioning System
UTM	Universal Transverse Mercator
WGS84	World Geodetic System 84
ArcGis	Is a suite consisting of a group of geographic information system (GIS) software products produced by ESRI
GIS	Geographical Information System. A geographic information system (GIS), is any system that captures, stores, analyzes, manages, and presents data that are linked to a location
Fa	Glenrosa and/or Mispah Forms (other soils may occur). Lime rare or absent in the entire landscape.
Fb	Glenrosa and/or Mispah Forms (other soils may occur). Lime rare or absent in upland soils but generally present in low-lying soils.
Fc	Glenrosa and/or Mispah Forms (other soils may occur). Lime generally present in the entire landscape
Land Type	Denotes an area that displays a marked degree of uniformity with respect to terrain form, soil pattern and climate
A-Horizon (30)	The depth of the topsoil horizon.
B-Horizon (100)	The bottom end of the sub-soil horizon
Effective rooting depth (ERD).	This is the average depth that roots will develop under irrigation or where they are limited by an impeding layer. The effective rooting depth is the most important from a management perspective, which includes irrigation design, water holding capacity, drainage and nutrition
W	Wetness in the soil. This is an indication of drainage problems
W1	Temporary wetness in the sub-soil. Slight mottling occurs in the sub-soil.
W2	Soil has a bleached / grayish color with stronger mottling. Indication of serious water logging for longer periods of the year.
W3	Permanent water logging for most parts of the year. Dark gray soil matrix with serious mottling. Free water visible in profile pit.
G	The percentage (G3 = 30%) of gravel soil (>2mm) in the total soil profile. This portion has a huge influence on the water holding capacity and

	water movement (permeability) in the soil.
R	The percentage of rocks in the profile. This has an influence on land preparation as well as the water holding capacity of the soil
Available moisture or water content per meter soil (AWC mm/m)	It is the amount of water available in a meter of soil.
Total available moisture (TAM)	It is a calculation between the AWC multiplied with the effective rooting depth (ERD). TAM values are therefore the most important value to determine from an irrigation design and scheduling perspective
Restriction layer:	It can be rock fragments, soil structure or hydromorphic soil conditions that can limit root development.
Profile available water capacity (PAWC)	It is a calculation between the AWC multiplied with the effective rooting depth (ERD). TAM values are therefore the most important value to determine from an irrigation design and scheduling perspective. It is also mentioned as total available moisture (TAM)
Topsoil:	Is defined as the A-Horizon and a portion of the red and yellow apedal A-Horizon where microbial activity takes place and the majority of the plants hair roots occur.
Soil Forms:	Soil Forms are identified according to the SA Taxonomic Soil Classification system.

LIST OF ABBREVIATIONS

AIA	Archaeological Impact Assessment
ASAPA	Association of Southern African Professional Archaeologists
BID	Background Information Document
CA	Competent Authority
CARA	Conservation of Agricultural Resources Act (Act 43 of 1983)
CSA	Constitution of South Africa (Act No. 108 of 1996)
DEA	Department of Environmental Affairs
LEDET	Limpopo Department of Economic Development, Environment and Tourism
DMRE	Department of Mineral Resources and Energy
DWS	Department of Water and Sanitation
EA	Environmental Authorisation
EAP	Environmental Assessment Practitioner
ECA	Environment Conservation Act (ECA), 1989 (Act No. 73 of 1989)
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
GN	Government Notice
HIA	Heritage Impact Assessment
I&AP's	Interested and Affected Parties
IEM	Integrated Environmental Management
IWULA	Integrated Water Use License Application
IWWMP	Integrated Water and Waste Management Plan
MPRDA	Minerals and Petroleum Resources Development Act (Act No. 28 of 2002) (as amended)
NEMA	National Environmental Management Act (EIA regulations of April 2017)
NEMAQA	National Environmental Management: Air Quality Act (Act No. 39 of 2004)
NEMBA	National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004)
NEMWA	National Environmental Management: Waste Act (Act No. 59 of 2008)
NHRA	National Heritage Resources Act, 1999 (Act No. 25 of 1999)
NWA	National Water Act, 1998 (Act No. 36 of 1998)
OHSA	Occupational Health and Safety Act (Act No. 85 of 1993)
PPP	Public Participation Process
SAHRA	South African Heritage Resources Agency
SANBI	South African National Biodiversity Institute
SR	Scoping Report

1 INTRODUCTION

Kusile Invest 133 (Pty) Ltd has appointed Archean Resources (Pty) Ltd, an independent consulting company, to conduct an Environmental Impact Assessment (EIA) process to evaluate the potential environmental and social impacts of the proposed project. The project is referred to as the Giyani Gold Mine Project. The applicant Kusile Invest has lodged a mining right on Un-Surveyed State land of Greater Giyani 891 LT and a portion of portion 0 of the farm 246 located within the town of Giyani, Limpopo Province and intends to establish an underground and open cast mine.

As part of the EIA process a soil and land capability study was undertaken to formulate potential impacts and mitigation measures relating to the proposed open pit mine. Broad soil classification, soil chemical analysis and agricultural potential was determined to get baseline information regarding soil potential, land use and land capability.

The soil investigation on the proposed area was done with a soil auger with the initial proposed sampling and observation points plotted on a grid system. A combination of variables was then used to obtain the land capability and agricultural potential of the soils using the soils' chemical and physical characteristics and site constraints (topography, climate etc.)

Soils were classified in terms of the Taxonomic System for South Africa. Land capability of the study area was classified into arable land use with Subsistence Farming Annual Crop Cultivation / Planted Pastures Rotation.

1.1 LOCATION OF STUDY AREA

The application area comprises of farms on Un-Surveyed State land of Greater Giyani 891 LT and a portion of portion 0 of the farm 246, within Greater Giyani Municipality, within Mopani District Municipality in Limpopo Province.

The Giyani gold mine is located within the town of Giyani, approximately 140 km to the north- east of the N1 National Road from Polokwane. A well maintained R81 road, from the N1 will provide as the main access to the mine. The mining area will be accessed through existing tarred roads that will link the mine to the various villages such as Thomo, Mninginisi, Mbatlo, Mavalani and Shikukwani.

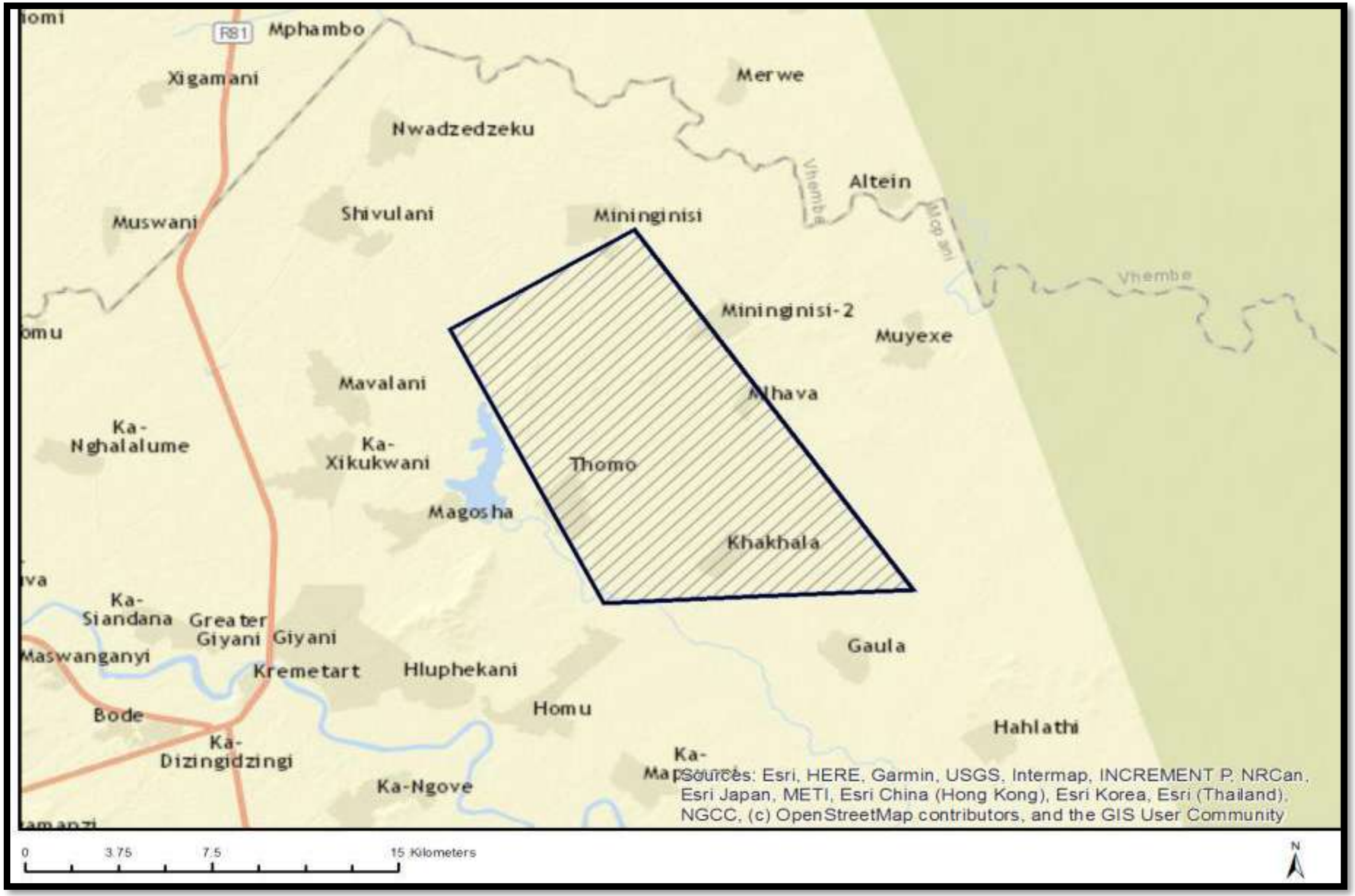


Figure 1: Locality Map Of The Project Area.

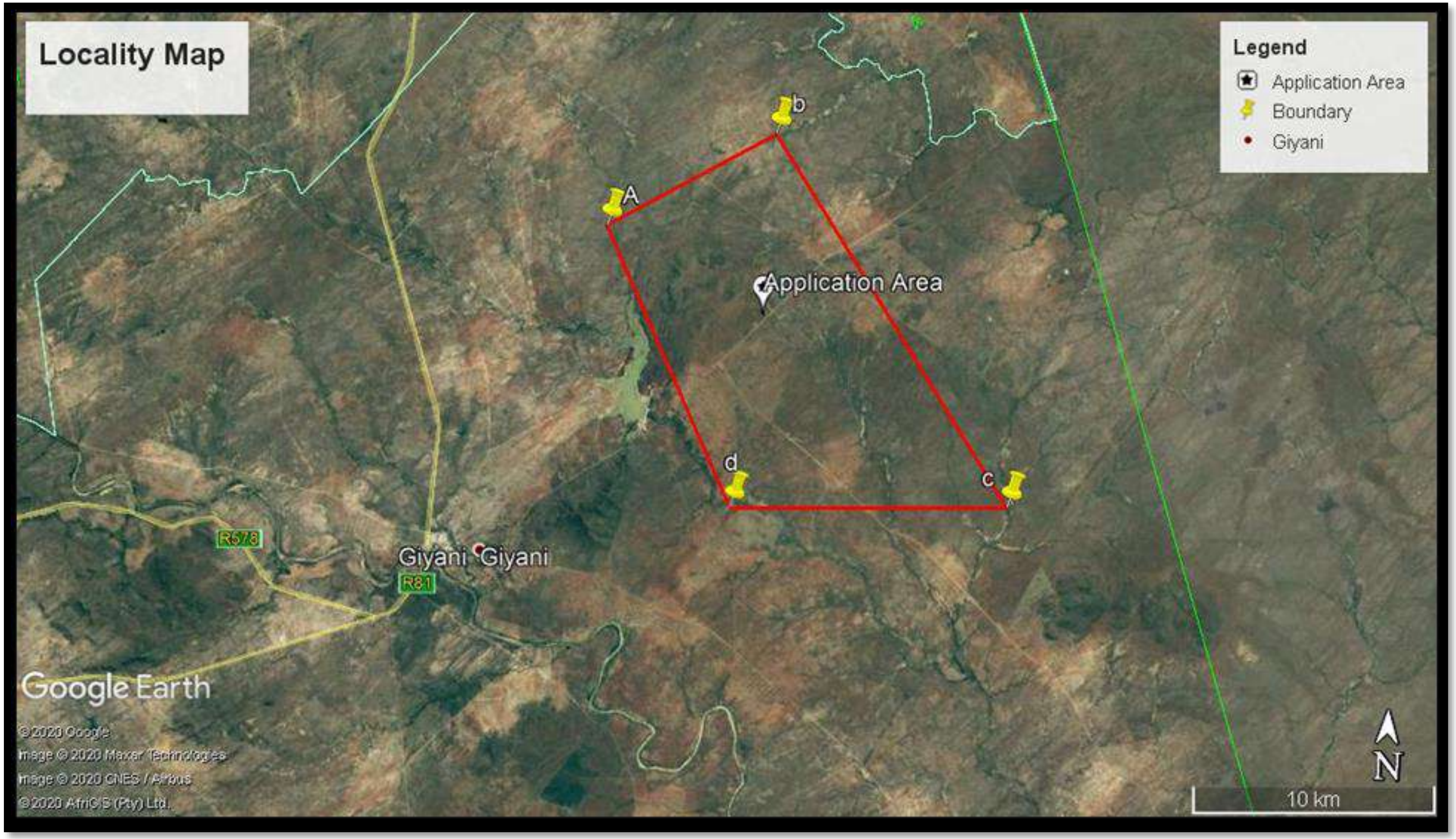


Figure 2: Locality Map

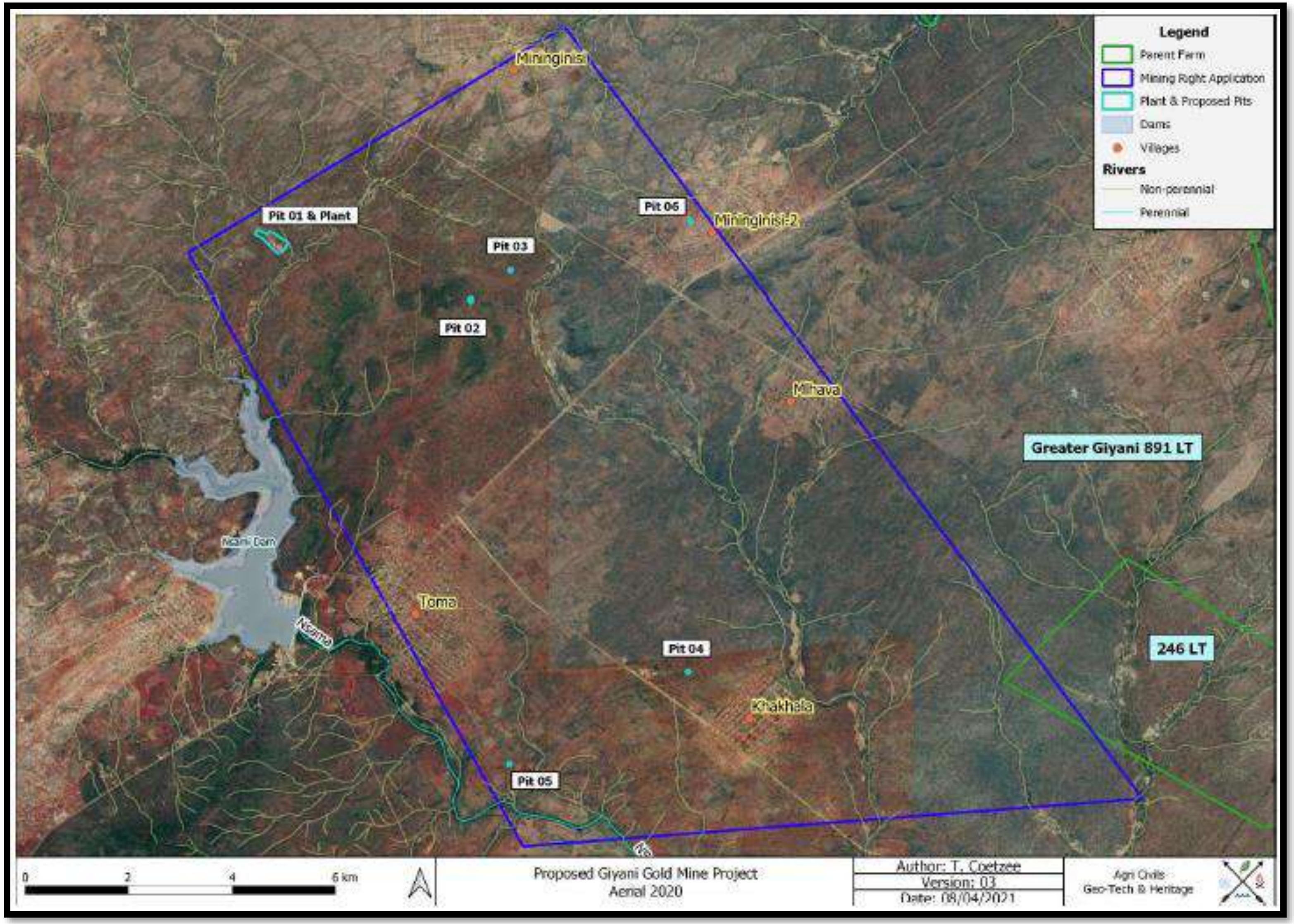


Figure 3: Site Layout

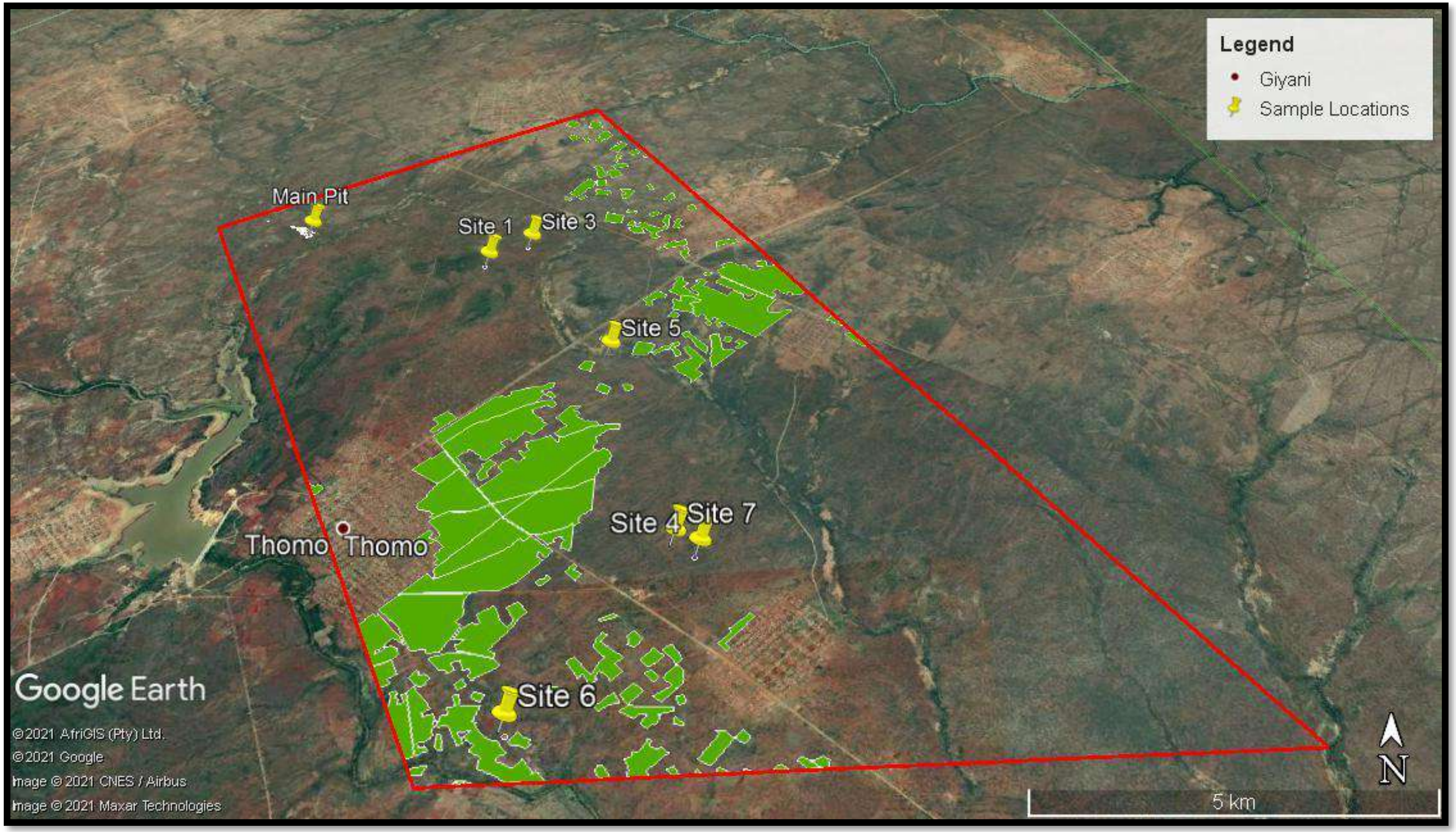


Figure 4: Sample locations with Farming and crop boundaries

2 PROJECT DESCRIPTION

2.1.1 Description of Mining Method

The planned mining methods will include both open cast/surface mining and conventional stoping underground. Mining activities will be carried out on the reef horizon by means of excavating, drilling, blasting, and cleaning of ore using heavy earth moving equipment and blasting using commercial explosives scraper cleaning operations and truck loading or hoisting. The broken ore will be loaded on to trucks and transported through the declines which will be developed below the reef horizon/stoping area for transporting to surface by conveyor belts. For underground mining, the excavation that remains after blasting and cleaning of ore on reef is supported by installing roof bolting to ensure a safe working environment.

Exploitation of the gold bearing ore using the techniques above is associated with costs for procurement of diesel; equipment maintenance; explosives; rock support material and transport costs, in addition to labour costs. Other costs related to general stores and consumables, water, electricity, and compressed air. During the build-up phase, it is expected that a high unit cost will be incurred for each ton of broken ore produced due to initial high fixed and variable costs compared to low production rate when establishing the working areas. The unit cost will gradually decrease and stabilize as production rate increases to reach a steady state.
The planned conventional open cast mining and stope mining methods will utilize compressed air powered rock-drills and electricity powered scraper winches. This equipment will increase electricity consumption and inefficient use of equipment will negatively impact on the operating cost for the mine.

2.1.1.1 Mining Right: Description of Mining Method

Mining operations will commence from five open cast pits which will later be developed into underground workings and expand into four working levels to reach the steady state production of 12 000 tons per month. Additional working areas will be established for sustainability and to replace the depletion of ore reserves being mined from the start-up working areas.

The open pit mine design shows the orebody being located centrally to the pit outer walls or pit shell. The waste surrounding the orebody will be stripped, with topsoil stored separately from waste rock for re-use during rehabilitation of the pit at closure of mining operations. The stripping will include the removal of surrounding topsoil and waste rock to fully expose the orebody and have enough area for movement of machinery inside the pit.

The sidewalls of the excavation, surrounding the orebody, referred to as Benches, will be excavated at intervals to a maximum depth 12 metres and must be slanted to ensure slope stability as per specifications determined by the project’s Rock Engineering expert. The pit development will include the creation of Berms, representing the flat area or horizontal distance of approximately 5 metres in width, when measured from the bottom of the preceding or top bench to the edge of the next bench as the pit goes dipper. An access ramp and haul road will also be created from the top bench on the outer limits of the pit, traversing the lower benches in order to have mining equipment and personnel accessing the pit floor where excavating or blasting of the ore bearing rock will be conducted.

The pit will be excavated to an optimal operating final depth of 400 metres below surface level, thereafter, the conversion of the mining operation from open pit to underground mining operation will be affected. The timing for the development of the underground mining infrastructure will be scheduled to reach its completion such that the commencement of underground operations will overlap with the final phase of the open pit mining operation for a period of 6 months. The basic design or layout for the underground mining operation, entails the conventional use of shafts and declines, with the development of footwall haulages, cross-cuts and raise-lines to establish conventional steep stoping and cut and fill mining panels.

2.1.1.2 Mining – Mining Method

The basic mining methods to be utilised for the Giyani gold mining operation are both surface mining using open pit and conventional stoping methods applied underground to excavate hard rock or ore containing gold and associated minerals such as copper, zinc, nickel and lead and uranium. The existing mine shafts in the area, which form part of the project, were generally mined by conventional breast stoping mining until they were mothballed during the mid-1990's.

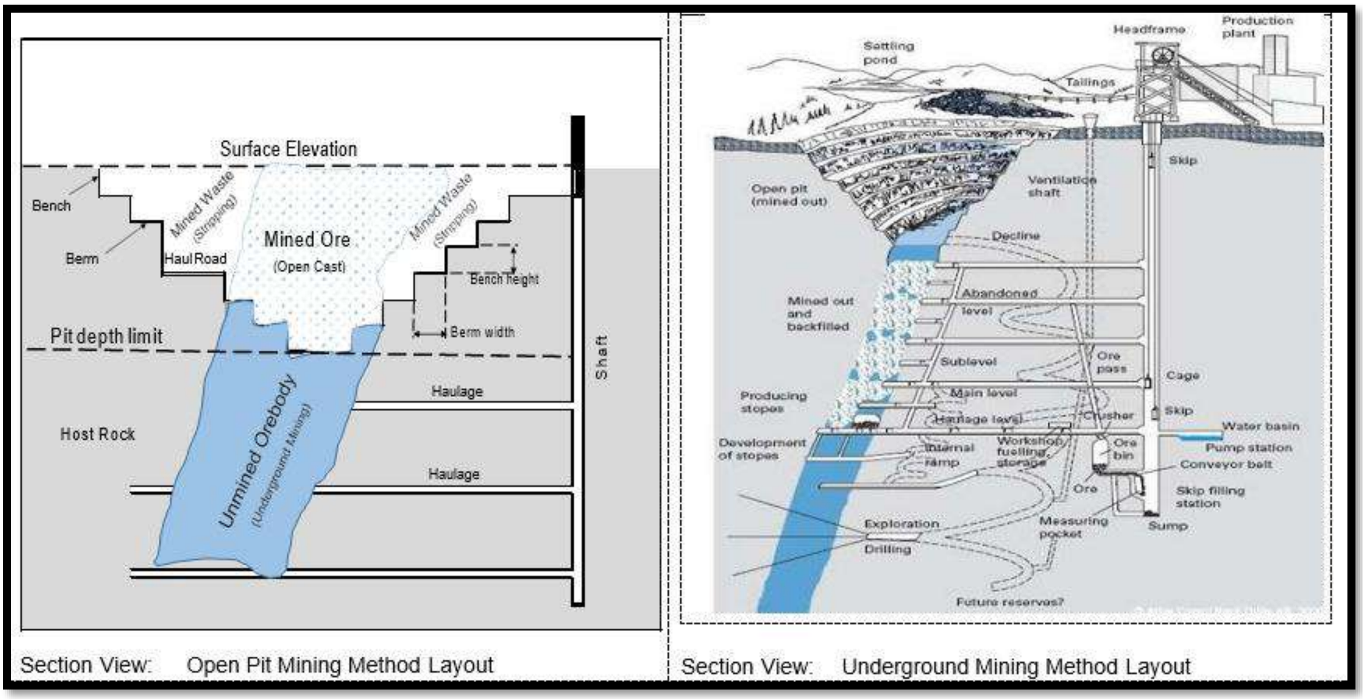


Figure 5: Schematic Diagram of Proposed Mining Methods (Open Cast and Underground)

Mining will commence using open pits on outcrops and later develop into underground workings. Typically, underground working areas are accessed through a vertical shaft positioned a distance away from the reef horizon to be mined. A mine shaft is vertical excavation sunk and equipped with conveyances to transport men, material, and rock when mining operations are being conducted. A number of horizontal haulages are developed from the shaft at equal vertical intervals of approximately 60m, to access and intersect the reef horizon by developing a tunnel referred to as a crosscut. A raise development is then carried out from the cross-cut intersection on true dip or angle of inclination of the reef plane to make a holing on the cross-cut developed on the haulage above. Instead of using the shaft system, an option exists to utilize a decline system, where inclines are developed from the bottom of surface pit limit to provide underground access to deeper lying orebodies

2.1.2 High level description of the processing plant

Gold ore mined will be transported by Articulated Dump Truck (ADT) from open cast pits and hoist skips or conveyor belts from underground to stockpiles and storage areas, where it will be transported to the central processing plant by side tipper trucks for stockpiling onto a ROM pad in front of a crusher unit. A ramp will be utilized to provide access for the loading and dumping of ore on the tipping station for crusher feed. A conveyor belt will carry the ore from the tipping station and feed the load on top of a grizzly above the feed bin of a crusher.

The key installations and stages of the processing plant for gold recovery are crushing, milling, gravity concentration, flotation, leaching or cyanidation, concentration/elution and smelting. Summarized below is a high-level description of the processing plant:

Crushing - ore extracted from the mine will be trucked and delivered to the ROM pad where it will be stockpiled. It will then be fed through a two-stage crushing process. The Primary Crusher will be a single toggle jaw crusher with the Secondary Crusher being a cone crusher.

Milling – the process is used to further agglomerate the crushed ore being fed into a semi autogenous grinding (SAG) mill with lime, water and steel balls to liberate the gold contained in the rock. The larger particles from this mill are returned to the SAG mill for more grinding. The finer particles receive more grinding in a ball mill and are size classified to give a final product of 80% <70 microns. Crushed ore will be ground using a 4.2m diameter, 5.3m long primary ball mill with 1650kw motor.

Gravity concentration – this stage of the process separates gold from the milling process using the metal's higher specific gravity to settle in a solution and separate from other metals and material. This will be done in two centrifugal concentrators installed as part of the plant.

Flotation – a process for producing a mineral concentrate through the use of chemical conditioning agents followed by intense agitation and air sparging of the agitated ore slurry to produce a mineral rich foam concentrate. The installation comprises a bank of eight forced air, mechanically agitated cells ($8m^3$ each).

Cyanidation/leaching - this process involves the dissolution of gold containing ores in dilute cyanide solution in the presence of lime and oxygen contained in acid resistant leach tank.

Concentration/elution – this process is called Carbon in Pulp (CIP) and is applied to control the gold precipitation from the cyanide solution by use of activated charcoal (carbon). The final loaded carbon then is removed and washed before undergoing "elution" desorption of gold cyanide at high temperature and pH

Smelting - The rich eluate solution that emerges from the elution process is passed through electro-winning cells where gold and other metals are precipitated onto the cathodes. After precipitation, the product is treated with dilute sulfuric acid to dissolve residual zinc and most of the copper. The gold precipitate is then filtered out of the solution, mixed with fluxes and smelted to form crude and impure bars which are sent to a refinery to separate the copper; PGMs; silver and other associated base metal minerals

2.1.3 Basic plant design. (supported by a process flow diagram, of the plant).

The basic plant design and anticipated process flow diagram (see diagram below) is based on the proven metallurgical technology currently being used by mines in South Africa and represents a typical free milling carbon-in-leach (CIL)/carbon-in-pulp (CIP) gold processing circuit comprising:

- Two stage crushing.
- Single stage milling designed for a grind size of 105 micron;
- Knelson Concentrator or Gravity recovery cyclone;
- Thickeners.
- CIL/CIP leaching and adsorption with a retention requirement of only 16 hours.
- Elution, gold smelting and carbon regeneration.
- Tailings disposal.

The modular nature of the proposed process plant layout will allow for modifications, including increasing plant throughput, to be undertaken when required. The process flow diagram of the processing plant showing the key components of the plant is as below:

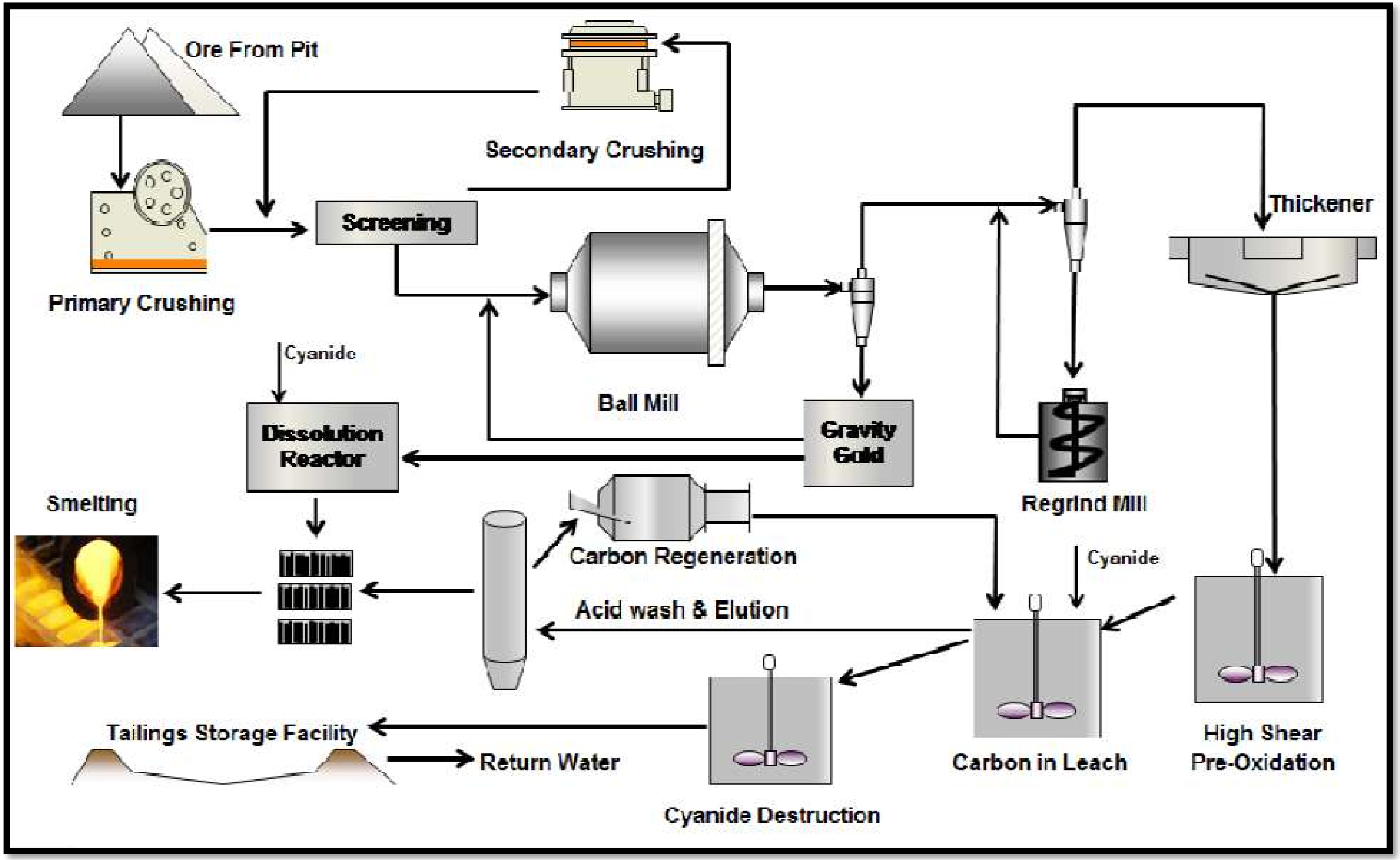


Figure 6: Schematic layout of processing plant

2.1.4 Summary of infrastructure such as roads, rail, electricity and water

2.1.4.1 Access roads

The Giyani gold mine is located within the town of Giyani, approximately 140 km to the north- east of the N1 National Road from Polokwane. A well maintained R81 road, from the N1 will provide as the main access to the mine. The mining area will be accessed through existing tarred roads that will link the mine to the various villages such as Thomo, Mninginisi, Mbatlo, Mavalani and Shikukwani.

The existing town roads will be utilized for trucking of ore to the processing plant which will be located within a 20km radius from various mining pits and shafts. These roads will form part of the road infrastructure to be utilized for the development of the mine. The initial capital costs to be incurred by the company will be limited to re-establishment and maintenance costs for the access roads within the pits and shaft areas and this will be provided for by the mine.

2.1.4.2 Rail Infrastructure

The Giyani mine is located approximately 80km to the east of the Soekmekaar-Polokwane railway line, with the nearest station at Soekmekaar. The mine will not utilise any rail for the transport of ore or delivery of mine material as these will be done by means of trucking to and fro the mine to the central processing plant.

2.1.4.3 Power Supply - Electricity

There is an existing powerline located some 4km from the central processing area. A dedicated power feeder will be obtained by establishing a connection to this existing powerline. A new sub-station connection will installed at the central processing plant as a step-down transformer to reduce the voltage from the high tension overhead power line to 6.6kV, where this will be reduced further to levels suitable for use in the plant and nearby shafts and mine offices. The planned power usage at the mine is as summarized below:

Table 1: Planned mine power usage

Area	Usage
Processing Plant	500kVA
Mine Shafts/Winding Engine Room	500kVA
Surface Compressors	300kVA
Engineering Workshops	200kVA
Mine Offices	100kVA
Total	**1600kVA**

2.1.4.4 Water Supply

Water requirements on the mine will include the supply of water for drilling underground; dust suppression on surface and underground; general office use; cleaning of equipment; workshops and hauling roads. Potable water will also be needed for human consumption and change house facilities. The mine will source its water supply from the Giyani water scheme which is under the management of Greater Giyani Municipality. A pipe connection will be used to direct the water supply to the mine, where it will be stored in a mounted tank, with enough capacity to hold at least 100m3 required for mine services. There is an existing pipeline within a 10km distance, which supply water to Giyani town and surrounding villages.

Other sources of water will include ground water seepage into the pits and underground mine working and storm water in the event of heavy rains. Any excess water will be channeled into settling ponds and used as make-up water in the event of losses associated with mining operations, discard streams and evaporation.

2.1.4.5 Site Offices

To minimize the establishment cost and due to the relatively short life of mine plan for the envisaged mine operation, pre-fabricated buildings will be erected to function as workshops and mine offices, change houses, laboratories, first aid rooms, and warehousing..

2.1.4.6 Underground Infrastructure

- Decline lateral;
- Exhaust raises;
- Footwall drives;
- Ventilation lateral access;
- Cross cuts from decline;
- Sumps;
- Escapeway access;
- Escapeway raise;
- Decline rehandle bays;
- Production rehandle bays;
- Other lateral waste;
- Backfill tipping bay;
- Truck loop/loading access;
- Diamond drill chambers;
- Ore pass;
- Upper ventilation drive connection to surface;
- Intake Raise vertical;
- Main pump station;
- Longitudinal stope access;
- Transverse stope access lateral; and
- Exploration drive.

2.1.4.7 Surface infrastructure

The proposed project would comprise of the design and construction of all building structures, related earthworks and building services, electrical and mechanical installations. This would include *inter alia*:

- Central Plant and Mobile Process plant
- Loading area
- Stockpile areas
- Site clearing and storm water berms and trenches;
- Administration building and first aid;

- Change house and laundry;
- Lamp room, self-rescuer and proto room;
- Access control and security centre;
- TMM Maintenance workshop, services, lubrication, bays;
- Wash bay and oil skimmer;
- Bulk fuel storage area;
- Refueling bay;
- Tyre storage, repair and pump area;
- LVD workshop;
- Fitting, electrical and boiler making workshop;
- Main stores and yard;
- Salvage yard;
- External parking, shade ports and walkways;
- Electrical, water and sewage reticulation;
- Terraces, pavements, access, internal and haul roads;
- Perimeter and internal fencing; and
- Explosives off-loading, storage and distribution.
- One Slimes Dam and PCD"s

2.1.4.8 Minerals applied for:

- Gold Ore/Bearing Minerals: Code: (Au),
- Copper Ore/Bearing minerals: Code: (Cu),
- Silver Ore/Bearing minerals: Code: (Ag),
- Nickel Ore/Bearing minerals: Code: (Ni),
- Platinum Group Minerals: Code: (PGM),
- Zinc Ore/Bearing Minerals: Code: (Zn),
- Lead Ore/Bearing Minerals: Code: (Pb),
- Uranium Ore/Bearing Minerals: Code: (U),
- Chrome Ore/Bearing Minerals: Code (Cr),
- Aggregate Material

2.2 IDENTIFICATION OF RELEVANT LEGAL REQUIREMENTS AND GUIDELINES

A soil classification and agricultural potential study is required with every EIA where agricultural land is concerned. The following section outlines a summary of *South African Environmental Legislation* that needs to be considered for the proposed project with reference to management of soil.

2.2.1 South African Environmental and Soil Legislation

- The law on Conservation of Agricultural Resources (Act 43 of 1983) states that the degradation of the agricultural potential of soil is illegal.
- The Bill of Rights states that environmental rights exist primarily to ensure good health and well-being, and secondarily to protect the environment through reasonable legislation, ensuring the prevention of the degradation of resources.
- The Environmental right is furthered in the National Environmental Management Act (No. 107 of 1998) as amended in April 2017, which prescribes three principles, namely the precautionary principle, the “polluter pays” principle and the preventive principle.
    - It is stated in the above-mentioned Act that the individual/group responsible for the degradation/pollution of natural resources is required to rehabilitate the polluted source.
    - The National Environmental Management Act 107 of 1998 as amended in 2017 requires that pollution and degradation of the environment be avoided, or, where it cannot be avoided be minimized and remedied.
- Soils and land capability are protected under the National Environmental Management Act 107 of 1998 as amended in 2017, the Environmental Conservation Act 73 of1989, the MPRDA of 2002 and the Conservation of Agricultural Resources Act 43 of 1983.
- The Mineral and Petroleum Resources Development Act, 2002 (MPRDA), requires an EMPR, in which the soils and land capability be described.
- The Conservation of Agriculture Resources Act 43 of 1983 requires the protection of land against soil erosion and the prevention of water logging and salinization of soils by means of suitable soil conservation works to be constructed and maintained. The utilisation of marshes, water sponges and water courses are also addressed.
- The land capability of project footprints are usually assessed in accordance with the definitions and system outlined by Scotney et al. (1987) and updated for South African soils by the Agricultural Research Council (Schoeman, 2000), and compared to the National Land Capability values (DAFF, 2017).

3 BASELINE INFORMATION

3.1 BIODIVERSITY

3.1.1 Veld Description

Lowveld Rugged Mopaneveld

Distribution ranges over Limpopo and Mpumalanga Provinces with broken veld from the area southeast of Giyani in the west to Shimuwini and Boulders Camps in the east as well as the rugged area of the Olifants River Valley south of Phalaborwa, from Grietjieberg in the west to the Maveni River tributary in the east (**Figure 3**). Altitude ranges between 250 m to 550 m. Climate has some summer rainfall with very dry winters. Mean Annual Precipitation ranges from about 400 mm to 600 mm. Generally, a frost-free area, but frost sometimes occurs in the low-lying areas (Mucina and Rutherford, 2006).

Vegetation & Landscape Features are slightly too extremely irregular plains with sometimes steep slopes and a number of prominent hills. The area around the Olifants River has more dissected and steeper slopes than the northern part of this unit. Usually dense shrubs with occasional trees and a sparse ground layer. Woody plants can become particularly dense where fire is excluded by very rocky terrain, such as in the vicinity of the Olifants River. Vegetation is more open in the northeastern parts of this unit outside the Kruger National Park (Mucina and Rutherford, 2006).

Geology & Soils from the Goudplaats Gneiss and Makhutswi Gneiss underlie most of this area, with a smaller contribution from the ultramafic metavolcanics (rocks rich in chlorite, amphibole, talc and serpentine) and metasediments of the Giyani Greenstone Belt (all Swazian Erathem). Soils are red-yellow apedal, freely drained, but also shallow and stony, especially in the east. Soil forms are mainly Hutton, Mispah and Glenrosa. Land types Ae, Fb and Fa (Mucina and Rutherford, 2006).

Plant species as describer by Mucina and Rutherford (2006) occurring within the Lowveld Rugged Mopaneveld includes:

Tall Trees include: *Senegalia nigrescens, Sclerocarya birrea subsp. caffra*.

Small Trees: *Colophospermum mopane, Combretum apiculatum, Terminalia prunioides, Vachellia exuvialis, Vachellia nilotica,*

Boscia albitrunca, Commiphora mollis and *Dalbergia melanoxylon.*

Tall Shrubs: *Combretum hereroense, Dichrostachys cinerea, Grewia bicolor, G. villosa, Rhigozum zambesiacum.*

Low Shrubs: *Commiphora africana, Melhania forbesii, M. rehmannii, Solanum panduriforme. Graminoids: Aristida congesta,*

Enneapogon cenchroides, Melinis repens, Sporobolus panicoides, Bothriochloa radicans, Digitaria eriantha subsp. pentzii,
Fingerhuthia africana and *Panicum maximum.*
Herbs: *Crabbea velutina, Heliotropium steudneri, Hemizygia elliottii, Hibiscus sidiformis, Phyllanthus asperulatus* and
Xerophyta retinervis.

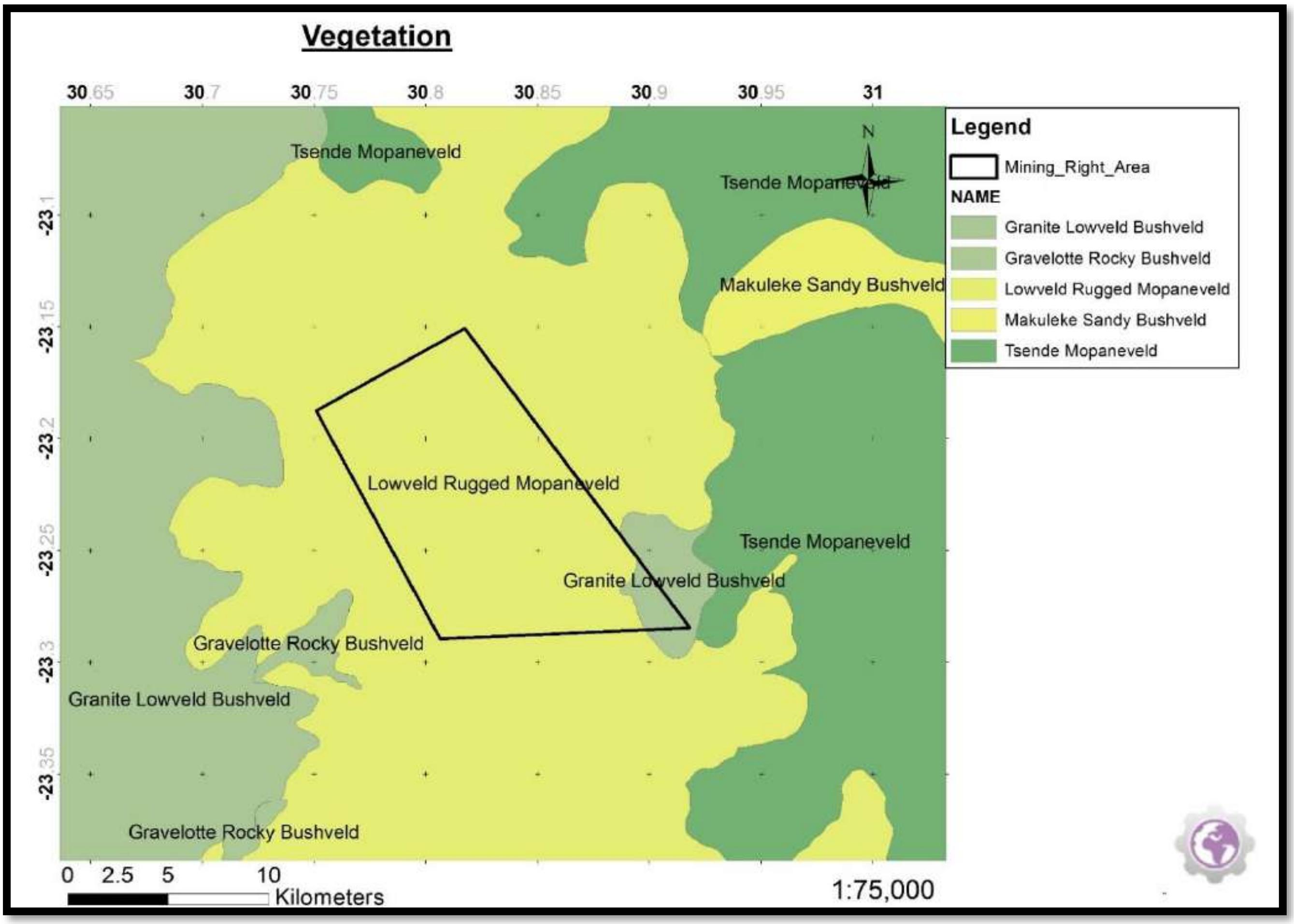


Figure 7: Vegetation

The majority of the application area is Mopaneveld characterised by medium to high shrub dominated savannah, with scattered trees and a dense field layer. Tree and shrub species include A.nigrescens and Sclerocarya birrea subsp. caffra (tall trees); C. mopane and C. apiculatum (small trees); and C. hereroense, D. cinerea, Euclea divinorum and Grewia bicolor (tall shrubs), amongst others. The field layer comprises of Clerodendrum ternatum and Indigofera schimperi (low shrubs); Bothriochloa radicans, Digitaria eriantha subsp. pentzii, Heteropogon contortus and Panicum maximum (grasses); and Blepharis integrifolia, Ceratotheca triloba and Chamaecrista absus (herbs), amongst others.

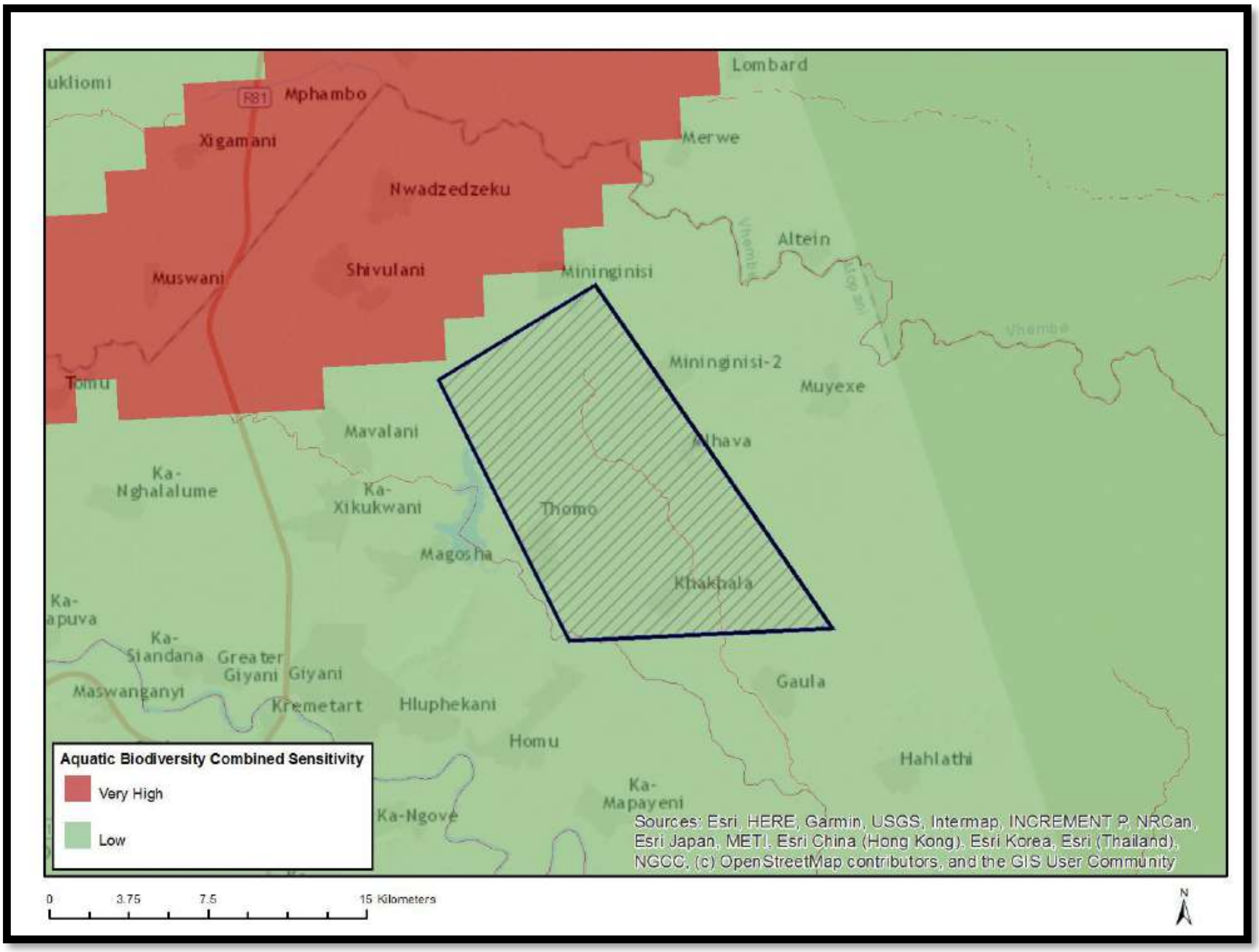


Figure 8: Combined Vegetation Sensitivity

Conservation is least threatened with majoprity being in the Kruger National Park. At least an additional 5% conserved in private reserves, such as Klaserie, Letaba Ranch and Selati Game Reserve. Some transformed landscapes occur mainly by cultivation and some urban and built-up areas. This vegetation occurring outside the conserved areas is under pressure from high-density rural human population and associated urban sprawl and agricultural activities. Some areas experience moderate erosion.The southern part of this unit in the Kruger National Park contains a number of tree species that are relatively scarce elsewhere in the park, e.g. *Kirkia wilmsii* and *Hexalobus monopetalus* (Mucina and Rutherford, 2006).

3.2 TOPOGRAPHY

The topography across the site is variable with a 0-0,5% gradient which trends in the North-East directions. The landscaping consist of moderately undulating plains and low hills dominated by tall, usually Hyperrhenia hirta dominated, grassland. The regional elevation ranges between 420 - 760 meters above mean sea level (mamsl), whereas for the Kusile Invest 133 (Pty) Ltd local site the elevation ranges 420-460 meters above mean sea level (mamsl).The topography of the investigation area ranges from flat to undulating surfaces in the headwaters of the B82H catchments where Nsami River is perennial and feeds into the Letaba River in the south. Several drainage depression areas are evident around the site but outside the proposed open mine.

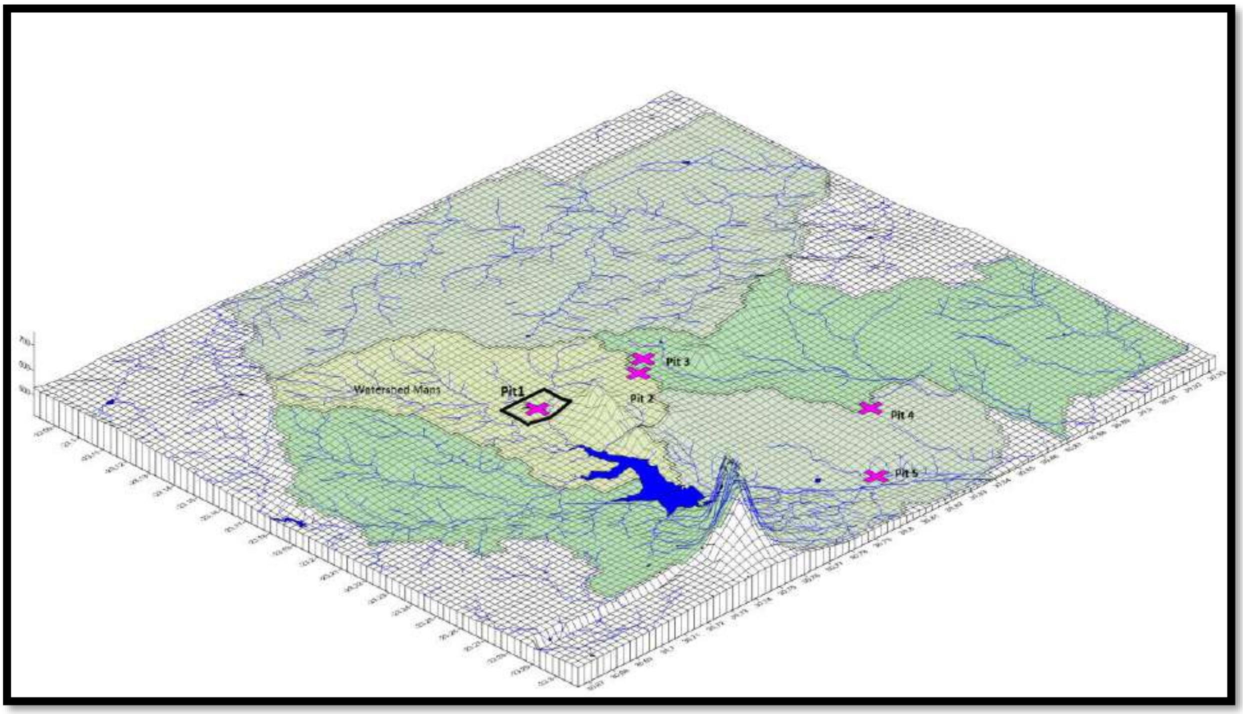


Figure 9: Watershed and landforms

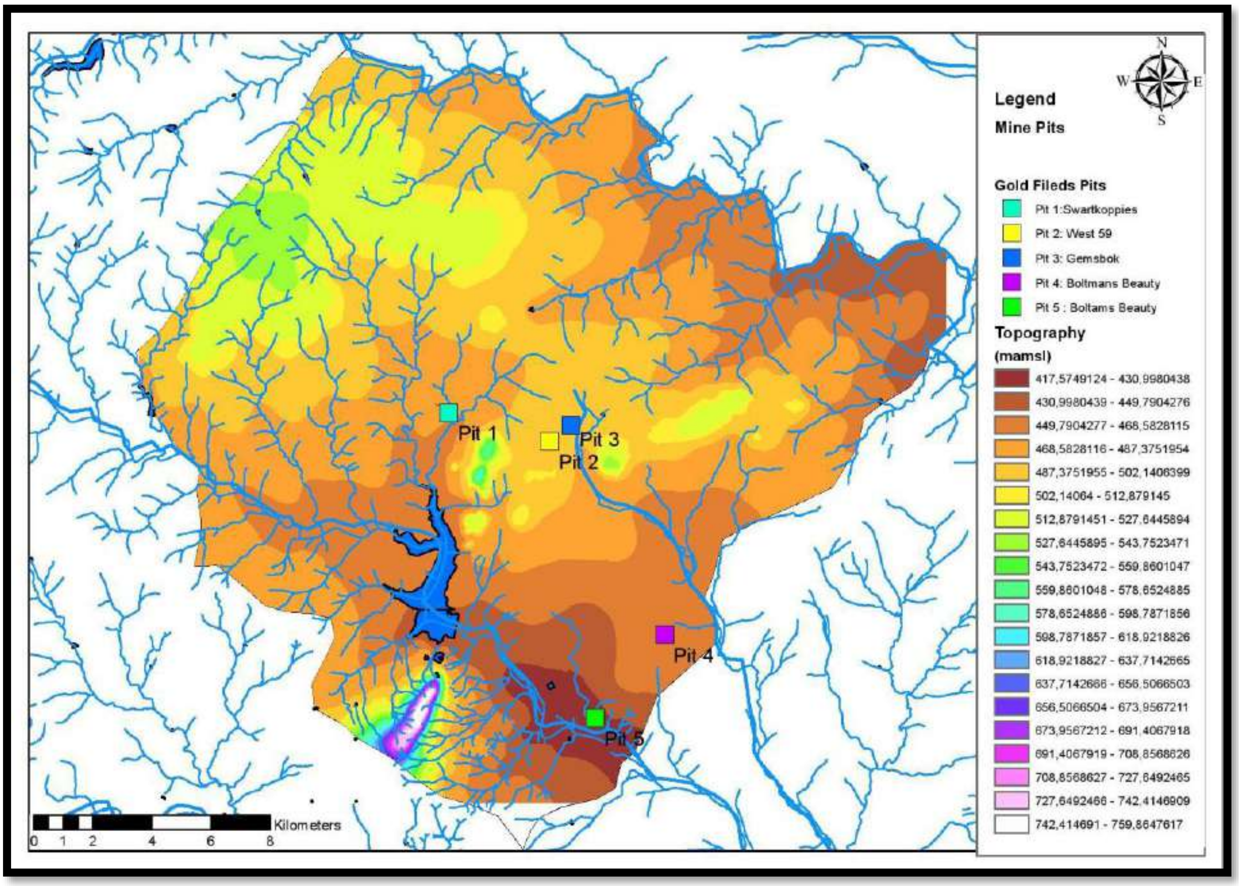


Figure 10: Digital Elevation Model map.

3.3 SURFACE HYDROLOGY

3.3.1 Quaternary catchment and Land Use

Kusile Invest 133 (Pty) Ltd Gold falls within B82H quaternary catchment. The catchment is located in the Luvuvhu and Letaba Water Management area. The site can be sub-divided into secondary drainage regions comprised of smaller catchment areas and streams. The surface topography is mainly consisting of a gently undulating plateau. Tributaries and streams have their origin in this area e.g. Nsami River, sourced from springs occurring on the North East (NE). The drainage forms a dendritic pattern flowing north-east along the stream channels. This B82H quaternary catchment is mostly impacted by unregulated grazing and development in the form of village holdings, farm dams, road networks, and previous mining.

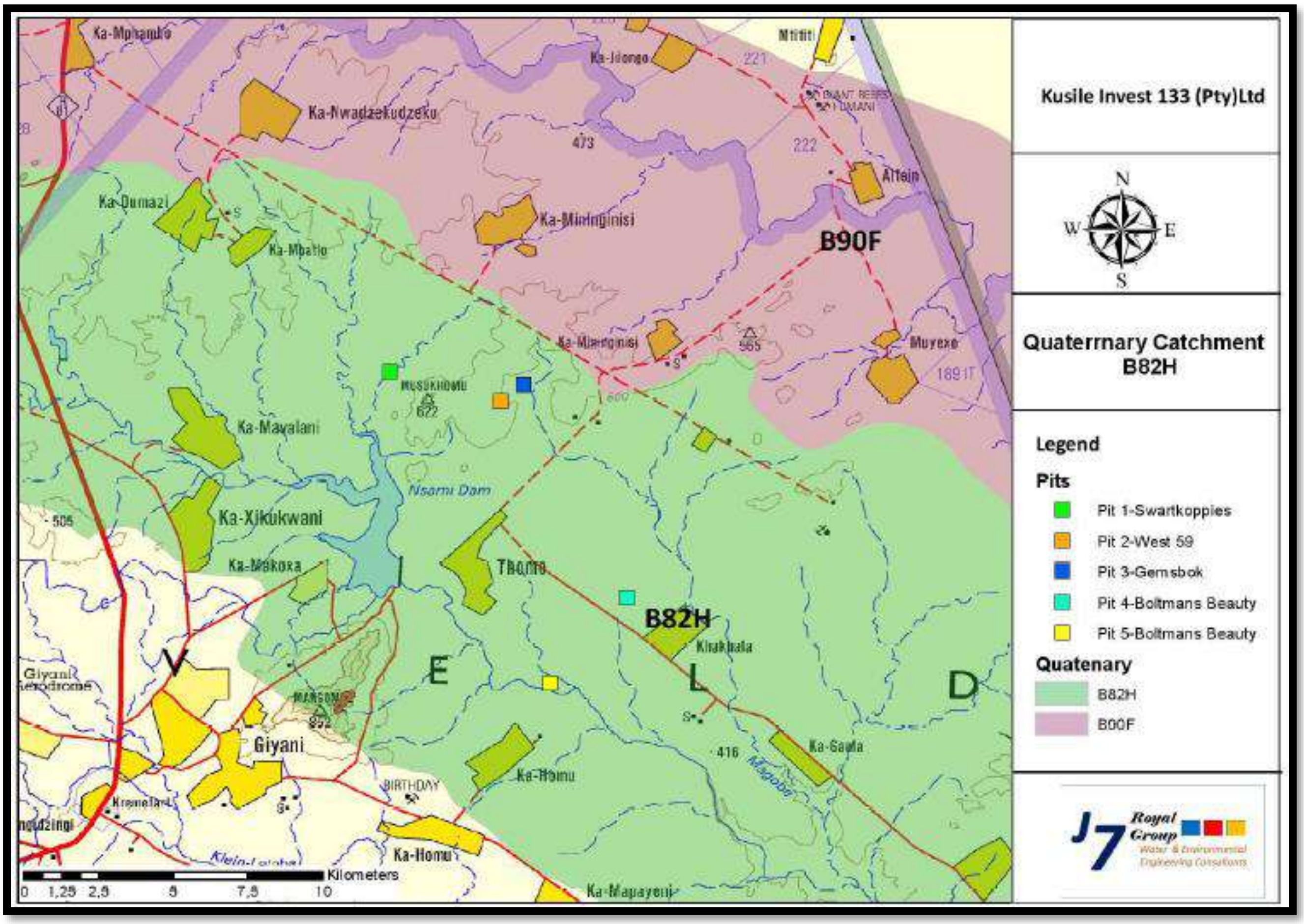


Figure 11: Topography quaternary catchment map.

3.4 REGIONAL GEOLOGY

The regional geological setting relating to the area of the mining right application is depicted by the characteristics of the Archaean crust of southern Africa, comprising the Kaapvaal Craton, the

Zimbabwe Craton and the Limpopo Metamorphic Complex. The Kaapvaal Craton has three major crustal elements, namely a core of Palaeo- to Meso-Archaean metamorphic rocks termed the Kaapvaal Shield and exemplified by the Barberton granitoid-greenstone terrane; the northern and western "rims" to this shield formed by granitoid-greenstone terranes accreted to the Kaapvaal Shield in the Neoarchaean and the Cratonic Basin successions.

The northern rim to the Kaapvaal Shield comprises the Murchison, Pietersburg and Giyani greenstone belts. The Giyani Greenstone Belt (GGB) is the main focus in relation to the area of application. The rock stratigraphy within the Giyani Greenstone Belt forms part of the Kaapvaal Craton sequence. The below shows the geological setting and extent of the Kaapvaal Craton, and the northern rim in which the application area is located.

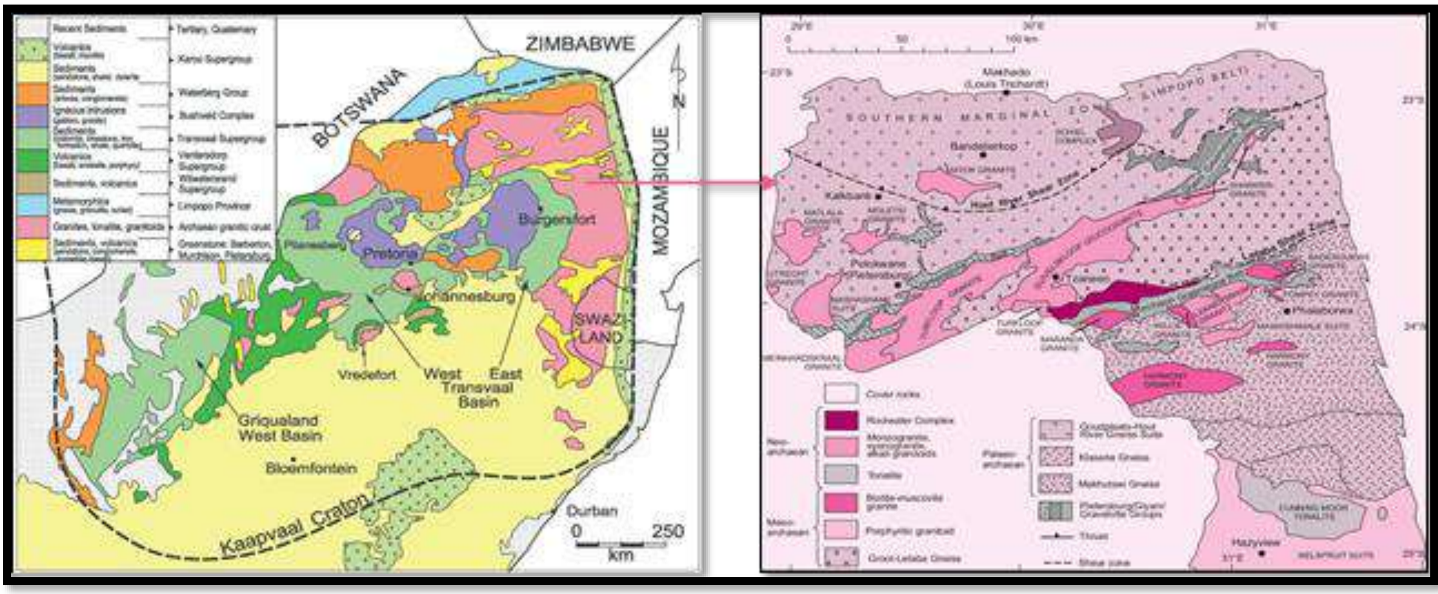


Figure 12: The Regional Geological Setting and Depositional Environment

The Cratonic Basin successions were deposited on the Kaapvaal Shield during the Mesoarchaean and are preserved as the Dominion Group and Witwatersrand Supergroup in the central part of the craton and the Pongola Supergroup in the southeast.

3.4.1 Regional Geological Structure and Stratigraphy

The regional geology depicting the area of interest comprise the Murchison, Pietersburg, Giyani, and Barberton greenstone belts. These belts are situated in the granite-gneiss terrain of the Kaapvaal Craton which is located south of the Southern Marginal Zone (SMZ). The supracrustal rocks of the GGB are classified as the Giyani Group and are dominated by mafic and ultramafic rocks with subordinate metasedimentary units but due to structural complexity, with no reliable stratigraphy being recognized within the sequence. Pillow-like structures in the tremolite schists near Klein Letaba Mine, and in amphibolite schists east of Giyani town, is evidence that the greenstone were originally volcanic rocks.

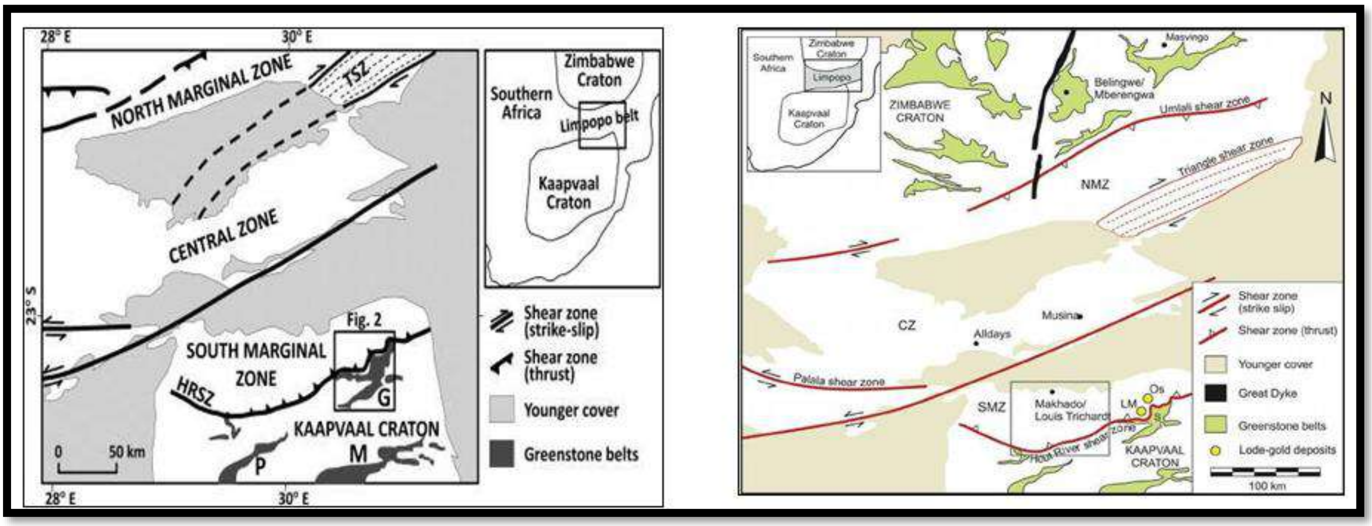


Figure 13: Regional Structure along the Giyani Greenstone Belt

3.4.2 Project Geological Setting

The GGB is approximately 17km wide and has a strike length of 70km. The belt has an overall NE-trend, but to the west, the GGB splits into a northern Khavagari arm and a southern Lwaji arm separated by granitoid gneiss (the Klein Letaba Gneiss) and younger granite. The Lwaji arm has more or less the same trend as the main part of the belt but the Khavagari arm has been rotated into an E-W orientation. The GGB is a shallow structure with a down dip extension of around 1.5km in the NW and 4km in the SE.

The predominant rocks in the project area include the ultramafic (tremolite) schists; mafic (chlorite) schists which are common throughout the belt. Also present in the area are the metasedimentary rocks which comprise Banded-Iron-Formation (BIF), quartzite, metapelite and rare dolomite. Although these formations are discontinuous, they form important structural markers throughout the belt. They are best developed in the northern sections including the Khavagari arm and the clastic metasedimentary rocks with obvious primary structures are abundant along the Nsama River in the central part of the belt.

The supracrustal rocks of the GGB have been subjected to amphibolite facies metamorphism. Peak metamorphism was followed by uplift and the influx of CO2 rich aqueous fluids. This rehydration event occurred during the exhumation of the Limpopo Complex along the Hout River Shear Zone and was responsible for shear-zone hosted alteration of the rocks in the GGB and the formation of the orogenic gold deposits.

The local geological setting and depositional environment described above is as shown in the diagram below.

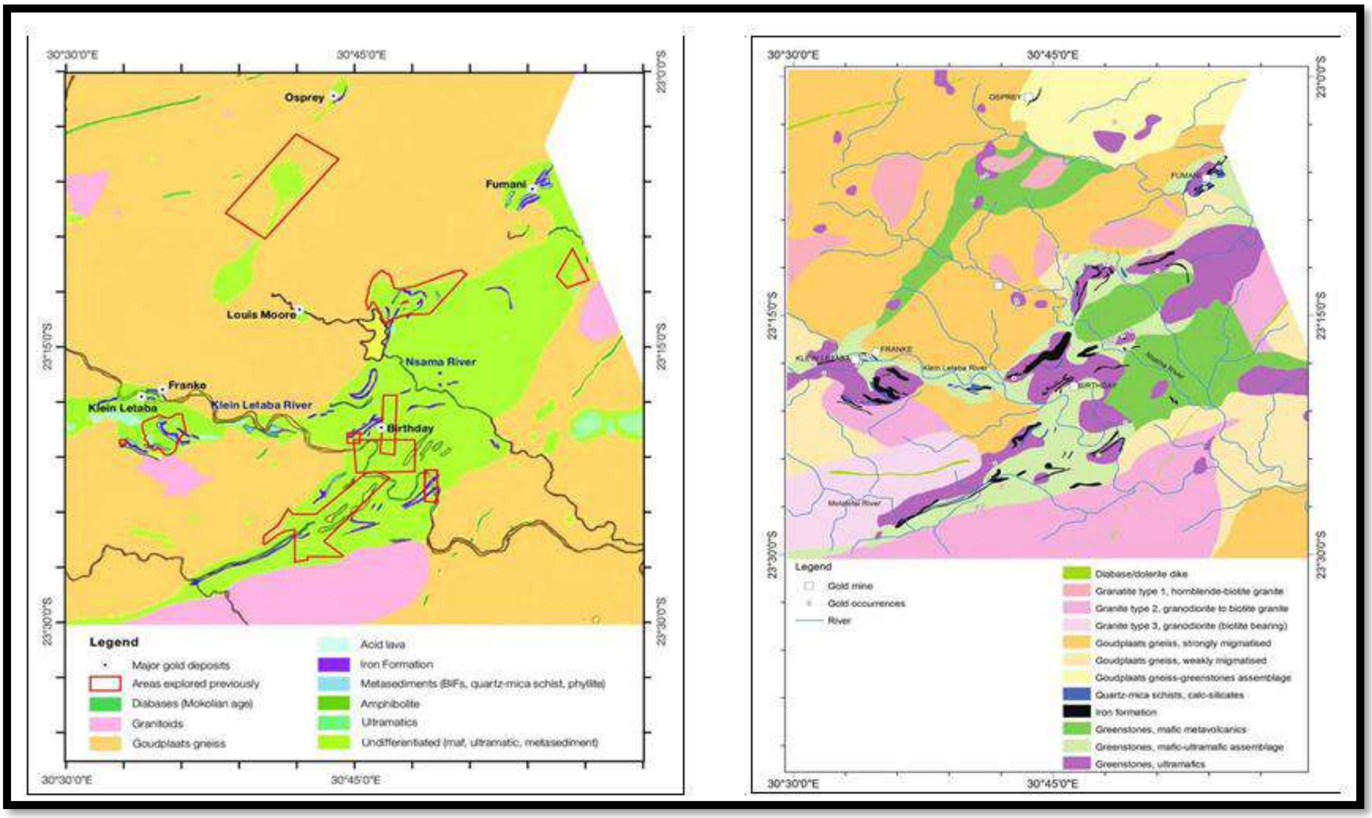


Figure 14: Local Geological Setting and Depositional Environment

The application area is located in the Greater Giyani magisterial district, Limpopo Province and covers an area known to have historical mining activities, with a number of disused mining areas found within the application area as shown in below.

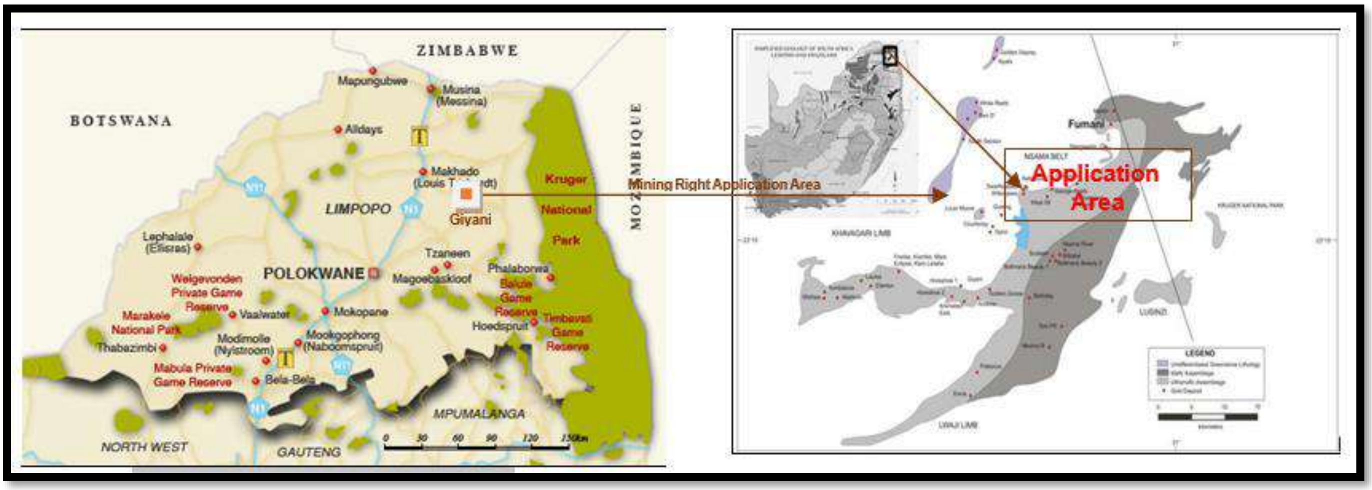


Figure 15: Giyani Gold Project Locality Plan

3.4.3 Structural Geology in Project Area

The structural configuration of the GGB is one of a north-east trending syncline forming an apex in the south-western corner of the Giyani Greenstone Belt. The established profile across the belt shows a 4km down dip extension into the crust for Lwaji and 1km depth for Khavagari arms respectively. The central portion of the belt is known to be shallow. The GGB is mainly made up of supra-crustal rocks of the Giyani Group which consists mainly of mafic-ultramafic rocks as detailed in the diagram below.

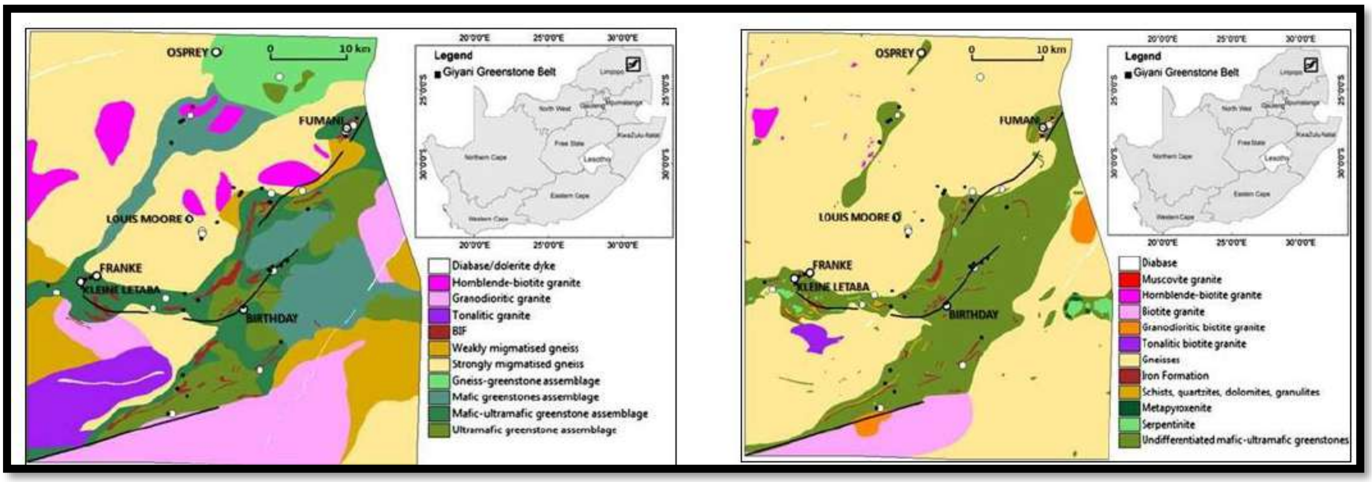


Figure 16: Geological Structure of the Giyani Greenstone Belt.

3.4.4 Mineralisation in the area

The origin of gold in the Giyani Greenstone Belt (GGB) can be classified into the modified placer theory, the syn-genetic theory, and the epigenetic theory. Gold mineralization in the GGB is orogenic in character and origin and can be directly linked to the exhumation phase of the Neoarchaean Limpopo Orogeny. Gold mineralization was late in the tectonic evolution of the GGB and related to the regional flow of CO2-rich aqueous fluids along foliation parallel ductile shear zones in the schists of the GGB. These fluids caused rehydration and hydrothermal alteration of suitable Fe-rich rocks in the GGB and the resultant deposition of gold. The gold occurrence is associated with hydrothermally altered mafic and ultramafic meta-volcanic schists and BIF, but is structurally controlled, due to being hosted in north-dipping anastomosing shear zones in the immediate footwall of the Hout River Shear Zone (HRSZ).

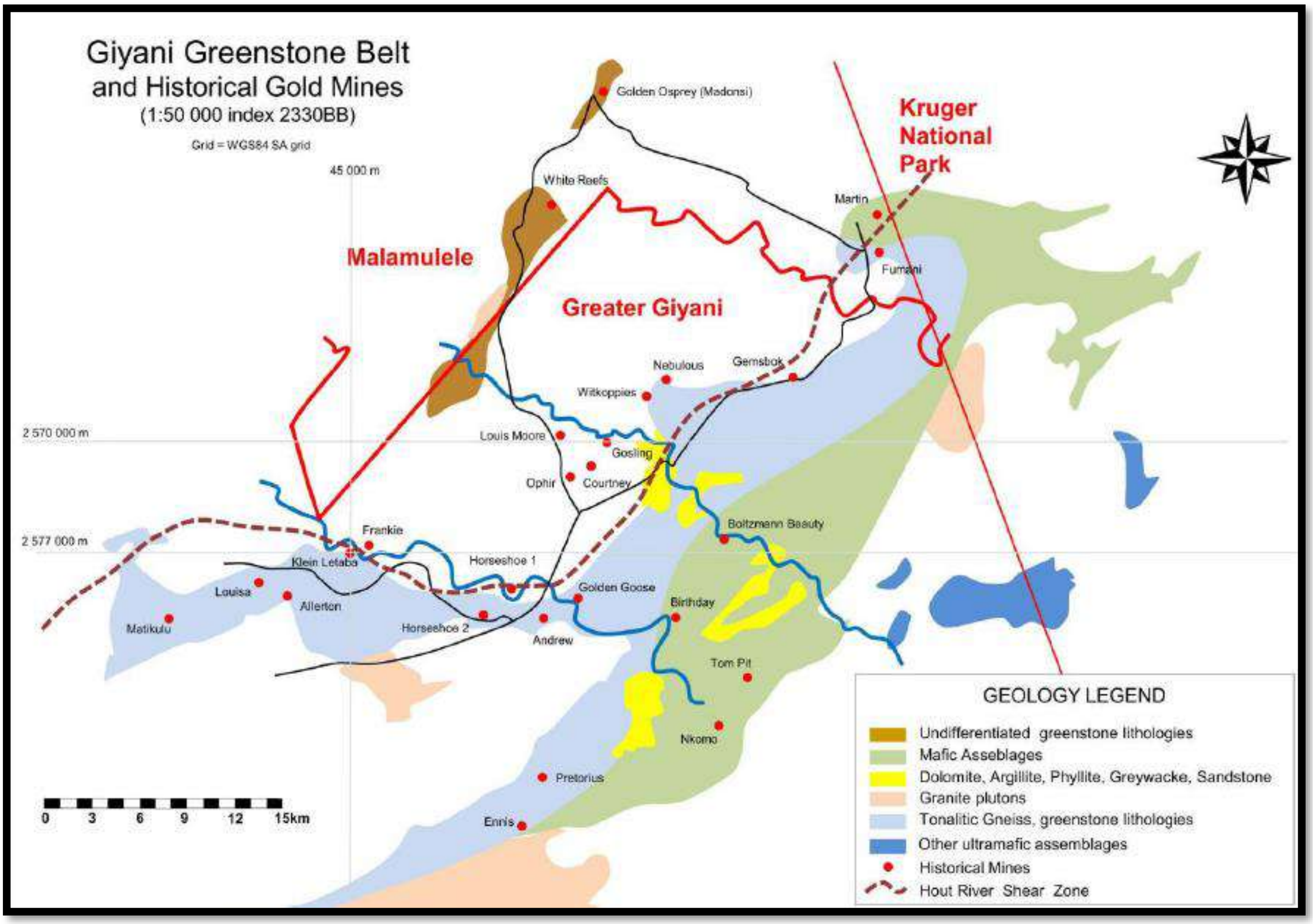


Figure 17: Depositional Environments within the Giyani Greenstone Belt

There are several known gold occurrences in the GGB and related satellite bodies to the north of the belt. A number of the occurrences were prospected and exploited in the past, evident in inactive mines which are found in the area. Six of the inactive mines (Klein Letaba, Louis Moore, Osprey, Fumani, Franke and Birthday) are known to have produced and recovered gold from the GGB. The distribution of the mineralization is strongly asymmetric with most deposits, including the main ones, located along the northern margin of the belt. Gold mineralization in the area is associated with mafic and ultramafic metavolcanic schists and BIF but is hosted in north-dipping anastomosing shear zones in the immediate footwall of the HRSZ. Gold is concentrated along the foliation in these shear zones and ore shoots plunge with the elongation lineation implying a direct relationship between mineralization and deformation along the shear zones.

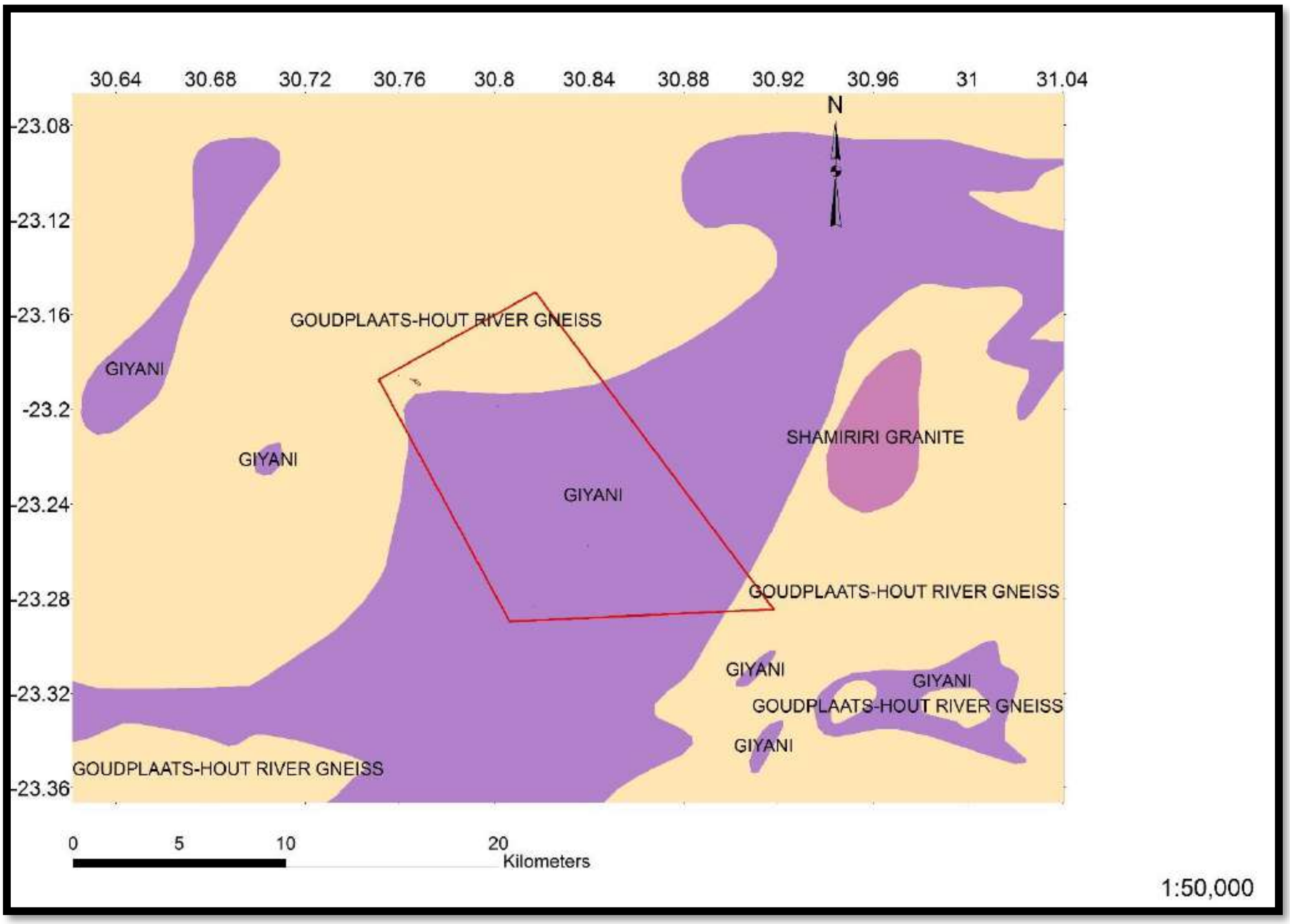


FIGURE 18: Geological Map of the Study Area

3.5 SOILS AND PARENT MATERIAL

3.5.1 Soils

The application area has Red, massive or weakly structured soils with high base status (association of well drained Lixisols, Cambisols, Luvisols) and Soils with minimal development, usually shallow on hard or weathering rock, with or without intermittent diverse soils with (association of Leptosols, Regosols, Calcisols and Durisols. In addition one or more of Cambisols, Luvisols.

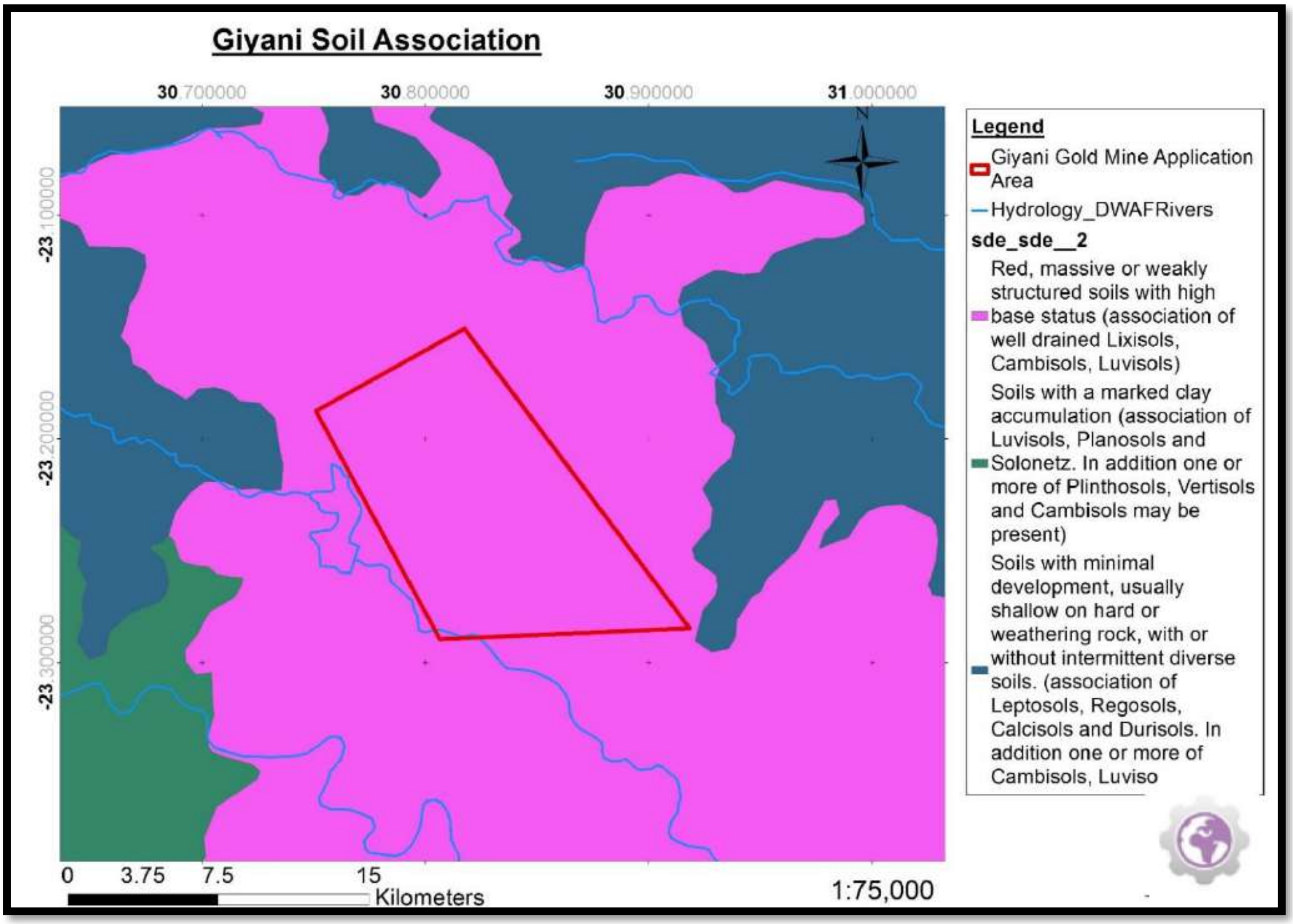


Figure 19: Soils

Soil is an open living ecosystem and can therefore be defined as a function of physical, chemical and biological processes. The following factors are involved in soil formation:

- Parent Material (geology, e.g. sedimentary rock (sandstone), acid igneous (granite) or basic rock dolerite) etc.;
- Topography (slope of landscape); Climate (wind, water, temperature etc.);
- Microbial Activity and microbial diversity ; and
- Time (soil formation occurs over a long time period, e.g. 1cm of topsoil is formed over 100yrs).

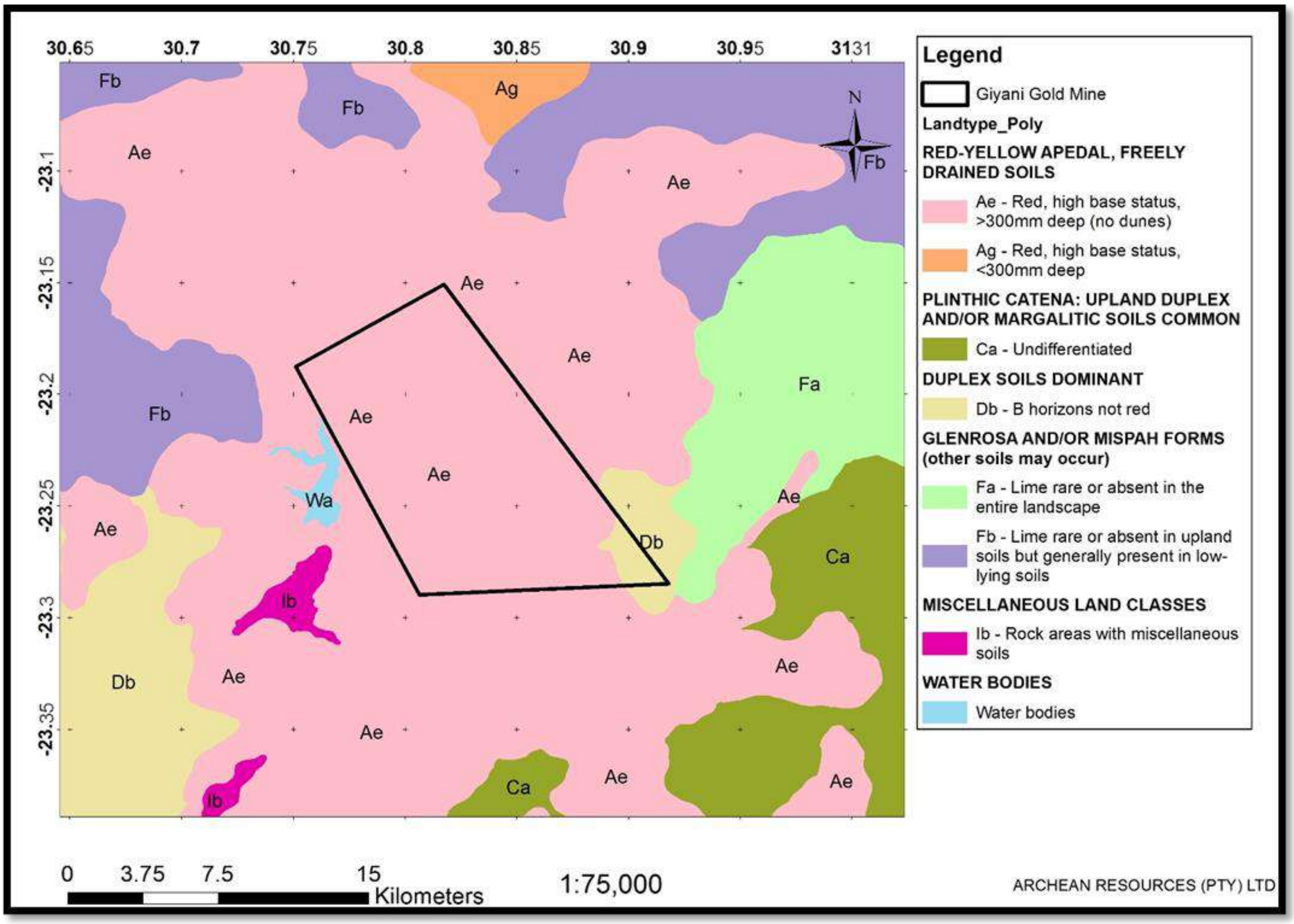


Figure 20: Landtype

From the investigation it is conclusive the dominant soils according to the Taxonomical Soil Classification System of South Africa include;

- **Glenrosa and/or Mispah forms** (other soils may occur).

- Red-yellow apedal, freely drained soils
  - Ae - Red, high base status, >300mm deep (no dunes)

3.5.2 GENERAL INVESTIGATION OF PRESENT LAND USE

The area has soil which is suited for arable land and for agricultural purposes. The majority of the land around the municipal land falls under the local traditional authorities. Commercial farming occurs at a lesser scale only to be superseded by subsistence farming. The rest of the land is used from communal grazing.

The present land use is the following:

- The majority of land is shallow soil under thorny bush encroachment.
- There are parts of the area disturbed with roads from the existing activities emanating from rural activities and subsistence farming.

4 SCOPING METHODOLOGY

A broad soil classification and soil sampling for chemical analysis was done to get a baseline of the soil types, agricultural potential and land capability for the proposed mine. Using a soil auger a free random survey was conducted. Any differences in soil types or depth, or any other soil physical properties that can have an influence on the soil forms and agricultural potential of this land of the proposed opencast mine was identified.

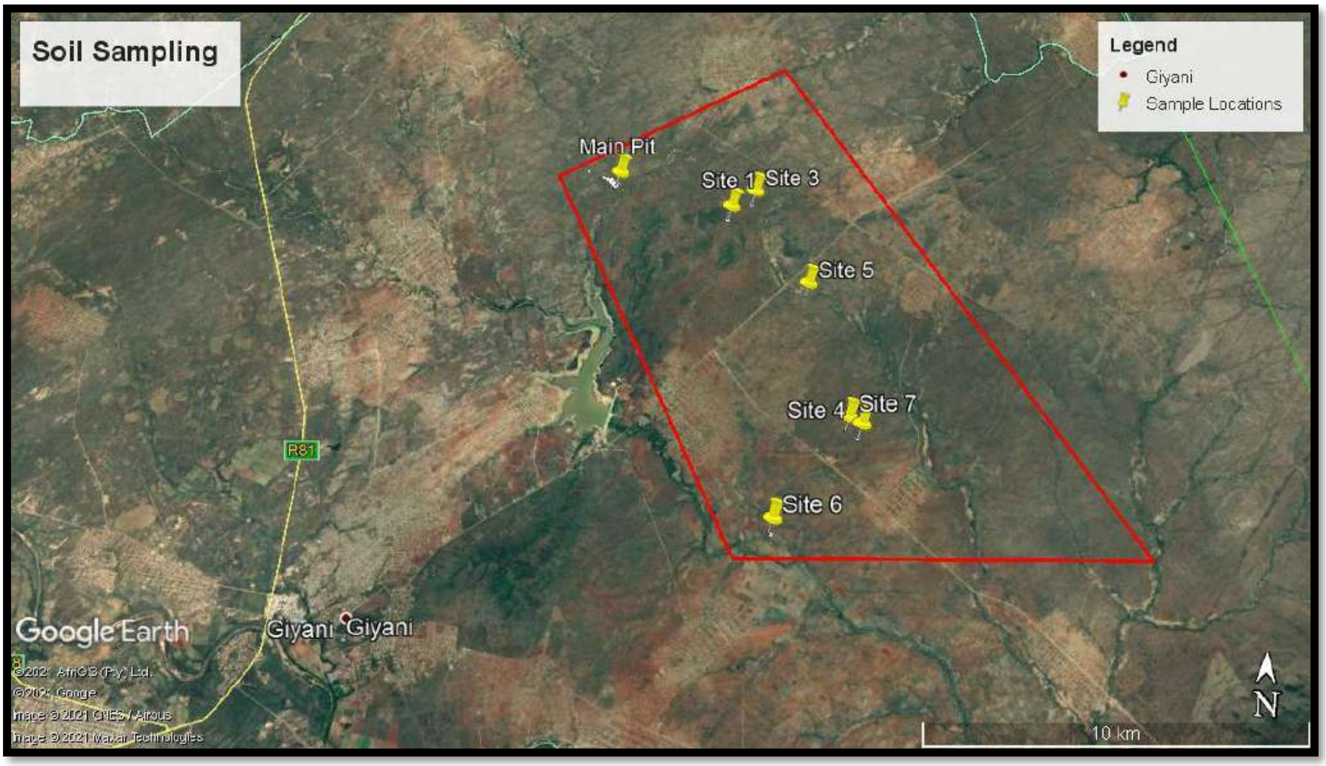


Figure 21: Sample Locations

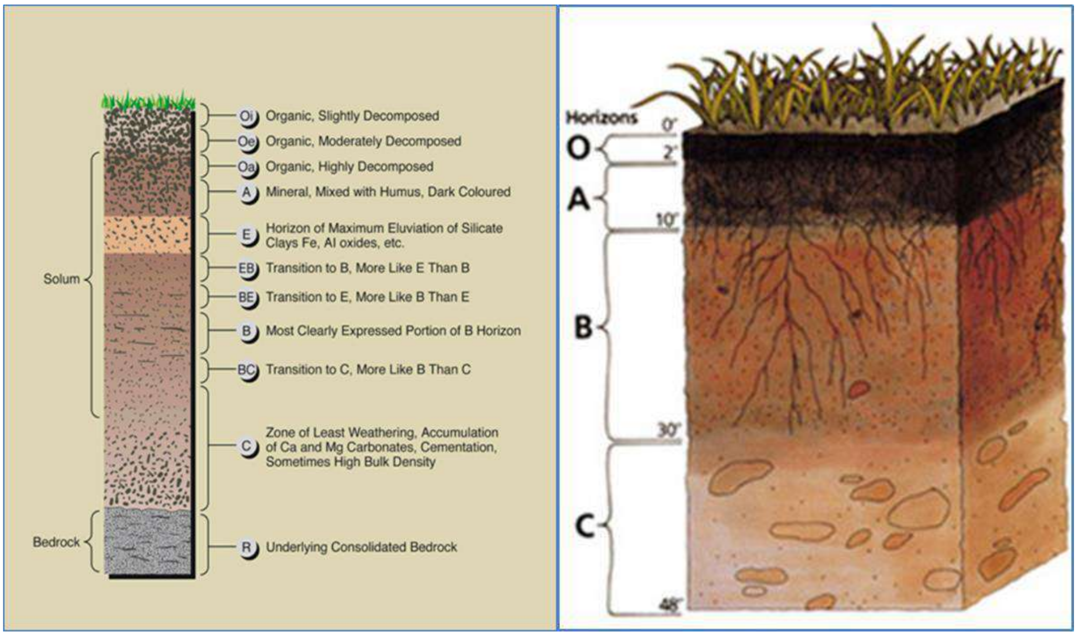
4.1 OBSERVATIONS

4.1.1 SOIL PHYSICAL PROPERTIES

According to A Glossary of Soil Science (1995), soil (**Insertion 1**) can be defined as:

"the unconsolidated mineral and organic material on the immediate surface of the earth that serves as a natural medium for growth of plants, or, the unconsolidated mineral matter on the surface of the earth that has been subjected to and influenced by genetic and environmental factors of parent material, climate (including precipitation and temperature effects), macro- and micro-organisms and topography all acting over the period of time and producing a product – soil – that differs from the material, which is derived in many physical, chemical, biological and morphological properties and characteristics".

Soil is a thin surface covering the bedrock of most of the land area of the Earth. It is a resource that, along with water and air, provides the basis of human existence. Soil develops when rock is broken down by weathering and material is exchanged through interaction with the environment. Organic matter becomes incorporated into the soil as the result of the activity of living organisms. Soil also contains water, minerals, and gases. The soil system (**insertion 1**) is dynamic and it develops a distinct structure, often with recognizable layers or soil horizons arranged vertically through the soil profile.

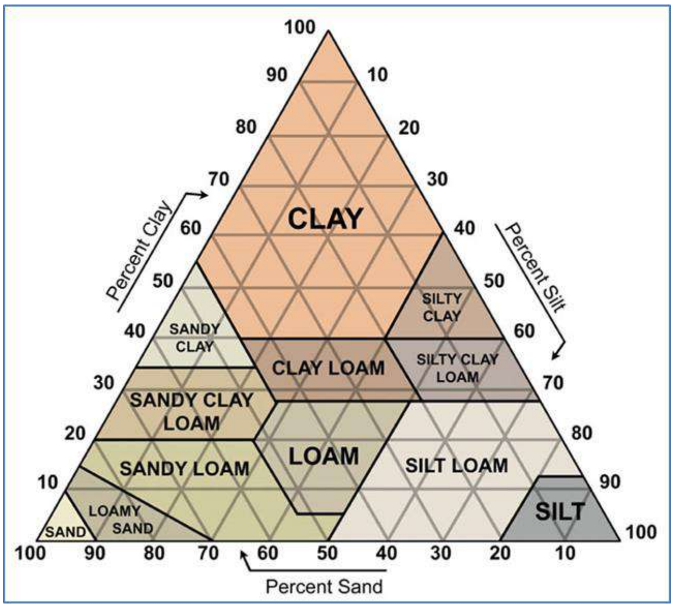


Insertion 1: Diagram of soil horizon types

In terms of soil texture, soil type usually refers to the different sizes of mineral particles in a particular sample. Soil is made up in part of finely ground rock particles, grouped according to size as sand and silt in addition to clay, organic material such as decomposed plant matter.

Each component, and their size, plays an important role. For example, the largest particles, sand, determine aeration and drainage characteristics, while the tiniest, sub-microscopic clay particles, and are chemically active, binding with water and plant nutrients. The ratio of these sizes determines soil type: clay, loam, clay-loam, silt-loam, and so on.

In addition to the mineral composition of soil, humus (organic material) also plays an important role in soil characteristics and fertility for plant life. Soil may be mixed with larger aggregate, such as pebbles or gravel. Not all types of soil are permeable, such as pure clay.



Insertion 2: Diagram of soil type classification

The soils in the project area was classified as sandy clay loamy sands based on the Sand, Silt and Clay compositions.

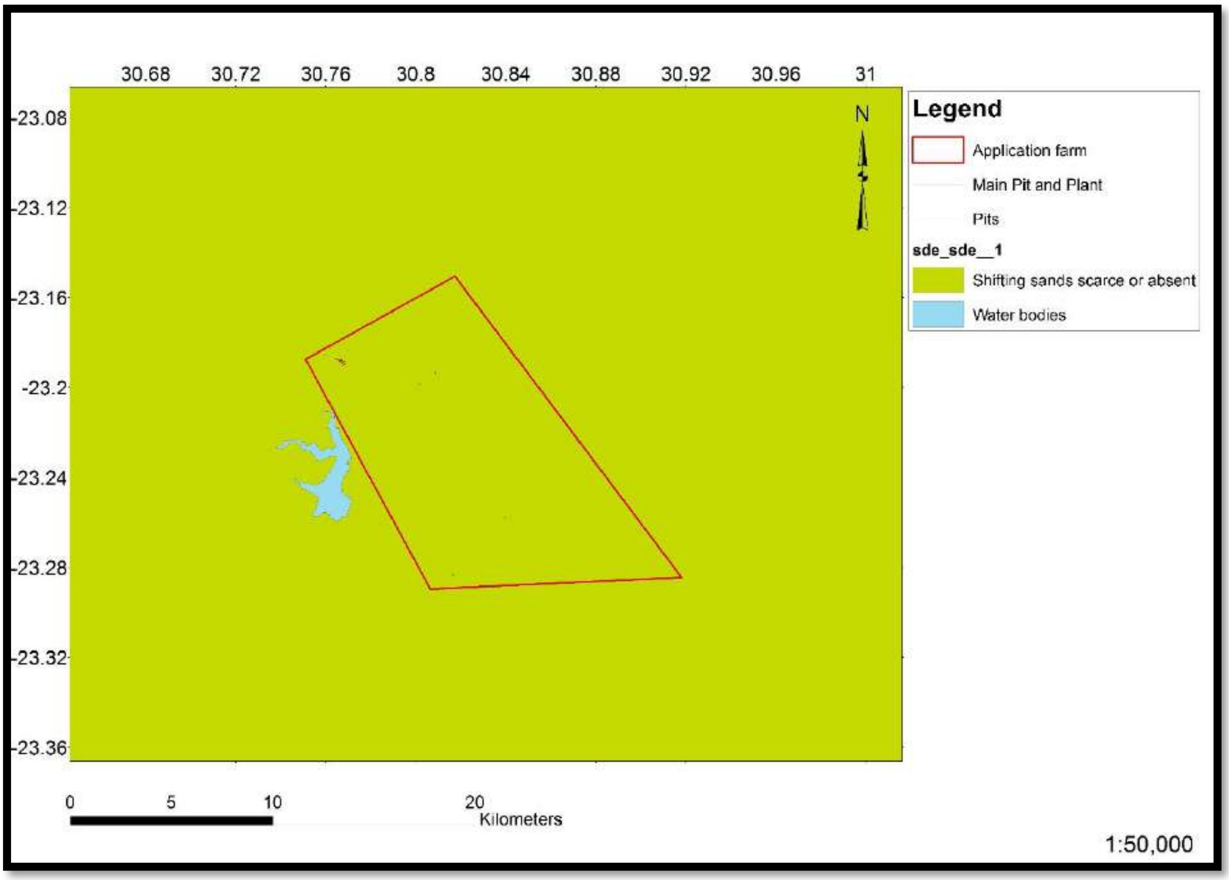


Figure 22: Landtype

TABLE 2: CLAY, SILT AND SAND COMPOSITIONS

#	LAB No	Reference	CLAY	SILT	SAND
			%	%	%
1	G25-54361	Plant	16	17	67
2	G25-54362	Pit	10	17	73
3	G25-54363	Site 1	20	19	61
4	G25-54364	Site 2	6	8	86
5	G25-54365	Site 3	10	2	88
6	G25-54366	Site 4	10	18	72
7	G25-54367	Site 5	14	21	65
8	G25-54368	Site 6	12	2	86
9	G25-54369	Site 7	8	3	89

4.1.2 TEXTURAL CONTRAST

Soils with minimal development, usually shallow on hard or weathering rock, with or without intermittent diverse soils. (Association of Leptosols, Regosols, Calcisols and Durisols. In addition one or more of Cambisols, Luvisols. The strong textural contrast displayed by Solonetz, Planosols and some Luvisols renders them problematic from a plant-extractable water viewpoint. Some members (mostly Solonetz or Planosols) display an abrupt transition between the topsoil (and sandy layer beneath the topsoil) and the subsoil with respect to texture, structure and consistence.

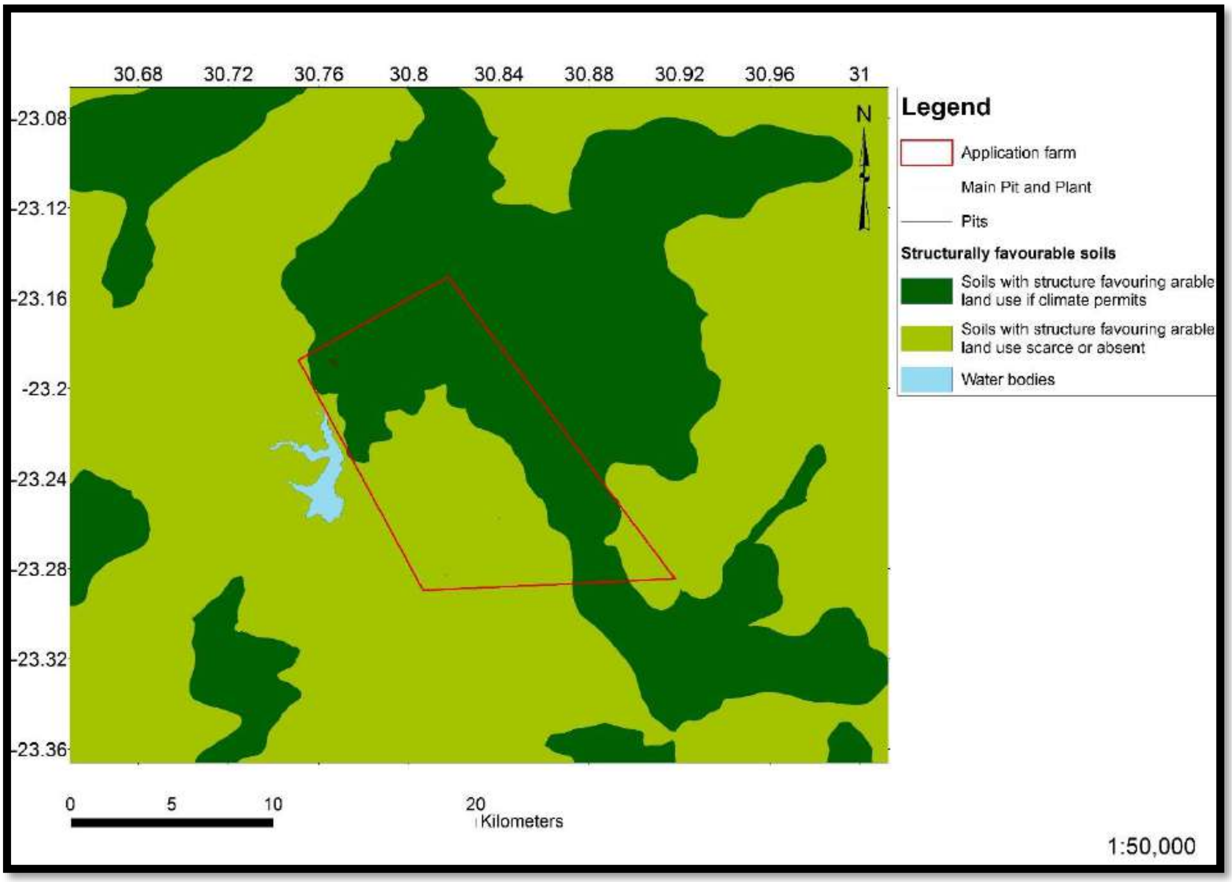


Figure 23:Soil Structure

The material above the transition is usually of light texture, permeable and can be penetrated readily by water and roots. The material below the transition is usually clayey, dense, and very slowly permeable and can be exploited by roots to a very limited extent Soils with structure favouring arable land use scarce or absent and Soils with structure favouring arable land use if climate permits A clear transition is found between the topsoil and the subsoil in respect of texture, structure and consistence. The topsoil is relatively sandy in relation to the subsoil, and the subsoil is clayey and dense, but commonly not to the extreme.

4.1.3 CHEMICAL SOIL PROPERTIES

The pH of the soil collected from sample points ranged from 5 -7.2 indicating that the soil ranges from acidic to neutral.

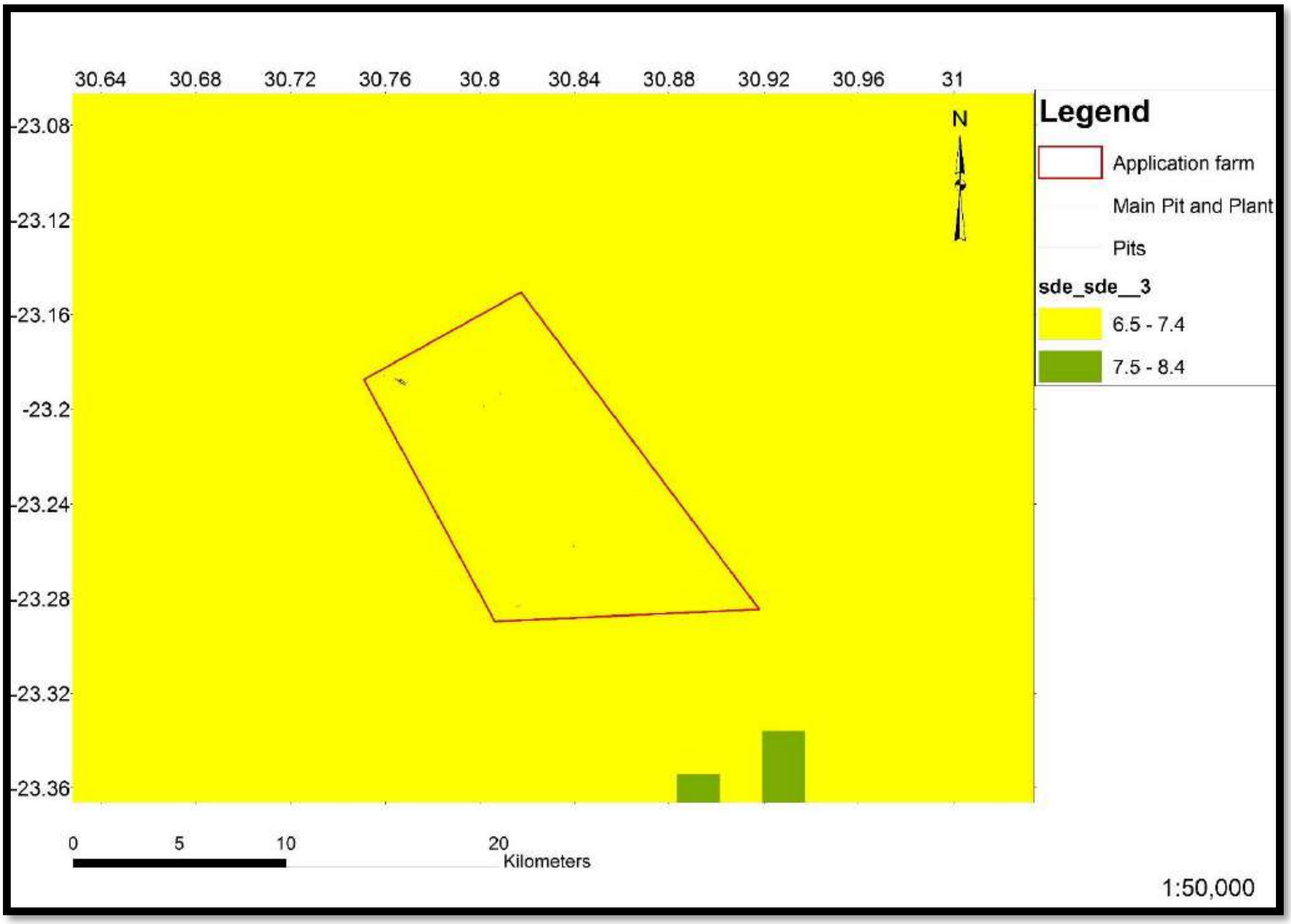


Figure 24: SOIL P.H

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NviroTek Labs

Verslag / Report

Grond / Soil

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To/Aan:	ARCHEM RESOURSES	**Representative/Verteenwoordiger:**	
		Farm Name/Plaas Naam:	
	27828701678	**Order/Bestel#:**	Archem Resources
	48 KINGBOLT CRESCENT ALKANTRANT PRETORIA 0081	**Email:**	yvonneguttoona@archem.com, yvonnegutoona@gmail.com

Lab Nommer	Sample Reference	pH KCl *	P Bray1	K AmAc *	Na AmAc	Ca AmAc	Mg AmAc *	EXCH ACID KCl	Ca% AmAc	Mg% AmAc	K% AmAc	Na% AmAc	ACID SAT. AmAc
Lab Number	Monsterverwysing	-	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	cmol(+)/kg	%	%	%	%	%
G25-54361	Plant	5.4	4	105	25	1457	999	0.00	45.96	51.65	1.69	0.69	0.00
G25-54362	Pit	7.0	2	42	26	2811	1265	0.00	57.04	42.06	0.43	0.47	0.00
G25-54363	Site 1	5.9	2	199	25	1443	537	0.00	58.98	35.98	4.16	0.88	0.00
G25-54364	Site 2	7.0	4	238	263	1092	727	0.00	41.47	45.23	4.61	8.68	0.00
G25-54365	Site 3	5.0	2	193	25	293	153	0.00	44.03	37.77	14.88	3.32	0.00
G25-54366	Site 4	5.0	1	36	99	643	571	0.00	38.21	55.57	1.08	5.14	0.00
G25-54367	Site 5	7.2	2	80	15	3125	92	0.00	93.83	4.53	1.23	0.40	0.00
G25-54368	Site 6	5.4	2	38	46	528	256	0.00	52.44	41.67	1.94	3.96	0.00
G25-54369	Site 7	5.7	1	30	106	259	119	0.00	46.17	34.76	2.73	16.34	0.00

Lab Nommer	Ca:Mg AmAc	(Ca+Mg)/K AmAc	Mg:K AmAc	S-VALUE AmAc	Na:K AmAc	T-VALUE AmAc *	Dens. *	S AmAc
Lab Number				cmol(+)/kg	cmol(+)/kg	cmol(+)/kg	g/ml	mg/kg
G25-54361	0.89	57.62	30.48	15.85	0.41	15.85	1.09	12.46
G25-54362	1.36	229.53	97.42	24.64	1.08	24.64	1.28	10.29
G25-54363	1.64	22.82	8.65	12.24	0.21	12.24	1.04	8.04
G25-54364	0.92	18.80	9.81	13.17	1.88	13.17	1.05	12.02
G25-54365	1.17	5.50	2.54	3.32	0.22	3.32	1.38	5.40
G25-54366	0.69	86.47	51.24	8.42	4.74	8.42	1.30	8.56
G25-54367	20.70	79.65	3.67	16.65	0.33	16.65	1.14	4.73
G25-54368	1.26	48.52	21.48	5.03	2.04	5.03	1.26	5.28
G25-54369	1.33	29.60	12.72	2.81	5.98	2.81	1.35	6.94

Lab Nommer	Sample Reference	CLAY	SILT	SAND
Lab Number	Monsterverwysing	%	%	%
G25-54361	Plant	16	17	67
G25-54362	Pit	10	17	73
G25-54363	Site 1	20	19	61
G25-54364	Site 2	6	8	86
G25-54365	Site 3	10	2	88
G25-54366	Site 4	10	18	72
G25-54367	Site 5	14	21	65
G25-54368	Site 6	12	2	86
G25-54369	Site 7	8	3	89

NOTAS / NOTES:

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4.2 LAND CAPABILITY EVALUATION

Land Capability is determined by the collective effects of soil, terrain and climate features, shows the most intensive long-term use of land for rain-fed agriculture and at the same time indicate the permanent limitations associated with the different land-use classes .Capability refers to general kinds of land use and used to allocate rationally to the different kinds of land use required i.e. rotational arable, permanent grazing, woodland etc. The main product of land capability classification of a map in which areas of land are put into capability classes ranging from I best to VIII (worst). The reason why an area is allocated to a given class is indicated by a letter suffix; thus sub class IIe indicates an erosion hazard, IIw a problem of excess water. Each class of land has the potential or capability for use in a prescribed number of ways, or with specified management techniques. Thus class I land can be put to arable use without soil conservation, measures whist class II to IV require increasingly conservation practices; classes VI to VIII should not be used for arable use.

TABLE 3: SOIL PHYSICAL PROPERTIES FOR THE DIFFERENT SOIL FORMS

Land Type	**Dominant soils**	**Depth(mm)**	**Characteristics**	**Agricultural Potential**
	Glenrosa + Mispah	100-600	Fb - Lime rare or absent in upland soils but generally present in low-lying soils	High: 6.0% Medium: 53.7% Low: 40.3%
Ae126	Red-Yellow Apedal, Freely Drained Soils	>300mm deep	Ae - Red, high base status, (no dunes)	Moderate

4.3 CONCEPTS AND ASSUMPTIONS

There are to concepts that are basic to the system. These are capability and limitation. The potential of the land for use in specified ways or with specified management practices is called capability. There is a sequence of assumed uses built in the system. These are as follows: (a) arable use for any crops and without soil conservation practices; (b) arable use with restriction on choice of crops/or with soil conservation practices;(c) grazing of improved pastures; (d) grazing of natural pastures or, at the same level, woodland; (e) and at the lowest level recreation, wildlife conservation, water catchment and aesthetic purposes (Dent and Young, 1981). Land that is allocated to any particular class has the potential for the use specified for that class and for all classes below it. Thus class I land whilst excellent for arable use can equally be put to other uses: class VI land use suited for improved pasture but also be any of the uses below it, whilst class VIII land can be only used for recreation. The capability class does not indicate what the best use for the land, nor the most profitable, it only indicates the range of uses to which each could be put.

Limitations are land characteristics, which have an adverse effect on capability. Permanent limitations are those which cannot easily be corrected. Temporary limitations can be correct, at least by minor land improvements. Land is classified mainly on the basis of permanent limitations. The general rule is that if any one limitation is of sufficient severity to lower the land to a given class it is allocated to that class, no matter how favorable all other characteristics might be.

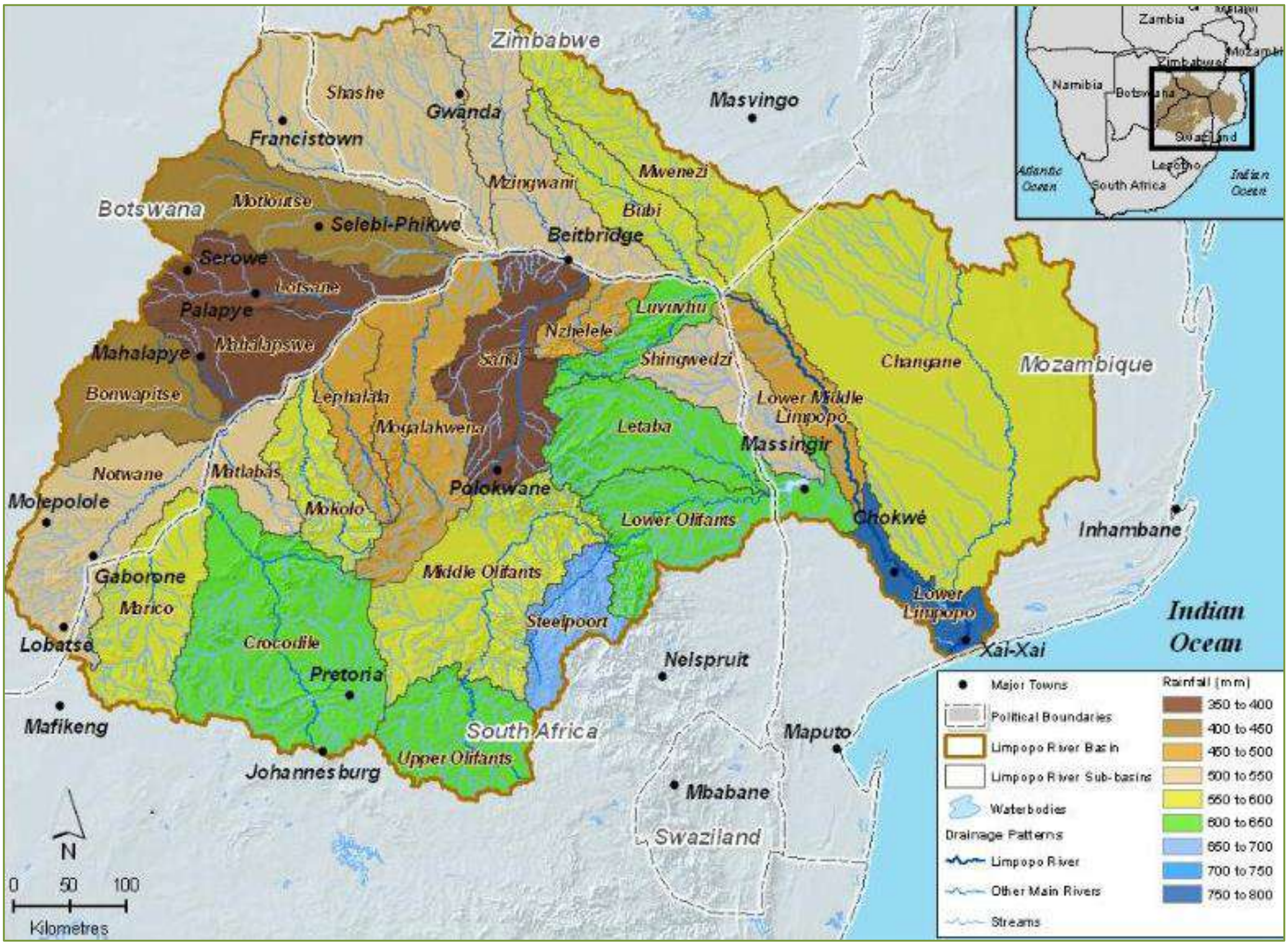


FIGURE 25: Average annual rain fall of the Limpopo basin

4.4 LAND EVALUATION

The interaction of two sets of factors influence land uses, there are physical factors such as geology, relief feature's, climate, soil and vegetation which limit the use of the land and secondly socio-economic factors. The unique combination of topography, geology, climate, soils and vegetation has endowed the province with incredible biodiversity, mineral and agricultural wealth. Limitations that cannot be corrected in the study area are a result from the following effects:

a. Erosion or erosion hazard
b. Climate

c. Stones

d. Low water-holding capacity

The soil loss potential prediction is high followed by moderate due to lack of grassy flora to hold the topsoil.

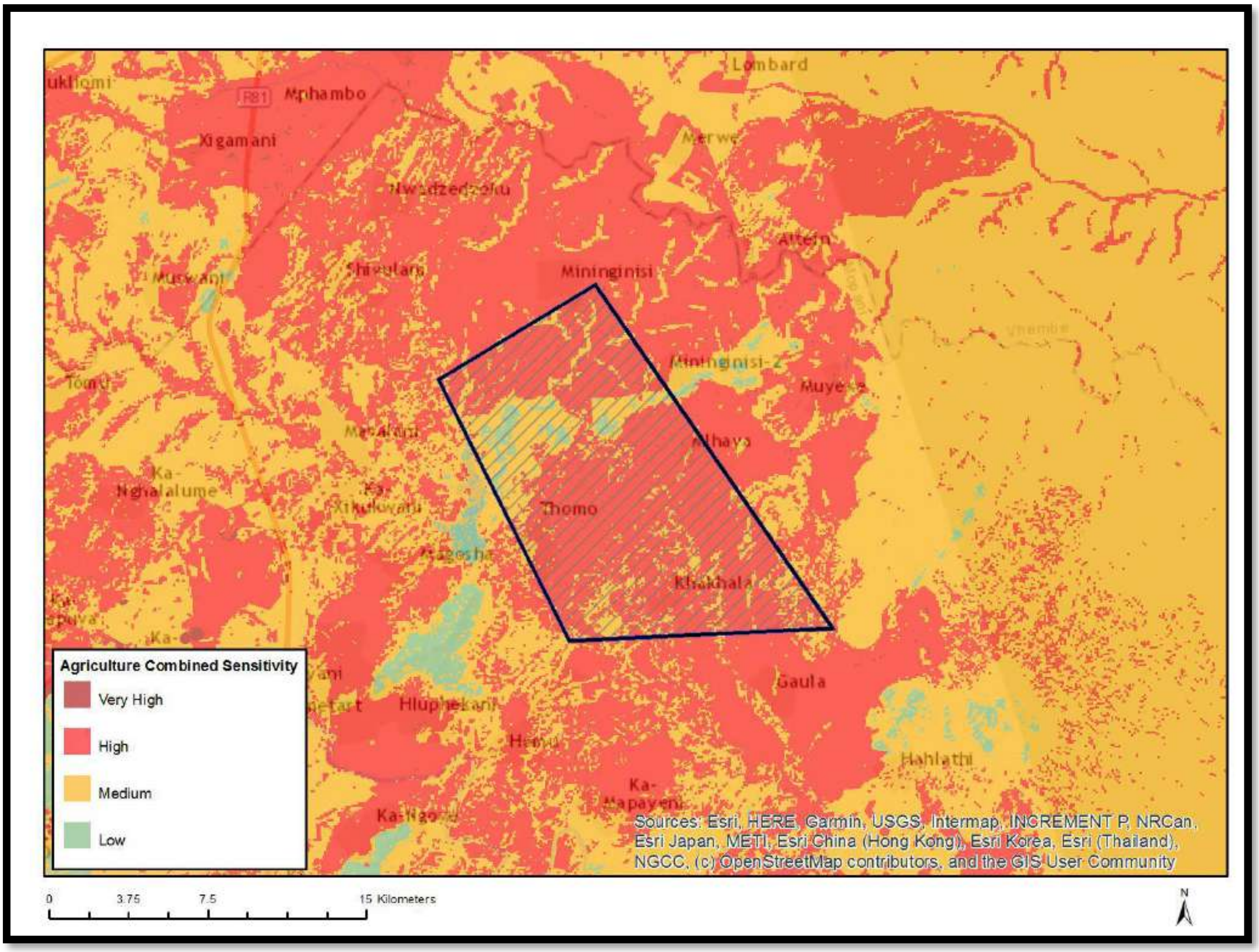


FIGURE 26: Combined Agriculture Sensitivity

Sensitivity	Feature(s)
High	Land capability;09. Moderate-High/10. Moderate-High
High	Subsistence Farming;Land capability;09. Moderate-High/10. Moderate-High
High	Subsistence Farming;Land capability;06. Low-Moderate/07. Low-Moderate/08. Moderate
High	Annual Crop Cultivation / Planted Pastures Rotation;Land capability;09. Moderate-High/10. Moderate-High
High	Annual Crop Cultivation / Planted Pastures Rotation;Land capability;06. Low-Moderate/07. Low-Moderate/08. Moderate
Low	Land capability;01. Very low/02. Very low/03. Low-Very low/04. Low-Very low/05. Low
Medium	Land capability;06. Low-Moderate/07. Low-Moderate/08. Moderate
Very High	Land capability;11. High/12. High-Very high/13. High-Very high/14. Very high/15. Very high
Very High	Subsistence Farming;Land capability;11. High/12. High-Very high/13. High-Very high/14. Very high/15. Very high

5 IMPACT ASSESSMENT

IMPACT IDENTIFICATION AND ASSESSMENT METHODS

5.1 ASSESSMENT OF BIOPHYSICAL AND CUMMULATIVE IMPACTS

The criteria for the description and assessment of environmental impacts were drawn from the Guidelines for EIA Regulations and in terms of the Environmental Conservation Act, 1989 (Act No 73 of 1989) [ECA]. The Environment Conservation has now largely been replaced by the National Environmental Management Act, but certain provisions still remain in force.

Activities to be undertaken in proposed development and its respective construction and operational phases, give rise to certain impacts. For the purpose of assessing these impacts, the project has been divided into two phases from which impacting activities can be identified, namely:

a. Construction phase:

All the construction related activities on site, until the contractor leaves the site.

b. Operational phase:

All activities, including the operation and maintenance of the proposed development.

The activities arising from each of these phases have been included in the tables. This is to identify activities that require certain environmental management actions to mitigate the impacts arising from them. The criteria against which the activities were assessed are given in the next section.

5.1.1 Assessment Criteria

The assessment of the impacts has been conducted according to a synthesis of criteria required by the integrated environmental management procedure.

5.1.2 Extent

The physical and spatial scale of the impact is classified as:

Footprint

a. Immediate

The impacted area extends only as far as the activity, such as footprint occurring within the total site area.

b. Site

The impact could affect the whole, or a significant portion of the site.

c. Regional

The impact could affect the area including the neighbouring properties, the transport routes and the adjoining towns.

d. National

The impact could have an effect that expands throughout the country (South Africa).

e. International

Where the impact has international ramifications that extent beyond the boundaries of South Africa.

5.1.3 Duration

The lifetime of the impact, that is measured in relation to the lifetime of the proposed development.

a. Short term

The impact would either disappear with mitigation or will be mitigated through natural processes in a period shorter than that of the construction phase.

b. Short to Medium term

The impact will be relevant through to the end of the construction phase.

c. Medium term

The impact will last up to the end of the development phases, where after it will be entirely negated.

d. Long term

The impact will continue or last for the entire operational life time of the development, but will be mitigated by direct human action or by natural processes thereafter.

e. Permanent

This is the only class of impact, which will be non-transitory. Mitigation either by man or natural process will not occur in such a way or in such a time span that the impact can be considered transient,

5.1.4 Intensity

The intensity of the impact is considered by examining whether the impact is destructive or benign, whether it destroys the impacted environment, alters its functioning, or slightly alters the environment itself. The intensity is rated as:

a. Low

The impact alters the affected environment in such a way that the natural processes or functions are not affected.

b. Medium

The affected environment is altered, but functions and processes continue, albeit in a modified way.

c. High

Function or process of the affected environment is disturbed to the extent where it temporarily or permanently ceases.

5.1.5 Probability

This describes the likelihood of the impacts actually occurring. The impact may occur for any length during the life cycle of the activity, and not at any given time. The classes are rated as follows:

a. Impossible

The possibility of the impact occurring is none, due either to the circumstances, design or experience. The chance of this impact occurring is zero (0%).

b. Possible

The possibility of the impact occurring is very low, due either to the circumstances, design or experience. The chances of this impact occurring is defined as 25%.

c. Likely

There is a possibility that the impact will occur to the extent that provisions must therefore be made. The chances of this impact occurring is defined as 50%.

d. Highly likely

It is most likely that the impacts will occur at some stage of the development. Plans must be drawn up before carrying out the activity. The chances of this impact occurring is defined as 75%.

e. Definite

The impacts will take place regardless of any provisional plans, and or mitigation actions or contingency plans to contain the effect can be relied on. The chance of this impact occurring is defined as 100%.

5.1.6 Mitigation

The impacts that are generated by the development can be minimised if measures are implemented in order to reduce the impacts. The mitigation measures ensure that the development considers the environment and the predicted impacts in order to minimise impacts and achieve sustainable development.

5.1.7 Determination of significance – Without Mitigation

Significance is determined through a synthesis of impacts as described in the above paragraphs. It provides an indication of the importance of the impact in terms of both tangible and intangible characteristics. The significance of the impact "without mitigation" is the prime determinant of the nature and degree of mitigation required. Where the impact is positive, significance is noted as "positive". Significance is rated on the following scale:

a. No significance

The impact is not substantial and does not require any mitigation action.

b. Low

The impact is of little importance, but may require limited mitigation.

c. Medium

The impact is of importance and is therefore considered to have a negative impact. Mitigation is required to reduce the negative impacts to acceptable levels.

d. High

The impact is of major importance. Failure to mitigate, with the objective of reducing the impact to acceptable levels, could render the entire development option or entire project proposal unacceptable. Mitigation is therefore essential.

5.1.8 Determination of significance – With Mitigation

Determination of significance refers to the foreseeable significance of the impact after the successful implementation of the necessary mitigation measures. Significance with mitigation is rated on the following scale:

a. No significance

The impact will be mitigated to the point where it is regarded as insubstantial.

b. Low

The impact will be mitigated to the point where it is of limited importance.

c. Low to Medium

The impact is of importance however, through the implementation of the correct mitigation measures such potential impacts can be reduced to acceptable levels.

d. Medium

Notwithstanding the successful implementation of the mitigation measures, to reduce the negative impacts to acceptable levels, the negative impact will remain of significance. However, taken within the overall context of the project, the persistent impact does not constitute a fatal flaw.

e. Medium to High

The impact is of major importance but through the implementation of the correct mitigation measures, the negative impacts will be reduced to acceptable levels.

f. High

The impact is of major importance. Mitigation of the impact is not possible on a cost-effective basis. The impact is regarded as high importance and taken within the overall context of the project, is regarded as a fatal flaw. An impact regarded as high significance, after mitigation could render the entire development option or entire project proposal unacceptable.

5.1.9 Assessment weighting

Each aspect within the impact description was assigned a series of quantitative criteria. Such criteria are likely to differ during the different stages of the project's life cycle. In order to establish a defined base upon which it becomes feasible to make an informed decision, it is necessary to weigh and rank all criteria.

5.1.10 Ranking, Weighting and Scaling

For each impact under scrutiny, a scale Weighting Factor is attached to each respective impact (refer to Figure 27: Description of biophysical assessment parameters with its respective weighting.), The purpose of assigning such weight serve to highlight those aspects considered most critical to the various stakeholders and ensure that each specialist's element of bias is taken into account. The weighting factor also provides a means whereby the impact assessor can successfully deal with the complexities that exist between the different impacts and associated aspects criteria.

Simply, such a weighting factor is indicative of the importance of the impact in terms of the potential effect that it could have on the surrounding environment. Therefore, the aspects considered to have a relatively high value will score a relatively higher weighting than that which is of lower importance.

Extent	Duration	Intensity	Probability	Weighting Factor (WF)	Significance Rating (SR)	Mitigation Efficiency (ME)	Significance Following Mitigation (SFM)
Footprint 1	Short term 1	Low 1	Probable 1	Low 1	Low 0-19	High 0,2	Low 0-19
Site 2	Short to medium 2		Possible 2	Low to medium 2	Low to medium 20-39	Medium to high 0,4	Low to medium 20-39
Regional 3	Medium term 3	Medium 3	Likely 3	Medium 3	Medium 40-59	Medium 0,6	Medium 40-59
National 4	Long term 4		Highly Likely 4	Medium to high 4	Medium to high 60-79	Low to medium 0,8	Medium to high 60-79
International 5	Permanent 5	High 5	Definite 5	High 5	High 80-100	Low 1,0	High 80-100

FIGURE 27: DESCRIPTION OF BIOPHYSICAL ASSESSMENT PARAMETERS WITH ITS RESPECTIVE WEIGHTING.

5.1.11 Identifying the Potential Impacts without Mitigation (WOM)

Following the assignment of the necessary weights to the respective aspects, criteria are summed and multiplied by their assigned weightings, resulting in a value for each impact (prior to the implementation of mitigation measures).

Equation 1:

Significance Rating (WOM) = (Extent + Intensity + Duration + Probability) x Weighting Factor

5.1.12 Identifying the Potential Impacts with Measures (WM)

In order to gain a comprehensive understanding of the overall significance of the impact, after implementation of the mitigation measures, it was necessary to re-evaluate the impact.

Mitigation Efficiency (ME)

The most effective means of deriving a quantitative value of mitigated impacts is to assign each significance rating value (WOM) a mitigation effectiveness (ME) rating. The allocation of such a rating is a measure of the efficiency and effectiveness, as identified through professional experience and empirical evidence of how effectively the proposed mitigation measures will manage the impact.

Thus, the lower the assigned value the greater the effectiveness of the proposed mitigation measures and subsequently, the lower the impacts with mitigation.

Equation 2:

Significance Rating (WM) = Significance Rating (WOM) x Mitigation Efficiency

Or WM = WOM x ME

Significance Following Mitigation (SFM)

The significance of the impact after the mitigation measures are taken into consideration. The efficiency of the mitigation measure determines the significance of the impact. The level of impact is therefore seen in its entirety with all considerations taken into account.

TABLE 4: PREDICTED IMPACT ASSESSMENT OF THE PROPOSED OPEN CAST MINE ON THE SOIL.

Project phase	Nature	Certainty	Extent	Duration	Reversibility	Severity	Significance
Before Mitigation							
Construction	**-**	4	3	3	4	4	**64**
Operation	**-**	4	3	4	4	4	**60**
Decommissioning	**-**	4	3	4	3	4	**64**
After Mitigation							
Construction	**-**	4	2	1	4	3	**38**
Operation	**-**	4	2	4	4	3	**52**
Decommissioning	**-**	4	2	4	3	3	**39**

5.2 MITIGATION MEASURES REQUIRED

5.2.1 SOIL STRIPPING IN CONSTRUCTION PHASE

- It is recommended that all usable soil is stripped and replaced after final removal of the mining infrastructure. The soils are overall fairly shallow 30-120cm on Glenrosa and Mispah soils.
- During the construction phase it is recommended that the topsoil be stripped and stockpiled in advance of construction activities that might contaminate the soil. Due to the shallow nature of the soils it is recommended to strip only 40-60cm of the soil. These estimates take into consideration a possible 10% topsoil loss through compaction and allow the rehabilitated areas to be returned to the pre-mining land capability.
- The stripped soils should be stockpiled upslope of areas of disturbance or mining development to prevent contamination of stockpiled soils by dirty runoff or seepage. Topsoil stripped should also be protected by a bund wall to prevent erosion of stockpiled material and deflect water runoff.

- Care should be taken that stockpiles do not to block too many drainage lines to prevent erosion due to intense high rainfalls that often occur in the region
- Soils within 100m of watercourses should be kept undisturbed.
- Any soil that might possibly be contaminated during the construction phase should be stripped and stockpiled in advance of construction activities.

5.2.2 OPERATIONAL PHASE

- Stockpiles can be used as a barrier to screen operational activities. If stockpiles are used as screens, the same preventative measures described above should be implemented to prevent loss or contamination of soil.
- The stockpiles should not exceed a maximum height of 6m and it is recommended that the side slopes and surface areas be vegetated in order to prevent water and wind erosion and to keep the soils biologically active.
- If used to screen mining operations, the surface of the stockpile should not be used as roadway as this will result in excessive soil compaction.

5.2.3 DECOMMISIONING AND REHABILITATION

The following issues need to be taken into consideration before, during mining operations, with closure and rehabilitation:

- Loss of topsoil and usable soil
    - Strip all usable soil and stockpile.
    - Vegetate long-term soil stockpiles
- Contamination of topsoil and stockpiled soil
    - Prevent contamination of topsoil and stockpiled soil.
    - Site all soil stockpiles upslope from any mining / development activities
    - Position stockpiles upslope of mining areas, or as screens to restrict visibility of the mining operation provided that in doing so, the stockpile is not exposed to the risk of seepage or dirty water contamination.
- Erosion of stockpiled soil
    - Ensure that all stockpiles have a storm water diversion berm for protection against erosion and contamination by dirty water.

5.2.4 MONITORING AND MEASUREMENT REQUIREMENTS

Sampling sites need to be established up-stream and down-stream on neighboring farms. These will monitor the depth of the boreholes and the quality of the ground water to monitor any impact the proposed development might have on the surrounding areas as well as sediment analysis to measure potential soil loss via wind/water erosion as well as pollution form roads and stockpiles.

6 SUMMARY

The proposed mining area has le than 10% of low to moderate and more than 85% of medium to high agricultural land use capability. The area is mostly used for Subsistence Farming Annual Crop Cultivation / Planted Pastures Rotation, most notably maize is the commonly planted crop. Mining activities will irreversibly impact the land capability of the soil hence proper management measures need to be implemented during construction, operations and decommissioning to prevent soil loss due to contamination.

Soils need to be stock piled so that they can be used for rehabilitation. Concurrent rehabilitation of open pits is expected to be complied with. After completion of each pit complete rehabilitation will be implemented to allow for substantial time for the normalisation of soils and proper monitoring of the rehabilitation whilst the company is still in operation. It is not possible to restore the soil potential and initial characteristics to its original state but huge improvements can be made in the methodology of stripping and re-dressing of soil material to ensure sustainability of rehabilitation. Over time these soils can produce proper agricultural yield production. The majority of the application areas is predominantly covered by thick woodland grass and trees, with gravel roads, rural settlements and substance farming.

Impacts on the environment must be minimized or limited on construction sites. The following is recommended if the area will be used for mining purposes:

- During the construction phase top soil should be removes and stockpiled in a designated area and vegetated to avoid loss of the soil due to wind and water erosion
- Topsoil stockpiled areas should be no go zones for vehicles and no waste can be stored in this area to avoid contamination
- Monthly surface water monitoring and quarterly groundwater monitoring will be implemented as an on-going process with high priority. High quality irrigation is present in some areas and should be kept in that state. If any changes are observed, the source of pollution should be determined and eliminated.
- For monitoring purposed specialist should be used to evaluate the erosion and other possible impacts during the entire mining process. The entire area should be vegetated throughout the entire duration of mining due to the possibility of wind erosion and relative dry conditions (low clay contents in the top soils).
- Specific control measures are needed to control water erosion and run-off to prevent excessive surface run-off from the site
- Limit impacts to the footprints to keep physical impacts as small as possible
- Areas for road and site lay-out should be minimized. There are already existing roads on the site, these roads should be used, as well as upgraded and maintained
- Dust generation and vehicle associated pollution must be minimized.

7 CONSULTATION AND REFERENCES

- Environmental Screening Tool
- Kusile Mine Works Program and Geohydrological assessment
- The Dept of Agriculture's website (Agis) was used to determine the relevant land type.
- Soil Classification, a Taxonomic System for South Africa. Memoirs on the Agricultural Natural resources of South Africa No. 15, Pretoria 1991.
- Development and application of a land capability classification for South Africa, CW/A/2000/57
- Geological Survey, 1984. Geological map of the Republic of South Africa. Department of Mineral and Energy Affairs, Pretoria.
- ARCGIS maps, using Agri S.A data, ARC etc.
- Soil Maps from ARC-Institute for Soil, Climate and Water, Pretoria

Appendix 1: Site Pictures

KUSILE UN-SURVEYED STATE LAND OF GREATER GIYANI 891 LT SOIL STUDY.

Site Pictures



Site 1

23°11'55"S 30°48'05"E

- Site 2
- 23°22'04"S 30°69'048"E

- Site 3
- 23°11'37"S   30°48'30"E

- Site 4
- 23°15'28"S 30°50'22"E

- Site 5
- 23°27'47"S   30°80'76"E

Site 6

23°11'23"S 30°40'05"E

Site 7

23°16'47"S 30°78'21"E

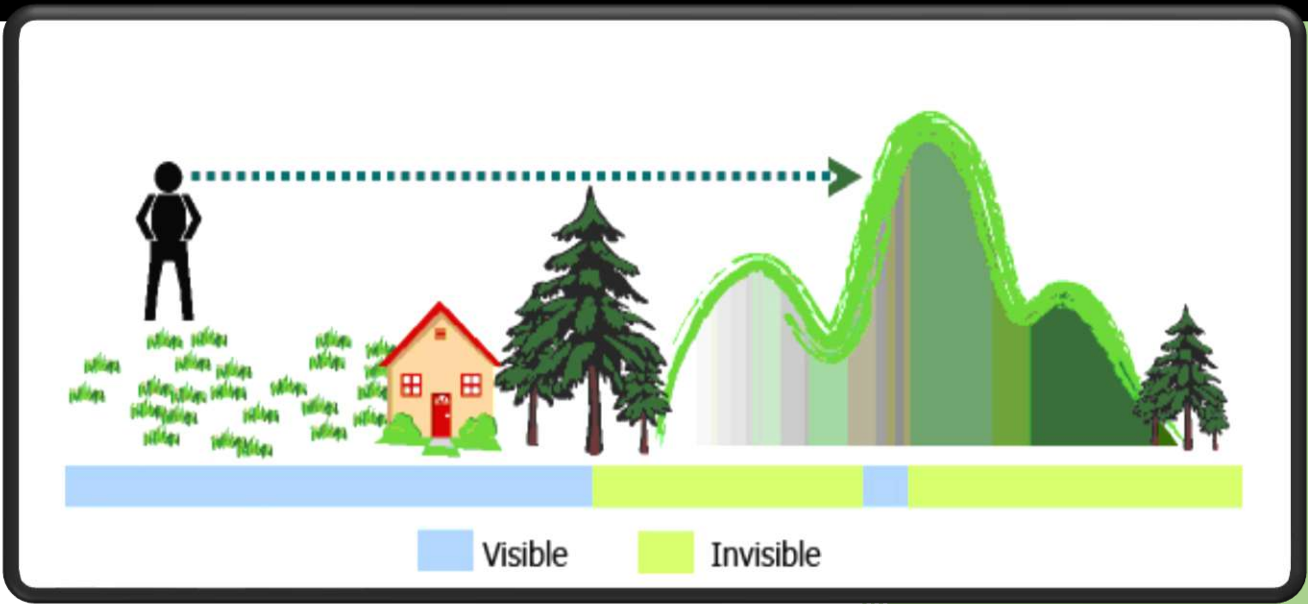
- Plant)
- 23°18'77"S 30°76'59"E

- Pit)
- 23°11'23"S   30°46'05"E

ANNEXURE 7 - VISUAL IMPACT ASSESSMENT

2021

VISUAL IMPACT ASSESSMENT FOR THE PROPOSED GIYANI GOLD MINE LOCATED WITHIN THE GREATER GIYANI MUNICIPALITY



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GLOSSARY OF TERMS

Background	Distance zone greater than 10 km from the proposed site. In this zone the number of perceivable land-cover classes decreases, whereas edge and outline of the landform still play a major role in the perception of space.
Cumulative Impact	Impact of the proposed development considering the context of other existing similar land uses, in the study area and greater regional context.
Foreground	Distance zone less than 1.5 km from the proposed site. In this zone details of single features such as trees or buildings are clearly identifiable.
Landscape Character	The overall impression of a landscape given by the topography, ecology, water bodies present, land use, etc.
Landscape Quality	Psychological value given to a perceived landscape.
Middle Ground	Distance zone between 1.5 km and 10 km from the proposed site. In this zone single elements are no longer discernible from one another but instead merge, e.g. single trees form a forest.
Residual Impact	Impacts that are expected to remain once decommissioning of any infrastructure and full post-closure rehabilitation has occurred.
Sense of Place	A viewer's sense of belonging. It is dependent on how people view, perceive, experience, value and interact with the landscape.
Study Area	The proposed development footprint / site as well as the area, up to a 10 km radius surrounding the proposed development footprint / site.
Viewer Incidence	The number of observers viewing the proposed development as well as the occurrence, rate, or frequency that the proposed development will be viewed.
Viewpoints	Points from where viewers will be able to view the proposed development.
Viewshed	The geographical area that is visible from a specific location. It includes all surrounding points that are in line-of-sight with that location and excludes points that are beyond the horizon or obstructed by terrain and other features (e.g. buildings, trees).
Visual Absorption Capacity	The ability of elements of the landscape to "absorb" or mitigate the visibilityof an element in the landscape. Visual absorption capacity is based on factors such as vegetation height, structures, and topographical variation.
Visual Exposure	Visual exposure relates directly to the distance of the view and can be categorized into distance zones to account for the effect of distance on the perception of size and colour.

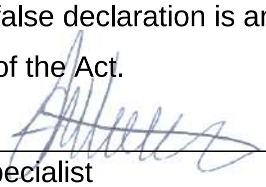
Visual Impact	A change in the appearance of the landscape as a result of development which can be positive (improvement) or negative (detraction).
Visual Intrusion	The extent of an observer's vertical field of view that is taken up by an object or objects.
Visual Receptors	Person or viewer groups which the proposed site will be visible to and which may experience a visual impact due to the proposed development.

Specialist Details and Declaration of Independence

This Visual Impact Assessment (VIA) was compiled by Judith Mlanda –Zvikaramba, who is a seasoned sustainable development practitioner with a special interest in environmental and social sustainability. She holds a master's degree in Environment and Society from the University of Pretoria's Centre for Environmental Studies as well as a Bachelor of Arts degree in Sociology and Psychology obtained from the University of Namibia. Judith Mlanda –Zvikaramba is the author of a book on public participation and stakeholder engagement entitled "Waste Management Exploring the Potential for Community Participation". She has over 15 years of experience. Judith has worked in the consulting industry on public and private sector projects. She has extensive experience and knowledge including but not limited to impact assessments, integrated water and waste management, environmental auditing and monitoring, carbon management and climate change.

I, __ Judith Mlanda –Zvikaramba ________, declare that –

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity.
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.



Signature of the Specialist

2021/03/20

Date

1 INTRODUCTION AND SCOPE OF REPORT

Archean Resources (Pty) Ltd. has been appointed by Kusile Invest 133 (Pty) Ltd as an independent Environmental Assessment Practitioner (EAP), to undertake an application for an integrated Environmental Authorisation (EA) and associated stakeholder engagement proposes, for the proposed project at the Giyani Gold Mine. The processes will be undertaken in terms of the requirements of the National Environmental Management Act (Act No. 107 of 1998) (NEMA) and the Mineral Resources and Petroleum Development Act (Act No. 28 of 2002) (MPRDA).

Giyani Gold is a proposed Gold mine which is to be established on Un-Surveyed State land of Greater Giyani 891 LT and a portion of portion 0 of the farm 246. approximately 10km North East town of Giyani and approximately 140 km north-east of Polokwane, accessible along the R81 road from the N1 National Road in Polokwane. (See **Figure *1***). The life of mine (LoM) for the Giyani Gold Gold Mine is estimated at approximately 30 years.

As part of the EA application process, several specialist studies have been identified. One of which was the need for a Visual Impact Assessment (VIA) (this report). The VIA will focus on the evaluation of potential visual impacts that may be associated with the proposed Gold mine. This assessment considers both the magnitude of the visual impact, rated and guided by the Western Cape Visual Impact Assessment guidelines (WC Guidelines) (Oberholzer, 2005), and the significance of the visual impact (rated per prescribed methodology). In addition to the existing mitigation measures built into the facility design, additional measures are proposed and are summarised as recommendations at the end of this report.

In addition, all requirements listed under Appendix 6 of the NEMA 2014 Environmental Impact Assessment (EIA) Regulations, Government Notice R982 of 04 December 2014, for all specialist studies undertaken as part of an EIA, are considered.

Figure 1 Locality Map

1.1 Objectives of the study

The objectives of the visual investigation are to:

- Gain a detailed understanding of the visual baseline environment.
- Determine and assess the visual impacts (including cumulative impacts) to receptors and resources in the vicinity of the proposed Giyani Gold Mine.
- Determine and assess any issues that may have been raised by Interested and Affected Parties (I&APs) during the Environmental Assessment process.
- Identify potential environmental management measures, where possible, in order that negative visual impacts may be mitigated against and positive benefits enhanced.
- Recommend mitigation measures to reduce the potential visual impacts on the project.

1.2 Scope of work

The scope of work for this study as a scoping level visual impact assessment is to define the spatial context/ sphere of influence of the proposed development in terms of visibility, and to identify possible sensitive viewer locations. The spatial context of the study is determined by a visibility analysis, and the proximity of viewer locations to the proposed Gold mine.

The scope of work included in this visual impact assessment entails:

- Describing the existing visual characteristics of the proposed Gold mining site and its environs.

- Determine the area from which the proposed mining area will be visible.
- Propose possible mitigation measures; and
- Assess the significance of the visual impacts that will be caused by the mining activities.

1.3 Terms of Reference

The purpose of this VIA is to assess the potential visual impacts that the proposed development may have on the surrounding landscape. This is to ensure that potential visual impacts are adequately addressed in the EA and associated documentation for the project. Furthermore, this VIA aims to identify adequate measures which could be implemented, to potentially mitigate against any possible adverse visual impacts associated with the project, on the surrounding visual environment.

Due to the absence of guidelines regarding VIA's in the Limpopo Province, this VIA is based upon the "*Guidelines for Involving Visual and Aesthetic Specialist in EIA Processes*" authored by the Provincial Government of the WC Guidelines.

For this study, the terms of reference are to:

- Determine areas that will be visually exposed to the proposed infrastructure.
- Determine the landscape character and the sense of place of the study area.
- Investigate the potential visual impacts of the proposed development.
- Describe and assess the specific visual impacts of the proposed development from selected identified critical areas and view fields.
- Provide recommendations for mitigation of and identify potential adverse visual effects that the proposed development may have on the surrounding landscape.

1.4 Methodology and Approach to the Assessment

Based on the WC Guidelines, the proposed Giyani Gold Mine development requires a Level three assessment, for which the following methodology was applied to meet the terms of reference in the most objective way:

Identification of data requirements and collation of data. This included acquiring spatial data on topography (contours), existing visual character and quality, details and plans of the proposed development, as well as other background information to:

- Become familiar with the site and its surroundings.
- Verify the desktop spatial analysis undertaken.
- Identify possible visual receptors.
- Identify and assess viewing points and visibility.

- A geo-spatial raster analysis[1] of all the processed data was conducted to determine the **magnitude** of the visual impacts of the following attributes:
  Visual exposure (view shed) and viewing distance.
  - Visibility.
  - Visual absorption capacity.
  - Landscape / townscape integrity.
  - Sensitivity of viewing receptors.
- The determination of the Environmental Significance of impact identified, as per the prescribed impact assessment methodology, was based on the following criteria:
  - Extent
  - Duration.
  - Magnitude.
  - Probability.
- Identification of potential mitigation measures to reduce the overall visual impact to acceptable levels will be presented.

1.5 Approach to the assessment

Due to the subjective nature of the VIA process, emphasis has been placed on an environmentally accepted methodology and rating criteria to ensure that the results are clearly stated and transparent. Furthermore, all ratings are motivated and, where possible, judged against explicitly stated and objective criteria. The assessment needs to be accurate, and several techniques were used in the analysis to ensure reliability and credibility.

For a visual impact to occur there must be a viewer and an object that invokes a response by the viewer. The response can either be negative or positive. As such, the potential areas of influence[2] were delineated and compared against the view shed (area of visual influence) in this VIA. Based on this model, areas that would not be visually influenced by the proposed development were not assessed further. The areas identified as influenced were investigated in further detail by means of a site visit (undertaken on 17-18 February 2021), a baseline comparison and further computer simulations and impact modelling using a Geographic Information System (GIS) [3].

The study focuses mainly on the construction and operational impacts that the proposed development may have on the landscape and to a lesser extent on the impacts during decommissioning, closure and post-closure. However, these impacts cannot be ignored and

[1] Using raster (data with cell based information) in conjunction with spatial information an analysis of the potential visual impacts can be undertaken 2 Areas of influence include suburbs / residential areas, roads, office blocks, recreational areas and tourist attractions. 3 The GIS package that was used is an ESRI ArcGIS 10.2.2 Spatial Analyst and 3-D Analyst Package.

recommendations of mitigation measures for all phases of the project are provided and should be taken into consideration during drafting of the EA for the site.

This report is intended to be contextualised with the main environmental assessment report and other specialist studies undertaken for the project.

1.6 Assumptions and limitations

The following limitations, constraints and assumptions are applicable to this study:

- Visual perception is by nature a subjective experience, as it is influenced largely by personal values. For instance, one viewer experiences as an intrusion in the landscape, another may regard as positive. Such differences in perception are greatly influenced by culture, education and socio-economic background. A degree of subjectivity is therefore bound to influence the rating of visual impacts. To limit such subjectivity, a combination of quantitative and qualitative assessment methods has been used. A high degree of reliance has been placed on analysis based on GIS view shed and visibility analysis and on making transparent assumptions and value judgements where assumptions or judgements are necessary.

- The purpose of this visual impact assessment study is to identify the visual impact of the project in relation to the existing landscape setting. However, while an effort is made to be rigorous and logical in the assessment process, the element of subjectivity does influence the ratings. It has nevertheless been reported in McCool, S.F. et al (1986) that the professional visual assessor is more critical than the public.

- The view shed generated in GIS is not 100% accurate and has therefore been ground truth during the site visit. Some viewpoints which are indicated on the view shed as being inside of the view shed, can be outside of the view shed. This is due to the modification of the natural environment surrounding the study area. Natural vegetation also plays a significant role and can have a positive or negative influence on the view shed.

- Determining a visual resource in absolute terms is not achievable. Evaluating a landscapes visual quality is both problematic and complex. Sundry approaches have been developed, but they all have one problem in common; unlike noise or air pollution which can be measured in a relatively simple way, for the visual landscape mainly qualitative standards apply. Therefore, subjectivity cannot be excluded in the assessment procedure (Lange, 1994). Individually there is a great variation in the evaluation of the visual landscape based on different experiences, social level and cultural background. Exacerbating the situation is the inherent variability in natural features. Climate, season, atmospheric conditions, region, sub region, all affect the attributes that comprises the landscape. What is considered scenic to one person may not be to another (NLA, 1997)

- The layouts as provided by the applicant were used to undertake the VIA analysis and were assumed to be up to date and accurate when this study commenced.

- The view shed illustrates the areas from which the proposed development is likely to be visible. It does not take local undulations, existing vegetation and man-made structures into account. Due to the interval of the contours, many of the undulations or natural landscape features smaller than 20 m tall in the surrounding areas could be lost. This means that the proposed development may not be visible from everywhere within the view shed, as the development may be obscured by other existing infrastructure, vegetation or small/localised variations in the topography. It therefore indicates a “worst case” scenario.

1.7 Legal Requirements

There are no specific legal requirements for visual impact assessment in South Africa. However, the following guidelines have been considered in the preparation of this report:

- Guideline on Generic Terms of Reference for EAPs and Project Schedules (DEADP, Provincial Government of the Western Cape, 2011).
- Guideline for Involving Visual and Aesthetic Specialists in EIA Processes (DEADP, Provincial Government of the Western Cape, 2005).

2 PROJECT LOCALITY AND DESCRIPTION

The Giyani Gold Project is located approximately 10km North East town of Giyani and approximately 140 km north-east of Polokwane, accessible along the R81 road from the N1 National Road in Polokwane. The project area covers a surface area of 13894.66 hectares (Extent of surface area required for mining is 1000 Hectares and extent of the area required for infrastructure, roads, servitudes etc. is 150 Hectares) the proposed mine will be located on Un-Surveyed State land of Greater Giyani 891 LT and a portion of portion 0 of the farm 246. The mine development activities will commence by establishing and installing the required mining infrastructure such as pit establishment, shaft headgear and winders, service water, compressed air.

and power supply, processing plant and installation of surface ventilations fans. The type and size of the mining infrastructure to be installed will be designed to support the proposed Life of Mine (LOM) production rate of 12 000 tons per month of Run of Mine material (ROM) for 30 (thirty) years.

Mining operations will commence from five open cast pits which will later be developed into underground workings and expand into four working levels to reach the steady state production of 12,000 tons per month. Additional working areas will be established for sustainability and to replace the

depletion of ore reserves being mined from the start-up working areas.

The open pit mine design shows the orebody being located centrally to the pit outer walls or pit shell. The waste surrounding the orebody will be stripped, with topsoil stored separately from waste rock for re-use during rehabilitation of the pit at closure of mining operations. The stripping will include the removal of surrounding topsoil and waste rock to fully expose the orebody and have enough area for movement of machinery inside the pit.

The sidewalls of the excavation, surrounding the orebody, referred to as Benches, will be excavated at intervals to a maximum depth 12 metres and must be slanted to ensure slope stability as per specifications determined by the project's Rock Engineering expert. The pit development will include the creation of Berms, representing the flat area or horizontal distance of approximately 5 metres in width, when measured from the bottom of the preceding or top bench to the edge of the next bench as the pit goes dipper. An access ramp and haul road will also be created from the top bench on the outer limits of the pit, traversing the lower benches in order to have mining equipment and personnel accessing the pit floor where excavating or blasting of the ore bearing rock will be conducted. The pit will be excavated to an optimal operating final depth of 400 metres below surface level, thereafter, the conversion of the mining operation from open pit to underground mining operation will be affected. The timing for the development of the underground mining infrastructure will be scheduled to reach its completion such that the commencement of underground operations will overlap with the final phase of the open pit mining operation for a period of 6 months. The basic design or layout for the underground mining operation, entails the conventional use of shafts and declines, with the development of footwall haulages, crosscuts and raise-lines to establish conventional steep stoping and cut and fill mining panels.

The backfilled waste and subsoil will be profiled, covered by topsoil and re-vegetated as part of the mining operation, and hence rehabilitation will be undertaken concurrently with the mining process. The final void and mine ramps will be backfilled to proximate pre-mining topography.

It is expected that from a visual perspective, the stockpiles (Run of Mine, overburden and topsoil stockpiles) will be the most visually prominent aspect of the proposed mine (250x250m footprint with an approximate height of 10-15m).

2.1 Project Locality

Giyani Gold Gold Mine The proposed mining project is located within the town of Giyani, Limpopo Province, approximately 140km north-east of Polokwane, accessible along the R81 road from the N1 National Road in Polokwane. The area is within the jurisdiction of Mopani District Municipality ("MDM), Limpopo Province. The Mopani district area consists of five local municipalities, namely, Greater Letaba; Greater Tzaneen; Ba-Phalaborwa; Maruleng and Greater Giyani municipalities, the latter being where the town of Giyani is located.

The project area covers a surface area of 13894.66 hectares (Extent of surface area required for mining is 1000 Hectares and extent of the area required for infrastructure, roads, servitudes etc. is 150 Hectares) The application area is located approximately 10km North East town of Giyani and approximately 140 km north-east of Polokwane, accessible along the R81 road from the N1 National Road in Polokwane.

The Greater Giyani Municipality is demarcated into 31 wards and has 10 Traditional Authority areas comprising of 93 villages. The town of Giyani is the economic hub in the area and attract a large portion of the population in the area for employment and other business opportunities.

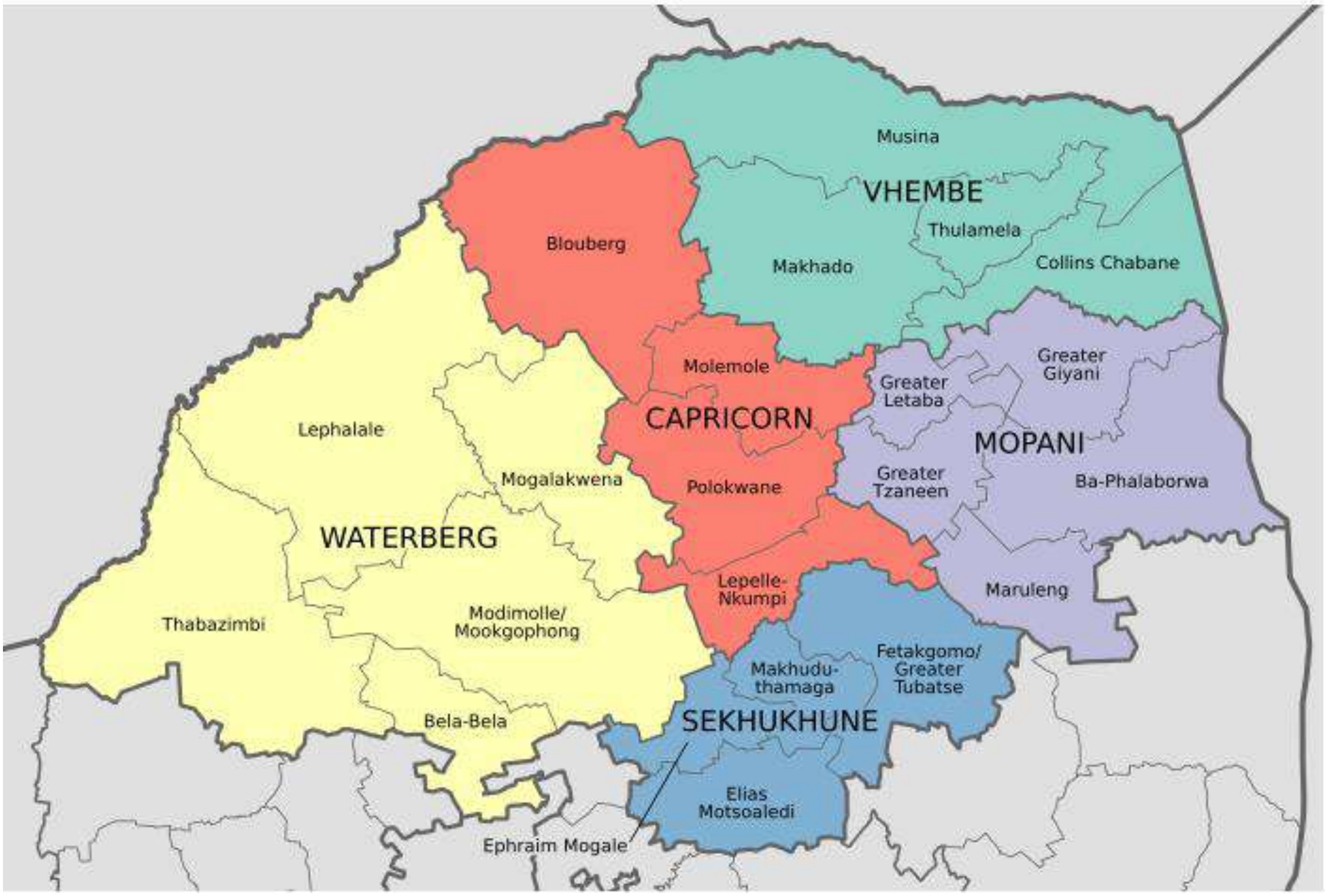
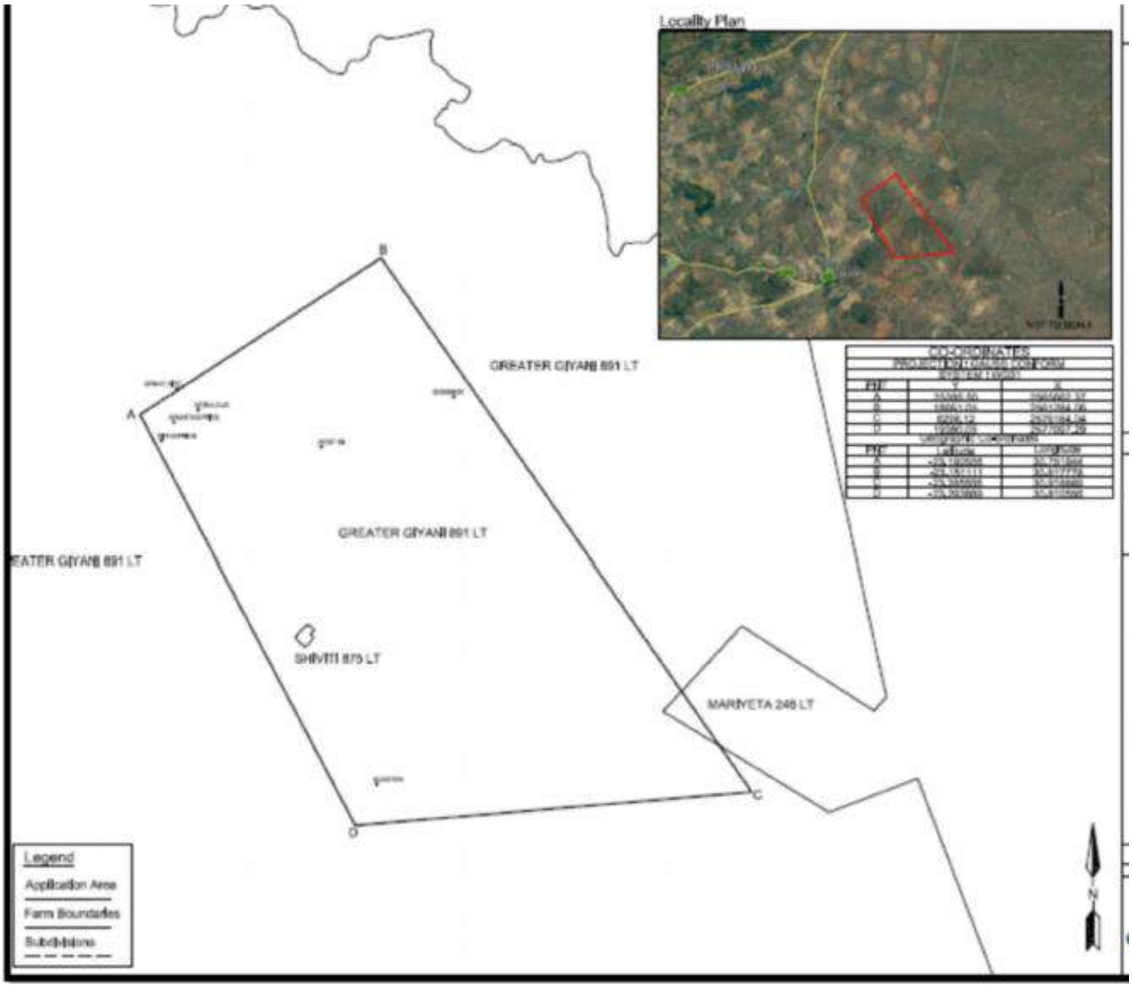


Figure 2: Location of Greater Giyani Municipality within Mopani district Limpopo Province



\Figure 3: Farm Location in the Greater Giyani Municipality

2.2 Summary of the main structural components

The proposed Gold mining operation consisting of the following main components:

- Gold Reserves to be mined by means of open cast and underground operations.
- Processing plant preparing the resource for off-site transportation.
- Infrastructure relating to the mining and processing operations.

The layout of the mine is conceptualised in the map in **Figure *1***. The main components which will form the subject of this study, are the mine shafts, topsoil, subsoil, overburden, discard and ROM stockpiles, office and workshops complex and the open cast mining area. See

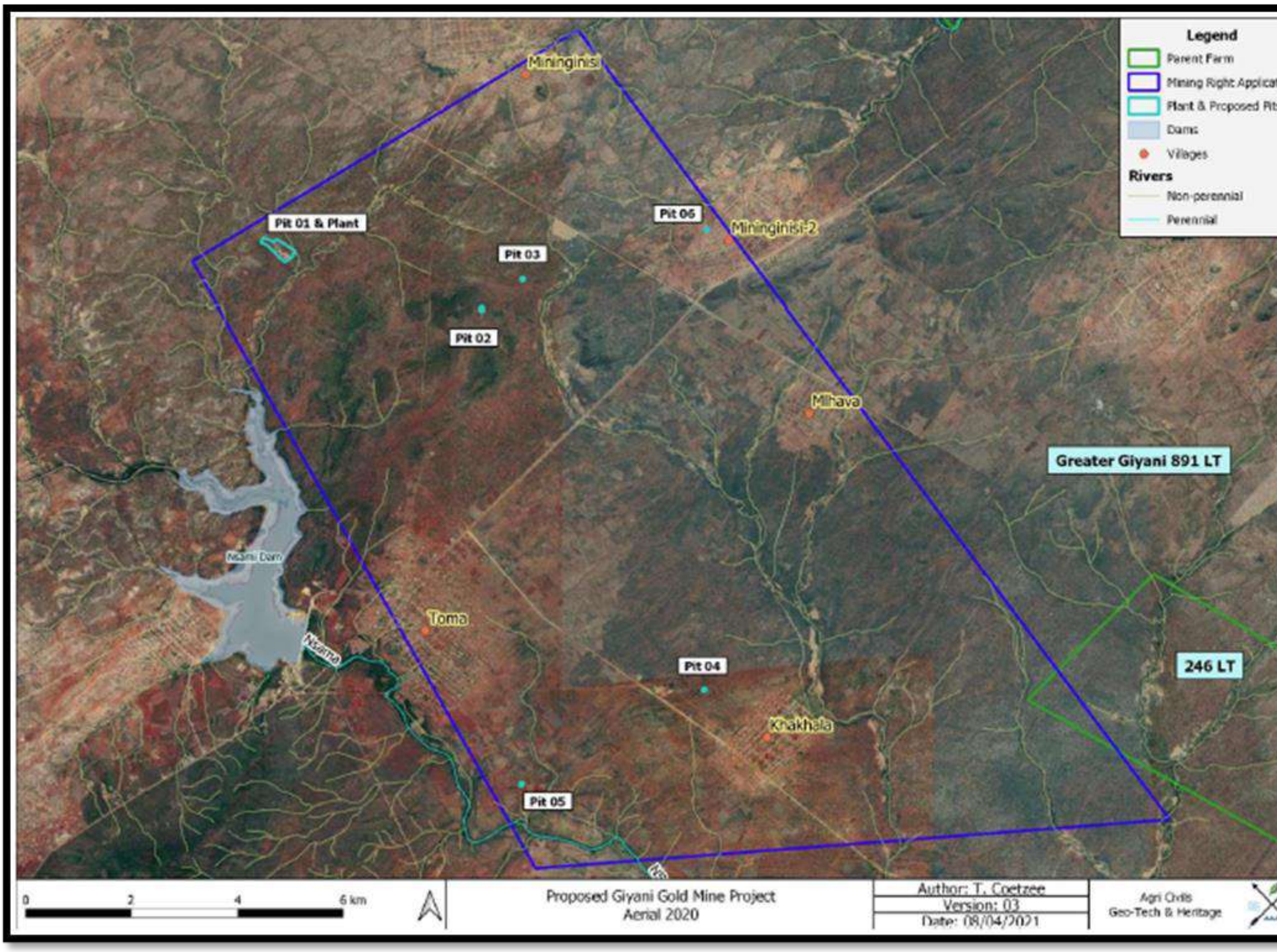


Figure 4 below.

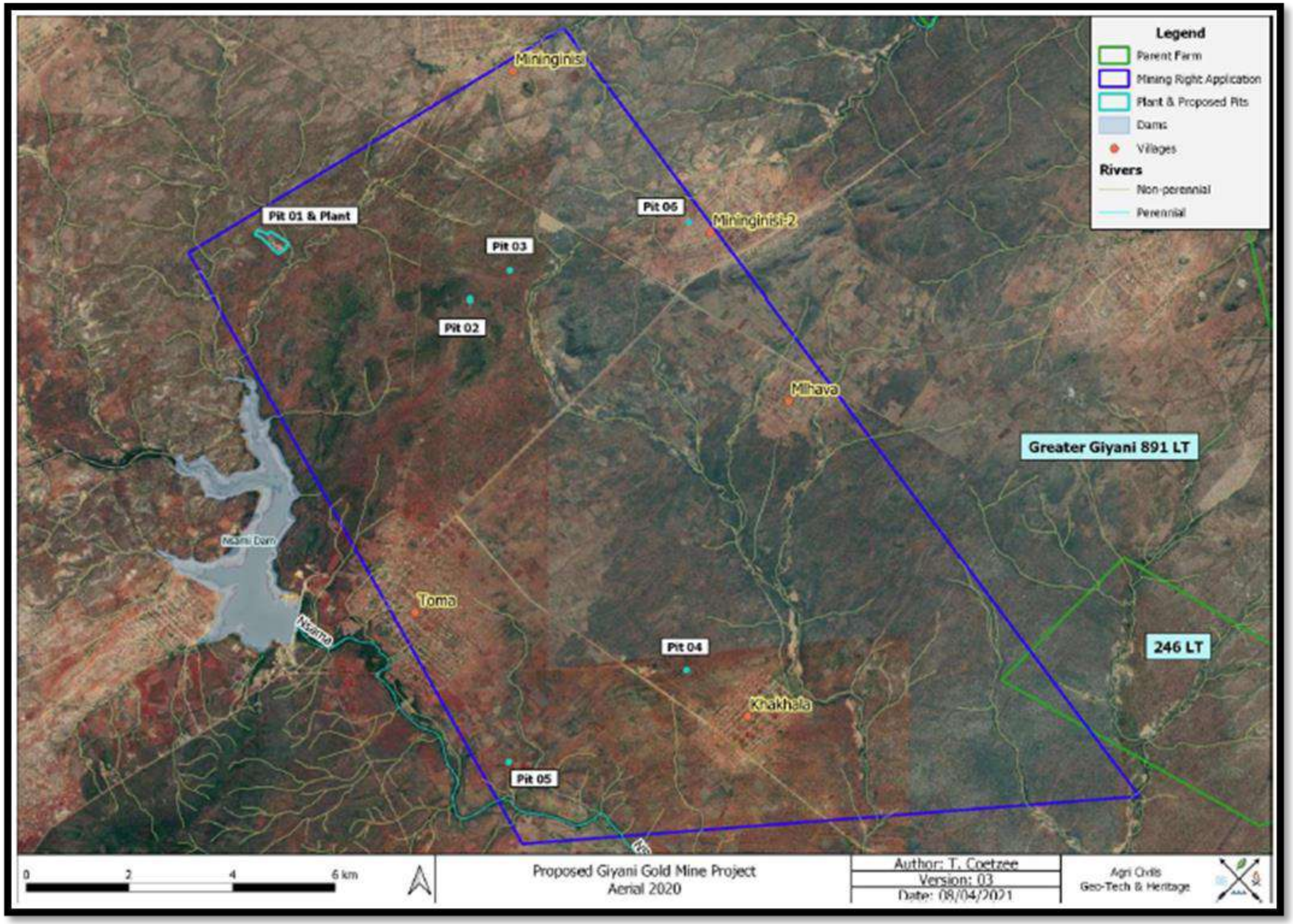


Figure 4: Surface Infrastructure

To understand the impact a structure may have on a receptor (viewer) it is important to understand what the structure will look like. The following key considerations are usually considered when assessing the probable visual impact on a receptor:

Height: The higher the structure or facility is, the wider the visual envelope (view shed) will be. The height of a structure may be mitigated / shielded by the topography of the surrounding area, man-made features or by natural features. The opposite is also true as the lack of the abovementioned “mitigation” or “shielding” may increase the visibility of the structure. Visually the perception of the height of a building or structure is partially a function of the spatial interaction between topography, height of existing man-made features and the height of natural features, such as trees and shrubs near the infrastructure.

Surface area: The combination of the total surface area and the degree of visibility of the site has an impact on receptors. A smaller surface / face-area / cross-sectional area may reduce visibility from areas further away from the infrastructure and, hence could reduce the potential visual impact the site may have. A larger surface / face / cross-sectional area will obstruct views which would previously have been visible and may lead to a more significant impact.

Arrangement of construction: A staggered configuration, such as a power line (as an example), ensures that the infrastructure might “blend” into the surrounding environment. Solid structures (retaining walls / buildings) are more obstructive and visible over a larger area.

Arrangement of colours: The colour of infrastructure has an important function as it could either add emphasis on the structure, or it could assist in hiding / camouflaging it. It is therefore important that structures or buildings are painted with neutral colours which should be consistent with the colours of similar structures in the wider area.

Boundary with the environment: The site earmarked for development may significantly change the appearance of the natural area in which it is located. It is therefore important to retain as many natural features as possible, such as the landscape and vegetation surrounding the site, where it does not pose a health or safety risk from an operational perspective.

3 BASELINE VISUAL LANDSCAPE EVALUATION CRITERIA

Due to the subjective nature of Visual Impact Assessments, a number of criteria have been used to describe the visual aspects of the environment. The criteria evaluate the current visual landscape and the potential changes to the landscape that the proposed development may have.
The following criteria can be used to describe the visual landscape of an area:

- **Visual Character**
- **Sense of Place**
- **Visual Quality**
- **View shed.**
- **Viewing Distance and Visibility**
- **Visual Absorption Capacity (VAC)**
- **Landscape Compatibility**
- **Viewer Sensitivity**

In the following section of the report, the magnitude of the visual impact of the proposed mine will be discussed, in terms of the criteria listed above.

3.1 Visual Character

The Project area is located in an area which is relatively flat lying (see **Photo plate 1**)at a surface elevation of 500 metres (m) to 580 metres (m) above sea level. No settlements are situated within the planned opencast mining area or the areas where the shafts are to be located.

Photo plate 1: Depicting landscape with a flat low-lying visual character.

The topography of the greater area surrounding the proposed Giyani Gold mine is shown in ***Figure 5: Topography*** hereunder and this shows that the area is relatively flat.

The areas surrounding the proposed mine is rural land use characterised by residential settlements, agriculture, livestock grazing and subsistence farming.

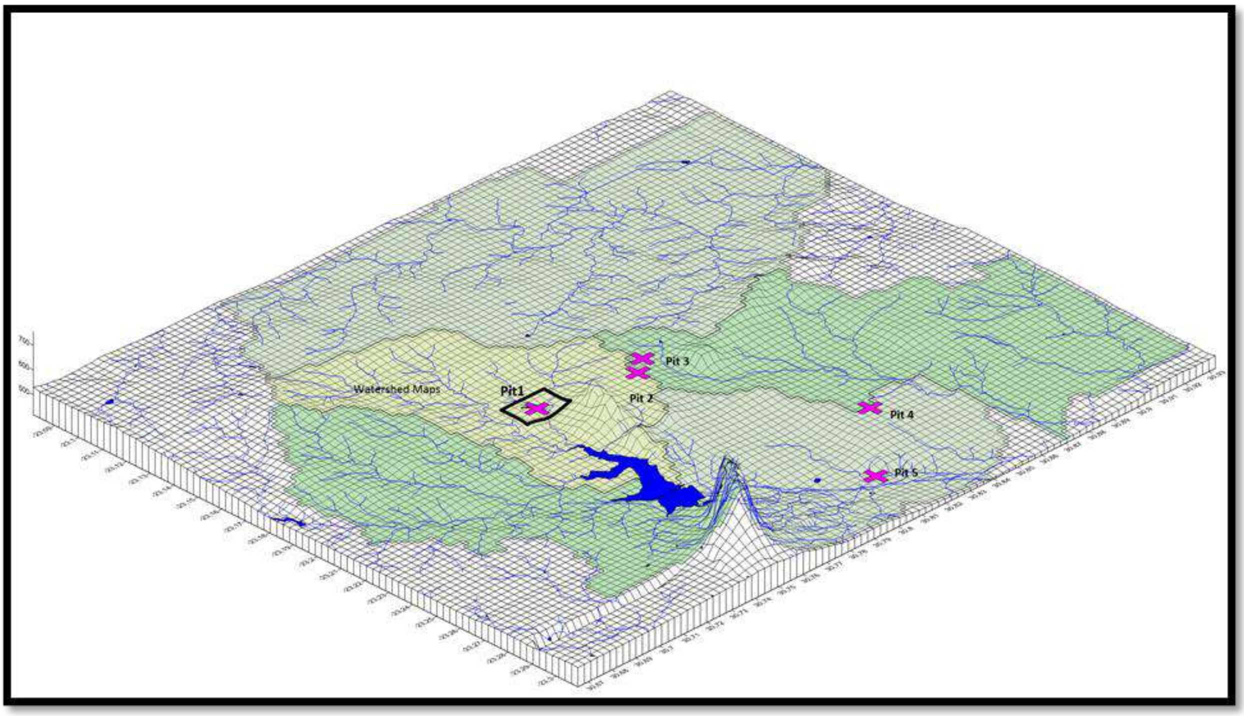


Figure 5: Topography

Section 4 of this report assigns a numerical value based on the land use character in which the proposed mine is located, calculated on the rating Hassell matrix tabulated in the below.

Table 1: Land use Character Rating System

Description	***Value***	***Typical Character / Use***
Unmodified landscape/natural	5	No / minimal impact associated with the actions of man. National parks, coastlines, pristine forest areas.
Natural transition landscape	4	A changing landscape character associated with the interface between natural areas and modified rural / pastoral or agricultural zones.
Modified rural landscape	3	Typical character is rural landscape, defined by field patterns, forestry plantations and agricultural areas and associated small-scale roads and buildings.
Transition landscape	2	Transitional landscape associated with the interface between rural, agricultural area and more developed suburban or urban zones.
Highly modified landscape, urban/industrial.	1	Substantially developed landscape. High levels of visual impact associated with buildings, factories, roads and other related infrastructure.

The land use character of study can be described as being rural settlements interspersed with mostly subsistence farming within Mopaneveld characterised by medium to high shrub dominated. savannah, with scattered trees and a dense field layer.

In terms of the rating system presented in ***Table 1*** above, the visual character of the study area can therefore be described as being a **Modified rural landscape (3)**, attributed to the rural character of the area with small scale roads, field patterns, various rural settlements and agricultural operations in close proximity.

Photo plate 2: Modified rural landscape.

3.2 Sense of Place

Our sense of a place depends not only on spatial form and quality but also on culture, temperament, status, experience and the current purpose of the observer (Lynch, 1992). Central to the idea of 'sense of place' or *Genus Loci* is identity. The concept of "a Sense of Place "does not equate simply to the creation of picturesque landscapes or pretty buildings but to recognise the importance of a sense of belonging. Embracing uniqueness as opposed to standardization attains quality of place. In terms of natural environment, it requires the identification, a response to and the emphasis of distinguishing features and characteristics of landscapes.

An area will have a stronger sense of place if it can easily be identified, that is to say if it is unique and distinct from other places. **Photo plate 3** shows various landscapes within the proposed mining area and these reflect that the area does not have any unique features which would visually set it apart from other areas where similar land uses are taking place. Lynch defines 'sense of place' as "the extent to which a person can recognise or recall a place as being distinct from other places – as having a vivid or unique, or at least a particular, character of its own" (Lynch, 1992:131).

Photo plate 3: Landscapes within the proposed site area

Using the above photo plate, it is clear that the natural landscape provides an aesthetically pleasing character. However, bearing in mind that sense of place centres around distinctiveness and uniqueness there are no specific visually unique that cannot be found in any other place with a similar land use landform.

3.3 Visual Quality

Visual quality is evaluated by identifying the vividness, intactness and unity present in the view shed. This approach to evaluating visual quality can also help identify specific methods for mitigating specific adverse impacts that may occur because of the project.

Aesthetic value is an emotional response derived from our experience and perceptions. As such, it is subjective and difficult to quantify in absolute terms. Studies in perceptual psychology have shown that humans prefer landscapes with higher complexity (Crawford, 1994). Landscape quality can be said to increase when:

- Topographic ruggedness and relative relief increase.
- Water forms are present.
- Diverse patterns of grassland and trees occur.
- Natural landscape increases and man-made landscape decreases.
- Where land use compatibility (coherence) increases.

Thus, visual quality decreases when elements defer from the natural environment and, hence, influence the wider area of influence in a negative way. Elements that decrease the visual quality of an area includes "visual clutter" and man-made features including, but not limited to:

- Roads and bridges.
- Dense developments and high buildings.
- Commercial facilities.
- Mines, factories, stacks, etc.

Visual Quality is largely subjective, therefore adapted from the United States Department of Transport: Visual Impact Assessment for Highway Projects (1981) and the Landscape Institute with the Institute of Environmental Management and Assessment (2002), visual quality can be calculated as per the Equation below:

$$Visual\ Quality = \frac{Vividness + Intactness + Unity}{3}$$

Equation 1

Where:

Vividness is defined as the extent to which a landscape is memorable – this is associated with the distinctiveness, diversity, and contrast of visual elements.

Intactness is defined as the integrity of visual order within the landscape, as well as the extent to which the landscape is free from visual intrusions.

Unity is defined as the extent to which visual intrusions are sensitive to the existing landscape.

Visual Quality was calculated according to ***Equation 1***, based on the following rating criteria specified in ***Table 2*** below.

Table 2: Visual *Quality rating criteria*

Rating	High (5)	Medium (3)	Low (1)
Vividness	The visual impression received is highly memorable, as contrasting landscape elements combine to form distinctive visual patterns.	The visual impression received is moderately. memorable, with some distinctive patterns moderately defined landscape or landforms are present.	The visual impression received is of low memorability. Little visual pattern is formed because landscape elements do not combine to from a striking or distinctive pattern.
Intactness	There is high visual integrity between the natural and man-made landscape to the extent that the landscape is free from visual encroachment.	There is an average visual integrity between the natural and man-made landscape. Some visual encroachment on to the landscape is present.	There is low visual integrity between the natural and Man-made landscape features. Visual encroachment onto the landscapes very apparent.
Unity	The visual elements of the landscape join to form a moderately coherent, harmonious visual pattern. Manmade and natural elements blend together.	The visual elements of the landscape join to form a moderately coherent, harmonious visual pattern. Manmade elements blend with natural elements; however,	Visual resources do not join together to form a coherent harmonious visual pattern. Manmade elements do not have a visual relationship to natural landforms or land cover

	the visual order is disrupted.	patterns and visual order is lacking.

The visual quality of the study area is calculated and described in ***Table 3***, based on ***Equation 1*** above and the rating criteria presented in ***Table 2***.

Table 3: Visual Quality rating for the proposed Giyani Gold Mine

Criteria	Rating	Description
Vividness	1	The study can be described as having a low memorable impression, based on the lack of a striking or distinctive pattern or unique features which would set the area apart from any other area in Limpopo. Thus, the vividness of the area is described as being **LOW.**
Intactness	3	The intactness of the area is described as **Medium**, due to the presence of scattered rural settlements and fields utilised for agriculture within the area. There is to an extent a visual integrity between the natural and man-made landscape.
Unity	3	The study area can be described as having a **Medium** unity classification, as the farming areas and natural zones are considered to be moderately coherent, although evidence of disruption in the visual order is evident.
Visual Quality $\frac{\mathbf{1+3+3}}{\mathbf{3}} =$ 2,3 MEDIUM		

4 MAGNITUDE OF THE VISUAL IMPACT

4.1 Introduction

The following section outlines the assessment that was undertaken to determine the **magnitude** of the visual impact for the proposed Gold mine. Visual impacts associated with the proposed Gold mine and the cumulative impacts of these were assessed.

Various factors were considered in the assessment, as indicated in Section 3, including:

- Visual exposure of the proposed development in terms of the view shed.
- Visibility and viewing distance.
- Visual absorption capacity (VAC).
- Integrity with existing landscape / townscape.
- The visual receptor sensitivity.

These criteria are explained further in the following sections and are used to determine the magnitude of visual impact.

4.2 Visual Exposure

4.2.1 Elements considered in determining visual exposure.

Visual exposure is determined by an objects “zone of visual influence” or how visible an object may be in the landscape. It describes the degree to which the receptor will be exposed to a proposed project and is primarily a function of distance. Receptors that are located, or that come within close proximity of a source of visual impact, are described as having a greater level of visual exposure in terms of the potential impact. The visual exposure of an object can be broken down into two elements:

- Firstly, how exposed is the object to the surrounding area? This can be determined by the topography in which the object is.
- Secondly, how exposed are viewers to the object? This can be determined through topography and land use in which the viewer is situated.

The technique to analyse visual exposure and the representation thereof on maps is referred to as ‘view shed analysis.

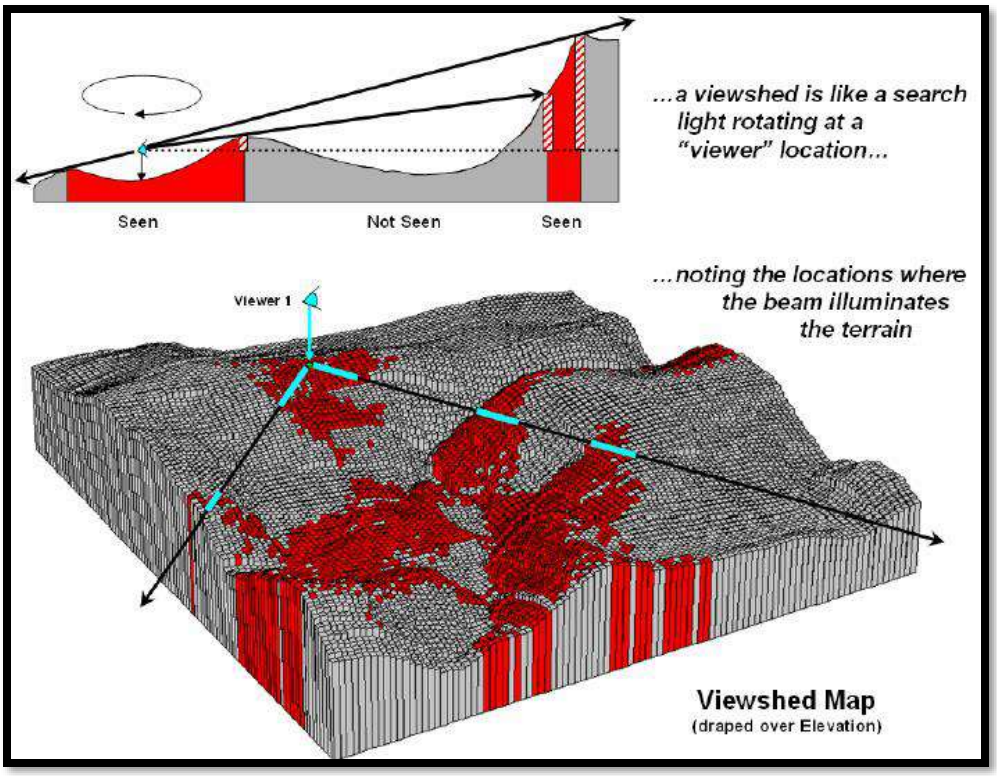


Figure 6: Example of the viewshed analysis technique

The following section will outline how both of these elements were used in determining the overall visual exposure of the proposed Giyani Gold Gold Mine.

The topography of an area can limits or expose the visibility of an object. In order to assess how topography influences the visual exposure of a feature, a predictive model known as a "view shed" is used.

A view shed model uses topography datasets to predict where in the landscape a given feature may be visible. This model assumes that the surface is smooth (not taking into account vegetation and man-made objects). Due to this, site verification of the view shed is required.

Table 4 below outlines a set of Visibility Criteria that were used to rank how visible the proposed Giyani Gold Gold Mine may be from the selected viewpoints. Each of the viewpoints identified in ***Figure 7*** have been rated according to visual exposure criteria, which is a combination of ratings in ***Table 4*** and verification through a site visit. Each of the viewpoints has been rated according to the Visibility Criteria ranking.

Table 4: Visibility criteria (Exposure)

Visibility Ranking – after Site Visit Verification			
Not Visible	Marginally Visible	Visible	Highly visible

Final Visibility Criteria (Exposure Rating)			
1	2	3	4

The visibility rankings were then applied to assess the visual exposure of each of the chosen viewpoints to assess what measure of screening any vegetation and man-made features may have on the visibility of the proposed Giyani Gold Gold Mine.

These viewpoints were chosen based upon their position in both the landscape and inside the visible areas of the view shed. Attempts were made to choose viewpoints from various angles and distances from the proposed Giyani Gold Gold Mine. The findings from the Visibility Criteria are summarised in ***Table 5*** below as a combination of the rankings identified and the site visit taking into account the viewpoints depicted in the figure below.

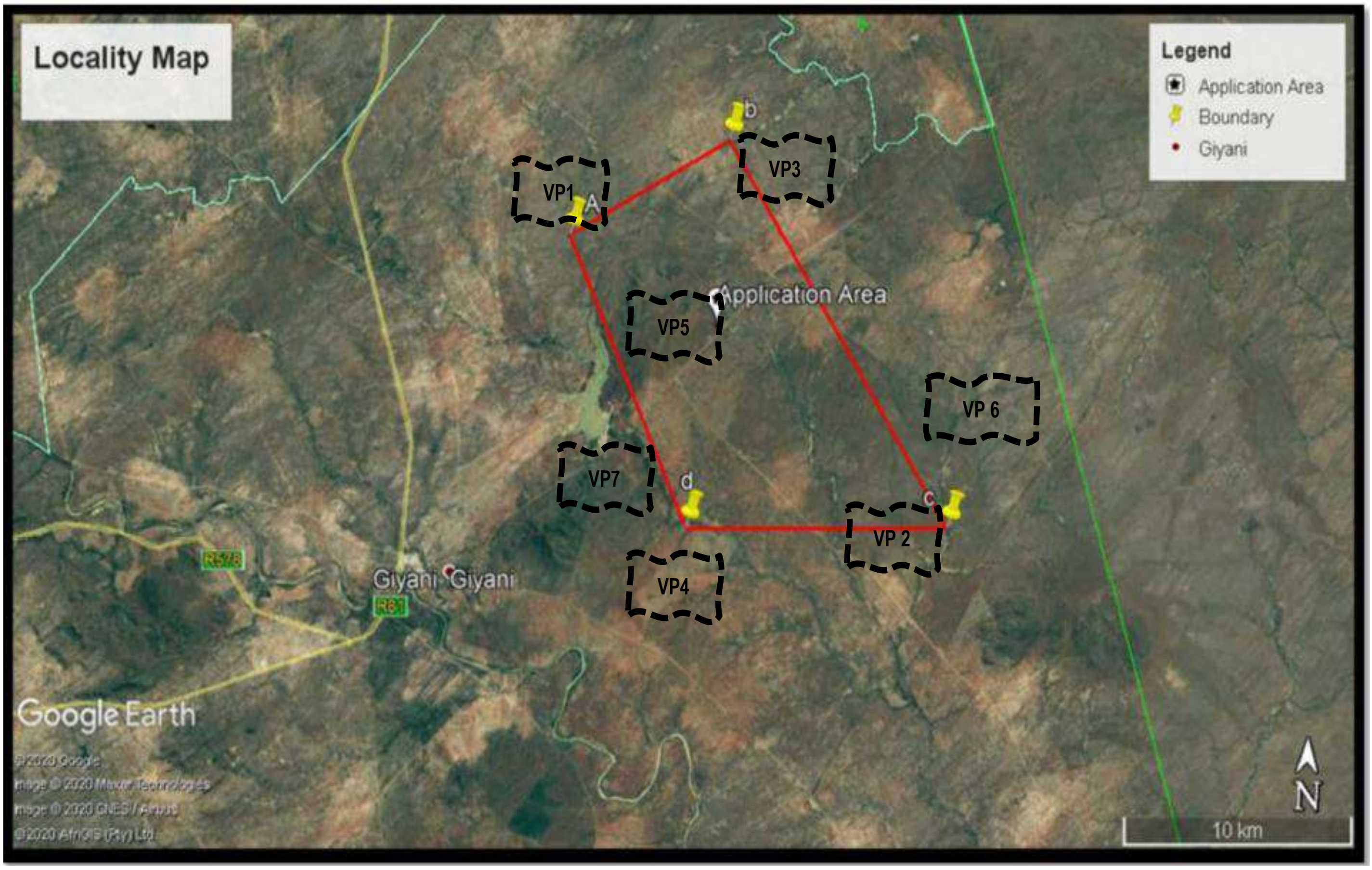


Figure 7: location of viewpoints in the study area

In total 7 viewpoints were used in the visual assessment for a true reflection of the potential visibility of the activities in the area. The viewpoints chosen represent a summary of the proposed Giyani Gold mine on the surrounding viewers. Appendix 2 presents the photographs taken during the site visit (18-20 April May 2021) from each of the viewpoints, highlighting the potential views towards the proposed Giyani Gold mine.

Table 5: Summarising the Visibility Exposure Rating for the proposed Giyani Gold Gold Mine

Component	Approx Height (meter)	Discussion	Rating
Open Casts pits and Underground shafts		The open pit has a relatively low potential visibility, as the visibility will be restricted due to the fact that it is not a high-rise structure, and it is below natural ground level therefore only visible to viewpoints with higher elevation the view shed is concentrated within 2km radius of the mine site. The visual effect of the mine vid is created by the colour of the raw earth and exposed rock contrasting with the surrounding landscape. The open mining face also creates strong form, shape and line characteristics that differ from the existing landscape. These effects are greatly decreasing over distance and by atmospheric conditions such as cloud cover backlight and heat haze. Moreover, not all the dense vegetation in the mining area will be cleared and this further obstructs the visibility.	**2**
Stockpiles, Topsoil, Overburden and discard dump	10-15 meters	The topsoil overburden and discard dump will create a strong contrasting form in the landscape and will initially also have a strong colour contrast. This contrast and high visual effect will be reduced to moderate/low by the progressive rehabilitation of the topsoil, overburden and discard dump. The high contrast is somewhat offset by the presence of vegetation and basal cover in the vicinity of the area, this is because the average canopy size of vegetation ranges between 3-5 meters which can have a shielding effect.	**3**
Central Plant and Mobile Process plant	10-15 meters	Based on the proposed positioning and height of the proposed Gold mine, the exposure rating can be described as being visible – whereby viewers from all compass directions are expected to be able to see the	**3**

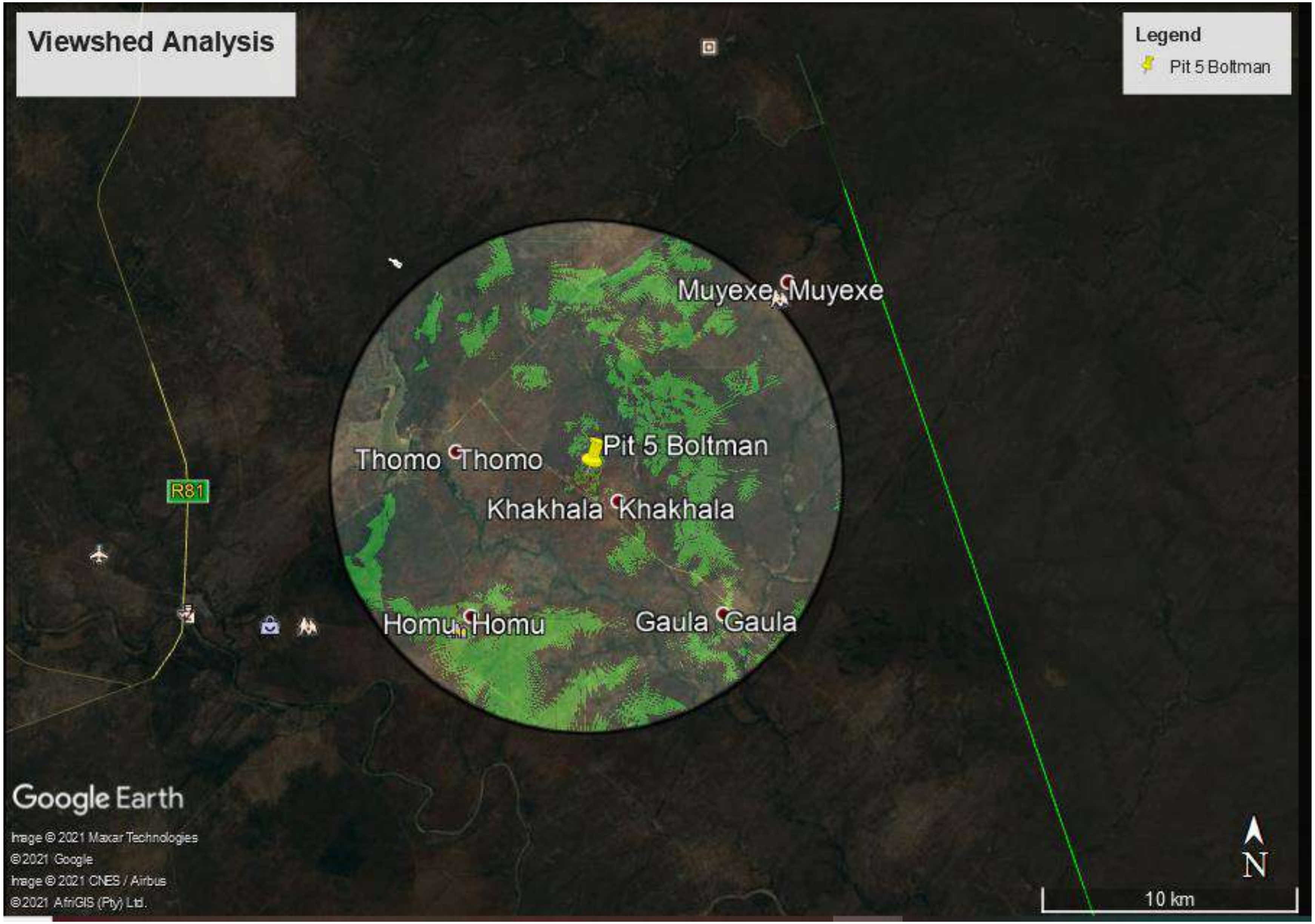
		mine. However, the visibility is expected to become lower as the distance between the viewer and the structure increases.	
Office & Workshop Complex	5-7 meters	The presence of buildings will significantly alter the visual baseline and will also be visually intrusive. The office and workshop complex will greatly contrast with the natural surroundings in terms of colour and texture thereby making them visible. However, the use of vegetation and appropriate paint and materials can greatly reduce the impact of these to low.	**3**

The viewshed analysis was conducted to determine the project visibility i.e., to identify the locations within the study area (10 km radius of the Giyani Goldmine infrastructure such as the pits, processing plants, offices and shaft) where it may be possible to view the proposed mine infrastructure taking into account the surrounding topography.

The resulting viewshed maps below define the maximum area from which the tallest elements of the proposed mine infrastructure (i.e., the top of the headgear and vent shaft) could potentially be seen from ground-level vantage points.

As the viewshed analysis is based on the maximum height of the proposed mine infrastructure and does not take into account the screening effect of vegetation or built structures, it provides a very conservative (i.e., the worst-case scenario) assessment of potential visibility.

The analysis revealed that based on the screening provided by topography alone, the proposed main pit and infrastructure has the potential to be visible from approximately 40 % of the study area (10 km radius).


Viewshed Analysis
Legend
Pit 5 Boltman
Muyexe Muyexe
Thomo Thomo
Pit 5 Boltman
R81
Khakhala Khakhala
Homu Homu
Gaula Gaula
Google Earth
Image © 2021 Maxar Technologies
© 2021 Google
Image © 2021 CNES / Airbus
© 2021 AfriGIS (Pty) Ltd.
N
10 km

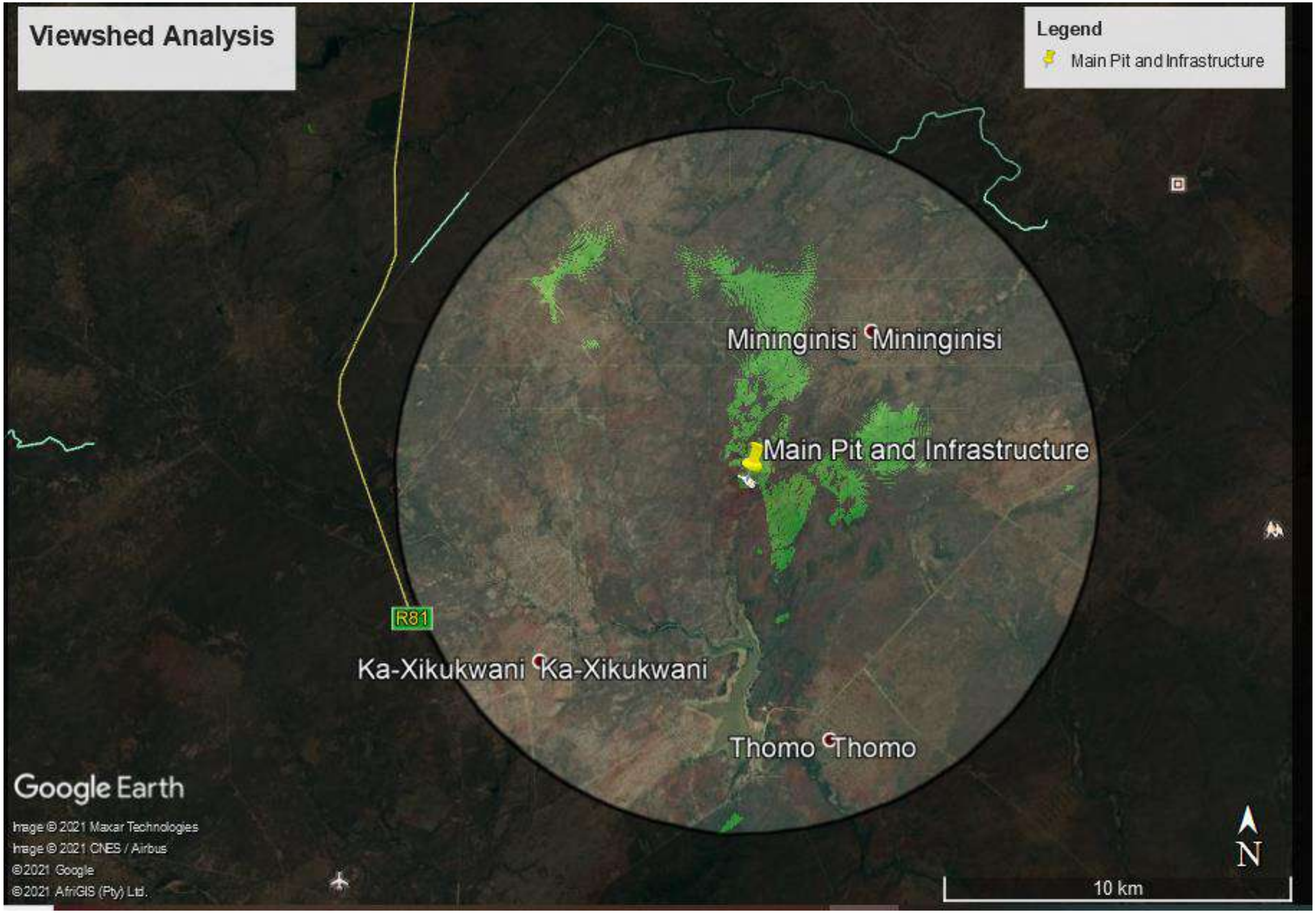

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Image © 2021 CNES / Airbus
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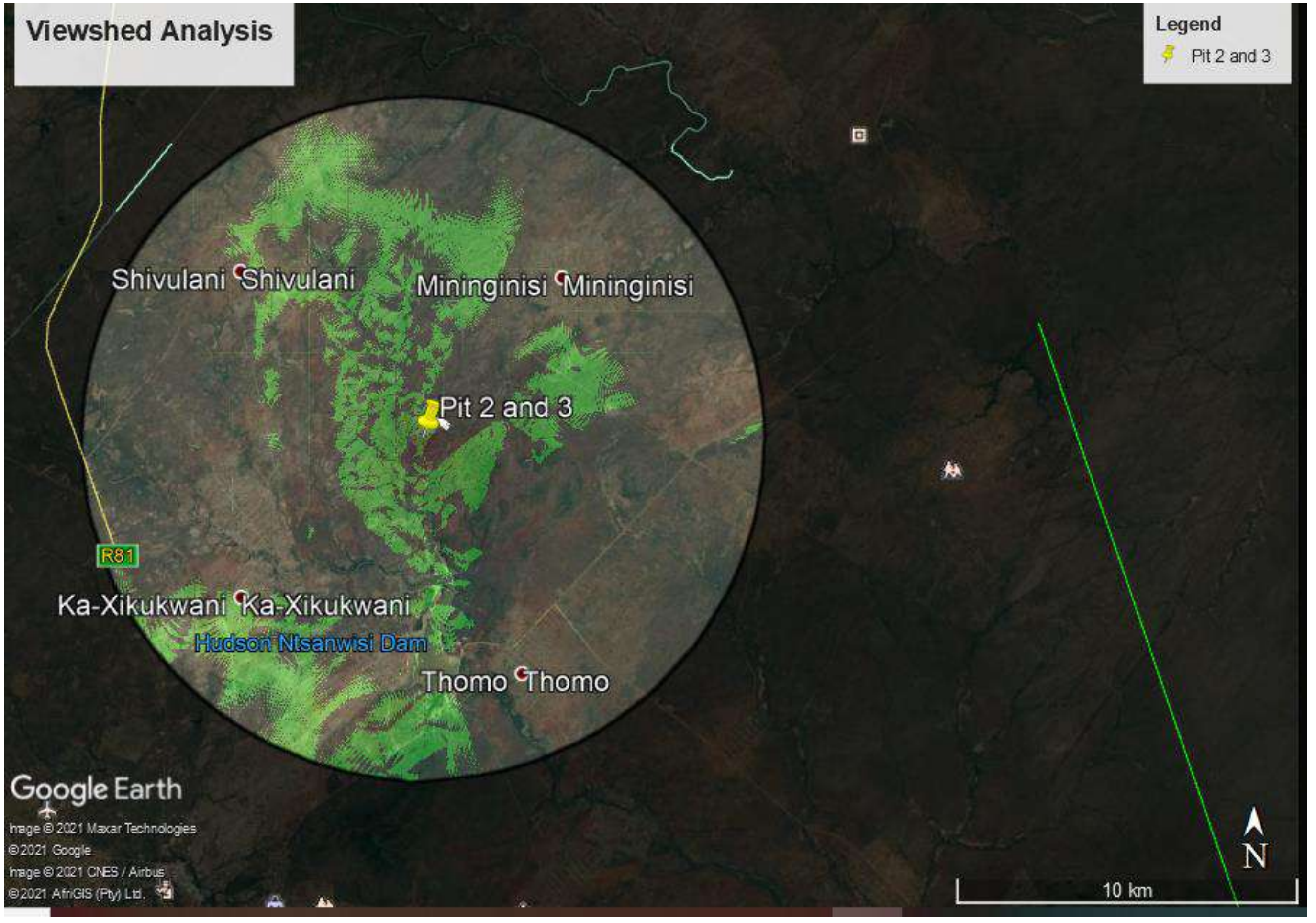


Figure 8: Viewshed 10 Km viewshed of various infrastructure components of Giyani Gold Mine

In spite of the 10km worst case scenario illustrated in the above viewsheds, the visual impact at this distance is expected to be low or insignificant because of the relatively small dimension of the mine in the total field of vision and the dense vegetation around the mine area, which if left relatively intact will reduce the visibility.

4.3 Visual Distance /Observer Proximity to the facility

The distance of a viewer from the proposed project area is an important determinant of the magnitude of the visual impact.

The visual impact of a development diminishes at an exponential rate as the distance between the observer and the object increases – refer to ***Figure 9*** below. Relative humidity and fog in the area directly influence the effect. Increased humidity causes the air to appear greyer, diminishing detail. Thus, the impact at 1 000 m would be 25% of the impact as viewed from 500 m. At 2 000 m it would be 10% of the impact at 500 m. The inverse relationship of distance and visual impact is well recognised in visual analysis literature (Hull and Bishop, 1998) and was used as important criteria for this study, along with the following rating system in ***Figure 9*** which has been utilised to assess the address the factor of distance between a viewer and an object. This rating system does not however, take into account all existing features (such as vegetation and man-made structures).

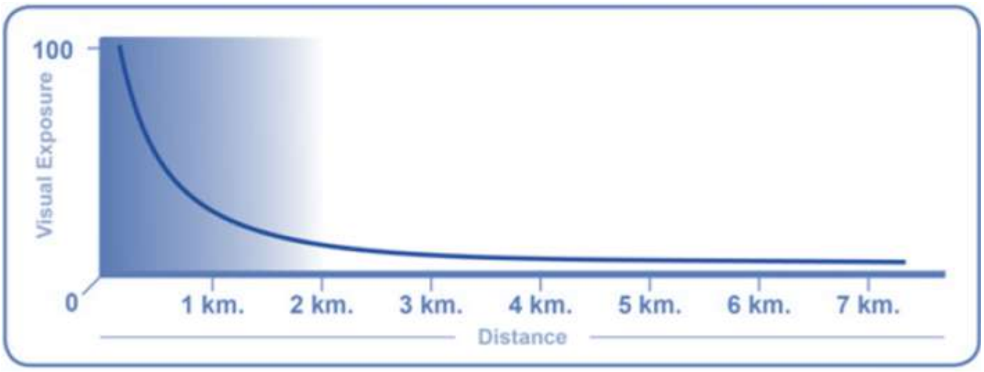


Figure 9: Visual Exposure Curve - Depicting how impact decreases with an increase in distance from a site.

Therefore, visual exposure is an expression of how close receptors are expected to get to the proposed mine on a regular basis. For the purposes of this assessment, close range views (equating to a high level of visual exposure) are views over a distance of 500 m or less, medium-range views (equating to a moderate/medium level of visual exposure) are views of 500 m to 2 km, and long-range views are over distances greater than 2 km (low levels of visual exposure).

Figure 10: Distance Rating System

Location of development from the viewpoint	Category	Value	Description
0 to 0.5 km	Adjacent	5	Adjacent – The development can clearly be seen. Usually on the property boundary or property grounds.
0.5 km to 1 km	Foreground	4	This is the zone in which details such as colour, texture and form can be appreciated. Objects in this zone are highly visible unless obscured by other landscape features, existing structures or vegetation.
1 km to 3 km	Middle ground	3	The zone which occupies the area "between" detail and indistinct colour and line discernment. Objects in this zone can be classified as visible to moderately visible unless obscured by other elements within the landscape.
3 km to 5 km	Distant middle ground	2	This zone is discerned by means of line and colour. Texture and form are generally not seen. Objects in this zone can be classified as marginally visible to not visible. Areas beyond 3 km are usually not investigated as the impact would be negligible on these areas.
5 km and greater	Background	1	Background – Not Visible (Proposed development can hardly / not be seen).

The proposed Giyani Gold Gold mine can be described as falling within the **Middle ground category (3)**, in relation to the nearest visual receptors, traveling on the nearby roads or residing in adjacent areas like Homu, Thomo, Ka Xhikuwani, Mlhava therefore it can be classified as being only visible from various areas within the study area due to the anticipated height of the Gold mine infrastructure and taking into account possible, obscuration from various points within the landscape.

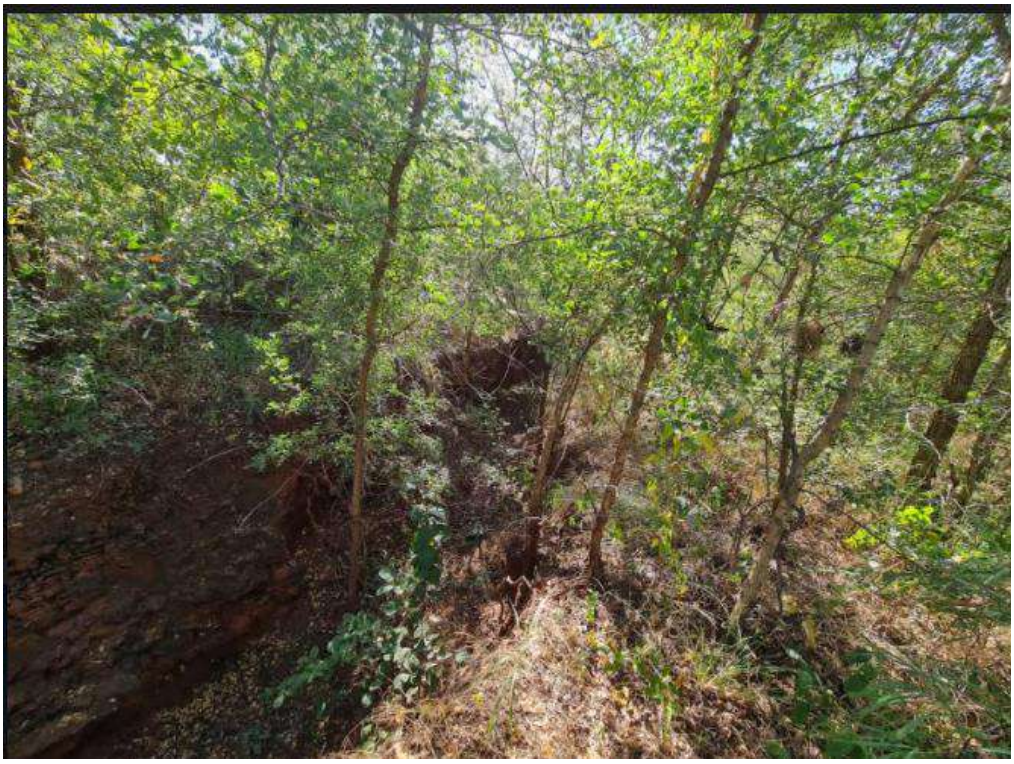
4.4 Visual Absorption capacity (VAC)

VAC can be defined as "an estimation of the capacity of the landscape to absorb development without creating a significant change in visual character or producing a reduction in scenic quality" (Oberholzer, 2005). The ability of a landscape to absorb development or additional human intervention is primarily determined by the nature and occurrence of vegetation cover, topographical character and human structures. Factors contributing to the VAC include:

- Topography and vegetation that is able to provide screening and increase the visual absorption capacity of a landscape.
- The degree of urbanisation compared to open space. A highly urbanised landscape is better able to absorb the visual impacts of similar developments.
- An interrelated landscape comprising a unified environment.
- The scale and density of surrounding developments.

A further major factor is the degree of visual contrast between the proposed project and the existing elements in the landscape. If, for example, a visually prominent industrial development already exists in an area, the capacity of that section of landscape to visually "absorb" additional industrial structures is higher than that of a similar section of landscape that is still in its natural state. VAC is therefore primarily a function of the existing land use and cover, in combination with the topographical ruggedness of the study area and immediate surroundings.

The VAC is rated from high (1) to low (5) based on the capacity of the environment to absorb the visual impact of the facility. The VAC will be high when the environment can hide the development and as such, the colour of a facility can also determine its VAC. The VAC will be low in areas where the topography is flat and natural features such as trees, koppies and mountains are absent.



Photoplate 4: Canopy cover >3 meters in height and dense basal cover

Photoplate 5: Prospecting area with tall savannah bush providing dense obstruction.

The immediate area surrounding the proposed development is generally flat there is however an abundance of vegetation. Due to the location and topography surrounding of the proposed project, as well as the vegetation surrounding the proposed project area, the

VAC is rated as being **Medium-high (3)**. ***Photoplate 4*** and **Photoplate *5*** Substantiates the rating given as it shows the dense basal coverage provided by vegetation that can obstruct views.

4.5 Landscape / townscape compatibility

Landscape or townscape compatibility refers to the compatibility of the proposed infrastructure with the existing landscape or townscape. The landscape / townscape compatibility of the proposed structures and infrastructure were rated based on the following criteria specified in ***Table 6*** below.

Table 6: Landscape / townscape compatibility rating criteria

High (1)	**Moderate (3)**	**Low (5)**
The development: • Is consistent with the existing land use of the area. • Is highly sensitive to the natural environment. • Is consistent with the urban texture and layout. • The buildings and structures are congruent / sensitive to the existing architecture / buildings; and • The scale and size of the development is similar to what exists.	The development: • Is moderately consistent with the existing land use of the area. • Is moderately sensitive to the natural environment. • Is moderately consistent with the urban texture and layout. • The buildings and structures are moderately congruent / sensitive to the existing architecture / buildings; and • The scale and size of the development is moderately similar to what exists.	The development: • Is not consistent with the existing land use of the area. • Is not sensitive to the natural environment. • Is very different to the urban texture and layout. • The buildings and structures are not congruent / sensitive to the existing architecture / buildings; and • The scale and size of the development is different to what exists.

According to the rating methodology outlined in the table above the consistency of the proposed Giyani Gold mine with the existing land use of the area can be determined.

There are several known gold occurrences in the area. A number of the occurrences were prospected and exploited in the past, evident in inactive mines which are found in the area. Six of the inactive mines (Klein Letaba, Louis Moore, Osprey, Fumani, Ranke and Birthday) are known to have produced and recovered gold. Due to the fact that these are historical mines and not ongoing mines shows the lack of any similar mining activities in the immediate vicinity. However, in assigning the rating consideration was given that mining is not new in the area since there have been historical mining in the area.

The proposed mining land use significantly differs from existing land use and is considered to be **Low (5) in terms of** compatibility with the surrounding land use.

4.6 Visual receptor sensitivity

Potential viewers, or visual receptors, are people that might see the proposed development, as visual impact is primarily an impact concerned with human interest. Receptor sensitivity refers to the degree to which an activity will actually impact on receptors and depends on how many persons see the project, how frequently they are exposed to it and their perceptions regarding aesthetics. Receptors of the proposed mining development can be broadly categorised into two main groups, namely:

1. People who live or work in the area and who will frequently be exposed to the project components (resident receptors); and
2. People who travel through the area and are only temporarily exposed to the project components (transient receptors).

A comparatively small number of resident receptors are located in close range (+ - 7km) to some of the proposed infrastructure such as Pit 5 Boltmans Beauty Operation and Pit 3 Gemsbok

Due to the area being mostly serviced by minor roads it is expected that a minimal number of transient receptors may therefore be exposed to the mine, although a large percentage of persons using these roads are locals in the region and therefore fall in the resident receptor category.

The sensitivity of viewers is determined by the number of viewers and by how likely they are to be impacted upon. Sensitivity is also dependent on the viewer’s perception of the area and their ability to adapt to changes in the environment. This can also include how frequently they are exposed to the view i.e., static views from houses would have a higher sensitivity than transient views experienced by motorists.

Residents living in close proximity to the proposed Giyani Gold Mine are considered to be the more sensitive towards the proposed development than those travelling within the study area. However, there are few dispersed and scattered residents near the site of the proposed project.

The viewer sensitivity is ranked from high (5) to low (1) based on the probable perceptions of the viewers and their willingness to change.

The viewer sensitivity related for the proposed development is rated as being **Medium (3)**. This rating is attributed to the current land use surrounding the proposed Giyani Gold mine. Residents residing in the areas adjacent to the Giyani Gold mine opencast pits are considered to be highly sensitive to the proposed development.

4.7 Magnitude Determination of the Visual Impacts

The following **Table *7*** combines the various factors influencing the visual impacts that the proposed development may have, thereby providing input towards calculating the magnitude of the visual impacts for the Giyani Gold Gold Mine.

Table 7: Summary of the criteria to determine the magnitude of the visual impact.

Criteria	Giyani Gold Mine Magnitude
Visibility and Distance[1]	Medium
Visual Absorption Capacity[2]	Medium-High
Landscape Compatibility[3]	Low
Viewer Sensitivity[4]	Medium
Comments	1 **<u>Distance</u>**: Due to the topography and vegetation cover within the study area, as well as the fact that the mine will have limited structures of a high-rise nature the proposed development is not expected to be visible beyond 5 km. 2 **<u>Visual Absorption Capacity:</u>** Trees and vegetation, surrounding the proposed development are expected to provide adequate shielding to portions of the proposed Giyani Gold Mine from viewers, from various directions. If substantial vegetation is left in place around the perimeter of the mine, the VAC will be enhanced. 3 **<u>Landscape Compatibility:</u>** Due to lack of ongoing similar land uses, and the fact that the area is characterised by dispersed rural households, the proposed development is expected to have a medium-low compatibility with the surrounding land uses. 4 **<u>Viewer Sensitivity:</u>** Due to the proposed Giyani Gold Mine being situated within a relatively flat landscape the viewer sensitivity is expected to be medium.

Table 8: Summary of the magnitude of the Visual Impact of the proposed Giyani Gold Mine

Criteria	Giyani Gold Mine
Visual Character	Medium -high
Visual Quality of the Environment	Medium
Visual Exposure	Medium
Visibility and Distance	Medium
Visual Absorption Capacity	Medium-High
Landscape Compatibility	Low
Viewer Sensitivity	Medium
Magnitude	
	Medium

The **magnitude** of the visual impact, which is a subjective measure, is calculated based on an average between all criteria listed in **Table *7*** and as described in Sections 3 and 4. The magnitude are used in Section 5 as the baseline without mitigation rating for the assessment of the visual impact.

5 IMPACT ASSESSMENT

5.1 Impact Assessment Methodology

The following section outlines the key factors used in the final assessment of the visual impacts associated with the proposed Giyani Gold Mine development, bearing in mind the findings of section 5.

Assessment Criteria

The assessment of the impacts will be conducted according to a synthesis of criteria required by the integrated environmental management procedure.

5.1.1 Extent

The physical and spatial scale of the impact is classified as:

a) Footprint

The impacted area extends only as far as the activity, such as footprint occurring within the total site area.

b) Site

The impact could affect the whole, or a significant portion of the site.

c) Regional

The impact could affect the area including the neighbouring properties, the transport routes and the adjoining towns.

d) National

The impact could have an effect that expands throughout the country (South Africa).

e) International

Where the impact has international ramifications that extent beyond the boundaries of South Africa.

5.1.2 Duration

The lifetime of the impact, that is measured in relation to the lifetime of the proposed development.

a) Short term

The impact would either disappear with mitigation or will be mitigated through natural processes in a period shorter than that of the construction phase.

b) Short to Medium term

The impact will be relevant through to the end of the construction phase.

c) Medium term

The impact will last up to the end of the development phases, where after it will be entirely negated.

d) Long term

The impact will continue or last for the entire operational lifetime of the development but will be mitigated by direct human action or by natural processes thereafter.

e) Permanent

This is the only class of impact, which will be non-transitory. Mitigation either by man or natural process will not occur in such a way or in such a time span that the impact can be considered transient,

5.1.3 Intensity

The intensity of the impact is considered by examining whether the impact is destructive or benign, whether it destroys the impacted environment, alters its functioning, or slightly alters the environment itself. The intensity is rated as:

a) Low

The impact alters the affected environment in such a way that the natural processes or functions are not affected.

b) Medium

The affected environment is altered, but functions and processes continue, albeit in a modified way.

c) High

Function or process of the affected environment is disturbed to the extent where it temporarily or permanently ceases.

5.1.4 Probability

This describes the likelihood of the impacts actually occurring. The impact may occur for any length during the life cycle of the activity, and not at any given time. The classes are rated as follows:

a) Impossible

The possibility of the impact occurring is none, due either to the circumstances, design or experience. The chance of this impact occurring is zero (0%).

b) Possible

The possibility of the impact occurring is very low, due either to the circumstances, design or experience. The chances of this impact occurring is defined as 25%.

c) Likely

There is a possibility that the impact will occur to the extent that provisions must therefore be made. The chances of this impact occurring is defined as 50%.

d) Highly likely

It is most likely that the impacts will occur at some stage of the development. Plans must be drawn up before carrying out the activity. The chances of this impact occurring is defined as 75%.

e) Definite

The impacts will take place regardless of any provisional plans, and or mitigation actions or contingency plans to contain the effect can be relied on. The chance of this impact occurring is defined as 100%.

5.1.5 Mitigation

The impacts that are generated by the development can be minimised if measures are implemented in order to reduce the impacts. The mitigation measures ensure that the development considers the environment and the predicted impacts in order to minimise impacts and achieve sustainable development.

5.2 Determination of significance – Without Mitigation

Significance is determined through a synthesis of impacts as described in the above paragraphs. It provides an indication of the importance of the impact in terms of both tangible and intangible characteristics. The significance of the impact “without mitigation” is the prime determinant of the nature and degree of mitigation required. Where the impact is positive, significance is noted as “positive”. Significance is rated on the following scale:

a) No significance

The impact is not substantial and does not require any mitigation action.

b) Low

The impact is of little importance but may require limited mitigation.

c) Medium

The impact is of importance and is therefore considered to have a negative impact. Mitigation is required to reduce the negative impacts to acceptable levels.

d) High

The impact is of major importance. Failure to mitigate, with the objective of reducing the impact to acceptable levels, could render the entire development option or entire project proposal unacceptable. Mitigation is therefore essential.

5.3 Determination of significance – With Mitigation

Determination of significance refers to the foreseeable significance of the impact after the successful implementation of the necessary mitigation measures. Significance with mitigation is rated on the following scale:

a) No significance

The impact will be mitigated to the point where it is regarded as insubstantial.

b) Low

The impact will be mitigated to the point where it is of limited importance.

c) Low to Medium

The impact is of importance however, through the implementation of the correct mitigation measures such potential impacts can be reduced to acceptable levels.

d) Medium

Notwithstanding the successful implementation of the mitigation measures, to reduce the negative impacts to acceptable levels, the negative impact will remain of significance. However, taken within the overall context of the project, the persistent impact does not constitute a fatal flaw.

e) Medium to High

The impact is of major importance but through the implementation of the correct mitigation measures, the negative impacts will be reduced to acceptable levels.

f) High

The impact is of major importance. Mitigation of the impact is not possible on a cost-effective basis. The impact is regarded as high importance and taken within the overall context of the project, is regarded as a fatal flaw. An impact regarded as high significance, after mitigation could render the entire development option or entire project proposal unacceptable.

5.3.1 Assessment weighting

Each aspect within the impact description was assigned a series of quantitative criteria. Such criteria are likely to differ during the different stages of the project's life cycle. In order to establish a defined base upon which it becomes feasible to make an informed decision, it is necessary to weigh and rank all criteria.

5.3.2 Ranking, Weighting and Scaling

For each impact under scrutiny, a scale weighting Factor is attached to each respective impact (refer to Figure 11: Description of biophysical assessment parameters with its respective weighting), The purpose of assigning such weight serve to highlight those aspects considered most critical to the various stakeholders and ensure that each specialist's element of bias is taken into account. The weighting factor also provides a means whereby the impact assessor can successfully deal with the complexities that exist between the different impacts and associated aspects criteria.

Simply, such a weighting factor is indicative of the importance of the impact in terms of the potential effect that it could have on the surrounding environment. Therefore, the aspects considered to have a relatively high value will score a relatively higher weighting than that which is of lower importance.

Extent	Duration	Intensity	Probability	Weighting Factor (WF)	Significance Rating (SR)	Mitigation Efficiency (ME)	Significance Following Mitigation (SFM)
Footprint 1	Short term 1	Low 1	Probable 1	Low 1	Low 0-19	High 0,2	Low 0-19
Site 2	Short to medium 2		Possible 2	Low to medium 2	Low to medium 20-39	Medium to high 0,4	Low to medium 20-39
Regional 3	Medium term 3	Medium 3	Likely 3	Medium 3	Medium 40-59	Medium 0,6	Medium 40-59
National 4	Long term 4		Highly Likely 4	Medium to high 4	Medium to high 60-79	Low to medium 0,8	Medium to high 60-79
International 5	Permanent 5	High 5	Definite 5	High 5	High 80-100	Low 1,0	High 80-100

Figure 11: Description of biophysical assessment parameters with its respective weighting

5.3.3 Identifying the Potential Impacts without Mitigation (WOM)

Following the assignment of the necessary weights to the respective aspects, criteria are summed and multiplied by their assigned weightings, resulting in a value for each impact (prior to the implementation of mitigation measures).

Equation 2:

Significance Rating (WOM) = (Extent + Intensity + Duration + Probability) x Weighting Factor

5.3.4 Identifying the Potential Impacts with Measures (WM)

In order to gain a comprehensive understanding of the overall significance of the impact, after implementation of the mitigation measures, it was necessary to re-evaluate the impact.

a) Mitigation Efficiency (ME)

The most effective means of deriving a quantitative value of mitigated impacts is to assign each significance rating value (WOM) a mitigation effectiveness (ME) rating. The allocation of such a rating is a measure of the efficiency and effectiveness, as identified through professional experience and empirical evidence of how effectively the proposed mitigation measures will manage the impact.

Thus, the lower the assigned value the greater the effectiveness of the proposed mitigation measures and subsequently, the lower the impacts with mitigation.

Equation 3:

Significance Rating (WM) = Significance Rating (WOM) x Mitigation Efficiency

Or WM = WOM x ME

b) Significance Following Mitigation (SFM)

The significance of the impact after the mitigation measures are taken into consideration. The efficiency of the mitigation measure determines the significance of the impact. The level of impact is therefore seen in its entirety with all considerations taken into account.

5.4 Visual Impact Assessment

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Visual impacts, as a result of the proposed development, are likely to result from a number of sources, including:

- The construction phase, i.e., the clearing of vegetation and earthworks.
- The operation phase of the proposed Giyani Gold Mine
- The decommissioning of the Giyani Gold Mine upon ceasing of the activities, i.e., rehabilitation.

Impacts from each of these sources are further discussed below, in relation to the proposed Gold mine.

The significant visual impacts, associated with the project, are only anticipated during the operational phase of the project, once the Gold mine is fully operational at its full capacity. Mitigation measures, however, have been provided for both the construction, operational and decommissioning phases of the project to mitigate and minimise the severity the impacts.

5.4.1 Construction Phase

1. Clearing of vegetation and earthworks

Visual impacts are expected to result from the stripping of vegetation and earthworks associated with the pre-construction and construction phases of the proposed Giyani Gold mine. The stripping of vegetation will result in the bare soil being exposed, creating a visual scar within the area, and a contrasting colour in the landscape.

2. Earthworks and construction of plant infrastructure

The process of construction equipment and related works in the construction of the plant and associated mining areas (e.g., storage areas, access roads) will introduce visually intrusive elements into the landscape and locally result in increased traffic. Although considered a temporary and intermittent impact the number of large vehicles will increase as construction progress. The construction of the project plant and infrastructure will require removal of vegetation and alteration of the existing topography that will result in a change in the existing landscape character. However, due to the relatively flat landscape it is anticipated that only limited topographical changes will be required.

The alterations to the topography will have a visual impact on the landscape that will be most visible during the early stages of construction. However, the alterations are not likely to be seen by the majority of receptors due to the presence of existing vegetation, therefore the impact from earthworks and construction of plant infrastructure is moderate. The loss of vegetation and prominent trees during clearing for the purposes of constructing the project will also have an impact as these elements are considered to be a valuable visual resource within the project area.

3. *Fugitive Dust*

The construction phase could result in increased fugitive dust emissions, particularly during windy conditions. Airborne dust is often visible over great distances and can be particularly bothersome, as it reduces visibility and also alter visual amenities by settling on plants, crops and built structures in large quantities and if not mitigated is expected to be of moderate significance. However, dust emissions will be kept at a minimum through mitigation measures identified under the amount of airborne dust will be significantly reduced, as well as the frequency and distance over which a dust plume will be visible. For this reason, the impact significance after mitigation is rated low.

4. *Lighting at night*

Night-time lighting will be required during construction. Due to the level of screening provided by the existing vegetation cover the impact of light pollution is expected to be limited but may increase as construction progresses and more cranes and large plant are housed on site. The significance of this impact could therefore substantially increase towards the end of construction to moderate significance if not mitigated. The impact can be limited somewhat using measures that reduce unnecessary illumination and “light spill”, but may still be of moderate significance afterwards, as the need for security and operational requirements will dictate the extent to which these measures can be implemented.

Table 9: Clearing of vegetation and earthworks.

Nature of the impact	Reduction in visual resource value		
Impact source(s)	Clearing of vegetation and earthworks		
Magnitude	Extent	Local/Site	
	Intensity	Medium	
	Duration	Short -Medium	
	Probability	Highly likely	
Significance	Without mitigation		**L-M**

	With m*itigation*		L
Confidence	High		

Mitigation measures

- Erosion control measures must be put in place if vegetation is to be cleared.
- Where possible, all the natural vegetation around the Gold mine should be retained, especially vegetation surrounding the perimeter and boundary areas within the Pit5 Boltman and Pit 3Gemsbok area as these are in relatively close proximity to residential settlements.

Table 10: Lighting at night

Nature of the impact	Reduction in visual resource value		
Impact source(s)	Lighting at night		
Magnitude	Extent	Local/Site	
	Intensity	Medium	
	Duration	Short -Medium	
	Probability	Highly likely	
Significance	Without mitigation		L-M
	With m*itigation*		L
Confidence	High		

Mitigation measures

- Where possible, all the natural vegetation around the Gold mine should be retained, especially vegetation surrounding the perimeter and boundary areas.
- During construction, selective lighting for the construction camps and other secured areas should be employed. Up-lighting of structures should be avoided.
- Avoid unnecessary illumination, but safety/security and operational requirements may limit the extent to which this can be implemented.
- Provide lights with cover fittings that limit lateral and upwards “light spill”, and position lights to shine towards the intended areas of illumination rather than using floodlights.
- Limit the heights at which lights are positioned where possible will reduce “light spill”.
- Make use of Low-Pressure Sodium lighting or other types of low impact lighting.
- Low wattage bulbs can be used to further reduce the impact; and
- Motion sensor activated lighting may be used instead of lights that illuminate continuously.

Table 11: Reduction in visual resource value because of construction

Nature of the impact	Reduction in visual resource value		
Impact source(s)	Construction of offices, plant infrastructure, workshops and other associated mine infrastructure		
Magnitude	Extent	Local/Site	
	Intensity	Medium	
	Duration	Short -Medium	
	Probability	Highly likely	
Significance	Without mitigation		**L-M**
	With *mitigation*		**L**
Confidence	High		

Mitigation measures

External signage should be kept to a minimum, were possibly shielding material should be utilised to fence of the construction site.

Where possible, all the natural vegetation around the Gold mine should be retained, especially vegetation surrounding the perimeter and boundary areas.

Table 12: Reduction in visual resource value because of fugitive dust

Nature of the impact	Reduction in visual resource value		
Impact source(s)	Fugitive dust		
Magnitude	Extent	Local/Site	
	Intensity	Medium	
	Duration	Short -Medium	
	Probability	Highly likely	
Significance	Without mitigation		**L-M**
	With *mitigation*		**L**
Confidence	High		

Mitigation measures

- Dust control measures must be implemented.

- If clearing of vegetation or construction is to occur during the night, all lighting should be placed to ensure that excessive lighting does not escape the site.
- When necessary, and particularly during the dry season, efficient watering of areas where construction activities result in dust creation and vehicular movements occur will should be used; and
- There must be an enforcement of low vehicle speeds on site.

Construction Phase Impact Summary

The removal of vegetation cover and alteration of the site topography for construction purposes will negatively impact on the sense of place of the site. This is due to the fact that the defining or recognisable attributes will be altered or removed, especially the larger trees and areas of denser indigenous vegetation cover. The extent of site clearance will directly impact on the visual impact.

The overall visual impacts associated with the construction phase are rated as follows:

- **Extent** –it was identified that areas immediately neighbouring the proposed Giyani Gold mine will be impacted upon. The clearing of vegetation, is therefore rated as having a **Local Area** impact, attributed to the contrasting colours, due to the exposure of bare soil, in the landscape.
- **Duration –** the duration of the impacts associated with the clearing of vegetation will be for the **Short Term,** i.e., during the construction phases of the project.
- **Magnitude –** the magnitude of the impact is rated in bearing in mind the analysis presented in section 4 of this report.
- **Probability –** the probability of the impact occurring, with respects to the clearing of vegetation is considered to be **High likely**.

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5.4.2 Operational Phase

Visual impacts are expected to result from the presence of the proposed Giyani Gold mine and with the actual operational phase of the project.

The following sections describe the potential impacts associated with the operational phase activities of the Giyani Gold mine:

1. Physical Structures

During operations all of the main components namely the open pit, topsoil stockpiles overburden stockpile, product and Run of Mine stockpile, discard dump and the plant along with other mine infrastructure are expected to have an impact on the visual amenities of the area as it impacts the sense of place and is visually intrusive to the surrounding landscape. The presence of the projects physical structures will greatly alter the visual baseline and will also be visually intrusive, due to the size, geometric shapes of the elements being introduced as well as the fact that mining is not a land use characteristic to this area.

The actual open pit is expected to have a large footprint area but limited impact due to it being below ground level therefore leading to limited visibility. The plant infrastructure, although far less expansive in extent than the other elements will also greatly contrast with the natural surroundings.it is therefore expected that the level of visual intrusion of all the main project components will be high during operations if mitigation measures are not implemented. Visual mitigation potential in terms of the open pit and the stockpile during operations is limited to best practice measure and ensuring that optimal progressive rehabilitation is implemented throughout the lifespan of the mine and will bring the impact to moderate significance.

Ancillary infrastructure such as roads, fences, small buildings and services will only be visually intrusive to a low degree as previously mentioned, as these elements are not uncommon even in rural or largely undeveloped areas. Nevertheless, the visual resource value of the study area will be adversely affected, hence the significance of the impact is expected to range from high to moderate depending on the actual level of visibility. Visual mitigation efforts should therefore be focussed on reducing the long-term post-closure impacts caused by the mine, through effective concurrent and post-operational rehabilitation.

2. Fugitive dust

The possibility exists that the project may result in the generation of fugitive dust operation from exposed surfaces and vehicular traffic. The severity of dust pollution will be determined by a number of different factors such as prevailing wind strength and the extent of the area/s cleared by the operations and may potentially be of moderate significance. However, mitigation measures will be implemented by Giyani Gold mine to minimize fugitive dust throughout the operational phase which are expected to limit the extent and frequency of visible dust plumes, which will reduce the significance of the impact to low.

3. *Night-time lightning*

Because of the relatively flat topography, limited levels of development within the study area and surroundings and the extent of the proposed development it is anticipated that night-time lighting could impact the visual landscape significantly. Lights can potentially be highly visible and intrusive in remote, low development areas. However, due to the availability of numerous mitigation measures the impact of the light on receptors can be reduced from high to relatively moderate.

The following are some mitigation measures that can reduce the impact of light pollution:

- ❖ Utilise security lighting (if feasible) that is movement activated rather than permanently switched on, to prevent unnecessary constant illumination.
- ❖ Plan the lighting requirements of the facilities to ensure that lighting meets the need to keep the site secure and safe, without resulting in excessive illumination.
- ❖ Reduce the height from which floodlights are fixed as much possible while still maintaining the required levels of illumination.
- ❖ Identify zones of high and low lighting requirements, focusing on only illuminating areas to the minimum extent possible to allow safe operations at night and for security surveillance.
- ❖ Avoid up-lighting of structures by rather directing lighting downwards and focussed on the area to be illuminated; and
- ❖ Fit all security lighting with ‘blinkers or specifically designed fixtures, to ensure light is directed downwards while preventing side spill. Light fixtures of this description are commonly available for a variety of uses and should be used to the greatest extent possible.

Table 13: Visual Impact of physical structures on site

<table>
<tr><td>Nature of the impact</td><td colspan="2">Operational Phase Reduction in visual resource value due to presence of physical structures on site</td></tr>
<tr><td>Impact source(s)</td><td colspan="2">presence of topsoil, Run of Mine, product and overburden stockpiles and discard dumps.
processing plant and other mining infrastructure;</td></tr>
<tr><td rowspan="2">Magnitude</td><td>Extent</td><td>Regional</td></tr>
<tr><td>Intensity</td><td>Medium</td></tr>
</table>

	Duration	Long Term	
	Probability	Highly Likely	
Significance	Without mitigation		M
	With m*itigation*		L-M
Confidence	High		

Mitigation measures

- ❖ Where possible, natural vegetation around the Giyani Gold Mine should be retained.
- ❖ Progressive rehabilitation of the Gold mine should be undertaken.
- ❖ Mine dumps and stockpiles should not exceed 15m of height.
- ❖ Litter control measures should be kept in place to ensure that the site is maintained in a neat and tidy condition.
- ❖ Employ 'smart architecture' on physical infrastructure to mimic natural elements and traditional building forms.
- ❖ External signage should be kept to a minimum (with the exception of safety notifications).
- ❖ Designated areas for material storage, waste sorting and temporary storage batching and other potentially intrusive activities will be created and screened off to the extent is feasible and
- ❖ Where feasible trees must be transplanted to locations adjacent to the mine where they will not be affected by mining activities.

Table 14: Visual Impact of Fugitive dust

Nature of the impact	Operational Phase Reduction in visual resource value due to Fugitive dust		
Impact source(s)	presence of topsoil, Run of Mine, product and overburden stockpiles and discard dumps;		
Magnitude	Extent	Regional	
	Intensity	Medium	
	Duration	Long Term	
	Probability	Highly Likely	
Significance	Without mitigation		M
	With m*itigation*		L-M
Confidence	High		

Mitigation measures

- ❖ Where possible, natural vegetation around the Giyani Gold Mine should be retained.
- ❖ Institute a rigorous planting regime along the project site boundaries to act as bio-filters.
- ❖ Areas where vegetation has been cleared on site should have erosion control measures in place.
- ❖ The planting of trees must be instituted along the entire access route to prevent dust plumes spreading.
- ❖ Progressive rehabilitation of the Gold mine should be undertaken.
- ❖ Dust control must be implemented by reducing and controlling dust through the use of approved dust suspension techniques as and when required.
- ❖ Consider fitting drills with dust collection systems.
- ❖ All stockpiles of material that maybe blown away during windy spells (such as sand, soil, and excavated material etc.) will be suitably covered or other measures taken to prevent such occurrence. Suitable measures will be determined by the environmental control officer or site engineer based on the nature of the material, its use etc.

Table 15: Visual Impact of nighttime Illumination

<table>
<tr><td>Nature of the impact</td><td colspan="3">Operational Phase Reduction in visual resource value due to Night-time illumination</td></tr>
<tr><td>Impact source(s)</td><td colspan="3">mining infrastructure</td></tr>
<tr><td rowspan="4">Magnitude</td><td>Extent</td><td colspan="2">Regional</td></tr>
<tr><td>Intensity</td><td colspan="2">Medium</td></tr>
<tr><td>Duration</td><td colspan="2">Long Term</td></tr>
<tr><td>Probability</td><td colspan="2">Highly Likely</td></tr>
<tr><td rowspan="2">Significance</td><td>Without mitigation</td><td></td><td>M</td></tr>
<tr><td>With mitigation</td><td></td><td>L-M</td></tr>
<tr><td>Confidence</td><td colspan="3">High</td></tr>
</table>

Mitigation measures

A number of measures can be implemented to further reduce the impact of lighting at night. These include:

- ❖ Outdoor lighting must be strictly controlled so as to prevent light pollution.
- ❖ All lighting must be installed at downward angles.

- ❖ Sources of light must as far as possible be shielded by physical barriers such as a planted trees and shrubs or built structures, where possible, natural vegetation around the Giyani Gold Mine should be retained so as reduce unnecessary illumination and "light spill".
- ❖ Consider the application of motion detectors to allow the application of lighting only where and when it is required.
- ❖ The height of poles and masts determines how broadly the light is dispensed. If the lights are mounted at an appropriate height, they will provide maximum illumination while minimizing light pollution into the surrounding area.
- ❖ providing lights with cover fittings that limit lateral and upwards light "spill", and positioning lights to shine towards the intended areas of illumination rather than using floodlights.
- ❖ The use of outdoor fixtures high up on tall structures should be limited or avoided.
- ❖ Consider installing anti-reflective coating on metal surfaces to reduce the sunlight that is reflected and increase the amount of sunlight that is absorbed during daytime, to reduce the effect of glare and reflection of metal infrastructure.
- ❖ Consider installing all electrical lines underground, to mitigate the potential impact of glare of such lines.

Operation Phase Impact Summary

The further removal of the vegetation cover and alteration of the site topography for mining and earth-removing will continue to negatively impact on the sense of place, as the defining or recognisable attributes of the site will be altered or removed on a large scale. Where it occurs, the removal of vegetation and land cover will also lower the VAC of the study area. The project infrastructure will be visually intrusive and secondary impacts such as dust clouds and night-time lighting will reduce the resource value of the visual landscape.

A comparison of the visual significance rating with and without mitigation, associated with the Gold mine is presented in the tables above, the overall visual impacts associated with the proposed Giyani Gold mine are rated as follows without mitigation:

- **Extent –** The operation of the proposed Gold mine and its associated infrastructure is rated as having a **Regional** impact, due to the anticipated height of the facility.
- **Duration** – the duration of the impacts associated with Giyani Gold Gold mine can be described as being **long term,** unless completely removed from site.
- **Magnitude –** the magnitude of the impact is rated bearing in mind the analysis presented in section 4 of this report.

- **Probability** – the probability of the impact occurring, with respects to the operations are considered to be **Highly Likely.**

The environmental significance associated with the operations can be moderated by maintaining as much of the existing vegetation as possible, and the establishment of vegetation along the perimeter of the Giyani Gold mine and also through progressive rehabilitation.

5.4.3 Decommissioning / Closure Phase

Visual impacts are expected to result from the rehabilitation processes associated with the decommissioning / Closure phases of the project... During decommissioning, impacts will not differ much from the operational phase except that there will be more activity on the site. Impacts associated with this will not be as significant those for the construction phase.

The following describes the potential impacts associated with the decommissioning and closure phase:

1. Decommissioning activities

The process of decommissioning the Giyani Gold mine, which will include dismantling and deconstruction of project-related infrastructure and removing the materials from site, is expected to cause a visual impact of a similar nature to that of the construction process, with two differences. Firstly, the process is expected to be somewhat shorter in duration than the construction process, and secondly will result in an increasingly improved visual condition thus creating a positive impact, due to the progressive removal of the project infrastructure from the landscape. Thus, although the nature of the impact itself maybe negative, the end result will be an improvement in the visual character of the landscape from that of the operational phase condition, albeit in itself of low significance.

2. Site rehabilitation

The implementation of post-closure rehabilitation measures, such as the re-contouring of the landscape to more closely resembling the natural topography and the re-installation of natural land cover, is expected to result in a significant additional improvement of the visual condition. Once implemented it is expected that visual condition will be very similar to that of the pre-project baseline and is therefore considered a positive visual impact associated with this phase of the project, of moderate significance.

Decommissioning and Closure Phase Impacts Summary

Decommissioning and closure of the plant and the subsequent rehabilitation of the project-affected area will have a positive visual impact and at least partially restore the sense of place and visual resource value of the site. The most visually intrusive elements of the project, the plant will be removed from the visual landscape and the topography will be re-shaped the site will also be re-vegetated and will in time to some extent resemble the pre-project condition.

A comparison of the visual significance rating with and without mitigation, associated with the rehabilitation of the site for the closure phase is presented in **Table *16*** below based on the above methodology the visual impacts associated with the decommissioning / closure phase of the project are rated as follows:

- **Extent** – from the view sheds and site visit, it was identified that areas surrounding the proposed mine may be impacted upon. The removal of infrastructure, and the rehabilitation of the site, is therefore rated as having a **Regional** impact, attributed to the contrasting colours, due to the exposure of bare soil, in the landscape.
- **Duration –** the duration of the impacts associated with the rehabilitation will be for the **Medium Term**. Thus, allowing the rehabilitated areas to be in union with the surrounding landscape.
- **Magnitude –** the magnitude of the impact is rated bearing in mind the analysis presented in section 4 of this report.
- **Probability –** the probability of the impact occurring, with respects to the decommissioning and closure activities are considered to be **High.**

Table 16: Comparison of the visual significance rating with and without mitigation associated with the Closure Phase.

Sources of Visual Impact During Decommissioning and Closure Phase		Status	Probability	Duration	Extent	Magnitude	Loss of Resources	Significance[1]	
Without Mitigation	Reinstatement of visual resource value due to dismantling of infrastructure and subsequent rehabilitation of footprint areas	Positive	4	3	3	8	2 (Minor)	**56**	**MODERATE**
With Mitigation	Permanent alteration of site topographical and visual character of mined areas	Positive	3	3	2	6	1 (Limited)	**33**	**MODERATE**

Mitigation Measures	It is recommended that best-practice methods will be followed regarding decommissioning, closure and subsequent rehabilitation of the entire site, which would include the following: ❖ Dismantle and remove all visible surface infrastructure during decommissioning. ❖ Re-shape all footprint areas to be as natural in appearance as possible. ❖ Implement progressive rehabilitation during operations. ❖ Shape and profile the final mining void to be free draining if possible and establish a vigorous and self-sustaining vegetation cover on the final rehabilitated landforms. ❖ Conduct on-going monitoring and maintenance of the rehabilitated areas to ensure that they establish. ❖ successfully and that erosion does not occur. Continuously assess condition of vegetation cover of rehabilitated areas for adequate cover density and species composition. Due to the unpredictable nature of vegetation growth the effectiveness of the re-vegetation will only become apparent after several years. Where specimens die, grow poorly or do not affect sufficient coverage the cause of the problem should be established and the afflicted specimens replaced, or a more suitable alternative established, based on a case-to-case basis; and ❖ Employ control measures to eradicate weedy and alien invader plant species as required. ❖ A detailed post-closure land use plan be compiled for the mine, which will take into consideration all present and likely future land uses surrounding the site, to ensure that the site is successfully re-integrated into the existing visual fabric.
Formula Used	$Significance = (extent + duration + magnitude) \times probability$

5.5 Visual Impact Statement

The project site is visible from most observation points in the foreground and middle ground, and this is further exacerbated by relatively flat terrain of the area. The results of the Visual Impact Assessment for the proposed Giyani Gold Mine therefore found that the proposed activity will have a moderate negative impact on the visual environment. However, with mitigation the impact can be reduced to a low –moderate ranking. This mitigation could be to ensure that the area minimises the removal of vegetation such as shrubs and trees which provide dense cover.

6 RECOMMENDATIONS AND MITIGATION MEASURES

The role of mitigation is critical in finding a design / rehabilitation solution that will be visually acceptable. Potential mitigation measures have been taken into consideration during the design phase, as discussed above and are also provided by natural features in the area. Only effective, economically feasible, appropriate and visually acceptable mitigation measures are recommended, and these should form part of an Environmental Management Plan to be implemented should the project be approved. Preliminary and conceptual mitigation recommendations include:

a. **Primary measures**

   These are measures that intrinsically comprise part of the development design through an iterative process. Mitigation measures are more effective if they are implemented from project inception when alternatives are being considered. Mining or closure is one of concepts that are used. The mine closure and rehabilitation, final landform and land use must be planned before the opencast mining is initiated. Primary measure that will be implemented will mainly be measures that will minimise the visual impact by softening the visibility of the mining activities by blending with the surrounding areas. Such measures will include concurrent rehabilitation of the mining area by re-vegetation of the mining site and surrounding area.

b. **Secondary measures**

   These are designed to specifically address the remaining negative effects of the final development proposals. Secondary measures will include the final rehabilitation, after care and maintenance of the vegetation to ensure that the final land reform is maintained.

6.1 Management Guidelines

In considering mitigating measures three rules were considered:

1) **Economic feasibility.**
2) **Effectiveness**- meaning how long it will take to implement and what provision is made for the management and maintenance; and
3) **Acceptability** within the framework of the existing landscape and land use policies for the study area. To address these, the following principles have been considered:
   I. Mitigation measures should be designed to suit the existing landscape character and needs of the locality. They should respect and built landscape distinctiveness.
   II. Mitigation measures would be feasible and effective in reducing the visual impact on some residential views from adjacent farms, tourist areas and local farm roads.

In order to allow for ease of understanding of the proposed mitigation measures during the varying phases at the proposed development, the following section below will present some guidelines to aid in managing the visual impacts as a result of the proposed development.

Visual Management Guidelines

1. Pre-Construction

All topsoil removed from the site, prior to construction activities should be stored for rehabilitation purposes at the site.

2. Construction

- Ensure, wherever possible all existing natural vegetation is retained and incorporated into the site rehabilitation to ensure views towards the proposed Gold mine are impeded.
- Dust suppression techniques should be in place at all the times during the construction and operational phases to ensure that undue interest is not drawn to the site.
- If vegetation is to be cleared on site, erosion control measures should be kept in place to ensure that excessive scarring of the landscape is reduced.
- If construction is to occur during the night, all lighting should be kept facing inward. This is to ensure that excessive light does not escape from the construction area.
- Investigation into the establishment of vegetation and/or the construction of man-made barriers between the sensitive viewers and the proposed development must be undertaken during the construction and operational phases.
- During construction, litter control measures should be kept in place to ensure that the site is maintained in a neat and tidy condition.
- External signage should be kept to a minimum.

3. Operation

- The mine must ensure low foot level lighting as possible, if it is possible where it is deemed safe, lighting should be avoided. Lighting pollution should be carefully considered and kept to a minimum wherever possible as light at night travels great distance.
- Physical barriers could be used as shielding or cover to prevent excess light leaving the site. It is also important to ensure that where possible, lighting should be faced/

shielded inward away from the viewer. Areas of high reflective surfaces should be covered in an attempt to reduce the reflection from the development.

- During operations, litter control measures should be kept in place to ensure that the site is maintained in a neat and tidy condition.
- The re-vegetation of the site during the operational phase should be considered only if it does not interfere with operations or pose a risk to the health and safety of people and animals. Vegetation around a structure tends to break the outline of the structure against the landscape and will therefore allow for the structure to be less pronounced. Vegetation can be used to reduce the visual scarring of the landscape and potentially reduce the visual impacts of the proposed development.
- Stockpiles should not exceed 15m in height.
- Blasting should be done under controlled conditions (i.e., windy days must be avoided and must be done in such a way that must be minimised).

4. Decommissioning and closure

- Re-establish vegetation within the development footprint areas to allow for the VAC of the area to be increased.
- All infrastructure used should be disassembled and removed from site to ensure the site resembles a natural state and the environment be restored to a condition whereby the natural functioning of the ecosystem can take place.

7 CONCLUSIONS

No potential visual impact, associated with the development of the proposed Giyani Gold mine, has been identified during this study which could be seen as a fatal flaw in terms of sensitive visual receptors located in close proximity to the proposed project area. The project therefore is considered to be acceptable from a visual perspective provided recommended mitigation measures are implemented.

The proposed project components will have a significant impact on the visual environment, the significance of the impact will generally be moderate. This is due to the fact that the proposed project, although unique to the area and the project being of a visually detrimental nature, the availability of mitigation measures can reduce the impact to within acceptable ranges.

The most significant visual impacts are expected to be caused during operations and will be caused by the appearance of the physical infrastructure, mine dumps, stockpiles and plant. However, a number of visual mitigation measures have been identified to address the anticipated visual impacts. The moderating factors of the visual impact of the facility in the close range are the following:

- Short exposure time of road users
- The time the structure will be visual due to roll-over mining.
- Number of human inhabitants located in the area.
- Natural topography and vegetation
- Mitigation measures that will be implemented such as the establishment of barriers or screens.
- The size of the operation
- Medium to high absorption capacity of the landscape

Subsequently, from a visual perspective, it is recommended that the proposed project goes ahead, provided that the recommended mitigation measures are implanted in a diligent manner.

8 REFERENCES

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APPENDIX 1: VIEWPOINT DESCRIPTION

Visibility Ranking – after Site Visit Verification			
Not Visible	Marginally Visible	Visible	Highly visible
Final Visibility Criteria (Exposure Rating)			
1	2	3	4

VIEWPOINT	DESCRIPTION	VISIBILITY RANKING
VP1	This viewpoint is located North of the project area facing towards R81	2
VP2	This viewpoint is facing Khakhala	1
VP3	This viewpoint is located North East facing towards Mtititi	3
VP4	This viewpoint is located facing towards Homu	2
VP5	This viewpoint is within the study area towards the main pit and shaft	2
VP6	This viewpoint is to the North facing the direction of Muyexe	4
VP7	This viewpoint is located on the south east of the project area towards Thomu and the dam	4

ANNEXURE 8 - SOCIAL IMPACT ASSESSMENT

AMBIENT NOISE ASSESSMENT FOR THE PROPOSED GIYANI GOLD MINE PROJECT, LOCATED IN GIYANI IN THE LIMPOPO PROVINCE

COMMISSIONED BY KUSILE INVEST 133 (PTY) LTD

ABSTRACT

Noise Assessment for the mining right application on Un-Surveyed State land of Greater Giyani 891 LT and a portion of portion 0 of the farm 246 located in the Greater Giyani Municipality, within Mopani District Municipality in Limpopo Province.

DATE: 24 APRIL 2021

EXECUTIVE SUMMARY

Kusile Invest 133 (Pty) Ltd has appointed Archean Resources (Pty) Ltd, an independent consulting company, to conduct an Environmental Impact Assessment (EIA) process to evaluate the potential environmental and social impacts of the proposed project. This Ambient Noise Assessment (ANA) forms a part of the specialist reports which will be incorporated into the Environmental Impact Report. The project is referred to as the Giyani Gold Mine Project. The applicant Kusile Invest has lodged a mining right on Un-Surveyed State land of Greater Giyani 891 LT and a portion of portion 0 of the farm 246 located within the town of Giyani, Limpopo Province. and intends to establish an underground and open cast mine.

The mine development activities will commence by establishing and installing the required mining infrastructure such as pit establishment, shaft headgear and winders, service water, compressed air and power supply, processing plant and installation of surface ventilations fans. The type and size of the mining infrastructure to be installed will be designed to support the proposed Life of Mine (LOM) production rate of 12 000 tons per month of Run of Mine material (ROM) for 30 (thirty) years.

The purpose of the Ambient Noise Assessment is to determine a baseline which can be used to measure future noise levels. The existing noise sources are form vehicles, rural area activities, subsistence farming and mining permit operations within the application area. Ambient noise was measured and can also be used as a baseline to analyse future noise assessment studies once mining commences. This report represents the Noise Impact Assessment, which forms one of a series of specialist studies which will be used in compiling background information and impact assessment for the environmental authorisation.

Noise is defined as unwanted sound. Sound travels through the air as waves moving outward from the source and exerts a sound pressure level that is measured in decibels (dB). The pressure wave travelling through the air exerts a force, which is registered by the human ear as sound. There is an existing ambient noise level (prevailing noise level) in any given situation and/or area. The introduction of a new activity in an area can be determined, evaluated and controlled for the receptor of the sound to perceive it as acceptable or an intrusion.

The noise levels recorded where indicative of each activity taking place in the proposed mining area. The noise levels recorded where indicative of each activity taking place in the proposed mining area. The noise levels closer to the **mining permit activities** where high with an average of **5**0dB characteristic of Urban districts. The noise levels reduce towards the townships and decreases even further at the villages (**Thomo** and **Shiviti**) with areas closer to the roads having higher noise levels but generally the noise levels range +-4**0**dB which is consistent with rural areas. The major sources contributing to noise levels observed where:

- Vehicle movement (commuter and light passenger vehicles).

- Mining Permit activities.
- Day to day human activities.
- Seasonal farming activities; and
- Fauna sound.

Mining operations generate noise that can be heard in the surrounding community. In terms of the South African National Standards, residential daytime ambient noise levels should not exceed 55 dBA; and night-time ambient noise levels should not exceed 45dBA. Therefore, the proposed mine and associated activities will have an impact as noise levels will increase significantly. The key aims and objectives of this study included:

- Establish Baseline Noise Climate by measurement
- Define criteria to be used for noise impact assessment
- Carry out noise impact assessment
- Recommend mitigation measures

This specialist study report includes the following sections:

- Methodology
- Baseline Noise Measurement
- Measurements on similar equipment and procedures
- Noise assessment and Mitigation measures

The following impacts will occur:

- Construction Phase
    - Increased noise levels from underground and surface remining and plant area construction activities; and
    - Increased noise levels along the boundary of the proposed site during inception of the proposed Site.
- Operational Phase

    - Increased noise levels off the proposed from mining activities; and
    - Increased noise levels along the feeder roads.

Mitigation

By understanding the potential noise impacts of an operation, selected practices can be applied to address specific noise issues at a mine site. Typical methods of noise management include:

Construction and Operational Phase

- Construction activities during the construction phase to take place during daytime only;
- Biannual noise assessments during construction and operation along the boundaries of the proposed Site to take place to identify noise intrusions;
- Using acoustic silencers on noisy equipment, all machinery and/or plant, which radiate noise levels exceeding 85.0dBA to be acoustically screened off;
- All vehicles operational at the proposed site to conform with the following health and safety standards, Operational procedures such as speed limits on roads on site;
- Selecting equipment with lower sound power levels;
- Installing acoustic enclosures for machinery and/or parts causing radiating noise;
- Conformance to the prevailing ambient noise level along the boundary of the proposed project area;
- Plant and equipment design and selection, replacing older equipment with new technology that is often quieter;
- House crushing plants within buildings, Enclosing conveyor systems;
- Reducing impact noise by lining chutes with hard wearing rubber and polyurethane materials;
- Using terrain to acoustically shield the operations, placing noisy equipment behind noise barriers;
- Alternate safety systems on mobile equipment to replace reversing alarms and horns
- Monitoring systems to reduce the impact of weather conditions and regular monitoring should also be implemented. Vibration and shock monitoring is an integral part of machine condition monitoring programs. All equipment that has belts, gears, bearings, drive motors, and other moving components has a “normal” range of vibration during operating cycles. Change in equipment vibration serves as an early warning of a decline in operating function and signals the need for maintenance to avoid more serious faults and/or failure.

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Acronyms and Abbreviations

AEL	Atmospheric Emissions License
APPA	Atmospheric Pollution Prevention Act (Act No. 45) of 1965
AQ	Air quality
AQA	National Environmental Management: Air Quality Act (Act No. 39) of 2004
AQO	Air Quality Officer
AQMP	Air Quality Management Plan
AZSL	Acceptable Zone Sound Level (Rating Level)
dB	Decibel
DM	District Municipality
I&APs	Interested and Affected Parties
IDP	Integrated Development Plan
LEDET	Limpopo Department of Economic Development, Environment and Tourism
LM	Local municipality
masl	Meters above mean sea-level
NAAQS	National Ambient Air Quality Standards
NO	Nitrogen oxide
NOX	Oxides of nitrogen
NO2	Nitrogen dioxide
O3	Ozone
Pb	Lead
PM	Particulate matter
PM10	Thoracic particulates (particulates with diameter of less than 10 µm)
PM2.5	Respirable particulates (particulates with diameter of less than 2.5 µm)
SAAQIS	South African Air Quality Information System
SANS	South African National Standard
SAWS	South African Weather Services
SO2	Sulphur dioxide
TSP	Total Suspended Particulates
VOCs	Volatile organic compounds
WHO	World Health Organisation

Glossary

Ambient noise

The totally encompassing sound in a given situation at a given time and usually composed of sound from many sources, both near and far.

Ambient sound level

Means the reading on an integrating impulse sound level meter taken at a measuring point in the absence of any alleged disturbing.

A-weighted sound pressure level (sound level) (L_{pA}), in decibels

The A-weighted sound pressure level is given by the equation:

$L_{pA} = 10 \log (p_A/p_o)2$

Where

p_A is the root-mean-square sound pressure, using the frequency weighting network A in pascals; and

p_o is the reference sound pressure (p_o = 20 μPa).

Distant source

A sound source that is situated more than 500 m from the point of observation

Impulsive sound

Sound characterised by brief excursions of sound pressure (acoustic impulses) that significantly exceed the residual noise

Initial noise

The component of the ambient noise present in an initial situation before any change to the existing situation occurs

Intelligible speech

Speech that can be understood without undue effort

Low frequency noise

Sound, which predominantly contains frequencies below 100 Hz

Nearby source

A sound source that is situated at a distance of 500 m or less from the point of observation

Noise nuisance

Means any sound which disturbs or impairs the convenience or peace of any person

Residual noise

The ambient noise that remains at a given position in a given situation when one or more specific noises are suppressed

Specific noise

A component of the ambient noise which can be specifically identified by acoustical means and which may be associated with a specific source

STATEMENT OF INDEPENDANCE AND PROFESSIONAL AFFILIATION

I, Yvonne Gutoona on behalf of Archean Resources hereby declare my independence during this study. I have no vested interest in the project and remuneration by the applicant is for the Ambient Noise Assessment report.

Y. Gutoona

Signed at: Pretoria

Signed: 24 April 2021

1 INTRODUCTION

1.1 Background

Kusile Invest 133 (Pty) Ltd has appointed Archean Resources (Pty) Ltd, an independent consulting company, to conduct an Environmental Impact Assessment (EIA) process to evaluate the potential environmental and social impacts of the proposed project. This Ambient Noise Assessment (ANA) forms a part of the specialist reports which will be incorporated into the Environmental Impact Report. The project is referred to as the Giyani Gold Mine Project. The applicant Kusile Invest has lodged a mining right on Un-Surveyed State land of Greater Giyani 891 LT and a portion of portion 0 of the farm 246 located within the town of Giyani, Limpopo Province. and intends to establish an underground and open cast mine.

The mine development activities will commence by establishing and installing the required mining infrastructure such as pit establishment, shaft headgear and winders, service water, compressed air and power supply, processing plant and installation of surface ventilations fans. The type and size of the mining infrastructure to be installed will be designed to support the proposed Life of Mine (LOM) production rate of 12 000 tons per month of Run of Mine material (ROM) for 30 (thirty) years..

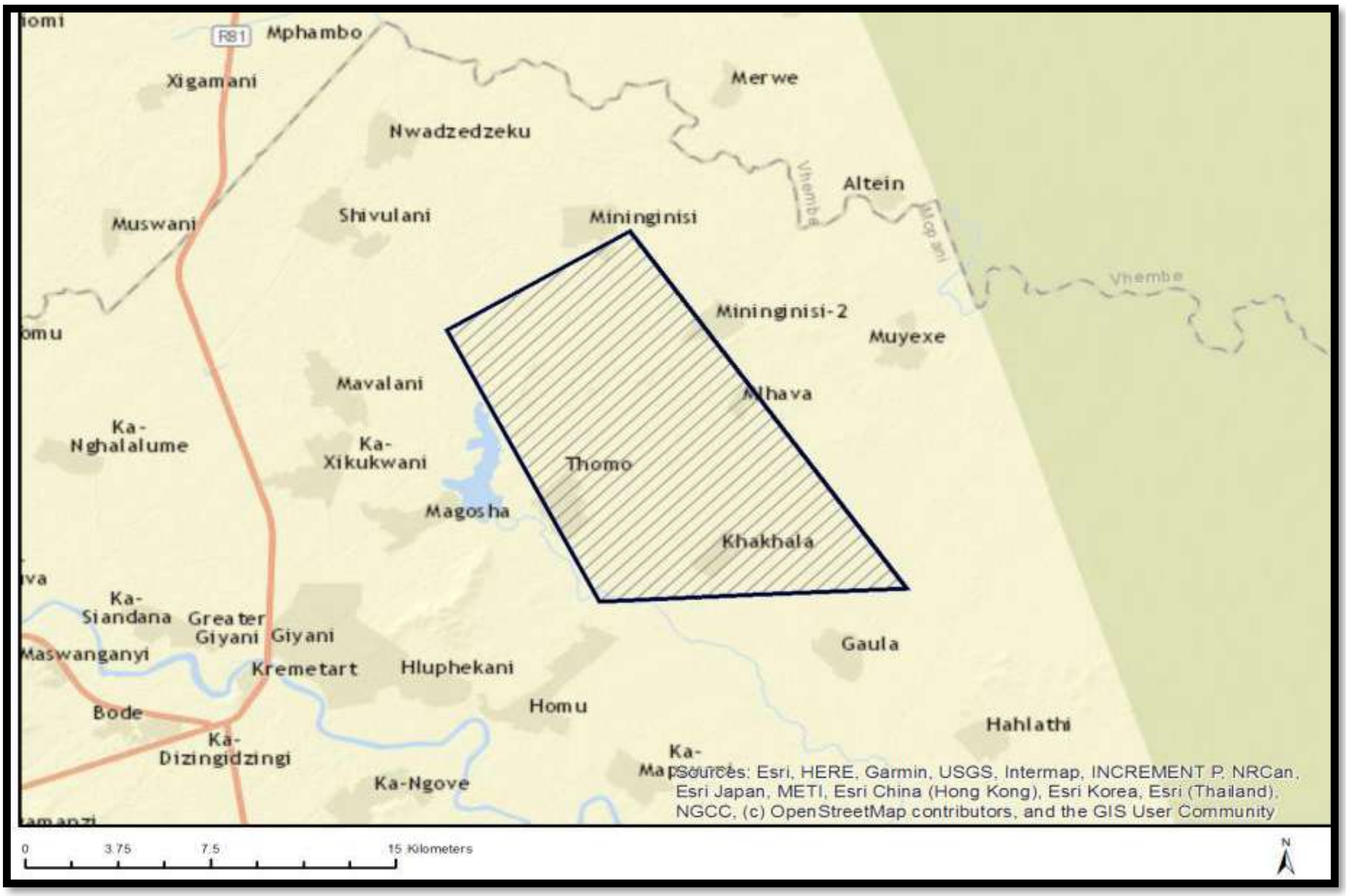

FIGURE 1: LOCALITY MAP

The Giyani gold mine is located within the town of Giyani, approximately 140 km to the northeast of the N1 National Road from Polokwane. A well-maintained R 81 road, from the N1 will provide as the main access to the mine. The mining area will be accessed through existing tarred roads that will link the mine to the various villages such as Thomo, Mninginisi, Mbatlo, Mavalani and Shikukwani.

Kusile Invest 133 (Pty) Ltd holds the following prospecting right (PR) and mining permit which form part of the mining application:

• (LP) 30/5/1/1//2/2724 PR on Un-Surveyed State land of Greater Giyani 891 LT and a portion of portion 0 of the farm 246.

• (LP) 30/5/1/3/2/10708MP on Un-Surveyed State land of Greater Giyani 891 LT.

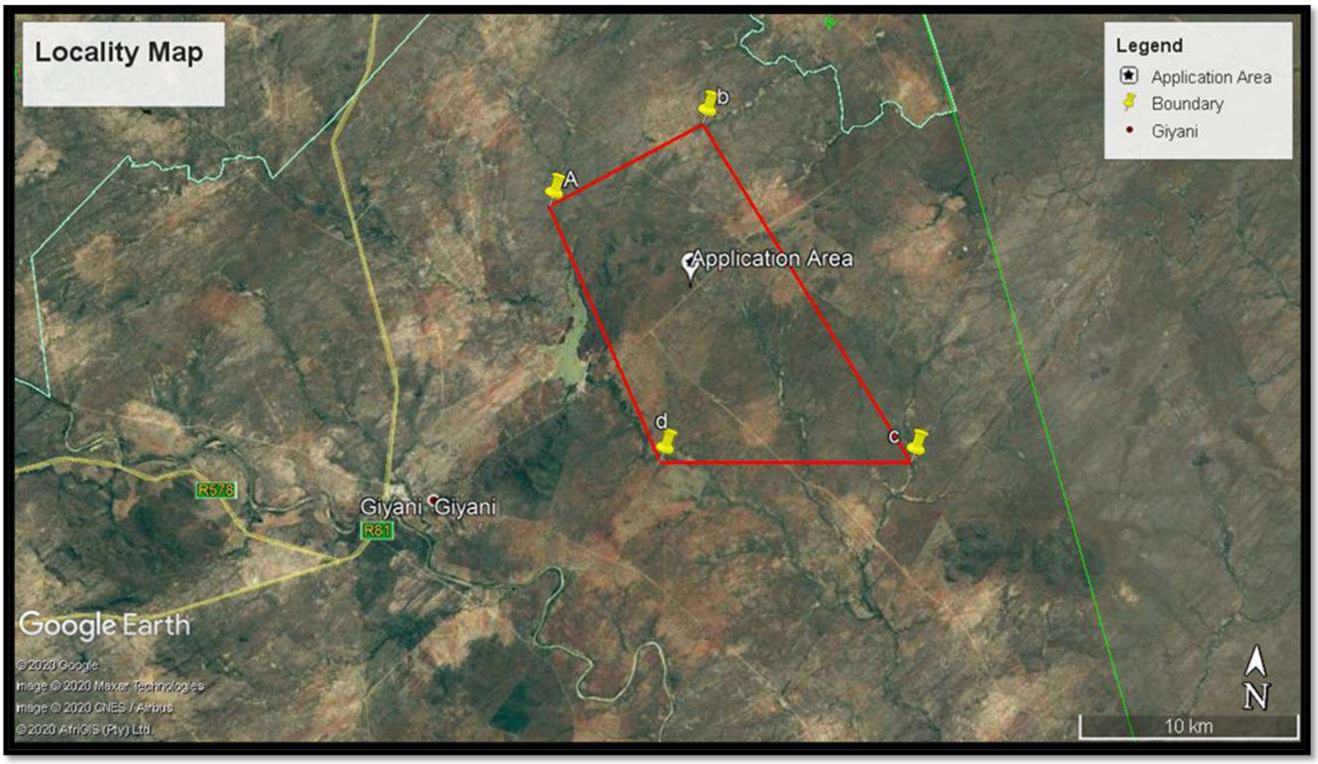

FIGURE 2: APPLICATION AREA

As part of the EIA process a noise assessment was undertaken to formulate potential impacts and mitigation measures relating to the proposed mining project. Mining operations generate noise that can be heard in the surrounding community. In terms of the South African National Standards, residential daytime ambient noise levels should not exceed 55 dBA; and night-time ambient noise levels should not exceed 45dBA.

The prevailing ambient noise levels along the proposed gold mine boundary will vary because of the existing feeder roads, seasonal agricultural type activities and faunal type noises. The levels of noise emissions and noise sources are a function of the following:

- The distance the receptors are from the proposed mining activities, roads, town, townships, villages and farming activities.
- The operation hours of the proposed Site.

- The intervening topography and structures that may shield the receiver from the noise, the area is generally flat with substantial indigenous trees which provide acoustical screening; and
- Meteorological conditions such as wind speed, temperature and the season.

The prevailing ambient noise level of the proposed site was determined by undertaking a noise survey at specific measuring points. For the noise study a Quest Technologies Sound Pro SE/DL Handheld Sound Level Meter and Real Time Frequency Analyzer which can measure both class I and class II frequencies were used. To establish ambient noise levels on the property the equivalent noise level (L_{Aeq}), the maximum sound pressure level (L_{Amax}) and the minimum sound pressure level (L_{Amin}) were recorded during the 5m and 10min running average per sampling location.

The meter was set up at each measurement site/sampling location with the microphone height at 1, 3 meters above the ground level and well clear of any reflecting surfaces (minimum of 5 meters clearance). The other aspects such as vehicle noise (to and from the proposed site) and plant activities are all variables that may change daily, which may have an influence on the noise levels and how the resultant noise is perceived by residents near the study area.

Sound Level Meters measure the change in pressure associated with sound waves and frequency range. This type of measurement also involves an adjustment to simulate the response of the human ear.

1.2 Mining Overview

The planned mining methods will include both open cast/surface mining and conventional stoping underground. Mining activities will be carried out on the reef horizon by means of excavating, drilling, blasting, and cleaning of ore using heavy earth moving equipment and blasting using commercial explosives scraper cleaning operations and truck loading or hoisting. The broken ore will be loaded on to trucks and transported through the declines which will be developed below the reef horizon/stoping area for transporting to surface by conveyor belts. For underground mining, the excavation that remains after blasting and cleaning of ore on reef is supported by installing roof bolting to ensure a safe working environment.

Exploitation of the gold bearing ore using the techniques above is associated with costs for procurement of diesel; equipment maintenance; explosives; rock support material and transport costs, in addition to labour costs. Other costs related to general stores and consumables, water, electricity, and compressed air. During the build-up phase, it is expected that a high unit cost will be incurred for each ton of broken ore produced due to initial high fixed and variable costs compared to low production rate when establishing the working areas. The unit cost will gradually decrease and stabilize as production rate increases to reach a steady state.

The planned conventional open cast mining and stope mining methods will utilize compressed air powered rock-drills and electricity powered scraper winches. This equipment will increase electricity consumption and inefficient use of equipment will negatively impact on the operating cost for the mine.

1.2.1 Mining Right: Description of Mining Method

Mining operations will commence from five open cast pits which will later be developed into underground workings and expand into four working levels to reach the steady state production of 12 000 tons per month. Additional working areas will be established for sustainability and to replace the depletion of ore reserves being mined from the start-up working areas.

The open pit mine design shows the orebody being located centrally to the pit outer walls or pit shell. The waste surrounding the orebody will be stripped, with topsoil stored separately from waste rock for re-use during rehabilitation of the pit at closure of mining operations. The stripping will include the removal of surrounding topsoil and waste rock to fully expose the orebody and have enough area for movement of machinery inside the pit.

The sidewalls of the excavation, surrounding the orebody, referred to as Benches, will be excavated at intervals to a maximum depth 12 metres and must be slanted to ensure slope stability as per specifications determined by the project's Rock Engineering expert. The pit development will include the creation of Berms, representing the flat area or horizontal distance of approximately 5 metres in width, when measured from the bottom of the preceding or top bench to the edge of the next bench as the pit goes dipper. An access ramp and haul road will also be created from the top bench on the outer limits of the pit, traversing the lower benches in order to have mining equipment and personnel accessing the pit floor where excavating or blasting of the ore bearing rock will be conducted.

The pit will be excavated to an optimal operating final depth of 400 metres below surface level, thereafter, the conversion of the mining operation from open pit to underground mining operation will be affected. The timing for the development of the underground mining infrastructure will be scheduled to reach its completion such that the commencement of underground operations will overlap with the final phase of the open pit mining operation for a period of 6 months. The basic design or layout for the underground mining operation, entails the conventional use of shafts and declines, with the development of footwall haulages, cross-cuts and raise-lines to establish conventional steep stoping and cut and fill mining panels.

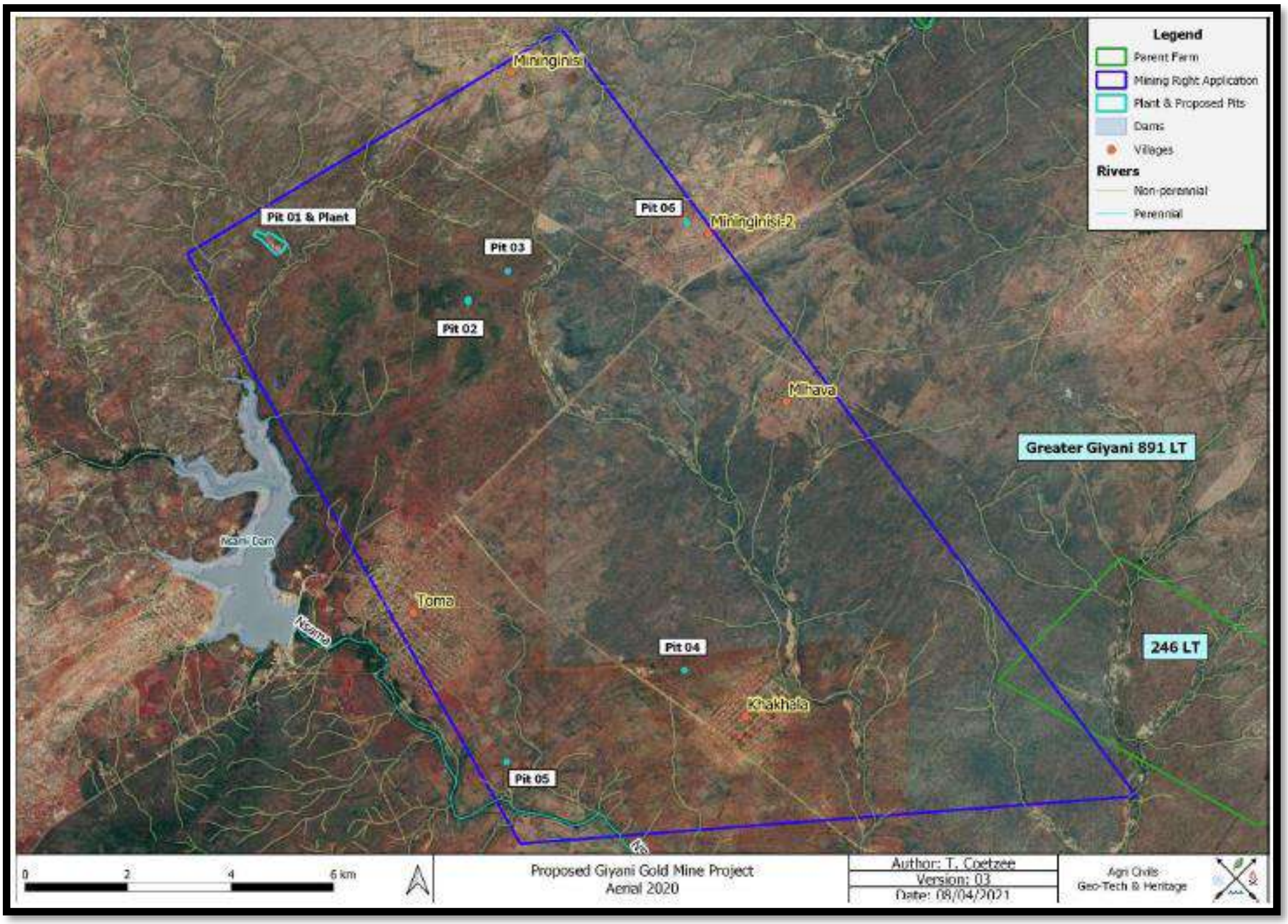

FIGURE 3: SITE LAYOUT AND INFRASTRUCTURE

1.2.1.1 Mining – Mining Method

The basic mining methods to be utilised for the Giyani gold mining operation are both surface mining using open pit and conventional stoping methods applied underground to excavate hard rock or ore containing gold and associated minerals such as copper, zinc, nickel and lead and uranium. The existing mine shafts in the area, which form part of the project, were generally mined by conventional breast stoping mining until they were mothballed during the mid-1990's.

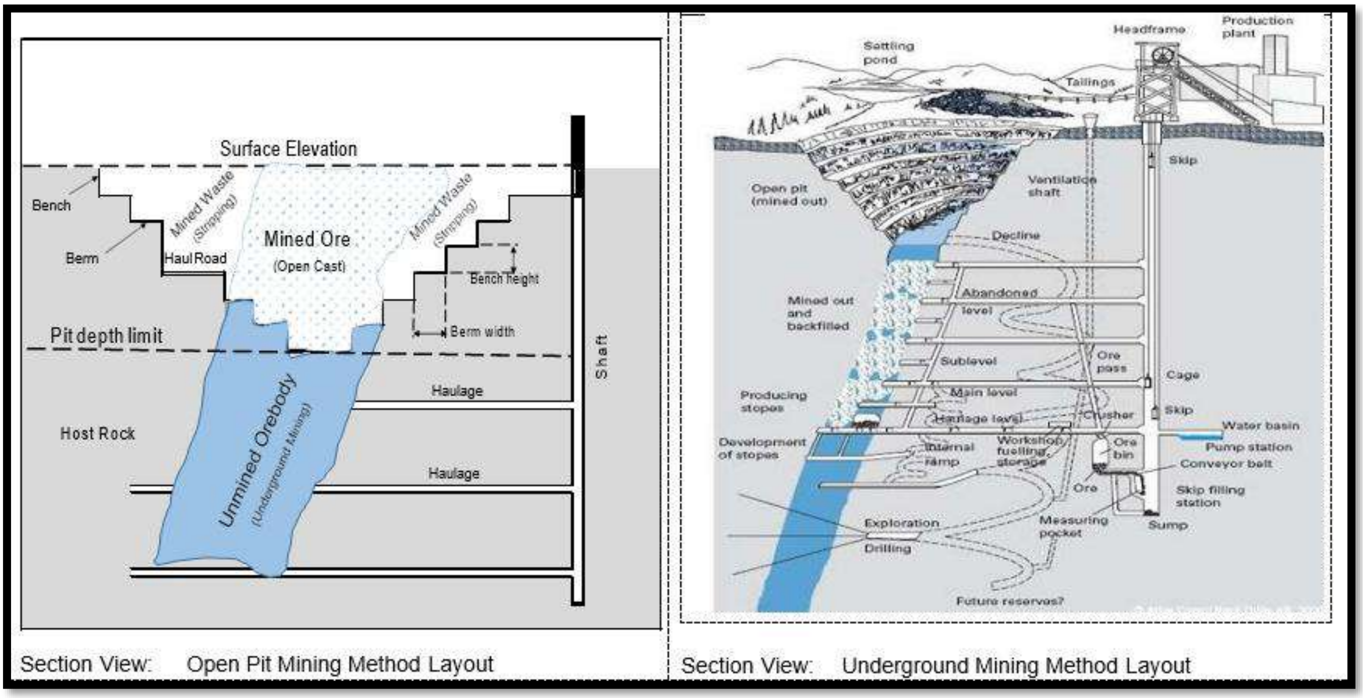

Figure 4: Schematic Diagram of Proposed Mining Methods (Open Cast and Underground)

Mining will commence using open pits on outcrops and later develop into underground workings. Typically, underground working areas are accessed through a vertical shaft positioned a distance away from the reef horizon to be mined. A mine shaft is vertical excavation sunk and equipped with conveyances to transport men, material, and rock when mining operations are being conducted. A number of horizontal haulages are developed from the shaft at equal vertical intervals of approximately 60m, to access and intersect the reef horizon by developing a tunnel referred to as a crosscut. A raise development is then carried out from the cross-cut intersection on true dip or angle of inclination of the reef plane to make a holing on the cross-cut developed on the haulage above. Instead of using the shaft system, an option exists to utilize a decline system, where inclines are developed from the bottom of surface pit limit to provide underground access to deeper lying orebodies

1.2.2 High level description of the processing plant

Gold ore mined will be transported by Articulated Dump Truck (ADT) from open cast pits and hoist skips or conveyor belts from underground to stockpiles and storage areas, where it will be transported to the central processing plant by side tipper trucks for stockpiling onto a ROM pad in front of a crusher unit. A ramp will be utilized to provide access for the loading and dumping of ore on the tipping station for crusher feed. A conveyor belt will carry the ore from the tipping station and feed the load on top of a grizzly above the feed bin of a crusher.

The key installations and stages of the processing plant for gold recovery are crushing, milling, gravity concentration, flotation, leaching or cyanidation, concentration/elution and smelting. Summarized below is a high-level description of the processing plant:

Crushing - ore extracted from the mine will be trucked and delivered to the ROM pad where it will be stockpiled. It will then be fed through a two-stage crushing process. The Primary Crusher will be a single toggle jaw crusher with the Secondary Crusher being a cone crusher.

Milling – the process is used to further agglomerate the crushed ore being fed into a semi autogenous grinding (SAG) mill with lime, water and steel balls to liberate the gold contained in the rock. The larger particles from this mill are returned to the SAG mill for more grinding. The finer particles receive more grinding in a ball mill and are size classified to give a final product of 80% <70 microns. Crushed ore will be ground using a 4.2m diameter, 5.3m long primary ball mill with 1650kw motor.

Gravity concentration – this stage of the process separates gold from the milling process using the metal's higher specific gravity to settle in a solution and separate from other metals and material. This will be done in two centrifugal concentrators installed as part of the plant.

Flotation – a process for producing a mineral concentrate through the use of chemical conditioning agents followed by intense agitation and air sparging of the agitated ore slurry to produce a mineral rich foam concentrate. The installation comprises a bank of eight forced air, mechanically agitated cells ($8m^3$ each).

Cyanidation/leaching - this process involves the dissolution of gold containing ores in dilute cyanide solution in the presence of lime and oxygen contained in acid resistant leach tank.

Concentration/elution – this process is called Carbon in Pulp (CIP) and is applied to control the gold precipitation from the cyanide solution by use of activated charcoal (carbon). The final loaded carbon then is removed and washed before undergoing "elution" desorption of gold cyanide at high temperature and pH

Smelting - The rich eluate solution that emerges from the elution process is passed through electro-winning cells where gold and other metals are precipitated onto the cathodes. After precipitation, the product is treated with dilute sulfuric acid to dissolve residual zinc and most of the copper. The gold precipitate is then filtered out of the solution, mixed with fluxes and smelted to form crude and impure bars which are sent to a refinery to separate the copper; PGMs; silver and other associated base metal minerals

1.2.2.1 Basic plant design. (supported by a process flow diagram, of the plant).

The basic plant design and anticipated process flow diagram (see diagram below) is based on the proven metallurgical technology currently being used by mines in South Africa and represents a typical free milling carbon-in-leach (CIL)/carbon-in-pulp (CIP) gold processing circuit comprising:

- Two stage crushing.
- Single stage milling designed for a grind size of 105 micron;
- Knelson Concentrator or Gravity recovery cyclone;
- Thickeners.
- CIL/CIP leaching and adsorption with a retention requirement of only 16 hours.
- Elution, gold smelting and carbon regeneration.
- Tailings disposal.

The modular nature of the proposed process plant layout will allow for modifications, including increasing plant throughput, to be undertaken when required. The process flow diagram of the processing plant showing the key components of the plant is as below:

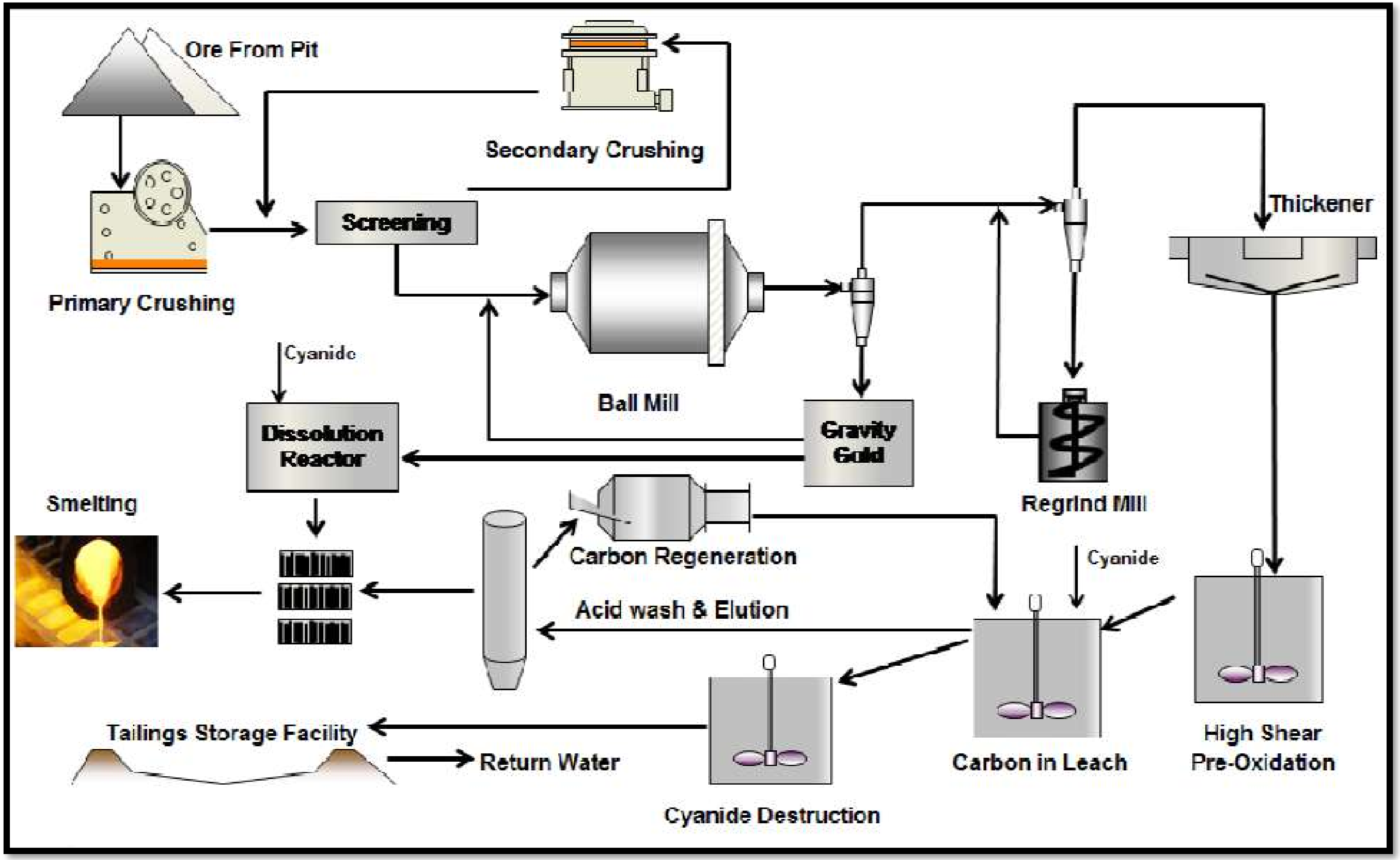

Figure 5: Schematic layout of processing plant

1.2.2.2 Summary of infrastructure such as roads, rail, electricity and water

1.2.2.2.1 Access roads

The Giyani gold mine is located within the town of Giyani, approximately 140 km to the north- east of the N1 National Road from Polokwane. A well maintained R81 road, from the N1 will provide as the main access to the mine. The mining area will be accessed through existing tarred roads that will link the mine to the various villages such as Thomo, Mninginisi, Mbatlo, Mavalani and Shikukwani.

The existing town roads will be utilized for trucking of ore to the processing plant which will be located within a 20km radius from various mining pits and shafts. These roads will form part of the road infrastructure to be utilized for the development of the mine. The initial capital costs to be incurred by the company will be limited to re-establishment and maintenance costs for the access roads within the pits and shaft areas and this will be provided for by the mine.

1.2.2.2.2 Rail Infrastructure

The Giyani mine is located approximately 80km to the east of the Soekmekaar-Polokwane railway line, with the nearest station at Soekmekaar. The mine will not utilise any rail for the transport of ore or delivery of mine material as these will be done by means of trucking to and fro the mine to the central processing plant.

1.2.2.2.3 Power Supply - Electricity

There is an existing powerline located some 4km from the central processing area. A dedicated power feeder will be obtained by establishing a connection to this existing powerline. A new sub-station connection will installed at the central processing plant as a step-down transformer to reduce the voltage from the high tension overhead power line to 6.6kV, where this will be reduced further to levels suitable for use in the plant and nearby shafts and mine offices. The planned power usage at the mine is as summarized below:

Table 1: Planned mine power usage

Area	Usage
Processing Plant	500kVA
Mine Shafts/Winding Engine Room	500kVA
Surface Compressors	300kVA
Engineering Workshops	200kVA
Mine Offices	100kVA
Total	**1600kVA**

1.2.2.3 Water Supply

Water requirements on the mine will include the supply of water for drilling underground; dust suppression on surface and underground; general office use; cleaning of equipment; workshops and hauling roads. Potable water will also be needed for human consumption and change house facilities. The mine will source its water supply from the Giyani water scheme which is under the management of Greater Giyani Municipality. A pipe connection will be used to direct the water supply to the mine, where it will be stored in a mounted tank, with enough capacity to hold at least 100m3 required for mine services. There is an existing pipeline within a 10km distance, which supply water to Giyani town and surrounding villages.

Other sources of water will include ground water seepage into the pits and underground mine working and storm water in the event of heavy rains. Any excess water will be channeled into settling ponds and used as make-up water in the event of losses associated with mining operations, discard streams and evaporation.

1.2.2.4 Site Offices

To minimize the establishment cost and due to the relatively short life of mine plan for the envisaged mine operation, pre-fabricated buildings will be erected to function as workshops and mine offices, change houses, laboratories, first aid rooms, and warehousing..

1.2.2.5 Underground Infrastructure

- Decline lateral;
- Exhaust raises;
- Footwall drives;
- Ventilation lateral access;
- Cross cuts from decline;
- Sumps;
- Escapeway access;
- Escapeway raise;
- Decline rehandle bays;
- Production rehandle bays;
- Other lateral waste;

- Backfill tipping bay;
- Truck loop/loading access;
- Diamond drill chambers;
- Ore pass;
- Upper ventilation drive connection to surface;
- Intake Raise vertical;
- Main pump station;
- Longitudinal stope access;
- Transverse stope access lateral; and
- Exploration drive.

1.2.2.6 Surface infrastructure

The proposed project would comprise of the design and construction of all building structures, related earthworks and building services, electrical and mechanical installations. This would include *inter alia*:

- Central Plant and Mobile Process plant
- Loading area
- Stockpile areas
- Site clearing and storm water berms and trenches;
- Administration building and first aid;
- Change house and laundry;
- Lamp room, self-rescuer and proto room;
- Access control and security centre;
- TMM Maintenance workshop, services, lubrication, bays;
- Wash bay and oil skimmer;
- Bulk fuel storage area;
- Refueling bay;
- Tyre storage, repair and pump area;
- LVD workshop;
- Fitting, electrical and boiler making workshop;

- Main stores and yard;
- Salvage yard;
- External parking, shade ports and walkways;
- Electrical, water and sewage reticulation;
- Terraces, pavements, access, internal and haul roads;
- Perimeter and internal fencing; and
- Explosives off-loading, storage and distribution.
- One Slimes Dam and PCD"s

1.2.3 Minerals applied for:

- Gold Ore/Bearing Minerals: Code: (Au),
- Copper Ore/Bearing minerals: Code: (Cu),
- Silver Ore/Bearing minerals: Code: (Ag),
- Nickel Ore/Bearing minerals: Code: (Ni),
- Platinum Group Minerals: Code: (PGM),
- Zinc Ore/Bearing Minerals: Code: (Zn),
- Lead Ore/Bearing Minerals: Code: (Pb),
- Uranium Ore/Bearing Minerals: Code: (U),
- Chrome Ore/Bearing Minerals: Code (Cr),
- Aggregate Material

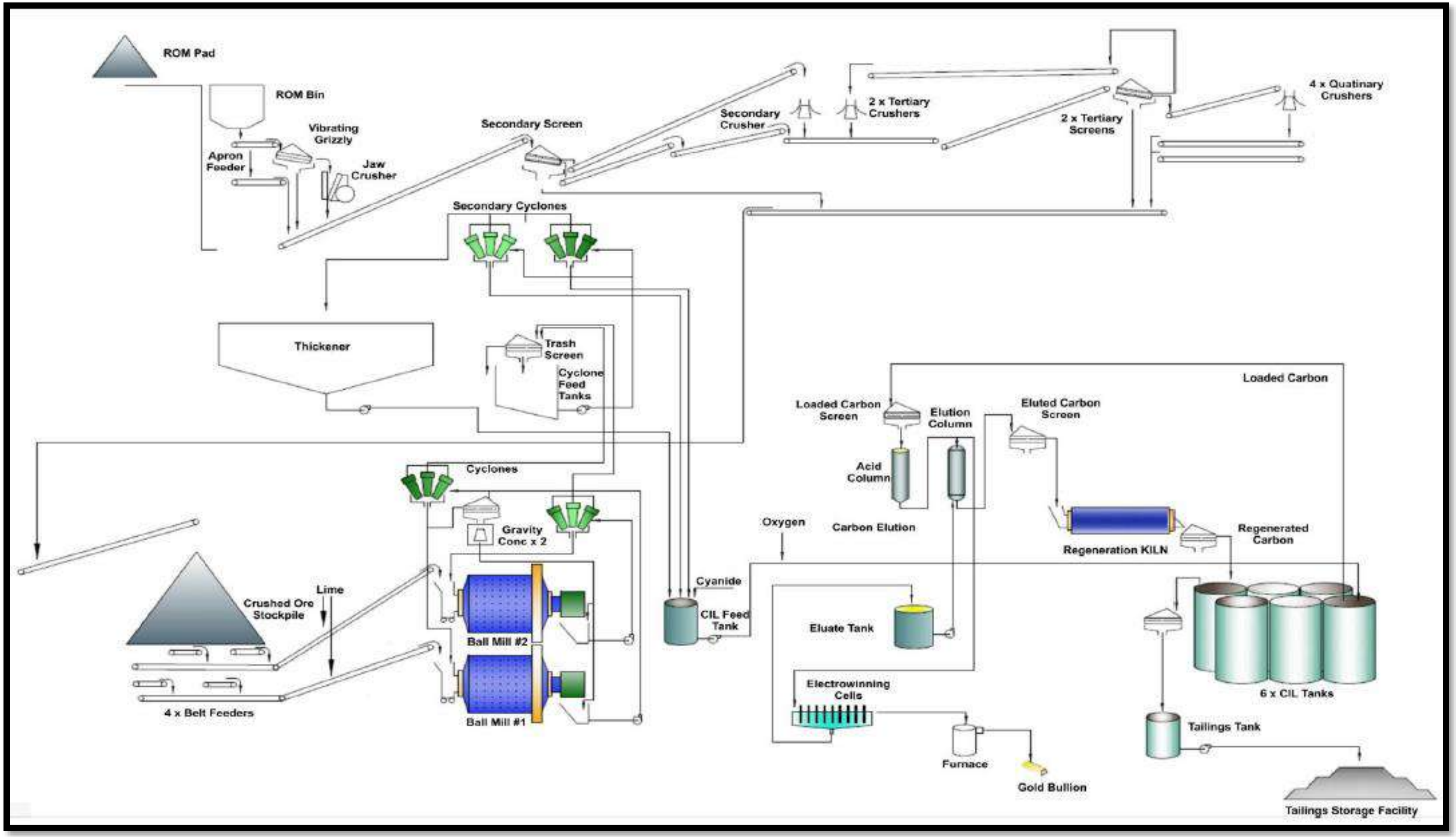

Figure 6: Processing Plant

1.3 Area Description

1.3.1 Topography

The topography across the site is variable with a 0-0,5% gradient which trends in the North-East directions. The landscaping consist of moderately undulating plains and low hills dominated by tall, usually Hyperrhenia hirta dominated, grassland. The regional elevation ranges between 420 - 760 meters above mean sea level (mamsl), whereas for the Kusile Invest 133 (Pty) Ltd local site the elevation ranges 420-460 meters above mean sea level (mamsl).The topography of the investigation area ranges from flat to undulating surfaces in the headwaters of the B82H catchments where Nsami River is perennial and feeds into the Letaba River in the south. Several drainage depression areas are evident around the site but outside the proposed open mine.

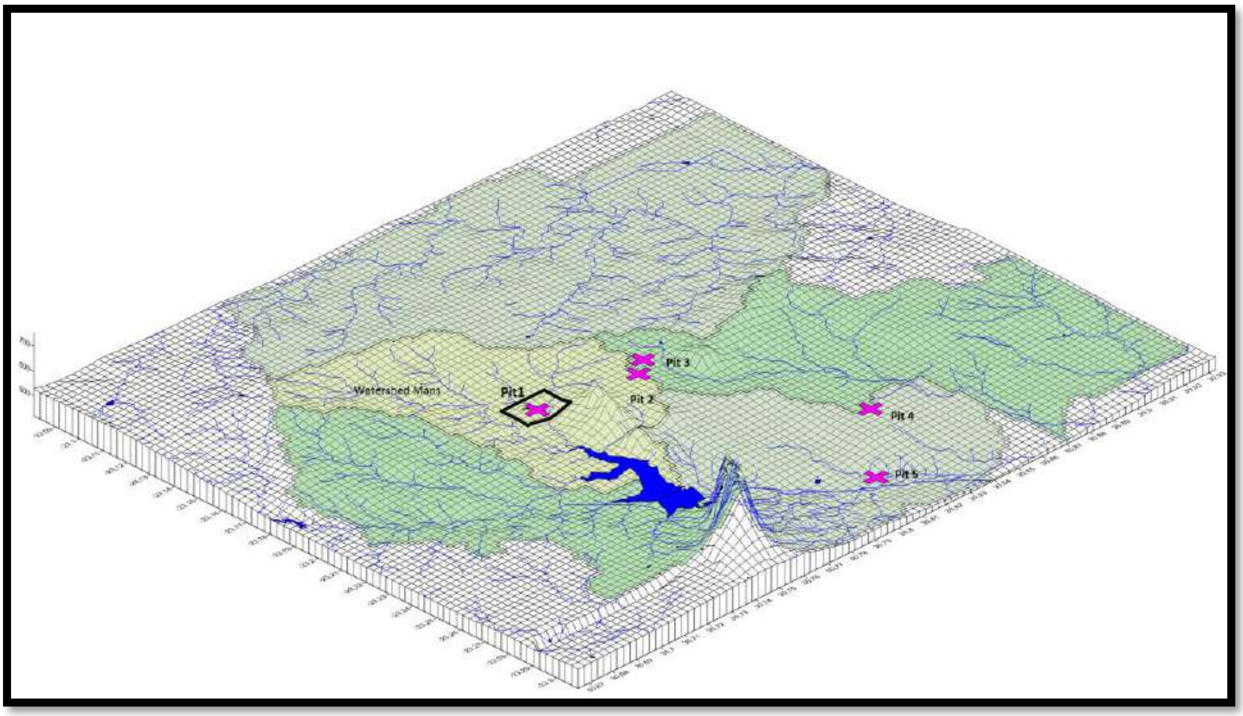

Figure 7: Watershed and landforms

1.3.2 Land Use

The area has soil which is suited for arable land and for agricultural purposes. The majority of the land around the municipal land falls under the local traditional authorities. Commercial farming occurs at a lesser scale only to be superseded by subsistence farming. The rest of the land is used from communal grazing.

The present land use is the following:

- The majority of land is shallow soil under thorny bush encroachment.
- There are parts of the area disturbed with roads from the existing activities emanating from rural activities and subsistence farming.

The area is mostly used for Subsistence Farming Annual Crop Cultivation / Planted Pastures Rotation, most notably maize is the commonly planted crop.

1.3.3 Climate and air quality

This climate type is characterized by extremely variable temperature conditions. The climate is characterized by low rainfalls with a very hot summer. This could be caused by its position in the Lowveld. The municipal area received between 200 – 400ml of rain annually. The general rainfall has a direct impact on development, especially on agriculture. This results in the shortage of surface water, leaving the municipality to rely on ground water.

Based on an evaluation of the meteorological data simulations run from the global NEMS weather model at ~30 km resolution from 1985 to current of the project area. The following deductions can be made from Figure below; in the summer months' maximum average daily temperatures are predicted to be 27°C - 30°C on average with a maximum of 38°C possible during hot days, dropping to a predicted 15°C - 20°C on average at night and 11°C minimum on cold nights. During winter months the average day time temperature are predicted in the 23°C - 25°C range while cold winter night time temperatures predicted to drop to 6°C.

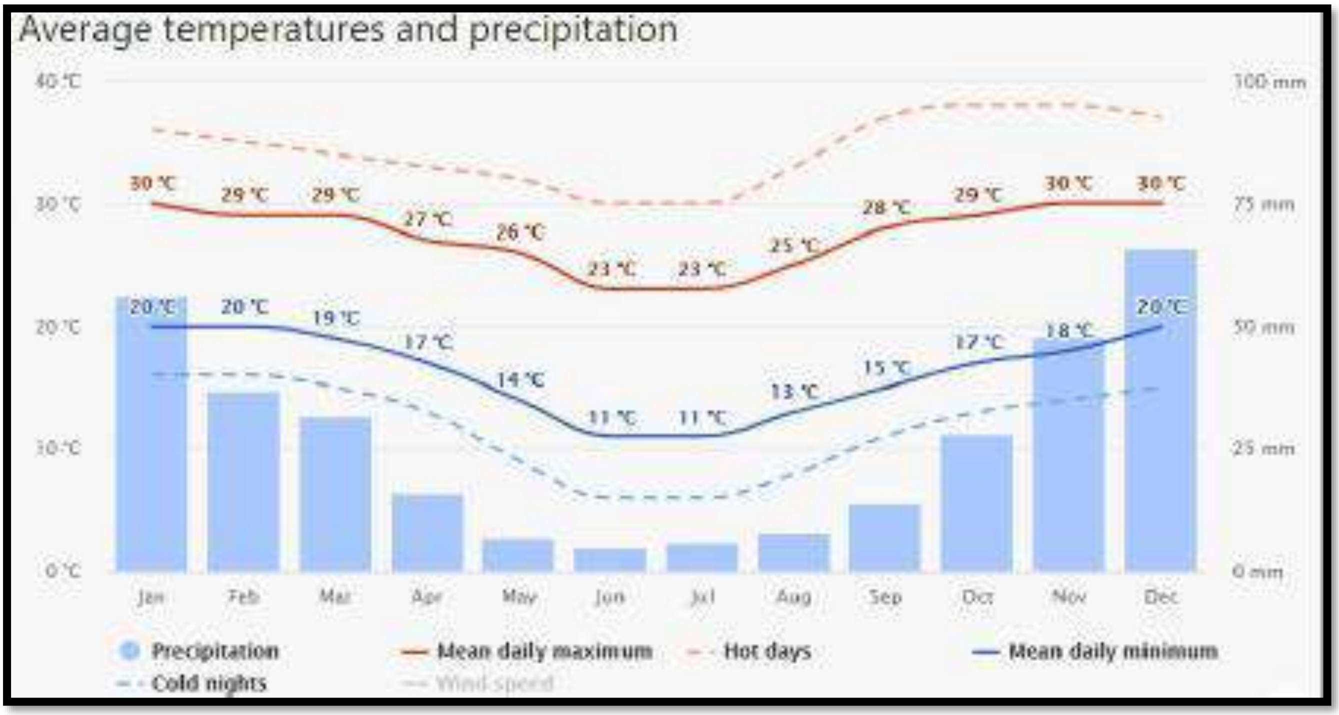

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Figure 8: **Temp and precipitation simulation results from the NEMS model for the Giyani project area (1985 - current).**

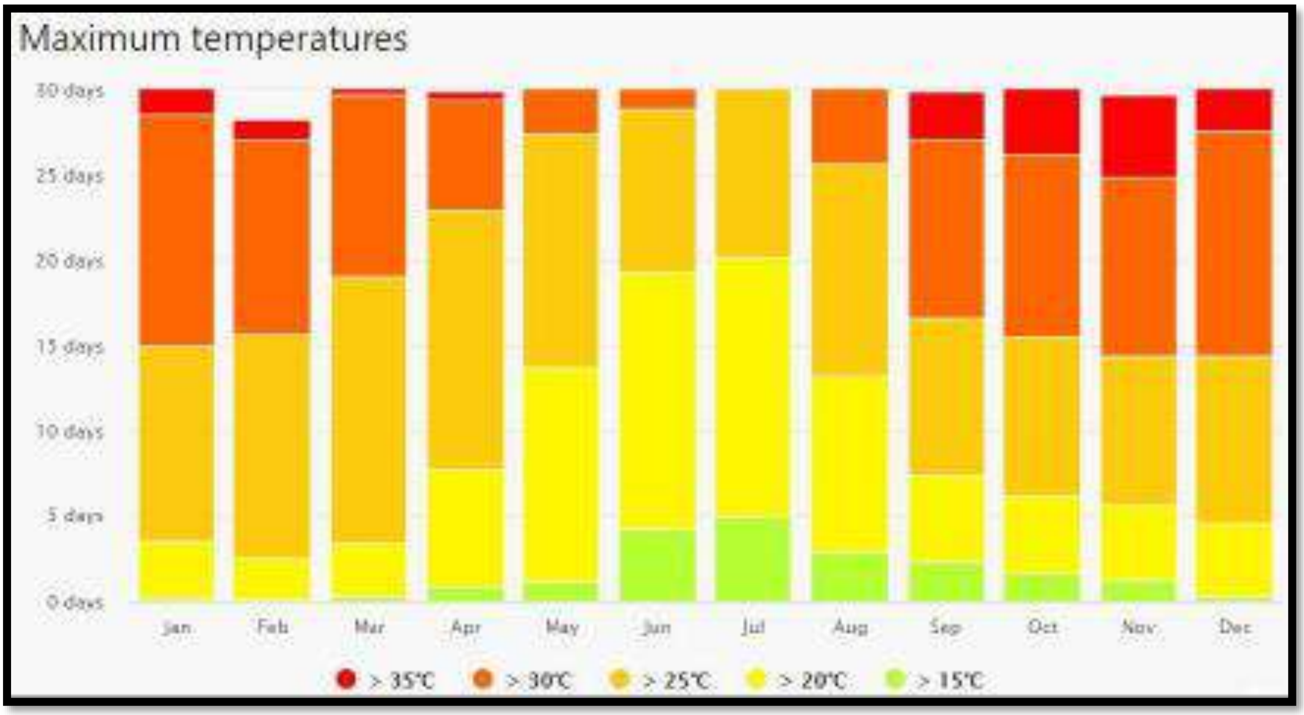

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Figure 9: **Maximum temperatures as simulated from the NEMS 30 km model for the proposed Giyani project area (1985 – current).**

1.3.3.1 Precipitation

Precipitation cleanses the air by washing out particles suspended in the atmosphere (Kupchella & Hyland, 1993). It is calculated that precipitation accounts for about 80-90% of the mass of particles removed from the atmosphere (CEPA/FPAC Working Group, 1999).

Falling in a summer rainfall area, the location is predicted to receive the most precipitation in the summer months of October - March overall as can be seen below. November - January are predicted the highest rainfall months with between 48-66mm predicted per month during these months. February, March and October is predicted to receive 28-37mm precipitation. All other months are predicted to receive less than < 16mm precipitation on average during the month.

The total precipitation days predicted at the Giyani project area is shown below.

The highest precipitation days are predicted during the months of October - March. During these months' precipitation is predicted to only occur 9-13 days on average. The rest of the year precipitation is predicted to occur less than 6 days per month.

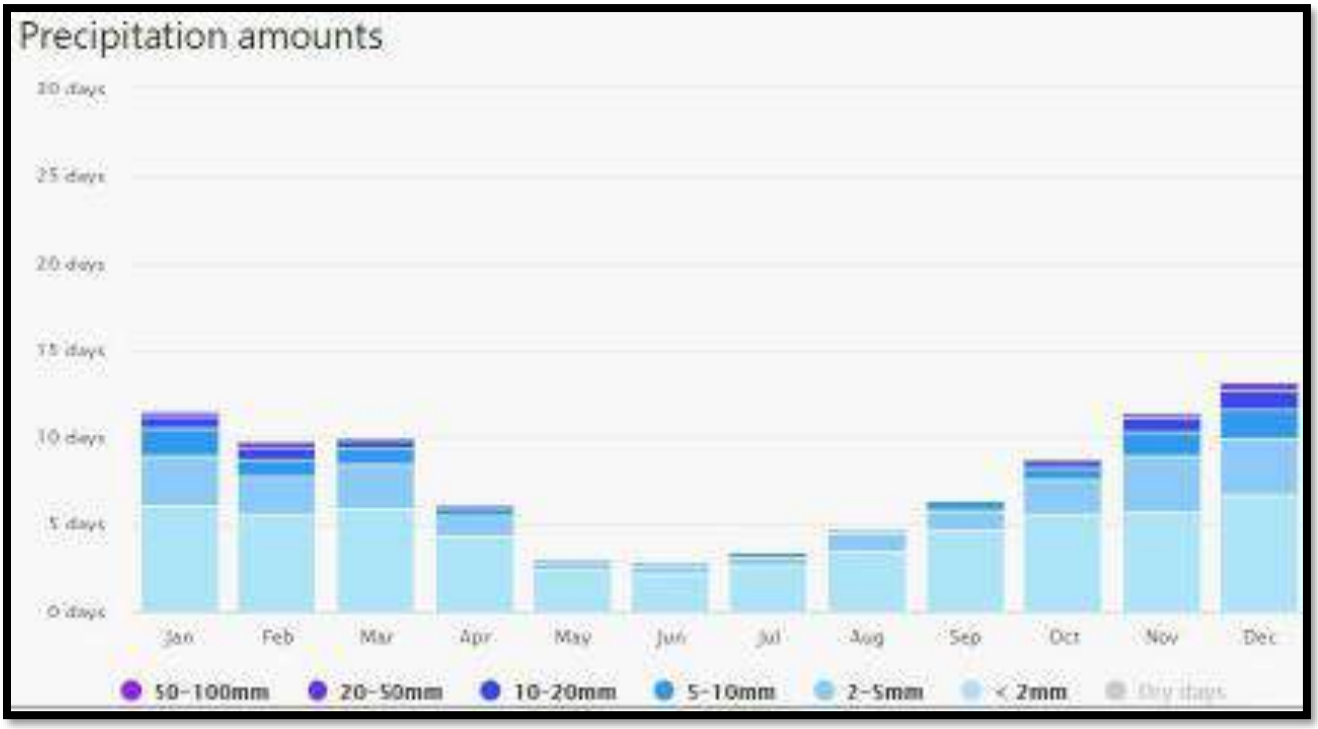


Figure 10: Day count of total daily precipitation per month for the proposed Giyani Gold Mine area for the period 1985 - current.

1.3.3.2 Winds Speed, Temperature and Precipitation Validation

Wind roses comprise of 16 spokes which represents the direction from which winds blew during the period. The colours reflect the different categories of wind speeds. The dotted circles provide information regarding the frequency of occurrence of wind speed and direction categories.

Based on an evaluation of the meteorological data simulations run from a global NEMS weather model at ~30 km resolution from 1985 to current of the project area. The following deductions regarding the prevailing wind direction and wind frequency can be assessed. Looking at the figure below, the predominant wind direction is predicted to occur mainly from the SE 1875 hours per year respectively. A secondary direction is predicted from ESE and SSE 1043 and 894 hours per year, respectively, with wind speeds higher than 5 km/h.

From Figure below, at the site, calm conditions with wind speeds of 12 km/h or less, are predicted 2-14 days per month throughout the year. 12-19 km/h winds are predicted 10-15 days per month through the year.

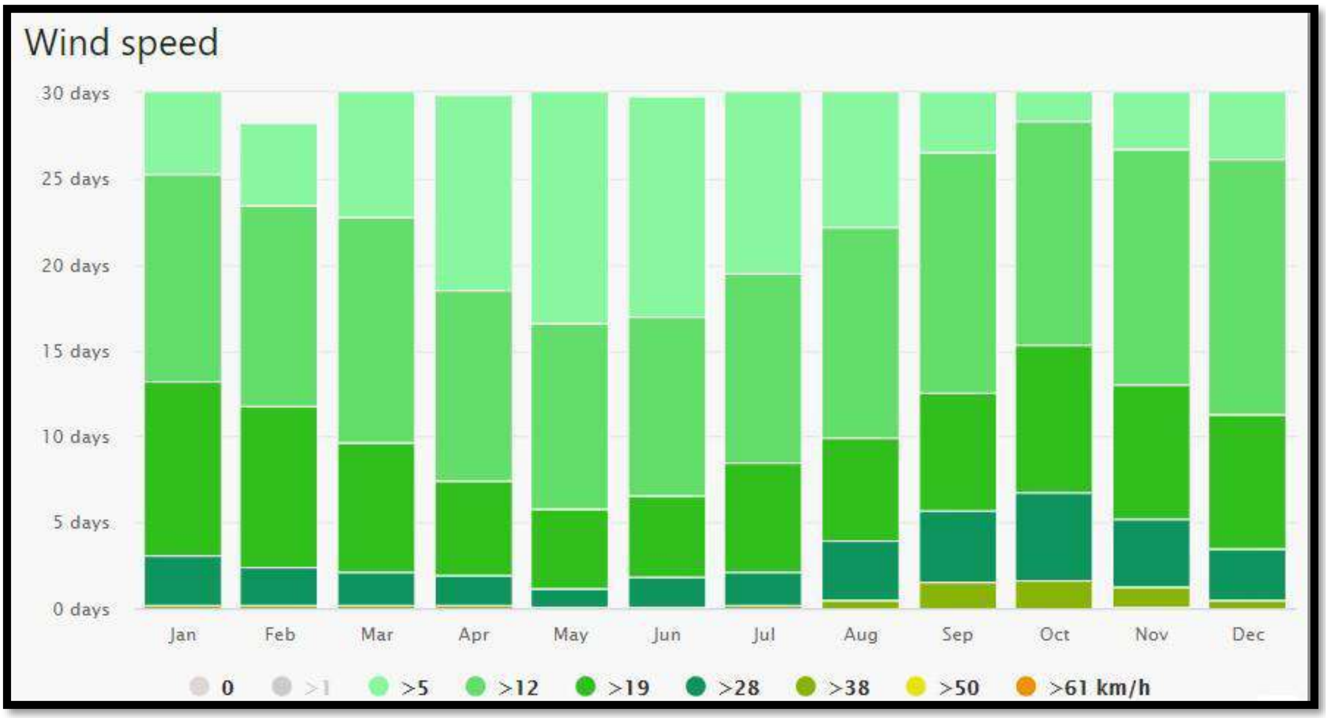


Figure 11: Wind Class Frequency Distribution per month.

Because noise travels through the air, meteorological conditions can increase or decrease the level of noise. Temperature, wind speed and direction, humidity and cloud cover all affect the level of the noise we hear in the area surrounding a mine.

Temperature inversions can potentially increase the impacts of noise. Temperature inversions occur at different heights above the earth's surface and reflect sound waves back to ground level due to a layer of warm air sitting above the cold air closer to the ground. There is a greater chance of hearing sound from a distant source when there is a temperature inversion.

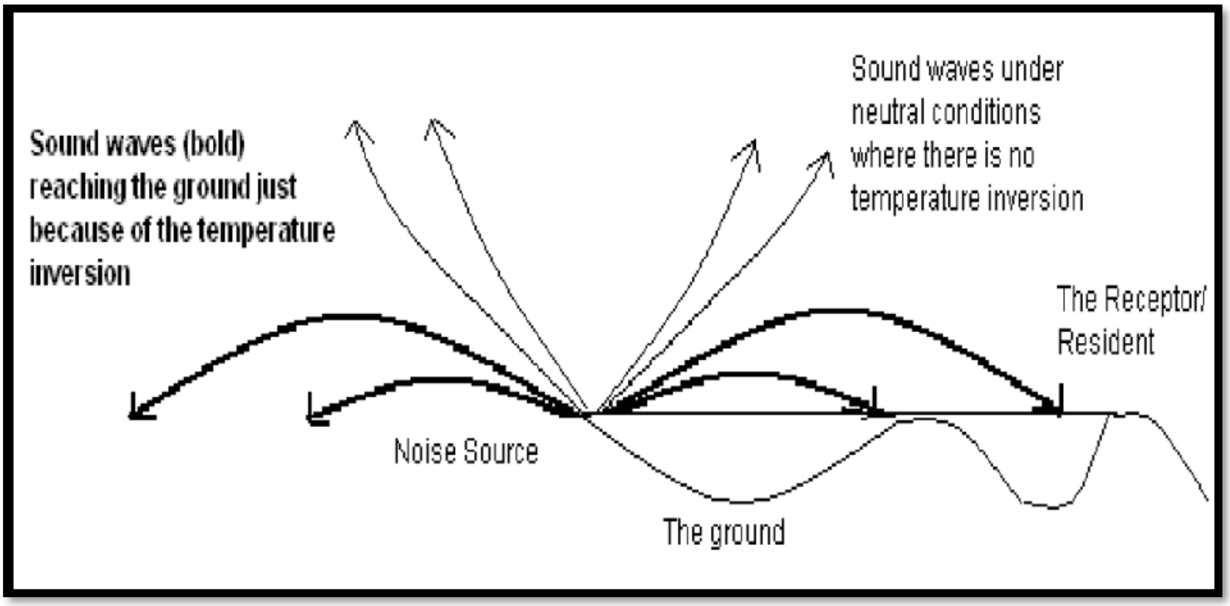
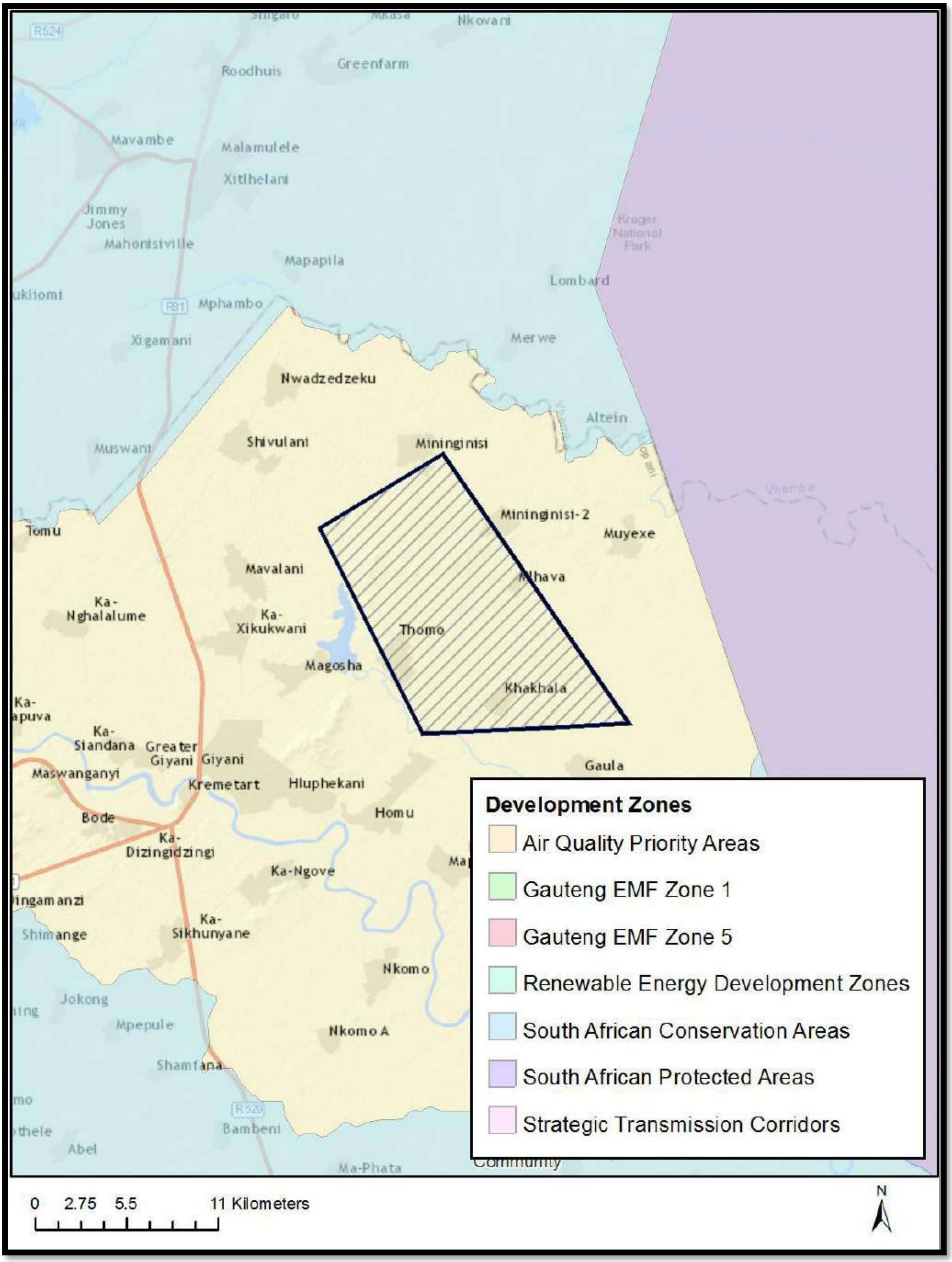


Figure 12: Effect of Temperature inversion on noise

The impact of a temperature inversion on sound waves is illustrated below. Distant traffic and noise sources which are not usually audible become louder. Wind in the direction from a source to a residential area will also increase the level of noise. The impact of wind is more significant at low wind speeds. These factors are described as noise enhancing and need to be considered when managing noise for a mining operation.


Development Zones
Air Quality Priority Areas
Gauteng EMF Zone 1
Gauteng EMF Zone 5
Renewable Energy Development Zones
South African Conservation Areas
South African Protected Areas
Strategic Transmission Corridors
0 2.75 5.5 11 Kilometers
N
Nkovani
Roodhuis
Greenfarm
Mavambe
Malamulele
Xitlhelani
Jimmy Jones
Mahonisiville
Mapapila
Lombard
Mphambo
Xigamani
Merwe
Nwadzedzeku
Altein
Shivulani
Mininginisi
Muswani
Mininginisi-2
Muyexe
Mavalani
Ka-Nghalalume
Ka-Xikukwani
Thomo
Magosha
Khakhala
Ka-Siandana
Greater Giyani
Giyani
Maswanganyi
Kremetart
Hluphekani
Gaula
Bode
Homu
Ka-Dizingidzingi
Ka-Ngove
Ka-Sikhunyane
Nkomo
Jokong
Mpepule
Nkomo A
Shamfana
Bambeni
Abel
Ma-Phata

2 TERMS OF REFERENCE AND LEGISLATIONS

2.1 Terms of reference

The main aims of the study are outlined below:

- Describe the environment that may be affected by the proposed activity;
- Identify all legislation and guidelines that have been considered in the preparation of the impact report;
- Assess the expected impacts during construction and operation of the project and
- Identify noise reduction opportunities and cost-effective noise abatement strategies.

The impacts which were evaluated for the proposed site included the following:

- Additional road traffic into the proposed site;
- The proposed project mining activities;
- The prevailing noise levels to which the people in the area are already exposed to.

2.1.1 Methodology

A site visit was carried out in March 2021 during the daytime as it is the busiest and most noise sources are recorded to determine the activities that takes place in an around the proposed Site that contribute to the prevailing ambient noise level of the study area. Measuring points were identified to measure and determine the prevailing ambient noise levels of the proposed Site. The noise measurements were done in terms of prescribed recommendations.

The following strategy was followed:

- Identification of sensitive receptors surrounding the project area in relation to spatial location
- Measurement of ambient noise level of the identified areas

The ambient noise levels in the affected areas were determined via noise measurements, in accordance ISO standards for:

- The measurement and assessment of environmental noise:
  - ISO 1996-1:2003 “Acoustics – Description, assessment and measurement of environmental noise – Part 1: Basic quantities and assessment procedures.”
  - ISO 1996-2:2007 “Acoustics – Description, measurement and assessment of environmental noise – Part 2: Determination of environmental noise levels.

- ISO 1996-3:2003. "Acoustics – Description and measurement of environmental noise -- Part 3: Application to noise limits."

2.1.2 Noise sampling assessment

The existing ambient noise climate in the vicinity and on the project area was undertaken in accordance with the requirements of the South African National Standard SANS 10103:2008, *The measurement and rating of environmental noise with respect to annoyance and to speech communication*. SANS 10328:2008, *Methods for environmental noise impact assessment* were also closely adhered to.

For the noise study a Quest Technologies Sound Pro SE/DL Handheld Sound Level Meter and Real Time Frequency Analyzer which can measure both class I and class II frequencies were used. To establish ambient noise levels on the property the equivalent noise level (L_{Aeq}), the maximum sound pressure level (L_{Amax}) and the minimum sound pressure level (L_{Amin}) were recorded during the 10min running average per sampling location.

The meter was set up at each measurement site/sampling location with the microphone height at 1, 3 meters above the ground level and well clear of any reflecting surfaces (minimum of 5 meters clearance). Since there was no wind present during sampling it was not necessary for the standard wind shield cover over the microphone.

Quest Technologies Sound Pro SE/DL Sound Level Meter

In addition, the following measures were taken into account during the assessment:

- minimum duration of measurement;
- microphone positions and height above ground level;
- calibration procedures and instrument checks; and
- Supplementary weather measurements and observations.

2.1.3 Study approach

Sampling locations were chosen in such a manner to enable the researchers to achieve a holistic representation of the study site. The purpose of a baseline study is to determine the existing ambient noise in the area of future influence. For a baseline study it is necessary to not only take samples on the borders of the property but all across the site since there is not a point/source of pollution/impact on the ambient environmental climate to determine buffering sample distances. Therefore, it is imperative to understand the initial cumulative impacts and later compare the change when the proposed mine starts to operate.

The human ear is more accurate with auditory observations but the margin for human error is too large to include physical olfactory observations in a scientific study of this nature.

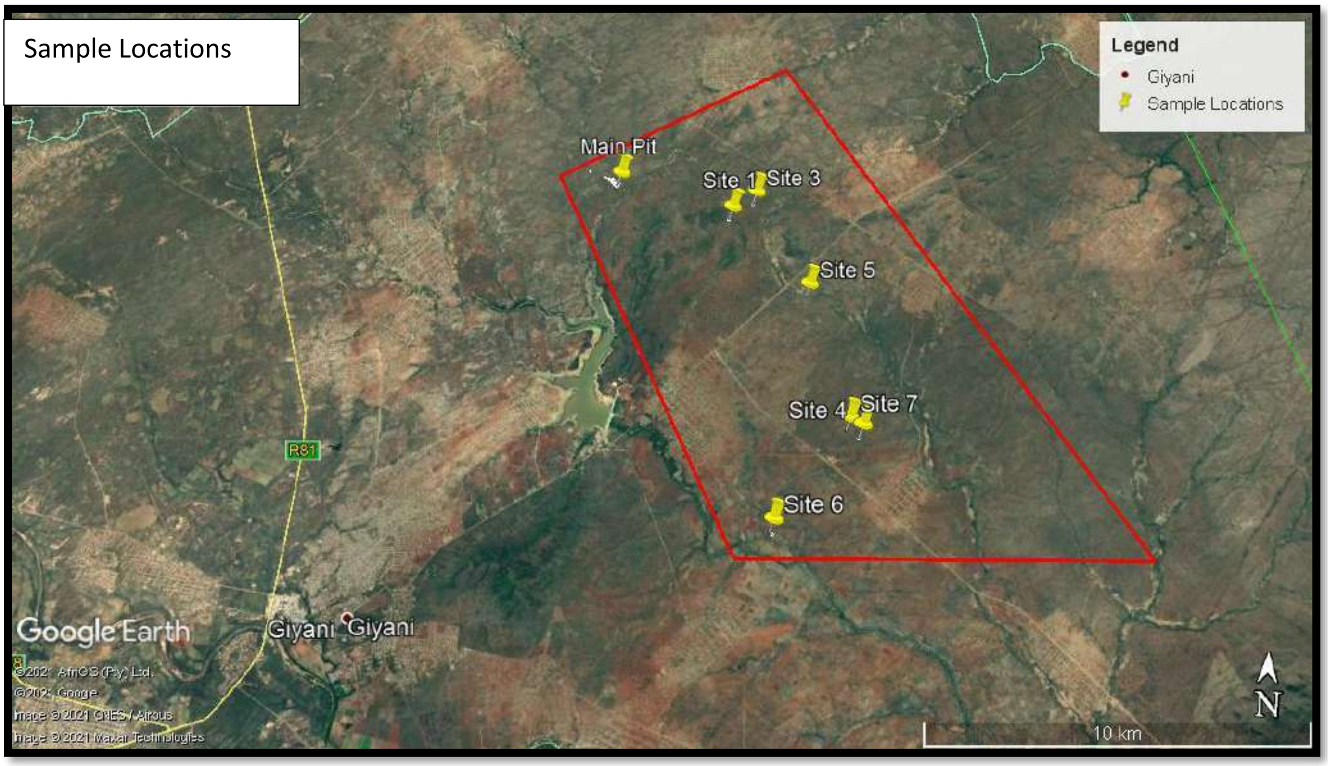


Figure 13: Map showing location of all 9 measured points close to sensitive receptors

2.1.4 Study Area Sensitivity Analysis

. This area is already a disturbed area as there is an access road which will also be used by traffic to the proposed Site. The prevailing ambient noise levels for the study area are made up from the existing activities notably from the existing road network, seasonal farming activities and fauna activities. The people living in within the area exposed to rural noise levels as notably there are villages in the area.

The following two aspects are important when considering potential noise impacts of a project:

- The increase in the noise level because of the construction (temporary increase) and operational phases (more permanent of nature); and
- The overall noise level produced by the activities on the proposed project area.

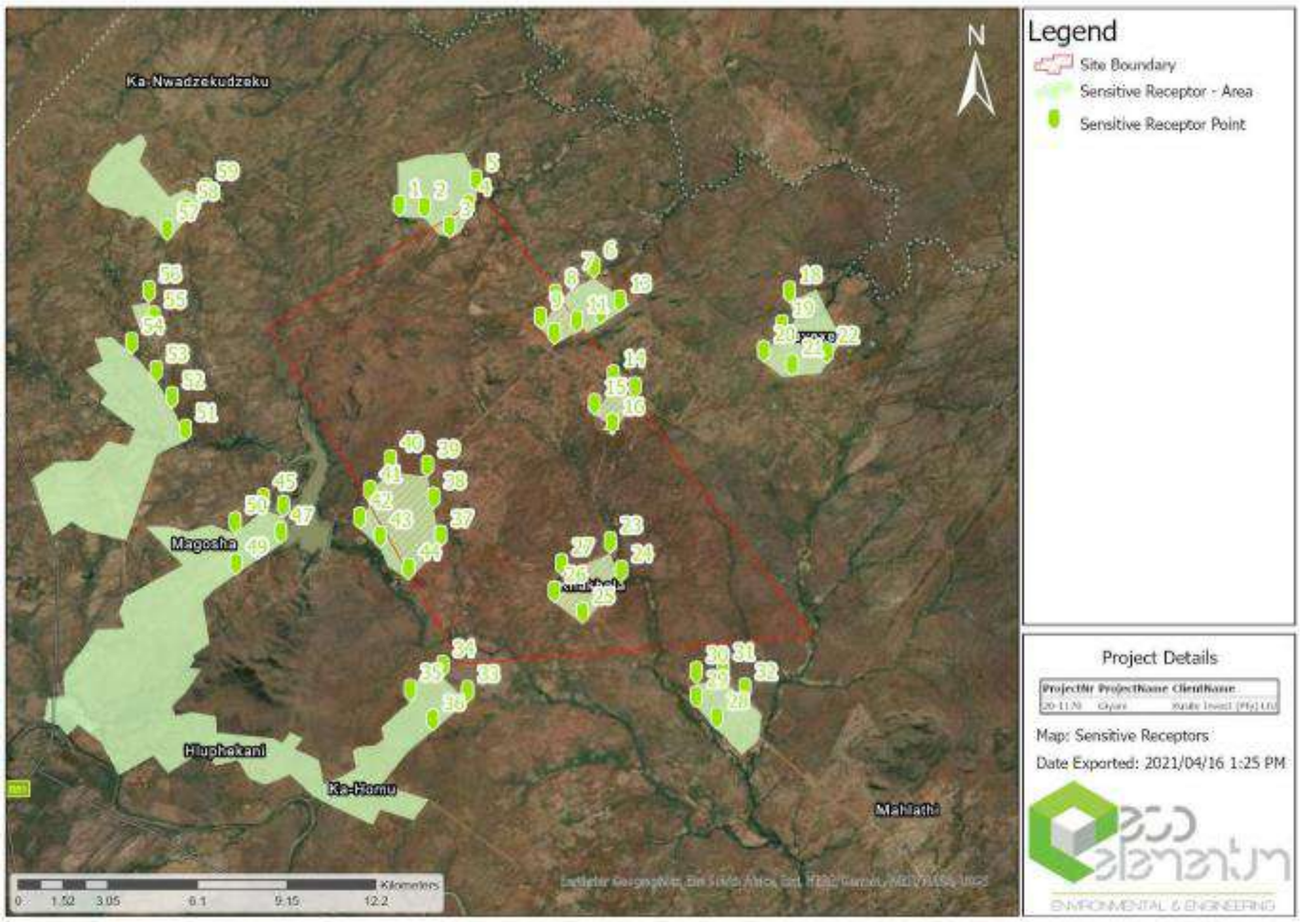


Figure 14: Sensitive areas and Population areas within the immediate vicinity of the proposed Giyani project.

2.1.5 Recorded Noise Levels

The noise levels recorded where indicative of each activity taking place in the proposed mining area. The noise levels closer to the mining permit activities where high with an average of 50dB characteristic of Urban districts. The noise levels reduce towards the townships and decreases even further at the villages (Thomo and Shiviti) with areas closer to the roads having higher noise levels but generally the noise levels range +-40dB which is consistent with rural environment.

The major sources contributing to noise levels observed where:

- Vehicle movement (commuter and light passenger vehicles)
- Mining Permit Activies
- Day to day human activities
- Seasonal farming activities
- Fauna sound

TABLE 2: NOISE LEVELS

Location	South	East	Min dB	AVG dB	Max dB
Pit)	23°11'23"S	30°46'05"E	25.00	41.90	78.90
Plant)	23°18'77"S	30°76'59"E	0.00	43.80	79.50
Site 7	23°16'47"S	30°78'21"E	25.50	33.70	55.10
Site 6	23°11'23"S	30°40'05"E	24.70	36.40	73.10
Site 5	23°27'47"S	30°80'76"E	27.20	38.00	56.50
Site 4	23°15'28"S	30°50'22"E	23.10	37.70	74.10
Site 3	23°11'37"S	30°48'30"E	22.10	35.60	69.60
Site 2	23°22'04"S	30°69'048"E	0.00	50.50	77.50
Site 1	23°11'55"S	30°48'05"E	0.00	50.50	77.50

LAeq,T - Equivalent A-weighted noise level, similar to an average noise level
LA,max - Maximum noise level measured at the point
LA, min - Minimum noise level measured at the point

2.1.6 Assumptions and limitations

Using the point source and attenuation-by-distance model, the following assumptions were made:

- The study assumed no attenuation due to absorption at the ground surface takes place. The effects of frequency-dependent atmospheric absorption were also not considered.
- Meteorological conditions. Neutral weather conditions, i.e. windless and inversionless, and standard conditions of temperature and humidity (20 C and 50%RH) were assumed, representing a neutral evaluation of the noise impact.
- Ambient noise levels. Measured levels are assumed typical of the environment, representing a neutral evaluation of the noise impact.
- Barrier effect of temporary stockpiles and levees. Because of the highly mobile nature of all operations on the proposed project, the effect of these temporary structures on the noise climate was not considered except for the plant area, representing a conservative evaluation of the potential noise impact.
- Current noise control technology is assumed. No allowance is made in the noise level predictions for improvements in noise control techniques or mitigation measures which may be incorporated into the proposed project, representing a conservative evaluation of the potential noise impact.
- Worst case operational noise level assumption. The highest noise level of plant as measured at the operating sites was used as the criterion value for the noise predictions at the proposed project.

2.2 Applicable Legislation

2.2.1 The South African Constitution

This section provides an overview of the legislative requirements applicable to this project and it includes the Acts, guidelines and policies considered in the compilation of this report. The legislative motivation for this project is underpinned by the Constitution of South Africa, 1996 (Act No. 108 of 1996), which states that:

The State must, in compliance with Section 7(2) of the Constitution, respect, protect, promote and fulfil the rights enshrined in the Bill of Rights, which is the cornerstone of democracy in South Africa. Section 24 of the Constitution:

24. Environment

-Everyone has the right-

(a) to an environment that is not harmful to their health or well-being; and

(b) to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that-

(i) prevent pollution and ecological degradation;

(ii) promote conservation; and

(iii) secure ecologically sustainable development and use of natural resources while promoting a justifiable economic and social development.

Section 24 of the Constitution of South Africa (Act No. 108 of 1996) requires that all activities that may significantly affect the environment and require authorisation by law must be assessed prior to approval. In addition, it provides for the Minister of Environmental Affairs or the relevant provincial Ministers to identify:

- new activities that require approval;
- areas within which activities require approval; and
- existing activities that should be assessed and reported on.

Section 28(1) of the Constitution of South Africa (Act No. 108 of 1996) states that: *"every person who causes, has caused or may cause significant pollution or degradation of the environment must take reasonable measures to prevent such pollution or degradation from occurring, continuing or recurring".* If such pollution or degradation cannot be prevented, then appropriate measures must be taken to minimise or rectify such pollution or degradation. These measures may include:

- Assessing the impact on the environment;
- Informing and educating employees about the environmental risks of their work and ways of minimising these risks;
- Ceasing, modifying or controlling actions which cause pollution/degradation;

- Containing pollutants or preventing movement of pollutants;
- Eliminating the source of pollution or degradation; and
- Remedying the effects of the pollution or degradation.

2.2.2 The South African following legislation and guidelines deals with environmental management and air quality:

- ❖ The National Environmental Management Act, Air Quality Act (NEMAQA) (Act No. 39 of 2004)
- ❖ Section 34 of the National Environmental Management: Air Quality Act (Act 39 of 2004) makes provision for:
  - ➢ (1) the Minister to prescribe essential national noise standards -
    - (a) for the control of noise, either in general or by specified machinery or activities or in specified places or areas; or
    - (b) for determining –
    - (i) a definition of noise; and
    - (ii) the maximum levels of noise.
  - ➢ (2) When controlling noise the provincial and local spheres of government are bound by any prescribed national standards.

2.2.3 National Noise Control Regulations (GN R154 of 1992)

In terms of section 25 of the ECA, the national Noise Control Regulations (GN R154 in *Government Gazette* No. 13717 dated 10 January 1992) were promulgated. The NCRs were revised under Government Notice Number R. 55 of 14 January 1994 to make it obligatory for all authorities to apply the regulations.
Subsequently, in terms of Schedule 5 of the Constitution of South Africa of 1996 legislative responsibility for administering the noise control regulations was devolved to provincial and local authorities. Provincial Noise Control Regulations exist in the Free State, Gauteng and Western Cape provinces. The Limpopo Province currently has no provincial noise control regulations and the National Regulations will be in effect.

The National Noise Control Regulations (GN R154 1992) defines:
"**Controlled area**" as:
a piece of land designated by a local authority where, in the case of--
c) Industrial noise in the vicinity of an industry-

i. the reading on an integrating impulse sound level meter, taken outdoors at the end of a period of 24 hours while such meter is in operation, exceeds 61 dBA; or

ii. the calculated outdoor equivalent continuous "A"-weighted sound pressure level at a height of at least 1,2 meters, but not more than 1,4 meters, above the ground for a period of 24 hours, exceeds 61 dBA;

"**disturbing noise**" as:
noise level which exceeds the zone sound level or, if no zone sound level has been designated, a noise level which exceeds the ambient sound level at the same measuring point by 7 dBA or more.

"**zone sound level**" as:
a derived dBA value determined indirectly by means of a series of measurements, calculations or table readings and designated by a local authority for an area. *This is the same as the Rating Level as defined in SANS 10103.*

3 EXPECTED NOISE SOURCES

Mining operations are complex sites involving many different activities that produce different types of noise. They will vary at different times of the day based on the type and location of the mining operation. Mining operations typically involve a transport fleet, which can include dump-trucks and large earth moving equipment, road and rail activity, draglines, blasting, conveyors, crushing, screening and process plants. The proposed Giyani Gold Mine will increase noise levels during construction, operation and decommissioning due to various activities associated with the surface and at a later stage underground mining, associated infrastructure and other related activities.

Noise levels generated by individual pieces of construction equipment and specific construction operations form the basis for the prediction of construction-related noise levels. A variety of information exists related to sound emissions related to such equipment and operations. This information exists for both stationary and mobile sources and for steady, intermittent, and impulse type generators of noise.

3.1 Proposed Project Activities that would Impact the noise levels of the Study Area

3.1.1 Construction Phase:

- Establishment of camp site for construction personnel;
- Selective clearing of vegetation in areas designated for surface infrastructure;
- Soil Stripping of the mining and stockpile area and pollution control dams;
- Digging of foundations and trenches;
- Excavations associated with the development of the surface remining and later underground mining;
- Establishment and development of the old and new access roads;
- Construction of mine infrastructure (sub-station, power lines, telecoms, water systems, offices, parking structures etc.; and
- Construction of crushing, screening and plant infrastructure.

All the activities listed above include general movement of heavy and light vehicles on site and in the Giyani area. On site the use of hydraulic shovels, dump trucks, loaders, dozers and in certain cases blasting will be evident. The impacts of vehicular movement will vary depending on each stage of the construction phase.

TABLE 3: SOUND PRESSURE LEVELS OF THE CONSTRUCTION MACHINERY

Equipment	Line-of-Sight Estimated Noise Level Attenuation (Operational Noise Level at given distance considering potential maximum noise levels) dBA											
	5 m	10 m	20 m	50 m	100 m	150 m	200 m	300 m	500 m	750 m	1000 m	2000 m
Auger Drill Rig	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Backhoe	89.7	83.7	77.6	69.7	63.7	60.1	57.6	54.1	49.7	46.2	43.7	37.6
Chain Saw	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Compactor (ground)	89.7	83.7	77.6	69.7	63.7	60.1	57.6	54.1	49.7	46.2	43.7	37.6
Compressor (air)	89.7	83.7	77.6	69.7	63.7	60.1	57.6	54.1	49.7	46.2	43.7	37.6
Concrete Batch Plant	92.7	86.7	80.6	72.7	66.7	63.1	60.6	57.1	52.7	49.2	46.7	40.6
Concrete Mixer Truck	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Concrete Pump Truck	91.7	85.7	79.6	71.7	65.7	62.1	59.6	56.1	51.7	48.2	45.7	39.6
Concrete Saw	99.7	93.7	87.6	79.7	73.7	70.1	67.6	64.1	59.7	56.2	53.7	47.6
Crane	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Dozer	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Drill Rig Truck	93.7	87.7	81.6	73.7	67.7	64.1	61.6	58.1	53.7	50.2	47.7	41.6
Drum Mixer	89.7	83.7	77.6	69.7	63.7	60.1	57.6	54.1	49.7	46.2	43.7	37.6
Dump Truck	93.7	87.7	81.6	73.7	67.7	64.1	61.6	58.1	53.7	50.2	47.7	41.6
Excavator	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Flat Bed Truck	93.7	87.7	81.6	73.7	67.7	64.1	61.6	58.1	53.7	50.2	47.7	41.6
Front End Loader	89.7	83.7	77.6	69.7	63.7	60.1	57.6	54.1	49.7	46.2	43.7	37.6
Generator	91.7	85.7	79.6	71.7	65.7	62.1	59.6	56.1	51.7	48.2	45.7	39.6
Generator (<25KVA, VMS Signs)	79.7	73.7	67.6	59.7	53.7	50.1	47.6	44.1	39.7	36.2	33.7	27.6
Grader	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Impact Pile Driver	104.7	98.7	92.6	84.7	78.7	75.1	72.6	69.1	64.7	61.2	58.7	52.6
Jackhammer	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Man Lift	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Mounted Impact Hammer	99.7	93.7	87.6	79.7	73.7	70.1	67.6	64.1	59.7	56.2	53.7	47.6

Paver	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Pickup Truck	64.7	58.7	52.6	44.7	38.7	35.1	32.6	29.1	24.7	21.2	18.7	12.6
Pumps	86.7	80.7	74.6	66.7	60.7	57.1	54.6	51.1	46.7	43.2	40.7	34.6
Rivit Buster/Chipping Gun	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Rock Drill	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Roller	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Sand Blasting (single nozzle)	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Scraper	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Sheers (on backhoe)	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Slurry Plant	87.7	81.7	75.6	67.7	61.7	58.1	55.6	52.1	47.7	44.2	41.7	35.6
Slurry Trenching Machine	91.7	85.7	79.6	71.7	65.7	62.1	59.6	56.1	51.7	48.2	45.7	39.6
Soil Mix Drill Rig	89.7	83.7	77.6	69.7	63.7	60.1	57.6	54.1	49.7	46.2	43.7	37.6
Tractor	93.7	87.7	81.6	73.7	67.7	64.1	61.6	58.1	53.7	50.2	47.7	41.6
Vacuum Excavator (Vac-Truck)	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Vacuum Street Sweeper	89.7	83.7	77.6	69.7	63.7	60.1	57.6	54.1	49.7	46.2	43.7	37.6
Ventilation Fan	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Vibrating Hopper	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Vibratory Concrete Mixer	89.7	83.7	77.6	69.7	63.7	60.1	57.6	54.1	49.7	46.2	43.7	37.6
Vibratory Pile Driver	104.7	98.7	92.6	84.7	78.7	75.1	72.6	69.1	64.7	61.2	58.7	52.6
Warning Horn	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Welder/Torch	82.7	76.7	70.6	62.7	56.7	53.1	50.6	47.1	42.7	39.2	36.7	30.6

The construction activities during the construction phase will increase the prevailing noise level along the immediate vicinity of the activity on a temporary basis. The following noise levels at different distances are applicable during the construction phase. Engineering control measures and topography can have an influence on how the noise level is perceived by the receptor some distance away from the activities. The noise levels some distance from a noise source are illustrated in Table 1.

Mines typically operate 24 hours a day, seven days a week, and there are also other noise sources in the communities where mines operate. In the project area noise generates from vehicular movement, farming activities, and domestic activities as the project is in a rural setting. The key question is what an acceptable level of noise is when these noise sources are accounted for and how it impacts daily life in the community. The additional noise sources from the mining activities will add to the prevailing ambient noise levels of the area and the sources are described in detail below.

3.1.2 Operation phase:

- Excavation of overburden and hard rock;
- Product excavation, loading and hauling;
- Conveying of mined product to the stock area;
- Vehicle movements within the site and in the Malamulele area (dust suppression, product transport, pit backfill etc.
- Remining of the dump and rehabilitation of open areas with aggregate such as topsoil etc.
- Ore receipt and management (stockpiling);
- Material handling, sorting and crushing (rotary crusher, grizzly etc);
- Gold ore crushing, separation and processing at the plant;
- Discard management of spoils, tailings etc. (material handling);
- Flotation and fines management;
- Tailings thickening and tailing disposal; and
- Product handling.

Of these activities significant noise levels are associated with the mining area, material tip and plant activities. A source of noise during the operational phase is additional traffic to and from the mine. Noise propagation due to road traffic depends on various acoustical factors. The most significant noise contributor above 60 km p/h is the tyre interaction with the road surface. Tyre road impacts and shocks as well as tyre to road pumping (during standard rolling conditions, pumping is the compression of air under tyre tread) can contribute mainly below and above 1000 Hz respectively (up to 2000 Hz for pumping).

Vehicles noise emissions at speed vary from vehicle to vehicle. For acoustical purposes the classification of vehicles are considered as light or heavy. Heavy vehicles could be considered as articulated, tanker or other industrial haul trucks.

3.1.3 Closure Phase:

A closure EMP must be developed by the mining operation at the end of the mining operation, which is more specific and accurate. Noise impacts from the decommissioning of the plant and pit are likely to be very similar to the construction phase as it is likely to utilize the same earthmoving equipment and procedures. There are no noise generating items left after decommissioning which could lead to irreversible degradation of the noise climate.

3.1.3.1 Residual impacts

It is expected that at the end of the project there will be no residual or latent impacts regarding noise as the activities generating the noise will have ceased.

3.1.3.2 Cumulative impacts

The cumulative impact assessment considers the project within the context of other similar land uses, in the local study area and greater regional context. The area has no other industrial or noise sources within 10 km of the legal boundary of the mine, so there are no impacts which are cumulative with other noise sources external to the mine except for existing traffic. In Addition, the dense bush vegetation serves to naturally screen noise and dust.

4 IMPACT OF MINING ACTIVITIES ON AMBIENT NOISE LEVELS

Mines are required to minimise the environmental impact of their operations by taking a systematic and disciplined approach and applying sophisticated risk assessment techniques that directly inform its strategic initiatives and plans. Coordinating environmental management is an intra- and inter-company affair with many internal engagements taking place. With regards to noise levels, the mine should monitor the levels generated by its activities at the plant (transfer points, extraction systems, open areas and roads) and mining areas (mine and contractor haul roads).

To manage the environmental impacts and to ensure that the mine fulfil its legal obligations in regard to noise levels, a monitoring programme should be implemented which measures the noise levels at all operating areas as well as boundaries of the project area. In some cases, additional monitoring points are required if the residents of the area raise concerns regarding noise levels.

Sound is a wave motion, which occurs when a sound source sets the nearest particles of air in motion. The movement gradually spreads to air particles further away from the source. Sound propagates in air with a speed of approximately 340 m/s. The sound pressure level in free field conditions is inversely proportional to the square of the distance from the sound source – inverse square law. Expressed logarithmically as decibels, this means the sound level decreases by 6 dB with the doubling of distance. This applies to a point source only. If the sound is uniform and linear then the decrease is only 3 dB per doubling of distance.

The decibel scale is logarithmic therefore decibel levels cannot be added together in the normal arithmetic way, for example, two sound sources of 50 dB each do not produce 100 dB but 53 dB, nor does 50 dB and 30 dB equal 80 dB, but remains 50 db. Air absorption is important over large distances at high frequencies. Air absorption depends on the humidity but is typically about 40 dB/km @ 4000 Hz. Road traffic noise frequencies are mainly mid/low and will be unaffected below distances of 200m.

When measuring the intensity of a sound, an instrument, which duplicates the ear variable sensitivity to sound of different frequency, is usually used. This is achieved by building a filter into the instrument with a similar frequency response to that of the ear. This is called a weighting filter because it conforms to the internationally standardized A-weighting curves. Measurements of sound level made with this filter are called A-weighted sound level measurements, and the unit is dB. Sound propagation is affected by wind gradient rather than the wind itself. The profile of the ground causes such a gradient. Sound propagation upwind is refracted upwards creating a sound shadow and downwind refracted towards the ground producing a slight increase in sound level over calm isothermal conditions.

The velocity of sound is inversely proportional to the temperature so that a temperature gradient produces a velocity gradient and a refraction of the sound. Temperature decreases with height and the sound is refracted upwards.

For a source and receiver close to the ground quite large attenuation can be obtained at certain frequencies over absorbing surfaces, noticeably grassland. This attenuation is caused by a change in phase when the reflected wave strikes the absorbing ground and the destructive interference of that wave with the direct wave. The reduction in sound tends to be concentrated between 250 Hz and 600 Hz.

Noise screening can be effective when there is a barrier between the receiver and the source for example walls, earth mounds, cuttings and buildings. The performance of barriers is frequency dependent. To avoid sound transmission through a barrier the superficial mass should be greater than 10 kg/m².

There is a complex relation between subjective loudness and the sound pressure level and again between annoyance due to noise and the sound pressure level. In general, the ear is less sensitive at low frequencies and the ear will only detect a difference in the sound pressure level when the ambient noise level is exceeded by 3-5 dBA. People exposed to an increase in the prevailing ambient noise level will react differently to the noise levels and the response is given in a table below.

TABLE 4: ESTIMATED COMMUNITY/GROUP RESPONSE WHEN THE AMBIENT NOISE LEVEL IS EXCEEDED (SANS 10103:2008)

Excess	**Estimated community/group response**	
***)L*Req, T** 1)	**Category**	**Description**
0	None	No observed reaction
0-10	Little	Sporadic complaints
5-15	Medium	Widespread complaints
10-20	Strong	Threats of community/group action
>15	Very strong	Vigorous community/group action
Calculate)*L*Req,T from the appropriate of the following:)*L*Req,T = *L*Req,T of ambient noise under investigation MINUS *L*Req,T of the residual noise (determined in the absence of the specific noise under investigation).		

The difference between the actual noise and the ambient noise level will determine how people respond to sound. The recommended noise level for a residential area according to the General Environmental Health and Safety Guidelines is 55.0dBA during the day time period and 45.0dBA during the night time period. SANS (10103:2008) have different recommended ambient noise levels and this is provided below.

TABLE 5: RECOMMENDED NOISE LEVELS FOR DIFFERENT DISTRICTS

Type of district	**Equivalent continuous rating level LReq.T for ambient noise (dBA)**					
	***Day- night LRdn*2)**	**Daytime *LRd* 1)**	**Night-time *LRn*1)**	***Day-night LRdn*2)**	**Daytime *LRn*1)**	**Night-time *LRn*1)**
a) Rural districts	45	45	35	35	35	25
b) Suburban districts with little road traffic	50	50	40	40	40	30
c) Urban districts	55	55	45	45	45	35
workshops, with business premises and with main roads	60	60	50	50	50	40
Central business district	65	65	55	55	55	45
Industrial districts	70	70	60	60	60	50

The reference time intervals can be specified to cover typical human activities, and variations in the operation of noise sources, and are for daytime between 06h00 to 22h00 and for night time between 22h00 and 06h00.

In terms of noise increases, persons exposed to an increase of 2dBA or less would not notice the difference. Some people exposed to increases of 3-4dBA will notice the increase in noise level, although the increase would not be considered serious. Noise increases of 5dBA and above are very noticeable, and if these are frequent incidents, or continuous in nature, could represent a significant disturbance.

Taking a precautious stance, the following SANS1010:2008 rating levels (zone sound levels for a quieter area than measured during the site visit) will be considered:

- “Sub-urban Districts” (50 and 40 dBA day/night-time Rating).

The International IFC (Equator Principle) Residential; institutional and educational referenced areas include ratings of:

- ❖ Use of LReq,D of 55 dBA during the daytimes; and
- ❖ Use of LReq,N of 45 dBA during the night-times.

4.1 Impacts and Issues Identification

A standardized impact assessment methodology was used to evaluate the impact during the construction, operational and decommissioning phases of the project. The prevailing ambient noise levels during each of these phases differ due to the location of these areas to other point and/or linear noise sources.

There are four common characteristics of sound, any or all of which determine listener response and the subsequent definition of the sound as "noise". These characteristics are:

- Intensity;
- Loudness;
- Annoyance; and
- Offensiveness.

Of the four common characteristics of sound, intensity is the only one which is not subjective and can be quantified.

4.2 Impact Assessment Methodology

The significance of the identified impacts will be determined using the approach outlined below. This incorporates two aspects for assessing the potential significance i.e. occurrence and severity, which are further sub-divided as indicated. The impact ranking will be described for both pre-and post-implementation of mitigation/management measures conditions.

4.2.1 Assessment Criteria

The assessment of the impacts will be conducted according to a synthesis of criteria required by the integrated environmental management procedure.

Extent

The physical and spatial scale of the impact is classified as:

a) Footprint

The impacted area extends only as far as the activity, such as footprint occurring within the total site area.

b) Site

The impact could affect the whole, or a significant portion of the site.

c) Regional

The impact could affect the area including the neighbouring properties, the transport routes and the adjoining towns.

d) National

The impact could have an effect that expands throughout the country (South Africa).

e) International

Where the impact has international ramifications that extent beyond the boundaries of South Africa.

Duration

The lifetime of the impact, that is measured in relation to the lifetime of the proposed development.

a) Short term

The impact would either disappear with mitigation or will be mitigated through natural processes in a period shorter than that of the construction phase.

b) Short to Medium term

The impact will be relevant through to the end of the construction phase.

c) Medium term

The impact will last up to the end of the development phases, where after it will be entirely negated.

d) Long term

The impact will continue or last for the entire operational lifetime of the development, but will be mitigated by direct human action or by natural processes thereafter.

e) Permanent

This is the only class of impact, which will be non-transitory. Mitigation either by man or natural process will not occur in such a way or in such a time span that the impact can be considered transient,

Intensity

The intensity of the impact is considered by examining whether the impact is destructive or benign, whether it destroys the impacted environment, alters its functioning, or slightly alters the environment itself. The intensity is rated as:

a) Low

The impact alters the affected environment in such a way that the natural processes or functions are not affected.

b) Medium

The affected environment is altered, but functions and processes continue, albeit in a modified way.

c) High

Function or process of the affected environment is disturbed to the extent where it temporarily or permanently ceases.

Probability

This describes the likelihood of the impacts occurring. The impact may occur for any length during the life cycle of the activity, and not at any given time. The classes are rated as follows:

a) Impossible

The possibility of the impact occurring is none, due either to the circumstances, design or experience. The chance of this impact occurring is zero (0%).

b) Possible

The possibility of the impact occurring is very low, due either to the circumstances, design or experience. The chances of this impact occurring is defined as 25%.

c) Likely

There is a possibility that the impact will occur to the extent that provisions must therefore be made. The chances of this impact occurring is defined as 50%.

d) Highly likely

It is most likely that the impacts will occur at some stage of the development. Plans must be drawn up before carrying out the activity. The chances of this impact occurring is defined as 75%.

e) Definite

The impacts will take place regardless of any provisional plans, and or mitigation actions or contingency plans to contain the effect can be relied on. The chance of this impact occurring is defined as 100%.

4.2.2 Mitigation

The impacts that are generated by the development can be minimised if measures are implemented in order to reduce the impacts. The mitigation measures ensure that the development considers the environment and the predicted impacts to minimise impacts and achieve sustainable development.

Determination of significance – Without Mitigation

Significance is determined through a synthesis of impacts as described in the above paragraphs. It provides an indication of the importance of the impact in terms of both tangible and intangible characteristics. The significance of the impact “without mitigation” is the prime determinant of the nature and degree of mitigation required. Where the impact is positive, significance is noted as “positive”. Significance is rated on the following scale:

a) No significance

The impact is not substantial and does not require any mitigation action.

b) Low

The impact is of little importance, but may require limited mitigation.

c) Medium

The impact is of importance and is therefore considered to have a negative impact. Mitigation is required to reduce the negative impacts to acceptable levels.

d) High

The impact is of major importance. Failure to mitigate, with the objective of reducing the impact to acceptable levels, could render the entire development option or entire project proposal unacceptable. Mitigation is therefore essential.

Determination of significance – With Mitigation

Determination of significance refers to the foreseeable significance of the impact after the successful implementation of the necessary mitigation measures. Significance with mitigation is rated on the following scale:

a) No significance

The impact will be mitigated to the point where it is regarded as insubstantial.

b) Low

The impact will be mitigated to the point where it is of limited importance.

c) Low to Medium

The impact is of importance however, through the implementation of the correct mitigation measures such potential impacts can be reduced to acceptable levels.

d) Medium

Notwithstanding the successful implementation of the mitigation measures, to reduce the negative impacts to acceptable levels, the negative impact will remain of significance. However, taken within the overall context of the project, the persistent impact does not constitute a fatal flaw.

e) Medium to High

The impact is of major importance but through the implementation of the correct mitigation measures, the negative impacts will be reduced to acceptable levels.

f) High

The impact is of major importance. Mitigation of the impact is not possible on a cost-effective basis. The impact is regarded as high importance and taken within the overall context of the project, is regarded as a fatal flaw. An impact regarded as high significance, after mitigation could render the entire development option or entire project proposal unacceptable.

4.2.3 Assessment weighting

Each aspect within the impact description was assigned a series of quantitative criteria. Such criteria are likely to differ during the different stages of the project's life cycle. In order to establish a defined base upon which it becomes feasible to make an informed decision, it is necessary to weigh and rank all criteria.

Ranking, Weighting and Scaling

For each impact under scrutiny, a scale weighting Factor is attached to each respective impact (refer to Figure 15: Description of biophysical assessment parameters with its respective weighting), The purpose of assigning such weight serve to highlight those aspects considered most critical to the various stakeholders and ensure that each specialist's element of bias is taken into account. The weighting factor also provides a means whereby the impact assessor can successfully deal with the complexities that exist between the different impacts and associated aspects criteria.

Simply, such a weighting factor is indicative of the importance of the impact in terms of the potential effect that it could have on the surrounding environment. Therefore, the aspects considered to have a relatively high value will score a relatively higher weighting than that which is of lower importance.

Extent	Duration	Intensity	Probability	Weighting Factor (WF)	Significance Rating (SR)	Mitigation Efficiency (ME)	Significance Following Mitigation (SFM)
Footprint 1	Short term 1	Low 1	Probable 1	Low 1	Low 0-19	High 0,2	Low 0-19
Site 2	Short to medium 2		Possible 2	Low to medium 2	Low to medium 20-39	Medium to high 0,4	Low to medium 20-39
Regional 3	Medium term 3	Medium 3	Likely 3	Medium 3	Medium 40-59	Medium 0,6	Medium 40-59
National 4	Long term 4		Highly Likely 4	Medium to high 4	Medium to high 60-79	Low to medium 0,8	Medium to high 60-79
International 5	Permanent 5	High 5	Definite 5	High 5	High 80-100	Low 1,0	High 80-100

Figure 15: Description of biophysical assessment parameters with its respective weighting

Identifying the Potential Impacts without Mitigation (WOM)

Following the assignment of the necessary weights to the respective aspects, criteria are summed and multiplied by their assigned weightings, resulting in a value for each impact (prior to the implementation of mitigation measures).

Equation 1:

Significance Rating (WOM) = (Extent + Intensity + Duration + Probability) x Weighting Factor

Identifying the Potential Impacts with Measures (WM)

To gain a comprehensive understanding of the overall significance of the impact, after implementation of the mitigation measures, it was necessary to re-evaluate the impact.

a) Mitigation Efficiency (ME)

The most effective means of deriving a quantitative value of mitigated impacts is to assign each significance rating value (WOM) a mitigation effectiveness (ME) rating. The allocation of such a rating is a measure of the efficiency and effectiveness, as identified through professional experience and empirical evidence of how effectively the proposed mitigation measures will manage the impact.

Thus, the lower the assigned value the greater the effectiveness of the proposed mitigation measures and subsequently, the lower the impacts with mitigation.

Equation 2:

Significance Rating (WM) = Significance Rating (WOM) x Mitigation Efficiency

Or WM = WOM x ME

b) Significance Following Mitigation (SFM)

4.2.4 Methodology for Assessing Environmental Issues, Alternatives and cumulative impacts (if any)

According to National Environmental Management Act (107/1998): Environmental Impact Assessment Regulations, 2017), the environment is described as the surrounding within which human exist and that are made up of:

(i) the land, water and atmosphere of the earth;

(ii) micro-organisms, plant and animal life;

(iii) any part or combination of (i) and (ii) and the interrelationships among and between them; and

(iv) the physical, chemical, aesthetic and cultural properties and conditions of the foregoing that influence human health and well-being.

Impact Assessment Methodology

(a) Nature of the impact

The NATURE of an impact can be defined as: "a *brief description of the impact being assessed, in terms of the proposed activity or project, including the socio-economic or environmental aspect affected by this impact*".

(b) Extent of the impact

The EXTENT of an impact can be defined as: "*a brief description of the spatial influence of the impact or the area that will be affected by the impact*".

EXTENT	**Footprint**	Only as far as the activity, such as footprint occurring within the total site area
	Site	Only the site and/or 500m radius from the site will be affected

Extent or spatial influence of impact	**Local**	Local area / district (neighbouring properties, transport routes and adjacent towns) is affected
	Region	Entire region / province is affected
	National	Country is affected

(a) Magnitude of the impact

The MAGNITUDE of an impact can be defined as: "*a brief description of the intensity or amplitude of the impact on socio-economic or environmental aspects".*

MAGNITUDE Magnitude / intensity of impact (at the specified scale)	**Zero**	Natural and/or social functions and/or processes remain *unaltered*
	Very low	Natural and/or social functions and/or processes are *negligibly* altered
	Low	Natural and/or social functions and/or processes are *slightly* altered
	Medium	Natural and/or social functions and/or processes are *notably* altered
	High	Natural and/or social functions and/or processes *severely* altered

(b) Duration of the impact

The DURATION of an impact can be defined as: "*a short description of the period of time the impact will have an effect on aspects*".

DURATION Duration of the impact	**Short term**	Construction phase up to 3 years after construction
	Medium term	Up to 6 years after construction
	Long term	More than 6 years after construction

(c) Probability of the impact occurring

The PROBABILITY of an impact can be defined as: "the *estimated chance of the impact happening*".

PROBABILITY	**Unlikely**	*Unlikely* to occur (0 – 25% probability of occurring)
	Possible	*May* occur (26 – 50% chance of occurring)
	Probable	*Likely* to occur (51 – 75% chance of occurring)
	Definite	Will *certainly* occur (76-100% chance of occurring)

(d) Degree to which impact can be reversed

The REVERSABILITY of an impact can be defined as: *"the ability of an impact to be changed from a state of affecting aspects to a state of not affecting aspects*".

REVERSABILITY	**Reversible**	Impacts can be reversed through the implementation of mitigation measures
	Irreversible	Impacts are permanent and can't be reversed by the implementation of mitigation measures

(e) Degree to which impact may cause irreplaceable loss of resources

The IRREPLACEABILITY of an impact can be defined as:" the amount of resources that can (not) be replaced".

IRREPLACEABILITY Irreplaceable loss of resources	**No loss**	*No* loss of any resources
	Low	*Marginal* loss of resources
	Medium	*Significant* loss of resources
	High	*Complete* loss of resources

(f) Degree to which the impact can be mitigated

The degree to which an impact can be MITIGATED can be defined as: "the effect of mitigation measures on the impact and its degree of effectiveness".

MITIGATION RATING	**MITIGATED** Degree impact can be mitigated	**High**	*Impact 100% mitigated*
		Medium	*Impact >50% mitigated*
		Low	*Impact <50% mitigated*

(g) Confidence rating

CONFIDENCE in the assessment of an impact can be defined as the:" *level of certainty of the impact occurring*".

CONFIDENCE RATING	**CONFIDENCE**	**Unsure**	Amount of information on and/or understanding of the environmental factors the potentially influence the impact is *limited*.
		Sure	Amount of information on and/or understanding of the environmental factors the potentially influence the impact is *reasonable and relatively sound.*
		Certain	Amount of information on and/or understanding of the environmental factors the potentially influence the impact is *unlimited and sound*.

(h) Cumulative impacts

The effect of CUMULATIVE impacts can be described as:" the effect the combination of past, present and "reasonably foreseeable" future actions have on aspects".

CUMULATIVE RATING	**CUMULATIVE EFFECTS**	**Low**	*Minor* cumulative effects
		Medium	*Moderate* cumulative effects
		High	*Significant* cumulative effects

It is expected that the noise impacts will occur on the Farm Kirsten where the operations will be based. The impacts and the environmental consequences during the construction, operational and closure phases are provided in Table 6, table 7 and table 8 respectively.

4.3 Construction Phase

TABLE 6: QUALITATIVE IMPACT DURING THE CONSTRUCTION PHASE

Impacts		**Occurrence**			**Severity**				**Environmental Consequence Before Mitigation**	**Environmental Consequence After Mitigation**
		Direction	**Probability**	**Duration**	**Magnitude**	**Geographic Extent**	**Reversibility**	**Frequency**		
Preparation of the foot print area	Increased noise levels on the proposed site	Negative	Definite	Short term	Low	Site	Reversible	Medium	**Low**	**Low**
	Increased noise levels off the proposed Site	Positive	Medium Probability	Short term	Low	Site	Reversible	Low	**Low**	**Low**
Civil construction	Increased noise levels along the boundary of the proposed Site	Negative	Definite	Short term	Low	Site	Reversible	Medium	**Low**	**Low**
	Increased noise levels at the mining area	Negative	Medium Probability	Short term	Low	Site	Reversible	Low	**High**	**Moderate**
Grading and building of new roads	Increased noise levels along the boundary of the proposed Site	Negative	Definite	Short term	Low	Site	Reversible	Medium	**Low**	**Low**
	Increased noise levels at the mine area	Negative	Medium Probability	Short term	Low	Site	Reversible	Low	**Low**	**Low**
Construction of buildings and/or plant	Increased noise levels along the boundary of the proposed Site	Negative	Definite	Short term	Low	Site	Reversible	Medium	**Low**	**Low**
	Increased noise levels at the mine area	Negative	Medium Probability	Short term	Low	Site	Reversible	Low	**Moderate**	**Low**

4.4 Operational Phase

TABLE 7: QUALITATIVE IMPACT DURING THE OPERATIONAL PHASE

Impacts		**Occurrence**			**Severity**				**Environmental Consequence Before Mitigation**	**Environmental Consequence After Mitigation**
		Direction	**Probability**	**Duration**	**Magnitude**	**Geographic Extent**	**Reversibility**	**Frequency**		
Mining activities area	Increased noise levels on the proposed Site	Negative	Definite	Long term	High	Site	Reversible	High	High	Moderate
	Increased noise levels off the proposed Site	Negative	Medium Probability	Long term	Low	Site	Reversible	Low	Moderate	Low
Hauling of ore	Increased noise levels along the feeder roads	Negative	Definite	Long term	High	Local	Reversible	Medium	Moderate	Low
Excavations	Increased noise levels off the proposed Site	Negative	Medium Probability	Long term	Low	Site	Reversible	Low	Moderate	Low
Processing Plant	Increased noise levels off the proposed Site	Negative	Medium Probability	Long term	Low	Site	Reversible	Low	Moderate	Low

4.5 Closure Phase

TABLE 8: QUALITATIVE IMPACT DURING THE CLOSURE PHASE

Impacts		Occurrence			Severity				Environmental Consequence Before Mitigation	Environmental Consequence After Mitigation
		Direction	**Probability**	**Duration**	**Magnitude**	**Geographic Extent**	**Reversibility**	**Frequency**		
Covering of underground and surface mining with capping layer and top soil	Increased noise levels on the proposed Site	Negative	Definite	Short term	High	Site	Reversible	High	Low	Low
	Increased noise levels off the proposed Site	Positive	Medium Probability	Short term	Low	Site	Reversible	Low	Low	Low
Removal of buildings and infra- structure	Increased noise levels along the feeder roads	Negative	Definite	Short term	Low	Local	Reversible	Medium	Low	Low
Rehabilitation	Increased noise levels along the feeder roads	Negative	Definite	Short term	Low	Local	Reversible	Medium	Low	Low
	Increased noise levels on the proposed Site	Negative	Definite	Short term	High	Site	Reversible	High	Low	Low

4.6 Recommendations for Mitigation

Due to the distance of receptors from the proposed activities it is likely (daytime and night-times) that potential noise-sensitive development will experience a noise impact with a magnitude higher than that of urban environments. This is only relevant when heavy equipment operates within 500 meters from sensitive receptors like the villages within the Giyani area (Thomo and Shiviti).

4.6.1 Construction phase

4.6.1.1 Mitigation Options: Mitigation of noise source

Mitigation options included both management measures as well as technical changes. Management options to reduce the noise impact during the construction phase include:

- Due to the thick vegetation in the area, tree removal should be minimised so that the natural cover acts as berms with a potential to act as a noise barrier around surface operations, the plant and other mining activities with the barrier being built as close as possible to the operations or at receptors as is feasible as possible.
- This should also be implemented at stockpile areas, although the higher the berm/barrier the better acoustical screen it will be. Certain heavy vehicles have their exhaust ports above the cabin of the vehicle and needs to be considered as the noise source point.
- The barrier should be sufficiently long to block the line of sight from receptors to the sides of the mining operations;
- Minimize any work that needs to take place at night. Night-time construction work should be limited to localities that are further than 2km from a noise-sensitive community when there is a direct line of sight (no barrier between the activity and receptor);
- 1km from a noise-sensitive community when there exists a barrier between the activity and receptor;
- Using the smallest/quietest equipment when operating near receptors;
- Ensuring that equipment is well maintained and fitted with the correct and appropriate noise abatement measures. Acoustical mufflers (or silencers) should be considered on equipment exhausts on open cast pits and stockpile areas.

4.6.1.2 Mitigation Options: Mitigation at Receptors

Normal daily activities will generate other noises that would most likely mask construction noises, minimizing the probability of an impact happening.

- Ensure a good working relationship between the mining management and all potentially sensitive receptors. Communication channels should be established to ensure prior notice to the sensitive receptor if work is to take place close to them. Information that should be provided to the potentially sensitive receptor(s) include:

- Proposed working times;
- How long the activity is anticipated to take place,
- What is being done, or why the activity is taking place;
- Contact details of a responsible person where any complaints can be lodged should there be an issue of concern;

Due to the distance between possible receptors and the site hauling trucks should be limited to operating between 6am and 6pm to reduce night noise levels when working in areas close to the villages i.e. pit Boltman.

4.6.2 Operational Phase

The layout as evaluated (also considering the locations of the various stockpiles) would allow some mitigation of noises from the development. The implementation of the mitigation measures as proposed for the construction phase would further assist in reducing noise levels (berms and barriers, with the natural dense woody vegetation functioning as a natural buffer).

4.6.2.1 Mitigation Options: Mitigation of noise source

Mitigation options included both management measures as well as technical changes. Management options to reduce the noise impact during the operational phase include:

- ➢ Mitigation measures as identified for construction phase still valid (berms barriers around open cast/stockpile boundaries);
- ➢ Environmental awareness training should include a noise component, allowing employees and contractors to realize the potential noise risks that activities (especially night-time activities) pose to the surrounding environment. All employees and contractors should receive this training;
- ➢ The use of white-noise generators instead of reverse alarms on heavy vehicles operating on roads, in mine pits and at stockpile areas;
- ➢ Minimize equipment or processes at high levels, such as the development of the material tip being significantly higher than the surrounding landscape. It limits the mitigation of this noise using berms or barriers. The developer may consider keeping the material tip at ground height or even slightly below ground level;
- ➢ Ensuring that equipment is well maintained and fitted with the correct and appropriate noise abatement measures. Acoustical mufflers (or silencers) should be considered on all equipment exhausts on surface and underground operations, stockpile areas as well as on exhausts from equipment facing receptors within 800 m. If technically feasible mine equipment exhaust ports should not face directly towards a receptor or upwards (due to diffraction in night-time atmosphere) but away from a receptor; and

- All equipment (especially crushers, conveyor transfer points, conveyor drive systems and washers and screeners) should be enclosed where practically possible.
- To limit the maximum speed on the haul roads to less than 60 km/h.
- A line of communication with the community where complaints could be lodged/registered. All potentially sensitive receptors should be made aware of this line of communication.

4.6.3 Risk assessment during operations

The aim of the risk assessment is to help you decide what you need to do to ensure the health and safety of your employees who are exposed to noise. It is more than just taking measurements of noise - sometimes measurements may not even be necessary. The risk assessment should:

- Identify where there may be a risk from noise and who is likely to be affected;
- Contain a reliable estimate of your employees' exposures, and compare the exposure with the exposure action values and limit values;
- Identify what you need to do to comply with the law, e.g. whether noise-control measures or hearing protection are needed, and, if so, where and what type; and
- Identify any employees who need to be provided with health surveillance and whether any are at particular risk.

Estimating employees' exposure

- It is essential that you can show that your estimate of employees' exposure is representative of the work that they do. It needs to take account of:
- the work they do or are likely to do;
- the ways in which they do the work; and
- how it might vary from one day to the next.
- Your estimate must be based on reliable information, e.g. measurements in your own workplace, information from other workplaces like yours, or data from suppliers of machinery.
- You must record the findings of your risk assessment. You need to record in an action plan anything you identify as being necessary to comply with the law, setting out what you have done and what you are going to do, with a timetable and saying who will be responsible for the work.
- Review your risk assessment if circumstances in your workplace change and affect noise exposures. Also review it regularly to make sure that you continue to do all that is reasonably practicable to control the noise risks. Even if it appears that nothing has changed, you should not leave it for more than about two years without checking whether a review is needed.

4.6.4 Competence

You need to make sure that your risk assessment:

- has been drawn up by someone who is competent to carry out the task; and
- is based on advice and information from people who are competent to provide it.
- You, or people within your company, may well be competent in some or all areas. You may, however, choose or need to go to external consultants.

The following impacts were identified to be moderate and should be addressed to comply with the Noise Control Regulations:

TABLE 9: NOISE MITIGATION MEASURES

Objective	• To comply with the Noise Control Regulations as promulgated under the Environment Conservation Act, 1989. Act No 73 of 1989; • Put measures in place to align the operations with the current provisions of SANS 10103:2008 and SANS 10328:2008 for residential and non-residential areas; • Environmental, Health and Safety (EHS) Guidelines, World Health Organisation (WHO, 2002).	***Responsibility***
Impacts:	***Construction Impacts*** • Increased noise levels during civil construction activities; • Increased noise levels during building of the plant and establishment of the mining. ***Operational Impacts*** • Increased noise levels during mining activities, • Increased noise levels during the hauling of ore and waste. • Blasting and vibration impacts from the underground operations	***Site engineer***

Mitigation measure(s):	***Construction and preparation*** • Construction activities to take place during daytime (6am – 6pm) only; • Biannual noise assessments along the boundaries of the site to take place to identify noise intrusions; • All machinery and/or plant which radiate noise levels exceeding 85.0dBA to be acoustically screened off; • All vehicles operational at the site to conform with the following health and safety standards: ➢ Noise Induced Hearing Loss Regulations, SANS 10103:2008 and SANS 10328:2008 for residential and non-residential areas; Occupational Health and Safety Act, 1993); (Act No. 85 of 1993 and the Occupational Hygiene Regulations, MHSAct (29 of 1996) • Selecting equipment with lower sound power levels; • Installing acoustic enclosures for machinery and/or parts	
Performance criteria	• Conformance to the prevailing ambient noise level along the boundary of the site.	

5 CONCLUSION AND RECOMMENDATIONS

Ambient sound levels were measured at 9 locations during a site visit conducted in March 2021. The noise levels recorded where indicative of each activity taking place in the proposed mining area. The noise levels closer to the **mining permit activities** where high with an average of **5**0dB characteristic of Urban districts. The noise levels reduce towards the townships and decreases even further at the villages (**Thomo** and **Shiviti**) with areas closer to the roads having higher noise levels but generally the noise levels range +- 4**0**dB which is consistent with rural environment. The major sources contributing to noise levels observed where:

- Vehicle movement (commuter and light passenger vehicles)
- Mining permit activities
- Day to day human activities
- Seasonal farming activities
- Fauna sound

Mining operations generate noise that can be heard in the surrounding community. In terms of the South African National Standards, residential daytime ambient noise levels should not exceed 55 dBA; and night-time ambient noise levels should not exceed 45dBA.

The noise-related aspects of a public involvement program are aimed at presenting project-related information to the public and obtaining public views and input. During the earlier phases of project development, the project's purpose and need is presented to regulatory agencies and the public. Both have opportunities to comment and provide input related to purpose and need. Presentations are made of the range of alternatives under consideration. Broad-scale corridor-type alternatives are usually presented in the earlier stages of project development when no or limited data is available related to noise effects. As such, any discussions related to project-related and construction-related noise are typically qualitative in nature at this stage.

The control measures should be introduced at the plant and along the haul route, especially closer to the sensitive receptors (the villages). For the wind speed reduction screens, consideration should be given to minimized tree removal of the zones around the potential sources with trees. Quarterly noise monitoring is recommended to be conducted by an acoustical consultant or approved noise inspection authority for the first year of operation. A noise monitoring programme should be designed considering the locations of the closest noise-sensitive developments as well as any other areas identified by other specialist studies (fauna, avifauna, macro-invertebrates, etc).

- Construction activities during the construction phase to take place during daytime only;
- Biannual noise assessments during construction and operation along the boundaries of the proposed Site to take place to identify noise intrusions;

- Using acoustic silencers on noisy equipment, all machinery and/or plant, which radiate noise levels exceeding 85.0dBA to be acoustically screened off;
- All vehicles operational at the proposed site to conform with the following health and safety standards, Operational procedures such as speed limits on roads on site;
- Selecting equipment with lower sound power levels;
- Installing acoustic enclosures for machinery and/or parts causing radiating noise;
- Conformance to the prevailing ambient noise level along the boundary of the proposed project area;
- Plant and equipment design and selection, replacing older equipment with new technology that is often quieter;
- House crushing plants within buildings, Enclosing conveyor systems;
- Reducing impact noise by lining chutes with hard wearing rubber and polyurethane materials;
- Using terrain to acoustically shield the operations, placing noisy equipment behind noise barriers;
- Alternate safety systems on mobile equipment to replace reversing alarms and horns
- Monitoring systems to reduce the impact of weather conditions and regular monitoring should also be implemented. All equipment that has belts, gears, bearings, drive motors, and other moving components has a “normal” range of vibration during operating cycles. Change in equipment vibration serves as an early warning of a decline in operating function and signals the need for maintenance to avoid more serious faults and/or failure.

6 STATEMENT OF INDEPENDANCE AND PROFESSIONAL AFFILIATION

I, Yvonne Gutoona, hereby declare that I:-

- Act as an independent consultant;
- Do not have any financial interest in the undertaking of this project, other than remuneration for the work performed in terms of the National Environmental Management Act EIA Regulations Amendment of April 2017
- Have and will not have vested interest in the proposed activity nor will I engage myself in any conflicting interest associated with this project
- I undertake to disclose and provide to the competent authority any material or information at my disposal regarding this project as required in terms of National Environmental Management Act (EIA regulations of April 2017);
- Based on the information provided to me by the client and in addition to information obtained during the course of this study, I have presented the results and conclusion with regard to this project to the best of my professional ability;

Y. Gutoona
Signed at: Pretoria

y. Gutoona

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7 REFERENCES

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ANNEXURE 9 - NOISE IMPACT ASSESSMENT

SOCIAL IMPACT ASSESSMENT

FOR THE PROPOSED GIYANI GOLD MINES LOCATED WITHIN THE GREATER GIYANI MUNICIPALITY 2021

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DEFINITION OF KEY CONCEPTS

The following served as operational definitions for purposes of assessing relevant social change processes and impacts:

COMMUNITY "Communities are marked by deep, intimate and co-operative ties between members. In this sense, 'community' is close to Durkheim's idea of social solidarity, which emerges from commitment to a shared set of values. He calls this 'the collective conscience.' Nisbet gives a formal definition. For him, community 'encompasses all forms of relationship which are characterized by a high degree of personal intimacy, emotional depth, moral commitment, social cohesion and continuity in time'' (Cohen & Kennedy, 2012: 375).

"The fact that people live close to one another does not necessarily mean that they have much to do with each other. There may be little interaction between neighbours. It is the nature of the relationships between people and the social networks of which they are a part that is often seen as one of the more significant aspects of 'community' (Lee & Newby, 1983; .57).

PSYCHOSOCIAL (also termed PSYCO PSYCHOLOGICAL)

The Oxford English Dictionary (1999) defines 'psychosocial' as "pertaining to the influence of social factors on an individual's mind or behaviour, and to the interrelation of behavioural and social factors."

Martikainen, Bartley and Lahelmac (1999) explain that "macro and meso-level social processes lead to perceptions and psychological processes at the individual level. These psychological changes can influence health through direct psychobiological processes or through modified behaviours and lifestyles. However, many psychosocial exposures such as unemployment (so called 'stressful life-event') and social networks/supports need not necessarily invoke psychosocial processes or require psychosocial explanations. Thus, unemployment that leads to loss of income and an inability to buy material necessities of life does not constitute a psychosocial explanation of health. However, a psychosocial process is operating when unemployment leads to loss of self-esteem and feelings of worthlessness that affect health via direct psychobiological processes or through modified behaviours and lifestyles. Similarly, social networks may provide instrumental and material benefits and opportunities as well as close person to person social contacts and emotional support; yet only the latter path seems to qualify as a psychosocial process."

QUALITY OF LIFE 'Quality of life' (QOL) may refer to health-related quality of life (HRQOL); or to non-health or environment-based quality of life (NHRQOL), thus QOL encompasses NHRQOL and HRQL. Teresi (undated) explains the differences as follows: "HRQOL encompasses domains of life directly affected by changes in physical health. Jaschke and colleagues provide a good thumbnail test of whether a domain falls within the category of health related QOL. In their view, HRQOL domains are aspects of life that improve when a physician successfully treats a patient.

A clinically significant change in HRQOL is indicated by a decline in a domain that leads a physician or health care provider to alter a medication or medical treatment. HRQOL domains minimally include functional status (e.g., whether a patient is able to manage a household, use the telephone, or dress independently), mental health or emotional wellbeing (e.g., depressive symptoms, positive affect), social engagement (e.g. involvement with others, engagement in activities), and symptom states (e.g., pain, shortness of breath, fatigue). These domains represent typical outcomes in medical and social science research.

Non-health-related QOL domains include features of both the natural and the created environment (i.e., economic resources, housing, air and water quality, community stability, access to the arts and entertainment) and personal resources (i.e., the capacity *to form friendships, appreciate nature, or find satisfaction in spiritual or religious life). These factors affect health-related QOL but, unlike health-related QOL domains, are less likely to improve with appropriate medical care."* NHRQOL, as opposed to HRQOL, is the focus of this report. Measuring NHRQOL is not within the scope of this report, as it will differ from person to person and therefore requires a rigorous scientific study to get an indication of the overall NHRQOL experienced by affected parties in the study area. The focus in this report is on the potential impact of changes on the experience of NHRQOL. The assumption is that the better the natural and created environment as well as personal resources, the better the overall NHRQOL. Quality of Life is therefore more than Standard of Living, although increase in living standard might contribute to a better QOL.

STANDARD OF LIVING

The following definitions for standard of living where found: "A minimum of necessities, comforts, or luxuries considered essential to maintaining a person or group in customary or proper status or circumstances (http://www.teachmefinance.com/Financial Terms/standard_of_living.html)."

"The financial health of a population, as measured by the quantity of consumption by the members of that population. The measure most frequently used to estimate standard of living is gross national income per capita. One drawback to the standard of living measurement is that it does not take into account some factors which are important but hard to quantify, such as crime rate or environmental impact (http://www.investorwords.com/4691)."

1. INTRODUCTION

Archean Resources (Pty) has been appointed to undertake the Social Impact Assessment (SIA) for the project known as the Giyani Gold Mine Project. The operation is located on Un-Surveyed State land of Greater Giyani 891 LT and a portion of portion 0 of the farm 246 within the town of Giyani, Limpopo Province. .

The Social Impact Assessment, together with other specialist studies, forms part of the Environmental Impact Assessment process. EIA practitioners draw on inputs from a range of scientific disciplines, with the benefit of translating good theory into good practice (DEAT, 2002a).

The SIA provides a baseline description of the study area, specifically focusing on the communities living and working in close proximity to the proposed development. The potential impacts of the proposed development on the social environment will be identified and assessed in terms of an agreed assessment methodology. Mitigation measures will be proposed to enhance the positive impacts and reduce the significance of the negative impacts. Mitigation measures are suggested, proposing a course of action with greatest 'net benefit for society'(Barbour, 2007) .

1.1 Background and Location of the Proposed Project

Kusile Invest 133 (Pty) Ltd (Kusile) proposes to develop a new Gold mine within the town of Giyani, approximately 140 km to the north- east of the N1 National Road from Polokwane., in Limpopo Province, Republic of South Africa. The project is referred to as the Giyani Gold Mine Project. The applicant Kusile Invest has lodged a mining right on Un-Surveyed State land of Greater Giyani 891

LT and a portion of portion 0 of the farm 246 located within the town of Giyani, approximately 140 km to the north- east of the N1 National Road from Polokwane. The well maintained R81 road, from the N1 will provide as the main access to the mine. The mining area will be accessed through existing tarred roads that will link the mine to the various villages such as Thomo, Mninginisi, Mbatlo, Mavalani and Shikukwani. (See locality Map below).

The project area covers a surface area of 13894.66 hectares (Extent of surface area required for mining is 1000 Hectares and extent of the area required for infrastructure, roads, servitudes etc. is 150 Hectares.

The mine development activities will commence by establishing and installing the required mining infrastructure such as pit establishment, shaft headgear and winders, service water, compressed air and power supply, processing plant and installation of surface ventilations fans. The type and size of the mining infrastructure to be installed will be designed to support the proposed Life of Mine (LOM) production rate of 12 000 tons per month of Run of Mine material (ROM) for 30 (thirty) years.

Mining operations will commence from five open cast pits which will later be developed into underground workings and expand into four working levels to reach the steady state production of 12 000 tons per month. Additional working areas will be established for sustainability and to replace the depletion of ore reserves being mined from the start-up working areas.

The project is located within the Giyani Greenstone Belt (GGB), located in the north-eastern corner of the Kaapvaal Craton. The belt is 17km wide and stretches for over 70km in the north-easterly direction, passing through the town of Giyani and ending on the eastern boundary of the Kruger National Park.

Figure 1: Giyani Town and the Proposed Giyani Gold Mines project site

2. LEGAL REQUIREMENTS

Within the South African context, this Social Impact Assessment was undertaken in compliance with the following legal requirements and guidelines.

Constitution of the Republic of South Africa (Act 108 of 1996)

Chapter 2, the Bill of Rights, enshrines the rights of all people in the country and affirms the democratic values of human dignity, equality and freedom. These rights represent the cornerstone of democracy in South Africa. Some of the key rights that have bearing on social rights are mentioned below.

- Human Dignity: Everyone has inherent dignity and the right to have their dignity respected and protected.

- Equality: Everyone is equal before the law and has the right to equal protection and benefit from the law.

- Environment: Everyone has the right to an environment that is not harmful to their health or wellbeing, and to have the environment protected for the benefit of present and future generations, through reasonable legislative and other measures that prevent pollution and ecological degradation, promote conservation and secure ecologically sustainable development and the use of natural resources, while promoting justifiable economic and social development.

- Property: No person may be deprived of property except in terms of the law of general application, and no law may permit arbitrary deprivation of property. Property may be expropriated only in terms of the law of general application for a public purpose or in the public interest. The public interest includes South Africa's commitment to land reform and to reforms to bring about equitable access to all South Africa's natural resources. Property is not limited to land;

- Health care, food, water and social security: Everyone has the right to have access to health care services, including reproductive health care, sufficient food and water and social security, including, if they are unable to support themselves and their dependents, appropriate social assistance;

- Language and culture: Everyone has the right to use the language and participate in the cultural life of their choice, but no one exercising these rights may do so in a manner inconsistent with any provision of the Bill of Rights.

- Access to information: Everyone has the right of access to any information held by the state and any information that is held by another person and that is required for the exercise or protection of any rights; and

<u>National Environmental Management Act (Act 107 of 1998)</u>

The following NEMA principles have an important bearing on social issues:

- Environmental management must place people and their needs at the forefront of its concern, and serve their physical, psychological, developmental, cultural and social interests equitably;

- Development must be socially, environmentally and economically sustainable;

- Environmental management must be integrated, acknowledging that all elements of the environment are linked and interrelated, and it must take into account the effects of decisions on all aspects of the environment and all people in the environment by pursuing the selection of the best practicable environmental option;

- Environmental justice must be pursued so that adverse environmental impacts shall not be distributed in such a manner as to unfairly discriminate against any person, particularly vulnerable and disadvantaged persons;

- Equitable access to environmental resources, benefits and services to meet basic human needs and ensure human well-being must be pursued and special measures may be taken to ensure access thereto by categories of persons disadvantaged by unfair discrimination;

- The participation of all interested and affected parties in environmental governance must be promoted, and all people must have the opportunity to develop the understanding, skills and capacity necessary for achieving equitable and effective participation, and participation by vulnerable and disadvantaged persons must be ensured;

- Decisions must take into account the interests, needs and values of all interested and affected parties, and this includes recognising all forms of knowledge, including traditional and ordinary knowledge;

- Community well-being and empowerment must be promoted through environmental education, the raising of environmental awareness, the sharing of knowledge and experience and other appropriatemeans;

- The social, economic and environmental impacts of activities, including disadvantages and benefits, must be considered, assessed and evaluated, and decisions must be appropriate in light of such consideration and assessment;

- The right of workers to refuse work that is harmful to human health or the environment and to be informed of dangers must be respected and protected;

- Decisions must be taken in an open and transparent manner, and access to information must be provided in accordance with the law;

- The environment is held in public trust for the people. The beneficial use of environmental resourcesmust serve the public interest and the environment must be protected as the peoples' common heritage; and,

- The vital role of women and youth in environmental management and development must be recognised and their full participation therein must be promoted.

<u>The NEMA Protected Areas Act (Act 57 of 2003)</u>

The main aim of the Act is to protect and ensure sustainable decision making for the environment. Accordingto the 2010 regulations there are specific regulations for compilation of specialist report. The SIA has been undertaken in compliance with these regulations.

The International Finance Corporation Performance Standards

Environmental and Social Assessment and Management System; Labour and Working Conditions; Pollution Prevention and Abatement; Community Health, Safety and Security; Land Acquisition and Involuntary Resettlement; Biodiversity Conservation and Sustainable Natural Resource Management– Protection of Indigenous Peoples; and Cultural Heritage.

3. APPROACH AND METHODOLOGY

3.1 Approach

When considering social impacts it is important to recognise that social change is a natural and on-going process. However, it is also important to know and understand that proposed projects implemented by government departments and or private institutions have the potential to influence and alter both the rate and direction of social change (Barbour, 2007) The approach adopted in assessing, understanding and analysing social change has given consideration to the following aspects also applicable to the South African and Developmental Local Government context.

Aspect	Definition
Principles of sustainable development and social sustainability	Sustainable development reflects a process that meets the needs of the present without compromising the ability of future generations to meet their own needs. The concept of "social sustainability" in this approach includes such aspects as: social equity, liveability, health equity, community development, social capital, social support, human rights, labour rights, placemaking, social responsibility, social justice, cultural competence, community resilience, and human adaptation.

Vulnerable groups	Vulnerability as defined by WHO (2002) is the degree to which a population, individual or organisation is unable to anticipate, cope with, resist and recover from the impacts of disasters. Children, pregnant women, elderly people, malnourished people, and people who are ill or immunocompromised, are particularly vulnerable when a disaster strikes, and take a relatively high share of the disease burden associated with emergencies. Poverty – and its common consequences such as malnutrition, homelessness, poor housing and destitution – is a major contributor to vulnerability.
Meeting basic needs and services	In line with the 2030 Agenda for Sustainable Development
Livelihood strategies	Livelihood is defined as a set of activities, involving securing water, food, fodder, medicine,shelter, clothing and the capacity to acquire above necessities working either individually or as a group by using endowments (both human and material) for meeting the requirements of the self and his/her household on a sustainable basis with dignity.
Fairness and equity	Fairness is defined as the quality of having an unbiased disposition. It is the characteristic of being just to everyone, of treating them without discrimination or partiality. It is the absence of prejudice. “Equality” is defined as the quality of being the same in quantity, value, or status. It is the state of having a balanced social, economic, and political standing among individuals in a society despite differences in race, religion, sex, social and economic status, and culture. It refers to providing every

	individual the same opportunities to improve his rank or condition in life without expecting that the results would also be equal.
Social justice	The fair and proper administration of laws conforming to the natural law that all persons, irrespective of ethnic origin, gender, possessions, race, religion, etc., are to be treated equally and without prejudice.

3.2 Methodology

The methodology followed in undertaking the SIA is described below.

The SIA is best understood as an overarching framework that includes a process of identifying, analysing, managing and monitoring positive and negative impacts on people that may be intentionally or unintentionally caused by developments. Its core purpose is to guide decision making in order to create sustainable socio-cultural, economic and biophysical environments (Vanclay, 2003).

Assessment of social impacts is a complex and dynamic process involving a range of steps. It requires an understanding of the values, concerns, attitudes and aspirations of stakeholders and also the socio-economic and cultural conditions, trends and dynamics that characterise communities and their characteristics.

Secondary data sources were used to supplement data collected in the Scoping Phase in order to fulfil the objectives of the study. Primary data collection methods involved a field trip by motor vehicle to undertake visual observations of the proposed development site as well as surrounding land use and current economic activities. In addition to this, examination of updated project description details to determine possible social and economic benefits and impacts was also undertaken. Further issues were obtained from the output of the public participation process conducted during the scoping phase.

The data collected was through the review of the following sources:

- Demographic indicators from Stats SÁ;
- The Scoping Report, with specific focus on the Social components.
- Spatial Development Frameworks of the local municipalities;

- Integrated Development Plans of the local municipalities;
- Specialist reports for this project;
- Literature on the extractive industry and specifically coal mining;
- Maps and aerial survey of the study area;
- Issues and comments submitted to the Environmental Assessment Practitioner

No primary data was collected in preparation of this SIA.

3.2.1 Profiling

Profiling involves a description of the social characteristics and history of the area being assessed, an analysisof demographic data, of changes in the local population, and of the land-use pattern in the study area, aswell as of other significant developments in the area and thus in its social character over time. Such information could include:

- Historical background;
- Social characteristics;
- Culture, attitudes and socio-psychological conditions;
- Population characteristics;
- Community and institutional structures;
- Community resources; and
- Broad economic impacts

3.2.2 Significance criteria

The significance rating process is defined below and serves two purposes: firstly, it helps to highlight the critical impacts which require consideration in the management and approval process; secondly, it also shows the primary impact characteristics associated with the identified mining activity that are used to evaluate impact significance.

The impact significance rating system is presented in the tables below and involves three parts:

Part A: Define impact consequence using the three primary impact characteristics of magnitude, spatial scale/ population and duration;

Part B: Use the matrix to determine a rating for impact consequence based on the definitions identified in Part A; and

Part C: Use the matrix to determine the impact significance rating, which is a function of the impact consequence rating (from **Part B**) and the probability of occurrence.

Table 1: Significance Rating Methodology

PART A: DEFINING CONSEQUENCE IN TERMS OF MAGNITUDE, DURATION AND SPATIAL SCALE ***Use these definitions to define the consequence in Part B***		
Impact characteristics	**Definition**	**Criteria**

MAGNITUDE	Major -	Substantial deterioration or harm to receptors; receiving environment has an inherent value to stakeholders; receptors of impact are of conservation importance; or identified threshold often exceeded
	Moderate -	Moderate/measurable deterioration or harm to receptors;receiving environment moderately sensitive; or identified threshold occasionally exceeded
	Minor -	Minor deterioration (nuisance or minor deterioration) or harm to receptors; change to receiving environment notmeasurable; or identified threshold never exceeded
	Minor +	Minor improvement; change not measurable; or thresholdnever exceeded
	Moderate +	Moderate improvement; within or better than thethreshold; or no observed reaction
	Major +	Substantial improvement; within or better than thethreshold; or favourable publicity
SPATIAL SCALE OR POPULATION	Site or local	Site specific or confined to the immediate project area
	Regional	May be defined in various ways, e.g. cadastral, catchment,topographic
	National/ International	Nationally or beyond

DURATION	Short term	Up to 18 months.
	Medium term	18 months to 5 years
	Long term	Longer than 5 years

PART B: DETERMINING CONSEQUENCE RATING *Rate consequence based on definition of magnitude, spatial extent and duration (Part A)*					
			SPATIAL SCALE/ POPULATION		
			Site or Local	**Regional**	**National/ International**
MAGNITUDE					
Minor	DURATION	Long term	Medium	Medium	High
		Medium term	Low	Low	Medium
		Short term	Low	Low	Medium
Moderate	DURATION	Long term	Medium	High	High
		Medium term	Medium	Medium	High
		Short term	Low	Medium	Medium
Major	DURATION	Long term	High	High	High
		Medium term	Medium	Medium	High
		Short term	Medium	Medium	High

PART C: DETERMINING SIGNIFICANCE RATING *Rate significance based on consequence and probability*			
	CONSEQUENCE		
	Low	**Medium**	**High**

PROBABILITY (of exposureto impacts)	Definite	Medium	Medium	High
	Possible	Low	Medium	High
	Unlikely	Low	Low	Medium

3.3 Gaps, Limitations and Assumptions

It is acknowledged that the SIA has been developed based on certain assumptions and bounded by limitations which were outside the scope of influence of the SIA team. Some of the key assumptions and limitations are listed below:

- The relevant IAIA SIA principles have been adapted for this study, including the precautionary and uncertainty principle when predicting social impacts. Any predicted social impact may change as more information about the Project is known, and the Project is being constructed and operated. Therefore actual social impacts of the Project were not known with certainty when writing this report. A monitoring program has been developed in order to provide information on whether potential social impacts actually occur or not.

- Social impacts are highly contextual and the social impacts of a particular project may be influenced by a range of social, socio-economic and economic trends that are outside the control of the proponent. Additionally, Provincial, State, Regional and local policy and planning frameworks may change considerably over time and this will necessarily affect the identification and management of social impacts. This introduces an unavoidable level of uncertainty into predictions of future impacts which necessitates ongoing monitoring and an adaptive management approach. Conclusions presented in this report are derived primarily from results of previous research and secondary sources.

- Workforce numbers and characteristics of the workforce are based on estimates only and may change as the Project moves into detailed design phase and operations phase.

- This study was carried out with the information available to the specialist at the time of executing the study, within the available timeframe and budget. The sources consulted are not exhaustive and additional information, which might strengthen arguments or contradict information in this report might exist.

- The absence of up-to-date census data on the local population. The last comprehensive census was undertaken in 2011 and the next one is only scheduled for 2021. While census data used is not up-to- date, it does provide sufficient detail to establish a baseline that is relatively accurate in terms of orders of magnitude and allows for the establishment of trends; and

- The absence of a comprehensive, up-to-date database of educational facilities, health care facilities, places of worship, and cultural historical sites. While not every facility or site may have been accounted for, the data does provide sufficient detail to determine quantity, in terms of order of magnitude, and the relative distribution of the facilities and/or sites within the regional study area.

4. DESCRIPTION OF THE PROPOSED PROJECT

The Giyani Gold resources are proposed to be mined using both open cast/surface mining and conventional stoping underground. Mining activities will be carried out on the reef horizon by means of excavating, drilling, blasting, and cleaning of ore using heavy earth moving equipment and blasting using commercial explosives scraper cleaning operations and truck loading or hoisting. The broken ore will be loaded on to trucks and transported through the declines which will be developed below the reef horizon/stoping area for transporting to surface by conveyor belts. For underground mining, the excavation that remains after blasting and cleaning of ore on reef is supported by installing roof bolting to ensure a safe working environment.

4.1 Extraction Methodology

The basic mining methods to be utilised for the Giyani gold mining operation are both surface mining using open pit and conventional stoping methods applied underground to excavate hard rock or ore containing gold and associated minerals such as copper, zinc, nickel and lead and uranium. The existing mine shafts in the area, which form part of the project, were generally mined by conventional breast stoping mining until they were mothballed during the mid-1990's.

Mining will commence using open pits on outcrops and later develop into underground workings.

Typically, underground working areas are accessed through a vertical shaft positioned a distance away from the reef horizon to be mined. A mine shaft is vertical excavation sunk and equipped with conveyances to transport men, material, and rock when mining operations are being conducted. A number of horizontal haulages are developed from the shaft at equal vertical intervals of approximately 60m, to access and intersect the reef horizon by developing a tunnel referred to as a crosscut. A raise development is then carried out from the cross-cut intersection on true dip or angle of inclination of the reef plane to make a holing on the cross-cut developed on the haulage above.

Instead of using the shaft system, an option exists to utilize a decline system, where inclines are developed from the bottom of surface pit limit to provide underground access to deeper lying orebodies.

Separate declines will be developed for men and material access and rock handling. Footwall haulages will be developed from the declines to create crosscuts and raise lines similar to those used in a shaft system. Stoping or conventional breast mining commences from the raise line with mining panels laid out at 20- 30m lengths. The rock breaking process or excavation entails drilling of blast holes and charging of holes. Blasting of ore is done from both sides of the raise advancing on strike along the reef horizon.

The broken ore will be loaded by LHD’s on to trucks and transported through the declines which will be developed below the reef horizon/stoping area for transporting to surface by conveyor belts. In a typical SA gold mine, cleaning of broken ore is conducted by scraper winches to collect ore from the panel into an ore-pass for loading onto a hoppers on the haulage below the stope. The development of the access haulage and the on-reef development is carried out using hand-held rock-drills and pneumatic loaders employed for cleaning of the broken rock into hoppers. The broken rock loaded onto the hoppers is transported/trammed by a locomotive into an ore-pass or rock handling system for hoisting to surface.

One of the most important aspects of underground hard rock mining is ventilation. Ventilation is required to clear toxic fumes from blasting. In deep hot mines ventilation is also required for cooling the workplace for miners. Ventilation raises are excavated to provide ventilation for the workplaces and can be modified to be used as escape routes in case of emergency. The main sources of heat in underground hard rock mines are virgin rock temperature, machinery, auto compression, and fissure water although other small factors contribute like people breathing, inefficiency of machinery, and blasting operations. Each mining area will have a dedicated ventilation shaft to extract hot air and underground fumes to keep the working places free of nauseous fumes and keep the temperature to within statutory requirements.

4.2 Mining Infrastructure

The proposed project would comprise of the design and construction of all building structures, related earthworks and building services, electrical and mechanical installations. This would include *inter alia*:

- Central Plant and Mobile Process plant
- Loading area
- Stockpile areas
- Site clearing and storm water berms and trenches;
- Administration building and first aid;
- Change house and laundry;
- Lamp room, self-rescuer and proto room;
- Access control and security centre;
- TMM Maintenance workshop, services, lubrication, bays;
- Wash bay and oil skimmer;
- Bulk fuel storage area;
- Refueling bay;
- Tyre storage, repair and pump area;
- LVD workshop;

- Fitting, electrical and boiler making workshop;
- Main stores and yard;
- Salvage yard;
- External parking, shade ports and walkways;
- Electrical, water and sewage reticulation;
- Terraces, pavements, access, internal and haul roads;
- Perimeter and internal fencing; and
- Explosives off-loading, storage and distribution.
- One Slimes Dam and PCD"s

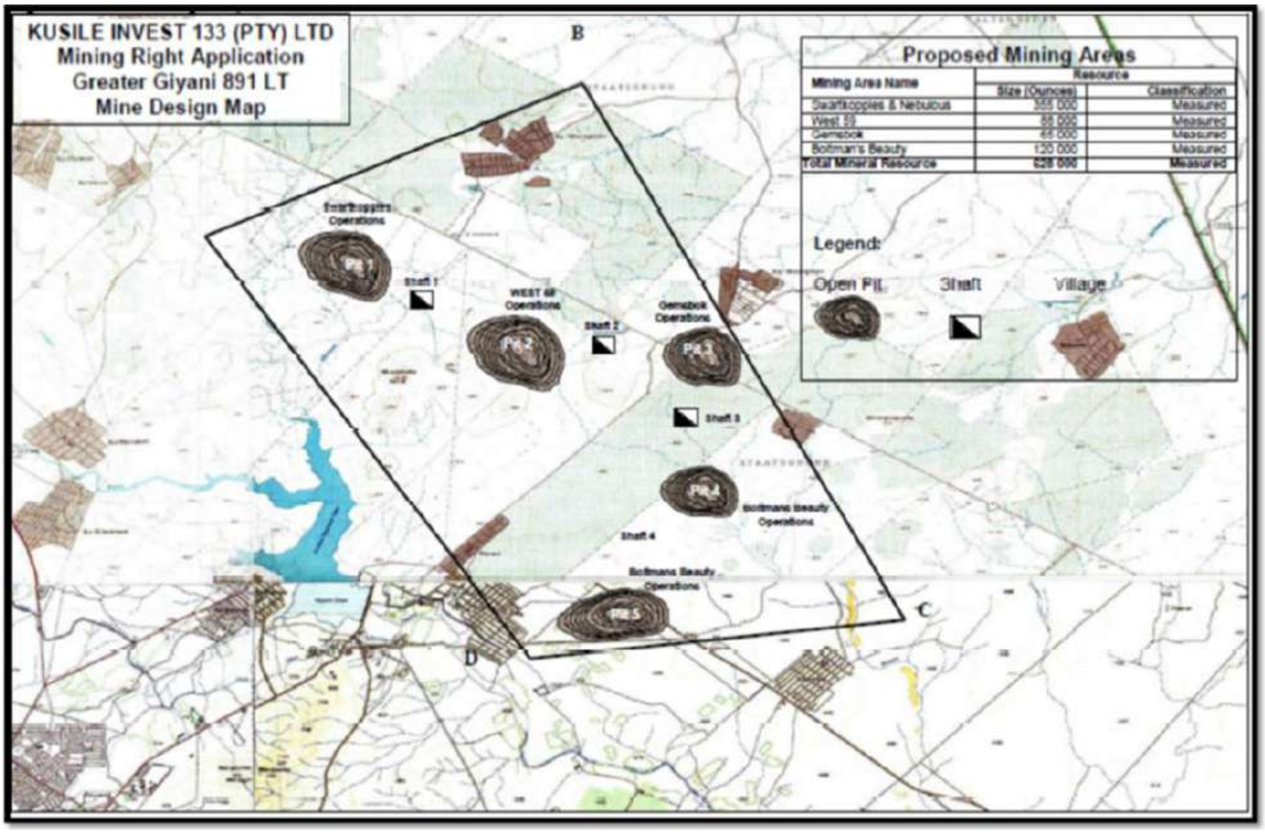


Figure 2: Proposed Giyani Gold Mines Site Layout

5. GUIDING PRINCIPLES OF THE SOCIAL IMPACT ASSESSMENT

The aim of the study was to identify and manage the social issues of project development including the effective engagement of affected communities in participatory processes of identification, assessment and management of social impacts. The study was conducted as part of the application to be submitted for an Environmental Authorization

The overall business objective of the SIA is to identify and assess the social impacts that are likely to occur in the human environment due to the construction and operation of the proposed mine . The analysis includes a baseline study describing the social characteristics of the affected population, as well as the cultural and socio-political dynamics in the broader project area. This SIA Report will inform the EIA Report with regards to the impacts that may be anticipated and how the positive impacts can be promoted.

Conducting a SIA for this proposed development will be very important for the following reasons:

- In general, it will be used to alert the affected communities, landowners, property owners, key stakeholders, including residents and local officials, of the impact and magnitude of the proposed development on the community's social and economic well-being.

- The assessment will further help affected stakeholders in creating an environment for mitigation of negative impacts and enhancement of positive impacts associated with this mine.

- The SIA will embrace information from a variety of sources in a systematic, scientifically verifiable manner and presents this information in a form that Berenice will be able to use to their benefit. This approach will be necessary to ensure that all stakeholders' interests and needs are systematically considered and incorporated in the analysis.

- The SIA will further provide estimates of expected changes in the quality of life of the affected vulnerable communities that will result from this proposed mining project. Equally important, the assessment will present an opportunity for diverse values to be integrated into the decision-making process. Together, these components of the assessment will offer a foundation on which decisions about the Berenice Coal mining development will be based.

- Lastly, the SIA will provide a foundation for assessing the cumulative impacts of this proposal on the affected community's social and economic resources.

The IAIA International Principles for Social Impact Assessment provide the framework for the SIA methodology. These principles summarize the social intentions implied in landmark international agreements and declarations, such as the 1992 Rio Declaration on Environment and Development and 1986 Declaration of Right to Development. The following guiding principles from the IAIA have been utilized when identifying social impacts and management strategies:

- Precautionary principle
- Uncertainty principle
- Prevention principle
- Protection and promotion of health and safety

Precautionary principle

In order to protect the environment, a concept which includes people's way of life and the integrity of their communities, the precautionary approach shall be applied. Where there are threats or potential threats of serious social impact, lack of full certainty about those threats should not be used as a reason for approving the planned intervention or not requiring the implementation of mitigation measures and stringent monitoring.

Uncertainty principle

It is recognized that our knowledge of the social world and of social processes is incomplete and because the social environment and the processes affecting it are changing constantly, and vary from place to place over time, our social knowledge can never be fully complete.

Prevention principle

It is preferable to prevent negative social impacts and ecological damage from happening than having to restore or rectify damage after the event.

Protection and promotion of health and safety

Health and safety of people and communities are paramount. All planned actions and interventions should be assessed for health impacts and accident risks, especially in terms of assessing and managing the risks from hazardous substances, technologies or processes, so that their harmful effects are minimized, including not bringing them into use or phasing them out as soon as possible. Health impacts cover the physical, mental and social wellbeing and safety of all people, paying particular attention to those groups of the population who are more vulnerable. This may include such groups as the economically deprived, indigenous groups, children and women, the elderly, the disabled, as well as to the population most exposed to risks from the planned intervention.

5.1 Social variables

Different types of social variables exist and these variables can almost be used as a 'check-list' when identifying potential social impacts of a proposed development.

Vanclay (cited in DEAT, 2006) identified categories of social impacts that have informed this assessment and have been used as a guideline to ensure that all potential impacts are considered.

Table 2: Categories of social impacts

Health and social well-being	Death; nutrition; actual health and fertility; perceived health; mental health; aspirations for future; autonomy; stigmatization; feelings in relation to the project
Quality of the living environment	Physical quality – exposure to noise, dust, risk, odour etc.; leisure and recreation opportunities; aesthetic quality; availability of housing; quality of housing; physical and social infrastructure; personal safety and hazard exposure; crime and violence
Economic impacts and material well-being	Workload; standard of living; economic prosperity and resilience; income; property values; employment; replacement cost of environmental functions; economic dependency
Cultural impacts	Change in cultural values; violation of culture; experience of being culturally marginalized; commercial exploitation of culture; loss of local language; loss of natural and cultural heritage
Family and community impacts	Alterations in family structure; obligations to family/ancestors; family violence; social networks – interaction with others in community; community connection – sense of belonging; community cohesion; social differentiation and inequity; social tension and violence
Institutional, legal, political and equity impacts	Capacity of government agency to handle workload generated by project; integrity of government agencies – absence of corruption and competence of agency; legal rights; human rights; participation in decision making; access to legal advice; fairness of distribution of impacts across community
Gender relations	Women's physical integrity – can decide about own body; personal autonomy of women – independence in all aspects; gendered division of labour – income, household, childbearing and rearing of children; access

	to resources and facilities; political emancipation of women

In addition, the Interorganizational Committee on Guidelines and Principles for SIA (2003) provides a list of social variables that must be investigated when conducting socio-economic impacts assessments.

Table 3: List of social variables

Population change	Population size, density and change; influx and outflow of temporary workers; presence of seasonal (leisure) residents; relocation of individuals or families; racial and ethnic composition and distribution
Community/ Institutional arrangements	Voluntary associations; interest group activity; size and structure of local government; industrial/commercial diversification; employment/income characteristics; local/regional/ national linkages; employment equity of disadvantaged groups; historical experience of change
Political and social resources	Distribution of power and authority; inter-organisational cooperation; conflict between newcomers and long term residents; identification of stakeholders; interested and affected parties; leadership capability and characteristics
Individual and family level impacts	Displacement/relocation concerns; trust in political and social institutions; residential stability; family and friendship networks; density of acquaintanceships; perceptions of risk, health and safety; attitudes towards the proposed action; concerns about social well-being
Community resources	Change in community infrastructure; indigenous populations; changing land use patterns; family and friendship networks; effects on known cultural, historical, sacred and archaeological resources

These variables should be used in all four project stages, which will be discussed in detail in the next section.

4.1 Project stages

There are four stages in the project cycle, namely planning, construction/implementation, operation/maintenance and decommissioning. Social impacts will be different for each stage and not all social impacts will occur at each stage (ICGP, 1994).

The ICGP (1994) developed a matrix to demonstrate how social impacts occur in each stage and to assist in identifying all those impacts, using the list of social variables they compiled.

Table 4: Matrix Relating Project Stage to Social Impact Assessment Variables

SIA variables	Planning	Construction	Operation/	Decommissionin
Population change: **population size, density and change; influx and outflow of temporary workers; presence of seasonal (leisure) residents; relocation of individuals or families; racial and ethnic composition and distribution**				
Community/ Institutional arrangements: **voluntary associations; interest group activity; size and structure of local government; industrial/ commercial diversification; employment/income**				

characteristics; local/regional/national linkages; employment equity of disadvantaged groups; historical experience of change				
Political and social resources: **distribution of power and authority; inter-organisational cooperation; conflict between newcomers and long term residents; identification of stakeholders; interested and affected parties; leadership capability and characteristics**				
Individual and family level impacts: **displacement/relocation concerns; trust in political and social institutions; residential stability; family and friendship networks; density of acquaintanceships; perceptions of risk, health and safety; attitudes towards the proposed action; concerns about social well-being**				
Community resources: **change in community infrastructure; indigenous populations; changingland use patterns; family and friendship networks; effects on known cultural, historical, sacred and archaeological resources**				

Source: ICGP, 1994

6. BASELINE DESCRIPTION OF RECEIVING ENVIRONMENT

Establishing the baseline conditions is essential for describing the receiving environment, the status quo and for identifying and predicting potential impacts. "A prediction of change can only be as effective as the baseline information from which it is derived. It is thus important that the specialist puts the proposed project in perspective by comparing the current state with the potential future state" (DEAT, 2002a).

South African legislation and policy states that, a prediction of change can only be as effective as the baseline information from which it is derived. It is thus important that this study puts the proposed projectin perspective by comparing the current state with the potential future state implicated by the development. This chapter describes the socio-economic characteristics of the receiving environment discussed in the context of the province (Limpopo), district (Mopani) and local municipality (Greater Giyani).

6.1 Limpopo Province

Limpopo Province is South Africa's northernmost province and shares its borders with Mozambique, Zimbabwe and Botswana. It is named after the great Limpopo River that flows along its northern border. The province is rich in wildlife, spectacular scenery and a wealth of historical and cultural treasures, including being home to Modjadji, the fabled Rain Queen, the Stone Age and Iron Age relics of Makapansgat Valley and the treasures of Mapungubwe World Heritage Site.

The northern section (and the bigger part) of the Kruger National Park is located in Limpopo. On the park's western border, privately owned game reserves and lodges can be found. The mountainous area of the Waterberg is also home to numerous game reserves.

Beyond the mountains of the Soutpansberg region, Mopani trees and giant Baobab trees dominate the plains sweeping northward to Zimbabwe. There are 340 indigenous tree species here, an abundance of animal life and the world's highest concentration of leopard.

The capital of Limpopo is Polokwane, which is located halfway between Pretoria and the Zimbabwean border. Limpopo consists of five District Municipalities (DMs): Waterberg, Capricorn, Vhembe, Mopani and Sekhukhune DMs.

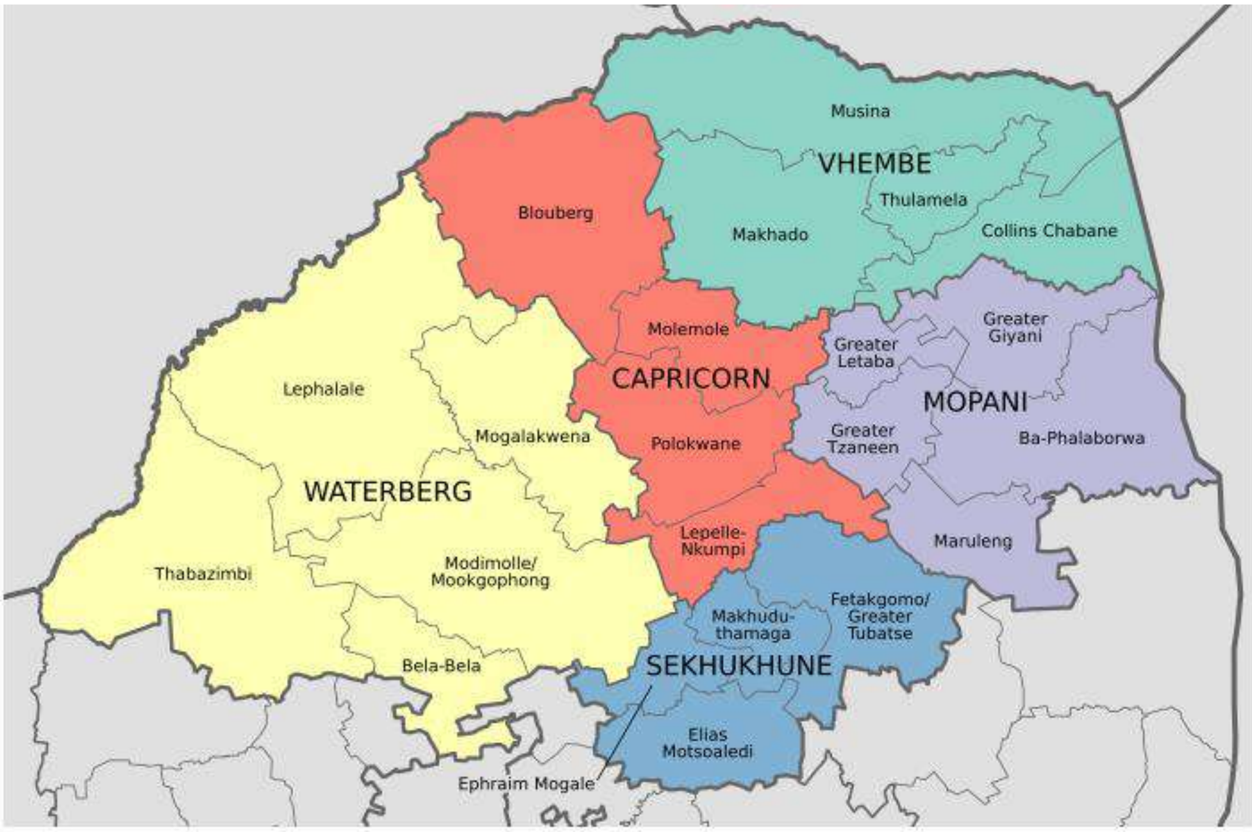


Figure 3: Limpopo, South Africa

Limpopo's climate is characterised by hot summer months (October-March), while winter is characterised by chilly mornings, warm middays, dry afternoons and cool to cold nights. The Lowveld area of Limpopo can get as hot as 45º Celsius during summer.

The population of Limpopo consists of the following ethnic groups distinguished by culture, language and race:

- The Northern Sotho (Sepedi): Approximately 57%;
- The Tsonga (Shangaan): Approximately 23%;
- The Venda: Approximately 12%;
- The Afrikaner: Approximately 2.6%; and
- The English: Approximately 0.5%.

In terms of Agriculture, the province produces 75% of the country's mangoes, 65% of its papaya, 36% of its tea, 25% of its citrus, bananas and litchis, 60% of its avocados, 66% of its tomatoes and 285 000 tons of potatoes. Other products include coffee, nuts, guavas, sisal, cotton, tobacco and timber, with more than 170 plantations. Limpopo also boasts rich mineral resources, with mining contributing 22% of the GDP. Mineral resources include platinum, chromium, nickel, cobalt, vanadium, tin, limestone and uranium clay. Limpopo has 54 provincial reserves and many private game reserves, making the province a popular tourist destination.
(Source: About Limpopo)

6.1.1 Demographics

Figure 4 below indicates that Limpopo's population is young, with the majority of the populationaged below 35 years.

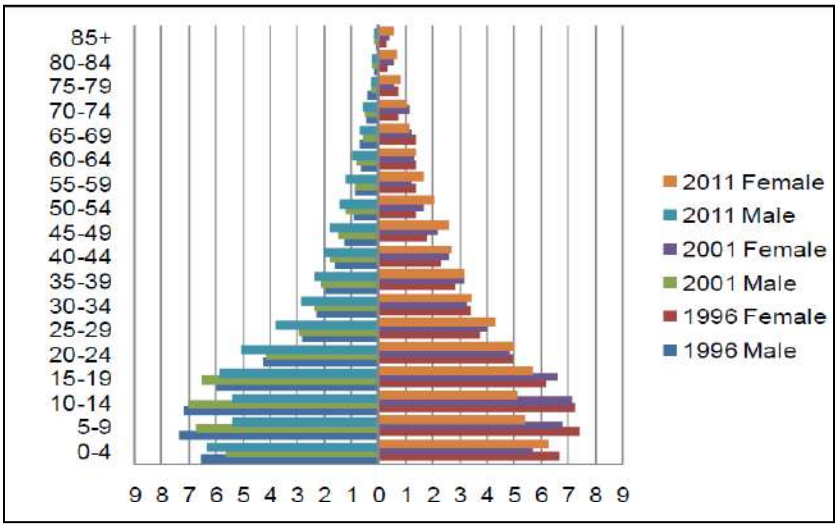


Figure 4: Distribution of population by age and sex, Limpopo - 1996, 2001 and 2011

Source: Census 2011 Municipal report – Limpopo

6.2 Mopani District Municipality

Mopani is one of the 5 districts of Limpopo province of South Africa. The seat of Mopani is Giyani Town. Mining has been the dominant sector in Mopani since 1996, and in 2006 accounted for 31% of the gross value added. The other large sectors (in descending order) are community service (government employment), trade (which includes tourism) and finance. Mopani has almost nomanufacturing sector (just 2%). The second major industry is agriculture. There are a number of producers but ZZ2 dominates in terms of output and the major focus is on sub-tropical fruit(tomatoes, bananas, mangoes, oranges and pineapples). The main focus of both these industries is to produce for exportation. (Mopani District Municipality, 2017).

6.2.1 Demographics

Figure 5:Mopani District in a snapshot

The population of the Mopani District Municipality has increased from 1 061107 (Census 2001) to 1 068 569 (Community Survey 2007) to 1 092 507 (Census 2011) to 1 159 185 Community Survey 2016. Out of the entire district population, 81% reside in rural areas, 14% in urban areas and 5% stay on farms. The population densities vary from municipality to another, but the average is 23 people/ ha. Its how that people are sparsely populated with sufficient land around them. The problem of land shortage for economic development is perpetrated by the vast land occupied for dwelling purposes, leaving much little for economic growth. A move towards reduction of stands sizes may need due consideration. Portion of Kruger National park is mainly occupied by animals with very few people employed.

6.2.2 Economic Outlook of Mopani District

In 2019, there were 628 941 people living in poverty, using the upper poverty line definition, across Mopani District Municipality - higher than the 674 588 in 2009. The lowest percentage of people living in poverty can be observed in the Ba-Phalaborwa Local Municipality with a total of 58.6% living in poverty, using the upper poverty line definition This could be attributed to the mining activities providing employment opportunites within the area . The average annual household income of the regional study area (Mopani District Municipality) was R14 600, which is about the same in the Limpopo province and about half the amount in the country (R29 400).

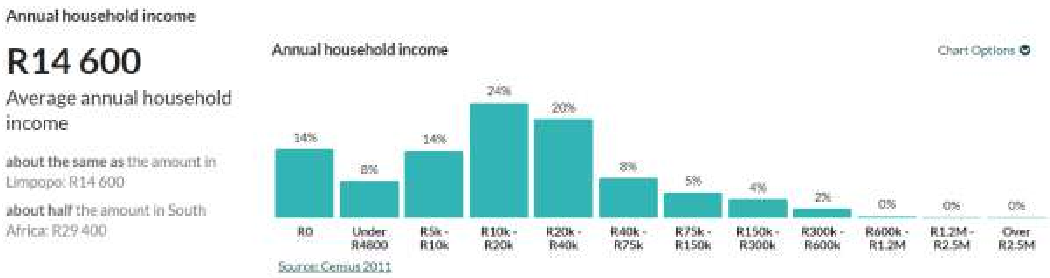


Figure 6:Annual income in the regional study area (Mopani District)

People in the Mopani district are employed in the following sectors: Farming, Industry, Mining, Trade, Government, Transport, Tourism, Manufacturing, Construction and Energy. The Government Sector is the largest employer in the district e.g. 39% of the employed in Greater pg. 18 Giyani work for government. The second largest employer in Mopani district is the farming sector with 25, 9% of the employed people. This is however, not the case when considering the municipalities separately with the mining sector employing the second largest portion of the Ba-Phalaborwa population (19, 5%). The number of people unemployed as a percentage of the total employable population of the District (287 405) is 39%. It is however important to note that of the unemployed people in the district, about 60% are women.

6.2.3 Education and Literacy

The literacy levels in the Mopani District are very low. Only 12.7% of the adult population in the district has completed their matric and 6.5% any form of higher education. Existence of the ABET programme in the district made substantial impact since the illiteracy rate from 37.8% to 27.1%.

6.2.4 Crime

According to the South African Police Services there are not enough law enforcement officers in the Mopani district to adequately serve the community. The highest crime rate within the district is experienced in Greater Tzaneen , followed by Ba-Phalaborwa and Greater Giyani the area where Giyani

Gold Mines is to be located. The top ten crimes in Mopani District Municipality are Theft, Burglary at residential premises, Assault with the intent to inflict grievous bodily harm, Common assault, Malicious damage to property, Burglary at non-residential premises, Sexual Crimes, Shoplifting, Commercial crime, Theft out of or from motor vehicle.

6.2.5 Health

The provision of health facilities to all settlements in the district is a problem because of the large number of settlements (varying in size), with the majority of them being relatively small and scattered throughout the district.

District Hospital Services are provided in six district hospitals, namely; Maphutha LM Malatjie hospital in Ba-Phalaborwa, Sekororo hospital in Maruleng, Kgapane Hospital in Greater Letaba, Nkhensani Hospital in Greater Giyani, Van Velden and Dr CN Phatudi hospitals in Greater Tzaneen Sub district.vThe hospitals provide services to across municipal boundaries and international refugees. Prevalent Diseases in Mopani District include diarrhoea; Pneumonia; Tuberculosis; HIV and AIDS; Malaria; and Sexually Transmitted Infections (STI).

6.3 Giyani Local Municipality

6.3.1 Demographics

Figure 7:Snapshot of Greater Giyani Municipality

The total population of Giyani is 256, 300 with a total number of households of 70,537. The municipality has 31wards grouped into 5 clusters. In most wards, the population exceeds 5000 people. In the past few years, the population has shown a slight decline. In the 2011 census, the population was counted at 247 565but according to the 2011 census, it has declined by almost 3000 people. The decline may be attributed to migration to other urban centers, such as Polokwane, Gauteng and Tzaneen in which the migrants search for better working conditions.

The sex ratio distribution provides an indication of the gender breakdown in an area, and it is suggestive of the composition of the labour force. Sex ratios will be affected by sex-selective out-migration such as men migrating. Migrant labour-receiving areas usually have higher sex ratio figures (i.e. more males to females) as the migrants are usually male. South Africa’s average sex ratio is around 0,95, that is 95 men to 100 women. Lower sex ratios are found in areas with a higher number of female-headed households, where household sizes are generally larger, with higher dependency levels this is the case for Giyani and it could be attributed to Men leaving the area in search of economic opportunities.

6.3.2 Educational Levels

The level of education determines the mix of skilled labour within an area. Furthermore, a population that is skilled does not necessarily aspire to employment but to entrepreneurship, which will add businesses to the area, increase economic activity and consequently increase the number of available jobs.

Approximately 22.6% of adults are without education in Greater Giyani, and an estimated 74.4% have attended school but not proceeded to attend tertiary institutions. The percentage of the population that acquired higher education with tertiary certificates; diplomas and degrees is very low at 0.7%. The possible factors that could negatively contribute to low education levels and enrolment amongst young population group could include accessibility to higher learning institutions and affordability. The prevailing low levels of education will result in low levels of absorption into the labour market, thus resulting in increased levels of unemployment in the area.

6.3.3 Economic Outlook

Giyani is the main town in the municipality and the Central Business District (CBD) is located in this town. The majority of the population lives in rural areas located on average, at a distance of some 35km away from the Giyani CBD, resulting in limited economic activities in the areas where the majority of the population lives. The majority of the economically active population residing in the area have employment in the public service, informal retail and agriculture. Greater Giyani Municipality is considered to have a relatively small economy. The public service is by far the largest sectorial contributor of employment opportunities that support the local economy. Other job opportunities are provided by economic sectors such as agriculture, wholesale & retail trade. Other business activities in the area include transport, construction, electricity and water supply, catering, and accommodation; community, social, and other personal services and general government services.

Table 5:Labour Force and Employment status

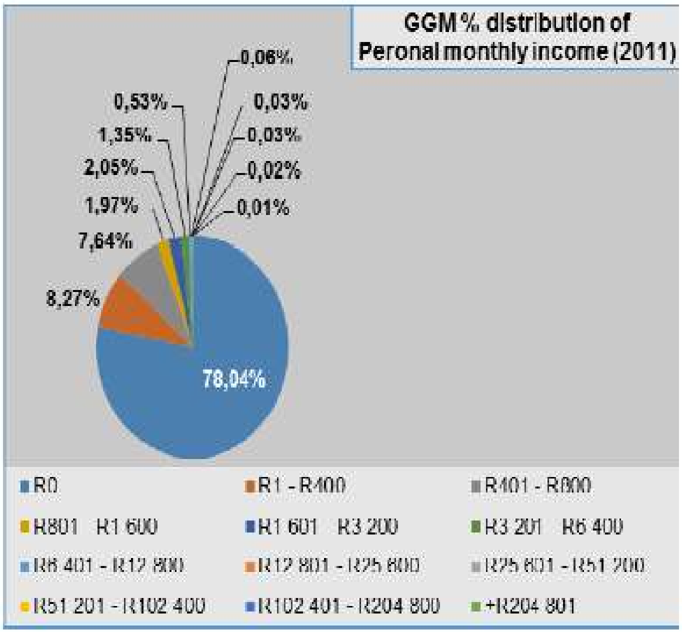
Persons	2011	%	2016	%
Employed	19979	49.3	20759	39.6
Unemployed	20534	50.7	31636	60.4
Total Labour Force	40513	100	52395	100
Not economically active			75829	

Data for Giyani indicates that the number of unemployed people has increased from 20 534 (50.7%) in 1996 to 31 636 (60.4%) in 2001. Unemployment has a negative impact on society which might eventually result in an increase in crime, grant dependency, and non-payment of services.

6.3.4 Income Profile

A total of 78% of the individuals in Greater Giyani municipality had no recordable income in 2011 compared to 53.7% in 2016. There has also been significant growth in the income bracket earning from R400 - R800 per to the next category of R800– R1600 income per month, indicating a positive upward migration of residents

from low income levels. The number of low income earners between no income and R1600 has significantly decreased between 2011 and 2016. Most importantly the number of residents with no income has reduced by more than 29%. This is considered to be an indication of the improvement of socio-economic condition of the population in Greater Giyani.



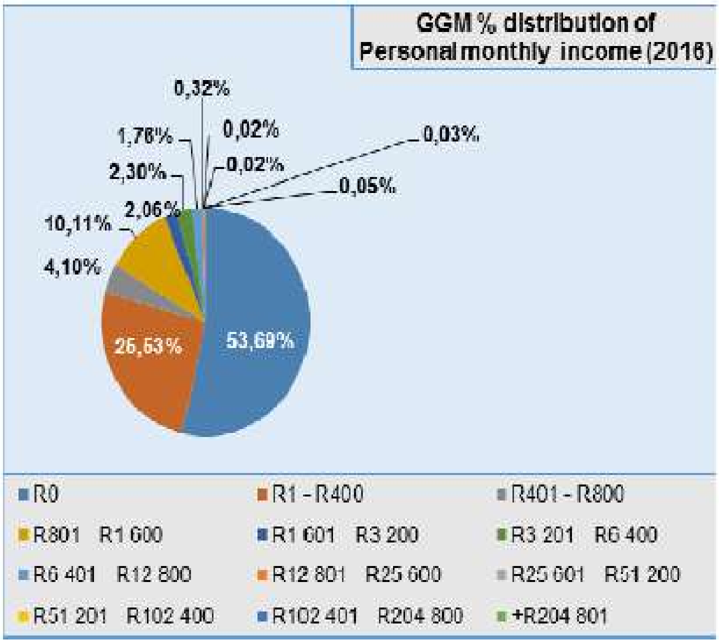


Figure 8:Household Income Profile

6.3.5 Health Profile

The health services concerning the primary healthcare for the general population is provided by the provincial government and the municipality through local hospitals and clinics as well as private health practitioners that are found in the different locations within the Greater Giyani Municipality. Some of the challenges related to health services include inaccessibility to clinics by communities due to the distance travelled to visiting points, and the frequency of the service being provided. In addition, the number of clinics and hospitals are inadequate and mostly overcrowded. Emergency medical services are not readily available during emergencies and the response time is at times slow. The availability of medicine in clinics is problematic due to inadequate control and poor distribution.

As an already established fact, South Africa is more affected by the HIV and AIDS epidemic than any other country in the world. The key challenge with respect to public health within Greater Giyani Municipality is managing with the levels of HIV & Aids prevalence in the area.

As an already established fact, South Africa is more affected by the HIV and AIDS epidemic than any other country in the world. The key challenge with respect to public health within Greater Giyani Municipality is managing the levels of HIV & Aids prevalence to keep new infection rates low in the area.

According to statistics reflected in the Mopani District Revision of the IDP for 2016 - 2019 the District's HIV prevalence was 24.6% in 2017, after having shown a decline from similar level in 2008 to reach an average of 24,46% over 10 years from 2008 to 2017.

6.3.6 Infrastructure

The availability of infrastructure within towns and communities is essential for economic development of local areas and provision of basic services. Greater Giyani municipality has a well-established road infrastructure; comprising regional and provincial roads such as the R81; R578; R529 which form the road network that link the town of Giyani and its surrounding villages with other main towns like Polokwane; Tzaneen; Palaborwa; Louis Trichardt; Malamulele; Thohoyandou and access to the Kruger National Park. In addition, a landing strip is available in the area to connect

Giyani by air travel to major regional and national industrial and urban centres. The main roads linking Giyani to other provincial towns are mostly surfaced and those in the villages are gravel roads, with current work to upgrade the roads from gravel to surfaced road being rolled out in some of the villages. There is no rail network that passes through Giyani. The nearest rail connection is in the small town of Moeketsi, Duiweskloof and Soekmekaar. The roads provide the necessary transport infrastructure for the population using busses; taxis and private vehicles. The public transport system mostly used in Greater Giyani is privately owned taxis and buses.

The longer distances between the town and various villages in the municipality make all communities dependent on the regional distribution roads for social as well as economic functioning. A number of these roads are however require need to be upgraded and maintained to support the local economy. Other infrastructure related to telecommunications, water and electricity supply are well established within the town of Giyani, with villages mainly relying on bulk water supply with no sanitation.

7. SOCIAL IMPACT PREDICTION AND EVALUATION

The following section describes the social impacts anticipated to occur during the construction and operational stages of the proposed Giyani Gold mine.

7.1 Average household income and educational attainment

The primary objective of the Skills Development Policy for Giyani Gold Mine is to promote a culture of lifelong learning and develop a pool of skilled resources. This policy, together with the mine's Adult Basic Education and Training (ABET) programme, provides a platform improving the skills of local labour. Potentially this drive would enable labour to i) access employment ii) improve literacy levels and iii) improve job security, thereby marginally increasing their household income. These offerings from the mine could potentially profit the community, provided that the mine maintains its policy of employing local labour.

Despite the economic contribution of mines to surrounding communities, a huge amount of social and environmental harm is associated with the mining industry. In this regard, mining companies have, on the one hand, contributed toward improved social development, by providing jobs, paying taxes and earning

foreign exchange. On the other hand, and in certain cases, the mines reportedly had poor labour conditions, did not manage pollution incidents, failed on health and safety issues, and also showed disrespect of human rights.

The assessment of the demographics in Giyani Gold's Social and Labour Plan (SLP) indicates that concerted effort will be required at local level to enhance the education levels. Skills programmes have to be identified and aligned to the list of scarce skills areas published for the local district/municipal area.

A major positive impact could potentially be achieved, should the recommended mitigation measure, to employ and upskill local labour, be implemented. As this assessment was done in anticipation of a new mine development for a company with integrity and with serious intent to implement their Skills Development Policy, the risk is reduced that published plans to upskill local labour would be mere window dressing.

Change in average household income and educational attainment		
	Construction Phase	**Operational Phase**
Magnitude	Moderate +	Moderate +
Duration	Long term	Long term
Spatial	Local	Local
Consequence	Medium	Medium
Probability	Possible	Possible
Significance	Medium	Medium

Mitigation:

- Ensure and maximise the use of local labour and contractors
- Ensure implementation of the social and labour policy and associated skills development plan
- Source construction workers needed in the semi-skilled to unskilled category from the local population as far as possible
- Develop and implement a communications strategy regarding a recruitment policy that can serve to encourage local employment and reduce the potential influx of jobseekers to the area
- Ensure Local Community and Government Leaders have the correct expectations of opportunities provided by the mine
- Give preference to local people when there is any need for additional procurement
- Set targets for procurement of capital goods, consumer goods and services from local sources. Giyani Gold Mines should develop an action plan to meet these targets. These plans could include, but are not limited to, the development of Economic Empowerment (EE) policies, procedures and guidelines, as well as the development of a database of local small businesses (entrepreneurs and SMMEs)

7.2 Change in employment status

It is indicated in the Social Labour Plan that the mine is expected to employ a minimum of 400 employees over the life of the mine. It is this level of employment that many of the currently unemployed local community members would apply for.

Although Limpopo province is known to have the lowest unemployment rate of 18.9%, when compared with other provinces and the national unemployment rate of 29% in 2019, the GGM unemployment rate is very high. According to 2011 statistics, the Greater Giyani Municipality unemployment rate was at 47%, with this situation being exacerbated by an abnormally high youth unemployment rate of 61%. This high level of unemployment amongst the population could be resulting from lack of meaningful economic activities in the rural areas

Any subsequent loss of employment due to the impact of the proposed mine results in shrinking the local tourism industry, has not been quantified.

Change in unemployment		
	Construction Phase	**Operational Phase**
Magnitude	Moderate +	Moderate +
Duration	Short term	Long term
Spatial	Local	Local
Consequence	Medium	Medium
Probability	Possible	Possible
Significance	Medium	Medium
Mitigation: • Ensure and maximise the use of local labour and contractors. • Development and implement a communications strategy regarding a recruitment policy that can serve to encourage local employment and reduce the potential influx of jobseekers to thearea. • Ensure Local Community and Government Leaders have the correct expectations of the		

offerings from the mine.

- Ensure implementation of the Skills Development Plan.
- Ensure actual implementation of Giyani Gold Mine's Supplier Development Programme set out in SLP where preferred supplier status will be given to local SMMEs, HDSA entrepreneurs and local service providers.

7.3 Inflow of Job seekers and Workforce

Experience has shown that construction related projects attract jobseekers from within the study area or even from other provinces and neighbouring countries. Limpopo Province has a much higher unemployment rate than Greater Giyani Local Municipality (GLM). The influx of jobseekers settling in the Tribal Authority areas (rural areas) has already been noted. Inexpensive accommodation in these areas provides an entry point for jobseekers looking for work and more permanent accommodation.

News of the prospective mine could attract further jobseekers to the area even prior to construction commencing. This situation is usually worsened by exaggerated rumours of possible employment opportunities. As they are attracted by the manufacturing and mining industry in the municipal area. The current influx of foreign Nationals is far greater than the capacity of the local community's administrative systems and independent arrangements are made between residents and jobseekers. Together with this trend is the subsequent increase in crime related incidents in the community[13]. The impact on the cultural aspects of community life is significant which can possibly advance social disintegration.

Communities undergoing social disintegration have been observed to display some of the following behavioural patterns to a greater or lesser extent[14]:

- Family breakdowns, single parenthood, high teenage pregnancy rates.
- Low job participation with both high unemployment and unemployable rates.
- High alcohol and drug abuse.
- Low performance in all spheres of life including school and skills training.
- High crime rates and endemic violence at all levels of social interaction: family, inter-personal,neighbourhood and wider community.
- Despair and acceptance of the victim image.
- Flight of skills and positive role models from the townships into higher income areas.

It would be difficult to monitor and prevent the inflow of jobseekers. Mining activities, irrespective of the extent thereof, are perceived as an employment creator, which means jobseekers in search of permanent employment would probably also materialise during the operational phase of the mine.

At this stage, employment of locals is a pro-active mitigating factor that could limit an inflow of additional

'outside' jobseekers, to avoid negative long term impacts (e.g. sub-letting) in this regard.

Inflow of Job Seekers and Workforce		
	Construction Phase	**Operational Phase**
Magnitude	Moderate -	Major -
Duration	Long term	Long term
Spatial	Local	Regional

Consequence	Medium	High
Probability	Possible	Definite
Significance	Medium	High
Mitigation: • Early project (Operations) documentation outlining the potential benefit that locals can expect during the life of the project can help curb in-migration of job seekers. • Giyani Gold needs to collaborate with GLM and the Tribal Authorities to initiate communications eliminating unrealistic employment expectations regarding the prospective mine. • Lists of unemployed individuals are maintained by both by Tribal Authority and by GLM (ward Councilors). • A rural settlement management plan would benefit the local community and help mitigate the impact of the in- migration.		

7.4 Economic Impact

Mining has the potential to shape and directly and indirectly affect economies. Mining brings employment, government revenues, and opportunities for economic growth and diversification. It is these positive aspects of mining that Giyani Local Municipality (GLM) appears to want to attract to their region within the framework of the Strategic Plan. However, market fluctuations, economic and public institutions, and resource revenues can present challenges in converting natural resource wealth into sustainable economic growth and development.[15]

The economic impact of the new mine would thus be based on its continued contribution to Gross Value Added (GVA) and the number of (direct and in-direct) local employment opportunities that would be created.

The health and welfare status of communities living in close proximity to mines has been well researched in North West Province and concerns were raised where mines externalise the social and health costs of their employees, transferring a negative impact on labour sending communities thereby depreciating the economic impact. To achieve the full local economic impact or benefit which incorporates the increase in local spending and the increase in local buying power, Giyani Gold would need to maintain their obligation to the environmental regulations and a robust long-term community development and participation programme.

Through responsible employment and income generation during the mining processes, some economic benefits to the region and local communities accrue. The mine would continue to contribute to the local economy through its employee wages, procurement of local contractors and services, purchasing of water and electricity, and by paying taxes to GLM.

To achieve the goal of sustainable economic development and job creation through the mining industry, government needs to ensure the development of basic skills; and ensure that service delivery and necessary infrastructure are not compromised or overlooked during the operation of the mine.

This section recognizes the positive economic impact that GIYANI GOLD can potentially achieve through creating employment opportunities.

Economic Impact		
	Construction Phase	**Operational Phase**
Magnitude	Moderate +	Moderate +
Duration	Short-term	Long term
Spatial	Local	Regional
Consequence	Medium	High
Probability	Definite	Definite
Significance	Medium	High
Mitigation: • Giyani Gold to adopt a robust community and human resource development plan, to prevent the externalisation of social costs and reduced economic benefit in the labour sending communities. • Local goods and services should be used as far as possible. • Contractors' procurement procedures have to also favour local goods and services • Collaborate with GLM on Local Economic Development initiatives		

7.5 Poverty Alleviation and Socio-Economic Development

For 20 years and more, Government has grappled with the development challenges created by the old Apartheid Government Alleviating poverty, however, requires a multi-sector approach of Government, Private and NGO's. Poverty is not just about income, it incorporates aspects of housing, adequate services, health care and training and development. Although education, training and service delivery are mainly the responsibility of government, there is increased pressure on the business sector in South Africa to contribute to the development of each business's own workforce. The Mining Charter promotes employment, advancing the social and economic welfare of mine communities and major labour sending areas.

The charter recognizes that mine communities form an integral part of mine development and there must therefore be a balance between mine development and mine community socio-economic development. Considering the socio- economic environment surrounding the study area.

Poverty Alleviation and Socio-Economic Development		
	Construction Phase	**Operational Phase**
Magnitude	Minor +	Moderate +
Duration	Short term	Long term
Spatial	Local	Local
Consequence	Medium	Medium
Probability	Possible	Possible
Significance	Moderate +	High +
Mitigation: • Noting the high levels of unemployment and youth unemployment in particular, GIYANI GOLD should give preference to the training and employment of people from the local communities. • Proactively engage the Local Municipality to establish platforms where the mine can contribute through their Human Resource and Mine Development Programme, to poverty		

alleviation initiatives. This should be a programmatic longer-term approach that builds towards a sustainable solution for the labour sending communities.

- Maintain communications with local community leaders to manage expectations on an ongoing basis.
- Develop a community communications strategy that will channel information and educational opportunities.

7.6 Impact on Daily Living and Movement Patterns

Vehicle related fatalities and injuries are Categories of social impacts related to Health and social well-being and quality of life that are of most important concerns to communities in proximity to mines . Unlike forces of nature or natural disasters, vehicle related incidents are much more preventable. Speed management should form part of the overall risk management approach that mining operations should have in place and actively promote. Mine management has the responsibility to ensure that work areas, such as roads, are safe and that Improved road safety and the prevention of road-related injuries are identified as a need.

Most of the daily vehicle movement associated with the operation of the mine will be within the proposedGiyani Gold mining area. Access to the mine will be solely from the existing roads in the area.

Impact of Daily Living and Movement Patterns		
	Construction Phase	**Operational Phase**
Magnitude	Moderate -	Moderate -

Duration	Short term	Long term
Spatial	Local	Local
Consequence	Medium	Medium
Probability	Possible	Possible
Significance	Moderate +	High -

Mitigation:

- Traffic calming to be considered at the point on the R518 where Giyani Gold Mines accesses the road, thereby limiting vehicle speed creating a safer environment for vehicles to access the road from the site.
- Road safety awareness to be incorporated as part of the Mine's Community Development Programme.
- Road Safety criteria and principles to be incorporated into Giyani Gold Mine's general risk management plan.
- The mining sites should be clearly marked and 'danger' and 'no entry' signs should be erected.
- Speed limits on the local roads surrounding the mining areas should be enforced.
- Speeding of construction vehicles must be strictly monitored and drivers penalised.

7.7 Residential Proximity

The residential component of the study area consists mainly of farmsteads, rural dwellings , that are dispersed throughout the area.

Residential proximity to mining activities is associated with poorer health status.There are increasing number of research studies highlighting the impact of gases and air pollutants on humans. Many of these emissions, even in small quantities, have adverse effects on workers and neighbouring residents alike. These adverse effects include a wide range of problems that include respiratory, neurological and carcinogenic effects.For land owners adjacent to the farms where mining rights have been awarded and for residents in the mentioned settlements, the adverse effects of the mining operations are mitigated through compliance with the stringent environmental regulations.

Residential Proximity		
	Construction Phase	**Operational Phase**
Magnitude	Major -	Major -
Duration	Short term	Long term
Spatial	Local	Local
Consequence	Medium	Medium
Probability	Possible	Possible
Significance	Moderate +	High -
Mitigation: • Monitoring of the air quality and water quality and quantity should continue to limit any possible negative impacts on the human environment thereby ensuring that human health and the environment are protected. • Intrusion impacts should be mitigated through sound environmental practices. • Dust suppression methods should be implemented.		

7.8 Safety and Security Related Impacts

Safety and security issues relate to the in-migration of workers during the construction and operations of thenew project. The negative environmental, social, and economic impacts associated with labour in-migration often lead to deterioration in the social context of the labour sending communities. Migrants may cause an overall decline in the wellbeing and welfare of the resident population by threatening their way of life and the basis of existing livelihoods and placing additional pressure on what often already may be inadequate public infrastructure, services, and utilities.

Problems such as increased indebtedness, disease epidemics, increased occurrence and practice of social vices, increased domestic violence and rape, increased intra- and intergroup jealousy, rising crime and violence, ethnic tensions and a general breakdown of law and order.

Safety of community members and workers can be impacted by:

- The movement of construction vehicles transporting goods and materials on the local roads.
- Increased number of vehicles transporting construction and mine personnel, for continuous day andnight shifts;
- The trespassing of workers on private properties, mainly to access areas of work;
- An increased risk of veld fires due to the presence of construction workers and construction relatedactivities on site that in turn pose a threat to the surrounding wilderness / bushveld area.

Further to the in-migration of job-seekers, once employment contracts have ended, the newly unemployed tend to remain in the area. In select instances, these individuals seek accommodationin the rural settlements which is more affordable. Such practices result in sub-letting which, if not contained,could not only become an indirect intensifying safety and security problem but also cause additional environmental pollution.

Safety and Security Related Impacts		
	Construction Phase	**Operational Phase**
Magnitude	Moderate -	Moderate -
Duration	Short term	Long term
Spatial	Local	Regional
Consequence	Medium	Medium
Probability	Possible	Possible
Significance	Moderate +	High -

Mitigation:

- Early Communications outlining opportunities and benefits associated with the proposed mine to help curb in-migration of job seekers.
- Giyani Gold to incorporate as part of their risk management plan an in-migration management strategy that is prepared in collaboration with the Tribal Authority and GLM and communicated widely.
- Giyani Gold should discuss the safety and security issues, as well as construction schedule with the local community leaders and local police service.
- The mining area should be fenced and access to the area should be controlled to avoid animals or people entering the area without authorisation.
- Workers should make use of protective clothing and equipment that would effectively prevent bodily injuries.

- Workers should make use of formal approved access roads when travelling to work

7.9 Decommissioning and closure

Decommissioning and Closure			
Decommissioning of all surface infrastructure andrehabilitation of all disturbed surface areas	Release of GHG due tothe oxidisation of minedumps containing carboniferous Medium (-)	• Carboniferous material will be sealed • Rehabilitation monitoring and maintenance will be applied to allow for revegetation and therefore carbondioxide uptake to be reinstated	Low (-)
	Release of GHGs due tothe removal of infrastructure using heavy machinery Medium (-)	• Where possible infrastructure will berepurposed	Low (-)

	Compaction of soil and contamination of soil resources from heavy vehicles Low (-)	• Reinstatement of stored soils onto areas of disturbance where infrastructure has been demolished • Contour and stabilise slopes to befree- draining • Cultivation of growing medium, the planting of required vegetative coverand irrigation if required	Low (-)
	Potential for establishment of alieninvasive vegetation Medium (-)	• Ensure the removal of the alien invasive vegetation encountered onthe rehabilitated area • Regular inspection of establishedvegetation	Low (-)
	Pollution of surface water resources during decommissioning activities Low (-)	• The stormwater management infrastructure, including the PCD, willbe decommissioned last to ensure adequate stormwater management during the rehabilitation phase	Low (-)

		• Erosion protection measures will beimplemented at steep areas • Spill kits will available and	

Decommissioning and Closure			
		hydrocarbon spills will be cleaned upimmediately • All traces of hydrocarbons and residual waste will be removed beforeinfrastructure is demolished	
	Potential disturbanceof wetland habitats Low (-)	• Alien vegetation management will be implemented following revegetation to clear alien species • Develop a watercourse crossing method statement for demolition ofcrossings	Low (-)

	Increase in dust falloutMedium (-)	• Regular watering of the site roads • Dressing off of tip faces, unused roadsand disturbed areas • Minimising unnecessary disturbanceof non-operational areas • Use of chemical additives to controldust to be employed if necessary under BATNEEC (Best Available Techniques Not Entailing Excessive Cost) principles.	Low (-)
	General increase inambient noise levels Medium (-)	• Regular planned mobile plant maintenance, with special attention paid to the maintenance of engine efficiency and silencer effectiveness. • Regular planned vehicle services	Low (-)

	Loss of employmentand enterprise development opportunities High (-)	• Develop and implement Labour and Human Resources Plan (LHRP) that addressed the impacts associated with retrenchment, job losses and reduced demand for local goods andservices • Develop a closure plan which will aim to reinforce the objectives of the SLPby reducing the reliance on LCM for employment by promoting skills transfer to ensure alternative livelihoods	Medium (-)

8. IMPACT ASSESSMENT AND MITIGATION MEASURE SUMMARY

Affected Environment	Activity	Impact Description	BEFORE MITIGATION						Cumulative Impact	Mitigation measures /Recommendations	AFTER MITIGATION					
			Magnitude	Duration	Spatial Scale	Consequence	Probability	SIGNIFICANCE			Magnitude	Duration	Spatial Scale	Consequence	Probability	SIGNIFICANCE
Construction and Operation																
Socio-economic	Change in average Household Income	Employment opportunities and access to income	*Moderate +*	*Short Term < 18months*	*Regional*	Medium	*Possible*	Medium	No	Policy for employment of local labour, youth and women	*Moderate +*	*Long Term > 5years*	*Site or Local*	Medium	*Possible*	Medium
Socio-economic	Change in unemployment	Improved household income	*Moderate +*	*Short Term< 18 months*	*Regional*	Medium	*Possible*	Medium	No	Policy for employment of local labour, youth and women	*Moderate +*	*Long Term > 5years*	*Regional*	High	*Possible*	High
Socio-economic	Change in % households living	Marginal improvement of household poverty levels	*Minor +*	*Long Term >*	*Regional*	Medium	*Possible*	Medium	No	Policy for employment of local labour,	*Minor +*	*Long Term >*	*Regional*	Medium	*Possible*	Medium

	below poverty line			*5years*						youth and women		*5years*				
Socio-economic	Inflow of Job-Seekers	Diluting of job opportunities available to local population	*Moderate -*	*Long Term> 5 years*	*Regional*	High	*Definite*	High	Yes	Early Communications and Community Engagement outling potential benefit and employment Opportunities	*Minor -*	*Medium Term > 18 months < 5 years*	*Regional*	Low	*Possible*	Low
Socio-economic	Inflow of Job-Seekers	Increased pressure on housing and accommodation in mine communities	*Major -*	*Long Term> 5 years*	*Regional*	High	*Definite*	High	Yes	Collaboration with GLM in considering a rural settlement management plan for local settlements	*Moderate -*	*Long Term > 5years*	*Regional*	High	*Possible*	High

Affected Environment	Activity	Impact Description	BEFORE MITIGATION						Cumulative Impact	Mitigation measures / Recommendations	AFTER MITIGATION					
			Magnitude	Duration	Spatial Scale	Consequence	Probability	SIGNIFICANCE			Magnitude	Duration	Spatial Scale	Consequence	Probability	SIGNIFICANCE
Safety and Security	Inflow of Job-Seekers and Workforce	Increased demand for housing. Externalisation of social costs - densification of settlements and associated social problems	*Major -*	*Long Term > 5 years*	*Site or Local*	High	*Definite*	High	Yes	Maintain social monitoring within local community and implement mitigation plan in collaboration with GLM to manage the impact. Adapt SLP if necessary	*Major +*	*Long Term > 5 years*	*Site or Local*	High	*Possible*	High
Economic Impact	Utilisation of local goods and services	Increase in local income	*Moderate +*	*Long Term> 5 years*	*Regional*	High	*Possible*	High	Yes	Maintain commitment to local employment policy	*Major +*	*Long Term > 5 years*	*Regional*	High	*Possible*	High
Infrastructure Development	Inflow of Job	Increased pressure on		*Long Term>*	*Regiona*					Adoption of robust Community	*Major -*	*Long Term*	*Regio*			

	Seekers and Workforce	Clinics and Health Systems	*Major -*	*5 years*	*l*	High	*Definite*	High	Yes	Monitoring and Development Programme		*> 5 years*	*nal*	High	*Possible*	High
Infrastructure Development	Inflow of Job Seekers and Workforce	Increased demand water and sanitation services	*Moderate -*	*Long Term > 5years*	*Regional*	High	*Possible*	High	Yes	Collaboration with GLM and assistance with the development of water and sanitation services in the local communities	*Minor -*	*Long Term > 5 years*	*Regional*	Medium	*Possible*	Medium

Affected Environment	**Activity**	**Impact Description**	**BEFORE MITIGATION**						**Cumulative Impact**	**Mitigation measures / Recommendations**	**AFTER MITIGATION**					
			Magnitude	**Duration**	**Spatial Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**			**Magnitude**	**Duration**	**Spatial Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**
Safety and Security	Increased daily living movement patterns	Increased road accident injury and fatalities	*Major -*	*Long Term > 5 years*	*Site or Local*	High	*Possible*	High	No	Road safety awareness to be incorporated into the mine's Community Development Programme	*Major -*	*Medium Term > 18 months < 5 years*	*Site or Local*	Medium	*Possible*	Medium

Safety and Security	Increased traffic on provincial roads	Safety risk around the Mines access point off the R518	*Major -*	*Medium Term > 18 months < 5 years*	*Site or Local*	Medium	*Possible*	Medium	No	Install traffic calming mechanism at the Mines access point to the provincial road.	*Minor -*	*Medium Term > 18 months < 5 years*	*Site or Local*	Low	*Possible*	Low
Safety and Security	Increased traffic on provincial roads	Road safety	*Major -*	*Medium Term > 18 months < 5 years*	*Site or Local*	Medium	*Possible*	Medium	No	Institute speed limits in and around the mine and for the R518 for sections close to the mine entrance.	*Minor -*	*Medium Term > 18 months < 5 years*	*Site or Local*	Low	*Possible*	Low
Residential proximity	Mine is granted mining rights for listed farms	Impact on farming and livelihoods activities for Landowners	*Major -*	*Long Term > 5 years*	*Site or Local*	High	*Definite*	High	Yes	Negotiated compensation mitigates the loss of income	*Minor -*	*Medium Term > 18 months < 5 years*	*Site or Local*	Low	*Possible*	Low
Residential proximity	Mine is granted mining rights for listed farms	Loss of employment for farm workers	*Major -*	*Short Term < 18 months*	*Site or Local*	Medium	*Definite*	Medium	Yes	Possible re-deployment on the mine	*Moderate -*	*Medium Term > 18months < 5*	*Site or Local*	Medium	*Possible*	Medium

												years				

Affected Environment	Activity	Impact Description	BEFORE MITIGATION						Cumulative Impact	Mitigation measures / Recommendations	AFTER MITIGATION					
			Magnitude	**Duration**	**Spatial Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**			**Magnitude**	**Duration**	**Spatial Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**
Residential proximity	Exposure to hazardous emmissions and dust	Health implications	*Major -*	*Long Term > 5 years*	*Site or Local*	High	*Definite*	High	Yes	Compliance with stringent environmental criteria to reduce harmful emission and manage dust	*Major -*	*Long Term > 5 years*	*Site or Local*	High	*Possible*	High
Residential proximity	Visual interference and impact on sense of place	Rural experience and Wilderness experience is deminished	*Major -*	*Long Term> 5 years*	*Regional*	High	*Definite*	High	Yes	Not possible to completely mitigate this impact. One is looking at the trade- off between the status qou of rural setting and and Mining Sector	*Major -*	*Long Term> 5 years*	*Regional*	High	*Definite*	High

	Activity	Impact Description	BEFORE MITIGATION						Cumulative Impact	Mitigation measures / Recommendations	AFTER MITIGATION					
			Magnitude	Duration	Spatial Scale	Consequence	Probability	SIGNIFICANCE			Magnitude	Duration	Spatial Scale	Consequence	Probability	SIGNIFICANCE
Decommissioning and Closure																
Closure Strategy	Comprehensive and sensitive consultation with stakeholder groups from the local communities, government departments and other identified groups	Ease the transition from employment to unemployment, re-skilling, job search services	*Major -*	*Short Term < 18 months*	*Regional*	Medium	*Possible*	Medium	Yes	Mitigation beyond initial activity will be limited	*Major -*	*Short Term < 18 months*	*Regional*	Medium	*Possible*	Medium

Closure Strategy	Capacity building to assist retrenched employees to set up their own businesses or assist local business to expand their operations	Reduced impact due to loss of income from the mine	*Major -*	*Short Term < 18 months*	*Regional*	Medium	*Possible*	Medium	Yes	Mitigation beyond initial activity will be limited	*Major -*	*Short Term < 18 months*	*Regional*	Medium	*Possible*	Medium
Closure Strategy	Continued mentorship of empowerment groups and local community structures started during the life of the	Discouraged employees	*Major -*	*Short Term < 18 months*	*Regional*	Medium	*Possible*	Medium	Yes	Mitigation beyond initial activity will be limited	*Major -*	*Short Term < 18 months*	*Regional*	Medium	*Possible*	Medium

	mine in line with the needs of															
Affected Environment	**Activity**	**Impact Description**	**BEFORE MITIGATION**						**Cumulative Impact**	**Mitigation measures / Recommendations**	**AFTER MITIGATION**					
			Magnitude	**Duration**	**Spatial Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**			**Magnitude**	**Duration**	**Spatial Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**
	these groups/structures using ad-hoc mechanisms already in place															
Closure Strategy	Provision of portable skills to employees facing retrenchment	Increase opportunities for re-trenched employees	*Major -*	*Short Term < 18 months*	*Regional*	Medium	*Possible*	Medium	Yes	Mitigation beyond initial activity will be limited	*Major -*	*Short Term < 18 months*	*Regional*	Medium	*Possible*	Medium

9. SOCIAL MANAGEMENT PROGRAMME

This SMP addresses the management of potential environmental impacts related to the proposed Giyani Gold Mines Mine project. The EMPr is used for managing, mitigating, and monitoring of the socila impacts associated with the construction, operational and rehabilitation phases of the project.

The SMP should be reviewed at least annually, taking into consideration analysis of complaints and community perceptions.

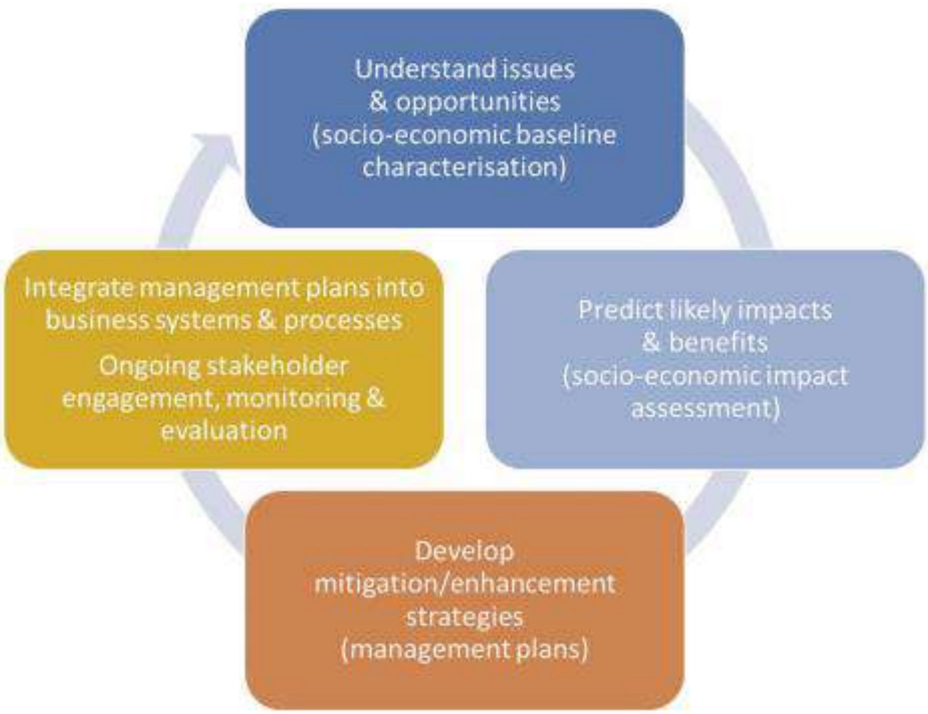


Figure 9: Social Management Plan process

9.1 Objectives

The objectives of the SMP are to:

- Maximise the potential socio-economic benefits of the mine within its area of influence, in particular:
- Local and regional employment o Regional business development
- Community preparedness and collaboration (to manage indirect impacts such as those arising from increased population

9.2 Social Management and Mitigation Measures Identified

9.2.1 Communication Plan

Giyani Gold Mines should understands that communities' capacity to adapt to the impacts of the mine depends on the way in which interactions between workers and landholders and community members are conducted, their being aware of activities before they occur and having access to an avenue to raise concerns (complaints procedure). Giyani Gold Mines Mine is committed to providing accessible and effective channels of communication to promote positive interactions between the mine and local communities. The communication plan contained herein relates specifically to the management of socio-economic impacts.

A summary of the identified mitigation measures is presented here:

- Stakeholder engagement program that facilitates good, two-way communication, and provides access to information of relevance and concern to landholders and the wider community on project developments.
- Operating protocols to manage interactions between project workers and adjoining

landholders and their properties, developed in consultation with landholders, incorporating as much as possible, specifications and requirements considered important by landholders in minimizing inconvenience to them.

- System of advanced notification of major activities or disruptions that may affect landholders or the broader communities. Include advanced notice, nature of, reason for, duration and severity of the activity or disruption.
- System for identifying, monitoring and responding to landholder and community concerns. Must be well publicised, accessible and easy to use for landholders and the wider community

The above-mentioned mitigation measures will ensure that:

Complaints are addressed quickly and effectively to complainant's satisfaction.

Minimise inconvenience and disruption to landholders and the broader community

9.2.2 Local Employment Plan

Giyani Gold Mines understands that its procurement and employment practices significantly influence local and regional communities' potential to realise employment and economic development opportunities from the mine.

Giyani Gold Mines Mine is committed to providing opportunities for local and Indigenous businesses and community members to benefit from the mine.

A summary of the identified mitigation measures is presented here:

- Set appropriate targets for employment of people with the relevant skills or experience from the Mopani District , that is considerate of both the desire to maximize the economic benefits of the Project without depleting the region of skilled workers in other industries / businesses.

- Training and education programs (as per the Social and Labour Plan) that give preference to participation by people from the Mopani District, in order to maximise local employment and human capital development.
- Appropriate targets for the employment of, and participation in training programs by, under privileged and vulnerable people, where possible.
- Training and education programs in order to maximize the 'pool' of skilled labour in the region for employment at the Project. Where appropriate, Giyani Gold Mines Mine will offer non-mine employees the opportunity to participate in training and education programs in order to increase the 'pool' of skilled labour available to other businesses/industries once the mine starts entering the end of its life.
- Procedures for the identification of potential workforce reductions and appropriate communication of such to the workforce and local communities.
- Strategies to minimise the potential impact of workforce reductions on local communities.

The above-mentioned mitigation measures will ensure that:

- Promote and create local employment opportunities
- Equal employment opportunities resulting in diverse workforce

- Appropriate goals encourage, women, school leavers, and unemployed to seek opportunities
- Provision of increased access to formal structured training programs such as apprenticeships and traineeships promote skill development and increased employment opportunities
- Ongoing up-skilling and professional development of staff
- Policies, practices and procedures to provide for the safety, health and wellbeing of the workforce.

9.2.3 Local Business Development Plan

The SIA identified two potentially positive impacts relating to local business:

Effect of increased population on retail and commercial services – the Company will procure goods and services from within the region to maximise the local economic benefit of the mine and a larger population will provide additional demand for a spectrum of goods and services available in the region.

Effect on economy – the mine will contribute to growth in regional and State product, increase wage rates, increase income expenditure in the region, contribute to local, provincial and national government revenue and provide additional industry diversification in the region.

A summary of the identified mitigation measures to enhance these impacts is presented here:

- Engage with, local government and other employers to plan, on a regional scale, to maximize the regional skilled labour pool.

- Identify goods and services provision capacity in the region and develop and implement a policy of preferential regional procurement.

- Conduct training and awareness sessions for small businesses in the region to assist them to understand the potential supply opportunities to the Project and the Project's procurement requirements (ie, HSSE and quality standards).
- Engage with agencies, local government, industry associations and other businesses to develop strategies to mutually benefit industries in the region.

The above-mentioned mitigation measures will ensure that:

There is a maximising of local business Opportunity from the mine by:

- providing full and fair opportunity for local businesses to tender on contracts,
- assisting in equipping local businesses to access supply chain opportunities.

9.3 Mechanisms for Monitoring Compliance

Monitoring and reporting requirements are provided in the table below.

Table 6:: Monitoring and reporting requirements

Category	Method for monitoring	Time period	Frequency of monitoring	Mechanism for monitoring compliance	Responsible person
Construction Phases					
Socio-economic	Tracking local employment against agreed to target.	Duration of construction phase.	Ongoing.	Monthly internal environmental audit report.	Human Resources Manager
Socio-economic	Tracking local procurement against agreed to target.	Duration of construction phase.	Ongoing.	Monthly internal environmental audit	Financial Manager.

				report.	
Air quality.	Dust bucket monitoring at the fence line with a minimum of four buckets. Samples to be sent to an accredited laboratory for analysis.	Baseline sample 1 month prior to start of pre- construction activities, and for duration of construction phase.	Monthly.	Monthly internal environmental audit report.	ECO and/or SHEQ Manager.
Air quality.	Monitor complaints register held at security gate or administration office for complaints about dust.	Duration of construction phase.	As and when required (notified immediately of complaint being lodged).	Complaint and actions taken to address complaint about dust recorded in complaints register.	ECO and/or SHEQ Manager

Noise.	Monitor complaints register held at security gate or administration office for complaints about noise.	Duration of construction phase.	As and when required (notified immediately of complaint being lodged).	Complaint and actions taken to address complaint about noise recorded in complaints register.	ECO and/or SHEQ Manager
Traffic.	Monitor incidents register for records of incidents of near-misses, injuries or death from construction vehicles.	Duration of construction phase.	As and when required (notified immediately of incident involving construction vehicle being lodged).	Monthly internal environmental audit report.	ECO and/or SHEQ Manager
Traffic.	Monitor complaints register held at security gate or administration office for complaints about	Duration of construction phase.	As and when required (notified immediately of complaint being	Complaint and actions taken to address complaint about construction vehicles	ECO and/or SHEQ Manager

	construction vehicles.		lodged).	recorded in complaints register.	
Category	**Method for monitoring**	**Time period**	**Frequency of monitoring**	**Mechanism for monitoring compliance**	**Responsible person**
Socio-economic.	Tracking local employment against agreed to target.	Duration of operational phase.	Ongoing.	Monthly internal SHEQ report.	Human Resources Manager.
Socio-economic.	Tracking local procurement against agreed to target.	Duration of operational phase.	Ongoing.	Monthly internal SHEQ report.	Financial Manager

Traffic.	Monitor incidents register for records of incidents of near-misses, injuries or death from road tankers.	Duration of operational phase.	As and when required (notified immediately of incident involving road tanker being lodged).	Monthly SHEQ report.	SHEQ Manager.
Traffic.	Monitor complaints register held at security gate or administration office for complaints about road tankers.	Duration of operational phase.	As and when required (notified immediately of complaint being lodged).	Monthly SHEQ report.	SHEQ Manager.
Socio-economic.	Tracking placement/training of permanent employees.	Duration of closure phase.	Ongoing.	Monthly internal environmental audit report.	Human Resources Manager.

Category	Method for monitoring	Time period	Frequency of monitoring	Mechanism for monitoring compliance	Responsible person
Air quality.	Dust bucket monitoring at the fence line with a minimum of four buckets. Samples to be sent to an accredited laboratory for analysis.	Duration of closure phase.	Monthly.	Monthly internal environmental audit report.	ECO and/or SHEQ Manager.
Air quality.	Monitor complaints register held at security gate or administration office for complaints about dust.	Duration of closure phase.	As and when required (notified immediately of complaint being lodged).	Complaint and actions taken to address complaint about dust recorded in complaints register.	ECO and/or SHEQ Manager.
Noise.	Monitor complaints register held at security gate or administration office for complaints about noise.	Duration of closure phase.	As and when required (notified immediately of complaint being lodged).	Complaint and actions taken to address complaint about noise recorded in complaints register.	ECO and/or SHEQ Manager.

Traffic.	Monitor incidents register for records of incidents of near-misses, injuries or death from demolition vehicles.	Duration of closure phase.	As and when required (notified immediately of incident involving demolition vehicle being lodged).	Monthly internal environmental audit report.	ECO and/or SHEQ Manager.

Category	**Method for monitoring**	**Time period**	**Frequency of monitoring**	**Mechanism for monitoring compliance**	**Responsible person**
Traffic.	Monitor complaints register held at security gate or administration office for complaints about mine vehicles.	Duration of closure phase.	As and when required (notified immediately of complaint	Complaint and actions taken to address complaint about demolition vehicles recorded in complaints	ECO and/or SHEQ Manager.

			being lodged).	register.	

10. CONCLUSION AND RECOMMENDATIONS

As is typical for mining projects, there is more potential for people living in the immediate surroundings of the Project site to experience negative impacts, however, local benefits may also be experienced as a result of the mine's investments in local communities. At a regional level, negative social impacts are likely to be minimal, and benefits due to employment and business opportunities are likely to be experienced.

Therefore, from a social perspective based on the initial assessment of the receiving environment, there will be no fatal flaws associated with the proposed development that can have grave social consequences. The majority of the negative social impacts can respond to well-orchestrated mitigation measures, since they are general construction related problem, such as inflow of workers and jobseekers, possible impacts on farming and conservation activities, noise pollution, increased vehicle movement, as well as safety and security issues.

It is the opinion of this specialist that the proposed Project should be authorised, subject to the implementation of the recommended mitigation measures and mechanisms for monitoring compliance. The success of mitigation measures aimed to reduce the socio-economic impact of the expected influx largely depends on Giyani Gold Mines developing and implementing the programmes proposed in their Social and Labour Plan. These measures include;

- Local Labour Employment Policy
- Human Resource Development Programme
- Local Economic Development Programme which incorporates; A Programme improving Nutrition amongst the workforce; Infrastructure Projects and Poverty Eradication Projects, Community Participation and Communications Programme, and

- Risk Management Plan

Within these programmes, it would be necessary to understand how Giyani Gold Mines will;

- Collaborate with the Tribal Authorities and Local Government to develop appropriate community monitoring programmes to identify and evaluate socioeconomic impacts resulting from the mining operations. These programmes ought to collect data reflecting economic, fiscal, and social impacts of the development at both the tribal and local government level. Parameters to be evaluated could include impacts on local labour and housing arrangements, local consumer product prices and availability, local public services (e.g., police, fire, and public health), and educational initiatives. Monitoring the indicators of social disruption (e.g., crime, alcoholism, drug use, and mental health) and the effectiveness of community welfare programmes in addressing these problems, will also be beneficial.

- Define clear targets for the employment of local people. The targets and details need to be well communicated to the local communities and their leaders. Care needs to be taken that opportunities offered by the mine are not syphoned off by prominent or influential individuals.

- Improve literacy through their ABET Programme.

- Commit to establishing vocational training programmes for the local workforce to develop skills required during operation of the mine;

11. SPECIALIST DECLARATION

This Social Impact Assessment (SIA) was compiled by Judith Chipo Mlanda, who is a seasoned environmental and social safeguards practitioner with a special interest in environmental and social sustainability. She holds a Masters degree in Environment and Society from the University of Pretoria's Centre for Environmental Studies as well as a Bachelor of Art honours degree in Sociology and Psychology obtained from the University of Namibia. Judith is the author of a book on public participation and stakeholder engagement entitled "Waste Management Exploring the Potential for Community Participation". She has over 15 years of experience. Judith has worked in the consulting industry on public, private and development sector projects. She has extensive experience and knowledge including but not limited to environmental and social impact assessments, integrated water and waste management, environmental auditing and monitoring, carbon management and climate change integration for sustainable projects.

I, __ Judith Mlanda –Zvikaramba ________, declare that –

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity.

- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

Signature of the Specialist

2021/03/20

Date

.

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ANNEXURE 10 - AIR QUALITY IMPACT ASSESSMENT

ENVIRONMENTAL & ENGINEERING

REPORT

KUSILE INVEST (PTY) LTD

AIR QUALITY IMPACT ASSESSMENT (AQIA)

REPORT REF: 20-1170

PORTION OF THE FARM GREATER GIYANI 891 LT, PORTION OF THE FARM MARLYATA 246 LT AND THE FARM SHLVLTL 875 LT - LIMPOPO PROVINCE.)

2021-05-04

VERSION BB

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Nature of Signoff	Responsible Person	Role / Responsibility	Qualification
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Quality Reviewer	Leoni le Roux	Administrator	Professional Secretary and Personal Assistant
Reviewer	Henno Engelbrecht	Senior Environmental Consultant	BSc Honns Env Mgmt & Analysis MSc Project Mgmt
Client			

DISCLAIMER:

This is not a legally binding document and many of the actions and recommendations remain the responsibility of the client (as the owner / lessee of the property). This is the Air Quality Assessment for the Giyani Project 2021 and does not constitute a binding legal commitment of the parties.

Eco Elementum (Pty) Ltd and the authors of this report are protected from any legal action, possible loss, damage or liability resulting from the content of this report. This document is considered confidential and remains so unless requested by a court of law.

It is however important to note that although all effort is put into conducting a thorough audit, due to the length of time for an audit, or the nature of activities viewed on the day of the audit, only a sample of the operations can be reasonably assessed.

Please consider the environment and only print this document if necessary.

EXPERTISE OF THE REVIEWER

Name	Henno
Surname	Engelbrecht
Company	Eco Elementum (Pty) Ltd
Position	Director - Senior Environmental Scientist
Location	The Willows Office Park, Die Wilgers, Pretoria
Email	henno@ecoe.co.za
Telephone Number	082 690 9105 / 012 348 5214
Education	- Senior Certificate Matric (Cum Laude). - B.Sc. Geography (Cum Laude) (University of Pretoria). - BSc Honours Environmental Management and Analysis (Cum Laude) (University of Pretoria). - MSc Project Management (Thesis Cum Laude) (University of Pretoria).
Professional skills	Mr. Henno Engelbrecht has 10 years working experience as an Environmental Consultant and specialized in Environmental Management and Analysis. Henno worked for Environmental Assurance Pty (Ltd) as an environmental consultant since completing his studies until mid-2013 and served an array of clients in various fields of environmental practice. He has vast environmental monitoring & measurement, environmental authorisations, mine closure, and environmental impact assessment experience and worked within various project teams, up to the level of Programme Manager being responsible for all projects which fell within the Environmental Assurance (Pty) Ltd programme. His expertise led to his specialist inputs and studies to be used in several Environmental Impact Assessments, Water Use License Applications, Waste License Applications, Air Emission License Applications and Mine Closure/Rehabilitation Planning Activities. Henno holds the MSc Project Management degree at the Engineering Faculty with the University of Pretoria. He worked in mining, industrial, natural and construction environments but his expertise lies mainly within the mining sector and currently holds the position of Director at Eco Elementum (Pty) Ltd.
Skills	- Mine Closure financial quantum determination, mine closure planning and reporting. - Rehabilitation planning, reporting, management and coordination of opencast and underground mining. - Ambient air quality monitoring, measurement and implementation (passive and active) in accordance to the National Environmental Management: Air Quality Act 39 of 2004, Government Notice 248 NEM: AQA (39/2004) which contains the Listed Activities, and the National Ambient Air Quality Standards (SANS 1929: 2005). - Noise monitoring and measurement according to SANS 10103:2008, the measurement and rating of environmental noise with respect to annoyance and to speech communication & SANS 10328:2008, Methods for environmental noise impact assessment. - Water quality monitoring, measurement, reporting and data analyses including surface water, ground water, process water, sewage water and biological indicators. - Groundwater hydrocensus studies - borehole surface water depth monitoring, measurement, transections and analysis. - ISO 14001 Environmental Management Systems auditing, system implementation, training and environmental analysis (creation of aspect/impact registers, contractor training, general environmental awareness training, legal compliance audits, GAP analysis, documentation reviews, roles and authority allocations etc.) - Legal compliance auditing and reporting in accordance with the National Environmental Management Acts and other associated environmental related (NEMA listed activities, Air Quality Act listed activities, Water Use Licensing, Waste Licensing, Air Emissions Licensing etc.) - Environmental training (contractor training, monitoring and measurement training, awareness training). - Environmental impact assessments and Integrated Water Use License Applications. - Environmental Management Plan development, monitoring, compliance auditing etc. - Environmental Control Officer Site inspections- non-conformance reporting (NCR), corrective action request (CAR) and preventative action request (PAR).

EXECUTIVE SUMMARY

Kusile Invest (Pty) Ltd appointed Archean Resources (Pty) Ltd to undertake environmental authorisations associated with the proposed Giyani project. The applicant wants to conduct opencast rollover mining on an area of 13 895.78 ha comprising of Portion of the farm Greater Giyani 891 LT, Portion of the farm Marlyata 246 LT and the farm Shlvltl 875 LT in the Limpopo Province of South Africa.

Eco Elementum (Pty) Ltd is to undertake the Air Quality Impact Assessment for the Giyani project.

Kusile Invest wants to conduct opencast mining on various pits. Life of Mine (LOM) is estimated at 30 years with a production rate of 12 000 tons per month at full production.

The opencast pits will be excavated to an optimal operating final depth of 400 meter below surface level, thereafter, the conversion of the mining operation from open pit to underground mining operation will occur.

The ROM ore is then going to be transported by road to an on-site processing plant.

The scope of this report will not include the Smelting operation.

The purpose of this study is to:

1. Study the available information relevant to the pre and post-development ambient air quality pollution concentrations in the environment;
2. Identify the major existing air emission sources in the environment;
3. Identify the existing sensitive air pollution areas in the environment;
4. Estimate by means of measurements and integration of the results with those of any relevant existing information the present ambient air quality climate;
5. Identify the mining related processes and equipment that will cause the major contribution to the future air quality impact;
6. Consider, evaluate and rate the potential air quality impacts; and
7. Propose relevant management and mitigation measures to lessen the anticipated impacts.

SUMMARY OF FINDINGS

The air quality impact assessment undertaken for the project includes a meteorological overview of the area. An emissions inventory was undertaken with the aim of quantifying emissions associated with the activities involved in the mining of coal. The emissions for specific activities such as bulldozing, tipping, wind erosion and materials handling activities were calculated and the cumulative impacts were compared to the relevant ambient air quality standards to determine legal compliance.

The findings reported here is therefore a combination of historical, observed and previously modelled data and provided the background and predicted scenario of various pollutants in the proposed Giyani project mining area. The construction and operational phases were assessed. Based on the dispersion modelling simulations, the following conclusions can be summarised as follows

PM10

For the unmitigated Daily PM10 concentrations it was predicted to be higher than the 75 µg/m³ limit for 2 of the sensitive receptors as can be seen in Table 19.

When comparing the Daily Mitigated PM10 modelled concentrations, the sensitive receptors exceeding the 75 µg/m³ limit dropped to 0 of the identified sensitive receptors. This as well is the highest levels predicted for a 24 hour period within the period. Due to site specific atmospheric conditions these exceedances may still occur within the limit of 4 per year.

The annual average PM10 limit of 40 µg/m³ are predicted to also exceed at 2 of the sensitive receptors for the unmitigated scenario and dropping to 0 of the identified sensitive receptors for the mitigated scenario

TSP

MITIGATION MEASURES

The following mitigation measures are recommended at the various sources:

Table 1: Calculated Source Emission Rates Summary

Operation	Reduction	Method
Excavator ROM	50%	Water Sprays
Excavator Overburden	50%	Water Sprays
Wind Erosion	50%	Water Sprays
	90%	Revegetation on OB and Topsoil
Pit Haul Road A	90%	Encrusting (Dust Aside or Similar)
Truck Dumping (Overburden)	50%	Water Sprays
Inpit Operations	50%	Inpit

Based on the results presented the following further recommendations are outlined:

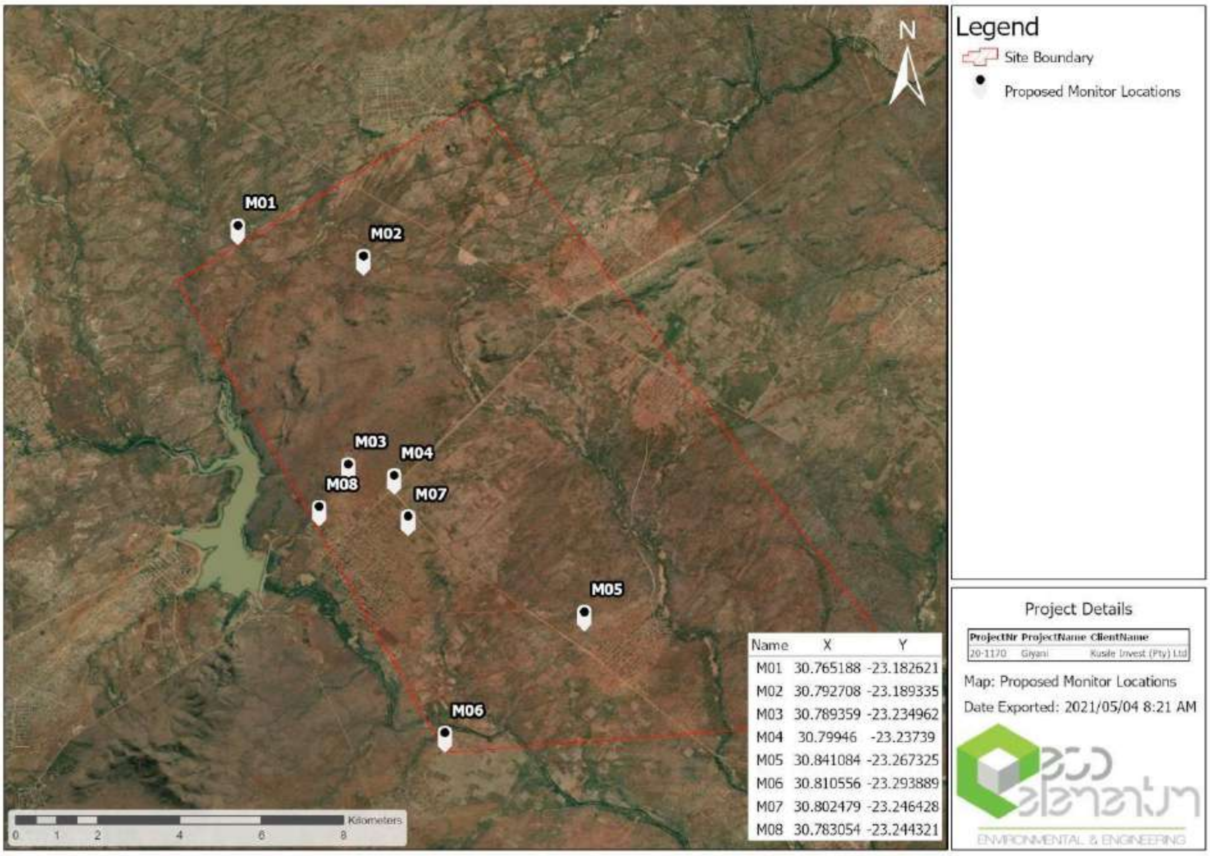

Figure 1: Proposed Monitor Locations

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Glossary

Assessment	A systematic, independent and documented review of operations and practises to ensure that relevant requirements are met. Qualified professionals with relevant auditing experience should conduct audits and, where possible, independent external auditors should also be used.
Construction	The time period that corresponds to any event, process, or activity that occurs during the Construction phase (e.g., building of site, buildings, and processing units) of the proposed project. This phase terminates when the project goes into full operation or use.
Director-General	means the Director-General of the Department;
Environmental Component	An attribute or constituent of the environment (i.e., air quality; marine water; waste management; geology, seismicity, soil, and groundwater; marine ecology; terrestrial ecology, noise, traffic, socio-economic) that may be impacted by the proposed project.
Environmental Impact	A positive or negative condition that occurs to an environmental component as a result of the activity of a project or facility. This impact can be directly or indirectly caused by the project's different phases (i.e., Construction, Operation, and Decommissioning).
Record of Decision	Is an environmental authorisation issued by a state department.
Responsible authority	in relation to a specific power or duty in respect of water uses, means - (a) if that power or duty has been assigned by the Minister to a catchment management agency, that catchment management agency; or (b) if that power or duty has not been so assigned, the Minister;
Air quality	A measure of exposure to air which is not harmful to your health. Air quality is measured against health risk thresholds (levels) which are designed to protect ambient air quality. Various countries including South Africa have Air Quality Standards (legally binding health risk thresholds) which aim to protect human health due to exposure to pollutants within the living space.
Ambient air	The air of the surrounding environment.
Baseline	The current and existing condition before any development or action.
Boundary layer	Within the earth's atmosphere, the boundary layer is defined as the planets boundary layer which is the air layer near the ground affected by diurnal heat, moisture or momentum transfer to or from the surface.
Climatology	The study of the long term effect of weather over a certain area during a certain period.
Concentration	When a pollutant is measured in ambient air it is referred to as the concentration of that pollutant in air. Pollutant concentrations are measured in ambient air for various reasons, i.e. to determine whether concentrations are exceeding available health risk thresholds (air quality standards); to determine how different sources of pollution contribute to ambient air concentrations in an area; to validate dispersion modelling conducted for an area; to determine how pollutant concentrations fluctuate over time in an area; and to determine the areas with the highest pollution concentrations.
Condensation	The change of physical state of matter from a gaseous phase into a liquid phase.
Dispersion model	A mathematical model which can be used to assess pollutant concentrations and deposition rates from a wide variety of sources. Various dispersion modelling computer programs have been developed.
Dispersion potential	The potential a pollutant has of being transported from the source of emission by wind or upward diffusion. Dispersion potential is determined by wind velocity, wind direction, height of the mixing layer, atmospheric stability, presence of inversion layers and various other meteorological conditions.
Emission	The rate at which a pollutant is emitted from a source of pollution.
Emission factor	A representative value, relating the quantity of a pollutant to a specific activity resulting in the release of the pollutant to atmosphere.
Evaporation	The opposite of condensation.
Front	A synoptic-scale swath of cloud and precipitation associated with a significant horizontal zonal temperature gradient. A front is warm when warm air replaces cold on the passage of the front; with a cold front cold air replaces warm air.
Fugitive dust	Dust generated from an open source and is not discharged to the atmosphere in a confined flow stream.
Inversion	An increase of atmospheric temperature with an increase in height.
Mixing layer	The layer of air within which pollutants are mixed by turbulence. Mixing depth is the height of this layer from the earth's surface
Particulate matter (PM)	The collective name for fine solid or liquid particles added to the atmosphere by processes at the earth's surface and includes dust, smoke, soot, pollen and soil particles. Particulate matter is classified as a criteria pollutant, thus national air quality standards have been developed in order to protect the public from exposure to the inhalable fractions. PM can be principally characterised as discrete particles spanning several orders of magnitude in size, with inhalable particles falling into the following general size fractions: * PM10 (generally defined as all particles equal to and less than 10 microns in aerodynamic diameter; particles larger than this are not generally deposited in the lung); * PM2.5, also known as fine fraction particles (generally defined as those particles with an aerodynamic diameter of 2.5 microns or less); * PM10-2.5, also known as coarse fraction particles (generally defined as those particles with an aerodynamic diameter greater than 2.5 microns, but equal to or less than a nominal 10 microns); and * Ultra fine particles generally defined as those less than 0.1 microns.
Precipitation	Ice particles or water droplets large enough to fall at least 100 m below the cloud base before evaporating.
Relative Humidity	The vapour content of the air as a percentage of the vapour content needed to saturate air at the same temperature.

PROJECT INFORMATION

Table 2: Applicant Details

Name of Applicant:	Kusile Invest (Pty) Ltd
Contact Person:	Mzamani Mdaka
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Email:	mzamanim@vodamail.co.za
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Physical Address:	
File Reference Number DMR:	

Table 3: EAP Details

EAP Company:	
Company Reg. No.:	
Physical Address:	
Postal Address:	
Contact Person:	
Contact Number:	
Email:	
Website:	

Table 4: Specialist Details

Specialist Company:	Eco Elementum (Pty) Ltd
Company Reg. No.:	2012/021578/07
Physical Address:	442 Rodericks Road, Lynwood, Pretoria, 0081
Postal Address:	Postnet Suite #252, Private Bag X025. Lynnwood Ridge, Pretoria, 0040
Contact Person:	Henno Engelbrecht
Contact Number:	082 690 9105
Email:	henno@ecoe.co.za info@ecoe.co.za
Website:	www.ecoe.co.za

SPECIALIST DECLARATION OF INDEPENDENCE

In support of an application in terms of the National Environmental Management Act 107 of 1998 (GNR983, GNR984 and GNR985, GG38282 of 4 December 2014 ("Listed Activities") that will require an environmental authorisation if triggered. As amended by GNR 327, GNR 325 and GNR 324.

I, **Neel Breitenbach** as specialist, has been appointed in terms of regulation 12(1) or 12(2), and can confirm that I shall –

a. Be independent;
b. have expertise in undertaking specialist work as required, including knowledge of the Act, these Regulations and any guidelines that have relevance to the proposed activity;
c. ensure compliance with these Regulations;
d. perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the application;
e. take into account, to the extent possible, the matters referred to in regulation 18 when preparing the application and any report, plan or document relating to the application; and
f. disclose to the proponent or applicant, registered interested and affected parties to the proponent or applicant, registered interested and affected parties and the competent authority all material information in the possession of the EAP and, where applicable, the specialist, that reasonably has or may have the potential of influencing -
g. any decision to be taken with respect to the application by the competent authority in terms of these Regulations; or
h. the objectivity of any report, plan or document to be prepared by the EAP or specialist, in terms of these Regulations for submission to the competent authority;
i. Unless access to that information is protected by law, in which case it must be indicated that such protected information exists and is only provided to the competent authority.

Neel Breitenbach	[signature]
Name and Surname	**Signature**
2021-04-16	George
Date	**Signed at**

1. INTRODUCTION

Kusile Invest (Pty) Ltd appointed Archean Resources (Pty) Ltd to undertake environmental authorisations associated with the proposed Giyani project. The applicant wants to conduct opencast rollover mining on an area of 13 895.78 ha comprising of Portion of the farm Greater Giyani 891 LT, Portion of the farm Marlyata 246 LT and the farm Shlvltl 875 LT in the Limpopo Province of South Africa.

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The ROM ore is then going to be transported by road to an on-site processing plant.

The scope of this report will not include the Smelting operation.

1.1 Mining Techniques

1.1.1 Description of Mining Method

Opencast mining are planned initially, which will later be converted to underground mining methods.

Openpit mine design shows the orebody being located centrally to the pit outer walls or pit shell. The waste surrounding the orebody will be stripped, with topsoil stored separately from waste rock for re-use during rehabilitation of the pit at closure of mining operations. The stripping will include the removal of surrounding topsoil and waste rock to fully expose the orebody and have enough area for movement of machinery inside the pit.

The pit will be excavated to an optimal operating final depth of 400 meters below surface, where after the conversion of the mining operation from open pit to underground will commence.

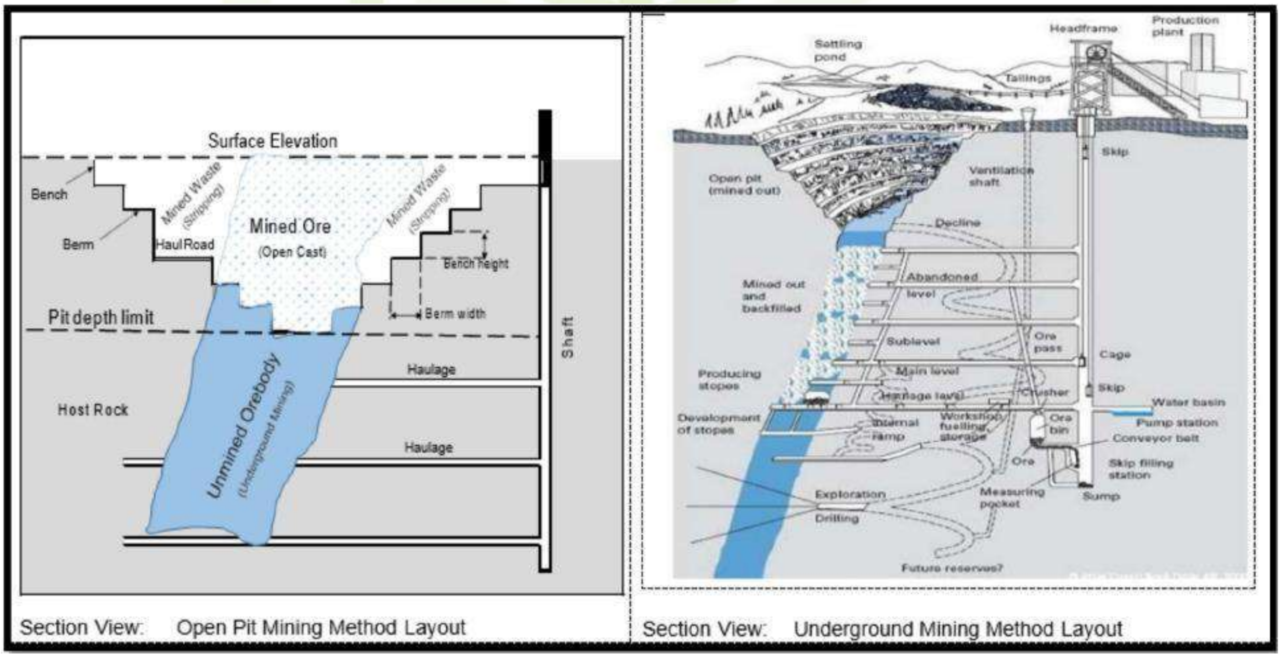


Figure 2: Visual representation of the mining method for the proposed Giyani project.

Table 5: Project Locality

Farm Name:	Portion of the farm Greater Giyani 891 LT, Portion of the farm Marlyata 246 LT and the farm Shlvltl 875 LT – Limpopo Province - South Africa
Application Area:	13 895.78 ha
Magisterial District:	Mopani District Municipality, Limpopo Province South Africa
Distance and direction from nearest town:	The Project Area is ~ 13km north-east of . See Figure 3

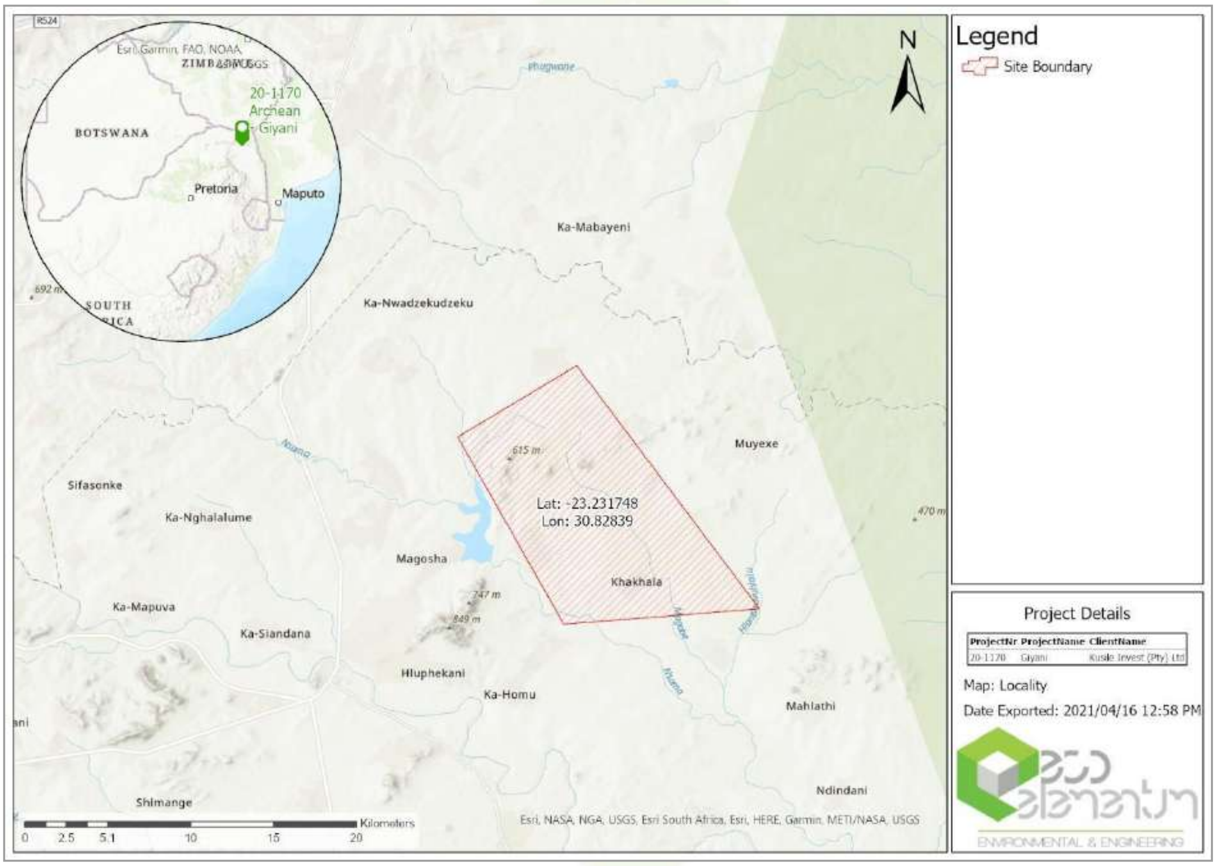


Figure 3: Locality map of the proposed Giyani project.

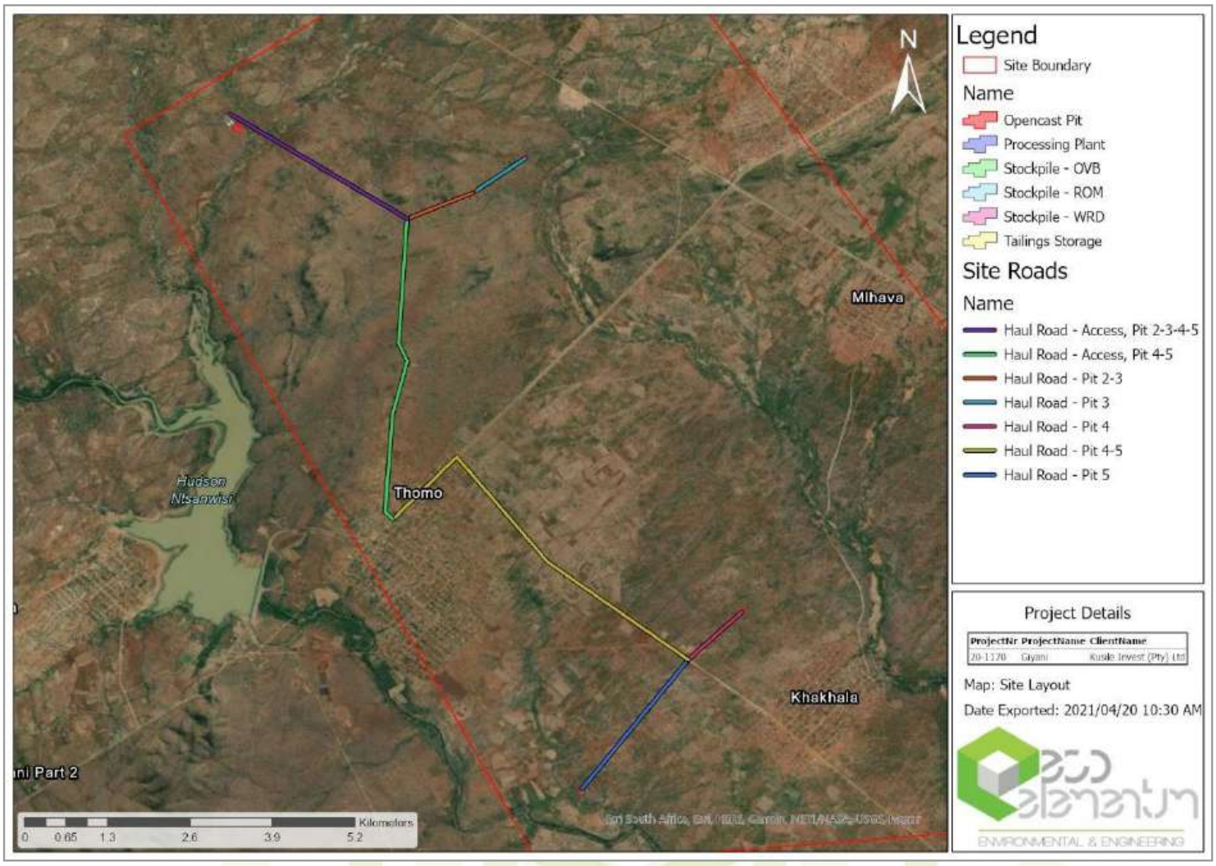


Figure 4: Proposed Site Layout for the proposed Giyani project.

2. SCOPE OF WORK

The purpose of this study is to:

1. Study the available information relevant to the pre and post-development ambient air quality pollution concentrations in the environment;
2. Identify the major existing air emission sources in the environment;
3. Identify the existing sensitive air pollution areas in the environment;
4. Estimate by means of measurements and integration of the results with those of any relevant existing information the present ambient air quality climate;
5. Identify the mining related processes and equipment that will cause the major contribution to the future air quality impact;
6. Consider, evaluate and rate the potential air quality impacts; and
7. Propose relevant management and mitigation measures to lessen the anticipated impacts.

2.1 Assumptions and Limitations

This Air quality impact report of the proposed Giyani project will include, but may not be limited to, the following assumptions and limitations:

- Only the opencast operations have been assessed.
- The proposed smelter in the processing plant diagram have not been included in this report as is not part of the scope of this report.
- TSP was only modelled at the sensitive receptors. Due to the large extent of the proposed project area, the modelling run for the full grid will take an extended period time.

3. STUDY AREA

3.1 LOCATION

3.1.1 Industries

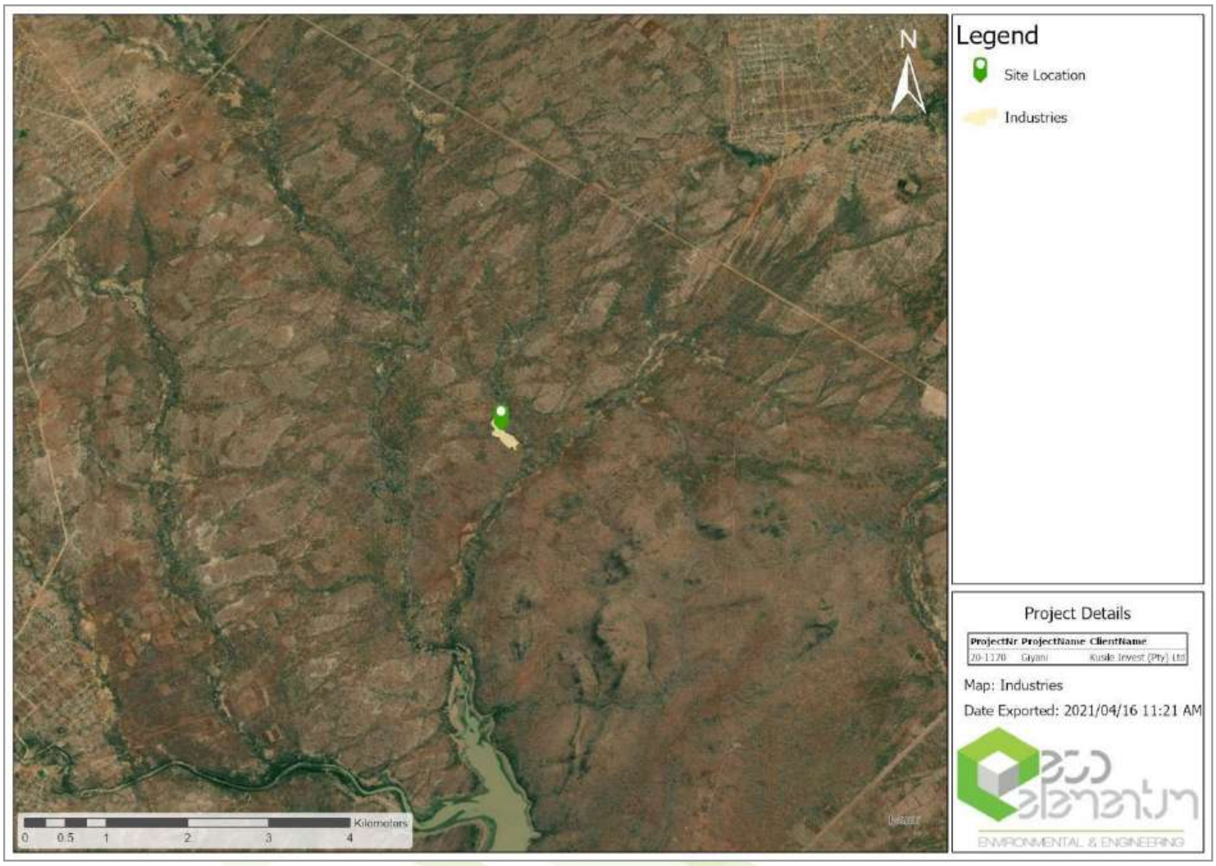


Figure 5: Other industries in the immediate vicinity of the proposed Giyani project.

From a desktop study of satellite imagery only the current operations have been identified within the vicinity of the proposed Giyani project as can be seen in Figure 5.

3.1.2 Population

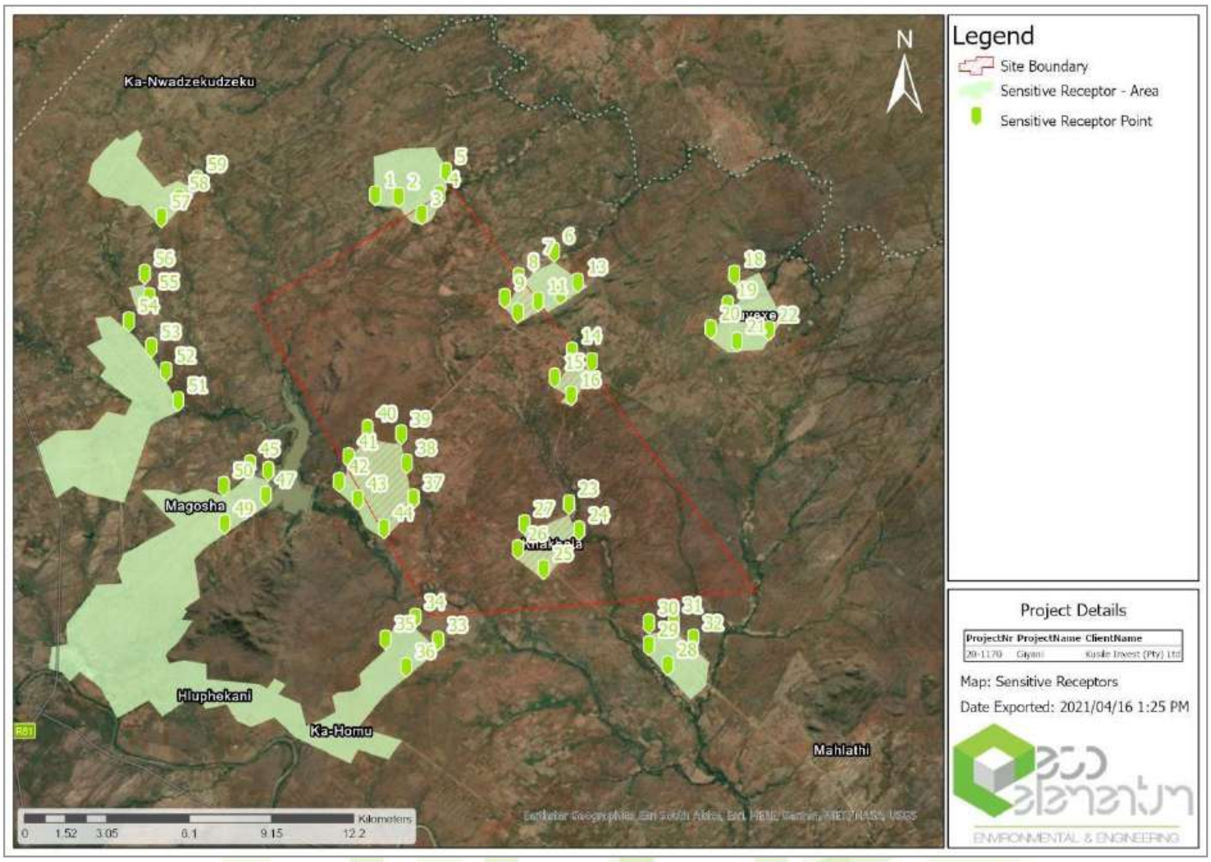


Figure 6: Population areas within the immediate vicinity of the proposed Giyani project.

From a desktop study of satellite imagery various sensitive receptors in the form of human habitation areas, consisting of the rural settlements have been identified within 5km of the proposed Giyani project area as can be seen in Figure 6. It should be noted that the sensitive receptors in the area may differ from those identified as not all areas may have been identified from the imagery successfully.

3.1.3 Topography

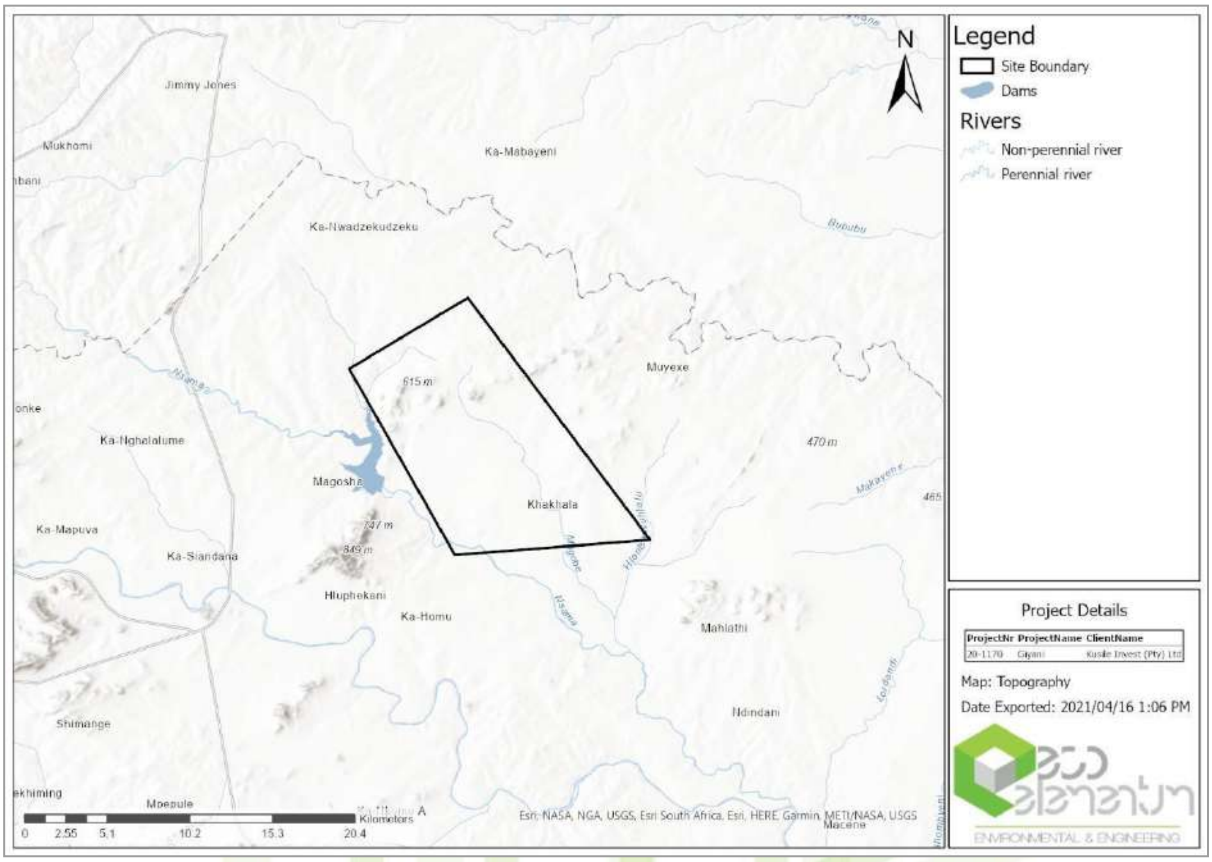


Figure 7: 3D map showing the terrain relief of the area around the proposed Giyani project.

The proposed mining operation area is situated in undulated terrain with a minor mountain terrain found to the south-west of the proposed project area as can be seen in Figure 7 above.

3.2 Meteorological Data

3.2.1 Regional Air Quality

South Africa is located in the sub-tropics where high pressures and subsidence dominate. However, the southern part of the continent can serve as a source of hot air that intrudes sub-tropics, and that sometimes lead to convective movement of air masses. On average, a low pressure will develop over the southern part of the continent, while the normal high pressures will remain over the surrounding oceans. These high pressures are known as Indian High Pressure Cells and Atlantic High pressure Cells. The intrusion of continents will allow for the development of circulation patterns that draw moisture (rain) from either tropics (hot air masses over equator) or from the mid-latitude and temperate latitudes.

Southern Africa is influenced by two major high pressure cells, in addition to various circulation systems prevailing in the adjacent tropical and temperate latitudes. The mean circulation of the atmosphere over Southern Africa is anticyclonic throughout the year (except near the surface) due to the dominance of the three high pressure cells, namely South Atlantic High Pressure, off the west coast, the South Indian High Pressure off the east coast and the Continental High Pressure over the interior.

It is these climatic conditions and circulation movements that are responsible for the distribution and dispersion of air pollutants within the proposed Giyani Project area and between neighbouring provinces and countries bordering South Africa.

3.2.2 Meso-Scale Meteorology

The nature of the local climate will determine what will happen to the pollution when it is released into the atmosphere (Tyson and Preston-Whyte, 2000). Pollution levels fluctuate daily and hourly, in response to changes in atmospheric stability and variations in mixing depth. Similarly, atmospheric circulation patterns will have an effect on the rate of transport and dispersion of pollution.

The release of atmospheric pollutants into a large volume of air results in the dilution of those pollutants. This is best achieved during conditions of free convection and when the mixing layer is deep (unstable atmospheric conditions). These conditions occur most frequently in summer during the daytime. This dilution effect can however be inhibited under stable atmospheric conditions in the boundary layer (shallow mixing layer). Most surface pollution is thus trapped under a surface inversion (Tyson and Preston-Whyte, 2000).

Inversion occurs under conditions of stability when a layer of warm air is situated directly above a layer of cool air. This layer prevents a pollutant from diffusing freely upward, resulting in an increased pollutant concentration at or close to the earth's surface. Surface inversions develop under conditions of clear, calm and dry conditions and often occur at night and during winter (Tyson and Preston-Whyte, 2000). Radiative loss during the night results in the development of a cold layer of air close to the earth's surface. These surface inversions are however, usually destroyed as soon as the sun rises and warm the earth's surface. With the absence of surface inversions, the pollutants are able to diffuse freely upward; this upward motion may however be prevented by the presence of an elevated inversion (Tyson and Preston-Whyte, 2000).

Elevated inversions occur commonly in high pressure areas. Sinking air warms adiabatically to temperatures in excess of those in the mixed boundary layer. The interface between the upper, gently subsiding air is marked by an absolutely stable layer or an elevated subsidence inversion. This type of elevated inversions is most common over Southern Africa (Tyson and Preston-Whyte, 2000).

The climate and atmospheric dispersion potential of the interior of South Africa is determined by atmospheric conditions associated with the continental high pressure cell located over the interior. The continental high pressure present over the region in the winter months results in fine conditions with little rainfall and light winds with a northerly flow. Elevated inversions are common in such high pressure areas due to the subsidence of air. This reduces the mixing depth and suppresses the vertical dispersion of pollutants, causing increased pollutant concentrations (Tyson and Preston- Whyte, 2000).

Seasonal variations in the positions of the high pressure cells have an effect on atmospheric conditions over the region. For most of the year the tropical easterlies cause an air flow with a north-easterly to north-westerly component. In the winter months the high pressure cells move northward, displacing the tropical easterlies northward resulting in disruptions to the westerly circulation. The disruptions result in a succession of cold fronts over the area in winter with pronounced variations in wind direction, wind speeds, temperature, humidity, and surface pressure.

Airflow ahead of a cold front passing over the area has a strong north-north-westerly to north-easterly component, with stable and generally cloud-free conditions. Once the front has passed, the airflow is reflected as having a dominant southerly component (Tyson and Preston-Whyte, 2000).

Easterly and westerly wave disturbances cause a southerly wind flow and tend to hinder the persistence of inversions by destroying them or increasing their altitude, thereby facilitating the dilution and dispersion of pollutants. Pre-frontal conditions tend to reduce the mixing depth. The potential for the accumulation of pollutants during pre-frontal conditions is therefore enhanced over the plateau (Tyson and Preston-Whyte, 2000).

3.2.3 Site-Specific Dispersion Potential

A period wind rose for the site is presented in Figure 9 below. Wind roses comprise of 16 spokes which represents the direction from which winds blew during the period. The colours reflect the different categories of wind speeds. The dotted circles provide information regarding the frequency of occurrence of wind speed and direction categories.

Based on an evaluation of the meteorological data simulations run from a global NEMS weather model at ~30 km resolution from 1985 to current of the project area. The following deductions regarding the prevailing wind direction and wind frequency can be assessed. Looking at Figure 9 below, the predominant wind direction is predicted to occur mainly from the SE 1875 hours per year respectively. A secondary direction is predicted from ESE and SSE 1043 and 894 hours per year, respectively, with wind speeds higher than 5 km/h.

From Figure 8, at the site, calm conditions with wind speeds of 12 km/h or less, are predicted 2-14 days per month throughout the year. 12-19 km/h winds are predicted 10-15 days per month through the year. Wind speeds of more than 19 km/h are predicted to occur 6-15 days per year on average.

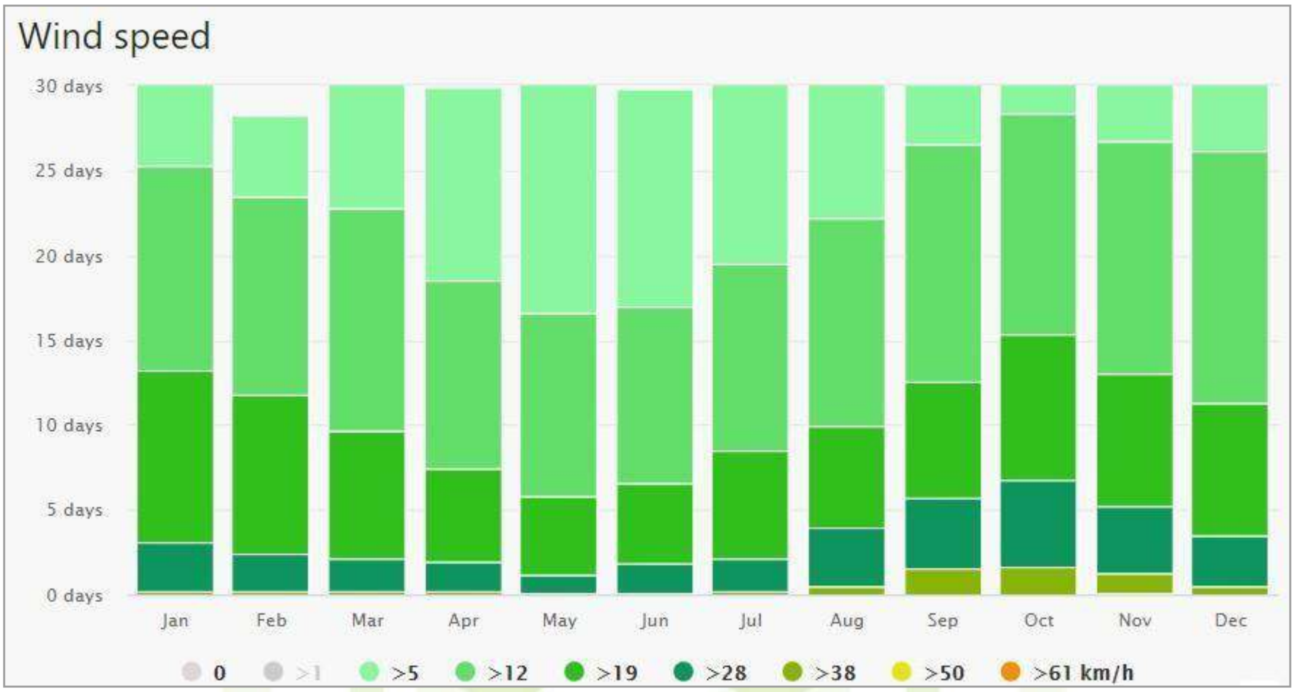


Figure 8: Wind Class Frequency Distribution per month.

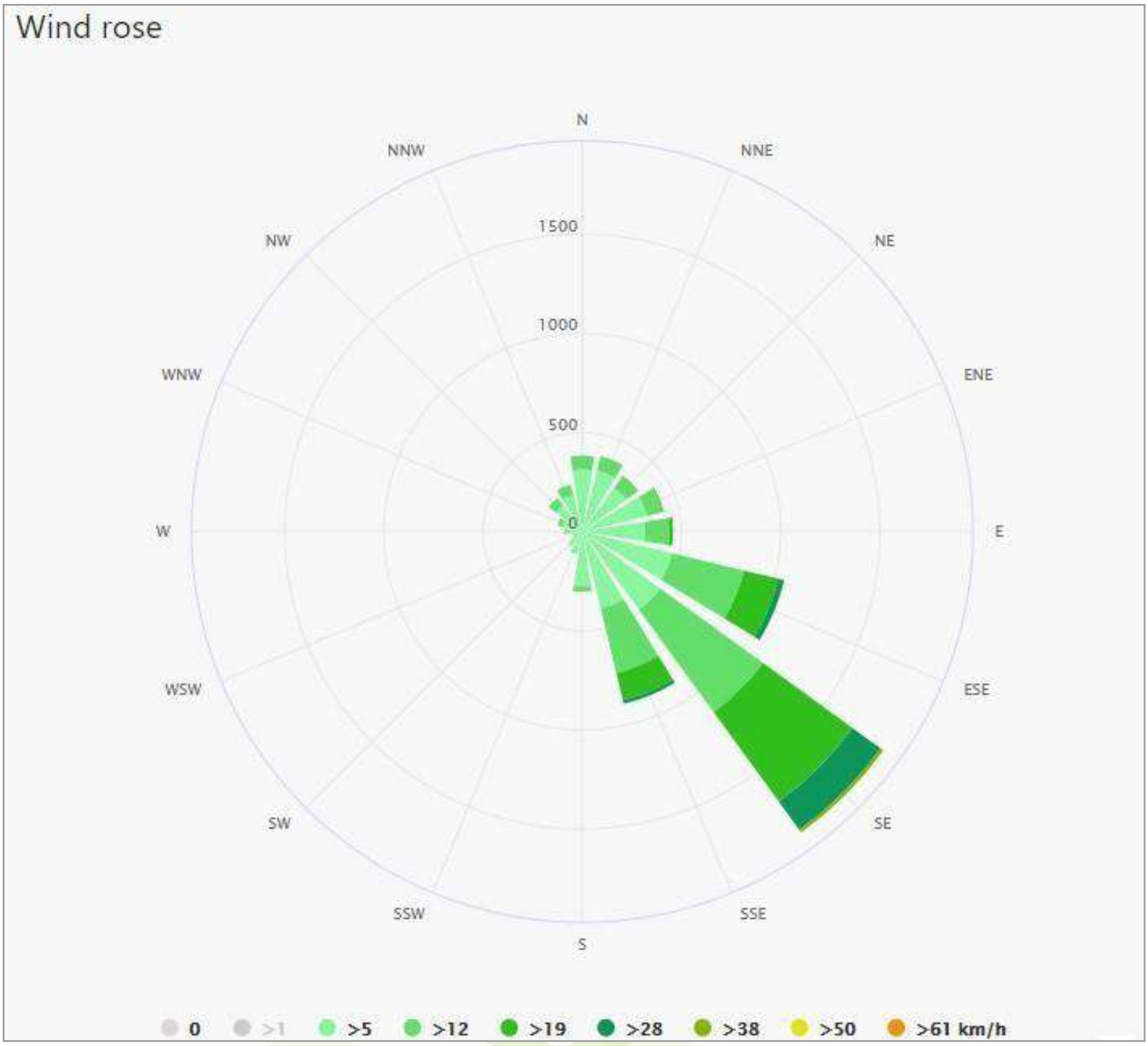


Figure 9: NEMS 30 km simulation model wind rose for the proposed Giyani project area for the period 1985 to current.

3.2.4 Atmospheric Stability

The tendency of the atmosphere to resist or enhance vertical motion and thus turbulence is termed atmospheric stability. Stability is related to both the change of temperature with height and wind speed. A neutral atmosphere neither enhances nor inhibits mechanical turbulence. An unstable atmosphere enhances turbulence, whereas a stable atmosphere inhibits mechanical turbulence. The turbulence of the atmosphere is the most important parameter affecting dilution of air pollution as the more unstable the atmosphere, the greater the dilution of air pollution.

Atmospheric stability is commonly categorised into six stability classes as per Table 6 below. The atmospheric boundary layer is usually unstable during the day due to turbulence caused by the sun's heating effect on the earth's surface. The depth of this mixing layer depends mainly on the amount of solar radiation, increasing in size gradually from sunrise to reach a maximum at about 5 - 6 hours after sunrise. The degree of thermal turbulence is increased on clear warm days with light winds. During the night-time a stable layer, with limited vertical mixing, exists. During windy and/or cloudy conditions, the atmosphere is normally neutral.

Table 6: Atmospheric Stability Classes

A	Very unstable	calm wind, clear skies, hot daytime conditions
B	Moderately unstable	clear skies, daytime conditions
C	Unstable	moderate wind, slightly overcast daytime conditions
D	Neutral	high winds or cloudy days and nights
E	Stable	moderate wind, slightly overcast night-time conditions
F	Very stable	low winds, clear skies, cold night-time conditions

A neutral atmospheric potential neither enhances nor inhibits mechanical turbulences. Unstable atmospheric condition enhances turbulence, whereas stable conditions inhibit mechanical turbulence as seen in Table 6.

3.2.5 Temperature

Temperature affects the formation, action, and interactions of pollutants in various ways (Kupchella and Hyland, 1993). Chemical reaction rates tend to increase with temperature and the warmer the air, the more water it can hold and hence the higher the humidity. When relative humidity exceeds 70%, light scattering by suspended particles begins to increase, as a function of increased water uptake by the particles (CEPA / FPAC Working Group, 1999). This results in decreased visibility due to the resultant haze. Many pollutants may dissolve in water to form acids. Temperature also provides an indication of the rate of development and dissipation of the mixing layer.

Based on an evaluation of the meteorological data simulations run from the global NEMS weather model at ~30 km resolution from 1985 to current of the project area. The following deductions can be made from Figure 10; in the summer months' maximum average daily temperatures are predicted to be 27°C - 30°C on average with a maximum of 38°C possible during hot days, dropping to a predicted 15°C - 20°C on average at night and 11°C minimum on cold nights. During winter months the average day time temperature are predicted in the 23°C - 25°C range while cold winter night time temperatures predicted to drop to 6°C.

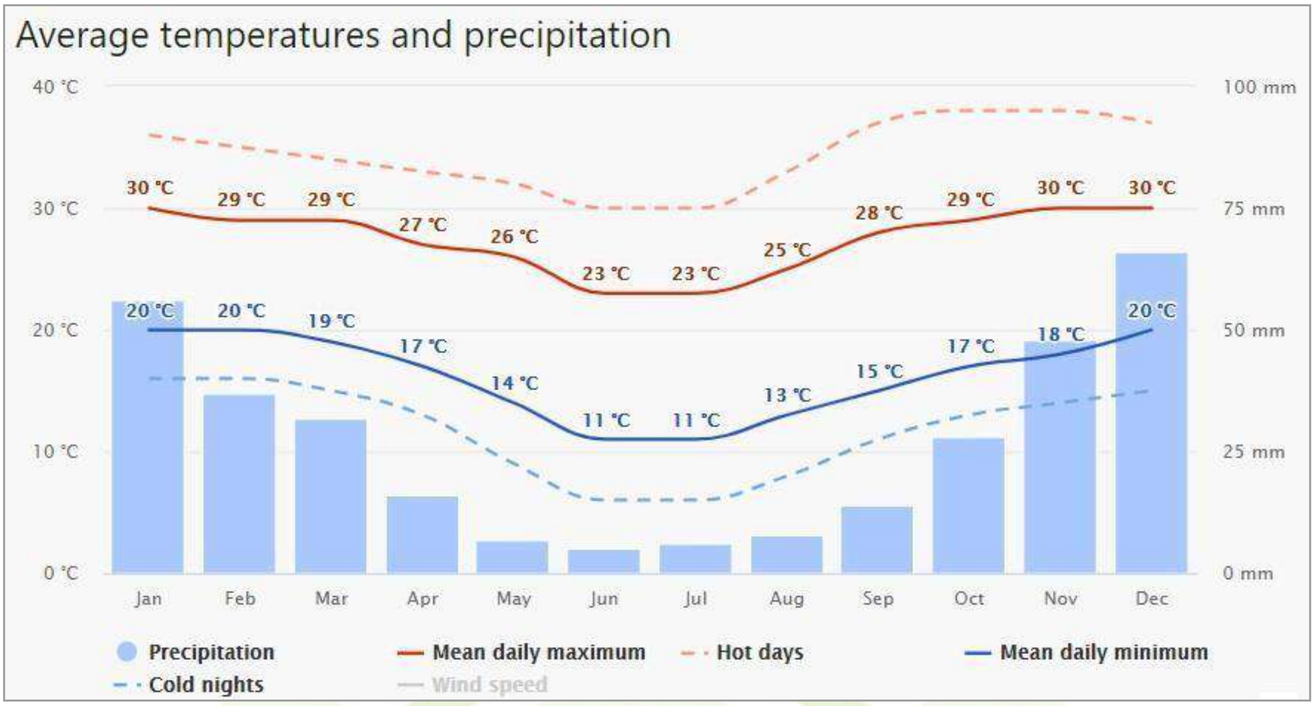


Figure 10: Temp and precipitation simulation results from the NEMS model for the Giyani project area (1985 - current).

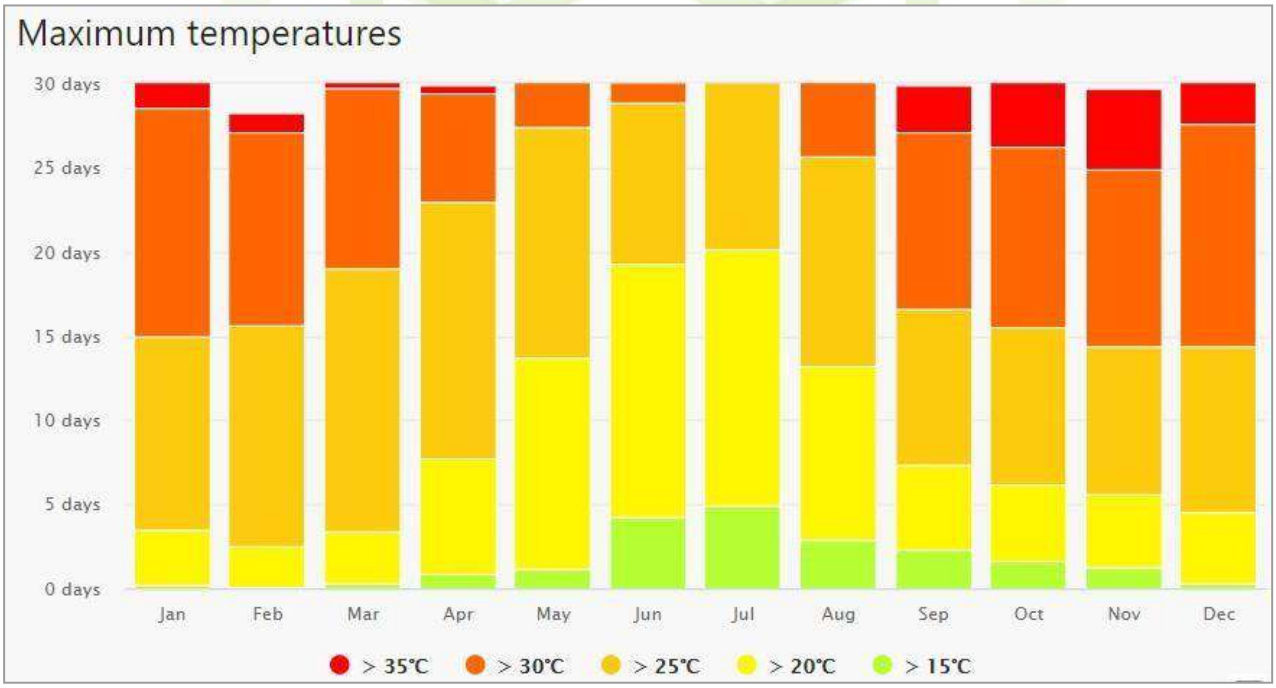


Figure 11: Maximum temperatures as simulated from the NEMS 30 km model for the proposed Giyani project area (1985 – current).

3.2.6 Precipitation

Precipitation cleanses the air by washing out particles suspended in the atmosphere (Kupchella & Hyland, 1993). It is calculated that precipitation accounts for about 80-90% of the mass of particles removed from the atmosphere (CEPA/FPAC Working Group, 1999).

Falling in a summer rainfall area, the location is predicted to receive the most precipitation in the summer months of October - March overall as can be seen in Figure 10. November - January are predicted the highest rainfall months with between 48-66mm predicted per month during these months. February, March and October is predicted to receive 28-37mm precipitation. All other months are predicted to receive less than < 16mm precipitation on average during the month.

The total precipitation days predicted at the Giyani project area is shown in Figure 12 below.

The highest precipitation days are predicted during the months of October - March. During these months' precipitation is predicted to only occur 9-13 days on average. The rest of the year precipitation is predicted to occur less than 6 days per month.

Figure 12: Day count of total daily precipitation per month for the proposed Giyani project area for the period 1985 – current.

3.2.7 Winds Speed, Temperature and Precipitation Validation

To validate the NEMS model simulation results, only weather stations with more than 10 years' consistent data are considered for validation. The validation is thus not necessarily the closest station with actual measured data but rather the closest reliable station. The measurements from the chosen station is then aggregated on a weekly or monthly data. Figure 13 show the closest station to the proposed Giyani project area that fall within the validation criteria as stated above, in this case Toyandou, 41km away with the project site at an altitude difference of 143m. The recorded data show good correlation in respect to temperature and wind speed. No precipitation comparison was made.

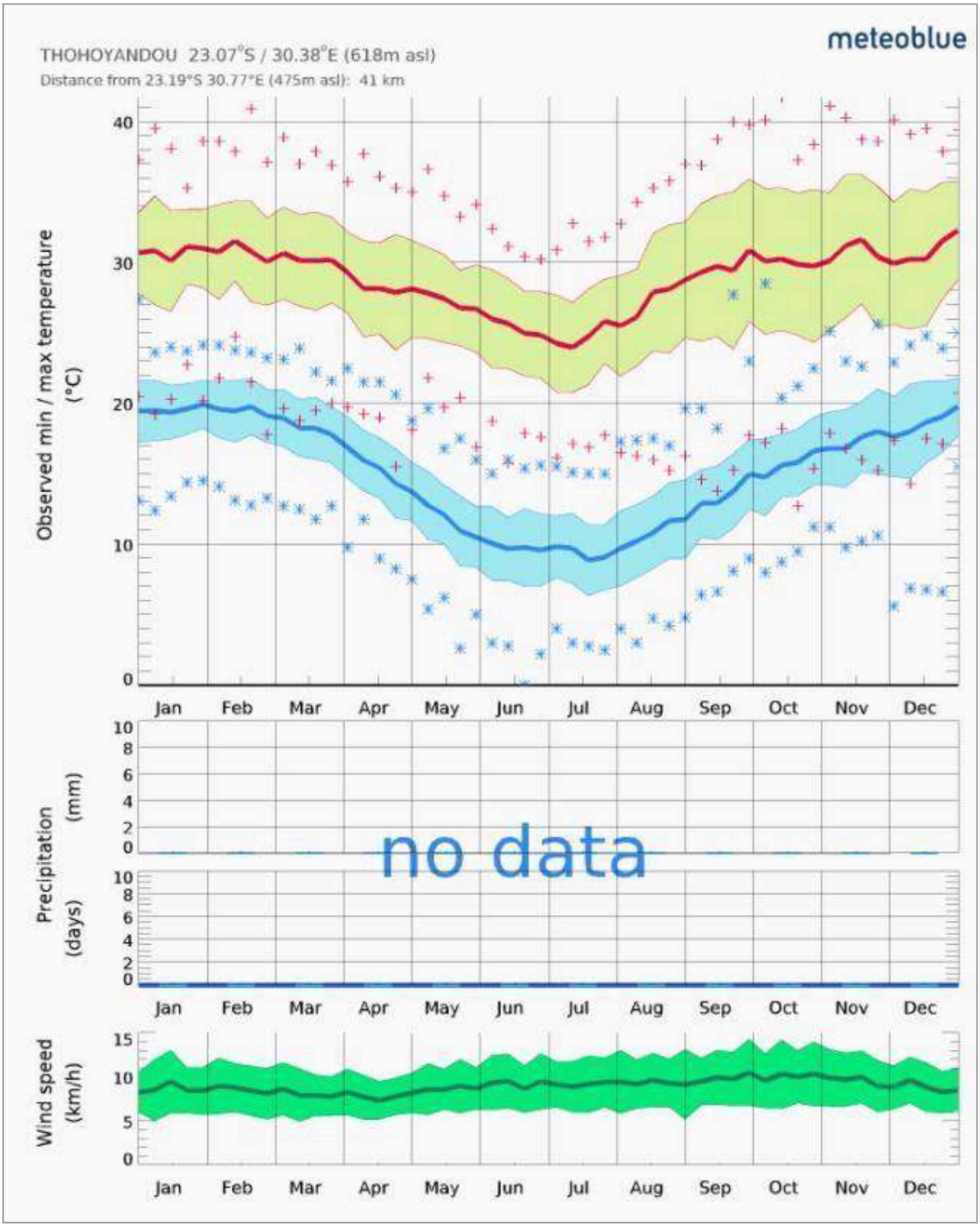


Figure 13: Measurement data for the closest measurement location with enough data to verify the NEMS model result.

4. OVERVIEW

The National Environmental Management: Air Quality Act, Act No. 39 of 2004 is in the process of replacing, and has to a large extent already replaced, the Atmospheric Pollution Prevention Act (APPA), Act 45 of 1965. The Air Quality Act requires a shift from source-based air pollution control to a receiving environment, air quality management approach. Key features of the new approach to air quality governance include:

1. Decentralisation of air quality management responsibilities.
2. A requirement that all significant sources be identified, quantified and addressed.
3. Setting of ambient air quality targets as goals to achieve emission reductions.
4. Recognition of source-based, command-and-control measures (i.e. authorities set source requirements and emission limits requiring adherence by responsible parties), in addition to alternative measures, including market incentives and disincentives, voluntary programmes, and education and awareness.
5. Promotion of cost-optimised mitigation and management measures.
6. Required air quality management planning by authorities and emission reduction and management planning by sources.
7. Access to information and public consultation.
8. The new approach has significant implications for government, business and civil society.

This report and investigation aims to identify potential air quality impacts as a result of the proposed operations and therefore propose management and mitigation measures to mitigate the impact. This assessment forms part of the environmental impact assessment phase of this investigation and will focus on the impacts from the proposed mine in order to provide a better understanding of the magnitude of these impacts.

As a summary the following proposed activities related to air emissions will be established and executed and are associated with the Giyani project:

1. Site preparation;
2. Opencast mining;
3. Wind-blown emissions from Stockpiles;
4. Materials handling;
5. Material movement via Haul Roads;
6. Mine closure and rehabilitation.

4.1 Particulate Matter

Particulate matter (PM) is the collective name for fine solid or liquid particles added to the atmosphere by processes at the earth's surface. PM includes dust, smoke, pollen and soil particles (Kemp, 1998). PM has been linked to a range of serious respiratory and cardiovascular health problems. The key effects associated with exposure to ambient particulate matter include: premature mortality, aggravation of respiratory and cardiovascular disease, aggravated asthma, acute respiratory symptoms, chronic bronchitis, decreased lung function, and an increased risk of myocardial infarction (USEPA, 1996).

PM can principally be characterised as discrete particles spanning several orders of magnitude in size, with inhalable particles falling into the following general size fractions (USEPA, 1996):

1. PM10 (generally defined as all particles equal to and less than 10 microns in aerodynamic diameter; particles larger than this are generally not deposited in the lung);
2. PM2.5, also known as fine fraction particles (generally defined as those particles with an aerodynamic diameter of 2.5 microns or less);

3. PM10-2.5, also known as coarse fraction particles (generally defined as those particles with an aerodynamic diameter greater than 2.5 microns, but equal to or less than a nominal 10 microns); and
4. Ultra-fine particles generally defined as those less than 0.1 microns.

Particles can be classified by their aerodynamic properties into coarse particles, PM10 (particulate matter with an aerodynamic diameter of less than 10 µm) and fine particles, PM2.5 (particulate matter with an aerodynamic diameter of less than 2.5 µm) (Harrison and van Grieken, 1998). The fine particles contain the secondarily formed aerosols such as sulphates and nitrates, combustion particles and re-condensed organic and metal vapours. The coarse particles contain earth crust materials and fugitive dust from roads and industries (Fenger, 2002).

Fine and coarse particles are distinct in terms of the emission sources, formation processes, chemical composition, atmospheric residence times, transport distances and other parameters. Fine particles are directly emitted from combustion sources and are also formed secondarily from gaseous precursors such as sulphur dioxide, nitrogen oxides, or organic compounds. Fine particles are generally composed of sulphate, nitrate, chloride and ammonium compounds, organic and elemental carbon, and metals. Combustion of coal, oil, diesel, gasoline, and wood, as well as high temperature process sources such as smelters and steel mills, produce emissions that contribute to fine particle formation. Fine particles can remain in the atmosphere for days to weeks and travel through the atmosphere hundreds to thousands of kilometres, while coarsest particles typically deposit to the earth within minutes to hours and within tens of kilometres from the emission source.

Some scientists have postulated that ultra-fine particles, by virtue of their small size and large surface area to mass ratio may be especially toxic. There are studies that suggest these particles may leave the lung and travel through the blood to other organs, including the heart. Coarse particles are typically mechanically generated by crushing or grinding and are often dominated by resuspended dusts and crustal material from paved or unpaved roads or from construction, farming, and mining activities (USEPA, 1996).

In terms of health impacts, particulate air pollution effects are broad, but are predominately associated with effects of the respiratory and cardiovascular systems (WHO, 2005). Particle size is important for health because it controls where in the respiratory system a given particle deposits. Fine particles have been found to be more damaging to human health than coarse particles as larger particles are less respirable in that they do not penetrate deep into the lungs compared to smaller particles (Manahan, 1991). Larger particles are deposited into the extra thoracic part of the respiratory tract while smaller particles are deposited into the smaller airways leading to the respiratory bronchioles (WHO, 2000).

A study by Pope and Burnett (2002) indicated that PM2.5 leads to high plaque deposits in arteries, causing vascular inflammation and atherosclerosis (Kaonga and Kgabi, 2009). No evidence of a threshold in the relationship between particulate concentrations and adverse human health effects has been determined (Burger and Scorgie, 2000a; Burger and Scorgie 2000b; WHO 2005).

4.1.1 Short-Term Exposure

Recent studies suggest that short-term exposure to particulate matter leads to adverse health effects, even at low concentrations of exposure (below 100 µg/m³). Morbidity effects associated with short-term exposure to particulates include increases in lower respiratory symptoms, medication use and small reductions in lung function.

4.1.2 Long-Term Exposure

Long-term exposure to low concentrations (~10 µg/m³) of particulates is associated with mortality and other chronic effects such as increased rates of bronchitis and reduced lung function (WHO, 2000). Those most at risk include the elderly, individuals with pre-existing heart or lung disease, asthmatics and children; with an increased risk associated with an increase in exposure (WHO 2005).

4.1.3 Nuisance Dust

Nuisance dust may be defined as coarse fraction of airborne particulates. Nuisance dust is known to result in the soiling of materials and has the potential to reduce visibility. Nuisance dust has a long history of having little adverse effect on the lungs. Any reaction that may occur from nuisance dust is potentially reversible. However, excessive concentrations of nuisance dust in the workplace may reduce visibility, may cause unpleasant deposits in eyes, nasal passages and may cause injury to the skin or mucous membranes by the chemical or mechanical action. The light is scattered and visibility is diminished by the atmospheric particulate.

Various costs are associated with the loss of visibility, including: the need for artificial illumination and heating; delays, disruption and accidents involving traffic; vegetation growth reduction associated with reduced photosynthesis; and commercial losses associated with aesthetics. The soiling of building and materials due to dust frequently gives rise to damages and costs related to the increased need for washing, cleaning and repainting. Dustfall may also impact negatively on sensitive industries, e.g. bakeries or textile industries. Certain elements in dust may damage materials. For instance, it was found that sulphur and chlorine if present in dust may cause damage to copper (Maeda et al., 2001).

Nuisance dust can also cause serious aesthetic deterioration in the surrounding environment and communities. Fortunately, due to relatively large particulate matter sizes associated with the mining emissions and the relatively short release height of the pollutants, such negative impacts are usually confined in relatively small areas. Within these areas of impact, fugitive dust may result in damage to the vegetation and agriculture. The deposited particulate matter may block the plant leaf stomata hence inhibit gas exchange, or smother the plant leaf surfaces reducing photosynthesis levels. Besides the impacts on vegetation, health effects of particulates on mine personnel and public may also be significant.

Air pollution is a recognized health hazard for man and domestic animals (Newman et al., 1979). Air pollutants have had a worldwide effect on both wild birds and wild mammals, often causing decreases in local animal populations (Newman et al., 1979). The major effects of industrial air pollution on wildlife include direct mortality, debilitating industrial-related injury and disease, physiological stress, anaemia, and bioaccumulation. Some air pollutants have caused a change in the distribution of certain wildlife species.

4.2 The Importance of Managing Dust

Managing dust from mines is important as it can impact local and regional air quality, adversely affect local amenity and pose a risk to public health.

4.3 Protecting Local And Regional Air Quality

An important aspect of the protection of air quality from mining operations is to minimise dust generated from sources such as wind erosion, crushing & screening, vehicles using unsealed roads and blasting. Mines are required by the National Environmental Management Air Quality Act to meet certain criteria for ambient air quality. In order to meet these criteria, mines must manage the emissions of dust from their activities in a competent manner.

4.3.1 Community Health

Health impacts of mine dust vary depending on the nature of the particles, their origin and their size, which is measured as particulate matter (PM). Exposure to fine particles can have potential health impacts on the respiratory system. Infants and children, elderly people, people with existing respiratory conditions, heart disease or diabetes may be more susceptible to the health effects from fine and coarse particles. Mines must be operated with proper dust controls to ensure that people are not affected by the dust generated.

4.3.2 Community Amenity

If not properly managed, dust from mines can be a nuisance to local communities. Nuisance dust usually has a particle size larger than 10 microns (gravimetric dust fallout). High levels of nuisance dust may reduce visibility and amenity. The presence of nuisance dust can also cause a perceived increase in health risk. The impact of dust from mines on local amenity depends on the distance from the mine site and climatic conditions including wind speed and direction. Concerns about amenity from mine site dust often relate to the 'visibility' of dust plumes and dust sources. Visible dust is usually due to short-term episodes of high emissions, such as blasting. Other amenity impacts include dust depositing on fabrics (such as washing) or on house roofs, and dust transported from roofs to water tanks during rain.

5. RELEVANT LEGISLATION, GUIDELINES AND STANDARDS

5.1 National Environmental Management: Air Quality, 2004 (Act 39 Of 2004)

The National Environmental Management: Air Quality Act 39 of 2004 shifted the approach of air quality management from source-based control to receptor-based control. The Act made provision for National ambient air quality standards, however it is generally accepted that more stringent standards can be established at the Provincial and Local levels. Emissions are controlled through the listing of activities that are sources of emission and the issuing of emission licences for these listed activities. Atmospheric emission standards have been established for each of these activities and an atmospheric licence is now required to operate.

The issuing of emission licences for Listed Activities will be the responsibility of the Metropolitan and District Municipalities. Municipalities are required to 'designate an Air Quality Officer to be responsible for co-ordinating matters pertaining to air quality management in the Municipality'. The appointed Air Quality Officer will be responsible for the issuing of atmospheric emission licences or the Air Quality Officer could delegate the responsibility to the Director of Community Environmental Services.

According to the Act, the Department of Environmental Affairs) (DEA), the provincial environmental departments and local authorities (district and local municipalities) are separately and jointly responsible for the implementation and enforcement of various aspects of NEM: AQA. Each of these spheres of government is obliged to appoint an Air Quality Officer and to co-operate with each other and co-ordinate their activities through mechanisms provided for in the National Environment Management Act, 1998 (Act 107 of 1998) (NEMA).

The purpose of NEM: AQA is to set norms and standards that relate to:

- Institutional frameworks, roles and responsibilities;
- Air quality management planning;
- Air quality monitoring and information management;
- Air quality management measures; and
- General compliance and enforcement.

5.1.1 National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004) - National Dust Control Regulations (Government Gazette No. 36794 - No. R 827)

The National Dust Control Regulations were published on 1 November 2013, in terms of the National Environmental Management Air Quality Act, which prescribes general measures for the control of dust.

Table 7: Dust Fallout permitted rates

Restriction Areas	Dust Fall Rate (mg/m³/day - 30 day average)	Permitted Frequency of exceeding dust fall rate
Residential Areas	D < 600	2 within a year, not sequential months.
Non-Residential Area	600 < D < 1200	2 within a year, not sequential months.

According to regulations, any person conducting any activity in such a way that would give rise to dust in quantities and concentrations that exceeded the dustfall standard set out in the regulation was impelled to, upon receipt of a notice from an air quality officer, implement a dustfall monitoring programme.

The method to be used for measuring the dustfall rate and the guideline for locating sampling points would be the American Standards for Testing and Materials method, or an equivalent method approved by any internally recognised body.

The regulation further stated that an Air Quality Officer could require any person, through a written notice, to undertake a dustfall monitoring programme if the officer reasonably suspected that the person was contravening the regulations or that the activity being conducted required a fugitive dust emission management plan. A person required to implement the programme must then, within a specified period, submit a dustfall monitoring report to the air quality officer. A dustfall monitoring report must provide information on the location of sampling sites, classification of the area where samplers were located, as well as reference to the standard methods used for site selection, sampling and analysis.

The report would also be required to provide meteorological data for the sampling area, the dustfall monitoring results, including a comparison of current year and historical results for each site, as well as a tabular summary of compliance with the dustfall standard. Any person that had exceeded the dustfall standard must, within three months after submission of the dustfall monitoring report, develop and submit a dustfall management plan to the Air Quality Officer for approval. This management plan must identify all possible sources of dust within the affected site, detail the best practicable measures to be undertaken to mitigate dust emissions, identify the line management responsible for implementation and incorporate the dust fallout monitoring plan. Such a plan would need to be implemented within a month of the date of approval and an implementation progress report must be submitted to the Air Quality Officer at agreed time intervals.

5.1.2 Legislation for Local Government

The Local Government: Municipal Systems Act 32 of 2000, together with the Municipal Structures Act 117 of 1998, establishes local government as an autonomous sphere of government with specific powers and functions as defined by the Constitution. Section 155 of the Constitution provides for the establishment of Category A, B and C municipalities each having different levels of municipal executive and legislative authorities. According to Section 156(1) of the Constitution, a municipality has the executive authority in respect of, and has the right to, administer the local government matters (listed in Part B of Schedule 4 and Part B of Schedule 5) that deal with air pollution.

5.1.3 Ambient Air Quality Guidelines and Standards

Guidelines provide a basis for protecting public health from adverse effects of air pollution and for eliminating, or reducing to a minimum, those contaminants of air that are known or likely to be hazardous to human health and well-being (WHO, 2000). Once the guidelines are adopted as standards, they become legally enforceable. The South African Bureau of Standards (SABS), in collaboration with DEA, established ambient air quality standards for gravimetric dust fallout and is listed in the Table 8 below.

5.2 South African National Standard - SANS 1929:2011

5.2.1 Ambient Air Quality - Limits for Common Pollutants

Table 8: Limits for PM10 in ug/m³

Average period	Concentration (µg/m³)	Frequency of exceedances
Target		
24 h	75	4
1 year	40	0

Table 9: Four-band scale evaluation criteria for dust deposition in mg/m²/day

Band Number	Band Description Label	Dust Fall Rate (mg/m²/day - 30 day average)	Comment
1	Residential	D < 600	Permissible for residential and light commercial.
2	Industrial	D < 1200	Permissible for heavy commercial and industrial.
3	Action	1200 < D < 2400	Requires investigation and remediation if two sequential months lie in this band, or more than three occur in a year.
4	Alert	D > 2400	Immediate action and remediation required following the first incidence of the dustfall rate being exceeded. Incident report to be submitted to the relevant authority.

Table 10: Target, action and alert thresholds for dust deposition in mg/m²/day

Level	Dust Fall Rate (mg/m²/day - 30 day average)	Average Period	Permitted frequency of exceeding dustfall rate
Target	300	Annual	
Action Residential	600	30 days	2 within any year, no 2 sequential months.
Action Industrial	1 200	30 days	2 within any year, not sequential months.
Alert Threshold	2 400	30 days	None. First incidence of dustfall rate being exceeded requires remediation and compulsory report to the relevant authorities.

6. METHODOLOGY

At the time of this report no monitoring campaign exist for the proposed Giyani project. It is recommended that at least a baseline dust monitoring campaign be run before the commencement of the project. The samples can then be compared to the guidelines and standards as well as the modelling results while giving attention to the relevant referencing sites of a similar nature in the vicinity of the proposed project area to determine the impacts that have been experienced before.

Passive Sampling in the form of Dust Buckets lack crucial information such as wind direction to determine the direction of the source of the emissions. To help fill this lack of information, Eco-E developed a cost effective solution that incorporates the latest technology to offer a real time indicative monitoring solution to help in the management of dust emissions. Passive, active and real-time sampling techniques to be used for the baseline determination is explained below.

6.1 Passive Sampling

At the time of this report, no passive sampling campaign do exist for the proposed Giyani project. It is highly recommended that a passive sampling campaign be run before the commencement of the project. Below is the features of a passive sampling campaign:

At each gravimetric dust fallout gauge/receptor point there is a stand built according to specification containing the dust sample collection bucket. Samples are collected after a 1 month running period (+-30 day's exposure). After sample collection, the samples are taken to the relevant SANAS accredited laboratory as required. A visual site investigation is done where after correlations are drawn and findings identified and reported on.

Dust buckets of a standard size and shape are prepared and set up at locations related to the eight main compass points on the borders of the property so that dust can settle in them for periods of 30 +/-2 days. The dust buckets are then sealed and replaced with new empty ones and send away to the SANAS accredited laboratory for analysis. The masses of the water-soluble and -insoluble components of the material collected are then determined and results are reported as $mg/m^2/day$. This methodology is described according to South African National Standards 1929:2004 and the American Society for Testing and Materials (ASTM) Designation: D 1739-98 (2010). The results for this method of testing are obtained by gravimetrical weighing. The apparatus required include open top buckets/containers not less than 150 mm in diameter with a height not less than twice its diameter. The buckets must be placed on a stand at a height of 2 +/-0.2 m above the ground.

6.2 Active Sampling

For the Active Sampling the new DUSTTRAK II Dust Monitor can be used is a battery-operated, data-logging, light-scattering laser photometer that gives you real-time aerosol mass readings. This active sampling machine uses a sheath air system that isolates the aerosol in the optics chamber to keep the optics clean for improved reliability and low maintenance. Site layout for the sampling points has been carried out according to the eight main compass directions; the site layout and equipment placement is done in accordance with the ASTM standard, D 1739 - 2010, thereafter relevant sampling reference numbers were allocated to the receptors accordingly.

6.3 Indicative Sampling

New technology to perform cost effective real-time dust and particulate matter is currently becoming a cost-effective option. This type of technology can record real-time wind speed and direction together with particulate concentrations. It can thus be used more effectively for management purposes. Actionable intelligence is generated on dust and particulate matter emissions, which in turn can then be used to determine the origin of the particulate emissions. In a scenario where operations are situated in close proximity to each other and residential areas, this type of technology can become instrumental in decision making on the management of dust for a mining operation

EcoE developed a cost effective, MCERTS certified (refer to Figure 19), Remote Active Indicative Real-Time Particulate Matter Dust Monitoring solution;

- This particular service offering is backed up and supported by a team of experienced Environmental Scientists, Electronic and Information Technology Engineers.

- Our dust monitoring stations are proudly manufactured in-house in South Africa. See Figure 14 for a typical field node.
- The design allows to have full remote telemetry with real-time live feed alerts for corrective actions.
- Stations incorporate sensors for single or simultaneously Particulate Matter fraction measurements ranging from Pm_1 to Pm_{10}
- In addition to this the stations also include weather sensors to ensure ease of integrated data interpretation, analysis and future predictive modelling.
- Units are wireless, mobile and solar powered with built in battery banks, to allow the stations to run for up to 10 days during inclement weather.
- Data is pushed via FTP to our secure cloud-based server, or can be viewed/accessed via any web-enabled device on our remote monitoring data portal as can be seen in Figure 15.
- A network of nodes can be utilized to better understand the specific operation emissions and assist in managing the emissions.

Further analysis of the data include, but not limited to:

- Trend Analysis to determine trends in the particulate emissions and assist in when extra mitigation measures and specific operations should occur to limit dust emission. (Figure 16)
- Polar plots to determine at what wind direction and speed higher emissions occur to help determine if exceedances recorded by compliance instruments are from neighbouring sites or the project site. (Figure 17)
- Site specific weather data to help in management decision making on mitigation measure increases during certain hours of the day or night. (Figure 18)

Figure 14: Real Time Indicative Monitor field node

Figure 15: Typical Real-Time Ambient Particulate Matter monitoring dashboard communication interface

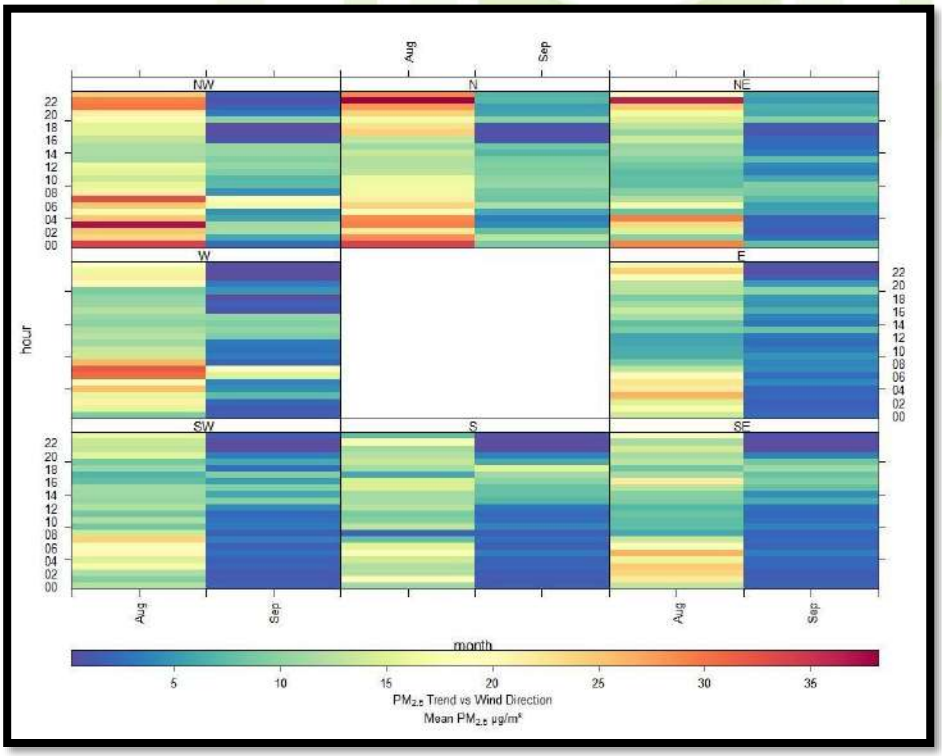


Figure 16: Trend Analysis showing trends in higher emissions at specific hours and wind direction.

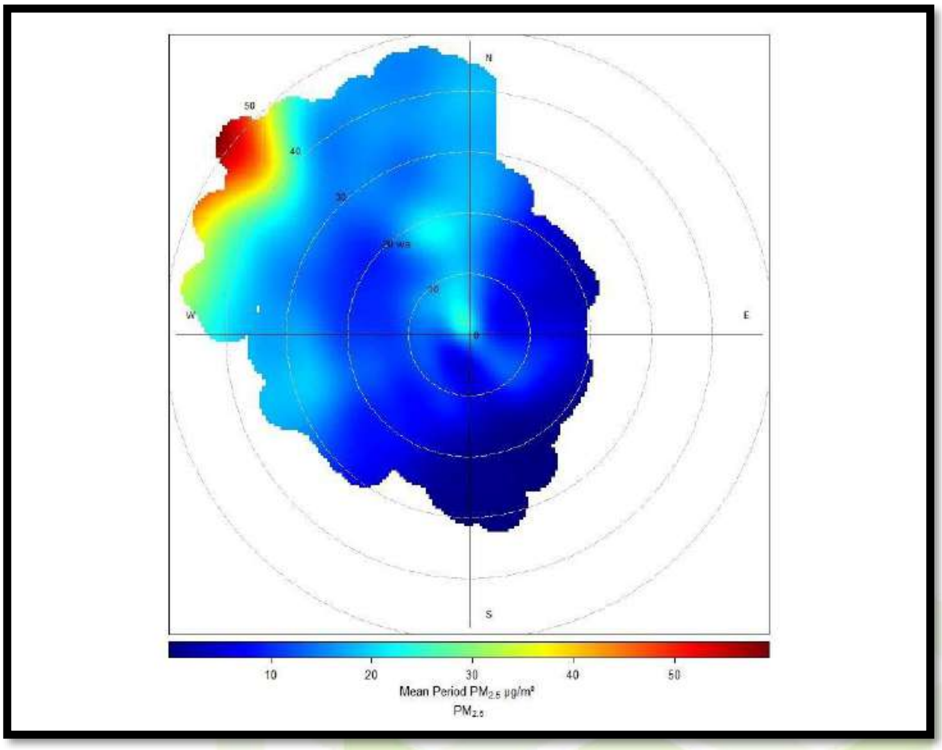


Figure 17: Polar Plot indicating higher emissions at higher windspeeds from the north-west.

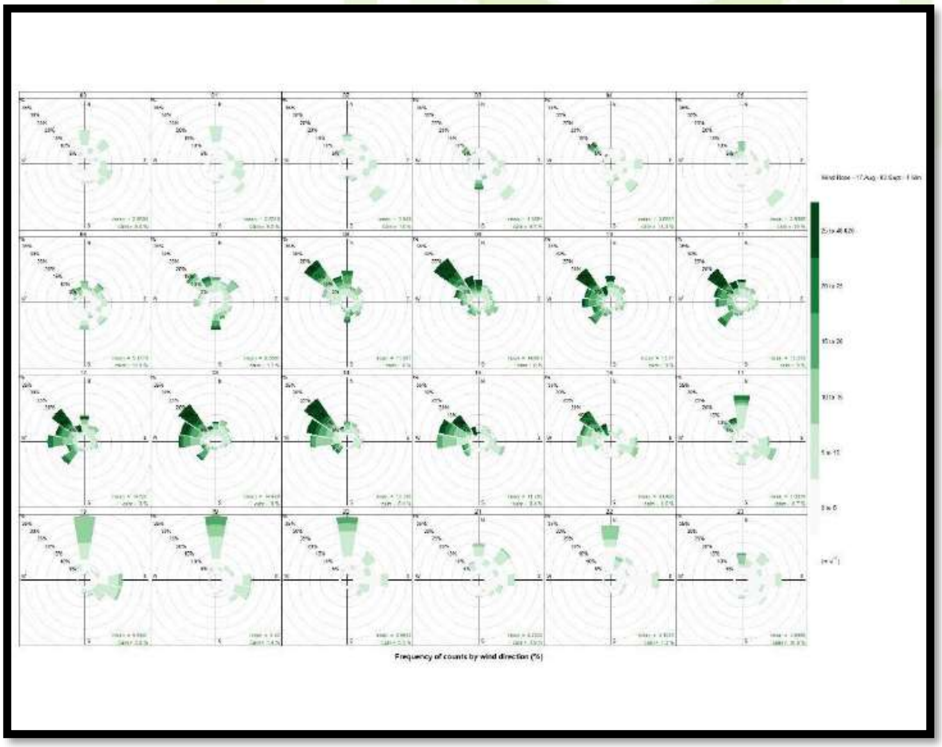
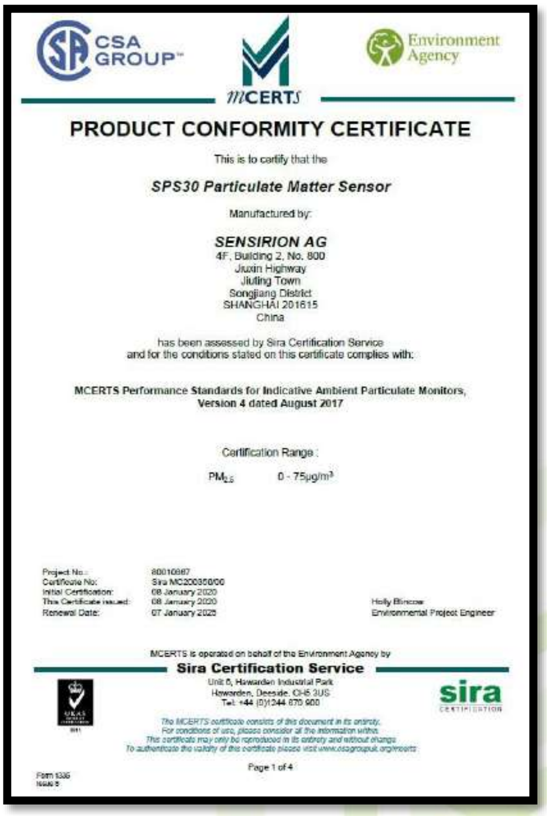


Figure 18: Hourly average wind roses to assist in decision making.



CSA GROUP™ · MCERTS · Environment Agency

PRODUCT CONFORMITY CERTIFICATE

This is to certify that the

SPS30 Particulate Matter Sensor

Manufactured by:

SENSIRION AG
4F, Building 2, No. 800
Juxin Highway
Jiuting Town
Songjiang District
SHANGHAI 201615
China

has been assessed by Sira Certification Service
and for the conditions stated on this certificate complies with:

MCERTS Performance Standards for Indicative Ambient Particulate Monitors, Version 4 dated August 2017

Certification Range :

$PM_{2.5}$ 0 - 75µg/m³

Project No.:	80010867
Certificate No:	Sira MC200350/00
Initial Certification:	08 January 2020
This Certificate issued:	08 January 2020
Renewal Date:	07 January 2025

Holly Blincow
Environmental Project Engineer

MCERTS is operated on behalf of the Environment Agency by
Sira Certification Service
Unit 6, Hawarden Industrial Park
Hawarden, Deeside, CH5 3US
Tel: +44 (0)1244 670 900

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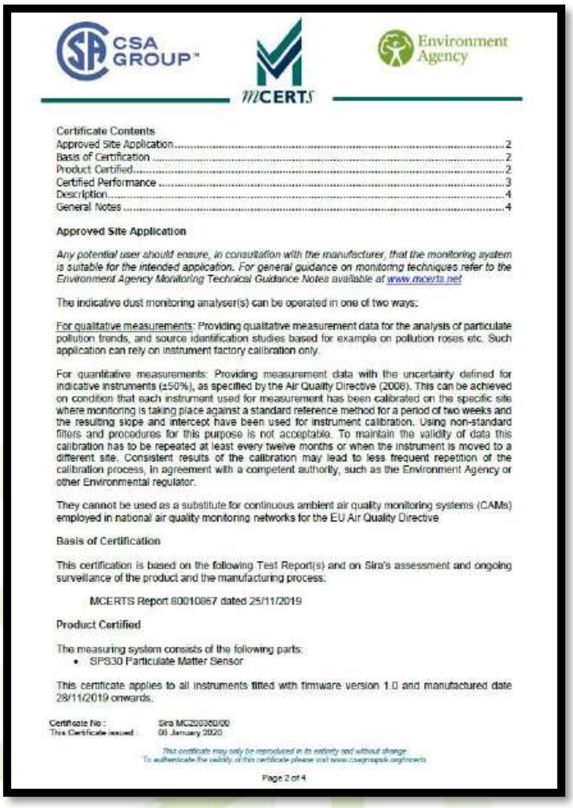

CSA GROUP™ · MCERTS · Environment Agency

Certificate Contents

Approved Site Application

Any potential user should ensure, in consultation with the manufacturer, that the monitoring system is suitable for the intended application. For general guidance on monitoring techniques refer to the Environment Agency Monitoring Technical Guidance Notes available at www.mcerts.net

The indicative dust monitoring analyser(s) can be operated in one of two ways:

For qualitative measurements: Providing qualitative measurement data for the analysis of particulate pollution trends, and source identification studies based for example on pollution roses etc. Such application can rely on instrument factory calibration only.

For quantitative measurements: Providing measurement data with the uncertainty defined for indicative instruments (±50%), as specified by the Air Quality Directive (2008). This can be achieved on condition that each instrument used for measurement has been calibrated on the specific site where monitoring is taking place against a standard reference method for a period of two weeks and the resulting slope and intercept have been used for instrument calibration. Using non-standard filters and procedures for this purpose is not acceptable. To maintain the validity of data this calibration has to be repeated at least every twelve months or when the instrument is moved to a different site. Consistent results of the calibration may lead to less frequent repetition of the calibration process, in agreement with a competent authority, such as the Environment Agency or other Environmental regulator.

They cannot be used as a substitute for continuous ambient air quality monitoring systems (CAMs) employed in national air quality monitoring networks for the EU Air Quality Directive

Basis of Certification

This certification is based on the following Test Report(s) and on Sira's assessment and ongoing surveillance of the product and the manufacturing process:

MCERTS Report 80010867 dated 25/11/2019

Product Certified

The measuring system consists of the following parts:
- SPS30 Particulate Matter Sensor

This certificate applies to all instruments fitted with firmware version 1.0 and manufactured date 28/11/2019 onwards.

Certificate No.:	Sira MC200350/00
This Certificate issued:	08 January 2020

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To authenticate the validity of this certificate please visit www.csagroupuk.org/mcerts

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Figure 19: MCERTS Performance Standards for Indicative Ambient Particulate Monitors Certificate

6.4 Dispersion Model

Emission factors are quantified using the Australian National Pollutant Inventory (NPI) which is an improvement on the US Environmental Protection Agency (US.EPA) AP-42 document of Air Pollution Emission Factors for Australian conditions, for fugitive dust deriving from material handling, on-site roads, milling and crushing operations, drilling and blasting, and wind erosion from exposed surfaces. Various mitigation measures were incorporated into the project design as discussed in the emission factor section.

Dispersion models represents the most likely outcome of experimental results; it does not contain all the features of a real world system but contain the feature of interest for management of an issue. Gaussian plume models have an uncertainty range of between -50% to 200%.

There will always be some error in any geophysical model, the total uncertainty can be described as the sum of three components:

- Uncertainty due to errors in the model physics;
- Uncertainty due to data errors; and
- Uncertainty due to the atmospheric conditions.

6.4.1 Model Selection

Increasing reliance has been placed on estimates from models as the primary basis for environmental and health impact assessments. It is therefore important to carefully select a dispersion model for the purpose. Dispersion models compute ambient concentrations as a function of source configurations, and meteorological characteristics, providing a tool to calculate the spatial and temporal patterns in the ground level concentrations arising from the emissions of emissions sources.

Gaussian-plume models are best used for near-field applications where the steady-state meteorology assumption is most likely to apply. The most widely used Gaussian plume model is the US.EPA AERMOD model.

The regulatory model of the US.EPA, AERMET/AERMOD dispersion model suite, was chosen for the study. AERMET uses both surface and upper air data. The model also has a terrain pre-processor (AERMAP) for including a large topography into the model. The AERMET / AERMOD suite was developed with the support of the AMS/EPA Regulatory Model Improvement Committee (AERMIC), whose objective was to include state-of the-art science in regulatory models.

1. AERMOD is an advanced new-generation model. It is designed to predict pollution concentrations from continuous point, flare, area, line, and volume sources.
2. AERMET is a meteorological pre-processor for AERMOD. Input data can come from hourly cloud cover observations, surface meteorological observations and twice-a-day upper air soundings. Output includes surface meteorological observations and parameters and vertical profiles of several atmospheric parameters.
3. AERMAP is a terrain pre-processor designed to simplify and standardise the input of terrain data for AERMOD. Input data includes receptor terrain elevation data which are used for the computation of air flow around hills.

A disadvantage of the model is the range of uncertainty of the model predictions could to be -50% to 200% and spatial varying wind fields, due to topography or other factors cannot be included. The accuracy of the model improves with fairly strong wind speeds and during neutral atmospheric conditions.

The stochastic uncertainty includes all errors or uncertainties in data such as source variability, observed concentrations, and meteorological data. Model evaluation studies suggest that the data input error term is often a major contributor to total uncertainty. Even in the best tracer studies, the source emissions are known only with an accuracy of ±5%, which translates directly into a minimum error of that magnitude in the model predictions. It is also well known that wind direction errors are the major cause of poor agreement, especially for relatively short-term predictions (minutes to hourly) and long downwind distances. All of the above factors contribute to the inaccuracies not associated with the mathematical models themselves.

Input data required for the AERMOD model include:

- Source emissions and type data;

- Meteorological data (pre-processed by the AERMET model);
- Terrain data; and
- The receptor grid.

6.4.2 Meteorological Data

AERMOD requires two specific input files generated by the AERMET pre-processor. AERMET is designed to be run as a three-stage processor and operates on three types of data (upper air data, on-site measurements, and the national meteorological database).

Use was made of the WRF - AERMET ready Meteorological data for the period 1 January 2018 to 31 December 2020.

6.4.3 Source Data

AERMOD is able to model point, area, volume, pit and line sources. Wind erosion sources such as stockpiles and unpaved roads modelled as area sources. Material transfer points and crushing and screening were modelled as volume sources. With the input sources using factors applied to the emission as described in the Australian NPI.

6.4.4 Sensitive Receptor Grid

The pollutant dispersion is setup for a modelled domain of 20 km (north-south) by 20 km (east-west) with the centre of the proposed project area in the centre of the modelling domain. The area was divided into a variable grid with the following resolutions:

- 10 km from Centre:
  - 100 m (north-south) by 100 m (east-west).
- 5 km from boundary of first grid box:
  - 200 m (north-south) by 200 m (east-west).

6.4.5 Modelling Runs

Modelling was undertaken for two proposed operational phase scenarios.

1. Unmitigated - Material handled dry.
2. Mitigated - Mitigation measures applied as per Table 14.

The construction and decommissioning phases were qualitatively assessed.

6.4.6 Model Results

Dispersion modelling was undertaken to determine 2nd highest daily and annual average ground level concentrations (GLCs) for PM10 Total daily dust fallout rates were also simulated. These averaging periods are selected to draw comparisons between PM10 predicted concentrations / deposition with relevant air quality guidelines and dust fallout limits, respectively.

Isopleths plots are also generated, to visually display the interpolated values from the concentrations predicted by the model for each of the receptor grid points. Plots reflecting daily averaging periods contain only the 2nd highest predicted ground level concentrations for the daily concentration, over the entire period for which simulations were undertaken. It is therefore possible that even though a high hourly or daily average concentration is predicted at certain locations, this may only be true for one day during the modelling period.

7. BASELINE AIR QUALITY MEASUREMENT RESULTS

7.1 Discussion Of The Baseline Air Quality

7.1.1 Sensitive Receptors

Sensitive receptors identified in the immediate vicinity (Figure 20) of the study area and proposed project area have been listed below:

- The town of Giyani.

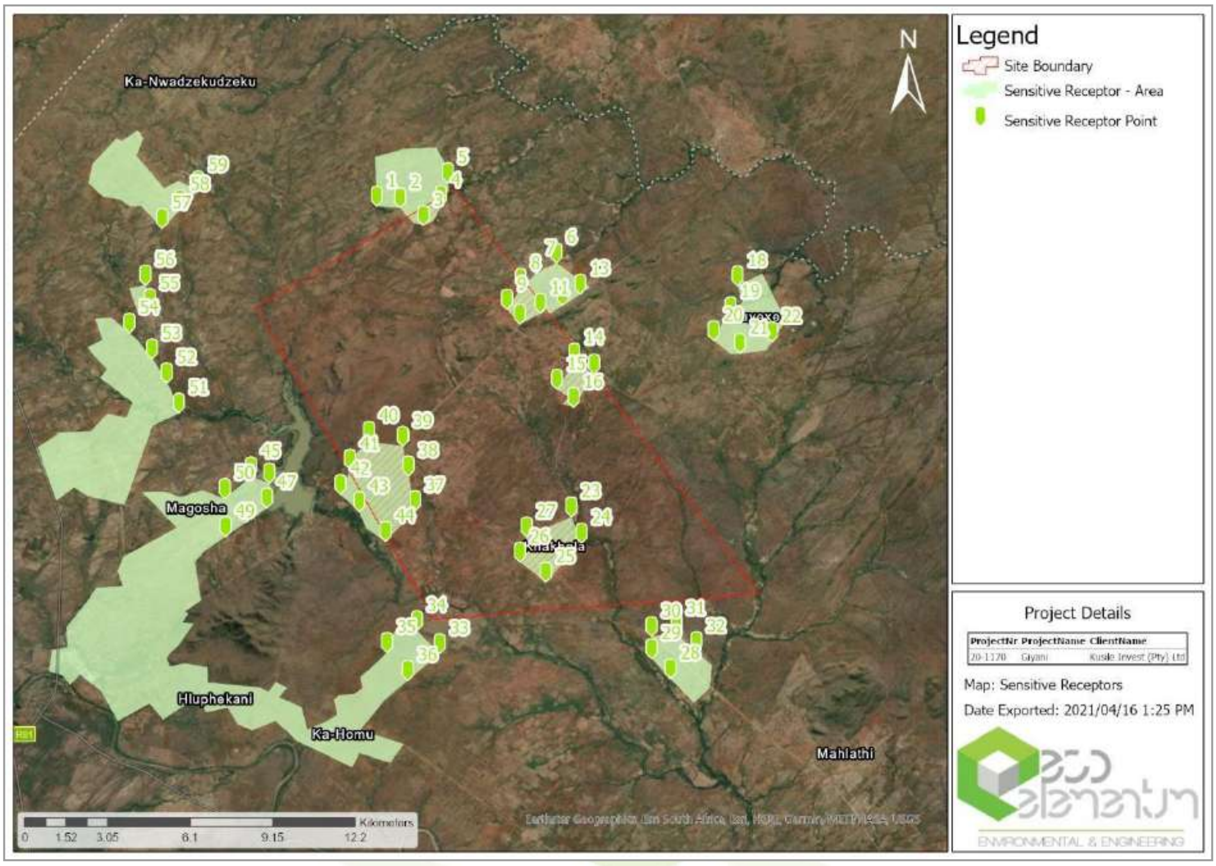


Figure 20: Sensitive receptors in the immediate area of the mining boundary.

7.1.2 Sources of Emissions

7.1.2.1 Vehicle Exhaust Gases

Vehicle exhausts contain a number of pollutants including carbon dioxide (CO^2), carbon monoxide (CO), hydrocarbons, oxides of nitrogen (NOx), sulphur and PM10. Tiny amounts of poisonous trace elements such as lead, cadmium and nickel are also present. The quantity of each pollutant emitted depends upon the type and quantity of fuel used, engine size, speed of the vehicle and abatement equipment fitted. Once emitted, the pollutants are diluted and dispersed in the ambient air. Pollutant concentrations in the air can be measured or modelled and then compared with ambient air quality criteria.

7.1.2.2 Veld Fires

Veld fires are widespread across the world, occurring in autumn, winter and early spring. In addition to controlled burning for fire-breaks and veld management, many fires are set deliberately for mischievous reasons. Some are accidental, notably those started by motorists throwing cigarettes out of car windows. Emissions from veld fires are similar to those generated by coal and wood combustion. Whilst veld fire smoke primarily impacts visibility and landscape aesthetic quality, it also contributes to the degradation of regional scale air quality. Dry combustible material is consumed first when a fire starts. Surrounding live, green material is dried by the large amount of heat that is released when there are veld fires, sometimes this material also burn. The major pollutants from veld burning are particulate matter, carbon monoxide, and volatile organics. Nitrogen oxides are emitted at rates from 1 to 4 g/kg burned, depending on combustion temperatures. Emissions of sulphur oxides are negligible (USEPA, 1996).

7.1.2.3 Trucks Passing on the Roads, Loading and Offloading Raw Materials

Dust emissions occur when soil is crushed by a vehicle, as a result of the soil moisture level being low. Vehicles used on the roads will generate PM-10 emissions throughout the area and they carry soils onto the paved roads which would increase entrainment PM-10 emissions. The quantity of dust emissions from unpaved roads varies linearly with the volume of traffic.

7.1.2.4 Wind Erosion as a Result Of ROM Material and Topsoil Stockpiles

The topsoil and waste rock stockpiles generated during the construction phase will be minimal and probably used for construction purposes on site (berm and foundations for buildings), reason being that this will be limited to the mining areas - since the project is mainly an opencast operation. At the ROM stockpile, there will be constant transfer of ore from the opencast to the stockpile.

7.1.2.5 Material Handling (Loading, Hauling and Tipping)

Material handling during loading, hauling and tipping as mining processes has been known to have influence on dust generation in terms of increasing the fugitive dust emissions being generated. With the different kind of materials - topsoil, soft, and hard, tipping will be negligible. The tipping is mostly associated with the ROM at the processing plant vicinity. During these activities factors such as the surrounding wind regime, the material tipping rate, and the moisture content of the material all have an influence on the dust generation at the tipping transfer points.

8. DISPERSION MODEL

8.1 Emissions Inventory

Table 11 below describes the through put rates on which the calculations were based. In the quantification of the emissions the emission factor equations published by the US.EPA as well as the NPI compiled by the Australian Government were used. See

Table 12. Table 14 shows the summarised Emissions Inventory.

Table 11: Modelling Parameter Summary

Project Specific Information			
Type	**Spec**	**Quantity**	**Unit**
Material	ROM	12 000	tpm
Material Bulk Density	ROM	2.745	g/cm³
Operations	Hours*	24	
	Days*	31	
Stockpile - ROM	Height*	15	m
Stockpile - OVB	Height*	30	m
Stockpile - Tailings	Height*	30	m
Haul Road – Pit 2-3-4-5	Width*	9	m
	Length*	3	km
	Trips	0.7	per h
	VKT	2.09	per h
Haul Road – Pit 2-3	Width*	9	m
	Length*	1	km
	Trips	0.35	per h
	VKT	0.35	per h
Haul Road – Pit 3	Width*	9	m
	Length*	0.87	km
	Trips	0.17	per h
	VKT	0.15	per h
Haul Road – Access, Pit 4-5	Width*	9	m
	Length*	4.8	km
	Trips	0.35	per h
	VKT	1.67	per h

Project Specific Information			
Type	**Spec**	**Quantity**	**Unit**
Haul Road – Pit 4-5	Width*	9	m
	Length*	4.6	km
	Trips	0.35	per h
	VKT	1.6	per h
Haul Road – Pit 4	Width*	9	m
	Length*	1	km
	Trips	0.17	per h
	VKT	0.17	per h
Haul Road – Pit 5	Width*	9	m
	Length*	2.5	km
	Trips	0.17	per h
	VKT	0.44	per h
Haul Trucks	Type	Bell B40D	
	Height	4.2	m
	Width	3.8	m
	Payload	37	t
Note:	* Assumed		

Table 12: NPI Emission Factors

NPI Emission Factors				
Operation	**TSP**	**PM10**	**Units**	**Rating**
Handling Transfering and Conveying	0.005	0.002	kg/t	U
Wind Erosion	0.4	0.2	kg/ha/h	U
Haul Road	4.23	1.25	kg/VKT	B
Primary Crushing	0.2	0.02	kg/t	C
Secondary Crushing	0.6	0.06	kg/t	D

Many published emission factors have and associated emission factor rating (EFR) code. These EFR codes are based on rating systems developed by the USEPA and by the European Environmental Agency. See Table 13 below.

Table 13: Emission Factor Ratings

Factor Ratings	
A	Excellent
B	Above Average
C	Average
D	Below Average
E	Poor
U	Unrated

8.1.1 Mitigation Measures

8.1.1.1 Material Handling

According to the Australian NPI, dust generation from material transfer points can be reduced by 50% where water sprays are applied. Adding wind break can reduce the dust emissions with 30%. Enclosing the operations, the emissions will become insignificant.

8.1.1.2 Opencast Pit

50% mitigation on the various operations can be achieved using water sprays according to the Australian NPI.

8.1.1.3 Stockpile

Wind erosion from stockpiles can be mitigated by 50% using water sprays according to the Australian NPI. Revegetation of stockpiles can bring 90% mitigation.

Total enclosure of the stockpiles can mitigate erosion by 99%. (Also from the Australian NPI.)

Vegetal cover retards erosion by binding the residue with a root network, by sheltering the residue surface and by trapping material already eroded. Vegetation is considered the most effective control measure in terms of its ability to control water erosion. In investigating the feasibility of vegetation types the following properties are normally taken into account: indigenous plants; ability to establish and regenerate quickly; proven effective for reclamation elsewhere; tolerant to the climatic conditions of the area; high rate of root production; easily propagated by seed or cuttings; and nitrogen-fixing ability.

The long-term effectiveness of suitable vegetation selected for the site will be dependent on (a) the nature of the cover, and (b) the availability of aftercare. The Department of Minerals and Energy in Western Australia in its Guidelines on the Safe Design and Operating

Standards for Tailings Storages (1996), for example, stipulates a covering of a minimum of 500 mm of suitable waste rock, followed by a layer of topsoil (or growth medium) and subsequent seeding. According to these guidelines all external surfaces should have a self-generating cover compatible with the surrounding environment

8.1.1.4 Haul Road

For haul roads the Australian NPI indicate that dust emissions can be mitigated by 50% for level 1 watering (2 litres/m²/h) or 75% for level 2 watering (>2 litres/m²/h).

Sealing the road or salt-encrusted roads can mitigate 100% according to the Australian NPI.

The roads on-site were identified as the most significant source of dust emissions. Three types of measures may be taken to reduce emissions from unpaved roads:

- measures aimed at reducing the extent of unpaved roads, e.g. paving,
- traffic control measures aimed at reducing the entrainment of material by restricting traffic volumes and reducing vehicle speeds, and
- measures aimed at binding the surface material or enhancing moisture retention, such as wet suppression and chemical stabilization (EPA, 1987; Cowherd *et al.*, 1988; APCD, 1995).

Given the indication that unsurfaced roads would be watered, control efficiencies which may be achieved through wet suppression were investigated. In addition, the reduction in vehicle entrainment due to reduced vehicle kilometres travelled are also included.

Permanent improvements in travel surfaces, such as the paving of a road, results in continuous control efficiencies. The control efficiencies obtained by wet suppression and the use of chemical stabilizers are, however, cyclic rather than continuous by nature as indicated previously. The efficiency afforded by the application of water or chemicals decay over time, requiring periodic reapplication to maintain the desired average efficiency (Cowherd et al., 1988). The following empirical model for the estimation of the average control efficiency of watering, developed by the US-EPA (EPA, 1996), can be applied in the estimation of control efficiencies achievable by unpaved road watering programmes:

$$C = 100 - \left(\frac{0.8pdt}{i}\right)$$

Where,

c = average control efficiency (%)

d = average hourly daytime traffic rate (hr-1)

i = application intensity (litres per m2)

t = time between applications (hr)

p = potential average hourly daytime evaporation rate (mm/hr)

Table 14: Calculated Source Emission Rates Summary

Emissions Released								
	Unmitigated			**Mitigated**				
Operation	**TSP**	**PM10**	**Unit**	**TSP**	**PM10**	**Unit**	**Reduction**	**Method**
Material Handling	2.24E-02	8.96E-03	g/s	1.12E-02	4.48E-03	g/s	50%	Water Sprays
Wind Erosion	1.11E-05	5.56E-06	g/s/m²	5.56E-06	2.78E-06	g/s/m²	50%	Water Sprays
				1.11E-06	5.56E-07	g/s/m²	90%	Revegetation on OB and Topsoil

Emissions Released								
	Unmitigated			Mitigated				
Operation	TSP	PM10	Unit	TSP	PM10	Unit	Reduction	Method
Haul Road - Pit 2-3-4-5	2.73E-04	8.07E-05	g/s/m²	2.73E-05	8.07E-06	g/s/m²	90%	Sealed or Salt-Encrusted roads
Haul Road - Pit 2-3	4.55E-05	1.35E-05	g/s/m²	4.55E-06	1.35E-06	g/s/m²	90%	Sealed or Salt-Encrusted roads
Haul Road - Pit 3	1.98E-05	5.85E-06	g/s/m²	1.98E-06	5.85E-07	g/s/m²	90%	Sealed or Salt-Encrusted roads
Haul Road - Access, Pit 4-5	2.19E-04	6.46E-05	g/s/m²	2.19E-05	6.46E-06	g/s/m²	90%	Sealed or Salt-Encrusted roads
Haul Road - Pit 4-5	2.09E-04	6.19E-05	g/s/m²	2.09E-05	6.19E-06	g/s/m²	90%	Sealed or Salt-Encrusted roads
Haul Road - Pit 4	2.28E-05	6.73E-06	g/s/m²	2.28E-06	6.73E-07	g/s/m²	90%	Sealed or Salt-Encrusted roads
Haul Road - Pit 5	5.69E-05	1.68E-05	g/s/m²	5.69E-06	1.68E-06	g/s/m²	90%	Sealed or Salt-Encrusted roads
Primary Crushing	0.90	0.09	g/s	4.48E-01	4.48E-02	g/s	50%	Water Sprays
Secondary Crushing	2.69	0.27	g/s	1.34E+00	1.34E-01	g/s	50%	Water Sprays

8.2 Modelling Results

Isopleth plots are shown in the images below to visually show the predicted ground level concentrations of PM10.

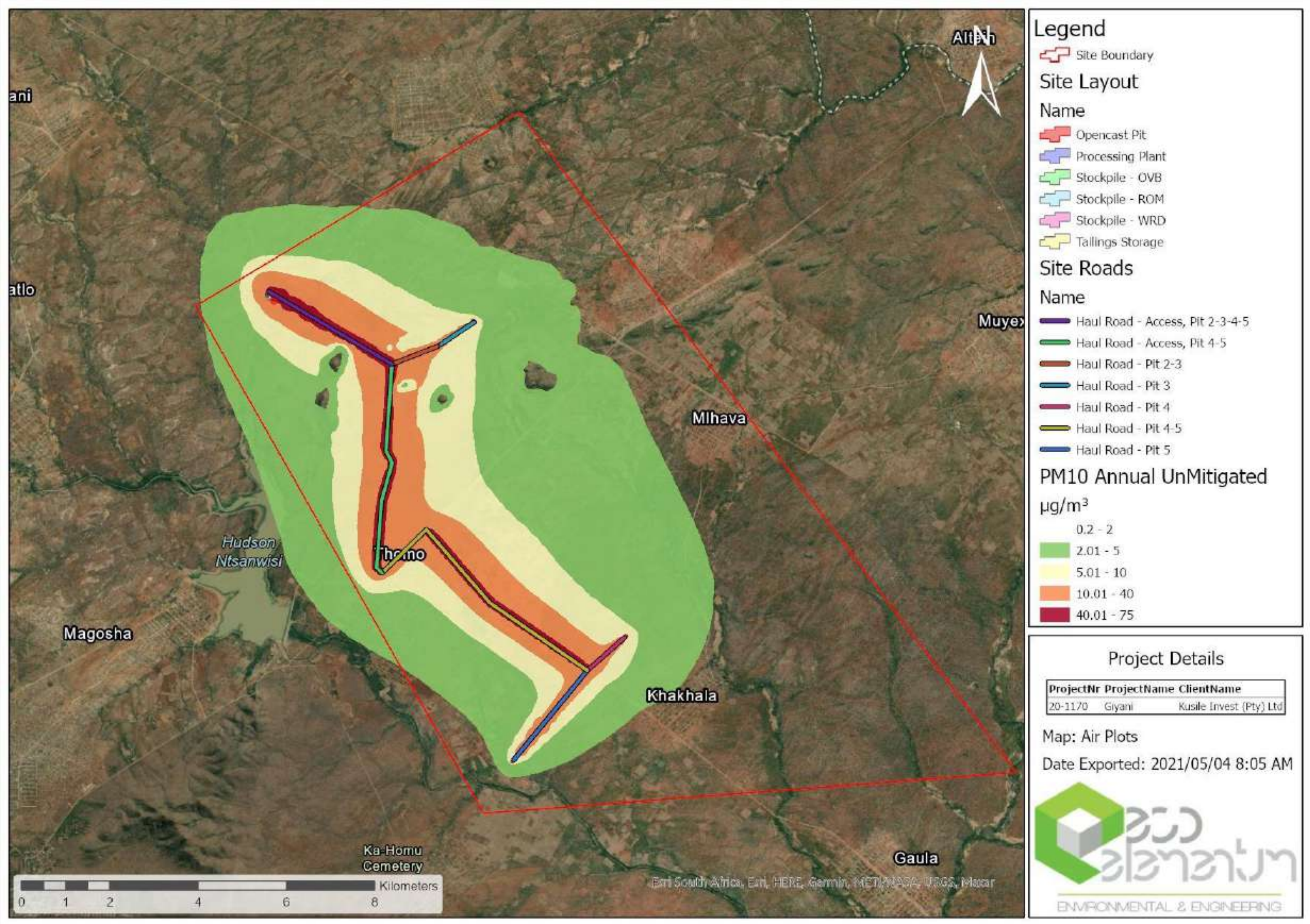


Figure 21: Predicted average annual concentrations for PM10 for the proposed Giyani project when unmitigated.

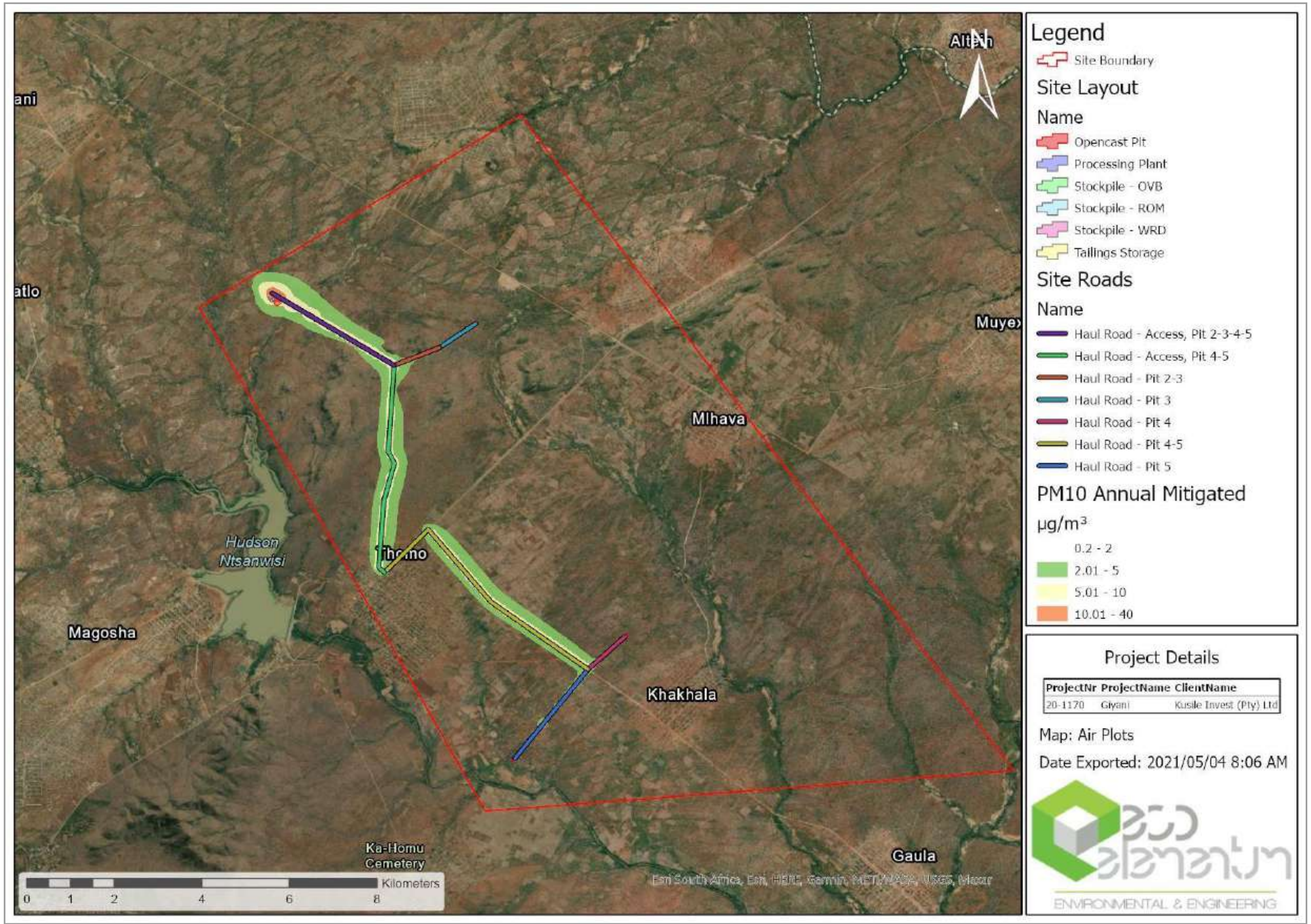


Figure 22: Predicted average annual concentrations for PM10 for the proposed Giyani project operations when mitigated.

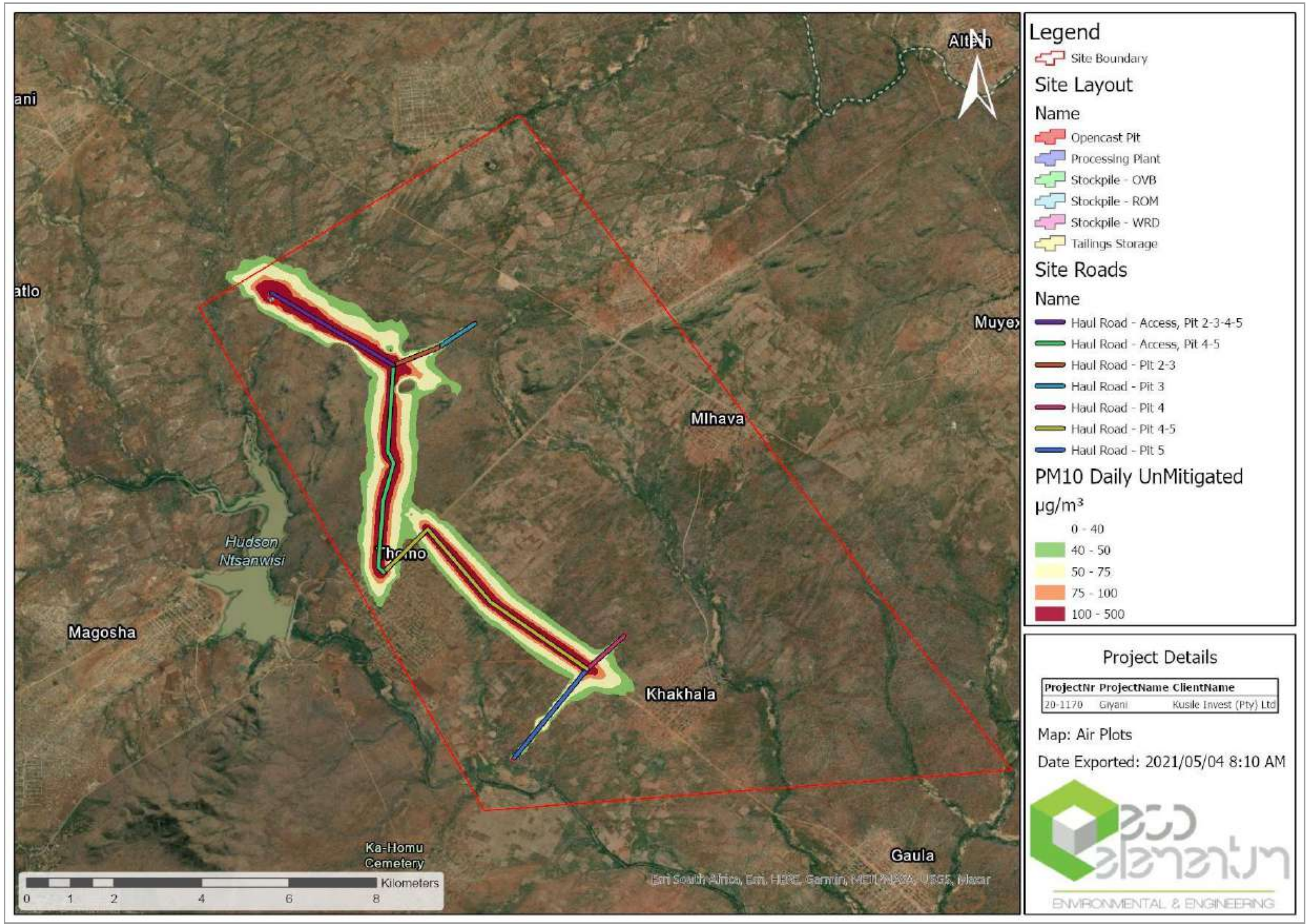


Figure 23: Predicted 2nd Highest daily concentrations for PM10 for the proposed project operations when unmitigated.

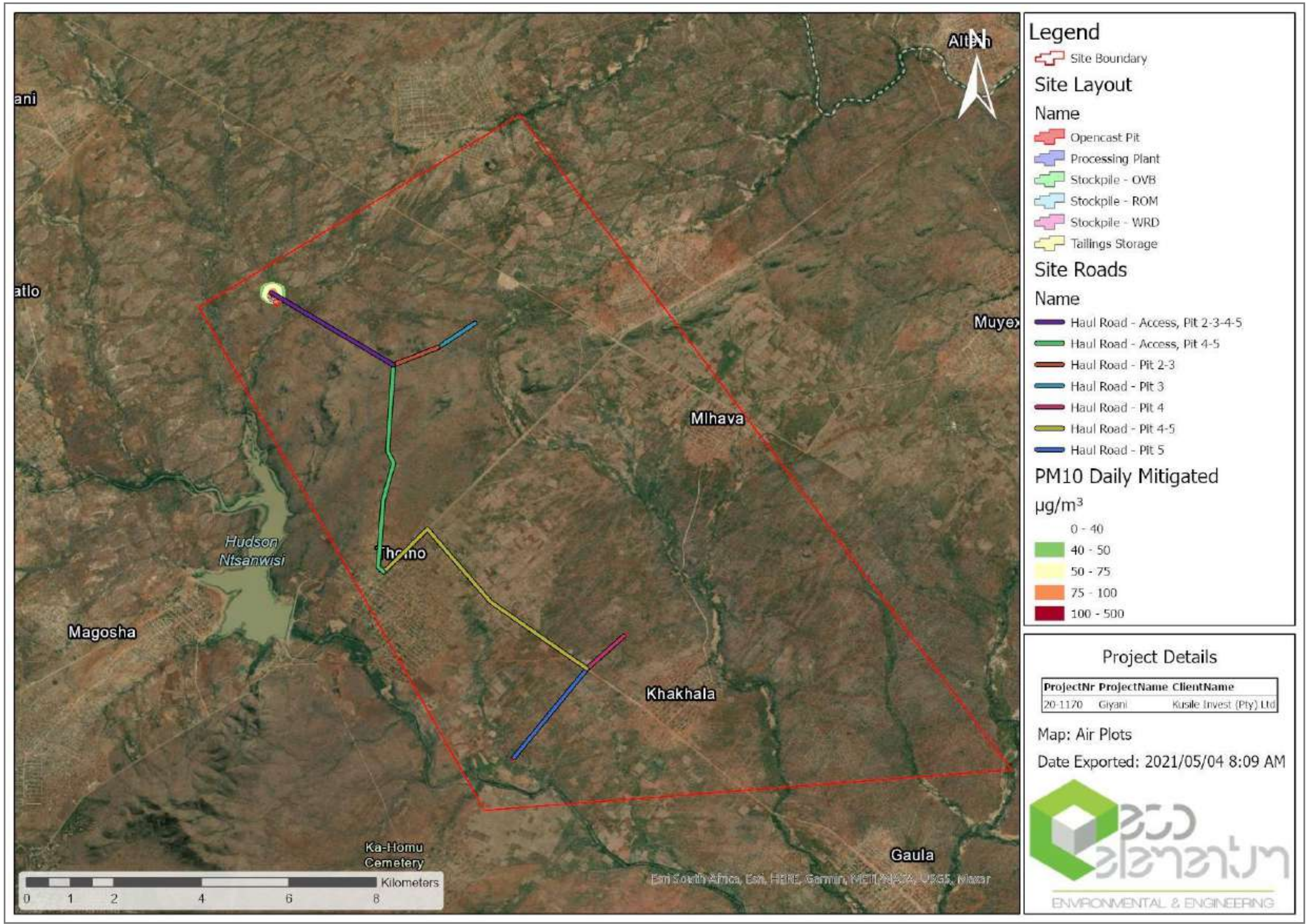


Figure 24: Predicted 2nd Highest daily concentrations for PM10 for the proposedGiyani project operations when mitigated.

9. IMPACT ASSESSMENT

9.1 Impact Assessment Methodology

The level of detail as depicted in the EIA regulations were fine-tuned by assigning specific values to each impact. In order to establish a coherent framework within which all impacts could be objectively assessed, it was necessary to establish a rating system, which was applied consistently to all the criteria. For such purposes each aspect was assigned a value, ranging from one (1) to five (5), depending on its definition. This assessment is a relative evaluation within the context of all the activities and the other impacts within the framework of the project.

The impact assessment criteria used to determine the impact of the proposed development are as follows:

1. ***Severity*** of the impact;
2. **Spatial Scale** - The physical and spatial scale of the impact;
3. ***Duration*** - The lifetime of the impact, measured in relation to the lifetime of the proposed development;
4. ***Frequency of the Activity*** - How often do the activity take place;
5. ***Frequency of the incident/impact*** - How often does the activity impact on the environment;
6. ***Legal Issues*** - How is the activity governed by legislation; and
7. ***Detection*** - How quickly/easily the impacts/risks of the activity be detected on the environment, people and property.

To ensure uniformity, the assessment of potential impacts will be addressed in a standard manner so that a wide range of impacts is comparable. For this reason a clearly defined rating scale will be provided to the specialist to assess the impacts associated with their investigation. See Table 15

Table 15: Assessment criteria

SEVERITY	
Insignificant / non-harmful	1
Small / potentially harmful	2
Significant / slightly harmful	3
Great / harmful	4
Disastrous / extremely harmful / within a regulated sensitive area	5
SPATIAL SCALE	
Area specific (at impact site)	1
Whole site (entire surface right)	2
Local (within 5 km)	3
Regional / Neighbouring areas (5 km to 50 km)	4
National	5
DURATION	
One day to one month (immediate)	1
One month to one year (Short term)	2
One year to 10 years (medium term)	3
Life of the activity (long term)	4
Beyond life of the activity (permanent)	5
FREQUENCY OF THE ACTIVITY	
Annually or less	1

6 monthly	2
Monthly	3
Weekly	4
Daily	5
FREQUENCY OF THE INCIDENT/IMPACT	
Almost never / almost impossible / >20%	1
Very seldom / highly unlikely / >40%	2
Infrequent / unlikely / seldom / >60%	3
Often / regularly / likely / possible / >80%	4
Daily / highly likely / definitely / >100%	5
LEGAL ISSUES	
No legislation	1
Fully covered by legislation	5
DETECTION	
Immediately	1
Without much effort	2
Need some effort	3
Remote and difficult to observe	4
Covered	5
Immediately	1

The impacts that are generated by the development can be minimised if measures are implemented in order to reduce the impacts. The mitigation measures ensure that the development considers the environment and the predicted impacts in order to minimise impacts and achieve sustainable development.

9.1.1 Consequence

Consequence is determined by the following equation after the assessment of each impact.

Consequence = Severity + Spatial Scale + Duration

9.1.2 Likelihood

The Likelihood of the activity is then calculated based on frequency of the activity and impact, how easily it can be detected and whether the activity is governed by legislation. Thus:

Likelihood = Frequency of activity + frequency of impact + legal issues + detection

9.1.3 Risk

The risk is then based on the consequence and likelihood.

Risk = Consequence x likelihood

9.1.4 Impact Ratings

The impact is then rated according to Table 16:

Table 16: Impact Rating Table

Rating	Class
1-55	(L) Low Risk
56-169	(M) Moderate Risk
170-600	(H) High Risk

9.2 Predicted Impacts

9.2.1 Summarised Impacts According To Development Phases

Table 17 Summarises the activities from each phase of the project.

Table 17: Impacts according to Development Phases

PHASE	ACTIVITIES
Construction Phase	**Typical Activities** - Site clearing, removal of topsoil and vegetation, Construction of Infrastructure, General Transportation and hauling of material.
Operational Phase	**Typical Activities** - Mining Operations such as Drilling and blasting, Hauling of ROM, Crushing and Screening etc.
Closure and Decommissioning	**Typical Activities** - Demolition & Removal of all infrastructure (incl. transportation off site) and Rehabilitation (Spreading of soil, revegetation, profiling / contouring)

9.2.2 Construction Phase

- **Typical Activities** - Site clearing, removal of topsoil and vegetation, construction of Infrastructure, general transportation and hauling of material. (Table 18)

Table 18: Summarizing the significance of the impacts on the sensitive receptors for the Construction phase.

	Construction Phase		
		Unmitigated	**Mitigated**
Assessment Criteria	**Severity** [Insignificant / non-harmful (1); Small / potentially harmful (2); Significant / slightly harmful (3); Great / harmful (4); Disastrous / extremely harmful / within a regulated sensitive area (5)]	**2**	**2**
	Spatial Scale [Area specific (at impact site) (1); Whole site (entire surface right) (2); Local (within 5 km) (3); Regional / neighbouring areas (5 km to 50 km) (4); National (5)]	**1**	**1**
	Duration [One day to one month (immediate) (1); One month to one year (Short term) (2); One year to 10 years (medium term) (3); Life of the activity (long term) (4); Beyond life of the activity (permanent) (5)]	**2**	**2**
	Frequency of Activity [Annually or less (1); 6 monthly (2); Monthly (3); Weekly (4); Daily (5)]	**4**	**4**

	Construction Phase		
	Frequency of Incident/Impact [Almost never / almost impossible / >20% (1); Very seldom / highly unlikely / >40% (2); Infrequent / unlikely / seldom / >60% (3); Often / regularly / likely / possible / >80% (4); Daily / highly likely / definitely / >100% (5)	**4**	**3**
	Legal Issues [No legislation(1); Fully covered by legislation (5)]	**5**	**5**
	Detection [Immediately(1); Without much effort (2); Need some effort (3); Remote and difficult to observe (4); Covered (5)]	**2**	**2**
Consequence	Severity + Spatial Scale + Duration	**5**	**5**
Likelihood	Frequency of Activity + Frequency of impact + Legal issues + Detection	**15**	**14**
Risk	Consequence * Likelihood	**MODERATE (75)**	**MODERATE (70)**

9.2.3 Operational Phases

The following activities during the Operational Phases are identified as possible fugitive emission sources and may impact on the ambient air quality at the relevant environmental sensitive receivers:

1. Dust from material handling.
    - Inside and outside the pit area.
2. Haul roads; for transporting the ROM to the Processing plant.
3. Wind erosion from stockpiles.

These sources were uses as inputs in the AERMOD model as unmitigated and mitigated, as discussed earlier.

9.2.3.1 PM10

For the unmitigated Daily PM10 concentrations it was predicted to be higher than the 75 µg/m³ limit for 2 of the sensitive receptors as can be seen in Table 19.

When comparing the Daily Mitigated PM10 modelled concentrations, the sensitive receptors exceeding the 75 µg/m³ limit dropped to 0 of the identified sensitive receptors. This as well is the highest levels predicted for a 24 hour period within the period. Due to site specific atmospheric conditions these exceedances may still occur within the limit of 4 per year.

The annual average PM10 limit of 40 µg/m³ are predicted to also exceed at 2 of the sensitive receptors for the unmitigated scenario and dropping to 0 of the identified sensitive receptors for the mitigated scenario.

Table 19: PM Concentrations at sensitive receptors

Receptor	PM10 2nd Highest Daily (µg/m³)		PM10 Annual Average (µg/m³)	
	Unmitigated	Mitigated	Unmitigated	Mitigated
1	10.6	1.4	1.1	0.1
2	8.9	1.4	1.1	0.1
3	9.7	1.3	1.4	0.2
4	8.7	1.3	1.1	0.1
5	7.5	1.0	0.9	0.1
6	6.7	0.7	1.2	0.1
7	7.3	1.0	1.4	0.2
8	8.6	1.0	1.6	0.2
9	9.8	1.1	1.8	0.2
10	7.2	0.8	1.3	0.1
11	8.4	0.9	1.4	0.2
12	6.2	0.7	0.9	0.1
13	6.6	0.8	1.0	0.1
14	7.7	1.0	1.5	0.2
15	9.3	1.1	1.8	0.2
16	9.1	1.1	1.7	0.2
17	8.3	0.9	1.4	0.1
18	4.3	0.5	0.7	0.1
19	4.5	0.5	0.7	0.1
20	4.9	0.5	0.8	0.1
21	4.1	0.5	0.7	0.1
22	4.4	0.5	0.6	0.1
23	12.3	1.3	1.9	0.2
24	15.2	1.6	1.4	0.1
25	13.9	1.5	1.1	0.1
26	25.0	2.5	2.1	0.2
27	35.8	3.6	3.5	0.4

Receptor	PM10 2nd Highest Daily (µg/m³)		PM10 Annual Average (µg/m³)	
	Unmitigated	Mitigated	Unmitigated	Mitigated
28	5.7	0.6	0.3	0.0
29	5.9	0.6	0.3	0.0
30	8.0	0.8	0.4	0.0
31	7.0	0.7	0.4	0.0
32	6.8	0.7	0.3	0.0
33	7.0	0.7	0.7	0.1
34	8.4	0.9	0.9	0.1
35	6.4	0.7	0.7	0.1
36	5.5	0.6	0.6	0.1
37	18.0	1.8	4.1	0.4
38	37.0	3.7	10.4	1.1
39	112.7	11.3	41.0	4.1
40	467.1	46.7	159.6	16.0
41	26.8	2.7	4.9	0.5
42	15.3	1.6	2.3	0.2
43	20.0	2.0	2.2	0.2
44	11.2	1.1	1.8	0.2
45	6.0	0.7	0.9	0.1
46	6.7	0.7	1.0	0.1
47	6.2	0.6	0.9	0.1
48	5.6	0.6	0.7	0.1
49	5.0	0.5	0.6	0.1
50	5.2	0.5	0.7	0.1
51	4.2	0.5	0.6	0.1
52	4.4	0.5	0.6	0.1
53	5.4	0.7	0.5	0.1
54	5.8	0.6	0.5	0.1
55	8.7	0.9	0.5	0.1
56	8.5	1.0	0.5	0.1
57	7.0	0.9	0.5	0.1
58	6.5	0.9	0.5	0.1
59	9.1	1.0	0.6	0.1

9.2.3.2 Total Dust Fallout

In the unmitigated and mitigated scenarios, 1 sensitive receptor are predicted to exceed the monthly dust fallout for the highest month residential limit of 600 mg/m²/day.

The predicted annual dust fall out for the unmitigated and mitigated scenarios are predicted to exceed at 1 of the sensitive receptors for the annual limit of 300 mg/m²/day.

This receptor is next to the haul road that is proposed to be used.

Table 20: TSP Deposition rates at the sensitive receptors

Receptor	TSP Highest Monthly (mg/m²/day)		TSP Annual Average (mg/m²/day)	
	Unmitigated	Mitigated	Unmitigated	Mitigated
1	2.35	0.07	0.88	0.03
2	1.93	0.06	0.72	0.03
3	1.92	0.06	0.75	0.03
4	1.31	0.04	0.50	0.02
5	0.99	0.03	0.37	0.01
6	0.95	0.03	0.30	0.01
7	1.18	0.03	0.38	0.01
8	1.41	0.04	0.46	0.02
9	1.90	0.05	0.58	0.02
10	1.78	0.04	0.52	0.02
11	1.41	0.04	0.41	0.02
12	1.07	0.03	0.33	0.01
13	0.85	0.03	0.28	0.01
14	1.19	0.04	0.33	0.01
15	1.29	0.05	0.40	0.02
16	1.33	0.05	0.34	0.02
17	1.02	0.03	0.29	0.01
18	0.35	0.01	0.10	0.00
19	0.40	0.01	0.11	0.00
20	0.43	0.01	0.12	0.01
21	0.35	0.01	0.11	0.00
22	0.32	0.01	0.09	0.00
23	0.86	0.06	0.32	0.02
24	0.69	0.05	0.27	0.02
25	0.68	0.04	0.31	0.02
26	1.06	0.09	0.52	0.04
27	1.82	0.16	0.66	0.05
28	0.24	0.01	0.09	0.00

Receptor	TSP Highest Monthly (mg/m²/day)		TSP Annual Average (mg/m²/day)	
	Unmitigated	Mitigated	Unmitigated	Mitigated
29	0.27	0.01	0.11	0.01
30	0.28	0.01	0.11	0.01
31	0.25	0.01	0.10	0.01
32	0.22	0.01	0.09	0.00
33	0.79	0.05	0.33	0.02
34	0.93	0.05	0.42	0.03
35	0.75	0.04	0.36	0.02
36	0.68	0.04	0.29	0.02
37	2.91	0.21	1.83	0.15
38	6.42	0.59	4.81	0.44
39	19.11	1.85	13.22	1.26
40	346612.34	34661.18	267089.50	26708.86
41	4.69	0.34	2.90	0.22
42	2.82	0.17	1.56	0.10
43	2.25	0.14	1.31	0.09
44	1.74	0.10	0.97	0.07
45	2.62	0.09	1.23	0.05
46	2.74	0.09	1.27	0.06
47	2.31	0.08	1.04	0.05
48	2.06	0.07	0.88	0.04
49	1.81	0.06	0.75	0.03
50	2.08	0.07	0.95	0.04
51	2.06	0.07	1.18	0.04
52	2.09	0.07	1.27	0.05
53	2.25	0.07	1.26	0.05
54	2.40	0.07	1.13	0.04
55	2.77	0.09	1.43	0.05
56	2.97	0.10	1.49	0.06
57	4.02	0.13	2.23	0.08
58	4.97	0.16	2.70	0.10
59	4.63	0.16	2.88	0.10

9.2.4 Decommissioning and Closure Phase

- **Typical Activities** - Demolition & Removal of all infrastructure (incl. transportation off site) and Rehabilitation (Spreading of soil, revegetation, profiling / contouring). (Table 21)

Table 21: Summarizing the significance of the impacts on the sensitive receptors for the Closure and Decommissioning phase.

	Closure and Decommissioning Phase		
		Unmitigated	**Mitigated**
Assessment Criteria	**Severity** [Insignificant / non-harmful (1); Small / potentially harmful (2); Significant / slightly harmful (3); Great / harmful (4); Disastrous / extremely harmful / within a regulated sensitive area (5)]	**3**	**3**
	Spatial Scale [Area specific (at impact site) (1); Whole site (entire surface right) (2); Local (within 5 km) (3); Regional / neighbouring areas (5 km to 50 km) (4); National (5)]	**2**	**2**
	Duration [One day to one month (immediate) (1); One month to one year (Short term) (2); One year to 10 years (medium term) (3); Life of the activity (long term) (4); Beyond life of the activity (permanent) (5)]	**2**	**2**
	Frequency of Activity [Annually or less (1); 6 monthly (2); Monthly (3); Weekly (4); Daily (5)]	**4**	**4**
	Frequency of Incident/Impact [Almost never / almost impossible / >20% (1); Very seldom / highly unlikely / >40% (2); Infrequent / unlikely / seldom / >60% (3); Often / regularly / likely / possible / >80% (4); Daily / highly likely / definitely / >100% (5)	**4**	**3**
	Legal Issues [No legislation(1); Fully covered by legislation (5)]	**5**	**5**
	Detection [Immediately(1); Without much effort (2); Need some effort (3); Remote and difficult to observe (4); Covered (5)]	**2**	**2**
Consequence	Severity + Spatial Scale + Duration	**7**	**7**
Likelihood	Frequency of Activity + Frequency of impact + Legal issues + Detection	**15**	**14**
Risk	Consequence * Likelihood	**MODERATE (105)**	**MODERATE (98)**
Mitigation Measures	- Demolition should not be performed during windy periods (August, September and October), as dust levels and the area affected by dust fallout will increase. - The area of disturbance must be kept to a minimum, as demolition should be done judiciously avoid the exposure of larger areas to wind erosion. - Cabs of machines should be swept or vacuumed regularly to remove accumulated dust. - Exhaust pipes of vehicles should be directed so that they do not raise dust. - Engine cooling fans of vehicles should be shrouded so that they do not raise dust. - Hard surfaced haul roads or standing areas should be washed down and swept to remove accumulated dust. - Dust suppression of roads being used during rehabilitation should be enforced. - Revegetation of exposed areas for long-term dust and water erosion control is commonly used and is the most cost-effective option. - Plants with roots that bind the soil, and vegetation cover should be used that breaks the impact of falling raindrops, thus preventing wind and water erosion. - Plants used for revegetation should be indigenous to the area, hardy, fast-growing, nitrogen-fixing, provide high plant cover, be adapted to growing on exposed and disturbed soil (pioneer plants) and should easily be propagated by seed or cuttings. - The area of disturbance must be kept to a minimum, as demolition should be done judiciously avoid the exposure of larger areas to wind erosion. - Spreading of soil must be performed on less windy days. - The bare soil will be prone to erosion and therefore there is need to reduce the velocity near the surface of the soil by re-vegetation. - Leaving the surface of soil in a coarse condition reduces wind erosion and ultimately reduces dust levels.		

	Closure and Decommissioning Phase
	- Additional mitigation measures include keeping soil moist using sprays or water tanks, using wind breaks. - The best time to re-vegetate the area must be linked to the distribution and reliability of rainfall. - Cabs of machines should be swept or vacuumed regularly to remove accumulated dust. - Exhaust pipes of vehicles should be directed so that they do not raise dust. - Engine cooling fans of vehicles should be shrouded so that they do not raise dust. - Hard surfaced haul roads or standing areas to be washed down and swept to remove accumulated dust. - Dust suppression of roads being used during rehabilitation should be enforced. - It is recommended that the rehabilitation by vegetating should begin during the operational phase already as the objective is to minimise the erosion. - These measures should be aimed to reduce the potential for fugitive dust generation and render the impacts on ambient air quality negligible.

9.3 Climate Change

During an assessment in 2016 of South Africa's mining sectors' response to climate change adaption demands undertaken by B. Chavalala from UNISA, Climate change adaptation has received limited attention compared to mitigation across all spatial levels. This is besides the documented adverse impacts of climate change in different sectors of societies including mining in general.

Against this background, the study set three objectives:

- **The first objective** was to identify current and possible future climate change impacts that may affect selected coal mines in South Africa.
- **The second objective** was to establish the nature and extent to which these mines were ready to address and implement adaptation measures.
- **The last objective** was to determine and document existing climate change adaptation practices in selected mines.

Employing the mixed methods approach, the research engaged five coal mines located in Mpumalanga, Free State and Kwa Zulu-Natal, gathering both the qualitative and quantitative data. This data was analysed thematically.

The research made three major findings:

- The first finding was that the climatic conditions in the research areas have been changing over the observed period. In general, rainfall has been declining and temperatures have been increasing, leading to increased cases of extreme fog, mist and heatwaves.
- The second finding was that there has been an increase in frequency and intensity of extreme weather events, most notably, floods and droughts. These changes in the climate and associated weather events have frequently affected mine operations particularly at the production sub-chain of the coal mining value chain.
- The third major finding was that despite this evidence of adverse impact of climate change on the production sub-chain of the South African coal mining value chain, adaption responses in all the studied mines showed reactive adaptation to extreme events instead of proactive adaptation planning and implementation.

10. MONITORING PROGRAMME

As reported previously, no current monitoring campaign exists. It is highly recommended that a dust monitoring campaign be conducted prior to the proposed mining operations commence and then continue for the life of mine in order to establish historical repository of data needed to fully understand/address fugitive and airborne dust emissions from the construction, operation and closure activities. Managing dust fallout effectively will result in the reduction of respiratory diseases that are as a result of air pollution, reduced risk of damage to property, improved visibility, and fewer disturbances to existing flora and fauna habitats.

10.1.1 Proposed Monitor Locations

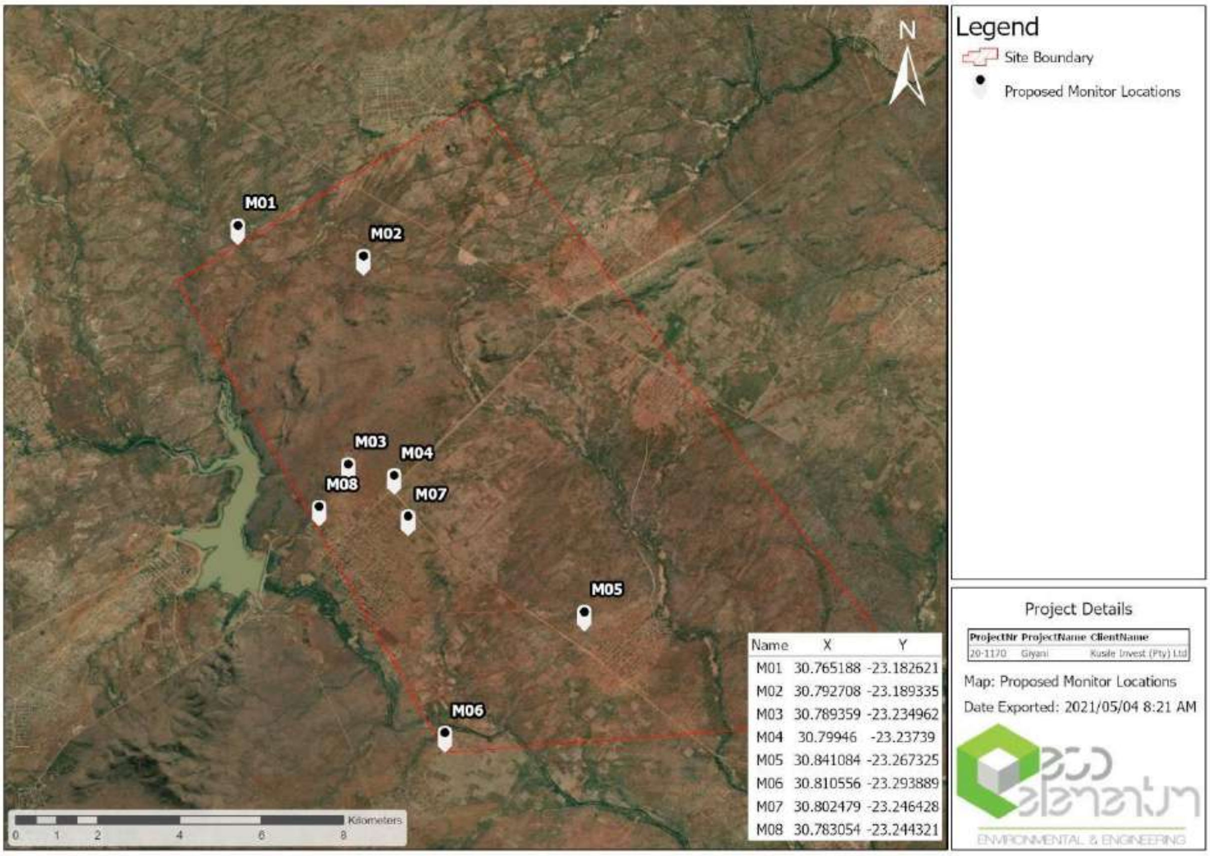


Figure 25: Proposed Monitor Locations

10.2 Gravimetrical Dust Fallout - (Milligram/Square Meter/Day) Or (Mg/M²/Day) (Monthly 8 Samples)

Site layout for sampling points must be carried out according to the eight main compass directions; the site layout and equipment placement must be done in accordance with the ASTM standard, D 1739 - 2010, thereafter relevant sampling reference numbers will be allocated to the receptors accordingly. At each gravimetric dust fallout gauge/receptor point there is a stand built according to specification containing the dust sample collection bucket. Samples will be collected after a 1 month running period (+-30 day's exposure). After sample collection, the samples are taken to a SANAS accredited laboratory as required. A visual site investigation is done where after correlations are drawn and findings are identified and reported on.

Dust buckets of a standard size and shape are prepared and set up at locations related to the eight main compass points on the borders of the property so that dust can settle in them for periods of 30+/-2 days. The dust buckets are then sealed and replaced with new empty ones and send away to the SANAS accredited laboratory for analysis. The masses of the water-soluble and -insoluble components of the material collected are then determined and results are reported as $mg/m^2/day$. This methodology is described according to South African National Standards 1929:2004 and the American Society for Testing and Materials (ASTM) Designation: D 1739-98 (2010). The results for this method of testing are obtained by gravimetrical weighing. The apparatus required include open top buckets/containers not less than 150 mm in diameter with a height not less than twice its diameter. The buckets must be placed on a stand at a height of 2 +/-0.2 m above the ground.

10.3 Particulate Matter PM10 (Monthly 8 Samples)

It is recommended that the client should establish a fine particulate monitoring programme, which should include one particulate instrument to monitor PM10 and preferably PM2.5 specifically at the problem areas shown by the passive sampling campaign at the residential areas. Handheld sampling instruments not only allows for sampling in the 8 main wind directions, but also on-site sampling down-wind of potential dust sources to quantify and determine impacts that need to be managed. It is advised to conduct this sampling on a monthly basis but also when the need arise during periods of elevated dust concentrations being emanated from the site.

Passive Sampling in the form of Dust Buckets lack crucial information such as wind direction to determine the direction of the source of the emissions. To help fill this lack of information, Eco-E developed a cost effective solution that incorporates the latest technology to offer a real time indicative monitoring solution to help in the management of dust emissions. Passive, active and real-time sampling techniques to be used for the baseline determination is explained below.

10.4 Indicative Sampling

New technology to perform cost effective real-time dust and particulate matter is currently becoming a cost-effective option. This type of technology can record real-time wind speed and direction together with particulate concentrations. It can thus be used more effectively for management purposes. Actionable intelligence is generated on dust and particulate matter emissions, which in turn can then be used to determine the origin of the particulate emissions. In a scenario where operations are situated in close proximity to each other and residential areas, this type of technology can become instrumental in decision making on the management of dust for a mining operation

EcoE developed a cost effective, MCERTS certified (refer to Figure 19), Remote Active Indicative Real-Time Particulate Matter Dust Monitoring solution;

- This particular service offering is backed up and supported by a team of experienced Environmental Scientists, Electronic and Information Technology Engineers.
- Our dust monitoring stations are proudly manufactured in-house in South Africa.
- The design allows to have full remote telemetry with real-time live feed alerts for corrective actions.
- Stations incorporate sensors for single or simultaneously Particulate Matter fraction measurements ranging from Pm_1 to Pm_{10}
- In addition to this the stations also include weather sensors to ensure ease of integrated data interpretation, analysis and future predictive modelling.
- Units are wireless, mobile and solar powered with built in battery banks, to allow the stations to run for up to 10 days during inclement weather.
- Data is pushed via FTP to our secure cloud-based server, or can be viewed/accessed via any web-enabled device on our remote monitoring data portal as can be seen in Figure 15.
- A network of nodes can be utilized to better understand the specific operation emissions and assist in managing the emissions.

Further analysis of the data include, but not limited to:

- Trend Analysis to determine trends in the particulate emissions and assist in when extra mitigation measures and specific operations should occur to limit dust emission. (Figure 16)
- Polar plots to determine at what wind direction and speed higher emissions occur to help determine if exceedances recorded by compliance instruments are from neighbouring sites or the project site. (Figure 17)
- Site specific weather data to help in management decision making on mitigation measure increases during certain hours of the day or night. (Figure 18)

Figure 26: Typical Real-Time Ambient Particulate Matter monitoring dashboard communication interface

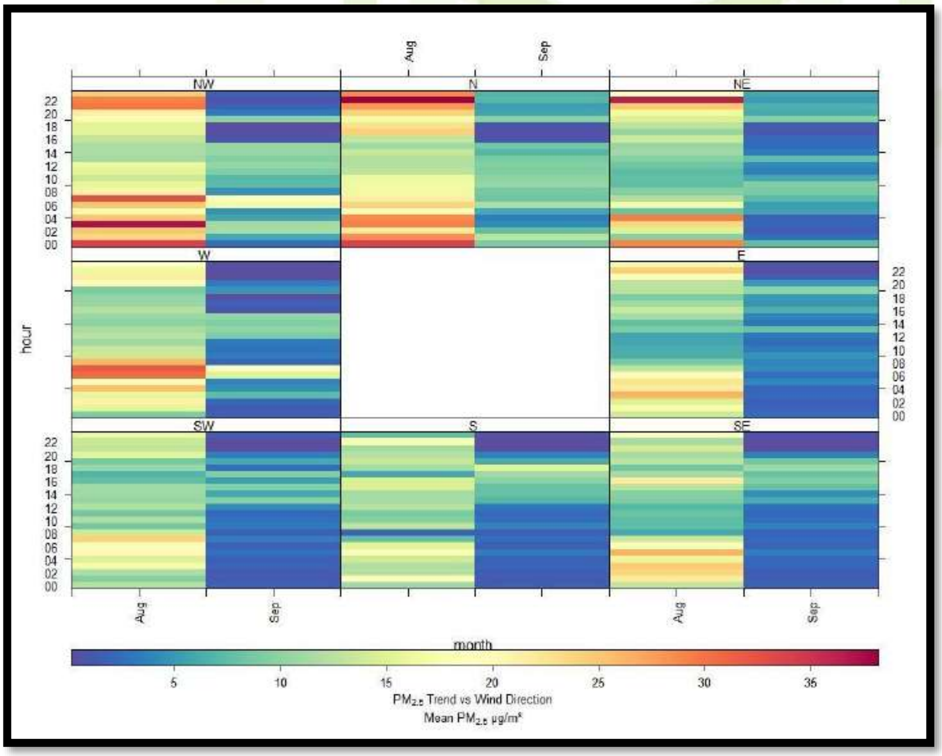


Figure 27: Trend Analysis showing trends in higher emissions at specific hours and wind direction.

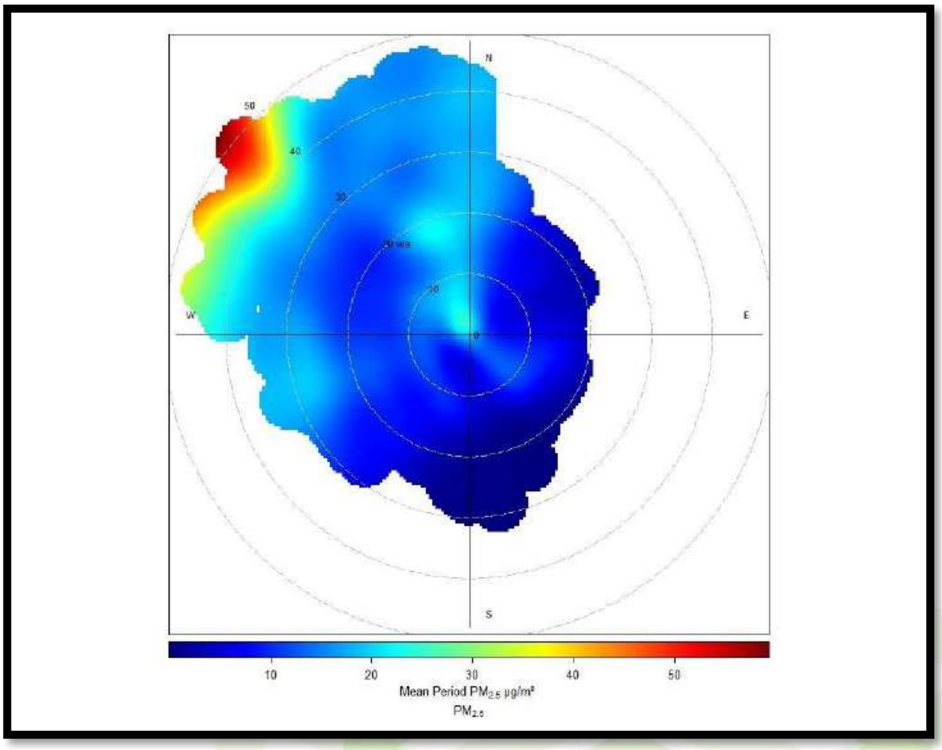


Figure 28: Polar Plot indicating higher emissions at higher windspeeds from the north-west.

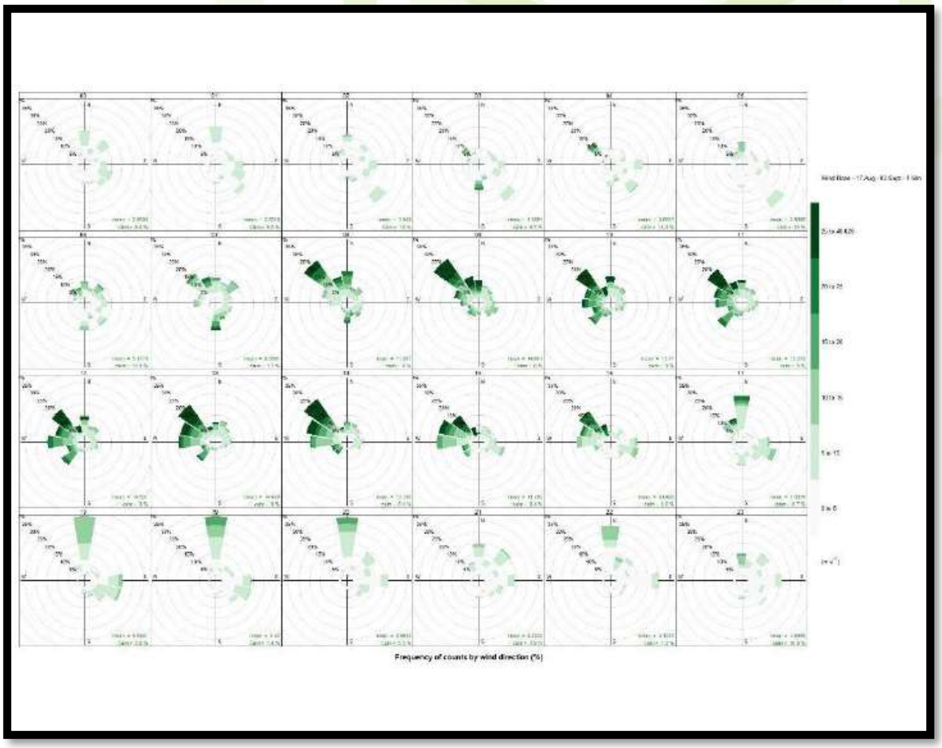
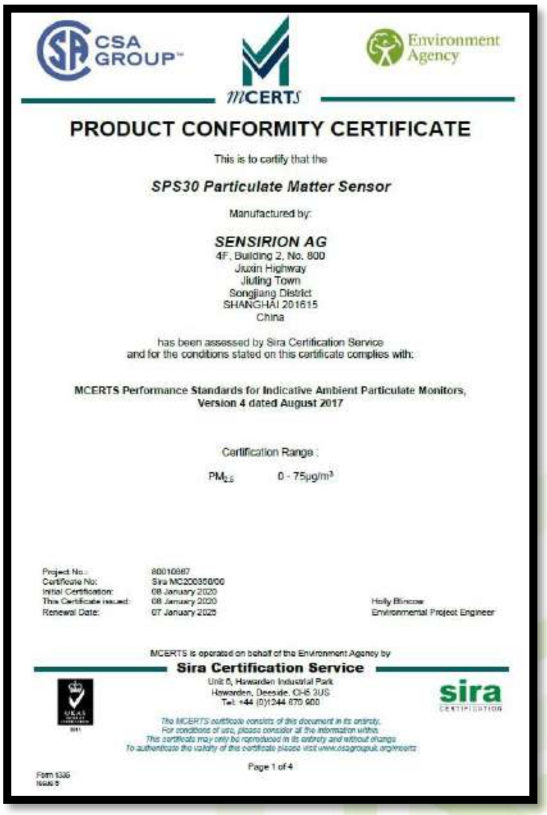


Figure 29: Hourly average wind roses to assist in decision making.



CSA GROUP™ — mCERTS — Environment Agency

PRODUCT CONFORMITY CERTIFICATE

This is to certify that the

SPS30 Particulate Matter Sensor

Manufactured by:

SENSIRION AG
4F, Building 2, No. 800
Jiuxin Highway
Jiuting Town
Songjiang District
SHANGHAI 201615
China

has been assessed by Sira Certification Service
and for the conditions stated on this certificate complies with:

MCERTS Performance Standards for Indicative Ambient Particulate Monitors, Version 4 dated August 2017

Certification Range :

$PM_{2.5}$ 0 - 75μg/m³

Project No.:	80010867
Certificate No:	Sira MC200350/00
Initial Certification:	08 January 2020
This Certificate issued:	08 January 2020
Renewal Date:	07 January 2025

Holly Briscoe
Environmental Project Engineer

MCERTS is operated on behalf of the Environment Agency by

Sira Certification Service
Unit 6, Hawarden Industrial Park
Hawarden, Deeside, CH5 3US
Tel: +44 (0)1244 670 900

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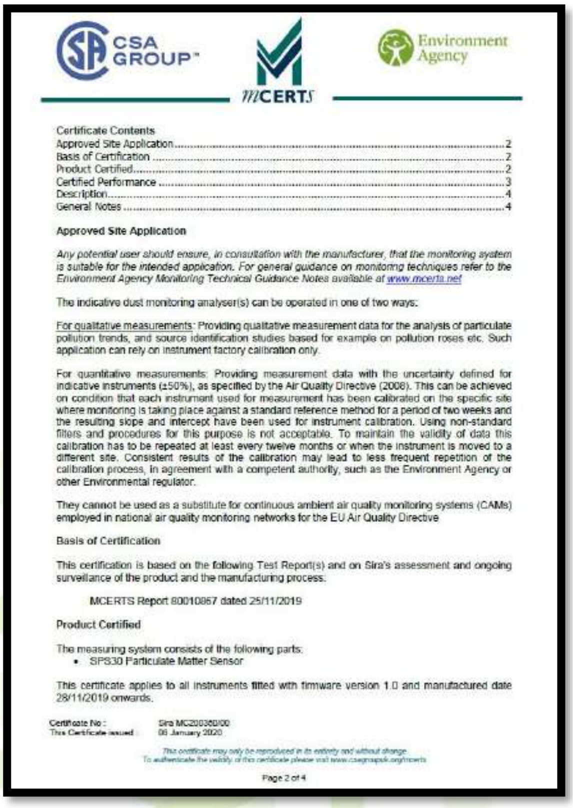
Form 1336
Issue 5



CSA GROUP™ — mCERTS — Environment Agency

Certificate Contents

Approved Site Application

Any potential user should ensure, in consultation with the manufacturer, that the monitoring system is suitable for the intended application. For general guidance on monitoring techniques refer to the Environment Agency Monitoring Technical Guidance Notes available at www.mcerts.net

The indicative dust monitoring analyser(s) can be operated in one of two ways:

For qualitative measurements: Providing qualitative measurement data for the analysis of particulate pollution trends, and source identification studies based for example on pollution roses etc. Such application can rely on instrument factory calibration only.

For quantitative measurements: Providing measurement data with the uncertainty defined for indicative instruments (±50%), as specified by the Air Quality Directive (2008). This can be achieved on condition that each instrument used for measurement has been calibrated on the specific site where monitoring is taking place against a standard reference method for a period of two weeks and the resulting slope and intercept have been used for instrument calibration. Using non-standard filters and procedures for this purpose is not acceptable. To maintain the validity of data this calibration has to be repeated at least every twelve months or when the instrument is moved to a different site. Consistent results of the calibration may lead to less frequent repetition of the calibration process, in agreement with a competent authority, such as the Environment Agency or other Environmental regulator.

They cannot be used as a substitute for continuous ambient air quality monitoring systems (CAMs) employed in national air quality monitoring networks for the EU Air Quality Directive

Basis of Certification

This certification is based on the following Test Report(s) and on Sira's assessment and ongoing surveillance of the product and the manufacturing process:

MCERTS Report 80010867 dated 25/11/2019

Product Certified

The measuring system consists of the following parts:
- SPS30 Particulate Matter Sensor

This certificate applies to all instruments fitted with firmware version 1.0 and manufactured date 28/11/2019 onwards.

Certificate No.:	Sira MC200360/00
This Certificate issued:	08 January 2020

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Figure 30: MCERTS Performance Standards for Indicative Ambient Particulate Monitors Certificate

11. CONCLUSION

The air quality impact assessment undertaken for the project includes a meteorological overview of the area. An emissions inventory was undertaken with the aim of quantifying emissions associated with the activities involved in the mining of coal. The emissions for specific activities such as bulldozing, tipping, wind erosion and materials handling activities were calculated and the cumulative impacts were compared to the relevant ambient air quality standards to determine legal compliance.

The findings reported here is therefore a combination of historical, observed and previously modelled data and provided the background and predicted scenario of various pollutants in the proposed Giyani project mining area. The construction and operational phases were assessed. Based on the dispersion modelling simulations, the following conclusions can be summarised as follows:

11.1 PM10

For the unmitigated Daily PM10 concentrations it was predicted to be higher than the 75 µg/m³ limit for 2 of the sensitive receptors as can be seen in Table 19.

When comparing the Daily Mitigated PM10 modelled concentrations, the sensitive receptors exceeding the 75 µg/m³ limit dropped to 0 of the identified sensitive receptors. This as well is the highest levels predicted for a 24 hour period within the period. Due to site specific atmospheric conditions these exceedances may still occur within the limit of 4 per year.

The annual average PM10 limit of 40 µg/m³ are predicted to also exceed at 2 of the sensitive receptors for the unmitigated scenario and dropping to 0 of the identified sensitive receptors for the mitigated scenario.

11.2 TSP

In the unmitigated and mitigated scenarios, 1 sensitive receptor are predicted to exceed the monthly dust fallout for the highest month residential limit of 600 mg/m²/day.

The predicted annual dust fall out for the unmitigated and mitigated scenarios are predicted to exceed at 1 of the sensitive receptors for the annual limit of 300 mg/m²/day.

This receptor is next to the haul road that is proposed to be used. It should however be noted that is the modelling results. A monitoring station, M03 as seen in Figure 31, at this receptor is necessary to get a better understanding of the actual impact at this receptor.

11.3 Mitigation Measures

The mitigation measures as seen in Table 22 are recommended at the various sources:

Table 22: Mitigation Method Summary

Operation	Reduction	Method
Handling Transferring and Conveying	50%	Water Sprays
Wind Erosion	50%	Water Sprays
	90%	Revegetation on OB and Topsoil
Haul Roads	90%	Encrusting (Dust Aside or Similar)
Primary Crushing	50%	Water Sprays
Secondary Crushing	50%	Inpit

Based on the results presented the following further recommendations are outlined:

- It is recommended that ambient air quality monitoring be established to get a baseline condition prior to the onset of the operations and in order to establish the level at which the proposed operations are noted to impact on the ambient air quality.

- Fallout monitoring should be continued for the life of mine to better assess the level of nuisance dust associated with both mining and process related operations. Sampling of fallout should be undertaken within the neighbouring areas as well as on-site. Dust fallout monitoring is recommended at the locations as shown in Figure 31.
- PM10 and PM2.5 dust monitoring must also be undertaken at the same sites as mentioned under the previous bullet but also in and around potential fugitive emission sources to determine mitigation measures and focus management efforts.
- If it is found that dust and PM10 levels are measured to be exceeding limits, it is highly recommended to establish a Real-Time indicative monitoring network to quantitatively help identify the sources and to assist in the management of the mitigation of these sources.

The impacts from dust fallout and Particulate matter can be reduced by implementing dust control measures. The highest intensity of the construction work should be carried out during the summer months and not over the harsh winter months as can result in increased dispersion of fugitive dust. The mine should ensure that unpaved roads are continuously watered and treated with dust binding additive products to reduce the volume of fugitive dust emitted from unpaved roads.

Mitigation and management measures for mining operation as discussed in this report should be sufficient to ensure the mining operation can be conducted with minimal impact on the receiving environment and therefore not have a detrimental effect and can go ahead.

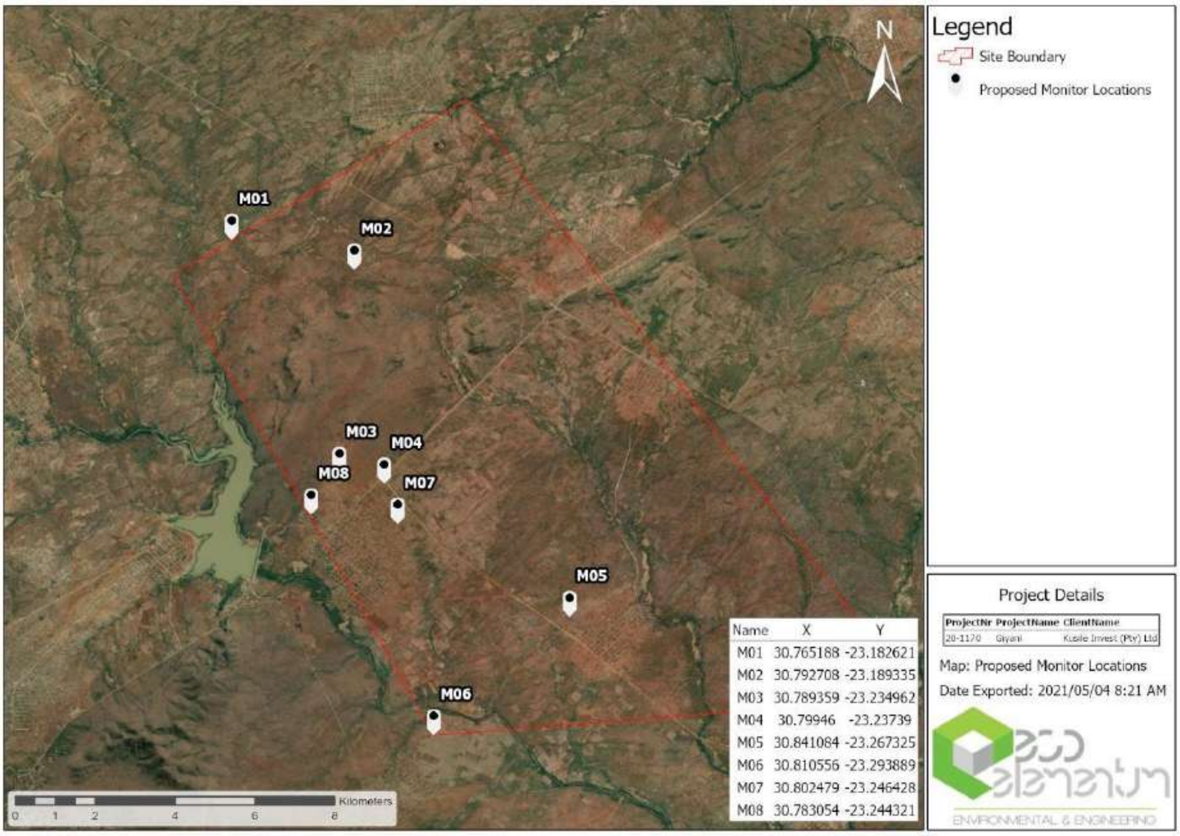

Figure 31: Proposed Monitor Locations

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ANNEXURE 11 – TRAFFIC IMPACT ASSESSMENT

4/20/2021

Traffic Impact Assessment for the Proposed Giyani Gold Mine Project

Assessment for the mining right application on Un-Surveyed State land of Greater Giyani 891 LT and a portion of portion 0 of the farm 246 located in the Greater Giyani Municipality, within Mopani District Municipality in Limpopo Province.

ARCHEAN RESOURCES PTY LTD

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STATEMENT OF INDEPENDANCE AND PROFESSIONAL AFFILIATION

I, Yvonne Gutoona, hereby declare that I:-

- Act as an independent consultant;
- Do not have any financial interest in the undertaking of this project, other than remuneration for the work performed in terms of the National Environmental Management Act EIA Regulations Amendment of April 2017
- Have and will not have vested interest in the proposed activity nor will I engage myself in any conflicting interest associated with this project
- I undertake to disclose and provide to the competent authority any material or information at my disposal regarding this project as required in terms of National Environmental Management Act (EIA regulations of April 2017);
- Based on the information provided to me by the client and in addition to information obtained during the course of this study, I have presented the results and conclusion with regard to this project to the best of my professional ability;

Y. Gutoona

Signed at: Pretoria

Y. Gutoona

----

1 EXECUTIVE SUMMARY

Kusile Invest 133 (Pty) Ltd has appointed Archean Resources (Pty) Ltd, an independent consulting company, to conduct an Environmental Impact Assessment (EIA) process to evaluate the potential environmental and social impacts of the proposed project. The project is referred to as the Giyani Gold Mine Project. The applicant Kusile Invest has lodged a mining right on Un-Surveyed State land of Greater Giyani 891 LT and a portion of portion 0 of the farm 246 located within the town of Giyani, Limpopo Province. and intends to establish an underground and open cast mine. As part of the Environmental Impact Assessment a Traffic Impact study has been done to review the current road usage patterns and projected changes once the Giyani Gold Project (hereon the project) has been commissioned.

The existing and forecast traffic environment was established through a combination of route information in line with Road Agency Limpopo (RAL): an analysis of published RTA traffic count data for the local road network; and traffic counts completed in March 2021.

The Giyani gold mine is located within the town of Giyani, approximately 140 km to the northeast of the N1 National Road from Polokwane. A well-maintained R 81 road, from the N1 will provide as the main access to the mine. The mining area will be accessed through existing tarred roads that will link the mine to the various villages such as Thomo, Shiviti, Mninginisi, Mbatlo, Mavalani and Shikukwani. Limpopo. The R81 Starts at R71, in Polokwane, crosses N1 [410], stg. crosses R36(1,5km) at Mooketsi, past R578 past R529, through Giyani, ends at R524 between Thohoyandou and Punda Maria. The R81 This road can be classified as a Class 3 road (major arterial road) and falls under the jurisdiction of the South African National Roads Authority Limited (SANRAL.

The manual set the guidelines for carrying out a traffic impact investigation. In terms of the guideline, a fully-fledged traffic impact analysis is required to be carried out if more than 150 vehicle trips per hour will be generated by any development. This should include conducting vehicle count surveys, conflicting turning movement analysis, and intersection performance analysis and road safety assessment if applicable. Measures such as level of service, delay, and volume or capacity ratio can be used to quantify the performance of an intersection or a roadway facility.

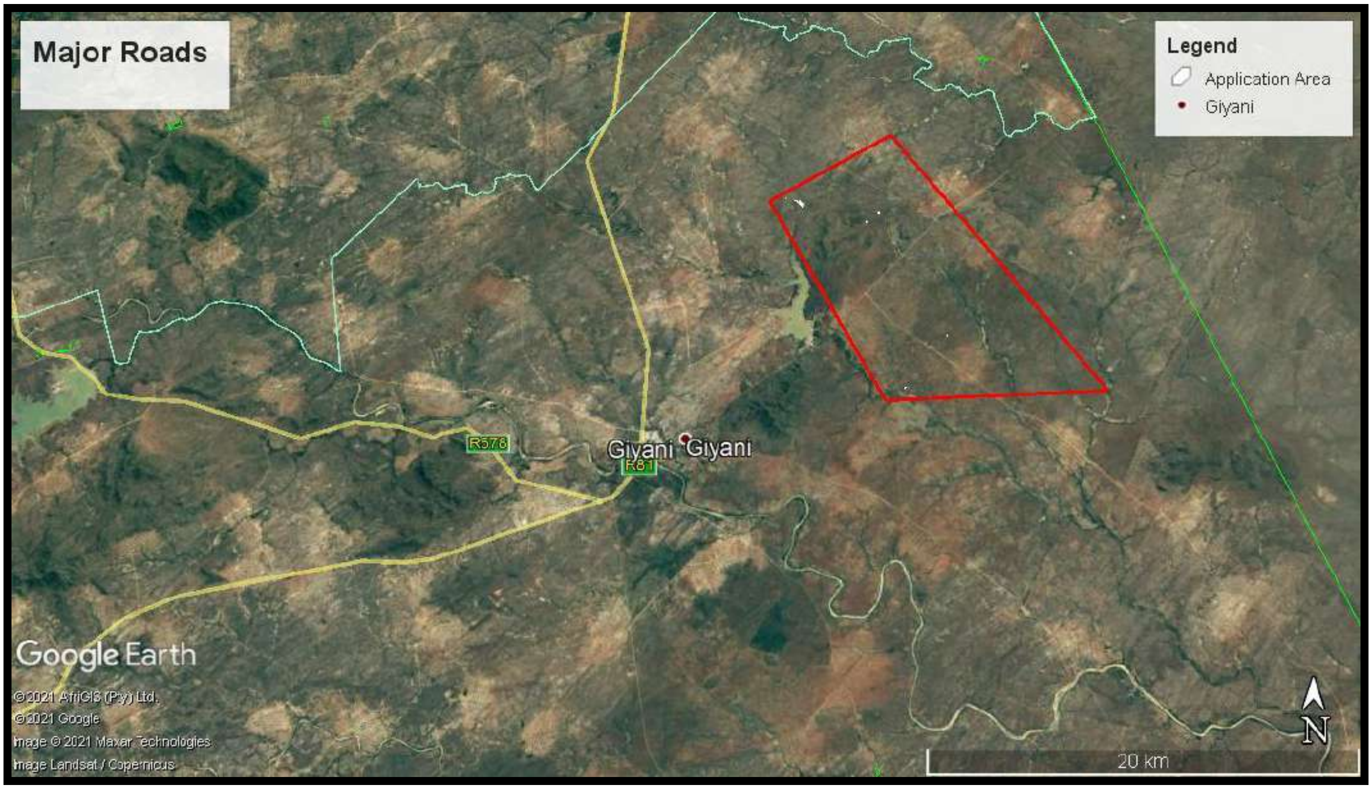

FIGURE 1: MAJOR ARTERIAL ROUTES IN THE PROJECT AREA

The purpose of this report is to provide findings of the traffic investigation conducted to assess the impact of the mine traffic on the existing external road networks surrounding the development area. Based on this assessment, mitigation measures are recommended for the proponent to minimise the potential impacts on the existing road network.

The construction and operations of this new infrastructure will generate additional traffic on the existing road within the study area. The purpose of this specialist traffic and transportation study is therefore to estimate the daily traffic that the proposed construction and operations of the new infrastructure is likely to generate. Furthermore, this study will endeavour to assess the impact of this additional traffic on the surrounding road network and make recommendations for mitigation or improvements.

The objectives for this specialist traffic and transportation study are thus as follows:

- To undertake a review of all relevant literature and a field study to describe the baseline traffic conditions.
- To determine the potential environmental and social (including labour, health and safety) indirect, direct and cumulative risks / impacts to receptors for each activity.
- To propose mitigation measures for the identified significant risks / impacts and enhance positive risks / impacts of the project.

- To identify monitoring and capacity requirements and costs for implementing the suggested mitigation measures.
- To ensure that the project operations are in compliance with the relevant social and environmental standards, policies, laws and regulations.

The Scope of Work for includes the following:

- Scope of work undertaken and assumptions / limitations.
- Methodology used to obtain supporting information.
- Overview of relevant legislation.
- Results of all investigations.
- Interpretation of information.
- Assessment of impacts (including cumulative impacts) associated with all stages of the project (construction, operation, closure and post-closure) in accordance with the impact assessment methodology

1.1 Terms of reference

TASK	ACTIVITIES REQUIRED TO COMPLETE TASK
Review existing information	➢ Undertake a desktop study to review relevant available information.
Baseline Assessment	The scope of this investigation will deal specifically with increased traffic levels on the existing roads and the increased safety hazards that local communities will be exposed to as a result of the additional traffic during the key stages of the project, which will include: ➢ Identify the anticipated increase in road traffic during all phases of the project. ➢ Identify transportation routes likely to be used by construction and operation vehicles as a result of the proposed mine. ➢ Establish the status quo with regard to traffic flows in the areas surrounding the site including the road condition.
Assessment of risks/impacts	➢ Identify and predict the significance of the direct, indirect and cumulative risks/impacts arising from the activity for the key stages of the project including: preconstruction, construction, operation and post-closure.
Identify mitigation measures	➢ Identify management and mitigation measures and actions where required that address the direct, indirect and cumulative risks and impacts in order to comply with applicable laws and standards
Monitoring	➢ Recommendations will be formulated where required for the future monitoring of significant impacts.

In addition, this specialist traffic and transportation study has also referred to the following guideline documents:

1. Guidelines for Traffic Impact Studies (BKS Incorporated 1995 an update of the National Department of Transport's document Guidelines for Traffic Impact Studies 1990) which provides guidelines to determine the extent of the study area for such a project, the type of impact assessment required, the type of traffic analysis that needs to be undertaken, the time periods that need to be analysed and the methodology to be used.

2. Southern African Road Safety Manual (National Department of Transport 1999) which gives guidelines and the methodology to undertake a road safety assessment of existing roads.

3. Southern African Development Community Road Traffic Signs Manual (South African Department of Transport)

4. National Guidelines for Traffic Calming (South African Department of Transport) COD Report CR-96/036

1.2 Route Assessments

Figure below presents the regional and local setting of the proposed operations, identifying the roads that would be used by Project generated traffic. The scope of the traffic impact assessment takes into consideration, but is not limited to the following:

- A description of the Project and area of potential impact, i.e. the area of assessment.
- An assessment of the local road network considering geometry, safety and pavement condition.
- An assessment of the potential impact of the Project on traffic.
- Providing recommendations as to appropriate safeguards and traffic management measures to minimise the potential impact on traffic of the Project.
- The established existing (2021) and forecast peak hour traffic figures used in this assessment are presented in Table 1.
- Assessment of risks/ impacts
- Identify mitigation measures
- Monitoring

2 PROJECT OVERVIEW

Mining operations will commence from five open cast and expand into four working levels to reach the steady state production of 12 000 tons per month. Additional working areas will be established for sustainability and to replace the depletion of ore reserves being mined from the start-up working areas.

The open pit mine design shows the ore body being located centrally to the pit outer walls or pit shell. The waste surrounding the ore body will be stripped, with topsoil stored separately from waste rock for re-use during rehabilitation of the pit at closure of mining operations. The stripping will include the removal of surrounding topsoil and waste rock to fully expose the ore body and have enough area for movement of machinery inside the pit.

The sidewalls of the excavation, surrounding the ore body, referred to as benches, will be excavated at intervals to a maximum depth 12 metres and must be slanted to ensure slope stability as per specifications determined by the project's Rock Engineering expert. The pit development will include the creation of Berms, representing the flat area or horizontal distance of approximately 5 metres in width, when measured from the bottom of the preceding or top bench to the edge of the next bench as the pit goes dipper.

An access ramp and haul road will also be created from the top bench on the outer limits of the pit, traversing the lower benches in order to have mining equipment and personnel accessing the pit floor where excavating or blasting of the ore bearing rock will be conducted. The pit will be excavated to an optimal operating final depth of 60 metres below surface level.

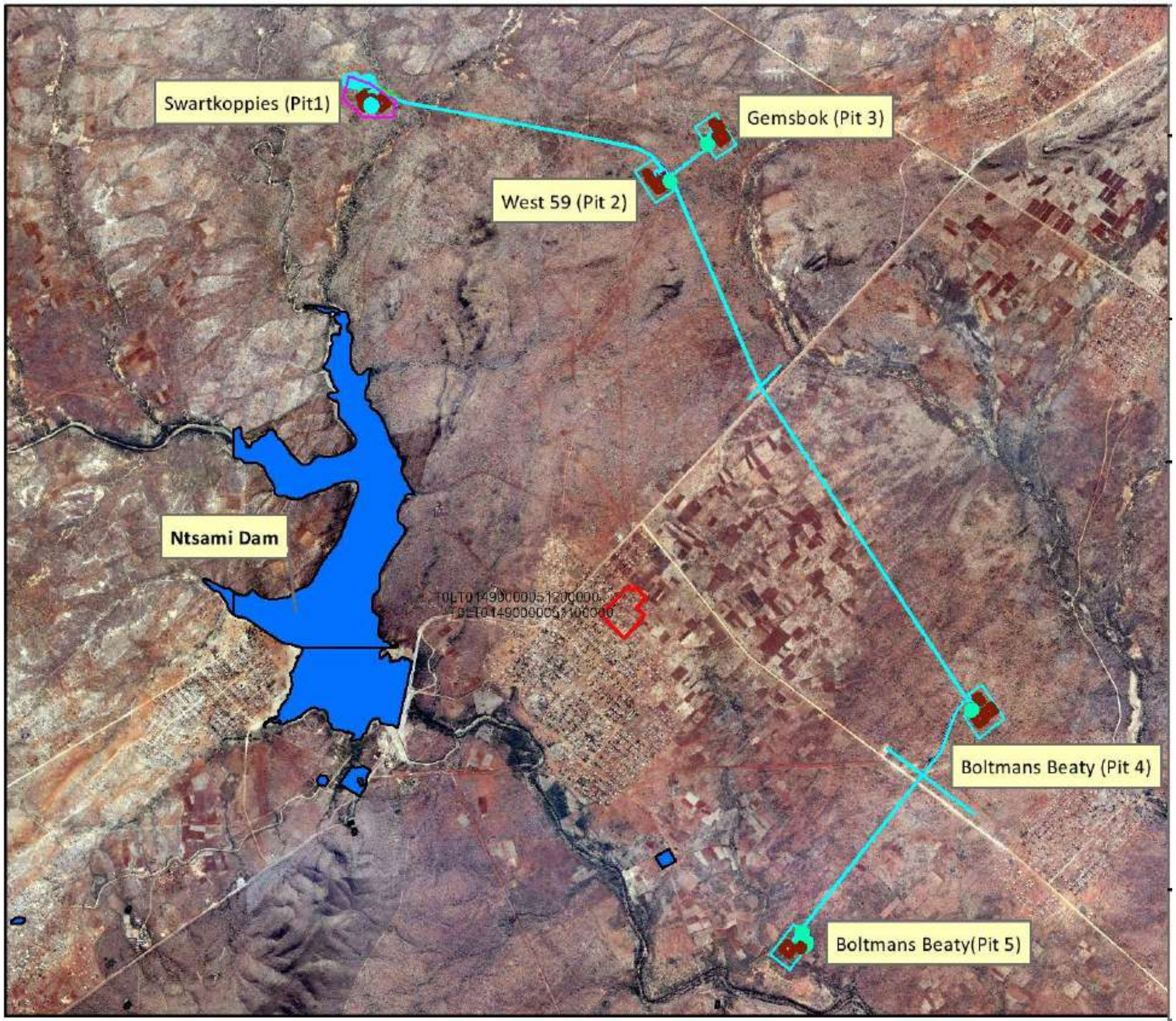

FIGURE 2:: Pit location and routes

2.1 Mining Method and Products

The planned mining methods will include open cast/surface mining. Mining activities will be carried out on the reef horizon by means of excavating, drilling, blasting, and cleaning of ore using heavy earth moving equipment and blasting using commercial explosives scraper cleaning operations and truck loading or hoisting. The broken ore will be loaded on to trucks and transported through the declines which will be developed below the reef horizon/stoping area for transporting to surface by conveyor belts. The following type of minerals are applied for:

- Gold Ore/Bearing Minerals: Code: (Au),
- Copper Ore/Bearing minerals: Code: (Cu),
- Silver Ore/Bearing minerals: Code: (Ag),
- Nickel Ore/Bearing minerals: Code: (Ni),
- Platinum Group Minerals: Code: (PGM),
- Zinc Ore/Bearing Minerals: Code: (Zn),
- Lead Ore/Bearing Minerals: Code: (Pb),
- Uranium Ore/Bearing Minerals: Code: (U),
- Chrome Ore/Bearing Minerals: Code (Cr),
- Aggregate Material

Mining will commence using open pits on outcrops on the site .Separate declines will be developed for men and material access and rock handling. Footwall haulages will be developed from the declines to create crosscuts and raise lines similar to those used in a shaft system. Stoping or conventional breast mining commences from the raise line with mining panels laid out at 20 - 30m lengths. The rock breaking process or excavation entails drilling of blast holes and charging of holes. Blasting of ore is done from both sides of the raise advancing on strike along the reef horizon. The broken ore will be loaded by LHD’s on to trucks and transported through the declines which will be developed below the reef horizon/stoping area for transporting to surface by conveyor belts. In a typical SA gold mine, cleaning of broken ore is conducted by scraper winches to collect ore from the panel into an ore-pass for loading onto a hoppers on the haulage below the stope. The development of the access haulage and the on-reef development is carried out using hand-held rock-drills and pneumatic loaders employed for cleaning of the broken rock into hoppers. The broken rock loaded onto the hoppers is transported/trammed by a locomotive into an ore-pass or rock handling system for hoisting to surface.

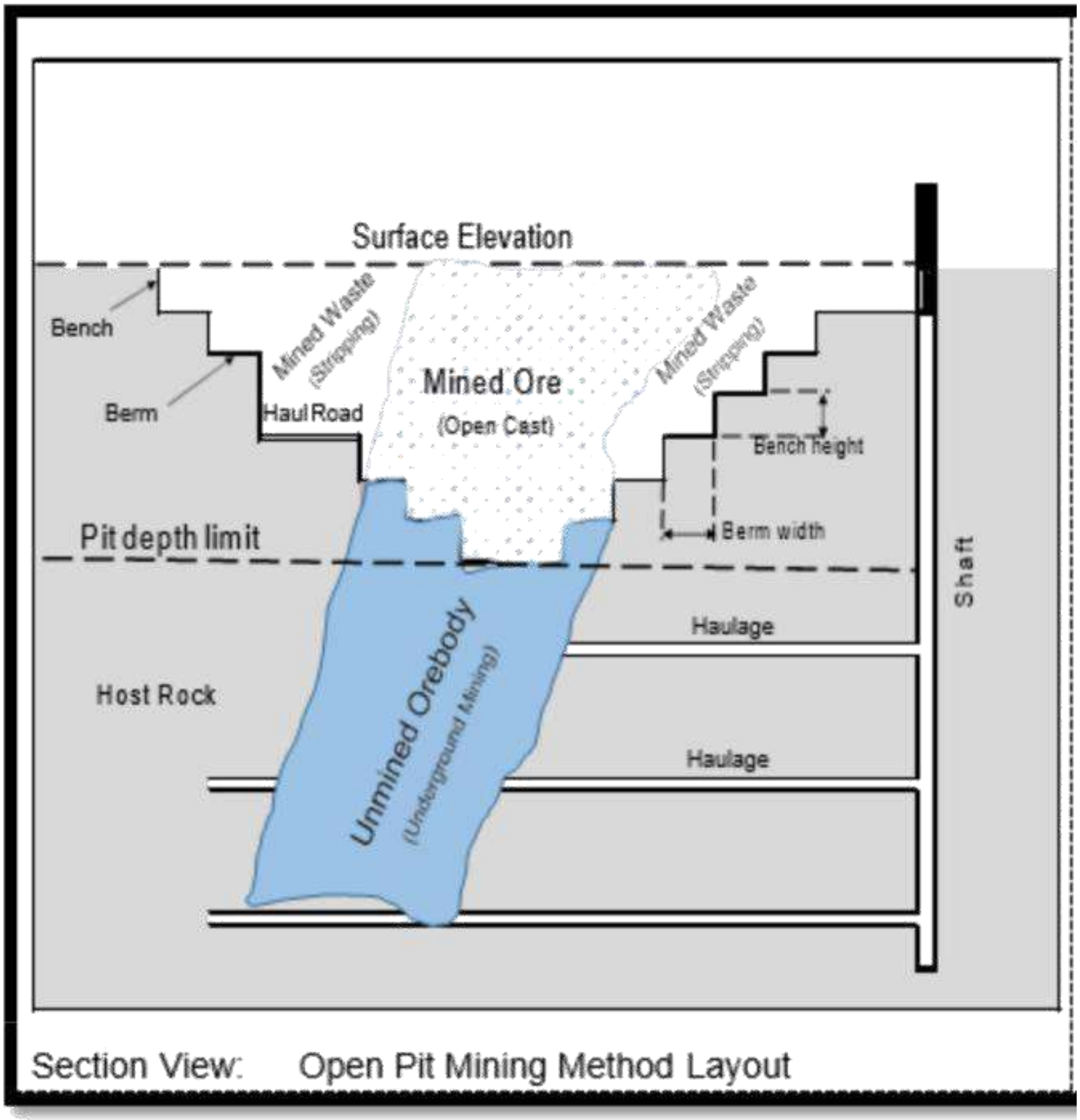

FIGURE 3: Schematic Diagram of Proposed Mining Methods (Open Cast)

2.2 Extent of Activity

The mine development activities will commence by establishing and installing the required mining infrastructure such as pit establishment; shaft headgear and winders, service water, compressed air and power supply, processing plant and installation of surface ventilations fans. The type and size of the mining infrastructure to be installed will be designed to support the proposed Life of Mine (LOM) production rate of 12 000 tons per month of Run of Mine material (ROM) for 30 (thirty) years.

2.2.1 Expansion Plans

The construction work required to develop the mine and mining infrastructure will commence in January 2021 for a period of six months. Thereafter, the mining operation is scheduled to commence immediately after the completion of construction work and granting of the Mining Right in September 2021. Mining operations will be conducted on surface, using open cast mining methods applying conventional stoping methods

2.2.2 Activity Life Description

The construction work required to develop the mine and mining infrastructure will commence in January 2021 for a period of six months. Thereafter, the mining operation is scheduled to commence immediately after the completion of construction work and granting of the Mining Right in September 2021. Mining operations will be conducted on surface applying conventional stoping methods. The Giyani Gold Mine project is comprised of three different phases which include the construction phase, operational phase, and decommissioning phase.

2.2.2.1 Construction Phase

The construction work required to develop the mine and mining infrastructure will commence in January 2021 for a period of six months. Thereafter, the mining operation is scheduled to commence immediately after the completion of construction work and granting of the Mining Right in September 2021

2.2.2.2 Operational Phase

- Total estimated Life of Mine (LoM) for the operational phase is 30 years with a production capacity of 12000 tons per month of Run of Mine Material; which equates to 3,4 million tonnes over the 30 year period
- Mining will commence using open pits on outcrops.
- Total recoverable and sealable ore for the total resource is 14 tonnes

2.2.2.3 Decommissioning Phase

- The decommissioning phase is expected to begin once all economically exploitable ore reserves have been extracted. This phase will kick-off immediately after end of the operational phase.

2.3 Activity Infrastructure Description

2.3.1 Surface infrastructure

The proposed project would comprise of the design and construction of all building structures, related earthworks and building services, electrical and mechanical installations. This would include *inter alia*:

- Central Plant and Mobile Process plant
- Loading area

- Stockpile areas
- Site clearing and storm water berms and trenches;
- Administration building and first aid;
- Change house and laundry;
- Lamp room, self-rescuer and proto room;
- Access control and security centre;
- TMM Maintenance workshop, services, lubrication, bays;
- Wash bay and oil skimmer;
- Bulk fuel storage area;
- Refuelling bay
- Tyre storage, repair and pump area;
- LVD workshop;
- Fitting, electrical and boiler making workshop;
- Main stores and yard;
- Salvage yard;
- External parking, shade ports and walkways;
- Electrical, water and sewage reticulation;
- Terraces, pavements, access, internal and haul roads;
- Perimeter and internal fencing; and
- Explosives off-loading, storage and distribution.
- One Slimes Dam and PCD"s

2.3.2 Water Supply

Water requirements on the mine will include the supply of water for drinking, dust suppression, general office use; cleaning of equipment; workshops and hauling roads. Potable water will also be needed for human consumption and change house facilities. The mine will source its water supply from groundwater boreholes to be drilled on each mine site. Any excess water will be channelled into settling ponds and used as make-up water in the event of losses associated with mining operations, waste streams and evaporation.

2.3.3 Sewage Disposal

Waterborne sanitation will be in place for ablution facilities at the mine office, change house, and workshop area, to be located. An internal sewage reticulation system will be provided to drain all raw sewage and grey water from the mine office complex and workshops. The sewage will be treated in a package sewage treatment plant. The treated sewage effluent will be drained to the PCD for reuse in the processing plant and for dust suppression. The system will employ an activated sludge process and disinfection to General Effluent Standards. In addition, portable chemical toilets will be provided at the pit area. The raw sewage will be collected by an authorized contractor for disposal into an authorized sewage treatment works. Safe Disposal Certificates will be kept in record at the mine.

2.3.4 Process Water

Process water includes all water pumped and used in especially mine operations for various processes such as washing , crushing , ore processing and dust suppression. Water utilisation will be maximised through recycling of dirty water within the process operations.

2.3.5 Processing Plant facility

Gold ore mined will be transported by Articulated Dump Truck (ADT) from open cast pits and hoist skips or conveyor belts to stockpiles and storage areas, where it will be transported to the central processing plant by side tipper trucks for stockpiling onto a ROM pad in front of a crusher unit. A ramp will be utilized to provide access for the loading and dumping of ore on the tipping station for crusher feed. A conveyor belt will carry the ore from the tipping station and feed the load on top of a grizzly above the feed bin of a crusher.

The key installations and stages of the processing plant for gold recovery are crushing, milling, gravity concentration, flotation, leaching or cyanidation, elution/concentration and smelting. Summarized below is a high level description of the processing plant for the Giyani mining operations:

2.3.5.1 Crushing

Ore extracted from the mine will be trucked and delivered to the ROM pad where it will be stockpiled. It will then be fed through a two stage crushing process. The Primary Crusher will be a single toggle jaw crusher with the Secondary Crusher being a cone crusher.

2.3.5.2 Milling

The process is used to further agglomerate the crushed ore being fed into a semiautogenous grinding (SAG) mill with lime, water and steel balls to liberate the gold contained in the rock. The larger particles from this mill are returned to the SAG mill for more grinding. The finer particles receive more grinding in a ball mill, and are size classified to give a final product of 80% <70 microns. Crushed ore will be ground using a 4.2m diameter, 5.3m long primary ball mill with 1650kw motor.

2.3.5.3 Gravity concentration

This stage of the process separates gold from the milling process using the metal's higher specific gravity to settle in a solution and separate from other metals and material. This will be done in two centrifugal concentrators installed as part of the plant.

2.3.5.4 Flotation

It’s a process for producing a mineral concentrate through the use of chemical conditioning agents followed by intense agitation and air sparging of the agitated ore slurry to produce a mineral rich foam concentrate. The installation comprises a bank of eight forced air, mechanically agitated cells ($8m^3$ each).

2.3.5.5 Cyanidation/leaching –

This process involves the dissolution of gold containing ores in dilute cyanide solution in the presence of lime and oxygen contained in acid resistant leach tank.

2.3.5.6 Elution/concentration –

This process is called Carbon in Pulp (CIP) and is applied to control the gold precipitation from the cyanide solution by use of activated gold (carbon). The final loaded carbon then is removed and washed before undergoing "elution" desorption of gold cyanide at high temperature and pH.

2.3.5.7 Smelting

The rich eluate solution that emerges from the elution process is passed through electro winning cells where gold and other metals are precipitated onto the cathodes. After precipitation, the product is treated with dilute sulfuric acid to dissolve residual zinc and most of the copper (if any is present). The gold precipitate is then filtered out of the solution, mixed with fluxes and smelted to form crude and impure bars which are sent to a refinery to remove the copper and silver.

2.3.6 Basic plant design. (supported by a process flow diagram, of the plant).

The basic plant design and anticipated process flow diagram (see diagram below) is based on the proven metallurgical technology currently being used by mines in South Africa and represents a typical free milling carbon-in-leach (CIL)/carbon-in-pulp (CIP) gold processing circuit comprising:

- Two stage crushing;
- Single stage milling designed for a grind size of 105 micron;
- Knelson Concentrator or Gravity recovery cyclone;
- Thickeners;
- CIL/CIP leaching and adsorption with a retention requirement of only 16 hours;
- Elution, gold smelting and carbon regeneration;
- Tailings disposal.

The modular nature of the proposed process plant layout will allow for modifications, including increasing plant throughput, to be undertaken when required.

The process flow diagram of the processing plant showing the key components of the plant is as below:

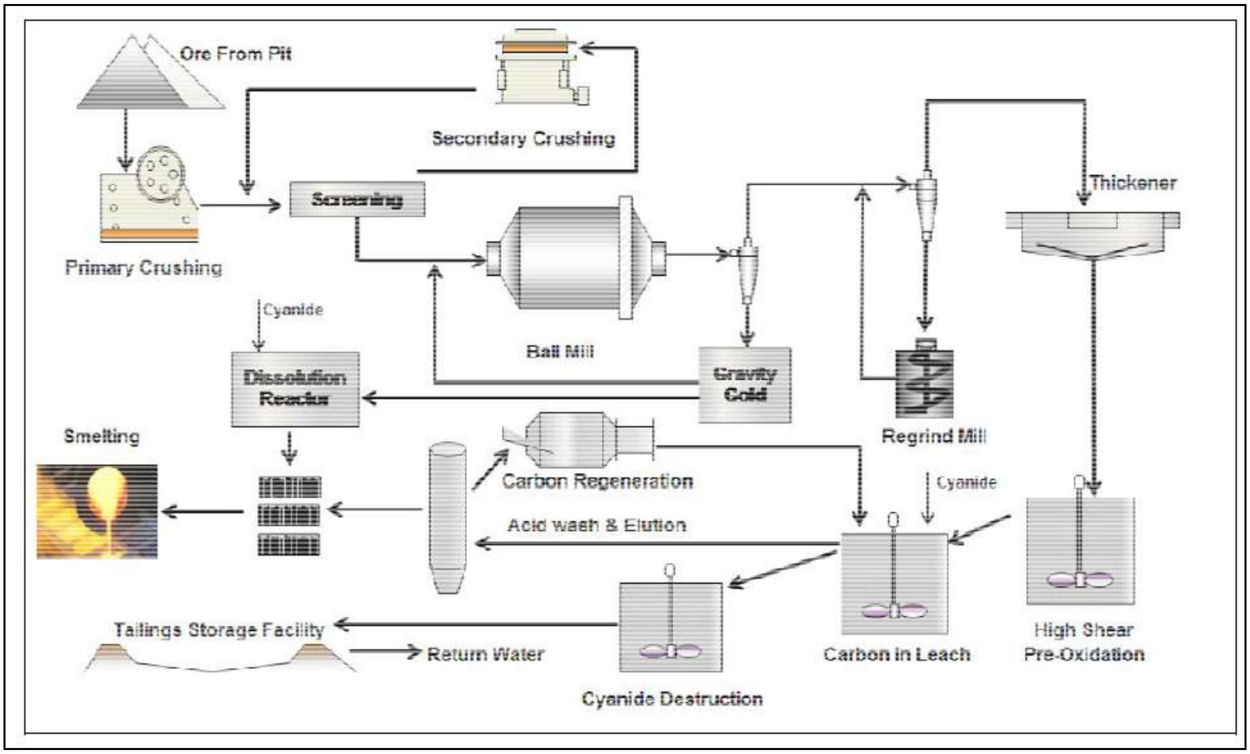

FIGURE 4: **Schematic layout of processing plant**

2.3.6.1 Efficiency of the process

Together with an estimate of the mineral recovery rate, and the expected mass or volume of mine waste or residues together with the manner in which it would be disposed of.

The processing plant is based on the production rate of 50 tons per hour of feed material. Based on the flow above diagram, the ROM broken ore will be fed on the primary crusher using front end loaders and dump trucks, operating on a two 12-hour shifts per day. Liberation of mineral product will be achieved through crushing the ROM, milling, floatation, leaching and concentration to liberate the gold and separate it from other metals before smelting into gold bars in a furnace. A ROM stockpile will be established to allow for continuous feed to both the primary and secondary crushers.

When using the Carbon in Leach process, the expected overall recovery of gold in comparison to the plant feed or head grade will be approximately 95% for every gramme of gold contained in the ROM feed material. The amount of residue using a head grade of 5 grammes for every ton of rock implies that 12000 tons/month will contain 57kg or 0.057tons of recovered gold, the balance being waste rock to be disposed as residue. Therefore, the expected mass or volume of mine waste/tailings or residue is calculated to be approximately 11 999.94 tons. The design, construction and operation of the tailings dam will take into account the final closure and rehabilitation requirements of the mine as well as safety. This must be done in a manner that will minimize negative impact on the land and environment post mining operation. The greatest danger of tailings deposition is dam failure, as this can result in catastrophic damage to property and loss of life. To prevent the possible negative impacts as stated above, a conventional tailings disposal method will be applied. Using this method, the underflow from the thickeners will be pumped and discharged on a relatively flat ground to an approved purpose-built tailings dam by means of controlled deposition. The supernatant water contained in the tailings will be collected behind a water-retaining perimeter containment wall or in a water-tight perimeter channel surrounding the tailings dam to prevent affluent water from running into the streams

2.4 Project Objectives

In addition to reviewing the current status quo of the affected area the methodology for the assessment is also highlighted.

The objective of the project is to develop new roads and upgrade the current roads and the proposed upgrades will add a demand on the existing services infrastructure as the population will increase as well as employment opportunities. The project will lead to an increase in traffic flow from light motor vehicles, taxi's and buses shuttling workers to and from site as well as heavy vehicles operating with the site and the roads hauling of ore from pits to the main plant area.

The following has been realized:

- Collection of traffic information to determine the status quo;
- Determination of trip generation resulting from the activities of the mine, including capacity evaluation of existing routes (number of lanes ad type of intersection control);
- Assessing the impact of transportation aspects related to the mining activities; the capacity analysis of the route R81 (The R81 Starts at R71, in Polokwane, crosses N1 [410], stg. crosses R36(1,5km) at Mooketsi, past R578 past R529, through Giyani, ends at R524 between Thohoyandou and Punda Maria), including the intersection analysis.
- Safety Statement: an assessment of R81 Geometrical standards in terms of the vertical and horizontal alignment to accommodate more trucks; and a further investigation and determination if additional climbing lanes may be needed for the R81 road.
- Investigation of the public transport and pedestrian activities that might be impacted by the mine traffic or activities;
- A detailed proposal of site specific mitigations which include any road network upgrading and specifications on preferred routes

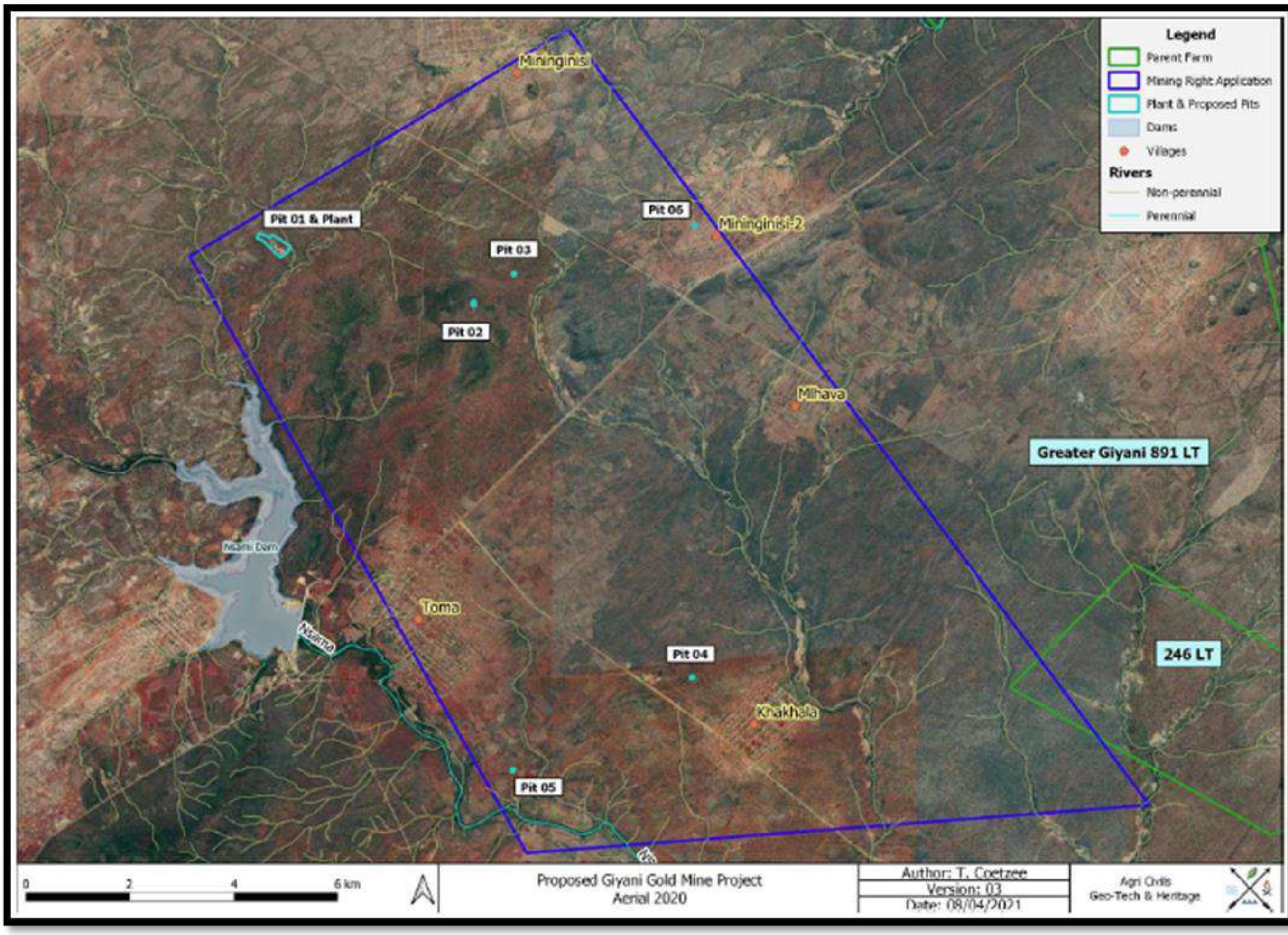

FIGURE 5: SITE LAYOUT

2.5 Assessment Methodology

The assessment methodology entailed the baseline assessment, traffic impact assessment and recommended mitigation measures and the flow chart or steps followed are illustrated in figure below

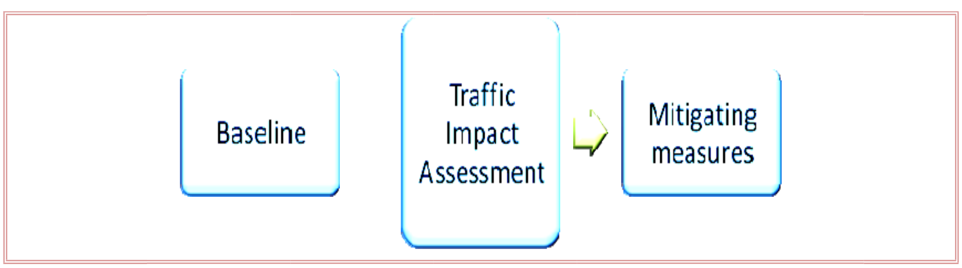

FIGURE 6: REVIEW OF EXISTING INFORMATION

The proposed open pits will be located on the following farms

- Swartkoppies (Pit - 1),
- West 59 (Pit - 2),
- Gemsbok (Pit - 3),
- Boltmans Beaty (Pit – 4); and
- Boltmans Beaty (Pit – 5)

The project area covers a surface area of 13894.66 hectares (ha) .Extent of surface area required for mining is 1000 hectares and extent of the area required for infrastructure, roads, servitudes etc. is 150 hectares. The site is delineated on the site layout plan depicted on the figure below. The proposed mining activities are outside the 1:50 and 1:100 year floodlines. The site layout plan depicts positions of the mining activity and related infrastructure including the following:

- Mine opencast workings (pits area)
- Ore/gold processing plant area
- Mine office complex
- Tailings Storage Facility
- Overburden dump
- Topsoil stockpiles
- Access and haul roads

2.6 Baseline Assessment

The baseline assessment included the identification of the affected external roads; the investigation ad assessment of the status quo of internal and external road networks; existing traffic volumes, capacity analysis of the existing road network and of the affected intersections.

The baseline assessment further included identification of the assessment variables of the basic road network investigation (i.e cross sections, condition of the road, existing signage and vertical and horizontal alignment of the roads).

2.6.1 Traffic Impact Assessment

A detailed traffic impact assessment was conducted which included the investigation and assessment of the existing and future transport requirements related to the Giyani Gold Project activities; existing and future transport demands, public transport and pedestrian movement investigation and road safety aspects investigations.

2.6.2 Identification of mitigations

The potential impacts of the Giyani Gold Project activities were identified and assessed in accordance with the methodology presented in part of this report. Details on the potential impacts and mitigation measures are further addressed.

3 FINDINGS OF THE BASELINE ASSESSMENT

This section of the report provide details and findings of the baseline assessment conducted, as outlined below:

3.1 Existing external road network

A well-maintained R 81 road, from the N1 will provide as the main access to the mine. The mining area will be accessed through existing tarred roads that will link the mine to the various villages such as Thomo, Shiviti, Mninginisi, Mbatlo, Mavalani and Shikukwani. Limpopo. The access roads to the mine and plant area as well as to the opencast area, will be constructed from this road. The R81 Starts at R71, in Polokwane, crosses N1 [410], stg. crosses R36(1,5km) at Mooketsi, past R578 past R529, through Giyani, ends at R524 between Thohoyandou and Punda Maria. The R81 This road can be classified as a Class 3 road (major arterial road) and falls under the jurisdiction of the South African National Roads Authority Limited (SANRAL.

The internal roads will be 6 m wide surfaced roads, with semi-mountable curbs and non- mountable curbs on both sides of the road, as required. These roads will be equipped with all the required storm water systems and structures to prevent any possible flooding. Dust from these roads will be controlled by applying road binders and regular watering with water tankers.

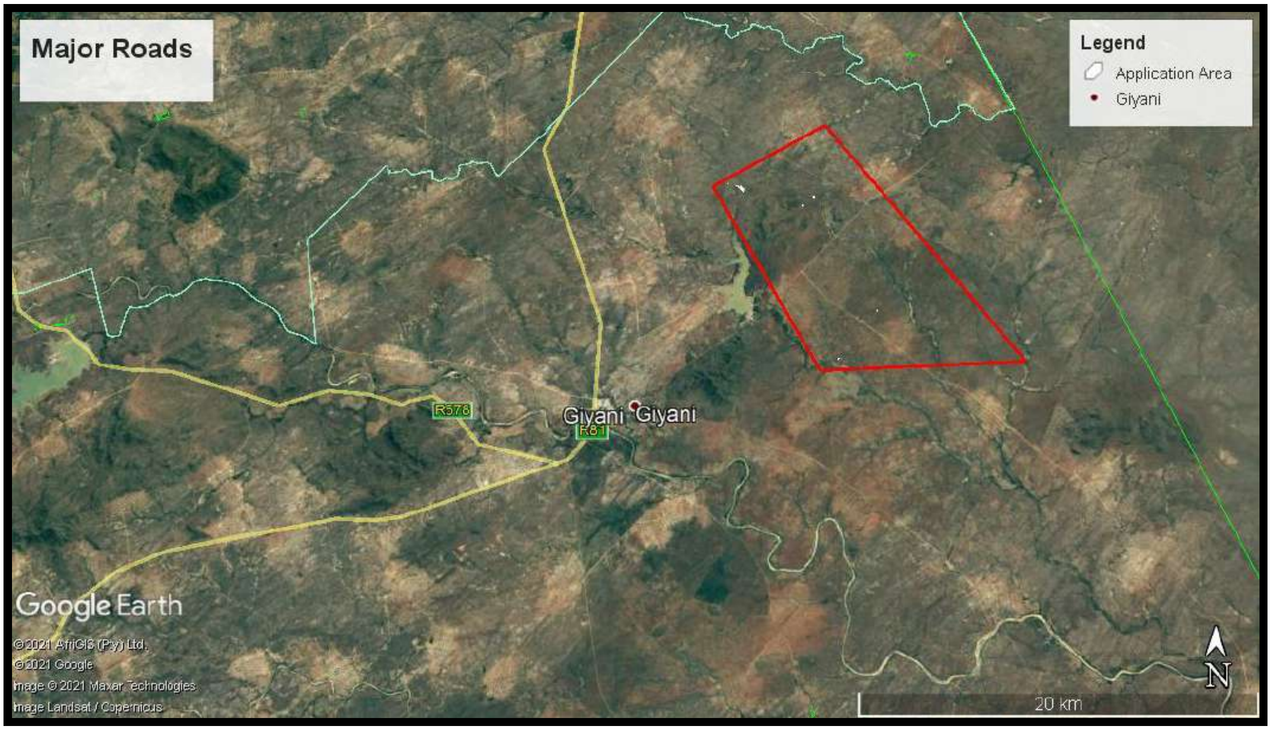

Figure 7: Access roads R81

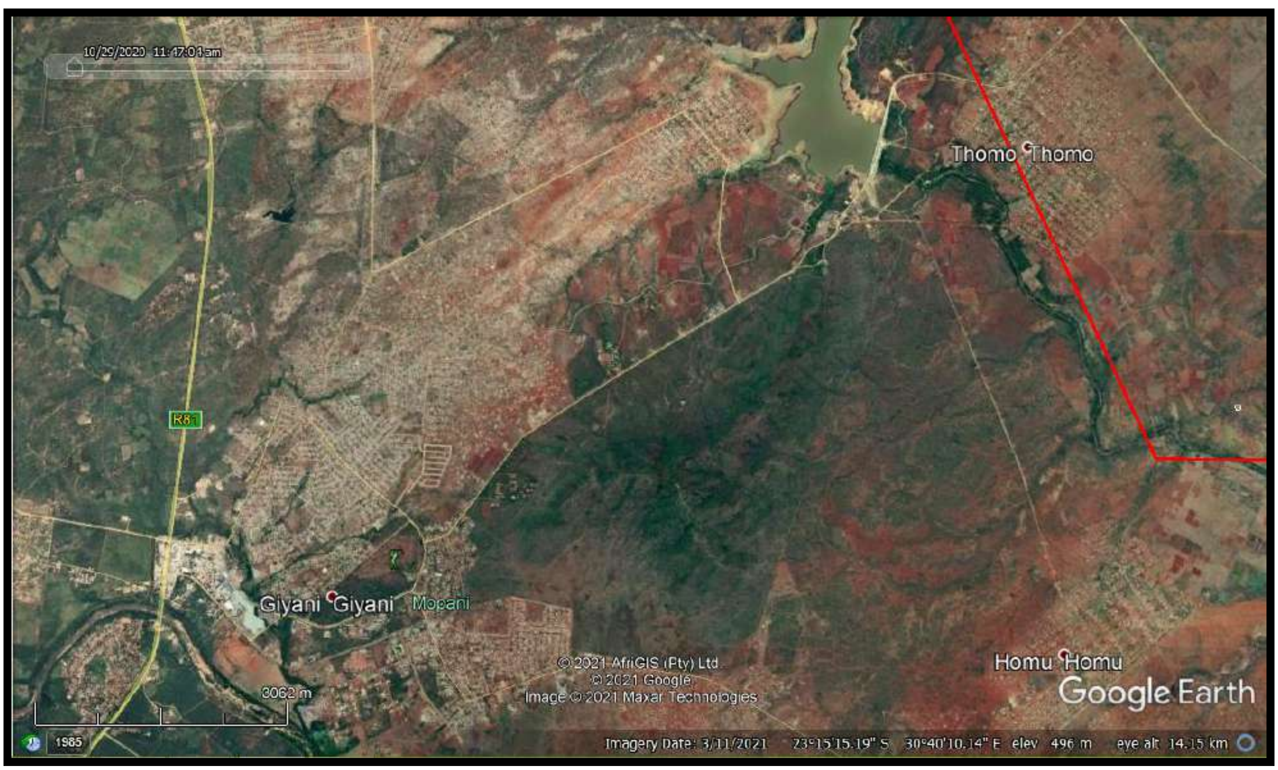

Figure 8: Access roads R81 towards Thomo

3.2 Access to the project site

Two alternative road have been assessed.

Figure 9: Access road alternatives

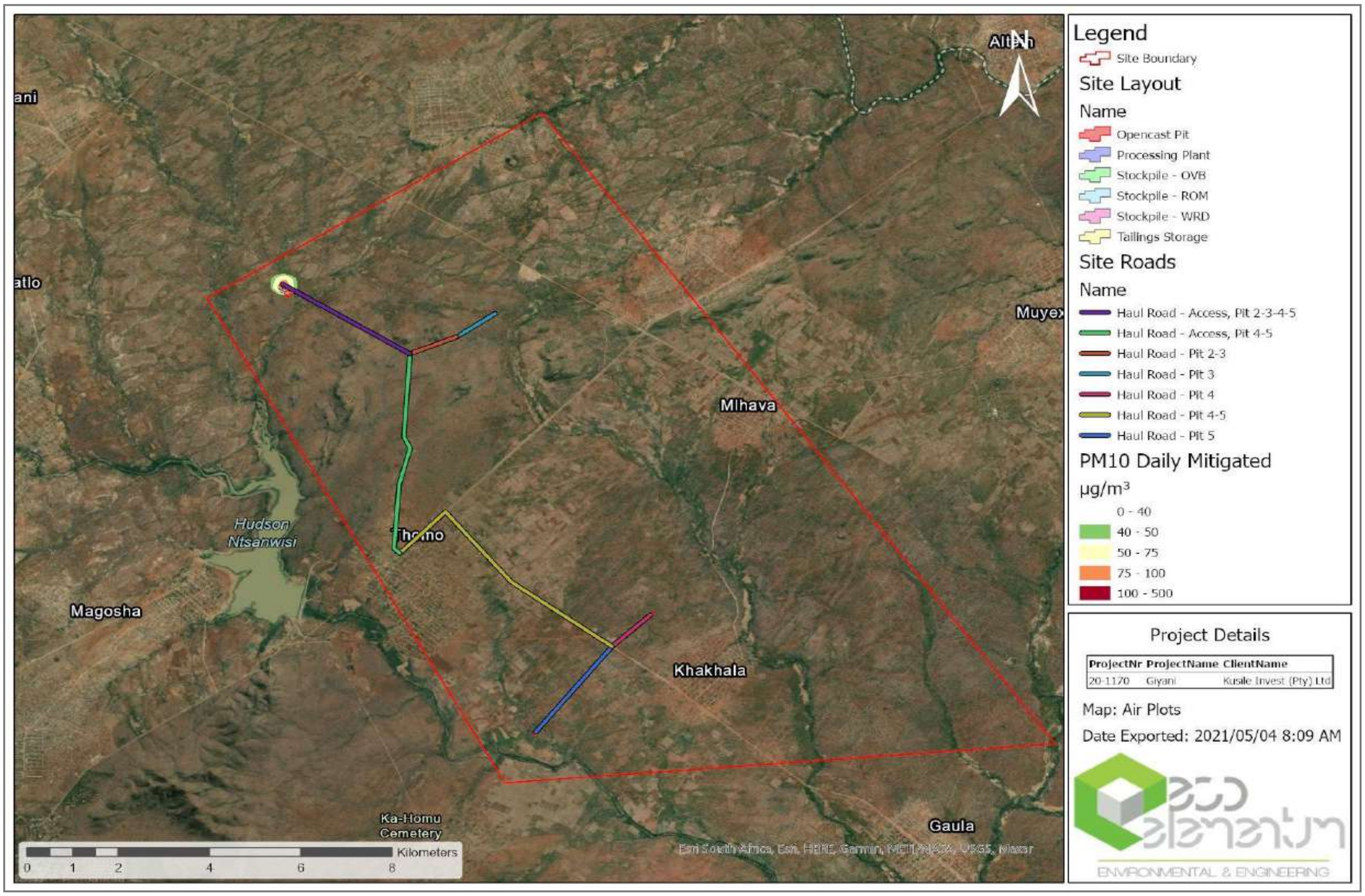

Figure 10: Haul Roads on site

Figure 11: Primary Access road

Figure 12: Alternative road

3.3 Status quo traffic volumes

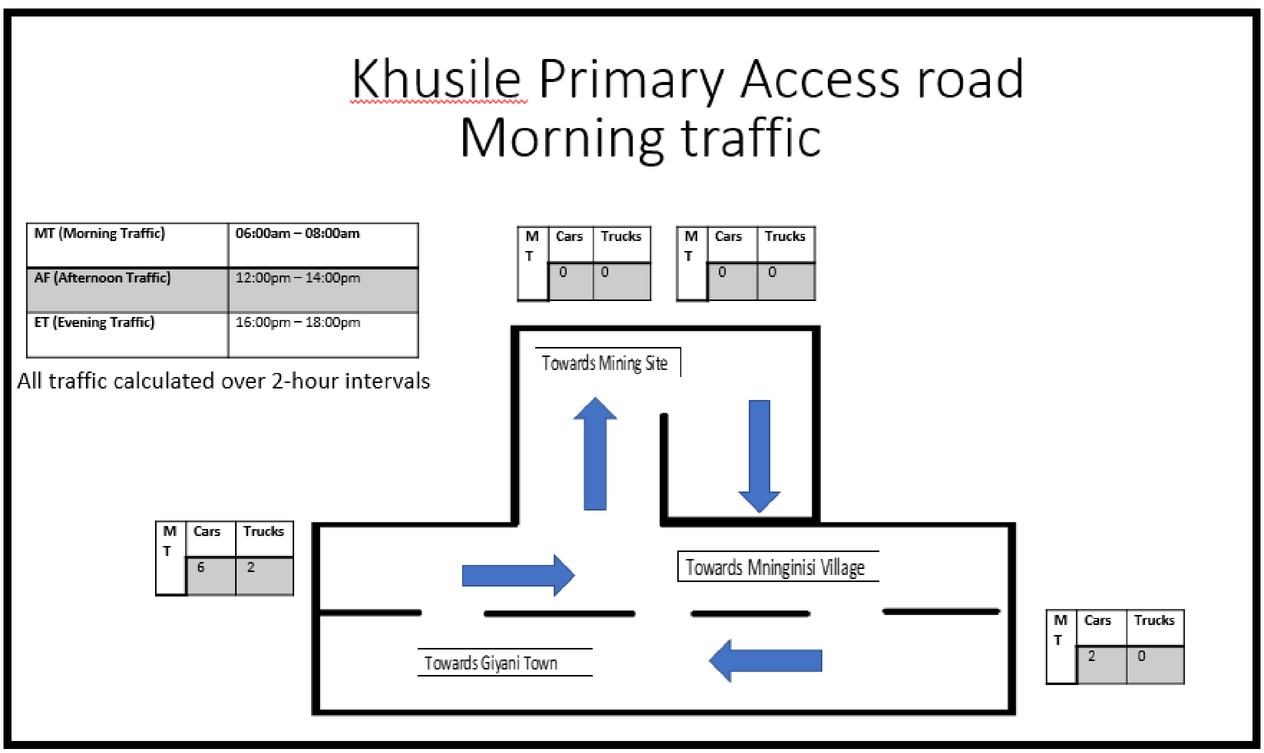

Figure 13: Primary Access road morning traffic count

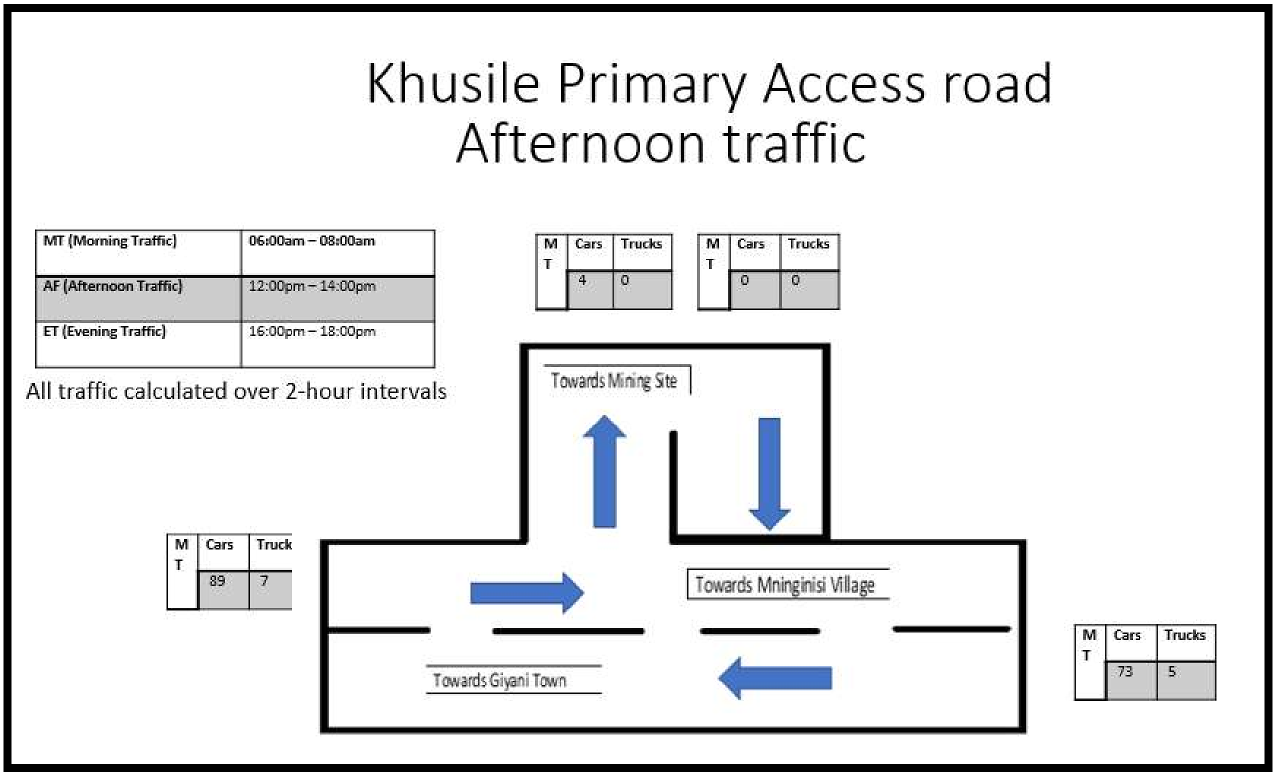

Figure 14: Primary Access road afternoon traffic count

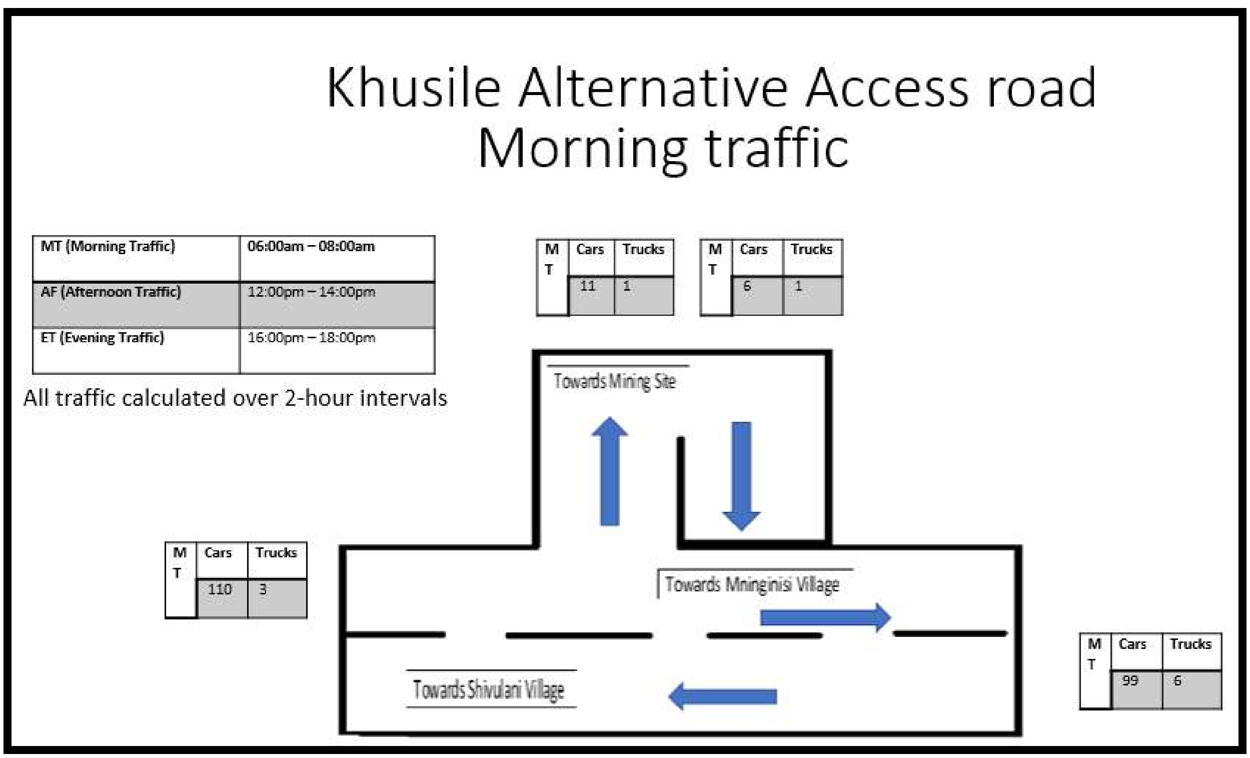

Figure 15: Alternative road morning traffic count

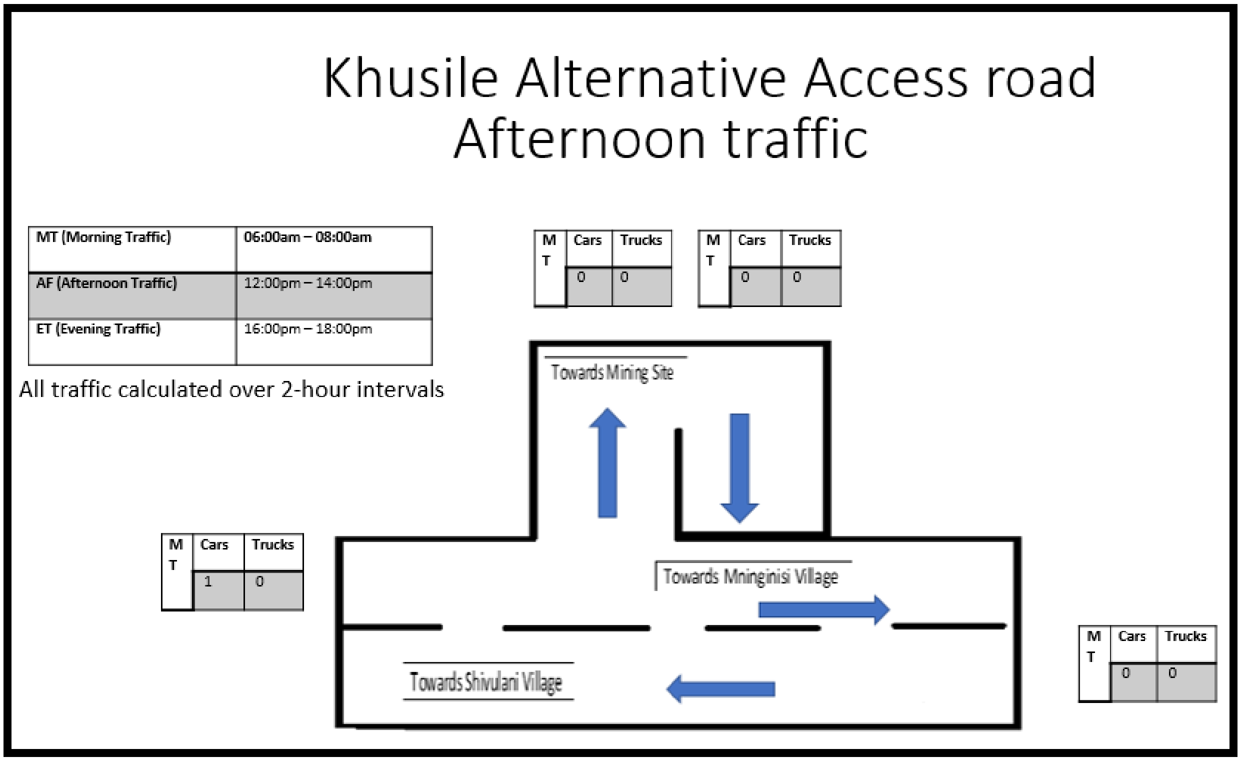

Figure 16: Alternative road afternoon traffic count

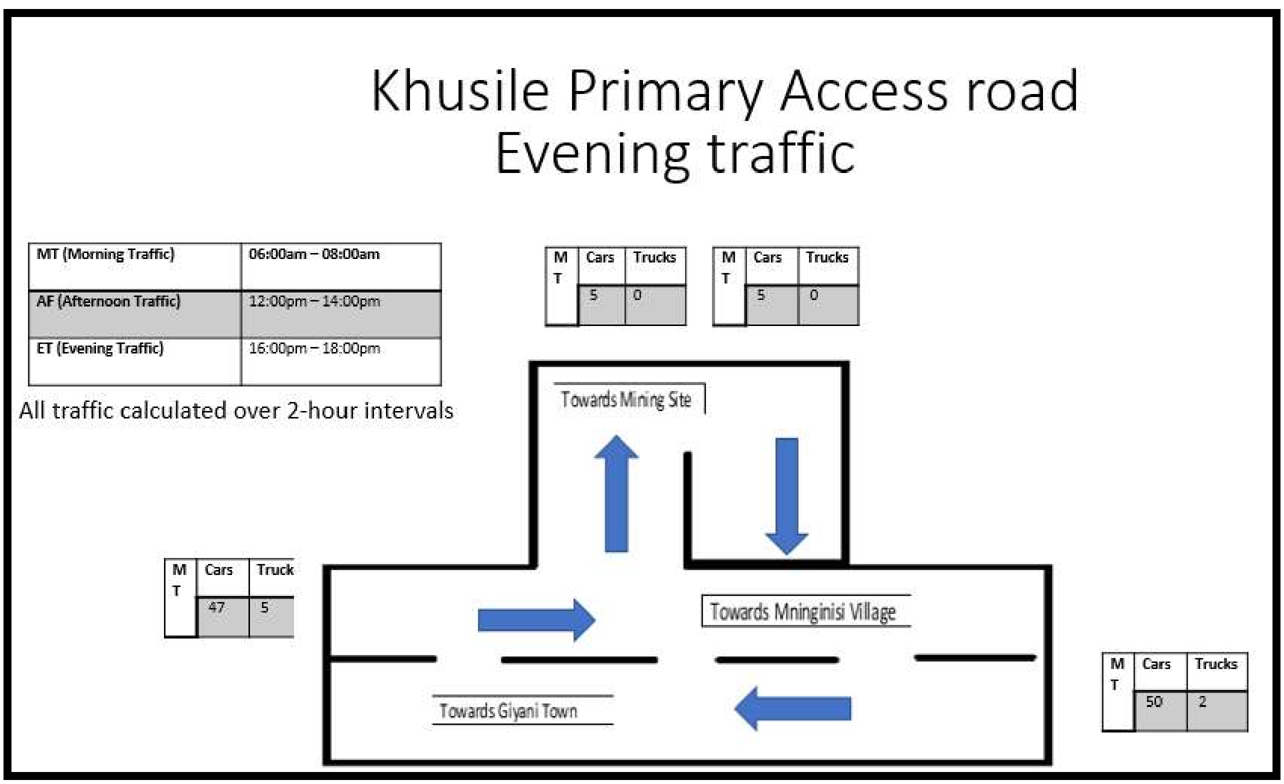

Figure 17: Alternative road evening traffic count

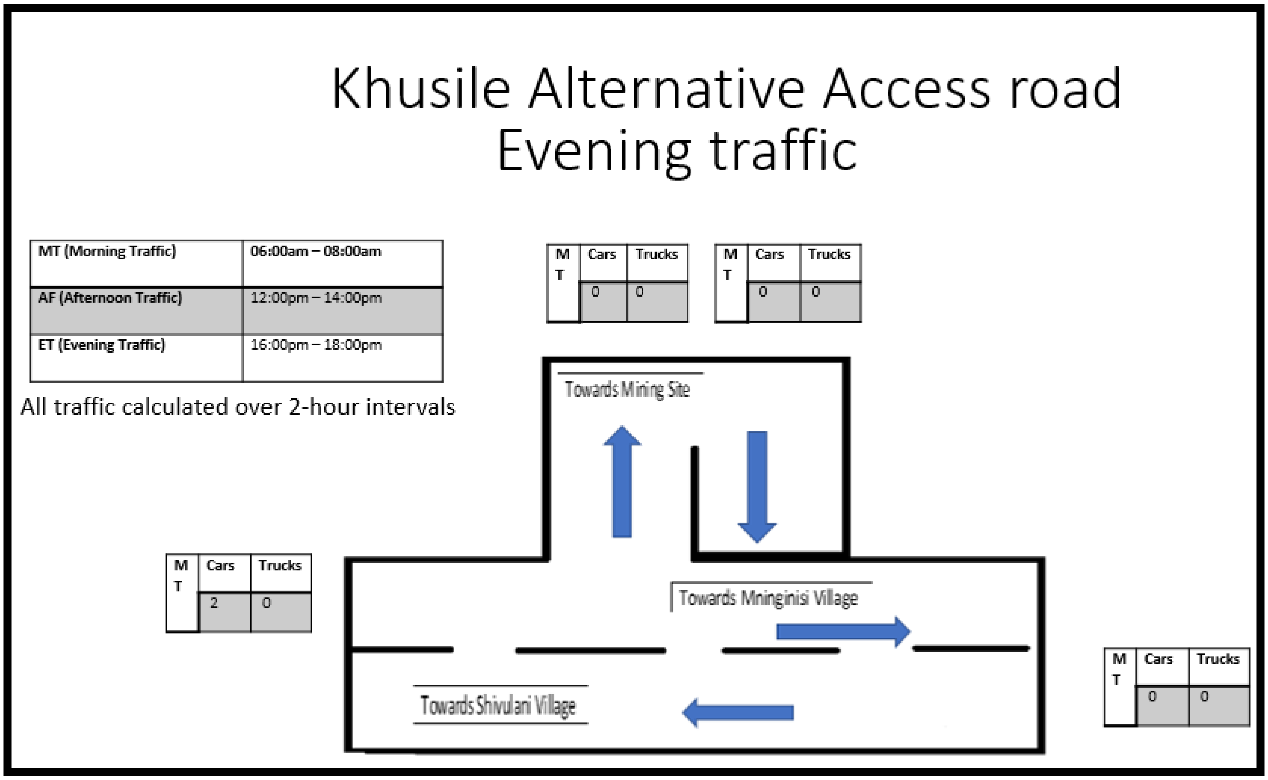

Figure 18: Alternative road evening traffic count

Site visits were conducted in March 2021 as part of the assessment and scoping process. Traffic counts were carried out for 12 hours (05:30 AM – 05:30 PM) at all intersections mentioned above. The light vehicles, heavy vehicles (2-4 axels) and very heavy vehicles (>5), were all counted during the scoping process.

The AM ad PM peak hour was further determined based on the highest traffic volumes registered during the morning and afternoon period respectively. The AM peak was recorded from 06:30 to 08:30 and the PM peak hour was recorded at 15:30 to 17:30.

Based on the existing traffic counts it can be concluded that the AM peak is the most critical period given that during the said period, the highest peak in number of vehicles on the road was registered. For that reason, the analysis scenarios refer to the AM peak hour which is the most critical hour..

3.4 Assessment variables

The following variables have been considered to assess the impact of the mine traffic:

3.4.1 Level of Service (LOS):

A measure of intersections or roadway performance, determined based o delay for unsignalized intersections. The LOS definitions in terms of delay are show in Table 2 below:

Table 1: LOS definitions based on vehicle delay

LEVEL-OF-SERVICE	DEFIITIONS BASED ON	VEHICLES DELAY
Level of Service	Control Delay per vehicle seconds	Level of Acceptability
A	**D ≤ 14.5**	Acceptable
B	**14.5 <d ≤ 28.5**	Acceptable
C	**28.5 < d ≤ 42.5**	Acceptable
D	42.5 < d ≤ 56.5	Acceptable
E	**56.5 < d ≤ 70.5**	**Not Acceptable**
F	**70.5 < d**	**Not Acceptable**

In most urban areas overall rating of A to D are normally considered acceptable. Levels of service C or better are considered desirable ad levels of service E and F are normally undesirable. (*Department of Transport (DoT), 1995).*

3.4.2 Delay:

A measure of intersection or roadway performance. It is the measure of driver discomfort frustration, fuel consumption and lost travel time. Delay at intersections depends on various factors such as type of signal control, volume of traffic and volume/capacity ratio of each approach at an intersection (C A O'Flaherty, 1997). The intersections performance has been rated based on the average delay, i.e. the LOS of the intersections under investigation (including the access to the Mine) will be measured based on the intersection average delay.

3.4.3 Volume or capacity ratio:

A measure of intersection or roadway performance. It is the ratio of number of vehicles on the road to the available capacity of the roadway. The road link capacity in the study area has been rated based on the volume/capacity ratio, i.e. the LOS of the link roads will be measured based on the volume/capacity of the roads.

3.4.4 Road Safety Aspects:

This variable has been subjectively assessed in terms of pedestrian and driver's safety on the roads under investigation. Variables such as speed limit ad alignment and geometry of the road have been taken into consideration for the safety assessment. Based on observation during the site visit, the road safety conditions are generally acceptable during the day when visibility is good and smaller vehicles are able to overtake the heavy vehicles fairly safely.

At night however, when visibility is reduced, passenger vehicles still overtake heavy vehicles even though visibility is limited, resulting in collisions which at times have been fatal. The large number of heavy vehicles however frustrates passenger vehicle drivers both during the day and night forcing them to overtake even though it may not be safe to do so, further increasing the chances for a collision.

The vehicle speeds and driver behaviour within the study area are generally good based on observation during the site visit, with the occasional vehicle exceeding the speed limit. There is signage displaying the maximum permissible speed on the R81. From observation, pedestrian activity did not pose a road safety threat on any of the roads surrounding the project area.

4 FINDINGS OF THE TRAFFIC IMPACT ASSESSMENT

The impact assessment of the transportation aspects related to the mine was determined based on the evaluation of the worst traffic scenario during the peak phases of the Mine development, Construction phase, operational phase and decommissioning phase.

4.1 Transport requirement of Giyani Gold Site: Trip Generation

The mine transport requirement will be as follows:

4.1.1 Transportation of Ore

Trips are expected to be generated within the application farm as ore is hauled from satellite its to the main plant. Initially 2-5/hour of heavy vehicles movement will be generated daily and this number will increase from the construction phase to the operation phase. However once peak production has been reached it is expected that the number will reduce to accommodate mostly haulage truck.

4.1.2 Transport of Goods (deliveries):

Trips are expected to be generated as a result of service delivery as well as transportation of goods/products to /from the mine. Initially 20/hour of heavy vehicles movement will be generated daily and this number will increase from the construction phase to the operation phase. However once peak production has been reached it is expected that the number will reduce to accommodate mostly haulage trucks.

4.1.3 Commuter trips (private and public transport):

Commuter trips are expected to be generated daily from Giyani to/from the mine. The commuter's trips will be split I private and company dedicated bus transport trips. Table 3 shows the daily expected trip generation, based on the different transport requirements listed above.

Table 2: Daily Transport Requirements

Daily Transport Requirements						
Analysis Scenario	Year 0 (2021):	Year 1 (202)	Year 2 (2023)	Year 3 (2024)	Year 4 (2025)	Year 5 (2026):

	Start of operations					
Gold production (tons)	4000	6000	8000	10000	10000	12000
Gold ore transport (heavy vehicles)	5	7	10	15	15	20
Suppliers (heavy duty)	2	3	5	10	10	10
Private vehicle (vehicle)	5	10	20	30	50	50
Public transport (buses)	1	2	3	3	5	5
Total number of vehicles	13	22	38	48	70	85

4.1.4 Geotechnical Stability

Additional surface water management structures would be constructed within the Project Site to control surface water flows within the mine development Site. Construction and use of dewatering ponds to store water accumulating in and pumped from the open cuts. Disturbance associated with the mine development and associated activities would be progressively rehabilitated to create a geotechnical stable final landform, suitable for a final land use of nature conservation, agriculture, tourism and/or light industry.

It is noted that the design of the proposed mine development is an indicative design only, with additional infrastructures required to further define the needs of customers. As a result, the indicative design for the mine development presented represents the maximum area that would be developed. The development of this maximum impact footprint has been taken into account in all other aspects of the Project, including the required capacity, layout and design of the waste management emplacements and residue storage facility, and the life of the Project.

5 TRAFFIC GENERATION

5.1 Traffic Risk Impact Assessment

This section of the report identifies the potential impacts associated with the planned transportation activities and the mitigation measures. The significance (quantification) of traffic impacts were identified during the assessments was determined using a ranking scale, based on the following terminology:

Occurrence entailing the probability of occurrence i.e. how likely the impact may occur, duration refers to how long the impact may last. Severity is the magnitude of the impact, whether it will be high, moderate or low. The extent/scale of the impact refers to the extent at which the impact will affect the national, regional or local environment, or only that of the site. Each of these factors has been assessed each for the current and potential impacts using the following ranking scale values

Table 3: Impact Risk Assessment Criteria

Duration		
Short term	6 Months	1
After construction	5 years	2
Life of project	30 Years	3
Post rehabilitation	Time for re-establishment of natural systems	4
Residual	Beyond the project life	5
Extent		
Site specific	Site of the proposed development	1
Local	Farm and surrounding farms	2
District	Giyani Municipal District	3
Regional	Mopani region	4
Provincial	Limpopo Province	5
National	Republic of South Africa	6
International	Beyond RSA borders	7

Probability		
Almost Certain	100% probability of occurrence -is expected to occur	5

Likely	99%-60% probability of occurrence-will probably occur in most circumstances	4
Possible	59%-16% chance of occurrence-might occur at some time	3
Unlikely	15%-6% probability of occurrence-could occur at some time	2
Rare	5% probability of occurrence-may occur in exceptional circumstances	1
	Severity	
Critical	LOS = F	5
High	LOS = E	4
Moderate	LOS = C or LOS = D	3
Minor	LOS = B	2
Insignificant(low)	LOS = A	1

RISK ESTIMATION (Nel 2002)					
	Severity				
Probability	Insignificant (1)	Minor (2)	Moderate (3)	Major (4)	Critical (5)
Almost certain(5)	H	H	E	E	E
Likely(4)	H	H	H	E	E
Possible(3)	L	M	H	E	E
Unlikely (2)	L	L	Moderate (3)	H	E
Rare (1)	L	L	Moderate (3)	H	H

E- Extreme risk-immediate action required, detail considerations required in planning by specialists-alternatives to be considered.	4
H- High risk-specific management plans required by specialists in planning process to determine if risk can be reduced by design and management and auditing plans in planning process, taking into consideration capacity,capabilities and desirably - if cannot, alternatives to be considered ,senior management responsibility.	3
M - Moderate risk-management and monitoring plans required with responsibilities outlined for implementation, middle management responsibility.	2
L- Low risk- management as part of routine requirements.	1

IMPACT SIGNIFICANCE
Negligible -The impact is non-existent or insubstantial, is of no or little importance to any stakeholder and can be ignored.
Low - The impact is limited in extent, even if the intensity is major, whatever its probability of occurrence, the impact will not have a significant impact considered in relation to the bigger picture, no major material effect on decisions and is unlikely to require management intervention bearing significant costs.

Moderate - The impact is significant to one or more stakeholders, and its intensity will be medium or high, therefore, the impact may affect the decision, and management intervention	
High - The impact could render development options controversial or the entire project unacceptable levels, and/or the cost of management intervention will be a significant factor in	
Very high- Usually applies to potential benefits arising from projects.	

Based on the significance assessment, it can be concluded that the traffic generated by Giyani Gold Project will have a low to moderate significance rating on the external road network. The significance of the traffic impact will become negligible should the planned rail link be constructed.

In terms of the intersection and road link capacity, no additional road improvements are required as a result of the mine traffic. However, in terms of the social impact, i.e. pedestrian and driver safety, it is recommended that driver behavior be monitored frequently to ensure adherence to operation speed limits of 60km/h from the mine to the siding. The following are additional mitigation measures that should be implemented and monitored at all times:

- The gravel shoulder lane on the R81 will require maintenance by the Roads Agency Limpopo (RAL);
- Provision of shelters and bus lay-byes at the bus stop, placed strategically at the mine property are recommended
- Truck drivers must ensure that headlights are switched on at all times to increase visibility when travelling on the roads. This should form part of the site rules to also facilitate compliance with the Mine Health and Safety Act, 1996;
- Ore being hauled should be covered or dust suppressed to avoid dust particles to be blown by wind and impact on air quality, pollution of the receiving environment, or become a health risk to the public and other road users.
- Noise supervision devices are recommended on heavy vehicles to mitigate the noise impact.

Table 4: Significance rating of Potential Mine Traffic Impact

Activity	Potential Impact	D	E	P	S	RE	Significance without mitigation	Mitigation measure	Significance with mitigation

Transportation of ore road	Heavy vehicle impact at the Intersections (congestion)	2	2	4	1	2	Low	not required as traffic congestion at intersections is not anticipated not required	-
	Delay at Intersections	2	2	4	1	2	Low		
	Social Impact (unsafe pedestrian and drivers conditions)	2	2	3	3	2	Moderate	Mitigations outline in 6.1 above	Low

To consider the effect of the Project on traffic, the following (most adverse traffic conditions) were considered.

- Bad weather conditions
- Night time driving
- Driving in the rain
- Road surfaces
- Emergency

To prevent the weather conditions from controlling your vehicle, you must

- Anticipate potential problems. This may mean driving cautiously or not driving at all when dangerous weather conditions exist
- Be ready to respond to weather conditions and their effects on you and your vehicle. If you learn about potential weather hazards and learn what to do when you begin to lose control of your vehicle, you will be better prepared to deal with adverse weather conditions.
- Adherence to speed limit and road signs
- Visibility of roads and routes to be used
- Site construction in 2021 with existing background traffic volumes.
- Normal operation in 2026 with forecast background traffic volumes.
- Final land use.

5.2 Site Construction

During the site construction stage, it is anticipated that the maximum work force on site at any one time would be 400 full-time equivalent positions. It has been conservatively assumed that each site construction worker would commute to and from site during a morning and afternoon peak in their own vehicle. Deliveries of plant and materials (heavy vehicle movements) would also occur during the morning and afternoon peak but would more likely be spread over the day. Refer to **table 2** for site construction traffic volumes.

6 MITIGATION OF TRAFFIC IMPACTS

6.1 ROADS AND INTERSECTIONS OF THE STUDY AREA

As discussed previously the traffic engineering impact of the Project on the traffic of the study area would be negligible. Roads and intersections of the study area would be expected to operate satisfactorily with minimal delays and spare capacity. Therefore, no intersection improvements would be required. A comprehensive Transport Management Plan for construction and normal township development operation should be developed, which would be agreed with stakeholders and implemented. A comprehensive Transport Management Plan for construction and normal operation to ensure that impacts of the proposed development would be minimised. The Transport Management Plan would provide for the following.

- Safe driving practices/procedures.
- Community information and awareness program of traffic activities. This could include press releases, specific newsletters and letter drops to neighboring residents.
- Sign posting of with heavy vehicle and construction signage during the site construction stage.
- Restrictions on the timing of large equipment and material deliveries.
- Establishment of an inspection and maintenance program for the local road network to ensure conditions of roads are maintained.
- Driver code of conduct with disciplinary action for non-compliance.
- Emergency, accident, incident, complaint or non-compliance response and reporting.
- Training requirements.
- Audit and review.

RESTRICTED ACCESS VEHICLES

- To mitigate the impact of Restricted Access Vehicles (RAVs), an individual Traffic Control Plan would be developed for each over mass and over weight delivery. The individual Traffic Control Plan would address the following issues.
- NSW RTA and NSW Police permit requirements.
- Use of escort vehicles where necessary.
- Any localized pavement strengthening or road widening requirements for the particular delivery.
- Provision of traffic controllers where difficult or unsafe maneuvers are required.
- Restriction on times of delivery of over mass or over weight deliveries.

7 CONCLUSION

In summary, the Project would have negligible impact on local traffic. Roads and intersections of the study area would be expected to operate satisfactorily with minimal delays and spared Capacity. Conditional on a suitable Transport Management Plan being developed, agreed with stakeholders and implemented, any traffic safety impacts of the proposed development would have a negligible impact.

In summary and based on the content of this document, the following key conclusions are made with regard to the proposed project:

- This report forms part of the environmental authorisations associated with the application for mining rights required;
- The purpose of this report is to investigate the traffic impact that the proposed project will have on the surrounding road network and, if necessary, propose possible measures to mitigate such impact;
- The study area (receiving environment) was defined based on the extent and type of the project activities, and the characteristics of the traffic expected to be generated as a result. Based on this, the boundaries of the study area are limited to the location of the following key intersection:
    - Road R81 / Site Access Road
- No vulnerabilities or sensitivities currently exists in the defined study area;
- To determine the existing traffic demand on the nearby road network a traffic survey was conducted at the key study intersection;

Operating conditions were determined and compared for the following three scenarios:

- Baseline;
- Project construction phase; and
- Project operational phase

- By comparing the operating conditions for the different scenarios, it was concluded that the proposed project will have an insignificant traffic impact on the surrounding road network;
- The construction phase of the project will have a negative impact only requires current management of traffic to be maintained. The operational phase of the project, however, has higher a negative impact requires current management of traffic to be improved.
- Based on the contents of this report it is concluded that the project can be authorised from a traffic engineering viewpoint provided that the recommendations made in this report are implemented.

Reduced visibility is often associated with night driving and is more dangerous than daytime driving, therefore controlled driving must be applied at a rate of speed. Sunlight glare, either direct or reflected poses a dangerous driving situation. To reduce this problem , adjust your sun visor and wear sunglasses. If this does not help stop on the roadside well away from moving traffic for safety rules. Gravel or dirt roads requires careful driving as they are unpaved. Under ideal conditions and when driving slowly, controlling your vehicle may be difficult because loose dirt or gravel on these surfaces increases stopping distances significantly. Drive cautiously in all portions of the proposed mine development.

REFERENCES

Committee of Transport Officials. TMH 16 Volume 2, ***South African Traffic Impact and Site Traffic Assessment Standards and Requirements Manual. Version 1.0***, August 2012.

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