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## **ATMOSPHERIC IMPACT REPORT: Kusasa Refining in Wadeville, Gauteng**

Project done on behalf of **Environmental Impact Management Services (Pty) Ltd**

**Project Compiled by:**  
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**Report No:** 25EIM18 | **Date:** March 2026



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## Report Details

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<b>Project Name</b>	Atmospheric Impact Report: Kusasa Refining in Wadeville, Gauteng
<b>Client</b>	Environmental Impact Management Services (Pty) Ltd
<b>Report Number</b>	25EIM18
<b>Report Version</b>	Rev 2
<b>Date</b>	March 2026
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## Revision Record

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<b>Revision Number</b>	<b>Date</b>	<b>Reason for Revision</b>
Draft	January 2026	First draft for client review.
Revision 1	February 2026	Addressed client comments.
Revision 2	March 2026	Comment regarding modelled stack heights. Inclusion of 2025 stack emissions measured data.

## List of Acronyms and Symbols

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AEL	Atmospheric Emission Licence
Ag	Silver
AIR	Atmospheric Impact Report
APCS	Air pollution control systems
Au	Gold
ATSDR	Agency for Toxic Substances and Disease Registry
°C	Degrees Celsius
CALEPA	California Environmental Protection Agency
Cl <sub>2</sub>	Chlorine
CO	Carbon monoxide
CO <sub>2</sub>	Carbon dioxide
CH <sub>4</sub>	Methane
DEA	Department of Environmental Affairs
DFFE	Department of Forestry, Fisheries and the Environment (previously known as the DEA)
EIMS	Environmental Impact Management Services (Pty) Ltd
EMM	Ekurhuleni Metropolitan Municipality
HCl	Hydrogen chloride
HF	Hydrogen fluoride
HPA	Highveld Priority Area
H <sub>2</sub> S	Hydrogen sulfide
IRIS	Integrated Risk Information System
m/s	Meters per second
MES	Minimum Emission Standards
MRLs	Minimum risk levels
NAAQS	National Ambient Air Quality Standards
NEM:AQA	National Environmental Management: Air Quality Act, 2004
NH <sub>3</sub>	Ammonia
NO <sub>x</sub>	Oxides of nitrogen
NO <sub>2</sub>	Nitrogen dioxide
O <sub>3</sub>	Ozone
OEHHA	Office of Environmental Health Hazard Assessment
ORTIA	OR Tambo International Airport
PGMs	Platinum Group Metals
Pb	Lead
PM	Particulate matter or Precious metals
PM <sub>10</sub>	Particulate Matter with an aerodynamic diameter of less than 10µm
PM <sub>2.5</sub>	Particulate Matter with an aerodynamic diameter of less than 2.5µm
RAIS	Risk Assessment Information System
RELS	Reference exposure levels
RfCs	Inhalation reference concentrations
SAWS	South African Weather Service
SO <sub>2</sub>	Sulfur dioxide
TOC	Total organic compounds
US EPA	United States Environmental Protection Agency
VOCs	Volatile organic compounds
WHO	World Health Organisation

# Executive Summary

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## **Purpose**

Kusasa Refining (Pty) Ltd (previously EcoPackaging (Pty) Ltd), located in Wadeville, Gauteng, propose to expand their current refining plant by installing an additional processing line of equipment for Platinum Group Metals (PGMs). The existing operation at Kusasa is used for the refining of metallic precious metal bars, principally containing gold (Au) and silver (Ag). To date, PGMs were agglomerated only and resold as encountered, but economic opportunity exists for the additional refining of these PGMs, thus the motive to install the PGM processing line of equipment. Airshed Planning Professionals (Pty) Ltd was appointed by Environmental Impact Management Services (Pty) Ltd to compile an Atmospheric Impact Report (AIR) for the proposed expansion. Typically, an AIR would accompany the application for a variation to the atmospheric emission licence (AEL).

## **Air Emission License Requirement**

Air emissions from the project must comply with the Minimum Emission Standards (MES) applicable to new plants. The production or processing of precious and associated base metals through chemical treatment fall under *Subcategory 4.17: Precious and Base Metal Production and Refining*, as defined in *Section 21 of the National Environmental Management: Air Quality Act, 2004 (NEM:AQA)*. This subcategory applies to all installations and therefore requires an AEL. The facility currently has an AEL but plans to amend the licence to include the expansion activities.

## **Potential Air Emissions**

Emissions from the expansion process are expected to be similar to the current emissions and will make use of the same abatement control technology. MES applicable for the type of listed activity (as per Section 21 of the Air Quality Act) in preparation for the variation application for the AEL was used for the simulations.

## **Baseline Conditions**

Meteorological data from the South African Weather Service's (SAWS) OR Tambo International Airport (ORTIA), 14.3 km to the north-northeast of the facility, was acquired for the period 2020 to 2022. The wind regime for the area largely reflects the synoptic scale circulation with dominant north-westerly and northerly flow fields.

Baseline air quality in the vicinity of the project (conducted by Ekurhuleni Metropolitan Municipality (EMM) at the Thokoza station), for the period 2024, was available for sulfur dioxide (SO<sub>2</sub>) and particulate matter with an aerodynamic diameter of less than 10µm (PM<sub>10</sub>). No measurements of other compounds were available to serve as a baseline for the area. The availability of valid data from the EMM station over the 2024 period was average, with less than 75% available data. Analysis of the available valid data showed that exceedances of the hourly SO<sub>2</sub> National Ambient Air Quality (NAAQ) limit amounted to 4 during 2024. Ambient SO<sub>2</sub> values at Thokoza were compliant with National Ambient Air Quality Standards (NAAQS). Analysis of the available valid data showed that exceedances of the daily PM<sub>10</sub> NAAQ limit amounted to 164 during 2024. Ambient PM<sub>10</sub> values at Thokoza were non-compliant with NAAQS.

## **Predicted Air Quality Impacts**

The impact of the proposed project on ambient air quality was simulated using the US Environmental Protection Agency's (US-EPA) approved regulatory model – AERMOD. Simulated pollutant concentrations were compared against the NAAQS and international health screening criteria.

The ground level concentrations due to proposed project operations (assuming maximum allowable emissions according to the MES) was well within NAAQS and health effect screening levels at the closest sensitive receptors for all averaging periods, with the exception of simulated annual chlorine (Cl<sub>2</sub>) concentrations. Current stack measurements are well below the MES, so the actual impact is anticipated to be lower than these simulated results.

The significance rating due to maximum operation of the proposed project was medium-low for construction, operation and decommissioning phases.

### **Conclusions and Recommendations**

It is recommended that the proposed project go-ahead and that stack emissions be measured once the expansion has been completed in order to verify pollutants and emission concentrations from the process. The stack emissions must comply with the emission limits stipulated in the MES.

# Table of Contents

---

Preface.....	1
Background and Context.....	1
Purpose and Scope.....	1
Management of Uncertainties .....	2
1    Enterprise Details .....	3
1.1    Enterprise Details.....	3
1.2    Location and Extent of the Plant .....	3
1.3    Description of Surrounding Land Use (within 5 km radius) .....	4
1.4    Atmospheric Emission Licence and other Authorisations .....	4
2    Nature of the Process.....	5
2.1    Process Description .....	5
2.2    Listed Activities .....	6
2.3    Unit Processes .....	6
3    Technical Information.....	9
3.1    Raw Material Consumption Rates.....	9
3.2    Production Rates.....	10
3.3    Appliances and Abatement Equipment Control Technology.....	10
4    Atmospheric Emissions .....	11
4.1    Point Source Parameters .....	11
4.2    Point Source Maximum Emission Rates during Normal Operating Conditions.....	12
5    Impact of Enterprise on the Receiving Environment .....	13
5.1    Analysis of Emissions' Impact on Human Health.....	13
5.1.1    Approach and Methodology.....	13
5.1.2    Legal Requirements .....	14
5.1.3    Atmospheric Dispersion Potential.....	20
5.1.4    Measured Baseline Ambient Air Quality .....	25
5.1.5    Existing Sources of Emissions near the Proposed Project.....	28
5.1.6    Identification of Possible Sensitive Receptors in the Area .....	29
5.1.7    Screening of Human Health Impacts due to Operational Activity from the Project .....	30
5.1.8    Significance Rating.....	39
5.1.9    Main Findings and Recommendations .....	41
5.2    Analysis of Emissions' Impact on the Environment.....	41

6	Annexure A.....	42
7	Annexure B.....	43
8	References.....	44
	APPENDIX A: Impact Significance Rating Methodology.....	45
	APPENDIX B: Curriculum Vitae of Project Team.....	51

## List of Tables

---

Table 1-1: Enterprise details .....	3
Table 1-2: Contact details of responsible person.....	3
Table 1-3: Location and extent of the plant.....	3
Table 2-1: Listed activities at the project.....	6
Table 2-2: The unit processes for the project .....	6
Table 3-1: Raw materials used .....	9
Table 3-2: Production rates.....	10
Table 3-3: By-Product rates .....	10
Table 3-4: Abatement Equipment Control Technology used .....	10
Table 4-1: Point sources of atmospheric pollutant emissions at the proposed project .....	11
Table 4-2: Atmospheric pollutant emission rates for the project.....	12
Table 5-1: South African National Ambient Air Quality Standards.....	15
Table 5-2: Proposed non-carcinogenic exposure thresholds for pollutants of interest in the current study.....	16
Table 5-3: Listed Activity Subcategory 4.17.....	16
Table 5-4: Emission Reduction Activities for Industrial Sources.....	19
Table 5-5: Monthly temperature summary (ORTIA data, January 2020 to December 2022) .....	22
Table 5-6: Atmospheric stability classes.....	24
Table 5-7: Data availability from the EMM Thokoza ambient air quality monitoring station for the period 2024 .....	25
Table 5-8: Plots for the simulated impacts due to routine operations from the proposed project.....	30
Table 5-9: Simulated concentrations at the nearest sensitive receptor due to operations from the project .....	30
Table 5-10: MES versus stack measurements at Kusasa .....	31
Table 5-11: Significance rating for potential air quality impacts due to the project activities .....	40

## List of Figures

---

Figure 1-1: Location of proposed project .....	4
Figure 2-1: The current project flow diagram .....	7
Figure 2-2: The proposed project flow diagram .....	8
Figure 5-1: Period, day-, and night-time wind roses (SAWS ORTIA data, January 2020 to December 2022) .....	21
Figure 5-2: Seasonal wind roses (SAWS ORTIA data, January 2020 to December 2022) .....	22
Figure 5-3: Diurnal temperature profile (SAWS ORTIA data, January 2020 to December 2022) .....	23
Figure 5-4: Monthly rainfall for ORTIA (2020-2022) .....	23
Figure 5-5: Diurnal atmospheric stability (SAWS ORTIA data, 2020 to 2022) .....	25
Figure 5-6: AQMS in the project vicinity .....	26
Figure 5-7: Hourly ambient SO <sub>2</sub> concentrations at Thokoza during 2024 .....	26
Figure 5-8: Daily ambient SO <sub>2</sub> concentrations at Thokoza during 2024 .....	27
Figure 5-9: Daily ambient PM <sub>10</sub> concentrations at Thokoza during 2024 .....	27
Figure 5-10: Highest daily particulate concentrations due to routine operations from the project .....	31
Figure 5-11: Annual average particulate concentrations due to routine operations from the project .....	32
Figure 5-12: Highest hourly SO <sub>2</sub> concentrations due to routine operations from the project .....	32
Figure 5-13: Highest daily SO <sub>2</sub> concentrations due to routine operations from the project .....	33
Figure 5-14: Annual average SO <sub>2</sub> concentrations due to routine operations from the project .....	33
Figure 5-15: Highest hourly NO <sub>2</sub> concentrations due to routine operations from the project .....	34
Figure 5-16: Annual average NO <sub>2</sub> concentrations due to routine operations from the project .....	34
Figure 5-17: Highest hourly Cl <sub>2</sub> concentrations due to routine operations from the project .....	35
Figure 5-18: Annual average Cl <sub>2</sub> concentrations due to routine operations from the project .....	35
Figure 5-19: Highest hourly HCl concentrations due to routine operations from the project .....	36
Figure 5-20: Annual average HCl concentrations due to routine operations from the project .....	36
Figure 5-21: Highest hourly HF concentrations due to routine operations from the project .....	37
Figure 5-22: Annual average HF concentrations due to routine operations from the project .....	37
Figure 5-23: Highest hourly NH <sub>3</sub> concentrations due to routine operations from the project .....	38
Figure 5-24: Annual average NH <sub>3</sub> concentrations due to routine operations from the project .....	38

## Specialist Report Requirements, NEMA Regulation (2017), Appendix 6

<b>NEMA Regulations (2017) - Appendix 6</b>	<b>Relevant section in report</b>
Details of the specialist who prepared the report.	Report details (page i)
The expertise of that person to compile a specialist report including curriculum vitae.	Report details (page i) Appendix B
A declaration that the person is independent in a form as may be specified by the competent authority.	Report details (page i)
An indication of the scope of, and the purpose for which, the report was prepared.	Purpose and Scope (Page 1)
An indication of quality and age of base data used.	Section 5.1.4: Measured Baseline Ambient Air Quality
A description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change.	Section 5.1.4: Measured Baseline Ambient Air Quality Section 5.1.7: Screening of Human Health Impacts due to Operational Activity from the Project
The date and season of the site investigation and the relevance of the season to the outcome of the assessment.	A site investigation was undertaken. Description of the current land use in the region, simulations undertaken for the current operations and meteorological data used in the study are considered representative of all seasons. Section 5.1: Analysis of Emissions' Impact on Human Health
A description of the methodology adopted in preparing the report or carrying out the specialised process.	Section 5.1.1 – Approach and Methodology
The specific identified sensitivity of the site related to the activity and its associated structures and infrastructure.	Section 5.1.4: Measured Baseline Ambient Air Quality
An identification of any areas to be avoided, including buffers.	Section 5.1.7: Screening of Human Health Impacts due to Operational Activity from the Project
A map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers.	Section 5.1.7: Screening of Human Health Impacts due to Operational Activity from the Project
A description of any assumptions made and any uncertainties or gaps in knowledge.	Management of Uncertainties (Page 2)
A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment.	Section 5.1.9: Main Findings and Recommendations
Any mitigation measures for inclusion in the EMPr.	Section 5.1.9: Main Findings and Recommendations
Any conditions for inclusion in the environmental authorisation	Section 5.1.9: Main Findings and Recommendations
Any monitoring requirements for inclusion in the EMPr or environmental authorisation.	Section 5.1.9: Main Findings and Recommendations
A reasoned opinion as to whether the proposed activity or portions thereof should be authorised.	Section 5.1.9: Main Findings and Recommendations
If the opinion is that the proposed activity or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan.	Section 5.1.9: Main Findings and Recommendations
A description of any consultation process that was undertaken during the course of carrying out the study.	Not applicable.
A summary and copies of any comments that were received during any consultation process.	Not applicable.
Any other information requested by the competent authority.	Not applicable.

## PREFACE

### Background and Context

Kusasa Refining (Pty) Ltd (previously EcoPackaging (Pty) Ltd), located in Wadeville, Gauteng, propose to expand their current refining plant. The existing operation at Kusasa is used for the refining of metallic precious metal bars, principally containing gold (Au) and silver (Ag). To date, Platinum Group Metals (PGMs) were agglomerated only and resold as encountered, but economic opportunity exists for the additional refining of these PGMs, thus the motive to install the PGM processing line of equipment.

Infrastructure-wise the current enclosed facility can comfortably and securely house both the existing process equipment and the proposed ancillary PGM equipment. It should be noted that both the current and additional equipment lines use the same process, i.e. aqua regia refining and subsequent selective precipitation of the desired metals. The equipment installations are not exclusive to only Au/Ag or PGMs but serves to provide the technical flexibility needed via multiple mixer tank units as well as operational continuity through the provisioning of the titanium aqua regia reactor recently acquired. The PGMs also melt at higher temperatures than the typical Au-Ag-Cu bars historically processed, so an induction melter that can accommodate this higher temperature is becoming part of the equipment suite.

The abatement systems (baghouse, 2x interior pre-scrubbers, and main wet scrubber) can be used as is, even though the PGM line boasts its own additional pre-scrubber as well to ensure proper emission treatment. The existing effluent plant is buffered with an additional filter press and neutralization tank for operational efficiency to get the correct-pH effluents to the storage tanks for removal by waste contractors.

No new types of waste, emissions or effluents are being introduced, simply an additional amount of the same as has been generated over the lifetime of the plant and still far below the licensed quantities for the site.

Airshed Planning Professionals (Pty) Ltd was appointed by Environmental Impact Management Services (Pty) Ltd to assess the air quality impacts from the proposed expansion. The format of the assessment meets the prescribed format of an Atmospheric Impact Report (AIR) set out in the Regulations gazetted on 11<sup>th</sup> of October 2013 (Gazette No. 36904). Typically, an AIR would accompany the application for, or amendment of, an AEL. An Impact Assessment Rating is, included in this report, as required by the Environmental Impact Assessment (EIA) process.

### Purpose and Scope

The main purpose of the project is to develop an AIR in support of the application for an AEL variation for the proposed expansion. To successfully develop an AIR, the following tasks are included in the scope of work:

1. Review of available ambient air quality monitoring information.
2. Review of guidelines and standards against which air emissions, ambient air quality and inhalation health impacts are assessed and/or screened.
3. Study of physical environmental parameters that influence the dispersion of pollutants in the atmosphere, including meteorology.
4. Identification of *routine* air quality emissions from the proposed project assuming operation at the minimum emission standards (MES).
5. Atmospheric dispersion modelling to determine ground level pollutant concentrations.

6. A health risk and environmental screening study based on predicted ground level pollutant concentrations in comparison with selected air quality criteria, such as National Ambient Air Quality Standards (NAAQS) and international health screening criteria.

### Management of Uncertainties

The main assumptions, exclusions and limitations are summarised below:

- Meteorological data: Use was made of data from the closest South African Weather Service (SAWS) Station (OR Tambo International Airport (ORTIA)) for the project area.
- Emissions:
  - The quantification of sources of emission was restricted to the project activities only. Although other background sources were identified, such sources were not quantified.
  - Routine emissions from the project were modelled. Atmospheric releases occurring as a result of start-up or accidents were not accounted for.
  - Vehicle exhaust emissions were not quantified as the impacts from these sources are localized (on less than 100 m of on-site road length) and will not exceed NAAQS offsite.
  - It was assumed that atmospheric emissions from the project will be at or below the MES for subcategory 4.17.
  - All pollutants as specified in the MES for subcategory 4.17 were assumed to be emitted from the project.
- Impact assessment:
  - The construction and closure phases were assessed qualitatively (Section 5.1.8) due to the temporary nature of these operations, whilst the operational phase was assessed quantitatively.
  - As no on-site ambient baseline measurements were available for the assessment; current impacts were assessed assuming the ambient data measured at the closest ambient monitoring station with data available (Thokoza).
  - It was assumed that the project would operate 8760 hours per year. The impacts are therefore conservative, since the project may only be used when sufficient feedstock is available.

## 1 ENTERPRISE DETAILS

### 1.1 Enterprise Details

The details of the project operations are summarised in Table 1-1. The contact details of the responsible person are provided in Table 1-2.

**Table 1-1: Enterprise details**

<b>Enterprise Name</b>	Kusasa Refining Proprietary Limited
<b>Trading as</b>	Kusasa Refining Proprietary Limited
<b>Type of Enterprise</b>	Company
<b>Company Registration Number</b>	2018/235292/07
<b>Registered Address</b>	535 Murray Road, Wadeville
<b>Telephone Number (General)</b>	082 084 4497
<b>Industry Type/Nature of Trade</b>	Metal Recovery / Precious Metals Refiner and Trader
<b>Land Use Zoning as per Town Planning Scheme</b>	Industrial
<b>Land Use Rights if Outside Town Planning Scheme</b>	N/A

**Table 1-2: Contact details of responsible person**

<b>Responsible Person</b>	Kabelo Mashabela
<b>Telephone Number</b>	010 001 6284
<b>Cell Number</b>	063 827 0762
<b>Fax Number</b>	N/A
<b>Email Address</b>	production2@kusasarefining.co.za
<b>After Hours Contact Details</b>	063 827 0762

### 1.2 Location and Extent of the Plant

**Table 1-3: Location and extent of the plant**

<b>Physical Address of the Plant</b>	Corner of Murray and Wadeville Road, Wadeville, Germiston
<b>Description of Site (Where no Street Address)</b>	N/A
<b>Coordinates of Approximate Centre of Operations</b>	26° 15' 34.88" S; 28° 10' 50.95" E
<b>Extent</b>	3 200 m <sup>2</sup>
<b>Elevation Above Sea Level</b>	1 583 m
<b>Province</b>	Gauteng
<b>Metropolitan/District Municipality</b>	Ekurhuleni Metropolitan Municipality
<b>Local Municipality</b>	Not applicable
<b>Designated Priority Area</b>	Highveld Priority Area

### 1.3 Description of Surrounding Land Use (within 5 km radius)

Kusasa Refining is located within the Ekurhuleni Metropolitan Municipality (EMM), located at the intersection of Rossouw and Murray roads, in the industrial area of Wadeville (Figure 1-1). The closest residential areas to the facility are Mimosa Park, about 300 m north-northwest; and Lambton Gardens, about 400 m north-northeast of the site. Other nearby residential area include Estera, Castleview, Dinwiddie, Elsburg, Lambton, Albemarle, Verwoerdpark, Delville, Tedstone Ville and Reiger Park.

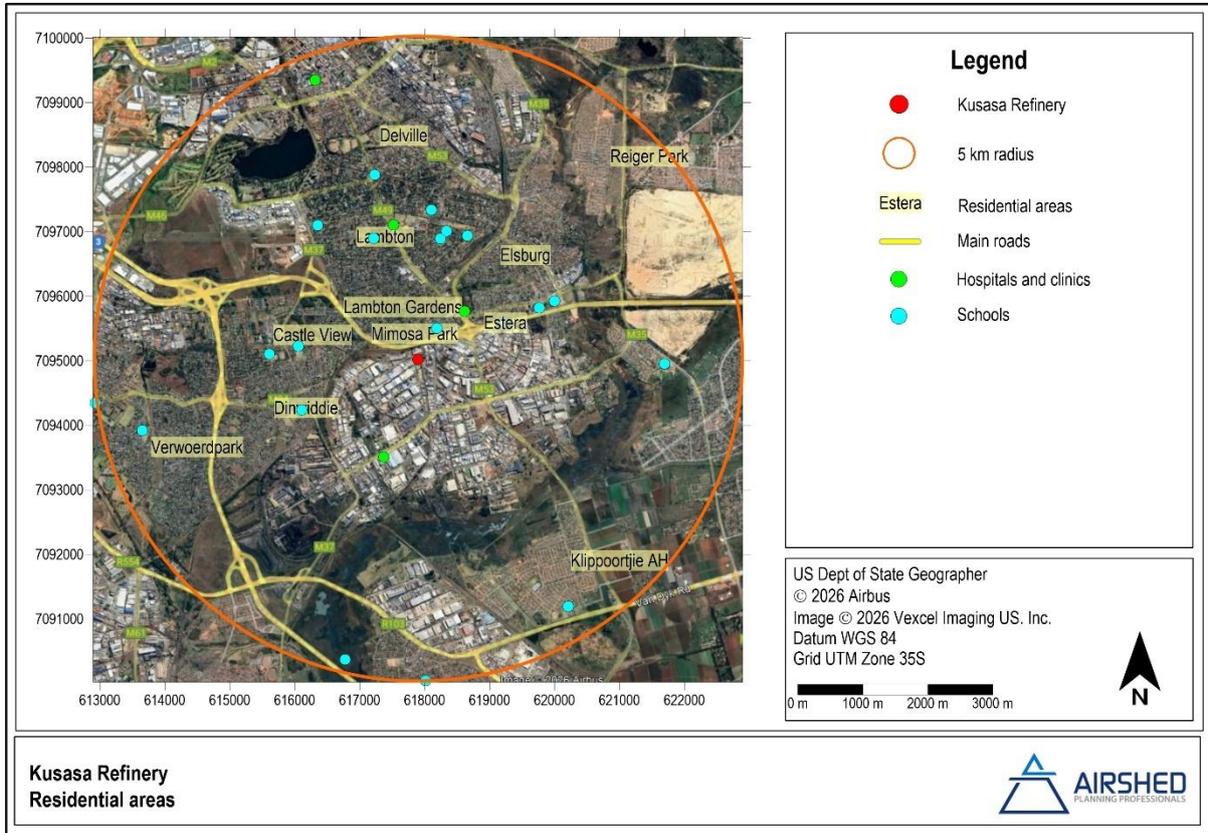


Figure 1-1: Location of proposed project

### 1.4 Atmospheric Emission Licence and other Authorisations

Kusasa Refining has an existing Atmospheric Emissions License (AEL) (14/1/1/7/8/188/Kusas/Wadeville/ALB). Kusasa Refining are planning to apply for a variation to their current AEL.

## 2 NATURE OF THE PROCESS

### 2.1 Process Description

The process for refining precious metals (PMs) focuses on gold, silver, and the following proposed platinum group metals (PGMs) refining: platinum, palladium, rhodium, iridium, and ruthenium. The process-intent is to, in an economically efficient and environmentally conscious manner, separate these elements into saleable products for both the local and international markets. Depending on the element, the saleable product might be a refined bullion bar, pure powder, metal-salt powder or sludge(s).

The process commences with the raw material obtained in the form of a crude impure bar containing the PMs and other dilutants from suppliers' processes (like copper, zinc, iron and others). The bars are accepted with full documentation, weighted, classified and sampled. The samples are processed, typically in-house, with the standard fire assay and ICP processes that's already in use to obtain accurate indicators of the bars' precious metal contents.

The sampled bars are grouped and aggregated until a production-ready batch is formed.

For PGM-containing batches, the production size will be such that the volume is compatible with all unit process as well as regulatory limits imposed by the existing AEL. The production batch is first granulated in a high-temperature induction melter. The granulated metal grain/flake is fed into an existing acid parting process that aims to dissolve the contained silver, palladium and base metals, leaving the gold and other PGMs as undissolved solids. The resultant solution is mixed with another acid to precipitate silver-cement as a product to be filtered out. The silver sediment proceeds to an existing silver processing circuit where it is processed to nearly pure metallic silver powder. This powder is melted into silver bars and introduced to the electrowinning cell(s) for further refining to 99.99% pure silver crystals for melting, sampling and sale.

The acid solution that previously would've only been neutralized, filtered for copper sludge, and stored for collection by waste contractor, is now further treated with organic complexing agent in a mixing tank to create a yellow palladium precipitation salt to be recovered via filtering. The filtered salt is heated in the existing roasting/calcining muffle furnace. The roast drives off the organics, moisture and chlorides (all to be directed into the wet scrubbing circuit for capture) to leave a crude palladium sponge that is melted in the current induction melter and cast into a pure bullion bar for sampling and sale.

The undissolved solids from the acid parting step are fed into an aqua regia reactor for dissolution. After 6 hours the tank is emptied onto a filter. Iridium and ruthenium remains undissolved whereas the gold, platinum and rhodium will be dissolved. The iridium and ruthenium are oxidized in the roasting muffle furnace to produce compounds that can be subsequently dissolved in aqua regia. The aqua regia solution from the reactor proceeds to a mixer tank for conditioning before gold precipitation. The conditioned solution is mixed with a reductant, facilitating precipitation into suspended metallic gold particles. The gold powder is filtered out, washed, dried and melted (in an existing melter) into pure bullion bars for sampling and sale.

The filtered solution proceeds to a subsequent mixer tank for pH conditioning and concentration prior to platinum precipitation. The resultant platinum salt solid is filtered out, washed, and heated in the roasting muffle furnace. A platinum sponge is obtained that is melted in a high-temperature induction furnace to yield a bullion bar for sampling and sale.

At this stage rhodium, iridium and ruthenium are still in solution for recovery. A mixer tank is used to contact the solution with a strong alkaline base causing rhodium-hydroxide to precipitate out as a solid. The sediment is filtered, washed, and heated in the muffle furnace to yield a rhodium-rich sponge for melting, sampling and sale.

Iridium is dropped from solution to produce an iridium precipitate. This salt is filtered out, washed, and heated in the muffle furnace to yield a crude iridium sponge. The powder product is sampled and stored as-is for sale.

The solution is then mixed and conditioned to favour the formation of ruthenium-hydroxide precipitate. This brown-black salt is filtered, washed and heated in the roasting muffle furnace to yield a crude ruthenium-oxide sponge for sampling and sale. The now-barren solution is lastly mixed with zinc powder to ensure all remaining trace precious metals are cemented out of solution prior to the liquid proceeding to the effluent treatment circuit. The solution is neutralised resulting in copper (and other base metals if present) precipitating out as hydroxides in sludge form. This sludge is separated from the effluent with a filter press, recovered and stored for offtake into the market. The effluent is stored in tanks for removal by accredited and registered waste contractors for responsible treatment and disposal.

## 2.2 Listed Activities

All listed activities, as per Section 21 of the National Environmental Management: Air Quality Act, 2004 (NEM:AQA), for the project are given in Table 2-1.

**Table 2-1: Listed activities at the project**

Section 21 Subcategory	Name of the Listed Activity	Description of the Listed Activity
4.17	Precious and base metal production and refining	The production or processing of precious and associated base metals through chemical treatment

## 2.3 Unit Processes

The unit processes associated with the project are listed in Table 2-2.

**Table 2-2: The unit processes for the project**

Unit Process	Function of Unit Process	Batch or Continuous Process
Granulation melter	Impure jewellery scrap metals are granulated in electric induction melters.	Batch
Refining reactor	Use of HCl and HNO <sub>3</sub> to chemically refine and treat the precious metals into separation of silver and gold pure metals.	Batch
Electrowinning baths	Used to purify relatively pure precious and base metals via application of electrical current into an electrolyte liquid that contains dissolved precious metals.	Batch
Assaying oven	Used in the fire assay process for cupellation where gold analysis is conducted.	Batch
Assaying fume hood	Used in the fire assay process for dissolution where impure constituents are removed.	Batch
Effluent treatment	Spent acids and process liquids are neutralised and filtered to recover precious sludge, storage of neutral process grey water in outside tanks for disposal by an accredited waste handler.	Batch
Pure metal melter	The final pure metal sponge is melted and cast into ingots, plates or bars for sale or reuse.	Batch
Metal Recovery	The recovery of metal from scrap material	Continuous

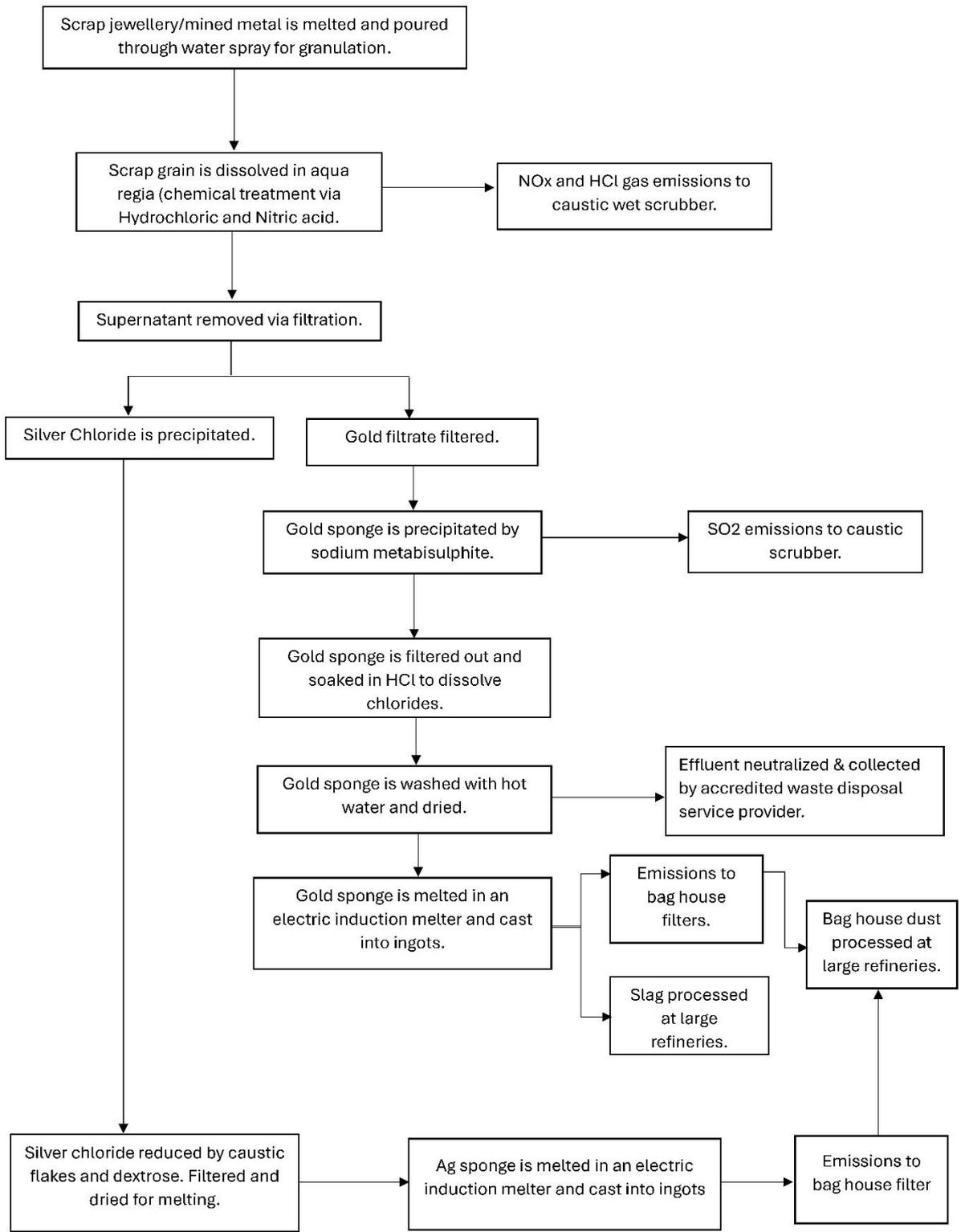


Figure 2-1: The current project flow diagram

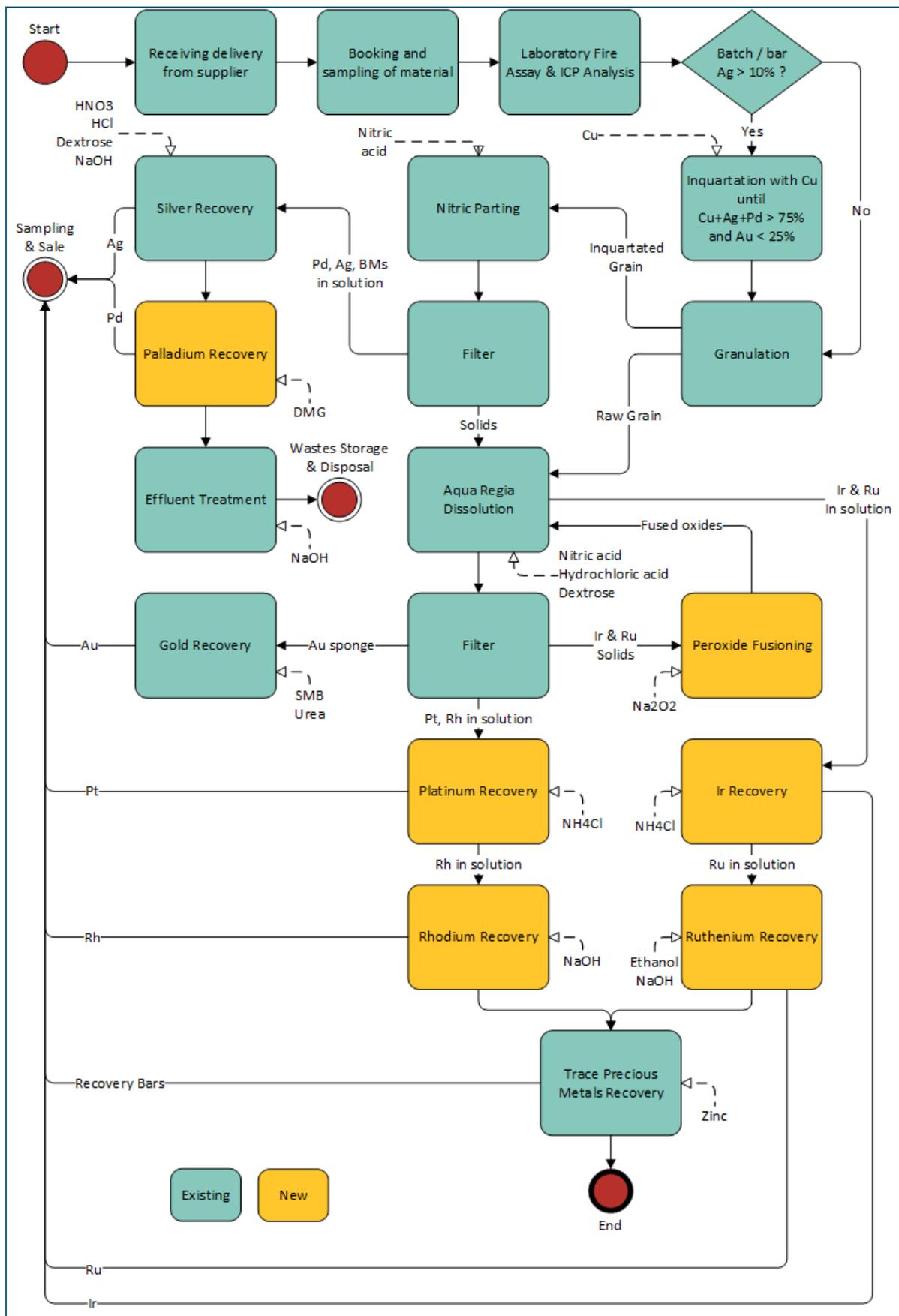


Figure 2-2: The proposed project flow diagram

### 3 TECHNICAL INFORMATION

Raw material consumption rates are tabulated in Table 3-1. Production rates are tabulated in Table 3-2, with by-products listed in Table 3-3. Appliances to prevent air pollution are given in Table 3-4 with proposed equipment linked to the current abatement technology underlined.

#### 3.1 Raw Material Consumption Rates

Table 3-1: Raw materials used

Raw Material Type	Design Consumption Rate (Quantity)	Actual Consumption Rate 2025 (Quantity)	Units (quantity/period)
jewellery waste	28	3.9	tonne/annum
hydrochloric acid	25 920	1 750	litres/month
nitric acid	19 200	500	litres/month
sodium metabisulfite	5 280	158	kg/month
ammonium chloride	7 200	*	kg/month
sodium hydrosulphide	300	100	kg/month
ethanol	120	5	litres/month
mine waste (rudimentary bars)	3	1.47	tonne/month
sodium hydroxide	11 580	1 200	litres/month
dimethylglyoxime	3 000	*	kg/month
soda ash	200	50	kg/month
zinc	114	*	kg/month
sodium peroxide	4 800	*	kg/month
hydrogen peroxide	10	*	litres/month
urea	1 920	50	kg/month
dextrose	100	70	kg/month
borax	800	400	kg/month

\*New chemical

### 3.2 Production Rates

Table 3-2: Production rates

Production Name	Design Production Capacity (Quantity)	Actual Production Capacity 2025 (Quantity)	Units (quantity/period)
gold	160	8	kg/day
silver	80	16	kg/day
platinum	40	*	kg/day
palladium	40	*	kg/day
rhodium	20	*	kg/day
iridium	20	*	kg/day
ruthenium	20	*	kg/day
borax	800	400	kg/month

\*New product

Table 3-3: By-Product rates

Production Name	Design Production Capacity (Quantity)	Actual Production Capacity 2025 (Quantity)	Units (quantity/period)
copper	100	5	kg/day
slag	60	60	kg/day

### 3.3 Appliances and Abatement Equipment Control Technology

Table 3-4: Abatement Equipment Control Technology used

Appliance Name	Appliance Type / Description	Appliance Function / Purpose
Wet scrubber	SG plastic polyprop caustic wet scrubber	Au pre-scrubber (BR800, BR100, PR001 and PR002), lab fume hoods, silver cells, nitric parting tank, AG reactor, neutralisation tank, acid holding tanks. <u>PGM pre-scrubber (titanium reactor, PGM precipitation tanks), neutralisation tank.</u>
Reverse pulse baghouse	Freudenberg reverse pulse dust extraction baghouse	Induction melters (melter 1-3), lab furnaces (LE0019, LE0020, LE0021), front loading furnace. <u>Process Makina melter, SuperbMelt melter, roasting muffle furnace</u>

## 4 ATMOSPHERIC EMISSIONS

The following sections describe the location and parameters of the individual sources associated with the project (as per the prescribed format of an AIR - Gazette No. 36904, 2013).

### 4.1 Point Source Parameters

**Table 4-1: Point sources of atmospheric pollutant emissions at the proposed project**

Point Source code	Source name	Latitude (degrees, min, sec)	Longitude (degrees, min, sec)	Height of Release Above Ground (m)	Height Above Nearby Building (m)	Diameter at Stack Tip / Vent Exit (m)	Actual Gas Exit Temperature (°C)	Actual Gas Volumetric Flow (m <sup>3</sup> /hr)	Actual Gas Exit Velocity (m/s)
SV001	Scrubber stack (linked to chemical processes)	26° 15' 34.54" S	28° 10' 52.07" E	8 <sup>(a)</sup>	2 m below roof height	0.78	28.1	6 432	3.6
SV002	Baghouse stack (linked to the induction melting processes)	26° 15' 35.08" S	28° 10' 52.20" E	8 <sup>(a)</sup>	2 m below roof height	0.49	45.7	4 464	6.3
<p>Notes:</p> <p>(a) Although the dispersion modelling is based on a stack height of 8m, Kusasa plan to extend their stacks to 9m. The results are therefore conservative, as a lower stack results in lower dispersion and higher ground level concentrations.</p>									

#### 4.2 Point Source Maximum Emission Rates during Normal Operating Conditions

Table 4-2: Atmospheric pollutant emission rates for the project

Point Source code	Pollutant Name	Maximum Release Rate				Emissions Hours <sup>(b)</sup>	Type of Emissions (Continuous / Routine but Intermittent / Emergency Only)
		(mg/Nm <sup>3</sup> ) <sup>(a)</sup>	(mg/Am <sup>3</sup> )	(kg/hr)	(tpa)		
SV001	PM	50	40	0.26	2.27	8760	Routine but Intermittent
	Cl <sub>2</sub>	50	40	0.26	2.27	8760	Routine but Intermittent
	SO <sub>2</sub>	400	322	2.07	18.15	8760	Routine but Intermittent
	HCl	30	24	0.16	1.36	8760	Routine but Intermittent
	HF	30	24	0.16	1.36	8760	Routine but Intermittent
	NH <sub>3</sub>	100	81	0.52	4.54	8760	Routine but Intermittent
	NO <sub>x</sub>	300	242	1.55	13.61	8760	Routine but Intermittent
SV002	PM	50	38	0.17	1.49	8760	Routine but Intermittent
	Cl <sub>2</sub>	50	38	0.17	1.49	8760	Routine but Intermittent
	SO <sub>2</sub>	400	304	1.36	11.90	8760	Routine but Intermittent
	HCl	30	23	0.10	0.89	8760	Routine but Intermittent
	HF	30	23	0.10	0.89	8760	Routine but Intermittent
	NH <sub>3</sub>	100	76	0.34	2.98	8760	Routine but Intermittent
	NO <sub>x</sub>	300	228	1.02	8.93	8760	Routine but Intermittent

Notes:

(a) Maximum release concentration as per the New Plant MES for sub-category 4.17 (Section 21 of NEM:AQA)

(b) Total operational hours per annum (assumed)

## 5 IMPACT OF ENTERPRISE ON THE RECEIVING ENVIRONMENT

### 5.1 Analysis of Emissions' Impact on Human Health

#### 5.1.1 Approach and Methodology

##### 5.1.1.1 Atmospheric Dispersion Model Selection

Dispersion models compute ambient pollutant concentrations as a function of source configurations, emission strengths and meteorological characteristics, thus providing a useful tool to ascertain the spatial and temporal patterns in the ground level concentrations arising from the emissions from various sources. Increasing reliance has been placed on concentration estimates from models as the primary basis for environmental and health impact assessments, risk assessments and emission control requirements.

The US Environmental Protection Agency's (US-EPA) approved regulatory model – AERMOD - was selected for this study. It is one of the models recommended for Level 2 assessments, for near-source (less than 50 km from source) applications in all terrain types, in the South African Regulations Regarding Air Dispersion Modelling (Government Gazette No. 37804;11 July 2014).

The AERMOD suite of models was developed under the support of the American Meteorological Society/US-EPA Regulatory Model Improvement Committee (AERMIC), whose objective has been to include state-of-the-art science in regulatory models (Hanna et al., 1999). The AERMOD is a dispersion modelling system with three components, namely: AERMOD (AERMIC Dispersion Model), AERMAP (AERMOD terrain pre-processor), and AERMET (AERMOD meteorological pre-processor).

AERMOD is an advanced new-generation model. It is designed to predict pollution concentrations from continuous point, flare, area, line, and volume sources. AERMOD offers new and potentially improved algorithms for plume rise and buoyancy, and the computation of vertical profiles of wind, turbulence and temperature however retains the single straight line trajectory limitation of ISCST3 (Hanna et al., 1999).

AERMET is a meteorological pre-processor for the AERMOD model. Input data can come from hourly cloud cover observations, surface meteorological observations and twice-a-day upper air soundings. Output includes surface meteorological observations and parameters and vertical profiles of several atmospheric parameters.

AERMAP is a terrain pre-processor designed to simplify and standardize the input of terrain data for the AERMOD model. Input data includes receptor terrain elevation data. The terrain data may be in the form of digital terrain data. For each receptor, output includes location and height scale, which are elevations used for the computation of air flow around hills.

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 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.

The stochastic uncertainty includes all errors or uncertainties in data such as source variability, observed concentrations, and meteorological data. Even if the field instrument accuracy is excellent, there can still be large uncertainties due to unrepresentative placement of the instrument (or taking of a sample for analysis). Model evaluation studies suggest that the

data input error term is often a major contributor to total uncertainty. Even in the best tracer studies, the source emissions are known only with an accuracy of  $\pm 5\%$ , which translates directly into a minimum error of that magnitude in the model predictions. It is also well known that wind direction errors are the major cause of poor agreement, especially for relatively short-term predictions (minutes to hourly) and long downwind distances. All of the above factors contribute to the inaccuracies not even associated with the mathematical models themselves.

Dispersion models do not contain all the features of a real environmental system but contain the feature of interest for the management issue or scientific problem to be solved (MFE, 2001). Gaussian plume models are generally regarded to have an uncertainty range of -50% to 200%. It has generally been found that the accuracy of off-the-shelf dispersion models improve with increased averaging periods. The accurate prediction of instantaneous peaks are the most difficult and are normally performed with more complicated dispersion models specifically fine-tuned and validated for the location.

Input data types required for the AERMOD model include: meteorological data, source data, and information on the nature of the receptor grid. Each of these data types will be described below.

#### *5.1.1.2 Meteorological Data Requirements*

AERMOD requires two specific input files generated by the AERMET pre-processor. AERMET is designed to be run as a three-stage processor and operates on three types of data (upper air data, on-site measurements, and the national meteorological database). Meteorological data (including wind speed, wind direction and temperature) recorded at the SAWS weather station located at the ORTIA was used to generate AERMOD-ready meteorological files. The period of the meteorological data was 2020 to 2022.

#### *5.1.1.3 Source Data Requirements*

The AERMOD model is able to model point, area, volume and line sources. The atmospheric emissions of the pollutants of concern, as a result of the operations from the project, were modelled as point sources (chimney stacks).

#### *5.1.1.4 Modelling Domain*

The dispersion of pollutants was modelled for an area covering 2 km (north-south) by 2 km (east-west) centred over the facility. The modelling domain was selected on the basis of the sources of emissions and potential impact areas. This area was divided into a grid with a resolution of 40 m (north-south) by 40 m (east-west). AERMOD simulates ground-level concentrations for each of the receptor grid points.

### *5.1.2 Legal Requirements*

#### *5.1.2.1 Atmospheric Impact Report*

According to the National Environmental Management: Air Quality Act (NEM:AQA), an Air Quality Officer (AQO) may require the submission of an Atmospheric Impact Report (AIR) in terms of section 30, if:

- The AQO reasonably suspects that a person has contravened or failed to comply with the AQA or any conditions of an AEL and that detrimental effects on the environment occurred or there was a contribution to the degradation in ambient air quality.

- A review of a provisional AEL or an AEL is undertaken in terms of section 45 of the AQA.

The format of the AIR is stipulated in the Regulations Prescribing the Format of the Atmospheric Impact Report, Government Gazette No. 36904, Notice Number 747 of 2013 (11 October 2013), its amendment stipulated in Government Gazette No. 38633, No. R284 (2 April 2015).

#### 5.1.2.2 National Ambient Air Quality Standards

National Ambient Air Quality Standards (NAAQS) are available for inhalable particulate matter less than 2.5 µm in diameter (PM<sub>2.5</sub>) gazetted on 29 June 2012 (no. 35463), inhalable particulate matter less than 10 µm in diameter (PM<sub>10</sub>), sulfur dioxide (SO<sub>2</sub>), nitrogen dioxide (NO<sub>2</sub>), ozone (O<sub>3</sub>), carbon monoxide (CO), lead (Pb) and benzene, gazetted on 24 December 2009. The NAAQS are provided in Table 2-1.

**Table 5-1: South African National Ambient Air Quality Standards**

Substance	Molecular formula / notation	Averaging period	Concentration limit (µg/m <sup>3</sup> )	Frequency of exceedance	Compliance date
Sulfur dioxide	SO <sub>2</sub>	10 minutes	500	526	Immediate
		1 hour	350	88	Immediate
		24 hours	125	4	Immediate
		1 year	50	-	Immediate
Nitrogen dioxide	NO <sub>2</sub>	1 hour	200	88	Immediate
		1 year	40	-	Immediate
Particulate matter	PM <sub>10</sub>	24 hour	75	4	Immediate
		1 year	40	-	Immediate
Fine particulate matter	PM <sub>2.5</sub>	24 hour	40		Immediate
			25		1 Jan 2030
		1 year	20		Immediate
			15		1 Jan 2030
Ozone	O <sub>3</sub>	8 hours (running)	120	11	Immediate
Benzene	C <sub>6</sub> H <sub>6</sub>	1 year	5	-	Immediate
Lead	Pb	1 year	0.5	-	Immediate
Carbon monoxide	CO	1 hour	30 000	88	Immediate
		8 hour (calculated on 1 hour averages)	10 000	11	Immediate

#### 5.1.2.3 Screening Criteria for Non-Criteria Pollutants

Air quality screening levels for non-criteria pollutants are published by various sources. These sources include:

- World Health Organization (WHO) guideline values for non-carcinogens and unit risk factor guidelines for carcinogens,
- Chronic and sub-chronic inhalation reference concentrations (RfC) and cancer unit risk factors published by the US-EPA in its Integrated Risk Information System (IRIS),

- Reference exposure levels (RELs) published by the Californian Office of Environmental Health Hazard Assessment (OEHHA), and
- Minimal risk levels (MRLs) issued by the US Federal Agency for Toxic Substances and Disease Registry (ATSDR).

The non-carcinogenic exposure thresholds for pollutants of interest for the project are highlighted in Table 5-2 (based on the hierarchy of toxicity values from the Risk Assessment Information System (RAIS)).

**Table 5-2: Proposed non-carcinogenic exposure thresholds for pollutants of interest in the current study**

Pollutant	Averaging Period	Selected Criteria	Source
Ammonia (NH <sub>3</sub> )	Acute (µg/m <sup>3</sup> )	1 184	ATSDR
	Chronic (µg/m <sup>3</sup> )	500	IRIS
Chlorine (Cl <sub>2</sub> )	Acute (µg/m <sup>3</sup> )	170	ATSDR
	Chronic (µg/m <sup>3</sup> )	0.145	ATSDR
Hydrogen chloride (HCl)	Acute (µg/m <sup>3</sup> )	2 100	OEHHA
	Chronic (µg/m <sup>3</sup> )	20	IRIS
Hydrogen fluoride (HF)	Acute (µg/m <sup>3</sup> )	16.4	ATSDR
	Chronic (µg/m <sup>3</sup> )	14	OEHHA

#### 5.1.2.4 Listed Activities and Minimum Emission Standards

The recovery of precious metals from scrap material is a Listed Activity under Section 21 of the Air Quality Act (AQA) and requires an AEL to operate. The project will be required to comply with the new plant Minimum Emission Standards (MES). The applicable listed activity is Subcategory 4.17 (Precious and Base Metal Production and Refining) (Table 5-3).

**Table 5-3: Listed Activity Subcategory 4.17**

Subcategory 4.17 – Precious and Base Metal Production and Refining			
Description:	The production or processing of precious and associated base metals through chemical treatment.		
Application:	All installations.		
Substance or Mixture of Substances		Plant Status	mg/Nm <sup>3</sup> under normal conditions of 273 Kelvin and 101.3 kPa
Common Name	Chemical Symbol		
Particulate matter	N/A	New	50
Chlorine	Cl <sub>2</sub>		50
Sulfur dioxide	SO <sub>2</sub>		400
Hydrogen chloride	HCl		30
Hydrogen fluoride	HF		30
Ammonia	NH <sub>3</sub>		100
Oxides of nitrogen	NO <sub>x</sub> , expressed as NO <sub>2</sub>		300

#### 5.1.2.5 Regulations Regarding Air Dispersion Modelling

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

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

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

- The distribution of pollutants concentrations and depositions are required in time and space.
- Pollutant dispersion can be reasonably treated by a straight-line, steady-state, Gaussian plume model with first order chemical transformation. The model specifically to be used in the air quality impact assessment of the proposed operation is AERMOD.
- Emissions are from sources where the greatest impacts are in the order of a few kilometres (less than 50 km) downwind.

Dispersion modelling provides a versatile means of assessing various emission options for the management of emissions from existing or proposed installations. Chapter 3 of the Regulations prescribe the source data input to be used in the models. Dispersion modelling can typically be used in the:

- Apportionment of individual sources for installations with multiple sources. In this way, the individual contribution of each source to the maximum ambient predicted concentration can be determined. This may be extended to the study of cumulative impact assessments where modelling can be used to model numerous installations and to investigate the impact of individual installations and sources on the maximum ambient pollutant concentrations.
- Analysis of ground level concentration changes as a result of different release conditions (e.g. by changing stack heights, diameters and operating conditions such as exit gas velocity and temperatures).
- Assessment of variable emissions as a result of process variations, start-up, shut-down or abnormal operations.
- Specification and planning of ambient air monitoring programs which, in addition to the location of sensitive receptors, are often based on the prediction of air quality hotspots.

The above options can be used to determine the most cost-effective strategy for compliance with the NAAQS. Dispersion models are particularly useful under circumstances where the maximum ambient concentration approaches the ambient air quality limit value and provide a means for establishing the preferred combination of mitigation measures that may be required including:

- Stack height increases;
- Reduction in pollutant emissions through the use of air pollution control systems (APCS) or process variations;
- Switching from continuous to non-continuous process operations or from full to partial load.

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

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

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

Chapter 5 provides general guidance on geophysical data, model domain and coordinates system required in dispersion modelling, whereas Chapter 6 elaborates more on these parameters as well as the inclusion of background air concentration data. The chapter also provides guidance on the treatment of NO<sub>2</sub> formation from NO<sub>x</sub> emissions, chemical transformation of sulfur dioxide into sulfates and deposition processes.

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

#### 5.1.2.6 Highveld Priority Area

The Highveld Airshed Priority Area (HPA) was declared the second national air quality priority area (after the Vaal Triangle Airshed Priority Area) by the Minister of Environmental Affairs at the end of 2007 (HPA, 2011). This required that an Air Quality Management Plan for the area be developed. The plan includes the establishment of emissions reduction strategies and intervention programmes based on the findings of a baseline characterisation of the area. The implication of this is that all contributing sources in the area will be assessed to determine the emission reduction targets to be achieved over the following few years.

The Department of Environmental Affairs (DEA) now the Department of Forestry, Fisheries and the Environment (DFFE) published the management plan for the Highveld Priority Area in September 2011. Included in this management plan are seven goals, each of which has a further list of objectives that has to be met. The seven goals for the Highveld Priority area are as follows:

- **Goal 1:** By 2015, organisational capacity in government is optimised to efficiently and effectively maintain, monitor and enforce compliance with ambient air quality standards.
- **Goal 2:** By 2020, industrial emissions are equitably reduced to achieve compliance with ambient air quality standards and dust fall-out limit values.

- **Goal 3:** By 2020, air quality in all low-income settlements is in full compliance with ambient air quality standards.
- **Goal 4:** By 2020, all vehicles comply with the requirements of the National Vehicle Emission Strategy.
- **Goal 5:** By 2020, a measurable increase in awareness and knowledge of air quality exists.
- **Goal 6:** By 2020, biomass burning and agricultural emissions will be 30% less than current.
- **Goal 7:** By 2020, emissions from waste management are 40% less than current.

A second-generation air quality management plan for the HPA was published in March 2025. The proposed strategies to reduce the emissions from industrial sources within the HPA are summarised in Table 5-4. The target is to reduce emissions by 40% in 2030.

**Table 5-4: Emission Reduction Activities for Industrial Sources**

Objectives	Key Activities/ Opportunities	Responsibility
Reduce emissions from industries	Compliance with the minimum emission standards and other atmospheric emission licence conditions.	Identified stakeholders in regulation 3(2)(a) and 3(2)(b).
	Assessment of compliance monitoring reports.	Identified stakeholders in regulation 3(2)(e): DFFE, Provinces, Metros, Districts and Local municipalities.
	Development and implementation of emission reduction plans.	Identified stakeholders in regulation 3(2)(a) and 3(2)(b).
	Monitor and enforce compliance.	Identified stakeholders in regulation 3(2)(e): DFFE, Provinces, Metros, Districts and Local municipalities
	Identify opportunities and incentive schemes to support industries to implement air quality improvement initiatives.	Identified stakeholders in regulation 3(2)(e): DTIC, DFFE, Provinces, Metros, Districts and Local municipalities
	Establish incentive schemes for energy efficiency improvements and fuel switching that directly reduce air emissions.	Identified stakeholders in regulation 3(2)(e): DTIC, DFFE, Provinces, Metros, Districts and Local municipalities

Notes: DTIC – Department of Trade, Industry and Competition, DFFE – Department of Forestry, Fisheries and the Environment

### 5.1.3 Atmospheric Dispersion Potential

Meteorological mechanisms direct the dispersion, transformation and eventual removal of pollutants from the atmosphere. The extent to which pollution will accumulate or disperse in the atmosphere is dependent on the degree of thermal and mechanical turbulence within the earth's boundary layer. This dispersion comprises vertical and horizontal components of motion. The stability of the atmosphere and the depth of the surface-mixing layer define the vertical component. The horizontal dispersion of pollution in the boundary layer is primarily a function of the wind field. The wind speed determines both the distance of downwind transport and the rate of dilution as a result 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, determines the general path pollutants will follow, and the extent of crosswind spreading. The pollution concentration levels therefore fluctuate in response to changes in atmospheric stability, to concurrent variations in the mixing depth, and to shifts in the wind field (Tiwary and Colls, 2010).

The spatial variations, and diurnal and seasonal changes, in the wind field and stability regime are functions of atmospheric processes operating at various temporal and spatial scales (Goldreich and Tyson, 1988). The atmospheric processes at macro- and meso-scales need therefore be taken into account in order to accurately parameterise the atmospheric dispersion potential of a particular area. A qualitative description of the synoptic systems determining the macro-ventilation potential of the region may be provided based on the review of pertinent literature. These meso-scale systems may be investigated through the analysis of meteorological data observed for the region.

Since no weather measurements are available from the site, meteorological information was obtained from the nearest South African Weather Services weather station. The station is located at the ORTIA, 14.3 km to the north-northeast of the facility. The following summary is based on the period 2020 to 2022.

#### 5.1.3.1 Local Wind Field

The horizontal dispersion of pollution is largely a function of the wind field. The wind speed determines both the distance of downward transport and the rate of dilution of pollutants. The generation of mechanical turbulence is similarly a function of the wind speed, in combination with the surface roughness (Tiwary and Colls, 2010).

The wind roses comprise 16 spokes, which represent the directions from which winds blew during a specific period. The colours used in the wind roses below, reflect the different categories of wind speeds; the yellow area, for example, representing winds in between 5 and 6 m/s. The dotted circles provide information regarding the frequency of occurrence of wind speed and direction categories. The frequency with which calms occurred, i.e. periods during which the wind speed was below 1 m/s, are also indicated.

The period wind field and diurnal variability in the wind field are shown in Figure 5-1, while the seasonal variations are shown in Figure 5-2. During the 2020 to 2022 period, the wind field was dominated by winds from the north, northwest and west-northwest, with less frequent winds from the south and east. During the day, the prevailing wind field is similar to the period wind field, but during the night there is a decrease in north-westerly flow. Long-term air quality impacts are therefore expected to be the most significant to the south and southeast of the project area. The strongest winds (more than 7 m/s) were also from the north and occurred mostly during the day, with a maximum wind speed of 13 m/s recorded. The average wind speed over the three years is 4 m/s, with calm conditions occurring for 2.2% of the time

Seasonally, the wind flow pattern mostly conforms to the period average wind flow pattern but with clear changes between the seasons. During summer, the prevailing winds are from the north and east, with a change to more frequent southerly and west-north-westerly winds during autumn. These prevailing wind fields remain during winter but with an increase in winds

from the north and northwest. Springtime results in dominant northerly winds followed by winds from the northwestern sector. Spring also has the lowest percentage calm conditions (1.1%).

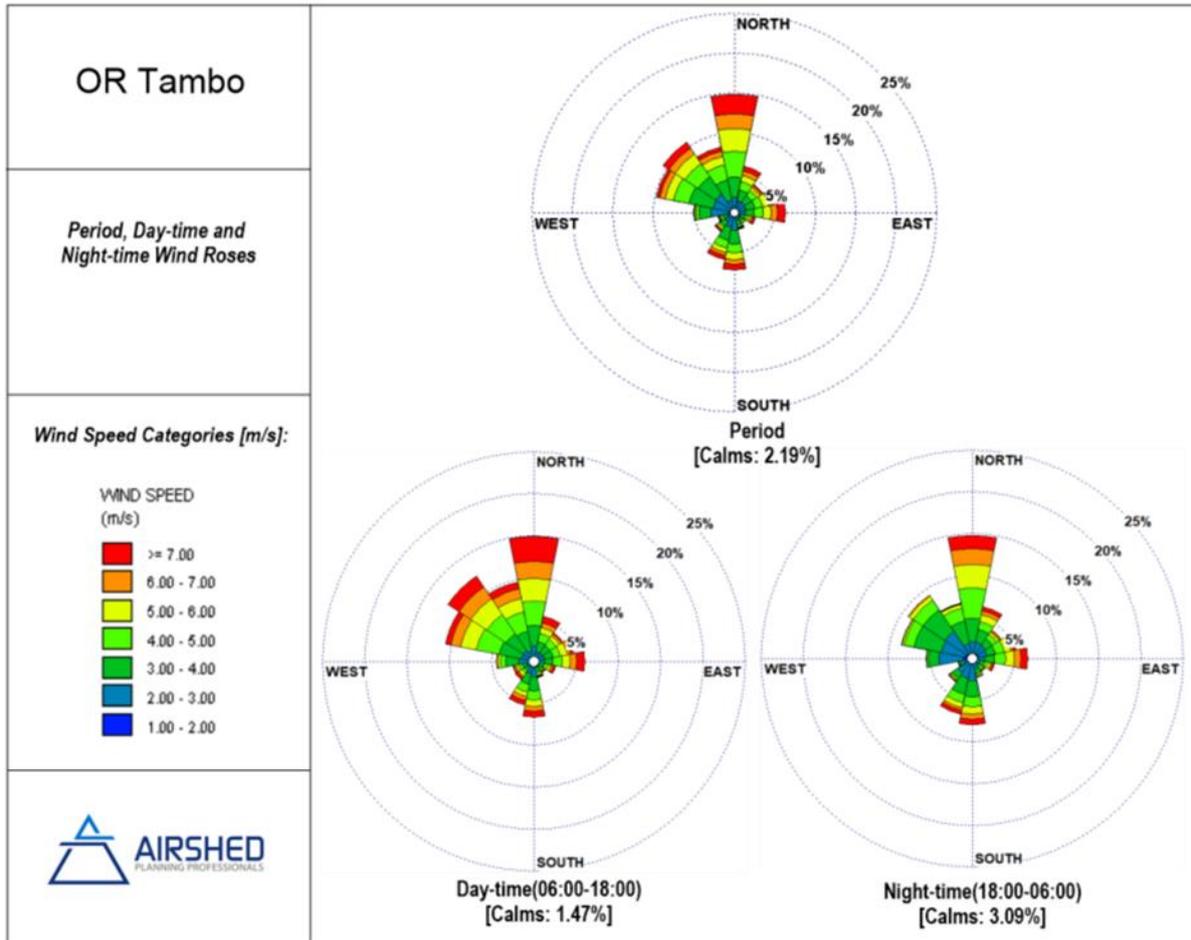


Figure 5-1: Period, day-, and night-time wind roses (SAWS ORTIA data, January 2020 to December 2022)

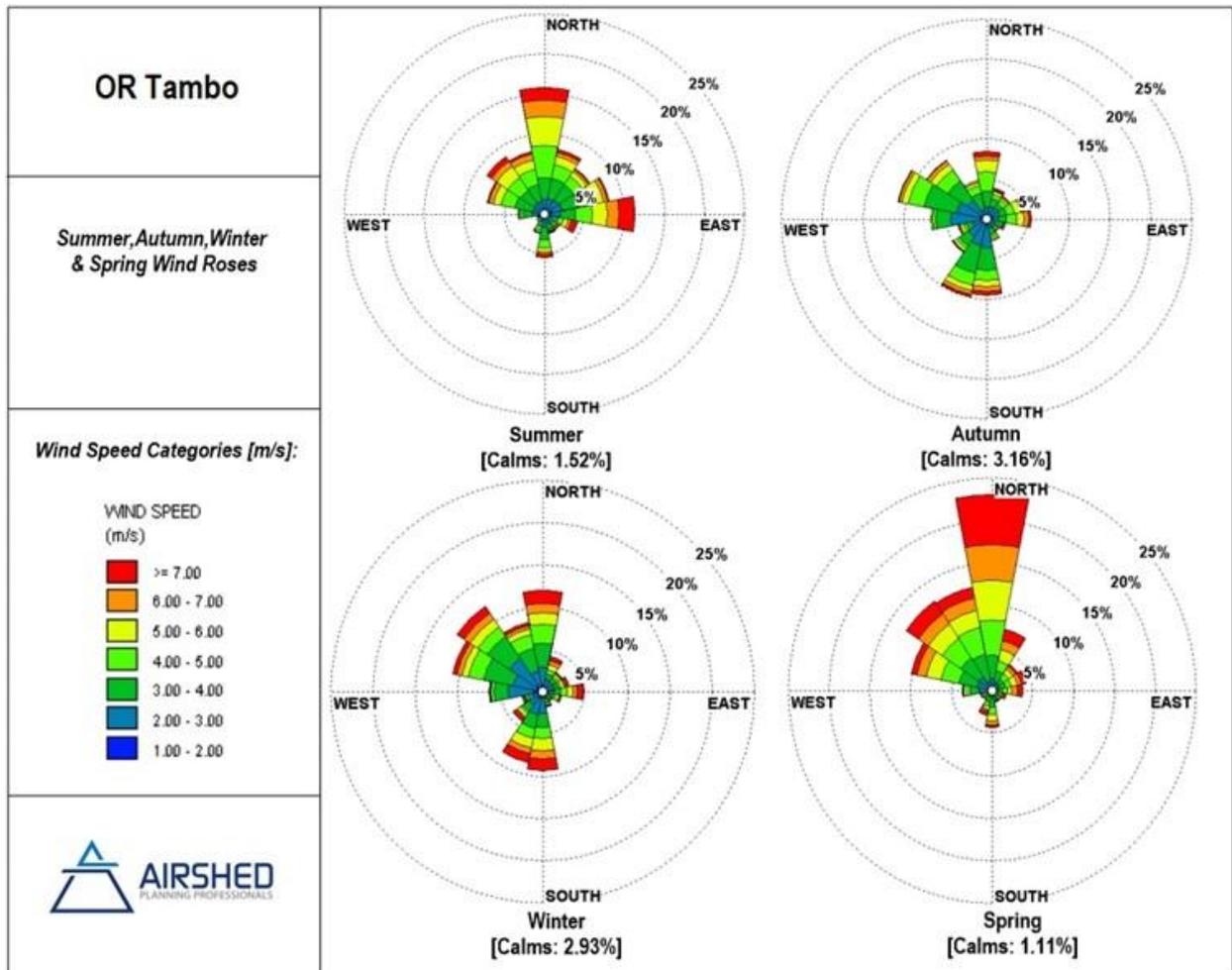


Figure 5-2: Seasonal wind roses (SAWS ORTIA data, January 2020 to December 2022)

### 5.1.3.2 Ambient Temperature

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

Monthly mean, maximum and minimum temperatures are given in Table 5-5. Diurnal temperature variability is presented in Figure 5-3. Temperatures ranged between -6°C in July and 32°C in October. During the day, temperatures increase to reach maximum at around 15:00 in the afternoon. Ambient air temperature decreases to reach a minimum at around 06:00 i.e. just before sunrise.

Table 5-5: Monthly temperature summary (ORTIA data, January 2020 to December 2022)

Monthly Minimum, Maximum and Average Temperatures (°C)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
<b>Minimum</b>	10	10	9	5	0	-3	-6	-2	4	6	10	7
<b>Average</b>	20	19	18	16	14	11	11	13	18	19	19	19
<b>Maximum</b>	30	30	29	28	23	23	22	25	31	32	31	29

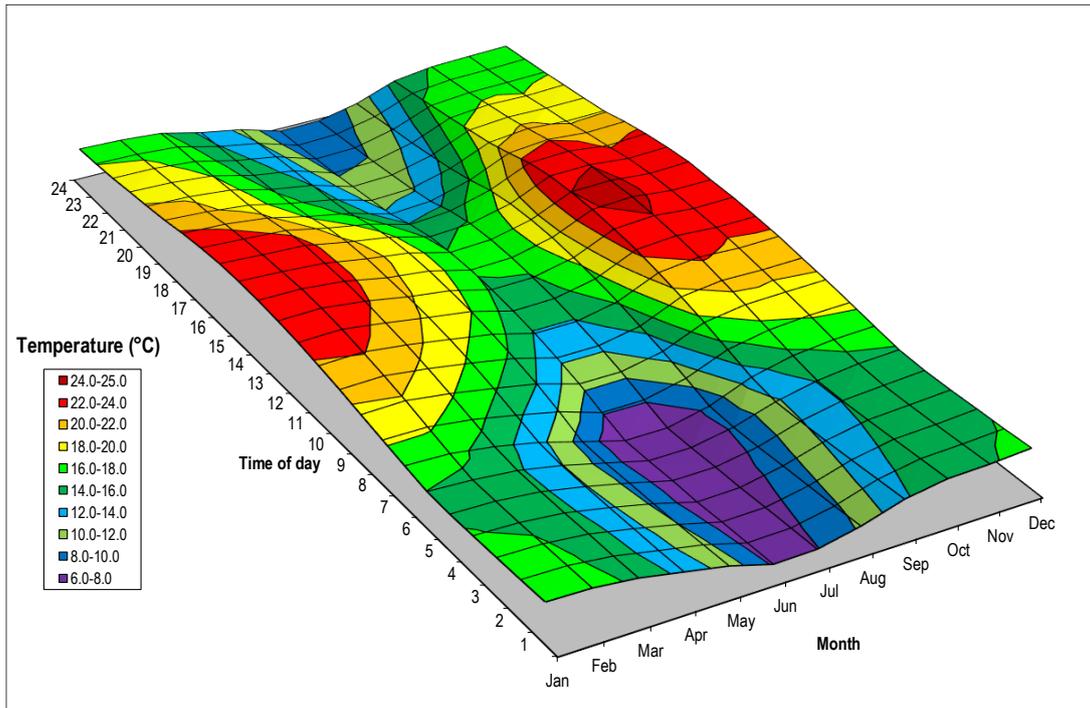


Figure 5-3: Diurnal temperature profile (SAWS ORTIA data, January 2020 to December 2022)

5.1.3.3 Precipitation

Precipitation represents an effective removal mechanism of atmospheric pollutants. Precipitation reduces wind erosion potential by increasing the moisture content of materials. Rain-days are defined as days experiencing 0.1 mm or more rainfall. Rainfall in the region is almost exclusively due to showers and thunderstorms and falls mainly in summer, from October to April (Figure 5-4). The maximum rainfall occurs during the November-January period. Annual rainfall ranged between 650 mm in 2020, 687 mm in 2021 and 710 mm in 2022.

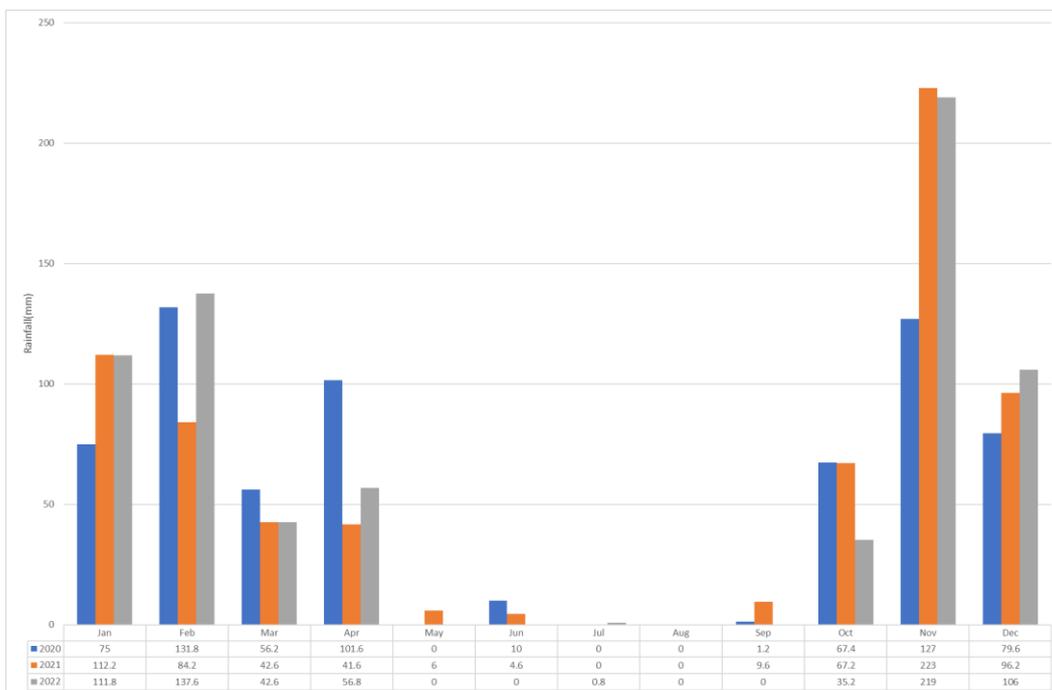


Figure 5-4: Monthly rainfall for ORTIA (2020-2022)

#### 5.1.3.4 Atmospheric Stability and Mixing Depth

The atmospheric boundary layer constitutes the first few hundred metres of the atmosphere. This layer is directly affected by the earth's surface, either through the retardation of flow due to the frictional drag of the earth's surface, or as result of the heat and moisture exchanges that take place at the surface. 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. The radiative flux divergence during the night usually results in the establishment of ground-based inversions and the erosion of the mixing layer. The night times are characterised by weak vertical mixing and the predominance of a stable layer. These conditions are normally associated with low wind speeds, hence less dilution potential.

The mixed layer ranges in depth from a few metres (i.e. stable or neutral layers) during night times, to the base of the lowest-level elevated inversion during unstable, daytime conditions. Elevated inversions may occur for a variety of reasons and on some occasions as many as five may occur in the first 1000 m above the surface.

Atmospheric stability is frequently categorised into one of six stability classes – these are briefly described in Table 5-6. The most commonly occurring stability class calculated the site is Class C and F, representing Unstable and Very Stable conditions respectively. For elevated releases (e.g. from the plant stack), the highest GLCs would occur during unstable, daytime conditions. For low level releases, such as vehicle and materials handling activities, the highest GLCs would occur during weak wind speeds and stable (night-time) atmospheric conditions. Windblown dust is likely to occur under high winds (neutral conditions).

**Table 5-6: Atmospheric stability classes**

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

Diurnal variation in atmospheric stability, as calculated from OR Tambo SAWS data, and described by the inverse Monin-Obukhov length and the boundary layer depth is provided in Figure 5-5. The highest concentrations for ground level, or near-ground level releases from non-wind dependent sources would occur during weak wind speeds and stable (night-time) atmospheric conditions. For elevated releases, unstable conditions can result in very high concentrations of poorly diluted emissions close to the stack. This is called looping and occurs mostly during daytime hours. Neutral conditions disperse the plume fairly equally in both the vertical and horizontal planes and the plume shape is referred to as coning. Stable conditions prevent the plume from mixing vertically, although it can still spread horizontally and is called fanning (Tiway & Colls, 2010). For ground level releases such as fugitive dust the highest ground level concentrations will occur during stable night-time conditions.

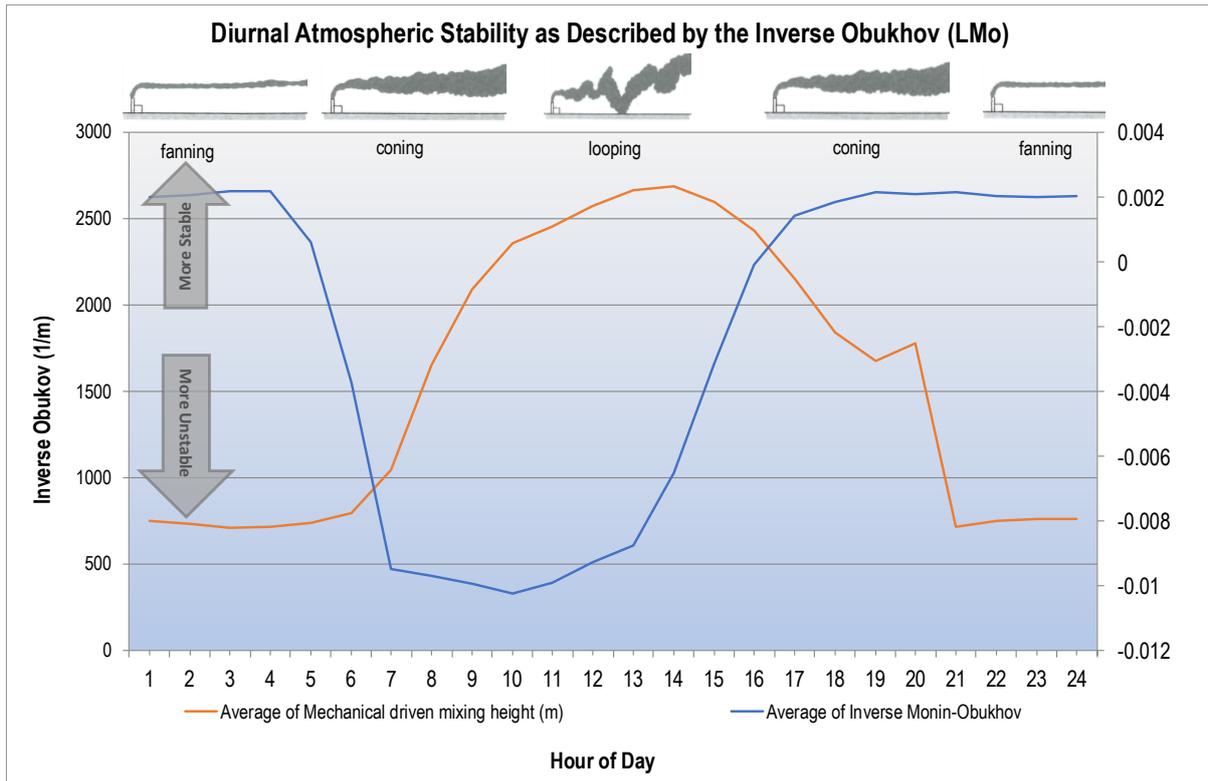


Figure 5-5: Diurnal atmospheric stability (SAWS ORTIA data, 2020 to 2022)

#### 5.1.4 Measured Baseline Ambient Air Quality

Ambient air quality monitoring is conducted by EMM at three stations in the vicinity of the project (Germiston-Delville, Leondale and Thokoza stations) (Figure 5-6). Only Thokoza had ambient air quality measurements for the period 2024. The measurements were for SO<sub>2</sub> and PM<sub>10</sub>. No measurements of other pollutants were available to serve as a baseline for the area.

The availability of valid data from the Thokoza station for the 2024 period was low for meteorological data, with less than 50% available data for all meteorological parameters. Data availability for SO<sub>2</sub> and PM<sub>10</sub> was over 70% (Table 5-6).

Analysis of the available valid data showed that exceedances of the hourly SO<sub>2</sub> NAAQ limit amounted to 4 during 2024, within the allowable 88 exceedances per year (Figure 5-7). No daily SO<sub>2</sub> averages were over the NAAQ limit of 125 µg/m<sup>3</sup>, and the annual average was 22 µg/m<sup>3</sup>, within the NAAQS of 50 µg/m<sup>3</sup> (Figure 5-8). Ambient SO<sub>2</sub> values at Thokoza were compliant with NAAQS.

Analysis of the available valid data showed that exceedances of the daily PM<sub>10</sub> NAAQ limit amounted to 164 during 2024, over the allowable 4 exceedances per year (Figure 5-9). The annual average was 118 µg/m<sup>3</sup>, over the NAAQS of 40 µg/m<sup>3</sup>. Ambient PM<sub>10</sub> values at Thokoza were non-compliant with NAAQS. Most of the daily ambient PM<sub>10</sub> concentrations over 75 µg/m<sup>3</sup> were during the winter months.

Table 5-7: Data availability from the EMM Thokoza ambient air quality monitoring station for the period 2024

Year	Wind speed	Wind direction	Solar radiation	Temperature	SO <sub>2</sub>	NO <sub>2</sub>	PM <sub>10</sub>
2024	37.9%	37.9%	46.2%	46.2%	71.6%	0%	72.1%



Figure 5-6: AQMS in the project vicinity

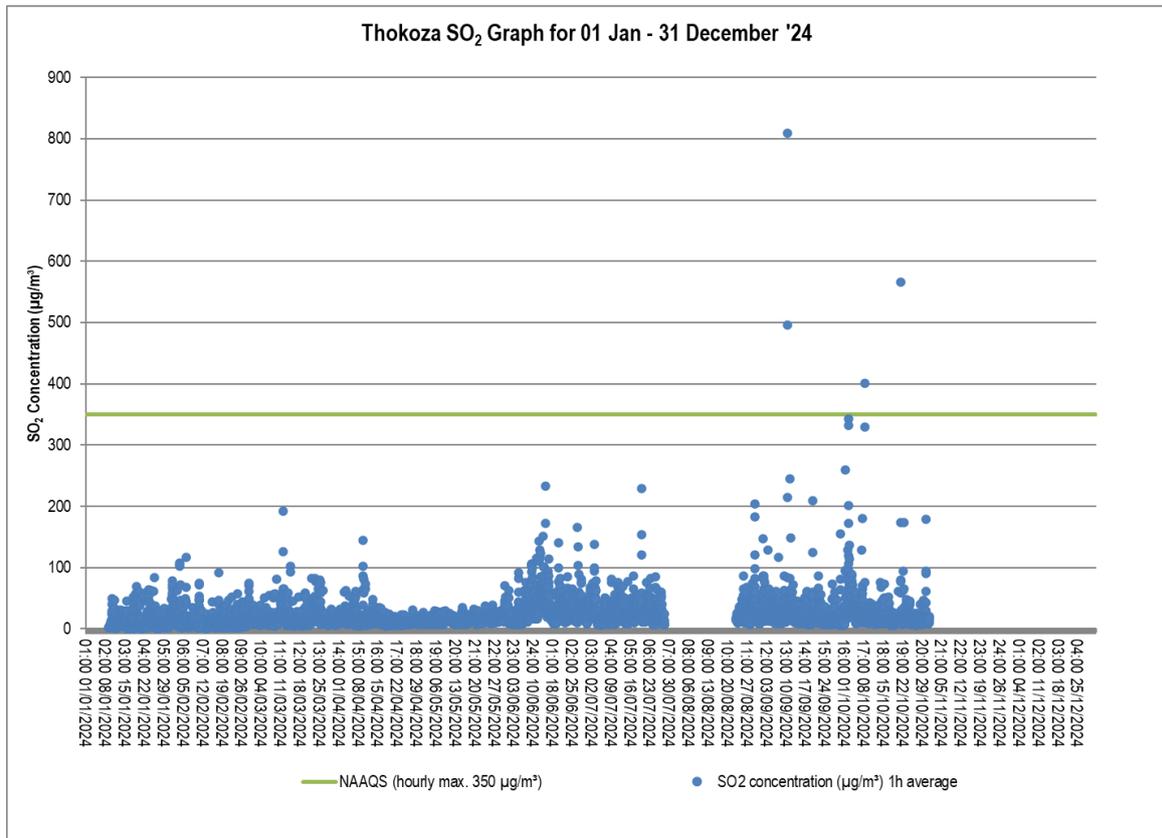


Figure 5-7: Hourly ambient SO<sub>2</sub> concentrations at Thokoza during 2024

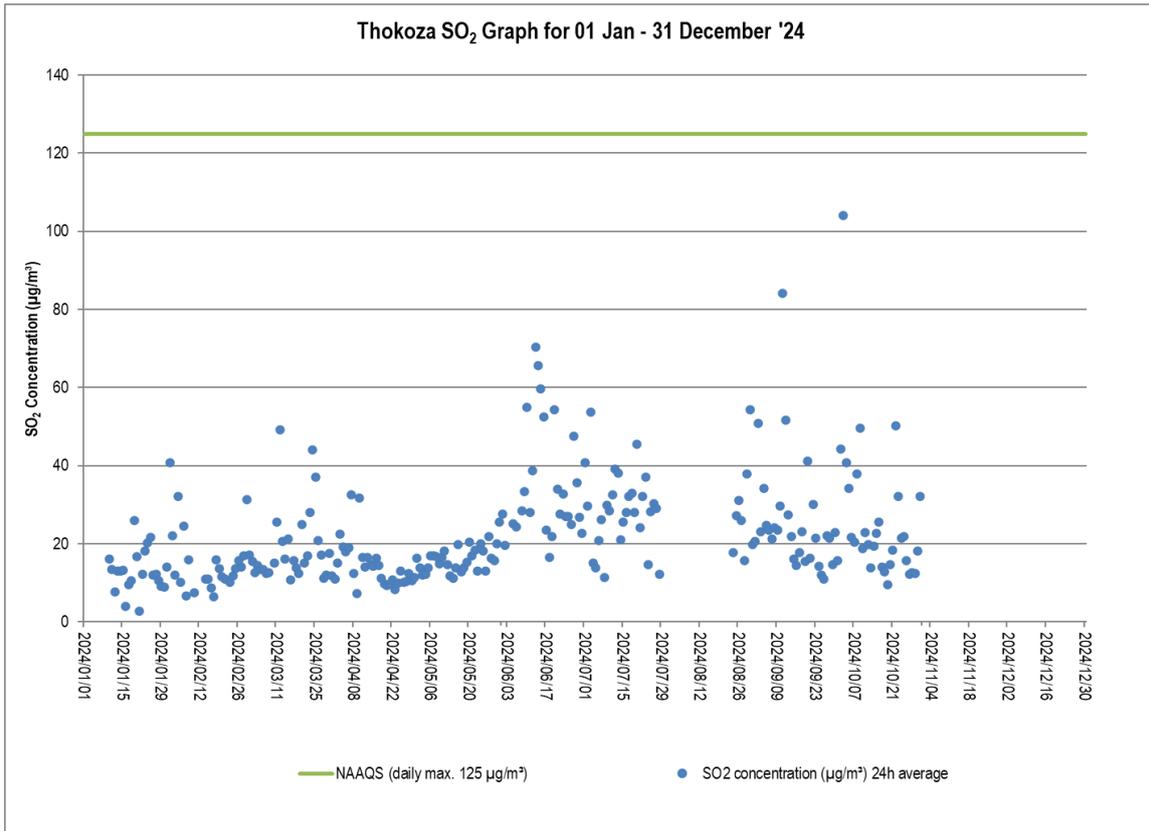


Figure 5-8: Daily ambient SO<sub>2</sub> concentrations at Thokoza during 2024

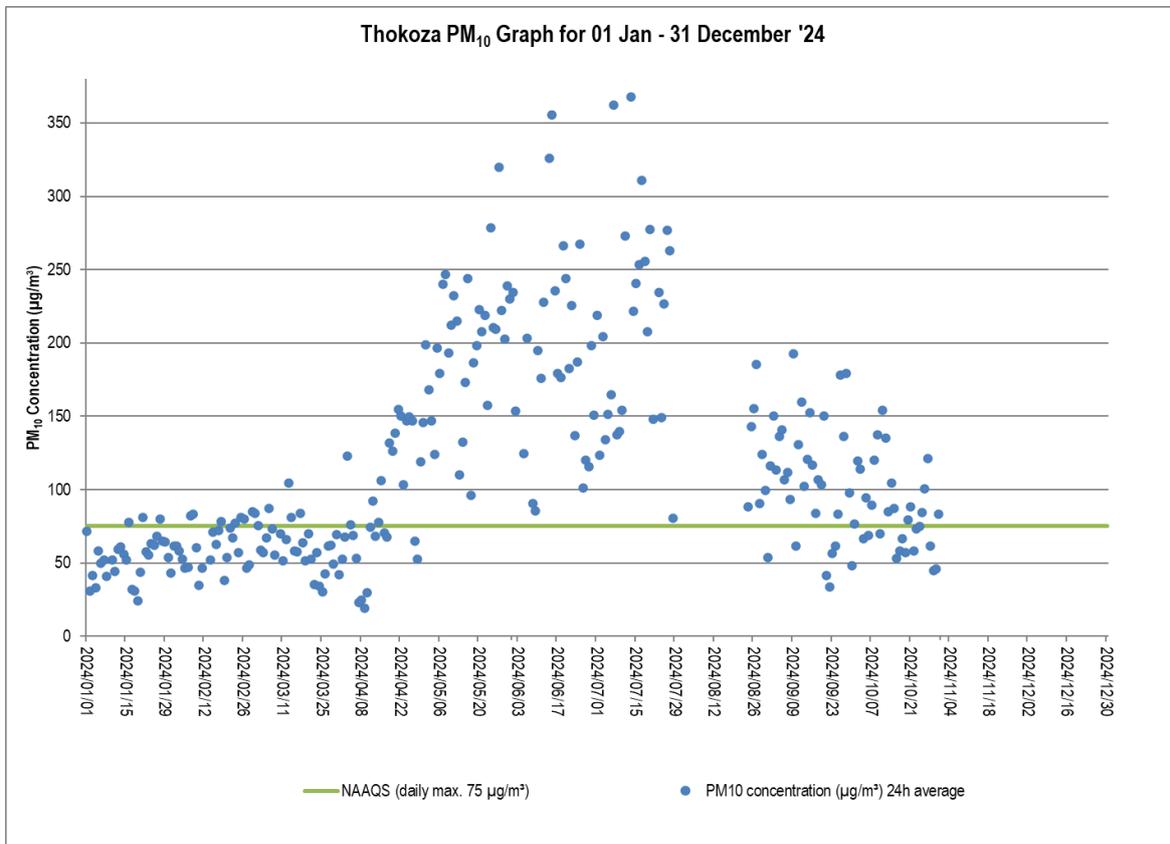


Figure 5-9: Daily ambient PM<sub>10</sub> concentrations at Thokoza during 2024

## 5.1.5 Existing Sources of Emissions near the Proposed Project

### 5.1.5.1 Industrial Emission Sources

The location of the project is in the industrial area of Wadeville. Activities in this area are likely to include several continuous point sources of atmospheric pollutants. The industrial activities within Wadeville are varied and include: food and beverage manufacturers; a glass manufacturer; steel processing facilities; automobile repair facilities; and, warehousing and distribution facilities. The diversity of the operations within Wadeville will result in a diversity of potential atmospheric pollutants from the sources, however SO<sub>2</sub>, NO<sub>x</sub>, CO, PM, and VOCs are likely to be the common pollutants across most processes.

### 5.1.5.2 Vehicle Tailpipe Emissions

Emissions resulting from motor vehicles can be grouped into primary and secondary pollutants. While primary pollutants are emitted directly into the atmosphere, secondary pollutants form in the atmosphere as a result of chemical reactions. Significant primary pollutants emitted by internal combustion engines include CO<sub>2</sub>, CO, carbon (C), SO<sub>2</sub>, oxides of nitrogen (mainly NO) and particulates. Secondary pollutants include NO<sub>2</sub>, photochemical oxidants such as ozone, sulfur acid, sulfates, nitric acid, and nitrate aerosols (particulate matter). Vehicle (i.e. model-year, fuel delivery system), fuel (i.e. type, oxygen content), operating (i.e. vehicle speed, load), and environmental parameters (i.e. altitude, humidity) influence vehicle emission rates (Onursal and Gautam, 1997). The release of volatile organic compounds (VOCs) via vehicle emissions is likely to have localised impacts and be within ambient air quality standards and are considered to be a minor contributor to an emissions inventory.

The main roads in the region include the N3, N17, M37 (Black Reef Road), M49 (Webber road / Osborn road), and Dekema road. Access to the site would be via Wadeville or Rossouw roads, both tarred suburban roads.

### 5.1.5.3 Agricultural Sources

Small scale crop farming and livestock rearing occurs to the south-east of the proposed project in the Klippoortjie AH area. Crop farming activities that may result in atmospheric emissions include land tilling operations, fertiliser and pesticide applications, and harvesting. By applying fertiliser and pesticides use are typically made of vehicles (tractors) driving on unpaved roads and exposed soil. Land tilling include dust entrainment on exposed surfaces, wind-blown dust and scraping and grading type activities resulting in fugitive dust releases. Both particulate matter (PM) and gaseous air emissions (mainly NO, NO<sub>2</sub>, NH<sub>3</sub>, SO<sub>2</sub> and VOCs) are generated from the application of nutrients as fertilizers or manures. There are primarily three harvesting operations resulting in particulate emissions: (1) crop handling by the harvest machine, (2) loading of the harvested crop into trucks, and (3) transport by trucks in the field. Particulate matter, composed of soil dust and plant tissue fragments (chaff), may be entrained by wind (US-EPA, 1995).

Livestock farms, especially cattle, are also significant sources of fugitive dust especially when feedlots are used and the cattle trample in confined areas. Pollutants associated with dairy production for instance include ammonia (NH<sub>3</sub>), hydrogen sulfide (H<sub>2</sub>S), methane (CH<sub>4</sub>), carbon dioxide (CO<sub>2</sub>), oxides of nitrogen (NO<sub>x</sub>) and odour related trace gasses. According to the US-EPA, cattle emit methane through a digestive process that is unique to ruminant animals called enteric fermentation. The calf-cow sector of the beef industry was found to be the largest emitter of methane emissions. Where animals are densely confined the main pollutants of concern include dust from the animal movements, their feed and their manure, NH<sub>3</sub> from the animal urine and manure, and hydrogen sulfide (H<sub>2</sub>S) from manure pits.

Organic dust includes dandruff, dried manure, urine, feed, fungi, bacteria and endotoxins (produced by bacteria, and viruses). Inorganic dust is composed of numerous aerosols from building, materials and the environment. Since the dust is biological it

may react with the defence system of the respiratory tract. Odours and VOCs associated with animal manure is also a concern when cattle are kept in feedlots. The main impact from methane is on the dietary energy due to the reduction of carbon from the rumen. Dust and gasses levels are higher in winter or whenever animals are fed, handled or moved (<http://www.cdc.gov/nasd/docs>).

#### 5.1.5.4 *Fugitive Dust Sources*

These sources are termed fugitive because they are not discharged to the atmosphere in a confined flow stream. Sources of fugitive dust identified to potentially occur in the study area include paved and unpaved roads; agricultural tilling operations; and wind erosion of sparsely vegetated surfaces.

#### 5.1.5.5 *Unpaved and Paved Roads*

Emissions from unpaved roads can constitute a substantial source of emissions to the atmosphere in the South African context. The force of the wheels of a vehicle traveling on an unpaved road, results in the pulverization of surface material. Particles are lifted and dropped from the rolling wheels, and the road surface is exposed to strong turbulent air shear with the surface. The turbulent wake behind the vehicle continues to act on the road surface after the vehicle has passed. Dust emissions from unpaved roads vary in relation to the vehicle traffic (including average vehicle speed, mean vehicle weight, average number of wheels per vehicle) and the silt loading on the roads.

Emissions from paved roads are significantly less than those originating from unpaved roads; however, they do contribute to the particulate load of the atmosphere. Particulate emissions occur whenever vehicles travel over a paved surface. The fugitive dust emissions are due to the re-suspension of loose material on the road surface.

Roads in the vicinity of the project are mostly paved roads.

#### 5.1.5.6 *Wind Erosion of Open Areas*

Emissions generated by wind erosion are dependent on the frequency of disturbance of the erodible surface. Every time a surface is disturbed, its erosion potential is restored. Erodible surfaces may occur as a result of industrial processes (for example tailings storage facilities), agriculture and/or grazing activities. The Klippoortjie AH small-holdings could also be a source of wind-blown particulates after harvesting when fields are fallow.

#### 5.1.6 *Identification of Possible Sensitive Receptors in the Area*

The NAAQS (detailed in Section 5.1.2) are based on human exposure to specific criteria pollutants and as such, possible sensitive receptors were identified where the public is likely to be unwittingly exposed. NAAQS are enforceable outside of project operational boundaries and therefore the sensitive receptors identified include the residential areas as well as schools and hospitals within a 5 km radius (as indicated in Figure 1-1). Potential impacts from the project will be assessed at the closest sensitive receptor and screened against NAAQS or, in their absence, health effect screening criteria.

## 5.1.7 Screening of Human Health Impacts due to Operational Activity from the Project

### 5.1.7.1 Non-Carcinogenic Effects

The simulated impacts were based on maximum operational emissions as stipulated for MES for new plant operations (Section 4). Plots for the simulated impacts are provided in Table 5-8. A summary of the simulated concentrations at the closest sensitive receptor is provided in Table 5-9.

**Table 5-8: Plots for the simulated impacts due to routine operations from the proposed project**

Pollutant	Averaging Period	Figure
PM	Highest daily	5-10
	Annual average	5-11
SO <sub>2</sub>	Highest hourly	5-12
	Highest daily	5-13
	Annual average	5-14
NO <sub>2</sub>	Highest hourly	5-15
	Annual average	5-16
Cl <sub>2</sub>	Highest hourly	5-17
	Annual average	5-18
HCl	Highest hourly	5-19
	Annual average	5-20
HF	Highest hourly	5-21
	Annual average	5-22
NH <sub>3</sub>	Highest hourly	5-23
	Annual average	5-24

**Table 5-9: Simulated concentrations at the nearest sensitive receptor due to operations from the project**

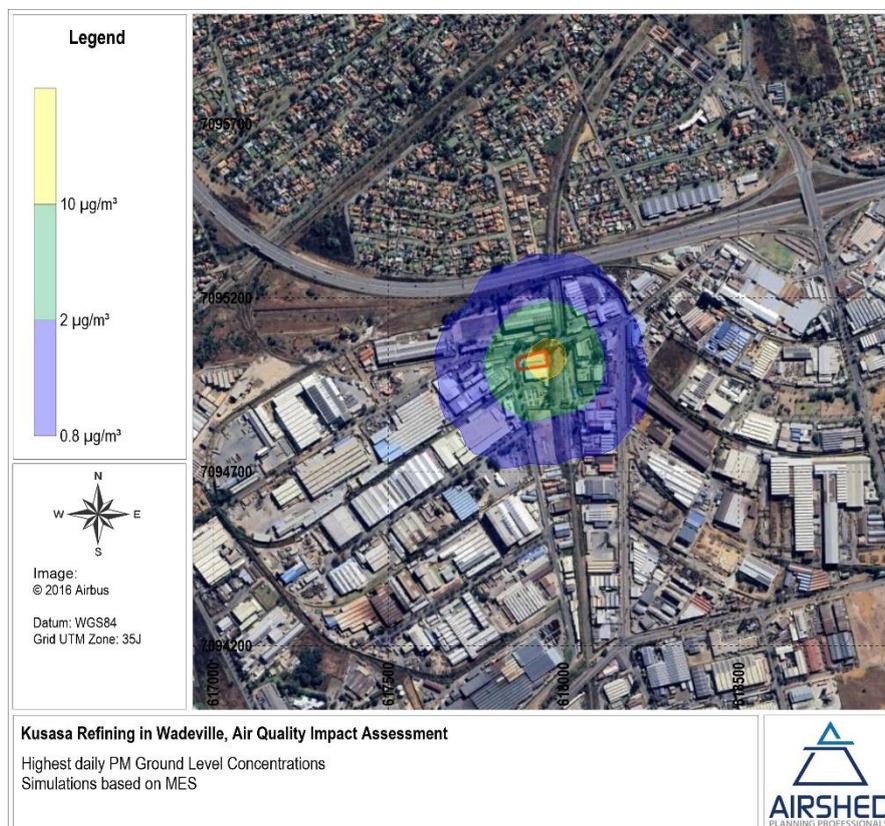
Pollutant	Averaging Period	NAAQS/ Health Effect Screening Level (HESL) (µg/m <sup>3</sup> )	Concentration at the closest sensitive receptor (µg/m <sup>3</sup> )
PM	Highest daily	75 - 4 exceedences annually (PM <sub>10</sub> ) 40 - 4 exceedences annually (PM <sub>2.5</sub> )	0.8
	Annual average	40 (PM <sub>10</sub> ) 20 (PM <sub>2.5</sub> )	0.25
SO <sub>2</sub>	Highest hourly	350 - 88 exceedences annually	48
	Highest daily	125 - 4 exceedences annually	6.4
	Annual average	50	2
NO <sub>2</sub>	Highest hourly	200 - 88 exceedences annually	40
	Annual average	40	1.5
Cl <sub>2</sub>	Highest hourly	170	0.8
	Annual average	0.145	<b>0.25</b>
HCl	Highest hourly	2100	5
	Annual average	20	0.08
HF	Highest hourly	16.4	0.6
	Annual average	14	0.01
NH <sub>3</sub>	Highest hourly	1 184	1.3
	Annual average	500	0.02

The simulated concentrations (assuming maximum allowable emissions according to the MES) are well within the NAAQS and health effect screening levels at the closest sensitive receptor for all averaging periods, with the exception of the simulated annual Cl<sub>2</sub> concentrations.

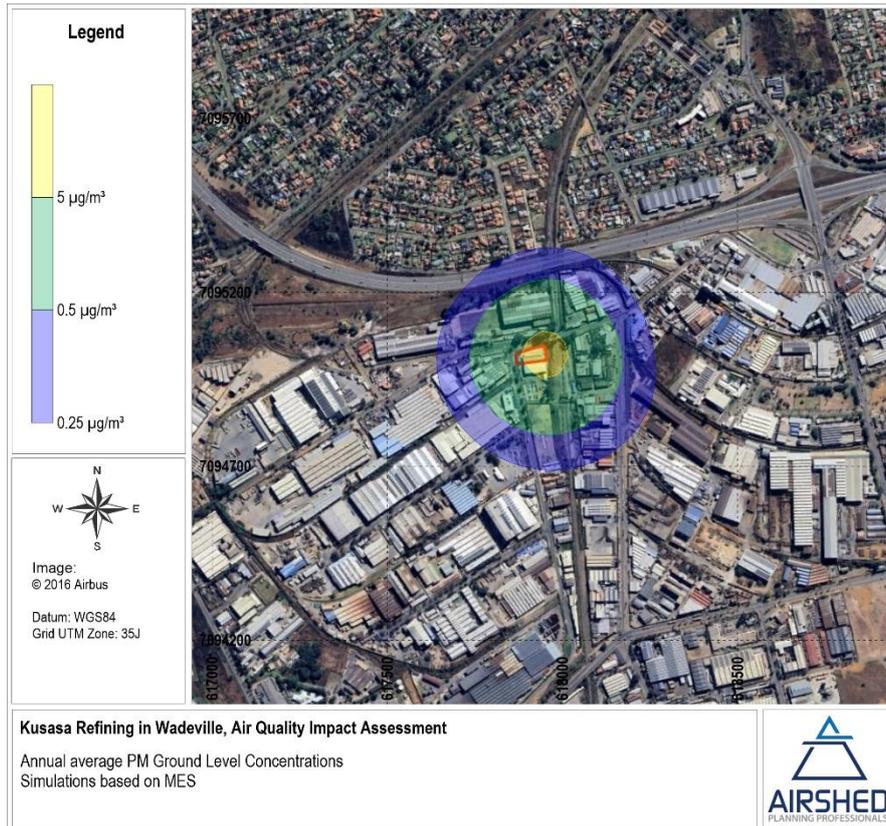
The most recent stack measurements are well below the MES (Table 5-10), so the actual impact is anticipated to be lower than these simulated results.

**Table 5-10: MES versus stack measurements at Kusasa**

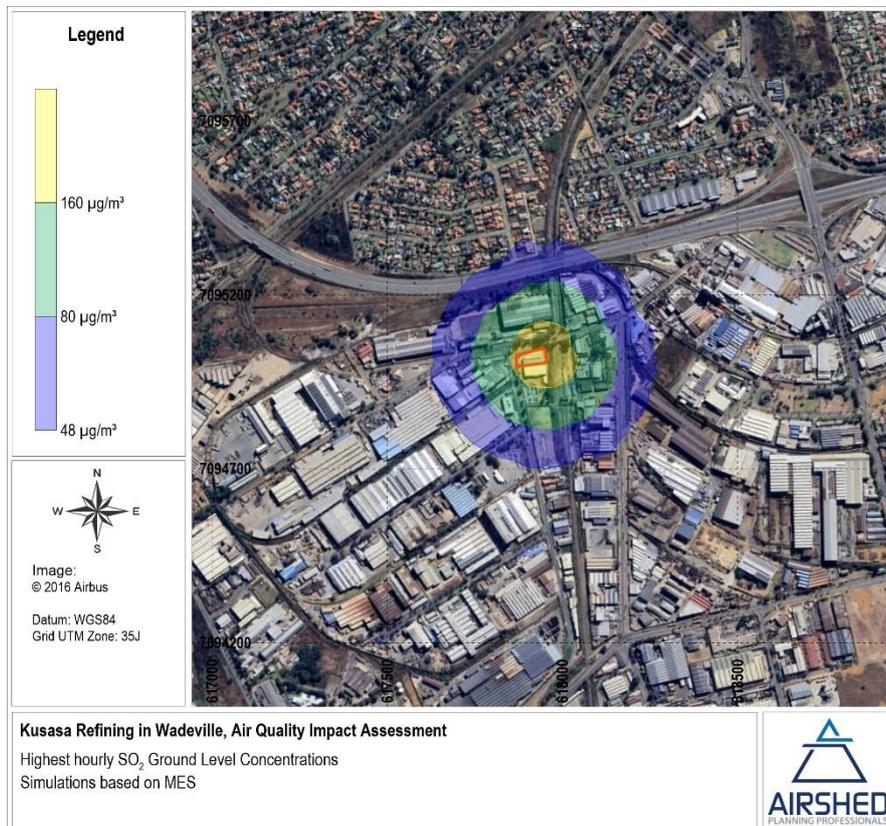
Pollutant	MES (mg/Nm <sup>3</sup> under normal conditions of 273 Kelvin and 101.3 kPa)	Stack measurements during 2024 (mg/Nm <sup>3</sup> )		Stack measurements during 2025 (mg/Nm <sup>3</sup> )	
		Baghouse	Scrubber	Baghouse	Scrubber
Particulate matter	50	7	14	6.4	4
Chlorine	50	<2	<2	<2	<2
Sulfur dioxide	400	-	15.3	-	-
Hydrogen chloride	30	<0.5		0.31	<0.5
Hydrogen fluoride	30	<0.1		<0.1	<0.1
Ammonia	100	0.1	0.04	0.04	0.01
Oxides of nitrogen	300	-	163	-	61



**Figure 5-10: Highest daily particulate concentrations due to routine operations from the project**



**Figure 5-11: Annual average particulate concentrations due to routine operations from the project**



**Figure 5-12: Highest hourly SO<sub>2</sub> concentrations due to routine operations from the project**

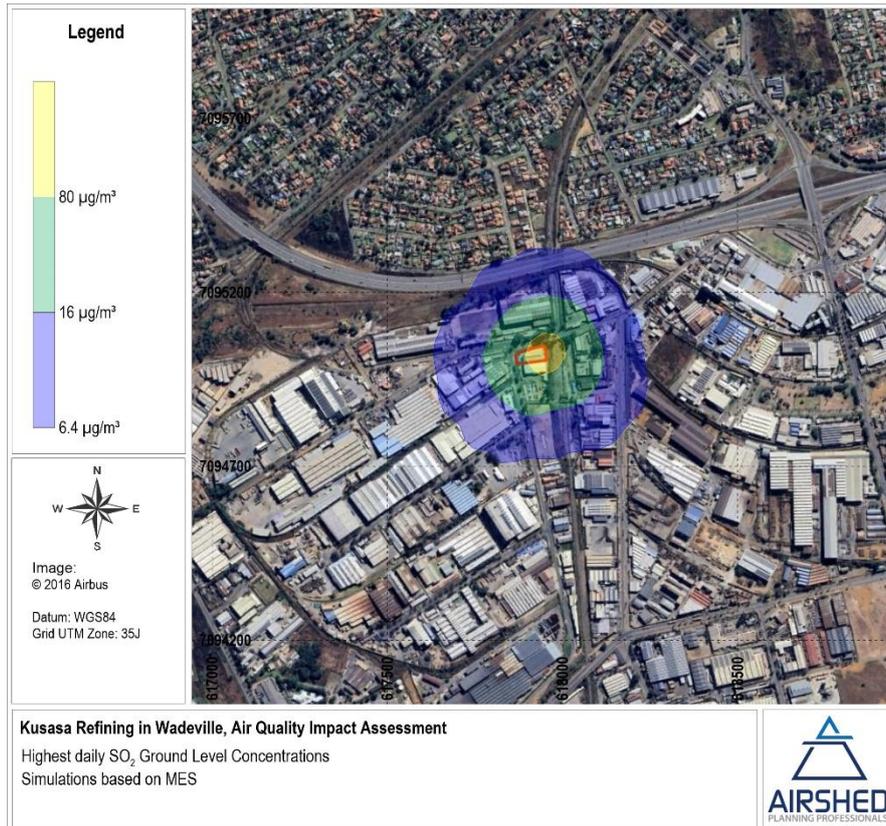


Figure 5-13: Highest daily  $\text{SO}_2$  concentrations due to routine operations from the project

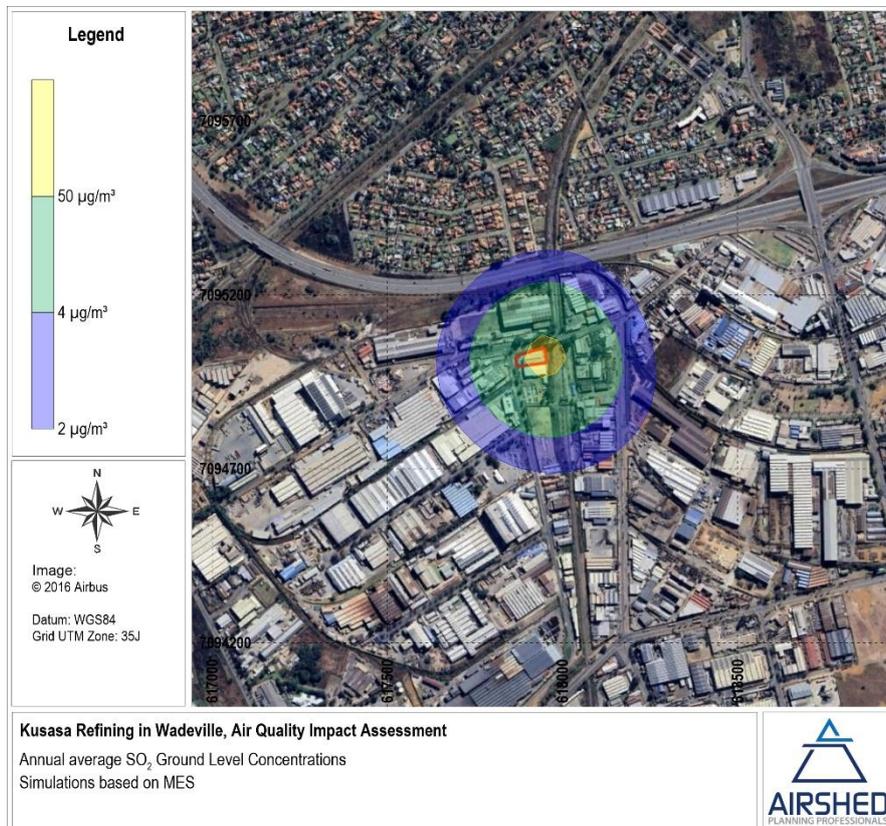


Figure 5-14: Annual average  $\text{SO}_2$  concentrations due to routine operations from the project

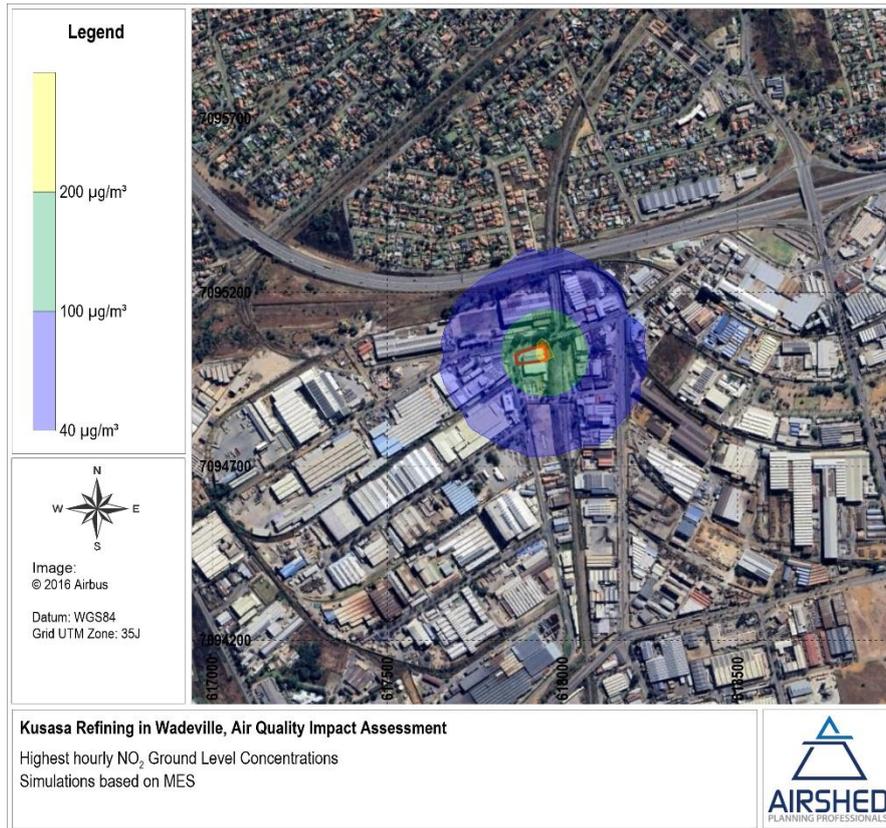


Figure 5-15: Highest hourly NO<sub>2</sub> concentrations due to routine operations from the project

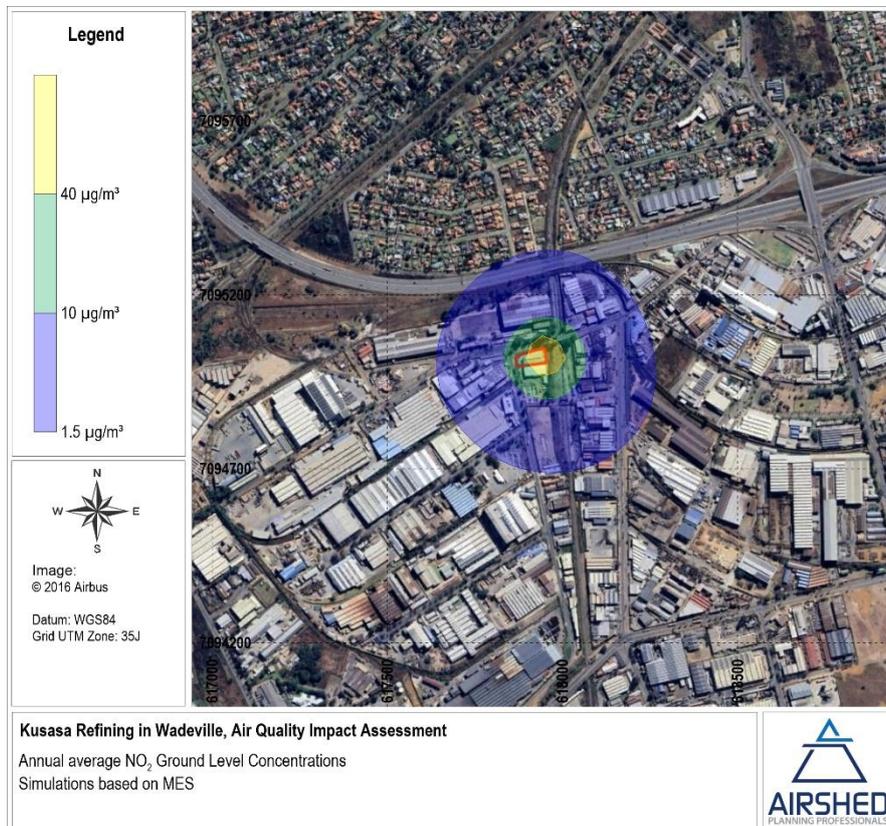


Figure 5-16: Annual average NO<sub>2</sub> concentrations due to routine operations from the project

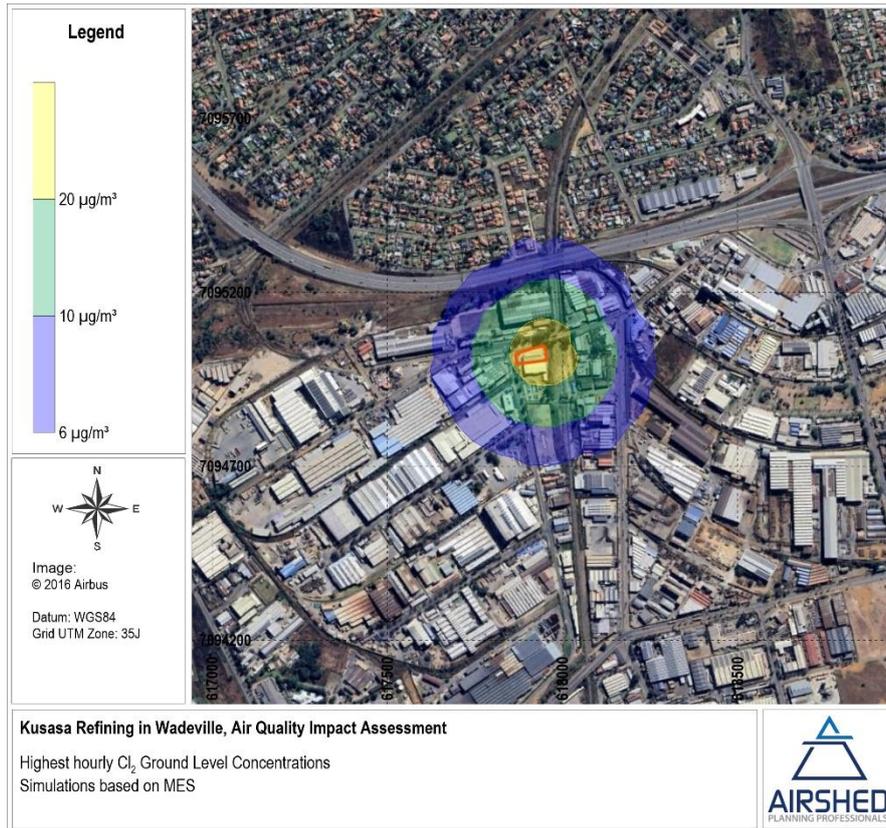


Figure 5-17: Highest hourly  $\text{Cl}_2$  concentrations due to routine operations from the project

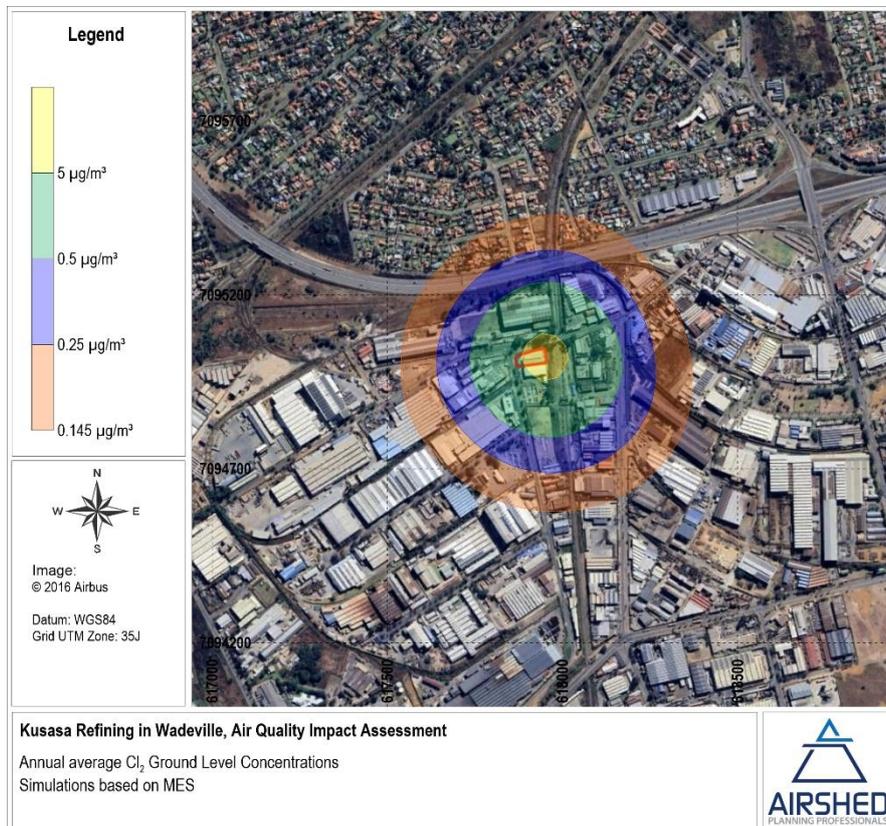


Figure 5-18: Annual average  $\text{Cl}_2$  concentrations due to routine operations from the project

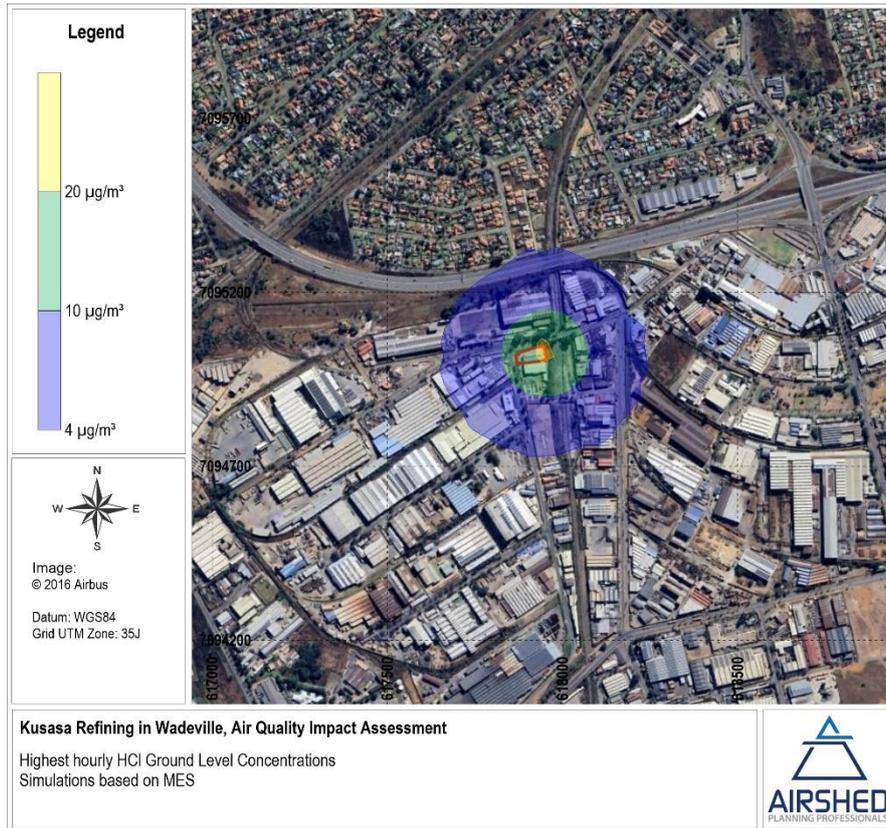


Figure 5-19: Highest hourly HCl concentrations due to routine operations from the project

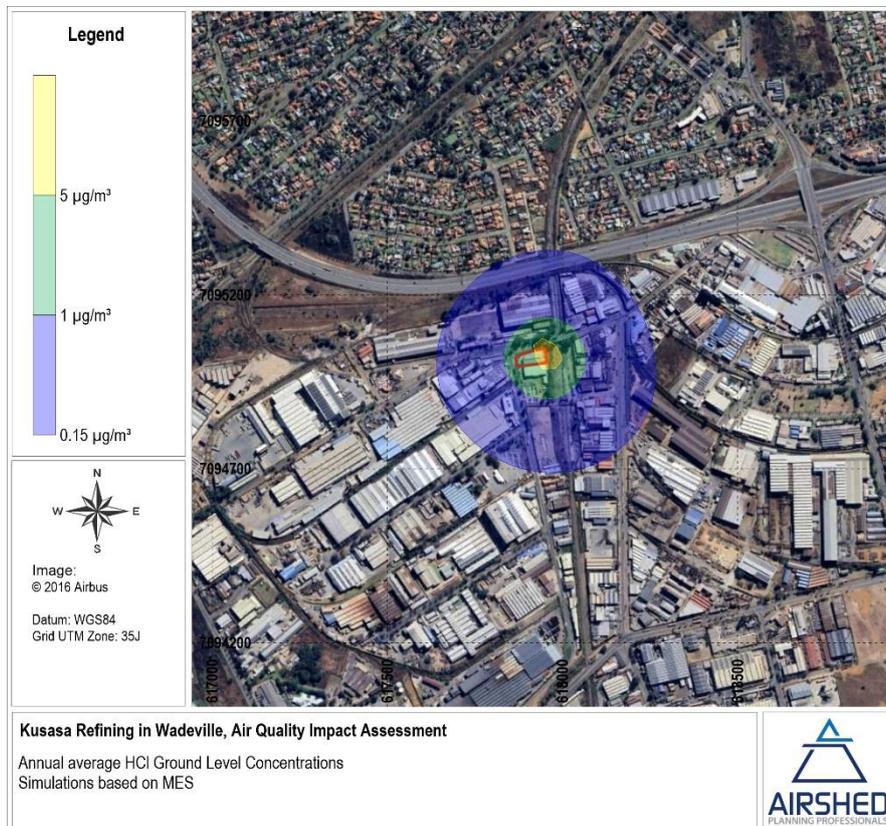


Figure 5-20: Annual average HCl concentrations due to routine operations from the project

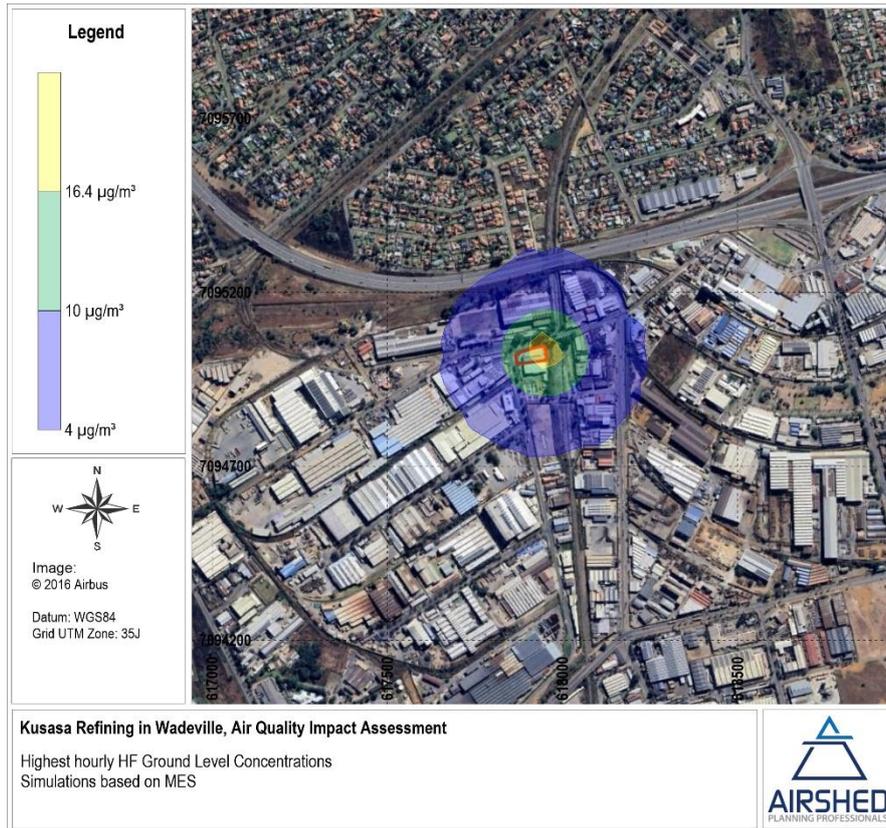


Figure 5-21: Highest hourly HF concentrations due to routine operations from the project

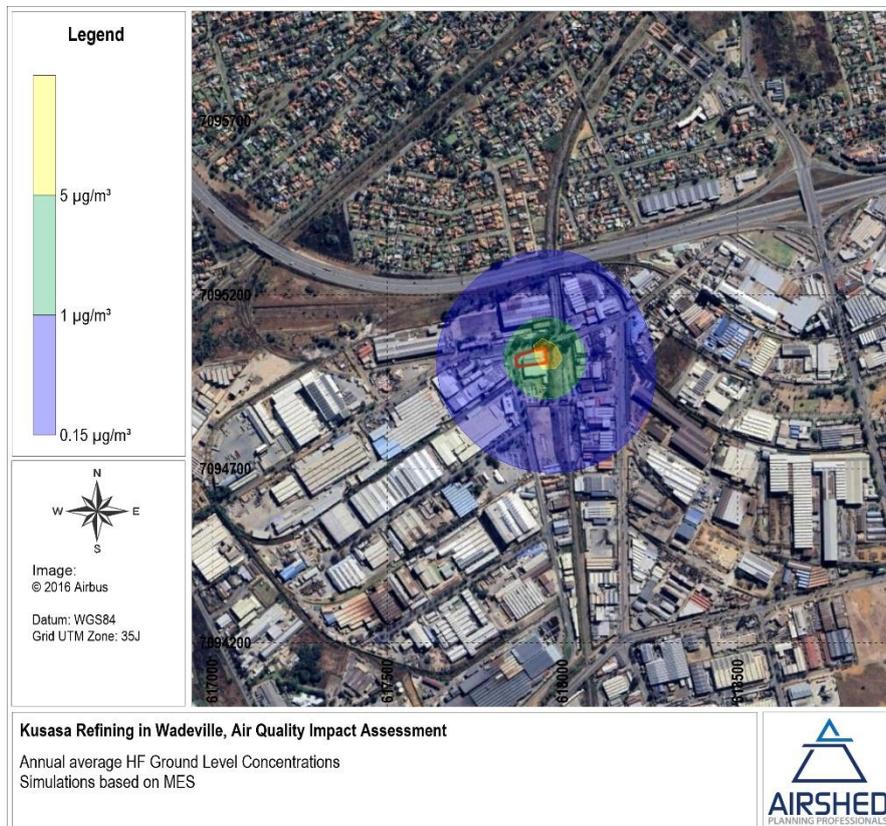


Figure 5-22: Annual average HF concentrations due to routine operations from the project

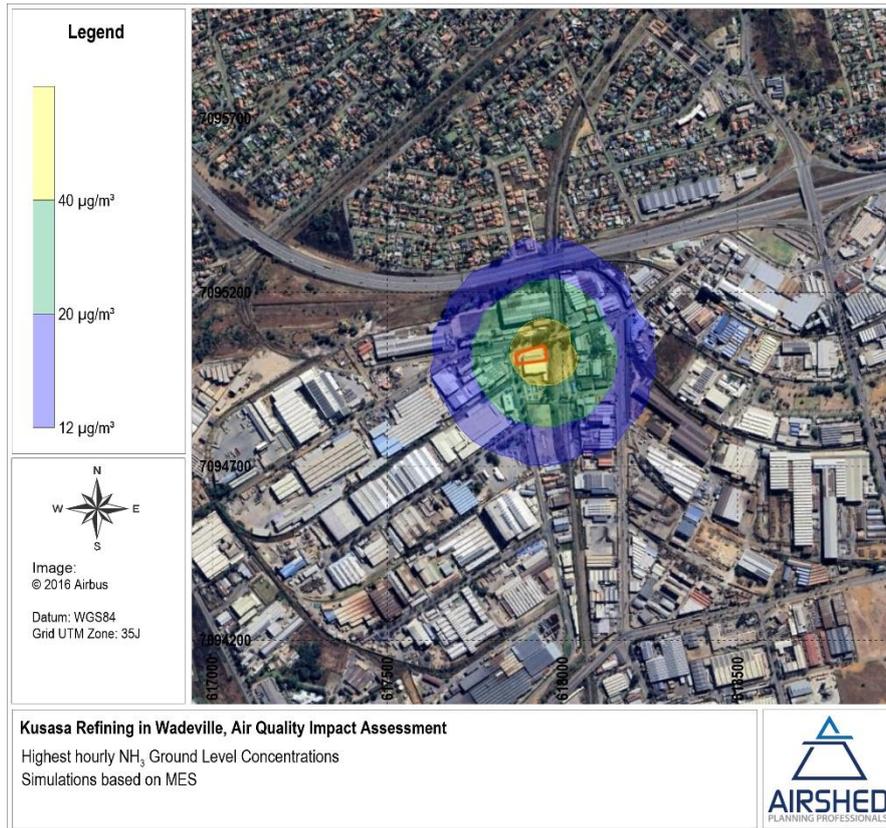


Figure 5-23: Highest hourly  $\text{NH}_3$  concentrations due to routine operations from the project

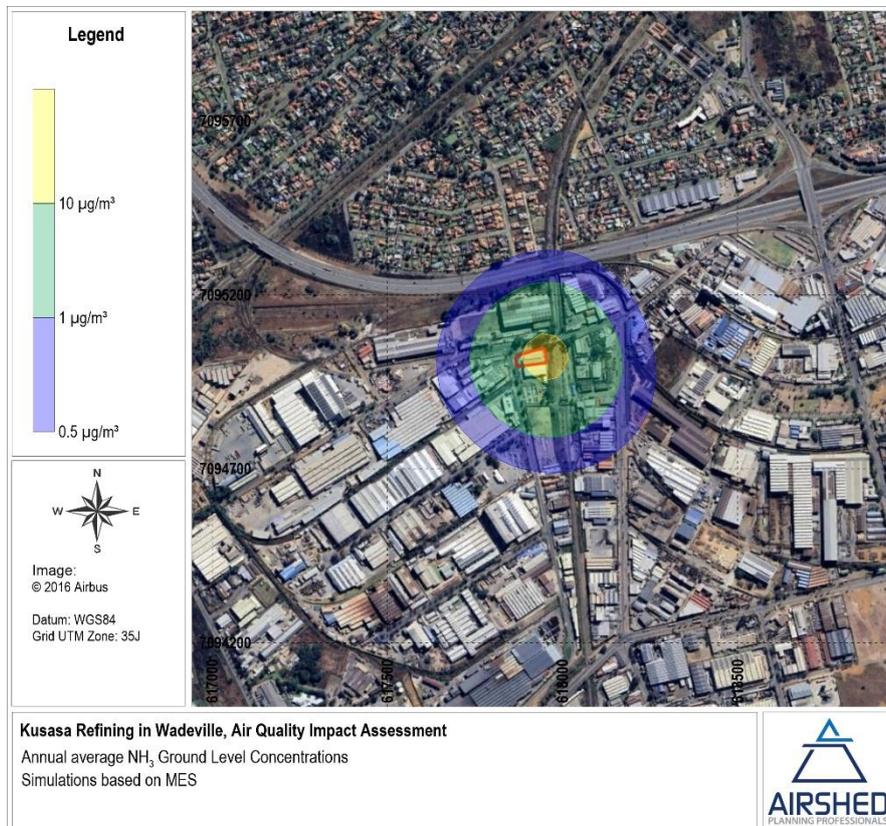


Figure 5-24: Annual average  $\text{NH}_3$  concentrations due to routine operations from the project

### 5.1.8 Significance Rating

2014 EIA Regulations require that impacts be assessed in terms of the nature, significance, consequence, extent, duration and probability of the impacts including the degree to which these impacts can be reversed, may cause irreplaceable loss of resources, and can be avoided, managed or mitigated. The significance ranking methodology used in this scoping report is provided in Appendix A.

The project is expected to have the following significance rating (Table 5-11):

- Construction Phase:
  - Without mitigation: medium-low negative significance rating.
  - With Mitigation (good housekeeping practices): medium-low negative significance rating.
- Operation Phase:
  - Without mitigation: medium-low negative significance rating.
  - With Mitigation: medium-low negative significance rating.
- Decommissioning Phase:
  - Without mitigation: medium-low negative significance rating.
  - With Mitigation (good housekeeping practices): medium-low negative significance rating.

**Table 5-11: Significance rating for potential air quality impacts due to the project activities**

Impact Description		Pre-Mitigation						Pre-mitigation significance	Post Mitigation						Post-mitigation significance	Confidence	Priority Factor Criteria		Priority Factor	Final score
Impact	Phase	Nature	Extent	Duration	Magnitude	Reversibility	Probability		Nature	Extent	Duration	Magnitude	Reversibility	Probability			Cumulative Impact	Irreplaceable loss		
Ambient air quality	Construction	-1	2	2	2	1	3	-5.25 (low medium)	-1	2	2	1	1	3	-4.5 (low medium)	Medium	2	1	1.125	-5.1
Ambient air quality	Operation	-1	3	4	2	1	3	-7.5 (low medium)	-1	2	4	2	1	3	-6.75 (low medium)	Medium	2	1	1.125	-7.6
Ambient air quality	Decommissioning	-1	2	2	3	1	3	-6 (low medium)	-1	2	2	2	1	3	-5.25 (low medium)	Medium	2	1	1.125	-5.9

## 5.1.9 *Main Findings and Recommendations*

### 5.1.9.1 *Main Findings*

The findings from the air quality impact assessment are:

1. The wind regime for the area largely reflects the synoptic scale circulation with dominant north-westerly and northerly flow fields.
2. No baseline ambient ground level concentrations were available for Leondale and Delville. Baseline ambient ground level concentrations measured at Thokoza, for the period 2024:
  - a. Ambient SO<sub>2</sub> values at Thokoza were compliant with NAAQS.
  - b. Ambient PM<sub>10</sub> values at Thokoza were non-compliant with NAAQS.
3. The ground level concentrations due to proposed project operations (assuming maximum allowable emissions according to the MES) were well within NAAQS and health effect screening levels at the closest sensitive receptors for all averaging periods, with the exception of simulated annual Cl<sub>2</sub> concentrations. Current stack measurements are well below the MES, so the actual impact is anticipated to be lower than these simulated results.
4. The significance rating due to maximum operation of the proposed project was medium-low for construction, operation and decommissioning phases.

### 5.1.9.2 *Recommendations*

It is recommended that the proposed project go-ahead and that stack emissions be measured once the expansion has been completed in order to verify pollutants and emission concentrations from the process.

## 5.2 **Analysis of Emissions' Impact on the Environment**

An assessment of air pollution impacts on soil, water and receptors other than human were not included in the investigation. No exceedances of the NAAQS or health effect screening levels were simulated due to project operations at maximum operating conditions (with the exception of Cl<sub>2</sub>). Actual stack measurements are well below the MES. Air pollution impacts on soil, water and other receptors as a result of the project operations are therefore expected to be low in the context of contributions from other industries within the greater Wadeville area.

## 6 ANNEXURE A

### DECLARATION OF ACCURACY OF INFORMATION – APPLICANT

Name of Enterprise: Kusasa Refining (Pty) Ltd

Declaration of accuracy of information provided:

#### Atmospheric Impact Report in terms of section 30 of the Act.

I, André Grobbelaar [*duly authorised*], declare that the information provided in this atmospheric impact report is, to the best of my knowledge, in all respects factually true and correct. I am aware that the supply of false or misleading information to an air quality officer is a criminal offence in terms of section 51(1)(g) of the National Environmental Management : Air Quality Act (Act No. 39 of 2004).

Signed at Wadeville on this 20th day of March 2026



**SIGNATURE**

#### CAPACITY OF SIGNATORY

General Manager

## 7 ANNEXURE B

### DECLARATION OF INDEPENDENCE - PRACTITIONER

**Name of Practitioner:** Gillian Petzer

**Name of Registration Body:** Engineering Council of South African

**Professional Registration No.:** 20170315

Declaration of independence and accuracy of information provided:

#### **Atmospheric Impact Report in terms of section 30 of the Act.**

I, Gillian Petzer declare that I am independent of the applicant. I have the necessary expertise to conduct the assessments required for the report and will perform the work relating the application in an objective manner, even if this results in views and findings that are not favourable to the applicant. I will disclose to the applicant and the air quality officer all material information in my possession that reasonably has or may have the potential of influencing any decision to be taken with respect to the application by the air quality officer. The information provided in this atmospheric impact report is, to the best of my knowledge, in all respects factually true and correct. I am aware that the supply of false or misleading information to an air quality officer is a criminal offence in terms of section 51(1)(g) of the National Environmental Management: Air Quality Act (Act No. 39 of 2004).

Signed at Centurion on this 3 day of February 2026.

#### **SIGNATURE**

Principal Air Quality Scientist

**CAPACITY OF SIGNATORY**

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## APPENDIX A: IMPACT SIGNIFICANCE RATING METHODOLOGY

The impact significance rating methodology, as presented herein and utilised for all EIMS Impact Assessment Projects, is guided by the requirements of the NEMA EIA Regulations 2014 (as amended). The broad approach to the significance rating methodology is to determine the environmental risk (ER) by considering the consequence (C) of each impact (comprising Nature, Extent, Duration, Magnitude, and Reversibility) and relate this to the probability/ likelihood (P) of the impact occurring. The ER is determined for the pre- and post-mitigation scenario. In addition, other factors, including cumulative impacts and potential for irreplaceable loss of resources, are used to determine a prioritisation factor (PF) which is applied to the ER to determine the overall significance (S). The impact assessment will be applied to all identified alternatives.

### Determination of Environmental Risk:

The significance (S) of an impact is determined by applying a prioritisation factor (PF) to the environmental risk (ER). The environmental risk is dependent on the consequence (C) of the particular impact and the probability (P) of the impact occurring. Consequence is determined through the consideration of the Nature (N), Extent (E), Duration (D), Magnitude (M), and Reversibility (R) applicable to the specific impact.

For the purpose of this methodology the consequence of the impact is represented by:

$$C = \frac{(E + D + M + R) * N}{4}$$

Each individual aspect in the determination of the consequence is represented by a rating scale as defined in Table A-1 below.

**Table A-1: Criteria for determining impact consequence**

Aspect	Score	Definition
Nature	- 1	Likely to result in a negative/ detrimental impact
	+1	Likely to result in a positive/ beneficial impact
Extent	1	Activity (i.e. Highly localised, limited to the area applicable to the specific activity)
	2	Site (i.e. within the development property or site boundary, or the area within a few hundred meters of the site)
	3	Local (i.e. beyond the site boundary within the Local administrative boundary (e.g. Local Municipality) or within consistent local geographical features, or the area within 5 km of the site)

Aspect	Score	Definition
	4	Regional (i.e. Far beyond the site boundary, beyond the Local administrative boundaries within the Regional administrative boundaries (e.g. District Municipality), or extends into different distinct geographical features, or extends between 5 and 50 km from the site)
	5	Provincial / National / International (i.e. extends into numerous distinct geographical features, or extends beyond 50 km from the site)
Duration	1	Immediate (<1 year)
	2	Short term (1-5 years)
	3	Medium term (6-15 years)
	4	Long term (15 – 65 years, the impact will cease after the operational life span of the project)
	5	Permanent (> 65 years, no mitigation measure of natural process will reduce the impact after construction/operation/decommissioning)
Magnitude/ Intensity	1	Minor (where the impact affects the environment in such a way that natural, cultural and social functions and processes are not affected)
	2	Low (where the impact affects the environment in such a way that natural, cultural and social functions and processes are slightly affected)
	3	Moderate (where the affected environment is altered but natural, cultural and social functions and processes continue albeit in a modified way)
	4	High (where natural, cultural or social functions or processes are altered to the extent that it will temporarily cease)
	5	Very high / don't know (where natural, cultural or social functions or processes are altered to the extent that it will permanently cease)
Reversibility	1	Impact is reversible without any time and cost
	2	Impact is reversible without incurring significant time and cost
	3	Impact is reversible only by incurring significant time and cost

Aspect	Score	Definition
	4	Impact is reversible only by incurring prohibitively high time and cost
	5	Irreversible Impact

Once the C has been determined the significance is determined in accordance with the standard risk assessment relationship by multiplying the C and the P. Probability is rated/scored as per Table A-2.

**Table A-2: Probability scoring**

Probability	1	Improbable (Rare, the event may occur only in exceptional circumstances, the possibility of the impact materialising is very low as a result of design, historic experience, or implementation of adequate corrective actions; <5% chance)
	2	Low probability (Unlikely, impact could occur but not realistically expected; >5% and <20% chance)
	3	Medium probability (Possible, the impact may occur; >20% and <50% chance)
	4	High probability (Likely, it is most probable that the impact will occur- > 50 and <90% chance)
	5	Definite (Almost certain, the impact is expected to, or will, occur, >90% chance)

The result is a qualitative representation of relative significance (S) associated with the impact. S is therefore calculated as follows:

$$S = C \times P$$

**Table A-3: Determination of significance**

Consequence	5 – very high	5	10	15	20	25
	4 - high	4	8	12	16	20
	3 - medium	3	6	9	12	15
	2 - low	2	4	6	8	10
	1 – very low	1	2	3	4	5
		1 - improbable	2 - low	3 - possible	4 - probable	5 - definite
<b>Probability</b>						

The outcome of the environmental risk assessment will result in a range of scores, ranging from 1 through to 25. These S scores are then grouped into respective classes as described in Table -4.

**Table A-4: Significance scores**

Significance Scores	
Value	Description
≤4.25	Low (i.e. where this impact is unlikely to be a significant environmental risk/ reward)
>4,25, ≤8.5	Low-Medium (i.e. where the impact could have a significant environmental risk/ reward)
>8.5, ≤13.75	High-Medium (i.e. where the impact could have a significant environmental risk/ reward)
>13.75	High (i.e. where the impact will have a significant environmental risk/ reward)

The impact significance will be determined for each impact without relevant management and mitigation measures (pre-mitigation), as well as post implementation of relevant management and mitigation measures (post-mitigation). This allows for a prediction in the degree to which the impact can be managed/mitigated.

Impact Prioritisation:

Further to the assessment criteria presented in the section above, it is necessary to assess each potentially significant impact in terms of:

- Cumulative impacts; and
- The degree to which the impact may cause irreplaceable loss of resources.

To ensure that these factors are considered, an impact prioritisation factor (PF) will be applied to each impact significance (post mitigation). This prioritisation factor does not aim to detract from the risk ratings but rather to focus the attention of the decision-making authority on the higher priority/significance issues and impacts. The PF will be applied to the significance score based on the assumption that relevant suggested management/mitigation impacts are implemented.

**Table A-5: Criteria for determining prioritisation**

<b>Cumulative Impact (CI)</b>	Low (1)	Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is unlikely that the impact will result in spatial and temporal cumulative change.
	Medium (2)	Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.
	High (3)	Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is highly probable/definite that the impact will result in spatial and temporal cumulative change.
<b>Irreplaceable loss of resources (LR)</b>	Low (1)	Where the impact is unlikely to result in irreplaceable loss of resources.
	Medium (2)	Where the impact may result in the irreplaceable loss (cannot be replaced or substituted) of resources but the value (services and/or functions) of these resources is limited.

	High (3)	Where the impact may result in the irreplaceable loss of resources of high value (services and/or functions).
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The value for the final impact priority is represented as a single consolidated priority, determined as the sum of each individual criteria represented in Table A-5. The impact priority is therefore determined as follows:

$$Priority = Cl + LR$$

The result is a priority score which ranges from 2 to 6 and a consequent PF ranging from 1 to 1.5 (refer to Table A-6).

**Table A-6: Determination of prioritisation factor**

Priority	Prioritisation Factor
2	1
3	1.125
4	1.25
5	1.375
6	1.5

In order to determine the final impact significance (FS), the PF is multiplied by the significance of the post mitigation scoring. The ultimate aim of the PF is an attempt to increase the post mitigation environmental risk rating by a factor of 0.5, if all the priority attributes are high (i.e. if an impact comes out with a high medium environmental risk after the conventional impact rating, but there is significant cumulative impact potential and significant potential for irreplaceable loss of resources, then the net result would be to upscale the impact to a high significance).

**Table A-7: Final environmental significance rating**

Significance Rating	Description
< -25	Very High (Impacts in this class are extremely significant and pose a very high environmental risk. In certain instances these may represent a fatal flaw. They are likely to have a major influence on the decision and may be difficult or impossible to mitigate. Offset's may be necessary.
-13.75 to -25	High negative (These impacts are significant and must be carefully considered in the decision-making process. They have a high environmental risk or impact and require extensive mitigation measures).
-8.5 to -13.75	Medium-High negative (i.e. Impacts in this class are more substantial and could have a significant environmental risk. They may influence the decision to develop in the area and require more robust mitigation measures).
-4.25 to -8.5	Medium- Low negative (i.e. These impacts are slightly more significant than low impacts but still do not pose a major environmental risk. They might require some mitigation measures but are generally manageable).

-1 to -4.25	Low negative (i.e. Impacts in this class are minor and unlikely to have a significant environmental risk. They do not influence the decision to develop in the area and are typically easily mitigated.
0	No impact
1 to 4.25	Low positive
4.25 to 8.5	Medium-Low positive
8.5 to 13.75	Medium-High positive
>13.75	High positive

The significance ratings and additional considerations applied to each impact will be used to provide a quantitative comparative assessment of the alternatives being considered. In addition, professional expertise and opinion of the specialists and the environmental consultants will be applied to provide a qualitative comparison of the alternatives under consideration. This process will identify the best alternative for the proposed project.

## APPENDIX B: CURRICULUM VITAE OF PROJECT TEAM

## CURRICULUM VITAE

<b>Name</b>	Gillian Petzer (née Möhle)
<b>Date of Birth</b>	1 December 1975
<b>Nationality</b>	South African
<b>Employer</b>	Airshed Planning Professionals (Pty) Ltd
<b>Position</b>	Principal Consultant and Project Manager
<b>Profession</b>	Chemical Engineer employed as an Air Quality and Climate Change Impact Assessment Consultant
<b>Years with Firm</b>	20+ years

### MEMBERSHIP OF PROFESSIONAL SOCIETIES

- South African Institute of Chemical Engineers, 2003 to present
- Institution of Chemical Engineers (IChemE) - Membership number 99964317
- National Association for Clean Air (NACA), 2003 to present
- Professional Engineer – Registration number 20170315

### EXPERIENCE

Gillian has over twenty years of experience in air quality impact assessment and management and ten years in greenhouse gas quantification and climate change impact assessments. She is an employee of Airshed Planning Professionals (Pty) Ltd and is involved in the compilation of emission inventories, air pollution mitigation and management, and air pollution and climate change impact work.

A list of projects competed in various sectors is given below.

#### *Air Quality Management*

- Richards Bay Air Quality Management Plan
- Tshwane Air Quality Management Plan
- Dust Management Plan for various mines

### *Mining Sector*

Lusthof Colliery, South Deep Mine, Kangra, MacWest, Sishen Iron Ore Mine, Kolomela Mine, SA Chrome, Esase Gold Project (Ghana), Mampon Gold Mine (Ghana), Navachab (Namibia), Skorpion Zinc mine (Namibia), Debswana Diamond Mines (Botswana). Quarries: Afrisam Pietermaritzburg, AMT operations (Rustenburg and Wonderstone).

### *Industrial Sector*

Various Brickworks, Middelburg Ferrochrome, Impala Platinum (Springs), Delta EMD Project, PetroSA, Alfluroco Aluminium Fluoride Project, PPC, Rand Carbide, Vanchem, BCL incinerator, AEL, Namakwa Sands Plant, Liquid Natural Gas Refinery (Equatorial Guinea), Phalaborwa Mining Company, Asphalt plants, Ceramic facilities, Arcelor Mittal.

### *Energy Sector*

Walvis Bay Power Station Project (Namibia), various small power stations (Eritrea, Nigeria, Mauritania, Kenya), Matimba Power Station, Mossel Bay OCGT Power Station, Sese Power Station (Botswana), Geothermal Power Station (Kenya), Kusile Power Station.

### *Waste Disposal and Treatment Sector*

Rosslyn and Chloorkop Waste Disposal Sites, Organic waste disposal site.

### *Transport and Logistics Sector*

Kolomela Iron Ore Railway Line, Guinea Port and Railway Project (Guinea), Grindrod Coal Terminal, VALE Port Project (Mozambique), various fuel depots.

### *Greenhouse Gas Emissions Inventories and Climate Change Impact Assessments*

Van Eck Power Station (Namibia), Sheberghan Gas Fields (Afghanistan), Cabinda Refinery (Angola), Oil and gas offshore exploration (West Coast of SA), review of coal and gold mines climate change impact assessments.

### *Ambient Air Quality and Noise Sampling*

- Gravimetric Particulate Matter (PM) and dustfall sampling
- Passive diffusive gaseous pollutant sampling

## SOFTWARE PROFICIENCY

- Atmospheric Dispersion Models: AERMOD, ISC, CALPUFF, ADMS (United Kingdom), CALINE, GASSIM, TANKS
- Graphical Processing: Surfer, ArcGIS (basic proficiency)
- Other: MS Word, MS Excel, MS Outlook

## EDUCATION

- BEng: (Chemical Engineering), 2002, University of Pretoria

## RECENT COURSES COMPLETED AND CONFERENCES ATTENDED

- Conference: IUAPPA (October 2013), Attended
- Course: Climate change and carbon management. Presented by Environmental & Sustainability Solutions (July 2014)
- Conference NACA (October 2016), Attended
- Conference NACA (October 2017), Attended
- Process Vessel and Tank Design Course (May 2019)
- Multi-Variable Problems and Solutions Course (May 2020)
- Knowledge Management, Communication and Report Writing Course (June 2020)
- Materials Design Course (June 2020)
- Excel for Engineers and Other Built Environment Professionals (August 2022)
- IAIA Impact Assessment and Climate Change Symposium (September 2022), Attended and presented a climate change impact assessment
- IAIA Impact Assessment Conference (August 2023), Attended
- Conference NACA (October 2024), Attended

## COURSES PRESENTED

- National Environmental Management: Air Quality Act and its Implementation (course arranged by the North-West University - NWU)

## COUNTRIES OF WORK EXPERIENCE

South Africa, Namibia, Botswana, Ghana, Eritrea, Mauritania, Mozambique, Kenya, Guinea, Equatorial Guinea, Nigeria, Angola and Afghanistan.

## LANGUAGES

Language	Proficiency
English	Native language
Afrikaans	Full professional proficiency

## REFERENCES

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## CERTIFICATION

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



13/03/2025