REPORT

Air Quality Impact Assessment for the Tronox Kwa-Zulu Natal Sands (Pty) Ltd Heleza Moya Project

Tronox Kwa-Zulu Natal Sands (Pty) Ltd

Submitted to:

Tronox Kwa-Zulu Natal Sands (Pty) Ltd

Submitted by:

WSP Group Africa (Pty) Ltd

Building 1, Maxwell Office Park, Magwa Crescent West, Waterfall City, Midrand, 1685, South Africa

P.O. Box 6001, Halfway House, 1685

+27 11 254 4800

41104206

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Executive Summary

Tronox Kwa-Zulu Natal Sands (Pty) Ltd (Tronox) currently operates the Fairbreeze Mine, located immediately south-west of Mtunzini, where heavy mineral sands are mined. The heavy mineral concentrate is then trucked to the Tronox Central Processing Plant (CPC) for refinement. The Fairbreeze Mine is supported by a Mineral Separation Plant (MSP) and Smelter, collectively known as the CPC in Empangeni. The main products include titanium dioxide (TiO_2) slag, rutile, zircon, leucoxene and high purity iron which are produced for sale mainly to international markets.

Tronox plans to extend its Fairbreeze mining operations to include a surface right known as Heleza Moya. Heleza Moya tenement falls within the approved Fairbreeze mining right and was recently acquired through a sale agreement.

Having concluded the sale agreement with the owner, Tronox now plans to incorporate this area into their active mine plan as it lies immediately adjacent to mineable reserves. This inclusion will require an amendment to the approved environmental management program (EMP) to authorise mining activities on this property. Tronox has appointed WSP Group Africa (Pty) Ltd (WSP) as the independent Environmental Assessment Practitioner (EAP) to undertake the EMP amendment. As part of the EMP amendment, a specialist Air Quality Impact Assessment (AQIA) is required. The AQIA comprised a baseline assessment, impact assessment and recommended mitigation measures.

The baseline assessment included a geographic overview of the proposed Project operations and a review of available meteorological and ambient air quality data for the study area. Key pollutants associated with the project operations included dust fallout and particulate matter of aerodynamic diameter of 10 and 2.5 microns (PM_{10} and $PM_{2.5}$).

To accurately represent meteorological conditions for the project, site-specific data from the South African Weather Service (SAWS) Mtunzini weather station (Latitude: 28.9470°S, Longitude: 31.7070°E, approximately 6 km northeast of the proposed site) for the period January 2020 to December 2022, was obtained. Additionally, modelled AERMET-Ready Weather Research and Forecasting (WRF)-Mesoscale Model Interface Program (MMIF) data was purchased from Lakes Environmental for comparison of the data. An AERMET-ready WRF dataset for the period January 2020 to December 2022 centred in the middle of the project site (Latitude: 29.0031°S, Longitude: 31.6980 °E) and covering a domain of 50 km x 50 km was utilised.

The South African National Accreditation System (SANAS, 2012) TR 07-03 standards stipulate a minimum data recovery of 90% for the dataset to be deemed representative of conditions during a specific reporting period. The percentage recovery for the SAWS and WRF modelled data was above 90% and is thus considered reliable for use in this assessment. The meteorological data indicated the following:

- Mtunzini Station:
  - The total rainfall received for 2020, 2021 and 2022 was 1 037 mm, 1 591 mm and 1 208 mm, respectively.
  - Temperatures ranged from a low of 2°C, 1°C and 2°C in 2020, 2021 and 2022, respectively in winter to a high of 41°C, 43°C and 39°C in 2020, 2021 and 2022, respectively in summer.
  - The average relative humidity for 2020, 2021 and 2022 recorded was 75%, 76% and 76%, respectively.
  - Northeast winds prevail in the region for the entire period, with calm conditions occurring ~22% of the time and an average wind speed of 3 m/s recorded.
- WRF Modelled Data:

- The total rainfall received for 2020, 2021 and 2022 was 804 mm, 1 102 mm and 1 322 mm, respectively.
- Temperatures ranged from a low of 6°C, 6°C and 8°C in 2020, 2021 and 2022, respectively in winter to a high of 41°C, 40°C and 39°C in 2020, 2021 and 2022, respectively in summer.
- The average relative humidity for 2020, 2021 and 2022 recorded was 70%, 72% and 74%, respectively.
- North-northeast winds prevail in the region for the entire period, with calm conditions occurring ~1% of the time and an average wind speed of 5 m/s recorded.

- Comparisons:
  - Both data sets produced similar ranged values for temperatures, rainfall and humidity and hence gives confidence that the WRF modelled data is an accurate representation for the dispersion model.
  - When comparing the wind data, it was observed that winds from the north northeast prevailed using the modelled WRF data, whilst the Mtunzini station indicated a slight shift in winds with prevailing winds from the northeast. As such, similar trends in wind directions were observed and hence gives confidence that the WRF modelled data is an accurate representation for the dispersion model. The slight changes in data can be associated with the height of the datasets and the location of the datasets.

Dust fallout monitoring data for the Fairbreeze mine for the most recent six-year period from January 2018 to August 2023 was obtained and assessed:

- In 2018, one exceedance was recorded at Site 5 in July, two non-sequential exceedances at N2S1 in June and November and two non-sequential exceedances at FBC100 in January and March. No exceedances were recorded at the other sites. As such, all monitoring locations were compliant with the National Dust Control Regulations (600 mg/m^2/day for residential sites and 1 200 mg/m^2/day for non-residential sites) which allow for two non-sequential exceedances within one year.
- In 2019 one exceedance was recorded at Site 5 in November, one in exceedance in March and one exceedance at N2S1 in February. No exceedances were recorded at the other sites. As such, all monitoring locations were compliant with the National Dust Control Regulations which allow for two non-sequential exceedances within one year.
- In 2020 one exceedance was recorded at Site 5 in January, two sequential exceedances at Pump Station 02 in October and November and two non-sequential exceedances at Pump Station 03 in August and October. No exceedances were recorded at the other sites. As such, most monitoring locations were compliant with the National Dust Control Regulations which allow for two non-sequential exceedances within one year, with the exception of Pump Station 02.
- In 2021 three sequential exceedances each were recorded at Site 2, Tree Barrier and FBC200 from October to December, one exceedance each at Site 5 and Site 10 in February and seven sequential exceedances at Pump Station 03 from April to October. No exceedances were recorded at the other sites. As such, most monitoring locations were compliant with the National Dust Control Regulations which allow for two non-sequential exceedances within one year, with the exception of Site 2, Tree Barrier, FBC200 and Pump Station 03.
- In 2022 no exceedances were recorded. All monitoring locations were thus compliant with the National Dust Control Regulations which allow for two non-sequential exceedances within one year.
- In 2023 two sequential exceedances were recorded at the Wetlands, Twinstreams Educational Centre, and Site 10 from January 2023 to August 2023, which resulted in a non-compliance with the National Non-residential Dust Control Regulations (Figure 16).

- An average dust fallout rate of 223 mg/m^2/day, 213 mg/m^2/day, 247 mg/m^2/day, 429 mg/m^2/day, 106 mg/m^2/day and 676 mg/m^2/day was recorded for 2018, 2019, 2020, 2021, 2022 and 2023 respectively. The average dust fallout rate over the six-year period was 316 mg/m^2/day.

Particulate matter monitoring is measured at three nearby on-site monitoring stations namely Shepley Farm (~3 km away), Mtunzini, (~5 km away) and McMurray Farm (~1 km away). However, the station data was poor with low data recovery and could not be used for assessment purposes. As such, ambient measured PM_{10} concentrations were sourced from the eSikhaleni Richards Bay Clean Air Association (RBCAA) station and from the South African Air Quality Information System (SAAQIS) eSikhawini monitoring station, which are the closest stations to the site (~20 km and ~25 km away from the site). Although these stations are the closest stations to the site, both stations are considered far and not completely representative of the site. Data was obtained for the most recent period from January 2020 to December 2022 for both monitoring stations. The data recovery was adequate, with percentages above 70% over each year at each station. The monitoring results indicated the following:

- No exceedances of the daily PM_{10} standard (75 µg/m^3) were recorded at the eSikhaleni and eSikhawini stations, except for 2021 which recorded two exceedances at each station. Annual averages at the monitoring station were below the annual (40 µg/m^3) PM_{10} standards.

The impact assessment comprised of an emissions inventory and subsequent dispersion modelling simulations. An emissions inventory for the project operations was developed using the United States Environmental Protection Agency (USEPA AP-42) and the Australian Government National Pollutant Inventory (NPI) emission factors. This emissions inventory was input into a Level 2 atmospheric dispersion model, AERMOD, together with prognostic WRF meteorological data, to calculate ambient air concentrations at specified sensitive receptors of key pollutants associated with the project operations. Sensitive receptors were identified as areas that may be impacted negatively due to emissions from the propose Heleza Moya operations.

Modelled predicted long-term and short-term average concentrations were compared with the respective National Ambient Air Quality Standards (NAAQS) as applicable for the proposed project. Additionally, cumulative impacts (i.e. existing background concentrations monitored combined with modelled predicted concentrations) were assessed.

Results indicated that:

- The modelled predicted and cumulative dust fallout rates at all sensitive receptors and across the modelling domain are expected to be below the residential and non-residential dust fallout standards.

- Modelled predicted and cumulative 24-hour and annual average PM_{10} concentrations at each sensitive receptor and across the modelling domain were below their respective 24-hour and annual average NAAQSs.

- Modelled predicted 24-hour and annual average $PM_{2.5}$ concentrations at each sensitive receptor and across the modelling domain were well below their respective 24-hour and annual average NAAQSs. No $PM_{2.5}$ background concentrations were available for the project area and as such, cumulative impacts for $PM_{2.5}$ could not be assessed.

Further, all impacts of the proposed project operations were evaluated using a semi-quantitative risk assessment methodology. The resultant environmental air quality risks for sensitive receptors were ranked “low” during the construction and operational phases with mitigation in place.

Based on the findings of the assessment, WSP recommends that the Project be authorised with the mitigation and monitoring measures, as discussed in Section 10.0 and Section 11.0, ongoing, to effectively control fugitive emissions.

Declaration of Independence

Novania Reddy is a consultant with over 10 years' experience in the environmental industry. Her area of expertise lies within the air quality and acoustics fields related to sectors ranging from mining to the oil and gas industry. She holds the responsibility of data collection, inventory development, compilation of air emission licence and scientific modelling and reporting. Novania has a broad understanding of the various laws and regulations associated with the air quality and noise procedures.

I hereby declare that I am fully aware of my responsibilities in terms of the National Environmental Management Act: Environmental Impact Assessment Regulations of 2014 and that I have no financial or other interest in the undertaking of the proposed activity other than the imbursement of consultant's fees.

Name:	Novania Reddy
Company:	WSP Group Africa (Pty) Ltd
Contact Details:	+27 11 254 4917
	novania.reddy@wsp.com
Signature:	

List of Abbreviations and Terms	
AQIA	Air Quality Impact Assessment
ASTM	American Society for Testing and Materials
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CoA	Commonwealth of Australia
CPC	Central Processing Complex
EA	Environmental Authorisation
EAP	Environmental Assessment Practitioner
EIA	Environmental Impact Assessment
EMP	Environmental Management Program
EMPr	Environmental Management Programme
FBA	Fairbreeze A
FBB	Fairbreeze B
FBC	Fairbreeze C
FBCX	Fairbreeze C Extension
GNR	Government Notice Regulation
KZN	KwaZulu-Natal
LDV	Light Duty Vehicle
LoM	Life of Mine
MMIF	Mesoscale Model Interface Program
MSP	Mineral Separation Plant
NAAQS	National Ambient Air Quality Standard
NEM:AQA	National Environmental Management: Air Quality Act (Act no. 39 of 2004)
NO_2	Nitrogen Dioxide
NO_x	Oxides of Nitrogen
NPI	National Pollutant Inventory
O_3	Ozone
Pb	Lead
PM_{10}	Particulate matter of aerodynamic diameter 10 microns
$PM_{2.5}$	Particulate matter of aerodynamic diameter 2.5 microns
PR	Prospecting Right
PWP	Primary Wet Plant

List of Abbreviations and Terms	
ROM	Run-of-Mine
RSF	Residue Storage Facility
SANAS	South African National Accreditation System
SAWS	South African Weather Service
SO_2	Sulphur Dioxide
SRTM	Shuttle Radar Topography Mission
TiO_2	Titanium Dioxide
Tronox	Tronox Kwa-Zulu Natal Sands (Pty) Ltd
TSP	Total Suspended Particulates
USEPA	United States Environmental Protection Agency
WRF	Weather Research and Forecasting
WSP	WSP Group Africa (Pty) Ltd

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1.0 INTRODUCTION

Tronox Kwa-Zulu Natal Sands (Pty) Ltd (Tronox) currently operates the Fairbreeze Mine, located immediately south-west of Mtunzini, where heavy mineral sands are mined. The heavy mineral concentrate is then trucked to the Tronox Central Processing Plant (CPC) for refinement. The Fairbreeze Mine is supported by a Mineral Separation Plant (MSP) and Smelter, collectively known as the CPC in Empangeni. The main products include titanium dioxide (TiO_2) slag, rutile, zircon, leucoxene and high purity iron which are produced for sale mainly to international markets.

Tronox plans to extend its Fairbreeze mining operations to include a surface right known as Heleza Moya. Heleza Moya tenement falls within the approved Fairbreeze mining right and was recently acquired through a sale agreement.

Having concluded the sale agreement with the owner, Tronox now plans to incorporate this area into their active mine plan as it lies immediately adjacent to mineable reserves. This inclusion will require an amendment to the approved environmental management program (EMP) to authorise mining activities on this property. Tronox has appointed WSP Group Africa (Pty) Ltd (WSP) as the independent Environmental Assessment Practitioner (EAP) to undertake the EMP amendment. As part of the EMP amendment, a specialist Air Quality Impact Assessment (AQIA) is required.

This report presents the findings from the AQIA, using a Level two dispersion model (AERMOD) to predict the potential air quality impacts associated with the proposed Project. Included in this report is a description of the background of the proposed Project; a discussion on the associated atmospheric emissions and relevant air quality legislation; a description of the methodology utilised in the study; identification of sensitive receptors; dispersion modelling predictions as well as an assessment of the related impacts.

1.1 Terms of Reference

The terms of reference to best meet the Project requirements are summarised below:

- Baseline Assessment:
  - Review of applicable local air quality legislation.
  - Review of the potential pollutants and associated human health effects.
  - Review of available ambient air quality and meteorological data for the area where available.
  - Identification of neighbouring sensitive receptors, including adjacent communities and farmers and residential areas in and around the Project mining rights area.
  - Identification of any neighbouring sources surrounding the proposed operations. Emissions from these sources are not included into the dispersion model, but a discussion on how they may contribute to the cumulative air quality conditions is included.
- Emissions Inventory and Dispersion Modelling:
  - Compilation of an emissions inventory for identified sources of emissions, with a focus on particulate matter of aerodynamic diameter 10 and 2.5 microns (PM_{10} and $PM_{2.5}$) and total suspended particulates (TSP), in the form of dust fallout.
  - Undertake dispersion modelling simulations (AERMOD, Level two) to determine the air quality impacts associated with the proposed operations.
  - Comparison of predicted model concentrations to air quality standards.
- AQIA:

- Compilation of an AQIA, including recommendations for mitigation measures and ambient air quality monitoring (if required).

2.0 PROJECT LOCATION

The proposed project area is in the uMhlathuze Local Municipality that falls under the King Cetshwayo District Municipality in the province of KwaZulu-Natal. The mining rights area is also bound to the east by the Umlalazi Nature Reserve and Mondi plantations (Figure 1).

The total footprint of the current Fairbreeze mining lease area is approximately 4 120 hectares (ha) and Heleza Moya will add approximately 118.6 ha to the mining footprint, where 73.2 ha of this mineral resource has been identified as the minable reserve. The economical portion and proposed mining area is located towards the northern boundary of the Heleza Moya Farm (along the Fairbreeze B orebody).

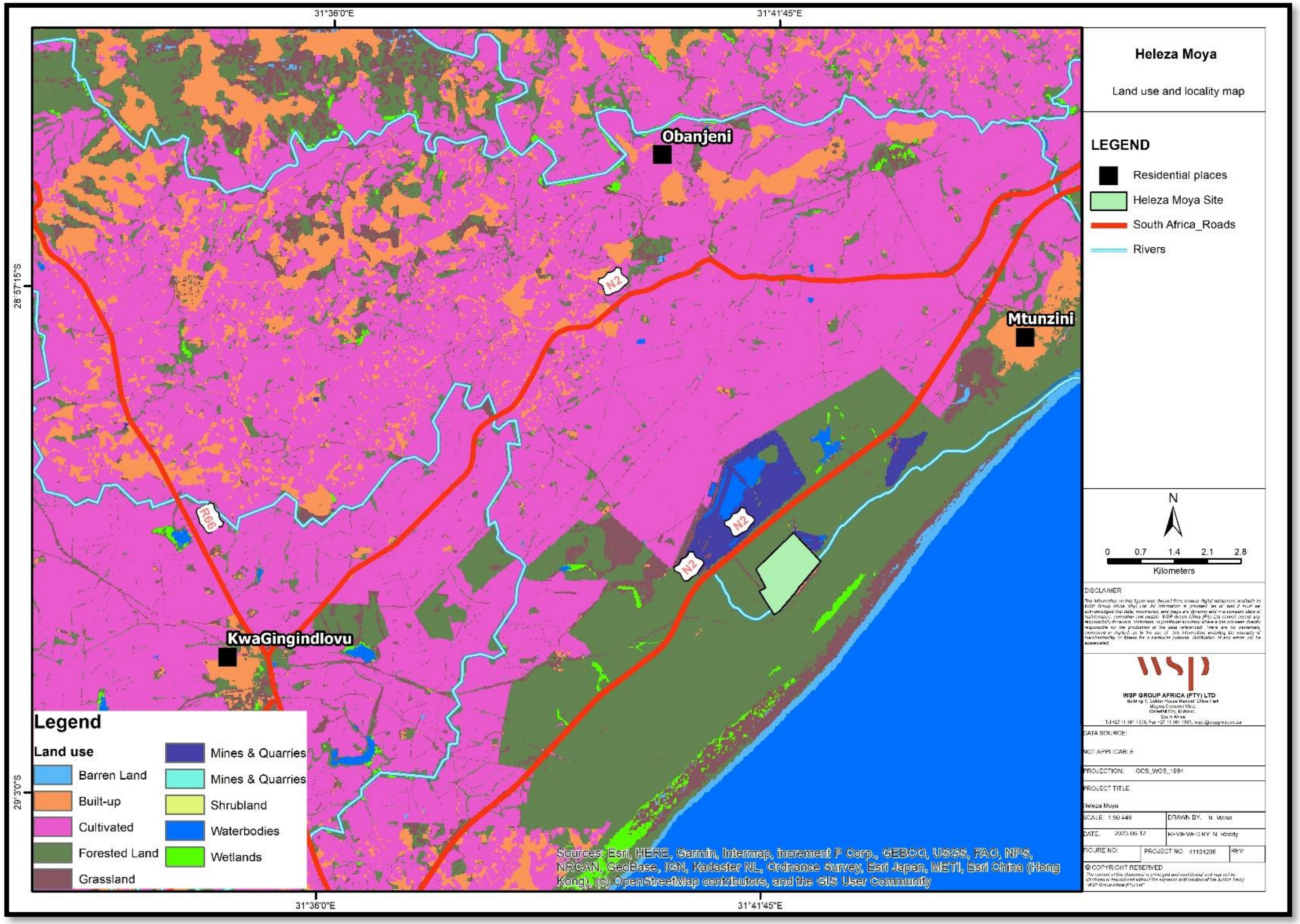


Figure 1: Locality and land use map of the Heleza Moya site

3.0 PROJECT BACKGROUND

An overview of the background to the Project is summarised below.

3.1 Activity Life Description

The proposed Project is for the mining of mineralised coastal sands at the Fairbreeze Mine, including, TiO_2 slag, rutile, zircon, leucoxene and high purity iron. The target product destination includes various end users. The heavy minerals extracted from the sand are used to produce the following:

- TiO_2 pigment which is used in paints, plastics, paper laminates, ink and the food market.
- Titanium metal.
- Welding consumables.
- Titanium feedstocks used in the manufacture of brake pads, roof tiles and in the glass industry.
- Zircon used for the manufacturing of ceramics, foundry, refractory, zirconia and other zircon chemicals.

There are four ore bodies presently forming part of the Fairbreeze Mine, known as:

- Fairbreeze A (FBA).
- Fairbreeze B (FBB).
- Fairbreeze C (FBC).
- Fairbreeze C extension (FBCX).

The current proposal is to expand the FBB ore body to include economically viable mineralised areas within the Heleza Moya property, as an extension to the FBB ore body which is currently being mined.

The required mineral beneficiation and infrastructure to support the mining activity and fleet is already in place and authorized under the Fairbreeze EA (DMRE Ref: KZN30/5/1/2/2/123MR) and includes water supply, power supply, on and off ramps at the N2 highway, a processing plant and tails processing infrastructure.

The remaining Life of Mine (LoM) at Fairbreeze Mine associated with all four ore bodies mentioned above is estimated to be fifteen years (i.e., 2037) at a mining rate of 2 160 tonnes per hour (tph). The proposed expansion of FBB will increase the LoM by two years (i.e., 2039). It is intended that the proposed Port Durnford mining activities (currently undergoing an EA process) will facilitate the continuation of Tronox mining operations in the area once mining at Fairbreeze ceases.

3.2 Mining Process

The detailed steps required for the mining of material from the ore body include the preparation of the mining area through the removal of vegetation and the stripping of topsoil. Specific topsoil stockpile areas have been identified and will be managed as per the current practice at Fairbreeze as defined by the existing Environmental Management Programme (EMPr).

The topsoil to be stripped is regarded as the uppermost surface layer of soil; it typically extends to a depth of 300 mm from the earth's surface. It has the highest concentration of organic matter and microorganisms and is where most of the earth's biological soil activity occurs, including plant growth. It is composed of mineral particles, organic matter, water and air. In preparation of mining, a 300 mm layer of topsoil will be stripped prior to mining of ore. The material will be hauled to the designated topsoil stockpile.

The mining method employed at Fairbreeze mine is hydraulic mining. A jet of high-pressure water is aimed at a mining face, thereby cutting into and loosening the in-situ sand so that it collapses onto the floor. The water acts as a carrier medium for the sand (Run-of-mine (ROM)), due to the high clay fines content contained in the ROM. The slurry generated by the monitors, flows to a collection sump where oversize material is removed, and the slurry is then pumped towards the Primary Wet Plant (PWP) through a system of booster pumps. The varying grade and slimes content requires the mining of different faces concurrently to reduce large variations. Up to six monitors and three pump stations (collection sump) will operate to produce rates up to 2 160 tonnes per hour. This hydraulic mining method which is in use at the FBB will continue as the FBB pit is extended to include the Heleza Moya ore body.

At the PWP the heavy minerals will be separated from the sand, silt and clay fraction. The heavy mineral concentrate will then be trucked by road to Tronox CPC at Empangeni for refinement. The fine discard or slimes material from the PWP will be pumped to an existing Residue Storage Facility (RSF) while the coarse discard or tailings will be pumped back to the mining area to backfill the mining void. The mined-out areas will be rehabilitated to achieve a pre-mining land capability.

To move from the FBB mining area onto the Heleza Moya area, some of the mining components will need to be relocated onto the area. These include the mining pumps stations which are installed by excavating the ore body mechanically and installing the pump station such that the hydraulicly slurried ROM can flow to the pump station under gravity. The high-pressure water lines would need to be extended from the current FBB area onto Heleza Moya to power the hydraulic monitor guns. Backfilling of the mined-out areas will be undertaken once mining in an ore body (or part thereof) is completed and the backfilling infrastructure is in place. Sand tails and return water pipelines will thus also be installed in areas post mining either located on previously mined footprint or along the perimeter of the mining footprint based on practical on-site considerations. Backfilling will be undertaken with coarse dewatered sand that will be returned from the PWP and distributed with open-end method. Backfilling will be undertaken so that no mining void remains, but the post-mining surface will be lower than the original surface due to the removal of the slimes component from the sand. Once the mining area is backfilled it will be contoured mechanically to assure slopes blend into the current landscape. The topsoil that was stockpiled before the mining commenced, will be returned and the area will be vegetated as per the rehabilitation process implemented on the current Fairbreeze mine areas.

3.3 Silt Management

The slurry will flow to a pump station from where it will be pumped to the existing PWP. The PWP is located immediately adjacent to the Heleza Moja area. At the PWP the heavy minerals will be separated from the sand, silt and clay fraction. The heavy mineral concentrate will then be trucked by road to Tronox CPC at Empangeni for refinement. The fine discard or slimes material from the PWP will be pumped to an existing RSF while the coarse discard or tailings will be pumped back to the mining area to backfill the mining void.

3.4 Rehabilitation and Closure

The mined-out areas will be rehabilitated with the aim of achieving a pre-mining land capability. Once mining is completed in an area, backfilling of the area with sand tailings will commence, i.e., active rehabilitation. Sand will be pumped directly from the processing plant to the void area. The process water used to transport the sand, after deposition will gravitate to a low point in the mining void from where it will be collected and returned to the PWP for re-use. Sand tails and return process water pipelines will therefore be installed in areas post mining either located on previously mined footprint or along the perimeter of the mining footprint based on practical on-site considerations.

Once the mining area is backfilled it will be contoured mechanically to assure slopes blend into the current landscape characteristics. The topsoil stockpiled before the mining will be returned and the area will be vegetated as per the rehabilitation process implemented on the current Fairbreeze mine areas and as recommended in the current EMPr. Maintenance and after care of the revegetated areas will be implemented for a minimum of three years after closure in accordance with the approved EMP to ensure that pre-mining land capability is achieved. Furthermore, rehabilitation measures for specific components will be considered should it differ to the generic EMP recommendations.

3.5 Proposed Process Description

An overview of the activities and the activity infrastructure proposed for Heleza Moya Farm is provided in the table below.

Table 1: Mining operation

Location	The mining operations will be located on Portion 3 of Farm Emoyeni 9105.
Mining rate	2 160 tph.
Mining process	The proposed mining process will involve Heleza Moya RoM material being mined using hydraulic mining method. The heavy mineral concentrate will be trucked to the Tronox CPC for further beneficiation process.
Mining programme	Mining is intended for a fifteen-year period, between 2024 and 2039.
Mineral processing	The hydraulically reclaimed ROM slurry will be pumped to the existing Fairbreeze PWP for processing. The heavy mineral concentrate will then be trucked by road to Tronox CPC at Empangeni for refinement. The fine discard or slimes material from the PWP will be pumped to an existing RSF while the coarse discard or tailings will be pumped back to the mining area to backfill the mining void.
Project layout and infrastructure	Equipment from the FBB ore body will be relocated and used at Heleza Moya. In addition, the following infrastructure and areas will also be further implemented to accommodate mining operations at Heleza Moya (Figure 2): ▪ Haul roads. ▪ Designated Light Duty Vehicle (LDV) parking. ▪ Corridor (3.6 ha) (Heleza Moya to PWP). ▪ Topsoil stockpile (40 m x 40 m x10 m) and laydown area (9.4 ha). ▪ Three pump stations along the corridor.

	■ Stormwater containment area.
Associated infrastructure	***Power supply*** Eskom's existing 88kV powerline supplies electricity to the buildings that are currently located on the property. No additional powerlines will be required for the operation of Heleza Moya. ***Water supply*** Water is currently obtained from Mthlathuze water, there is a pipeline from Hillendale mine to Fairbreeze mine for the supply of water.
Employment requirements	It is currently estimated that the employment opportunities available will remain the same as the current Faibreeze mine operation, However, contractors will be used in site establishment and site preparation for Heleza Moya.

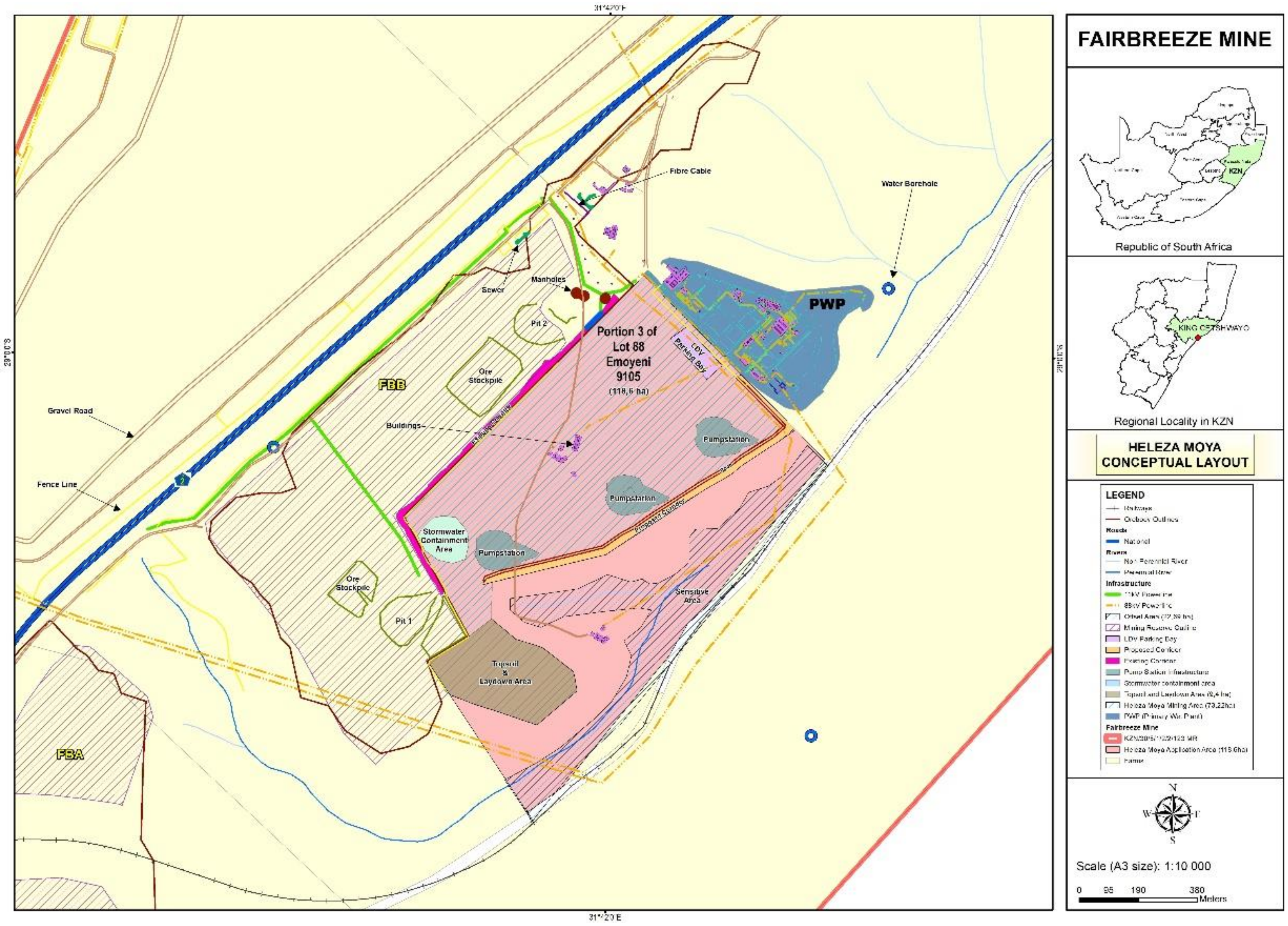


Figure 2: Moya conceptual layout

3.6 Project Activities for each Phase of the Proposed Project

The following activities are anticipated for each phase of the proposed Project:

- Construction phase:
  - Obtaining the rights to the mine the land.
  - Prior to site establishment all authorisations need to be in place.
  - Bulk earthworks.
  - Development and relocation of required service infrastructure on the site.
  - Development of access roads.
  - Site establishment.
  - Topsoil stripping.
  - Construction of Project components.
- Operational phase:
  - Mining to commence.
  - Progressive backfilling and rehabilitation to take place. Anticipated that two to four years post the commencement of mining in a block, this area will be subject to rehabilitation.
  - Ongoing processing and supporting activities.
  - Disposal of wastes from the mining process.
- Decommissioning phase:
  - Plant to be demolished and materials to be removed.
  - Termination of all services to the area.
  - Rehabilitation of all areas to be completed sufficiently to meet relevant commitments of the closure plan.
- Closure and post closure
  - Ongoing monitoring of post-closure impacts and success of rehabilitation as required in terms of the closure plan.

4.0 ATMOSPHERIC EMISSIONS AND IMPACTS

4.1 Health and Environmental Impacts

The key pollutants associated with the proposed Project include dust fallout and particulate matter (PM) of aerodynamic diameter 10 and 2.5 microns (PM_{10} and $PM_{2.5}$). A description of the health effects of these pollutants is provided below.

4.1.1 Dust

Dust fallout also known as settleable PM is defined as any material composed of particles small enough to pass through a 1 mm screen and large enough to settle by virtue of weight into a sampling container from ambient air (DEA, 2013). Impacts on the environment as a result of dust fallout are often limited to nuisance effects.

Nuisance effect refers to environmental impacts of dust that are not health related. Nuisance dust effects often result in the soiling and discolouration of personal property and can result in physical irritation in plants and animals (Michigan Department of Environmental Quality, 2016).

4.1.2 Particulate Matter

PM refers to solid or liquid particles suspended in the air. PM varies in size from particles that are only visible under an electron microscope to soot or smoke particles that are visible to the human eye. PM contributes greatly to deteriorations in visibility, as well as posing major health risks, as small particles (PM_{10}) can penetrate deep into lungs, while even smaller particle sizes ($PM_{2.5}$) can enter the bloodstream via capillaries in the lungs, with the potential to be laid down as plaques in the cardiovascular system or brain.

Health effects include:

- Respiratory problems;
- Lung tissue damage;
- Cardiovascular problems; cancer; and
- Premature death.

Acidic particles may damage buildings, vegetation and acidify water sources (USEPA, 2011).

5.0 AIR QUALITY LEGISLATION

5.1 South African Ambient Air Legislation

The National Environmental Management: Air Quality Act 39 of 2004 (NEM:AQA), which repeals the Atmospheric Pollution Prevention Act (APPA) of 1965, came into effect on 11 September 2005, with the promulgation of regulations in terms of certain sections resulting in the APPA being repealed entirely on 1 April 2010. The NEM:AQA introduced a management system based on ambient air quality standards and corresponding emission limits to achieve them.

5.1.1 Ambient Air Quality Standards

Ambient air quality standards are specified in the NEM:AQA, with the priority pollutants being sulphur dioxide (SO_2), nitrogen dioxide (NO_2), PM_{10}, $PM_{2.5}$, ozone (O_3), benzene (C_6H_6), lead (Pb) and carbon monoxide (CO). Standards for SO_2, NO_2, PM_{10}, O_3, C_6H_6, Pb and CO were promulgated in 2009, with the standards for $PM_{2.5}$ later promulgated in 2012. Only the pollutants relevant to this study, PM_{10} (Government Notice (GN) 1210 of 2009) and $PM_{2.5}$ (GN 486 of 2012) are summarised in Table 1.

Table 1: South African ambient air quality standards for particulate matter (PM_{10} and $PM_{2.5}$)

Pollutant	Averaging Period	Concentration (µg/m^3)	Frequency of Exceedance	Compliance Date
PM_{10}	24-hour	75	4	1 January 2015
	1 year	40	0	1 January 2015
$PM_{2.5}$	24-hour	40	4	1 January 2016 – 31 December 2029
		25	4	1 January 2030
	1 year	20	0	1 January 2016 – 31 December 2029

Pollutant	Averaging Period	Concentration ($\mu g/m^3$)	Frequency of Exceedance	Compliance Date
		15	0	1 January 2030

5.1.2 National Dust Fallout Standards

The NEM:AQA, National Dust Control Regulations, were published in Government Notice Regulation (GNR) 827 of November 2013 (Government Gazette 36974). However, updated Draft National Dust Control Regulations were subsequently published in GNR 517 of May 2018 (Government Gazette 41650), bringing about certain changes in the permitted dust fallout monitoring methodology. Where GNR 827 of November 2013 allowed the use of American Society for Testing and Materials (ASTM) D1739:1970 or equivalent methodology, GNR 517 of May 2018 specifically states that the latest version of the ASTM D1739 method must be utilised. Currently the latest version is ASTM D1739:1998 methodology of 2010.

5.1.2.1 Updates to the National Dust Control Regulations

Key changes, although not limited to these, in the Draft Dust Control Regulations include:

- Permission to exclude exceedances caused by non-anthropogenic sources.
- The reference method is now the latest version of ASTM (D1739:1998), no longer ASTM D1739:1970.
- The latest ASTM D1739 requires samplers be installed with a windshield, which has been proven to increase the accuracy of capturing dust fallout.
- All mining operations must implement a dust fallout monitoring program.
- Analysis of both the soluble and insoluble content of samples. Current legislation only requires insoluble content analysis.
- Submission of dust fallout monitoring reports on a monthly basis to the relevant Air Quality Officer.
- Current dust fallout levels compared to historic results for at least the previous four years (where available).
- All mining operations must implement a dust management plan.
- Provide proof of the implementation of the dust management plan in the monthly monitoring reports.

The Draft National Dust Control Regulations (GN 517 of May 2018) are effective as of 1 November 2019. However, despite this effective date, the new regulations have not yet been promulgated, therefore GNR 827 of 2013 remains in force.

The dust fallout rates, as included in the National Dust Control Regulations, are presented in Table 2.

Table 2: National dust fallout standards

Restriction Areas	Dust Fallout Rate (D) ($mg/m^2/day$) 30-day average(1)	Permitted frequency of exceeding dust fallout Rate	Reference Method
Residential Area	D < 600	Two within a year, not sequential months	ASTM D1739
Non-Residential Area	600 < D < 1 200(2)	Two within a year, not sequential months	ASTM D1739

This table provides the information as contained in the National Dust Control Regulations. Two aspects to note:

(1) The dust fallout rate is referred to only in mg/m^2/day and not normalised to the 30-day average. The rate can only be presented to either and not both. The 30-day average will require an adjustment to the accepted rates.

(2) The accepted dust fallout rate at Non-Residential areas is below 1 200 mg/m^2/day.

6.0 BASELINE ASSESSMENT

6.1 Study Area

The predominant land use in the project development area is agriculture, with commercial timber plantations and forestry. The largest portion of the Project area is currently used for commercial Eucalyptus plantations. Endemic vegetation in the form of swamp forests, wetlands and small portions of coastal dune forests, occurs in the drainage channels and streams between the plantations (Exxaro, 2009). Other land uses in the area include mining, commercial sugarcane farming, aqua-ponic exotic fish farming, organic flower farming, tea-tree cultivation, fruit farming, university, rural and urban settlements, Umlalazi Nature Reserve, industry, roads and railways (Snyman, 2008; Exigent, 2012). General infrastructure in the project development area includes electric power lines, which cross the area in an east to west direction, as well as a railway line that transects the eastern portion of the area.

6.2 Sensitive Receptors

Sensitive receptors are identified as areas that may be impacted negatively due to air quality associated with the proposed project. Examples of receptors include, but are not limited to, schools, shopping centres, hospitals, office blocks and residential areas. The identification of sensitive receptors was based on a desktop assessment using the most recent satellite imagery available on Google Earth Pro™. Additionally, this was cross-correlated with receptors identified in previous monitoring campaigns. Some of those receptors are no longer in place and hence not included in this report. It is therefore assumed that all key receptors have been considered.

Surrounding towns include Mtunzini (immediately northeast of Fairbreeze), Mbizimbelwe (immediately southwest of Fairbreeze), KwaGingindlovu (~3.7 km west-northwest of Fairbreeze), Mabhokweni (~3.9 km northwest of Fairbreeze), Mabangwa (~2.5 km northwest of Fairbreeze), Nguqu (~3.4 km northwest of Fairbreeze), Obanjeni (~5.2 km northwest of Fairbreeze) and Izingeni (~4.2 km north-northwest of Fairbreeze). Scattered farmhouses / free-standing receptors are also evident at varying distances from Fairbreeze.

The sensitive receptors identified in the area surrounding the Fairbreeze Mine and proposed Heleza Moya operations are listed in Table 3 and depicted in Figure 4 below.

Importantly, the scope of this report does not include the acoustic impacts on avifauna or any other animals. It is assumed that these impacts will be addressed in a separate biodiversity specialist study. Nonetheless, based on the fact that Fairbreeze has been a mining site for the past eight years (Tronox, 2019), the immediate climate has been dominated by anthropogenic mining activities and animal receptors are likely used to this, so no additional impacts as a result of the Heleza Moya operations are assumed.

Table 3: Sensitive receptors surrounding the proposed Heleza Moya operations

Receptor ID	Latitude (°S)	Longitude (°E)	Distance from Site Boundary (km)	Direction from Site
FB 01	28.9550	31.7349	6.0	North-northeast
FB 02	28.9611	31.7288	5.1	North-northeast
FB 03	28.9870	31.7280	3.0	Northeast
FB 04	28.9854	31.7316	3.3	Northeast

Receptor ID	Latitude (°S)	Longitude (°E)	Distance from Site Boundary (km)	Direction from Site
FB 05	28.9822	31.7369	4.0	Northeast
FB 06	29.0357	31.6616	4.3	Southwest
FB 07	29.0441	31.6542	5.4	Southwest
FB 08	29.0379	31.6185	8.0	West-southwest
FB 09	29.0384	31.6382	6.3	Southwest
FB 10	29.0241	31.6519	4.4	West
FB 11	29.0233	31.6450	5.0	West
FB 12	29.0139	31.6463	4.7	West
FB 13	29.0287	31.6011	9.3	West-southwest
FB 14	29.0280	31.5973	9.7	West-southwest
FB 15	29.0410	31.6091	9.0	Southwest
FB 16	29.0475	31.6048	9.6	Southwest
FB 17	29.0166	31.6203	7.3	West
FB 18	29.0023	31.6104	8.2	West
FB 19	29.0007	31.6151	7.7	West
FB 20	29.0019	31.6274	6.5	West
FB 21	28.9920	31.6323	6.3	Northwest
FB 22	28.9941	31.6430	5.0	Northwest
FB 23	28.9902	31.6474	4.7	Northwest
FB 24	28.9924	31.6563	3.8	Northwest
FB 25	28.9941	31.6607	3.4	Northwest
FB 26	28.9884	31.6574	4.0	North-northwest
FB 27	28.9802	31.6531	4.7	North-northwest
FB 28	28.9844	31.6657	3.4	North-northwest
FB 29	28.9719	31.6873	3.2	North
FB 30	28.9788	31.6674	3.7	North-northwest
FB 31	28.9497	31.6790	5.8	North
FB 32	28.9452	31.6824	6.3	North
FB 33	28.9506	31.6974	5.3	North
FB 34	28.9474	31.7006	5.7	North
FB 35	28.9483	31.7090	5.7	North

Receptor ID	Latitude (°S)	Longitude (°E)	Distance from Site Boundary (km)	Direction from Site
FB 36	28.9463	31.7104	6.0	North
FB 37	28.9421	31.7118	6.5	North
FB 38	28.9447	31.7196	6.3	North
FB 39	28.9553	31.7283	5.6	North-northeast

Figure 3: Sensitive receptors surrounding the proposed Heleza Moya operations

6.3 Meteorology

Since meteorological conditions affect how pollutants emitted into the air are directed, diluted and dispersed within the atmosphere, the incorporation of reliable data into an air quality assessment is of the utmost importance. Dispersion comprises vertical and horizontal components of motion. The stability of the atmosphere and the depth of the atmospheric mixing layer control the vertical component. The horizontal dispersion of pollution in the boundary layer is primarily a function of the wind field. The wind speed determines both the distance of downwind transport and the rate of dilution as the plume 'stretches'. Mechanical turbulence is influence by wind speed in combination with surface roughness.

Parameters that need to be taken into account in the characterisation of dispersion potential include wind speed, wind direction, atmospheric stability, ambient air temperature and mixing depth. To accurately represent meteorological conditions for the project, site-specific data from the South African Weather Service (SAWS) Mtunzini weather station (Latitude: 28.9470°S, Longitude: 31.7070°E, approximately 6 km northeast of the proposed site) for the period January 2020 to December 2022, was obtained. Additionally, modelled AERMET-Ready Weather Research and Forecasting (WRF)-Mesoscale Model Interface Program (MMIF) data was purchased from Lakes Environmental for comparison of the data. An AERMET-ready WRF dataset for the period January 2020 to December 2022 centred in the middle of the project site (Latitude: 29.0031°S, Longitude: 31.6980 °E) and covering a domain of 50 km x 50 km was utilised.

The South African National Accreditation System (SANAS, 2012) TR 07-03 standards stipulate a minimum data recovery of 90% for the dataset to be deemed representative of conditions during a specific reporting period. The percentage recovery for the SAWS and WRF modelled data was above 90% and is thus considered reliable for use in this assessment. The percentage data recovery for each meteorological variable for all data sets are given in Table 4.

Table 4: Percentage data recovery for the SAWS Mtunzini weather station and WRF modelled data for the period January 2020 to December 2022

Parameter	SAWS Mtunzini Recovery (%)	WRF Data Recovery (%)
Wind speed (m/s)	97	100
Wind direction (°)	97	100
Temperature (°C)	97	100
Relative Humidity (%)	97	100
Rainfall (mm)	97	100

6.3.1.1 Temperature, Rainfall and Humidity

Air temperature in any pollutant study is important for assessing the effects of plume buoyancy as well as the development of inversion and mixing layers, while rainfall is an important pollutant removal mechanism especially in the case of particulate matter.

Figure 6 presents the average, maximum and minimum temperatures, whilst Figure 7 presents the humidity and total monthly rainfall recorded using the Mtunzini station data for the 2020 to 2022 period. The region typically receives higher levels of rainfall during the warmer, summer (December to February) months, with drier conditions during the cooler, winter months (June, July and August). The total rainfall received for 2020, 2021 and 2022 was 1 037 mm, 1 591 mm and 1 208 mm, respectively. Temperatures ranged from a low of 2°C, 1°C and 2°C in 2020, 2021 and 2022, respectively in winter to a high of 41°C, 43°C and 39°C in 2020, 2021 and

2022, respectively in summer. The average relative humidity for 2020, 2021 and 2022 recorded was 75%, 76% and 76%, respectively.

Figure 6 presents the average, maximum and minimum temperatures, whilst Figure 7 presents the humidity and total monthly rainfall recorded using WRF modelled data for the 2020 to 2022 period. The region typically receives higher levels of rainfall during the warmer, summer (December to February) months, with drier conditions during the cooler, winter months (June, July and August). The total rainfall received for 2020, 2021 and 2022 was 804 mm, 1 102 mm and 1 322 mm, respectively. Temperatures ranged from a low of 6°C, 6°C and 8°C in 2020, 2021 and 2022, respectively in winter to a high of 41°C, 40°C and 39°C in 2020, 2021 and 2022, respectively in summer. The average relative humidity for 2020, 2021 and 2022 recorded was 70%, 72% and 74%, respectively.

Both data sets produced similar ranged values and hence gives confidence that the WRF modelled data is an accurate representation for the dispersion model.

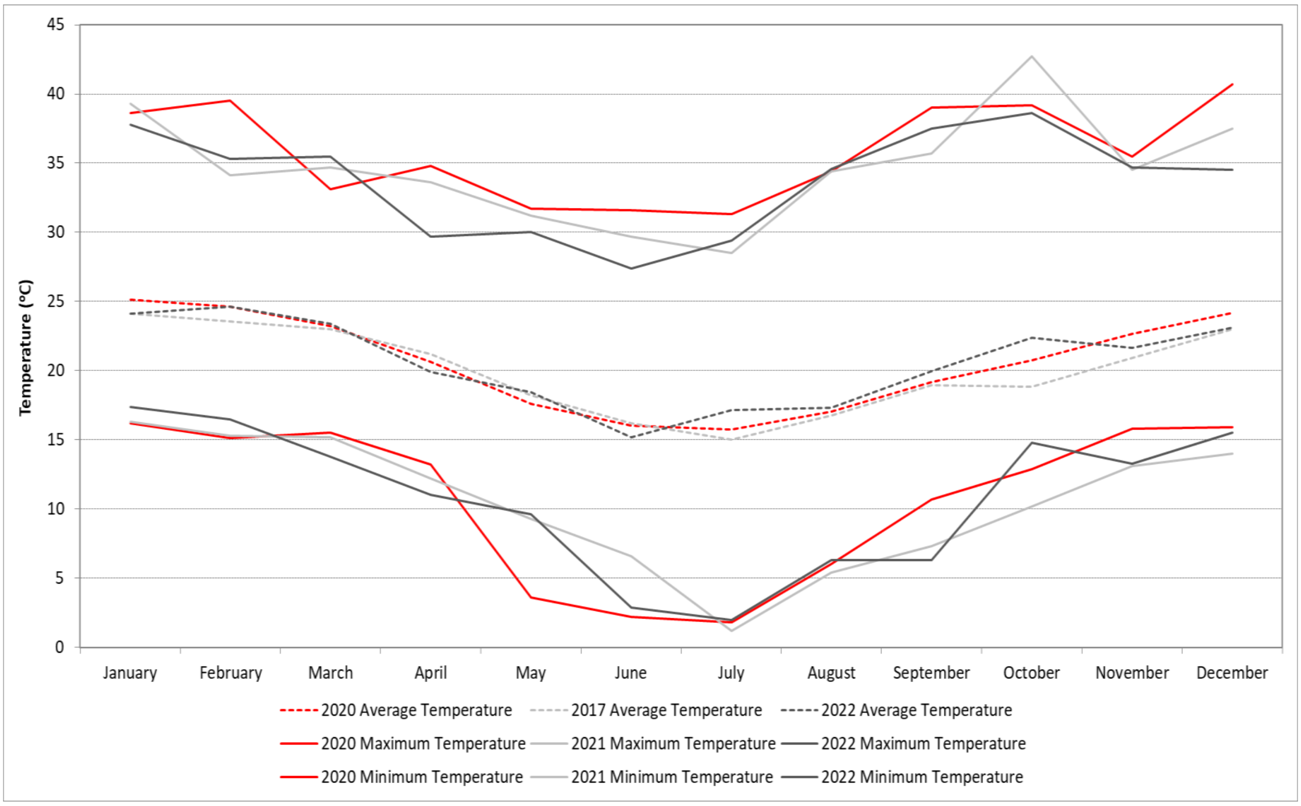


Figure 4: Average, maximum and minimum monthly temperatures for the period January 2020 to December 2022 using the SAWS Mtunzini weather station data

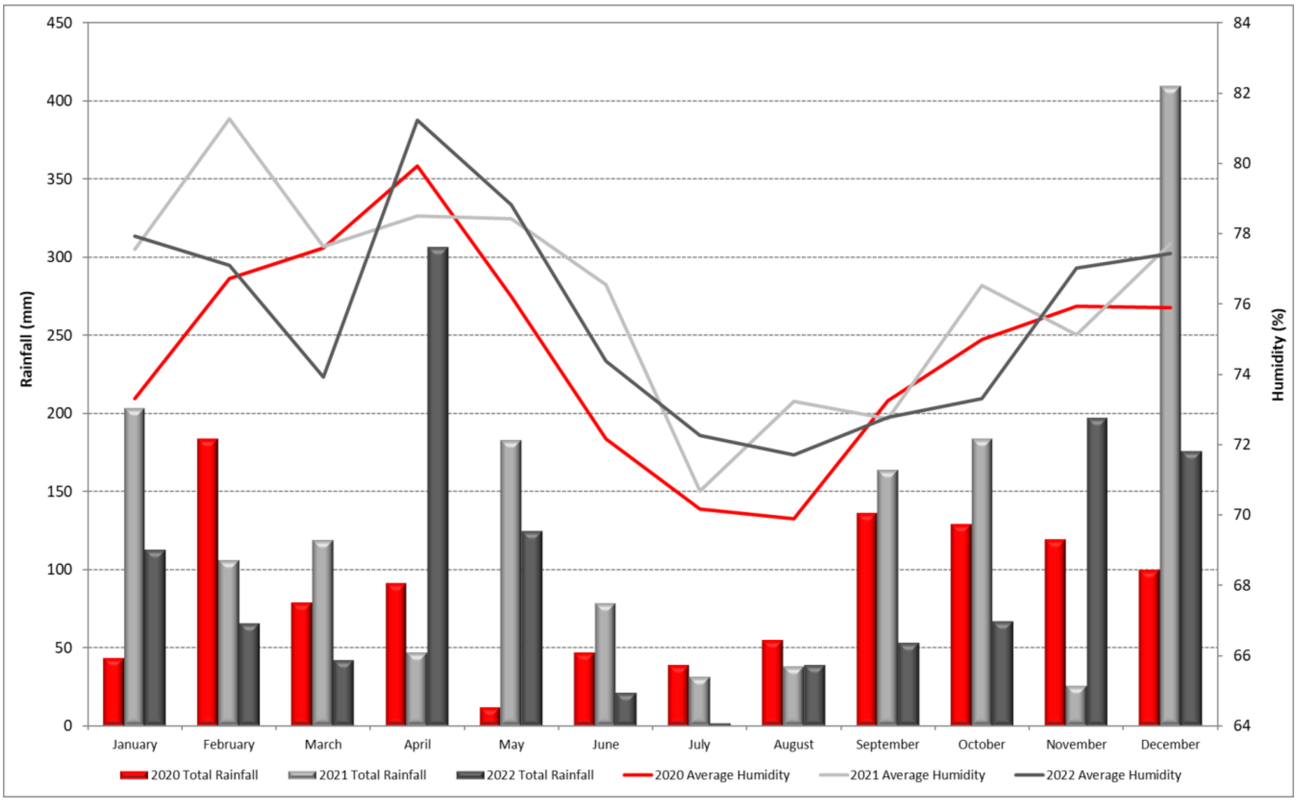


Figure 5: Total monthly rainfall and average humidity for the period January 2020 to December 2022 using the SAWS Mtunzini weather station data

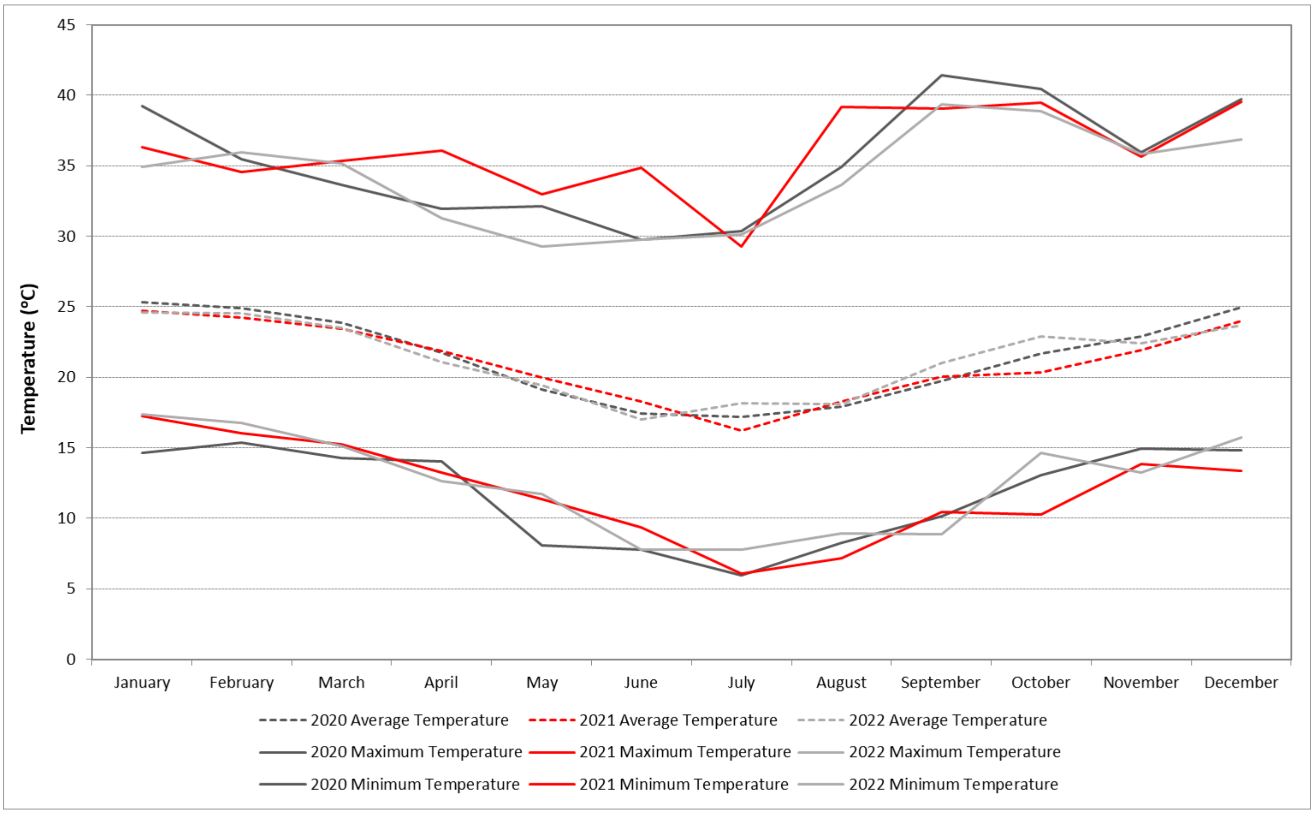


Figure 6: Average, maximum and minimum monthly temperatures for the period January 2020 to December 2022 using modelled WRF data

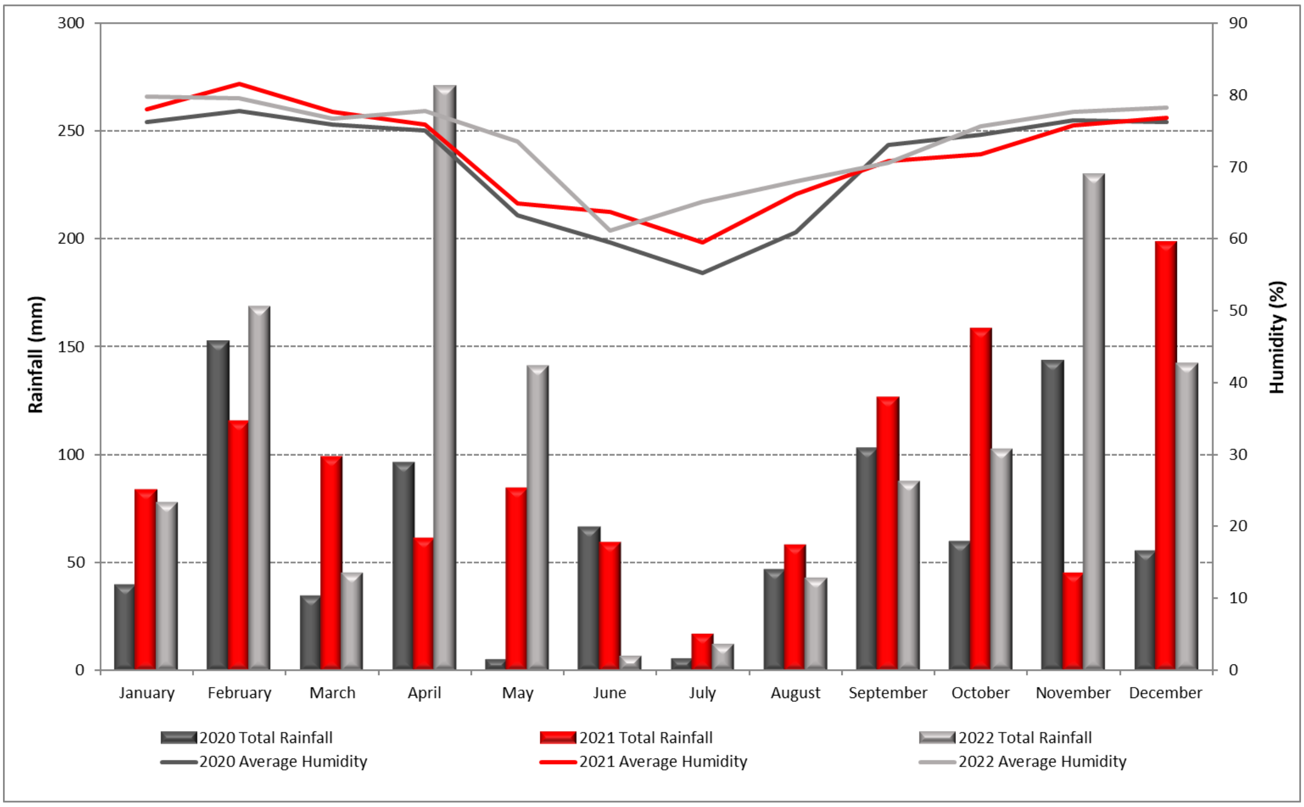


Figure 7: Total monthly rainfall and average humidity for the period January 2020 to December 2022 using modelled WRF data

6.3.1.2 Wind Field

Wind roses summarize wind speed and directional frequency at a location. Calm conditions are defined as wind speeds less than 1.0 m/s. Each directional branch on a wind rose represents wind originating from that direction. Each directional branch is divided into segments of colour, each representative of different wind speeds.

Typical wind fields are analysed for the full period; diurnally for early morning (00h00–06h00), morning (06h00–12h00), afternoon (12h00–18h00) and evening (18h00–00h00); and seasonally for summer (December, January and February), autumn (March, April and May), winter (June, July and August) and spring (September, October and November), using the Mtunzini weather station data and WRF modelled data.

Wind roses from the Mtunzini weather station data are presented in Figure 8 and are further discussed below.

- North-easterly winds are dominant in the region for the entire period, with calm conditions occurring ~22% of the time and an average wind speed of 3 m/s recorded.
- West-south-westerly winds are dominant during the early morning hours (00h00-06h00).
- From the morning and into the night (06h00-00h00) north-easterly winds are dominant.
- North-easterly winds prevail during summer and spring, whilst west-south-westerly winds prevail during autumn and winter. A west-south-westerly wind is also evident throughout the year. Stronger wind speeds are observed during spring.

Wind roses from the WRF modelled data are presented in Figure 9 and are further discussed below.

- North-north-easterly winds prevail in the region for the entire period, with calm conditions occurring ~1% of the time and an average wind speed of 5 m/s recorded.

- North-north-easterly winds prevail during the early morning hours (00h00-06h00) into the late morning (06h00-12h00). Winds from the west-south-west are however stronger from 06h00-12h00.
- In the afternoon (12h00-18h00) east-north-easterly winds prevail, with speeds strengthening at this time. During the night (18h00-00h00) north easterly winds prevail.
- Seasonally, winds from the north-northeast prevail throughout the year with stronger wind speeds observed during spring.

When comparing both wind datasets, it was observed that winds from the north-northeast prevailed using the modelled WRF data, with the Mtunzini weather station indicated a slight shift in winds with prevailing winds from the northeast. As such, similar trends in wind directions were observed and hence gives confidence that the WRF modelled data is an accurate representation for the dispersion model. The slight changes in data can, however, be associated with the height of the datasets and the location of the datasets.

Furthermore, when comparing this data with the wind conditions in the Air Quality Impact Assessment for the Fairbreeze Mine, undertaken by SGS in 2011, which stated that the predominant winds at Mtunzini over the 2007 to 2009 period originated from the north to the east-northeast (28.5%), a slight difference in wind direction is noted. The average wind speed for the 2007 to 2009 period was 4.8 m/s with calms occurring ~ 0.04% of the time. Changes in data can be attributed to the changes in climatic conditions over time (i.e. over ten years).

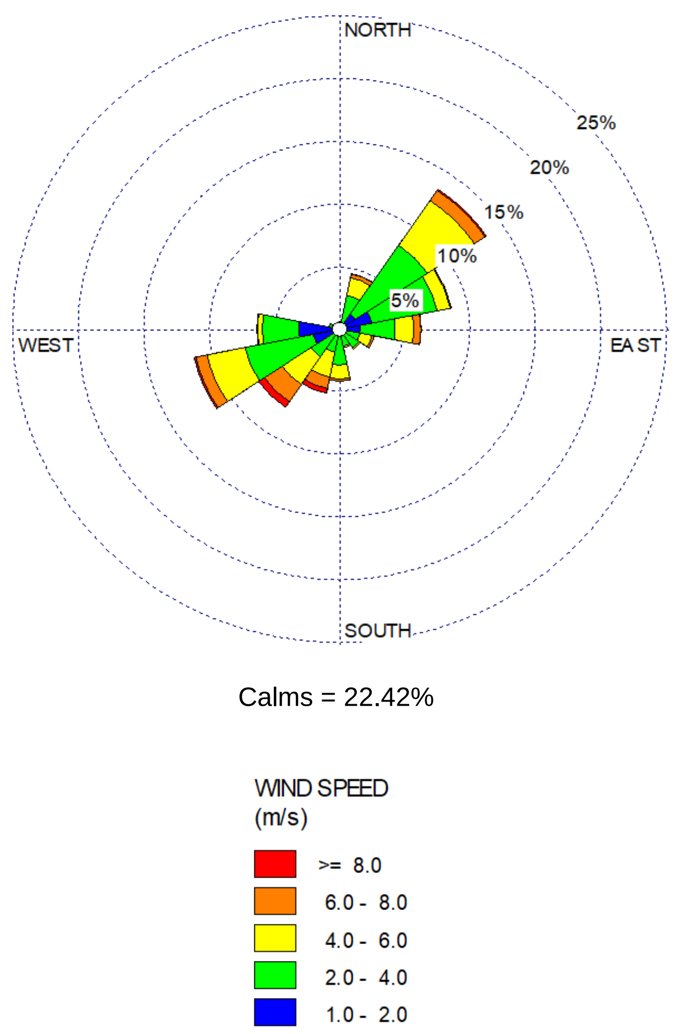
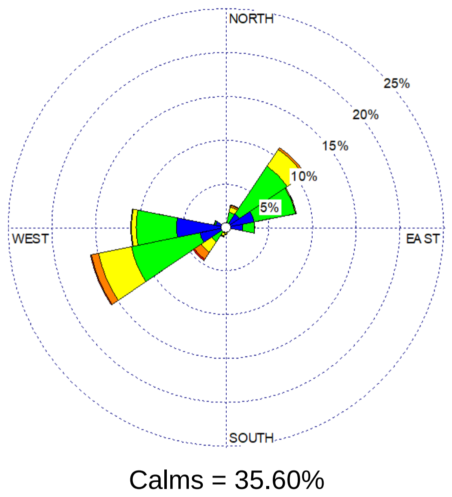
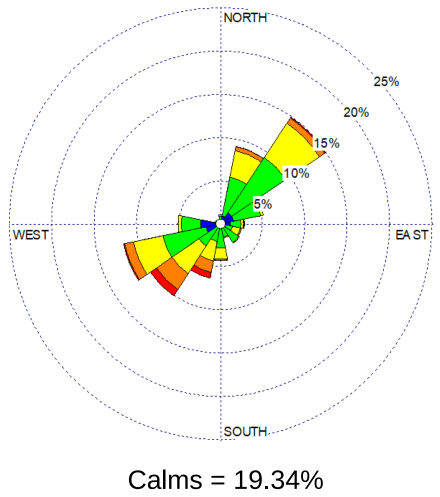
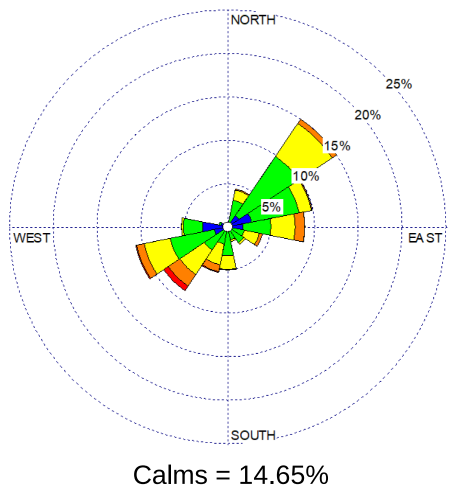
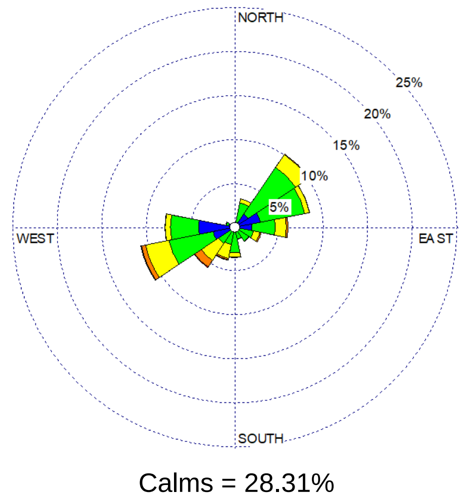
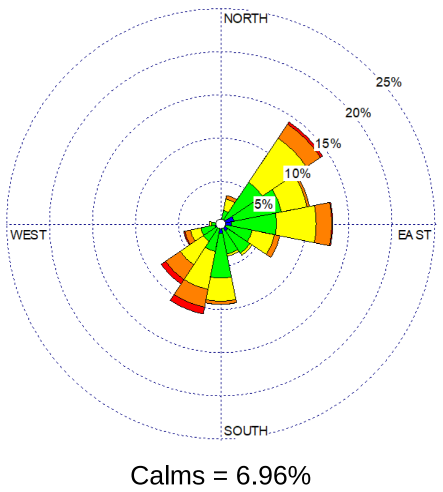
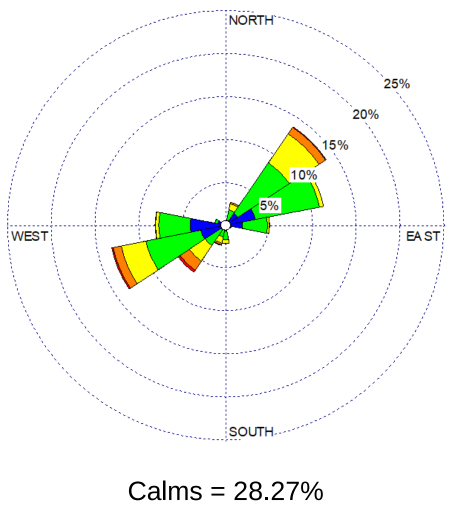
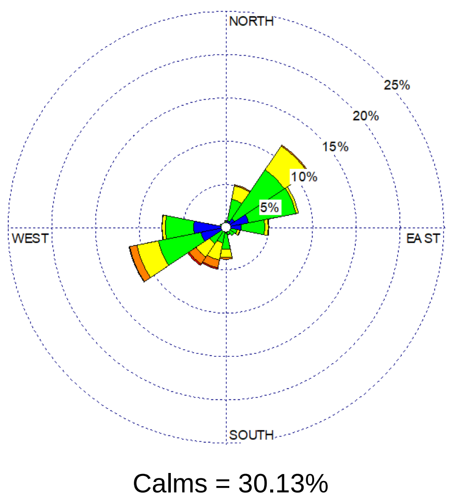
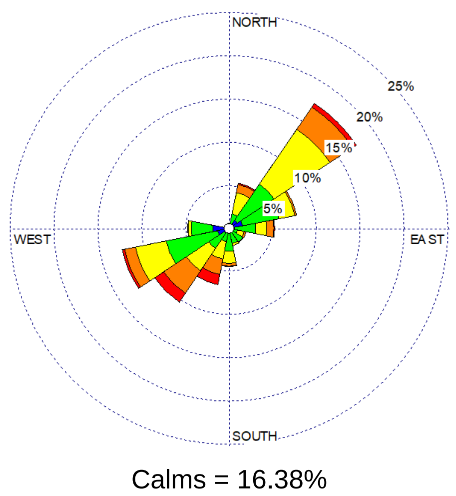
SAWS Mtunzini Weather Data	Early Morning	Late Morning	Summer	Autumn
January 2020 – December 2022	00h00 – 06h00	06h00 – 12h00	December, January & February	March, April & May
				
	Afternoon / Evening	Night	Winter	Spring
	12H00 – 18H00	18h00 – 00h00	June, July & August	September, October & November
				

Figure 8: Wind conditions for the Port Dunford region for the period January 2020 to December 2022 using SAWS Mtunzini weather data

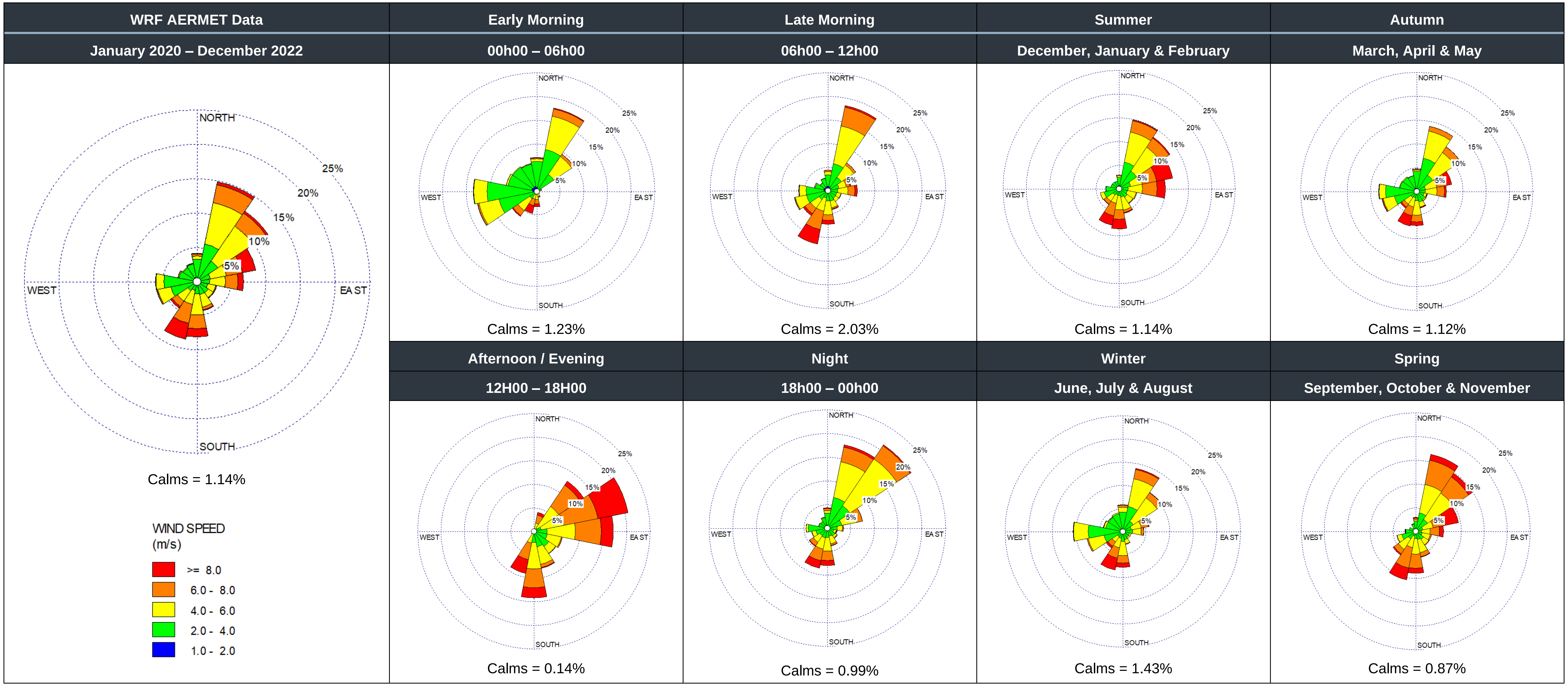


Figure 9: Wind conditions for the Heleza Moya region for the period January 2020 to December 2022 using WRF modelled data

6.4 Ambient Air Quality

6.4.1 Existing Sources of Emissions

The predominant land use in the Project development area is mining and agriculture. Other land uses in the area include vehicle tailpipe emissions and domestic fuel burning at neighbouring residential areas and settlements.

6.4.1.1 Agricultural Activities

Emissions from agricultural activities are difficult to control due to the seasonality of emissions and the large surface area producing emissions (USEPA, 1995). Expected emissions resulting from agricultural activities include particulates associated with wind erosion, ploughing and burning of crop residue, chemicals associated with crop spraying and odiferous emissions resulting from manure, fertilizer and crop residue.

Dust associated with agricultural practices may contain seeds, pollen and plant tissue, as well as agrochemicals, such as pesticides. The application of pesticides during temperature inversions increases the drift of the spray and the area of impact. Dust entrainment from vehicles travelling on gravel roads may also cause increased particulates in an area. Dust from traffic on gravel roads increases with higher vehicle speeds, more vehicles and lower moisture conditions.

The proposed Project is surrounded by commercial timber plantations and forestry as well as commercial sugarcane farming. These are most likely the contributors of fugitive emissions from agricultural activities. However, it is noted that fugitive emissions from agricultural activities generally have confined impacts near to the source, limiting the regional impacts.

6.4.1.2 Industrial Activities

Several industrial sources are located within the regional Project area which result in a significant amount of particulate emissions. These include the existing Fairbreeze Mine just north of the proposed site, Antioxidants Aromas and Fine Chemicals (AAFC), BHP Billiton Bayside and Hillside Smelters, Foskor Fertiliser Plant, Tongaat Hulett Sugar Mill, Mondi Felixton and Richards Bay Pulp Mills, The Port of Richards Bay, Richards Bay Coal Terminal and Richards Bay Minerals.

6.4.1.3 Vehicle Tailpipe Emissions

Atmospheric pollutants emitted from vehicles include hydrocarbons, CO, carbon dioxide (CO_2), nitrogen oxides (NOx), SO_2 and particulates. These pollutants are emitted from the tailpipe, from the engine and fuel supply system, and from brake linings, clutch plates and tyres. Hydrocarbon emissions, such as C_6H_6, result from the incomplete combustion of fuel molecules in the engine. CO is a product of incomplete combustion and occurs when carbon in the fuel is only partially oxidized to CO_2. NOx are formed by the reaction of nitrogen and oxygen under high pressure and temperature conditions in the engine. Sulphur dioxide is emitted due to the high sulphur content of the fuel. Particulates, such as lead, originate from the combustion process as well as from brake and clutch linings wear (Samaras and Sorensen, 1999).

Possible contributors to mobile combustion emissions include vehicle activity on the R102, R66, the N2 as well as other access roads surrounding the site. Neighbouring communities are likely to use these routes on a daily basis for work. Furthermore, the railway line running from Richards Bay to Durban is likely a significant source of dust emissions within the area.

6.4.1.4 Domestic Fuel Burning

Pollutants released from these fuels include CO, NO_2, SO_2, inhalable particulates and polycyclic aromatic hydrocarbons. Particulates are the dominant pollutant emitted from the burning of wood. Smoke from wood burning contains respirable particles that are small enough in diameter to enter and deposit in the lungs. These particles comprise a mixture of inorganic and organic substances including aromatic hydrocarbon compounds, trace metals, nitrates and sulphates. Polycyclic aromatic hydrocarbons are produced as a result of incomplete combustion and are potentially carcinogenic in wood smoke (Maroni *et al.,* 1995). The main pollutants emitted from the combustion of paraffin are NO_2, particulates, CO and polycyclic aromatic hydrocarbons.

Domestic fuel burning usually shows a characteristic diurnal and seasonal signature. Periods of elevated domestic fuel burning, and hence emissions, occurs in the early morning and evening for space heating and cooking purposes. During the winter months, an increase in domestic fuel burning is recorded as the demand for space heating increases with the declining temperature.

While electricity is predominantly used within the urban settlements area, a portion of households are likely to make use of gas, paraffin and wood as a fuel source, more specifically within the rural settlements area.

6.4.2 Local Ambient Air Quality

6.4.2.1 Dust Fallout Monitoring

Dust fallout monitoring data for the Fairbreeze Mine for the most recent six-year period from January 2018 to August 2023 was obtained and has been assessed below. The description and coordinates of the monitoring locations are shown in Table 5 and illustrated in Figure 10, whilst the dust fallout results are illustrated from Figure 11 to Figure 15.

Missing dust fallout results are representative of months where no data was recorded, samples were contaminated, dust buckets were either removed, missing, or stolen from the location, no site access, road to site was damaged or worms were found in the sample.

In 2018, one exceedance was recorded at Site 5 in July, two non-sequential exceedances at N2S1 in June and November and two non-sequential exceedances at FBC100 in January and March. No exceedances were recorded at the other sites. As such, all monitoring locations were compliant with the National Dust Control Regulations (600 mg/m^2/day for residential sites and 1 200 mg/m^2/day for non-residential sites) which allow for two non-sequential exceedances within one year (Figure 11).

In 2019 one exceedance was recorded at Site 5 in November, one in exceedance in March and one exceedance at N2S1 in February. No exceedances were recorded at the other sites. As such, all monitoring locations were compliant with the National Dust Control Regulations which allow for two non-sequential exceedances within one year (Figure 12).

In 2020 one exceedance was recorded at Site 5 in January, two sequential exceedances at Pump Station 02 in October and November and two non-sequential exceedances at Pump Station 03 in August and October. No exceedances were recorded at the other sites. As such, most monitoring locations were compliant with the National Dust Control Regulations which allow for two non-sequential exceedances within one year, with the exception of Pump Station 02 (Figure 13).

In 2021 three sequential exceedances each were recorded at Site 2, Tree Barrier and FBC200 from October to December, one exceedance each at Site 5 and Site 10 in February and seven sequential exceedances at Pump Station 03 from April to October. No exceedances were recorded at the other sites. As such, most monitoring locations were compliant with the National Dust Control Regulations which allow for two non-sequential exceedances within one year, with the exception of Site 2, Tree Barrier, FBC200 and Pump Station 03 (Figure 14).

In 2022 no exceedances were recorded. All monitoring locations were thus compliant with the National Dust Control Regulations which allow for two non-sequential exceedances within one year (Figure 15).

In 2023 two sequential exceedances were recorded at the Wetlands, Twinstreams Educational Centre, and Site 10 from January 2023 to August 2023, which resulted in a non-compliance with the National Non-residential Dust Control Regulations (Figure 16).

An average dust fallout rate of 223 mg/m^2/day, 213 mg/m^2/day, 247 mg/m^2/day, 429 mg/m^2/day, 106 mg/m^2/day and 676 mg/m^2/day was recorded for 2018, 2019, 2020, 2021, 2022 and 2023 respectively. The average dust fallout rate over the six-year period was 316 mg/m^2/day.

Importantly, the dust fallout results in the Air Quality Impact Assessment for the Fairbreeze Mine, undertaken by SGS in 2011, cannot be directly compared to the current dust fallout results presented here as the current locations are different to the historic locations.

Table 5: Dust fallout monitoring locations at the Fairbreeze Mine

Sampling Point	Classification	Latitude (°S)	Longitude (°E)
Site 2	Residential	28º 58' 02.2"	31º 44' 42.2"
Site 3	Industrial	28º 57' 56.1"	31º 43' 10.6"
Site 4	Industrial	28º 59' 05.2"	31º 43' 40.5"
Site 5	Industrial	28º 59' 56.1"	31º 42' 09.2"
Site 6	Industrial	29º 01' 22.9"	31º 41' 35.4"
Site 7	Industrial	29º 01' 46.4"	31º 39' 59.5"
Site 8	Industrial	29º 02' 24.6"	31º 39' 11.2"
Site 9	Industrial	29º 00' 09.9"	31º 41' 58.1"
Site 10	Residential	28º 57' 52.1"	31º 44' 41.8"
Medical Centre	Residential	28º 57' 23.0"	31º 45' 18.1"
Sports field	Residential	28º 57' 19.7"	31º 44' 51.9"
Town Park	Residential	28º 57' 36.5"	31º 44' 56.9"
Tree Barrier	Residential	28º 57' 40.7"	31º 44' 36.9"
Topsoil	Industrial	28º 58' 04.4"	31º 44' 24.2"
Wetlands	Industrial	28º 58' 13.5"	31º 44' 39.9"
N2S1	Industrial	28º 58' 24.0"	31º 44' 1.50"
Farmhouse	Residential	28º 58' 50.2"	31º 43' 36.2"
N2B2	Industrial	28º 58' 36.3"	31º 43' 19.6"
Twin streams Educational Centre	Industrial	28º 58' 51.9"	31º 44' 09.6"
Twinstreams Nursery	Industrial	28º 59' 12.7"	31º 43' 39.4"
Shepley Farm	Industrial	29º 00' 16.6"	31º 40' 27.5"
Pump Station 02	Industrial	No coordinates provided	
Pump Station 03	Industrial	No coordinates provided	
FBC100	Internal monitoring	28º 58' 44.8"	31º 43' 41.6"
FBC200	Internal monitoring	28º 58' 40.8"	31º 43' 45.3"

Figure 10: Dust fallout monitoring locations at the Fairbreeze Mine

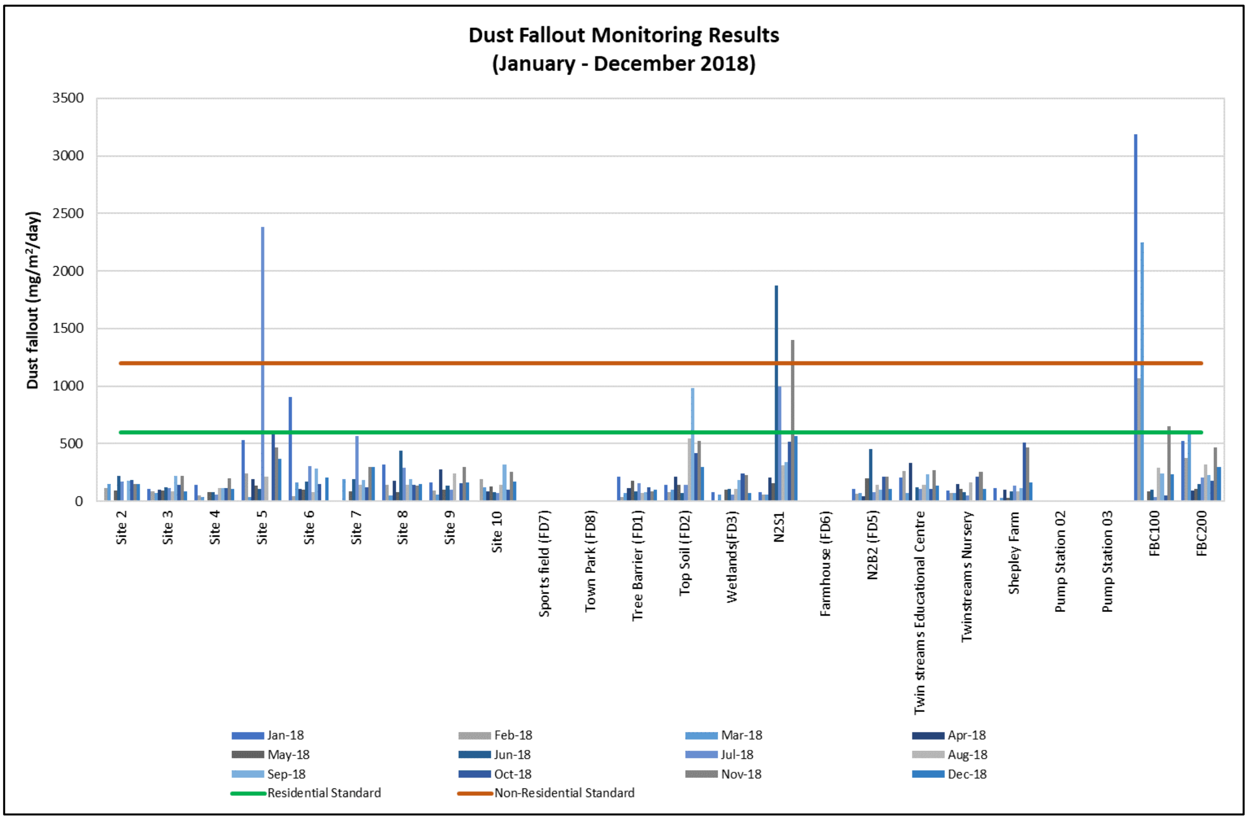


Figure 11: **Dust fallout results from January to December 2018 at the Fairbreeze Mine**

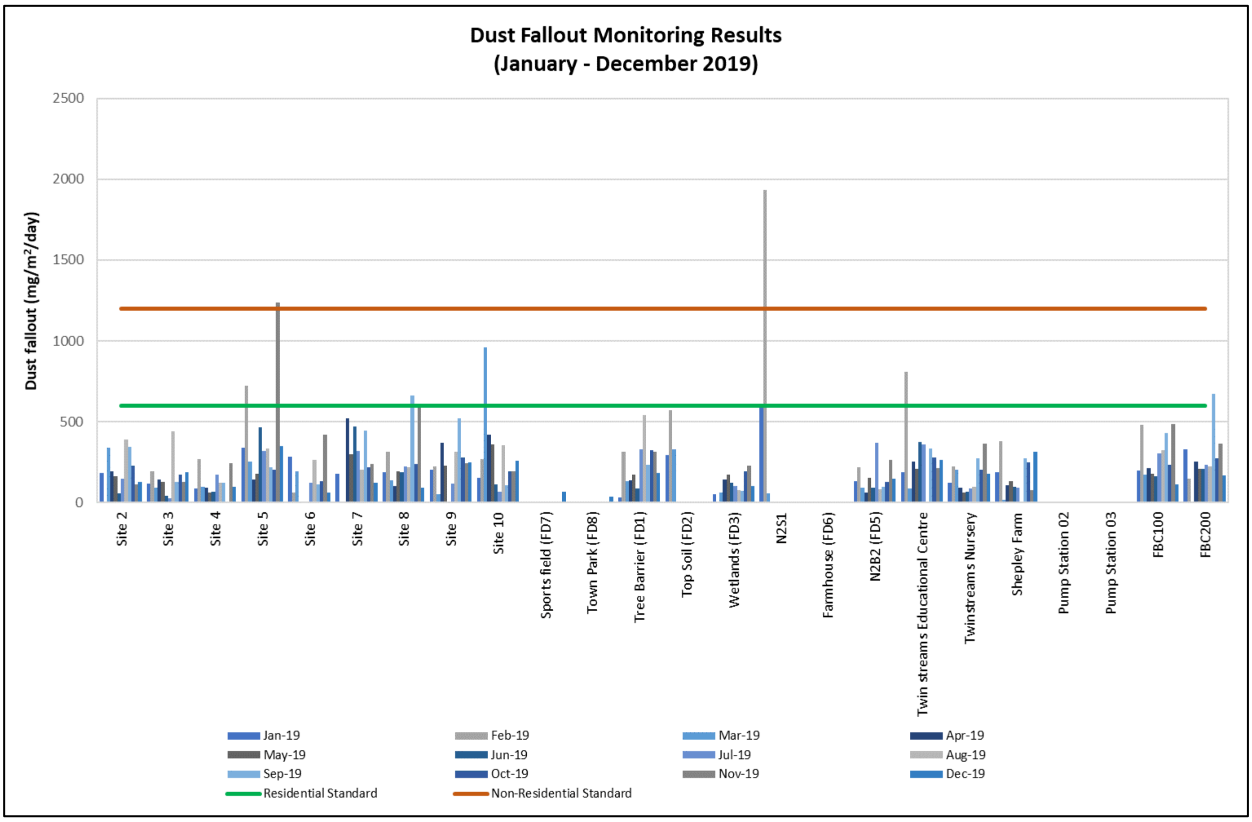


Figure 12: **Dust fallout results from January to December 2019 at the Fairbreeze Mine**

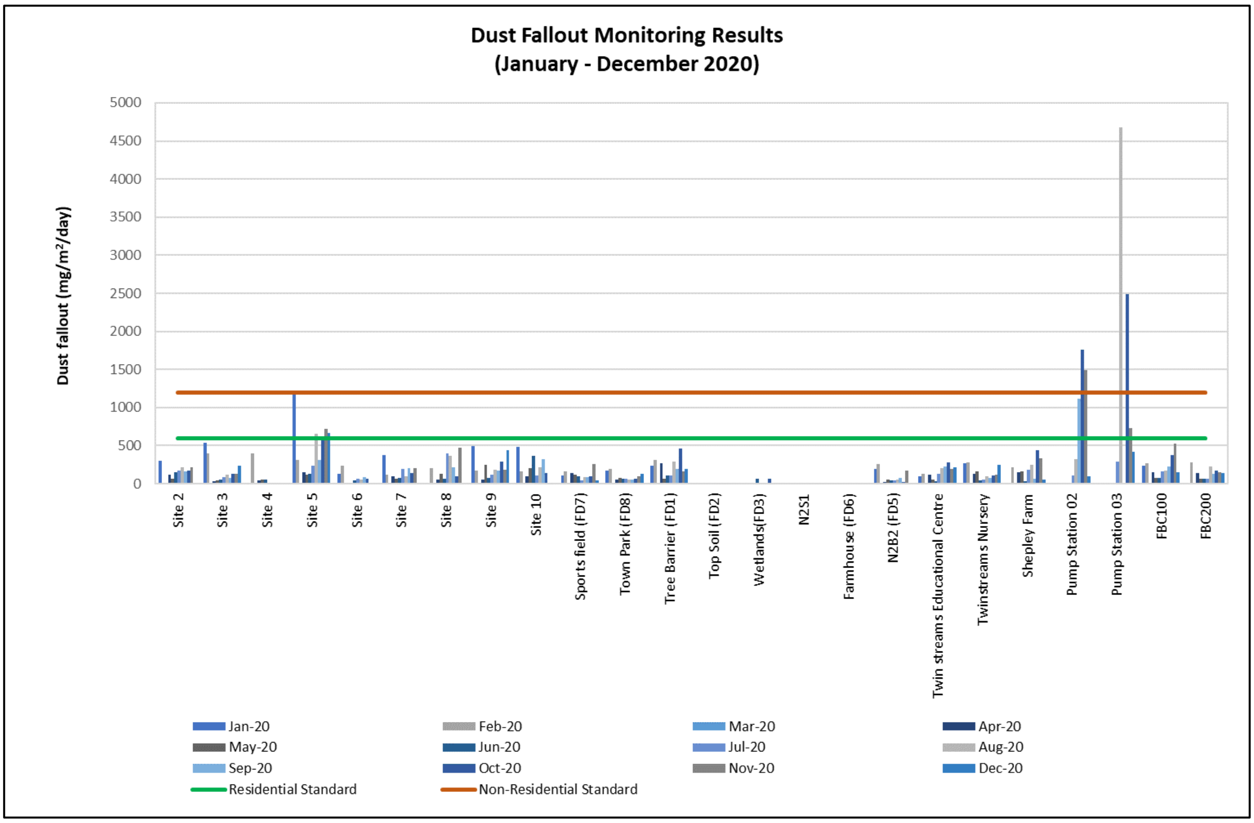


Figure 13: **Dust fallout results from January to December 2020 at the Fairbreeze Mine**

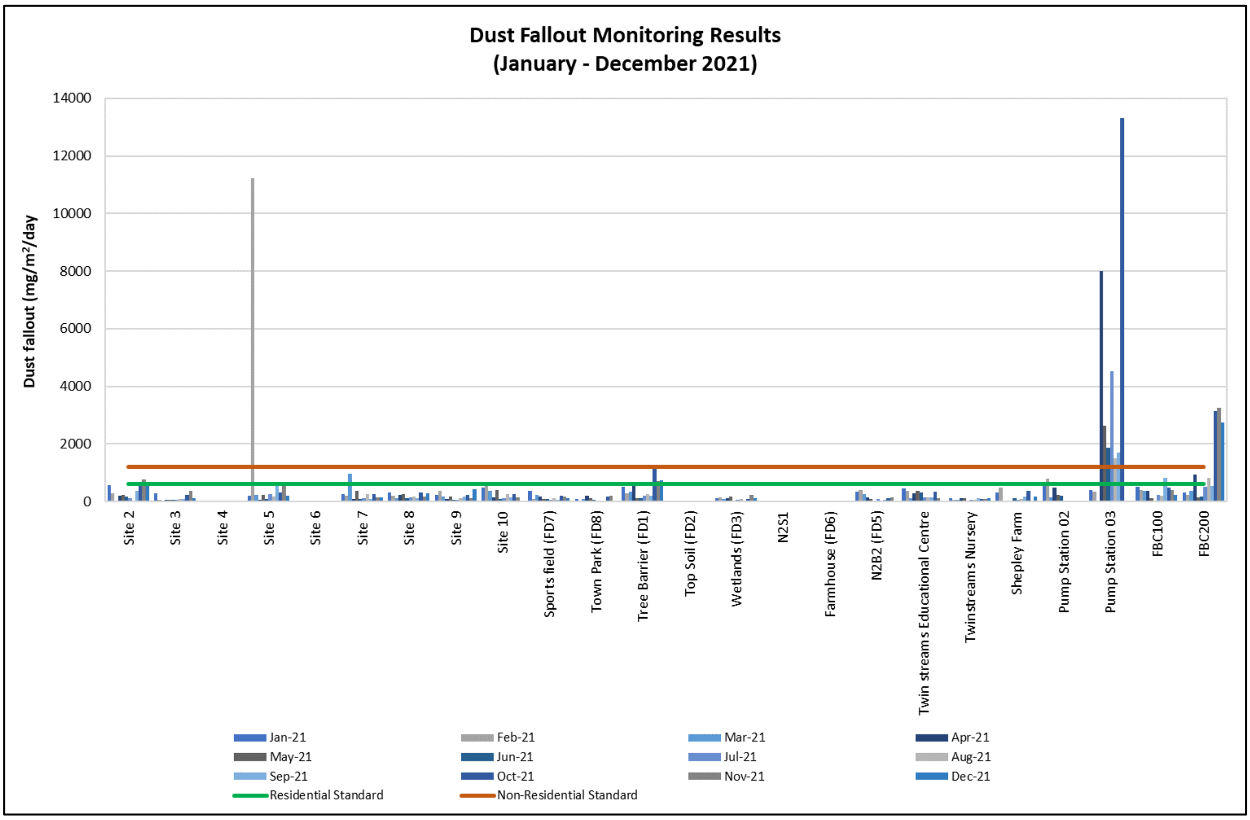


Figure 14: **Dust fallout results for January to December 2021 at the Fairbreeze Mine**

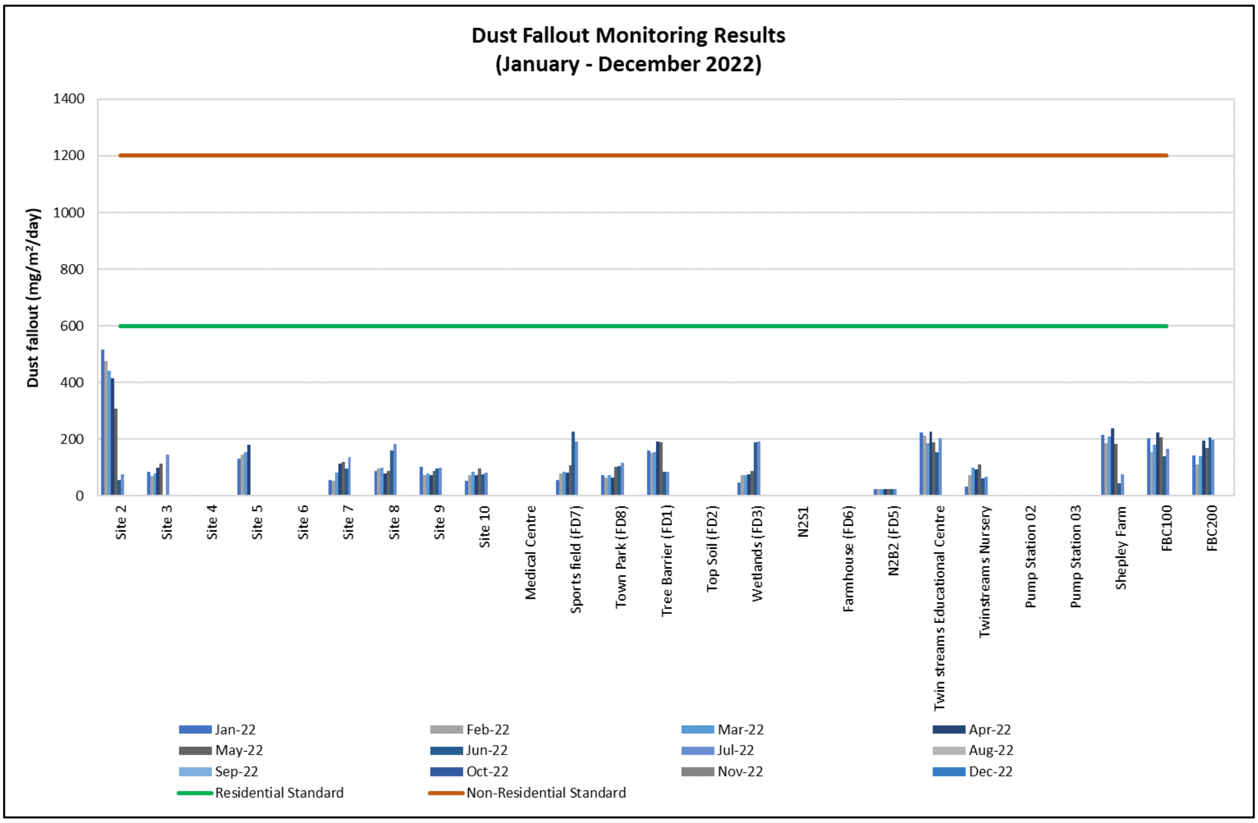


Figure 15: **Dust fallout results from January to December 2022 at the Fairbreeze Mine**

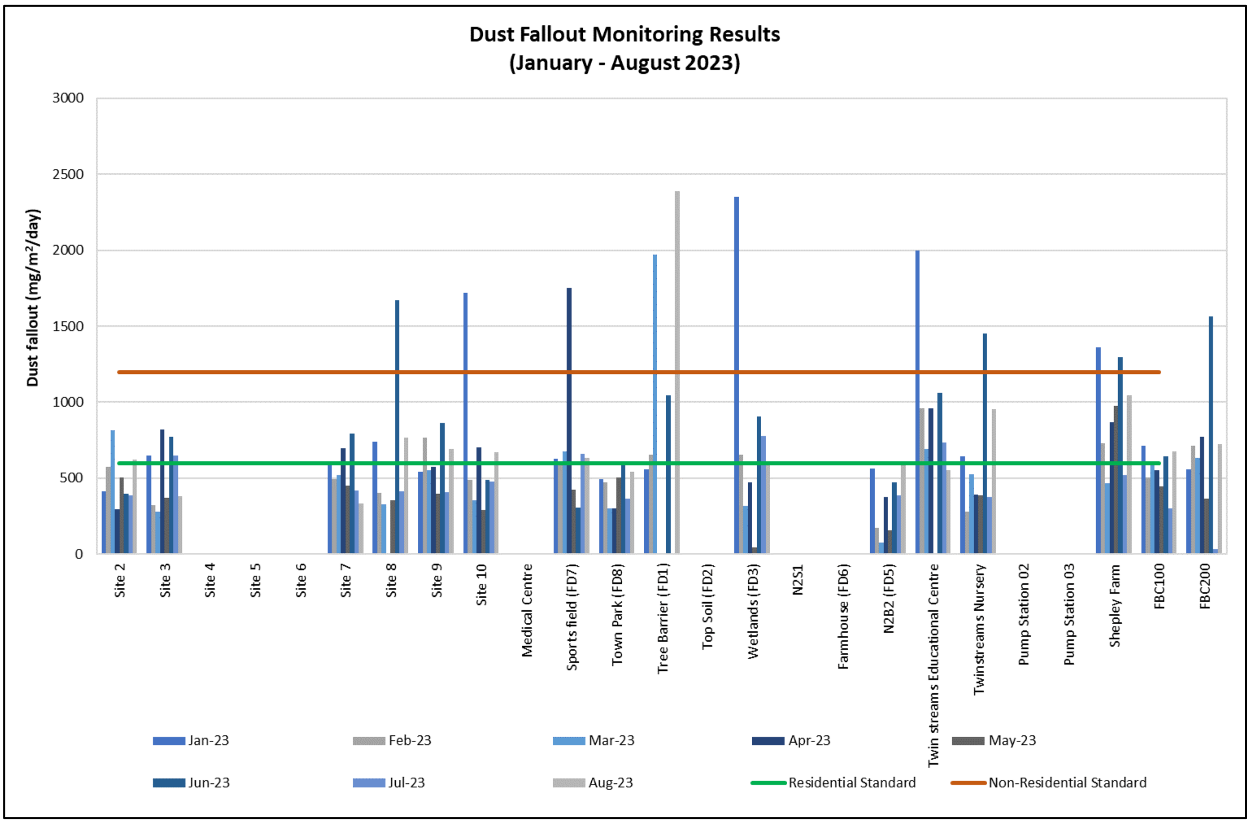


Figure 16: Dust fallout results from January to August 2023 at the Fairbreeze mine

6.4.2.2 Particulate Matter Monitoring

Particulate matter monitoring is measured at three nearby on-site monitoring stations namely Shepley Farm (~3 km away), Mtunzini, (~5 km away) and McMurray Farm (~1 km away). However, the station data was poor with low data recovery and could not be used for assessment purposes. As such, ambient measured PM_{10} concentrations were sourced from the eSikhaleni Richards Bay Clean Air Association (RBCAA) station and from the South African Air Quality Information System (SAAQIS) eSikhawini monitoring station, which are the closest stations to the site with suitable data recovery (~20 km and ~25 km away from the site). Although these stations are the closest stations to the site, both stations are considered far and not completely representative of the site. Data was obtained for the most recent period from January 2020 to December 2022 for both monitoring stations. Table 6 shows the coordinates and data recovery for the two monitoring stations. The data recovery was adequate, with percentages above 70% over each year at each station.

Table 6: Coordinates and data recovery of the eSikhaleni and eSikhawini monitoring stations

Station	Latitude (°S)	Longitude (°E)	Distance from Site (km)	Data Recovery (%)		
				2020	2021	2022
eSikhaleni	26.3295	28.1429	~20	79.00	92.80	75.50
eSikhawini	26.3295	28.1429	~25	85.60	96.40	71.10

Table 7 presents the 24-hour (99th percentile (P99)), annual average PM_{10} concentrations and the number of 24-hour exceedances recorded over the monitoring period, whilst Figure 17 shows the 24-hour PM_{10} concentrations over the monitoring period for the eSikhaleni monitoring station.

No exceedances of the 24-hour PM_{10} standard (75 µg/m^3) were recorded, except for 2021 which recorded two exceedances (Table 7). Annual averages over all three years were below the annual (40 µg/m^3) average PM_{10} standard.

Table 7: Ambient PM_{10} concentrations recorded at the eSikhaleni monitoring station from January 2020 to December 2022

Station	Daily P99 Concentration (µg/m^3)			Annual Average Concentration (µg/m^3)			Number of 24-Hour NAAQS Exceedances		
	2020	2021	2022	2020	2021	2022	2020	2021	2022
eSikhaleni	50.32	65.61	34.41	25.30	23.29	12.90	0	2	0

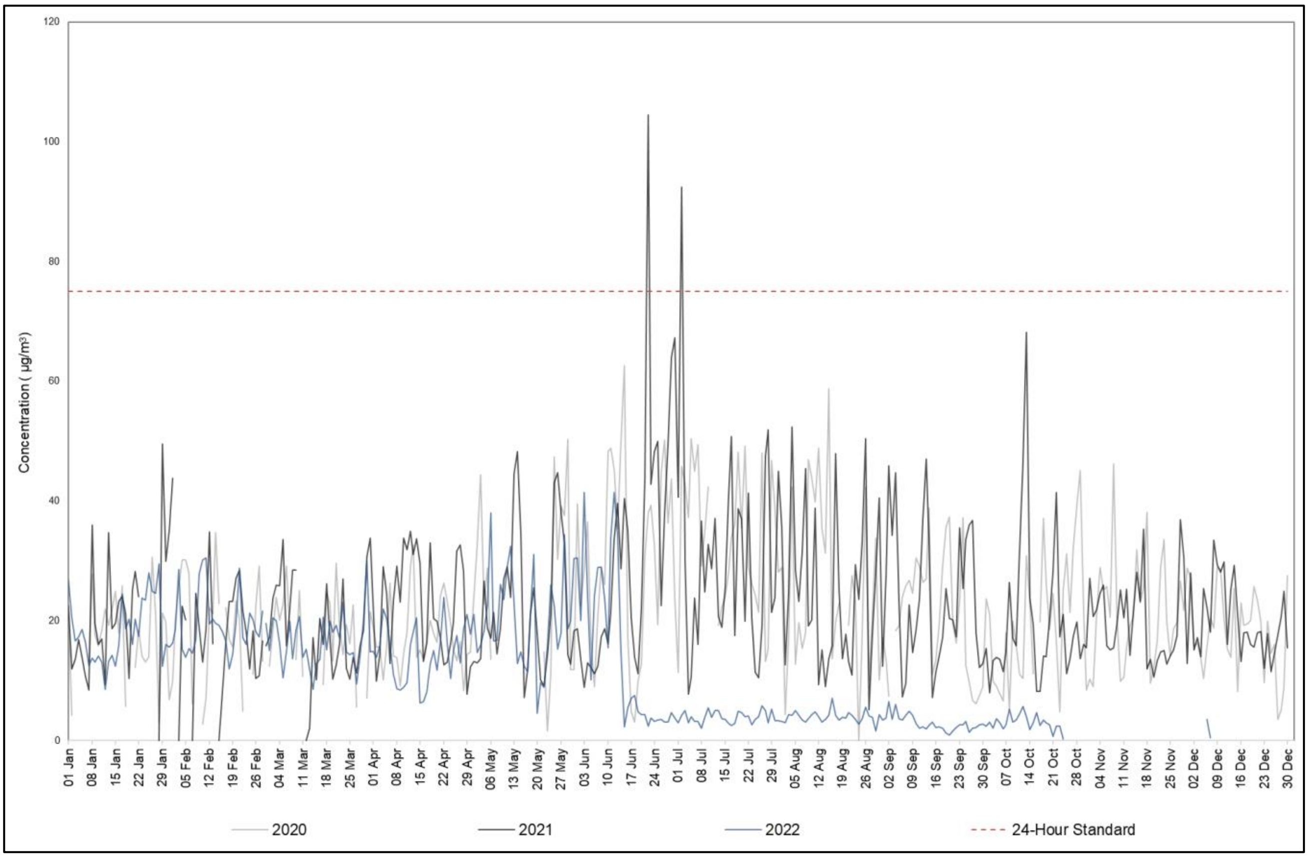


Figure 17: **Daily average PM_{10} concentration at the eSikhaleni monitoring station from January 2020 to December 2022**

Table 8 presents the 24-hour (P99) and annual average PM_{10} concentrations as well as the number of exceedances recorded over the monitoring period, whilst shows the 24-hour PM_{10} concentrations over the monitoring period for the eSikhawini monitoring station.

No exceedances of the 24-hour PM_{10} standard (75 µg/m³) were recorded except for 2021 which recorded two exceedances (Table 8). Annual averages were below the annual (40 µg/m³) average PM_{10} standards.

Table 8: Ambient PM_{10} concentrations recorded at the eSikhawini monitoring station from January 2020 to December 2022

Station	Daily P99 Concentration (µg/m³)			Annual Average Concentration (µg/m³)			Number of 24-Hour NAAQS Exceedances		
	2020	2021	2022	2020	2021	2022	2020	2021	2022
eSikhawini	50.34	67.04	32.78	23.35	22.84	12.50	0	2	0

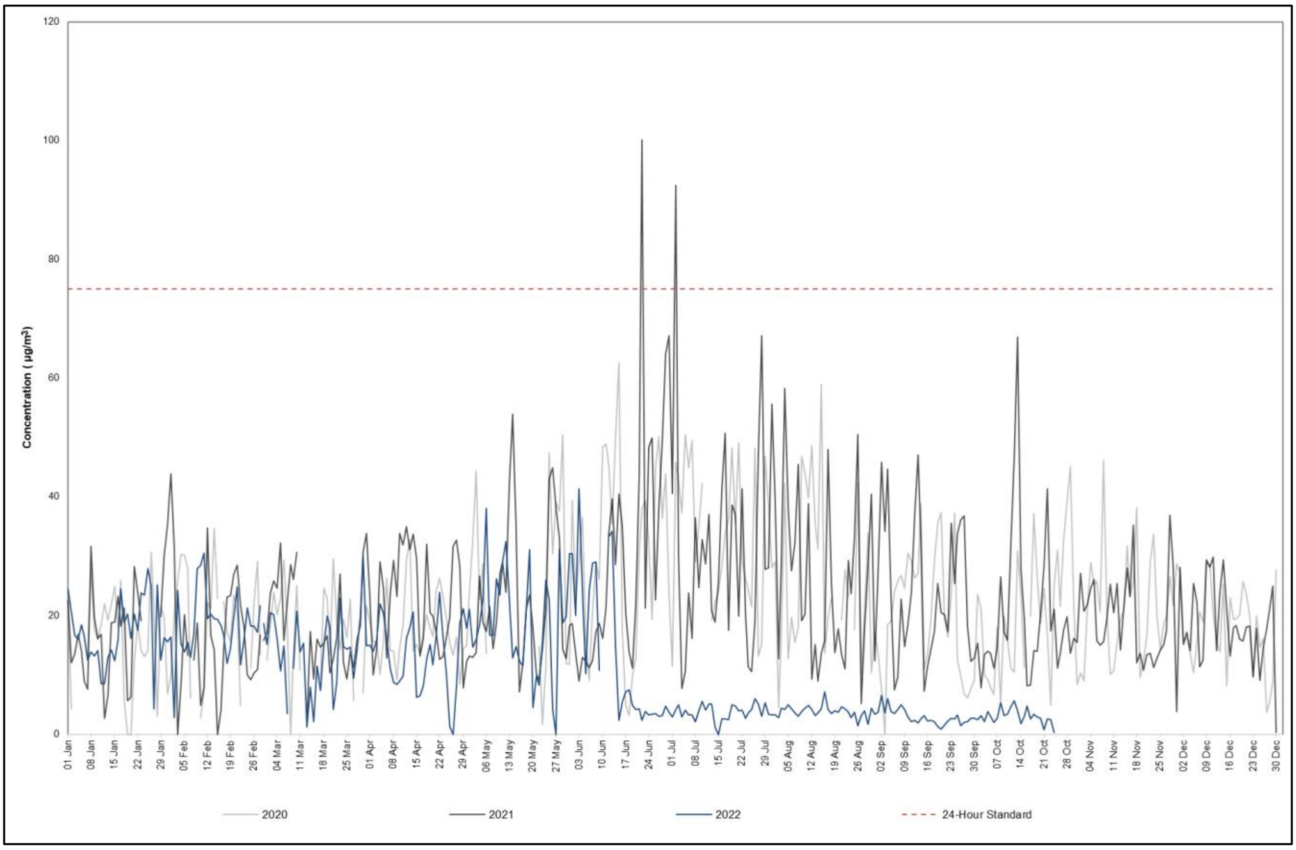


Figure 18 Daily average PM_{10} concentrations at the eSikhawini monitoring station from January 2020 to December 2022

Important to note is that the Air Quality Impact Assessment for the Fairbreeze Mine, undertaken by SGS in 2011, reported an annual average PM_{10} concentration of 26 µg/m³ for the period April to December 2010 from the ambient air quality monitoring station in Mtunzini (the nearest ambient air quality station to the site at the time with suitable data recovery).

7.0 STUDY METHODOLOGY

7.1 Emission Estimation

An emission factor is a value representing the relationship between an activity and the rate of emissions of a specified pollutant. These emission factors have been developed based on test data, material mass balance studies and engineering estimates.

Emission factors are always expressed as a function of the weight, volume, distance or duration of the activity emitting the pollutant. The general equation used for the estimation of emissions is:

$$E = A \times EF \times \left(1 - \frac{ER}{100}\right)$$

Where:

E = emission rate.

A = activity rate.

EF = emission factor.

ER = overall emission reduction efficiency (%).

Emission rates for the proposed project operations were calculated using the United States Environmental Protection Agency (USEPA) AP-42 and the Australian Government National Pollutant Inventory (NPI) emission factors. The following USEPA AP-42 and NPI references were used:

- USEPA AP-42 Chapter 13.2.2: Unpaved Roads.
- USEPA AP-42 Chapter 13.2.3: Heavy Construction Operation.
- USEPA AP-42 Chapter 13.2.4: Aggregate Handling and Storage Piles.
- NPI Emission Estimation Technique Manual for Mining Version 3.1.

The emission calculations and resultant emission rates are discussed in the sections below using the equation presented above and information provided by the Client.

7.1.1 Construction Phase

Heavy construction activities are a source of dust emissions that can have a substantial temporary impact on the local ambient air quality. Dust emissions vary substantially on a daily basis, depending on the level of activity, the specific operations and the prevailing meteorological conditions (USEPA, 1995).

The quantity of dust emissions from construction operations is proportional to the area of land being worked and to the level of construction activity. Emissions from heavy construction are positively correlated with the silt content of the soil and the weight and speed of the average vehicle and negatively correlated with the soil moisture content (USEPA, 1995).

Total suspended particulate (TSP) emissions generated by general construction activities (i.e., bulk earthworks, development and relocation of required service infrastructure on the site, development of access roads, site establishment, topsoil stripping and construction of project components, etc), were calculated using the following equation:

$$E_{TSP} = 2.69 \text{ tonnes/ha/month of activity}$$

The emission factor relates the tons of TSP emitted per hectare covered by construction activities per month of activity. Based on the USEPA particle size distribution data, PM_{10} and $PM_{2.5}$ constitute 35% and 5.3% of TSP, respectively. A control efficiency of 50% has been assumed for water sprays as confirmed by the Client.

It must be noted that the estimation of emissions from construction activities are highly uncertain due to the site-specific and erratic nature of construction activities. The emission rate used to calculate such emissions is a gross overestimation at most construction sites and the results presented here may be slightly over predicted to those that will be experienced in reality. As such, the construction phase has only been semi-quantitatively assessed and is presented in Table 9. Importantly, activities will only last for 10 hours during the day as per Client data.

Table 9: Emission rates for the construction phase for the proposed Heleza Moya operations

Location	Controlled Emission Rate (g/m^2/s)		
	TSP	PM_{10}	$PM_{2.5}$
Construction activities	1.87E-04	6.54E-05	9.90E-06

7.1.2 Operational Phase

Fugitive emissions from the proposed Project have the potential to arise from the following sources:

- Materials handling activities.
- Wind erosion from stockpiles.
- Unpaved roads.

7.1.2.1 Material Handling

Materials handling operations predicted to result in fugitive emissions include the transfer of material by means of tipping, loading and offloading. The quantity of dust which will be generated from such loading and off-loading operations will depend on various climatic parameters, such as wind speed and precipitation, in addition to non-climatic parameters such as the nature (moisture content) and volume of the material handled. Fine particulates are more readily disaggregated and released to the atmosphere during the material transfer process as a result of exposure to strong winds. Increase in the moisture content of the material being transferred would decrease the potential for dust emissions since moisture promotes the aggregation and cementation of fines to the surfaces of larger particles (USEPA, 2006).

The following default emission factors were used to calculate particulate emissions from topsoil removal (CoA, 2012):

$$E_{TSP} = 0.029 \text{ kg}/tonne$$

$$E_{PM10} = 0.007 \text{ kg}/tonne$$

The following equation was used to calculate particulate emissions from tipping, offloading and or loading activities (USEPA, 2006):

$$E = \left(k \times 0.0016 \times \left(\frac{U}{2.2}\right)^{1.3} \div \left(\frac{M}{2}\right)^{1.4}\right) \; kg/MG$$

Where:

U = wind speed = 5 m/s as per the WRF modelled mean wind speed data

M = moisture content = 2.1 % as per USEPA Chapter 13.2.4 Aggregate Handling and Storage Piles for Stone Quarrying and Processing

$PM_{2.5}$ emissions were assumed to equal 5.3% of TSP (USEPA, 2006) in the absence of a $PM_{2.5}$ emission factor. Various control measures are applied to the materials handling activities (CoA, 2012). Source details and calculated emission rates for materials handling are given in Table 10 and Table 11 for a 10-hour operation, as per Client data.

Table 10: Source parameters for materials handling activities

Source	Control Efficiency (%)	Total Throughput (Tonnes/hr)
Removal of topsoil	50 – naturally moist	68
Offloading of topsoil onto stockpile	50 – water sprays	68
Backfill tipping of course discards	50 – naturally moist	1 296
Backfill loading of topsoil	50 – water sprays	6
Backfill offloading of topsoil	70 – water sprays	6

Table 11: Emission rates for materials handling activities for the proposed Heleza Moya operations

Source	Controlled Emission Rate (g/s)		
	TSP	PM_{10}	$PM_{2.5}$
Removal of topsoil	2.74E-01	6.89E-02	1.45E-02
Offloading of topsoil onto stockpile	3.04E-02	1.44E-02	2.17E-03
Backfill tipping of course discards	5.79E-01	2.74E-01	4.14E-02
Backfill loading of topsoil	2.47E-03	1.17E-03	1.77E-04
Backfill offloading of topsoil	1.48E-03	7.02E-04	1.06E-04

7.1.2.2 Wind Erosion

Fugitive emissions due to the erosion of open storage piles and exposed areas occur when the threshold wind speed is exceeded (Cowherd *et al*., 1988; EPA, 1995). The threshold wind speed is dependent on the erosion potential of the exposed surface, which is expressed in terms of the availability of erodible material per unit area (mass/area). Any factor which binds the erodible material or otherwise reduces the availability of erodible material on the surface, thus decreases the erosion potential of the surface. Studies have shown that when the threshold wind speeds are exceeded, emission rates tend to decay rapidly due to the reduced availability of erodible material (Cowherd *et al*., 1988).

The default particulate emission factors for wind erosion over open areas are calculated using the below equation (CoA, 2012):

$$E_{TSP} = 0.4\ \text{kg}/ha/hour$$

$$E_{PM10} = 0.2\ \text{kg}/ha/hour$$

$PM_{2.5}$ emissions were assumed to equal 15% of TSP (USEPA, 2006) in the absence of a $PM_{2.5}$ emission factor. A 50% control efficiency for the use of wet suppression (as per Client data) was applied as an environmentally conservative approach (CoA, 2012). Source parameters for areas subject to wind erosion are given in Table 12. Emission rates were applied to the various stockpiles and are presented in Table 13 for a 24-hour operation as per Client data.

Table 12: Source parameters for the stockpiles subject to wind erosion

Source	Height (m)	Area (m^2)	Control efficiency (%)
Topsoil stockpile	10	1 600	50 – wet suppression

Table 13: Emission rates for wind erosion for the stockpiles for the proposed Heleza Moya operations

Source	Controlled Emission Rate ($g/s/m^2$)		
	TSP	PM_{10}	$PM_{2.5}$
Topsoil stockpile	5.56E-06	2.78E-06	4.17E-07

7.1.2.3 Vehicle Entrainment on Unpaved Roads

Particulate emission estimates of haul trucks travelling on the main unpaved haul roads are presented here. The equation used to determine particulate emissions from vehicles travelling on unpaved roads is presented below:

$$E = \left(k\left(\frac{s}{12}\right)^{a}\left(\frac{W}{3}\right)^{b}\right)(281.9)\ \ g/VKT$$

Where:

s = the surface material silt content (%)

W = the mean vehicle weight

a, b and k = empirical constants

These emission factors relate the amount of particulate emissions (in grams) to the number of kilometres travelled by vehicles on site (VKT). Table 14 presents the empirical constants used in the equation for different particle sizes. A silt content of 4.8% for industrial unpaved roads for sand and gravel processing (USEPA AP-42 Chapter 13.2.2: Unpaved Roads, 2006) and a mean vehicle weight of 60 tonnes was used.

Table 14: Empirical constants for different particle sizes

Constant	TSP	PM_{10}	$PM_{2.5}$
a	0.7	0.9	0.9
b	0.45	0.45	0.45
k	4.9	1.5	0.15

The estimated emission rates for haul roads are presented in Table 15. Emissions are calculated for haul trucks travelling from the mining pit to the topsoil stockpile. The number of hauls trucks was provided by the Client. A control efficiency factor of 75% (wet suppression) (CoA, 2012) was applied to the haul roads for the use of water tankers for dust suppression, as provided by the Client.

Calculations of emissions from light duty vehicles (LDV) were not considered in this assessment as emissions are deemed negligible when compared to emissions from haul trucks.

Table 15: Emission rates and parameters for unpaved haul roads for the proposed Heleza Moya operations

Description	No. of trucks	Vehicle kilometres travelled per day	Length (m)	Width (m)	Controlled Emission Rate (g/s/m^2)		
					TSP	PM_{10}	$PM_{2.5}$
Unpaved roads for topsoil	3 ADTs, 5 trips per ADT @ one week per month	4.2	1 400	8	7.29E-06	1.86E-06	1.86E-07

7.2 Dispersion Modelling

Atmospheric dispersion modelling mathematically simulates the transport and fate of pollutants emitted from a source into the atmosphere. Sophisticated software with algorithms that incorporate source quantification, surface contours and topography, as well as meteorology can reliably predict the downwind concentrations of these pollutants.

As per the *Regulations Regarding Air Dispersion Modelling (Modelling Regulations* (GNR 533 of 2014)), the level of assessment is dependent on technical factors such as geophysical and meteorological context and the complexity of the emissions inventory. The temporal and spatial resolution and accuracy required from a model must also be taken into account. As such, this assessment is considered to be a Level 2 assessment. Level 2 assessments should be used for air quality impact assessment in standard/generic licence or amendment processes where:

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

For this assessment, the AERMOD dispersion modelling software was utilised. AERMOD is a new generation air dispersion model designed for short-range dispersion of airborne pollutants in steady state plumes that uses hourly sequential meteorological files with pre-processors to generate flow and stability regimes for each hour, that produces output maps of plume spread with key isopleths for visual interpretation and enables, through its statistical output, direct comparisons with the latest National and International ambient air quality standards for compliance testing. AERMOD is the recommended level 2 model prescribed in the *Modelling Regulations.*

7.2.1 Meteorological Input

The model was run in accordance with guidance issued by the *Modelling Regulations*. The modelled WRF meteorological data used by the model to simulate the dispersion and dilution effects generated by the atmosphere was obtained from Lakes Environmental for the years 2020 to 2022, for the proposed Project. Data describing the topography of the local area was obtained from the Shuttle Radar Topography Mission (SRTM) 1 Arc-Second Global elevation data that offers worldwide coverage of void filled data at a resolution of 1 arc-second (30 meters). Table 16 presents the model input parameters utilised in this assessment.

Table 16: Dispersion model input parameters

Parameter	Model Input
Model	
Assessment Level	Level 2
Dispersion Model	Aermod 10.2.1
Supporting Models	AERMET and AERMAP
Emissions	
Pollutants modelled	PM_{10}, $PM_{2.5}$ and TSP (as dust fallout)
Scenarios	Proposed operating conditions

Parameter	Model Input
Chemical transformation	N/A
Exponential decay	N/A
Settings	
Terrain setting	Elevated
Terrain data	SRTM1
Terrain data resolution (m)	30
Land characteristics (bowen ratio, surface albedo, surface roughness)	Rural
Grid Receptors	
Modelling domain (km)	50 x 50
Property line resolution (m)	50
Fine grid resolution (m)	100
Medium grid resolution (m)	250
Course grid resolution (m)	1 000

7.2.2 Modelling Domain

A modelling domain of 50 km × 50 km was used (Table 17) with multi-tier cartesian grid receptor spacing of 50 m, 100 m, 250 m and 1 000 m. The grid spacing selected for the receptor grid is in accordance with those specified in the *Modelling Regulations*.

Table 17: Modelling domain coordinates

Domain Point	Latitude (°S)	Longitude (°E)
North-Eastern Point	28.7835	31.9538
South-Western Point	29.2288	31.4374

7.2.3 Modelling Scenarios

Only one dispersion modelling scenario was undertaken for the proposed expansion operational phase.

This scenario includes all proposed sources of emissions associated with the expansion, inclusive of wind erosion, materials handling and vehicle entrainment from unpaved roads.

7.2.4 Model Outputs

The model output maps and tables that follow show concentrations that would be experienced at the ground. The following statistical outputs were calculated:

- Long-term average: This is calculated by averaging all hourly concentrations over the modelled period (three years). Values can be compared with the annual National Ambient Air Quality Standards (NAAQS) to assess likely health impacts across the model domain. The calculation is conducted for each grid point within the modelling domain and at each discrete receptor for every line of meteorological data.

- P99 24-hour average: The P99 24-hour average concentration is calculated for the entire meteorological period (three years). For example, the 24-hour PM_{10} NAAQS allows for four 24-hour exceedances of the standard per annum at any location. Thus, if the P99 24-hour average is lower than the standard, the location can be considered compliant. Although the P99 results are graphically presented in the maps that follow as concentration isopleths, in reality these values do not occur simultaneously across the model domain. Hence the P99 images do not depict a continuous average plume but rather a statistical distribution of the twelfth highest 24-hour average PM_{10} concentrations over the three-year modelling period.

As defined in the *Modelling Regulations*, ambient air quality objectives are applied to areas outside the facility fenceline (i.e. beyond the facility boundary). Within the facility boundary, environmental conditions are prescribed by occupational health and safety criteria. The facility boundary is defined based on these criteria:

The facility fence line or the perimeter where public access is restricted:

- If the facility is located within another larger facility boundary, the facility boundary is the boundary of the encompassing facility.
- If a public access road passes through the facility, the facility boundary is the perimeter along the road allowance.

8.0 RESULTS AND DISCUSSION

This section presents the predicted results of the atmospheric dispersion modelling conducted for the proposed Project. Results at specified sensitive receptors are presented in tabular format, while concentration isopleths are presented graphically to indicate the dispersion of pollutants.

Additionally, the National Framework for Air Quality Management in South Africa calls for air quality assessment in terms of cumulative impacts rather than the contributions from an individual facility. Compliance with the NAAQS is to be determined by considering all local and regional contributions to background concentrations. For each averaging time, the sum of the model predicted concentration (C_P) and the background concentration (C_B) must be compared with the NAAQS. The background concentrations C_B must be the sum of contributions from non-modelled local sources and regional background air quality. If the sum of background and predicted concentrations ($C_B + C_P$) is more than the NAAQS, the design of the facility must be reviewed (including pollution control equipment) to ensure compliance with NAAQS. Compliance assessments must provide room for future permits to new emissions sources, while maintaining overall compliance with NAAQS. For the different facility locations and averaging times, the comparisons with NAAQS must be based on recommendations in Table 18.

As such, cumulative impacts for dust fallout were assessed using the ambient background dust fallout rate that was presented in Section 6.4.2. Background PM_{10} concentrations from the eSikhaleni and eSikhawini stations were not representative of the proposed Heleza Moya site due to the great distance from the proposed site to the stations, therefore the cumulative impacts from PM_{10} concentrations could not be assessed. Further, no $PM_{2.5}$ background concentrations were available for the project area and as such, cumulative impacts for $PM_{2.5}$ could also not be assessed.

Table 18: Summary of recommended procedures for assessing compliance with NAAQS

Facility Location	Annual NAAQS	Short-term NAAQS (24 hours or less)
Isolated facility not influenced by other sources, C_B insignificant*.	Highest C_P must be less than the NAAQS, no exceedances allowed.	99th percentile concentrations must be less than the NAAQS. Wherever one year is modelled,

		the highest concentrations shall be considered.
Facilities influenced by background sources e.g. in urban areas and priority areas.	Sum of the highest C_P and background concentrations must be less that the NAAQS, no exceedances allowed.	Sum of the 99th percentile concentrations and background CB must be less than the NAAQS. Wherever one year is modelled, the highest concentrations shall be considered.

*For an isolated facility influenced by regional background pollution C_B must be considered.

8.1 Dust Fallout

Predicted and cumulative dust fallout rates associated with the proposed Heleza Moya operations at each sensitive receptor are presented in Table 19, whilst Figure 19 shows the plume isopleths for the daily dust fallout rates. Importantly, the plume isopleths show the modelled predicted dust fallout levels only and not the cumulative dust fallout levels.

The modelled predicted and cumulative dust fallout rates at all sensitive receptors and across the modelling domain are expected to be below the residential and non-residential dust fallout standards.

Table 19: Daily average dust fallout rates at nearby sensitive receptors

Receptor ID	Residential Dust Fallout Standard	Non-residential Dust Fallout Standard	Daily Average Dust Fallout Rate (mg/m²/day)	
			Modelled Predicted	Cumulative
FB 01	**600**	**1 200**	0.18	241.93
FB 02	**600**	**1 200**	0.24	241.99
FB 03	**600**	**1 200**	0.62	242.37
FB 04	**600**	**1 200**	0.52	242.27
FB 05	**600**	**1 200**	0.40	242.15
FB 06	**600**	**1 200**	0.46	242.21
FB 07	**600**	**1 200**	0.38	242.13
FB 08	**600**	**1 200**	0.13	241.88
FB 09	**600**	**1 200**	0.17	241.92
FB 10	**600**	**1 200**	0.32	242.07
FB 11	**600**	**1 200**	0.28	242.03
FB 12	**600**	**1 200**	0.38	242.13
FB 13	**600**	**1 200**	0.13	241.88

Receptor ID	Residential Dust Fallout Standard	Non-residential Dust Fallout Standard	Daily Average Dust Fallout Rate (mg/m²/day)	
			Modelled Predicted	Cumulative
FB 14	600	1 200	0.13	241.88
FB 15	600	1 200	0.11	241.86
FB 16	600	1 200	0.10	241.85
FB 17	600	1 200	0.25	242.00
FB 18	600	1 200	0.18	241.93
FB 19	600	1 200	0.20	241.95
FB 20	600	1 200	0.25	242.00
FB 21	600	1 200	0.24	241.99
FB 22	600	1 200	0.29	242.04
FB 23	600	1 200	0.30	242.05
FB 24	600	1 200	0.38	242.13
FB 25	600	1 200	0.44	242.19
FB 26	600	1 200	0.35	242.10
FB 27	600	1 200	0.27	242.02
FB 28	600	1 200	0.42	242.17
FB 29	600	1 200	0.56	242.31
FB 30	600	1 200	0.46	242.21
FB 31	600	1 200	0.26	242.01
FB 32	600	1 200	0.25	242.00
FB 33	600	1 200	0.35	242.10
FB 34	600	1 200	0.29	242.04
FB 35	600	1 200	0.26	242.01
FB 36	600	1 200	0.25	242.00
FB 37	600	1 200	0.23	241.98

Receptor ID	Residential Dust Fallout Standard	Non-residential Dust Fallout Standard	Daily Average Dust Fallout Rate (mg/m²/day)	
			Modelled Predicted	Cumulative
FB 38	**600**	**1 200**	0.23	241.98
FB 39	**600**	**1 200**	0.21	241.96
Highest Offsite Rate	**600**	**1 200**	2.02	243.77

[1]An average background rate of 241.8 mg/m^2/day (over the five-year period from 2018 to 2022, Section 6.4.2.1) was utilized to assess the cumulative concentrations.

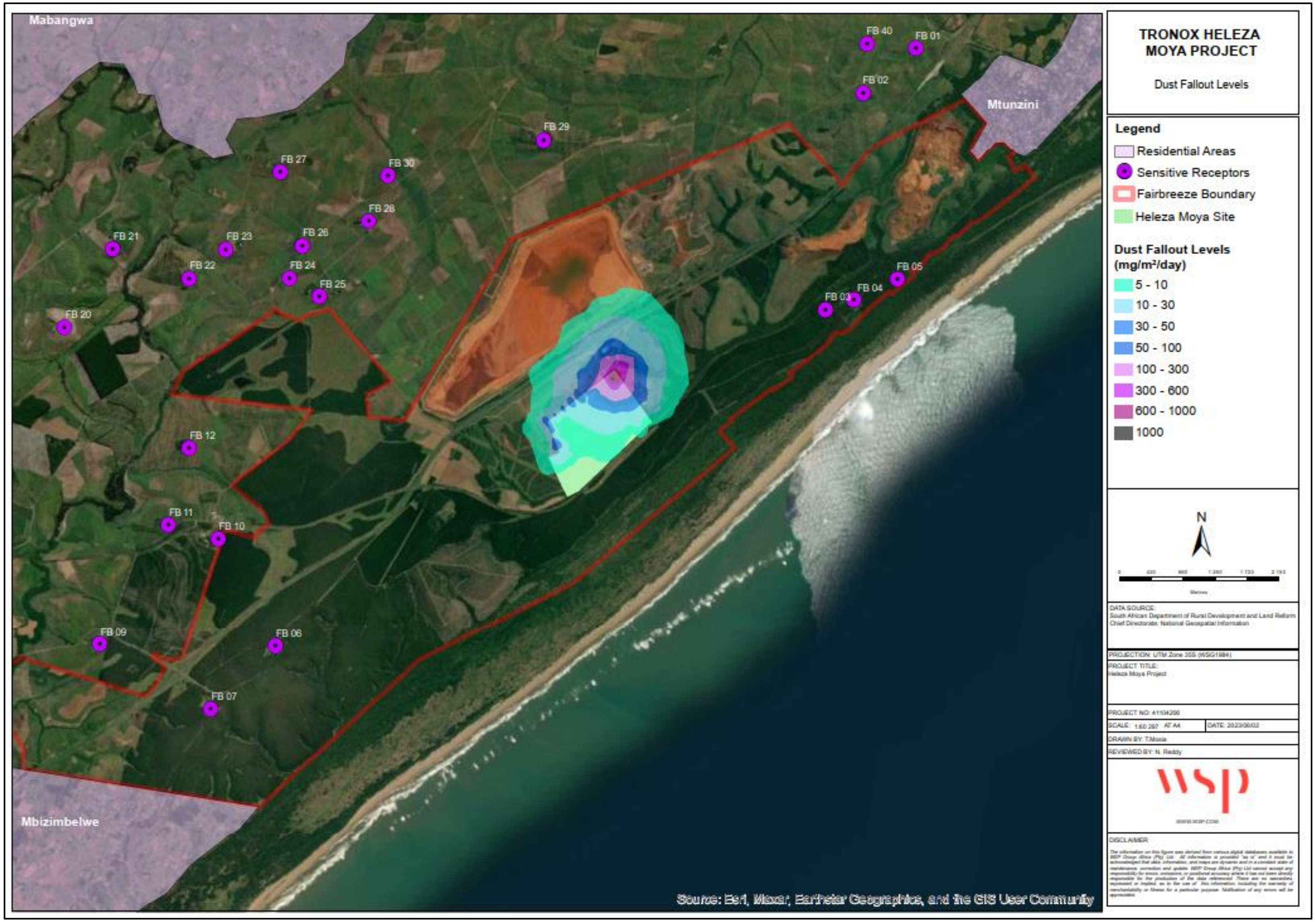


Figure 19: Predicted dust fallout rates from the Heleza Moya operations (mg/m²/day)

8.2 PM_{10} Concentrations

Predicted PM_{10} concentrations associated with the proposed Heleza Moya operations at each sensitive receptor are presented in Table 20, whilst Figure 20 and Figure 21 show the plume isopleths for the annual and 24-hour average PM_{10} concentrations. Importantly, the plume isopleths show the modelled predicted concentrations only and not the cumulative concentrations.

Modelled predicted 24-hour and annual average PM_{10} concentrations at each sensitive receptor and across the modelling domain are below their respective 24-hour and annual average NAAQS. Background PM_{10} concentrations from the eSikhaleni and eSikhawini stations were not representative of the proposed Heleza Moya site due to the great distance from the proposed site to the stations, therefore the cumulative impacts from PM_{10} concentrations could not be assessed.

Table 20: PM_{10} concentrations at nearby sensitive receptors

Receptor ID	24-Hour Average Standard (µg/m³)	P99 24-Hour Average Concentration (µg/m³)	Annual Average Standard (µg/m³)	Annual Average Concentration (µg/m³)
		Modelled Predicted		Modelled Predicted
FB 01	75	0.0055	40	0.0006
FB 02	75	0.0063	40	0.0008
FB 03	75	0.0268	40	0.0029
FB 04	75	0.0222	40	0.0023
FB 05	75	0.0165	40	0.0017
FB 06	75	0.0163	40	0.0014
FB 07	75	0.0123	40	0.0011
FB 08	75	0.0085	40	0.0007
FB 09	75	0.0102	40	0.0010
FB 10	75	0.0151	40	0.0014
FB 11	75	0.0130	40	0.0012
FB 12	75	0.0138	40	0.0014
FB 13	75	0.0074	40	0.0006
FB 14	75	0.0074	40	0.0006
FB 15	75	0.0070	40	0.0006
FB 16	75	0.0073	40	0.0006
FB 17	75	0.0097	40	0.0009
FB 18	75	0.0088	40	0.0007
FB 19	75	0.0091	40	0.0008
FB 20	75	0.0105	40	0.0009
FB 21	75	0.0110	40	0.0009

Receptor ID	24-Hour Average Standard (µg/m³)	P99 24-Hour Average Concentration (µg/m³)	Annual Average Standard (µg/m³)	Annual Average Concentration (µg/m³)
		Modelled Predicted		Modelled Predicted
FB 22	**75**	0.0125	**40**	0.0011
FB 23	**75**	0.0125	**40**	0.0011
FB 24	**75**	0.0151	**40**	0.0015
FB 25	**75**	0.0171	**40**	0.0017
FB 26	**75**	0.0140	**40**	0.0013
FB 27	**75**	0.0110	**40**	0.0010
FB 28	**75**	0.0157	**40**	0.0014
FB 29	**75**	0.0168	**40**	0.0022
FB 30	**75**	0.0142	**40**	0.0013
FB 31	**75**	0.0089	**40**	0.0010
FB 32	**75**	0.0084	**40**	0.0010
FB 33	**75**	0.0085	**40**	0.0013
FB 34	**75**	0.0076	**40**	0.0012
FB 35	**75**	0.0070	**40**	0.0013
FB 36	**75**	0.0067	**40**	0.0012
FB 37	**75**	0.0064	**40**	0.0011
FB 38	**75**	0.0057	**40**	0.0011
FB39	**75**	0.0053	**40**	0.0010
Highest Offsite Concentration	**75**	0.2900	**40**	0.0100

Figure 20: Predicted P99 24-hour PM_{10} concentrations from the Heleza Moya operations (µg/m³)

Figure 21: Predicted annual PM_{10} concentrations from the Heleza Moya operations (µg/m^3)

8.3 $PM_{2.5}$ Concentrations

Predicted $PM_{2.5}$ concentrations associated with the proposed Heleza Moya operations at each sensitive receptor are presented in Table 21, whilst Figure 22 and Figure 23 show the plume isopleths for annual and 24-hour average $PM_{2.5}$ concentrations.

Modelled predicted 24-hour and annual average concentrations at each sensitive receptor and across the modelling domain were well below their respective 24-hour and annual average NAAQS. No $PM_{2.5}$ background concentrations were available for the project area and as such, cumulative impacts for $PM_{2.5}$ could not be assessed.

Table 21: $PM_{2.5}$ concentrations at nearby sensitive receptors

Receptor ID	24-Hour Average Standard (µg/m³)	P99 24-Hour Average Concentration (µg/m³)	Annual Average Standard (µg/m³)	Annual Average Concentration (µg/m³)
		Modelled Predicted		Modelled Predicted
FB 01	40	0.0009	20	0.0001
FB 02	40	0.0010	20	0.0001
FB 03	40	0.0042	20	0.0005
FB 04	40	0.0035	20	0.0004
FB 05	40	0.0026	20	0.0003
FB 06	40	0.0024	20	0.0002
FB 07	40	0.0019	20	0.0002
FB 08	40	0.0013	20	0.0001
FB 09	40	0.0016	20	0.0002
FB 10	40	0.0023	20	0.0002
FB 11	40	0.0020	20	0.0002
FB 12	40	0.0021	20	0.0002
FB 13	40	0.0012	20	0.0001
FB 14	40	0.0011	20	0.0001
FB 15	40	0.0011	20	0.0001
FB 16	40	0.0012	20	0.0001
FB 17	40	0.0014	20	0.0001
FB 18	40	0.0013	20	0.0001
FB 19	40	0.0014	20	0.0001
FB 20	40	0.0016	20	0.0002
FB 21	40	0.0016	20	0.0001
FB 22	40	0.0019	20	0.0002
FB 23	40	0.0018	20	0.0002

Receptor ID	24-Hour Average Standard (µg/m³)	P99 24-Hour Average Concentration (µg/m³) Modelled Predicted	Annual Average Standard (µg/m³)	Annual Average Concentration (µg/m³) Modelled Predicted
FB 24	**40**	0.0023	**20**	0.0002
FB 25	**40**	0.0027	**20**	0.0003
FB 26	**40**	0.0022	**20**	0.0002
FB 27	**40**	0.0017	**20**	0.0002
FB 28	**40**	0.0024	**20**	0.0002
FB 29	**40**	0.0027	**20**	0.0003
FB 30	**40**	0.0023	**20**	0.0002
FB 31	**40**	0.0014	**20**	0.0002
FB 32	**40**	0.0013	**20**	0.0002
FB 33	**40**	0.0014	**20**	0.0002
FB 34	**40**	0.0012	**20**	0.0002
FB 35	**40**	0.0011	**20**	0.0002
FB 36	**40**	0.0011	**20**	0.0002
FB 37	**40**	0.0010	**20**	0.0002
FB 38	**40**	0.0009	**20**	0.0002
FB39	**40**	0.0008	**20**	0.0002
Highest Offsite Concentration	**40**	0.0500	**20**	0.0023

Figure 22: Predicted P99 24-hour $PM_{2.5}$ concentrations from the Heleza Moya operations (µg/m³)

Figure 23: Predicted annual $PM_{2.5}$ concentrations from the Heleza Moya operations (µg/m³)

9.0 ASSUMPTIONS AND LIMITATIONS

In this AQIA, various assumptions and limitations were considered:

- Construction Phase:
  - Construction is expected to last 6 months for 10 hours/day, 5 days/ week, as per Client data.
  - Area to be constructed is 13 ha, as per Client data.
  - Wet suppression will be used to mitigate dust during construction activities – a control efficiency of 50% will be used for wet suppression (National Pollutant Inventory, 2012).
- Operational Phase:
  - Wind erosion as a result of the topsoil (dozing) stockpile:
    - An area of 1 600 m^2 (40 m by 40 m) is assumed with a height of 10 m, as per Client data.
    - Wet suppression via water trucks is assumed, as per Client data. A control efficiency of 50% is assumed (CoA, 2012).
  - Material handling activities:
    - Assumed normal operation of 10 hours/day, as per Client data.
    - Assumed an average wind speed of 5 m/s, as per WRF modelled data.
    - Assumed a moisture content for mineral sands of 2.1% (as per USEPA AP-42 Chapter 13.2.4 Aggregate Handling and Storage Piles - Stone Quarrying and Processing).
    - The capacities were provided, as per Client data and the control efficiencies were assumed, as per the CoA, 2012.
  - Vehicle entrainment from unpaved roads for topsoil:
    - Assumed normal operation of 10 hours/day, 5 days a week, as per Client data.
    - Mean vehicle weight of 60 tonnes was assumed, as per Client data.
    - Three ADTs, with 5 trips per ADT for one week per month was assumed, as per Client data.
    - Average width road of 8 m and length of 1 400 m was assumed as per Client data.
    - Typical silt content of 4.8% has been assumed for industrial unpaved roads for sand and gravel processing plant haul roads (USEPA AP-42 Chapter 13.2.2: Unpaved Roads, 2006).
    - A control efficiency of 75% was assumed (CoA, 2012), for water tankers used, as per Client data.
- Background Concentrations:
    - Cumulative impacts for dust fallout were assessed using the ambient background dust fallout rate that was presented in Section 6.4.2. Background PM_{10} concentrations from the eSikhaleni and eSikhawini stations were not representative of the proposed Heleza Moya site due to the great distance from the proposed site to the stations, therefore the cumulative impacts from PM_{10} concentrations could not be assessed. Further, no $PM_{2.5}$ background concentrations were available for the project area and as such, cumulative impacts for $PM_{2.5}$ could also not be assessed.

– An average dust fallout background rate of 241.8 mg/m²/day (over the five-year period from 2018 to 2022, Section 6.4.2.1) was utilized to assess the cumulative concentrations.

10.0 MITIGATION MEASURES

Although emissions during the construction phase are transient in nature, the following measures can be considered to mitigate emissions during the construction phase and should be included within the Environmental Management Programme (EMPr).

10.1 Construction Phase

The following mitigation measures would serve to further reduce air quality impacts on the receiving environment and sensitive receptors:

- Planning construction activities in consultation with nearby residences. Information regarding construction activities should be provided to all nearby residences of the proposed site. Such information includes:
  - Contact details of a responsible person on site should complaints arise to reduce emissions in a timely manner.
- Avoid dust generating works during the windiest conditions.
- When working near a potential sensitive receptor, limit the number of simultaneous activities to a minimum as far as possible.
- Ensure construction fleet vehicles are kept at speed limits within 20-40 km/h at the construction site.
- Wet suppression and wind speed reduction are common methods used to control open dust sources at construction sites as a source of water and material for wind barriers tend to be readily available.

General control methods for open dust sources, as recommended by the USEPA, are given in Table 22.

Table 22: Mitigation measures for general construction (US EPA, 1995)

Emission Source	Recommended Control Method
Truck transport[(1)]	Wet suppression
	Paving e.g. asphalt concrete
	Chemical stabilisation[(2)]
Bulldozers	Wet suppression[(3)]
Cut/fill material handling	Wind speed reduction
	Wet suppression
Cut/fill haulage	Wet suppression
	Paving
	Chemical stabilisation
General construction	Wind speed reduction
	Wet suppression
	Early paving of permanent roads

Notes: [(1)] Loads could be covered to avoid loss of material in transport, especially if material is transported offsite.
[(2)] Chemical stabilisation usually cost-effective for relatively long-term or semi-permanent unpaved roads

(3) Excavated materials may already be moist and may not require additional wetting.

10.2 Operational Phase

Emissions during the operational phase from the proposed Heleza Moya operations are minimal and no further mitigation measures are deemed necessary for the proposed site. Furthermore, there are no complaints or issues associated with the proposed Heleza Moya operations, however block FBCX will still be mined up until December 2023 (ie FBB and FBX will be mined simultaneously) and as such, the following mitigation methods should, be ongoing and are relevant to the entire Fairbreeze Mine. Further consideration should also be taken should complaints arise.

10.2.1 Unpaved Roads

Vehicle movement along unpaved roads manifests a range of dust emission mechanisms. Firstly, as the vehicle's tyres move across the road surface the frictional forces result in the soil and rock particles breaking down into smaller sized particles (which are more readily entrained into the air compared with larger, heavier particles). Air turbulence from the moving tyres, the bulk of the vehicle itself and even the exhaust can result in entrainment of dust which would have otherwise remained on the ground surface. The USEPA suggests that vehicle restrictions are one of three categories of mitigation efforts that may be employed to reduce dust emission from unpaved roads. Its recommendations include reducing vehicle speed, reducing vehicle weights and limiting the amount of traffic using the roads.

The following measures are suggested:

- Water is to be applied as a dust suppressant to the unpaved roads at the site.
- Implement vehicle speed and access restrictions within the site (approximately 20 - 40 km/h).
- Vehicles carrying loose aggregate should be covered with tarpaulins or sheets at all times.
- Prevention of material deposition onto haul roads through avoiding the overloading of truck loads resulting in spillages on the roads; preventing wind erosion from adjacent open areas; and ensure adequate storm water drainage to prevent water erosion of the roads.
- Prioritising source reduction measures through the use of the most direct travel routes on site; undertaking backhauling; using conveyors instead of haul roads where possible; and using larger capacity trucks to minimise the number of trips.
- Water bowser routes should align with the daily/weekly mine plan schedule and a maintenance programme should be in place to ensure continuous availability of the water bowsers.

10.2.2 Material Handling Activities

Material handling activities are also likely to contribute significantly to the amount of dust generated from materials handling activities at mines. Tipping, removal, loading and offloading activities are fairly difficult to mitigate, although the following techniques can be employed to assist with dust suppression (Katestone, 2011):

- Modifying or ceasing loading activities during dry and windy conditions.
- Avoid double handling of material where possible.
- Minimising the drop height of the material from truck loads.
- Using water carts with boom sprayers or wet suppression systems when loading and unloading activities occur.

10.2.3 Stockpiles

Dust emissions from stockpiles can occur during the loading of the piles, when wind disturbs the stockpile surface, and during reclamation (USEPA, 2006a). Smaller stockpiles can be covered using hessian sheets or alternatively protected by a shade cloth windbreak (porous wall). Both of these techniques aim to reduce wind speed at the surface of the stockpile, in turn reducing the potential for dust scour and entrainment. An important characteristic about wind erosion is that each time a surface is disturbed, its erosion potential is restored.

In order to decrease the erosion potential of stockpiles at the mine, the following mitigation techniques are suggested:

- The height of existing berms at stockpiles be increased, reducing the impact of winds on the stockpile.
- Temporary stockpiles be enclosed by porous walls.
- Small, temporary stockpiles can be covered with a porous sheet (preferably hessian).

10.2.4 Exposed Areas

Windbreaks in the form of shade cloth screens may be erected at exposed areas. The windbreaks aim to mitigate dust transportation by reducing the wind speed across the surface of the ground (higher wind speeds tend to scour the surface, leading to dust entrainment and subsequent transportation).

Rehabilitation of exposed ground on the pits are intended to be on-going at the mine, with the placement of topsoil. WSP suggests that this rehabilitation/re-vegetation procedure be undertaken in full force in order to offer the most natural and effective means of combatting wind erosion. Alternatively, in high erosion areas on high wind days, water sprayers should be considered.

10.2.5 Wind Erosion

Wind-blown dust is currently minimised with the use of water sprays, which have an estimated control efficiency of 50%. While wind-blown dust may not be a significant contributor to overall dust emissions, wind erosion can substantially increase dust entrainment at any site.

11.0 MONITORING MEASURES

It is recommended that the following monitoring requirements are ongoing and/or considered as below. Additionally, these should be included in the EMPr.

11.1 Dust Fallout Monitoring

It is understood that dust fallout monitoring is currently undertaken for the wider Fairbreeze Mine. The monitoring locations are considered to be adequate covering a good spatial area and should be ongoing. Samples should be collected and changed monthly and analysed by an accredited laboratory. Monthly and annual reporting should be ongoing and used to identify problem areas/activities to target mitigation.

11.2 Continuous Particulate Matter Monitoring

- It is recommended that the particulate matter monitoring stations are maintained and monitoring is ongoing. A minimum requirement of 90% data recovery should be achieved maintained in order to obtain useful and credible data. As such, the following is further advised in order to achieve maintain this:Ensuring data recovery remains high (above 90% (SANAS, 2012). Regular maintenance and calibration of the unit will ensure data recovery meets the required minimum.
- Ensuring monthly maintenance on the unit continues, including flow rate checks, filter changes and inlet cleaning.

- Ensuring the unit is sent to the supplier for calibration in alignment with manufactures specifications.

Additionally, monthly/quarterly/annual reporting should be used to identify problem areas/activities to target mitigation.

11.3 Meteorological Monitoring

Site-specific meteorological data is highly beneficial for interpretation of air quality monitoring data. It is recommended that a weather station within the project area be installed and remain fully functional and calibrated in accordance with manufacturer specifications, to aid in mitigating further dust releases, given that the assessment of meteorological conditions (predominantly winds) is key in managing site activities. Additionally, monthly/quarterly/annual reporting of meteorological data within the ambient monitoring reports (dust fallout and PM_{10} and $PM_{2.5}$ monitoring) should be used to identify problem areas/activities to target mitigation.

12.0 IMPACT ASSESSMENT

All impacts of the proposed Heleza Moya operations were evaluated using the risk matrix as defined within APPENDIX A, which is a semi-quantitative risk assessment methodology. This system derives an environmental impact level on the basis of the nature, significance, consequence, extent, duration and probability of potentially significant impacts. The overall risk level is determined using professional judgement based on a clear understanding of the nature of the impact, potential mitigatory measures that can be implemented and changes in risk profile as a result of implementation of these mitigatory measures. Key localised air quality impacts associated with the proposed Project operations include:

- Construction phase impacts of air quality on sensitive receptors.
- Operational phase impacts of air quality on sensitive receptors.

Outcomes of the air quality impact assessment are contained within Table 23 outlining the impact of each parameter and the resulting risk level. Important to note that impacts predicted here are from the proposed Heleza Moya operations only and not a result of cumulative impacts.

The resultant environmental air quality risks for sensitive receptors were ranked “moderate” during the construction phase and “low” during the operational phase without mitigation in place.

Table 23: Impact assessment of risks associated with the proposed Project operations

Description	Without Mitigation						With Mitigation					
	Magnitude	Duration	Scale	Probability	Significance Rating		Magnitude	Duration	Scale	Probability	Significance Rating	
Construction phase impacts of air quality (Dust, PM_{10} and $PM_{2.5}$) on sensitive receptors	6	2	2	3	**30**	Moderate	4	2	1	2	**14**	Low
Operational phase impacts of air quality (Dust, PM_{10} and $PM_{2.5}$) on sensitive receptors	4	4	1	2	**18**	Low	2	4	1	1	**7**	Low

13.0 CONCLUSION

An AQIA was undertaken for the proposed Heleza Moya operations. Key pollutants associated with on-site activities were identified as dust fallout, PM_{10} and $PM_{2.5}$.

Key findings from the dispersion modelling simulations for the Project indicated that:

- The modelled predicted and cumulative dust fallout rates at all sensitive receptors and across the modelling domain are expected to be below the residential and non-residential dust fallout standards.
- Modelled predicted and cumulative 24-hour and annual average PM_{10} concentrations at each sensitive receptor and across the modelling domain were below their respective 24-hour and annual average NAAQS.
- Modelled predicted 24-hour and annual average $PM_{2.5}$ concentrations at each sensitive receptor and across the modelling domain were well below their respective 24-hour and annual average NAAQS. No $PM_{2.5}$ background concentrations were available for the project area and as such, cumulative impacts for $PM_{2.5}$ could not be assessed.

Based on the findings of the assessment, WSP recommends that the Project be authorised with the mitigation and monitoring measures, as discussed in Section 10.0 and Section 11.0, ongoing, to effectively control fugitive emissions.

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WSP Group Africa (Pty) Ltd

Novania Reddy
Principal Consultant

Kirsten Collett
Principal Consultant

NR/KC

APPENDIX A

Impact Assessment Methodology

The significance of each identified impact was determined using the approach outlined below (terminology from the Department of Environmental Affairs and Tourism Guideline document on Environmental Impact Assessment (EIA) Regulations, April 1998). This approach incorporates two aspects for assessing the potential significance of impacts, namely occurrence and severity, which are further sub-divided as follows.

Impact assessment factors

Occurrence		Severity	
Probability of occurrence	Duration of occurrence	Scale/extent of impact	Magnitude of impact

To assess these factors for each impact, the following four ranking scales are used.

Impact assessment scoring methodology

Probability	Duration
5 - Definite/don't know	5 - Permanent
4 - Highly probable	4 - Long-term
3 - Medium probability	3 - Medium-term (8 - 15 years)
2 - Low probability	2 - Short-term (0 - 7 years) (impact ceases after the operational life of the activity)
1 – Improbable	1 – Immediate
0 – None	
Scale	**Magnitude**
5 – International	10 - Very high/don't know
4 – National	8 - High
3 – Regional	6 - Moderate
2 – Local	4 - Low
1 - Site only	2 - Minor
0 – None	

Once these factors are ranked for each impact, the significance of the two aspects, occurrence and severity, is assessed using the following formula:

SP (significance points) = (magnitude + duration + scale) x probability

The maximum value is 100 significance points (SP). The impact significance will then be rated as follows.

Significance of impact based on point allocation

SP >75	Indicates high environmental significance	An impact which could influence the decision about whether or not to proceed with the project regardless of any possible mitigation.
SP 30 – 75	Indicates moderate environmental significance	An impact or benefit which is sufficiently important to require management and which could have an influence on the decision unless it is mitigated.
SP <30	Indicates low environmental significance	Impacts with little real effect and which should not have an influence on or require modification of the project design.
+	Positive impact	An impact that constitutes an improvement over pre-project conditions,

For the methodology outlined above, the following definitions were used:

- **Magnitude** is a measure of the degree of change in a measurement or analysis (e.g. the area of pasture, or the concentration of a metal in water compared to the water quality guideline value for the metal), and is classified as none/negligible, low, moderate or high. The categorization of the impact magnitude may be based on a set of criteria (e.g. health risk levels, ecological concepts and/or professional judgment) pertinent to each of the discipline areas and key questions analysed. The specialist study must attempt to quantify the magnitude and outline the rationale used. Appropriate, widely recognised standards are to be used as a measure of the level of impact.
- **Scale/Geographic** extent refers to the area that could be affected by the impact and is classified as site, local, regional, national, or international.
- **Duration** refers to the length of time over which an environmental impact may occur: i.e. immediate/transient, short-term (0 to 7 years), medium term (8 to 15 years), long-term (greater than 15 years with impact ceasing after closure of the project), or permanent.
- **Probability of occurrence** is a description of the probability of the impact actually occurring as improbable (less than 5% chance), low probability (5% to 40% chance), medium probability (40% to 60% chance), highly probable (most likely, 60% to 90% chance) or definite (impact will definitely occur).

APPENDIX B

CV and Qualifications

Novania Reddy

Air Quality, Climate Change, Principal Consultant

CAREER SUMMARY

Novania is a consultant with over 9 years' experience in the environmental industry. Her area of expertise lies within the air quality, climate change and acoustics fields related to sectors ranging from mining to the oil and gas industry. She holds the responsibility of data collection, inventory development, compilation of air emission licence and scientific modelling and reporting.

Novania has a broad understanding of the various laws and regulations associated with the air quality, climate change and noise procedures. Novania has also obtained a certificate in the Greenhouse Gas Reporting Training Course and was involved in the development of a municipality wide greenhouse gas evaluation in South Africa which included two major refineries.

Additionally, Novania has a year of experience within the petrochemical industry at Total SA where she has learnt prominent aspects such as communication skills, having attended a 3-day course for a communication workshop and leadership traits, by training fellow staff members. These characteristics along with her sound knowledge of the petrochemical industry has attained her to become the consultant she is today.

Countries of work experience include, but are not limited to, South Africa, Ghana, Mozambique, Botswana, Cameroon, Ethiopia, Democratic Republic of Congo, Australia and United Arab Emirates.

1 year with WSP

>9 years of experience

Area of expertise

Air Quality

Climate Change

Acoustics

Language

English - Fluent

EDUCATION

Bachelor of Science in Engineering (Chemical Engineering), Howard College, Durban	2011

ADDITIONAL TRAINING

Leadership Training	2022
AERMOD and CALPUFF Modelling Course	2018
HIRA Training	2018
Snake Awareness Training, African Snakebite Institute	2016

PROFESSIONAL HISTORY

WSP Group Africa (Pty) Ltd	July 2021 – present
Golder Associates Africa (Pty) Ltd	April 2020 - June 2021

Novania Reddy

Air Quality, Climate Change, Principal Consultant

WSP Environmental (Pty) Ltd	2016 – 2020
WKC Group	2013 – 2016
Total SA	2012 – 2013

PROFESSIONAL EXPERIENCE

Climate Change

TEEPSA Block 11B/12B Climate Change Impact Assessment, South Africa
2023
Principal Consultant
A Climate Change Impact Assessment, including GHG Assessment was undertaken for the proposed development of the Paddavissie fairway at Block 11B/12B. This entailed the identification of potential physical climate risks and hazards anticipated for the project region, including recommended adaptation measures. Additoanally the GHG assessment evaluated the impact of the project and mitigation measures to reduce such emissions were proposed.

Dangote GHG Emissions Inventory and Reporting, South Africa
2023
Principal Consultant
A GHG inventory and reporting assessment was undertaken for the Dangote Petroleum Refinery and Petrochemicals Free Zone Enterprise (DPRPFZE), a subsidiary of Dangote Industries Limited (DIL) for the refinery component of their proposed DPRPFZE site in Lekki Peninsula, Lagos State, Nigeria. The proposed refinery will have a capacity of 650,000 barrels per stream day (BPSD), receiving crude oil and ethanol from the proposed single point mooring (SPM) system and pipeline network, with refined products transferred to the SPM via the pipeline network for distribution to local and foreign markets. The total GHG emissions from the proposed refinery was quantified and assessed. Alternatives were also considered and used as a comparison.

Kamoa Copper SA GHG Updates and Scenario Analysis, South Africa
2023
Principal Consultant
A GHG assessment was undertaken for Kamoa Copper SA (Kamoa). Additionally, an Alternative Analysis Assessment was required to comply with the Equator Principles since the Project's Scope 1 and 2 emissions were in excess of 100, 000 tonnes of CO_2e annually. Lastly, a GHG Scenario analysis was also undertaken which entailed, an assessment of the worst-case scenario as the possible base case, which is using all diesel for the entire mine and an assessment of a progressive mix of hydo-grid-power and diesel for the mine.

Tronox Port Durnford Climate Change Impact Assessment, South Africa
2023
Principal Consultant
A GHG and Climate Change Risk Assessment for the proposed expansion project at Tronox Mineral Sands (Pty) Ltd (Tronox) was undertaken. Tronox intends to develop a very low-rate mining only operation initially (producing Run-of-Mine (ROM) to be sent to Fairbreeze for primary beneficiation), and then expanding operations to provide the heavy mineral concentrate for the KZN Mineral Separation Plant once mining at Fairbreeze is completed.

NATREF Hybrid Refinery Climate Change Impact Assessment, South Africa
2023
Principal Consultant
A Climate Change Impact Assessment (including GHG Assessment) for the proposed Hybrid Refinery at National Petroleum Refiners of South Africa (Pty) Ltd (Natref) was undertaken. Given the Natref configuration and the Clean Fuels II (CFII) and Biofuel legislation, an opportunity exists to produce sustainable fuels (utilizing existing assets) and support South Africa's decarbonisation agenda. To enable Natref to comply with

the Department of Mineral and Energy Resources (DMRE) CFII Regulations and Biofuels legislation in accordance with newly negotiated dates with Government, a Hybrid Refinery (crude and bio-material processing) Flow Scheme was proposed.

Vesuvius GHG Inventory and Carbon Tax, South Africa
2023
Principal Consultant
A GHG emissions inventory and Carbon Tax liability for the reporting calendar period from 1 January 2020 to 31 December 2022 was undertaken for Vesuvius South Africa (Pty) Ltd (Vesuvius). This also entailed uploading the submission onto the National SAGERS platform.

Kelvin Power Annual Reporting and GHG Emissions Inventory, South Africa
2023
Principal Consultant
An annual report for the Kelvin power station as required by their atmospheric licence (AEL) conditions was compiled. As part of this annual report, a GHG emissions inventory for the power station was developed.

Sibanye-Stillwater Limited, Climate Change Impact Assessment for the Closure Activities at Sibanye, South Africa
2022
Principal Consultant
A Climate Change Impact Assessment was undertaken to inform the closure and rehabilitation planning of the gold and PGM mining operations. This entailed the; identification of potential climate hazards anticipated for the project region using the current and future climate change projections relevant for the closure of the project; the assessment of whether the climate hazards identified for the project region have the potential to interact with the project infrastructure; the assignment of a relative risk rating to each project hazard interaction and identification of potential opportunities for adapting to the projected changes.

Air Quality

Canyon Camalco, Air Quality Impact Assessment for Bauxite Project, Cameroon
2021
Lead Consultant
An Air Quality Impact Assessment was undertaken to develop the Minim Martap Bauxite Project in Cameroon. The Project is made up of the Minim Martap, Makan and Ngaoundal exploration permits, the haul route to transport the bauxite from the mine to the railway facility, the rail transport corridor, the Port facilities within the Douala port and transhipment between the Douala berth and a deep-water transhipment location.

Vale, Air Quality Impact Assessment for the Vale BSM 4&5 Project, Mozambique
2021
Lead Consultant
An Air Quality Impact Assessment was undertaken for the Vale's Moatize Coal Mine in the District of Moatize, in the province of Tete, in Mozambique. The mine has been producing coking coal (CC) and thermal coal (TC) for export to several countries since 2011, through the Ports of Beira and Nacala. A Level two dispersion model (AERMOD) was utilized to predict the potential air quality impacts associated with the proposed project.

Kamoa Copper SA, Air Quality Impact Assessment for Kamoa-Kakula Project, Democratic Republic of the Congo
2020/2021
Lead Consultant
An Air Quality Impact Assessment was undertaken which focused on the Kakula mine development, that aimed to produce 565,000 tonnes of copper concentrate per annum, through the mining of 6 MTPA of copper sulphide ore from the Kakula deposit. A Level two dispersion model (AERMOD) was utilized to predict the potential air quality impacts associated with the proposed project.

Novania Reddy

Air Quality, Climate Change, Principal Consultant

Groupe Forrest International, Air Quality Impact Assessment for the Kolwezi Road Project, Democratic Republic of the Congo
2020/2021
Lead Consultant
An Air Quality Impact Assessment was undertaken for a new Bypass Toll road that will divert heavy truck traffic (mining, general freight, agriculture) of over 220,000 trucks per year around the Kolwezi city centre in the DRC. A Level two dispersion model (AERMOD) was utilized to predict the potential air quality impacts associated with the proposed project.

Anglo American IniNyosi Coal (Pty) Ltd Zibulo Colliery, Air Quality Impact Assessment for the Zibulo Colliery, Mpumalanga, South Africa
2020/2021
Lead Consultant
An Air Quality Impact Assessment was undertaken for the Zibulo Colliery for the development of a proposed coal and discard dump, located north-west of the town of Ogies, on the footprint of its opencast mine in Mpumalanga. A Level two dispersion model (AERMOD) was utilized to predict the potential air quality impacts associated with the proposed project.

Mafube Coal Mining (Pty) Ltd, Air Quality Impact Assessment for the Mafube Colliery, Mpumalanga, South Africa
2020
Lead Consultant
An Air Quality Impact Assessment was undertaken for the Mafube Colliery to provide the environmental inputs into the Crush and Stockpile project, which supported mining of the MGF pit. A Level one screening model (SCREENVIEW) was utilized to predict the potential air quality impacts associated with the proposed project.

Tulu Kapi Gold Mine S.C., Air Quality Impact Assessment for the Tulu Kapi Gold Mine, Ethiopia
2020
Lead Consultant
An Air Quality Impact Assessment was undertaken to determine the potential air quality impacts on the surrounding environment from the proposed mining operations. A Level two dispersion model (AERMOD) was utilized to predict the potential air quality impacts associated with the proposed project.

Palabora Copper Stream Operations, Air Quality Impact Assessment, Limpopo, South Africa
2020
Project Manager and Lead Consultant
An Air Quality Impact Assessment was undertaken for the Palabora Copper Stream Operations in Limpopo. Palabora was proactively seeking an emissions inventory and dispersion modelling study to supplement their management plan for emissions reduction and control.

Palabora Vermiculite Operations, Air Quality Impact Assessment, Limpopo, South Africa
2020
Project Manager and Lead Consultant
An Air Quality Impact Assessment was undertaken for the Palabora Verrmiculite Operations in Limpopo. Palabora was proactively seeking an emissions inventory and dispersion modelling study to supplement their management plan for emissions reduction and control.

SANRAL, N3 Project, Durban, South Africa
2019 – 2020
Project Manager and Lead Consultant
An Air Quality Impact Assessment for the proposed widening, realignment and upgrades of the N3 in the Key Ridge area in KwaZulu-Natal was undertaken. It was understood that the N3 was operating at full capacity with traffic studies indicating the need to upgrade sections of the N3 to accommodate future growth and to improve road safety. Therefore, the South African National Roads Agency SOC Limited proposed to widen, realign and upgrade a section of the N3, extending from approximately just after the M13 Interchange, at the

top of Key Ridge, to the Hammersdale Interchange at the bottom of Key Ridge. The study required an AQIA to be undertaken, using a Level 2 dispersion model (AERMOD) to assess the potential impacts of specified sensitve receptors on the surrounding environment.

Koumbia Bauxite, Air Quality Monitoring and Management Plan, Guinea
2019 – 2020
Project Manager and Lead Consultant
The Koumbia Bauxite Project included the exploration and development of an open cut mine as well as related infrastructure.

Loci Environmental (Pty) Ltd, T3 Copper Mine, Ghanzi District, Botswana
2018 – 2019
Project Manager and Lead Consultant
The proposed development included an open pit mine and processing plant (concentrator) at the project site as well as all associated facilities and infrastructure including tailings disposal, waste dumps, water and power supply, workshops, offices and other required facilities. Key pollutants associated with on-site activities were identified as PM_{10} and $PM_{2.5}$. A Level two dispersion model (AERMOD) was utilized to predict the potential air quality impacts associated with the proposed project.

Ekurhuleni Metropolitan Municipality, Kelvin Power Station, Johannesburg, Gauteng
2018
Project Manager and Lead Consultant
In support of the Air Emission License renewal for the Kelvin Power Station, an Air Quality Impact Assessment was undertaken. This assessment aimed to assess the ambient impact of PM, SO_2, NO_2 and CO emissions associated with the operations onsite. An emissions inventory for the onsite sources was developed, and inputted to a Level 3 atmospheric dispersion model, CALPUFF, to calculate ambient air concentrations of key pollutants associated with the operations. Relevant long-term (period) and short-term 99th percentile 24-hour and 1-hour average concentrations for the pollutants of focus were compared with the relevant National Ambient Air Quality Standard.

Permoseal Facility, Air Quality Impact Assessment, Montague Gardens, Cape Town, South Africa
2018
Project Manager and Lead Consultant
In support of the Air Emission License. This assessment aimed to assess the ambient impact of PM and VOC emissions associated with the operations onsite. An emissions inventory for the onsite sources was developed, and inputted to a Level 2 atmospheric dispersion model, AERMOD, to calculate ambient air concentrations of key pollutants associated with the operations. Relevant long-term and short-term average concentrations for the pollutants of focus were compared with the relevant National Ambient Air Quality Standard.

ArcelorMittal South Africa Newcastle Works facility, Atmospheric Impact Report, Amajuba District Municipality, Newcastle, South Africa
2016
Project Manager and Lead Consultant
An Air Quality Impact Assessment was undertaken using the AERMOD atmospheric dispersion model in order to assess the potential ambient air quality impacts. The results were assessed against the South African Ambient Air Quality Standards.

Boseto Mine in Botswana, Air Quality Impact Assessment, Ghanzi, Botswana
2016
Project Manager and Lead Consultant
The study comprised a screening level assessment, using a Level 1 dispersion modelling platform (SCREEN3), to predict the potential air quality impacts associated with the mine for a current throughput of 2 mtpa and an increased throughput of 3.6 mtpa. Ambient PM_{10} and TSP were identified to be the key pollutants of concern from the mining operations.

Weir Minerals Isando Foundry, Annual Reporting, Johannesburg, South Africa
2016
Project Manager and Lead Consultant
An Annual Report for the 2015 reporting period in the heavy industrial zone of Isando in Ekurhuleni Metropolitan Municipality in the Gauteng Province was compiled. Annual reporting of emissions, auditing and upgrades of the facility are an important component of tracking progress on air pollution and for tracking performance and relative contributions of pollution sources which will in turn assist in assessing historic trends. This report included key items such as operations at the facility, legal framework, pollutant emission trends, compliance audit reports, major upgrades projects (abatement or process equipment) and greenhouse gas emissions.

Al Lajun Shale Processing Facility, Air Quality Impact Assessment, Amman, Jordan
2015
Project Manager and Lead Consultant
An air quality impact assessment for the proposed mining facility located in Jordan was performed. The objective of this Project was to design, construct and operate an oil shale processing facility that is safe and efficient to operate and maintain combined with a minimal environmental footprint. The Project involved the construction and operation of a 4,000 barrels per day plant, based on retort technology, with an operating capacity of 250 tonnes per hour. Further Project phases are planned to enable full development of the oil shale resource. The project involved developing an emission inventory of the entire facility and was modelled using CAPLUFF as the modelling platform.

Nemai Consulting, Scrap Metal Recycling Plant, Durban, Isipingo and Isies Rivier, Cape Town, South Africa
2014
Project Manager and Lead Consultant
A review of relevant Republic of South Africa ambient air quality legislation was undertaken and a summary of the minimum standards that was required to be achieved was quantified and assessed. Emissions of NO_2, CO, PM, HCl, HF, NH_3, Hg, metals, Cd + TI and PCDD/PCDF were assessed.

Eskom Grootvlei, Atmospheric Impact Report, Mpumalanga, South Africa
2014
Project Manager and Lead Consultant
An Atmospheric Impact Report was prepared in order to accompany Eskom's application for a temporary relaxation of certain requirements of the Grootvlei Atmospheric Emission Licence. This involved developing an emission inventory for the existing power station and modelling the PM emissions which were of concern.

Nemai NATREF Clean Fuels Project II, Air Quality Impact Assessment for, Sasolburg, South Africa, 2014
Project Manager and Lead Consultant
An air quality impact assessment for the NATREF Plant was undertaken, which involved developing an emission inventory for the both the normal and upset conditions. The key emissions included NOx, SO_2, CO and PM.

Shell Majnoon, Odour Impact Assessment for the, Basra, Iraq
2014
Project Manager and Lead Consultant
An odour screening study at the DS1 facility located at the Shell Majnoon Field was conducted. The quantitative assessment has been undertaken to determine whether continuous venting of hydrocarbon gases from two oil flow tank vents could lead to odour nuisance experienced by workers.

eThekwini Municipality, Update of Greenhouse Gas Emission Inventory Project, Durban, KwaZulu-, Natal, South Africa
2014
Project Manager and Lead Consultant

Novania Reddy

Air Quality, Climate Change, Principal Consultant

An evaluation of the greenhouse gas emissions from certain activities within the municipal boundaries was undertaken. The scope included a high-level review and verification of the whole 2012 Greenhouse Gas Emission Inventory that was prepared by the Energy Office. The inventory provided the basis for creating emissions forecast and reduction target tool and enabled the quantification of emissions reductions associated with implemented and proposed measures.

Sunderland and Hennops, Odour Impact Assessment, Sunderland / Hennops, South Africa
2013
Project Manager and Lead Consultant
An odour impact assessment was conducted. The project involved developing an odour emission inventory for the existing and proposed facilities and AERMOD modelling software was thereafter utilized to quantify and assess the odour impact.

Rustenburg Incinerator, Air Quality Impact Assessment, Rustenburg, South Africa
2013
Project Manager and Lead Consultant
An air quality impact assessment for the proposed incinerator in Rustenburg was undertaken. Key emission sources included SO_2, NOx, PM and CO.

SABIC Carbon Fiber, Atmospheric Dispersion Modelling Assessment, Yanbu, Kingdom of Saudi Arabia
2013
Project Manager and Lead Consultant
An air dispersion modelling assessment for the SABIC PAN Precursor and Carbon Fiber Project was undertaken. This involved developing an emission inventory for the combustion sources and vent scrubbers. The key emissions included NO_2, CO, SO_2, PM_{10}, NH_3, HCN, and tar. Acrylonitrile, vinyl acetate monomer, dimethylamine and dimethylacetamide were also considered for an emergency case for the vent scrubbers.

Petro Rabigh Phase II Project, Atmospheric Dispersion Modelling Assessment, Rabigh, Kingdom of Saudi Arabia
2013
Project Manager and Lead Consultant
This Project consisted of expanding the ethane cracker and new aromatics complex at the Petro Rabigh facility. This considered emissions of NO_2, CO, SO_2, PM_{10}, cumene, alpha-methyl styrene, acetone, phenol, acetaldehyde, propanol, dimethyl benzyl alcohol and acetophenone.

PROFESSIONAL EXPERIENCE

Noise

Canyon Camalco, Noise Impact Assessment for Bauxite Project, Cameroon
2021
Lead Consultant
A Noise Impact Assessment was undertaken to develop the Minim Martap Bauxite Project in Cameroon. The Project is made up of the Minim Martap, Makan and Ngaoundal exploration permits, the haul route to transport the bauxite from the mine to the railway facility, the rail transport corridor, the Port facilities within the Douala port and transhipment between the Douala berth and a deep-water transhipment location.

Vale, Noise Impact Assessment for the Vale BSM 4&5 Project, Mozambique
2021
Lead Consultant
A Noise Impact Assessment was undertaken for the Vale's Moatize Coal Mine in the District of Moatize, in the province of Tete, in Mozambique. The mine has been producing coking coal (CC) and thermal coal (TC) for

export to several countries since 2011, through the Ports of Beira and Nacala. The CadnaA model was utilized to predict the potential noise impacts associated with the proposed project.

Noise Impact Assessment for the proposed T3 Copper Mine Project in the Ghanzi District, Botswana (2018/2019)
Project Manager and Lead Consultant
Ghanzi, Botswana
In order to assess the environmental acoustic impacts of the proposed development both baseline (monitored) and proposed construction and operational noise levels were assessed. Comparison of the existing and proposed noise levels at various specified sensitive receptors (noise receivers) enabled an assessment of changes in noise levels at these locations as a result of the proposed development. Such changes were then assessed against the South African National Standards community or group responses in order to assess the anticipated impacts/responses as a result of such increases.

Polokwane Smelter, Noise Impact Assessment, Limpopo province
2017
Project Manager and Lead Consultant
An acoustic impact assessment for the proposed SO_2 abatement equipment, during the operational phase, at the Polokwane Smelter was performed. CadnaA was used as the advanced modelling platform to assess the impact of the proposed noisy sources.

Ma'aden Ammonia, Preliminary and Final Noise Impact Assessment, Ras Al Khair Kingdom of Saudi Arabia
2016
Project Manager and Lead Consultant
A Preliminary and Final Acoustic Impact Assessment for the Ma'aden Umm Wu'al Phosphate Project's Ammonia Package Project was undertaken to determine the findings of a predictive acoustic modelling analysis of high noise emitting equipment associated with the Project.

Munali Nickel Mine Facility, Noise Impact Assessment, Albidon, Zambia
2016
Project Manager and Lead Consultant
An acoustic impact assessment for the existing and proposed sources within the mining facility was conducted. SoundPlan was used as the modelling podium to assess the impact of the existing and proposed noisy equipment to be implemented on site.

Boseto Mine, Noise Impact Assessment, Ghanzi, Botswana
2016
Project Manager and Lead Consultant
A screening-level acoustic impact assessment of the proposed 3.6 mtpa operations at the Boseto Mine was undertaken in order to determine the acoustic impacts of the Proposed Project on the nearby residential receptors.

Amasundu Quarry, Noise Impact Assessment, KwaZulu-Natal
2016
Project Manager and Lead Consultant
A screening-level acoustic impact assessment of the proposed development of a staged mobile crushing plant at the Amasundu Quarry, near Mtunzini was undertaken. This assessment evaluated the potential acoustic impacts associated with the establishment and operational phases of the proposed crushing on the nearby residential receptors.

Al Lajun Shale Processing Facility, Noise Impact Assessment, Amman, Jordan
2015
Project Manager and Lead Consultant
Undertook an acoustic impact assessment for the proposed mining facility located in Jordan. Sound Plan was used as the advanced modelling platform to assess the impact of the noisy equipment on site.

UNIVERSITY OF KWAZULU-NATAL

INYUVESI YAKWAZULU-NATALI

This is to certify that

Novania Reddy

was admitted this day
at a congregation of the University
to the degree of

Bachelor of Science in Engineering
(Chemical Engineering)

having satisfied the conditions prescribed for the degree.

M W Makgoba
Vice-Chancellor

J J Meyerowitz
Registrar

C Trois
Dean

17 April 2012

UV PROTECTED