PROPOSED VYGENHOEK MINING PROJECT

BASELINE AIR QUALITY & PLAN OF STUDY REPORT

July 2020

Rayten Project Number: ENV-EMA-207020

info@rayten.co.za **011 792 0880** **086 592 0298** **www.rayten.co.za**

PO Box 1369 Bromhof 2154

REVISION AND APPROVAL PAGE

Revision Number	**1.0**		
Rayten Project Number	**RES-EMA-207020**		
Report Title	**PROPOSED VYGENHOEK MINING PROJECT BASELINE AIR QUALITY & PLAN OF STUDY REPORT**		
	Name	**Signature**	**Date**
Author	Gertrude Mafusire *(M. Phil)* *Snr Air Quality Specialist*		17 July 2020
Document Reviewer	Clive Wray *((Pr. Eng)* *Engineering Manager*		17 July 2020
Document Authorisation	Claire Wray *(Pri.Sci. Nat)* *Atmospheric Scientist*		17 July 2020

Report Submission Summary		
Report Revision Number	1.0	Date Submitted: 17 July 2020
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DISCLAIMER

Information contained in this report was based on the last information received from Environmental Management Assistance in July 2020. Where data supplied by the client or other external sources, including previous site investigation data, have been used, it has been assumed that the information is correct unless otherwise stated. No responsibility is accepted by Rayten Environmental (Pty) Ltd for incomplete or inaccurate data supplied by others. We are aware of the fact that there might have been changes since this report was submitted, however this report and its findings is based on the last information received from the client in July 2020. To the best of our knowledge the assumptions and findings are correct at the time of submission of the specialist report. Should any of the assumption or findings prove to be incorrect subsequent to submission of the report we as the specialist cannot be held accountable. Note that although every effort has been made by Rayten Environmental (Pty) Ltd to obtain the correct information and to carry out an appropriate, independent, impartial and competent study, Rayten Environmental (Pty) Ltd cannot be held liable for any incident which directly or indirectly relates to the work in this document and which may have an effect on the client or on any other third party.

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DECLARATION OF PRACTITIONER

PROJECT TITLE

Proposed Vygenhoek Platinum Mine - Air Quality Impact Assessment Report

Specialist:	Rayten Environmental		
Contact person:	Gertrude Mafusire		
Postal address:	PO BOX 1369, Bromhof, 2154		
Postal code:	2154	Cell:	
Telephone:	0117920880	Fax:	086 592 0298
E-mail:	info@rayten.co.za		
Professional affiliation(s) (if any)	SACNASP (Claire Wray owner of company)		

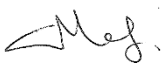
Name of Practitioner: Rayten Environmental (Pty) Ltd
Name of Registration Body: South African Council for Natural Scientific Professions
Professional Registration No: 400073/11 (Claire Wray)

Declaration of accuracy of information provided:

Atmospheric Impact Report in terms of Section 30 of the National Environmental Management Air Quality Act (NEM:AQA) (No. 39 of 2004):

I Gertrude Mafusire, declare that – General declaration

I am independent of the applicant;
I have the necessary expertise to conduct the assessments required for the report; and
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 will disclose to the applicant and the air quality officer 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 air quality officer.
The information provided in this atmospheric impact report is, to the best of my knowledge, in all respects factually true and correct. I am aware that the supply of false or misleading information to an air quality officer is a criminal offence in terms of section 51(1)(g) of the NEM:AQA (No.39 of 2004).



Signature of the specialist:

Rayten Environmental (Pty) Ltd

Name of company (if applicable):

17 July 2020

Date:

EXECUTIVE SUMMARY

Rayten Environmental (Pty) Ltd was appointed by Environmental Management Assistance (EMA) to compile an Air Quality Impact Assessment report (AQIAr) for the proposed operation of Vygenhoek Platinum Mine, located within Ehlanzeni District Municipality, Mpumalanga Province.

Mining at the proposed Vygenhoek Platinum Mine will be by means of conventional truck and shovel operations and will be by opencast only. An advancing open pit mining method, which allows for concurrent filling of the pit, will occur during the operational phase. Ore (Run-of Mine: ROM) will be loaded onto trucks at the pit area using excavators, transported via trucks on an unpaved haul route to the ROM stockpile, sold and loaded onto trucks for dispatch to a preferred Concentrator plant for further processing. The proposed mine belongs to Nomamix (Pty) Ltd. The AQIAr has been compiled specifically as a supporting document for the application for an Environmental Authorisation for the proposed Vygenhoek Platinum Mine.

The main objective of the AQIA is to determine the potential impact of emissions associated with the operational activities at the proposed Vygenhoek Platinum Mine on ambient air quality in terms of dust-fall, PM_{10} and $PM_{2.5}$.

As part of the AQIA, a baseline air quality assessment was undertaken to determine the following:

- the prevailing meteorological conditions at the site;
- baseline concentrations of key air pollutants of concern;
- identify existing sources of emissions; and
- identify key sensitive receptors surrounding the project site.

MM5 meteorological data for the project area for the period 01 January 2017 – 31 December 2019 was used. Baseline air quality at the proposed Vygenhoek Platinum Mine could not be assessed as there are currently no air quality monitoring stations in the vicinity of the proposed site, nor are there any dust fall networks that we know of.

The main conclusions based on the information obtained during the Baseline Assessment are as follows:

The proposed mine is located on portions 3 and 7 of the farm Vygenhoek 10 JT, within Thaba Chweu Local Municipality, and Ehlanzeni District Municipality, Mpumalanga Province. The project area does not fall within a nationally declared priority area. The land use immediately surrounding the proposed Vygenhoek Platinum mine consists mostly of grassland and forested land, with few areas consisting of cultivated land. Urban built up, mines and quarries, waterbodies and wetlands are observed, to a lesser extent, in surrounding areas, within 20km radius. The area is classified as rural in nature. Existing key sources of airborne emissions surrounding the project site have been identified as follows:

- Forestry activity/Plantations (surrounding areas)

Based on the prevailing wind fields for the period January 2017 to December 2019, emissions from activities at the proposed Vygenhoek Platinum Mine will likely be transported towards the north-westerly and west-north-westerly quadrants. Moderate to fast wind speeds observed during all the

time periods, may result in effective dispersion and dilution of emissions from the proposed Vygenhoek Platinum Mine operations; however, higher wind speeds can also facilitate fugitive dust emissions from open exposed areas such as stockpiles and opencast areas. Removal of particulates via wet depositional processes would be evident during the warmer (wet) seasons (spring – early autumn) thus lower ambient concentrations of dust could be expected during these seasons. Over the remainder of the year higher ambient concentrations of particulates could be expected.

There is little variation in terms of prevailing wind direction occurring at the project site. During all seasons, prevailing south-easterly and east-south-easterly winds were observed, with wind speeds being consistent and moderate to fast; which could subsequently facilitate dust emissions from stockpiles, onsite and offsite activities.

Dust-fall, PM_{10} and $PM_{2.5}$ are key pollutants of concern associated with operations at the proposed Vygenhoek Platinum Mine and will be emitted from the following key sources:

Dust and Particulate Emissions:

- Drilling and blasting at the opencast pit;
- Bulldozing (profiling of waste);
- Materials handling operations (truck loading/offloading operations);
- Transportation of material (trucks);
- Material storage: Stockpiling,
- Excavators (stripping ore and waste and loading trucks);
- Wind erosion from exposed areas (i.e. the open cast pit, exposed surfaces, and material stockpile areas); and
- Vehicle dust entrainment on unpaved roads.

The anticipated impact of activities at the proposed Vygenhoek Platinum Mine will be quantitatively assessed through dispersion modelling and presented in the final Level 2 Air Quality Impact Assessment report. It is expected that emissions from activities at the proposed mine will most likely result in air quality impacts in terms of dust-fall, PM_{10} and $PM_{2.5}$.

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LIST OF ABBREVIATIONS

AEL	Atmospheric Emissions License
AQIA	Air Quality Impact Assessment
AQIAr	Air Quality Impact Assessment Report
CH_4	Methane
CO	Carbon Monoxide
CO_2	Carbon Dioxide
$CO_{2\text{-eq}}$	Carbon dioxide equivalent
DEA	Department of Environmental Affairs
DR	Discrete Receptor
GHG	Greenhouse gas
GMT	Greenwich Meridian Time
HFC	Hydrofluorocarbons
NAEIS	National Atmospheric Emissions Inventory System
NAAQS	National Ambient Air Quality Standards
NEMA	National Environmental Management Act
NEM:AQA	National Environmental Management Air Quality Act
NPI	National Pollutant Inventory
NO_2	Nitrogen Dioxide
NO_x	Nitrogen Oxides
N_2O	Nitrous Oxide
Mtpa	Million tonnes per annum
O_3	Ozone
PBL	Planetary Boundary Layer
PFC	Perfluorocarbons
PM_{10}	Particulate Matter, aerodynamic diameter equal to or size less than 10µm
$PM_{2.5}$	Particulate Matter, aerodynamic diameter size equal to or less than 2.5µm
PRIME	Plume Rise Model Enhancements
ROM	Run of Mine
SAAQIS	South African Air Quality Information System
SF_6	Sulphur hexafluoride
SO_2	Sulphur Dioxide
USEPA	United States Environmental Protection Agency

1. INTRODUCTION

Rayten Environmental (Pty) Ltd (hereafter referred to as “Rayten”) was appointed by Environmental Management Assistance (hereafter referred to as “EMA”) to compile an Air Quality Impact Assessment report (AQIAr) for the proposed operation of Vygenhoek Platinum Mine, located within Ehlanzeni District Municipality, Mpumalanga Province.

The main objective of the AQIA is to determine the potential impact of emissions associated with the operational activities of the proposed Vygenhoek Platinum Mine on ambient air quality in terms of dust-fall, PM_{10} and $PM_{2.5}$.

As part of the AQIA for the proposed Vygenhoek Platinum Mine, a baseline air quality assessment was undertaken through a review of meteorological monitoring data, available air quality monitoring data, air quality legislation and the identification of nearby sensitive receptors and existing emissions sources surrounding the project site. The main objective of the baseline air quality assessment was to determine the prevailing meteorological conditions at the site, establish baseline concentrations of key air pollutants of concern, identify existing sources of emissions and identify key sensitive receptors surrounding the project site.

A description of the expected emissions from the proposed mining activities will be presented in the form of a detailed emissions inventory as part of the AQIA. The potential impact of emissions from the mining activities associated with the proposed mine on air quality is evaluated through the compilation of an emissions inventory and subsequent dispersion modelling simulations using AERMOD. Comparison of predicted concentrations for criteria air pollutants is made with the South African Ambient Air Quality Standards and the South African National Dust Control Regulations, 2013 where applicable.

1.1. Project Details

Applicant	Nomamix (Pty) Ltd
Mine	Proposed Vygenhoek Platinum Mine
Co-ordinates	25.045084°S 30.162327°E
Municipality and Province	Ehlanzeni District Municipality, Mpumalanga Province.
AEL number	Not required
Mining Right	TBC
Designated Air Quality Priority Area	N/A
Modelling contractor	Rayten Environmental (Pty) Ltd *Gertrude Mafusire (MPhil.)* *Snr Air Quality Specialist* *3.5 years working experience* *0117920880* *info@rayten.co.za*

1.2. Brief Project Description

Mining at the proposed Vygenhoek Platinum Mine will be by means of conventional truck and shovel operations and will be by opencast only. An advancing open pit mining method, which allows for concurrent filling of the pit, will occur during the operational phase. Ore (Run-of Mine: ROM) will be loaded onto trucks at the pit area using excavators, transported via trucks on an unpaved haul route to the ROM stockpile, sold and loaded onto trucks for dispatch to a preferred Concentrator plant for further processing. The Vygenhoek project footprint is small, with the life of mine expected to be 10 years. Therefore, no processing plant will be established on the proposed mine premises. Several stockpile areas will be established and used for storage of different type of material, mainly ROM ore, topsoil, waste and overburden (softs and hards).

The focus of this study is to quantify emissions of dust-fall, PM_{10} and $PM_{2.5}$ associated with operational activities at the proposed Vygenhoek Platinum Mine which include:

- Drilling and blasting at the opencast pit;
- Bulldozing (profiling of waste);
- Materials handling operations (truck loading/offloading operations);
- Transportation of material (trucks);
- Material storage: Stockpiling,
- Excavators (stripping ore and waste and loading trucks);
- Wind erosion from exposed areas (i.e. the open cast pit, exposed surfaces, and material stockpile areas); and
- Vehicle dust entrainment on unpaved roads.

A preliminary site layout diagram is given in Figure 1-1. This was considered as the preferred layout plan for the proposed Vygenhoek Platinum Mine and will be used in this Baseline Air Quality Assessment.

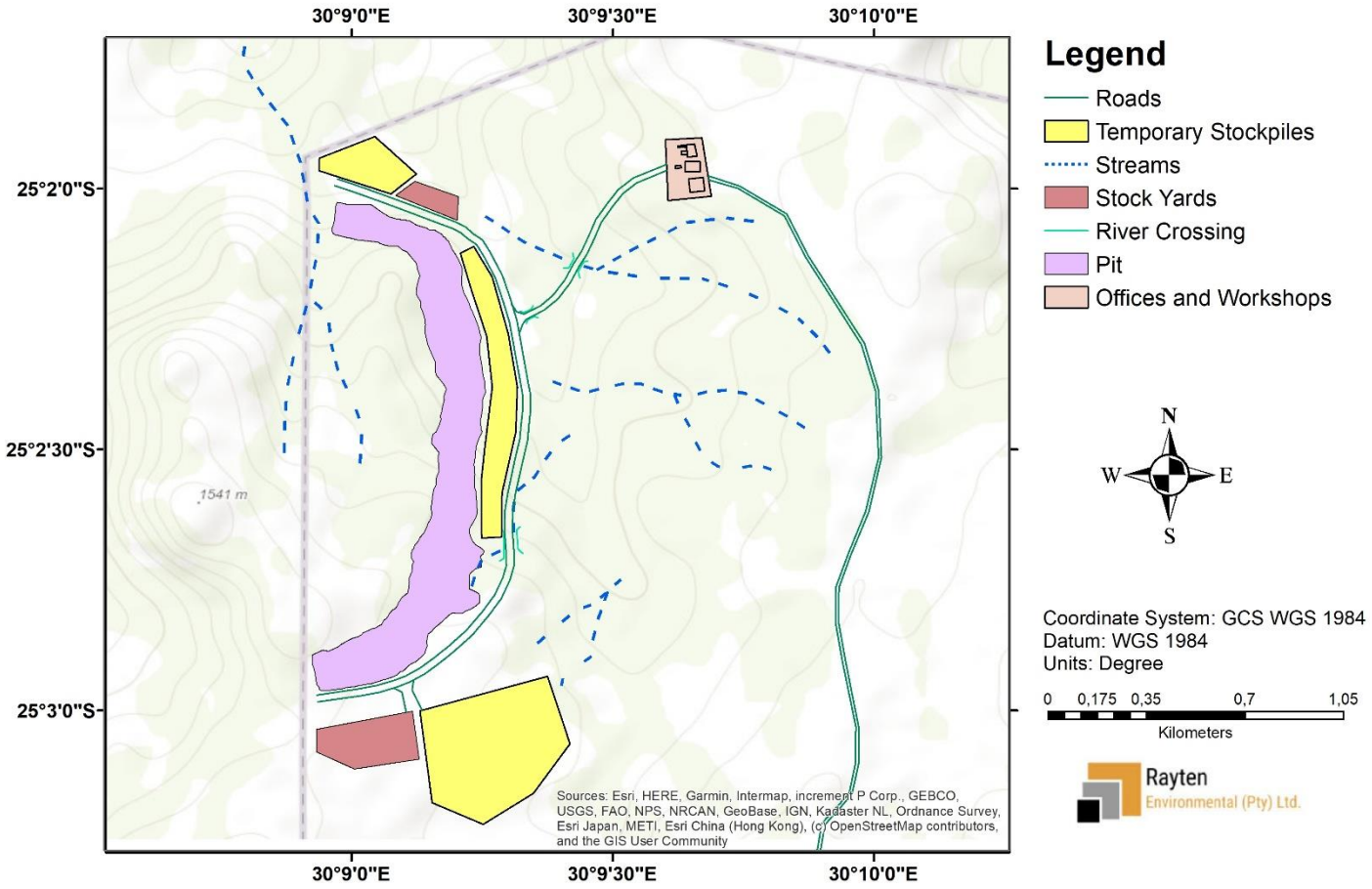

Figure 1-1: Proposed Vygenhoek Platinum Mine Preferred Layout Plan.

1.3. Terms of Reference

The scope of work for the Baseline Air Quality Assessment for the proposed Vygenhoek Platinum Mine is as follows:

- A review of the study site and activities;
- An overview of the prevailing meteorological conditions in the area which influence the dilution and dispersion of pollutants in the atmosphere;
- The identification of existing sources of emissions;
- The identification of key air pollutants of concern that may be emitted from proposed mining activities (dust-fall, PM_{10} and $PM_{2.5}$);
- Characterisation of the ambient air quality within the area using available air quality monitoring data;
- A review of the current South African legislative and regulatory requirements for air quality;
- The identification of sensitive receptors, such as local communities, surrounding the study area;

1.4. Outline of Report

An overview of the site location including surrounding receptors is given in **Section 2**. National Ambient Air Quality Standards, dust control regulations and associated health impacts for the relevant criteria pollutants are discussed in **Section 3**. The local meteorological conditions and baseline air pollutants concentrations are provided in **Section 4**. Potential emissions associated with proposed operations are outlined in **Section 5**, with the report summary presented in **Section 6**.

2. SITE CHARACTERISTICS

2.1. Site Location

The proposed Vygenhoek Platinum Mine is located on portions 3 and 7 of the farm Vygenhoek 10 JT, approximately 20 - 25km south of Mashingshing Town, within Thaba Chweu Local Municipality, and Ehlanzeni District Municipality, Mpumalanga Province (25.045084°S; 30.162327°E) (Figure 2-1). The project area does not fall within a nationally declared priority area.

2.2. Surrounding Land Use

The land use immediately surrounding the proposed Vygenhoek Platinum Mine consists predominantly of grassland and forested land, with few areas consisting of cultivated land. Urban built up, mines and quarries, waterbodies and wetlands are observed, to a lesser extent, in surrounding areas, within 20km radius (Figure 2-2). The area is classified as rural in nature.

2.3. Topography

The topography surrounding the proposed Vygenhoek Platinum Mine is shown in Figure 2-3. Surrounding elevations range from 546 – 2330 m above sea level. The project site is situated approximately 1260 – 1680 m above sea level; with increasing elevation towards the west, north-west, north and south (Figure 2-3 below).

2.4. Sensitive Receptors

A sensitive receptor is defined as a person or place where involuntary exposure to air pollutants released by the site's activities could occur. Identified sensitive receptors which are located within a 20 km radius of the mine are given in Figure 2-4.

Few sensitive receptors are located with a 0 – 20km radius of the proposed mine, and these are mainly dwellings/villages, village schools and nature reserves. The Sterkspruit and Verloren Vallei Nature Reserves are located approximately 20km north and west of the proposed mine, respectively Further, few sensitive receptors are located within a 20 - 25 km radius, the largest being the town of Mashingshing and associated educational and health facilities, which are located north of the proposed mine. The discrete receptors will be elaborated further in the modelling report.

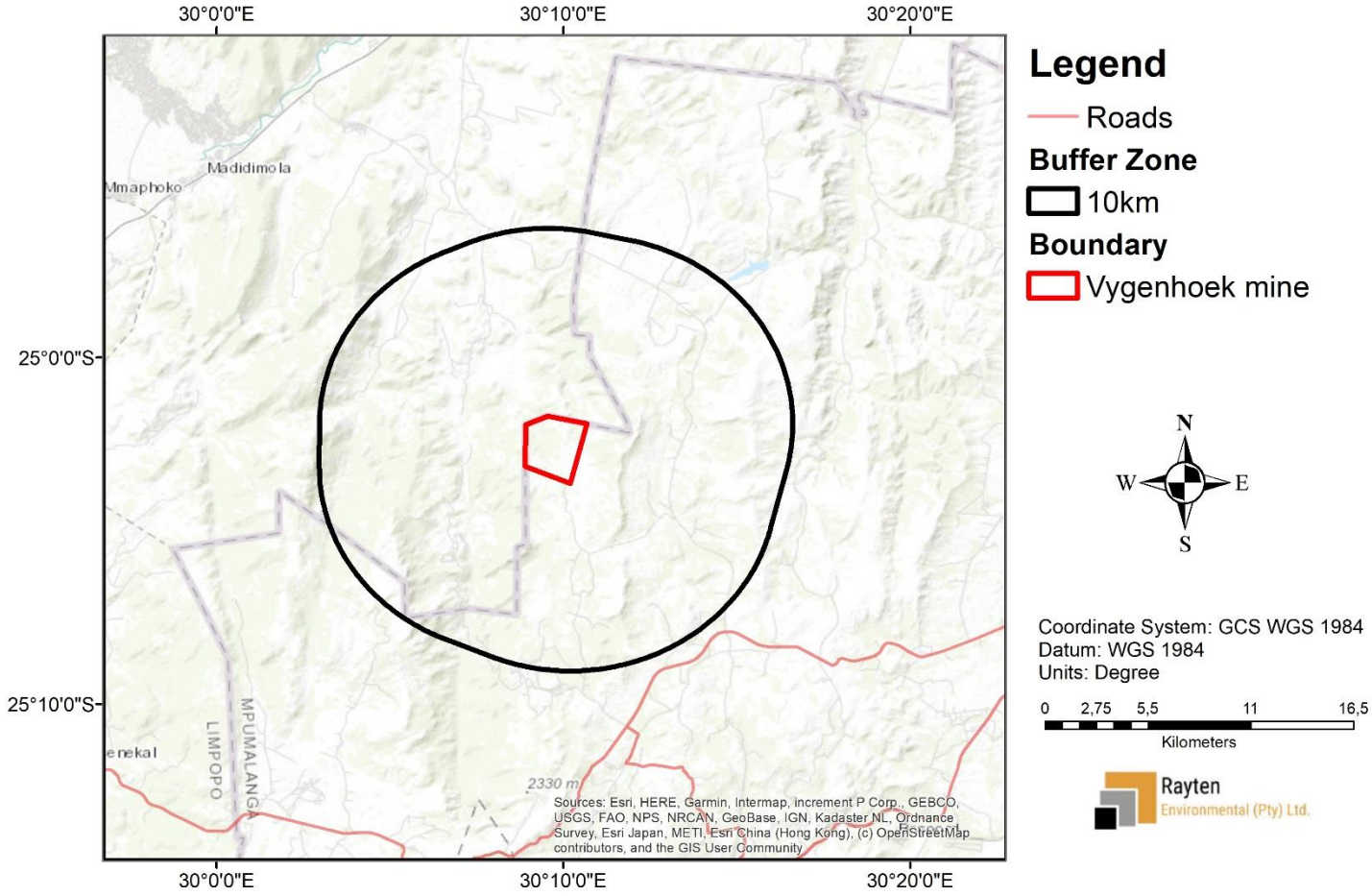

Figure 2-1: Site locality for the proposed Vygenhoek Platinum Mine.

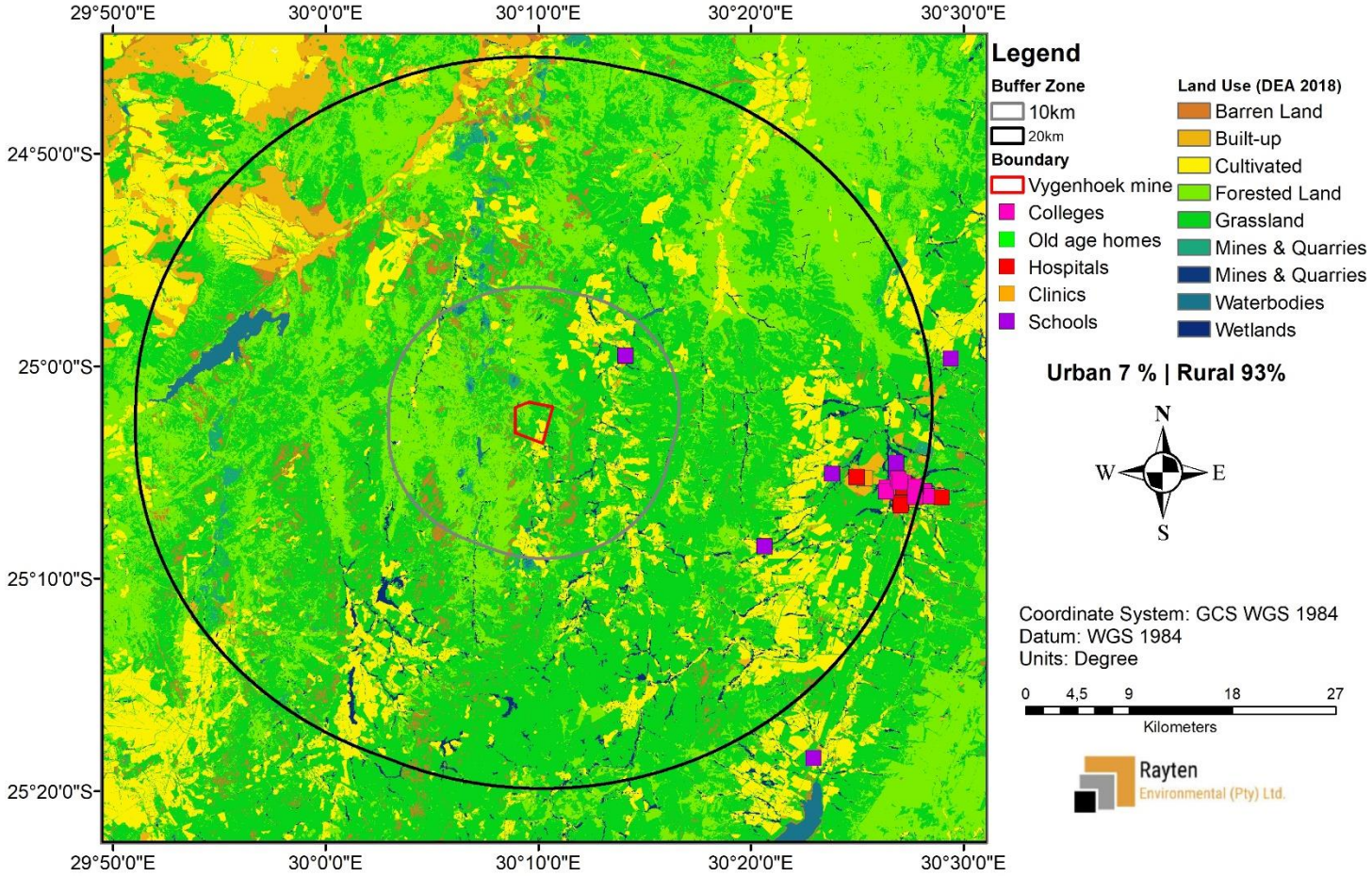

Figure 2-2: Land use surrounding the proposed Vygenhoek Platinum Mine.

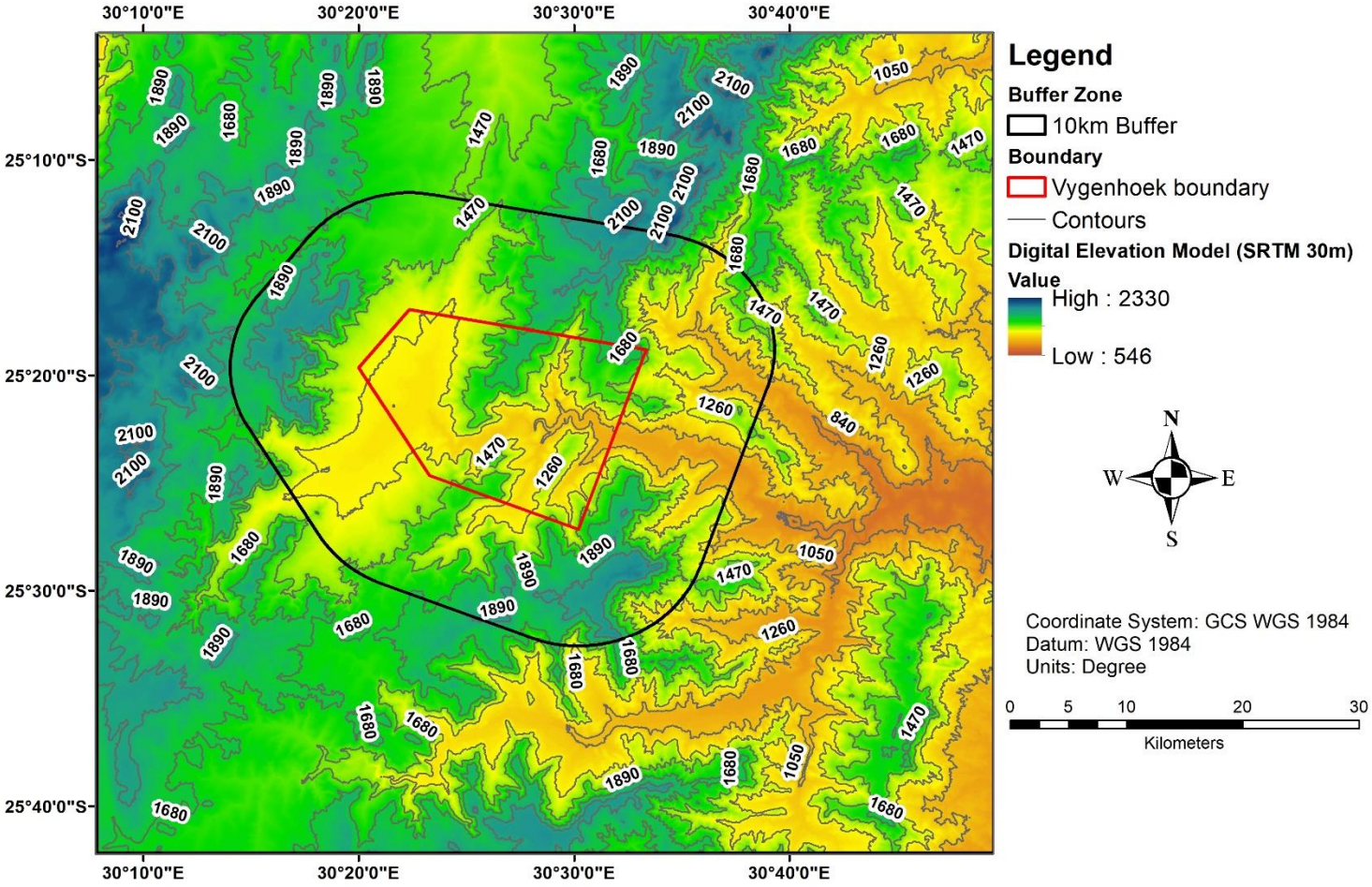

Figure 2-3: Topography surrounding the proposed Vygenhoek Platinum Mine.

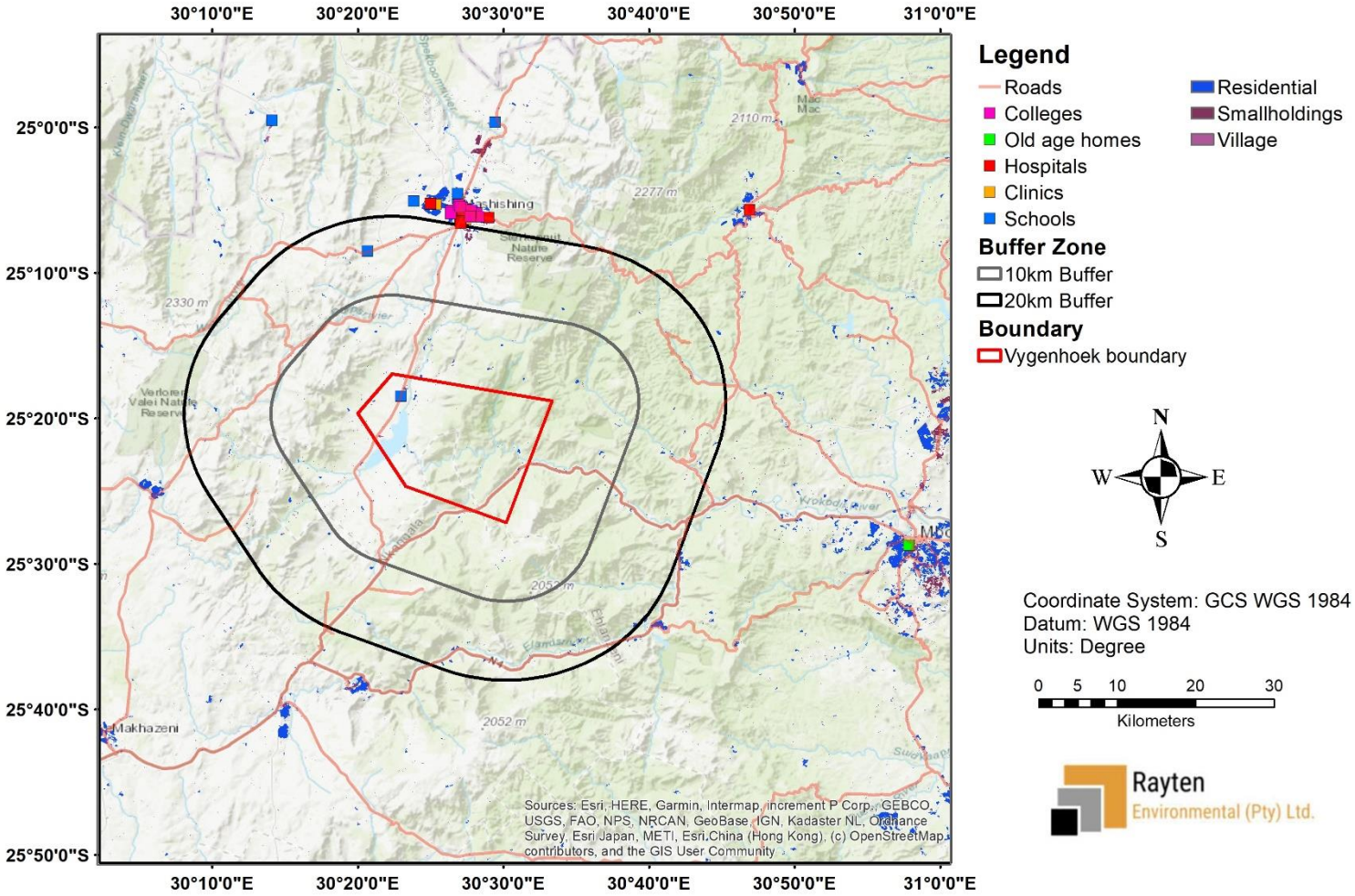

Figure 2-4: Sensitive receptors surrounding the proposed Vygenhoek Platinum Mine.

3. LEGISLATION

3.1. National Environmental Management: Air Quality Act

The NEM: AQA, has shifted the approach of air quality management from source-based control to receptor-based control. The main objectives of the Act are to;

- protect the environment by providing reasonable measures for—
  - i. the protection and enhancement of the quality of air in the Republic;
  - ii. the prevention of air pollution and ecological degradation; and
  - iii. securing ecologically sustainable development while promoting justifiable economic and social development; and
- generally, to give effect to section 24(b) of the Constitution in order to enhance the quality of ambient air for the sake of securing an environment that is not harmful to the health and wellbeing of people.

The Act makes provisions for the setting and formulation of National Ambient Air Quality Standards for “substances or mixtures of substances which present a threat to health, well-being or the environment”. More stringent standards can be established at the provincial and local levels.

The control and management of emissions in the NEM: AQA relates to the listing of activities that are sources of emissions and the issuing of Atmospheric Emission Licences (AEL). Listed activities are defined as activities which “result in atmospheric emissions and are regarded as having a significant detrimental effect on the environment, including human health”. Listed activities have been identified by the Minister of the Department of Environmental Affairs (DEA) (now known as the Department of Environment, Forestry and Fisheries (DEFF)) and atmospheric emission standards have been established for each of these activities. These listed activities now require an AEL to operate. The issuing of AELs for listed activities is the responsibility of the Metropolitan and District Municipalities, with the exception of those associated within mining operations.

In addition, the Minister may declare any substance contributing to air pollution as a priority pollutant. Any industries or industrial sectors that emit these priority pollutants will be required to implement a Pollution Prevention Plan. 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 is responsible for the issuing of AELs.

3.2. Listed Activities and Minimum Emission Standards

The NEM: AQA requires all persons undertaking listed activities in terms of Section 21 of the Act to obtain an AEL. The listed activities and associated minimum emission standards were issued by the DEA on 31 March 2010 (Government Gazette No. 33064 of 31 March 2010) and were amended in:

- 2013 (Government Gazette No. 37054 of 22 November 2013);
- 2015 (Government Gazette No. 38863 of 12 June 2015);
- 2018 (Government Gazette No.41650 of 25 May 2018; Government Gazette No.42013 of 31 October 2018);
- 2019 (Government Gazette No.42472 of 22 May 2019); and
- 2020 (Government Gazette No. 43174 of 27 March 2020.

The proposed Vygenhoek Platinum Mine will not trigger any of the S21 listed activities based on their proposed operations.

South Africa launched an online National reporting system, referred to as the National Atmospheric Emissions Inventory System (NAEIS). The NEM:AQA requires all emission source groups identified in terms of the National Atmospheric Emission Reporting Regulations (Government Gazette No. 38633 of 02 April 2015), to register and report emissions on the NAEIS. Mines are classified as Group C emitters and thus are required to report annually and comply with the National Atmospheric Emission Reporting Regulations.

Once operational, the proposed Vygenhoek Platinum Mine must register on the NAEIS and report on their fugitive dust emissions annually before the 31 March each year.

3.3. Ambient Air Quality Standards

National Ambient Air Quality Standards (NAAQS), including permitted frequencies of exceedance and compliance timeframes, were issued by the Minister of Water and Environmental Affairs on 24 December 2009 (Table 3-1). National standards for $PM_{2.5}$ were established by the Minister of Water and Environmental Affairs on 29 June 2012.

Table 3-1: National Ambient Air Quality Standards for Criteria Pollutants.

POLLUTANT	AVERAGING PERIOD	CONCENTRATION (µg/m^3)	FREQUENCY OF EXCEEDANCE (3)
Sulphur dioxide (SO_2)	10 minutes	500 (191)	526
	1 hour	350 (134)	88
	24 hours	125 (48)	4
	1 year	50 (19)	0
Nitrogen dioxide (NO_2)	1 hour	200 (106)	88
	1 year	40 (21)	0
Particulate Matter (PM_{10})	24 hours	75	4
	1 year	40	0
Particulate Matter ($PM_{2.5}$)	24 hours	40(1) 25(2)	0
	1 year	20(1) 15(2)	0
Ozone (O_3)	8 hours (running)	120 (61)	11
Benzene (C_6H_6)	1 year	5 (1.6)	0
Lead (Pb)	1 year	0.5	0
Carbon monoxide (CO)	1 hour	30 000 (26 000)	88
	8 hours (calculated on 1 hourly averages)	10 000 (8 700)	11

Notes:

*Values indicated in blue are expressed in part per billion (ppb)

(1) Compliance required by 1 January 2016 – 31 December 2029.

(2) Compliance required by 1 January 2030.

(3) Frequency of exceedance refers to the number of times an exceedance is allowed within a calendar year.

3.4. Dust Deposition Standards

The DEA issued National Dust Control Regulations on 1 November 2013 (Table 3-2). The purpose of the regulations is to prescribe general measures for the control of dust in all areas. The regulations prohibit activities which give rise to dust in such quantities and concentrations that the dust-fall at the boundary or beyond the boundary of the premises where it originates exceeds:

a) 600 mg/m^2/day averaged over 30 days in residential areas measured using reference method ASTM D1739.
b) 1 200 mg/m^2/day averaged over 30 days in non-residential areas measured using reference method ASTM D1739.

Updated draft National Dust Control Regulations were published on 25 May 2018. The regulations prescribe the method that should be used for undertaking dust-fall monitoring, which includes the use of dust bucket stations with a wind shield.

Table 3-2: South African National Dust Control Regulations.

RESTRICTION AREAS	DUST-FALL RATE (D) (1)	REQUENCY OF EXCEEDANCE
Residential Areas	D < 600 mg/m^2/day	Two within a year, no two sequential months (2)
Non-residential areas	600 < D < 1200 mg/m^2/day	Two within a year, no two sequential months (2)

Notes:

(1) Averaged over 1 month (30±2-day average) (mg/m^2/day)

(2) Per dust-fall monitoring site.

Any person who has exceeded the dust-fall standard must, within three months after submission of a dust-fall monitoring report, develop and submit a dust management plan to the air quality officer for approval. The dust management plan must:

a) Identify all possible sources of dust within the affected site;
b) Detail the best practicable measures to be undertaken to mitigate dust emissions;
c) Develop an implementation schedule;
d) Identify the line management responsible for implementation;
e) Incorporate the dust-fall monitoring plan;
f) Establish a register for recording all complaints received by the person regarding dust-fall, and for recording follow up actions and responses to the complainants.

The dust management plan must be implemented within a month of the date of approval. An implementation progress report must be submitted to the air quality officer at agreed time intervals.

3.5. GHG Emissions

On 14 March 2014, the following six greenhouse gases were declared as priority air pollutants in South Africa:

- Carbon dioxide (CO_2)
- Methane (CH_4)
- Nitrous Oxide (N_2O)
- Hydrofluorocarbons (HFCs)
- Perfluorocarbons (PFCs)
- Sulphur hexafluoride (SF_6)

National GHG Emission Reporting Regulations (Government Gazette No. 40762 of 3 April 2017), were published by the DEA. A person identified as a Category A data provider in terms Annexure 1 of these regulations, must register their facilities by filling in the form under Annexure 2 of these regulations and must submit a GHG emissions inventory and activity data in the required format given under Annexure 3 of these regulations on an annual basis. All data must be provided annually, by the 31 March of the following year. Data providers are required to register on the NAEIS and report on their direct GHG emissions on an annual basis and comply with the reporting requirements as detailed in the National GHG Emission Reporting Regulations.

National Pollution Prevention Plan Regulations (Gazette No. 40996) were published on 21 July 2017 by the DEA. A Pollution Prevention Plan will be required should the development do the following:

a) Undertake any of the following activities identified in Annexure A of the National GHG Emission Reporting Regulations (Government Gazette No. 40762 of 3 April 2017), which involves the direct emission of GHG more than 0.1 Megatonnes (Mt) annually measured as carbon dioxide equivalents ($CO_{2\text{-eq}}$); or
b) Undertake any of the following activities identified in Annexure A of the National Pollution Prevention Plan Regulations (Gazette No. 40996 of 21 July 2017) as a primary activity, which involves the direct emission of GHG more than 0.1 Megatonnes (Mt) annually measured as carbon dioxide equivalents ($CO_{2\text{-eq}}$);

<u>Annexure A activities in terms of the National Pollution Prevention Plan Regulations include:</u>

- Coal mining
- Production and /or refining of crude oil
- Production and/or processing of natural gas
- Production of liquid fuels from coal or gas
- Cement production
- Carbon black production
- Iron & steel production
- Ferro-alloys production
- Aluminium production
- Polymers production
- Pulp and paper production
- Electricity production
- Nitric acid production

- Glass production
- Ammonia production

Should the proposed Vygenhoek Platinum Mine trigger any of the activities in terms of Annexure A, they will need to quantify and report on their GHG emissions by the 31 March of each year.

Mining falls under category 1A2i (i.e. Mining and Quarrying) in terms of Annexure 1 of the National GHG emission reporting regulations (Government Gazette No. 40762 of 3 April 2017). All facilities conducting this activity (i.e. Mining and Quarrying) are required to register and report on their GHG emissions by the 31 March of every year.

3.6. Carbon Tax Act

The Carbon Tax Act No. 15 of 2019 was promulgated on the 23 May 2019 and is implemented using a phased approach, allowing emitters time to transition to cleaner and more efficient technologies resulting in lower GHG emissions. Phase One is effective from 1 June 2019 to 31 December 2022.

Any person, company or entity who undertakes an activity (above a certain threshold) and is responsible for the release of GHG emissions is required to report on their emissions to the DEA by the 31 March each year and pay tax on those emissions by July each year.

The tax rate is R120 per tonnes of $CO_{2\text{-eq}}$ (carbon dioxide equivalent) emitted by the generation facility or entity for the relevant reporting period. The carbon tax rate will increase by CPI + 2% during the first phase and thereafter by CPI. However, there are tax-free allowances that apply that can make the overall effective tax rate much lower between R6 and R48 per tonnes of $CO_{2\text{-eq}}$ emitted. Tax free allowances are capped at 95% and include:

- A basic tax-free allowance of 60% during Phase One (until December 2022).
- An additional tax-free allowance of 10% for process emissions.
- An additional tax-free allowance of 10% for fugitive emissions.
- An additional tax-free allowance of up to a maximum of 10% for trade exposed sectors.
- An additional tax-free performance allowance of 5% based on performance against intensity benchmarks.
- An additional tax-free allowance of 5% for companies who participate in the carbon budget system.
- An additional tax-free carbon offset allowance of 5% or 10%.

3.7. Human Health Effects

3.7.1. Dust-Fall

3.7.1.1. Dust-Fall

Dust-fall are particles with an aerodynamic diameter greater than 20 µm that have been entrained into the air by a physical process such as wind, movement of vehicles, stack emissions or from fugitive

dust. These particles are generally too heavy to remain in suspension in the air for any period and fall out of the air over a relatively short distance depending on a combination of various factors such as particle size, density, temperature (of the air and particle), emission velocity or method, ambient wind speed and humidity. These particles are therefore commonly known as “dust-fall”. Particulates in this range are generally classified as a nuisance dust and can cause physical damage to property and physical irritation to plants, animals and humans.

3.7.1.2. Particulates (PM_{10} & $PM_{2.5}$)

Particles can be classified by their aerodynamic properties into coarse particles, PM_{10} (particulate matter with an aerodynamic diameter equal to or less than 10 µm) and fine particles, $PM_{2.5}$ (particulate matter with an aerodynamic diameter equal to or less than 2.5 µm). The fine particles mostly contain secondary formed aerosols such as sulphates and nitrates, combustion particles and re-condensed organic and metal vapours. The coarse particles mostly contain earth crust materials and fugitive dust from roads and industries (Harrison and van Grieken, 1998) (Fenger, 2002).

In terms of health impacts, particulate air pollution is associated with effects on the respiratory system (WHO, 2000). When looking at human health particle size is an important factor to consider because it controls where in the respiratory system a given particle will be deposited. Fine particles are thought to be more damaging to human health than coarse particles as larger particles do not penetrate deep into the lungs compared to smaller particles. Larger particles are deposited into the extra thoracic part of the respiratory tract while smaller particles are deposited into smaller airways that lead to the respiratory bronchioles (WHO, 2000).

Recent studies suggest that short-term exposure to particulate matter leads to adverse health effects, even at low concentrations of exposure (below 100 µg/m^3). Morbidity effects associated with short-term exposure to particulates include increases in lower respiratory symptoms, medication use and small reductions in lung function. Long-term exposure to low concentrations (~10 µg/m^3) 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.

4. BASELINE ASSESSMENT

4.1. Meteorological Overview

Meteorological processes will determine the dispersion and dilution potential of pollutants emitted into the atmosphere. The vertical dispersion of pollution is governed by the stability of the atmosphere as well as the depth of the surface mixing layer. Horizontal dispersion of pollution is defined by dominant wind fields. Therefore, meteorological parameters including temperature, precipitation, wind speed and wind direction are of significance as they will influence the degree to which pollution will accumulate or disperse in the atmosphere.

As per the Code of Practice for Air Dispersion Modelling in Air Quality Management in South Africa (DEA, 2014), representativeness of the meteorological data is influenced by the following four factors:

- Proximity of the meteorological site to the area being modelled;
- Complexity of the terrain;
- Exposure of the meteorological measurement site; and
- Period of data collection.

MM5 modelled meteorological data was used for the project area. MM5 meteorological data was obtained from Lakes Environmental for the period January 2017 to December 2019. MM5 is a PSU/NCAR meso-scale model used to predict meso-scale and regional-scale atmospheric circulation. The model provides integrated model meteorological data, which can be used in a wide range of applications. This model is often used to create weather forecasts and climate projections. Details of the meteorological data obtained are summarised in Table 4-1 below.

The South African dispersion modelling regulations requires a minimum of 3-years of meteorological data for input into the dispersion model. The meteorological overview given below is with reference to the data used for input into the model. The meteorological data is representative of recent prevailing weather conditions that will likely be experienced at the project site.

Table 4-1: Meteorological Data Details.

Meteorological Data Details	
Met Data Information	**Description**
Met data type	MM5 AERMET-Ready (Surface & Upper Air Data)
Datum	WGS 84
Closest Town	Lydenburg - South Africa
Co-ordinates of centre of met grid:	
Latitude	25.045084° S
Longitude	30.162327° E
Time zone	UTC +2 hours
Period of record	January 2017 - December 2019
Met Station Parameters	**Description**
Anemometer height	13 m
Station base elevation	1463 m
Upper air adjustment	-2 hours
Grid Cell Information	
Cell centre	25.045084°S, 30.162327° E
Cell dimension	12km * 12km
Surface Met Data	**Description**
File format	SAMSON file
Output interval	Hourly
Upper Air Data	**Description**
Format	TD-6201- Fixed Length
Reported in	GMT
Output interval	00Z and 12Z
Models used to process met data	

Model used to process data for wind roses	WR Plot
Model used to process data for AERMOD	AERMET

4.1.1. Local Wind Field

Figure 4-1 below provides the period wind rose plot for the proposed Vygenhoek Platinum Mine for the period January 2017 to December 2019. The predominant wind directions for the period are observed from the south-east (~24.1% of the time) and east-south-east (~12.01% of the time). Additional low frequency winds are observed form the north-north-west (7.22% of the time). Wind speeds for the three-year period were generally moderate to fast with calm conditions, defined as wind speeds less than 1 m/s, observed for 4.33% of the time (Figure 4-1).

The morning (AM) and evening (PM) period wind rose plots for the period January 2017 to December 2019 are given in Figure 4-2 below and show diurnal variation in the wind field data. During the morning (AM) period, high frequency winds are mainly observed from the south-east and east-south-east; as opposed to the evening (PM) period, where winds are predominantly observed from the south-east, north-north-west, and east-south-east/north-west (Figure 4-2). Greater variation in winds is observed during the evening period.

There is slight seasonal variation in winds at the proposed Vygenhoek Platinum Mine, as shown in Figure 4-3 below. Over the different seasons, south-easterly and east-south-easterly winds prevail. Additional less frequent easterly, northerly, south-south-westerly, and north-westerly winds are observed. Easterly and northerly winds prevail in summer and spring, respectively, while south-south-westerly winds are observed during autumn and winter. North-westerly winds prevail in autumn. Wind speeds were generally high during all seasons, which could subsequently facilitate dust emissions from stockpiles, onsite and offsite activities.

Based on the prevailing wind fields for the period January 2017 to December 2019, emissions from activities at the proposed Vygenhoek Platinum Mine will likely be transported towards the north-westerly and west-north-westerly quadrants. Moderate to fast wind speeds observed during all the time periods, may result in effective dispersion and dilution of emissions from the proposed mine operations; however, higher winds speeds can also facilitate fugitive dust emissions from open exposed areas such as stockpiles and opencast areas.

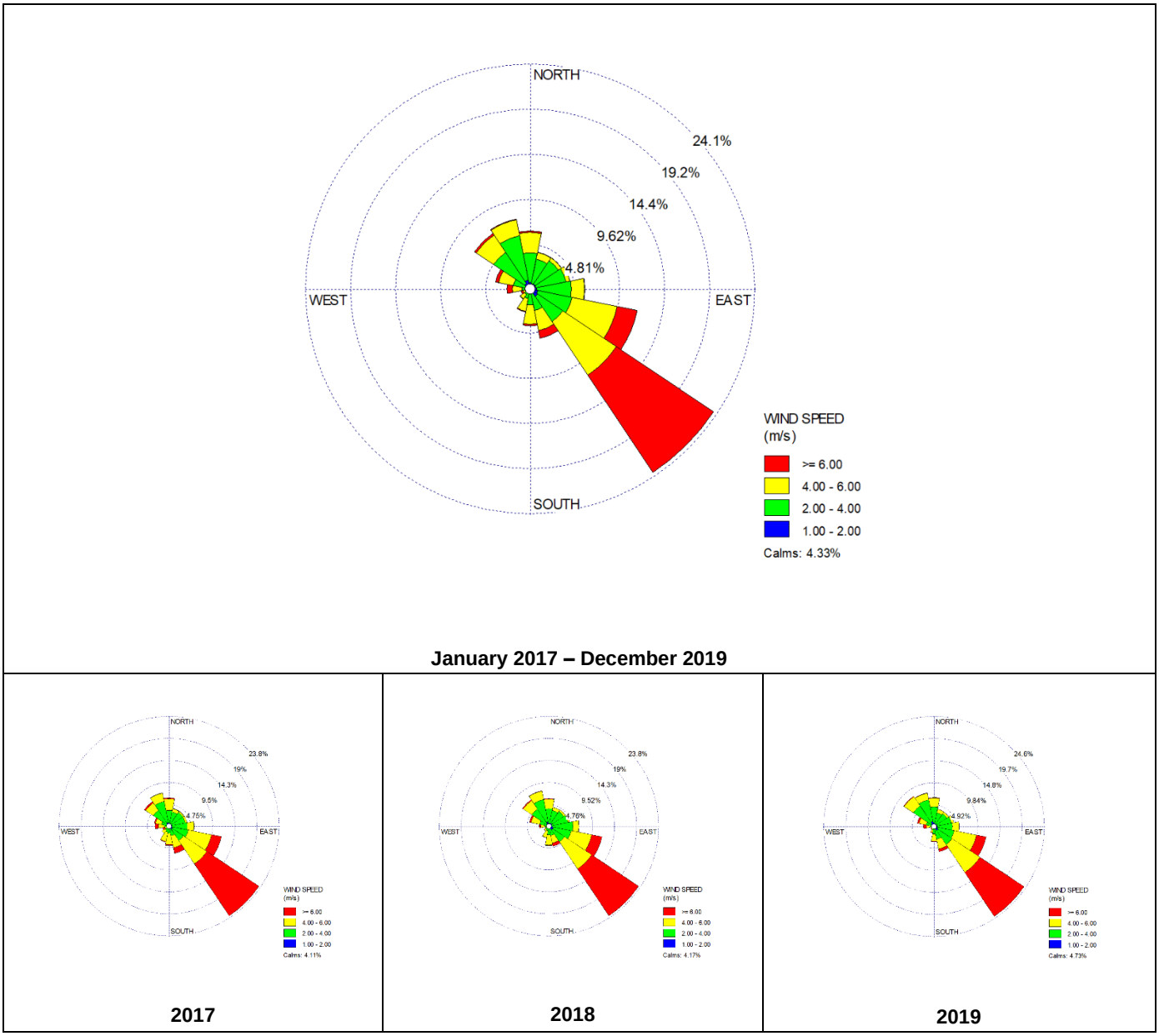

Figure 4-1: Period Wind Rose Plots for the proposed Vygenhoek Platinum Mine for the period January 2017 - December 2019

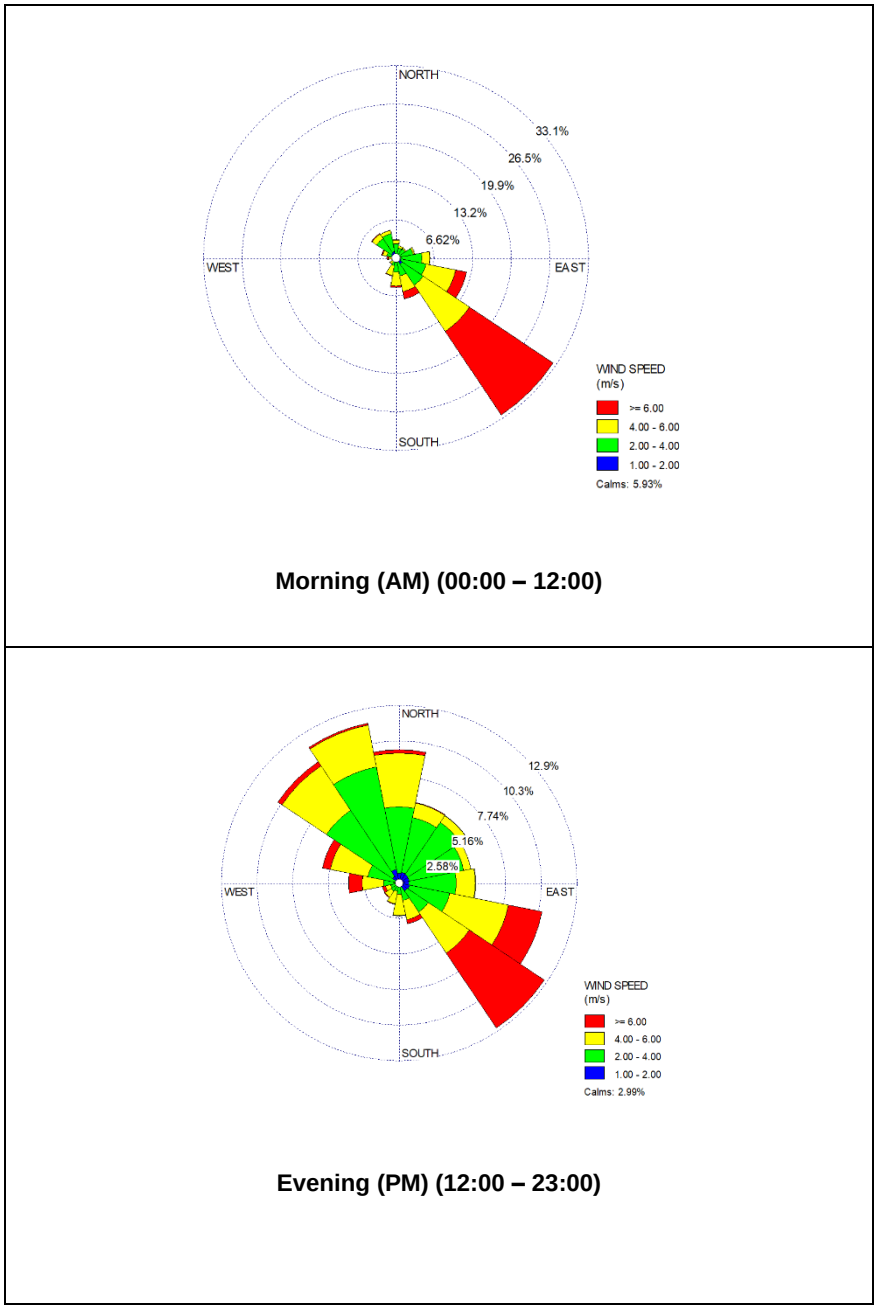

Figure 4-2: Morning (AM) (00:00 - 12:00) and Evening (PM) (12:00 - 23:00) Period Wind Rose Plots for proposed Vygenhoek Platinum Mine for the Period January 2017 - December 2019.

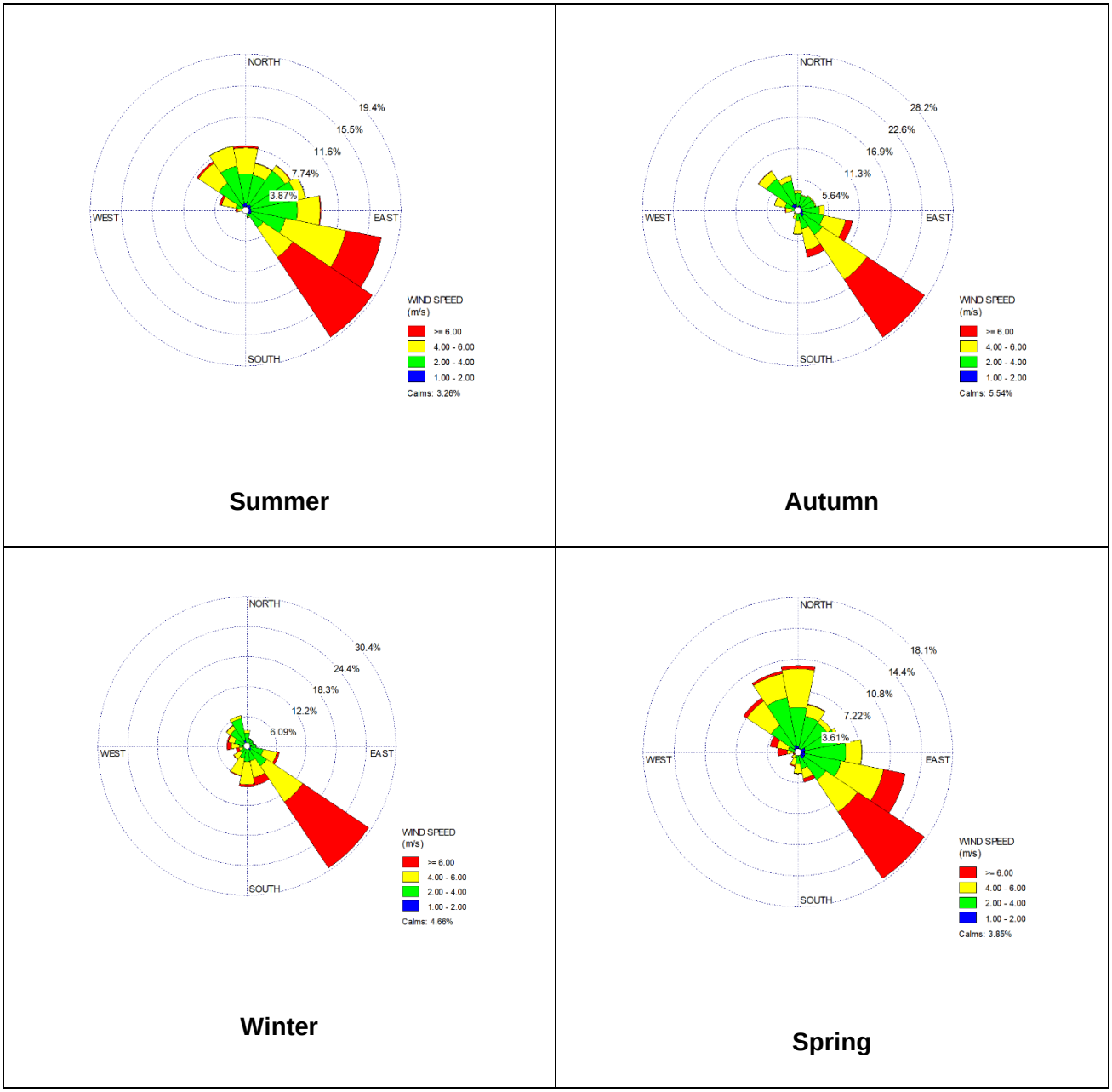

Figure 4-3: Seasonal Variation of Winds for the proposed Vygenhoek Platinum Mine for the Period January 2017 - December 2019.

4.1.2. Temperature and Relative Humidity

Temperature affects the formation, action and interactions of pollutants in various ways. Temperature provides an indication of the rate of development and dissipation of the mixing layer, which is largely controlled by surface inversions. Surface temperature inversions play a major role in air quality, especially during the winter months when these inversions are the strongest. Higher ambient temperatures will facilitate the dispersion of air pollutants which can result in lower ambient concentrations.

Chemical reaction rates also tend to increase with temperature and the warmer the air, the more water it can hold and therefore 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. This results in decreased visibility due to the resultant haze. Many pollutants may also dissolve in water to form acids.

The Mpumalanga Province generally experiences a sub-tropical climate with warm, rainy summers and cold winters. Monthly average temperatures and relative humidity profiles at the project site for the period January 2017 to December 2019 are presented in Figure 4-4 below. Average monthly temperatures range from 12.0 – 20.4 ºC (Table 4-2). Highest temperatures are observed during the spring, summer and autumn months (September – April) and minimum temperatures are observed during the late autumn and winter months (May – August). Relative humidity is higher during the warmer spring, summer and autumn seasons (October – April).

Table 4-2: Hourly Minimum, Maximum and Monthly Average Temperatures for January 2017 - December 2019.

MINIMUM, MAXIMUM AND MONTHLY AVERAGE TEMPERATURES (ºC)												
	JAN	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**
Minimum	10.1	11.8	8.6	9.5	5.4	4.9	3.8	4.4	5.1	6.0	7.6	10.4
Maximum	30.5	29.4	28.1	27.0	22.6	20.9	22.0	24.1	27.2	30.1	29.1	31.0
Average	20.0	20.0	19.2	16.9	14.2	12.0	11.7	14.0	16.6	17.6	18.9	20.4

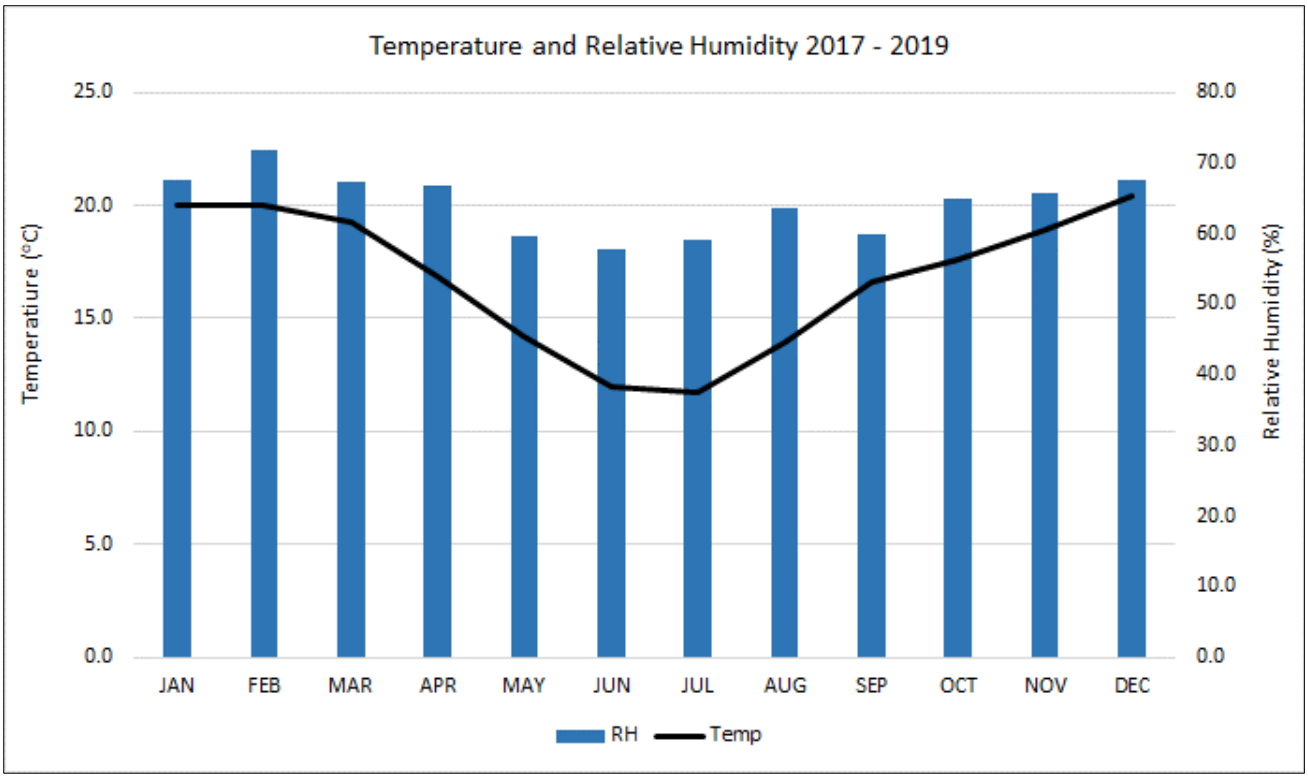

Figure 4-4: Monthly Average Temperature and Relative Humidity profiles for the proposed Vygenhoek Platinum Mine for January 2017 - December 2019.

4.1.3. Precipitation

Precipitation has an overall dilution effect and cleanses the air by washing out particles suspended in the atmosphere. Monthly total rainfall at the project site for the period January 2017 to December 2019 is presented in Figure 4-5. The area receives most of its rainfall during the spring, summer and early autumn seasons during the months October - March. Little to no rainfall is observed during the mid-autumn and winter seasons from April to August (Table 4-3). Removal of particulates via wet depositional processes would be evident during the warmer (wet) seasons thus lower ambient concentrations of dust could be expected during these seasons. Over the remainder of the year higher ambient concentrations of particulates could be expected.

Table 4-3: Total Monthly Rainfall for January 2017 - December 2019.

TOTAL MONTHLY RAINFALL (mm)												
YEAR	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**
2017	86.1	106.9	40.1	18.3	16.5	0.0	0.0	1.0	20.6	127.8	108.0	102.6
2018	151.6	210.3	115.6	9.9	5.1	1.8	2.0	33.0	51.3	72.6	91.7	203.7
2019	207.5	117.3	54.1	38.9	33.5	0.0	0.0	2.5	22.1	47.2	117.6	265.2

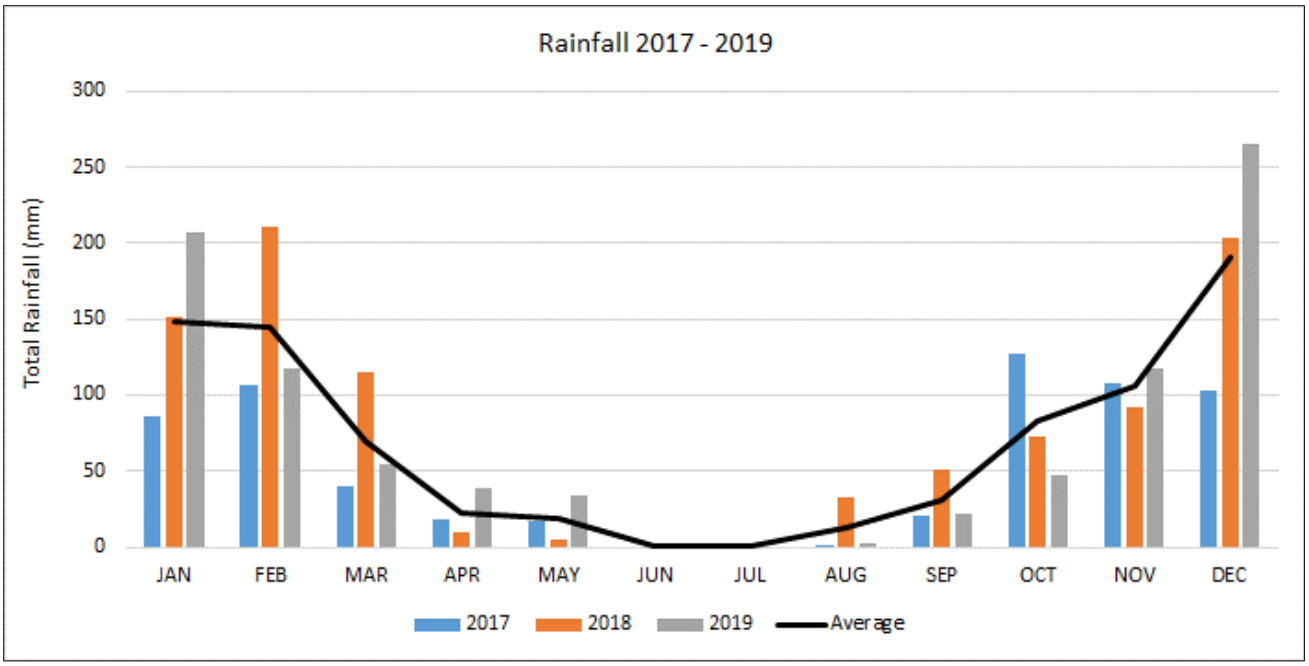

Figure 4-5: Total Monthly and Average Rainfall (mm) for the proposed Vygenhoek Platinum Mine for the period January 2017 - December 2019.

4.2. Baseline Air Quality Concentrations

The existing air quality situation is usually evaluated using available monitoring data from permanent ambient air quality monitoring stations and dust-fall networks operated near the project site. There was no South African Air Quality Information System (SAAQIS) data available (that could be determined) to present background concentrations for SO_2, NO_2, CO, PM_{10} and $PM_{2.5}$ concentrations at the project site, nor are there any dust-fall networks that we know of. Therefore, baseline air quality at the proposed Vygenhoek Platinum Mine could not be assessed.

4.3. Surrounding Sources of Air Pollution

Existing key sources of air pollution surrounding the proposed Vygenhoek Platinum Mine were identified during a desktop exercise and were limited, with the main pollution source being forestry activity/plantations in surrounding areas (Figure 4-6 and Figure 4-7):

Mining, refuse dumps, villages and industrial activity were identified as additional sources of air pollution but to a minimal extent. Mining activities are mostly concentrated south of the proposed mine, while industrial activities and refuse dumps are mainly located to the north. Villages and associated solid fuel combustion activities are concentrated north to north-west of the proposed mine within 15 – 20km radius.

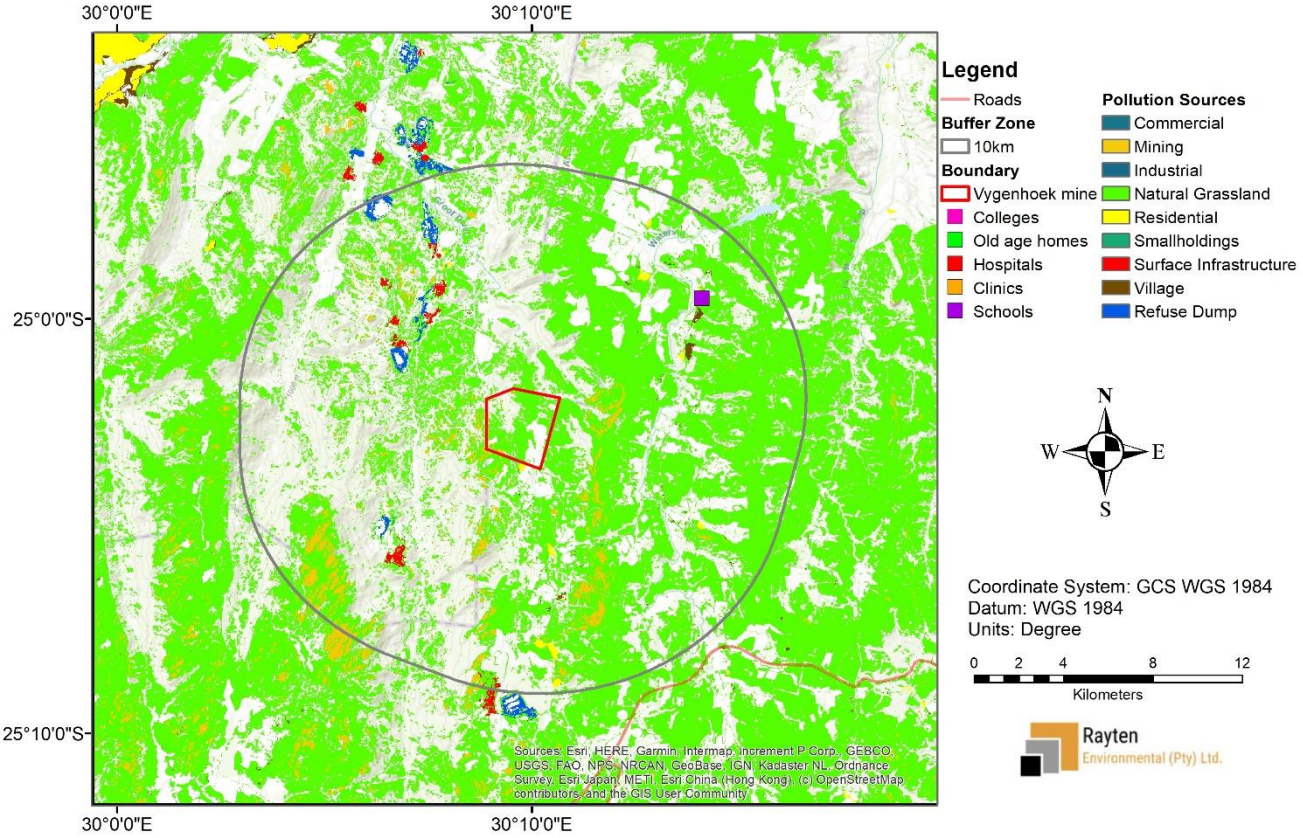

Figure 4-6: Identified surrounding emission sources within 10km of the proposed Vygenhoek Platinum Mine.

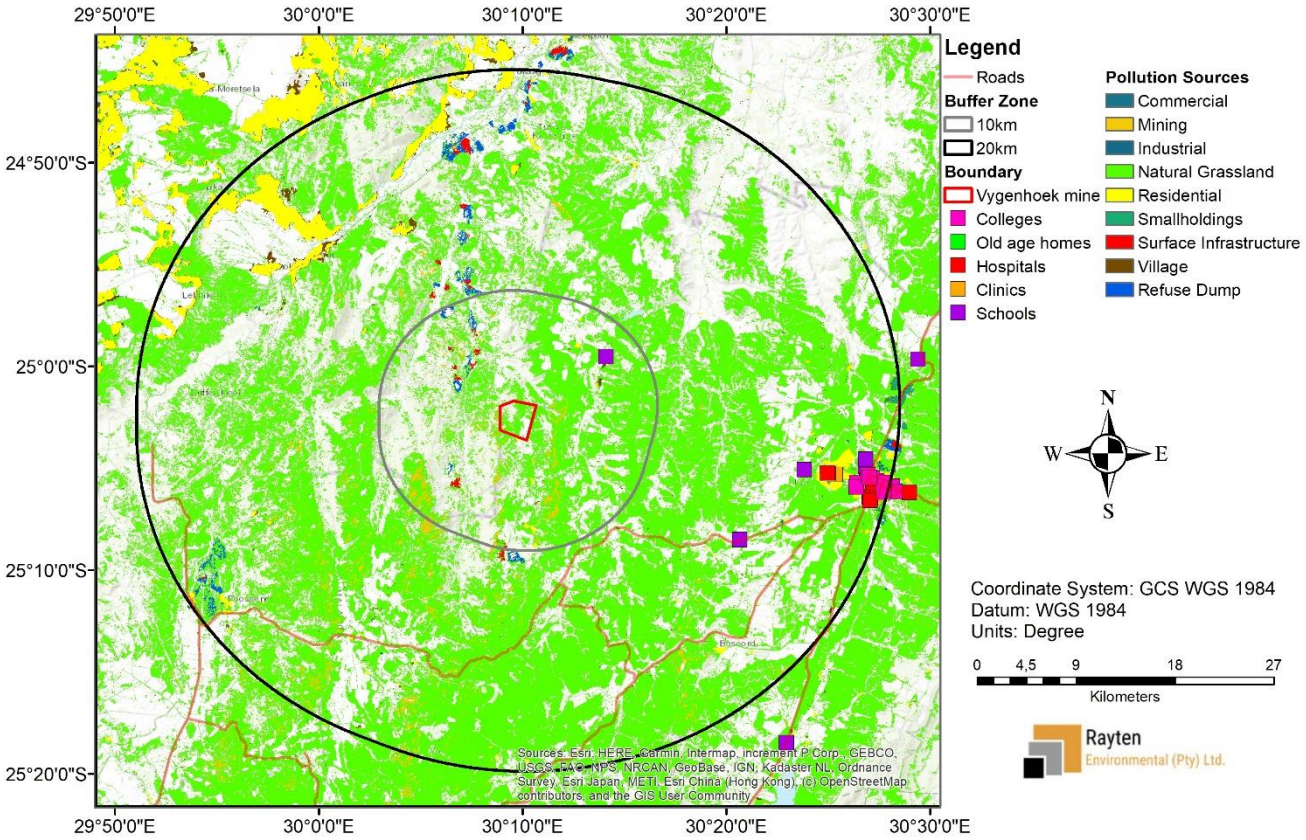

Figure 4-7: Identified surrounding emission sources within 20km of the proposed Vygenhoek Platinum Mine.

4.3.1. Forestry Activities/Plantations

Forestry activity occurs over several areas around the proposed mine. The effects of plantations on ambient air quality are dependent on the type of plantations. Oil tree plantations, for example, are associated with production of high levels of VOCs, particularly isoprene. In general, plantations result in an increase in ambient NOx concentrations due to the frequent and heavier use of fertiliser (https://nerc.ukri.org/planetearth/stories/561). The use of mobile equipment and trucks during land preparation and removal of trees are also a source of emissions such as PM, SO_2 and NO_x.

Plantations generally have sawmills. Air pollutants generated from sawmill operations are mainly associated with combustion processes such as wood recycling and disposal, as well as boilers. Additional sources of pollutants include wood drying in kilns, sawing, machining and sanding operations. Pollutants associated with boilers are dependent on the type of wood and fuel used to power the boilers and may include sulphur oxides (SO_X), PM, NO_X, CO, and VOCs. VOCs are also emitted from wood drying in kilns and during the application of solvents, coatings and lacquers to wood. Wood dust is an additional pollutant mainly associated with sawing, machining and sanding operations (Environmental, Health, and Safety Guidelines – Sawmilling and Manufactured Wood Products, International Finance Corporation).

5. AIR QUALITY IMPACT ASSESSMENT

Dust-fall, PM_{10} and $PM_{2.5}$ are key pollutants of concern associated with operational activities at the proposed Vygenhoek Platinum Mine and will be emitted from the following key sources:

Dust and Particulate Emissions:

- Drilling and blasting at the opencast pit;
- Bulldozing (profiling of waste);
- Materials handling operations (truck loading/offloading operations);
- Transportation of material (trucks);
- Material storage: Stockpiling,
- Excavators (stripping ore and waste and loading trucks);
- Wind erosion from exposed areas (i.e. the open cast pit, exposed surfaces, and material stockpile areas); and
- Vehicle dust entrainment on unpaved roads.

The above-mentioned sources were identified for the proposed mine based on the information provided by the client. A detailed questionnaire was given to the client prior to modelling to obtain specific details needed for input into the model and for calculation of emission rates. The conservative scenario will be assumed where information is not known for input into the model.

To investigate the potential impact of operations associated with the proposed mine on local ambient air quality, the following air pollutants were chosen in the quantification of emissions for the operational phase of the project. This project focused on dust emissions as this is a key pollutant emitted from operations at the proposed mine:

- Dust-fall;
- Particulate matter (PM_{10} and $PM_{2.5}$);

A detailed emissions inventory will be compiled for the proposed Vygenhoek Platinum Mine operations and the impact of these on air quality will be assessed through dispersion modelling using AERMOD. The results of the assessment will include dispersion isopleth plots and will be presented in the final Air Quality Impact Assessment report. A summary of the AERMOD model used is given in Section 5.1 below.

5.1. Model Overview

5.1.1. AERMOD View

AERMOD, a state-of-the-art Planetary Boundary Layer (PBL) air dispersion model, was developed by the American Meteorological Society and USEPA Regulatory Model Improvement Committee (AERMIC). AERMOD utilizes a similar input and output structure to ISCST3 and shares many of the same features, as well as offering additional features. AERMOD fully incorporates the PRIME building downwash algorithms, advanced depositional parameters, local terrain effects, and advanced meteorological turbulence calculations.

The AERMOD atmospheric dispersion modelling system is an integrated system that includes three modules:

- A steady-state dispersion model designed for short-range (up to 50 km) dispersion of air pollutant emissions from stationary industrial sources.
- A meteorological data pre-processor (AERMET) for surface meteorological data, upper air soundings, and optionally, data from on-site instrument towers. It then calculates atmospheric parameters needed by the dispersion model, such as atmospheric turbulence characteristics, mixing heights, friction velocity, Monin-Obukov length and surface heat flux.
- A terrain pre-processor (AERMAP) which provides a physical relationship between terrain features and the behaviour of air pollution plumes. It generates location and height data for each receptor location. It also provides information that allows the dispersion model to simulate the effects of air flowing over hills or splitting to flow around hills.

AERMOD includes Plume Rise Model Enhancements (PRIME) building downwash algorithms which provide a more realistic handling of building downwash effects. PRIME algorithms were designed to address two fundamental features associated with building downwash; enhanced plume dispersion coefficients due to the turbulent wake and to reduce plume rise caused by a combination of the descending streamlines in the lee of the building and the increased entrainment in the wake. AERMOD is suitable for a wide range of near field applications in both simple and complex terrain. The evaluation results for AERMOD, particularly for complex terrain applications, indicate that the model represents significant improvements compared to previously recommended models.

AERMOD has been used in various dispersion modelling studies in the United States and around the world (Perry *et al*., 2004).

5.1.2. Model Requirements

The approach to this dispersion modelling study is based on the Code *of Practice for Air Dispersion Modelling in Air Quality Management in South Africa* (DEA, 2014). As per the *Code of Practice*, this assessment is a Level 2 assessment. Level 2 assessments should be used for air quality impact assessment in standard/generic licence or amendment processes where:

- The distribution of pollutant concentrations and depositions are required in time and space;
- Pollutant dispersion can be reasonably treated by a straight-line, steady-state, Gaussian plume model with first order chemical transformation. Although more complicated processes may be occurring, a more complicated model that explicitly treats these processes may not be necessary depending on the purposes of the modelling and the zone of interest.
- Emissions are from sources where the greatest impacts are in the order of a few kilometres (less than 50 km) downwind.

A summary of the key variables input into the AERMOD model is given in Table 5-1 below. Data input into the model includes MM5 modelled meteorological data (surface and upper air) for 01 January 2017 – 31 December 2019. Terrain data at a resolution of 90 m (SRTM90) is used for input into the model, as generated by the terrain pre-processor, AERMAP. A modelling domain of 20 km × 20 km

is used. A multi-tier grid with a grid receptor spacing of 250m (5 km from facility), 500 m (10 km from facility) and 1000 m (20 km from facility) (3 tiers) will be used.

Table 5-1: Key Variables to be used in the modelling study.

Parameter	Model Input
Model	**Input**
Assessment level	Level 2
Dispersion model	AERMOD Version 9.9.0
Supporting models	AERMET Version 9.9.0 AERMAP Version 9.9.0
Emissions	**Input**
Pollutants to be modelled	Dust-fall, PM_{10} and $PM_{2.5}$
Scenarios	Operational
Chemical transformations	N/A
Exponential decay	Rural
Settings	**Input**
Terrain setting	Elevated
Terrain data	SRTM90
Terrain data resolution (m)	90
Land use characteristics	Grassland
Grid receptors	**Input**
Farm boundary (m)	50
Modelling domain (km)	20 x 20
Fine grid resolution (m)	250 (5 km from facility)
Medium grid resolution (m)	500 (10 km from facility)
Large grid resolution (m)	1000 (beyond 10 km from facility)

6. SUMMARY AND CONCLUSIONS

Rayten was appointed by EMA to compile an Air Quality Impact Assessment report (AQIAr) for the proposed operation of Vygenhoek Platinum Mine, located within Ehlanzeni District Municipality, Mpumalanga Province.

Mining at the proposed Vygenhoek Platinum Mine will be by means of conventional truck and shovel operations and will be by opencast only. An advancing open pit mining method, which allows for concurrent filling of the pit, will occur during the operational phase. Ore (Run-of Mine: ROM) will be loaded onto trucks at the pit area using excavators, transported via trucks on an unpaved haul route to the ROM stockpile, sold and loaded onto trucks for dispatch to a preferred Concentrator plant for further processing. The proposed mine belongs to Nomamix (Pty) Ltd. The AQIAr has been compiled specifically as a supporting document for the application for an Environmental Authorisation for the proposed Vygenhoek Platinum Mine.

The main objective of the AQIA is to determine the potential impact of emissions associated with the operational activities at the proposed Vygenhoek Platinum Mine on ambient air quality in terms of dust-fall, PM_{10} and $PM_{2.5}$.

As part of the AQIA, a baseline air quality assessment was undertaken to determine the following:

- the prevailing meteorological conditions at the site;
- baseline concentrations of key air pollutants of concern;
- identify existing sources of emissions; and
- identify key sensitive receptors surrounding the project site.

MM5 meteorological data for the project area for the period 01 January 2017 – 31 December 2019 was used. Baseline air quality at the proposed Vygenhoek Platinum Mine could not be assessed as there are currently no air quality monitoring stations in the vicinity of the proposed site, nor are there any dust fall networks that we know of.

The main conclusions based on the information obtained during the Baseline Assessment are as follows:

The proposed mine is located on portions 3 and 7 of the farm Vygenhoek 10 JT, within Thaba Chweu Local Municipality, and Ehlanzeni District Municipality, Mpumalanga Province. The project area does not fall within a nationally declared priority area. The land use immediately surrounding the proposed Vygenhoek Platinum mine consists mostly of grassland and forested land, with few areas consisting of cultivated land. Urban built up, mines and quarries, waterbodies and wetlands are observed, to a lesser extent, in surrounding areas, within 20km radius. The area is classified as rural in nature. Existing key sources of airborne emissions surrounding the project site have been identified as follows:

- Forestry activity/Plantations (surrounding areas)

Based on the prevailing wind fields for the period January 2017 to December 2019, emissions from activities at the proposed Vygenhoek Platinum Mine will likely be transported towards the north-westerly and west-north-westerly quadrants. Moderate to fast wind speeds observed during all the time periods, may result in effective dispersion and dilution of emissions from the proposed Vygenhoek Platinum Mine operations; however, higher wind speeds can also facilitate fugitive dust emissions from open exposed areas such as stockpiles and opencast areas. Removal of particulates via wet depositional processes would be evident during the warmer (wet) seasons (spring – early autumn) thus lower ambient concentrations of dust could be expected during these seasons. Over the remainder of the year higher ambient concentrations of particulates could be expected.

There is little variation in terms of prevailing wind direction occurring at the project site. During all seasons, prevailing south-easterly and east-south-easterly winds were observed, with wind speeds being consistent and moderate to fast; which could subsequently facilitate dust emissions from stockpiles, onsite and offsite activities.

Dust-fall, PM_{10} and $PM_{2.5}$ are key pollutants of concern associated with operations at the proposed Vygenhoek Platinum Mine and will be emitted from the following key sources:

Dust and Particulate Emissions:

- Drilling and blasting at the opencast pit;
- Bulldozing (profiling of waste);

- Materials handling operations (truck loading/offloading operations);
- Transportation of material (trucks);
- Material storage: Stockpiling,
- Excavators (stripping ore and waste and loading trucks);
- Wind erosion from exposed areas (i.e. the open cast pit, exposed surfaces, and material stockpile areas); and
- Vehicle dust entrainment on unpaved roads.

The anticipated impact of activities at the proposed Vygenhoek Platinum Mine will be quantitatively assessed through dispersion modelling and presented in the final Level 2 Air Quality Impact Assessment report. It is expected that emissions from activities at the proposed mine will most likely result in air quality impacts in terms of dust-fall, PM_{10} and $PM_{2.5}$.

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