Ambient Air Quality Impact Study Commissioned By

ZUTARI NDODANA JOINT VENTURE

ON BEHALF OF OMMP-BRWSP PHASE 2F

Project Reference 0924-P006-ZUT OMMP BRWSP 2F AQIS

Date 17 March 2025

This report documents the results and findings of an air quality impact investigation resulting from the construction and operation of the Olifants Management Model Programme Bulk Raw Water Study Phase (OMMP-BRWSP): Proposed Phase 2F in the Fetakgomo Tubatse Local Municipality, within the Sekhukhune District Municipality and Lepelle Nkumpi Local Municipality, within the Capricorn District Municipality of the Limpopo Province.

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EXECUTIVE SUMMARY

EHRCON (Pty) Ltd (EHRCON) was commissioned by the Zutari Ndodana Joint Venture (ZNJV) to assess the air quality impact associated with the Olifants Management Model Programme Bulk Raw Water Study Phase (OMMP-BRWSP): Proposed Phase 2F. The Phase 2F project area is located with the Fetakgomo Tubatse Local Municipality, within the Sekhukhune District Municipality (SDM) and Lepelle Nkumpi Local Municipality, within the Capricorn District Municipality (CDM) of the Limpopo Province.

Phase 2F comprises approximately 60 kilometre (km) of pipeline intended to convey water to the Olifantspoort Water Treatment Works (WTW), thereby augmenting the water supply to Polokwane and surrounding rural areas. The alignment of Phase 2F starts near Havercroft Junction, deviating from the R37 to take a more direct route to the Olifantspoort WTW, following existing gravel roads along part of the way. The pipeline starts as a 1 200 millimetre (mm) diameter over 18.5 km, reducing to a 1 000 mm diameter over 25.6 km, originating at the Klipfontein Balancing Dam (or Break Pressure Dam) with a projected capacity of 21 megalitres ML.

The objectives of this study were to characterise and describe ambient emissions from the construction, operation and rehabilitation of the Phase 2F project and to assess the impact on the health of the receiving community. The findings of the study are aimed at providing ZNJV, the SDM, CDM and other stakeholders with scientific data required in terms of present and future air quality management systems.

The assessment considered a review of the relevant health legislation, ambient air quality guidelines and standards. An overview was given of the prevailing meteorological conditions as well as available data on criteria air pollutant concentrations in the area. A process description and emission inventory were compiled, founded on current emission factors.

An evaluation of the potential for human health and environmental impacts, centred on comparisons of modelled pollutant concentrations with relevant guidelines and standards was performed. An assessment of the contribution and outcome of the process on the current air quality, completed the study.

The air quality impact study concludes the following:

- The process falls within the Fetakgomo Tubatse Local Municipality, within the SDM and Lepelle Nkumpi Local Municipality, within the CDM of the Limpopo Province.
- Ambient monitoring data from the SDM Dilokong Hospital station and Anglo Platinum South Farm station was included in the study.
- A total emission rate of 226.41 gram per second (g/s) was calculated for Phase 2F.
- Construction emissions will most possibly be the largest source of ambient pollution (87.4%), followed by rehabilitation (12.4%) and operations (0.2%).
- Particulate matter comprises approximately 98.4 % of the pollution load. PM_{10} is the criteria pollutant of concern and contributes about 27.4% of the pollution load. Total suspended particulates (TSP) and $PM_{2.5}$ contribute 68.3% and 2.7% respectively.
- Dispersion of emissions from the process was modelled using the ISC-AERMOD View model based on the standard Gaussian solution.
- The results present the spectrum from maximum ground level concentration to maximum impact area, and accounts for annual averages.
- Ground level concentrations were predicted for atmospheric conditions based on local meteorological data for the period 1 July 2023 to 30 June 2024.
- Winds are mostly from the north easterly sector 45.1%. Calm periods are the exception (2.8%) and wind speeds are mostly light, between 0.5 and 2.1 metres per second (m/s) (45.6%). Moderate winds between 2.1 and 3.6 m/s occur 27.3% and brisk winds above 3.6 m/s, 17%. Strong winds above 5.7 m/s occur 7.3%.
- Maximum deposition rates around the Klipfontein Balancing Dam are expected to exceed the residential standard of 600 milligrams per square metres per day ($mg/m^2/day$) up to maximum distance of 250 metre (m) from the centre of construction operations. It is unlikely that deposition rates will exceed current background levels beyond 150 m from the construction alignment. The impact of dust deposition during rehabilitation and operation are not significant.

- Contravention of the daily average PM_{10} standard may exceed the allowable number of four per annum around the Klipfontein Balancing Dam, up to a distance of 500 m during construction and up to distance of 250 m during rehabilitation. Further contraventions of the daily standard will most likely occur infrequently along the alignment.
- Annual average PM_{10} concentrations are expected to be insignificant (i.e. <50% of the standard) throughout the life of the project.
- The incremental impact of all pollutants during construction, rehabilitation and operations are expected to be negligible. Current industry standard techniques should be maintained and supplemented with administrative control measures to maintain the residual impact at the nearest sensitive receivers at current background levels.
- Ambient monitoring should be used in combination with modelling and emission inventory to assess the effectiveness of control measures at source and receivers, on an annual basis.
- Monitoring of ambient air quality will assist effective air quality management and open communication to all stakeholders.

DECLARATION AND REPORT APPROVAL

Report 0924-P006-ZUT OMMP-BRWSP 2F AQIS issued on this day, 17 March 2025, is the sole property of the Zutari Ndodana Joint Venture and supersedes any previous versions. No part of this report may be reproduced or transmitted in any form or by any means, unless in full and with the exclusive permission, in writing, from the author. EHRCON declares that:

- it acts as an independent specialist.
- all results and related data have been obtained through careful and precise execution of recognised methods of evaluation and are related to the scope of work covered in this report and of prevailing conditions at the time of the assessment.
- the opinions and interpretations are embraced through judgment, discernment and comprehension to the best of available knowledge and are outside the scope of any accreditation.
- it performed the work relating to this project in an objective manner, notwithstanding the results, views and findings.
- it has expertise in conducting the specialist report relevant to this project, including knowledge of the Act, regulations and any guidelines that may have relevance.
- it complies with the Act, regulations and all other applicable legislation.
- it has no, and will not engage in, conflicting interests in the undertaking of the activity.
- it undertakes to disclose to the client and authorities all material information it possesses that reasonably has or may have the potential of objectively influencing any decision based on the results and finings of this project.
- all the particulars furnished by EHRCON in this report are true and correct; and any false declaration is a punishable offence.

Report compile by EHRCON (Pty) Ltd

17 March 2025

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Environmental and Social Lead

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1.1 PROJECT OUTLINE

EHRCON was commissioned by the ZNJV to assess the air quality impact associated with the OMMP-BRWSP: Proposed Phase 2F. The Phase 2F project area is located with the Fetakgomo Tubatse Local Municipality, within the SDM and Lepelle Nkumpi Local Municipality, within the CDM of the Limpopo Province.

Phase 2F comprises approximately 60 km of pipeline intended to convey water to the Olifantspoort WTW, thereby augmenting the water supply to Polokwane and surrounding rural areas. The alignment of Phase 2F starts near Havercroft Junction, deviating from the R37 to take a more direct route to the Olifantspoort WTW, following existing gravel roads along part of the way. The pipeline starts as a 1,200 mm diameter over 18.5 km, reducing to a 1,000 mm diameter over 25.6 km, originating at the Klipfontein Balancing Dam (or Break Pressure Dam) with a projected capacity of 21 ML.

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The assessment considered a review of the relevant health legislation, ambient air quality guidelines and standards. An overview was given of the prevailing meteorological conditions as well as available data on criteria air pollutant concentrations in the area. A process description and emission inventory were compiled, founded on current emission factors.

An evaluation of the potential for human health and environmental impacts, centred on comparisons of modelled pollutant concentrations with relevant guidelines and standards was performed. An assessment of the contribution and outcome of the process on the current air quality, completed the study.

The report was compiled with due consideration of all process information and specific conditions outlined by the ZNJV.

1.2 PROJECT DESCRIPTION

The study area is in the Fetakgomo Tubatse Local Municipality, within the SDM and Lepelle Nkumpi Local Municipality, within the CDM of the Limpopo Province. Current land use includes commercial, educational institutions, municipal services, mining, agricultural processes and residential developments. (See **Figure 1**).

The study area is classified as agricultural rural (A2) based on the Auer method recommended for selecting atmospheric dispersion coefficients.

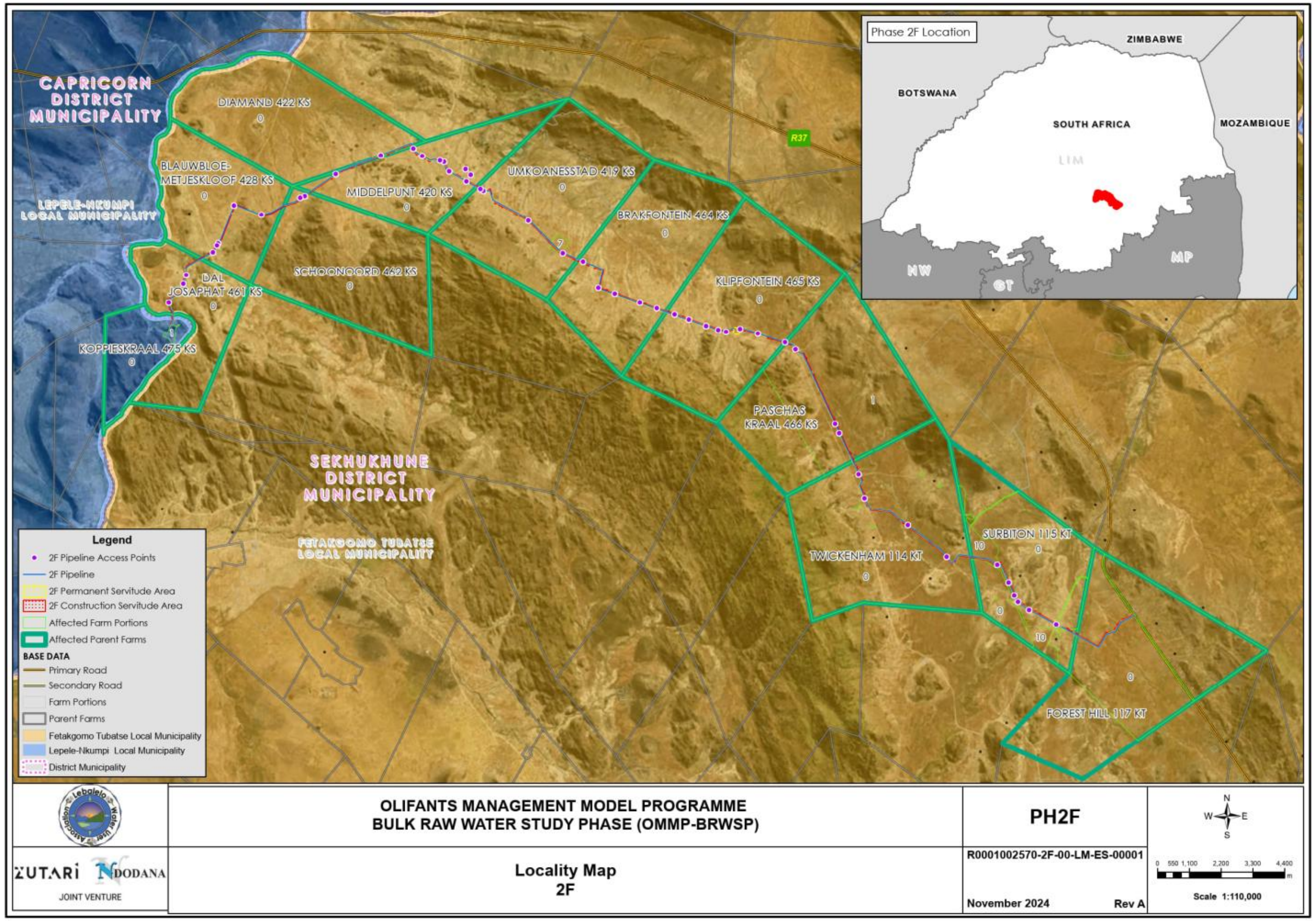

Figure 1: OMMP-BRWSP Phase 2F Locality.

The assessment of the potential air quality impact associated with the Phase 2F project comprised the following terms of reference:

- A review of relevant health legislation, ambient air quality guidelines and standards.
- A process description and emission inventory.
- An overview of the prevailing meteorological conditions in the area.
- An overview of available data on criteria air pollutant concentrations in the area.
- Evaluation of the potential for human health and environmental impacts centred on comparisons of modelled pollutant concentrations with relevant guidelines and standards.

1.3 METHODOLOGICAL OVERVIEW

The establishment of an emissions inventory formed the basis for assessing the impact from the Phase 2F project. This comprised the identification of sources of emissions and the quantification of each source's contribution to ambient air concentrations. In the emissions inventory, dispersion simulation and impact assessment, reference was made to routine emissions from the process.

Process emission rates were obtained from emission factors which associate the quantity of a pollutant to the activity associated with its release. Due to the absence of locally generated emission factors, use was made of the comprehensive set of emission factors published by the United States Environmental Protection Agency (US-EPA) in its AP-42 document *Compilation of Pollution Emission Factors* and the National Pollutant Inventory *Emission Estimation Technique Manual*.

The simulation of emissions was performed through the application of the ISC-AERMOD View Model. AERMOD is a steady-state plume model, applicable to rural and urban areas, flat and complex terrain, surface and elevated releases, and multiple sources (including, point, area and volume sources).

In the stable boundary layer (SBL), the concentration distribution is assumed to be Gaussian in both the vertical and horizontal. In the convective boundary layer (CBL), the horizontal distribution is assumed to be Gaussian, but the vertical distribution is described with a bi-Gaussian probability density function. Additionally, in the CBL, AERMOD treats 'plume lofting,' whereby a portion of plume mass, released from a buoyant source, rises to and remains near the top of the boundary layer before becoming mixed into the CBL. AERMOD also tracks any plume mass that penetrates elevated stable layer, and then allows it to re-enter the boundary layer when and if appropriate.

The dispersion simulations of emissions facilitated a preliminary or screening study of the potential for human health impacts. To assess the health implications, the simulated concentrations were compared to ambient air quality guidelines and standards.

1.4. ASSUMPTIONS, EXCLUSIONS AND LIMITATIONS

Data limitations and assumptions associated with the air quality impact study in support of the Phase 2F project are listed below:

- Ambient monitoring data from the SDM Dilokong Hospital station and Anglo Platinum South Farm station was included in the study.
- Unified model meteorological data supplied by Meteoblue was used for dispersion modelling.
- Dispersion simulations were based on the process descriptions and predicted production data provided by the ZNJV.
- All sources were digitised from layout drawings provided by the ZNJV.

2. LEGISLATION, GUIDELINES AND STANDARDS

2.1 AIR QUALITY ACT

The Department of Forestry, Fisheries and the Environment (DFFE) has brought into effect the National Environmental Management: Air Quality Act (Act No. 39 of 2004, NEMAQA) on 11 September 2005 as part of a broad programme of air quality management reform.

The purpose of the Act is to set norms and standards that relate to institutional frameworks, roles and responsibilities; air quality management planning; air quality monitoring and information management; air quality management measures and general compliance and enforcement. Amongst other things, it is intended that the setting of norms and standards will achieve the following:

- The protection, restoration and enhancement of air quality in South Africa.
- Increased public participation in the protection of air quality and improved public access to relevant and meaningful information about air quality.
- The reduction of risks to human health and the prevention of the degradation of air quality.

A key aspect is the establishment of national ambient air quality standards. These standards provide the goals for air quality management plans and provide the yardstick by which the effectiveness of these management plans is measured. The Act provides for the identification of priority pollutants and the setting of ambient standards with respect to these pollutants.

The Act describes various regulatory tools that should be developed to ensure the implementation and enforcement of air quality management plans. These include:

- Priority Areas, which are air pollution 'hot spots'.
- Listed Activities, which are 'problem' processes that require an Atmospheric Emission Licence.
- Controlled Emitters, which includes the setting of emission standards for 'classes' of emitters, such as motor vehicles, incinerators.
- Control of Noise.
- Control of Odours.

2.2 AMBIENT AIR QUALITY STANDARDS

The exclusive use of source-based controls (e.g. emission limits) as an air quality management tool has been found to have important short-comings. Emission limits do not take the unique characteristics of the receiving environment into account, such as the dispersion potential, existence of other sources, existing ambient pollutant concentrations, and the sensitivity of the receiving environment. Such limits therefore provide no insurance that ambient air quality objectives will be achieved and that there will be no adverse effects on human health and welfare.

There has been a strong shift from air pollution control based exclusively on source-based methods (e.g. emission limits) to air quality management based on an effects-based approach (e.g. air quality objectives). An effects-based approach requires the setting of ambient air quality guidelines and standards.

Ambient air quality guidelines and standards are laid down by various countries, including South Africa, for the regulation of air concentrations of various criteria pollutants (e.g. sulphur dioxide, particulate matter, nitrogen oxides and lead). Such ambient guideline and standards define satisfactory air quality to ensure human health and welfare, thus providing objectives for air quality management.

Air quality guidelines and standards are fundamental to effective air quality management, providing the link between the source of atmospheric emissions and the receptor. These guideline values indicate safe daily exposure levels for most of the population, including the very young and the elderly, throughout the individual's entire lifetime. Air quality guidelines and standards are normally given for specific averaging periods, i.e. the duration over which the standard or guideline is applicable. Generally, five averaging periods are applicable, namely an instantaneous peak, 1-hour average, 24-hour average, 1-month average and annual average.

The NEMAQA is part of a broad programme of air quality management reform. The publication in May 2000 of government's Integrated Pollution and Waste Management Policy (IP & WM Policy) marked a turning point for pollution and waste governance in South Africa. The National Air Quality Management Plan (NAQMP), borne from the IP & WM Policy, has as its definition the NEMAQA.

Government's vision with respect to the NAQMP is that the programme will develop, implement and maintain an air quality management regime that contributes to sustainable development and a measurable improvement in the quality of life of all, by harnessing the energy and commitment of all South Africans for the effective prevention, minimisation and control of atmospheric pollution.

The DFFE is responsible for establishing a national framework for achieving the objectives of NEMAQA, which includes:

- Mechanisms, systems and procedures to attain compliance with ambient air quality standards.
- Mechanisms, systems and procedures to give effect to South Africa's obligations in terms of international agreements.
- National norms and standards for the control of emissions from point and non-point sources.
- National norms and standards for air quality monitoring.
- National norms and standards for air quality management planning.
- National norms and standards for air quality information management.
- Any other matter which the Minister considers necessary for achieving the objectives of the Act.

The establishment of national ambient air quality standards is achieved through NEMAQA and the South African Bureau of Standards (SABS) standard setting initiative. The National Ambient Air Quality Standards (NAAQS) have subsequently been published in the Government Gazette of 24 December 2009 and 29 June 2012.

The standards are summarised in **Table 1**.

Table 1: Ambient Air Quality Standards

Substance	Time weighted average (µg/m³)				
	10-minutes	1-hour	8-hour	24-hour	Annual
Ozone (O_3)	n.a.	n.a.	120[1]	n.a.	n.a.
Nitrogen dioxide (NO_2)	n.a.	200[2]	n.a.	n.a.	40
Sulphur dioxide (SO_2)	500[3]	350[2]	n.a.	125[4]	50
Lead (Pb)	n.a.	n.a.	n.a.	n.a.	0.5
Particulate matter (PM_{10})	n.a.	n.a.	n.a.	75[4]	40
Particulate matter ($PM_{2.5}$)	n.a.	n.a.	n.a.	40[4] 25[4]*	20 15*
Carbon monoxide (CO)	n.a.	30 000[2]	10 000[1]	n.a.	n.a.
Benzene (C_6H_6)	n.a.	n.a.	n.a.	n.a.	5

Notes:

µg/m³	:	microgram per cubic meter air @ 25°C and 101.3kPa
DFFE	:	Department of Forestry, Fisheries and the Environment.
1	:	Not to be exceeded more than 11 times per annum.
2	:	Not to be exceeded more than 88 times per annum.
3	:	Not to be exceeded more than 526 times per annum.
4	:	Not to be exceeded more than 4 times per annum.
5	:	Not to be exceeded more than 4 times per annum.
*	:	All standards are to be complied with immediately. Standards with an asterisk are to be complied with as from 1 January 2030.

2.3 DUST CONTROL REGULATIONS

National Dust Control Regulations were published on 1 November 2013 (Notice 827 of 2013). The purpose of the regulations is to prescribe general measures for the control of dust in all areas.

Standards for the acceptable dustfall rate for residential and non-residential areas are set out in **Table 2** below.

Table 2: Acceptable Dustfall Rate

Restriction Areas	Dustfall rate (D) (mg/m²/day, 30 days average)	Permitted frequency of exceeding dust fall rate
Residential Area	D < 600	Two within a year, not sequential months
Non-residential Area	600 < D > 1200	Two within a year, not sequential months

According to the regulations, any entity conducting any activity in such a way as to give rise to dust in quantities and concentrations that exceeded the dustfall standard set out in the regulation is impelled to, upon receipt of a notice from an air quality officer, implement a dustfall monitoring programme.

The method to be used for measuring the dustfall rate and the guideline for locating sampling points is the American Standards for Testing and Materials method, or an equivalent method approved by any internationally recognised body.

The regulation further states that an air quality officer could require any entity, through a written notice, to undertake a dustfall monitoring programme, if the officer reasonably suspected that the entity was contravening the regulations or that the activity being conducted required a fugitive dust emission management plan. An entity required to implement the programme must then, within a specified period, submit a dustfall monitoring report to the air quality officer.

A dustfall monitoring report must provide information on the location of sampling sites, classification of the area where samplers were located, as well as reference to the standard methods used for site selection, sampling and analysis. The report must also provide meteorological data for the sampling area, the dustfall monitoring results, including a comparison of current year and historical results for each site, as well as a tabular summary of compliance with the dustfall standard.

Any entity that exceeds the dustfall standard must, within three months after submission of the dustfall monitoring report, develop and submit a dustfall management plan to the air quality officer for approval. This management plan must identify all possible sources of dust within the affected site, detail the best practicable measures to be undertaken to mitigate dust emissions, identify the line management responsible for implementation and incorporate the dust fallout monitoring plan. Such a plan would need to be implemented within a month of the date of approval and an implementation progress report must be submitted to the air quality officer at agreed time intervals.

2.4 ATMOSPHERIC EMISSION REPORTING REGULATIONS

The National Atmospheric Emission Reporting Regulations came into effect on the 2 April 2015 (Notice 283 of 2015). The purpose of the regulations is to regulate the reporting of data and information from an identified point, non-point and mobile source of atmospheric emissions to the internet based National Atmospheric Emissions Inventory System (NAEIS) as to compile atmospheric emission inventories.

The following entities will be required to report in terms of the regulations:

- **Listed Activities:** Any entity that undertakes a NEMAQA air quality-related listed activity.
- **Controlled Emitters:** Any entity that undertakes a NEMAQA listed activity and uses an appliance or conducts an activity that has been declared a controlled emitter. To date small boilers, asphalt and temporary asphalt plants have been declared as controlled emitters.
- **Air quality officer:** Any air quality officer receiving emission reports in terms of Section 23 of NEMAQA.
- **Mines:** Any entity that holds a mining right or permit in terms of the Mineral and Petroleum Resources Development Act (Act No. 28 of 2002).
- **Facilities with Criteria Pollutants:** Any entity that operates facilities which generate criteria pollutants and who has been identified in accordance with the applicable municipal by-law. Criteria pollutants are those for which national ambient standards are prescribed in Schedule A to the NEMAQA.

Entities must submit the required information for the preceding calendar year to the NAEIS by 31 March of each year. Records of data submitted must be kept for a period of 5 years and must be made available for inspection by the relevant authority.

2.5 ATMOSPHERIC IMPACT REPORT REGULATIONS

The Regulations Prescribing the Format of the Atmospheric Impact Report were published on 11 October 2013 (Notice 747 of 2013). The regulations prescribe the format of the impact reports and requires the submission of the following information:

- Full enterprise details
- Location and extent of the plant
- Atmospheric emission licenses and other authorisations
- The nature of the plant's processes and activities
- Description of the surrounding areas
- Raw materials used
- Appliances and abatement equipment control technology used
- Point sources parameters and maximum source emission rates
- Fugitive emissions
- Impact of the enterprise on human health and the environment

2.6 AIR DISPERSION MODELLING REGULATIONS

Regulations Regarding Air Dispersion Modelling were promulgated in terms of NEMAQA on 11 July 2014 (Notice 533 of 2014).

Air dispersion modelling is defined as a series of mathematical simulations of how air pollutants disperse in the ambient atmosphere and is performed with computer programs that solve the mathematical equations and algorithms which simulate the dispersion of pollutants.

The Code of Practice for Air Dispersion Modelling applies in the development of:

- An air quality management plan
- A priority area air quality management plan
- An atmospheric impact report
- A specialist air quality impact assessment study

The air dispersion regulations standardise model applications for regulatory purposes. The Code of Practice recommends a suite of dispersion models to be applied for regulatory practices. It also provides guidance on modelling input requirements, protocols and procedures.

2.7 AIR QUALITY MANAGEMENT

2.7.1 Limpopo Province Air Quality Management Plan

The Limpopo Department of Economic Development, Environment and Tourism (LEDET) developed a Provincial Air Quality Management Plan (AQMP) in accordance with the NEMAQA. The main aim is to provide the Province with an implementable AQMP that complements the existing District Municipality AQMPs and comply with National requirements.

The Provincial AQMP is primarily directed at protecting air quality in the Province and ensuring the quality of air that protects human health and well-being.

The vision of the AQMP is to work towards 'clean air throughout the Limpopo Province' and the mission is to 'ensure air quality that protects human health and the environment through enhanced air quality management systems and programs.

The principal goals of the plan are to:

- Establish and maintain sustainable air quality management practices within the Province incorporating all relevant stakeholders and role players.
- Establish an effective Air Quality Management System in the Province.
- Manage and control atmospheric emissions from major sources in the Province.

Limpopo Province consist of five District Municipalities: Capricorn, Waterberg, Vhembe, Mopani and Sekhukhune.

2.7.2 SDM Air Quality Management Plan

NEMAQA requires Municipalities to introduce AQMPs that set out what will be done to achieve the prescribed air quality standards. The SDM (SDM) comprises five local Municipalities namely Elias Motsoaledi (formerly Groblersdal), Marble Hall, Tubatse, Fetakgomo and Makhuduthamaga. Air quality challenges within the district are unique to each municipality considering the industrial activities in respective municipalities.

The SDM AQMP has been developed to achieve the overall goal of reducing and/or eliminating the generation and significant negative environmental impacts of all known air pollutants in its area of jurisdiction. Air quality management must be performed to protect the quality of the air in the SDM and to minimise the impact of air pollution emissions on neighbouring districts yet allowing ecologically sustainable and justifiable economic and social development.

The specific objectives of the AQMP are to:

- Ensure the identification of significant air pollutants.
- Control the emission of air pollutants.
- Implement planned Air Quality Management strategies.
- Achieve acceptable air quality levels throughout SDM.
- Promote a clean and healthy environment for all citizens within SDM.
- Minimise the negative impacts of air pollution on health and the environment.
- Promote the reduction of greenhouse gases to support the district's climate change protection programme.

2.7.3 SDM Air Quality Management By-Law

The SDM published the Air Quality Management By-Law on 18 May 2018.

The objectives of this by-law are to:

- Give effect to the right contained in section 24 of the Constitution by regulating air pollution within the area of the Municipality's jurisdiction.
- Provide, in conjunction with any other applicable law, an effective legal and administrative framework, the Council can manage environment and public health.
- Ensure that air pollution is avoided, or where it cannot be altogether avoided, mitigated or minimised.

The Draft Air Quality Management By-Law makes provision for:

- Duty of care – to prevent any potential significant air pollution from occurring and to mitigate, as far as reasonably possible any significant air pollution that may occur.

- Dust Emissions – any person who causes dust emissions shall take all reasonable precautions to prevent

- excessive emissions into the atmosphere that may be harmful to public health and well-being. Any person conducting certain activities (construction, unpaved roads and parking areas, vacant lots and all-terrain vehicles) which customarily produce excessive emissions of dust, shall be required to adopt control measures as prescribed by the authorised person prior to the commencement of activities, to abate and prevent excessive emissions.
- Emissions caused by open burning, burning of domestic and garden waste, sugar cane burning, tyre burning and burning of rubber products.
- Pesticide spraying emissions.
- Emissions that cause a nuisance.

2.7.4 CDM Air Quality Management Plan

The Directorate of Environmental Management at the CDM (CDM) developed an Air Quality Management Plan (AQMP) in accordance with the NEMAQA. The vision of the AQMP is the attainment and maintenance of good air quality to protect all citizens and natural environmental systems within the District Municipality.

The mission is to:

- Ensure the maintenance and improvement of current air quality through proactive and effective management principles that consider the need for sustainable development.
- Work in partnership with the community and stakeholders to ensure the air is healthy to breathe and does not impact significantly on the well-being of individuals.
- Ensure that transportation, housing and other infrastructure developments considers air quality impacts.
- Reduce the potential for damage to sensitive natural environmental systems from excessive air pollution both in the short and long-term.
- Uplift communities and promote public awareness on air quality issues.

- Facilitate intergovernmental communication with regards to emission inventories, source contributions, monitoring technologies and emission reduction strategies as to ensure effective implementation.

The objective includes:

- Maintaining and improving good air quality within the boundaries of the CDM.
- Promoting energy efficiency within all sectors including industrial, commercial, institutional, mining, transportation and domestic energy use.
- Actively maintaining the District's emission inventory and ensuring that ambient monitoring networks are set up, managed and information is available to public and private sectors.
- Ensuring that dedicated personnel are assigned air quality responsibilities and that these are carried out effectively.
- Enforcing ambient air quality standards.
- Assessing the contribution of domestic fuel burning to ambient air quality and setting measures in place to provide electricity to these areas.

2.7.5 CDM Air Quality Management By-Law

The CDM published the Air Quality Management By-Law on 18 May 2018.

The objectives of this by-law are to:

- Give effect to the right contained in section 24 of the Constitution to enhance the quality of the ambient air for the sake of securing an environment that is not harmful to the health and well-being of people.
- Provide, in conjunction with any other applicable law, an effective legal and administrative framework, within which the municipality can manage and regulate activities that have the potential to adversely impact the environment, public health and well-being.
- Secure ecologically sustainable development while promoting justifiable economic and social development.

The Draft Air Quality Management By-Law makes provision for:

- Duty of care – reasonable measure to prevent air pollution.
- Smoke control zones – declaration of air pollution control zone
- Controlled emitters and dust emissions – dust fallout monitoring, measures for control of dust and ambient air quality monitoring for PM_{10}
- Emissions caused by open burning, burning of material for recovery of metal
- Listed activities – licensing of listed activities and application for an atmospheric emission license
- Offences and penalties
- General matters – compliance monitoring, enforcement, co-operations between municipalities, appeals and exemption.

2.8 INTERNATIONAL AIR QUALITY GUIDELINES

2.8.1 World Health Organisation Air Quality Guidelines

The WHO air quality guidelines were last published in 2006: *Air quality guidelines - global update 2005. Particulate matter, ozone, nitrogen dioxide and sulphur dioxide*. Since they were issued, air pollution has become recognised as the single biggest environmental threat to human health based on its notable contribution to disease burden. This is particularly true for particulate matter (PM) (both $PM_{2.5}$ and PM_{10}). However, other commonly measured air pollutants such as ozone (O_3), nitrogen dioxide (NO_2),sulphur dioxide (SO_2) and carbon monoxide (CO) are also of concern, as are other components of air pollution.

The latest edition of World Health Organisation Global Air Quality Guidelines (WHO GAQGs) for ambient air pollutants was published in 2021 and included recommendations for the classical air pollutants PM, O_3, NO_2 and SO_2.

The overall objective of these guidelines is to offer quantitative health-based recommendations for air quality, expressed as long- or short-term concentrations of several key air pollutants. The goal of these guidelines is to provide guidance to help reduce levels of air pollutants to decrease the enormous worldwide health burden resulting from exposure to air pollution.

Particulate Matter

The WHO recommends an annual average for $PM_{2.5}$ of 5 µg/m^3 and a short-term, 24-hour average of 15 µg/m^3. When evaluating the WHO AQGs and IT, it is generally recommended that the annual average take precedence over the 24-hour average.

The annual average for PM_{10} is 15 µg/m^3 and the 24-hour mean is 45 µg/m^3. Besides the guideline values, four annual and 24-hour IT are defined for $PM_{2.5}$ and PM_{10} (see **Figure 2**, **Figure 3**, **Figure 4** and **Figure 5**).

IT are proposed as incremental steps in a progressive reduction of air pollution and are intended for use in areas where pollution is high.

Recommendation	$PM_{2.5}$ (µg/m^3)
Interim target 1	35
Interim target 2	25
Interim target 3	15
Interim target 4	10
AQG level	5

Figure 2: WHO AQGs for Annual $PM_{2.5}$

Recommendation	$PM_{2.5}$ (µg/m³)
Interim target 1	75
Interim target 2	50
Interim target 3	37.5
Interim target 4	25
AQG level	**15**

Figure 3: WHO AQGs for Short Term (24-hour) $PM_{2.5}$

Recommendation	PM_{10} (µg/m³)
Interim target 1	70
Interim target 2	50
Interim target 3	30
Interim target 4	20
AQG level	**15**

Figure 4: WHO AQGs for Annual PM_{10}

Recommendation	PM_{10} (µg/m³)
Interim target 1	150
Interim target 2	100
Interim target 3	75
Interim target 4	50
AQG level	**45**

Figure 5: WHO AQGs for Short Term (24-hour) PM_{10}

Sulphur dioxide

The WHO AQGs stipulates 40 µg/m³ as a 24-hour mean for Sulphur Dioxide (SO_2), while the 10-minute AQG of 500 µg/m³ remains valid. Besides the guideline values, two 24-hour IT are defined for SO_2 (see **Figure 6**).

Recommendation	SO_2 (µg/m³)
Interim target 1	125
Interim target 2	50
AQG level	**40**

Figure 6: WHO AQGs for Annual SO_2

Nitrogen dioxide

The current annual WHO AQG for NO_2 is 10 µg/m³ and a short-term, 24-hour average of 25 µg/m³. The 1-hour AQG of 200 µg/m³ remains valid. Besides the guideline values, three annual and two 24-hour IT are defined.

Recommendation	NO_2 (µg/m³)
Interim target 1	40
Interim target 2	30
Interim target 3	20
AQG level	**10**

Figure 7: WHO AQGs for Annual NO_2

Recommendation	NO_2 (µg/m³)
Interim target 1	120
Interim target 2	50
AQG level	**25**

Figure 8: WHO AQGs for Short Term (24-hour) NO_2

Carbon monoxide

The current short-term, 24-hour average for CO is 4 mg/m^3, while the15 minute AQG of 100 mg/m^3, 1-hour AQG of 35 mg/m^3 and the 8-hour AQG of 10 mg/m^3 remain valid. Besides the guideline value, one 24-hour IT is defined.

Recommendation	CO (mg/m³)
Interim target 1	7
AQG level	4

Figure 9: WHO AQGs for Annual CO

Ozone

The WHO AQG sets the value for ozone levels at 60 μg/m³ for an 8-hour daily average. Besides the guideline value, an 8-hour IT has been set for ozone (see **Figure 10**).

Recommendation	O_3 (μg/m³)
Interim target 1	100
Interim target 2	70
AQG level	**60**

Figure 10: WHO AQGs for Ozone

Lead

Levels of lead found in air, food, water and soil/dust vary widely throughout the world and depend on the degree of industrial development, urbanisation and other lifestyle factors. In cities of developing countries traffic-related lead levels range between 0.3 and 1 μg/m³ with extreme annual mean values between 1.5 and 2 μg/m³.

3. BACKGROUND ASSESSMENT

3.1 PROJECT OVERVIEW

Phase 2 of the Olifants River Water Resources Development Project (ORWRDP-2) is a Department of Water and Sanitation (DWS) project, which underwent an environmental impact assessment (EIA) process and obtained a positive Record of Decision (RoD) from the Department of Environmental Affairs (DEA) in 2006 in terms of the Environmental Conservation Act, No. 73 of 1989 (ECA). After many appeals by large organisations, including the Kruger National Park, the Minister decided to grant the Revised RoD (RRoD) (Ref: 12/12/20/553), dated 16 October 2006.

The approved ORWRDP-2 consists of various phases as defined below. These were previously implemented by the Trans-Caledon Tunnel Authority (TCTA). The phases are designed and implemented in a phased manner, depending on need and availability of finances. For this reason, phase specific Environmental Management Programmes (EMPrs) are developed and submitted for approval to the Competent Authority (CA).

- **Phase 2A:** Construction of De Hoop Dam.
- **Phase 2B:** Pipeline from Flag Boshielo Dam to Pruissen near Mokopane (72 km).
- **Phase 2B+:** Consists of a raw water pipeline from Pruissen Reservior to the proposed Sekuruwe WTW, including offtakes to the proposed Mokopane WTW and two commercial user offtakes.
- **Phase 2C:** Pipeline from De Hoop Dam to Mooihoek.

- **Phase 2F:** Pipeline from Steelpoort to Mooihoek (24 km).
- **Phase 2E:** Pipeline from Mooihoek to Havercroft Junction (14 km)
- **Phase 2F:** Pipeline from Havercroft Junction to Olifantspoort (44 km)
- **Phase 2G:** Possible second pipeline parallel to Phase 2B
- **Phase 2H**: Changes and additions to the current Phase 2H (Lebalelo Network); and
- **Phase 2I:** Pipeline from the De Hoop Dam to the proposed Eskom Tubatse Pump-storage Hydro-electric Scheme.

The ORWRDP-2 has since been reconstituted to become the OMMP-BRWSP in recent years, with the Lebalelo Water User Association (LWUA) acting as the implementing agent for the following portions of the project:

- Phase 2B.
- Phase 2B+.
- Phase 2F2.
- Phase 2F.

Furthermore, since inception, the project has acquired the status of strategic importance, and recently on 05 March 2023 the project was classified as a Strategic Integrated Project (SIP) under the SIP 19 (i.e., Water and Sanitation Infrastructure Portfolio). As such, it is critical that the project must be expedited in terms of Schedule 2 (Section 17(2)) of the Infrastructure Development Act, No. 23 of 2014. The purpose of this piece of legislation is to provide facilitation and coordination of public infrastructure development which is of economic significance or social importance in South Africa and to ensure that infrastructure development in the country is given priority in planning, approval, and implementation

The OMMP BRWSP project overview is included in **Figure 11**.

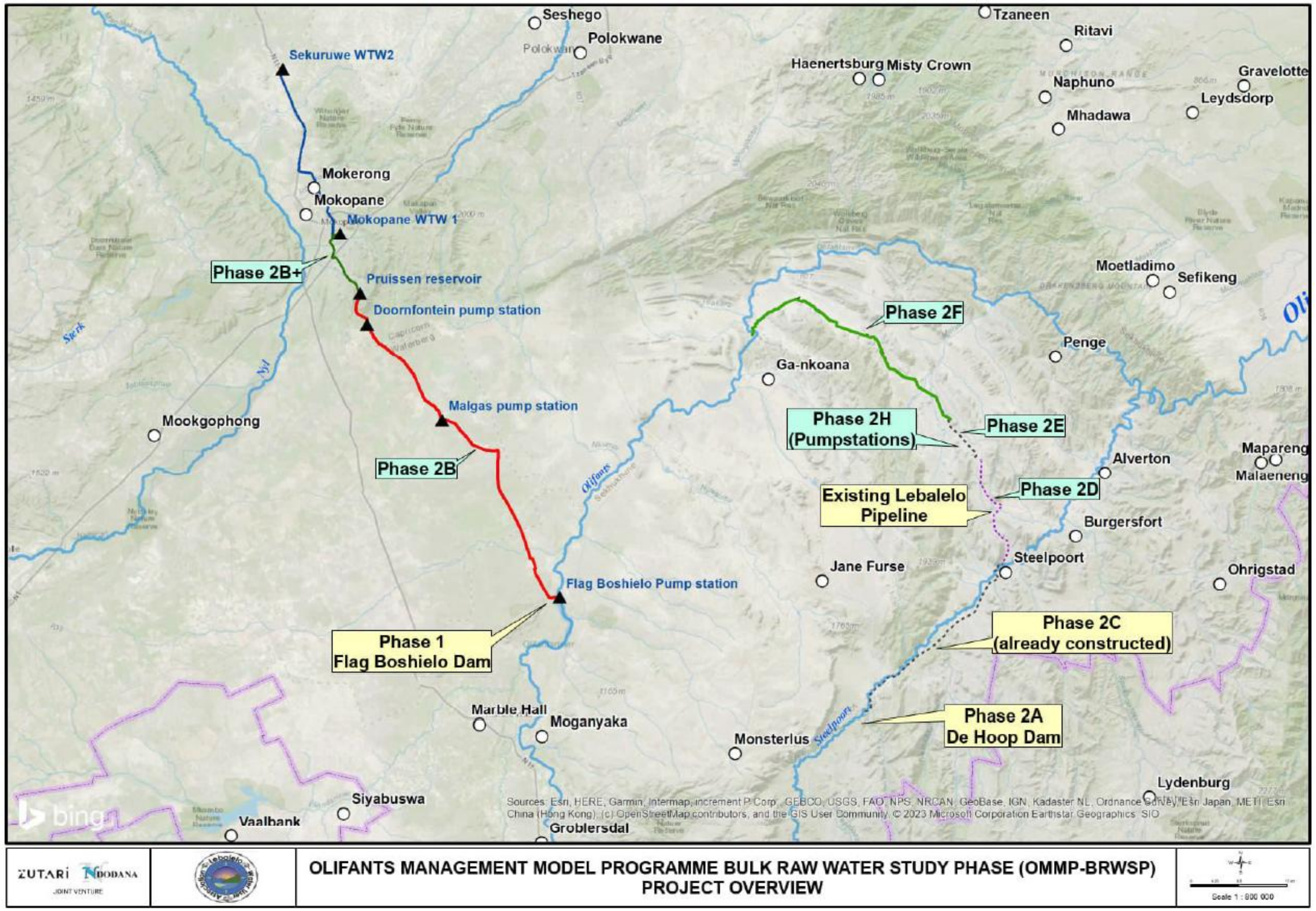

Figure 11: OMMP BRWSP Project Overview

3.2 PROCESS DESCRIPTION

Phase 2F comprises approximately 60 km of pipeline intended to convey water to the Olifantspoort WTW, thereby augmenting the water supply to Polokwane and surrounding rural areas. The alignment of Phase 2F starts near Havercroft Junction, deviating from the R37 to take a more direct route to the Olifantspoort WTW, following existing gravel roads along part of the way. The pipeline starts as a 1,200 mm diameter over 18.5 km, reducing to a 1,000 mm diameter over 25.6 km, originating at the Klipfontein Balancing Dam (or Break Pressure Dam) with a projected capacity of 21 ML.

An Environmental Authorisation (EA) (Ref:14/12/16/3/3/1/1626) was obtained for Phases 2E & 2F in May 2017 from the DFFE. This authorisation was valid for five (5) years and lapsed in June 2022. Following an interactive Public Participation Process (PPP) in April 2022, facilitated by DWS and ZNJV, Condition 7 of the EA was amended on 2 May 2017 (Ref: 14/12/16/3/3/1/1626/AM1). The revised condition stipulates that the activity must commence within ten years of the authorisation issue date (i.e., by 2 May 2027), after which the authorisation will lapse, necessitating a new application for EA to proceed with the activity.

3.3 EMISSION INVENTORY

3.3.1 Construction

Heavy construction is a source of dust emissions that may have substantial temporary impact on local air quality. Building and road construction are two examples of construction activities with high emissions potential. Emissions during the construction of a building or road can be associated with land clearing, drilling and blasting, ground excavation, cut and fill operations (i.e., earth moving), and construction of a facility itself.

Dust emissions often vary substantially from day to day, depending on the level of activity, the specific operations, and the prevailing meteorological conditions. A large portion of the emissions result from equipment traffic over temporary roads at the construction site.

The temporary nature of construction differentiates it from other fugitive dust sources as to estimation and control of emissions. Construction consists of a series of different operations, each with its own duration and potential for dust generation.

In other words, emissions from any single construction site can be expected (1) to have a definable beginning and an end and (2) to vary substantially over different phases of the construction process. This contrasts with most other fugitive dust sources, where emissions are either relatively steady or follow a discernable annual cycle. Furthermore, there is often a need to estimate area-wide construction emissions, without regard to the actual plans of any individual construction project.

The quantity of dust emissions from construction operations is proportional to the area of land being worked on and to the level of construction activity. By analogy to the parameter dependence observed for other similar fugitive dust sources, one can expect emissions from heavy construction operations to be positively correlated with the silt content of the soil (that is, particles smaller than 75 micrometers [µm] in diameter), as well as with the speed and weight of the average vehicle, and to be negatively correlated with the soil moisture content.

3.3.2 Vehicle Transport Emissions

Unpaved Roads

When a vehicle travels an unpaved road, the force of the wheels on the road surface causes pulverisation of surface material. Particles are lifted and dropped from the rolling wheels, and the road surface is exposed to strong air currents in turbulent shear with the surface. The turbulent wake behind the vehicle continues to act on the road surface after the vehicle has passed.

The quantity of dust emissions from a given segment of unpaved road varies linearly with the volume of traffic. Field investigations also have shown that emissions depend on source parameters that characterize the condition of a road and the associated vehicle traffic.

Characterisation of these source parameters allow for "correction" of emission estimates to specific road and traffic conditions present on public and industrial roadways.

Dust emissions from unpaved roads have been found to vary directly with the fraction of silt (particles smaller than 75 micrometers in diameter) in the road surface materials.

Other variables are important in addition to the silt content of the road surface material. For example, at industrial sites, where haul trucks and other heavy equipment are common, emissions are highly correlated with vehicle weight.

Paved Roads

Particulate emissions occur whenever vehicles travel over a paved surface such as a road or parking area. Particulate emissions from paved roads are due to direct emissions from vehicles in the form of exhaust, brake wear and tire wear emissions and resuspension of loose material on the road surface. In general terms, re-suspended particulate emissions from paved roads originate from, and result in the depletion of, the loose material present on the surface (i.e., the surface loading). In turn, that surface loading is continuously replenished by other sources. At industrial sites, surface loading is replenished by spillage of material and track-out from unpaved roads and staging areas.

In the absence of continuous addition of fresh material, paved road surface loading should reach an equilibrium value in which the amount of material re-suspended matches the amount replenished. The equilibrium surface loading value depends upon numerous factors. The most important factors are mean speed of vehicles traveling on site; the average daily traffic volume, the fraction of heavy vehicles and the presence/absence of curbs, storm sewers and marshalling areas.

3.4 EMISSION FACTORS

Due to the absence of locally generated emission factors, use was made of the comprehensive set of emission factors published by the United States Environmental Protection Agency (US-EPA) in its AP-42 document *Compilation of Pollution Emission Factors* and the National Pollution Inventory *Emission Estimation Technique Manual*.

Table 3 summarises emission factors, **Table 4** includes the emission rates for the Phase 2F project. The emission parameters are included in **Table 5**.

Table 3: Phase 2F Emission Factors

Activity	Emission unit	TSP	PM_{10}	$PM_{2.5}$	CO	Nox	SO_2
A. Construction							
1. Fugitive emissions	Mg/hectare/month	2.69E+00	1.40E+00	1.35E-01	-	-	-
2. Tipper truck traffic	kg/VKT or kg/kWh	3.15E+00	9.00E-01	9.00E-02	4.70E-03	1.10E-02	7.70E-06
3. Pipe delivery truck traffic	kg/VKT or kg/kWh	4.05E+00	1.16E+00	1.16E-01	4.70E-03	1.10E-02	7.70E-06
4. Plant delivery truck traffic	kg/VKT or kg/kWh	4.05E+00	1.16E+00	1.16E-01	4.70E-03	1.10E-02	7.70E-06
5. Service delivery truck traffic	kg/VKT or kg/kWh	1.43E+00	4.07E-01	4.07E-02	4.70E-03	1.10E-02	7.70E-06
6. Water truck traffic	kg/VKT or kg/kWh	3.19E+00	9.12E-01	9.12E-02	4.70E-03	1.10E-02	7.70E-06
7. Small plant vehicle traffic	kg/VKT or kg/kWh	8.01E-01	2.29E-01	2.29E-02	6.20E-03	1.50E-02	8.00E-06
B. Operations							
8. Small plant vehicle traffic	kg/VKT or kg/kWh	3.94E-02	1.83E-03	1.83E-03	6.20E-03	1.50E-02	8.00E-06
C. Rehabilitation							
9. Fugitive emissions	Mg/hectare/month	2.69E+00	1.40E+00	1.35E-01	-	-	-

Notes:

1, 9:	US EPA, AP42, Volume I, 5 Edition, Chapter 13.2.3 Heavy Construction Operations.
2, 3, 4, 5, 6, 7:	US EPA, AP42, Volume I, 5 Edition, Chapter 13.2.2 Unpaved Roads. NPI, Emission Estimation Technique Manual for Combustion Engines. Emission Factors for Diesel Industrial Vehicle (off-highway Truck).
8:	US EPA, AP42, Volume I, 5 Edition Chapter 13.2.1. Paved Roads. NPI, Emission Estimation Technique Manual for Combustion Engines. Emission Factors for Diesel Industrial Vehicle (Miscellaneous).

Table 4: Phase 2F Emission Rates

Activity	Emission rate (gram per second)						Totals	
	TSP	PM_{10}	$PM_{2.5}$	CO	NOx	SO_2		
A. Construction								
1. Fugitive emissions	58.03	30.20	2.90	-	-	-	91.13	40.25%
2. Tipper truck traffic	7.72E+01	2.21E+01	2.21E+00	1.34E-01	3.15E-01	2.20E-04	1.02E+02	45.04%
3. Pipe delivery truck traffic	7.03E-01	2.01E-01	2.01E-02	2.92E-01	6.83E-01	4.78E-04	1.90E+00	0.84%
4. Plant delivery truck traffic	2.34E-01	6.70E-02	6.70E-03	2.92E-01	6.83E-01	4.78E-04	1.28E+00	0.57%
5. Service delivery truck traffic	1.65E-01	4.71E-02	4.71E-03	6.27E-02	1.47E-01	1.03E-04	4.26E-01	0.19%
6. Water truck traffic	1.85E-01	5.28E-02	5.28E-03	1.06E-01	2.49E-01	1.74E-04	5.98E-01	0.26%
7. Small plant vehicle traffic	1.39E-01	3.98E-02	3.98E-03	1.12E-01	2.71E-01	1.44E-04	5.66E-01	0.25%
B. Operations								
8. Light vehicle traffic	5.47E-03	2.54E-04	2.54E-04	1.12E-01	2.71E-01	1.44E-04	3.89E-01	0.17%
C. Rehabilitation								
9. Fugitive emissions	17.92	9.33	8.96E-01	-	-	-	28.14	12.43%
Totals	**154.63**	**62.01**	**6.05**	**1.11**	**2.62**	**0.00**	**226.41**	
	68.30%	**27.39%**	**2.67%**	**0.49%**	**1.16%**	**0.00%**		

Table 5: Phase 2F Emission Parameters

Activity	Unit	Value
Operating days per annum	days	365.00
Days per month	days	30.00
Operating hours per annum	hours	8760.00
Operating hours per month	hours	730.00
Operating seconds per year	seconds	31536000.00
Construction Footprint	hectare	226.79
Rehabilitation Footprint	hectare	70.04
TSP Particle Size Multiplier for Paved Road Equation	unitless	3.23
PM10 Particle Size Multiplier for Paved Road Equation	unitless	0.62
PM2.5 Particle Size Multiplier for Paved Road Equation	unitless	0.15
Paved sufaces silt loading	percent	9.70
Unpaved Roads TSP constant k	constant	4.90
Unpaved Roads TSP constant a	constant	0.70
Unpaved Roads TSP constant b	constant	0.45
Unpaved Roads PM_{10} constant k	constant	1.50
Unpaved Roads PM_{10} constant a	constant	0.90
Unpaved Roads PM_{10} constant b	constant	0.45
Unpaved Roads $PM_{2.5}$ constant k	constant	0.15
Unpaved Roads $PM_{2.5}$ constant a	constant	0.90
Unpaved Roads $PM_{2.5}$ constant b	constant	0.45
Unpaved surfaces silt loading	percent	8.50
Tipper truck vehicle weight	tonnes	32.00
Pipe truck vehicle weight	tonnes	56.00
Plant truck vehicle weight	tonnes	56.00
Service truck vehicle weight	tonnes	5.50
Water truck (18 000 l) vehicle weight	tonnes	33.00
Small plant vehicle weight	tonnes	1.53
Tipper truck vehicle engine power	kW	206.00
Pipe truck vehicle engine power	kW	447.00
Plant truck vehicle engine power	kW	447.00

Activity	Unit	Value
Service truck vehicle engine power	kW	96.00
Water truck vehicle engine power	kW	163.00
Small plant vehicle engine power	kW	130.00
Tipper truck vehicle trips per day	trips	424.00
Pipe truck vehicle trips per day	trips	6.00
Plant truck vehicle trips per day	trips	2.00
Service truck vehicle trips per day	trips	4.00
Water truck vehicle trips per day	trips	2.00
Small plant vehicle trips per day - construction	trips	6.00
Small plant vehicle trips per day - operation	trips	10.00
Tipper truck traffic (return)	kilometres/trip	5.00
Pipe truck vehicle traffic (return)	kilometres/trip	2.50
Plant truck vehicle traffic (return)	kilometres/trip	2.50
Service truck vehicle traffic (return)	kilometres/trip	2.50
Water truck vehicle traffic (return)	kilometres/trip	2.50
Small plant vehicle traffic (return) - construction	kilometres/trip	2.50
Small plant vehicle traffic (return) - operation	kilometres/trip	1.50

3.5 METEOROLOGY

The nature of local climate will determine what will happen to pollution when it is released into the atmosphere (Tyson and Preston-Whyte, 2000). Pollution levels fluctuate daily and hourly, in response to changes in atmospheric stability and variations in mixing depth. Similarly, atmospheric circulation patterns will influence the rate of transport and dispersion of pollution.

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

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

With the absence of surface inversions, the pollutants can diffuse freely upward. This upward motion may however still be prevented by the presence of elevated inversions. Elevated inversions occur commonly in high pressure areas. Sinking air warms adiabatically to temperatures more than those in the mixed boundary layer. The interface between the upper, gently subsiding air is marked by a stable layer or an elevated subsidence inversion. This type of elevated inversions is most common over Southern Africa (Tyson and Preston-Whyte, 2000).

The climate and atmospheric dispersion potential of South Africa is determined by atmospheric conditions associated with the continental high-pressure cell over the region. The continental high-pressure present over the region in the winter months results in fine conditions with little rainfall and light winds with a northerly flow. Elevated inversions are common in such high-pressure areas due to the subsidence of air. This reduces the mixing depth and suppresses the vertical dispersion of pollutants, causing increased pollutant concentrations (Tyson and Preston-Whyte, 2000).

Seasonal variations in the positions of the high-pressure cells influence atmospheric conditions over the region. For most of the year the tropical easterlies cause an air flow with a north-easterly to north-westerly component. In the winter months the high-pressure cells move northward, displacing the tropical easterlies northward resulting in disruptions to the westerly circulation. The disruptions result in succession of cold fronts over the area in winter with pronounced variations in wind direction, wind speeds, temperature, humidity, and surface pressure. Airflow ahead of a cold front passing over the area has a strong north-north-westerly to north-easterly component, with stable and generally cloud-free conditions. Once the front has passed, the airflow is reflected as having a dominant southerly component (Tyson and Preston-Whyte, 2000).

Easterly and westerly wave disturbances cause a southerly wind flow and tend to hinder the persistence of inversions by destroying them or increasing their altitude, thereby facilitating the dilution and dispersion of pollutants. Pre-frontal conditions tend to reduce the mixing depth. The potential for the accumulation of pollutants during pre-frontal conditions is therefore enhanced (Tyson and Preston-Whyte, 2000).

The analysis of at least one year of hourly average meteorological data is required to facilitate a reasonable understanding of the ventilation potential of the site. The most important meteorological parameters to be considered are wind speed, wind direction, ambient temperature, atmospheric stability and mixing depth. Atmospheric stability and mixing depths are not routinely recorded and frequently need to be calculated from diagnostic approaches and prognostic equations, using as a basis routinely measured data, e.g. temperature, simulated solar radiation and wind speed.

Reference was made to Meteoblue Climate Diagrams, based on 30 years of hourly weather model simulations for Sealane (approximate centre of proposed development). This data provides a good indication of typical climate patterns and expected conditions (temperature, precipitation, sunshine and wind).

3.5.1 Surface wind field

Dispersion comprises vertical and horizontal components of motion. The wind field largely determines the horizontal dispersion of pollution in the atmospheric boundary layer. The wind speed determines both the distance of downwind transport and the rate of dilution because of plume stretching. The generation of mechanical turbulence is similarly a function of the wind speed, in combination with the surface roughness. The wind direction and the variability in wind direction, determine the general path pollutants will follow, and the extent of crosswind spreading.

The SDM experiences an average monthly wind speed of 0.72 m/s. Wind patterns are predominantly from the south-south-west (30.6%) and south-west (20.4%). The CDM generally observes wind speeds of between 4 – 6 m/s. The predominant wind direction is from the north-east (18%) and south (15%).

Wind roses comprise of 16 spokes which represents the direction from which the winds blew during the period under review. The colours reflect the different categories of wind speeds. The dotted circles provide information regarding the frequency of occurrence of wind speed and direction categories. The value given in the centre of the circle describe the frequency with which calms occurred, i.e. periods during which the wind speed was below 1 m/s.

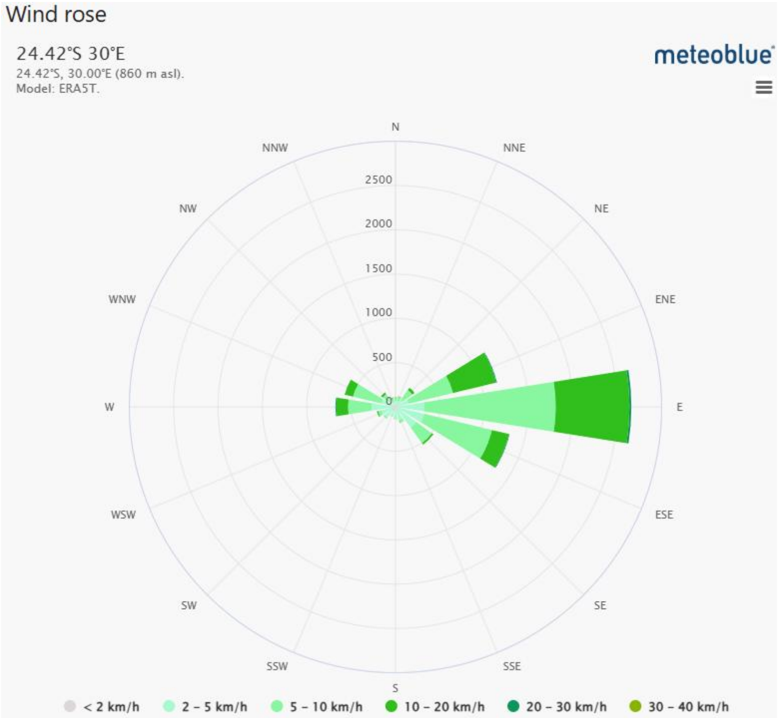

Figure 12: Sealane Wind Rose for the Period 1993 – 2023

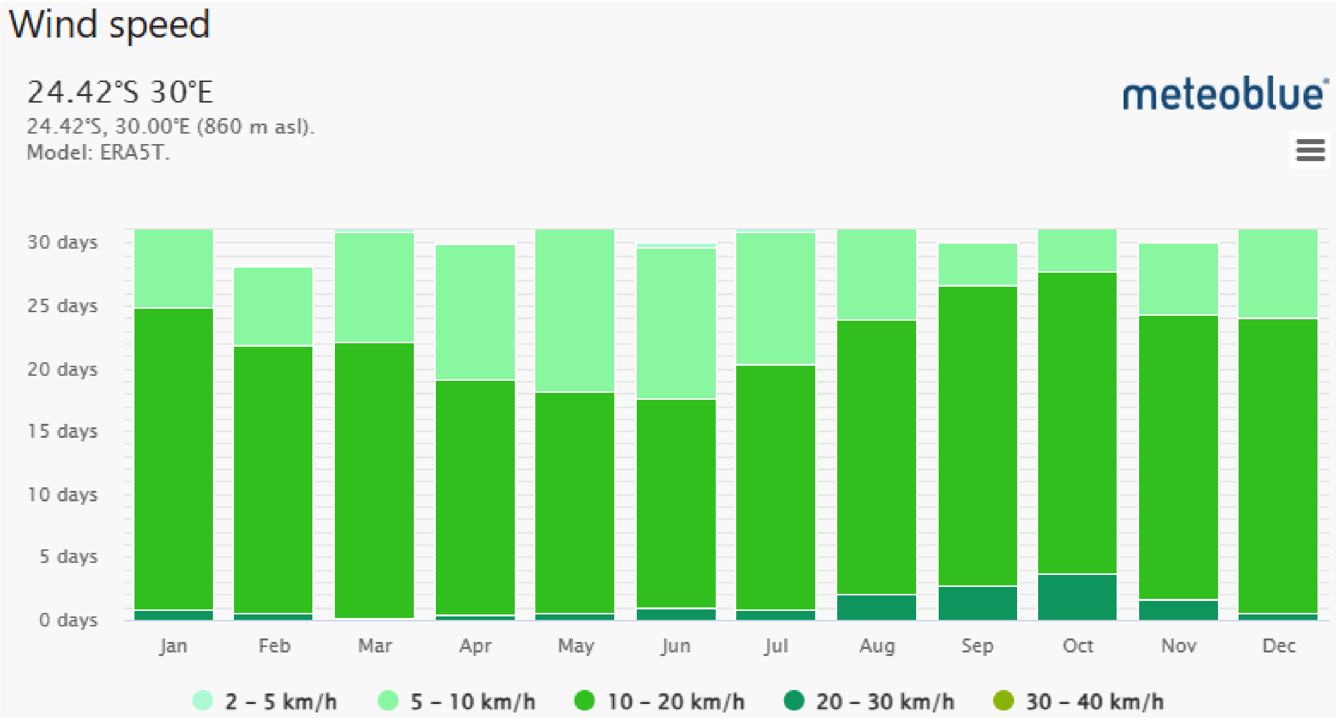

Figure 13: Sealane Average Wind Speed for the period 1993 – 2023

Atmospheric processes at meso-scale were considered in the characterisation of the atmospheric dispersion potential of the study area. For on-site data, hourly average Unified Model (UM) surface model data supplied by Meteoblue was used. Parameters that need to be considered in the characterisation of meso-scale ventilation potentials include wind speed, wind direction, extent of atmospheric turbulence, ambient air temperature and mixing depth.

Ground level concentrations were predicted for atmospheric conditions based on local meteorological data for the period 1 July 2023 to 30 June 2024. Winds are mostly from the north easterly sector 45.1%. Calm periods are the exception (2.8%) and wind speeds are mostly light, between 0.5 and 2.1 m/s (45.6%). Moderate winds between 2.1 and 3.6 m/s occur 27.3% and brisk winds above 3.6 m/s, 17%. Strong winds above 5.7 m/s occur 7.3%.

Period, diurnal, and seasonal wind roses for Steelpoort are presented in **Figure 14** to **Figure 21**.

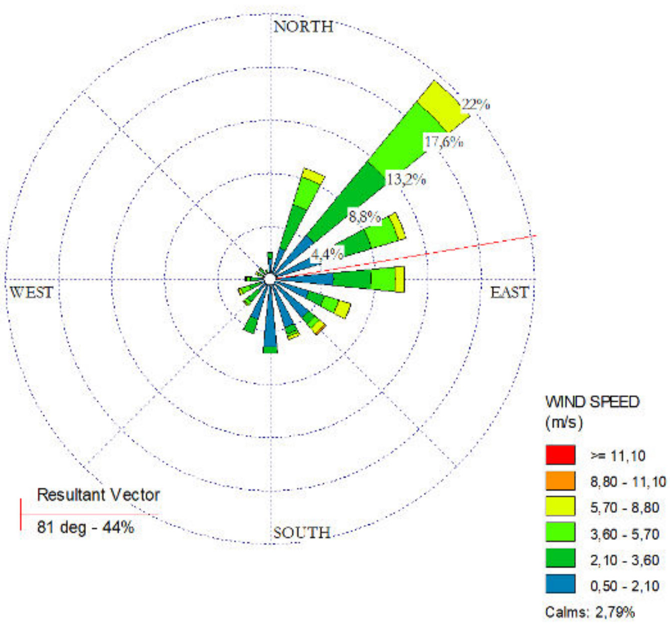

Figure 14: Period Wind Rose

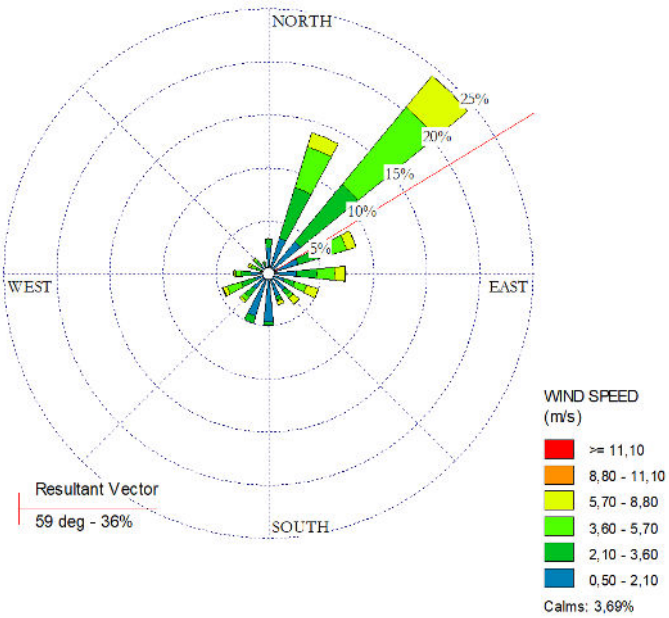

Figure 15: Day-time Wind Rose

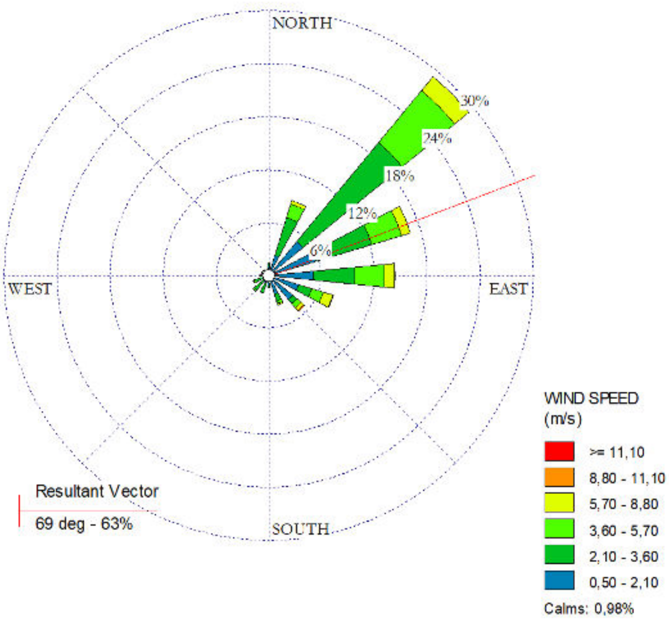

Figure 16: Evening Wind Rose

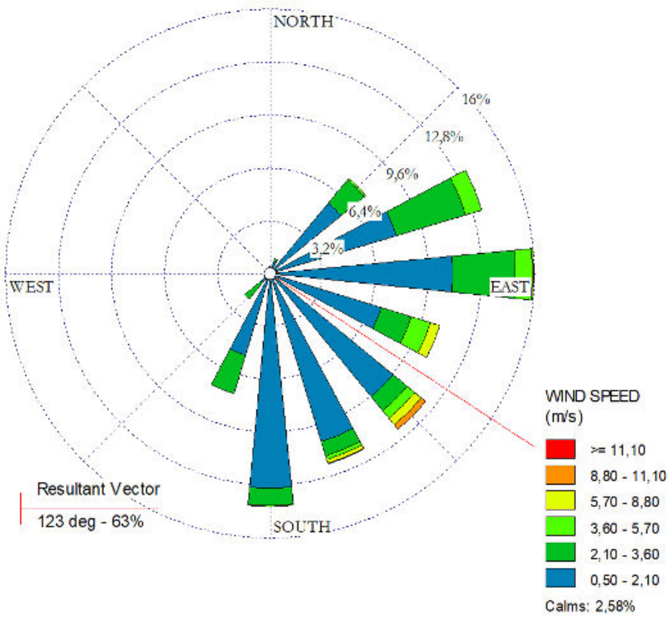

Figure 17: Night-time Wind Rose

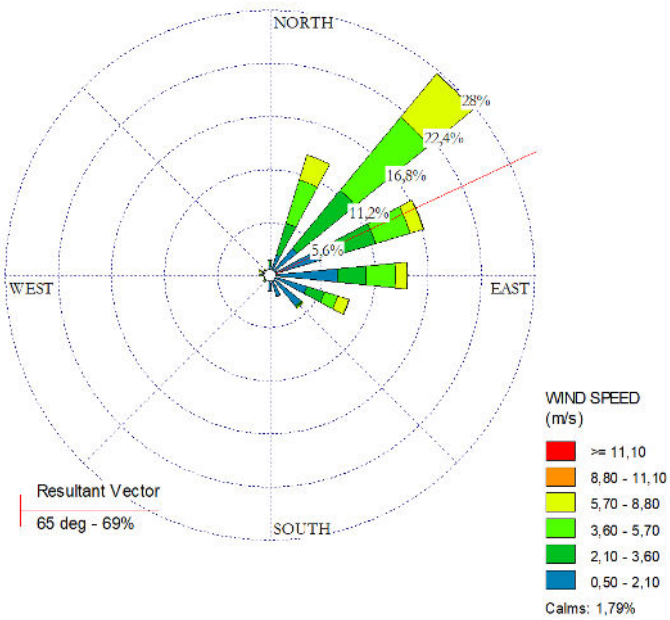

Figure 18: Spring Wind Rose

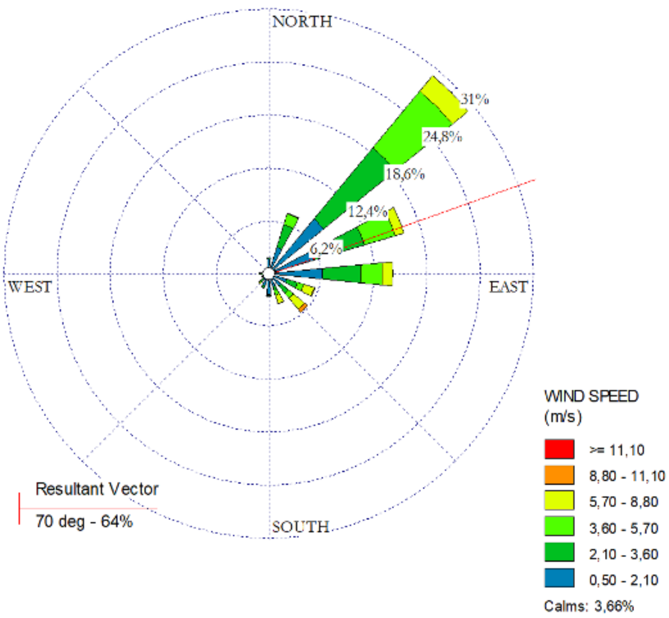

Figure 19: Summer Wind Rose

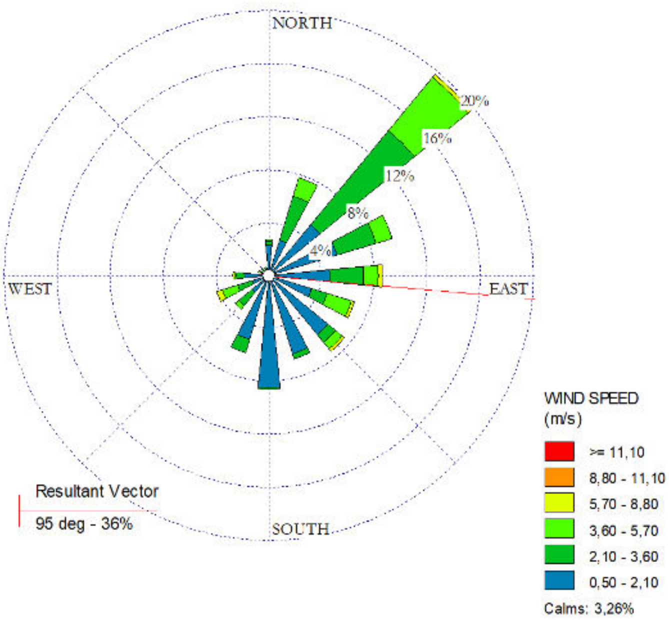

Figure 20: Autumn Wind Rose

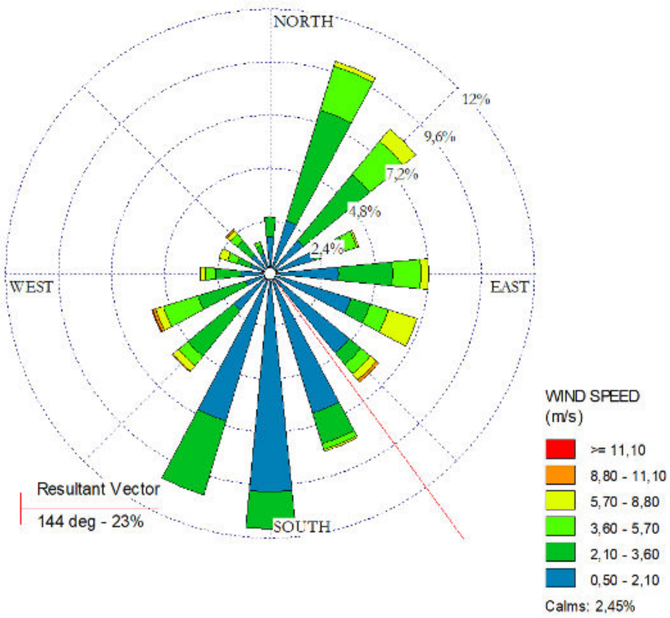

Figure 21: Winter Wind Rose

3.5.2 Temperature and Humidity

Temperature affects the formation, action, and interactions of pollutants in various ways (Kupchella & Hyland, 1993). Chemical reaction rates tend to increase with temperature and the warmer the air, the more water it can hold and hence the higher the humidity. Temperature also provides an indication of the rate of development and dissipation of the mixing layer as well as determining the effect of plume buoyancy; the larger the temperature difference between the plume and ambient air, the higher the plume can rise.

Higher plume buoyancy will result in an increased lag time between the pollutant leaving the source and reaching the ground. This additional time will allow for greater dilution and ultimately a decrease in the pollutant concentrations when reaching ground level.

Humidity is the mass of water vapour per unit volume of natural air. When temperatures are at their highest the humidity is also high, the moisture is trapped inside the droplets of the water vapour. This makes the moisture content of the air high. When relative humidity exceeds 70%, light scattering by suspended particles begins to increase, as a function of increased water uptake by the particles (CEPA/FPAC Working Group, 1999). This results in decreased visibility due to the resultant haze. Many pollutants may also dissolve in water to form acids, as well as secondary pollutants within the atmosphere.

The average monthly temperature in the SDM ranges between 4 and 32 ºC. The average maximum daytime temperature of 32 ºC occurs in January with the lowest average minimum temperature of 4 ºC occurring in July. Temperatures in the CDM are generally mild to warm in summer with an average summer maximum of 26°C. Winters are generally cool (average minimum temperature of 6°C; average maximum of 16°C) although low temperatures do occur.

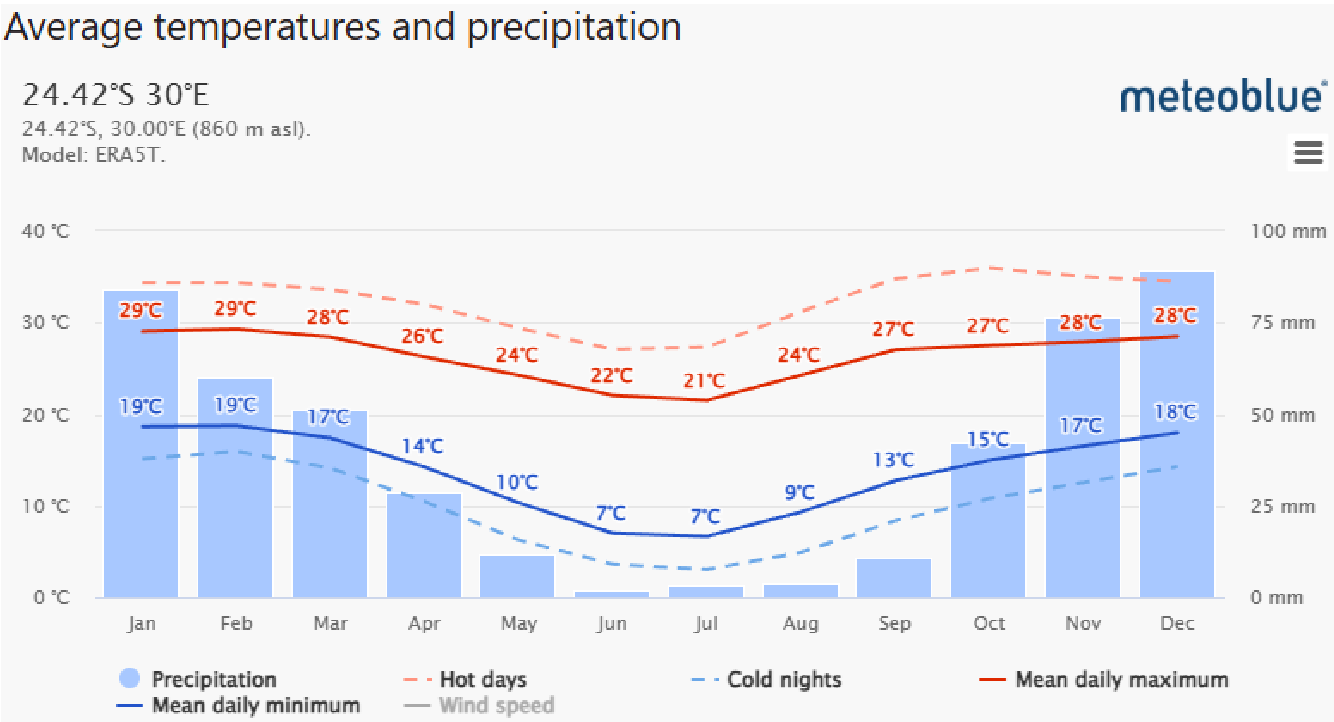

Figure 22: Sealane Average Temperature and Precipitation for the Period 1993 – 2023

3.5.3 Precipitation

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

The average annual rainfall for the SDM is 551 mm and the average maximum monthly rainfall in the summer month of December/January/February is 267 mm. Little rainfall occurs during the winter month of July with an average monthly precipitation of 3 mm. The average annual rainfall in the CDM ranges from 300 mm in the north to 1 000 mm in the south. The district has a semi-arid climate with hot, wet summers and cool, dry winters.

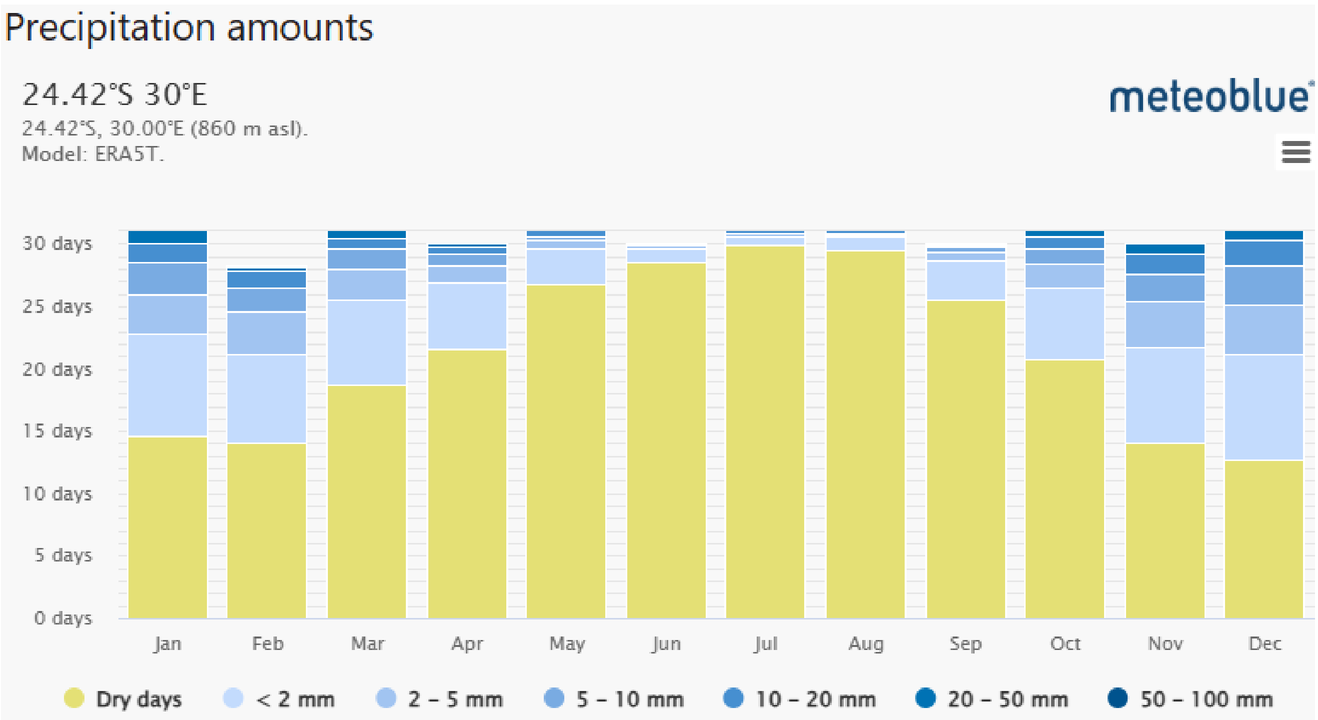

Figure 23: Sealane Average Monthly Rainfall for the Period 1993 – 2023

3.5.4 Mixing height and atmospheric stability

The vertical component of dispersion is a function of the extent of thermal turbulence and the depth of the surface mixing layer. Unfortunately, the mixing layer is not easily measured and must often be estimated using prognostic models that derive the thickness from some of the other parameters that are often measured, e.g. solar radiation and temperature.

During the daytime, the atmospheric boundary layer is characterised by thermal turbulence due to the heating of the earth's surface and the extension of the mixing layer to the lowest elevated inversion. Radiative flux divergence during the night usually results in the establishment of ground-based inversions and the erosion of the mixing layer.

Day-time mixing heights were calculated with the prognostic equations of Batchvarova and Gryning, while night-time boundary layer heights were calculated from various diagnostic approaches for stable and neutral conditions. The mixing layer in the study area ranges from 0 metres (only a stable or neutral layer exists) during night-times to the base of the lowest-level elevated inversion during unstable, day-time conditions (Batchvarova and Gryning, 1990).

Atmospheric stability is commonly categorised into one of seven stability classes. These are briefly described in **Table 6**. The atmospheric boundary layer is usually unstable during the day due to turbulence caused by the sun's heating effect on the earth's surface. The depth of this mixing layer depends mainly on the amount of solar radiation, increasing in size gradually from sunrise to reach a maximum at about 5-6 hours after sunrise. The degree of thermal turbulence is increased on clear warm days with light winds. During the night a stable layer, with limited vertical mixing, exists. During windy and/or cloudy conditions, the atmosphere is normally neutral. A neutral atmospheric potential neither enhances nor inhibits mechanical turbulences. An unstable atmospheric condition enhances turbulence, whereas a Stable atmospheric condition inhibits mechanical turbulence.

Table 6: Atmospheric Stability Classes.

Class	Stability	Description
Class A	Very unstable	Calm wind, clear skies, hot day-time conditions
Class B	Moderately unstable	Clear skies, day-time conditions
Class C	Slightly unstable	Moderate wind, slightly overcast day-time conditions
Class D	Neutral	High winds or cloudy days and nights
Class E	Slightly stable	Moderate wind, slightly overcast night-time conditions
Class F	Moderate stable	Low winds, clear skies, cold night-time conditions
Class G	Very stable	Calm winds, clear skies, cold clear night-time conditions

For elevated releases, the highest ground level concentrations would occur during unstable, day-time conditions. The wind speed resulting in the highest ground level concentration depends on the buoyancy. If the plume is considerably buoyant (high exit gas velocity and temperature) together with a low wind, the plume will reach the ground relatively far downwind. With stronger wind speed, on the other hand, the plume may reach the ground closer, but due to the increased ventilation, it will be more diluted. A wind speed between these extremes would therefore be responsible for the highest ground level concentrations. The highest concentrations for low level releases would occur during weak wind speeds and stable atmospheric conditions. Air pollution episodes frequently occur just prior to the passage of a frontal system that is characterised by calm wind and stable conditions.

The region is characterised by a combination of sunny and partly cloudy days. Overcast conditions are experienced less than 5 days per month (see **Figure 24**).

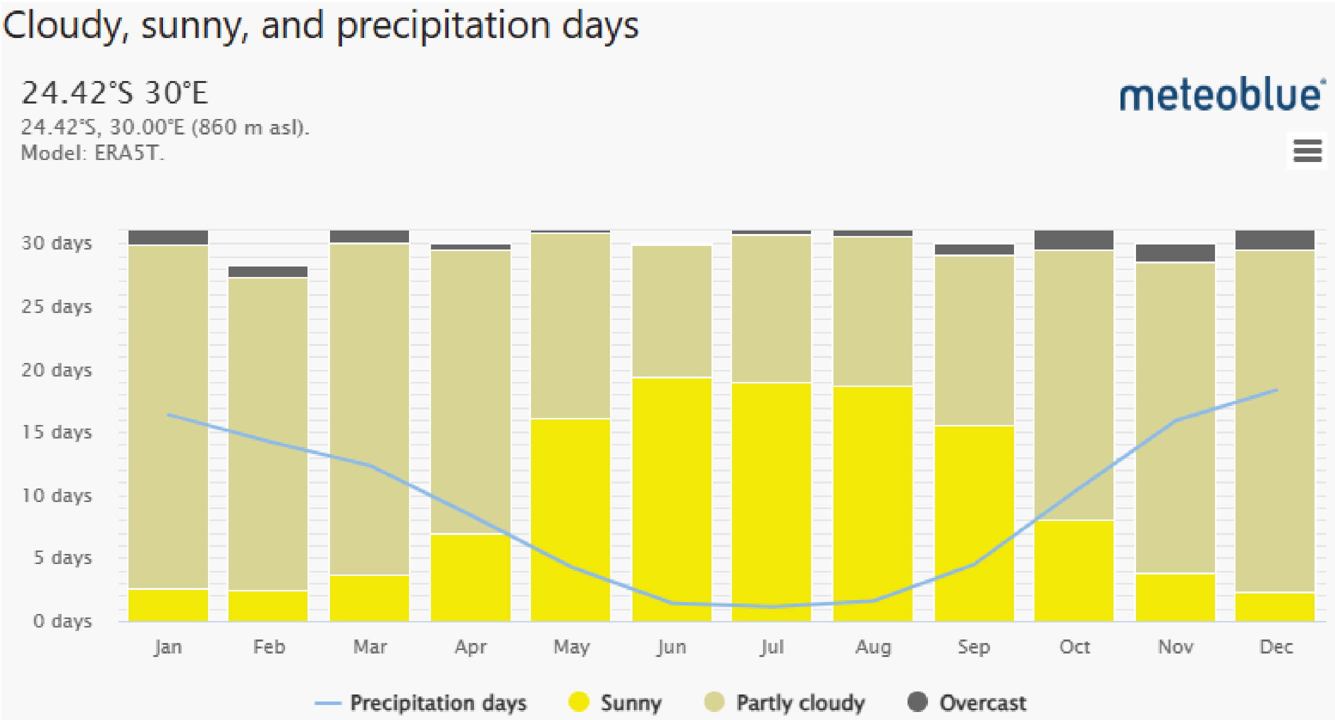

Figure 24: Sealane Cloud Cover and Precipitation Days for the Period 1993 – 2023

3.6 TOPOGRAPHY AND LAND USE

The Sekhukhune District falls within the Limpopo province and shares its borders with the Mpumalanga Province. The district of Sekhukhune covers an area of approximately 13 264 km^2, the majority of which is rural. The District Municipality is subdivided into four local municipalities, Fetakgomo Tubatse, Elias Motsoaledi, Ephriam Mogale and Makhuduthamaga.

The main economic activities in Sekhukhune are mining and irrigated agriculture Platinum, Chrome, Gold and Palladium mines are situated in the eastern part of the district, around the Leolo Mountains. The rocks and soils of the Sekhukhuneland region hold some of the highest concentrations of heavy metals in the world including chromium, platinum, titanium and vanadium. This has led to an enormous growth in the mining sector, with many more mines planned for the area.

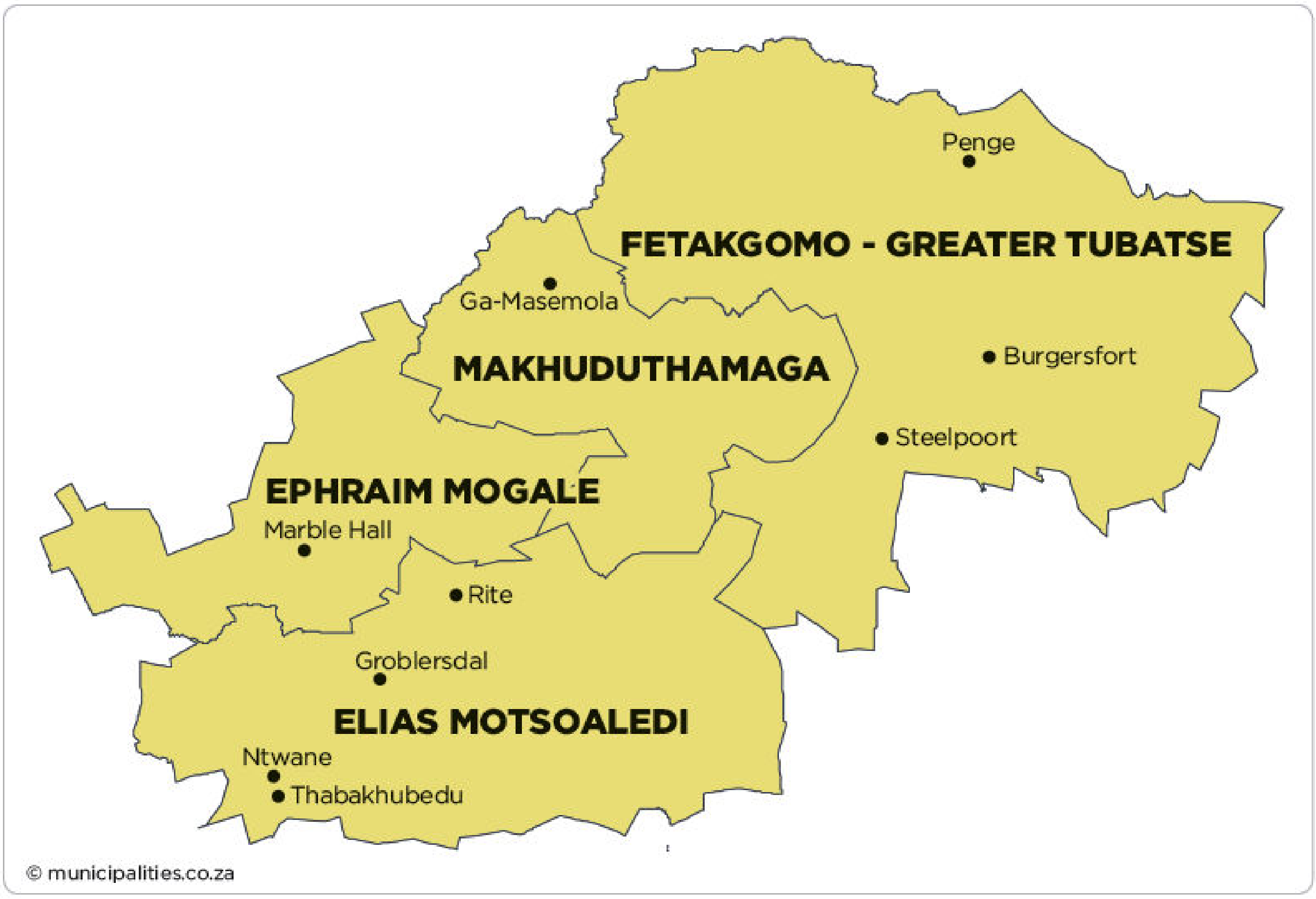

Figure 25: Local Municipalities of the SDM

Development of the Dilokong Corridor, an area rich in mineral deposits that stretches across the northeast of Sekhukhune through Fetakgomo and Tubatse, is expected to provide increased economic opportunity in the district. There are commercial irrigated farms near Groblersdal and Marble Hall in the south-west and Zebediela in the north, however only 30% of the land area of the district is under commercial farming.

CDM is in the centre of the Limpopo Province. The District comprises four local municipalities, including Blouberg, Molemole, Lepelle-Nkumpi and Polokwane. Polokwane Local Municipality is the largest of the five Municipalities in terms of gross geographic product.

In 2014, the sectors that contributed the most to CDM's economy were Community services (33.0%), Finance (20.8%), and Trade (21.6%). The Agricultural sector contributed the least to the economy at 1.9%. At present, agriculture besides farming includes forestry, fruit cultivation, dairy, poultry, mushroom and bee keeping.

Figure 26: Local Municipalities of the CDM

The topography of the Phase 2F project ranges from 740 m to 950 m Above Mean Sea Level (AMSL).

SRTM1/SRTM3 digital elevation model data was incorporated into the study using the appropriate terrain pre-processing options provided by AERMOD.

3.7 POLLUTION SOURCES AND RECEPTORS

3.7.1 Pollution Sources

The outdoor sources of air pollution resulting from human activities comprise three broad categories.

Stationary sources can be subdivided into; rural area sources, e.g. agriculture, mining and quarrying and industrial point and area sources, e.g. manufacturing of chemicals, non-metallic mineral products, basic metal industries and power generation.

Community sources i.e., heating of homes and buildings, municipal waste and sewage sludge incinerators, fireplaces, cooking facilities, laundry services and cleaning plants.

Mobile sources include sources such as combustion-engine vehicles, e.g. light duty petrol-powered cars, light and heavy-duty diesel-powered vehicles, motorcycles, aircraft and line sources such as fugitive emissions from vehicle traffic.

Air pollutants are traditionally classified into suspended particulate matter (dusts, fumes, mists and smokes), gaseous pollutants (gases and vapours) and odours.

The source groups per District Municipality for the Limpopo Province include industry, domestic fuel burning and mining, with differences in contribution by each source across the Districts. Other sources within the Province contributing to air pollution include domestic fuel burning, vehicle tailpipe emissions, and biomass burning.

The main sources of SO_2 and NOx within the Limpopo Province are the power generation sources within the Waterberg District Municipality. Small boilers, followed by mining operations (both coal and metallurgical), are the main contributing sources to total suspended particulate matter (TSP) with boilers (assuming all TSP to be PM_{10}) the main source of PM_{10}. Wood processing is the second most significant source of PM_{10}. The main contributor within the Province to fine particulate matter ($PM_{2.5}$) and CO is biomass burning. Vehicle tailpipe emissions are the main source of hydrocarbons specifically within the Districts of Waterberg, Capricorn and Vhembe. VOCs show to be primarily from wood treatment works and these are mainly restricted to Mopani District Municipality. Small boilers, where quantified, also indicated to be potential significant sources of CO_2.

Four "hot-spot" areas were selected for dispersion modelling based on the current understanding of the air quality within the Province, the location of significant sources as well as available emissions data.

These are:

- **Polokwane region**: a region with a high number of sources and no up-to-date ambient air quality data to determine the current state of air.
- **Lephalale region**: the only region within the Province with power stations and large-scale coal mining activities.
- **Phalaborwa region**: the only area with fertiliser manufacturing, a copper smelter and large opencast mining operations.
- **Steelpoort Valley**: an area with significant number of mining activities.

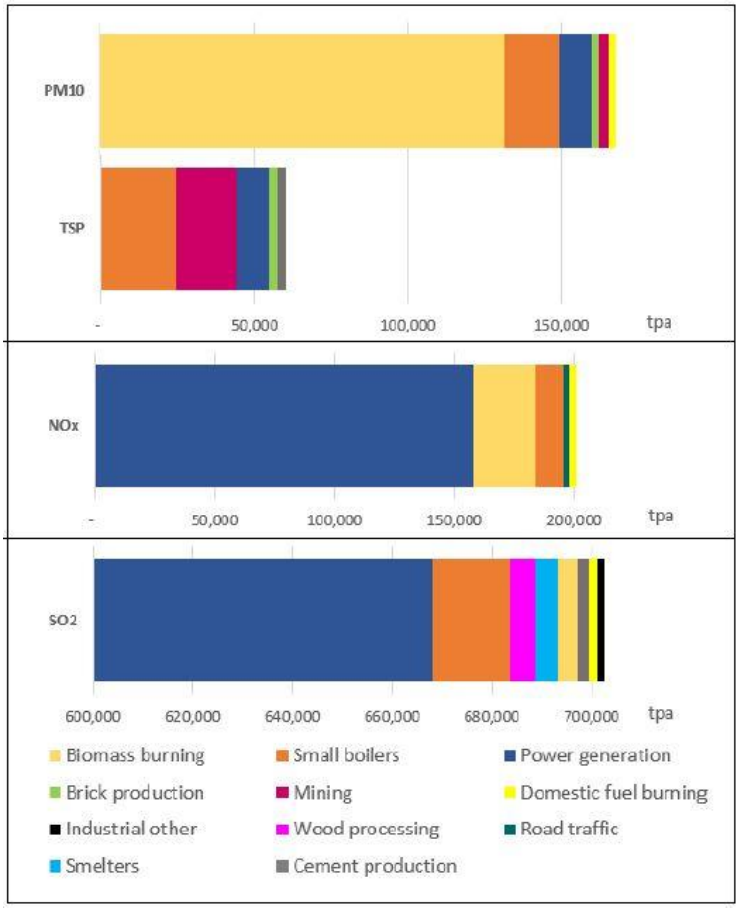

Figure 27: Limpopo Province Emission Per Source Group

Some of the concerns identified were:

- The predicted impacts within the Polokwane area are mainly localised.
- The area around Lephalale is of concern, due to the planned development rather than the current situation. Current Ground Level Concentrations (GLCs) PM_{10} are however a concern around the opencast mines in the area where it is predicted to exceed standards at nearby settlements.
- The main area of concern is around Phalaborwa due to very high SO_2 concentrations impacting the town.
- The Steelpoort area due to the numerous mining operations within proximity to villages and homesteads resulting in high PM_{10} GLCs.

Table 7: Predicted Impact at the Four "Hot-spot" Areas within the Limpopo Province.

Identified Areas	**Main Pollutant**	**Main Sources of Concern**	**Significance**
Polokwane	PM_{10}	Brickworks and asphalt plants	Medium
	SO_2	Smelters	Medium
Lephalale	PM_{10}	Mining operations	High
	SO_2	Power plants	Medium
Phalaborwa	PM_{10}	Mining operations	Medium
	SO_2	Smelter and fertiliser production	High
Steelpoort	PM_{10}	Mining operations	High

All source groups were ranked in order of significance employing a typical Environmental Impact Assessment significance ranking methodology.

The significance ranking for the areas of concern showed the following:

- Wood processing, mainly based on the number of activities, was ranked first in Mopani and in Vhembe. There are, however, far more wood processing activities in Mopani than in Vhembe.
- The smelting and fertiliser operations at Phalaborwa, even though both ranked fourth, are significant impacting sources.
- Mining resulted in a significant source at Sekhukhune and Waterberg District Municipalities. At Waterberg District Municipality the main concern is around the coal mining operations and at Sekhukhune it is around the numerous platinum mines within the Steelpoort Valley area.
- Brickworks and other industrial sources were flagged as significant contributing emission sources in the CDM.

Table 8: Ranked Significance of Source Groups in Each District Municipality

Source Group	Capricorn	Mopani	Sekhukhune	Vhembe	Waterberg
Brick production	1	3	-	3	2
Cement industry	3	-	-	-	5
Fertiliser	-	4	3	-	-
Fuel depot	-	7	5	-	-
Incinerators	-	-	-	-	-
Industrial stockpiles	7	-	-	-	-
Industrial other	1	6	4	4	3
Mining	3	2	1	2	1
Power generation	-	-	-	-	4
Small boilers	-	-	-	-	-
Smelter	5	4	2	-	-
Wood processing	6	1	-	1	-

Notes:
Ranking based on number of sources of each type and the total impact score.

The 2007 National Framework lists District and Metropolitan Municipalities where the ambient air is regarded as poor or potentially poor. For Limpopo Province, the ambient air in the Capricorn, Mopani and Waterberg District Municipalities are listed as "potentially poor" with the definition as "air quality poor at times or deteriorating".

The National Framework describes, *inter alia*, the implementation of ambient air quality standards. In this discussion five zones of control are described, each summarised briefly below.

Green Zone: Class 1 Air Quality Area: The areas where ambient air quality remains within Target Levels and no substantive corrective air quality management interventions are required other than basic good air quality governance.

Target Levels – The ambient air quality targets for South Africa that provide an adequate "development buffer" between air that is harmful and air that is not harmful to health and well-being. Target levels are likely to be set at 80% of the National ambient air quality standards.

Blue Zone: Class 2 Air Quality Area: The areas where ambient air quality remains within Alert Levels, but "pre-emptive" air quality management interventions are required other than basic good air quality governance.

Alert Levels – will be the levels of ambient air quality where "pre-emptive" governance interventions are triggered that provide an adequate "intervention development buffer" between air that is harmful and air that is not harmful to health and well-being. Alert levels are likely to be set at 90% of the National ambient air quality standards.

Purple Zone: Class 3 Air Quality Area: The areas where ambient air quality remains within the standards, but sustained air quality management interventions are required to, at least, maintain or improve this situation.

The Ambient Air Quality Standards will be the levels of ambient air quality where immediate governance interventions are triggered with the aim of, at least, bringing the area into compliance with the standard. This standard is the boundary between air that is potentially harmful and air that is not harmful to health and well-being.

Orange Zone: Class 4 Air Quality Area: The areas where ambient air quality represents a possible threat to health and well-being and requires immediate and sustained air quality management interventions to, at least, bring the area into compliance with the standards within agreed time frames.

For Government to prioritise efficient and effective air quality interventions, although immediate interventions are required, Class 4 Air Quality Areas need not necessarily be declared as priority areas in terms of the AQA.

Red Zone: Class 5 Air Quality Area: The areas where ambient air quality represents a possible threat to health and well-being and requires immediate and sustained air quality management interventions to, at least, bring the area into compliance with the standards within agreed time frames. Class 5 Air Quality Areas must immediately be declared National or Provincial priority areas in terms of the AQA.

Dispersion modelling carried out as part of the baseline assessment indicated that ambient air quality standards of PM_{10} and SO_2 may be exceeded from time-to-time near Lephalale, Phalaborwa and in the Steelpoort Valley. This implies a potential of Class 3 or 4 being approached, requiring action by Air Quality Officers. However, as no substantive air quality measurements have been conducted in these areas, other than SO_2 by Palabora Copper, it is suggested that insufficient information exists to indicate which of the two air quality control zones is applicable. It was recommended, therefore, that current monitoring requirements are aimed at a Class 3 (purple zone) level in those regions. Until better information becomes available, it was recommended that a Class 2 classification be given to the other areas in the Province.

3.7.2 Phase 2F Air Quality Monitoring

Ambient Particulate Matter Monitoring

Ambient PM_{10} and $PM_{2.5}$ concentrations (and meteorological parameters) were monitored at Dilokong Hospital, Driekop and the Samancor Chrome Winterton Recreational Club from October 2015 until March 2016.

Figure 32 and **Figure 33** include the particulate matter monitoring locations.

During 2015, eleven exceedances of the 24-hour PM_{10} standard were recorded at Dilokong Hospital, indicating non-compliance with the PM_{10} standard as only four exceedances of the standard are permitted per calendar year. $PM_{2.5}$ concentrations were low, with no exceedances recorded, indicating compliance with the standard. One exceedance of the PM_{10} standard was recorded on in February 2016, with no exceedances of $PM_{2.5}$ being recorded.

Figure 28 and **Figure 29** present the daily average PM_{10} and $PM_{2.5}$ concentrations recorded over the period 07 October 2015 to 05 February 2016 at Dilokong Hospital. For 2015, the PM_{10} annual average was 52.20 $\mu g/m^3$, exceeding the annual standard (40 µg/m3), while the $PM_{2.5}$ annual average was 8.25 $\mu g/m^3$, remaining well below the annual standard of 25 $\mu g/m^3$.

For 2016, the PM_{10} running annual average was 34.03 $\mu g/m^3$, falling below the annual standard, while the $PM_{2.5}$ running annual average was 5.50 $\mu g/m^3$, remaining well below the new more stringent annual standard of 20 $\mu g/m^3$.

No exceedances of PM_{10} or $PM_{2.5}$ were recorded at Samancor Chrome Winterton Recreational Club.

Figure 30 and **Figure 31** present the daily average PM_{10} and $PM_{2.5}$ concentrations recorded over the monitoring period of 06 February to 02 March 2016 at Samancor Chrome Winterton Recreational Club. The PM_{10} running annual average was 36.14 $\mu g/m^3$, falling below the annual standard while the $PM_{2.5}$ running annual average was 6.39 $\mu g/m^3$, falling well below the new more stringent annual standard of 20 $\mu g/m^3$.

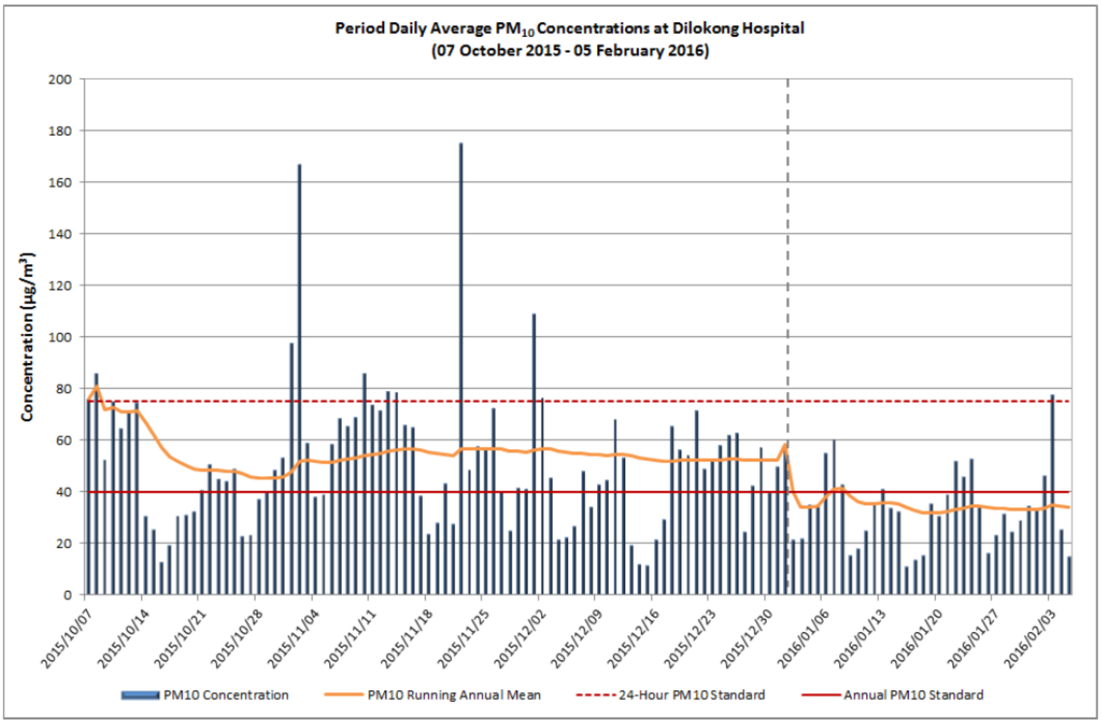

Figure 28: Daily Average PM_{10} Concentrations at Dilokong Hospital.

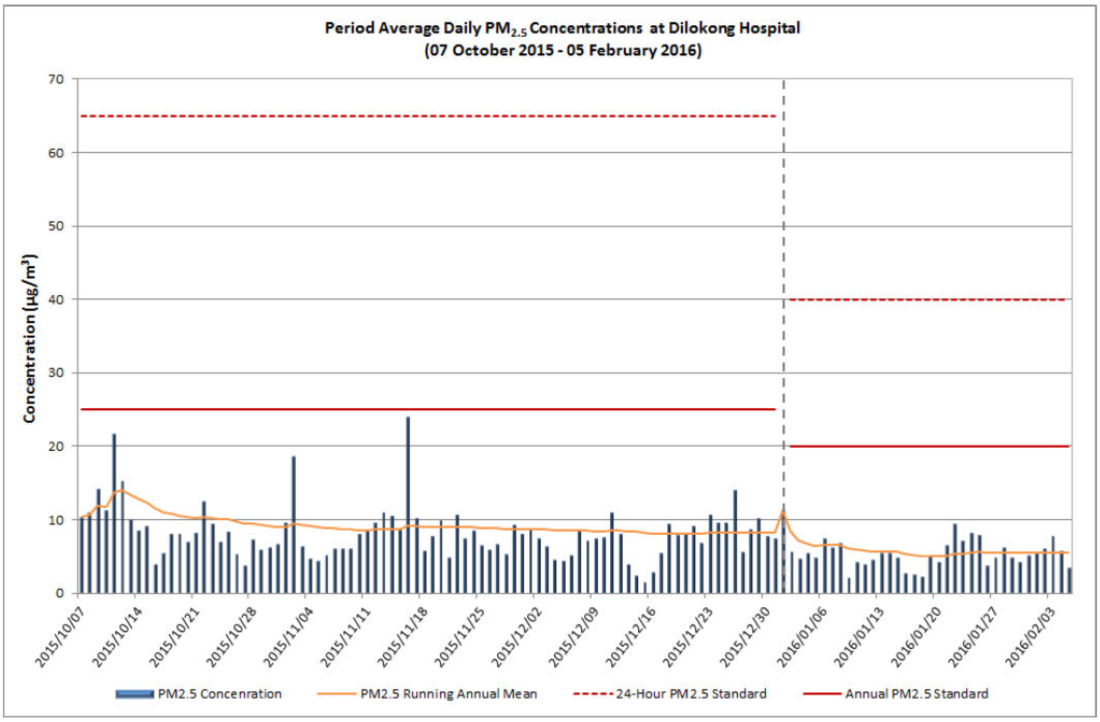

Figure 29: Daily Average $PM_{2.5}$ Concentrations at Dilokong Hospital.

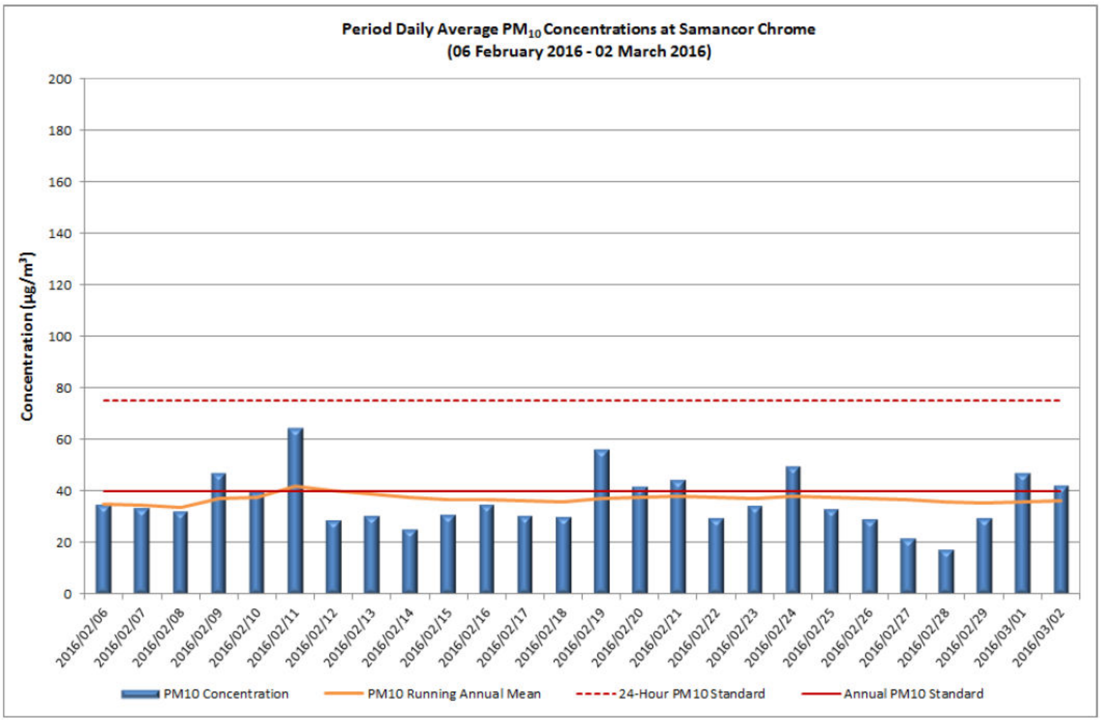

Figure 30: Daily Average PM_{10} Concentrations at Samancor Crome Winterton Recreational Club.

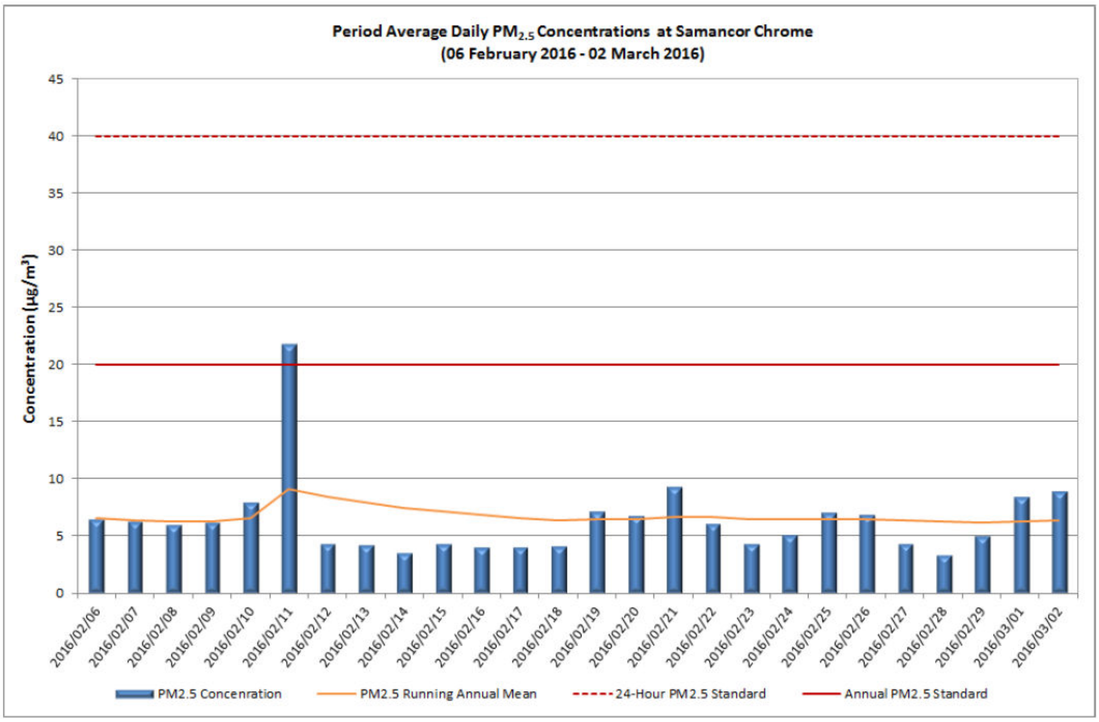

Figure 31: Daily Average $PM_{2.5}$ Concentrations at Samancor Crome Winterton Recreational Club.

Ambient Dust Deposition

Ambient dust deposition monitoring was conducted from October 2015 to March 2016. Eleven dust deposition monitoring stations were deployed along Phase 2F. The monitoring stations are indicated in **Figure 32** and **Figure 33**.

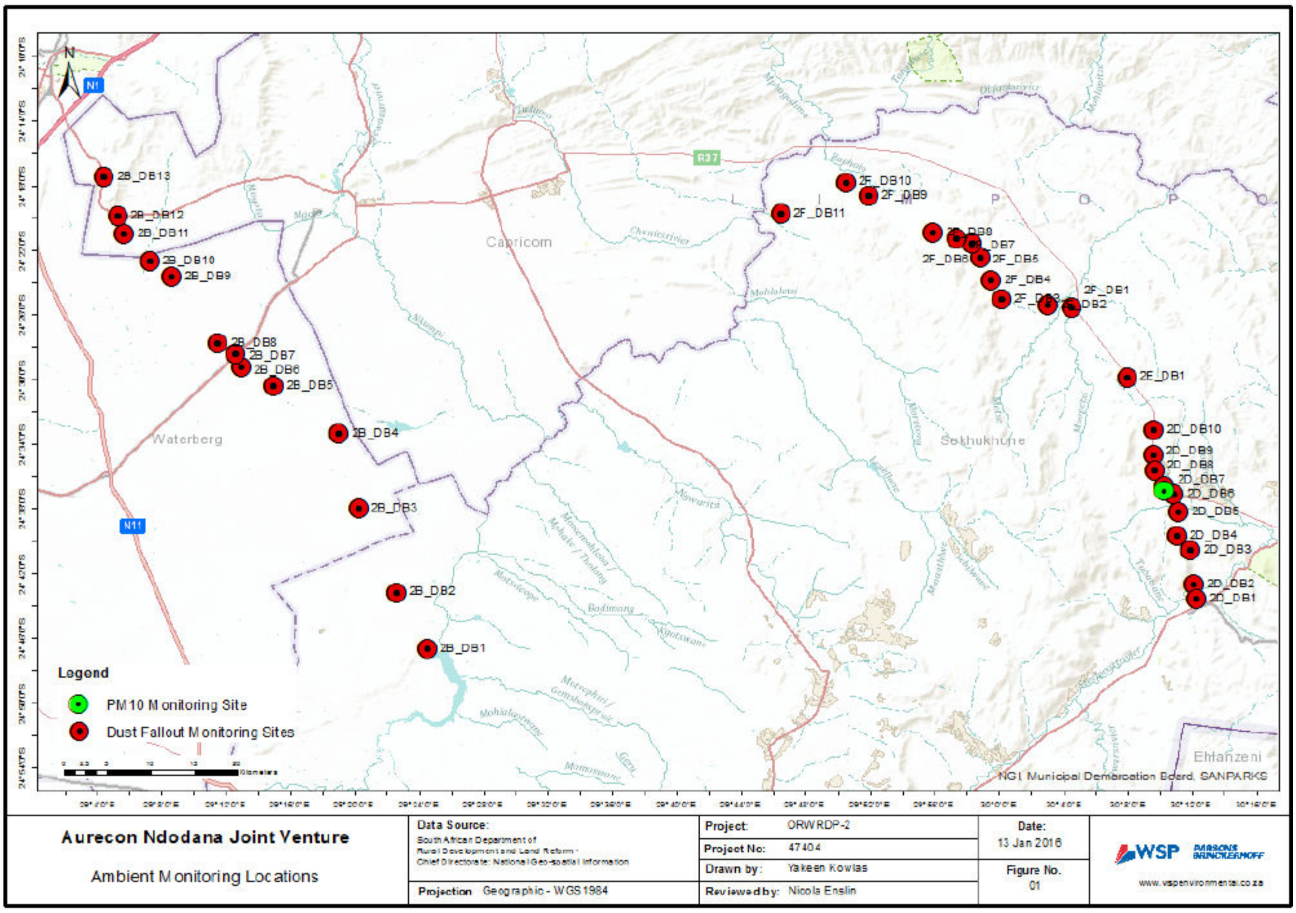

Figure 32: Dust Fallout and Particulate Monitoring (Dilokong Hospital) Locations for OMMP-BRWSP

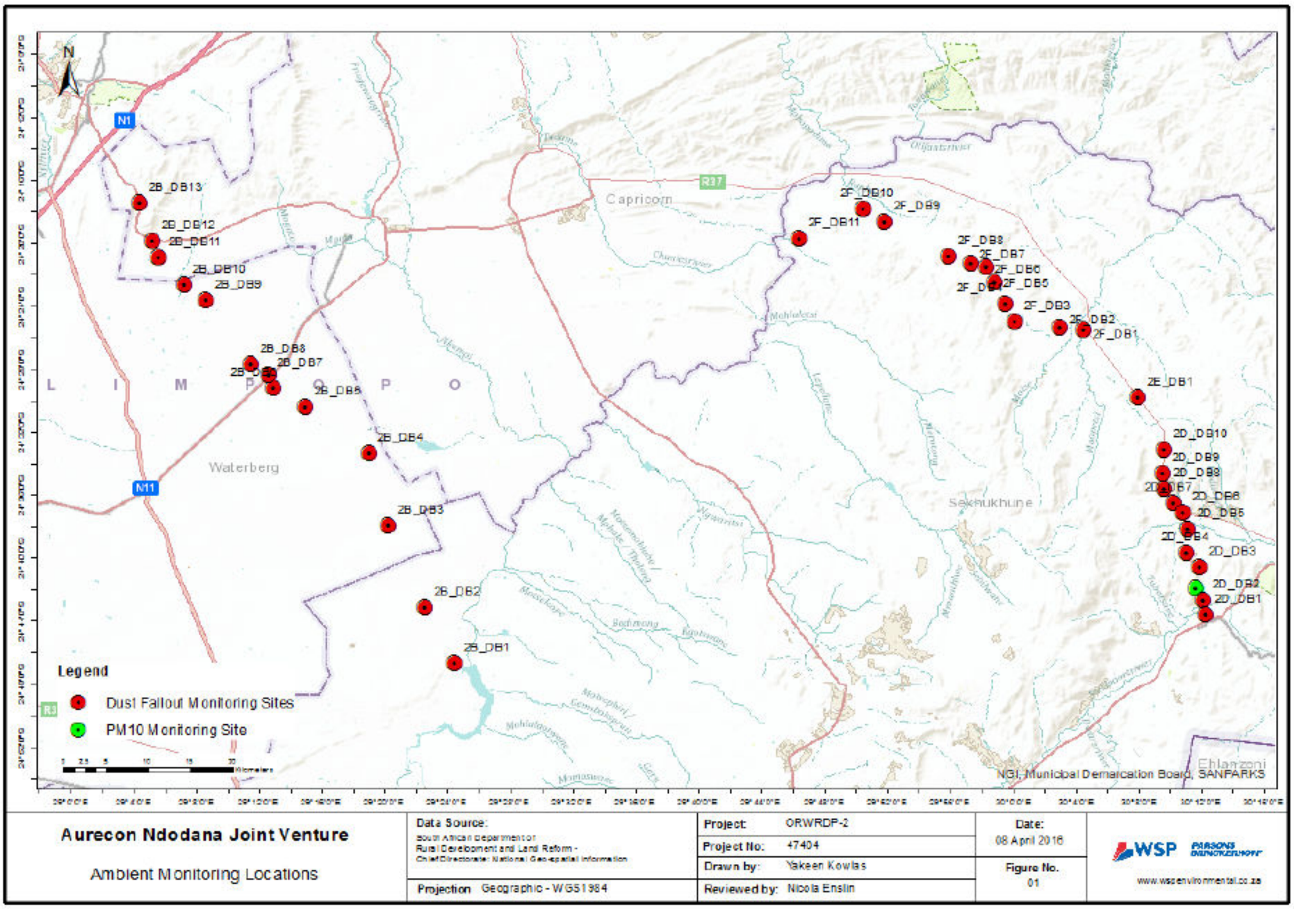

Figure 33: Dust Fallout and Particulate Monitoring (Samancor Chrome) Locations for OMMP-BRWSP

Table 9 presents the site descriptions, site classifications as well as the coordinates for each monitoring station. **Figure 34** provides an overview of the dust fallout levels measured at Phase 2F.

In 2015, one exceedance was recorded at 2F-DB3 (December 2015). During 2016 an exceedance was recorded at 2F-DB1 (January 2016). None of the other monitoring stations reported any exceedances.

Table 9: Phase 2F Dust Fallout Monitoring Stations Descriptions, Classifications and Coordinates

Description	Classification	Latitude (S)	Longitude (E)
2F-DB1	Residential	24°25'32.09"	30° 4'33.71"
2F-DB2	Residential	24°25'21.61"	30° 3'4.10"
2F-DB3	Residential	24°25'0.66"	30° 0'10.58"
2F-DB4	Residential	24°23'49.78"	29°59'33.65"
2F-DB5	Residential	24°22'28.78"	29°58'52.03"
2F-DB6	Residential	24°21'32.69"	29°58'20.96"
2F-DB7	Residential	24°21'15.66"	29°57'21.92"
2F-DB8	Residential	24°20'52.04"	29°55'57.14"
2F-DB9	Residential	24°18'38.12"	29°51'54.40"
2F-DB10	Residential	24°17'47.47"	29°50'32.39"
2F-DB11	Residential	24°19'44.72"	29°46'28.27"

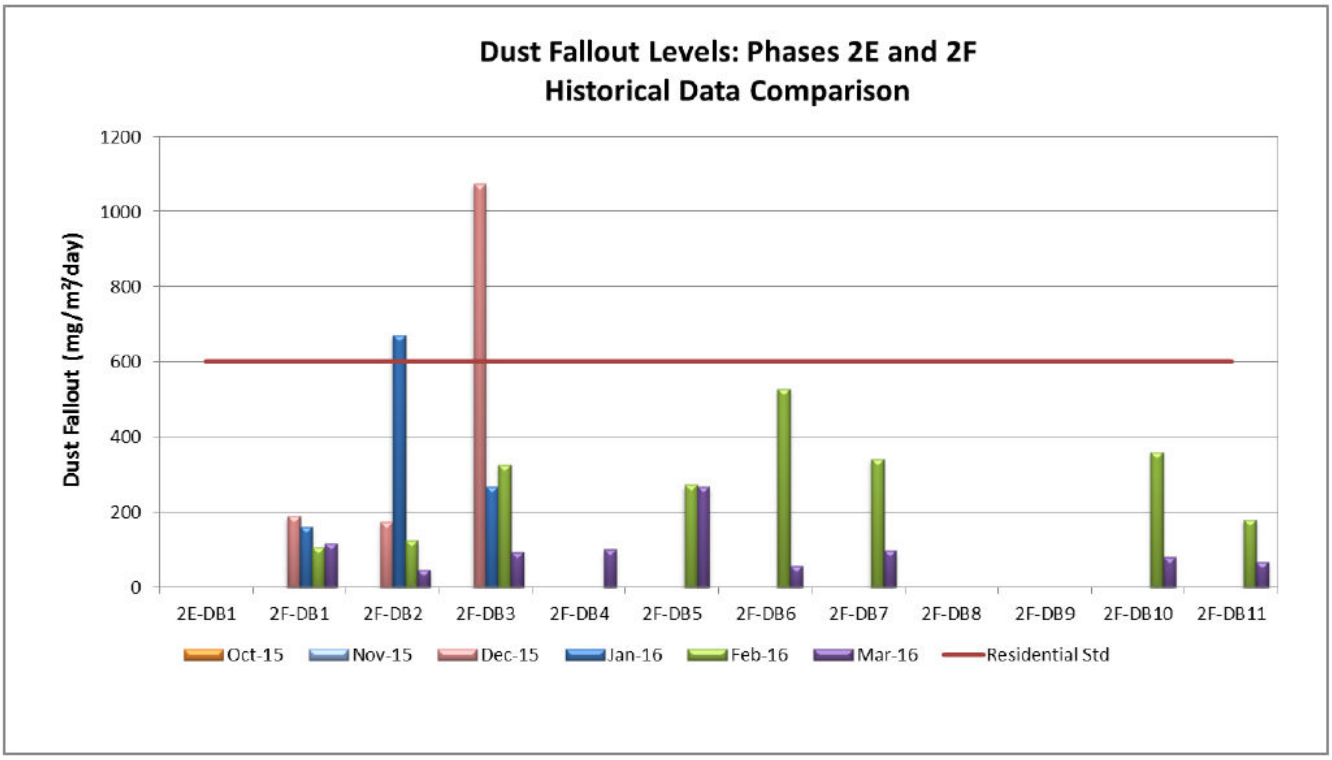

Figure 34: Dust Fallout Levels Measured at Phase 2E and 2F.

3.7.3 Pollution Receptors

Receptors are sites (or areas) which may potentially be impacted by the process or activity. In this study, receptors were identified during the site visit and selected based on available topographical data. The impact will must possibly include an area up to 150 metres and can extend to 1 km in worse case scenarios. Sensitive receptors include community areas, educational institutions, medical facilities, recreational facilities, places of worship and villages. Other receptors located within the vicinity of the project include mines and associated infrastructure (i.e. Twickenham Platinum Mine, Cromex Mining Mecklenburg , Sefateng Chrome Mines and Bokoni Platinum Mine).

3.8 SDM AND CDM

Criteria pollutants are pollutants commonly found from various sources and for which health-based criteria (science-based guidelines) have been established as the basis for setting permissible levels. Typical pollutants include particulates (including soot, fly ash and aerosols), sulphur oxides (SO_x), oxides of nitrogen (NO_x), carbon monoxide (CO), carbon dioxide (CO_2), volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), methane (CH_4), ammonia (NH_3), hydrogen chloride (HCl), hydrogen sulphide (H_2S), ozone (O_3) and other photochemical oxidants (as secondary pollutants) and various trace elements. Organic compounds released include formaldehyde, benzene, poly-aromatic hydrocarbons, PCBs and dioxins and furans.

There are several key sources of pollutant in the SDM, which include industrial processes, household emissions, agriculture, transportation, fires and waste disposal and wastewater treatment.

Table 10 provides a summary of the key pollution sources and associated pollutants. **Table 11** provides a summary of the current emission data for the SDM.

Table 10: SDM Key Pollution Sources and Associated Criteria Pollutants

Pollutant	Key Pollution Sources
SO_2	Industrial processes e.g. smelters, boilers, vehicle emissions, fuel combustion and biomass burning.
NOx	Industrial processes e.g. smelters, vehicle emissions, fuel combustion and biomass burning.
CO	Industrial processes e.g. smelters, boilers, vehicle emissions, fuel combustion and biomass burning.
PM_{10}	Industrial processes e.g. mining, smelters, vehicle emissions, fuel Combustion, biomass burning, unpaved road surfaces and farming.
VOCs	Industrial processes, vehicle emissions, fuel combustion and biomass burning.
Pb	Vehicle emissions and accessories.
CH_4	Landfill sites and wastewater treatment plants.
Pesticides	Spraying of agricultural fields.

Table 11: SDM Emissions

Town	VOCs	PM	CO	NOx	SOx
Burgersfort	0.026	3.343	1.453	1.533	8.033
Ohrigstad	0.004	0.358	0.234	0.151	0.731
Steelpoort	3.011	98.550	186.150	20.531	1.916
Jane Furse	0.026	3.796	1.424	1.779	9.490
Marble Hall	0.008	1.168	0.438	0.548	2.920
Groblersdal	0.042	6.132	2.300	2.874	15.330
Ga-Nkwana	722.7	23652.0	44676.0	4927.5	459.9
TOTAL	**725.8**	**23765.3**	**44868.0**	**4954.9**	**498.3**

Notes:
Emissions reported in tonnes.

Capricorn has been rated as having a potentially poor air quality due to the commercial /industrial nature of the Polokwane municipal area - this means that the air quality is within the standards, but sustained air quality management interventions are required to at least maintain or improve the situation.

The main sources of air pollution within CDM, based on the potential for human health risks are emissions from industries, domestic fuel burning and from vehicle emissions. Two major emitters are found within the district; they are Polokwane Smelters and Silicon Smelters. Several other smaller sources are found including but not limited to boiler operations.

Primary atmospheric emissions released from these sources include SO_2, NOx, CO, $PM_{2.5}$ and PM_{10} and VOCs. Secondary pollutants such as O_3 are formed in the atmosphere through the chemical transformation of precursors such as VOCs and NOx. The Polokwane municipal area and specifically the urban areas of Polokwane have been identified as a hot spot within the district.

There are two monitoring stations situated within the SDM, Steelpoort and Dilokong.

Ambient air quality monitoring conducted by the LEDET includes a station in Polokwane, Phalaborwa and two Eskom owned stations at Marapong and Medupi. CDM has a monitoring station in Polokwane.

Anglo Platinum monitors SO_2 and $PM_{2.5}$ concentrations at four monitoring stations within the vicinity of the smelter. Based on monitoring results provided by Anglo Platinum, SO_2 concentrations in 2004 were below the proposed air quality standard while $PM_{2.5}$ concentrations were exceeded on several occasions.

Hourly data was obtained from the South African Air Quality Information System (SAAQIS) and analysed to assess patterns in atmospheric concentrations, including seasonal and diurnal patterns of the ambient concentrations and to assess the impacts that such reported pollution concentration may have. Local source regions for PM_{10}, $PM_{2.5}$, SO_2, NOx, CO, and O_3 were identified and trends discussed.

Monitoring data for the Dilokong station and Anglo Platinum South Farm station was included in this study, as the monitoring stations are situated closest to the study area.

3.8.1 Particulate Matter

Figure 35 shows the 24-hour average PM_{10} concentrations (blue line) for the Dilokong monitoring station.

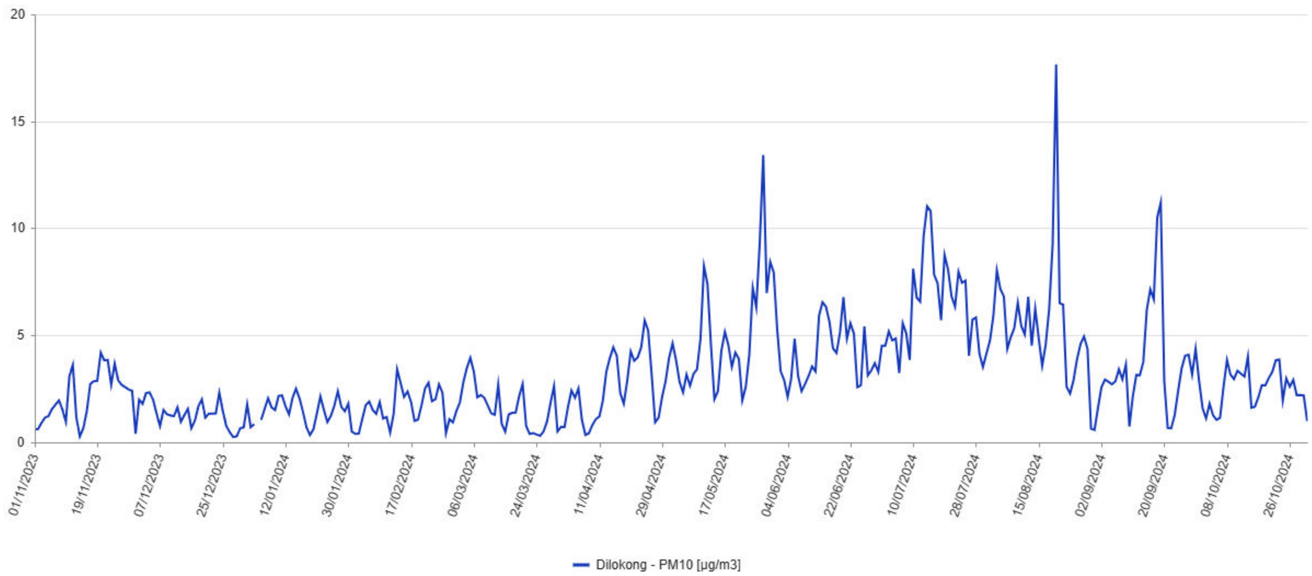

Figure 35: Dilokong Daily Average PM_{10} Concentration (SAAQIS 2024)

Figure 39 shows the 24-hour average PM_{10} concentrations (blue line) for the South Farm monitoring station.

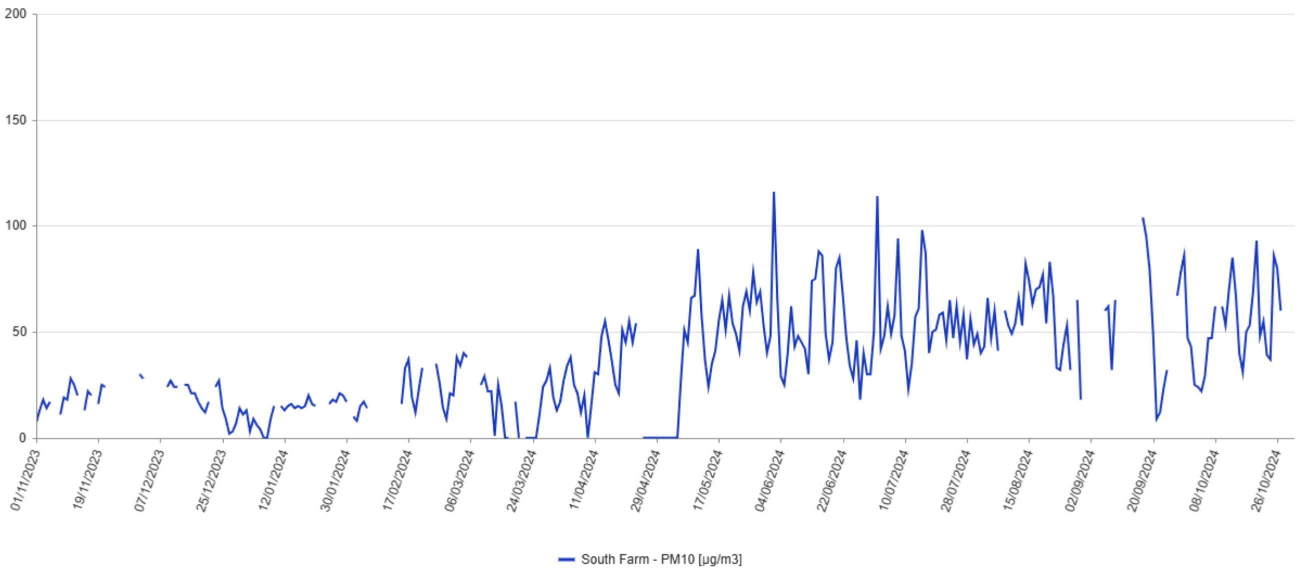

Figure 36: South Farm Daily Average PM_{10} Concentration (SAAQIS 2024)

PM is a broad term used to describe the fine particles found in the atmosphere, including soil dust, dirt, soot, smoke, pollen, ash, aerosols and liquid droplets. The most distinguishing characteristic of PM is the particle size and the chemical composition. Particle size has the greatest influence on the behaviour of PM in the atmosphere with smaller particles tending to have longer residence times than larger ones. PM is categorised, according to particle size, into TSP, PM_{10} and $PM_{2.5}$.

TSP consist of all sizes of particles suspended within the air smaller than 100 micrometres (µm). TSP is useful for understanding nuisance effects of PM, e.g. settling on houses, deposition on and discoloration of buildings, and reduction in visibility.

PM_{10} describes all particulate matter in the atmosphere with a diameter equal to or less than 10µm. Sometimes referred to simply as coarse particles, they are generally emitted from motor vehicles (primarily those using diesel engines), factory and utility smokestacks, construction sites, tilled fields, unpaved roads, stone crushing, and burning of wood. Natural sources include sea spray, windblown dust and volcanoes. Coarse particles tend to have relatively short residence times as they settle out rapidly and PM_{10} is generally found relatively close to the source except in strong winds.

$PM_{2.5}$ describes all particulate matter in the atmosphere with a diameter equal to or less than 2.5µm. They are often called fine particles, and are mostly related to combustion (motor vehicles, smelting, incinerators), rather than mechanical processes as is the case with PM_{10}.

$PM_{2.5}$ may be suspended in the atmosphere for long periods and can be transported over large distances.

Fine particles can form in the atmosphere in three ways: when particles form from the gas phase, when gas molecules aggregate or cluster together without the aid of an existing surface to form a new particle, or from reactions of gases to form vapours that nucleate to form particles.

Figure 37 shows the 24-hour average $PM_{2.5}$ concentrations (blue line) for the Dilokong monitoring station. **Figure 39** shows the 24-hour average $PM_{2.5}$ concentrations (blue line) for the South Farm monitoring station.

Particulate matter may contain both organic and inorganic pollutants. The extent to which particulates are considered harmful depends on their chemical composition and size, e.g. particulates emitted from diesel vehicle exhausts mainly contain unburned fuel oil and hydrocarbons that are known to be carcinogenic. Very fine particulates pose the greatest health risk as they can penetrate deep into the lung, as opposed to larger particles that may be filtered out through the airways' natural mechanisms.

In normal nasal breathing, particles larger than 10µm are typically removed from the air stream as it passes through the nose and upper respiratory airways, and particles between 3µm and 10µm are deposited on the mucociliary escalator in the upper airways. Only particles in the range of 1µm to 2µm penetrate deeper where deposition in the alveoli of the lung can occur (WHO, 2003).

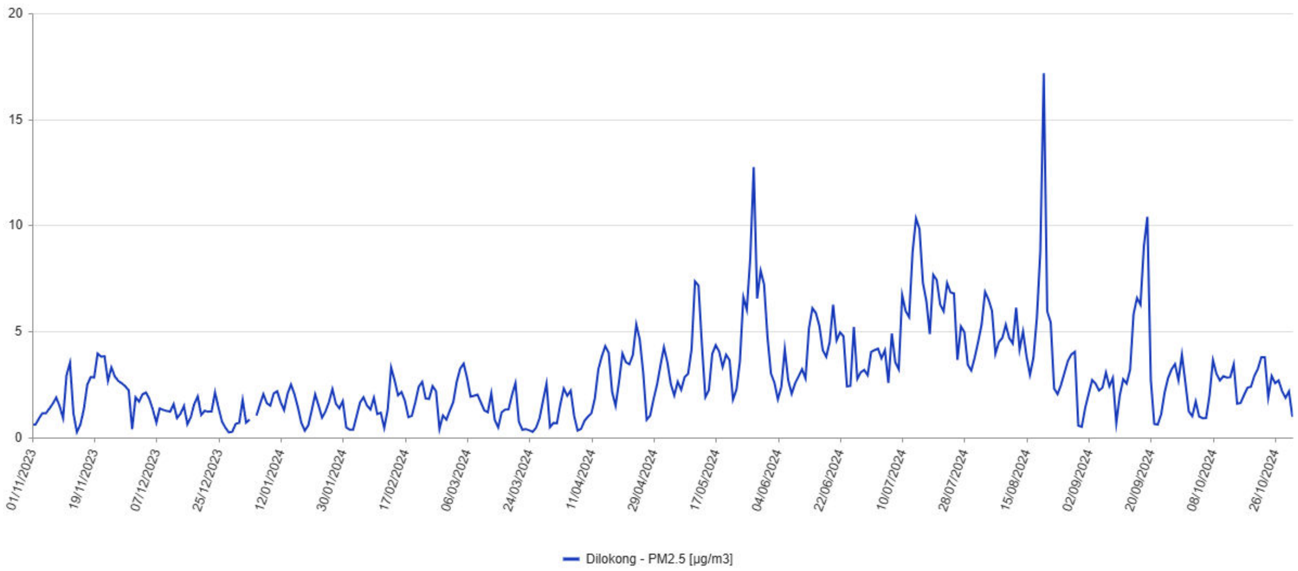

Figure 37: Dilokong Daily Average $PM_{2.5}$ Concentration (SAAQIS, 2024).

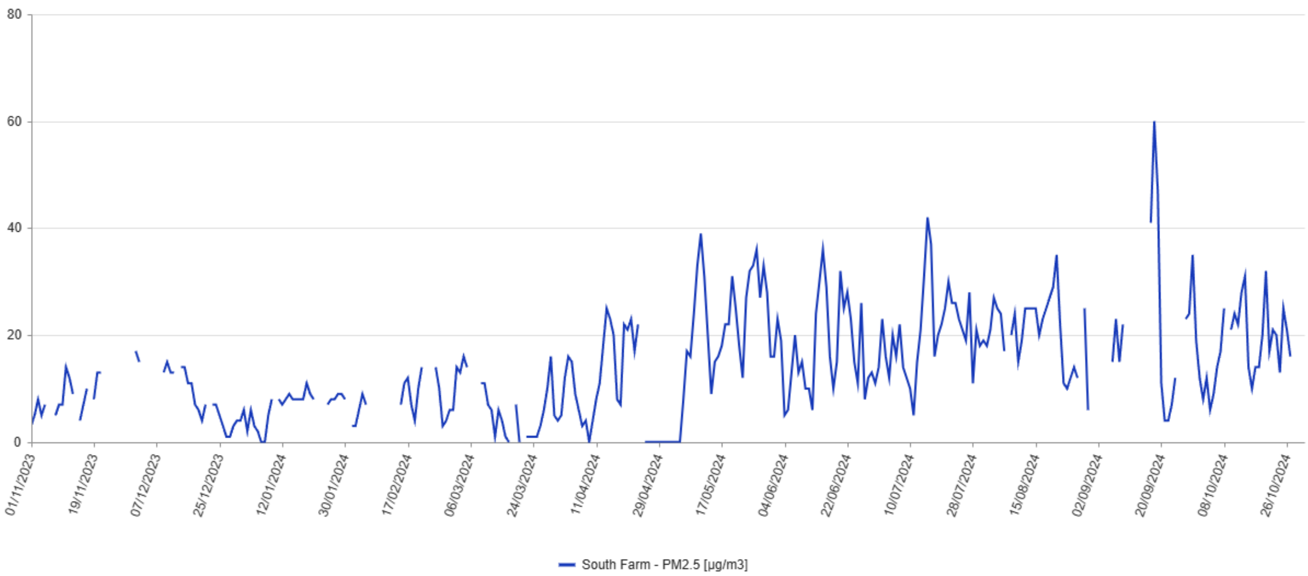

Figure 38: South Farm Daily Average $PM_{2.5}$ Concentration (SAAQIS, 2024).

Coarse particles (PM_{10} to $PM_{2.5}$) can accumulate in the respiratory system and aggravate health problems such as asthma. $PM_{2.5, which}$ can penetrate deeply into the lungs, are more likely to contribute to the health effects (e.g. premature mortality and hospital admissions) than coarse.

People with existing health conditions such as cardiovascular disease and asthmatics, as well as the elderly and children, are more at risk for the inhalation of particulates than normal healthy people.

Mortality outcomes calculated for South African urban areas estimate that outdoor air pollution caused 3.7% of total mortality from cardiopulmonary disease in adults aged 30 years and older, 5.1% of mortality attributable to cancers of the trachea, bronchus, and lung in adults, and 1.1% of mortality from acute respiratory infections in children under 5 years of age.

3.8.2 Sulphur Dioxide

SO_2 is a colourless pungent, irritating, water-soluble and reactive gas. The major source of SO_2 is the combustion fossil fuels such coal, oil and diesel which contain sulphur.

On inhalation, most SO_2 only penetrates as far as the nose and throat as it is readily soluble in the moist lining of the upper respiratory system, with minimal amounts reaching the lungs, unless the person is breathing heavily, breathing only through the mouth, or if the concentration of SO_2 is high.

The acute response to SO_2 is rapid, within 10 minutes in people suffering from asthma (WHO, 2005). SO_2 reacts with cell moisture in the respiratory system to form sulphuric acid. This can lead to impaired cell function and effects such as coughing, broncho-constriction, exacerbation of asthma and reduced lung function.

Effects such as a reduction in lung function, an increase in airway resistance, wheezing and shortness of breath, are enhanced by exercise that increases the volume of air inspired, as it allows SO_2 to penetrate further into the respiratory tract (WHO, 1999).

Figure 39 shows the 24-hour average SO_2 concentrations (blue line) for the Dilokong monitoring station.

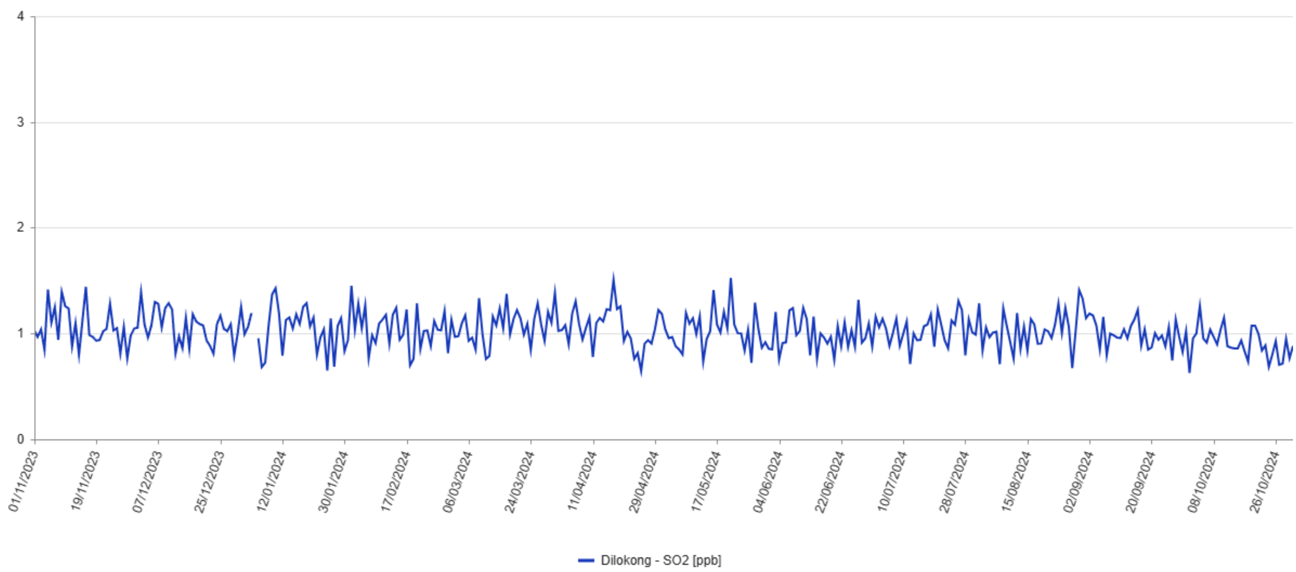

Figure 39: Dilokong Daily Average SO_2 Concentration (SAAQIS, 2024).

Due to its reactivity, SO_2 has a highly non-uniform dose distribution along the conductive airways of the respiratory tract. For low to moderate tidal volumes and nasal breathing, the penetration into the lungs is negligible. For larger tidal volumes and oral inhalation, doses of interest may extend into the segmental bronchi. SO_2 can only reach the gas-exchange region of the lungs after adsorption onto particulate matter.

Another special consideration for SO_2 is that there is great variation in susceptibility to bronchoconstrictive responses. Persons having asthma or atopy can be about ten times more responsive than healthy subjects.

Figure 39 shows the 24-hour average SO_2 concentrations (blue line) for the Dilokong monitoring station.

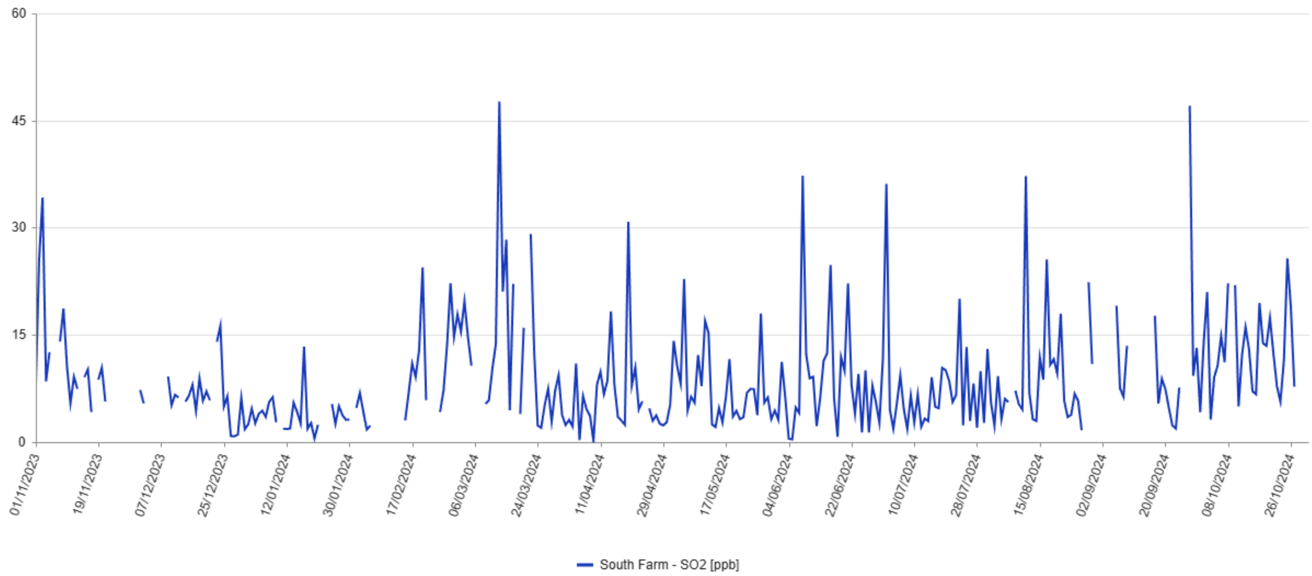

Figure 40: South Farm Daily Average SO_2 Concentration (SAAQIS, 2024).

3.8.3 Nitrogen Oxides

Figure 41 shows the 24-hour average NOx concentrations (blue line) for the Dilokong monitoring station. No NOx monitoring data was available for the South Farm monitoring station.

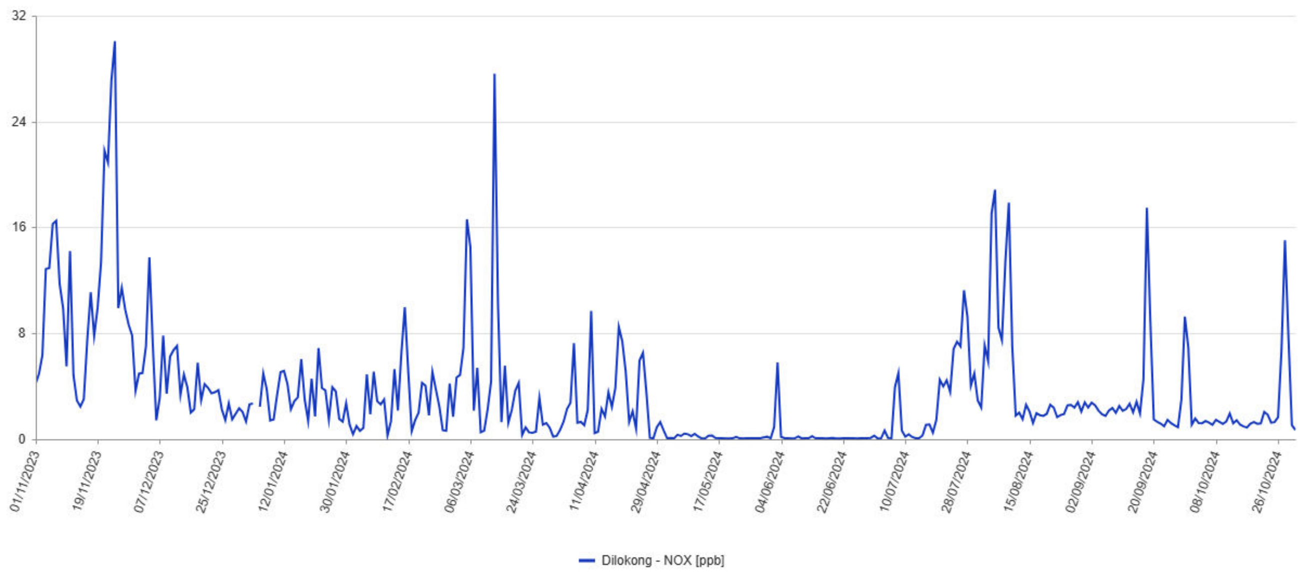

Figure 41: Dilokong Daily Average NOx Concentrations (SAAQIS, 2024).

Ambient concentrations of NO_2 in air are highly variable. Natural background concentrations can range from less than 0.4 $\mu g/m^3$ to more than 9 $\mu g/m^3$. In cities, ambient annual mean concentrations can range from 20 to 90 $\mu g/m^3$ with hourly maximum concentrations from 75 to 1 000$\mu g/m^3$.

NO_2 is formed in combustion processes and other high temperature operations such as metallurgical furnaces, blast furnaces, and internal combustion engines. In the atmosphere, NO_2 reacts with water vapour to produce nitric acid. This acidic pollution can be transported over long distances by wind and deposited as acid rain, causing the acidification of soils, lakes, and streams, accelerated corrosion of buildings and monuments and damages paintwork. NO_2 is also a major source of secondary fine particulate pollution, which decreases visibility, and contributes to surface ozone formation through its reaction with VOCs in the presence of sunlight.

The route of exposure to NO_2 is inhalation and the seriousness of the effects depends more on the concentration, than the length of exposure. The site of deposition for NO_2 is the distal lung as NO_2 does not readily dissolve in the moist upper respiratory system where it reacts with moisture in the fluids of the lower respiratory tract to form nitrous and nitric acids (WHO, 1997). About 80 to 90% of inhaled nitrogen dioxide is absorbed through the lungs (CCINFO, 1998). NO_2 present in the blood as the nitrite ion oxidises unsaturated membrane lipids and proteins, which result in the loss of cell permeability control. NO_2 causes decrements in lung function, particularly increased airway resistance. People with chronic respiratory problems and people who work, or exercise outside will be more at risk of NO_2 exposure.

3.8.4 Carbon Monoxide

Carbon monoxide is a product of incomplete combustion of fossil fuels. It is predominantly formed in internal combustion engines of motor vehicles, but the combustion of any carbon-based material can release CO. Chemical reactions in the atmosphere may also lead to the formation of CO by the oxidation of other carbon-based gases such as methane. Decomposition of organic material within soils can also result in the release of CO.

Natural ambient concentrations of CO range between 0.06 and 0.14 mg/m^3. In urban environments, mean concentrations over eight hours are usually less than 20 mg/m^3, and one-hour peak levels are usually less than 60mg/m^3. Highest concentrations are usually measured near major roads, as vehicles are the major source of CO.

When inhaled, CO enters the blood stream by crossing the alveolar, capillary and placental membranes. In the bloodstream approximately 80-90% of absorbed CO binds with heamoglobin to form carboxyhaemoglobin. The haemoglobin affinity for CO is approximately 200-250 times higher than that of oxygen. Carboxyhaemoglobin reduces the oxygen carrying capacity of the blood and reduces the release of oxygen from haemoglobin, which leads to tissue hypoxia. This may lead to neurological effects and sometimes delayed severe neurological effects that may include impaired coordination, vision problems, reduced vigilance and cognitive ability, reduced manual dexterity, and difficulty in performing complex tasks (WHO, 1999).

3.8.5 Ozone

Ozone is a colourless gas which carries a harsh odour. It occurs naturally in the lower stratosphere as the ozone layer. This layer protects the earth from shortwave ultraviolet radiation. Near the earth's surface, ozone is a secondary pollutant and a major constituent of photochemical smog. The formation of ozone is dependent on the availability of NOx, VOCs and sunlight. Thus, ozone may not be related directly to any source. Rather it may be associated with the sources of its precursor gases (NOx and VOCs). Ozone may also reach the lower troposphere from the stratosphere, mostly associated with deep frontal systems or with deep convective storms.

Background one-hour average concentrations of O_3 in remote and relatively unpolluted parts of the world are often in the range of 40 to 70 µg/m^3. In cities maximum mean hourly concentrations can be as high as 300 to 400µg/m^3. High O_3 concentrations can persist for 8 to 12 hours per day for several days, when atmospheric conditions favour O_3 formation and poor dispersion conditions exists.

Ozone is a very reactive gas and a strong oxidant, associated with several health effects. Ozone toxicity occurs in a continuum in which higher concentrations, longer exposure duration and greater activity levels during exposure cause greater effects. These include respiratory system effects such as coughing, aggravation of asthma and reduced lung function.

3.8.6 Lead

Lead is a metal that occurs naturally in small amounts in the earth's crust. It is used in the production of some types of batteries, ammunition, metal products (such as solder and pipes) ceramic glazes and paint. Chemicals containing lead, such as tetraethyl lead and tetramethyl lead are used as gasoline additives. In the atmosphere, lead exists primarily in the particulate form and is removed from air by wet and dry deposition. Nearly all environmental exposure to lead is attributed to inorganic compounds.

Levels of lead found in air, food, water and soil/dust vary widely throughout the world and depend on the degree of industrial development, urbanisation and other lifestyle factors. In cities of developing countries traffic-related lead levels range between 0.3 and 1 $\mu g/m^3$ with extreme annual mean values between 1.5 and 2 $\mu g/m^3$.

Exposure to Pb may be through inhalation of contaminated air and ingestion of contaminated food, water and soil. Lead can accumulate in plants and animals. The half-life of lead in human blood (it affects haemoglobin synthesis in the blood) is 28 to 36 days, but lead accumulates in the bones and teeth where it can stay for decades and be released again. Children absorb more and excrete less of the absorbed lead than adults.

4. IMPACT ASSESSMENT

4.1 METHODOLOGY

4.1.1 Model Approach

Dilution of air contaminants in the atmosphere is an important process in preventing undesirable levels of pollutants in the ambient air. Atmospheric dispersion of air contaminants is the result of ventilation, atmospheric turbulence and molecular diffusion. However, gaseous and particulate air contaminants are primarily dispersed into the ambient air through wind action and atmospheric turbulence, much of it on the micro scale level. Depending on the relevant environmental and adiabatic lapse rates, various plume formation can be predicted. These include, looping, neutral, coning, fanning, lofting, fumigating and trapping.

Moisture content and form in the atmosphere can have a profound effect upon the air quality. The presence and amount of water vapour in the atmosphere affects the amount of solar radiation received and reflected by the earth.

Several dispersion models have been developed and are the mathematical description of the meteorological transport and dispersion of air contaminants.

To describe the position of the place where the concentration of contaminants will be estimated, relative to both the source and the ground, a standard Cartesian (x, y, z) co-ordinate system is used in which:

- the physical source is located at the origin,
- the x-axis lies along the mean wind direction,
- x is the distance from the source,
- y is the lateral distance from the mean wind direction,
- z is the height above ground level,
- h is the physical height of the source,
- Δh is the additional height by which the plume rises due to its buoyancy and/or momentum,
- H = h + Δh is the effective (plume) height of the release, and
- u is the mean wind speed at plume height.

Most models in use today assumes Gaussian distribution of emission pollutants, horizontally and vertically downwind of the source. With the assumption that the distributions in the y and z directions is normal with a standard deviation of σ_i, the concentration of a gas or aerosol (<20µm diameter particles) can be calculated at ground level for a distance downwind of the source:

$$C_{x,y} = \frac{Q}{\pi u \sigma_z \sigma_y} \exp\left[-\frac{1}{2}\left(\frac{H}{\sigma_z}\right)^2\right] \exp\left[-\frac{1}{2}\left(\frac{y}{\sigma_y}\right)^2\right]$$

Where

$C_{x,y}$	=	pollutant concentration in g/m³ with a maximum ground level concentration where $\sigma_z = 0.707H$,
Q	=	pollutant emission rate in g/s
π	=	constant pi = 3.14159
u	=	mean wind speed in m/s
σ_y	=	standard deviation of horizontal plume concentration at distance x in m,
σ_z	=	standard deviation of vertical plume concentration at distance x in m,
exp	=	base of natural logarithm = 2.71828183
H	=	effective stack height in m,
x	=	downwind distance along plume mean centreline from point source in m, and
y	=	crosswind distance from centreline of plume in m

The Gaussian equation contains explicit references to y and z, and implicit references to x (since σ_y and σ_z are themselves functions of x). Empirical studies resulted in graphs where values for these constants could be obtained for different Pasquill stability categories. However, these graphs were inaccurate by nature and equations for the variation of σ_y and σ_z with stability class have been developed and are provided in **Table 12**.

Table 12: Stability Class Variation Constants

Pasquill stability class	σ_y	σ_z
A	0.22x(1+0.0001x)-0.5	0.20x
B	0.16x(1+0.0001x)-0.5	0.12x
C	0.11x(1+0.0001x)-0.5	0.08x(1+0.0002x)-0.5
D	0.08x(1+0.0001x)-0.5	0.06x(1+0.0015x)-0.5
E	0.06x(1+0.0001x)-0.5	0.03x(1+0.0003x)-1
F	0.04x(1+0.0001x)-0.5	0.016x(1+0.0001x)-1

Process stacks have exit velocity and buoyancy due to the temperature and density difference with the surrounding air that carries them up into the air. This would result in the effective plume height being greater than the physical stack height as presented below.

$$H = h + \Delta h$$

Where

H = effective stack height in m,
h = height of the stack in m, and
Δh = plume rise in m.

One of the popular equations for the distance the flue gas rises before levelling out is Holland's empirical equation.

$$\Delta h = \frac{v_s d}{u}\left[1.5 + \left(2.68x10^{-3} p \frac{\Delta T d}{T_s}\right)\right]$$

Where

Δh	=	rise of plume above the stack in m,
v_s	=	stack gas velocity in m/s,
d	=	inside stack diameter in m,
u	=	mean wind speed in m/s,
p	=	atmospheric pressure in millibars
ΔT	=	stack gas temperature minus air temperature in K, and
T_s	=	stack gas temperature

The above equation is suitable for neutral conditions. For unstable conditions, Δh should be increased by a factor of 1.1 to 1.2 and decreased by a factor of 0.8 to 0.9 for stable conditions. Holland's equation frequently underestimates the effective stack height, giving a conservative figure for design purposes. Although more complex models are available to determine the upward driving force in terms of a buoyancy flux, Holland's equation will suffice when insufficient information with regards the properties of the source is known.

The simplest Gaussian solution assumes that the plume is free to expand in all directions without constraint. In the usual situation of an elevated source at some height above the ground, downwind dispersion is always limited by the presence of the ground, while upward dispersion may be limited by an elevated inversion. Assuming that no pollutant is absorbed by the ground, any pollutant that reaches the ground is available for upward dispersion and the following equation considers reflection at the ground:

$$C_{x,y} = \frac{Q}{2\pi u \sigma_z \sigma_y} \exp\frac{-y^2}{2\sigma_y^2}\left[\exp-\frac{1}{2}\left(\frac{z - H}{\sigma_z^2}\right)^2\right] + \exp\left[-\frac{1}{2}\left(\frac{z + H}{\sigma_z^2}\right)^2\right]$$

4.1.2 Model Input

The dispersion of emissions from the Phase 2F project was modelled using the following inputs:

- Source Pathway –Source emission rates and variables contained in **Table 3** and **Table 4**.
- Receptor Pathway – Complex terrain option. All receptors up to 1km loaded as discrete receptors. A nested Cartesian grid with a resolution of 20m by 20m for the first 200m and thereafter 100m by 100m.
- Terrain Grid Pathway – SRTM1/SRTM3 digital elevation model data (~30m).
- Meteorology Pathway – Site specific Unified Model data for the period 1 July 2023 to 30 June 2024 supplied by Meteoblue.

4.2 MODEL RESULTS AND DISCUSSION

This section contains the results of the predicted maximum and average ground level concentrations generated through the ISC-AERMOD VIEW model.

Prior to an analysis of the simulation results it is recommendable to briefly review areas of uncertainty which needs to be considered in the interpretation of the results. The range of uncertainty of the Gaussian plume model is given by the US-EPA as being in the range of -50% to +200% when used under the recommended conditions. Uncertainties are, however, not only associated with the mathematical model itself, but also with the generation of the meteorological and source data used as input data. It is well known that wind data errors are the major cause of poor agreement, especially for short-term predictions and long down-wind distances. The selection of a suitable meteorological data set for use in the simulation analysis is fundamental to the accuracy of the results. Errors in source strengths translate directly into errors of similar magnitudes in the model prediction.

There will always be some error in any geophysical model, but it is desirable to structure the model in such a way to minimise the total error. A model really represents the most likely outcome of an ensemble of experimental results. The total uncertainty can be thought of as the sum of three components: the uncertainty due to errors in the model physics, the uncertainty due to data errors and the uncertainty due to stochastic processes (turbulence) in the atmosphere.

Concentration and deposition isopleths reflect interpolated values for each receptor grid point for various averaging periods. It has generally been found that the accuracy of dispersion models improves with increased averaging periods. The prediction of instantaneous peaks is the most difficult and are normally performed with more complicated dispersion models specifically fine-tuned and validated for the process and location. For this reason, concentrations resulting from routine releases are given for at least three averaging periods, viz. hourly, daily and annual averages. No significant upset (intermittent release) sources are expected for the process.

The results presented reflect the spectrum from maximum ground level concentrations, occurring during very unstable conditions with low wind speeds, to low wind speeds during very stable conditions resulting in maximum impact area.

Dispersion results for the Phase 2F project are presented for the following scenarios:

- Dust deposition rates during Construction Operations
- PM_{10} concentrations during Construction and Rehabilitation Operations

Please note that only modelling outcomes showing little or more impact (>10% of the standard) are reflected in the report.

NO_2, SO_2, CO and $PM_{2.5}$ emissions were quantified, but not modelled due to the relatively low expected risk.

4.2.1 Dust Deposition during Construction

Dispersion model output plots for dust deposition during construction is reflected in **Figure 42**. The results were evaluated in terms of current South African National Standards and are presented for the project independently (i.e. incremental).

Maximum deposition rates around the Klipfontein Balancing Dam is expected to exceed the residential standard of 600 mg/m^2/day up to maximum distance of 150 m from the centre of construction operations.

It is unlikely that deposition rates will exceed current background levels beyond 150m from the construction alignment.

4.2.2 PM_{10} during Construction and Rehabilitation

Contravention of the daily average PM_{10} standard may exceed the allowable number of four per annum around the Klipfontein Balancing Dam, up to a distance of 500 m during construction and up to distance of 250 m during rehabilitation (**Figure 43**). Further contraventions of the daily standard will most likely occur infrequently along the alignment.

Annual average PM_{10} concentrations are expected to be insignificant (i.e. <50% of the standard) throughout the life of the project, as seen in **Figure 44**.

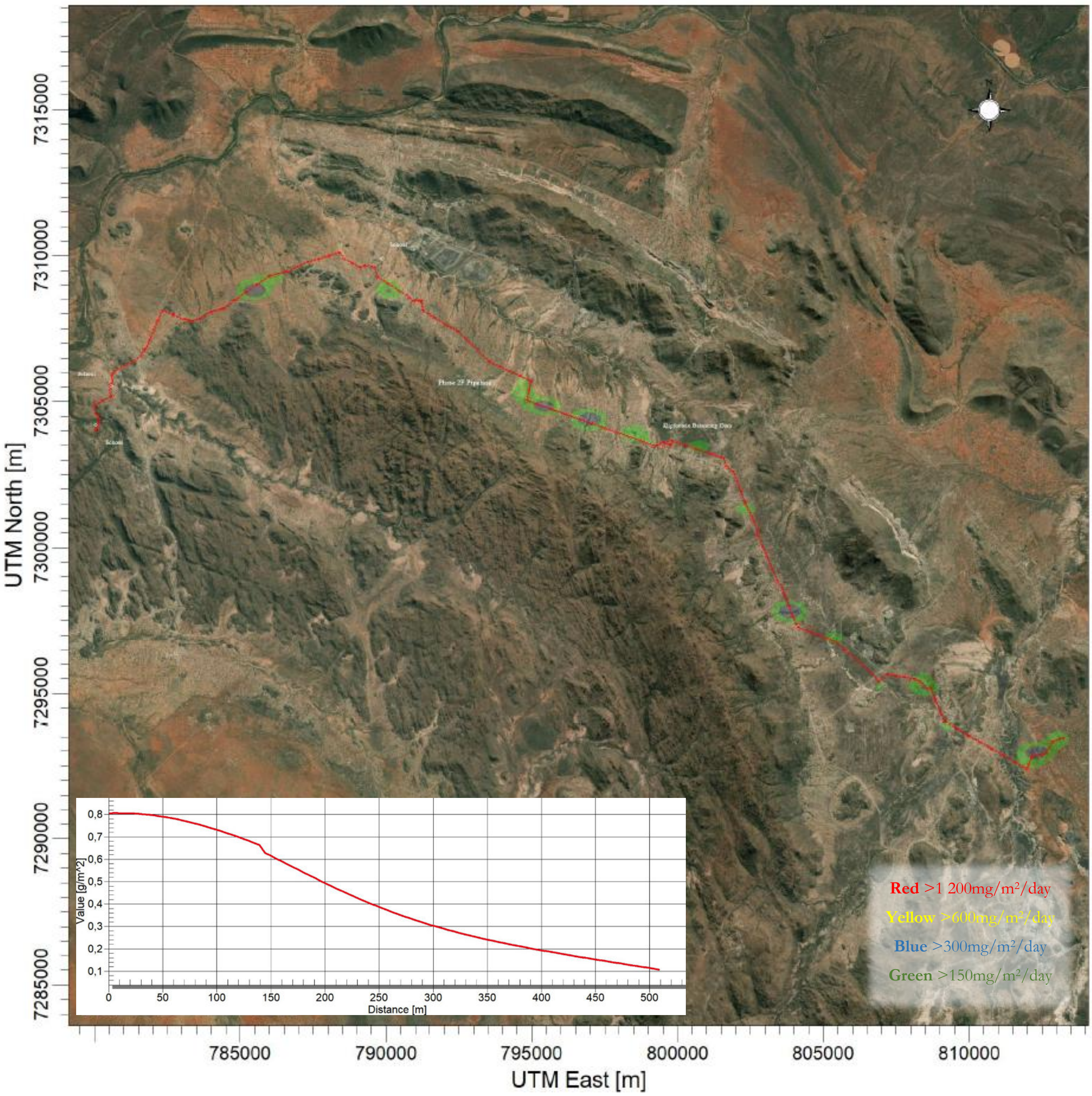

Figure 42: Daily Average Dust Deposition Rate – Construction

(Non-residential Standard – 1 200mg/m^2/day, Residential Standard – 600mg/m^2/day)

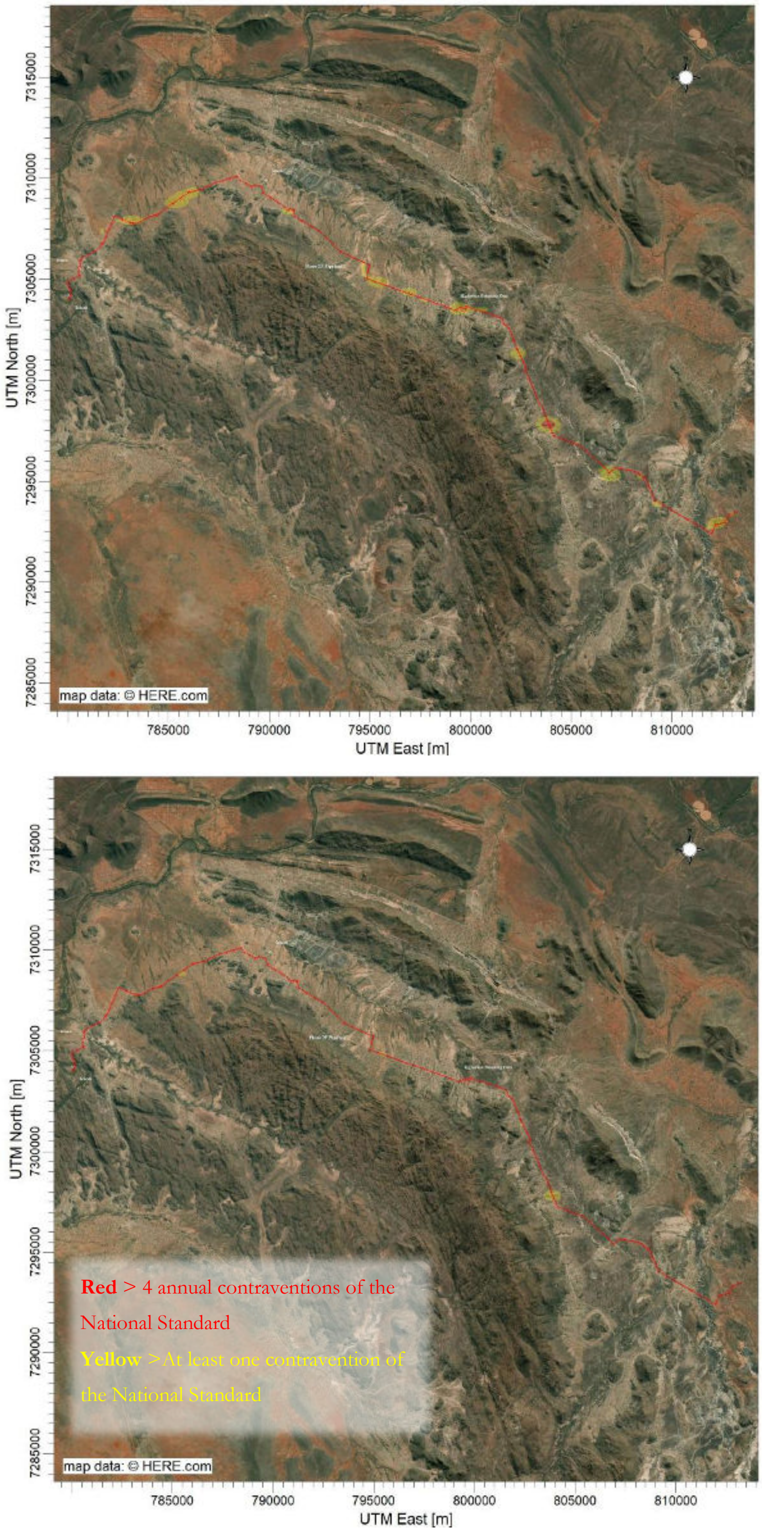

Figure 43: Daily Average PM_{10} Concentration – Construction (top) / Rehabilitation (Bottom) (South African National Standard - 75µg/m^3)

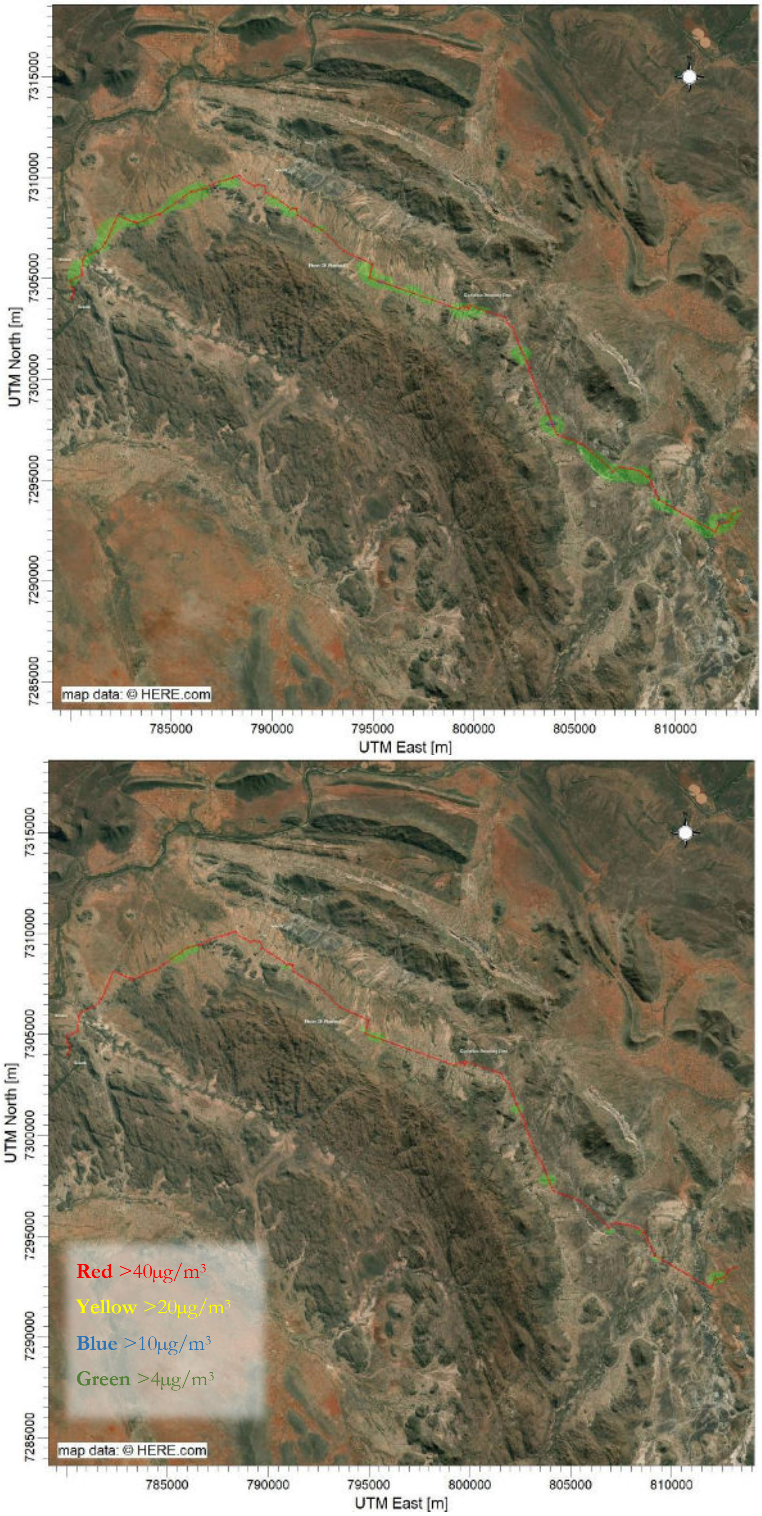

Figure 44: Annual Average PM_{10} Concentration – Construction (top) / Rehabilitation (Bottom) (South African National Standard - 75µg/m³)

4.3 SIGNIFICANCE ANALYIS

4.3.1 Significance Analysis Approach

The assessment of the significance of potential impact on ambient air quality was based on professional judgment, fieldwork and desktop analysis, as appropriate. Potential impacts were assessed using standardised and internationally recognised methodology adhering to International Organisation for Standardisations (ISO) 14001 for environmental management systems and World Bank/International Finance Corporation (IFC) requirements. For each predicted impact, criteria are applied to establish the significance of the impact based on likelihood and consequence firstly in the case of no mitigation and then with the most effective mitigation measure(s) in place.

The criteria that contribute to the consequence of the impact are intensity (the degree to which pre-development conditions are changed), duration (length of time that the impact will continue); and the extent (spatial scale) of the impact. The sensitivity of the receiving environment and/or sensitive receptors is incorporated into the consideration of consequence by appropriately adjusting the thresholds or scales of the intensity, duration and extent criteria, based on expert knowledge. For each impact, professional judgement is applied to ascribe a numerical rating for each criterion (see **Table 13** to **Table 15**). The consequence is then established using the formula:

Consequence = intensity x (duration + extent)

Table 13: Definition of Intensity Ratings

Rating	Criteria	
	Negative impacts (Type of impact = -1)	**Positive impacts (Type of impact = + 1)**
7	Complete destruction (irreversible and irreplaceable loss) of natural or social systems, resources (e.g. species) and human health. No chance of these processes or resources ever being restored to their pre-impact condition.	Noticeable, sustainable benefits that improve the quality and extent of natural or social system or resources, including formal protection.
6	Very high degree of damage to natural or social systems or resources. These processes or resources may restore to their pre-project condition over very long periods of time (more than a typical human lifetime).	Great improvement to ecosystem or social processes and services or resources.
5	Serious damage to components of natural or social systems or resources and the contravention of legislated standards.	On-going and widespread benefits to natural or social systems or resources.
4	High degree damage to natural or social system components, species or resources.	Average to intense positive benefits for natural or social systems or resources.
3	Moderate damage to natural or social system components, species or resources.	Average, on-going positive benefits for natural or social systems or resources.
2	Minor damage to natural or social system components, species or resources. Likely to recover over time. Ecosystems and valuable social processes not affected.	Low positive impacts on natural or social systems or resources.
1	Negligible damage to individual components of natural or social systems or resources, such that it is hardly noticeable.	Limited low-level benefits to natural or social systems or resources.

Table 14: Definition of Duration Ratings

Rating	Criteria
7	**Permanent:** The impact will remain indefinitely
6	**Beyond project life**: The impact will remain for some time after the life of the project.
5	**Project life:** The impact will cease after the operational life span of the project
4	**Long-term**: The impact will continue for 6-15 years.
3	**Medium-term:** The impact will continue for 2-5 years.
2	**Short-term:** The impact will continue for between 1 month and 2 years.
1	**Immediate**: The impact will continue for less than 1 month.

Table 15: Definition of Extent Ratings

Rating	Criteria
7	**International:** The effect will occur across international borders.
6	**National:** The impact will affect the entire country.
5	**Province/ Region:** The impact will affect the entire province or region
4	**Municipal Area:** The impact will affect the whole municipal area.
3	**Local:** The impact will extend across the site and to nearby properties.
2	**Limited:** The impact will be limited to the site.
1	**Very limited:** The impact will be limited to the footprint of the development and will not extend to the boundaries of the site.

Depending on the numerical result, the impact's consequence would be defined as either extremely, highly, moderately or slightly detrimental; or neutral; or slightly, moderately, highly or extremely beneficial. These categories are provided in **Table 16**.

Table 16: Application of Consequence Ratings.

Range		Consequence Rating
-21	-18	Extremely detrimental
-17	-14	Highly detrimental
-13	-10	Moderately detrimental
-9	-6	Slightly detrimental
-5	5	Negligible
6	9	Slightly beneficial
10	13	Moderately beneficial
14	17	Highly beneficial
18	21	Extremely beneficial

To determine the significance of an impact, the probability (or likelihood) of that impact occurring is also considered. In assigning probability, the likelihood of occurrence and cognisance of uncertainty and detectability of the impact is taken into consideration. The most suitable numerical rating for probability is selected from **Table 17** and applied with the consequence according to the following equation:

Significance = consequence x probability

Table 17: Definition of Probability Ratings.

Rating	Criteria
7	**Certain/ Definite:** There are sound scientific reasons to expect that the impact will definitely occur.
6	**Almost certain/Highly probable:** It is most likely that the impact will occur.
5	**Likely:** This impact has occurred numerous times here or elsewhere in a similar environment and with a similar type of development and could very conceivably occur.
4	**Probable:** This impact has occurred here or elsewhere in a similar environment and with a similar type of development and could conceivably occur.
3	**Unlikely:** This impact has not happened yet but could happen.
2	**Rare/ improbable:** The impact is conceivable, but only in extreme circumstances. The possibility of the impact manifesting is very low because of design, experience or implementation of adequate mitigation measures.
1	**Highly unlikely/None:** The impact is expected never to happen or has a very low chance of occurring.

When assigning probability to an impact, it is vitally important to distinguish this from the concepts of frequency and confidence:

- **Probability** refers to the likelihood that an impact will occur.
- **Frequency** refers to the regularity with which an impact occurs.
- **Confidence** (**Table 19**) refers to the degree of certainty of a prediction. Confidence may be related to any of the impact assessment criteria (extent, intensity, duration or probability) and is not necessarily only related to probability. Confidence may be influenced by any factors that introduce uncertainty into a prediction.

Depending on the numerical result of this calculation, the impact would fall into a significance category of negligible, minor, moderate or major, and the type would be either positive or negative. Once the significance of an impact occurring without mitigation has been established, ratings are assigned for the same impact after the proposed mitigation has been implemented.

Table 18: Application of Significance Ratings.

Range		Significance Rating	Action
-147	-109	Major - negative	Impact elimination since no cost-effective mitigation options are available to reduce the impact to the level of administrative control.
-108	-73	Moderate - negative	Substitution measures required to reduce impact to the level of administrative control.
-72	-36	Minor - negative	Engineering measures required to reduce impact to the level of administrative control.
-35	-1	Negligible - negative	Mitigation through administrative control and best industry practise.
0	0	Neutral	Additional mitigation to the point where the impact becomes beneficial.
1	35	Negligible - positive	Continuous improvement.
36	72	Minor - positive	Continuous improvement.
73	108	Moderate - positive	Continuous improvement.
109	147	Major - positive	Continuous improvement.

Despite attempts at ensuring objectivity and impartiality, environmental assessment remains an act of judgement and can never escape the subjectivity inherent in attempting to define significance. The determination of the significance of an impact depends on context (spatial and duration) and intensity of that impact. Since the rationalisation of context and intensity will ultimately be prejudiced by the observer, there can be no wholly objective measure by which to judge the components of significance, let alone how they are integrated into a single comparable measure.

This notwithstanding, to facilitate informed decision-making, air quality assessment must endeavour to come to terms with the impact significance.

Recognising this, EHRCON has attempted to address potential subjectivity for the current study as follows:

- Being explicit about the difficulty of being completely objective in the determination of significance, as outlined above.
- Developing an explicit methodology for assigning significance to impacts and outlining this methodology in detail. Having an explicit methodology not only forces the specialist to come to terms with the various facets that contribute to significance (thereby avoiding arbitrary assessment), but also provides the reader with a clear summary of how the specialist derived the significance.
- Wherever possible, differentiating between the significance of potential environmental impacts as experienced by the various affected parties.
- Utilising a team approach and internal review of the assessment to facilitate a rigorous and defendable system.

Although these measures may not eliminate subjectivity, they provide an explicit context within which to review the assessment of impacts. EHRCON has empirical knowledge of ambient air quality management and can comment on the confidence its findings based on the availability of data and the certainty of their findings (see **Table 19**).

Table 19: Definition of Confidence Ratings

Rating	Criteria
Low	Judgement is based on intuition and there some major assumptions used in assessing the impact may prove to be untrue.
Medium	Determination is based on common sense and general knowledge. The assumptions made, whilst having a degree of uncertainty, are fairly robust.
High	Substantive supportive data or evidence exists to verify the assessment.

4.3.2 Significance Analysis Assessment

An impact can be defined as any change in the physical-chemical, biological, cultural and/or socio-economic environmental system that can be attributed to human activities related to alternatives under study for meeting a project need.

Table 20: Phase 2F Particulate Emissions Significance Analysis

Item/Receptor	Impact of particulate emissions	Consequence Intensity + Duration + Extent				Significance Consequence x Probability			Motivation
		Intensity	Duration	Extent	Rating	Consequence	Probability	Rating	
CONSTRUCTION									Negligible to moderate damage to natural or social systems or resources. Impact could continue for less than 2 years. The impact could extend across the site and to nearby properties. Mitigation through administrative control and best industry practise (see Section 5.2). Residual impact at background levels. High assessment confidence.
1.	<250m	3	2	3	Slight	8	4	Negligible	
2.	250 to 500m	3	2	3	Slight	8	4	Negligible	
3.	>500m	1	2	3	Slight	6	4	Negligible	
REHABILITATION									
4.	<250m	2	2	3	Slight	7	4	Negligible	
5.	250 to 500m	2	2	3	Slight	7	4	Negligible	
6.	>500m	1	2	3	Negligible	5	4	Negligible	
OPERATION									
7.	<250m	1	2	2	Negligible	5	4	Negligible	

Table 21: Phase 2F Gaseous Emissions Significance Analysis

Item/Receptor	Impact of gaseous emissions	Consequence Intensity + Duration + Extent				Significance Consequence x Probability			Motivation
		Intensity	Duration	Extent	Rating	Consequence	Probability	Rating	
CONSTRUCTION, REHABILITATION & OPERATION									
1.	<250m	1	2	2	Negligible	5	4	Negligible	Negligible damage to natural or social systems or resources. Impact could continue for less than 2 years. The impact could extend across the site and to nearby properties Mitigation through administrative control and best industry practise (see Section 5.2). Residual impact at background levels. High assessment confidence.

In support of an emission reduction strategy, the OMMP-BRWSP must confirm or, where necessary revise, the current understanding of the significance of specific pollutants and sources. To fulfil this objective, emissions were ranked based on the emissions inventory and the impact significance analysis.

From the emissions inventory the following observations can be made:

- A total emission rate of 226.41 g/s was calculated for Phase 2F.

- Construction emissions will most possibly be the largest source of ambient pollution (87.4%), followed by rehabilitation (12.4%) and operations (0.2%).
- Particulate matter comprises approximately 98.4 % of the pollution load. PM_{10} is the criteria pollutant of concern and contributes about 27.4% of the pollution load. Total suspended particulates and $PM_{2.5}$ contribute 68.3% and 2.7% respectively.

From the impact significance analysis, the following observations can be made:

- The incremental impact of all pollutants during construction, rehabilitation and operations are expected to be negligible. Current industry standard techniques should be maintained and supplemented with administrative control measures to maintain the residual impact at the nearest sensitive receivers at current background levels.

5. EPILOGUE

5.1 AIR QUALITY MANAGEMENT APPROACH

OMMP-BRWSP's vision and policy on air quality management should essentially reflect the vision, principles and approach defined in the National Air Quality Management Plan (NAQMP). This includes a commitment to:

- Establishing goals and strategies for air quality improvement.
- The establishment and continued implementation of a comprehensive air quality monitoring and management system.
- Involving and educating people with the purpose of minimising pollution and facilitating the effective participation in air quality governance.
- Making greater use of innovative approaches to reducing pollution.
- Effectively using new information technologies.
- Responding creatively and vigorously to air quality challenges and emerging issues.

A shift from end-of-pipe air pollution control through the exclusive implementation of command-and-control measures to effects-based air quality management using proactive, flexible, varied and fair measures should be supported at all times.

The key approaches that are to be implemented to achieve policy objectives may be individually listed as follows:

- Adoption of a receiving environment approach which requires conformance to air quality standards. The standards define what constitutes satisfactory air quality to ensure human health and welfare, the protection of the natural and build environment, and finally the prevention of significant decline.
- Establishment of a sound technical basis for air quality management and planning. This would include the building of technical expertise and the development and implementation of various tools such as an emissions inventory, a meteorological and air pollution monitoring network, atmospheric dispersion model, impact assessment methodologies et cetera.
- Control and management of all significant sources of air pollution relative to their contributions to ambient air pollutant concentrations. This will ensure that improvements in air quality are secured in the most timely, even-handed and cost-effective manner.
- The integration of a wide range of emission reduction measures is required given the complexity of the process and the diversity of the receiving environment. Such approach will ensure innovative and flexible plans of action tailored to suit the specific source in the local circumstances.
- Identification and implementation of emission reduction measures that are: (i) environmentally beneficial taking all media into account, (ii) technically feasible, (iii) economically viable, and (iv) socially and politically acceptable.
- Provision will be made for the integration of air quality issues into the local community planning process to ensure that air quality issues are addressed in the long term.
- Empowerment of communities by providing easy access to ambient air quality information, including information on air pollution concentrations and environmentally harmful practices.
- Facilitation of public consultation and encouragement of public participation in the air quality management and planning process.

An air quality management plan cannot be successfully implemented and revised in the absence of an effective air quality management system. OMMP-BRWSP must therefore have as a key focus the establishment and support of such a system. Air quality guidelines represent one important air quality management 'tool'.

Such guidelines need to comprise, as a minimum, guideline or limit values and permissible timeframes for bringing air quality into compliance with such values. Other essential tools in any air quality management system are emissions inventory, air quality and meteorological monitoring and atmospheric dispersion modelling (**Figure 45**).

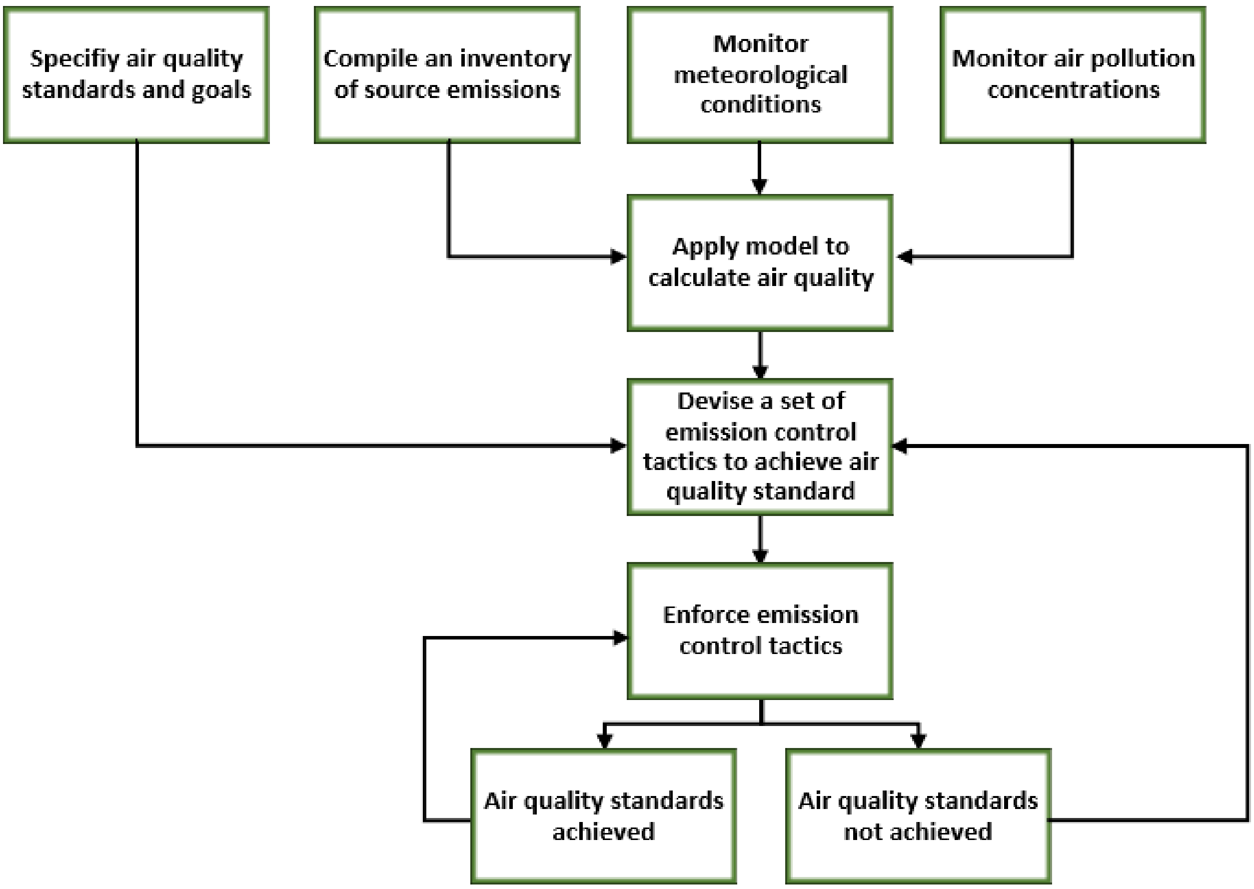

Figure 45: Air Quality Management Strategy

Based on a comprehensive emissions inventory, the application of monitoring, in combination with modelling, facilitates the effective characterisation of spatial and temporal variations in air pollutant concentrations. Such concentrations are evaluated based on local guideline values to determine the need for devising emission control strategies. Dispersion modelling is used to predict ambient air pollutant reductions possible through the implementation of specific emission control strategies. Emission control strategies may then be selected which are able to ensure compliance with the local guideline value, the socioeconomic acceptability and technological feasibility of such strategies having been assessed.

The control measures selected need to be enforced, and if the standards are achieved, they need continued enforcement. If the standards are not achieved after a reasonable period of time (i.e. within the permissible timeframe stipulated), the emission control measures may need to be revised.

An integrated air quality management system, which comprises components such as an emissions inventory and air quality monitoring and modelling, therefore, forms the basis of effective air pollution control and air quality management.

Air quality management components currently implemented by OMMP-BRWSP include the following:

- Emissions inventory.
- Atmospheric dispersion modelling.
- Public liaison and consultation mechanisms.

Based on the outputs of the air quality management system, health risk assessments and damage assessments could be undertaken and future impacts quantified in the medium-term (3 to 5 years). Such assessment could be undertaken in the following ways: (i) in-house, through the selection and acquisition of suitable models and acquisition and preparation of locally derived input data, (ii) in-house, though the application of manual calculations based on locally derived data and international protocols, or (iii) externally, through the appointment of consultants on a project-by-project basis.

5.2 RECOMMENDATIONS

5.2.1 Administrative Measures

According to the South African National Standard (SANS) 1929:2011 Ambient Air Quality – Limits for Common Pollutants, the concentrations of specific pollutants within an area shall be evaluated against the following thresholds to determine applicable assessment methods:

- Upper assessment threshold, i.e. the 99th percentile pollutant levels represent a pollutant value exceeding 70% of a limit value (considering limit values for all periods which have been used to derive averages).
- Lower assessment threshold, i.e. the 99th percentile pollutant levels represent a pollutant value below 50% of all limit values (considering limit values for all periods which have been used to derive averages).

Provision should be made for three air pollutant concentration assessment methods, based on the classification pollutant concentrations relative to the upper and lower assessment thresholds. These methods are:

- Mandatory monitoring, which may be supplemented by modelling techniques to provide an adequate level of information on ambient air quality. This method should be implemented where the upper assessment threshold for a specific pollutant is exceeded.
- A combination of measurement and modelling techniques should be implemented in areas and for pollutants for which concentrations are between the upper and lower assessment thresholds.
- The sole use of modelling or objective estimation techniques is permissible for pollutant concentrations below the lower assessment threshold.

The classification to determine applicable assessment methods should be based on air pollutant concentrations recorded during the previous five years where data is available.

Results from measurement campaigns of short duration during the period of a year and at locations likely to be typical of the highest pollution levels may be combined with information from emission inventories and modelling to provide the concentration data required. Classification should be reviewed earlier than every five years in the event of significant changes in activities relevant to ambient air pollutant concentrations.

In view of the predicted ambient pollutant concentrations resulting from emissions from the Phase 2F project, the following is recommended:

- Ambient monitoring in combination with modelling and emission inventory to assess the effectiveness of control measures at source and receivers, on an annual basis.

The ultimate purpose of monitoring is not merely to collect data, but to provide information necessary to make informed decisions on managing and improving the environment. Monitoring fulfils a central role in this process, providing the necessary sound scientific basis for policy and strategy development, objective setting, compliance measurement against targets and enforcement action.

However, the limitations of monitoring should be recognised. In many circumstances, measurements alone may be insufficient, or impractical for the purpose of fully defining population exposure. No monitoring programme, however well-funded and designed, can hope to comprehensively quantify patterns of air pollution in both space and time.

At best monitoring provides an incomplete, but useful, picture of current environmental air quality. Monitoring often needs to be used in conjunction with other objective assessment techniques, including modelling, emission measurement and inventories, interpolation and mapping.

The recommended performance assessment and reporting programme for continued dustfall monitoring during the Phase 2F project are provided in **Table 22**.

Table 22: Dustfall Monitoring Reporting Programme

Criteria	Dustfall Monitoring
Monitoring objectives	Assessment of compliance with dustfall limits within the main impact zone of the project. Facilitate the measurement of progress against environmental targets within the main impact zone of the operation. Temporal trend analysis to determine the potential for nuisance impacts within the main impact zone of the operation. Tracking of progress due to pollution control measure implementation within the main impact zone of the project. Informing the public of the extent of localised dust nuisance impacts occurring in the vicinity of the operation.
Monitoring location(s)	Four (4) single buckets should be installed around the Klipfontein Balancing Dam site and at least one (1) single bucket should be installed per km of the alignment. The following factors can severely affect the validity of data from a monitoring site: • Sites with restricted air flows in the vicinity of the monitor: Sites should not be adjacent to walls, buildings or trees that impede or distort the air flow. In general, the site should be in an open area, free of structures higher than 1 m within a 20 m radius of the gauge. • Obstacles between source to be monitored and the gauge. • Local sources of pollution and extraneous contamination that can affect the gauge. • Accessibility and security from vandalism are major considerations in the selection of a site.
Sampling techniques	Single bucket dust gauges measure the fallout of windblown settleable dust. Instruments to be deployed in accordance with ASTM D1739.
Accuracy of sampling technique	Margin of accuracy given as ±200 $mg/m^2/day$.
Sampling frequency and duration	On-going, continuous monitoring to be implemented facilitating data collection over 30-day averaging period. Monitoring may be suspended after the first six months of operation.
Commitment to QA/QC protocol	Comprehensive QA/QC protocol implemented.
Interim environmental targets (i.e. receptor-based performance indicator)	Relevant dust deposition standards not to be exceeded more than twice per annum and not in consecutive months.
Frequency of reviewing environmental targets	Annually (or may be triggered by changes in air quality regulations).
Action to be taken if targets are not met	Source apportionment and review of standard control measures and implementation of contingency measures where applicable.

Criteria	Dustfall Monitoring
Procedure to be followed in reviewing environmental targets and other elements of the monitoring strategy (e.g. sampling technique, duration, procedure)	Procedure to be drafted in liaison with interested parties considering: (i) trends in local and international ambient particulate guidelines and standards and/or compliance monitoring requirements, (ii) best practice regarding monitoring methods, (iii) current trends in local air quality, i.e. is there an improvement or deterioration, (iv) future development plans within the air shed (etc.)
Progress reporting	At least annually to the necessary authorities.

5.2.1 Best Available Industry Techniques

Fugitive Emissions from Unpaved Surfaces

Unpaved roads will most possibly be significant sources of dust emissions. Three types of measures may be taken to reduce emissions from unpaved roads:

- Measured aimed at reducing the extend of unpaved roads such as paving. Permanent improvements in road surfaces results in continuous control efficiencies
- Traffic control measures aimed at reducing the entrainment of material by restricting traffic volumes and reducing vehicle speeds.
- Measures aimed at binding the surface material or enhancing moisture retention, such as wet suppression and chemical stabilisation. The control efficiencies obtained by wet suppression and chemical stabilisation are cyclic. As efficiency decays over time, periodic re-application is required.

Fugitive Emissions from Paved Surfaces

The following measures are aimed at reducing fugitive dust emissions from paved surfaces:

- Construction integrity of all paved areas should be regularly inspected and frequently repaired if required.
- Set an acceptable speed limit for all onsite vehicles (30 kilometres per hour for construction vehicles and 40 kilometres per hour for light and passenger vehicles).

- Minimise travelling distance and unnecessary traffic.
- Measures which entail periodic removal of deposited material, i.e. broom and vacuum sweeping, may also be adopted to reduce dust generation.

5.3 KEY FINDINGS

The air quality impact study concludes the following:

- The process falls within the Fetakgomo Tubatse Local Municipality, within the SDM and Lepelle Nkumpi Local Municipality, within the CDM of the Limpopo Province.
- Ambient monitoring data from the SDM Dilokong Hospital station and Anglo Platinum South Farm station was included in the study.
- A total emission rate of 226.41 g/s was calculated for Phase 2F.
- Construction emissions will most possibly be the largest source of ambient pollution (87.4%), followed by rehabilitation (12.4%) and operations (0.2%).
- Particulate matter comprises approximately 98.4 % of the pollution load. PM_{10} is the criteria pollutant of concern and contributes about 27.4% of the pollution load. Total suspended particulates and $PM_{2.5}$ contribute 68.3% and 2.7% respectively.
- Dispersion of emissions from the process was modelled using the ISC-AERMOD View model based on the standard Gaussian solution.
- The results present the spectrum from maximum ground level concentration to maximum impact area, and accounts for annual averages.
- Ground level concentrations were predicted for atmospheric conditions based on local meteorological data for the period 1 July 2023 to 30 June 2024.
- Winds are mostly from the north easterly sector 45.1%. Calm periods are the exception (2.8%) and wind speeds are mostly light, between 0.5 and 2.1 m/s (45.6%). Moderate winds between 2.1 and 3.6 m/s occur 27.3% and brisk winds above 3.6 m/s, 17%. Strong winds above 5.7 m/s occur 7.3%.

- Maximum deposition rates around the Klipfontein Balancing Dam is expected to exceed the residential standard of 600 mg/m^2/day up to maximum distance of 250 m from the centre of construction operations. It is unlikely that deposition rates will exceed current background levels beyond 150 m from the construction alignment. The impact of dust deposition during rehabilitation and operation are not significant.
- Contravention of the daily average PM_{10} standard may exceed the allowable number of four per annum around the Klipfontein Balancing Dam, up to a distance of 500 m during construction and up to distance of 250 m during rehabilitation. Further contraventions of the daily standard will most likely occur infrequently along the alignment.
- Annual average PM_{10} concentrations are expected to be insignificant (i.e. <50% of the standard) throughout the life of the project.
- The incremental impact of all pollutants during construction, rehabilitation and operations are expected to be negligible. Current industry standard techniques should be maintained and supplemented with administrative control measures to maintain the residual impact at the nearest sensitive receivers at current background levels.
- Ambient monitoring should be used in combination with modelling and emission inventory to assess the effectiveness of control measures at source and receivers, on an annual basis.
- Monitoring of ambient air quality will assist effective air quality management and open communication to all stakeholders.

5.4 ABBREVIATIONS

AQIS	:	Air quality impact study
AQMP	:	Air quality management plan
ºC	:	Degree Celsius
CH_4	:	Methane
CO	:	Carbon monoxide
CO_2	:	Carbon dioxide
DFFE	:	Department of Forestry, Fisheries and the Environment
EIA	:	Environmental impact assessment
EMP	:	Environmental management programme
H_2S	:	Hydrogen sulphide
IFC	:	International Finance Corporation
km	:	Kilometre
km/h	:	Kilometre per hour
mg	:	Milligrams
$mg/m^2/day$	:	Milligrams per square metre per day
mm	:	Millimetres
Nm^3/h	:	Normal cubic metres per hour
m/s	:	Meters per second
NAAQS	:	National Ambient Air Quality Standards
NEMAQA	:	National Environmental Management: Air Quality Act (Act no. 39 of 2004)
NO	:	Nitrogen oxide
NO_2	:	Nitrogen dioxide

NO_x	:	Oxides of nitrogen
NPI	:	National Pollutant Inventory
O_3	:	Ozone
Pb	:	Lead
$PM_{2.5}$	:	Inhalable particulate matter with a mean aerodynamic diameter less than 2.5 micrometre
PM_{10}	:	Inhalable particulate matter with a mean aerodynamic diameter less than 10 micrometre
RfC	:	Inhalation Reference Concentration
REL	:	Recommended Exposure Limit
SANS	:	South African National Standards
SO_2	:	Sulphur dioxide
TSP	:	Total Suspended Particulates
µg	:	Microgram
$\mu g/m^3$	:	Microgram per cubic metre
US-EPA	:	United States Environmental Protection Agency
VOCs	:	Volatile organic compounds
WHO	:	World Health Organisation

5.5 GLOSSARY

Act means the National Environmental Management: Air Quality Act, 2004 (Act No.39 of 2004).

Air pollution means any change in the composition of the air caused by smoke, soot, dust (including fly ash), cinders, solid particles of any kind, gases, fumes, aerosols and odorous substances.

Air quality management plan means a plan referred to in section 15 of the **Act**.

Air quality officer means an officer appointed in terms of section 14 of the **Act**.

Air-shed means a geographical area that are defined according to topographical, meteorological, political or other criteria to address air quality issues that are common to the area.

Alternative fuels and resources mean general and hazardous wastes which are used to substitute conventional or primary fossil fuels and/or virgin raw materials in cement kilns and other industrial thermal processes.

Ambient air means environmental air excluding indoor air and air regulated by the Occupational Health and Safety Act, 1993 (Act No. 85 of 1993).

Ambient air quality standards are values that define targets for air quality management and establish the permissible amount or concentration of a particular substance in or property of discharges to air based on what a particular receiving environment can tolerate without significant deterioration.

Atmospheric emission or **emission** means any emission or entrainment process emanating from a point, non-point or mobile source that results in air pollution.

Atmospheric emission license means an atmospheric emission license contemplated in Chapter 5 of the **Act**.

ASTM D1739 means the American Standard for Testing and Materials method D1739, which is the standard test method for the collection and measurement of dust fall.

Averaging period means a period over which an average value is determined.

Baseline air quality assessment means a compilation of existing or current data and knowledge on air quality in a particular area. It forms an essential input into the subsequent formulation of the air quality management plan. It comprises an assessment of the current ambient air quality status; an assessment of current organisational structures for air quality management; and an assessment of current air quality initiatives to reduce air pollution.

Biomass means non fossilised and biodegradable organic material originating from plants, animals and micro-organisms excluding (a) sewage; and (b) treated or coated wood waste which may contain halogenated organic compounds or heavy metals.

Boundary layer in terms of the earth's planetary boundary layer means the air layer near the ground affected by diurnal heat, moisture or momentum to or from the surface.

Continuous sampling means ambient air quality sampling conducted by drawing air into sampling equipment with real time analysis of concentrations using accepted reference methods. Measurement and recording are done in a continuous manner.

Cost-benefit analysis means the process that involves weighing the total accepted costs against the total expected benefits to choose the best option.

Controlled emitter means any appliance or activity declared as a controlled emitter in terms of Section 23 of the **Act**.

Compliance date means the date on which compliance with the standard is required.

Design capacity means capacity as installed.

Dispersion modelling means a computer-based model that simulates the dispersion or movement of pollutants in the atmosphere based on a set of equations that are determined by the meteorological conditions of the atmosphere. The output is a set of predicted values of a pollutant for a defined location and time period.

Dispersion potential means the potential a pollutant has of being transported from the source of emission by wind or upward diffusion. Dispersion potential is determined by wind velocity, wind direction, height of the mixing layer, atmospheric stability, presence of inversion layers and various other meteorological conditions.

Dust means solid materials suspended in the atmosphere in the form of small irregular particles, many of which are microscopic in size.

Dust (or settleable particulate matter) means any material composed of particles small enough to pass through a 1 mm screen and large enough to settle by virtue of their weight into the sampling container from the ambient air.

Dustfall means the deposition of dust.

Dustfall monitoring programme means monitoring of the dustfall on a continuous basis.

Emission means pollution discharged into the atmosphere from a range of stationary and mobile sources. These include smokestacks, vents and surface areas of commercial or industrial facilities; residential sources; motor vehicles and other transport related sources.

Emission control technology means technology that aims to reduce emissions into the atmosphere.

Emission inventory means a listing or register of the amount of pollution entering the atmosphere from all sources within a given time and geographic boundaries.

Emission rate means the rate at which a pollutant is emitted from a source of pollution.

Emission factor means a representative value, relating the quantity of a pollutant to a specific activity resulting in the release of the pollutant to atmosphere.

Emission reduction strategy means an intervention designed to reduce emissions into the atmosphere.

Emission standard means a specific limit to the amount of pollutant that can be released to the atmosphere by a specified source.

Environment means the surroundings within which humans exist and that are made up of (i) the land, water and atmosphere of the earth; (ii) micro-organisms, plant and animal life; (iii) any part or combination of (i) and (ii) and the interrelationships among and between them; and (iv) the physical, chemical, aesthetic and cultural properties and conditions of the foregoing that influence human health and well-being.

Environmental management systems mean a part of the management system of an organisation in which specific competencies, behaviours, procedures and demands for the implementation of an environment policy are defined.

Exceedance means a situation in which a measured ambient air quality concentration (or emission rate) of a particular pollutant exceeds the ambient air quality guideline or standard (or emission limit) for that pollutant. Exceedances are normally expressed as a total number per time period and give an indication of the severity of the air pollution problem.

Existing plant unless where specified, shall mean any plant or process that was legally authorised to operate before 01 April 2010 or any plant where an application for authorisation in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), was made before 01 April 2010.

Frequency of exceedance means a frequency (number/time) related to a limit value representing the tolerated exceedance of that limit value, i.e. if exceedances of limit value are within the tolerances, then there is still compliance with the standard. This exceedance is applicable to a calendar year.

Fugitive emissions mean emissions that are difficult to identify and quantify, such as gases that "escape" from badly managed or maintained processes, e.g. leak in pipes.

Greenhouse gas means gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and re-emit infrared radiation, and includes carbon dioxide, methane and nitrous oxide.

Incineration means any method, technique or process to convert waste to flue gases and residues by means of oxidation.

Inversion means an increase of atmospheric temperature with an increase in height.

Licensing authority means an authority referred to in sections 36(1), (2), (3) or (4) responsible for implementing the licensing system set out in Chapter 5 of the **Act**.

Listed activity means any activity listed in terms of Section 21 of the **Act**.

Mitigation measures mean attempt to prevent pollution or to reduce the effects of pollution that occur.

Mixing layer means the layer of air within which pollutants are mixed by turbulence. Mixing depth is the height of this layer from the earth's surface.

Mobile source means a single identifiable source of atmospheric emission which does not emanate from a fixed location.

Monitoring means periodic or continuous surveillance or testing to determine the level of compliance with statutory requirements and/or pollutant levels in various media or in humans, plants, and animals.

New plant unless where specified, shall mean any plant or process where the application for authorisation in terms of the National Environmental Management Act 1998, (Act No. 107 of 1998), was made on or after 01 April 2010.

Normal operating condition means any condition that constitutes operation as designed.

Non-point source means a source of atmospheric emissions which cannot be identified as having emanated from a single identifiable source or fixed location, and includes veld, forest and open fires, mining activities, agricultural activities and stockpiles.

Non- residential area means any area not classified for residential use as per local town planning scheme.

Offensive odour means any smell which is malodorous or a nuisance to a reasonable person.

Oxides of nitrogen (NO_X) means the sum of nitrogen oxide (NO) and nitrogen dioxide (NO_2) expressed as nitrogen dioxide (NO_2)

Particulate matter (PM) means total particulate matter, that is the solid matter contained in the gas stream in the solid state as well as the insoluble and soluble solid matter contained in entrained droplets in the gas stream. The collective name for fine solid or liquid particles added to the atmosphere by processes at the earth's surface and includes dust, smoke, soot, pollen and soil particles.

Passive sampling means air quality monitoring by means of exposure of the sampler to ambient air and adsorption of the pollution into the sampling medium. Sampling is over longer time periods and subsequent analysis is required to determine concentrations.

Point source means a single identifiable source and fixed location of atmospheric emission and includes smokestacks and residential chimneys.

Point of compliance means any point within the off gas line, where a sample can be taken, from the last vessel closest to the point source of an individual listed activity to the open end of the point source or in the case of a combinations of listed activities sharing a common point source, any point from the last vessel closest to the point source up to the point within the point source prior to the combination/interference from another Listed Activity.

Precipitation means ice particles or water droplets large enough to fall at least 100 m below the cloud base before evaporating.

Priority Area means an area declared as such in terms of Section 18 of the **Act**.

Priority pollutant means pollutants which, through ambient concentrations, bioaccumulation, deposition or in any other way, present a threat to health, well-being or the environment. Factors that may influence whether a pollutant is identified as such include: its toxicity; the volume of emissions; or the proximity of the emission relative to sensitive receptors.

Residential area means any area classified for residential use in terms of the local town planning scheme.

SANAS means the South African National Accreditation System established by Section 3 of the Accreditation for Conformity Assessment, Calibration and Good Laboratory Practice Act, 2006 (Act No. 19 of 2006).

Total volatile organic compounds mean organic compounds listed under US EPA Compendium Method TO-14.

Upset conditions means any temporary failure of air pollution control equipment or process equipment or failure of a process to operate in a normal or usual manner that leads to an emission standard being exceeded.

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forestry, fisheries
& the environment

Department:
Forestry, Fisheries and the Environment
REPUBLIC OF SOUTH AFRICA

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SPECIALIST DECLARATION FORM – AUGUST 2023

Specialist Declaration form for assessments undertaken for application for authorisation in terms of the National Environmental Management Act, Act No. 107 of 1998, as amended and the Environmental Impact Assessment (EIA) Regulations, 2014, as amended (the Regulations)

REPORT TITLE
Olifants Management Model Programme Bulk Raw Water Study Phase – Phase 2F

Kindly note the following:

1. This form must always be used for assessment that are in support of applications that must be subjected to Basic Assessment or Scoping & Environmental Impact Reporting, where this Department is the Competent Authority.
2. This form is current as of August 2023. It is the responsibility of the Applicant / Environmental Assessment Practitioner (EAP) to ascertain whether subsequent versions of the form have been published or produced by the Competent Authority. The latest available Departmental templates are available at https://www.dffe.gov.za/documents/forms.
3. An electronic copy of the signed declaration form must be appended to all Draft and Final Reports submitted to the department for consideration.
4. The specialist must be aware of and comply with '*the Procedures for the assessment and minimum criteria for reporting on identified environmental themes in terms of sections 24(5)(a) and (h) and 44 of the act, when applying for environmental authorisation - GN 320/2020)*', where applicable.

1. SPECIALIST INFORMATION

Title of Specialist Assessment	Air Quality Impact Study
Specialist Company Name	EHRCON (Pty) Ltd
Specialist Name	Mr Uno Neveling
Specialist Identity Number	7510185234086
Specialist Qualifications:	BSc. Hons & MSc. *Cum Laude*
Professional affiliation/registration:	Not applicable
Physical address:	180 Doreen Street, Colbyn, 0083
Postal address:	180 Doreen Street, Colbyn, 0083
Postal address	-
Telephone	-
Cell phone	082 825 5919
E-mail	uno@ehrcon.com

2. DECLARATION BY THE SPECIALIST

I, Uno Neveling declare that –

- I act as the independent specialist in this application;
- I am aware of the procedures and requirements for the assessment and minimum criteria for reporting on identified environmental themes in terms of sections 24(5)(a) and (h) and 44 of the National Environmental Management Act (NEMA), 1998, as amended, when applying for environmental authorisation which were promulgated in Government Notice No. 320 of 20 March 2020 (i.e. "the Protocols") and in Government Notice No. 1150 of 30 October 2020.
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing –
  - any decision to be taken with respect to the application by the competent authority; and;
  - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 48 and is punishable in terms of section 24F of the NEMA Act.

Signature of the Specialist

EHRCON (Pty) Ltd

Name of Company:

18 Nov 2024

Date

3. UNDERTAKING UNDER OATH/ AFFIRMATION

I, _ Uno Neveling_________, swear under oath / affirm that all the information submitted or to be submitted for the purposes of this application is true and correct.

Signature of the Specialist

EHRCON (Pty) Ltd

Name of Company

18 Nov 2024

Date

Click or tap here to enter text.

Signature of the Commissioner of Oaths

18 Nov 2024

Date

Ek sertifiseer hierdie dokument as 'n ware afskrif van die oorspronklike wat aan my vir waarneming voorgelê is. Ek sertifiseer dat volgens my waarnemings daar geen verandering is nie

I certify that this document is a true copy of the original document, which was handed to me for authentication. I certify further that, from my observation an amendment or change was not made to the document

18/11/24

STELLA ELIZABETH NEL Ex Officio Service Provider
COMMISSIONER OF OATH / KOMMISSARIS VAN EDE Ref no: 9/1/8/2 Pretoria
9 AUGUSTUS 2005 Tel: (012) 328 4455