ESG | RISK | STRATEGY | COMMUNICATIONS | IMPACT

# Proposed Gruisfontein Coal Mine, Limpopo

# Air Quality Impact Assessment

PREPARED FOR:

Jacana Environmentals CC

DATE: 15 August 2019

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Proposed Gruisfontein Coal Mine: Air Quality Impact Report

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# Declaration of Interest

I, Stuart Thompson declare that: -

General Declaration:

- I act as the independent specialist in this application;
- I will perform work relating to the application in a manner, even if it results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have experience in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing – any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan, or document to be prepared by myself for submission to the competent authority; all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of Section 24F of the National Environmental Management Act.

**Signature of Specialist**

EBS Advisory Services (Pty) Ltd.

**Name of company (if applicable)**

1 August 2019

**Date**

## Summary of Requirements

In terms of the NEMA 2014 EIA Regulations contained in GN R982 of 04 December 2014 (as amended in 2017) all specialist studies must comply with Appendix 6 of the NEMA 2014 EIA Regulations (GN R982 of 04 December 2014). Table 1 shows the requirements as indicated above.

Table 1: Legal Requirements for All Specialist Studies Conducted

| Legal Requirement | | Relevant Section in Specialist study |
|---|---|---|
| (1) | A specialist report prepared in terms of these Regulations must contain- | |
| (a) | details of- | |
| | (i) the specialist who prepared the report; and | **Appendix B.** |
| | (ii) the expertise of that specialist to compile a specialist report including a curriculum vitae | **Appendix B.** |
| (b) | a declaration that the specialist is independent in a form as may be specified by the competent authority; | **Page 7.** |
| (c) | an indication of the scope of, and the purpose for which, the report was prepared; | **Section 1.** |
| (cA) | an indication of the quality and age of base data used for the specialist report; | **Section 3.** |
| (cB) | a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change; | **Section 4.C** |
| (d) | the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment; | **Section 3.E** |
| (e) | a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used; | **Section 4.** |
| (f) | details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives; | **Section 4.C** |
| (g) | an identification of any areas to be avoided, including buffers; | **Section 4.C** |
| (h) | 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 4.C**<br>**Appendix A** |
| (i) | a description of any assumptions made and any uncertainties or gaps in knowledge; | **Section 2.H** |
| (j) | a description of the findings and potential implications of such findings on the impact of the proposed activity or activities; | **Sction 4.D** |
| (k) | any mitigation measures for inclusion in the EMPr; | **Section 4.E** |
| (l) | any conditions for inclusion in the environmental authorisation; | **Section 4.E** |
| (m) | any monitoring requirements for inclusion in the EMPr or environmental authorisation; | **Section 6.** |
| (n) | a reasoned opinion | **Section 4.D** |
| | whether the proposed activity, activities or portions thereof should be authorised; | **Section 4.D** |

| Legal Requirement | | Relevant Section in Specialist study |
|---|---|---|
| | regarding the acceptability of the proposed activity or activities; and | **Section 4.D** |
| | if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan; | **Section 4.D** |
| (o) | a description of any consultation process that was undertaken during the course of preparing the specialist report; | **Not Applicable** |
| (p) | a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and | **Not Applicable** |
| (q) | any other information requested by the competent authority. | **Not Applicable** |

# 1. Introduction

The Gruisfontein Mining Project is proposed to undertake opencast coal mining on the farm Gruisfontein 230LQ, approximately 70km north west of Lephalale, Limpopo. (Figure 2). The proposed project will have a Life of Mine (LOM) of approximately 16 years, however closure and backfilling is only expected after the completion of the LOM. The final product will be transported via truck to the nearby Medupi Power Station. EBS Advisory Services have been appointed to undertake the Air Quality Specialist Study. The study will focus on determining the extent of the mines impact on the air in the region, this will be done through ambient baseline monitoring prior to mining operations, the development of an emissions inventory, and the dispersion the pollutants will follow with typical weather conditions at the region.

As part of the impact assessment for the proposed project, a baseline assessment was undertaken which includes a review of available meteorological data to evaluate the prevailing meteorological conditions in the area. The baseline air quality situation was assessed through a review of available monitored data which was obtained from the South African Weather Services, and ambient onsite monitoring. During the impact assessment phase, the potential impact of emissions from the proposed project on the surrounding environment was evaluated through the compilation of an emissions inventory and subsequent dispersion modelling simulations using the AERMOD dispersion model.

*Figure 1: Main Gruisfontein Farm Access Gate*

## a. Enterprise Details

| | |
|---|---|
| Enterprise Name | Nozala Coal (Pty) Ltd |
| Trading As | |
| Type of Enterprise, e.g. Company/Close Corporation/Trust, etc | Private Company |
| Company/Close Corporation/Trust Registration Number (Registration Numbers if Joint Venture) | |
| Registered Address | |
| Postal Address | |
| Telephone Number (General) | |
| Fax Number (General) | |
| Industry Type/Nature of Trade | Coal Mining Operations |
| Land Use Zoning as per Town Planning Scheme | Agricultural |
| Land Use Rights if outside Town Planning Scheme | Agricultural |
| Responsible Person Name or Emission Control Officer (where appointed) | |
| Telephone Number | |
| Cell Phone Number | |
| Fax Number | |
| E-mail Address | |
| After Hours Contact Details | |

## b. Location and Extent of the Plant

The Gruisfontein Mine Area is located of farm Gruisfontein 230 LQ in the Lephalale Local Municipality, within the Waterberg District of the Province. Lephalale is approximately 50 km south east of the Mining Right Application (MRA) area. The Gruisfontein Project is located strategically close to Matimba and Medupi Power Stations.

*Table 2: Location and extent of the plant.*

| | |
|---|---|
| Physical Address of the Plant | Gruisfontein 230IQ |
| Description of Site (Where No Street Address) | Farm Gruisfontein 230IQ near Steenbokpan, Lephalale Municipality |
| Coordinates of Approximate Centre of Operations | UTM reference – Grid Zone: 35K<br>North-south: 7393270.59 m S<br>East-west: 528294.87 m E |

| | |
|---|---|
| Extent (km²) | 11.3 |
| Elevation Above Mean Sea Level (m) | 859 |
| Province | Limpopo |
| Metropolitan/District Municipality | Waterberg District |
| Local Municipality | Lephalale Local Municipality |
| Designated Priority Area | Waterberg Priority Area |
| Emission Control Officer | |
| Telephone Number | |
| Cell Phone Number | |
| Fax Number | |
| E-mail Address | |
| Full Qualifications | |

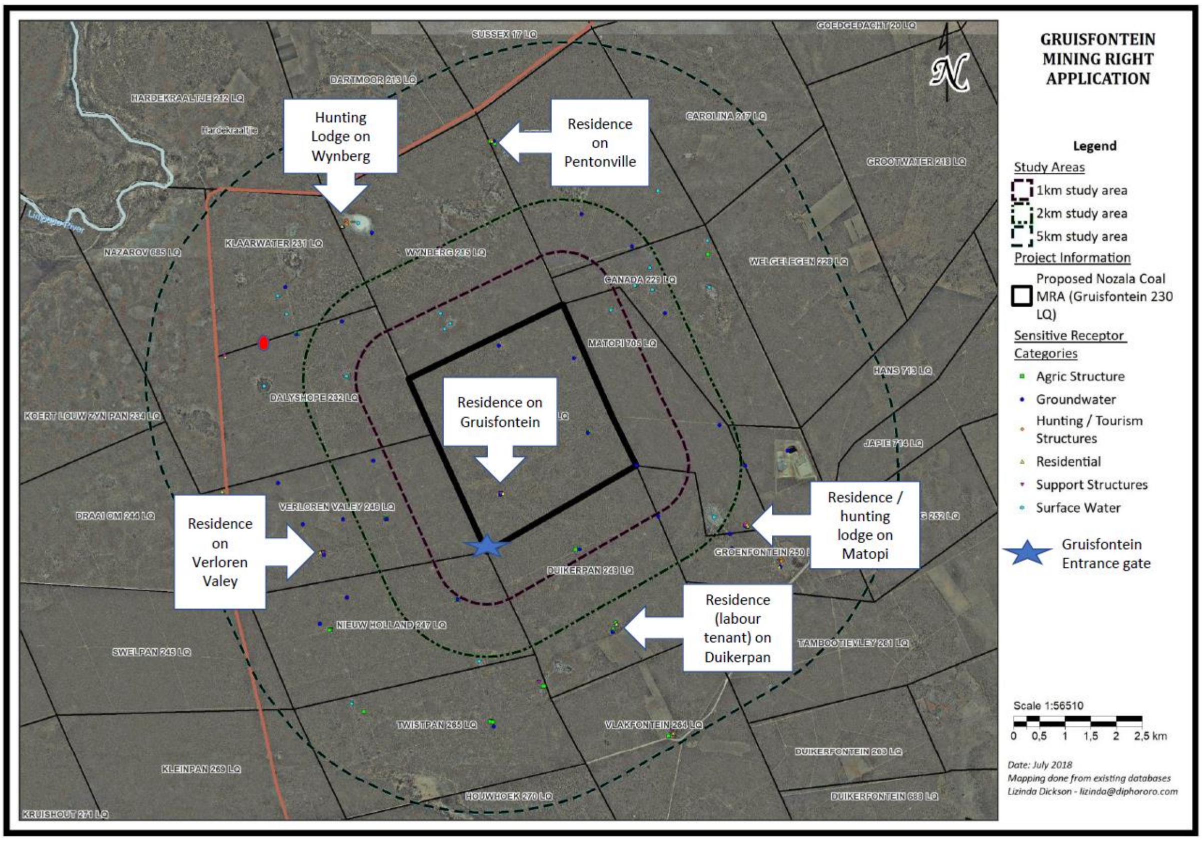


Figure 2: Gruisfontein Project Locality Map

## c. Nature of the Process

The general mineral category to be mined Thermal Coal. Table 3 details the key economic minerals within this category which are expected to be found in the MR area.

*Table 3: Mineral to be Mined*

| Type of Mineral expected to be found in Area |
|---|
| Thermal Coal |

## d. Authorisation Details

No Atmospheric Emission Licence has been applied for. It is not expected that an Atmospheric Emission Licence will be required for the operation of the mine or washing plant.

# 2. Process Details and Mass Balance

## a. Summary

*Table 4: summary of the process details*

| Process | Process Function | Input | Output | Emissions |
|---|---|---|---|---|
| Mining | Supply of raw material | | Thermal Coal | Dust (TSP, $PM_{10}$, $PM_{2.5}$) |
| Crushing and Screening | Crush raw material into manageable material for processing | Thermal Coal | Fine and Course material | Dust (TSP, $PM_{10}$, $PM_{2.5}$) |

## b. Process Description

Coal is planned to be mined by means of conventional opencast methods from a depth of approximately 30m to 100 meters below surface (mbs). The estimated life of mine (LOM) for the proposed Gruisfontein Project is 15 years.

The proposed project includes the following mining and related infrastructure:

- Opencast pit;
- Processing plant (i.e. crushing, wash plant, screening, etc.);
- Product stockpiles;
- Administration office facilities (i.e. security building, administration and staff offices, reception area, ablution facilities, etc.);
- Production facilities (i.e. locker rooms, laboratory, workshops, stores, explosives magazine, ablution facilities, etc.);
- Access roads; and
- Clean and dirty water management infrastructure.

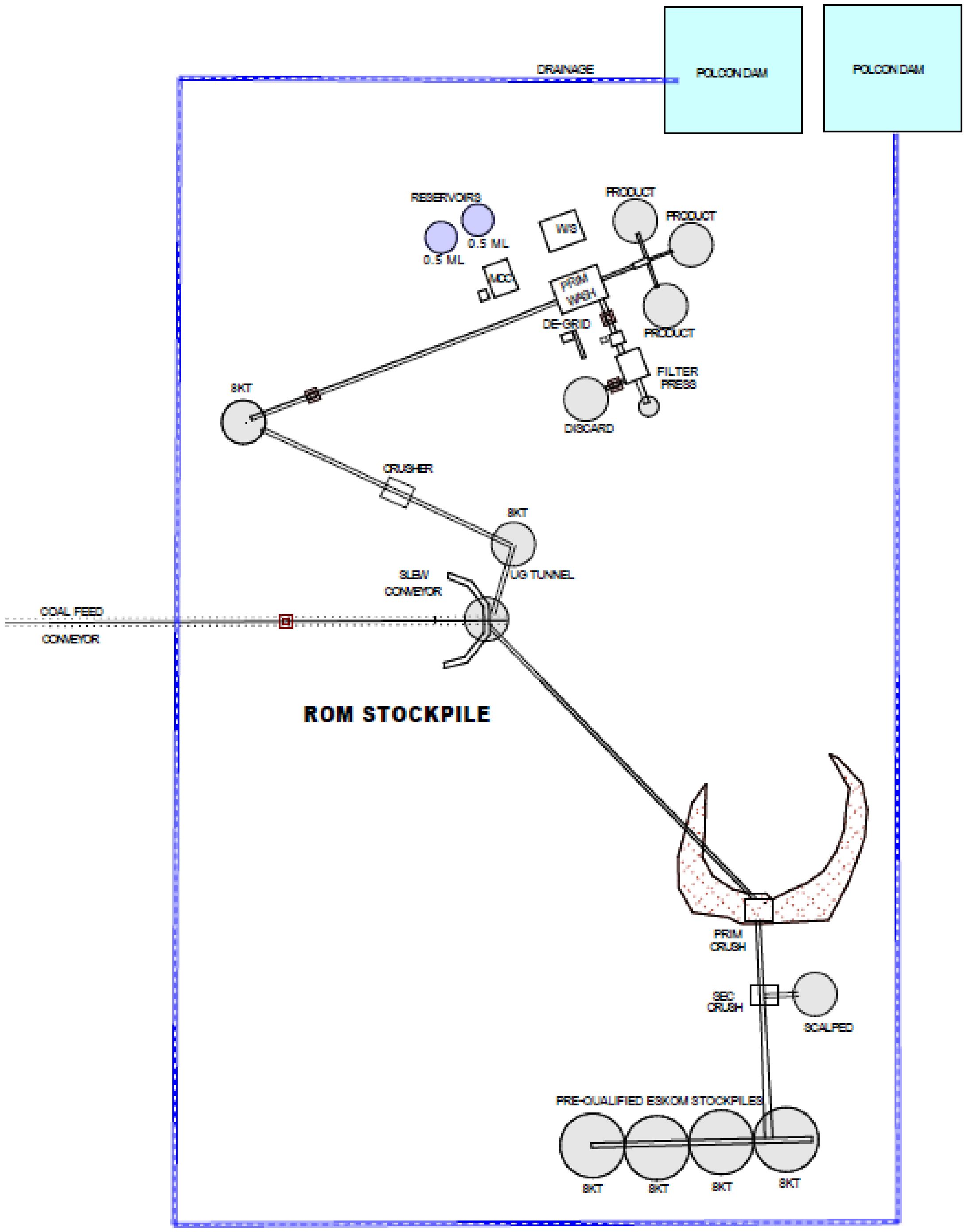


*Figure 3: Gruisfontein Project Layout*

## c. Resource Particulars

### *Type of Mineral*

The borehole analytical results and the associated geological report correlates with the historic geological model. Inclusive of the additional borehole results, the total in-situ resource is estimated to be 11.775 million tonnes (Mt).

*Table 4: Resources expected for the project*

| COAL CUT | VOLUME | GTIS | PRODUCT RD | RAW RD | YIELD | INHERENT MOISTURE | ASH | VOLATILES | FIXED CARBON | SULPHUR | CV |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 13 520 620 | 28 190 303 | 2.08 | 1.79 | 74.21 | 3.02 | 34.55 | 27.47 | 34.97 | 1.36 | 19 |
| 2 | 11 627 240 | 24 594 851 | 2.12 | 1.84 | 71.79 | 2.80 | 35.03 | 27.82 | 34.35 | 1.61 | 19 |
| 3 | 12 023 362 | 24 760 702 | 2.06 | 1.82 | 60.52 | 2.80 | 34.39 | 27.27 | 35.54 | 0.97 | 19 |
| 4 | 10 819 072 | 22 390 885 | 2.07 | 1.87 | 52.07 | 2.83 | 33.62 | 28.40 | 35.15 | 0.93 | 19 |
| 5 | 9 989 643 | 20 197 048 | 2.02 | 1.85 | 49.52 | 2.86 | 32.96 | 26.12 | 38.05 | 0.78 | 19 |
| 6 | 6 542 254 | 12 500 194 | 1.91 | 1.82 | 61.12 | 2.78 | 32.31 | 24.15 | 40.77 | 0.90 | 19 |
| SOB | 7 628 979 | - | - | - | - | - | - | - | - | - | - |
| HOB | 47 475 813 | - | - | - | - | - | - | - | - | - | - |
| **Total** | **119 626 984** | **132 633 984** | | | | | | | | | |

### *Products and Markets*

The main reason for this particular MRA is for the supply of thermal coal to the Medupi and Matimba Power Stations.

## d. Open Pit Mining

This section of the report describes all the surface support services associated with the operation and maintenance of the mine and coal processing facilities. The type and magnitude of enabling infrastructure proposed for the Gruisfontein project is based on similar projects proposed for development in the area.

The following strategy has been adopted in the layout of the surface infrastructure:

- Focus has been placed on the flow of coal from the top of the open-pit ramp through to the product stockpiles, including the coal processing plant
- For environmental reasons, the temporary (three year) discard dump will be located to the West of this infrastructure.
- All other supporting infrastructure related to the mining and coal processing plant operations will be located to the east of the coal processing infrastructure
- The mine will adopt contractor coal processing and mining operations with the mine providing the contractors with supporting infrastructure such as offices, change-house, stores, workshops etc.
- Temporary soft overburden, hard overburden, carbonaceous waste material and discard dumps will be located on the eastern portion of the farm. The strategy regarding the stockpile of waste material and open-pit backfilling will be covered in the next section of this report.

## e. Description of the Processing Plant

The Coal Handling and Processing Plant (CHPP) system has been designed to accommodate a ROM feed of 6.0 Mtpa at a practical product yield of 50% resulting in 3.0 Mtpa of Eskom product at an air-dried quality of 19.0 MJ/kg. The plant operating hours of 570 hours per month is based on a three-shift system, seven days a week and fifty week per annum with two weeks catering for public holidays.

The plant design feed rate is 1000 tonnes per hour based on an average throughput of 877 tonnes per hour.

## f. Mine Closure and Post Closure

As per the official guideline document published in January 2005 by the Department of Minerals Resources (DMR), Financial provision for environmental rehabilitation and closure requirements of mining operations forms an integral part of the Mineral and Petroleum Resources Development Act (MPRDA), as was the case with the now repealed Minerals Act, 1991 (Act 50 of 1991). The MPRDA, (Act No. 28 of 2002) and its Regulations was promulgated on 1 May 2004.

The aim to rehabilitation is to restore the site to a satisfactory condition by:

- Eliminating unacceptable health hazards and ensuring public safety;
- Limiting the production and circulation of substances that could damage the receiving environment and, in long-term, trying to eliminate maintenance and monitoring;
- Restoring the site to a condition in which it is visually acceptable to the community;
- Reclaiming the areas where infrastructures are located (excluding the accumulation areas) for future use.

It is assumed that following components will fall under the closure plan:

- Steel buildings and structures;
- Reinforced concrete buildings and structures;
- Access roads;
- Housing and facilities;
- Sealing of any adits;
- Overburden and spoils;
- Processing waste deposits and evaporation ponds (both acidic and basic);
- Subsided area if underground mining was completed;
- General surface rehabilitation;
- Water stream channel diversions;
- Fencing;
- Water management; and
- On-going maintenance

## g. Terms of Reference

The terms of reference for the Air Quality Impact Assessment for the proposed project can briefly be summarised as follows:

*Baseline Assessment*

- Provide an overview of the prevailing meteorological conditions in the area;
- Review applicable legislation and policies related to air quality management which are applicable to the proposed operations;
- Review potential health effects associated with emissions released from the proposed operations;
- Identification of existing sources of emission and surrounding sensitive receptors, such as local communities, surrounding the mine; and
- Assess the baseline air quality using available ambient air quality monitored data;

*Impact Assessment*

- Compilation of an emissions inventory for the proposed air quality related sources identified on site;
- Dispersion modelling simulations undertaken using AERMOD to determine the potential air quality impacts of the proposed activities on the surrounding area;
- Comparison of the modelled results to the National ambient air quality standards to determine compliance; and
- Compilation of an Air Quality Impact Assessment Report.

## h. Methodology

An overview of the methodological approach to be followed during this Air Quality Baseline and Impact Assessment is outlined in the section which follows.

*Baseline Assessment*

During the baseline assessment, a qualitative approach was used to assess the baseline conditions in the project area. Meteorological Data was obtained from the South African Weather Services' Lephalale Station (06743418). The data is from 2014 to 2017 to determine the atmospheric dispersion potential of the area.

*Impact Assessment*

During this phase, an emissions inventory was compiled to estimate emissions from the identified emission sources associated with the proposed activities. Where information is not available, use will be made of available United States Environmental Protection Agency (USEPA) emission factors or emission models to estimate emission releases. Dispersion modelling simulations were undertaken using the AERMOD dispersion model and presented graphically as isopleths plots. Comparison with the National ambient air quality standards were made to determine compliance. Based on the predicted results, recommendations for appropriate mitigation measures and/or ambient air quality monitoring programme was provided.

## i. Study Limitations

Prior to the outline of the proposed impacts in the area, the following issues need to be highlighted, which are considered limitations to undertaking the terms of reference detailed above.

- As no long term on-site meteorological data was available during the current investigation, it was decided to make use of measured data from the South African Weather Services Lephalale Meteorological Station to describe the micro meteorological aspects of the area.
- All information provided in regards to mining rates, infrastructure layouts and mining methodology is assumed to be correct.

## j. Report Structure

**Section 1** of the report provides background of the project. **Section 2** focuses on the process summaries and various operations involved in the project. Section 3 includes a meteorological overview of the region as well as a review of the applicable air quality legislation, pollutants and their potential health effects. The emissions inventory and impact assessment are presented in **Section 4**. **Section 5** gives a summary of the general conclusions and recommendations presented in the report. The references and glossary are provided in **section 6** and **section 7** respectively.

# 3. Baseline Description of the Area

## a. Meso-Scale Meteorology

The nature of the local climate will determine what will happen to particulates when released into the atmosphere (Tyson & Preston-Whyte, 2000). Concentration levels fluctuate daily and hourly, in response to changes in atmospheric stability and variations in mixing depth. Similarly, atmospheric circulation patterns will have an effect on the rate of transport and dispersion.

The release of atmospheric pollutants into a large volume of air results in the dilution of those pollutants. This is best achieved during conditions of free convection and when the mixing layer is deep (unstable atmospheric conditions). These conditions occur most frequently in summer during the daytime. This dilution effect can however be inhibited under stable atmospheric conditions in the boundary layer (shallow mixing layer). Most surface pollution is thus trapped under a surface inversion (Tyson & Preston-Whyte, 2000).

Inversion occurs under conditions of stability when a layer of warm air lies directly above a layer of cool air. This layer prevents a pollutant from diffusing freely upward, resulting in an increased pollutant concentration at or close to the earth's surface. Surface inversions develop under conditions of clear, calm and dry conditions and often occur at night and during winter (Tyson & Preston-Whyte, 2000). Radiative loss during the night results in the development of a cold layer of air close to the earth's surface. These surface inversions are however, usually destroyed as soon as the sun rises and warm the earth's surface. With the absence of surface inversions, the pollutants are able to diffuse freely upward; this upward motion may however be prevented by the presence of an elevated inversion (Tyson & Preston-Whyte, 2000).

Elevated inversions occur commonly in high pressure areas. Sinking air warms adiabatically to temperatures in excess of those in the mixed boundary layer. The interface between the upper, gently subsiding air is marked by an absolutely stable layer or an elevated subsidence inversion. This type of elevated inversion is most common over Southern Africa (Tyson & Preston-Whyte, 2000).

The study area is situated in a semi-arid rainfall region that is characterized by cool, dry winters (May to August) and warm, wet summers (October to March), with April and September being transition months.

### 2.1.1. Temperature

The long-term average monthly temperatures are depicted in Figure 4. Daily summer temperatures range between 23 °C and 32 °C. Winter temperatures range between 7 °C and 20 °C.

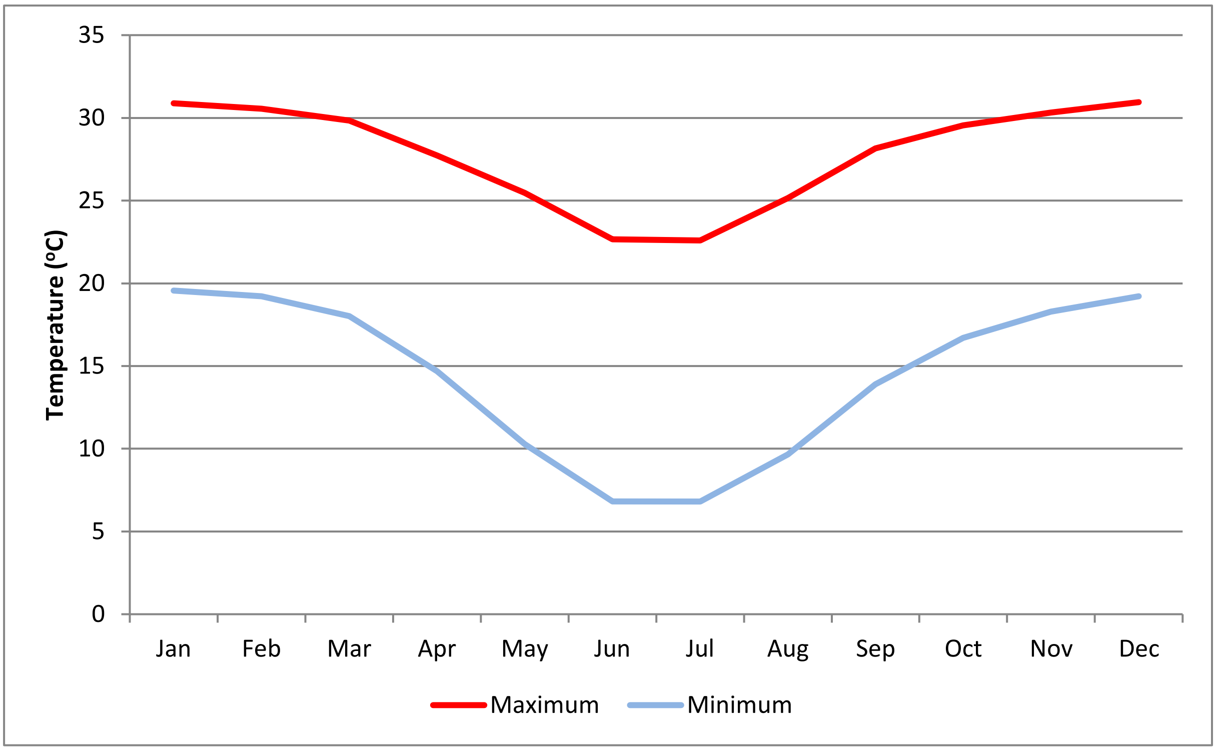


*Figure 4: Average monthly minimum and maximum temperatures for Lephalale for the period 1979 to 2017.*

### 2.1.2. Winds

Looking at Figure 5 and Figure 6 respectively, it can be seen that the Lephalale area is not an area of high wind speeds. On average, 29.74% of the time, calm conditions existed over the area. The highest frequency of wind speed lies between 0.5 to 2.1 m/s which occurred for 45.2% of the time. The second highest wind class (2.1 – 3.6 m/s) occurs 17.5% of the time. Figure 5 shows the prevailing winds blowing from a north easterly direction

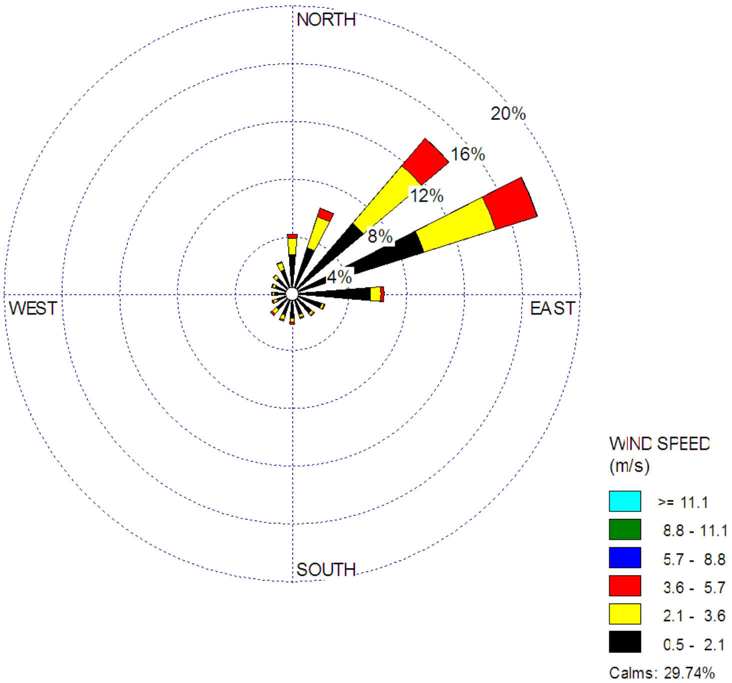


*Figure 5: Period wind rose for Lephalale for the period 2014 to 2017*

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

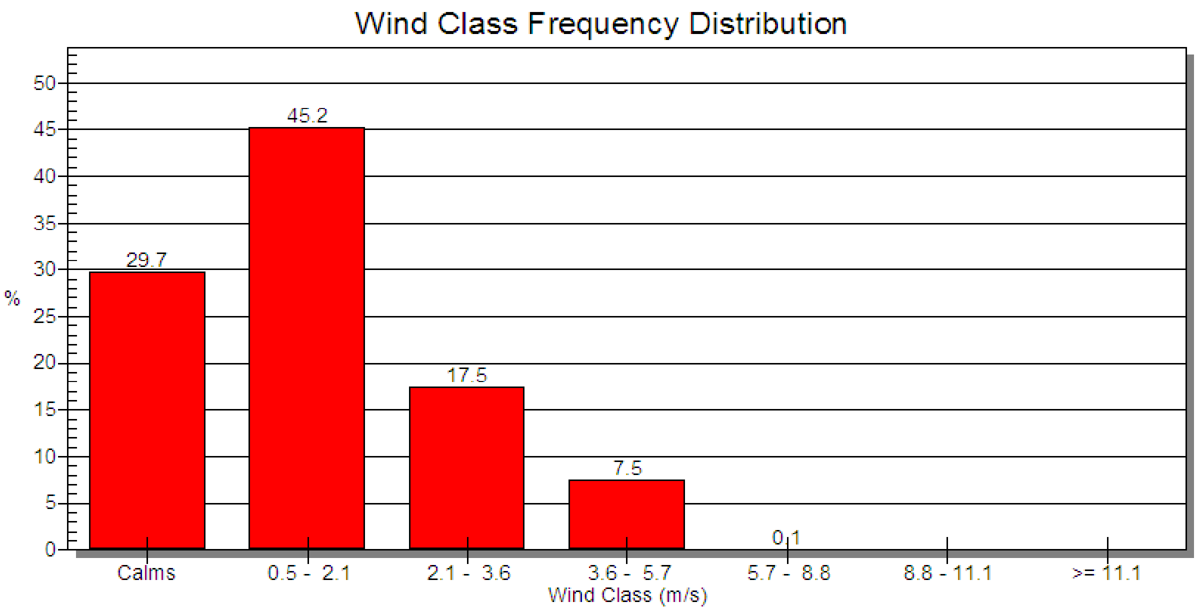


*Figure 6: Wind class frequency distribution for Lephalale for the period 2014 to 2017*

### 2.1.3. Atmospheric Stability

Atmospheric stability is commonly categorised into six stability classes. These are briefly described in Table 5. The atmospheric boundary layer is usually unstable during the day due to turbulence caused by the sun's heating effect on the earth's surface. The depth of this mixing layer depends mainly on the amount of solar radiation, increasing in size gradually from sunrise to reach a maximum at about 5-6 hours after sunrise. The degree of thermal turbulence is increased on clear warm days with light winds. During the night-time a stable layer, with limited vertical mixing, exists. During windy and/or cloudy conditions, the atmosphere is normally neutral. Figure 7 indicates that calm very stable conditions occur 29.1% of the time, which is conducive to the formation of inversion layers and a concentration of pollutants within the valleys surrounding the site.

*Table 5: Atmospheric stability classes*

| A | Very unstable | calm wind, clear skies, hot daytime conditions |
|---|---|---|
| **B** | Moderately unstable | clear skies, daytime conditions |
| **C** | Unstable | moderate wind, slightly overcast daytime conditions |
| **D** | Neutral | high winds or cloudy days and nights |
| **E** | Stable | moderate wind, slightly overcast night-time conditions |
| **F** | Very stable | low winds, clear skies, cold night-time conditions |

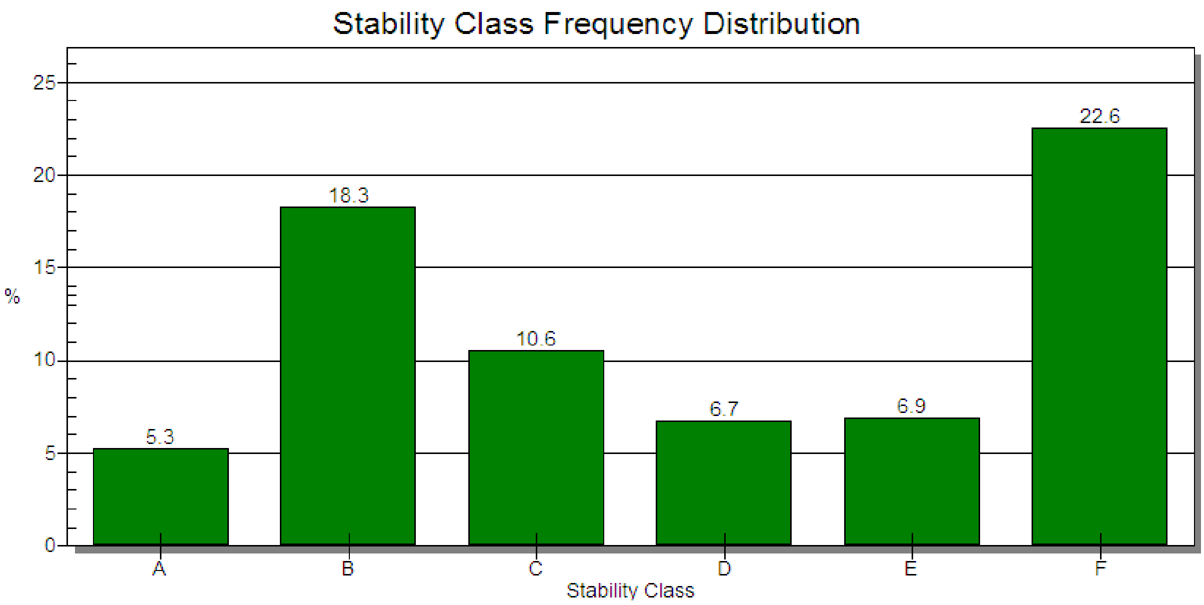


*Figure 7: Showing class stability frequency disbribution*

### 2.1.4. Precipitation

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

Based on the climate record and the rainfall patterns for Lephalale, this shows it lays in a marked summer rainfall region. Temperature affects the formation, action, and interactions of pollutants in various ways (Kupchella & Hyland, 1993). Chemical reaction rates tend to increase with temperature and the warmer the air, the more water it can hold and hence the higher the humidity.

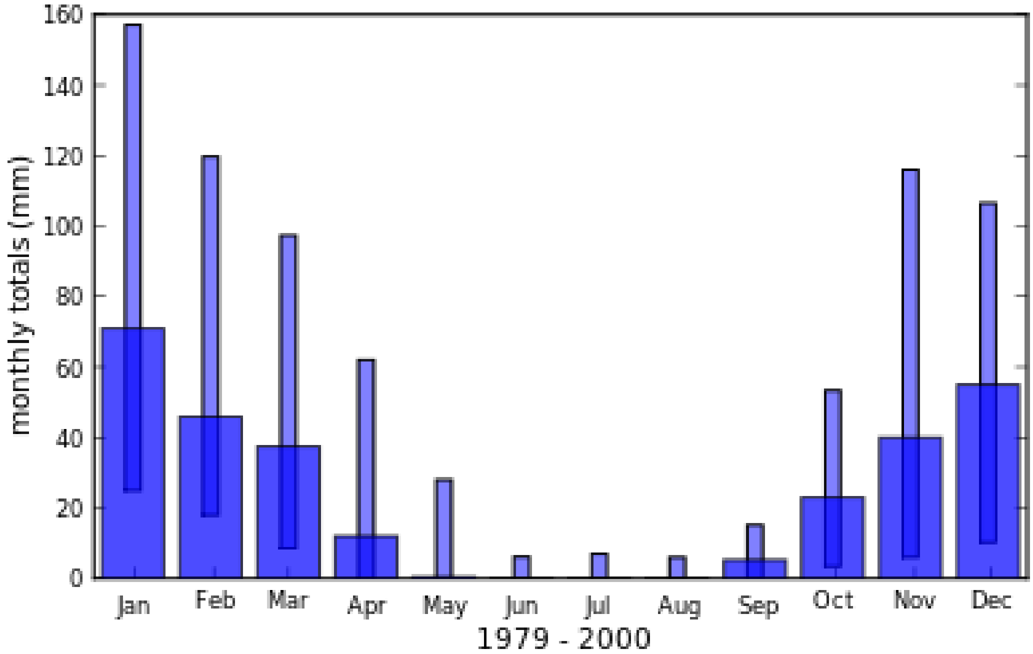


*Figure 8: Observed monthly rainfall totals climatology (wide bars) with 10th to 90th percentile inter-annual range (narrow bars)*

# 4. Applicable Air Quality Legislation

This Chapter is intended to identify all policies, legislation, regulations plans, guidelines, etc. which impact on the proposed planning, development and operation of the proposed project. The key pieces of legislation that have a direct bearing on the successful implementation of the proposed development are highlighted below.

## i. Particulate Matter with an aerodynamic diameter of less than 10microns ($PM_{10}$)

Particulate matter (PM) has been linked to a range of serious respiratory and cardiovascular health problems. The key effects associated with exposure to ambient particulate matter include: premature mortality, aggravation of respiratory and cardiovascular disease, aggravated asthma, acute respiratory symptoms, chronic bronchitis, decreased lung function, and increased risk of myocardial infarction (USEPA, 1996).

PM represents a broad class of chemically and physically diverse substances. Particles can be described by size, formation mechanism, origin, chemical composition, atmospheric behaviour and method of measurement. The concentration of particles in the air varies across space and time and is related to the source of the particles and the transformations that occur in the atmosphere (USEPA, 1996).

PM can be principally characterised as discrete particles spanning several orders of magnitude in size, with inhalable particles falling into the following general size fractions (USEPA, 1996):

- PM10 (generally defined as all particles equal to and less than 10 microns in aerodynamic diameter; particles larger than this are not generally deposited in the lung);
- PM2.5, also known as fine fraction particles (generally defined as those particles with an aerodynamic diameter of 2.5 microns or less)
- PM10-2.5, also known as coarse fraction particles (generally defined as those particles with an aerodynamic diameter greater than 2.5 microns, but equal to or less than a nominal 10 microns); and
- Ultra-fine particles generally defined as those less than 0.1 microns.

Table 6 outlines the local and international health risk criteria used for the assessment of inhalable particulate matter (PM10). Guidelines and standards are provided for a 24-hour exposure and annual average exposure period respectively

*Table 6: Available International Standards used for the Evaluation of Inhalable Particulate Matter (PM10).*

| Origin | 24-Hour Exposure (µg/m³) | Annual Average Exposure (µg/m³) |
|---|---|---|
| RSA | 75 | 40 |
| World Bank | 500 | 100 |
| WHO | 50 | 20 |

With regard to the setting of limit values for particulate matter, SANS 1929:2011 recognises the following:

- different types of particles can have different harmful effects on human health;
- there is evidence that risks to human health associated with exposure to man-made $PM_{10}$ are higher than risks associated with exposure to naturally occurring particles in ambient air; and
- as far as they relate to $PM_{10}$, action plans and other reduction strategies should aim to reduce concentrations of fine particles as part of the total reduction in concentrations of particulate matter.

Stringent Limit and Target Values for particulate matter (expressed in µg/m³) have been suggested as guidelines in SANS 1929:2009 and revised 2011. These were developed by a panel of experts on the basis of best international practice. However, the latest regulations emanating from NEM:AQA (GNR

1210) were promulgated in late 2009 and stipulate a phased approach towards the implementation of national ambient air quality standards as tabulated below (Table 7). The newer SANS 1929:2011 document differentiated between the phased in approach and now specifies two pollutant levels, Interim and Target levels.

*Table 7: National Ambient Air Quality Standards for Particulate Matter ($PM_{10}$)*

| Averaging Period | Concentration | Frequency of Exceedence (per calendar year) |
|---|---|---|
| 24-hour | 75 µg/m$^3$ | 4 |
| Annual | 40 µg/m$^3$ | 0 |

### ii. Dust Fallout (DFO)

Nuisance dust is known to result in the soiling of materials and has the potential to reduce visibility. Atmospheric particulates change the spectral transmission, thus diminishing visibility by scattering light. The scattering efficiency of such particulates is dependent upon the mass concentration and size distribution of the particulates. Various costs are associated with the loss of visibility, including: the need for artificial illumination and heating; delays, disruption and accidents involving traffic; vegetation growth reduction associated with reduced photosynthesis; and commercial losses associated with aesthetics. The soiling of building and materials due to dust frequently gives rise to damages and costs related to the increased need for washing, cleaning and repainting. Dust fall may also impact negatively on sensitive industries, e.g. bakeries or textile industries. Certain elements in dust may damage materials. For instance, it was found that sulphur and chlorine if present in dust may cause damage to copper (Maeda et al., 2001).

The physical smothering of the leaf surface of plants by dust particles causes reduced light transmission, affecting photosynthetic processes resulting in growth reduction (Thompson et al., 1984; Pyatt and Haywood, 1989; Farmer, 1993). Increases in the temperature of particle-covered leaves result in a positive impact on respiration and a negative impact on photosynthesis and productivity (Eller, 1977). The physical obstruction of the stomata has been observed to reduce stomatal resistance, resulting in the potential for higher uptake of pollutant gases, and it may also affect the exchange of water vapour (CEPA/FPAC Working Group, 1999). Particle accumulation on leaf surfaces may cause plants to become more susceptible to other stresses such as disease (CEPA/FPAC Working Group, 1999).

Air pollution is a recognized health hazard for man and domestic animals (Newman et al., 1979). Air pollutants have had a worldwide effect on both wild birds and wild mammals, often causing marked decreases in local animal populations (Newman et al., 1979). The major effects of industrial air pollution on wildlife include direct mortality, debilitating industrial-related injury and disease, physiological stress, anaemia, and bioaccumulation. Some air pollutants have caused a change in the distribution of certain wildlife species.

South Africa is one of the only countries who have issued guideline limits for the evaluation of nuisance dust levels. A banding system has traditionally been used which describes the dust deposition as resulting in a slight, moderate, heavy or very heavy nuisance impact. On the 7th of December 2012 the Minister of Water and Environmental affairs published the National Dust Control Regulations. This document now enforces the monitoring of dust fallout from activities that is suspected of contributing significantly to dust fallout in its region. The regulation provides a set standard for dust fallout to comply to, enforces that a baseline should be established to projects that would give rise to increased dust fallout, specifications for dust fallout monitoring and the format of reports if the activity should exceed the thresholds.

*Table 8: Acceptable Dust Fallout Rates measured at and beyond the boundary of the premises where dust originates.*

| Restriction Areas | Dust Fallout rate (mg/m²/30-days average) | Permitted frequency of exceeding dust fall rate |
|---|---|---|
| **Residential area** | D < 600 | Two within a year, not sequential months. |
| **Non-residential area** | 600 < D > 1200 | Two within a year, not sequential months. |

*Note – the measurement of dust fallout is in accordance with the methodology prescribed in **ASTM 1739:2017**

If an activity exceeds the standard the entity must submit a dust monitoring report to the air quality officer (local authority), before December 2013 (Section 4, GN1007 of 2012). The entity must develop a dust management plan, within three months after the submission of a dust monitoring report (Section 5, GN1007 of 2012). If the dust fallout is continued to be exceeded, the authority may request that continuous PM10 monitoring be conducted at the site.

"Slight" dustfall is barely visible to the naked eye. "Heavy" dustfall indicates a fine layer of dust on a surface, with "very heavy" dustfall being easily visible should a surface not be cleaned for a few days. Dustfall levels of > 2000 mg/m²/day constitute a layer of dust thick enough to allow a person to "write" words in the dust with their fingers. Local experience, gained from the assessment of impacts due to dust from mine tailings dams in Gauteng, has shown that complaints from the public will be activated by repeated dustfall in excess of ~2000 mg/m²/day. Dustfall in excess of 5000 mg/m²/day impacting on residential or industrial areas generally provoke prompt and angry complaints.

The main limitation in using this type of classification system is that it is purely descriptive and does not provide an indication as to what action needs to be taken to remediate the problem. The South African Bureau of Standards in their SANS 1929:2005 publication, "Ambient air quality – limits for common pollutants", provides additional criteria which can be used for the evaluation of fallout dust deposition

### 2.1.5. International guidelines and standards

#### iii. United Nations Framework Convention on Climate Change (UNFCCC1)

The Convention entered into force on 21 March 1994. The Convention on Climate Change sets an overall framework for intergovernmental efforts to tackle the challenge posed by climate change. It recognizes that the climate system is a shared resource whose stability can be affected by industrial and other emissions of carbon dioxide and other greenhouse gases. The Convention enjoys near universal membership, with 192 countries having ratified including South Africa.

Under the Convention, governments gather and share information on greenhouse gas emissions, national policies and best practices launch national strategies for addressing greenhouse gas emissions and adapting to expected impacts, including the provision of financial and technological support to developing countries and cooperate in preparing for adaptation to the impacts of climate change

#### iv. Kyoto Protocol

The Kyoto Protocol is an international agreement linked to the United Nations Framework Convention on Climate Change. The major feature of the Kyoto Protocol is that it sets binding targets for 37 industrialized countries and the European community for reducing greenhouse gas (GHG) emissions. This amounts to an average of five per cent against 1990 levels over the five-year period 2008-2012.

The Kyoto Protocol is generally seen as an important first step towards a truly global emission reduction regime that will stabilize GHG emissions and provides the essential architecture for any future international agreement on climate change. The Kyoto Protocol was adopted in Kyoto, Japan, on 11 December 1997 and entered into force on 16 February 2005. 180 nations including South Africa have ratified the treaty to date. Under the Treaty, countries must meet their targets primarily through national measures. However, the Kyoto Protocol offers them an additional means of meeting their targets by way of three market-based mechanisms.

The Kyoto mechanisms are:

- Emissions trading – known as “the carbon market"
- the clean development mechanism (CDM)
- joint implementation (JI).

These mechanisms help stimulate green investment and help Parties meet their emission targets in a cost-effective way.

[1] www.UNFCCC.org

### v. The Vienna Convention for the Protection of the Ozone Layer

The ultimate objective of the Convention is to protect human health and the environment against adverse effects resulting from human activities which modify or are likely to modify the ozone layer and urges the Parties to take appropriate measures in accordance with the provisions in the Convention and its Protocols which are in force for that party. To achieve the aforementioned objectives, the Parties, within their capabilities, are expected to: cooperate to better understand and assess the effects of human activities on the ozone layer and the effects of the modification of the ozone layer; adopt appropriate measures and cooperate in harmonizing appropriate policies to control the activities that are causing the modification of the ozone layer; cooperate in the formulation of agreed measures for the implementation of this Convention; and cooperate with competent international bodies to implement effectively this Convention and protocols to which they are party.

### vi. The Montreal Protocol on Substances that deplete the Ozone Layer

These protocol controls production of ozone depleting substances: The Montreal Protocol on Substances that Deplete Ozone Layer is a protocol under the Vienna Convention. The Protocol controls the production and consumption of the most commercially and environmentally significant ozone-depleting substances - those listed in the Annexes to the Protocol. One feature of the Montreal Protocol which makes it unique, is Article 6 that requires the control measures to be revised at least every four years (starting 1990), based on the review and assessment of latest available-information on scientific, environmental, technical and economic aspects of the depletion of the ozone layer. Based on reports of assessment panels appointed by the Parties and taking into consideration the needs and situation of the developing countries, the Protocol has already been adjusted and amended twice.

At present, 191 nations have become party to the Montreal Protocol. The Montreal Protocol on Substances that Deplete the Ozone Layer is an international treaty designed to protect the ozone layer by phasing out the production of a number of substances believed to be responsible for ozone depletion. The treaty was opened for signature on September 16, 1987 and entered into force on January 1, 1989 followed by a first meeting in Helsinki, May 1989. Since then, it has undergone seven revisions, in 1990 (London), 1991 (Nairobi), 1992 (Copenhagen), 1993 (Bangkok), 1995 (Vienna), 1997 (Montreal), and 1999 (Beijing).

### vii. The Stockholm Convention on Persistent Organic Pollutants (POPs)

The Stockholm Convention is an international legally binding agreement on persistent organic pollutants (POPs). In 1995, the Governing Council of the United Nations Environment Programme (UNEP) called for global action to be taken on POPs, which it defined as "chemical substances that persist in the environment, bio-accumulate through the food web, and pose a risk of causing adverse effects to human health and the environment".

Following this, the Intergovernmental Forum on Chemical Safety (IFCS) and the International Programme for Chemical Safety (IPCS) prepared an assessment of the 12 worst offenders. Known as the Dirty Dozen, this list includes eight organo-chlorine pesticides: aldrin, chlordane, DDT, dieldrin, endrin, heptachlor, mirex and toxaphene; two industrial chemicals: hexachlorobenzene (HCB) and the polychlorinated biphenyl (PCB) group; and two groups of industrial by-products: dioxins and furans.

The negotiations for the Stockholm Convention on Persistent Organic Pollutants were completed on May 23rd 2001 in Stockholm, Sweden. The convention entered into force on May 17th, 2004 with ratification by an initial 128 parties and 151 signatories. Co-signatories agreed to outlaw nine of the "dirty dozen" chemicals, limit the use of DDT to malaria control, and curtail inadvertent production of dioxins and furans. Parties to the convention have agreed to a process by which persistent toxic compounds can be reviewed and added to the convention, if they meet certain criteria for persistence and trans boundary threat. Several other substances are being considered for inclusion in the Convention. These are: hexabromobiphenyl, octaBDE, pentaBDE, pentachlorobenzene, short-chained chlorinated paraffin's, lindane, α- and β-hexachlorocyclohexane, dicofol, endosulfan, chlordecone and PFOS.

The Convention sets out several objectives including:

- The elimination from commerce of identified POPs and others that may be identified in the future;
- encouraging the transition in commerce to safer alternatives;
- identifying additional POPs;
- the clean-up of old stockpiles and equipment containing POPs; and
- encouraging all stakeholders to work towards a POP-free environment.

### viii. International Concerns Around mercury

There are international initiatives to address mercury but to date no international policy has been developed. A recent programme backed by the United Nations (UN) that aims to reduce the health and environmental impacts of mercury includes a two-year period of voluntary action to reduce emissions and an evaluation to determine whether an international treaty is necessary. It aims to develop partnerships between government, industry and other key groups to reduce emissions.

### ix. Equator Principles

The Environmental Assessment report required needs to addresses baseline environmental and social conditions, requirements under host country laws and regulations, applicable international treaties and agreements, sustainable development and use of renewable natural resources, protection of human health, cultural properties, and biodiversity, including endangered species and sensitive ecosystems, use of dangerous substances, major hazards, occupational health and safety, fire prevention and life safety, socio-economic impacts, land acquisition and land use, involuntary resettlement, impacts on indigenous peoples and communities, cumulative impacts of existing projects, the proposed project, and anticipated future projects, participation of affected parties in the design, review and implementation of the project, consideration of feasible environmentally and socially preferable alternatives, efficient production, delivery and use of energy, pollution prevention and waste minimization, pollution controls (liquid effluents and air emissions) and solid and chemical waste management.

### x. International Finance Corporation

The International Finance Corporation (IFC) recommends the following in regards to air pollution. "Emissions do not result in pollutant concentrations that reach or exceed relevant ambient quality guidelines and standards by applying national legislation standards, or in their absence, the current World Health Organization (WHO) Air Quality Guidelines (AQGs0 or other internationally recognized sources. …As a general rule, this Guideline suggests 25 percent of the applicable air quality standards to allow additional, future sustainable development in the same airshed." However also includes that the "25 percent increment rule itself is too strict to be applied universally on all guidelines, to be noted that the immission figures vary greatly between different guidelines and therefore a universal increment rule will lead in most cases to big unnecessary problems without enhancing the environment."

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[2]www.UNFCCC.org

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## Existing Sources of Air Pollution

Currently, a detailed emissions inventory for the area under investigation has not been undertaken. Based on an aerial photo and site description of the area, the following sources of potential air pollution have been identified:

- Power Stations (Matimba & Medupi {under construction})
- Veld fires;
- Domestic fuel burning;
- Vehicle entrainment;
- Agriculture;
- Mining Operations; and
- Existing ash facility.

A qualitative discussion on each of these source types is provided in the subsections which follow. These subsections aim to highlight the possible extent of cumulative impacts which may result due to the proposed operations.

### 2.1.6. Power Stations

The burning of coal for power generation can result in emissions being generated. At the power stations surrounding the ash facility, various mitigation measures have been put in place at the stations to reduce the emissions before entering the atmosphere. These include bag filters or electrostatic precipitators (ESPs) for the removal of particulate matter and ash, scrubbers for sulphur dioxide and over air burners for oxides of nitrogen. These mitigation measures are highly efficient with up to 99% of all emissions being captured or removed.

### 2.1.7. Veld Fires

A veld fire is a large-scale natural combustion process that consumes various ages, sizes, and types of flora growing outdoors in a geographical area. Consequently, veld fires are potential sources of large amounts of air pollutants that should be considered when attempting to relate emissions to air quality. The size and intensity, even the occurrence, of a veld fire depends directly on such variables as meteorological conditions, the species of vegetation involved and their moisture content, and the weight of consumable fuel per hectare (available fuel loading).

Once a fire begins, the dry combustible material is consumed first. If the energy released is large and of sufficient duration, the drying of green, live material occurs, with subsequent burning of this material as well. Under suitable environmental and fuel conditions, this process may initiate a chain reaction that results in a widespread conflagration. It has been hypothesized, but not proven, that the nature and amount of air pollutant emissions are directly related to the intensity and direction (relative to the wind) of the veld fire, and are indirectly related to the rate at which the fire spreads (Figure 9).

The factors that affect the rate of spread are:

- weather (wind velocity, ambient temperature, relative humidity);
- fuels (fuel type, fuel bed array, moisture content, fuel size); and
- topography (slope and profile).

However, logistical problems (such as size of the burning area) and difficulties in safely situating personnel and equipment close to the fire have prevented the collection of any reliable emissions data on actual veld fires, so that it is not possible to verify or disprove the hypothesis.

The major pollutants from veld burning are particulate matter, carbon monoxide, and volatile organics. Nitrogen oxides are emitted at rates from 1 to 4 g/kg burned, depending on combustion temperatures. Emissions of sulphur oxides are negligible (USEPA, 1996). A study of biomass burning in the African savanna estimated that the annual flux of particulate carbon into the atmosphere is estimated to be of the order of 8 Tg C, which rivals particulate carbon emissions from anthropogenic activities in temperate regions (Cachier *et al*, 1995).

*Figure 9: An Example of burnt agricultural land and burning fields near Lephalale.*

### 2.1.8. Domestic Fuel Burning

It is anticipated that the lower income households in the Marapong Village and other villages in the area surrounding the site are likely to use coal and wood for space heating and/ or cooking purpose. The problems facing Eskom around the impact of particulates generated indoors as a result of the use of coal and wood are not unique. Similar problems are reported around the world in poor communities which either lack access to electricity or lack the means to fully utilise the available supply of electricity (Van Horen et al. 1992).

Globally, almost 3 billion people rely on biomass (wood, charcoal, crop residues and dung) and coal as their primary source of domestic energy. Exposure to indoor air particulates (IAP) from the combustion of solid fuels is an important cause of morbidity and mortality in developing countries. Biomass and coal smoke contain a large number of pollutants and known health hazards, including particulate matter, carbon monoxide, nitrogen dioxide, sulphur oxides (mainly from coal), formaldehyde, and polycyclic organic matter, including carcinogens such as benzo[a]pyrene (Ezzati and Kammen, 2002).

Monitoring of exposures in biomass-burning households has shown concentrations are many times higher than those in industrialized countries. The latest Air Quality Objectives, for instance, required the monthly average concentration of PM10 (particulate matter < 10 µm in diameter) to be < 200 µg/m3 (annual average < 100 µg/m3). In contrast, a typical 24-hr average concentration of PM10 in homes using biofuels may range from 200 to 5000 µg/m3 or more throughout the year, depending on the type of fuel, stove, and housing. Concentration levels, of course, depend on where and when monitoring takes place, because significant temporal and spatial variations may occur within a house. Field measurements, for example, recorded peak concentrations of ≥ 50000 µg/m3 in the immediate vicinity of the fire, with concentrations falling significantly with increasing distance from the fire. Overall, it has been estimated that approximately 80% of total global exposure to airborne particulate matter occurs indoors in developing nations. Levels of CO and other pollutants also often exceed international guidelines (Ezzati and Kammen, 2002).

### 2.1.9. Vehicle entrained dust

The force of wheels of vehicles travelling on unpaved roadways causes the pulverisation of the surface material. Particles are lifted and dropped from the rotating wheels and the road surface is exposed to strong air currents in turbulent shear with the surface. The turbulent wake behind the vehicle continues to act on the road surface after the vehicle has passed. The quantity of dust emissions from unpaved roads varies linearly with the volume of traffic as well as the speed of the vehicles. These types of roads could also be used and new ones may be created to ensure access to the new facility where access cannot be obtained from the main roads in the area. The movement of construction vehicles and other infrastructure parts will result in unusually heavy loads being placed on the roads, which is likely to result in additional damage to the road surface (USEPA, 1996).

### 2.1.10. Agriculture

Agricultural activity can be considered a significant contributor to particulate emissions, although tilling, harvesting and other activities associated with field preparation are seasonally based. The main form of agriculture in the area is Game Farming.

Little information is available with respect to the emissions generated due to the growing of crops. The activities responsible for the release of particulates matter would however include:

- Particulate emissions generated due to wind erosion from exposed areas;
- Particulate emissions generated due to the mechanical action of equipment used for clearing of fences and roads, tilling and harvesting operations;
- Vehicle entrained dust on paved and unpaved road surfaces;

### 2.1.11. Mining Operations

Both Exxaro and Sasol have open cast mining operations are located in the general area. The mines produces coal for the use in the nearby Matimba and Medupi power stations. All aspects from blasting, to material handling and transport of coal can result in particulate emissions to the atmosphere from these mine operations. These mines need to ensure their own environmental obligations are met, by compliance to criteria outlined in their EMPs and air quality permits.


*Figure 10: Google Earth Image of the Grootegeluk Colliery near the Matimba power station*

### 2.1.12. Existing Ash Facility

Figure 11 below shows the advancing face of the existing ash facility at the power stations. Particulate matter and nuisance dust is expected from the working face, and transfer and tipping points during normal operations. Water sprays are in place for mitigation to reduce the air quality impacts associated with the facility.

*Figure 11: Advancing face of existing ash facility*

## b. Background Concentration

### Baseline Monitoring

Baseline monitoring is undertaken by the Department of Environmental Affairs at their Maropeng site ~70km South East of the site, however this monitoring station is currently not reporting to the SAAQIS online system for addition into this report.

Ambient monitoring of Total Suspended Particulates was undertaken between the 22nd and 24th January 2019.

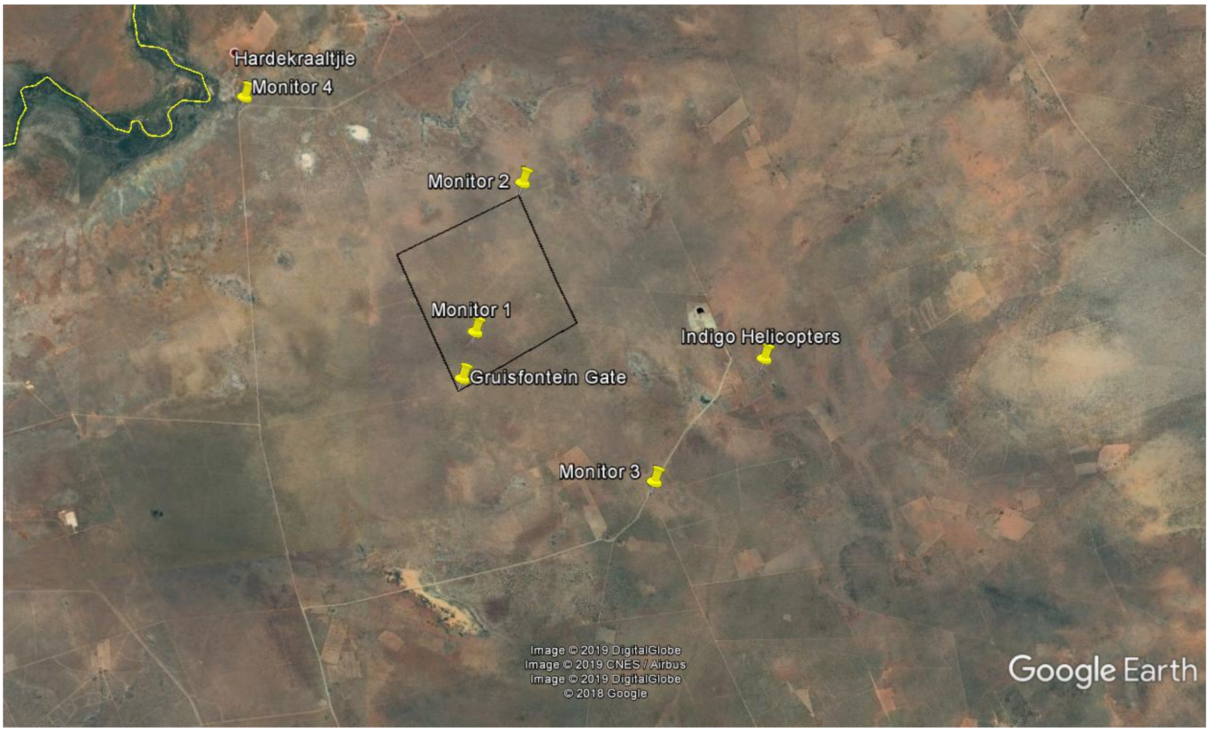



*Figure 12: 6 Monitoring Locations where ambient monitoring was undertaken*

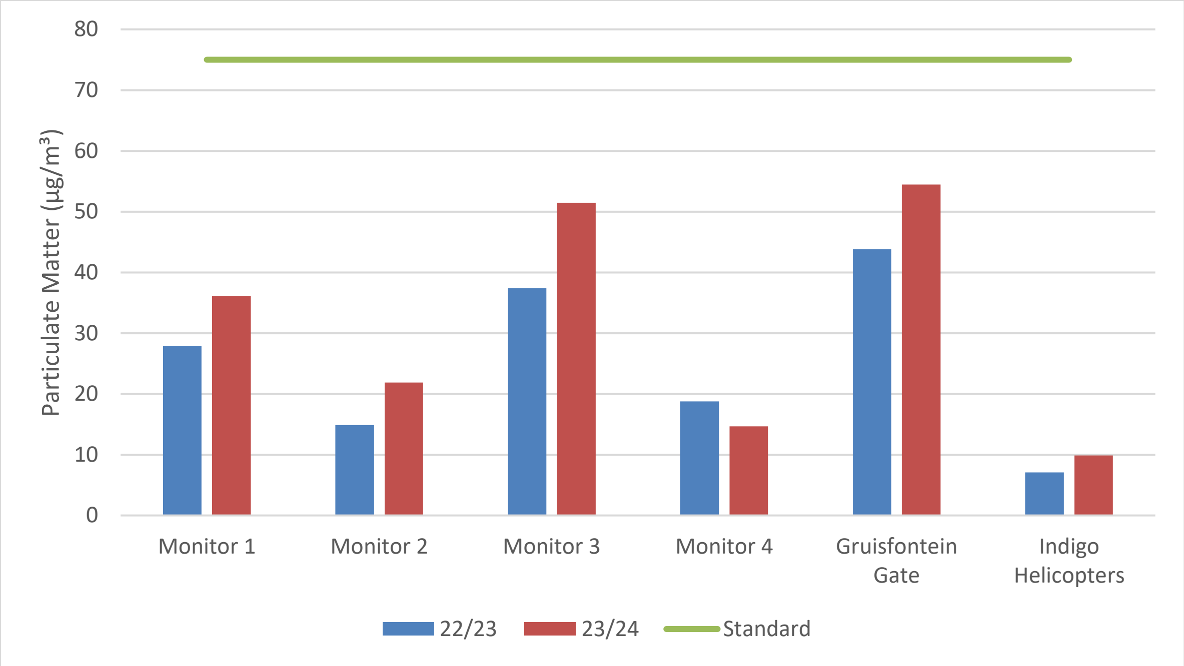



*Figure 13: Ambient Monitoring results for the 22/23rd January and 23/24th January*

Ambient monitoring was undertaken for 24 hours at each sampling point, and then sampled again for a further 24 hours with new filters.

The results indicate that the proposed mining operation will be impacted on by surrounding mining, and power generation operations.

### c. Sensitive Receptors

A list of identified sensitive receptors has been with the assistance of other consultants on the project to ensure completeness and is presented below.

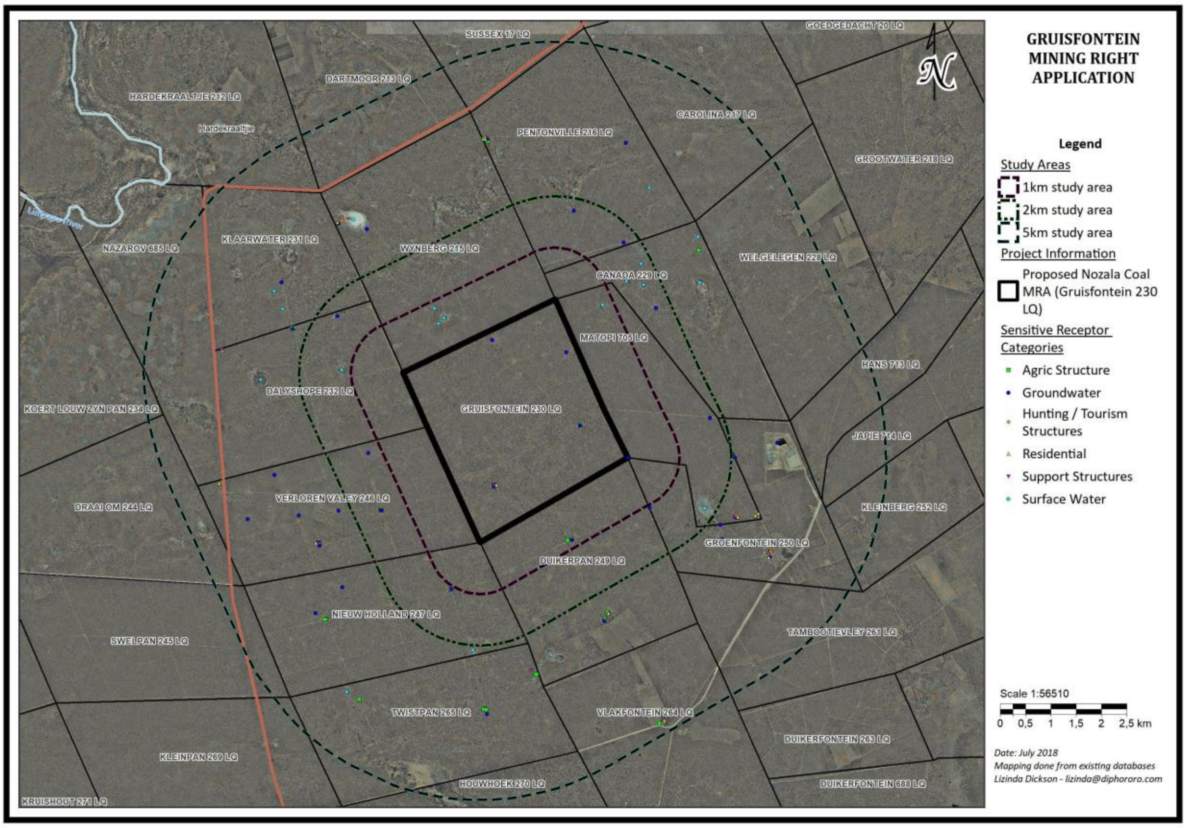



*Figure 14: Identified sensitive receptors*

# 5. Impact Assessment

This section of the report will outline the potential ambient air quality impacts associated with the proposed activities at the mine. During the Impact Assessment phase, a detailed emissions inventory was compiled to determine the emissions released from the proposed activities. Dispersion modelling simulations was undertaken using the AERMOD dispersion model and the impacts will be presented graphically as isopleths plots.

The plant layout was provided in Geographical Information System format for inclusion in the model development as follows:


*Figure 15: Infrastructure layout Map (Diphororo Development (Pty) Ltd)*

## a. Emission Inventory

The emission inventory for emissions was compiled based on US EPA AP42 Emission factors for the mining aspects as well as crushing and screening of material.

Emissions of total suspended particulates (TSP) and particulate matter with an aerodynamic diameter of less than 10-micron meters (PM10) and less than 2.5-micron meters (PM2.5), are classified as criteria pollutants from this listed activity and therefore were the focus.

The mining operations are made of different processes the emissions calculated will be for specific stages of different phases.

### i. Mining phase

During the mining phase, the pit is active. The emission factor is based on the amount of TSP (with the assumption that all TSP released is classed as $PM_{10}$) is released during this phase and the gathering of mineral ore.

- Drilling & Blasting
    - To determine the total amount of TSP emitted into the atmosphere per blast. The result was then multiplied to the number of blasts per year to get the annual emission rate.
- ROM handling & Hauling
    - To determine the total amount of TSP emitted by the handling and transport of material from pit to stockpiles.
- ROM Stockpiling
    - The emissions from wind erosion and the vehicle traffic at stockpiles (maintenance).

| Model Input Code | Description | Area ($m^2$) | PM10 (g/s) |
|---|---|---|---|
| **OPIT1** | Open Pit | 509483.1 | 3.82E-07 |
| **Area 1** | Discard Dump | 680233.4 | 4.61E-06 |
| **Area 2** | Hard Overburden Dump | 253016.2 | 9.66E-07 |
| **Vol 1** | Process Plant | 185 | 4.64E-07 |
| **Area 3** | Product Stockpile | 2937.2 | 2.15E-07 |
| **Area 4** | ROM Stockpile | 2710.8 | 6.91E-07 |
| **Vol 2** | ROM Tip | 328.7 | 9.81E-07 |
| **Area 5** | Soft Overburden Dump | 65433.2 | 4.95E-07 |
| **SLine 1** | Access Roads | | 1.73E-07 |

### ii. Transportation

Access and unpaved roads are constructed by the removal of overlying topsoil, whereby the exposed surface is graded to provide a smooth compacted surface for vehicles to drive on. Material removed is often stored in temporary piles close to the road edge, which allows for easy access once the road is no longer in use, whereby the material stored in these piles can be re-covered for rehabilitation purposes. Often however, these unused haul roads are left as is in the event that sections of them could be reused at a later stage.

A large amount of dust emissions are generated by vehicle traffic over these temporary unpaved roads (USEPA, 1996). Substantial secondary emissions may be emitted from material moved out from the site during grading and deposited adjacent to roads (USEPA, 1996). Passing traffic can thus re-suspend the deposited material. To avoid these impacts material storage piles deposited adjacent to the road edge should be vegetated, with watering of the pile prior to the establishment of sufficient vegetation cover. Piles deposited on the verges during continued grading along these routes should also be treated using wet or chemical suppressants depending on the nature and extent of their impacts.

A positive correlation exists between the amount of dust generated (during vehicle entrainment) and the silt content of the soil as well as the speed and size of construction vehicles. Additionally, the higher the moisture content of the soil the lower the amount of dust generated.

| Emission Factor | | Emission Factor | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| lb/VMT | lb/VMT | g/VKT | g/VKT | g/day | g/day | g/s | g/s | g/s/m² | g/s/m² |
| TSP | PM10 | TSP | PM10 | TSP | PM10 | TSP | PM10 | TSP | PM10 |
| **21.345405** | 4.3409329 | 6017 | 1224 | 409263.97 | 83230.438 | 4.7368515 | 0.9633153 | 2.914E-05 | 5.927E-06 |

### i. Additional Sources

An estimate of the particulate matter from the nearby Sasol Mafutha Mine, the Exxaro Grootegeluk Mine, Medupi and Matimba Power Stations is included in the model to determine cumulative impacts in the region. These estimates are based on emission factors from the AP42 with production capacity as the primary information. This information is seen as the best information publicly available and may not reflect information provided by these entities.

## b. AERMOD Dispersion Model Setup

### i. Air Dispersion Modelling Software

During the assessment the ISC/AERMOD view dispersion model was used to evaluate air quality impacts.

Dispersion modelling was undertaken using the US-EPA approved Aermod View Dispersion Model, a steady-state plume model that incorporates air dispersion based on planetary boundary layer turbulence structure and scaling concepts, including treatment of both surface and elevated sources, and both simple and complex terrain.

There are two input data processors that are regulatory components of the AERMOD modelling system: AERMET, a meteorological data pre-processor that incorporates air dispersion based on planetary boundary layer turbulence structure and scaling concepts, and AERMAP, a terrain data pre-processor that incorporates complex terrain using USGS Digital Elevation Data. Other non-regulatory components of this system include: AERSCREEN, a screening version of AERMOD; AERSURFACE, a surface characteristics pre-processor, and BPIPPRIME, a multi-building dimensions program incorporating the GEP technical procedures for PRIME applications.

The Aermod View model is used extensively to assess pollution concentrations and deposition rates from a wide variety of sources. Aermod View is a true, native Microsoft Windows application and runs in Windows 2000/XP and NT4 (Service Pack 6).

Some of the modelling capabilities are summarised as follows:

- Aermod View may be used to model primary pollutants and continuous releases of toxic hazardous waste pollutants;
- Aermod View model can handle multiple sources, including point, volume, area and open pit source types. Line sources may also be modelled as a string of volume sources or as elongated area sources;
- Source emission rates can be treated as constant or may be varied by month, season, hour of day, or other periods of variation, for a single source or for a group of sources;
- The model can account for the effects of aerodynamic downwash due to nearby buildings on point source emissions;
- The model contains algorithms for modelling the effects of settling and removal (through dry deposition) of large particulates and for modelling the effects of precipitation scavenging from gases or particulates;
- Receptor locations can be specified as gridded and/or discrete receptors in a Cartesian or polar coordinate system;
- Aermod View incorporates the COMPLEX1 screen model dispersion algorithms for receptors in complex terrain;
- Aermod View model uses real-time meteorological data to account for the atmospheric conditions that affect the distribution of air pollution impact on the modelling area; and
- Output results are provided for concentration, total deposition, dry deposition, and/or wet deposition flux.

Input data to the Aermod View model includes: source and receptor data, meteorological parameters, and terrain data. The meteorological data includes: wind velocity and direction, ambient temperature, mixing height and stability class, from surface and upper air stations.

The uncertainty of the Aermod View model predictions is considered to be equal to 2, thus it is possible for the results to be over predicting by double or under predicting by half, it is therefore recommended that monitoring be carried out at the proposed more during operation to confirm the modelled results, to ensure legal standards are maintained.

### ii. GIS Input Data

The Mine is located in an area that is surrounded by gentle undulating terrain systems, therefore requiring the inclusion of a complex terrain file. The modelling domain selected for this campaign is 20km x 20km, covering an approximate area of 400km$^2$, with the mine at the centre of the domain (Table 9). The dispersion model was setup to model 882 points evenly distributed across the domain.

*Table 9: GIS Domain input points – UTM zone 35J WGS84 projection*

| Domain Points | X Coordinate (m) | Y Coordinate (m) |
|---|---|---|
| **Domain Centre point** | 528246.95 m E | 7393557.57 m S |

A nested uniform Cartesian grid receptor network was used with the flowing parameters:

| Description | X Axis | Y Axis |
|---|---|---|
| **SW Coordinates (m)** | 478171.07 | 7343213.43 |
| **Centre Coordinates (m)** | 528297.67 | 7399079.43 |
| **No. of Points** | 21 | 21 |
| **Spacing (m)** | 5012.66 | 4986.6 |
| **Length (m)** | 100253.20 | 99732.00 |

| Description | X Axis | Y Axis |
|---|---|---|
| **SW Coordinates (m)** | 518307.12 | 7383349.48 |
| **Centre Coordinates (m)** | 528123.92 | 7392905.68 |
| **No. of Points** | 21 | 21 |
| **Spacing (m)** | 981.68 | 955.62 |
| **Length (m)** | 19633.60 | 1112.40 |

### iii. Topography

The general elevation in the region is shown in Figure 16.

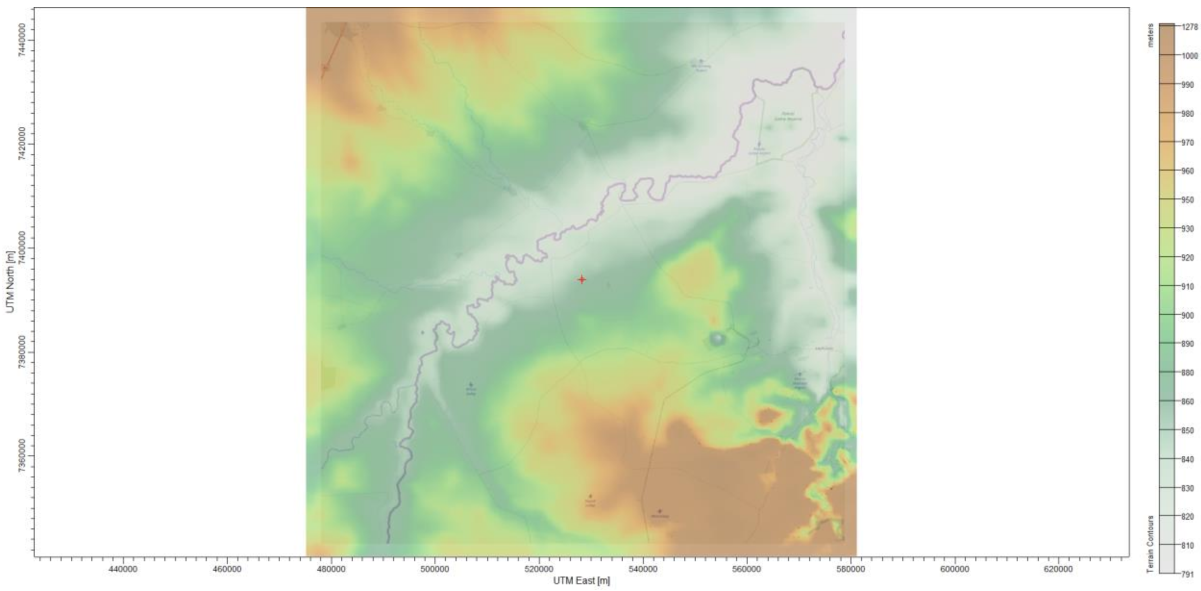



*Figure 16: Topography of the region*

### iv. Meteorological Input Data

Meteorological data was obtained from the South African Weather Service meteorological station located at Lephalale for the period 2014 – 2017 for inclusion into the dispersion model. Table 10 presents the data recovery statistics obtained by the model, which is affected by the requirements of the meteorological pre-processor within the model.

*Table 10: Meteorological data statistics*

| Period | Total Hours | Data used | Missing data | Calm conditions |
|---|---|---|---|---|
| **2014 - 2017** | 43824 | 43824 | 74 | 13036 |

## c. Dispersion Modelling Results

The dispersion of pollutants through the air was modelled with the AERMOD software. The physical environmental parameters, such as wind, temperature, humidity and rain, influence the concentrations over distance. The modelling software took all of these parameters into account in the primary calculations, a concentration value per pollutant was calculated at each of the grid points to be able to form iso-pleth images for graphical presentation of the typical plume dispersion in the region.

The modelled results are presented in the table below and compared with the national standards. The concentrations depicted are all the second highest concentration calculated, as per statistical law. The different modelled components are:

1. Mining phase – This focused on the pollutants generated during mining (pit operations);

2. Processing – This calculated the emission emitted from the processing plant, loading and unloading of stockpiles and the transport of product.

Results are a cumulative impact showing total impacts from the site. (Refer to Appendix A for graphical outputs)

*It should be duly noted that all the model runs were done as worst-case scenarios, thus no mitigation measures control efficiencies are included in the emission rate calculation. The mitigation measure control efficiencies are presented in the following section. The values noted in the table below is the maximum concentration calculated throughout the model, the majority of the maximum concentrations are most likely to be located either on-top of an area source or close to an area source. The concentration of the pollutant will decrease as it moves away towards the fence line (MRA boundary). The maximum concentration that enters the receiving environment, beyond the fence line is highlighted as the MRA Boundary concentration below*

*Table 11: Dispersion Results from AEMOD – Worst Case Scenario (all results represented as µg/m³)*

| **Total Project Impact** | | | |
|---|---|---|---|
| Averaging Period | Peak | MRA Boundary | Standard |
| Hourly | 298.93 | 137.04 | - |
| Daily | 74.71 | 29.62 | 75 |
| Annual | 32.12 | 10.24 | 40 |
| **Mining Impact** | | | |
| Averaging Period | Peak | MRA Boundary | Standard |
| Hourly | 280.42 | 130.99 | - |
| Daily | 73.26 | 27.14 | 75 |
| Annual | 29.81 | 6.90 | 40 |
| **Transport Impact** | | | |
| Averaging Period | Peak | MRA Boundary | Standard |
| Hourly | 83.60 | 83.60 | - |
| Daily | 29.48 | 29.48 | 75 |
| Annual | 16.48 | 16.48 | 40 |
| **Cumulative Impact (includes, Sasol, Exxaro & Eskom)** | | | |
| Averaging Period | Peak | MRA Boundary | Standard |
| Hourly | 298.93 | 252.26 (Sasol) | - |
| Daily | 83.07 | 83.07 (Sasol) | 75 |
| Annual | 33.86 | 33.86 (Sasol) | 40 |

Dust fallout modelling indicates the areas where fallout is expected to exceed the permissible limits for residential and industrial areas (Figure 17). Therefore it is recommended that dust fallout monitoring be undertaken to determine the effectiveness of the mitigation measures implemented.

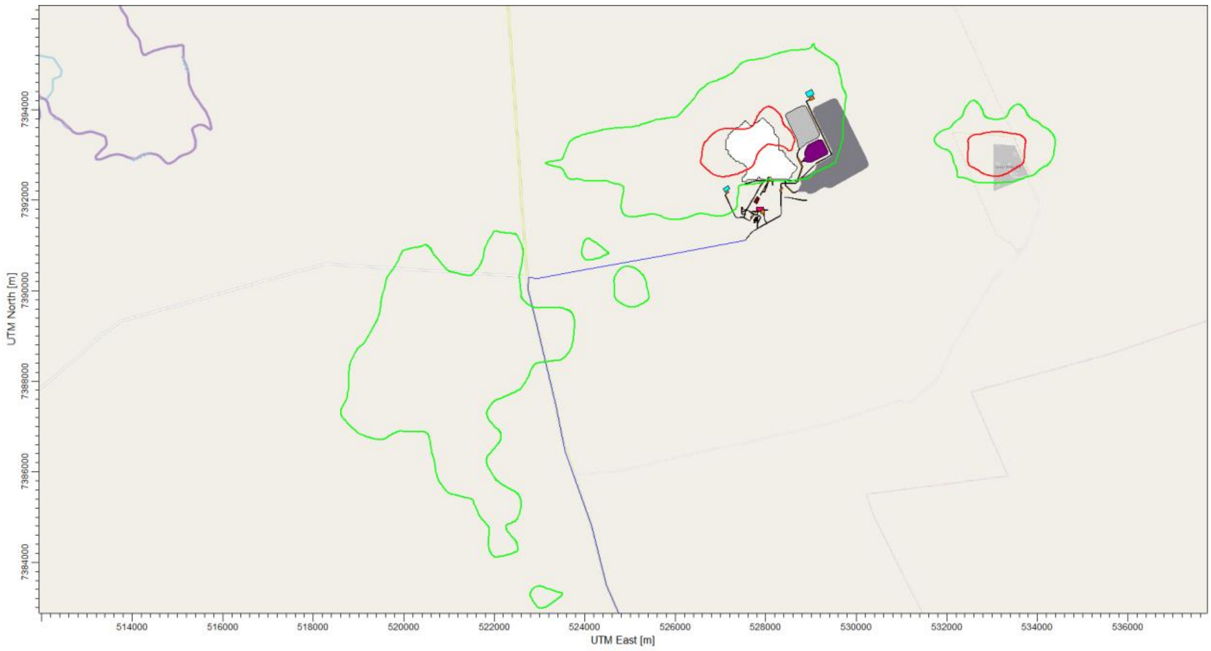



*Figure 17: Predicted dust fallout impacts with the residential impact (600mg/m²/day) in green and the industrial (1200mg/m²/day) in orange. The area on the right is the Sasol Mafutha Mine*

## d. Carbon Emissions

Carbon dioxide emissions are those stemming from the burning of fossil fuels and the manufacture of cement. They include carbon dioxide produced during consumption of solid, liquid, and gas fuels and gas flaring. Based on the Carbon Dioxide Information Analysis Centre, Environmental Sciences Division of the World Bank, estimated that South Africa's annual Carbon dioxide emissions are estimated at 489 772 kt.

Based on a total Life of Mine for the Gruisfontein Project being 16 years, and an estimate of 48 million tons of coal available. It is estimated that for the 16-year Life of Mine, it is estimated that the total Carbon dioxide generated by the two Eskom power stations the Gruisfontein mine will supply is 8 580 kt per year (137 280 kt over the life of project). This equates to a 1.75% contribution to the overall South African Carbon Footprint.

## e. Conclusion and Recommendations

The modelled results presented in the tables above indicated the possible worst-case future concentrations of pollutants that can be found in the region as a result of the proposed mining activities. The worst case is derived from the emission sources not being mitigated and the concentration level is the second highest concentration calculated from the model.

For the entire Receptor Grid modelled, beyond the MRA boundary, the impacts from the Gruisfontein mine are below the ambient air quality standards. When combined with the current background concentrations monitored during the study, the results are still below the health criteria standards for ambient air quality.

When the surrounding sources are included, the cumulative impact does show that exceedances do occur in the region. Overall the Gruisfontein Mine will likely contribute around 35% of the cumulative particulate matter load within the region.

Based on the information provided, the baseline assessment and the impact assessment and modelling results, no impacts have been identified which would result in this project having a significant impact on the local environment. To this end, the mitigation measures identified below need to be implemented to limit and further reduce impacts on the surrounding environment.

### f. Mitigation measures

There are a wide range of mitigation measures that can be implemented as part of the Gruisfontein Project operations, to further reduce the impacts. The table below list the activity and the plausible mitigation measure(s) that can be introduced to effectively control pollutants.

| Source | Description |
|---|---|
| **Vehicle wind and wheel dust** | Set the speed limit for hauling vehicles and vehicles in general to as low a speed possible and enforce the speed limits specified. The higher the speed the more dust will be generated. It is recommended the speed limit be set to 40km/h on unpaved roads.<br>Include speed-bumps to control the speed limits.<br>Include a program of wet-suppression of the unpaved roads with major vehicle activity. The wet-suppression can be of typical grey water from the mine or the water can contain a chemical that will increase the dust trapping capability once sprayed over a surface.<br>Limit the load size of the vehicles to ensure the wind in transit does not pick up more dust that need be.<br>Product transport trucks must be covered with tarpaulins, the covers must be secured. |
| **Mining** | Limit the area of operation to what is absolutely necessary.<br>During the pre-mining preparation of the area, ensure that only the minimum area is disturbed and not all the vegetation is removed from the site un-necessarily. It is recommended that the fauna of the areas be kept as natural as possible. |
| **Stockpiles** | Limit the height and slope of stockpiles to reduce wind entrainment. The ideal stockpile height is less than 3m with a slope no more than 30°. Ideally stockpiles should be fully enclosed or be kept in a store warehouse, this is very unlikely to occur at the mine and the maintenance of the stockpile.<br>the general vehicle traffic around the stockpile areas should be limited.<br>Windshield (barriers) can be implemented on the slopes and surface of the stockpile, these barriers are typically large trees with a good foliage coverage (the area of the mine and the soil characteristics cause the possibility of this option to be low). The substitute of the wind barriers is a wind shield made from a prose material (shade cover). It should be noted that the height of the wind shield will reduce the wind effect by 10x in distance. |
| **Crushing and Screening** | During the processing of material, the material should be kept wet to ensure the dust does not escape during the processing. Dust suppression should be installed along all conveyors, at conveyor transfer stations and at the drier plant. |

| | |
|---|---|
| **Air Quality Management Program** | The air quality management program will provide the health, safety and environment person to report to the managers about the air quality impact on the surrounding environment. This AQMP will include monitoring schedules and can be used to effectively determine if some mitigation measures are capable in reducing the emission effectively and to determine area of concern.<br>To limit potential risks, it is recommended that dust fallout monitoring be undertaken both on and off-site to determine potential exposure, to improve air quality management. Samples should be analysed regularly to determine silica exposure. |


*Figure 18: Figure showing access gate with PM monitor*

# 6. Environmental Ratings

The primary pollutant of concern is particulate matter and dust that will be generated and emitted from the activities of the mine. The environmental ratings will thus only focus on assessing the impacts from the dust (this include TSP and PM10).

The following table provide the results of the impact ratings.

| ID | Activity | Risk (impact) trigger | Potential Impact | Nature of Impact | Duration | Duration value | Extent | Extent Value | Probability | Probability Value | Intensity | Intensity Value | Weighting factor | Weigh value | Impact Significance | Significant Points | Proposed Mitigation measures | Mitigation Efficiency | Efficiency value | Impact Significance | Significant Points |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **CONSTRUCTION PHASE** | | | | | | | | | | | | | | | | | | | | |
| | Air quality | Transport of material | Access roads are constructed by the removal of overlying topsoil, whereby the exposed surface is graded to provide a smooth compacted surface for vehicles to drive on. Material removed is often stored in temporary piles close to the road edge, which allows for easy access once the road is no longer in use, whereby the material stored in these piles can be re-covered for rehabilitation purposes. Often however, these unused haul roads are left as is in the event that sections of them could be reused at a later stage. | Negative | Temporary | 1 | Local | 2 | Probable | 3 | Low | 2 | LowtoMedium | 2 | Low | 16 | Set the speed limit for hauling vehicles and vehicles in general to as low a speed possible and enforce the speed limits specified. The higher the speed the more dust will be generated. It is recommended the speed limit be set to 40km/h on unpaved roads.<br>Include speed-bumps to control the speed limits.<br>Include a program of wet-suppression of the unpaved roads with major vehicle activity. The wet-suppression can be of typical grey water from the mine or the water can contain a chemical that will increase the dust trapping capability once sprayed over a surface.<br>Limit the load size of the vehicles to ensure the wind in transit does not pick up more dust that need be. | Medium to High | 0.4 | Low | 6.4 |
| | Air quality | Pre-mining preparation | During the pre-mining phase it is expected that, the main sources of impact will result due to the construction of access roads, the clearing of land and initial clearing for of mine area. resulting in open unprotected soils which are prone to wind erosion. | Negative | Short Term | 2 | District | 3 | Probable | 3 | Medium | 3 | Medium | 3 | Low to Medium | 33 | Limit the area of operation to what is absolutely necessary. During the pre-mining preparation of the area, ensure that only the minimum area is disturbed and not all the vegetation is removed from the site un-necessarily. It is recommended that the fauna of the areas be kept as natural as possible. | Medium | 0.6 | Low | 19.8 |
| | Air quality | Construction of plant | During the construction assessment phase it is expected that, the main sources of impact will result due to the construction of infrastructure such as conveyor lines, etc. resulting in open unprotected soils which are prone to wind erosion. | Negative | Short Term | 2 | District | 3 | Probable | 3 | Medium | 3 | Medium | 3 | Low to Medium | 33 | Limit the area of operation to what is absolutely necessary. During the pre-mining preparation of the area, ensure that only the minimum area is disturbed and not all the vegetation is removed from the site un-necessarily. It is recommended that the fauna of the areas be kept as natural as possible. | Medium | 0.6 | Low | 19.8 |

| ID | Activity | Risk (impact) trigger | Potential Impact | Nature of Impact | Duration | Duration value | Extent | Extent Value | Probability | Probability Value | Intensity | Intensity Value | Weighting factor | Weigh value | Impact Significance | Significant Points | Proposed Mitigation measures | Mitigation Efficiency | Efficiency value | Impact Significance | Significant Points |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **OPERATIONAL PHASE** | | | | | | | | | | | | | | | | | | | | |
| | Air quality | In-pit activities | Activities include drilling and blasting, as well as the handling of materials from rock face to haul truck. | Negative | Long Term | 4 | Site specific | 1 | Highly Probable | 4 | Medium | 3 | Medium | 3 | Low to Medium | 36 | Water sprays should be applied during the removal of the waste rock to reduce fugitive emissions. Drilling and blasting activities should not be undertaken during high wind periods to avoid excess dust being transported across to neighbouring communities. Monitoring of key meteorological parameters such as wind speed, wind direction, temperature, precipitation, atmospheric pressure a | Low to Medium | 0.8 | Low to Medium | 28.8 |
| | Air quality | Transport | A large amount of dust emissions are generated by vehicle traffic over these temporary unpaved roads. Substantial secondary emissions may be emitted from material moved out from the site during grading and deposited adjacent to roads. Passing traffic can thus re-suspend the deposited material. To avoid these impacts material storage piles deposited adjacent to the road edge should be vegetated, with watering of the pile prior to the establishment of sufficient vegetation cover. Piles deposited on the verges during continued grading along these routes should also be treated using wet or chemical suppressants depending on the nature and extent of their impacts.<br><br>A positive correlation exists between the amount of dust generated (during vehicle entrainment) and the silt content of the soil as well as the speed and size of construction vehicles. Additionally, the higher the moisture content of the soil the lower the amount of dust generated. | Negative | Long Term | 4 | Local | 2 | Highly Probable | 4 | Medium | 3 | Medium | 3 | Low to Medium | 39 | Set the speed limit for hauling vehicles and vehicles in general to as low a speed possible and enforce the speed limits specified. The higher the speed the more dust will be generated. It is recommended the speed limit be set to 40km/h on unpaved roads.<br>Include speed-bumps to control the speed limits.<br>Include a program of wet-suppression of the unpaved roads with major vehicle activity. The wet-suppression can be of typical grey water from the mine or the water can contain a chemical that will increase the dust trapping capability once sprayed over a surface.<br>Limit the load size of the vehicles to ensure the wind in transit does not pick up more dust that need be.<br>Product transport trucks must be covered with tarpaulins, the covers must be secured. | Medium | 0.6 | Low to Medium | 23.4 |
| | Air quality | Stockpiling | Particulate matter and nuisance dust is expected from the working stockpiles, transfer and tipping points during normal operations. | Negative | Long Term | 4 | Local | 2 | Highly Probable | 4 | High | 4 | MediumtoHigh | 4 | Medium | 56 | Limit the height and slope of stockpiles to reduce wind entrainment. The ideal stockpile height is less than 3m with a slope no more than 30°. Ideally stockpiles should be fully enclosed or be kept in a store warehouse, this is very unlikely to occur at the mine and the maintenance of the stockpile.<br>the general vehicle traffic around the stockpile areas should be limited.<br>Windshield (barriers) can be implemented on the slopes and surface of the stockpile, these barriers are typically large trees with a good foliage coverage (the area of the mine and the soil characteristics cause the possibility of this option to be low). The substitute of the wind barriers is a wind shield made from a prose material (shade cover). It should be noted that the height of the wind shield will reduce the wind effect by 10x in distance. | Medium to High | 0.4 | Low to Medium | 22.4 |
| | Air quality | Plant Operations | During the crushing & screening process (beneficiation) phase, the ROM is processed to different grades of product. The emission elements are the handling, crushing and screening and stockpiling and transport of product. | Negative | Long Term | 4 | Local | 2 | Probable | 3 | High | 4 | Medium | 3 | Low to Medium | 39 | During the processing of material, the material should be kept damp to ensure the dust does not escape during the processing. Dust suppression should be installed along all conveyors, and at conveyor transfer stations. | Medium | 0.6 | Low to Medium | 23.4 |

| ID | Activity | Risk (impact) trigger | Potential Impact | Nature of Impact | Duration | Duration value | Extent | Extent Value | Probability | Probability Value | Intensity | Intensity Value | Weighting factor | Weigh value | Impact Significance | Significant Points | Proposed Mitigation measures | Mitigation Efficiency | Efficiency value | Impact Significance | Significant Points |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **DECOMMISSIONING** | | | | | | | | | | | | | | | | | | | | |
| 1 | Air quality | | The decommissioning phase is associated with activities related to the demolition of infrastructure and the rehabilitation of disturbed areas. The total rehabilitation will ensure that the total area will be a free draining covered with topsoil and grassed. The following activities are associated with the decommissioning phase . Exposed soil is often prone to erosion by water. The erodability of soil depends on the amount of rainfall and its intensity, soil type and structure, slope of the terrain and the amount of vegetation cover | Negative | Long Term | 4 | Site specific | 1 | Definite | 5 | Medium | 3 | Medium | 3 | Low to Medium | 39 | Revegetation of exposed areas for long-term dust and water erosion control is commonly used and is the most cost-effective option. Plant roots bind the soil, and vegetation cover breaks the impact of falling raindrops, thus preventing wind and water erosion. Plants used for revegetation should be indigenous to the area, hardy, fast-growing, nitrogen-fixing, provide high plant cover, be adapted to growing on exposed and disturbed soil (pioneer plants) and should easily be propagated by seed or cuttings. | Medium | 0.6 | Low to Medium | 23.4 |

# 7. References


- US EPA (1998). Compilation of Air Pollution Emission Factors (AP-42), 5th Edition, Volume 1, Chapeter 11 Section 9 “Western Surface Coal Mining”, as contained in the AirCHIEF CD-Rom, US Environmental Protection Agency, Research Triangle Park, North Carolina.
- US EPA (1982). Compilation of Air Pollution Emission Factors (AP-42), 5th Edition, Volume 1, Chapeter 11 Section 24 “Metallic Minerals Processing”, as contained in the AirCHIEF CD-Rom, US Environmental Protection Agency, Research Triangle Park, North Carolina.
- US EPA (2006). Compilation of Air Pollution Emission Factors (AP-42), 5th Edition, Volume 1, Chapeter 13 Section 2.2 “Unpaved Roads”, as contained in the AirCHIEF CD-Rom, US Environmental Protection Agency, Research Triangle Park, North Carolina.
- US EPA (1995). Compilation of Air Pollution Emission Factors (AP-42), 5th Edition, Volume 1, Chapeter 13 Section 2.3 “Heavy Construction Operations”, as contained in the AirCHIEF CD-Rom, US Environmental Protection Agency, Research Triangle Park, North Carolina.
- US EPA (2006). Compilation of Air Pollution Emission Factors (AP-42), 5th Edition, Volume 1, Chapeter 13 Section 2.4 “Aggregate handling and storage piling”, as contained in the AirCHIEF CD-Rom, US Environmental Protection Agency, Research Triangle Park, North Carolina.
- Australian Government (2012). National Pollutant Inventory Emission Estimation Technique Manual for Mining. Chapter 5, Version 3.1
- Australian Government (2012). National Pollutant Inventory Emission Estimation Technique Manual for Mining. Appendix 1, Version 3.1
- South African Government (2005). National Environmental Management: Air Quality Act. Cape Town, The Presidency, (Government Gazette, Volume 476).
- South African National Standards (2004). South African National Standard: Framework for setting and implementing national ambient air quality standards. Standards South Africa (a division of SABS). SANS 69:2004, Edition 1.
- South African National Standards (2011). South African National Standard: Ambient air quality – Limits for common pollutants. Standards South Africa (a division of SABS). SANS 1929:2005, Edition 1.1.

# 8. Appendix

## a. Air Dispersion Model Outputs

Appendix A.

The following dispersion results are a representation of the worst-case scenarios for each of the pollutants and their time frames.

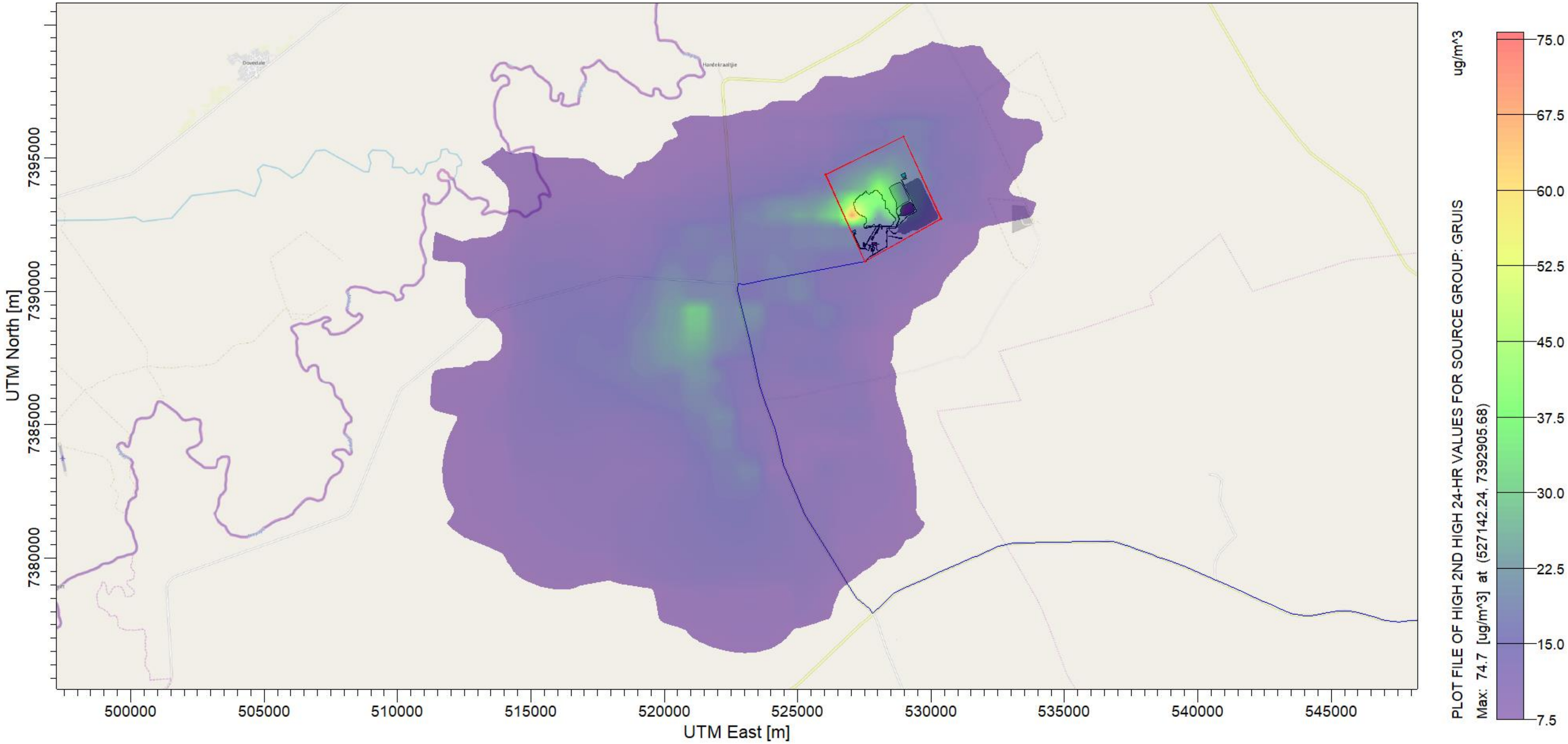



*Figure 19: Daily average predicted ambient ground level concentrations (µg/m³) of Particulate Matter (Standard: 75µg/m³) (Gruisfontein plant boundary highlighted in red)*

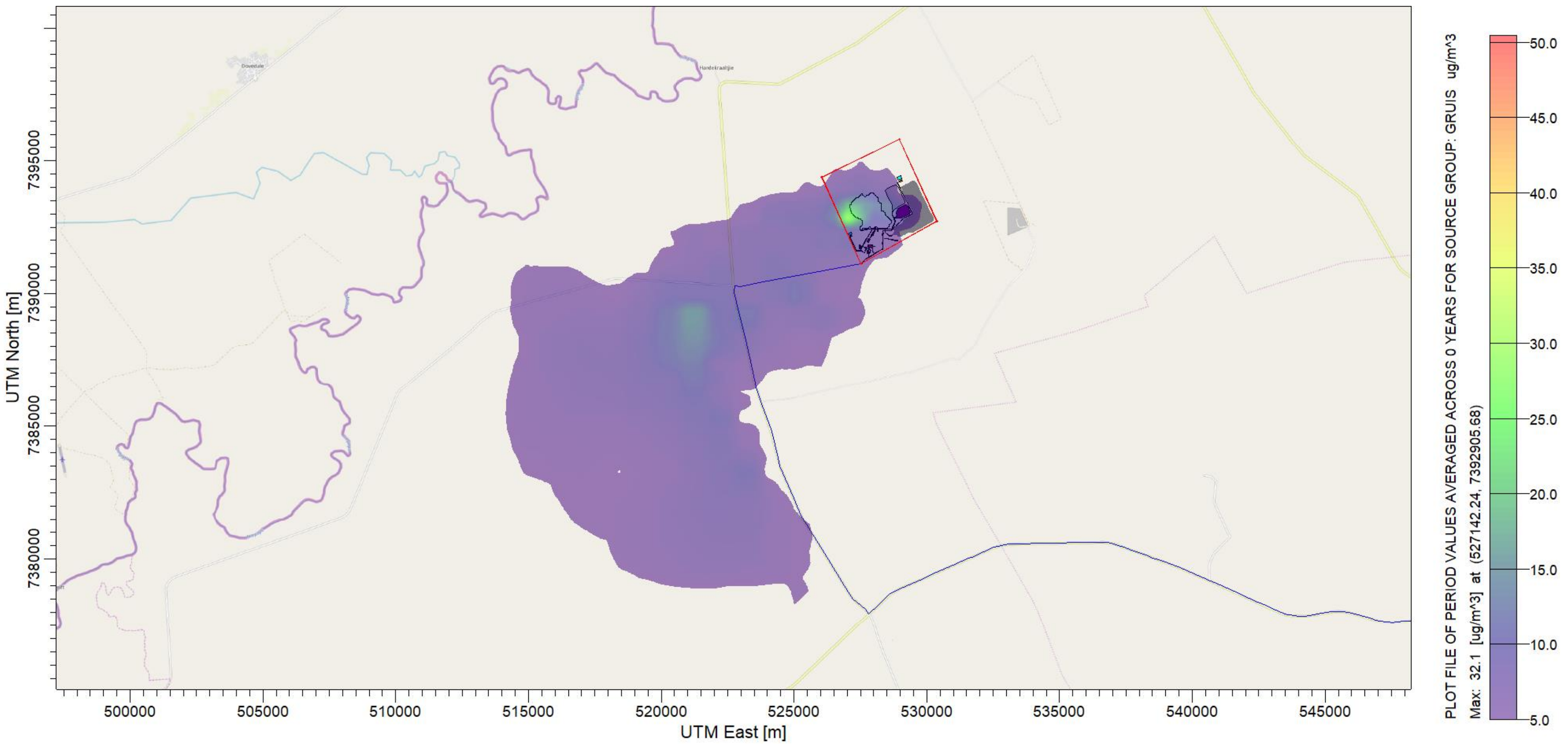



*Figure 20: Annual average predicted ambient ground level concentrations (µg/m³) of Particulate Matter (Standard: 40µg/m³) (Gruisfontein plant boundary highlighted in red)*

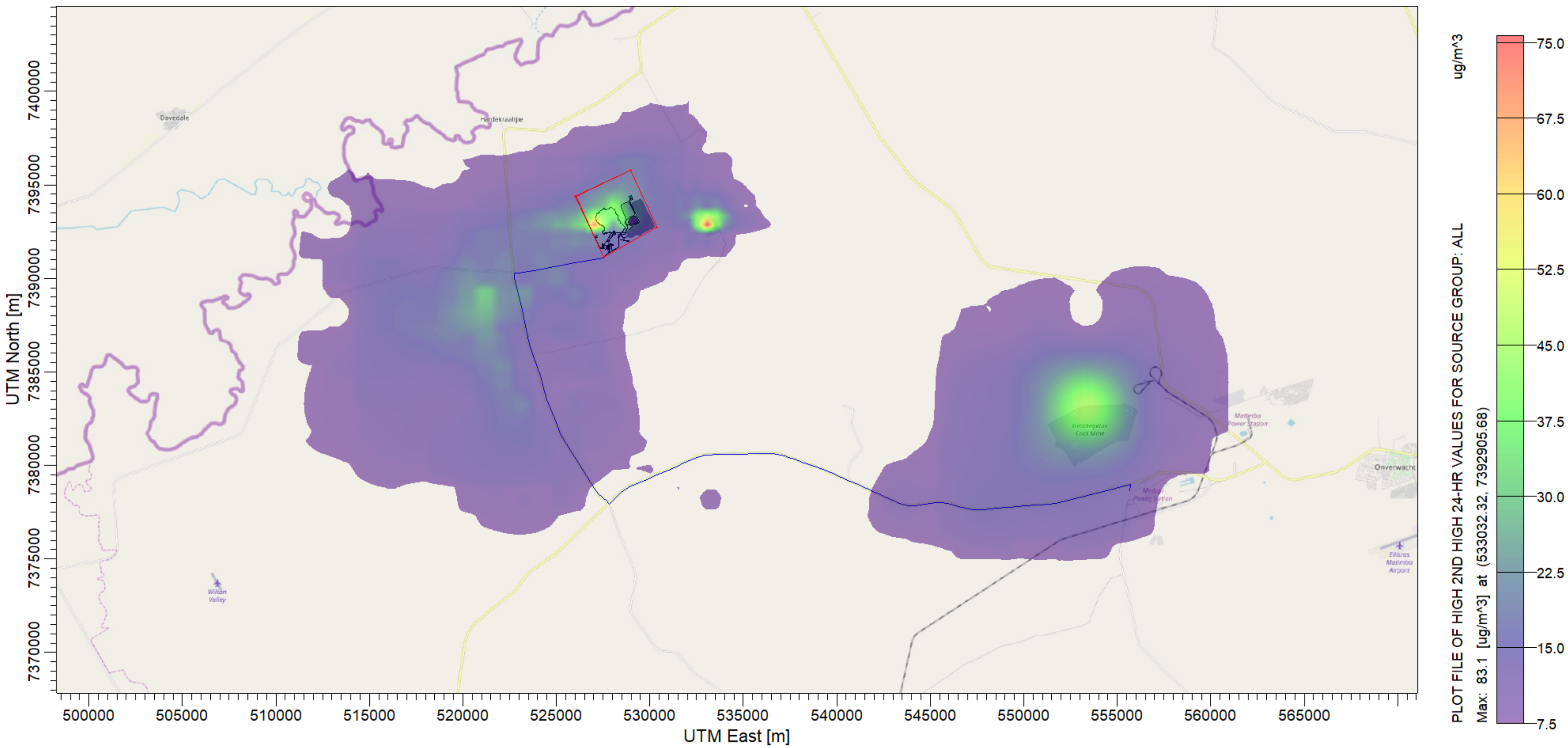



*Figure 21: Daily average predicted ambient ground level concentrations (µg/m³) of Particulate Matter (Standard: 75µg/m³) for the cumulative regional impact including Exxaro and Sasol (Gruisfontein plant boundary highlighted in red)*

## b. CVs of Specialists

**CURRICULUM VITAE**

**1. POSITION FOR THIS PROJECT**

Air Quality Specialist

**2. NAME OF PERSON**

Stuart John Thompson

**3. DATE OF BIRTH**

07 November 1981

**4. NATIONALITY**

South African

**5. MEMBERSHIP IN PROFESSIONAL SOCIETIES**

N/A

**6. EDUCATION**

| Qualification | Specialization | Date Obtained | Institution |
|---|---|---|---|
| BSc. | Environmental Science and Hydrology | 2003 | University of Natal |
| BSc (Hons) | Applied Environmental Science | 2004 | University of KwaZulu-Natal |

**7. OTHER TRAINING AND EDUCATION**

| Qualification | Specialisation | Date Obtained | Institution |
|---|---|---|---|
| **Certificate** | Wetland Management and Rehabilitation | 2003 | Mondi Working for Wetlands Group |
| **Certificate** | GPS for GIS, Practical GPS course | 2004 | ESRI, GIMS and Trimble |
| **Certificate** | CHIPS Advanced Remote Sensing | 2004 | University of Copenhagen |
| **Certificate** | Erdas Imagine Advanced Remote Sensing | 2004 | ITC, Netherlands |
| **Certificate** | Environmental Engineering and Design for Land Rehabilitation | 2005 | African Gabions/ Maccaferri |
| **Certificate** | Environmental Modelling for Retaining Wall Design | 2005 | African Gabions/ Maccaferri |
| **Certificate** | Introduction to PSNext | 2006 | Management Planning Systems |

| | | | |
|---|---|---|---|
| **Certificate** | Project Management | 2007 | Insite Education and Training |
| **Certification Course** | UNITAR, Climate Adaptation and Policy Development | 2012 | University of Cape Town |
| **Certificate** | Finance for Technical Managers | 2016 | Alusani Training |
| **Certification Course** | Climate Change: The Science | 2016 | University of British Columbia |

## 8. LANGUAGE AND DEGREE OF PROFICIENCY

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

## 9. COUNTRY OF WORK EXPERIENCE

Nigeria, Kenya, Ethiopia, Tanzania, Zambia, DRC, Lesotho, Swaziland, Botswana, Namibia, Zimbabwe, Mozambique, South Africa, Estonia, Georgia, The Netherlands, Britain, Peru, Mauritius, Malawi, Angola, Senegal, Sierra Leone, Ivory Coast, Indonesia, Canada, Sweden, India

## 10. EMPLOYMENT RECORD

| Designation | Duration | Company Name |
|---|---|---|
| Project Planner | June 2006 – February 2007 | SiVEST SA |
| Air Quality Specialist & Portfolio Manager | February 2007 – April 2017 | Royal HaskoningDHV (Formally SSI) |
| Senior ESG Consultant: Cleaner Production | May 2017 – Present | EBS Advisory |

## 11. WORK UNDERTAKEN THAT BEST ILLUSTRATES YOUR CAPABILITY TO HANDLE THIS ASSIGNMENT CERTIFICATE

Stuart Thompson has been involved in various projects which provide him with the necessary skills required to execute the project at hand and to provide technical support focusing on the delivery of the environmental aspects on the project. This includes:

- Specific Expertise on Steel projects undertaken for Arcelor Mittal x4 plants, Iscor Steel x3 plants, SCAW Metals x3 plants, Injaka Stainless Steel. Inputs provided included, technical advisory services, air quality modelling, emissions inventory development, carbon foot printing,
- Air Quality specialist studies for over 50 projects including mining (Coal, Diamonds, Gold, Copper, Chrome, Iron & Platinum) Power Generation (Coal, Gas, Hydro, Biofuels) Medical Centres (Hospital and Incineration), Heavy industry (Steel, Stainless Steel, Cement), and Urban Planning (Public Transport, housing)
- Development team for Strategic Frameworks for Government departments and Investment Entities, for example for the Eastern Cape Province DEDEAT - Development of a Strategic Framework for the establishment of an oil and gas economy in the Eastern Cape Province of South Africa. Technical support for the development of a master plan for the strategic development of the Port of

Eten, in Peru, this included the development of a greater industrial development zone at back of port. Central Energy Board Mauritius - Risk Assessment for the setting up of a Coal Transit Station at Mer Rouge, Mauritius.

- Undertaking Due Diligence exercises with a focus on Environmental and Social Risks, key projects include an oil refinery (Tallinn, Estonia – on site assessment undertaking a full Phase I E&S assessment), for Krones (Johannesburg, South Africa - Undertook an environmental due diligence assessment for a proposed new office block and warehouse facility), for GE Nigeria (Calabar, Nigeria - Undertook a Phase 1 and 2 environmental due diligence assessments for a Manufacturing Facility).

I, the undersigned, certify that (*i*) I was not a former employee of the Client immediately before the submission of this proposal, and (*iii*) to the best of my knowledge and belief, this bio data correctly describes me, my qualifications, and my experience. I understand that any willful miss-statement described herein may lead to my disqualification or dismissal, if engaged.

I have been employed by EBS Advisory continuously for the last twelve (12) months as regular full-time staff.

Indicate “Yes” or “No” in the boxes below:

**YES ~~NO~~**

**Signature**

Date of Signing
01 August 2019

**CURRICULUM VITAE-RAYLENE WATSON**

1. **Position:** Regional Managing Director – SADC
2. **Name of Firm:** EBS Advisory PTY Ltd.
3. **Name of Staff:** Raylene Watson
4. **Date of Birth**: 31-07-1973
5. **Years with Firm**: 3 year
6. **Nationality**: South African, British

**7.Membership in Professional Societies:**

Registered Natural Sciences Professional with SACNASP

**8.Education:**

| Qualification | Specialisation | Date Obtained | Institution |
|---|---|---|---|
| **PhD** | Eco Toxicology and Parasitology - Thesis: Evaluation of Fish Health Assessment Index under South African Conditions in the Olifants River Catchment Area | 2000 | Rand Afrikaans University, South Africa |
| **MSc** | MSc Eco Toxicology – Thesis: Metal Bio-accumulation in *Clarias gariepinus* in the Olifants River Catchment Area | 1997 | Rand Afrikaans University, South Africa |
| **BSc (Hons)** | Zoology - Ecotoxicology & Environmental Management | 1995 | Rand Afrikaans University, South Africa |
| **BSc** | BSc Natural Sciences | 1994 | Rand Afrikaans University, South Africa |

**9.Courses Attended:**

| | | |
|---|---|---|
| Project Management | 2007 | Internal SSI course |
| ISO 14001 auditing | 2010 | Internal SSI course |
| DHV Group Management Development Programme | 2011 | TiasNimbas Business School, University of Tilburg, The Netherlands |
| Green Buildings | 2012 | Green Buildings Council of South Africa |
| Financial and Business Management | 2014 | University of the Witwatersrand (Faculty Commerce, Law & Management), South Africa |

**10.Employment Record:**

| Designation | Duration | Company Name |
|---|---|---|
| Senior Consultant Air Quality Impact Assessments | 2000-2003 | Environmental Management Services (Pty) Ltd (EMS) |
| Principal Consultant Air Quality Impact Assessments | 2004-2005 | Airshed Planning Professionals (Pty) Ltd (formally EMS) |
| Unit Manager Air Quality | 2006-2008 | SSI Engineers and Environmental Consultant (Pty) Ltd, South Africa |
| Specialist Environmental Services Unit Manager | 2008-2010 | SSI Engineers and Environmental Consultant (Pty) Ltd, South Africa |
| Group Sector Manager: Environmental | 2011- June 2012 | SSI Engineers and Environmental Consultant (Pty) Ltd, South Africa |
| Southern & Eastern Africa Business Line (SEA BL) Sustainability & Environmental Manager; Market Segment Leader: Heavy Industrial Clients | July 2012 – December 2012 | Royal HaskoningDHV (Formally SSI) |
| SEA BL: Sustainability & Environmental Manager Deputy Business Unit Director: Industry and Energy Business Unit SA.<br>Director Advisory Group: Energy Creation and Resource Management | 2013 – March 2015 | Royal HaskoningDHV |
| South Africa Sustainability & Environmental Manager;<br>Director Advisory Group: Energy Creation and Resource Management within Industry and Energy Business Line SA | April 2015 – December 2015 | Royal HaskoningDHV |

| Designation | Duration | Company Name |
|---|---|---|
| South Africa Sustainability Manager;<br>Team Leader Resource Management within Industry and Buildings Business Line SA | January 2016 to July 2016 | Royal HaskoningDHV |
| Managing Director SADC | August 2016 - Present | EBS Advisory |

**11.Languages**:

| Language | Read | Speak | Write |
|---|---|---|---|
| **English** | Excellent | Excellent | Excellent |
| **Afrikaans** | Excellent | Excellent | Excellent |
| **Dutch** | Good | Poor | Poor |

**12.Work Experience**:

Raylene is a Professionally Registered Scientific Professional with the Council of Natural Sciences. Raylene has undertaken over 800 assessments focusing primarily on industrial related source impacts (air quality, due dilligence assesments applying IFC Performance Standards, Phase I and Phase II Environmental Assessments using the ASDM methodology, and ISO certification audits).

Key studies undertaken focused on the assessment of impacts related to:

- All phases of a project life cycle (construction, commissioning, operation, decommissioning of facilities and developments);
- Assessment of latent risks and liabilities faced by an operator or investor;
- Development of management systems;
- Application of the circular economy principles on projects (during construction, commissioning, operation, decommissioning of facilities and developments);
- Application of green building principles on projects;
- Carbon Footprinting (for various source based operations as input to emission reduction strategies, licensing requirements as well as strategy and master plan development);
- Impacts associated with mining operations (coal, gold, platinum, uranium, diamonds, chromium, zinc, copper, mineral sands);
- Impacts associated with smelters (platinum, iron ore, chromium, vanadium);
- Impacts associated with refineries (oil and gas);
- Impacts associated with chemical industry (polyethylene, carbon black, explosives, fertiliser manufacturing etc.);
- Impacts associated with the energy sector (Thermal and Renewable Options)
- Impacts associated with landfill sites (hazardous and domestic),
- Impacts associated with sewage works (municipal and industrial),
- Impacts associated with incineration (medical, ammunition destruction facility, crematoria etc.)
- Impacts associated with airports (airside and land side assessments);
- Impacts associated with harbour developments (ship movements as well as industrial developments on port side, extension of berths and inputs to HAZOP assessments),
- Impacts associated with residential developments (buffer zone delineation for low income housing to be located close to landfill or other hazardous activities);
- Impacts associated with commercial developments (hospitals, laboratories, shopping centres, breweries, factories); and
- Impacts associated with the expansion of road and rail networks.

Key strengths employed in executing these projects include, strong project management, good commercial accumen, driven by innovative solutions, analytical and detailed oriented, working well in a team.

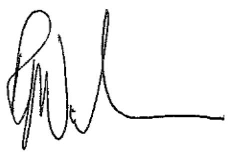
She also has extensive experience working with various financial institutions, including private equity, venture capital, asset managers, unit trusts, DFIs and commerical banks, Industrial Development Banks. Specific focus areas with respect to supporting these sectors include:

- Capacity building and training,

- ESG Due Diligence Assessments,
- Compilation of ESMS,
- Compilation of ESAPs,
- Traking of process implementation,
- Data analytics,
- Reporting,
- Tool development,
- Strategic workshops,
- Determining of materiality,
- Stakeholder engagement,
- Setting of KPIs,
- Advisr on Souring alternative funding streams,
- Assistance during fund raising,
- Process optimisation,
- Development of strategic communication,
- Providing crisis communication,
- Advisory services, and
- ESG recruitment services.

**<u>14. Certification:</u>**

I, the undersigned, certify that to the best of my knowledge and belief, this CV correctly describes me, my qualifications, and my experience.



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Date of Signing
01 August 2019