# Air Quality Baseline Assessment for the Elandsfontein Colliery in Mpumalanga

Project done for **Environmental Impact Management Services (EIMS)** on behalf of **Geo Soil & Water**


| **Report compiled by:** | **Project Manager:** |
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**Report No: 19EIM06** | **Date:** November 2019


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## Report Details

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| Client | Environmental Impact Management Services (EIMS) on behalf of Geo Soil & Water |
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## Revision Record

| Version | Date | Comments |
|---|---|---|
| Draft | 27 November 2019 | For client review |
| | | |

## Competency Profiles

**Report author: H Liebenberg-Enslin (PhD Geography (University of Johannesburg)**

Hanlie Liebenberg-Enslin started her professional career in Air Quality Management in 2000 when she joined Environmental Management Services (EMS) after completing her Masters Degree at the University of Johannesburg (then RAU) in the same field. She was one of the founding members of Airshed Planning Professionals in 2003 where she has worked as a company Director until she took over as Managing Director in May 2013.

She has extensive experience on the various components of air quality management including emissions quantification for a range of source types, using different dispersion models, and conducting impact assessments and health risk screening assessments. Hanlie was the project manager on a number of ground-breaking air quality management plan (AQMP) projects and the principal air quality specialist on regional environmental assessments. Her work experience, although mostly in South Africa, range over various countries in Africa, including extensive experience in Namibia, providing her with an inclusive knowledge base of international legislation and requirements pertaining to air quality.

Hanlie has lectured several Air Quality Management Courses and is actively involved in the International Union of Air Pollution Prevention and Environmental Protection Associations (IUAPPA) and the South African National Association for Clean Air (NACA), where she served as President for both organisations. Being an avid student, she received her PhD from the University of Johannesburg in June 2014, specialising in Aeolian dust transport.

The CV of Hanlie Liebenberg-Enslin is provided in Appendix A.

# Specialist Declaration

I, Hanlie Liebenberg-Enslin, as the appointed independent air quality specialist for the Elandsfontein Colliery Project, hereby declare that I:

- acted as the independent specialist in this scoping assessment;
- performed the work relating to the study in an objective manner;
- regard the information contained in this report as it relates to my specialist input/study to be true and correct,
- do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the Environmental Impact Assessment;
- declare that there are no circumstances that may compromise my objectivity in performing such work;
- have expertise in conducting the specialist report relevant to this application;
- have no, and will not engage in, conflicting interests in the undertaking of the activity;
- have no vested interest in the proposed activity proceeding;
- 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 the decision of the competent authority; and
- all the particulars furnished by us in this specialist input/study are true and correct.

Signature of the specialist: H Liebenberg-Enslin

Name of Specialists: Hanlie Liebenberg-Enslin

Date: 27 November 2019

# NEMA Regulation (2014), Appendix 6

| NEMA Regulations (2014) - Appendix 6 | Relevant section in report |
|---|---|
| Details of the specialist who prepared the report. | Report details (page ii) |
| The expertise of that person to compile a specialist report including curriculum vitae. | Report details (page ii)<br>Appendix A |
| A declaration that the person is independent in a form as may be specified by the competent authority. | Report details (page i) |
| An indication of the scope of, and the purpose for which, the report was prepared. | Introduction and background (Executive Summary)<br>Section 1.2: Scope of Work<br>Section 0: Project Approach and Methodology |
| The date and season of the site investigation and the relevance of the season to the outcome of the assessment. | Section 3.1: Atmospheric Dispersion Potential<br>Section **Error! Reference source not found.**: Monitored a mbient concentrations |
| A description of the methodology adopted in preparing the report or carrying out the specialised process. | Introduction and background (Executive Summary)<br>Section 1.1: Study Objective<br>Section 3.1: Scope of Work |
| The specific identified sensitivity of the site related to the activity and its associated structures and infrastructure. | Section 0: Receiving Environment<br>Section 3.3: Existing Sources of Emissions in the Region |
| An identification of any areas to be avoided, including buffers. | Not applicable |
| A map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers. | Section 0: Receiving Environment<br>Section 4.3: Sensitivity Mapping |
| A description of any assumptions made and any uncertainties or gaps in knowledge. | Section 1.4: Limitations and Assumptions |
| A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment. | Section 4. Preliminary Qualitative Impact Assessment for Elandsfontein Expansion<br>Section 5. Findings and Recommendations |
| Any mitigation measures for inclusion in the environmental management programme report | Section 5. Findings and Recommendations |
| Any conditions for inclusion in the environmental authorisation | Section 5. Findings and Recommendations |
| Any monitoring requirements for inclusion in the environmental management programme report or environmental authorisation. | Not applicable |
| A reasoned opinion as to whether the proposed activity or portions thereof should be authorised. | Not applicable |
| If the opinion is that the proposed activity or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the environmental management programme report, and where applicable, the closure plan. | Not applicable |
| A description of any consultation process that was undertaken during the course of carrying out the study. | Not applicable |
| A summary and copies if any comments that were received during any consultation process. | Not applicable. |
| Any other information requested by the competent authority. | Not applicable. |

# Abbreviations

| | |
|---|---|
| **AEL** | Atmospheric Emissions License |
| **Airshed** | Airshed Planning Professionals (Pty) Ltd |
| **APPA** | Air Pollution Prevention Act |
| **AQIA** | Air quality Impact Assessment |
| **AQSR** | Air Quality Sensitive Receptors |
| **ASTM** | American Standard Testing Method |
| **CE** | Control efficiency |
| **CHPP** | Coal Handling and Preparation Plant |
| **DEA** | Department of Environmental Affairs (now DEFF) |
| **DEFF** | Department of Environment, Forestry and Fisheries (previously DEA) |
| **EHS** | Environmental, Health, and Safety (IFC) |
| **EIA** | Environmental Impact Assessment |
| **GG** | Government Gazette |
| **GHG** | Greenhouse gas |
| **GLC** | Ground Level Concentration |
| **HFO** | Heavy Fuel Oil |
| **I&APs** | Interested and Affected Parties |
| **IFC** | International Finance Corporation |
| **LOM** | Life of Mine |
| **Ltd** | Limited |
| **NAAQSs** | National Ambient Air Quality Standards |
| **NDCR** | National Dust Control Regulations |
| **NEMAQA** | National Environment Management Air Quality Act |
| **NPI** | National Pollutant Inventory (Australia) |
| **ROM** | Run-of-mine |
| **SAAQIS** | South Africa Air Quality Information System |
| **SABS** | South African Bureau of Standards |
| **SANS** | South African National Standards |
| **SoW** | Scope of Work |
| **US EPA** | United States Environmental Protection Agency |
| **WBG** | World Bank Group |
| **WHO** | World Health Organisation |

## Symbols and Units

| | |
|---|---|
| **°C** | Degrees Celsius |
| **µg** | Microgram(s) |
| **µg/m³** | Micrograms per cubic meter |
| **$CH_4$** | Methane |
| **CO** | Carbon monoxide |
| **$CO_2$** | Carbon dioxide |
| **HFCs** | Hydrofluorocarbons |
| **$L_{MO}$** | Monin-Obukhov Length |
| **m/s** | Metres per second |
| **$m^2$** | Metres squared |
| **masl** | Metres above sea level |
| **mg** | Milligram(s) |
| **$mg/m^2/day$** | Milligram per metre squared per day |
| **mm** | Millimetres |
| **mtpa** | million tons per annum |
| **$N_2O$** | Nitrous oxide |
| **NOx** | Oxides of nitrogen |
| **$NO_2$** | Nitrogen dioxide |
| **PFCs** | Perfluorocarbons |
| **PM** | Particulate Matter |
| **$PM_{10}$** | Thoracic particulate matter |
| **$PM_{2.5}$** | Respirable particulate matter |
| **$SF_6$** | Sulfur hexafluoride |
| **$SO_2$** | Sulfur dioxide |
| **TSP** | Total Suspended Particulate |
| **%** | Percentage |

# Glossary

| | |
|---|---|
| **Air pollution** | This means any change in the composition of the air caused by smoke, soot, dust (including fly ash), cinders, solid particles of any kind, gases, fumes, aerosols and odorous substances |
| **Ambient Air** | This is defined as any area not regulated by Occupational Health and Safety regulations |
| **Atmospheric emission or emission** | Any emission or entrainment process emanating from a point, non-point or mobile source that results in air pollution |
| **Averaging period** | This implies a period of time over which an average value is determined |
| **Dispersion** | The spreading of atmospheric constituents, such as air pollutants |
| **Dust** | Solid materials suspended in the atmosphere in the form of small irregular particles, many of which are microscopic in size |
| **Frequency of Exceedance** | A frequency (number/time) related to a limit value representing the tolerated exceedance of that limit value, i.e. if exceedances of limit value are within the tolerances, then there is still compliance with the standard |
| **Mechanical mixing** | Any mixing process that utilizes the kinetic energy of relative fluid motion |
| **Particulate Matter (PM)** | These comprise a mixture of organic and inorganic substances, ranging in size and shape. These can be divided into coarse and fine particulate matter. The former is called Total Suspended Particulates (TSP), whilst $PM_{10}$ and $PM_{2.5}$ fall in the finer fraction. |
| **$PM_{10}$** | Particulate Matter with an aerodynamic diameter less than or equal to 10 µm. it is also referred to as thoracic particulates and is associated with health impacts due to its tendency to be deposited in, and damaging to, the lower airways and gas-exchanging portions of the lung |
| **$PM_{2.5}$** | Particulate Matter with an aerodynamic diameter less than or equal to 2.5 µm. it is also referred to as respirable particulates. It is associated with health impacts due to its high tendency to be deposited in, and damaging to, the lower airways and gas-exchanging portions of the lung |
| **Vehicle Entrainment** | This is the lifting and dropping of particles by the rolling wheels leaving the road surface exposed to strong air current in turbulent shear with the surface. The turbulent wake behind the vehicle continues to act on the road surface after the vehicle has passed |

## Executive Summary

Elandsfontein Colliery is an existing underground and opencast coal mine currently producing 500 000 tons of coal per annum (tpa) at their Coal Handling and Preparation Plant (CHPP). The mine plans to add an additional opencast and underground mining area to increase production to 100 000 tons of Run of Mine (ROM) per month (tpm) with a Life of Mine (LOM) of 6 years. The mining method will be a combination of opencast mining with a truck and shovel operation, and underground mining using conventional drill and blast, board and pillar mining.

Airshed Planning Professionals (Pty) Ltd was appointed by Environmental Impact Management Services (EIMS), on behalf of Geo Soil & Water, to assess the potential for air quality related impacts from the planned mining activities on the surrounding environment and human health as part of the EMPR amendment. The current study constitutes the baseline and preliminary impact assessment of the proposed study.

The findings from the baseline assessment can be summarised as follows:

- Meteorological data was obtained for the period Jan 2016 – Dec 2018 from the DEFF station in Emalahleni, located about 9 km to the east-northeast of the mine.
- The prevailing wind field in the area consists of northerly, easterly and east-southeasterly winds, with infrequent winds from the south and west. During the day, winds at higher wind speeds occurred more frequently from the north whereas at night-time the airflow shifts to more frequent winds from the east and east-southeast but at somewhat lower wind speeds. Day-time calms occurred for 3.6% of the time, with night-time calms for 7.6% of the time.
- Wind speeds exceeding 5.4 m/s occurred for 7.9% over the three years.
- The area experiences mild summers and cold winters with monthly average temperatures of between -2.1°C and 20.7°C.
- Average annual rainfall amounts to 730 mm per annum (November to April) with an average annual evaporation rate of 1500 mm (CPR, 2019).
- Air quality sensitive receptors (AQSRs) around the mine include the residential areas of Clewer immediately to the east, Kwa-Guqa 3 km to the north-northeast, Ackerville 6 km to the northeast, Phola 6 km to the southwest and Emalahleni 10 km to the east.
- Elandsfontein Mine is located within the Highveld Priority Area.
- Ambient air pollutant levels in the project area are currently affected by the following sources of emission:
    - Ambient air pollutant levels in the project area are currently affected by the following sources of emission: Coal Fired Power Plants – Kusile some 13 km to the west with Duvha Power Station approximately 21 km to the east.
    - Industrial (metallurgical) operations – Transalloys is located northeast of Elandsfontein Colliery; Highveld Steel is located to the north; and Ferro Metals is located in the western part of Emalahleni some 6 km away.

The findings from the qualitative assessment are:

- **2017 AQIA Report Review:** The AQIA Report compiled for Elandsfontein Colliery by DWE in August 2017 was assessed to determine whether the methodology followed are defendable; and whether the modelled results are regarded representative of the operations. As far as could be ascertained, the study followed the correct methodology for an air quality impact assessment. An underestimation in the emissions from the crushers was noted but not enough information was provided to verify all the calculations. The meteorological data used in the model is acceptable, and the dispersion model used is in line with the regulations. The modelled results, even though very high, could be possible. Only unmitigated results were provided for $PM_{10}$ and $PM_{2.5}$, where a mitigated modelling scenario would have assisted in the understanding of the potential impacts from the mine with controls in place. The reduction in the dustfall rates between unmitigated and mitigated indicated a significant improvement due to mitigation measures.
- **Construction Phase:** Two areas will be affected namely: 1) the north of the opencast reserve of Block H where a new box-cut will be opened with cuts developed in a southerly direction, and 2) Resource Block D and E where a new decline will be developed to access the No.1 Seam. The existing infrastructure will be used to access the other underground Resource Blocks and the new opencast areas. Both the box-cut and decline shaft construction will result in impacts from vehicle tailpipe emissions but these impacts are likely to be localised. Depending on the type and extend of the construction activities, especially for opencast operations in the eastern part of the mine, exceedances of the $PM_{10}$ and $PM_{2.5}$ NAAQS may reach the western part of Clewer. Clearing of vegetation and topsoil and levelling of transportation route areas can result in significant levels of particulate matter if not mitigated. With level 1 watering rate (2 litres/m²/hr) a CE of 50% could be achieved (NPI, 2012). With mitigation in place, the construction phase would have a “Medium” significance.
- **Operational Phase:**
    - Opencast mining activities would have significantly higher air quality impacts than underground operations. This is primarily due to excavation, material handling and vehicle entrainment on roads (haulage of ROM coal, waste and topsoil). Clever is the main AQSR to be affected by the planned opencast operations.
    - Various controls could be applied to opencast mining, with control efficiencies (CE) ranging from 50% due to water suppression to 99% control by using fabric filters on drills. Controls on the haul roads could range between watering (50% CE) to 100% CE for sealed or salt-crusted roads. Mitigation measures on crushing and screening range between 30% for windbreaks to 100% by enclosing the crusher and screen (NPI, 2012).
    - The significance rating for the operational phase would be “High” even after mitigation measures are applied due to the increased mining and production rates and the close proximity of AQSR to the mining operations.
- **Closure Phase:** From an air quality perspective, the only sources of pollution would be vehicles as part of the rehabilitation process and windblown dust from exposed surfaces. These impacts would result in a significance rating of “Low”.

- **Post closure Phase:** Depending on the level of rehabilitation and vegetation cover established on the exposed surfaces, the air quality impacts could be reduced to “Low” significance.
- For the significance mapping, the following criteria were used:
  - Construction – Medium (Post-mitigation).
  - Operational – High (Post-mitigation), mainly based on the previous AQIA (DWE, 2017).
  - Closure – Medium (Post-mitigation).
  - Post closure – Low (Post successful rehabilitation).

The conclusion from the qualitative impact assessment is that the planned mining operations would have a “High” significance on the surrounding environment and human health during the operational phase, even after mitigation is applied due to the increased mining and production rates and the close proximity of AQSR (Clever) to the planned mining operations.

In order to provide a quantitative evaluation of the proposed mining impacts, an AQIA is required for the planned opencast and underground operations at Elandsfontein Colliery as part of the EMPR amendment. Due to the uncertainty around the 2017 AQIA, the current baseline should be redone. As part of the AQIA, greenhouse gas (GHG) emissions will be quantified per legal requirements.

## Table of Contents

## List of Tables



## List of Figures

# 1 Introduction

Elandsfontein Colliery is an existing underground and opencast coal mine that started operations in the 1980s. Opencast operations commenced in October 2016 with pre-stripping of waste material to waste dumps to expose the No 2 seam. The No.1 Seam has been mined through underground board and pillar operation while No.4 Seam and No.2 Seam have been mined though opencast methods. The No.4 Seam is mined out with the No.2 Seam currently being mined. Elandsfontein Colliery has an operational Coal Handling and Preparation Plant (CHPP) producing 500 000 tons of coal per annum (tpa).

Elandsfontein Colliery plans to add an additional opencast and underground mining area into their existing approved Mine Works Programme and Environmental Management Plan (EMP)(Figure 1). The mining method will be a combination of opencast mining with a truck and shovel operation, and underground mining using conventional drill and blast, board and pillar mining. Production is planned at a rate of approximately 100 000 tons of Run of Mine (ROM) per month (tpm) with a Life of Mine (LOM) of 6 years. The product is transported by rail to the port of Richards Bay from the Oosbank siding.

As part of the EMP certain environmental indicators have to be monitored to ensure that the operation stays within legal requirements for water, dust and noise. This includes compliance monitoring obligations to ensure dust and $PM_{10}$ are kept below acceptable levels.

Airshed Planning Professionals (Pty) Ltd was appointed by Environmental Impact Management Services (EIMS), on behalf of Geo Soil & Water, to assess the potential for air quality related impacts from the proposed opencast and underground mining operations on the surrounding environment and human health as part of the EMPR amendment. As part of the air quality impact assessment (AQIA), greenhouse gas (GHG) emissions will be quantified per legal requirements.

## 1.1 Study Objective

The main objective of the investigation is to quantify the potential impacts resulting from the proposed activities on the surrounding environment and human health. As part of the air quality assessment, a good understanding of the regional climate and local dispersion potential of the site is necessary as well as an understanding of existing sources of air pollution in the region and the current and potential future air quality.

Two tasks need to be assessed:

1. The review of the existing specialist reports and a professional opinion on the additional impacts and associated management and mitigation measures (if any) associated with the proposed new underground mining area; and
2. A new assessment report for the proposed new mining areas- in the instance where the existing specialist study does not adequately address the new mining area and a new assessment is required.

This report covers the baseline characterisation as part of the AQIA and GHG study, including task 1 as described above.

The layout of the planned project is provided in Figure 1.

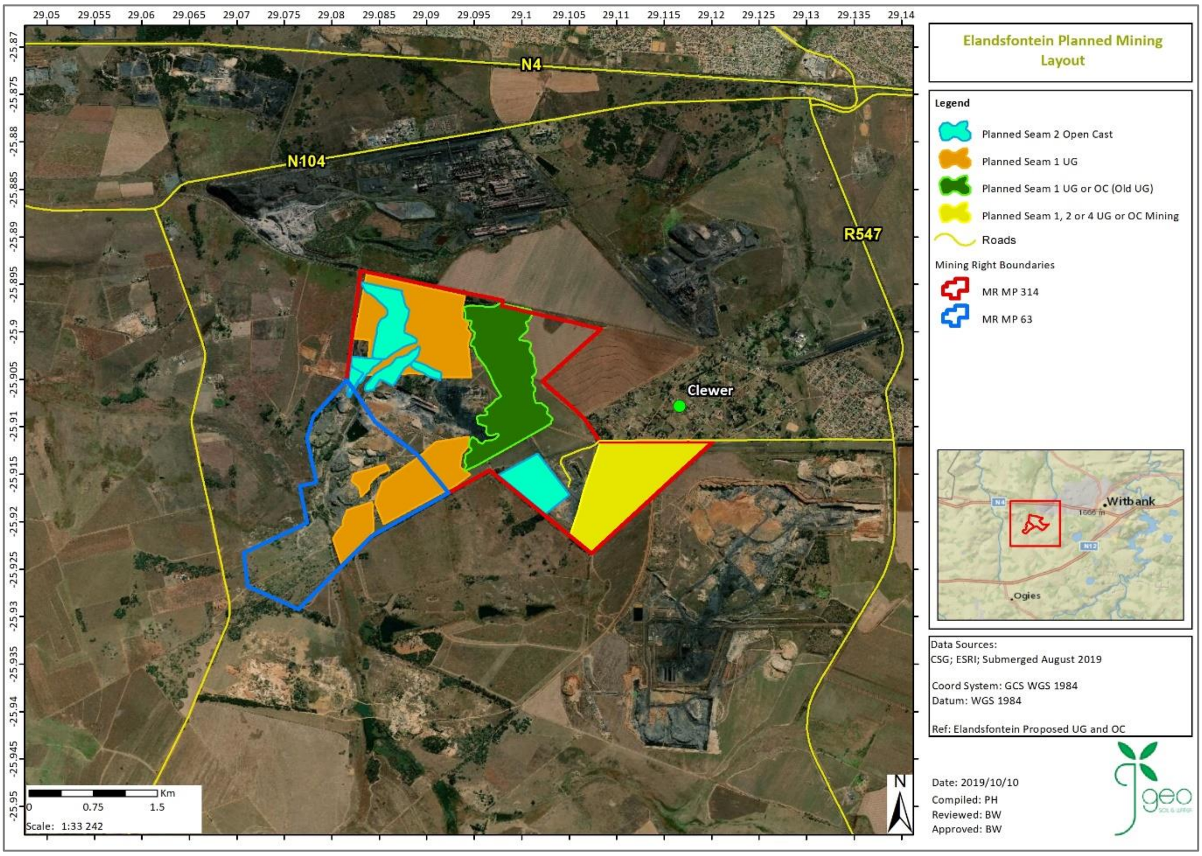


*Figure 1: Elandsfontein planned mining area*

## 1.2 Scope of Work

Based on the required scope, the following tasks have been identified to be covered as part of the baseline assessment:

- A study of the receiving environment by referring to:
  - Desktop review of all available project and associated data, including metrological data, previous air quality assessments, EIAs and technical air quality data and modelling.
  - A study of atmospheric dispersion potential by referring to available weather records or simulated hourly sequential meteorological data for a period of at least 3 years (required for dispersion modelling), land use and topography data.
  - Details on the physical environment i.e. meteorology (atmospheric dispersion potential), land use and topography.
  - Identification of existing air pollution sources (other mines; power stations; industries; etc.)

  - Identification of air quality-sensitive receptors, including any nearby residential dwellings and proposed receptors (temporary or permanent workers accommodation site(s)) in the vicinity of the mine;
  - Any and all freely available ambient air quality data for PM ($PM_{10}$, $PM_{2.5}$ and TSP).
- Review the existing specialist report to:
  - Determine whether the methodology followed is defendable; and
  - Determine whether the modelled results are regarded representative of the operations.
- Qualitatively assess the potential impacts for the planned underground and opencast mining operations.
- Provide recommendations for mitigation measures.

## 1.3 Brief Process Description

Air quality impacts will be associated with four distinct phases namely: the construction phase, the operational phase with underground and opencast mining operations, and the closure and post-closure phase.

**Construction phase:** The construction phase will involve a box-cut in the north of the opencast reserve of Block H and developing cuts in a southerly direction. A new decline will be developed to access the No.1 Seam at Resource Block D and E, with existing infrastructure used to access the other underground Resource Blocks. Typical sources of fugitive emissions associated with construction activities are shown in Table 1.

*Table 1: Typical sources of fugitive emissions associated with construction*

| Impact | Source | Activity |
|---|---|---|
| Gases | Vehicle tailpipe | Transport and general construction activities |
| Dustfall, $PM_{10}$ and $PM_{2.5}$ | Box-cut development | Clearing of groundcover |
| | | Excavation |
| | | Wind erosion from open areas |
| | | Materials handling |
| | New decline shaft | Clearing of groundcover |
| | | Excavation |
| | | Wind erosion from open areas |
| | | Materials handling |
| | Transport infrastructure (haul roads and access road) | Clearing of vegetation and topsoil |
| | | Levelling of transportation route areas |

**Operational phase:** According to the mine design, the mining method will be a combination of opencast mining with a truck and shovel operation and underground mining using conventional drill and blast, board and pillar mining (CPR, 2019). The LOM is estimated at 6 years.

*Opencast mining* production will be 50 000 tpm with 90% extraction. The mining strip width will be 40m and the mining depth 60m. Access to the No.2 Seam pits is already established, but to access Block H requires a new boxcut in the north where the historic discard dumps are. Opencast mining of Block H will be done in a roll over operation (mining and backfilling concurrently), with sequentially mining from east to west.

*Underground mining* of No.1 Seam will from three sections – Resource Block D and E, Resource Block B and C, and Resource Block A. A decline will be developed from the final highwall of the opencast pit in Resource Block G to access Resource Block D and E. Access to Resource Block B and C will be gained from the old underground Hayford Shaft. The No.1 Seam at Resource Block A will be accessed through the existing shaft and underground workings with access to the No.1 Upper Seam gained from the existing No.1 Seam workings by means of an inclined access. Production from the underground operations will be 50 000 tpm with a 70% extraction. The roads will have a width of 6 m.

The CHPP will have an increased throughput of 300 tons per hour (tph), operating at 6500 hours per year and at an efficiency of 70%.

The proposed opencast and underground mining activities, with associated air pollutants, are listed in Table 2.

*Table 2: Proposed mining activities with associated pollutants*

| Activity | Associated pollutants |
|---|---|
| **Mining Operations** | |
| Opencast mining: excavation of ROM coal and waste | Mostly Particulate matter (PM)[(a)], gaseous emissions from mining equipment (PM, sulfur dioxide ($SO_2$) oxides of nitrogen (NOx); carbon monoxide (CO); and carbon dioxide ($CO_2$)[(b)]) |
| Opencast mining: removal and stockpiling of topsoil | Mostly PM, gaseous emissions from excavation equipment (PM, $SO_2$; NOx; CO; $CO_2$) |
| Opencast mining: haulage of ROM coal, waste and topsoil | PM from road surfaces, windblown dust from trucks, gaseous emissions from truck exhaust (PM, $SO_2$; NOx; CO; $CO_2$) |
| Underground mining: drilling and blasting | PM, $SO_2$; NOx; CO; and $CO_2$ |
| Underground mining: conveying of ROM coal to surface ROM stockpile | Mostly PM, gaseous emissions from machinery (PM, $SO_2$; NOx; CO; $CO_2$) |
| Underground mining: haulage of ROM surface stockpile to DMS ROM stockpile | PM from road surfaces, windblown dust from trucks, gaseous emissions from truck exhaust (PM, $SO_2$; NOx; CO; $CO_2$) |
| Discard dump(s) | PM from tipping, windblown dust, gaseous emissions from truck exhaust (PM, $SO_2$; NOx; CO; $CO_2$) |
| **Processing Operations** | |
| ROM transfer point and reclaim system | Mostly PM, gaseous emissions from reclaim system (PM, $SO_2$; NOx; CO; $CO_2$) |

| Activity | Associated pollutants |
|---|---|
| Primary ROM crushing and screening | Mostly PM, gaseous emissions from diesel powered machinery (PM, $SO_2$; NOx; CO; $CO_2$) |
| Transfer conveyor to overland conveyor to plant ROM stockpile | Mostly PM, gaseous emissions from diesel powered machinery (PM, $SO_2$; NOx; CO; $CO_2$) |
| ROM feed conveyor | Mostly PM, gaseous emissions from machinery (PM, $SO_2$; NOx; CO; $CO_2$) |
| Dense medium cyclone plant | PM, $SO_2$; NOx; CO; and $CO_2$ |
| Fines treatment plant | PM, $SO_2$; NOx; CO; and $CO_2$ |
| Stockpiling of final product and fines spiral plant | Mostly PM, gaseous emissions from machinery (PM, $SO_2$; NOx; CO; $CO_2$) |
| Conveying of discard to a bin with overflow facility located at the plant | Mostly PM, gaseous emissions from machinery (PM, $SO_2$; NOx; CO; $CO_2$) |

**Notes**: [a] Particulate matter (PM) comprises a mixture of organic and inorganic substances, ranging in size and shape and can be divided into coarse and fine particulate matter. Total Suspended Particulates (TSP) represents the coarse fraction >10$\mu$m, with particulate matter with an aerodynamic diameter of less than 10$\mu$m ($PM_{10}$) and particulate matter with an aerodynamic diameter of less than 2.5$\mu$m ($PM_{2.5}$) falling into the finer inhalable fraction. TSP is associated with dust fallout (nuisance dust) whereas $PM_{10}$ and $PM_{2.5}$ are considered a health concern.

[b] $CO_2$ and methane are greenhouse gases (GHG).

**Closure and post-closure phase:** During closure, bulk earthworks and demolishing activities are expected. Very little information regarding the decommissioning phase was available for consideration, from an air quality perspective it is, however, likely to be similar in character and impact to the construction phase.

Due to the lack of detailed information and the relatively short duration of most of the activities associated with the construction, closure and post-closure phases, the assessment of impacts for these phases will be done qualitatively.

## 1.4 Limitations and Assumptions

The main assumptions, exclusions and limitations are summarized below:

- Meteorological data: no onsite meteorological data was available and measured data from the Department of Environment, Forestry and Fisheries (DEFF) station in Emalahleni was obtained for the period January 2016 – December 2018. The data is regarded representative with the station located approximately 9 km to the east-northeast of the mining offices.
- All information was obtained from the Independent Competent Person's (CPR) Report – Coal Resources/ Coal Reserves for the Elandsfontein Colliery operated by the Elandsfontein Colliery (Pty) Limited in the Mpumalanga Province of South Africa, dated 30 October 2019 (CPR, 2019). It was assumed that this information is correct.

# 2 Regulatory Requirements and Impact Assessment Criteria

Prior to assessing the impact of proposed activities on human health and the environment, reference needs to be made to the environmental regulations governing the impact of such operations; i.e. air emission standards, ambient air quality standards, and dust control regulations.

Air quality legislation that is relevant to the project is provided in Table 3.

*Table 3: Legislation applicable to the project*

| Air Quality Legislation | Implementation/ revision dates | Reference | Affected Project Activity |
|---|---|---|---|
| National Framework | Second Generation 2013<br>Third Generation 2018 | Government Gazette (GG) 37078, 29 Nov 2013<br>GG 41996 of 26 Oct 2018 | Industry legal responsibilities |
| Section 21 – Listed Activities | Implemented:<br>1 April 2010<br>Revised: 2013<br>Amendments: 2015 and 2018 | GG 37054, 22 Nov 2013<br>GG 38863, 12 Jun 2015 | N.A. – no Listed Activity planned |
| National Ambient Air Quality Standards (NAAQS) | 24 December 2009<br>29 July 2012 | GG 32816, 24 Dec 2009<br>GG 35463, 29 Jun 2012 | $SO_2$, $NO_2$, CO, $PM_{10}$ and $PM_{2.5}$ ground level concentrations as a result from the mining activities |
| National Dust Control Regulations (NDCR) | 1 November 2013 | GG 37054, 22 Nov 2013 | Dust fallout rates as a result from the mining activities |
| National Atmospheric Emission Reporting Regulations (NAERR) | 2 April 2015 | GG 3863, 2 Apr 2015 | Emissions reporting on mining operations |
| Regulation on Administrative Fines and Air quality offsets guideline | 18 March 2016 | GG 39833, 18 Mar 2016 | N.A. – no Listed Activity planned |
| Declaration of Greenhouse Gases (GHG) as Priority Air Pollutants | Draft in 2016 | GG 40996, 21 Jul 2017 | N.A.[a] |
| National Pollution Prevention Plans (PPP) Regulations | Draft in 2016<br>Final 2017 | GG 40996, 21 Jul 2017 | N.A.[a] |
| National Greenhouse Gas (GHG) Emission Reporting Regulations | 3 April 2017 | GG 40762, 3 Apr 2017 | Mining and quarrying to report on all stationary combustion emissions above 10 MW(th) |

Notes: [a] only apply to direct emission of GHG in excess of 0.1 Megatonnes (Mt) annually measured as carbon dioxide equivalents ($CO_2$-eq)

## 2.1 National Framework

The National Framework (first published in Government Gazette Notice No. 30284 of 11 September 2007) was updated in 2013) and provides national norms and standards for air quality management to ensure compliance. The National Framework states that aside from the various spheres of government's responsibility towards good air quality, industry too has a responsibility not to impinge on everyone's right to air that is not harmful to health and well-being. Industries therefore should take reasonable measures to prevent such pollution order degradation from occurring, continuing or recurring.

In terms of AQA, certain industries have further responsibilities, including:

- Compliance with any relevant national standards for emissions from point, non-point or mobile sources in respect of substances or mixtures of substances identified by the Minister, MEC or municipality.
- Compliance with the measurement requirements of identified emissions from point, non-point or mobile sources and the form in which such measurements must be reported and the organs of state to whom such measurements must be reported.
- Compliance with relevant emission standards in respect of controlled emitters if an activity undertaken by the industry and/or an appliance used by the industry is identified as a controlled emitter.
- Compliance with any usage, manufacture or sale and/or emissions standards or prohibitions in respect of controlled fuels if such fuels are manufactured, sold or used by the industry.
- Comply with the Minister's requirement for the implementation of a pollution prevention plan in respect of a substance declared as a priority air pollutant.
- Comply with an Air Quality Officer's legal request to submit an atmospheric impact report in a prescribed form.
- Taking reasonable steps to prevent the emission of any offensive odour caused by any activity on their premises.
- Furthermore, industries identified as Listed Activities have further responsibilities, including:
  - Making application for an AEL and complying with its provisions.
  - Compliance with any minimum emission standards in respect of a substance or mixture of substances identified as resulting from a listed activity.
  - Designate an Emission Control Officer **if** required to do so.
  - Section 51 of the Air Quality Act lists possible offences according to the requirements of the Act with Section 52 providing for penalties in the case of offences.

## 2.2 National Standards

### 2.2.1 Emission Standards

The NEMAQA (Act No. 39 of 2004 as amended) (DEA, 2005) mandates the Minister of Environment to publish a list of activities which result in atmospheric emissions and consequently cause significant detrimental effects on the environment, human health and social welfare. All scheduled processes as previously stipulated under the Air Pollution Prevention Act (APPA) (Dept of Labour, 1993) are included as listed activities with additional activities added to the list. The updated Listed Activities and Minimum National Emission Standards (MES) were published on the 22nd November 2013 (Government Gazette No. 37054). An amendment to this Act was published in June 2015, and further amendments in October 2018.

According to the Project description, none of the Project activities trigger the MES's nor the need for an Atmospheric Emissions Licence (AEL) application.

### 2.2.2 Ambient Air Quality Standards for Criteria Pollutants

Criteria pollutants are considered those pollutants most commonly found in the atmosphere, that have proven detrimental health effects when inhaled and are regulated by ambient air quality criteria. These include CO, $NO_2$, $SO_2$, $PM_{2.5}$ and $PM_{10}$. The pollutant of concern in this study is particulate matter.

The South African Bureau of Standards (SABS) assisted the DEA (now DEFF) in the development of ambient air quality standards. NAAQS were determined based on international best practice for $PM_{10}$, $PM_{2.5}$, dustfall, $SO_2$, $NO_2$, $O_3$, CO, lead and benzene.

The final revised NAAQSs were published in the Government Gazette on 24 of December 2009 (DEA, 2009) and in some instances included a margin of tolerance and linked implementation timelines. NAAQSs for $PM_{2.5}$ were published on 29 June 2012 (DEA, 2012). NAAQSs for the criteria pollutants assessed in this study are listed in Table 4. Currently, only $PM_{2.5}$ has a margin of tolerance, which is applicable until 31 December 2029. Short-term standards (daily) are represented by a limit value based on the 99th percentile of the observation (or simulated concentration) for that averaging period.

With the main pollutants of concern being particulates, the NAAQSs applicable to $PM_{10}$ and $PM_{2.5}$ are provided in Table 4.

*Table 4: Air quality standards for specific criteria pollutants (NAAQS)*

| Pollutant | Averaging Period | Limit Value (µg/m³) | Frequency of Exceedance | Compliance Date |
|---|---|---|---|---|
| $PM_{10}$ | 24-hour | 75 | 4 | 1 Jan 2015 |
| | 1 year | 40 | 0 | 1 Jan 2015 |
| $PM_{2.5}$ | 24-hour | 40 | 4 | 1 Jan 2016 – 31 Dec 2029 |
| | | 25 | 4 | 1 Jan 2030 |
| | 1 year | 20 | 0 | 1 Jan 2016 – 31 Dec 2029 |
| | | 15 | 0 | 1 Jan 2030 |

### 2.2.3 National Dust Control Regulations

The NDCR were published on the 1st of November 2013 (DEA, 2013). The purpose of the regulations is to prescribe general measures for the control of dust from areas operations identified by a local Air Quality Officer as potentially

causing a nuisance. Acceptable dustfall rates for residential and non-residential areas according to the regulation is summarised in
Table 5.

*Table 5: Acceptable dustfall rates*

| Restriction areas | Dustfall rate (D) in $mg/m^2$-day over a 30 day average | Permitted frequency of exceedance |
|---|---|---|
| Residential areas | D < 600 | Two within a year, not sequential months. |
| Non-residential areas | 600 < D < 1 200 | Two within a year, not sequential months. |

Limited information is available on the impact of dust on vegetation and grazing quality. While there is little direct evidence of the impact of dustfall on vegetation in the South African context, a review of European studies has shown the potential for reduced growth and photosynthetic activity in sunflower and cotton plants exposed to dustfall rates greater than 400 $mg/m^2/day$ (Farmer, 1993). In addition, there is anecdotal evidence to indicate that over extended periods, high dustfall levels in grazing lands can soil vegetation and this can impact the teeth of livestock (Farmer, 1993).

The regulation also specifies that the method to be used for measuring dustfall and the guideline for locating sampling points shall be American Standard Testing Method (ASTM, 1970)[1], or equivalent method approved by any internationally recognized body. It is important to note that dustfall is assessed for nuisance impact and not inhalation health impact.

## 2.3 National Atmospheric Emission Reporting Regulations (NAERR)

The National Atmospheric Emission Reporting Regulations (NAERR) was published on the 2nd of April 2015 by the Minister of Environmental Affairs. The regulation aims to standardize the reporting of data and information from an identified point, non-point and mobile sources of atmospheric emissions to an internet-based National Atmospheric Emissions Inventory System (NAEIS), towards the compilation of atmospheric emission inventories (DEA , 2015).

Annexure 1 of the NAERR classifies **mines** (holders of a mining right or permit in terms of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002)) as a data provider under **Group C**. **Listed Activities** as published in terms of Section 21(1) of the AQA falls under **Group A**.

Sections of the regulation that applies to data providers are summarized below.

[1] ASTM 1739:70 is a previous version of ASTM 1739 which did not prescribe a wind shield around the opening of the bucket; the addition of a wind shield is intended to deflect wind away from the lip of the container, allowing for a more laminar flow across the top of the collecting container (Kornelius *et al*., 2015). SANS 1929-2004 does, however, refer to ASTM 1739-98 (ASTM, 1998), which has a wind shield. The latest draft of the NDCR stipulates the latest version of D1738. It has not been propagated but is expected early 2020.

With regards to registration, the regulation stipulates that:

(a) A person classified as a data provider must register on the NAEIS within 30 days from the date upon which these Regulations came into effect;
(b) A person classified as a data provider and who commences with an activity or activities classified as emission source in terms of the regulation 4(1) after the commencement of these Regulations, must register on the NAEIS within 30 days after commencing with such an activity or activities.

With regards to reporting and record keeping, the regulation stipulates that:

(a) A data provider must submit the required information for the preceding calendar year, as specified in Annexure 1 to the Regulations, to the NAEIS by 31 March of each calendar year.
(b) A data provider must keep a record of the information submitted to the NAEIS for five years and such record must, on request, be made available for inspection by the relevant authority.

With regards to verification of information, the regulation requires data providers to verify requested information within 60 days after receiving the written request from the relevant authority.

## 2.4 Regulations Regarding Air Dispersion Modelling

Air dispersion modelling provides a cost-effective means for assessing the impact of air emission sources, the major focus of which is to assess compliance with the relevant ambient air quality standards. Regulations regarding Air Dispersion Modelling were promulgated in Government Gazette No. 37804 vol. 589; 11 July 2014, (DEA, 2014) and recommend a suite of dispersion models to be applied for regulatory practices as well as guidance on modelling input requirements, protocols and procedures to be followed. The Regulations regarding Air Dispersion Modelling are applicable –

a) in the development of an air quality management plan, as contemplated in Chapter 3 of the NEMAQA;
b) in the development of a priority area air quality management plan, as contemplated in section 19 of the NEMAQA;
c) in the development of an atmospheric impact report, as contemplated in section 30 of the NEMAQA; and,
d) in the development of a specialist air quality impact assessment study, as contemplated in Chapter 5 of the NEMAQA.

The Regulations have been applied to the development of this report. The first step in the dispersion modelling exercise requires a clear objective of the modelling exercise and thereby gives clear direction to the choice of the dispersion model most suited for the purpose. Chapter 2 of the Regulations present the typical levels of assessments, technical summaries of the prescribed models (SCREEN3, AERSCREEN, AERMOD, SCIPUFF, and CALPUFF) and good practice steps to be taken for modelling applications. The project falls under a Level 2 assessment – which is described as follows:

- The distribution of pollutant concentrations and deposition 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. The model specifically to be used in the air quality impact assessment of the proposed operation is AERMOD.

- Emissions are from sources where the greatest impacts are in the order of a few kilometers (less than 50 km) downwind.

Dispersion modelling provides a versatile means of assessing various emission options for the management of emissions from existing or proposed installations. Chapter 3 of the Regulation prescribe the source data input to be used in the model. Dispersion models are particularly useful under circumstances where the maximum ambient concentration approaches the ambient air quality limit value and provide a means for establishing the preferred combination of mitigation measures that may be required.

Chapter 4 of the Regulations prescribe meteorological data input from onsite observations to simulated meteorological data. The chapter also gives information on how missing data and calm conditions are to be treated in modelling applications. Meteorology is fundamental for the dispersion of pollutants because it is the primary factor determining the diluting effect of the atmosphere.

Topography is also an important geophysical parameter. The presence of terrain can lead to significantly higher ambient concentrations than would occur in the absence of the terrain feature. In particular, where there is a significant relative difference in elevation between the source and off-site receptors large ground level concentrations can result.

The modelling domain would normally be decided on the expected zone of influence; the extent being defined by simulated ground level concentrations from initial model runs. The modelling domain must include all areas where the ground level concentration is significant when compared to the air quality limit value (or other guideline). Air dispersion models require a receptor grid at which ground-level concentrations can be calculated. The receptor grid size should include the entire modelling domain to ensure that the maximum ground-level concentration is captured and the grid resolution (distance between grid points) sufficiently small to ensure that areas of maximum impact adequately covered. No receptors should however be located within the property line as health and safety legislation (rather than ambient air quality standards) is applicable within the site.

Chapter 5 provides general guidance on geophysical data, model domain and coordinates system requirements, whereas Chapter 6 elaborates more on these parameters as well as the inclusion of background air pollutant concentration data. Chapter 6 also provides guidance on the treatment of $NO_2$ formation from NOx emissions, chemical transformation of $SO_2$ into sulphates and deposition processes.

Chapter 7 of the Regulation outlines how the plan of study and modelling assessment reports are to be presented to authorities.

## 2.5 Greenhouse Gas Emissions

Greenhouse gasses – $CO_2$, $CH_4$, $N_2O$, HFCs, PFCs and $SF_6$ – have been declared priority pollutants under Section 29(1) of the Air Quality Act (Government Gazette 37421 of 14 March 2014). The declaration provides a list of sources and activities including (i) fuel combustion (both stationary and mobile), (ii) fugitive emission from fuels, (iii) industrial processes and other product use, (iv) agriculture; forestry and other land use and (v) waste management. GHGs in excess of 0.1 Megatons or more, measured as $CO_2$-e, is required to submit a Pollution Prevention Plan to the Minister for approval.

Regulations pertaining to GHG reporting using the NAEIS was published on 3 April 2017 (Government Gazette 40762, Notice 275 of 2017). The South African mandatory reporting guidelines focus on the reporting of Scope 1 emissions only. The three broad scopes for estimating GHG are:

- Scope 1: All direct GHG emissions.
- Scope 2: Indirect GHG emissions from consumption of purchased electricity, heat or steam.
- Scope 3: Other indirect emissions, such as the extraction and production of purchased materials and fuels, transport-related activities in vehicles not owned or controlled by the reporting entity, electricity-related activities not covered in Scope 2, outsourced activities, waste disposal, etc.

The NAEIS web-based monitoring and reporting system will also be used to collect GHG information in a standard format for comparison and analyses. The system forms part of the National Atmospheric Emission Inventory component of South African Atmospheric Emission Licensing & Inventory Portal (SAAELIP) and South African Air Quality Information System (SAAQIS).

The DEA is working together with local sectors to develop country specific emissions factors in certain areas; however, in the interim the Intergovernmental Panel on Climate Change's (IPCC) default emission figures may be used to populate the SAAQIS GHG emission factor database. These country specific emission factors will replace some of the default IPCC emission factors.

The Carbon Tax Act was introduced for a further round of public consultation. The Carbon Tax Policy Paper (CTPP) (Department of National Treasury, 2013) stated consideration will be given to sectors where the potential for emissions reduction is limited. GHG in excess of 0.1 Mt, measured as $CO_{2\text{-eq}}$, is required to submit a pollution prevention plan to the Minister for approval. The Carbon Tax Act was published in 2019 (GG 42483 of 23 May 2019).

## 2.6 Highveld Priority Area

The Highveld Airshed was declared the second priority area by the minister at the end of 2007. This required that an Air Quality Management Plan for the area be developed. The plan includes the establishment of an emissions reduction strategies and intervention programmes based on the findings of a baseline characterisation of the area. The implication of this is that all contributing sources in the area will be assessed to determine the emission reduction targets to be achieved over the following few years.

The project area is located within the footprint demarcated as the Highveld Priority Area. Emission reduction strategies will be included for the numerous coal mines in the area with specific targets. The DEA published the management plan for the Highveld Priority Area in September 2011. Included in this management plan are seven goals, each of which has a further list of objectives that must be met. The goals for the Highveld Priority area are as follows:

- Goal 1: By 2015, organisational capacity in government is optimised to efficiently and effectively maintain, monitor and enforce compliance with ambient air quality standards.
- Goal 2: By 2020, industrial emissions are equitably reduced to achieve compliance with NAAQSs and NDCR limit values.
- Goal 3: By 2020, air quality in all low-income settlements is in full compliance with ambient air quality standards.
- Goal 4: By 2020, all vehicles comply with the requirements of the National Vehicle Emission Strategy.
- Goal 5: By 2020, a measurable increase in awareness and knowledge of air quality exists.
- Goal 6: By 2020, biomass burning and agricultural emissions will be 30% less than current.
- Goal 7: By 2020, emissions from waste management are 40% less than current.

Goal 2 applies directly to the Project. The objectives associated with this goal include:

- Emissions are quantified from all sources;
- Gaseous and particulate emissions are reduced;
- Fugitive emissions are minimised;
- Emissions from dust generating activities are reduced;
- Incidences of spontaneous combustion are reduced;
- Abatement technology is appropriate and operational;
- Industrial Air Quality Management (AQM) decision making is robust and well-informed, with necessary information available;
- Clean technologies and processes are implemented;
- Adequate resources are available for AQM in industry;
- Ambient air quality standard and dustfall limit value exceedances as a result of industrial emissions are assessed; and,
- A line of communication exists between industry and communities.

Each of these objectives is further divided into activities, each of which have a timeframe, responsibility and indicator. Refer to the DEA (2011) Highveld Priority Management Plan for further details[2].

[2] This document can be downloaded from the SAAQIS website: www.saaqis.org.za

# 3 Description of the Receiving Environment

This chapter provides details of the receiving environment which is described in terms of:

- A study of the atmospheric dispersion potential of the area;
- The identification of Air Quality Sensitive Receptors (AQSRs) from available maps;
- The identification of existing sources of emissions in the study area; and
- The analysis of all available ambient air quality information/data.

## 3.1 Atmospheric Dispersion Potential

Physical and meteorological mechanisms govern the dispersion, transformation, and eventual removal of pollutants from the atmosphere. The analysis of hourly average meteorological data is necessary to facilitate a comprehensive understanding of the dispersion potential of the site. Parameters useful in describing the dispersion and dilution potential of the site i.e. wind speed, wind direction, temperature and atmospheric stability, are subsequently discussed.

The South African Weather Services (SAWS) operates, on behalf of DEFF, a weather and ambient air quality monitoring station in Emalahleni, approximately 9 km away from the mine offices (see Figure 9). Data from this station was obtained for the period January 2014 to December 2018 to quantify the atmospheric dispersion potential (http://saaqis.environment.gov.za/). A period of three years is required by the regulations on Air Dispersion Modelling (DEA, 2014). The dataset is regarded as representative of the weather conditions at the project site.

### 3.1.1 Surface Wind Field

The wind field determines both the distance of downward transport and the rate of dilution of pollutants. The generation of mechanical turbulence is a function of the wind speed, in combination with the surface roughness. The wind field for the study area is described with the use of wind roses. Wind roses comprise 16 spokes, which represent the directions from which winds blew during a specific period. The colours used in the wind roses below, reflect the different categories of wind speeds; the orange area, for example, representing winds in between 4 and 5 m/s. The dotted circles provide information regarding the frequency of occurrence of wind speed and direction categories. Calm conditions are periods when the wind speed was below 1 m/s. These low values can be due to "meteorological" calm conditions when there is no air movement; or, when there may be wind, but it is below the anemometer starting threshold.

The period wind field and diurnal variability in the wind field are shown in Figure 2. Seasonal variations in the wind field are provided in Figure 3. The wind field was predominantly from the north, east and east-southeast, also the directions associated with the strongest winds. The night-time wind rose shows a decrease in the northerly and the north-westerly winds with an increase in the easterly and east-southeasterly winds. The night-time is also characterised by a higher frequency of calm conditions. Summer and autumn show similar wind direction profiles to the period average, while winter shows more frequent winds from the west and spring more from the north.

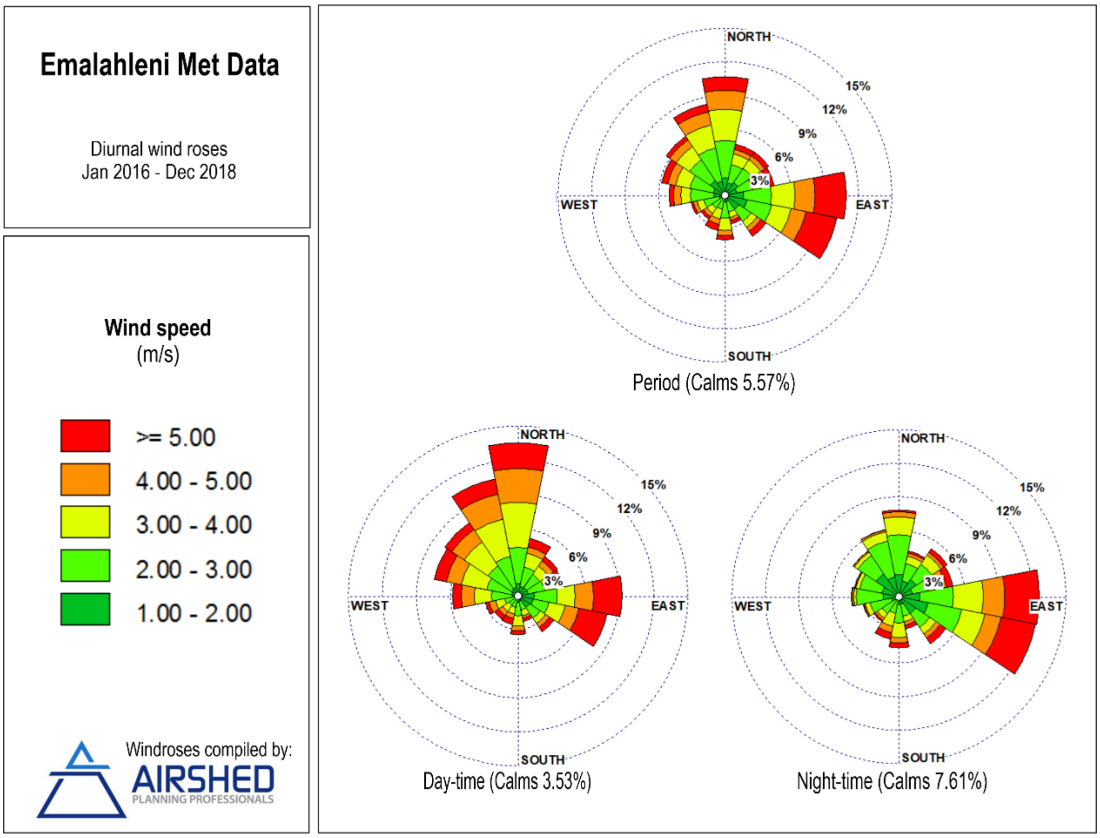


*Figure 2: Period, day- and night-time wind roses (DEFF data; 2014 to 2018)*

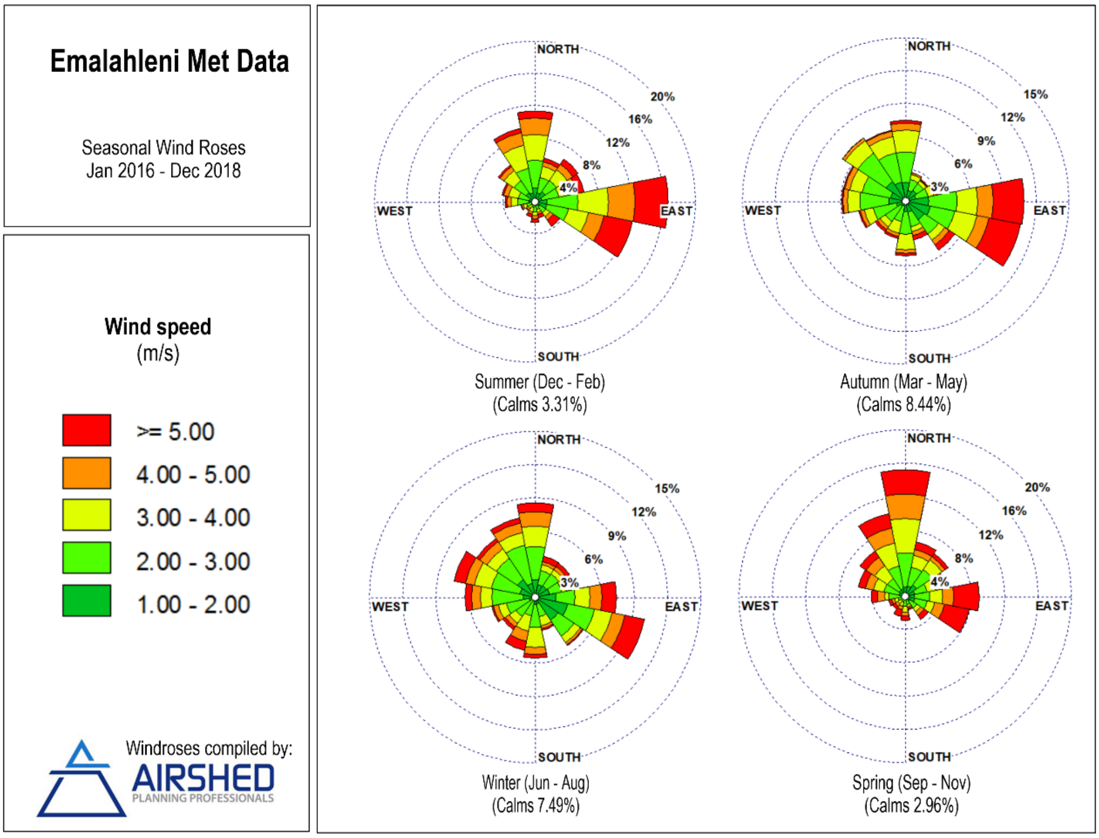


*Figure 3: Seasonal wind roses (DEFF data; 2014 to 2018)*

According to the Beaufort wind force scale (https://www.metoffice.gov.uk/guide/weather/marine/beaufort-scale), wind speeds between 6-8 m/s equates to a moderate breeze, with wind speeds between 14-17 m/s near gale force winds. Based on the three years of DEFF data, wind speeds exceeding 5 m/s occurred for only 12.6% of the time, with a maximum wind speed of 11.8 m/s. The average wind speed over the three years was 2.95 m/s. Calm conditions (wind speeds < 1 m/s) occurred for 5.6% of the time (Figure 4). The US EPA indicates a friction velocity of 5.4 m/s to initiate erosion from a coal storage piles (US EPA, 2006) and (Mian & Yanful, 2003). Thus, the likelihood exists for wind erosion to occur from open and exposed surfaces, with loose fine material, when the wind speed exceeds at least 5.4 m/s. Wind speeds exceeding 5.4 m/s occurred for 7.9% over the three years (2016 - 2018).

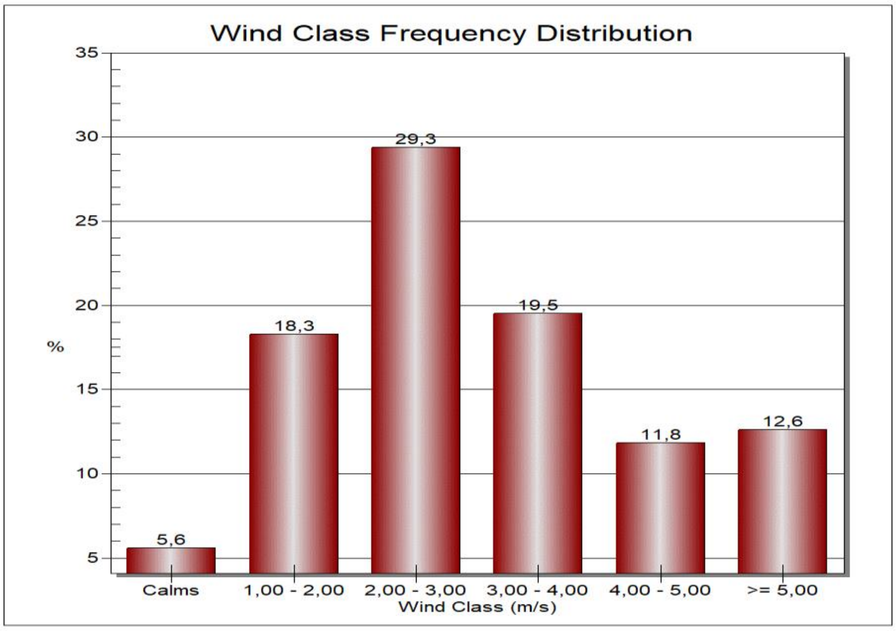


*Figure 4: Wind speed categories (DEFF data; 2016 to 2018)*

### 3.1.2 Temperature

Air temperature is important, both for determining the effect of plume buoyancy (the larger the temperature difference between the plume and the ambient air, the higher a pollution plume is able to rise) and determining the development of the mixing and inversion layers.

The diurnal temperature profile for the site is given in Figure 5 and the monthly mean and hourly maximum and minimum temperatures are given in Table 6. Monthly average temperatures ranged between 11.3°C and 20.7°C. The highest temperatures (35.8°C) occurred in January and the lowest (-2.1°C) in June/July. During the day, temperatures increase to reach maximum at around 15:00 in the afternoon. Ambient air temperature decreases to reach a minimum at around 07:00 i.e. just before sunrise.

*Table 6: Monthly temperature summary (2016 - 2018)*

| Hourly Minimum, Hourly Maximum and Monthly Average Temperatures (°C) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
| Minimum | 9.1 | 11.5 | 7.8 | 5.3 | 2.4 | 0.2 | -2.1 | 0.2 | 0.4 | 4.1 | 5 | 11.1 |
| Maximum | 35.8 | 33.5 | 31.2 | 30.1 | 24.5 | 23.9 | 23.3 | 28 | 33.1 | 33.6 | 3.4 | 34 |
| Average | 20.5 | 20.4 | 19.3 | 17.2 | 13.6 | 11.8 | 11.3 | 14.2 | 18.2 | 18.4 | 19.2 | 20.7 |

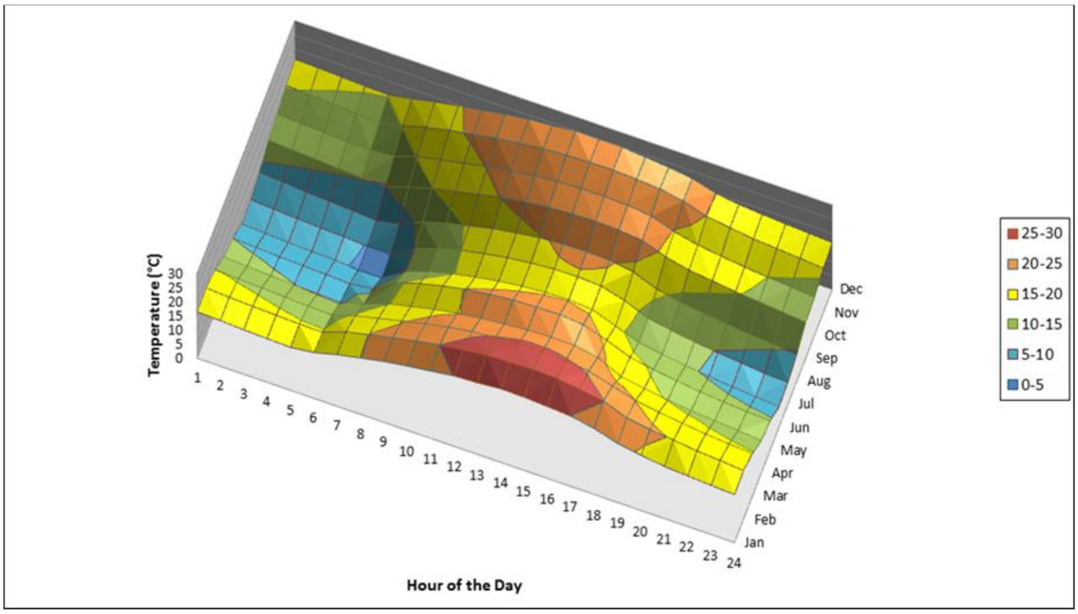


*Figure 5: Diurnal temperature profile (DEFF data; 2014 to 2018)*

### 3.1.3 Precipitation

Precipitation is important to air pollution studies since it represents an effective removal mechanism for atmospheric pollutants and inhibits dust generation potentials.

Average annual rainfall amounts to 730 mm per annum (November to April) with an average annual evaporation rate of 1500 mm (CPR, 2019).

## 3.2 Receiving Environment

AQSRs primarily refer to places where people reside; however, it may also refer to other sensitive environments that may adversely be affected by air pollutants. Ambient air quality guidelines and standards, as discussed under Section 0, have been developed to protect human health. Ambient air quality, in contrast to occupation exposure, pertains to areas outside of an industrial site/mine boundary where the public has access to and according to the NEMAQA, excludes areas regulated under the Occupational Health and Safety Act (Act No 85 of 1993) (Dept of Labour, 1993).

The main receptors near the mine are Clewer immediately to the east, Kwa-Guqa 3 km to the north-northeast, Ackerville 6 km to the northeast, Phola 6 km to the southwest and Emalahleni 10 km to the east. Sensitive receptors as shown in Figure 6 include schools, residential areas, clinics and farmsteads.

## 3.3 Existing Sources of Emissions in the Region

The sources of $SO_2$ and $NO_x$ that occur in the region include industrial emissions, blasting operations at mines, veld burning, vehicle exhaust emissions and household fuel burning.

Various local and far-a-field sources are expected to contribute to the suspended fine particulate concentrations (which would include $PM_{10}$ and $PM_{2.5}$) in the region. Local sources include metallurgical plants, coal fires power stations, wind erosion from exposed areas, fugitive dust from agricultural and mining operations, vehicle entrainment from roadways and veld burning. Long-range transport of particulates, emitted from remote tall stacks and from large-scale biomass burning in countries to the north of South Africa, has been found to contribute significantly to background fine particulate concentrations over the interior (Andreae et al., 1996; Piketh, 1996).

### 3.3.1 Materials handling

Materials handling operations associated with mining activities in the area include the transfer of material by means of tipping, loading and off-loading of trucks. The quantity of dust that will be generated from such loading and off-loading operations will depend on various climatic parameters, such as wind speed and precipitation, in addition to non-climatic parameters such as the nature (i.e. moisture content) and volume of the material handled.

### 3.3.2 Industrial Emissions

Industrial sources within the Mpumalanga region include the following:

- Emissions from coal combustion by power generation, metallurgical and petrochemical industries represent the greatest contribution to total emissions from the industrial / institutional / commercial fuel use sector within the Mpumalanga region.
    - The closest power station is Kusile some 13 km to the west with Duvha Power Station approximately 21 km to the east.
- The metallurgical group is estimated to be responsible for at least ~50% of the particulate emissions from this sector. This group includes iron and steel, ferro-chrome, ferro-alloy and stainless-steel manufacturers (includes Highveld Steel & Vanadium, Ferrometals, Columbus Stainless, Transalloys, Middelburg Ferrochrome).
    - Transalloys is located northeast of Elandsfontein Colliery;
    - Highveld Steel is located to the north; and
    - Ferro Metals is located in the western part of Emalahleni some 6 km away.

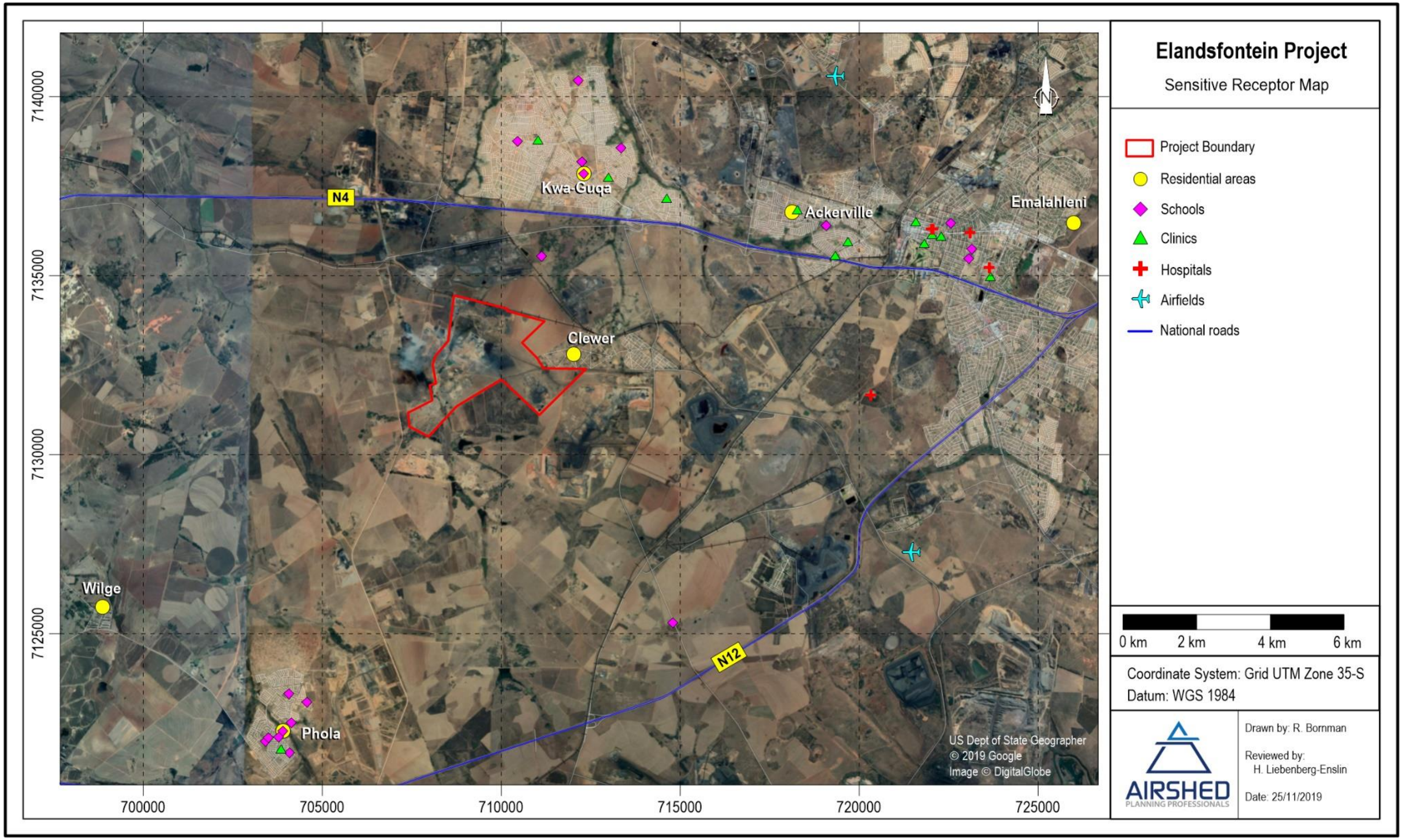


*Figure 6: Location of potential air quality sensitive receptors in the area*

- Petrochemical and chemical industries are primarily situated in Secunda (viz. Sasol Chemical Industries). The use of coal for power generation and the coal gasification process represent significant sources of sulfur dioxide emissions. (Particulate emissions are controlled through the implementation of stack gas cleaning equipment.)
- Other industrial sources include: brick manufacturers which use coal (e.g. Witbank Brickworks, Quality Bricks, Corobrik, Hoëveld Stene, Middelwit Stene) and woodburning and wood drying by various sawmills (Bruply, Busby, M&N Sawmills) and other heavy industries (use coal and to a lesser extent Heavy Fuel Oil (HFO) for steam generation). The contribution of fuel combustion (primarily coal) by institutions such as schools and hospitals to total emissions is relatively due to the extent of emissions from other groups.

### 3.3.3 Household Fuel Burning

Despite the intensive national electrification program, a large number of households continue to burn fuel to meet all or a portion of their energy requirements. The main fuels with air pollution potentials used by households within the study region are coal, wood and paraffin.

Coal burning emits a large amount of gaseous and particulate pollutants including sulfur dioxide, heavy metals, total and respirable particulates including heavy metals and inorganic ash, carbon monoxide, polycyclic aromatic hydrocarbons, and benzo(a)pyrene. Polyaromatic hydrocarbons are recognised as carcinogens. Pollutants arising due to the combustion of wood include respirable particulates, nitrogen dioxide, carbon monoxide, polycyclic aromatic hydrocarbons, particulate benzo(a)pyrene and formaldehyde. The main pollutants emitted from the combustion of paraffin are $NO_2$, particulates carbon monoxide and polycyclic aromatic hydrocarbons.

### 3.3.4 Biomass Burning

The biomass burning includes the burning of evergreen and deciduous forests, woodlands, grasslands, and agricultural lands. Within the project vicinity, crop-residue burning and wild fires (locally known as veld fires) may represent significant sources of combustion-related emissions.

The biomass burning is an incomplete combustion process (Cachier, 1992), with carbon monoxide, methane and nitrogen dioxide gases being emitted. Approximately 40% of the nitrogen in biomass is emitted as nitrogen, 10% is left is the ashes, and it may be assumed that 20% of the nitrogen is emitted as higher molecular weight nitrogen compounds (Held et al, 1996). The visibility of the smoke plumes is attributed to the aerosol (particulate matter) content. In addition to the impact of biomass burning within the vicinity of the proposed mining activity, long-range transported emissions from this source can be expected to impact on the air quality between the months August to October. It is impossible to control this source of atmospheric pollution loading; however, it should be noted as part of the background or baseline condition before considering the impacts of other local sources.

### 3.3.5 Vehicle Exhaust Emissions

Air pollution from vehicle emissions may be grouped into primary and secondary pollutants. Primary pollutants are those emitted directly into the atmosphere, and secondary, those pollutants formed in the atmosphere as a result of chemical reactions, such as hydrolysis, oxidation, or photochemical reactions. The significant primary pollutants emitted by motor vehicles include carbon dioxide ($CO_2$), carbon monoxide (CO), hydrocarbon compounds (HC), sulfur dioxide ($SO_2$), nitrogen oxides ($NO_x$) and particulate matter (PM). Secondary pollutants include nitrogen dioxide ($NO_2$), photochemical oxidants (e.g. ozone), hydrocarbon compounds (HC), sulfur acid, sulfates, nitric acid and nitrate aerosols.

### 3.3.6 Open Cast Mining

Open cast mines are associated with significant dust emissions, sources of which include land clearing, blasting and drilling operations, materials handling, vehicle entrainment, crushing, screening (etc.).

There are a number of underground and opencast mines in the vicinity of Elandsfontein Colliery, of which most are coal mines. Greenside Colliery is located 4 km to the east with other coal mines within a 10 km radius including Landau Colliery to the north and Tweefontein- and Klipspruit mines to the south.

### 3.3.7 Other Fugitive Dust Sources

Fugitive dust emissions may occur as a result of vehicle entrained dust from local paved and unpaved roads, wind erosion from open areas and dust generated by agricultural activities (e.g. tilling) and mining. The extent of particulate emissions from the main roads will depend on the number of vehicles using the roads, and on the silt loading on the roadways.

## 3.4 Baseline Air Quality

Particulates represent the main pollutant of concern in the assessment of mining operations. The particulates in the atmosphere may contribute to visibility reduction, pose a threat to human health, or simply be a nuisance due to their soiling potential.

### 3.4.1 Monitored Ambient Concentrations

A summary of ambient data measured at the DEFF Emalahleni station for the period 2018 is provided in Table 7. Time series of the measured ambient air quality data is provided in Appendix B.

*Table 7: Summary of the ambient measurements at Emalahleni for the period 2018 (units: µg/m³)*

| Period | Availability | Hourly Max | Annual Average | No of recorded hourly exceedances |
|---|---|---|---|---|
| $NO_2$ | | | | |
| 2018 | 67% | 139 | 30 | - |
| $SO_2$ | | | | |
| 2018 | 84% | 562 | 39 | 3 |
| **Period** | **Availability** | **Daily Max** | **Annual Average** | **No of recorded daily exceedances** |
| $SO_2$ | | | | |
| 2018 | 84% | 165 | 39 | 1 |
| $PM_{10}$ | | | | |
| 2018 | 16% | 235 | 83 | 67 |
| $PM_{2.5}$ | | | | |
| 2018 | 31% | 123 | 40 | 57 |

Note: Exceedances of the NAAQS are provided in red.

The measured ambient concentrations for 2018 indicate:

- The hourly and daily 99th percentiles for $SO_2$ were below the limit value of 350 µg/m³ and 125 µg/m³ respectively.
- The hourly 99th percentiles for $NO_2$ were below the limit value (200 µg/m³).
- The daily 99th percentiles for $PM_{10}$ exceeded the limit value (75 µg/m³) and the daily 99th percentiles for $PM_{2.5}$ exceeded the limit value (40 µg/m³).
- The $SO_2$ and $NO_2$ annual averages were below the NAAQS, but the $PM_{10}$ and $PM_{2.5}$ annual averages exceeded the limit value of 40 µg/m³ and 20 µg/m³ respectively for 2018 at the Emalahleni (DEFF) station.

This is similar to the trend seen from 2015 to 2017 data (State of Air Reports). It can be concluded that while $SO_2$ and $NO_2$ ambient concentrations are within acceptable levels within the Emalahleni area, ambient particulate concentrations are elevated.

Time series plots (mean with 95% confidence interval) of ambient $SO_2$, $NO_2$ and $PM_{10}$ concentrations measured at Emalahleni (Figure 7 and Figure 8) show the variation of these pollutants over daily, weekly and annual cycles.

Increased $NO_2$ concentrations during peak traffic times illustrate the contribution of vehicle emissions to the ambient $NO_2$ concentrations. The winter (June, July and August) elevation of $SO_2$ and $NO_2$ shows the contribution of residential fuel burning to the ambient $SO_2$ and $NO_2$ concentrations.

Monthly variation of $PM_{10}$ shows a typical Highveld signature of elevated concentrations during winter months due to the greater contribution from domestic fuel burning, windblown dust from exposed surfaces and the lack of the settling influence of rainfall.

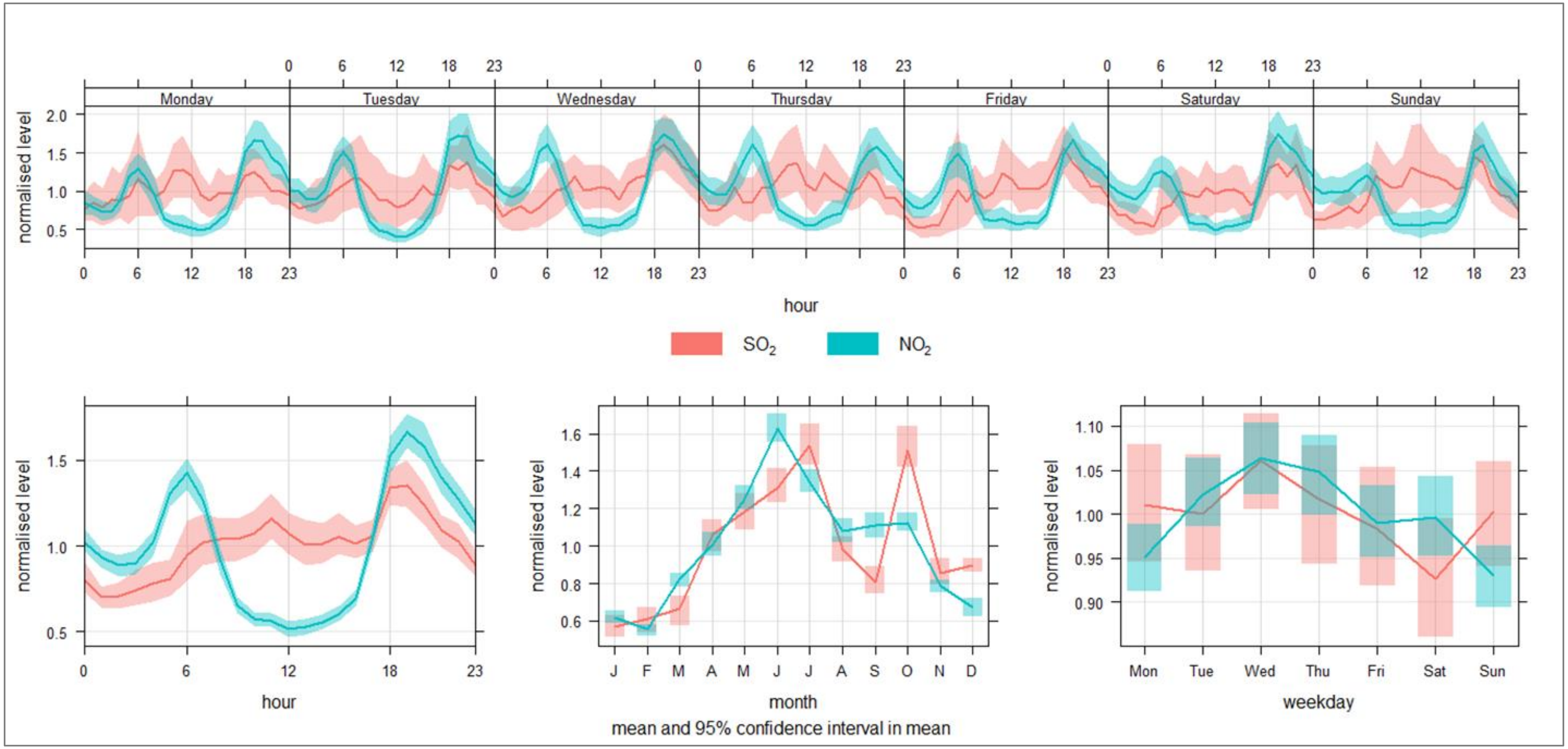


*Figure 7: Time series plot of normalised observed $SO_2$ and $NO_2$ concentrations at Emalahleni (shaded area indicates 95th percentile confidence interval)*

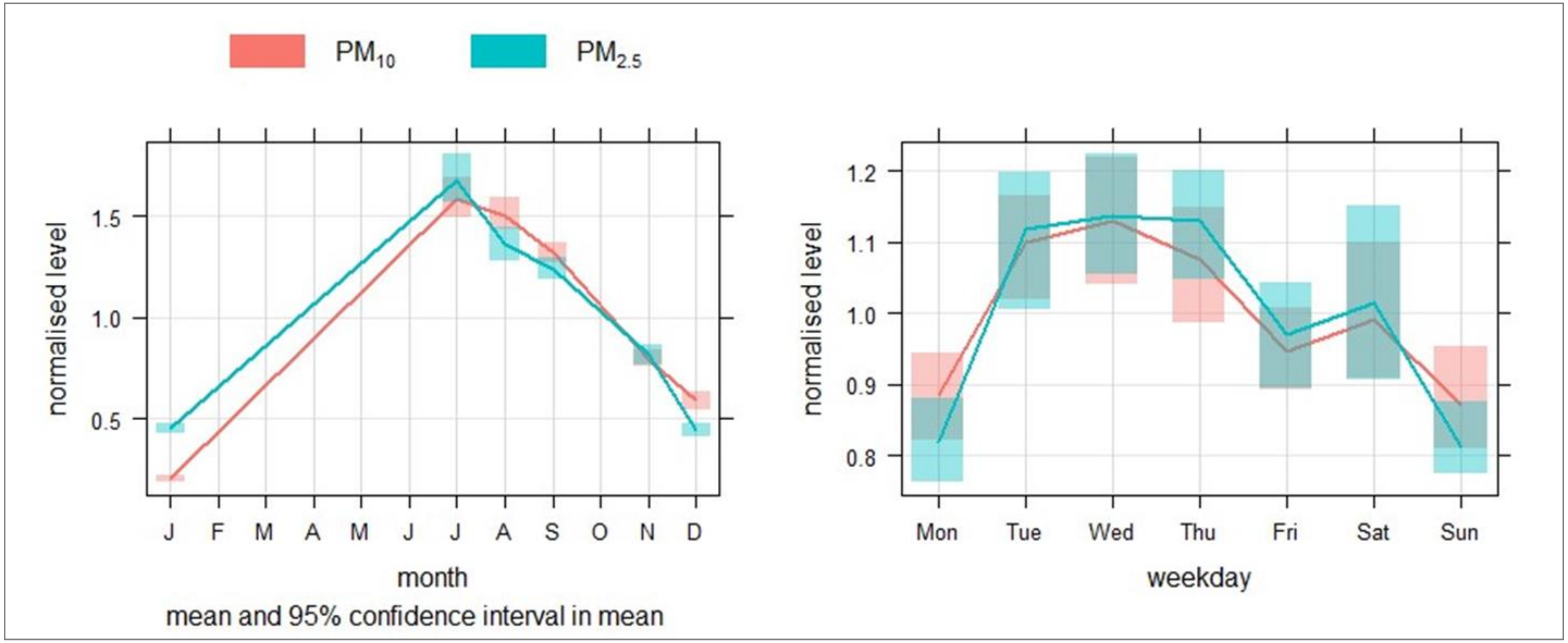


*Figure 8: Time series plot of normalised observed $PM_{10}$ and $PM_{2.5}$ concentrations at Emalahleni (shaded area indicates $95^{th}$ percentile confidence interval)*

### 3.4.2 Monitored Dustfall data

Dust fallout is governed by the NDCR (Section 2.2.3). Elandsfontein Colliery dustfall monitoring network comprises of seven (7) single dust fallout units placed strategically around the mine boundary to collect dust fallout from the unpaved haul roads and mining activities (Figure 9). The dustfall sampling campaign is managed by Geo Soil & Water, with the analysis conducted by Yanka Laboratories. The dustfall units were implemented in September 2019, with two months of data available for the periods: October 2019 (2 Sept- 2 Oct'19) and November 2019 (2 Oct- 4 Nov'19).

The dustfall results for the two months are provided in Table 8, also indicating the NDCR limit applicable to each site and a graphical representation is provided in and Figure 10. Only EFD East and EFD Clewer are evaluated against the residential limit (600 $mg/m^3$-day), with the other five sites evaluated against the non-residential limit (1,200 $mg/m^3$-day). During October 2019 the exposure period was for 30 days with dustfall rates below the non-residential- and residential limits at all the sites. Dust fallout rates ranged between 159 and 377 $mg/m^2$-day, with the highest rate at EFD North and the lowest at EFD South East. Dust fallout rates were generally higher for November 2019, but all the non-residential sites remained below the limit. For the two residential sites dust fallout at EFD Clewer was 706 $mg/m^3$-day, exceeding the residential limit – the reason for this is not clear since the October field log reported coal dust in the bucket, but the November field log only indicates "clear – water". The field logs are provided in Appendix C.

*Table 8: Dustfall rates at Elandsfontein Colliery*

| Site Name | NDCR | Dustfall rate ($mg/m^2$-day) | |
|---|---|---|---|
| | | **September 2019** | **October 2019** |
| EFD North | Non-residential | 377 | 1 160 |
| EFD East | Residential | Installed 2 Oct'19 | 303 |
| EFD Clewer | Residential | 291 | 706 |
| EFD South | Non-residential | 194 | 262 |
| EFD South West | Non-residential | 272 | 302 |
| EFD West | Non-residential | 159 | 308 |
| EFD South East | Non-residential | Installed 4 Nov'19 | Installed 4 Nov'19 |

Exceeds NDC limit for residential areas

Exceeds NDC limit for non-residential areas

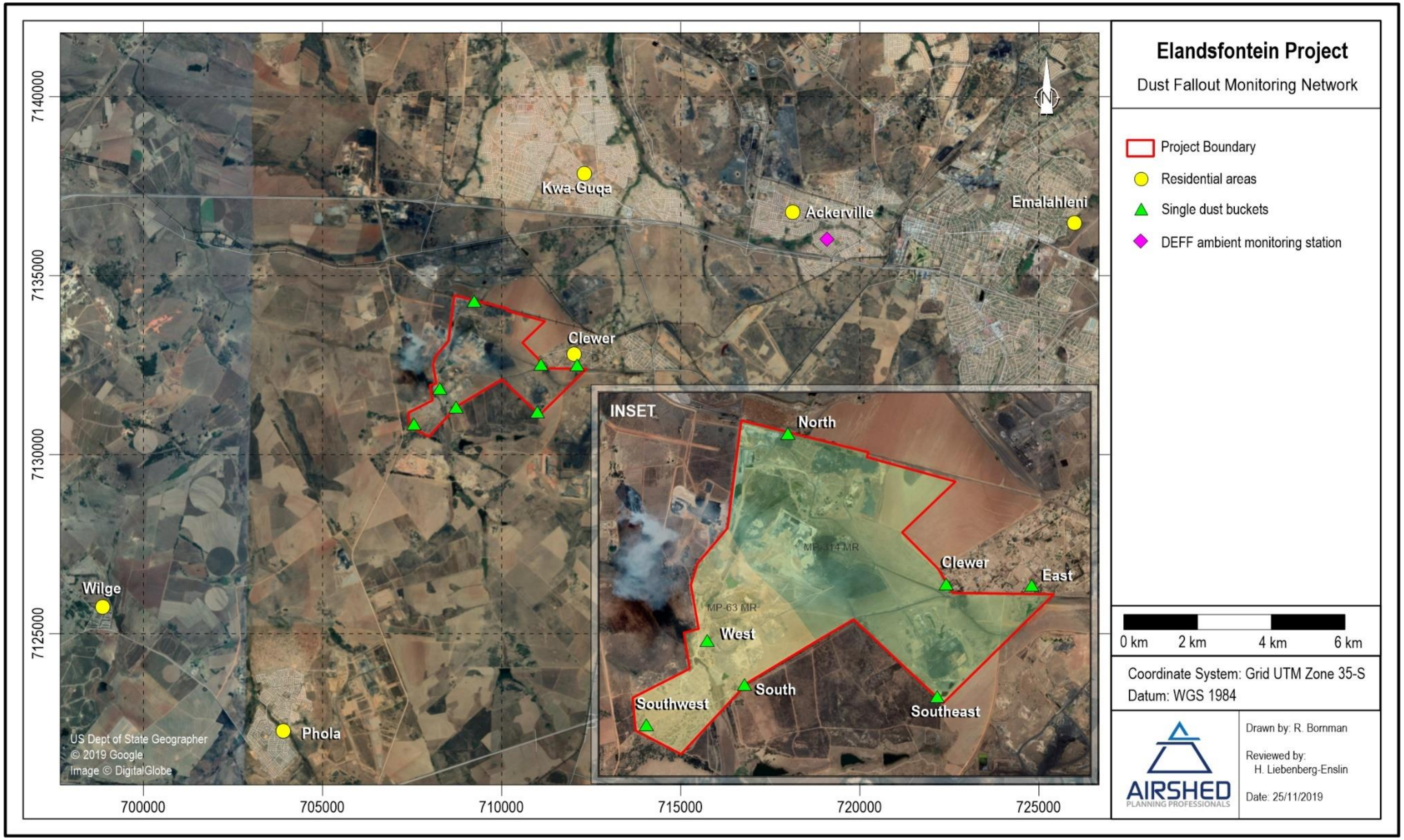


*Figure 9: Locality map dust fallout monitoring at Elandsfontein Colliery*

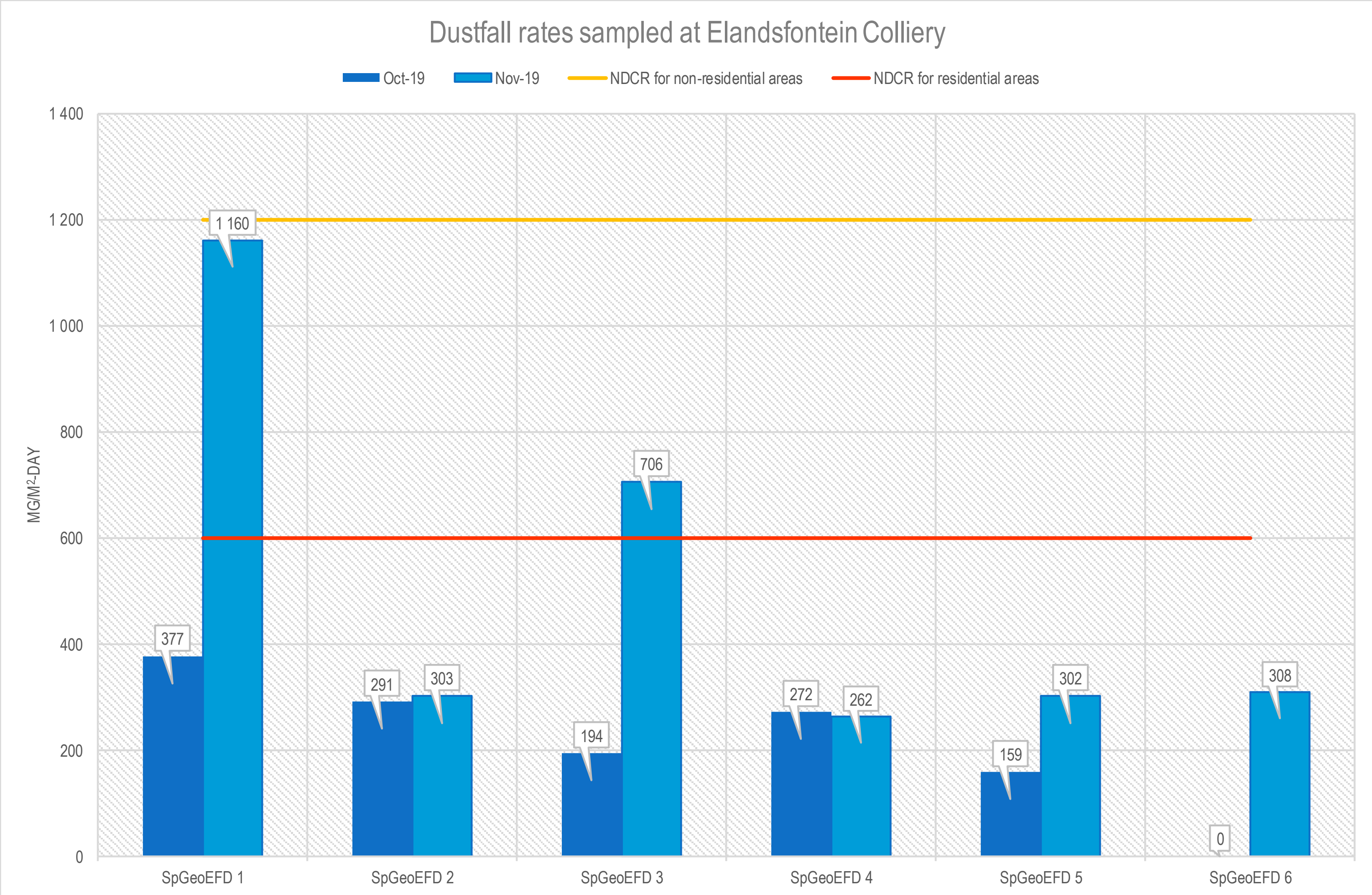


*Figure 10: Dustfall results for October and November 2019*

### 3.4.3 Modelled Ambient Air Pollutant Concentrations

The Elandsfontein Colliery is located within the Highveld Priority Area, and also falls within the modelled ambient Witbank "hotspot" area, where exceedances of the 24-hour ambient $PM_{10}$ and $SO_2$ NAAQS due to industrial sources were indicated (Figure 11 and Figure 12 respectively).

From Figure 11 it appears that the mine is situated in an area where more than 12 exceedances of the 24-hour ambient $PM_{10}$ NAAQS were predicted over a 3-year period (i.e. > 4 days per year). This is in agreement with the measured values reported for Emalahleni in Section 3.4.1.

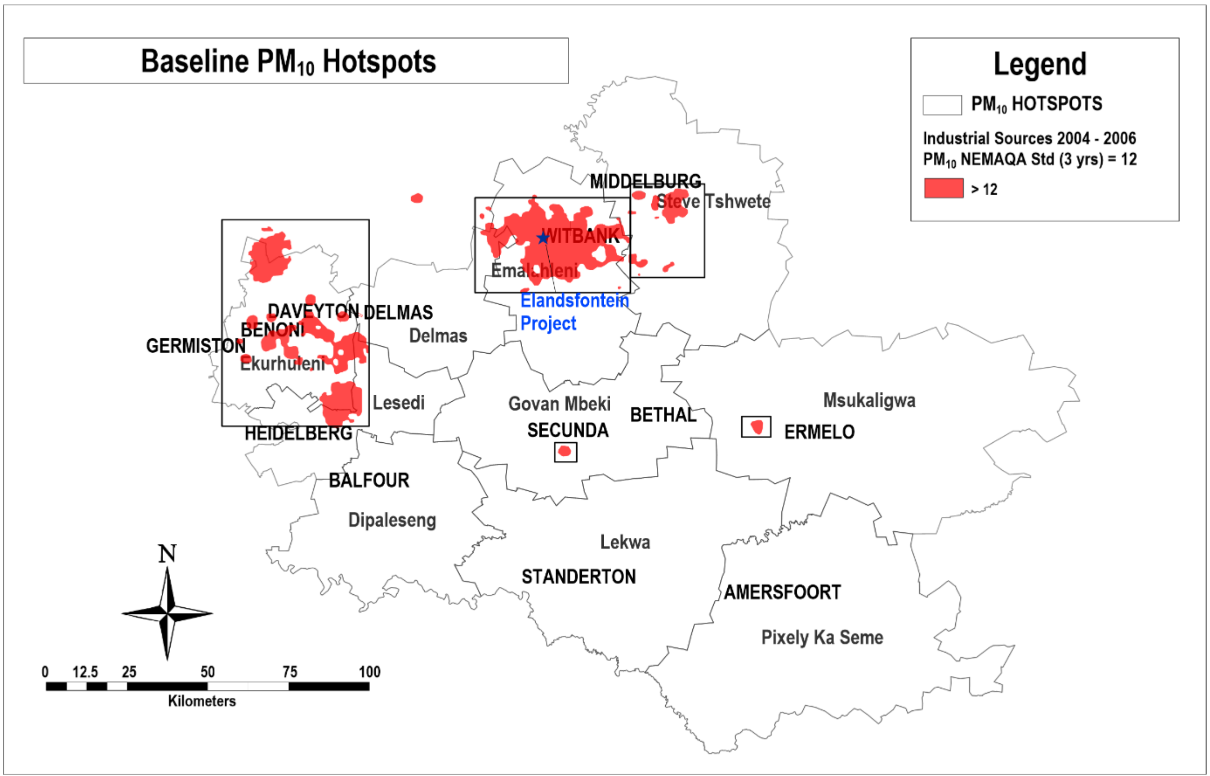


*Figure 11: Modelled frequency of exceedance of 24-hour ambient $PM_{10}$ standards in the Highveld Priority Area, indicating the modelled Air Quality Hot Spot areas*

From Figure 12 the Project falls outside the (red) area of non-compliance with the 24-hour ambient $SO_2$ NAAQS. It should be noted however that the ambient concentrations measured at the Emalahleni site may not be representative of the baseline ambient levels at the sensitive receptor sites included in the current assessment, as local sources of emissions (i.e. domestic fuel burning, local vehicles, etc.) will contribute to the background levels in both areas.

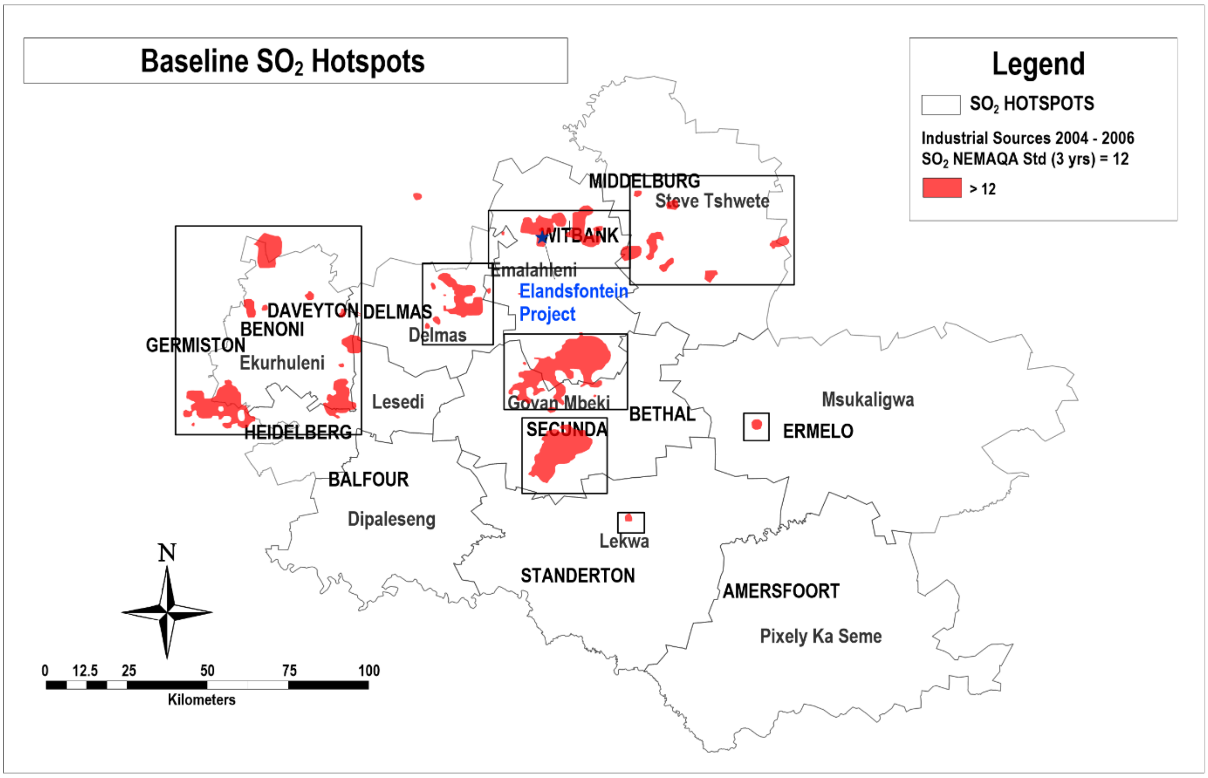


*Figure 12: Modelled frequency of exceedance of 24-hour ambient $SO_2$ standards in the Highveld Priority Area, indicating the modelled Air Quality Hot Spot areas*

# 4 Preliminary Qualitative Impact Assessment for Elandsfontein Expansion

## 4.1 2017 Air Quality Specialist Report Review

An Air Quality Impact Assessment (AQIA) Report was compiled by Digby Wells Environmental (DWE) for Elandsfontein Colliery in August 2017 (DWE, 2017). The AQIA was one of the specialist studies required to amend the approved Environmental Management Plan (EMP) and renewal of Mining Right (MR) MP 314 MR for the Elandsfontein Colliery. The study focussed only on MP 314 MR and the activities associated with this part of the Colliery.

### 4.1.1 Emissions Inventory

Air emissions were limited to activities associated with the operational phase and only included particulates ($PM_{2.5}$, $PM_{10}$, and dust fallout) with gaseous emissions such as $SO_2$, NOx, CO and hydrocarbons (HC) from vehicle exhaust emissions assumed to be negligible. The following mining activities associated with the MP314 MR were assessed:

- Drilling and blasting;
- Materials handling operations;
- Vehicle entrainment on unpaved roads during hauling of material; and
- Wind erosion from exposed area and volume sources.

Emissions were quantified using the US EPA and Australian NPI emission factors. The amount of coal processed was taken to be 720,000 tpa with operational hours of 8760 per annum (DWE, 2017).

<u>Review Comment</u>

The methodology followed in the quantification of the emissions are correct. The omission of gaseous emissions is not regarded a significant gap in the assessment, however tailpipe combustion from haul trucks could contribute notably to $NO_2$ concentrations. It is agreed that particulates matter is the main pollutant of concern from opencast mining activities. The amount of emissions (tpa) from each of the activities as provided in Table 8-6 of the DWE report seem in line with emissions from opencast coal mining operations of a similar size, except for the crusher emissions which appear to be underestimated. The throughput at the crusher is given as 720,000 tpa, operating for 8760 hours a year and a coal moisture of 3.4%. A control efficiency of 75% was assumed from the dust suppression system. When the low moisture emission factor as provided in Table 8-3 of the DWE report is applied (high moisture material is >4%), then the mitigated emissions from the primary and secondary crushers are 50 times higher for $PM_{10}$ and 100 times higher for TSP. Not all the emission calculations could be verified due to insufficient detailed information.

### 4.1.2 Meteorological data

MM5 modelled meteorological data (2013-2015) from Lakes Environmental Software was analysed and used to generate wind rose plots and determine the local prevailing weather conditions.

Review Comment

The use of MM5 data for a location at the mine is an accepted approach. The DEFF ambient monitoring station in Emapahleni provides actual measured data and is regarded representative of the mining area. By comparing the wind roses from the MM5 data to the DEFF ambient monitoring station wind roses, the prevailing wind field is similar with the MM5 wind speeds slightly stronger than the measured DEFF data.

### 4.1.3 Dispersion Modelling

The USA Environmental Protection Agency's Preferred/Recommended Models: AERMOD modelling system (as of December 9, 2006, AERMOD is fully promulgated as a replacement to ISC3 model) was used for the simulation of potential impacts form the project.

The modelling results indicated elevated $PM_{10}$ and $PM_{2.5}$ concentrations exceeding the NAAQSs at the mine boundary and selected receptors without mitigation measures in place. Similarly, the modelled dustfall rates exceeded the non-residential limit for a large area when no mitigation was applied. It was found that emissions from haul roads, drilling and blasting activities were the main contributors.

Review Comment

The dispersion model used is in line with the Air Dispersion Modelling Regulations (see Section 2.4). The area of exceedance from the modelled results seem extensive given the emission rates reported. It is however very difficult to determine whether this is an overestimation of the impacts. Only unmitigated impacts are shown for $PM_{10}$ and $PM_{2.5}$ concentrations with no indication as how the impact area would reduce with mitigation in place. This is only provided for dust fallout where there is a significant reduction in the impact area after mitigation is applied. The significance rating given to the modelled impacts seem too low based on the extent of the modelled impact area.

## 4.2 Preliminary Qualitative Impact Assessment

Based on the project description (see Section 1.3) the following impacts are to be considered.

### 4.2.1 Construction phase

During the construction phase, two areas will be affected namely:

- the north of the opencast reserve of Block H where a new box-cut will be opened with cuts developed in a southerly direction, and
- Resource Block D and E where a new decline will be developed to access the No.1 Seam.

It is understood that the existing infrastructure will be used to access the other underground Resource Blocks and the new opencast areas.

Both the box-cut and decline shaft construction will result in impacts from vehicle tailpipe emissions due to the transport and general construction activities but these impacts are likely to be localised. Depending on the type and extend of the construction activities, especially for opencast operations in the eastern part of the mine, the $PM_{10}$ and $PM_{2.5}$ may reach the western part of Clewer. Fortunately, the prevailing wind is from the east and the north and should result mostly in impacts away from Clewer. Gaseous emissions, especially $NO_2$, CO and $SO_2$ could be a concern at both the box-cut operations and the decline shaft.

Clearing of vegetation and topsoil and levelling of transportation route areas can result in significant levels of particulate matter if not mitigated. There are no AQSR within 1 km from the haul roads, but Clewer is close to the main access route and could be impacted on by additional traffic as part of construction. The Australian NPI provides a control efficiency of 50% from level 1 watering (2 litres/m²/hr)(NPI, 2012).

### 4.2.2 Operational phase

**Opencast mining** activities would have significantly higher air quality impacts than underground operations. This is primarily due to excavation, material handling and vehicle entrainment on roads (haulage of ROM coal, waste and topsoil). The main pollutant of concern is particulate matter, specifically $PM_{10}$ and $PM_{2.5}$ due to the potential for health impacts. Dustfall is likely to be high close to the active mining areas. The AQSR most likely to be affected by the opencast operations are the residents of Clever to the east of the mine and to the northeast of the planned open pit. Various controls could be applied to opencast mining, with control efficiencies (CE) ranging from 50% due to water suppression to 99% control by using fabric filters on drills (NPI, 2012).

**Underground mining** activities would mainly result in gaseous and particulate emissions from the ventilation shaft and the tipping of ROM from the conveyor onto the ROM stockpile. Vehicle entrained dust from road surfaces, windblown dust from trucks and gaseous emissions from truck exhaust (PM, $SO_2$; NOx; CO; $CO_2$) are most likely to impact the AQSR near the haul roads. Controls on the haul roads could range between watering (50% CE) to 100% for sealed or salt-crusted roads (NPI, 2012).

The **CHPP** is an existing plant but the production would increase from the current 500 000 tpa to 1,365,000 tpa (based on 300 tph, 6500 hrs/yr and 70% efficiency). This would result in increased emissions especially from the crushing and screening circuit.

### 4.2.3 Closure and Post-closure phases

From an air quality perspective, the only sources of pollution during the closure phase would be vehicles as part of the rehabilitation process and windblown dust from exposed surfaces. The impacts would be significantly lower that during the operational phase and even the construction phase.

During post closure, depending on the level of rehabilitation and vegetation cover established on the exposed surfaces, the air quality impacts could be reduced to low significance.

### 4.2.4 Cumulative Impacts

Modelled results from the 2017 AQIA report indicated very high uncontrolled $PM_{10}$ and $PM_{2.5}$ concentrations as well as dustfall rates (DWE, 2017). With the mining and production rates planned to increase by 2.73 times the impacts, although not linearly, would increase. Thus, based on the previous modelling results the planned mining operations would result in even higher ground level concentrations and dustfall rates covering larger non-compliance areas. With mitigation measures in place, the impacts would be less, but it is unclear whether it would result in compliance outside the mining area. The opencast mining would be the main source of emissions together with the haul truck activities followed by the crushing and screening operations.

## 4.3 Sensitivity Mapping

Sensitivity mapping was conducted in accordance with the EIMS methodology, which focusses on scoring the proposed project impact on landscape features. The sensitivity map as provided in Figure 13, is based on the expected impact extent on air quality from the mining operations. The understanding of the mining activities as described in Sections 1.3 and 4.2 in relation to the wind field (Section 3.1.1) was accounted for in the projection of possible impact areas. The main pollutant of concern from the planned opencast and underground mining activities is PM, with $PM_{10}$ and $PM_{2.5}$ the fractions associated with health impacts. The sensitivity map therefore focussed primarily on the expected impact areas from $PM_{10}$ and $PM_{2.5}$ concentrations. Nuisance impacts from dust fallout would be more localised. Gaseous emissions from mining equipment and vehicles are also expected to have a less significant impact with a much smaller footprint than $PM_{10}$ and $PM_{2.5}$.

Considerations for the projected impact areas were:

- The planned mining areas in relation to the AQSR;
- The prevailing wind field – the wind field determines both the distance of downward transport and the rate of dilution of pollutants, and
- The 2017 DWE modelled results used as baseline impacts.

Based on the annual dispersion modelling plots from the DWE 2017 report, the impact area extended beyond the mine boundary with a northwest to southeast orientation. Based on the credible meteorological data used in the model this impact area is regarded the possible footprint of the current operations and it was extended to account for the increase in mining and production rates from he planned activities.

The sensitivity was classified as follows (Figure 13):

- “High” is the area where the concentrations are expected to be in non-compliance with the NAAQS.
- “Medium” is the area is where there will be likely single exceedances of the NAAQS limit values but not resulting in non-compliance.
- “Low” area is where there is likely a low significant effect on human health and well-being.

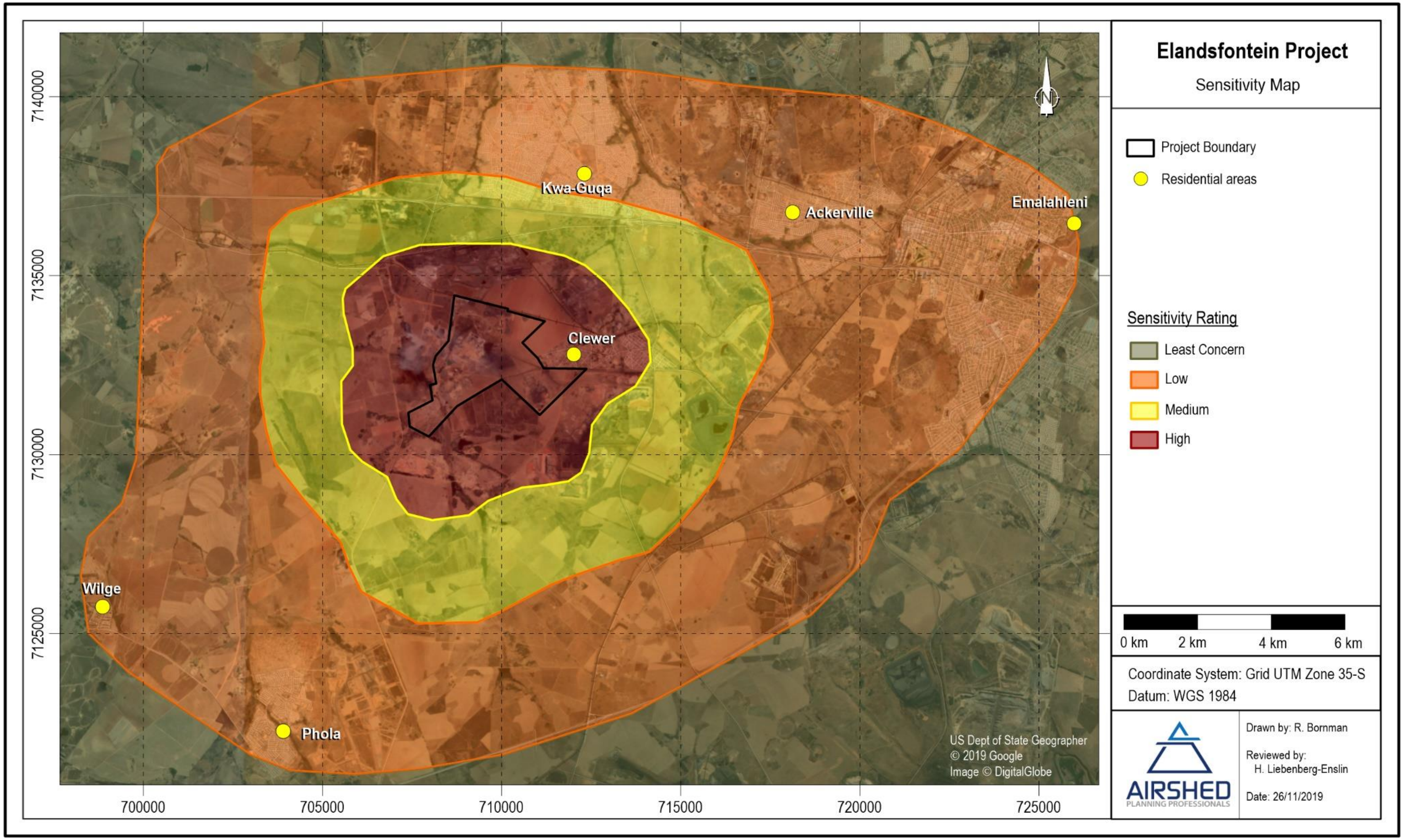


*Figure 13: Air quality sensitivity map*

## 4.4 Significance Rating

The EIA Regulations require that impacts be assessed in terms of the nature, significance, consequence, extent, duration and probability of the impacts; as well as the degree to which these impacts can be reversed, may cause irreplaceable loss of resources, and can be avoided, managed or mitigated. The significance ranking methodology as provided by EIMS was followed.

The impact significance for the three mining phases are provided in an excel spreadsheet to EIMS.

The significance ratings for the three phases can be summarised as follows:

- Construction – Medium (Post-mitigation).
- Operational – High (Post-mitigation), mainly based on the previous AQIA (DWE, 2017).
- Closure – Medium (Post-mitigation).
- Post closure – Low (Post successful rehabilitation).

# 5 Findings and Recommendations

This report preliminary assessed the potential for air quality impacts from the planned underground and opencast operations at Elandsfontein Colliery. All available project and associated data, including metrological data, previous air quality assessments, EIAs and technical air quality data were evaluated together with the planned mine design and schedule. The findings are based on the qualitative assessment of the potential impacts.

## 5.1 Main Findings

### 5.1.1 Baseline Assessment

The findings from the baseline assessment can be summarised as follows:

- Meteorological data was obtained for the period Jan 2016 – Dec 2018 from the DEFF station in Emalahleni, located about 9 km to the east-northeast of the mine.
- The prevailing wind field in the area consists of northerly, easterly and east-southeasterly winds, with infrequent winds from the south and west. During the day, winds at higher wind speeds occurred more frequently from the north whereas at night-time the airflow shifts to more frequent winds from the east and east-southeast but at somewhat lower wind speeds. Day-time calms occurred for 3.6% of the time, with night-time calms for 7.6% of the time.
- Wind speeds exceeding 5.4 m/s occurred for 7.9% over the three years.
- The area experiences mild summers and cold winters with monthly average temperatures of between -2.1°C and 20.7°C.
- Average annual rainfall amounts to 730 mm per annum (November to April) with an average annual evaporation rate of 1500 mm (CPR, 2019).
- Air quality sensitive receptors (AQSRs) around the mine include the residential areas of Clewer immediately to the east, Kwa-Guqa 3 km to the north-northeast, Ackerville 6 km to the northeast, Phola 6 km to the southwest and Emalahleni 10 km to the east.
- Elandsfontein Mine is located within the Highveld Priority Area.
- Ambient air pollutant levels in the project area are currently affected by the following sources of emission:
    - Ambient air pollutant levels in the project area are currently affected by the following sources of emission: Coal Fired Power Plants – Kusile some 13 km to the west with Duvha Power Station approximately 21 km to the east.
    - Industrial (metallurgical) operations – Transalloys is located northeast of Elandsfontein Colliery; Highveld Steel is located to the north; and Ferro Metals is located in the western part of Emalahleni some 6 km away.

- Opencast and underground mines – Greenside Colliery is located 4 km to the east with other coal mines within a 10 km radius including Landau Colliery to the north and Tweefontein- and Klipspruit mines to the south.
- Other sources – including domestic fuel burning; vehicle entrained dust on paved and unpaved roads; vehicle tailpipe emissions; and, agriculture.

- Monitoring data from the DEFF Emalahleni station (approximately 9 km east-northeast of the mine) for the period January to December 2018 was analysed. $SO_2$ and $NO_2$ ambient concentrations are within acceptable levels within the Emalahleni area, but ambient PM concentrations are elevated exceeding both the daily and annual NAAQS for $PM_{10}$ and $PM_{2.5}$.
- Time series plots of ambient $SO_2$, $NO_2$ and $PM_{10}$ concentrations show residential fuel burning contributions to $SO_2$ and $NO_2$ concentrations especially during the winter months, traffic contributions to $NO_2$ concentrations and more general industrial, mining and fuel burning contributions to PM.

### 5.1.2 Qualitative Impact Assessment

- **2017 AQIA Report Review:** The AQIA Report compiled for Elandsfontein Colliery by DWE in August 2017 was assessed to determine whether the methodology followed are defendable; and whether the modelled results are regarded representative of the operations. As far as could be ascertained, the study followed the correct methodology for an air quality impact assessment. An underestimation in the emissions from the crushers was noted but not enough information was provided to verify all the calculations. The meteorological data used in the model is acceptable, and the dispersion model used is in line with the regulations. The modelled results, even though very high, could be possible. Only unmitigated results were provided for $PM_{10}$ and $PM_{2.5}$, where a mitigated modelling scenario would have assisted in the understanding of the potential impacts from the mine with controls in place. The reduction in the dustfall rates between unmitigated and mitigated indicated a significant improvement due to mitigation measures.
- **Construction Phase:** Two areas will be affected namely: 1) the north of the opencast reserve of Block H where a new box-cut will be opened with cuts developed in a southerly direction, and 2) Resource Block D and E where a new decline will be developed to access the No.1 Seam. The existing infrastructure will be used to access the other underground Resource Blocks and the new opencast areas. Both the box-cut and decline shaft construction will result in impacts from vehicle tailpipe emissions but these impacts are likely to be localised. Depending on the type and extend of the construction activities, especially for opencast operations in the eastern part of the mine, exceedances of the $PM_{10}$ and $PM_{2.5}$ NAAQS may reach the western part of Clewer. Clearing of vegetation and topsoil and levelling of transportation route areas can result in significant levels of particulate matter if not mitigated. With level 1 watering rate (2 litres/m²/hr) a CE of 50% could be achieved (NPI, 2012). With mitigation in place, the construction phase would have a "Medium" significance.

- **Operational Phase:**
  - Opencast mining activities would have significantly higher air quality impacts than underground operations. This is primarily due to excavation, material handling and vehicle entrainment on roads (haulage of ROM coal, waste and topsoil). Clever is the main AQSR to be affected by the planned opencast operations.
  - Various controls could be applied to opencast mining, with control efficiencies (CE) ranging from 50% due to water suppression to 99% control by using fabric filters on drills. Controls on the haul roads could range between watering (50% CE) to 100% CE for sealed or salt-crusted roads. Mitigation measures on crushing and screening range between 30% for windbreaks to 100% by enclosing the crusher and screen (NPI, 2012).
  - The significance rating for the operational phase would be "High" even after mitigation measures are applied due to the increased mining and production rates and the close proximity of AQSR to the mining operations.
- **Closure Phase:** From an air quality perspective, the only sources of pollution would be vehicles as part of the rehabilitation process and windblown dust from exposed surfaces. These impacts would result in a significance rating of "Low".
- **Post closure Phase:** Depending on the level of rehabilitation and vegetation cover established on the exposed surfaces, the air quality impacts could be reduced to "Low" significance.
- For the significance mapping, the following criteria were used:
  - Construction – Medium (Post-mitigation).
  - Operational – High (Post-mitigation), mainly based on the previous AQIA (DWE, 2017).
  - Closure – Medium (Post-mitigation).
  - Post closure – Low (Post successful rehabilitation).

## 5.2 Conclusions and Recommendations

The conclusion from the qualitative impact assessment is that the planned mining operations would have a "High" significance on the surrounding environment and human health during the operational phase, even after mitigation is applied due to the increased mining and production rates and the close proximity of AQSR (Clever) to the planned mining operations.

In order to provide a quantitative evaluation of the proposed mining impacts, an AQIA is required for the planned opencast and underground operations at Elandsfontein Colliery as part of the EMPR amendment. Due to the uncertainty around the 2017 AQIA, the current baseline should be redone. As part of the AQIA, greenhouse gas (GHG) emissions will be quantified per legal requirements.

The scope of work will include the following tasks:

- The compilation of an emissions inventory including the identification and quantification of all emissions associated with the current and planned mining and processing operations. Pollutants quantified will include particulate matter (TSP, $PM_{10}$ and $PM_{2.5}$) and gaseous emissions ($SO_2$, $NO_2$ and CO). Use should be made of engineering design parameters, design emission standards, emissions factors published by the US EPA and Australian NPI.

- Dispersion modelling should be conducted using a regulatory approved dispersion model such as the US EPA AERMOD (Section 2.4).
- Impact assessment will be compiled by comparing ambient pollutant concentration levels to the relevant air quality standards to assess the potential impact on the surrounding environment (Section 2.2.3) and human health (Section 2.2.2).
- The identification of air quality management and mitigation measures based on the findings of the compliance and impact assessment.
- Since greenhouse gas (GHG) emissions reporting is a legal requirement in SA, a Tier 1 (if required Tier 2) greenhouse gas inventory will be compiled and a qualitative discussion on climate change impacts from the proposed mine included.

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## Appendix A – Specialist Curriculum Vitae

| CURRICULUM VITAE | HANLIE LIEBENBERG-ENSLIN |
|---|---|

# *FULL CURRICULUM VITAE*

| | |
|---|---|
| **Name of Firm** | Airshed Planning Professionals (Pty) Ltd |
| **Name of Staff** | Hanlie Liebenberg-Enslin |
| **Profession** | Managing Director / Air Quality Scientist |
| **Date of Birth** | 09 January 1971 |
| **Years with Firm/ entity** | 18 years |
| **Nationalities** | South African |

## MEMBERSHIP OF PROFESSIONAL SOCIETIES

- International Union of Air Pollution Prevention and Environmental Protection Associations (IUAPPA) – President 2010–2013, Board member 2013-present
- Member of the National Association for Clean Air (NACA) - President 2008-2010, NACA Council member 2010 –2014

## KEY QUALIFICATIONS

Hanlie Liebenberg-Enslin started her professional career in Air Quality Management in 2000 when she joined Environmental Management Services (EMS) after completing her Master's Degree at the University of Johannesburg (then Rand Afrikaans University) in the same field. She is one of the founding members of Airshed Planning Professionals in 2003 where she has worked as a company Director until May 2013 when she was appointed as Managing Director. She has extensive experience on the various components of air quality management including emissions quantification for a range of source types, simulations using a range of dispersion models, impacts assessment and health risk screening assessments. She has worked all over Africa and has an inclusive knowledge base of international legislation and requirements pertaining to air quality.

She has developed technical and specialist skills in various modelling packages including the industrial source complex models (ISCST3 and SCREEN3), EPA Regulatory Models (AERMOD and AERMET), UK Gaussian plume model (ADMS), EPA Regulatory puff-based model (CALPUFF and CALMET), puff-based HAWK model and line based models such as CALINE. Her experience with emission models includes Tanks 4.0 (for the quantification of tank emissions) and GasSim (for the quantification of landfill emissions).

Having worked on projects throughout Africa (i.e. South Africa, Mozambique, Botswana, Namibia, Malawi, Kenya, Mali, Democratic Republic of Congo, Tanzania, Madagascar, Guinea and Mauritania) Hanlie has developed a broad experience base. She has a good understanding of the laws and regulations associated with ambient air quality and emission limits in South Africa and various other African countries, as well as the World Bank Guidelines, European Community Limits and World Health Organisation.

Being an avid student, she received her PhD in 2014, specialising in Aeolian dust transport. Hanlie is also actively involved in the National Association for Clean Air and is their representative at the International Union of Air Pollution Prevention and Environmental Protection Associations.

## RELEVANT EXPERIENCE

### Air Quality Management Plans and Strategies

Vaal Triangle Airshed Priority Area AQMP Review (August 2017 to July 2019); Strategic Environmental Management Plan Air Quality Management Plan for the Erongo Region Update (May 2016 to February 2019); Provincial Air Quality Management Plan for the Limpopo Province (March 2013); Mauritius Road Development Agency Proposed Road Decongestion Programme (July 2013); Transport Air Quality Management Plan for the Gauteng Province (February 2012); Gauteng Green Strategy (2011); Air Quality and Radiation Assessment for the Erongo Region Namibia as part of a Strategic Environmental Assessment (June, 2010); Vaal Triangle Airshed Priority Area AQMP (March, 2009); Gauteng Provincial AQMP (January 2009); North West Province AQMP (2008); City of Tshwane AQMP (April 2006); North West Environment Outlook 2008 (December 2007); Ambient Monitoring Network for the North West Province (February 2007); Spatial Development Framework Review for the City of uMhlathuze (August 2006); Ambient Particulate Pollution Management System (Anglo Platinum Rustenburg):

Hanlie has also been the Project Director on all the listed Air Quality Management plan developments.

### Mining and Ore Handling

Hanlie has undertaken numerous air quality impact assessments and management plans for coal, platinum, uranium, copper, cobalt, chromium, fluorspar, bauxite and mineral sands mines. These include air quality impact assessments for: Trekkopje Uranium Mine near Swakopmund; Bannerman Uranium Project; Langer Heinrich Uranium Mine, Valencia Uranium Mine, Etango (Husab) Project, Rössing South Uranium Mine (Namibia); Sishen Iron Ore Mine (Kathu); Kolomela Iron Ore Mine (Postmasburg); Thabazimbi Iron ore Mine (Thabazimbi); UKM Manganese Mine (Hotazel); Everest Platinum Mine (Steelpoort); Murowa Diamond Mine (Zimbabwe); Jwaneng Diamond Mine (Botswana); Sadiola Gold Mine (Mali); North Mara Gold Mine (Tanzania); Tselentis Coal mine (Breyeton); Lime Quarries (De Hoek, Dwaalboom, Slurry); Beesting Colliery (Ogies); Anglo Coal Opencast Coal Mine (Heidelberg); Klippan Colliery (Belfast); Beesting Colliery (Ogies); Xstrata Coal Tweefontein Mine (Witbank); Xstrata Coal Spitskop Mine (Hendrina); Middelburg Colliery (Middelburg); Klipspruit Project (Ogies); Rustenburg Platinum Mine (Rustenburg); Impala Platinum (Rustenburg); Buffelsfontein Gold Mine (Stilfontein); Kroondal Platinum Mine (Kroondal); Lonmin Platinum Mine (Mooinooi); Rhovan Vanadium (Brits); Macauvlei Colliery (Vereeniging); Voorspoed Gold Mine (Kroonstad); Pilanesberg Platinum Mine (Pilanesberg); Kao Diamond Mine (Lesotho); Modder East Gold Mine (Brakpan); Modderfontein Mines (Brakpan); Bulyanhulu North Mara Gold Mine (Tanzania); Gold Mine (Tanzania); Zimbiwa Crusher Plant (Brakpan); RBM Zulti South Titanium mining (Richards Bay); Premier Diamond Mine (Cullinan).

### Metal Recovery

Air quality impact assessments have been carried out for Smelterco Operations (Kitwe, Zimbia); Waterval Smelter (Amplats, Rustenburg); Hernic Ferrochroime Smelter (Brits); Rhovan Ferrovanadium (Brits); Impala Platinum

(Rustenburg); Impala Platinum (Springs); Transvaal Ferrochrome (now IFM, Mooinooi), Lonmin Platinum (Mooinooi); Xstrata Ferrochrome Project Lion (Steelpoort); ArcelorMittal South Africa (Vandebijlpark, Vereeniging, Pretoria, Newcastle, Saldanha); Hexavalent Chrome Xstrata (Rustenburg); Portland Cement Plant (DeHoek, Slurry, Dwaalboom, Hercules, Port Eelizabeth); Vantech Plant (Steelpoort); Bulyanhulu Gold Smelter (Tanzania), Sadiola Gold Recovery Plant (Mali); RBM Smelter Complex (Richards Bay ); Chibuto Heavy Minerals Smelter (Mozambique); Moma Heavy Minerals Smelter (Mozambique); Boguchansky Aluminium Plant (Russia); Xstrata Chrome CMI Plant (Lydenburg); SCAW Metals (Germiston).

### Chemical Industry

Comprehensive air quality impact assessments have been completed for AECI (Pty) Ltd Operations (Modderfontein); Kynoch Fertilizer (Potchefstroom), Foskor (Richards Bay) and Omnia (Rustenburg).

### Petrochemical Industry

Numerous air quality impact assessments have been completed for SASOL operations (Sasolburg); Sapref Refinery (Durban); Health risk assessment of Island View Tank Farm (Durban Harbour).

### Pulp and Paper Industry

Air quality studies have been undertaken or the expansion of Mondi Richards Bay, Multi-Boiler Project for Mondi Merebank (Durban), impact assessments for Sappi Stanger, Sappi Enstra (Springs), Sappi Ngodwana (Nelspruit) and Pulp United (Richards Bay).

### Power Generation

Air quality impact assessments have been completed for numerous Eskom coal fired power station studies including the Coal 3 Power Project near Lephalale, Komati Power Station and Lethabo Power Stations. In addition to Eskom's coal fired power stations, projects have been completed for the proposed Mmamabula Energy Project (Botswana); Morupule Power Plant (Botswana); NamPower Van Eck Power Station; NamPower Erongo Power Project (Namibia).

Apart from Eskom projects, heavy fuel oil power station assessments have also been completed in Kenya (Rabai Power Station) and Namibia (Arandis Power Plant).

### Waste Disposal

Air quality impact assessments, including odour and carcinogenic and non-carcinogenic pollutants were undertaken for the proposed Coega Waste Disposal Facility (Port Elizabeth); Boitshepi Waste Disposal Site (Vanderbijlpak); Umdloti Waste Water Treatment Plant (Durban).

### Cement Manufacturing

Impact assessments for ambient air quality have been completed for the PPC Cement Alternative Fuels Project (which included the assessment of the cement manufacturing plants in the North West Province, Gauteng and Western). Air Impact Reporrs and Pollution Prevention Plans for Lafarge Cement in the North West Province.

### Vehicle emissions

Platinum Highway (N1 to Zeerust); Gauteng Development Zone (Johannesburg); Gauteng Department of Roads and Transport (Transport Air Quality Management Plan); Mauritius Road Development Agency (Proposed Road Decongestion Programme); South African Petroleum Industry Association (Impact Urban Air Quality).

### Government Strategy Projects

Hanlie was the project Director on the APPA Registration Certificate Review Project for Department of Environmental Affairs (DEA); Green Strategy for Gauteng (2011).

## EDUCATION

| | |
|---|---|
| **Ph.D Geography** | University of Johannesburg, RSA (2014)<br>Title: *A functional dependence analysis of wind erosion modelling system parameters to determine a practical approach for wind erosion assessments* |
| **M.Sc Geography and Environmental Management** | University of Johannesburg, RSA (1999)<br>Title: *Air Pollution Population Exposure Evaluation in the Vaal Triangle using GIS* |
| **B.Sc Hons. Geography** | University of Johannesburg, RSA (1995)<br>GIS & Environmental Management |
| **B.Sc Geography and Geology** | University of Johannesburg, RSA (1994)<br>Geography and Geology |

## ADDITIONAL COURSES AND ACADEMIC REVIEWS

| | |
|---|---|
| **External Examiner (January 2018)** | MSc Candidate: Ms B Wernecke<br>Ambient and Indoor Particulate Matter Concentrations on the Mpumalanga Highveld<br>Department of Geography and Environmental Management, North-West University |
| **External Examiner (January 2016)** | MSc Candidate: Ms M Grobler<br>Evaluating the costs and benefits associated with the reduction in $SO_2$ emissions from Industrial activities on the Highveld of South Africa<br>Department of Chemical Engineering, University of Pretoria |
| **External Examiner** | MSc Candidate: Ms Seneca Naidoo |

| | |
|---|---|
| **(August 2014)** | Quantification of emissions generated from domestic fuel burning activities from townships in Johannesburg<br>Faculty of Science, University of the Witwatersrand |
| **Air Quality Law – Lecturer (2012 -2016)** | Environmental Law course: Centre of Environmental Management. |
| **Air Quality law for Mining – Lecturer (2014)** | Environmental Law course: Centre of Environmental Management. |
| **Air Quality Management – Lecturer (2006 -2012)** | Air Quality Management Short Course: NACA and University of Johannesburg, University of Pretoria and University of the North West |
| **ESRI SA (1999)** | ARCINFO course at GIMS: Introduction to ARCINFO 7 course |
| **ESRI SA (1998)** | ARCVIEW course at GIMS: Advanced ARCVIEW 3.1 course |

## COUNTRIES OF WORK EXPERIENCE

South Africa, Mozambique, Botswana, Namibia, Malawi, Mauritius, Kenya, Mali, Zimbabwe, Democratic Republic of Congo, Tanzania, Zambia, Madagascar, Guinea, Russia, Mauritania and Saudi Arabia.

## EMPLOYMENT RECORD

### March 2003 - Present

**Airshed Planning Professionals (Pty) Ltd,** (previously known as Environmental Management Services cc until March 2003), Managing Director and Principal Air Quality Scientist, Midrand, South Africa.

### January 2000 – February 2003

**Environmental Management Services CC,** Senior Air Quality Scientist.

### May 1998 – December 1999

**Independent Broadcasting Authority (IBA),** GIS Analyst and Demographer.

### February 1997 – April 1998

**GIS Business Solutions (PQ Africa),** GIS Analyst

### January 1996 – December 1996

**Annegarn Environmental Research (AER),** Student Researcher

## LANGUAGES

| | Speak | Read | Write |
|---|---|---|---|
| **English** | Excellent | Excellent | Excellent |
| **Afrikaans** | Excellent | Excellent | Excellent |

## CONFERENCE AND WORKSHOP PRESENTATIONS AND PAPERS

- Understanding the Atmospheric Circulations that lead to high particulate matter concentrations on the west coast of Namibia. Hanlie Liebenberg-Enslin, Hannes Rauntenbach, Reneé von Gruenewaldt, and Lucian Burger. Clean Air Journal, 27, 2, 2017, 66-74.
- Cooperation on Air Pollution in Southern Africa: Issues and Opportunities. SLCPs: Regional Actions on Climate and Air Pollution. Liebenberg-Enslin, H. 17th IUAPPA World Clean Air Congress and 9th CAA Better Air Quality Conference. Clean Air for Cities - Perspectives and Solutions. 29 August - 2 September 2016, Busan Exhibition and Convention Center, Busan, South Korea.
- A Best Practice prescription for quantifying wind-blown dust emissions from Gold Mine Tailings Storage Facilities. Liebenberg-Enslin, H., Annegarn, H.J., and Burger, L.W. VIII International Conference on Aeolian Research, Lanzhou, China. 21-25 July 2014.
- Quantifying and modelling wind-blown dust emissions from gold mine tailings storage facilities. Liebenberg-Enslin, H. and Annegarn, H.J. 9th International Conference on Mine Closure, Sandton Convention Centre, 1-3 October 2014.
- Gauteng Transport Air Quality Management Plan. Liebenberg-Enslin, H., Krause,N., Burger, L.W., Fitton, J. and Modisamongwe, D. National Association for Clean Air Annual Conference, Rustenburg. 31 October to 2 November 2012. Peer reviewed.
- Developing an Air Quality Management Plan: Lessons from Limpopo. Bird, T.; Liebenberg-Enslin, H., von Gruenewaldt, R., Modisamongwe, D. National Association for Clean Air Annual Conference, Rustenburg. 31 October to 2 November 2012. Peer reviewed.
- Modelling of wind eroded dust transport in the Erongo Region, Namibia, H. Liebenberg-Enslin, N Krause and H.J. Annegarn. National Association for Clean Air (NACA) Conference, October 2010. Polokwane.
- The lack of inter-discipline integration into the EIA process-defining environmental specialist synergies. H. Liebenberg-Enslin and LW Burger. IAIA SA Annual Conference, 21-25 August 2010. Workshop Presentation. Not Peer Reviewed.
- A Critical Evaluation of Air Quality Management in South Africa, H Liebenberg-Enslin. National Association for Clean Air (NACA) IUAPPA Conference, 1-3 October 2008. Nelspuit.

- Vaal Triangle Priority Area Air Quality Management Plan – Baseline Characterisation, R.G. Thomas, H Liebenberg-Enslin, N Walton and M van Nierop. National Association for Clean Air (NACA) conference, October 2007, Vanderbijl Park.
- Air Quality Management plan as a tool to inform spatial development frameworks – City of uMhlathuze, Richards Bay, H Liebenberg-Enslin and T Jordan. National Association for Clean Air (NACA) conference, 29 – 30 September 2005, Cape Town.

## CERTIFICATION

I, the undersigned, certify that to the best of my knowledge and belief, these data correctly describe me, my qualifications, and my experience.

26/04/2019

Full name of staff member: Hanlie Liebenberg-Enslin

## Appendix B – Time Series Plots for the Measured Ambient Air Quality in the Study Area

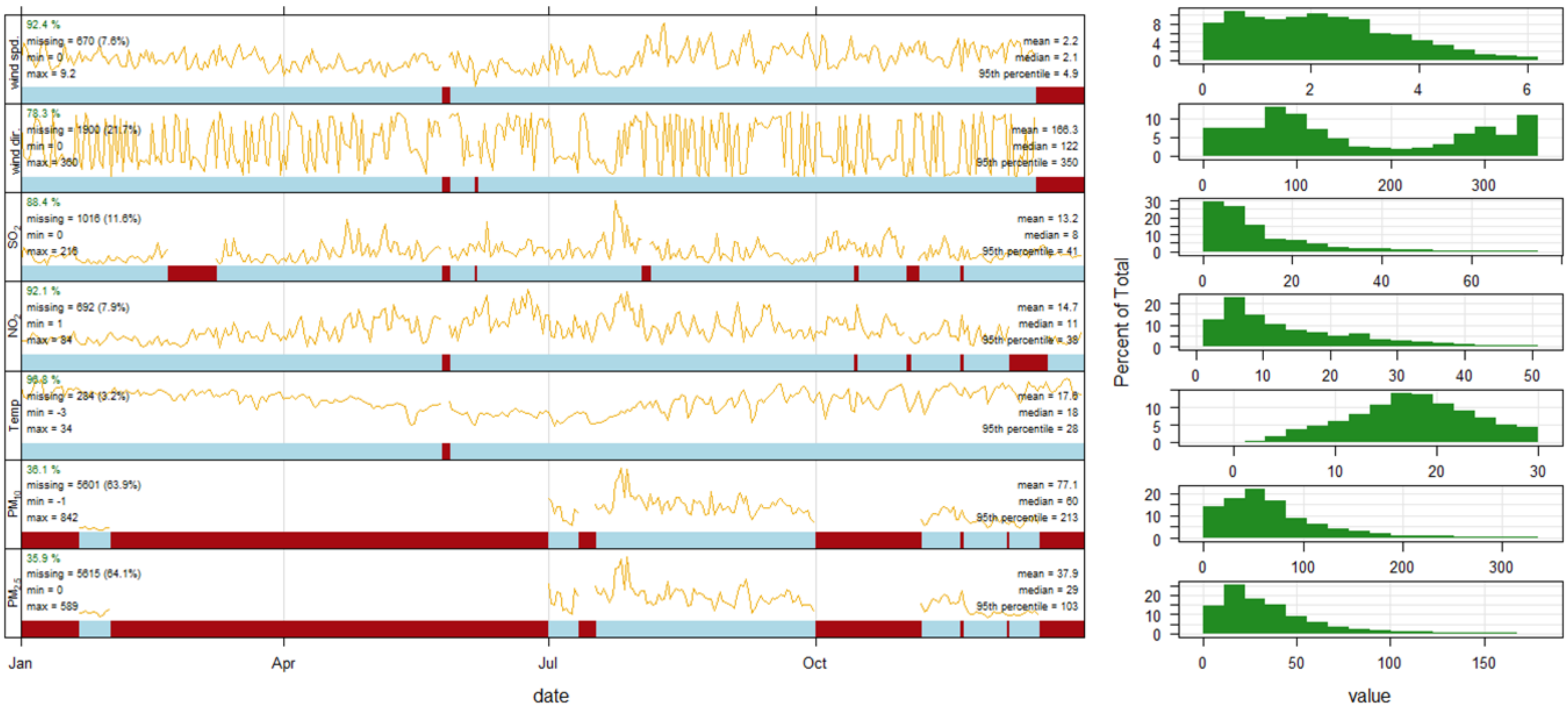


*Figure 14: Data available from the DEFF Emalahleni ambient air quality monitoring station (2018)*

# Appendix c – Field Log Sheets

YANKALABS

sanas South African National Accreditation System

T0647

Geo Soil and Water CC
Tel: 082 648 4765
Fax: 086 654 3631
E-mail: louis@geosoilwater.co.za
Web: www.geosoilwater.co.za
VAT No 4420244586
Postnet Suite C319 Private Bag X18 Lynnwood Ridge 0040
15A Midas Ave, Olympys, Pretoria

| | |
|---|---|
| Project | Elandsfontein Colliery |
| Monitoring Month | Oct-19 |
| Monitoring Occasion | Monthly Dust Fallout Monitoring |
| Date of Sampling | 02/10/2019 to 03/10/2019 |

Analyses Required: Dust Fallout

| | Locality ID | Time / Date | Sampled | Date on | Date off | Days | Comment/Observations |
|---|---|---|---|---|---|---|---|
| ✓ | EFD North | 15:25 | Yes | 02-Sep-19 | 02-Oct-19 | 30 | Dust – Dry |
| X | EFD East | 09:30 | No | 02-Sep-19 | 02-Oct-19 | ~~30~~ | ~~Monitored by WSP~~ On 2/10/19 |
| ✓ | EFD Clewer | 10:00 | Yes | 02-Sep-19 | 02-Oct-19 | 30 | Coal dust – Wet. |
| ✓ | EFD South | 12:40 | Yes | 02-Sep-19 | 02-Oct-19 | 30 | Dust – Wet |
| ✓ | EFD South West | 13:10 | Yes | 02-Sep-19 | 02-Oct-19 | 30 | Dust – Dry |
| ✓ | EFD West | 13:50 | Yes | 02-Sep-19 | 02-Oct-19 | 30 | Dust – Dry |
| X | EFD MD North | 12:06 | NO | 02-Sep-19 | 02-Oct-19 | 30 | Stand + buckets stolen. |
| X | EFD MD East | | | 02-Sep-19 | 02-Oct-19 | 30 | |
| X | EFD MD South | | | 02-Sep-19 | 02-Oct-19 | 30 | |
| X | EFD MD West | | | 02-Sep-19 | 02-Oct-19 | 30 | |

Sent by: L Maia [signature]

Received by: YANKA LABS

Date: 2019/10/08

YANKALABS

SANAS South African National Accreditation System

T0647

Geo Soil and Water CC
Tel: 082 648 4765
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Postnet Suite C319 Private Bag X18 Lynnwood Ridge 0040
15A Midas Ave, Olympys, Pretoria

| | |
|---|---|
| Project | Elandsfontein Colliery |
| Monitoring Month | Nov-19 |
| Monitoring Occasion | Monthly Dust Fallout Monitoring |
| Date of Sampling | 04/11/2019 to 04/11/2019 |

Analyses Required: Dust Fallout

| Locality ID | Time / Date | Sampled | Date on | Date off | Days | Comment/Observations |
|---|---|---|---|---|---|---|
| ✓ EFD North | 13:55 | Yes | 02-Oct-19 | 04-Nov-19 | 33 | Clear - Water |
| ✓ EFD East | 14:25 | Yes | 02-Oct-19 | 04-Nov-19 | 33 | Clear - Water |
| ✓ EFD Clewer | 14:05 | Yes | 02-Oct-19 | 04-Nov-19 | 33 | Clear - Water. |
| ✓ EFD South | 12:05 | Yes | 02-Oct-19 | 04-Nov-19 | 33 | Clear - Water |
| ✓ EFD South West | 12:30 | Yes | 02-Oct-19 | 04-Nov-19 | 33 | Clear - Water |
| ✓ EFD West | 13:05 | Yes | 02-Oct-19 | 04-Nov-19 | 33 | Clear - West. |
| ✓ EFD South East | 11:00 | No | 04-Nov-19 | - | - | On 4/11/19 |

Sent by: L Marais

Received by: Elize Smit

Date: 8/11/19