

FOSKOR (PTY) LTD – ATMOSPHERIC IMPACT REPORT

THE GAS BOILER EXCEEDED THE MAXIMUM PERMITTED METHANE GAS CONSUMPTION ALLOCATED BY THE KING CETSHWAYO DISTRICT MUNICIPALITY AIR QUALITY OFFICER.

Date: August 2026

Prepared by:

ZANOKUHLE ENVIRONMENTAL SERVICES

Your environment is our concern

379 LENA AHRENS ROAD, GLENWOOD, 4001 TEL: 031 202 2860 EMAIL : INFO@ZES.CO.ZA

DOCUMENT CONTROL

Client	FOSKOR (Pty) Ltd 21 John Ross Parkway, Richards Bay
Principal Contact	Kirona Harrypersad
Report Reference Number	ZES 20260513AQ
Project Team	Dudu Ngubane (Project Manager) Thandi Mfenqa (BTech Chemical Engineering) Nontobeko Madlala (BSc Honours Biological Sciences) Lisa Guastella M.Sc. (B.Sc (Hons)) Atmospheric Science and M.Sc (Oceanography), (Pr.Sci.Nat.)
Reviewer and Contributor	Lisa Guastella M.Sc. (B.Sc (Hons)) Atmospheric Science and M.Sc (Oceanography), (Pr.Sci.Nat.) - 400676/15

This report has been prepared by Zanokuhle Environmental Services on behalf of the Client, considering the agreed scope of work. Zanokuhle Environmental Services has exercised reasonable skill and care in preparing this report, aligning with the objectives and scope of work. Zanokuhle Environmental Services is not liable for any matters beyond the agreed scope of work due to negligence.

When issued in electronic format, Zanokuhle Environmental Services is not responsible for any unauthorised changes made by others. This report has been prepared by Zanokuhle Environmental Services on behalf of the Client taking into account the agreed scope of works.

FORMAL DECLARATION

DECLARATION OF INDEPENDENCE – PREPARER

I, **Dudu Ngubane**, declare that I am independent of the applicant and have the expertise to conduct the required assessments for this report. I will perform the work objectively, even if it results in findings unfavourable to the applicant. I will disclose all material information that may affect decisions regarding the application to both the applicant and the Air Quality Officer. The information in this Atmospheric Impact Report is accurate to the best of my knowledge. I am aware that providing false or misleading information to the Air Quality Officer is a criminal offense under section 51(1)(g) of the Act.

Review Schedule Version No.	Authoriser	Authoriser signature	Date	Status
1	D Ngubane		31 August 2026	Draft
2*	D Ngubane		15 October 2026	Final

**Added scenario 3 for AEL variation*

FORMAL DECLARATION

DECLARATION OF INDEPENDENCE – PRACTITIONER

Name of Practitioner: _____Ms Lisa Guastella_____

Name of Registration Body: _____The South African Council for Natural Scientific Professions____

Professional Registration No.: _____400676/15_____

Declaration of independence and accuracy of information provided:

Atmospheric Impact Report in terms of Section 30 of the Act.

I, **Lisa Guastella** I hereby declare that I am independent of the applicant and possess the necessary expertise to conduct the assessments required for this report. I will perform the work objectively, even if it leads to findings that are not favourable to the applicant. I commit to disclosing all material information that may influence decisions regarding the application to both the applicant and the Air Quality Officer. The information presented in this Atmospheric Impact Report is accurate to the best of my knowledge. I understand that providing false or misleading information to the Air Quality Officer is a criminal offense under section 51(1)(g) of this Act.

Signed at ___Durban_____ on this __13th__day of ____October 2026_____



SIGNATURE

Report Contributor and Reviewer_____

CAPACITY OF SIGNATORY

DECLARATION OF ACCURACY OF INFORMATION

Name of Enterprise: ___FOSKOR (Pty) Ltd___

Declaration of accuracy of information provided:

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

I, Kirona Harrypersad *[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 this Act.

Signed at Richards Bay on this 20th day of October 2026



Signature

EXECUTIVE SUMMARY

Background

FOSKOR (Pty) Ltd, located in Richards Bay, is an acid and fertiliser manufacturing facility that processes sulphuric acid, phosphoric acid and phosphate-based fertilisers. The facility employs approximately 605 permanent employees and serves both local and international markets.

Raw materials such as phosphate rock are mined at the Phalaborwa Mining Division and transported by rail to Richards Bay. The rock is tipped at Grindrod and conveyed via enclosed pipe conveyors to the rock store, with some being exported.

Sulphur is imported by ship, offloaded using a grab/hopper, and then moved to the facility through enclosed conveyors to minimise dust.

FOSKOR operates three sulphuric acid plants, A, B, and C, to produce sulphuric acid. During load shedding, a gas boiler is used to power the plant and prevent solidification of sulphur.

The Atmospheric Emission Licence (AEL) limits the boiler's methane gas consumption to 10,000,000 m^3 per year. During greenhouse gas reporting for 2025, it was found that the boiler had used 14,034,873.69 m^3, which is about 40% above the limit. FOSKOR then appointed Zanokuhle Environmental Services (Pty) Ltd to prepare an Atmospheric Impact Report (AIR) to support an AEL variation application.

The boiler is regulated under Part 3, Section 3 of the National Environmental Management Act, 2004: Air Quality Act, 2004. Emissions of concern include PM_{10}, $PM_{2.5}$, nitrogen dioxide (NO_2) and sulphur dioxide (SO_2), which are modeled using the AERMOD dispersion model and compared against National Ambient Air Quality Standards (NAAQS).

Scope of Work

The scope of work covered:

- Quantifying emissions with recognised emission factors, such as the US EPA AP-42 factors;
- Assessing the facility's impact on the surrounding areas through dispersion modeling in compliance with South African Regulations Regarding Air Dispersion Modeling (Government Notice no. R533, 11 July 2014); and
- Preparing a comprehensive AIR in accordance with Regulations Prescribing the Format of the Atmospheric Impact Report (GN 747, Government Gazette 36904, 11 October 2013), as amended by GN R284 (Government Gazette 38633, 2 April 2015).

Methodology

- The modelling was done with AERMOD, the recommended model for Level 2 assessments in the Code of Practice for Air Dispersion Modelling in Air Quality Management in South Africa. The Code is Appendix A to GN R533. The model was chosen based on the emission sources, terrain, meteorological conditions and level of risk, and the facility meets the criteria for a Level 2 assessment.
- AERMOD is a steady-state Gaussian plume model. It uses meteorological data processed by AERMET and terrain data processed by AERMAP to predict ground-level concentrations. Predicted concentrations were compared with the National Ambient Air Quality Standards (NAAQS).

Results

Three scenarios were modelled for the gas boiler on its own, without the other plant activities:

Table i: Summary of modelled scenarios and results

Scenario	Annual methane gas consumption (m^3)	Result
1: Actual consumption (2025)	14,034,873.69	Below the NAAQS. All concentrations at sensitive receptors below 1 µg/m³ (Table 19). Highest values at Betesda Independent School: 0.887 µg/m³ (1-hour) and 0.107 µg/m³ (annual).
2: Permitted consumption	10,000,000	Below the NAAQS. All concentrations at sensitive receptors below 1 µg/m³ (Table 21).
3: Proposed consumption (AEL variation)	15,000,000	Below the NAAQS. All concentrations at sensitive receptors below 1 µg/m³ (Table 23).

In all three scenarios, predicted concentrations of PM_{10}, $PM_{2.5}$, NO_2 and SO_2 were well below the NAAQS. NO_2 had the highest ground-level concentrations, which occurred at the point of maximum impact on the modelled receptor grid.

Conclusion

Even at the proposed consumption of 15,000,000 m³ per year (Scenario 3), the gas boiler poses a low risk to air quality at the sensitive receptors. All predicted concentrations at the receptors are below 1 µg/m³ and all pollutants remain below the NAAQS across the modelled grid. From an air quality perspective, increasing the permitted methane gas consumption to 15,000,000 m³ per year in the AEL variation application is acceptable.

Recommendations

1. **AEL variation**: FOSKOR should submit this AIR with an application to the licensing authority to vary the AEL. The variation would raise the permitted methane gas consumption to 15,000,000 m³ per year, under Section 46 of NEM:AQA.
2. **Fuel consumption monitoring**: FOSKOR should record gas consumption monthly and track it against the annual limit, so that any future exceedance is picked up early and not only during annual greenhouse gas reporting.
3. **Stack emission testing**: FOSKOR should test the boiler stack for PM, NO_x and SO_2 at the frequency the AEL requires, to confirm that actual emissions match the emission factors used in this assessment.

TABLE OF CONTENTS

EXECUTIVE SUMMARY **6**

1 INTRODUCTION **16**

2 ENTERPRISE DETAILS **17**

2.1 Enterprise Details 17

2.2 Location and Extent of the Plant 18

2.3 Description of Surrounding Land Use 18

2.4 Atmospheric Emission Licence and Other Authorisations 19

3 NATURE OF PROCESS **20**

4 UNIT PROCESSES **21**

5 TECHNICAL INFORMATION **22**

5.1 Raw Materials Used 22

5.2 Energy Source Used 22

5.3 Appliances and Abatement Equipment Control Technology 22

6 ATMOSPHERIC EMISSIONS **23**

6.1 Point Source Parameters 23

6.2 Fugitive Emissions (area and / or line sources) 23

6.3 Emergency Incidents 23

7 LEGISLATIVE CONTEXT **26**

7.1 National Environmental Management: Air Quality Act 26

8 GEOPHYSICAL SETTING AND CLIMATOLOGY **28**

8.1 Geophysical Setting 28

8.2 Climate and Meteorology Description 29

8.3 Summary 38

9 AIR QUALITY IMPACTS **39**

9.1 Areas of Influence 39

9.2 Health Effects 40

9.3 Ambient Air Quality Monitoring Concentrations 41

10 DISPERSION MODEL INPUT 45

10.1 Receptors 45

10.2 FOSKOR Buildings 49

10.3 Point Source Emission 50

10.4 Model Input summary 53

11 DISPERSION MODELING RESULTS 54

11.1 Modeling Methodology 54

11.2 Assumptions and Limitations 55

11.3 Scenario 1: Methane Gas Consumption Above Allowable Limit (14,034,873.69 m^3) 55

11.4 Scenario 2: Methane Gas Consumption as Permitted (10,000,000 m^3) 67

11.5 Atmospheric Emission Licence (AEL) Variation 78

11.6 Conclusions 92

11.7 Recommendations 92

12 COMPLAINTS 93

13 CURRENT OR PLANNED AIR QUALITY MANAGEMENT INTERVENTIONS 97

14 COMPLIANCE AND ENFORCEMENT ACTIONS 98

15 REFERENCES 99

LIST OF FIGURES

Figure 1: Surrounding Land Use Within a 5 km (Red) and 10 km (Yellow) radius of the FOSKOR Facility (Google Earth, 2026) 19
Figure 2: A Flow outlining the FOSKOR process to produce sulphuric acid, phosphoric acid and fertilisers 21
Figure 3: Topography of the Richards Bay area from Tessa near-global 30 metre DEM (https://en-za.topographic-map.com/). The black cross represents the location of the project site. 28
Figure 4: Zoomed in map of the main geomorphological features of Richards Bay (Kelbe, 2010). The approximate location of the project site is indicated by the black cross and the area shaded in green represents the historic floodplain 29
Figure 5: Examples of (a) summer, and (b) winter synoptic patterns over southern Africa (Meteona). Note the low-pressure trough over the interior during summer and the dominant high pressure over the interior during winter and approaching cold front west of the country. 31
Figure 6: Annual wind rose for the RBCAA Arboretum meteorological station from 1 January 2020 to 31 December 2025 using (a) 16 major compass points, and (b) 10-degree sectors 32
Figure 7: Annual surface wind rose derived from AERMET/ AERMOD-Ready Data (2023-2025). 33
Figure 8: Seasonal wind roses for the RBCAA monitoring station at Arboretum, 2020-2025 34
Figure 9: Seasonal wind roses derived from AERMET/ AERMOD-Ready Data (2023-2025) 35
Figure 10: Annual (a) diurnal, and (b) nocturnal wind roses at the Arboretum station, based on 2020-2025 data. 36
Figure 11: Monthly Average wind speed (m/s) at the Arboretum station, based on 2020-2025 data ... 36
Figure 12: Long-term mean (LTM) monthly rainfall at SASRI Felixton, based on 1957 – 2025 data, and Richards Bay Airport (SAWS) 20-year mean monthly rainfall and relative humidity. 37
Figure 13: Monthly average air temperature and maximum and minimum hourly average air temperature per month recorded at the RBCAA Arboretum station (2020-2025) 38
Figure 14: Arboretum annual wind rose, shown as direction towards which the wind blows, superimposed on the FOSKOR site and surrounds (Google Earth) to indicate the potential direction of plume dispersion. 39
Figure 15: Plume types as a function of air stability and winds (after Diab, undated) 40
Figure 16: RBCAA Ambient Air Quality Monitoring Stations (Source: https://rbcaa.org.za). 41
Figure 17: SO_2 Daily averages measured in 2025 (note that concentrations are in ppb) 42
Figure 18a: SO_2 Daily averages measured 2023- 2025 42
Figure 19: PM_{10} Daily averages in 2025 43
Figure 20: PM_{10} Daily averages 2023- 2025 43
Figure 21: $PM_{2.5}$ Daily averages in 2025 44
Figure 22a: $PM_{2.5}$ Daily averages 2023-2025 44
Figure 23: Sensitive receptors within a 5-kilometre (red) and 10-kilometre (yellow) radius of FOSKOR (Google Earth, 2026). 46

Figure 24: Sensitive receptors situated within 10 kilometres of the facility and Nested Grid (Lakes Environmental) 47
Figure 25: Map Showing Plant Boundary (Google Earth, 2026) 49
Figure 26: Aerial image (Google Earth) showing some of the FOSKOR buildings. 50
Figure 27: Point Source (Source: Google Maps Imagery © 2026) 51
Figure 28: 99%ile of 24-hour Mean $PM_{2.5}$ Gas Boiler Contributions (Lakes, 2026) 60
Figure 29: 99%ile of 24-hour Mean $PM_{2.5}$ Gas Boiler Contributions (+Sensitive Receptors) (Lakes, 2026) 60
Figure 30: Annual Mean $PM_{2.5}$ Gas Boiler Contributions ($\mu g/m^3$) (Lakes, 2026) 61
Figure 31: Annual Mean $PM_{2.5}$ Gas Boiler Contributions (+Sensitive Receptors) (Lakes, 2026) 61
Figure 32: 99%ile of 24-hour Mean PM_{10} Gas Boiler Contributions (Lakes, 2026) 62
Figure 33: 99%ile of 24-hour Mean PM_{10} Gas Boiler Contributions (+Sensitive Receptors} (Lakes, 2026) 62
Figure 34: Annual Mean PM_{10} Gas Boiler Contributions (Lakes, 2026) 63
Figure 35: Annual Mean PM_{10} Gas Boiler Contributions (+Sensitive Receptors) (Lakes, 2026) 63
Figure 36: 99%ile of 1-hour Mean NO_2 Gas Boiler Contributions ($\mu g/m^3$) (Lakes, 2026) 64
Figure 37: Annual Mean NO_2 Gas Boiler Contributions ($\mu g/m_3$) (Lakes, 2026). 64
Figure 38: 99%ile of 1-hour Mean SO_2 Gas Boiler Contributions (Lakes, 2026) 65
Figure 39: 99%ile of 24-hour Mean SO_2 Gas Boiler Contributions (Lakes, 2026) 65
Figure 40: Annual Mean SO_2 Gas Boiler Contributions (Lakes, 2026) 66
Figure 41: 99%ile of 24-hour Mean $PM_{2.5}$ Gas Boiler Contributions (Lakes, 2026). 71
Figure 42: 99%ile of 24-hour Mean $PM_{2.5}$ Gas Boiler Contributions (+Sensitive Receptors) (Lakes, 2026) 71
Figure 43: Annual Mean $PM_{2.5}$ Gas Boiler Contributions (Lakes, 2026) 72
Figure 44: Annual Mean $PM_{2.5}$ Gas Boiler Contributions (+Sensitive Receptors) (Lakes, 2026) 72
Figure 45: 99%ile of 24-hour Mean PM_{10} Gas Boiler Contributions (Lakes, 2026) 73
Figure 46: 99%ile of 24-hour Mean PM_{10} Gas Boiler Contributions (+Sensitive) (Lakes, 2026) 73
Figure 47: Annual Mean PM_{10} Gas Boiler Contributions (Lakes, 2026) 74
Figure 48: Annual Mean PM_{10} Gas Boiler Contributions (+Sensitive Receptors) (Lakes, 2026) 74
Figure 49: 99%ile of 1-hour Mean NO_2 Gas Boiler Contributions ($\mu g/m^3$) (Lakes, 2026) 75
Figure 50: Annual Mean NO_2 Gas Boiler Contributions (Lakes, 2026) 75
Figure 51: 99%ile of 1-hour Mean SO_2 Gas Boiler Contributions (Lakes, 2026) 76
Figure 52: 99%ile of 24-hour Mean SO_2 Gas Boiler Contributions (Lakes, 2026) 76
Figure 53: 99%ile of 24-hour Mean SO_2 Gas Boiler Contributions (+Sensitive Receptors) (Lakes, 2026) 77
Figure 54: Annual Mean SO_2 Gas Boiler Contributions (Lakes, 2026) 77
Figure 55: Annual Mean SO_2 Gas Boiler Contributions (+Sensitive Receptors) (Lakes, 2026) 78
Figure 56: 99%ile of 24-hour Mean $PM_{2.5}$ Gas Boiler Contributions (Lakes, 2026) 83
Figure 57: 99%ile of 24-hour Mean $PM_{2.5}$ Gas Boiler Contributions (+Sensitive Receptors) (Lakes, 2026) 83

Figure 58: Annual Mean $PM_{2.5}$ Gas Boiler Contributions (Lakes, 2026) 84
Figure 59: Annual Mean $PM_{2.5}$ Gas Boiler Contributions (+Sensitive Receptors) (Lakes, 2026) 84
Figure 60: 99%ile of 24-hour Mean PM_{10} Gas Boiler Contributions (Lakes, 2026) 85
Figure 61: 99%ile of 24-hour Mean PM_{10} Gas Boiler Contributions (+Sensitive Receptors) (Lakes, 2026) 85
Figure 62: Annual Mean PM_{10} Gas Boiler Contributions (Lakes, 2026) 86
Figure 63: Annual Mean PM_{10} Gas Boiler Contributions (+Sensitive Receptors) (Lakes, 2026) 86
Figure 64: 99%ile of 1-hour Mean NO_2 Gas Boiler Contributions (Lakes, 2026) 87
Figure 65: 99%ile of 1-hour Mean NO_2 Gas Boiler Contributions (+Sensitive Receptors) (Lakes, 2026) 87
Figure 66: Annual Mean NO_2 Gas Boiler Contributions (Lakes, 2026) 88
Figure 67: Annual Mean NO_2 Gas Boiler Contributions (+Sensitive Receptors) (Lakes, 2026) 88
Figure 68: 99%ile of 1-Hour SO_2 Gas Boiler Contributions (Lakes, 2026) 89
Figure 69: 99%ile of 1-Hour SO_2 Gas Boiler Contributions (+Sensitive Receptors) (Lakes, 2026) 89
Figure 70: 99%ile of 24-Hour SO_2 Gas Boiler Contributions (Lakes, 2026) 90
Figure 71: 99%ile of 24-Hr SO_2 Gas Boiler Contributions (+Sensitive Receptors) (Lakes, 2026) 90
Figure 72: Annual Mean SO_2 Gas Boiler Contributions (Lakes, 2026) 91
Figure 73: Annual Mean SO_2 Gas Boiler Contributions (+Sensitive Receptors) (Lakes, 2026) 91

LIST OF TABLES

Table 1: Enterprise Details 17

Table 2: Location and Extent of the Plant 18

Table 3: Other Authorisations 19

Table 4: Unit Processes 21

Table 5: Raw Materials Used 22

Table 6: Energy Source 22

Table 7: Point Source Parameters 23

Table 8: Emergency Incidents 24

Table 9: Air Quality Standards for NO_2, PM_{10}, $PM_{2.5}$, and SO_2 26

Table 10: Controlled Emitters (Section 23 NEM: AQA) 27

Table 11: Ambient air quality monitoring stations from RBCAA website 41

Table 12: Nested Grid Dimensions 46

Table 13: Sensitive receptors identified with their location 47

Table 14: FOSKOR buildings 50

Table 15: Stack Dimensions and Associated Appliance 51

Table 16: 2025 Calculated Emissions for all scenarios 51

Table 17: Model Input Data 53

Table 18: Maximum Gas Boiler predicted contribution at relevant receptors 56

Table 19: Predicted Gas Boiler Concentrations at Sensitive Receptors 57

Table 20: Maximum Gas Boiler predicted contribution at relevant receptors 67

Table 21: Predicted Gas Boiler Concentrations at Sensitive Receptors 68

Table 22: Maximum Gas Boiler predicted contribution at relevant receptors 79

Table 23: Predicted Gas Boiler Concentrations at Sensitive Receptors 80

ACRONYMS

ABBREVIATION	MEANING
AEL	Atmospheric Emission License
AIR	Atmospheric Impact Report
AQO	Air Quality Officer
AP 42	The United States Environmental Protection Agency (US EPA), Compilation of Air Pollutant Emission Factors, Volume 1: Stationary Point and Area Sources (AP 42) (Fifth Edition)
CBD	Central business district
DFFE	Department of Forestry, Fisheries, and the Environment
ELV	Emission Limit Value
KCDM	King Cetshwayo District Municipality
MAP	Monoammonium Phosphate
m/s	Metre per Second
m^3	Cubic metre
m^3/hr	Cubic metre per hour
NAAQS	National Ambient Air Quality Standards
NO_2	Nitrogen dioxide
NO_x	Oxides of nitrogen
PM	Particulate matter
$PM_{2.5}$	Particulate matter with an aerodynamic diameter equal to or less than 2.5 µm
PM_{10}	Particulate matter with an aerodynamic diameter equal to or less than 10 µm
NAAQS	National Ambient Air Quality Standards
NEM: AQA	National Environmental Management: Air Quality Act 2004
SHERQ	Safety, Health, Environment, Risk, and Quality
SO_2	Sulphur dioxide
SO_3	Sulphur trioxide
US EPA	United States Environmental Protection Agency
V_2O_5	Vanadium Pentoxide
ZES	Zanokuhle Environmental Services

1 INTRODUCTION

FOSKOR (Pty) Ltd, located in Richards Bay, is an acid and fertiliser manufacturing facility that processes:

- Sulphuric Acid
- Phosphoric Acid
- Phosphate-based fertilisers

The facility employs approximately 605 permanent employees and serves both local and international markets.

Raw materials such as phosphate rock are mined at the Phalaborwa Mining Division and transported by rail to Richards Bay. The rock is tipped at Grindrod and conveyed via enclosed pipe conveyors to the rock store, with some being exported.

Sulphur is imported by ship, offloaded using a grab/hopper, and then transported to the facility through enclosed conveyors to minimise dust.

FOSKOR operates three Sulphuric Acid Plants, A, B, and C, to produce sulphuric acid. During load shedding, a natural gas-fired boiler is used to provide steam to the plant and prevent solidification of sulphur.

The King Cetshwayo District Municipality (KCDM) Air Quality Officer (AQO) permitted FOSKOR to use 10,000,000 m^3 of methane gas as detailed in the facility's Atmospheric Emission License (AEL). However, due to high steam demand, the facility exceeded the maximum permitted fuel usage and used 14,034,873.69 m^3. The excess usage was identified during greenhouse gas reporting and FOSKOR management appointed Zanokuhle Environmental Services (Pty) Ltd (ZES) to conduct an impact assessment report.

The boiler is regulated under Part 3, Section 3 of the National Environmental Management Act, 2004: Air Quality Act, 2004 (Act No. 39 of 2004), as specified in the Declaration of a Small Boiler as a Controlled Emitter and Establishment of Emission Standards published in Government Gazette Number 36973, Vol. 831 on 01 November 2013. The emissions of concern modeled are:

- PM_{10} (i.e. particulate matter with an aerodynamic diameter equal to or less than 10 µm);
- $PM_{2.5}$ ((i.e. particulate matter with an aerodynamic diameter equal to or less than 2.5 µm);
- Nitrogen dioxide (NO_2);
- Sulphur dioxide (SO_2).

Concentrations were modeled using the AERMOD dispersion model, recommended in the South African Code of Practice for Level 2 Assessments, and interpreted against National Ambient Air Quality Standards (NAAQS).

The scope of work included:

- Quantifying emissions using appropriate factors, such as those from the US EPA (AP-42),
- Conducting dispersion modeling,
- Generating a comprehensive report in accordance with Regulations Prescribing the Format of the Atmospheric Impact Report, Government Gazette 36904, Notice No 747, 11 October 2013, and subsequent amendments (Government Notice R284 in Government Gazette 38633 dated 2 April 2015),

This study is based on 01 January to 31 December 2025 emissions data.

2 ENTERPRISE DETAILS

2.1 Enterprise Details

Table 1: Enterprise Details

Enterprise Name	FOSKOR (Pty) Ltd
Trading As	FOSKOR (Pty) Ltd
Type of Enterprise, e.g. Company / Close Corporation / Trust	Company
Company / Close Corporation / Trust Registration Number (Registration Numbers of Joint Venture)	1951/002918/07
Registered Address	21 John Ross Parkway Richards Bay
Postal Address	PO Box 208 Richards Bay, 3900
Industry Type / Nature of Trade	Production and storage of sulphuric acid, phosphoric acid and granulation fertiliser (MAP/DAP, UP, soluble MA, MCP and DCP)
Land Use Zoning as per Town Planning Scheme	Industrial
Land Use Rights if outside Town Planning Scheme	N/A
Responsible Person	Precious Buthelezi
Emission Control Officer	Kirona Harrypersad
Telephone Number	035 902 3050
Cell Phone Number	N/A
Fax Number	N/A
E-mail Address	kironah@foskor.co.za
After hours Contact Details	N/A

2.2 Location and Extent of the Plant

Table 2: Location and Extent of the Plant

Physical Address of the Plant	21 John Ross Parkway Richards Bay
Description of Site (Erf)	NOGU04210000533300001
Co-ordinates of Approximate Centre of Operations	Latitude: 28° 46.422'S Longitude: 32° 1.995'E
Extent (km^2)	0.33 km^2
Elevation Above Mean Sea Level (m)	21 m
Province	KwaZulu-Natal
Metropolitan / District Municipality	King Cetshwayo District Municipality
Local Municipality	Umhlathuze Municipality
Designated Priority Area (if applicable)	N/A

2.3 Description of Surrounding Land Use

FOSKOR is situated in the southern part of the industrial area of Richards Bay and approximately 2km to the south-west of the central business district (CBD). The surrounding area comprises of an industrial business zone, residential neighbourhoods, natural vegetation, railroads and main roads.

Surrounding areas include:

- Grindrod terminals Richards Bay, located 200 m East
- Mondi Group Richards Bay located 3 km Northwest.
- TWK Richards Bay Woodchip Mill located 100 m East.
- Hillside Aluminium located 500 m Southeast.
- John Ross Highway (R34) located 60 m North.
- Craiton (Pty) located 1 km South.
- Richards Bay Gypsum located 2.9 km Southeast.
- Nkocy Sugar Farm located 8 km South-Southwest
- Residential (Alton), located 2 km to the Northeast.
- Residential (Richards Bay central), located 1 km North-Northeast.
- Mzingazi River / Dam located 4 km East.
- Residential (Wildenweide), located 3 km North-Northeast
- Residential (Veldenvlei), located 4 km Northeast
- Residential (Brackenham), located 5 km North
- Residential (Aquadene), located 6.3 km North
- Residential (Meerensee), located 7.5 East

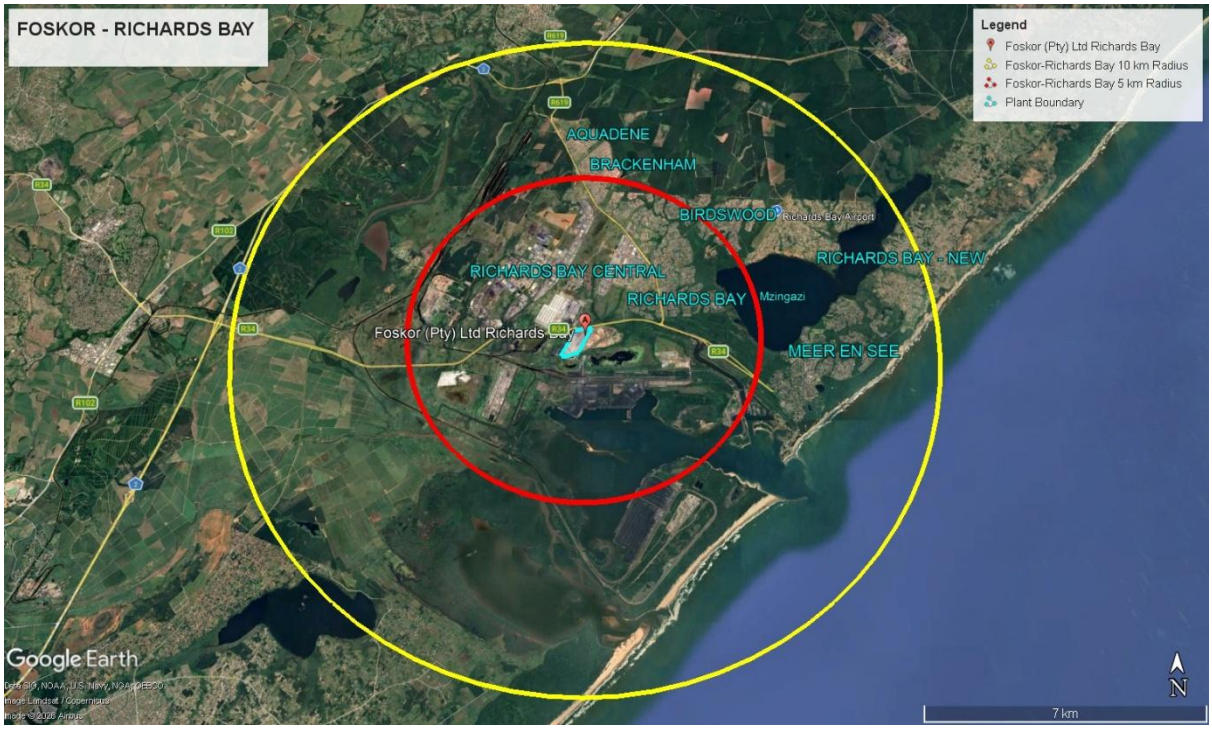


Figure 1: Surrounding Land Use Within a 5 km (Red) and 10 km (Yellow) radius of the FOSKOR Facility (Google Earth, 2026)

2.4 Atmospheric Emission Licence and Other Authorisations

- KNUT006/AEL0008/2-v2a

Table 3: Other Authorisations

APPA Registration Certificate Number	Date of Registration Certificate	Scheduled Process Number	Scheduled Process Description
N/A			

3 NATURE OF PROCESS

FOSKOR is an acid and fertiliser manufacturing facility located in Richards Bay and is a major producer of sulphuric acid, phosphoric acid, and phosphate-based fertilisers for both local and international markets. The primary raw materials used in the production process are phosphate rock and raw sulphur. Phosphate rock is mined at the Phalaborwa Mining Division and transported by rail to Richards Bay, where it is conveyed via enclosed pipe conveyors to the rock store, with some being exported. Sulphur is imported by ship, offloaded using a grab/hopper, and then transported to the facility through enclosed conveyors to minimise dust.

Steam Generation:

The natural gas-fired boiler (11 bar pressure) generates steam to support the sulphuric C plant (also capable of activating the sulphuric C plant turbine) and the sulphuric A & B plants during power disruptions. The steam is used to maintain the temperature of sulphur in the sulphur processing section, preventing solidification.

Sulphuric Acid Plant:

Sulphuric acid is produced in three Sulphuric Acid Plants, A, B, and C. Granular sulphur combusts with atmospheric dried air to form sulphur dioxide (SO_2), which is then converted to sulphur trioxide (SO_3) in the presence of a catalyst (V_2O_5/caesium). Excess heat generated is recovered in waste heat boilers and superheated steam economisers to produce steam, mainly used in the phosphoric acid concentration plant. The sulphuric acid produced is used as a raw material for phosphoric acid production, with excess steam going to the turbine generator for power generation.

Phosphoric Acid Plant:

Phosphoric acid is produced by reacting phosphate rock with sulphuric acid in the new and old plants, respectively. Phosphate rock is mixed and reacted with sulphuric acid, resulting in weak phosphoric acid and gypsum. The gypsum is slurried with buoyant line effluent or seawater and pumped out to sea via uMhlathuze water B or C dense line. The weak phosphoric acid is evaporated to remove excess water, forming concentrated phosphoric acid, which is clarified and pumped to the export storage tanks.

Granulation Plant:

The main raw materials feeding into the granulation plant are phosphoric acid, ammonia, and sulphuric acid. After passing through the reactor process, a slurry is formed. Micronutrients such as zinc, sulphur, and copper may be added in the granulator, based on customer requirements. The fertiliser products produced are Diammonium phosphate (DAP) and Monoammonium phosphate (MAP).

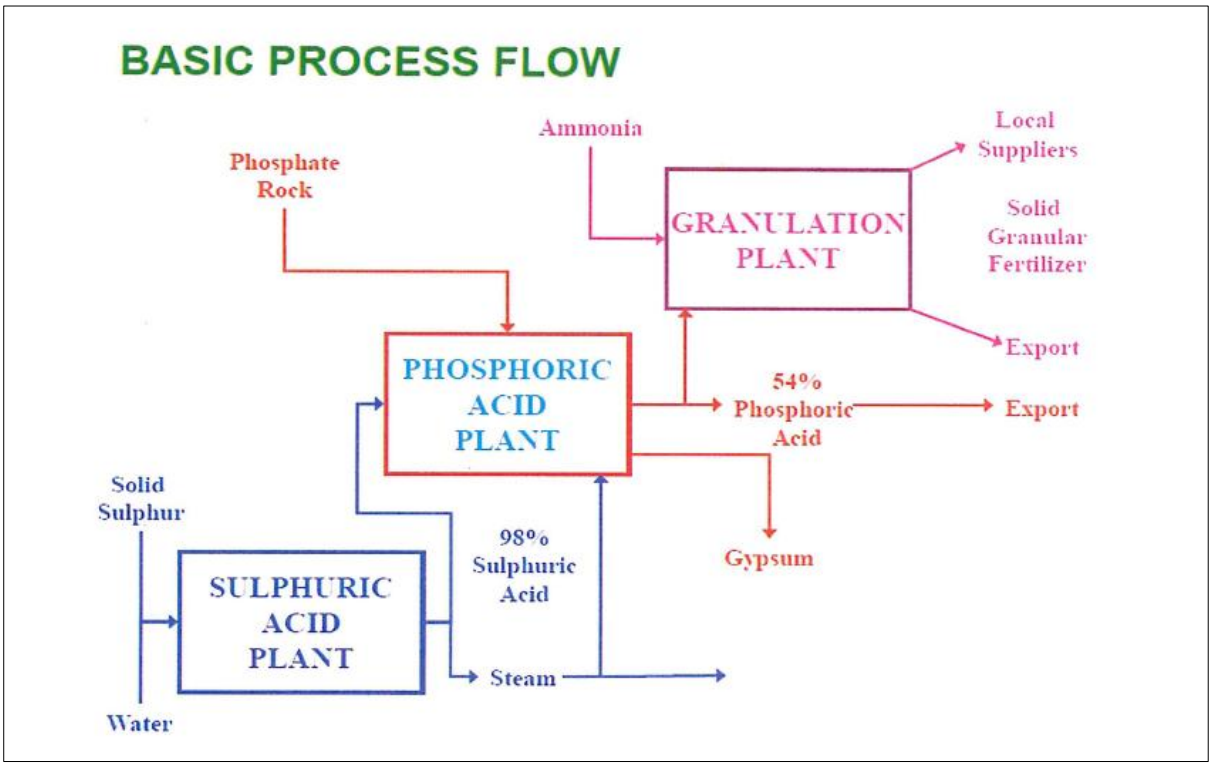


Figure 2: A Flow outlining the FOSKOR process to produce sulphuric acid, phosphoric acid and fertilisers

4 UNIT PROCESSES

Table 4: Unit Processes

Unit Process	Unit Process Function	Batch or Continuous Process
Steam Generation	Generate steam During Power Disruption	Continuous
Sulphuric Acid Plant	Produce Sulphuric Acid	Continuous
Phosphoric Acid Plant	Produce Phosphoric Acid	Continuous
Granulation Plant	Production of fertilisers	Continuous
Storage Tanks	Storage of Sulphuric Acid, Phosphoric Acid, Ammonia, and Coating Oil	Continuous

5 TECHNICAL INFORMATION

5.1 Raw Materials Used

Table 5: Raw Materials Used

Raw Material Type	Maximum Consumption Rate (Quantity/Year)	Units (Quantity/Period)
Sulphur	1 000 000	tonnes/annum
Vanadium Pentoxide	583 000	Litres
Phosphate Rock	2 675 000	tonnes/annum
Sulphuric Acid	2 400 000	tonnes/annum
Ammonia	55 280	tonnes/annum
Zinc	10 000	tonnes/annum
Sand	47 5220	tonnes/annum
Urea	51 600	tonnes/annum
Phosphate Acid	215 000	tonnes/annum
Strong Clarified Phosphoric Acid	55 000	tonnes/annum
Reactive Silica	100	tonnes/annum

5.2 Energy Source Used

Table 6: Energy Source

Energy Source	Maximum Consumption Rate (Quantity/Year)	Actual Consumption Rate (Quantity/Year)	Sulphur Content of Material (%)	Units (Quantity/Period)
Natural Gas	10 000 000	14 034 873.69	0.0000009	m^3/year

5.3 Appliances and Abatement Equipment Control Technology

The Gas boiler is not equipped with abatement equipment control technology.

6 ATMOSPHERIC EMISSIONS

6.1 Point Source Parameters

Table 7: Point Source Parameters

Point Source Code	Stack ID	Source Name	Latitude (decimal degrees) S	Longitude (decimal degrees) E	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^3/hr)	Actual Gas Exit Velocity (m/s)
None	None	Gas Boiler Stack	-28.771668°	32.034336°	11	2	1.3	213.0	1 630	0.34

6.2 Fugitive Emissions (area and / or line sources)

The impact of fugitive sources is not within the scope of this report and has not been considered, as it falls outside the study parameters set by FOSKOR.

6.3 Emergency Incidents

Table below provides a summary of emergency incidents in the last 2 years resulting in atmospheric emissions, including:

Table 8: Emergency Incidents

Date/ Time of Incident	Incident Type	Details Of Incident	Root Cause Analysis/ Investigation	Mitigation Measures
16 January 2025, 12:11 PM	Smoke and SO_2 emissions	A negligible quantity of SO_2 were emitted due to a fire on filter 3 at sulphuric acid plant.	The filter is used to filter molten sulphur and separate the clean sulphur from the sulphur ash. When fire occurs in the filter, the sulphur ash forms smoke which contains small amounts of SO_2 gas because of the sulphur content that remains in the ash during the process of filtration.	• Improving closing mechanism of filter system. • The fire was effectively controlled through immediate actions taken.
10 April 2025	SO_2 emissions	High SO_2 emissions during commissioning of a bypass duct installed on the hot heat exchanger at sulphuric C plant.	A bypass duct Commissioning took longer than what was envisaged due to the need to collect enough plant performance data. As a result, there was an unintentional increase in SO_2 emission levels leading to the abandonment of the commission process.	• Immediately stopped the plant and restored the interlocks before plant start-up. • Implementation of a continuous hourly SO_2 averages tracking system to guide the plant operators to avoid exceedances.
17 April 2025	SO_2 emissions	High SO_2 emissions during commissioning of a bypass duct installed on the hot heat exchanger at sulphuric C plant.	A second attempt to complete commissioning, however, there was an SO_2 exceedance of the daily average leading to another abandonment.	• Immediately stopped the plant and restored the interlocks before plant start-up. • Implementation of a continuous hourly SO_2 averages tracking system to guide the plant operators to avoid exceedances.

25 June 2025 06:00 AM	SO_2 emissions	Sulphuric B plant was stopped on the 24th of June 2025, while preparing for startup on the 25th of June 2025, molten sulphur entered the furnace before the oxygen supply unit was started due to the failure of the molten sulphur spray nozzles isolation valve(s), molten sulphur accumulated on the furnace floor, and on the Sulphuric A&B plant start up, resulting in high SO_2 concentration.	During the process of starting the plant after establishing molten sulphur flow into the buffer tank, molten sulphur supply pump was running while resources were being mobilized to start up the plant. Molten sulphur entered the furnace before the oxygen supply unit was started due to the failure of the molten sulphur spray nozzles isolation valve(s). This resulted in accumulation of the molten sulphur on the furnace floor, and on the plant start up, the ratio of molten sulphur and oxygen was imbalanced, resulting in high SO_2 concentration.	• Replace isolation valves on the furnace molten sulphur spray nozzles. • Blow plant cold to purge gases in the system and combust molten sulphur on the furnace floor.

7 LEGISLATIVE CONTEXT

7.1 National Environmental Management: Air Quality Act

The National Environmental Management: Air Quality Act was adopted in 2004 by the Department of Forestry, Fisheries, and the Environment (DFFE). The Act aims to regulate air quality to protect the environment by implementing measures to prevent pollution and ecological degradation, while promoting sustainable development and economic and social progress. It requires the establishment of norms, standards, mechanisms, systems, and procedures to enhance air quality.

7.1.1 National Ambient air Quality Standards

Table 9 presents the national ambient air quality standards in South Africa, as outlined in the Republic of South Africa publications from 2009 and 2012. These standards establish concentration levels below which adverse effects are unlikely, even in sensitive populations, and risks to public health are minimal. They are derived from scientific and medical research on the impact of specific pollutants. These standards apply to ambient air quality and do not cover air quality regulated under the Occupational Health and Safety Act, 1993 (Act No. 85 of 1993).

Table 9: Air Quality Standards for NO_2, PM_{10}, $PM_{2.5}$, and SO_2

Pollutant	Time Period	Objective	Compliance Date
Nitrogen Dioxide (NO_2)	1-hour Mean	200 μg/m^3 not to be exceeded more than 88 times a year	Immediate
	Annual Mean	40 μg/m^3	Immediate
Fine Particles (PM_{10})	24-hour Mean	75 μg/m^3 not to be exceeded more than 4 times a year	Since 1 January 2015
	Annual Mean	40 μg/m^3	Since 1 January 2015
Fine Particles ($PM_{2.5}$)	24-hour Mean	40 μg/m^3 not to be exceeded more than 4 times a year	1 January 2016 – 31 December 2029

Pollutant	Time Period	Objective	Compliance Date
	Annual Mean	20 μg/m^3	1 January 2016 – 31 December 2029
Sulphur Dioxide (SO_2)	10 Minute Mean	500 μg/m^3 not to exceed more than 526 per a year	Immediate
	1-hour Mean	350 μg/m^3 not to exceed more than 88 per a year	Immediate
	24-hour Mean	125 μg/m^3 (48 ppb) not to exceed more than 4 per a year	Immediate
	Annual Mean	50 μg/m^3	Immediate

7.1.2 Controlled Emitters

DFFE has identified certain activities that lead to significant atmospheric emissions with harmful effects on the environment under the Air Quality Act No. 39 of 2004. The gaseous fuel-fired small boiler (using natural gas) is classified as a controlled emitter in the emission standard, Section 3. Emission Limit Values (ELVs) have been established, as detailed in Table 10 below.

Table 10: Controlled Emitters (Section 23 NEM: AQA)

Pollutant Name	Chemical/Commonly used symbol	Emission Limit Value (mg/Nm^3)
Particulate matter	PM	10
Sulphur dioxide	SO_2	35

8 GEOPHYSICAL SETTING AND CLIMATOLOGY

8.1 Geophysical Setting

FOSKOR (Pty) Ltd is a phosphate fertiliser and acid producer located in an industrial area of Richards Bay at the junction of the West Central Arterial and the R34, John Ross Highway, which is the main thoroughfare into the Port of Richards Bay from the N2 and nearby town of Empangeni. It falls within the uMhlathuze Local Municipality and King Cetshwayo District Municipality of the KwaZulu-Natal (KZN) Province, South Africa.

The topographical context can be visualised through the Tessa near-global 30 metre Digital Elevation Model (DEM) https://en-za.topographic-map.com/ (Figure 3). The project site is located on flat terrain on the coastal plain at an elevation of approximately 25 m above mean sea level (amsl). A coastal plain is a low-relief area bordered by the sea on one side and higher relief inland. The Mhlathuze River, which drains from higher elevation areas to the north-west, in this case approximately 400 to 700 m amsl, has eroded the topography to create a wide, flat floodplain, consisting of meandering rivers and tributaries. The Nseleni River drains from the north and joins the Mhlathuze to discharge into the Richards Bay estuary. The floodplain has important implications for air quality, as it facilitates drainage flow of air from inland down the valleys as landbreeze flow, more prevalent during winter nights (refer Fig 8(c)).The shallow valley formed by the Msingazi River and lake NE of the Richards Bay harbour, between the relatively high (40-50 m) coastal dunes at Meerensee and the Arboretum-Airport area (refer Fig. 4), helps to channel the predominant NE-SW wind flow (refer also Figs 6 & 8).

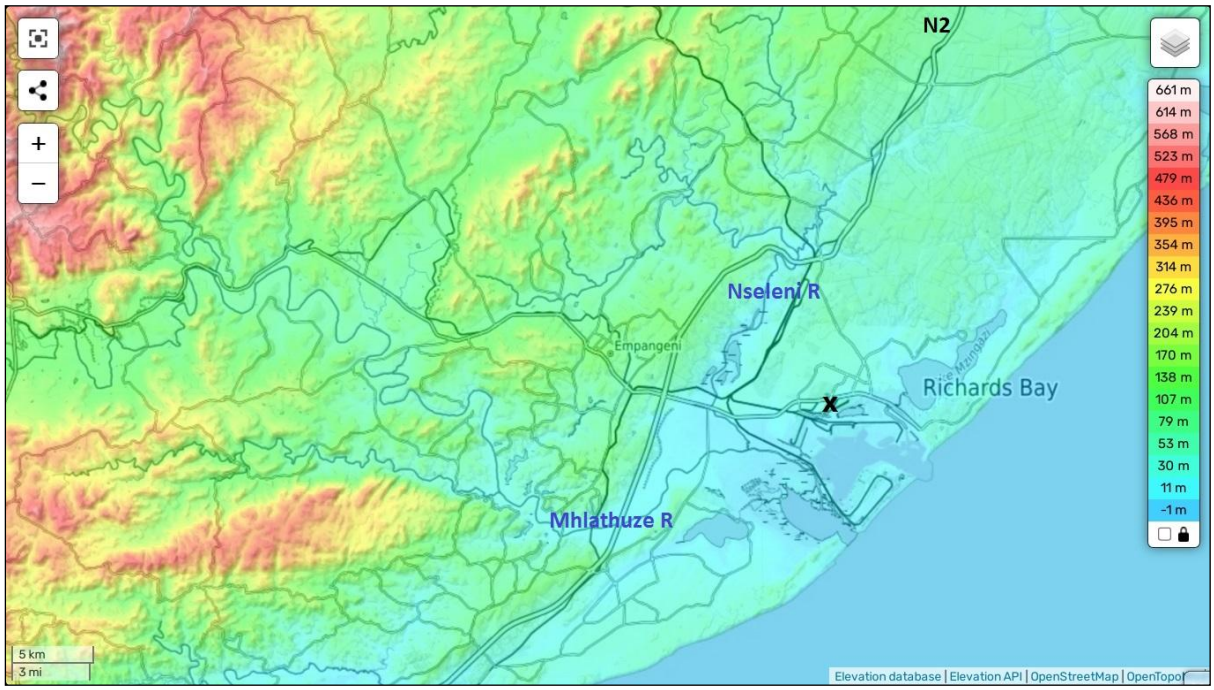


Figure 3: Topography of the Richards Bay area from Tessa near-global 30 metre DEM (https://en-za.topographic-map.com/). The black cross represents the location of the project site.

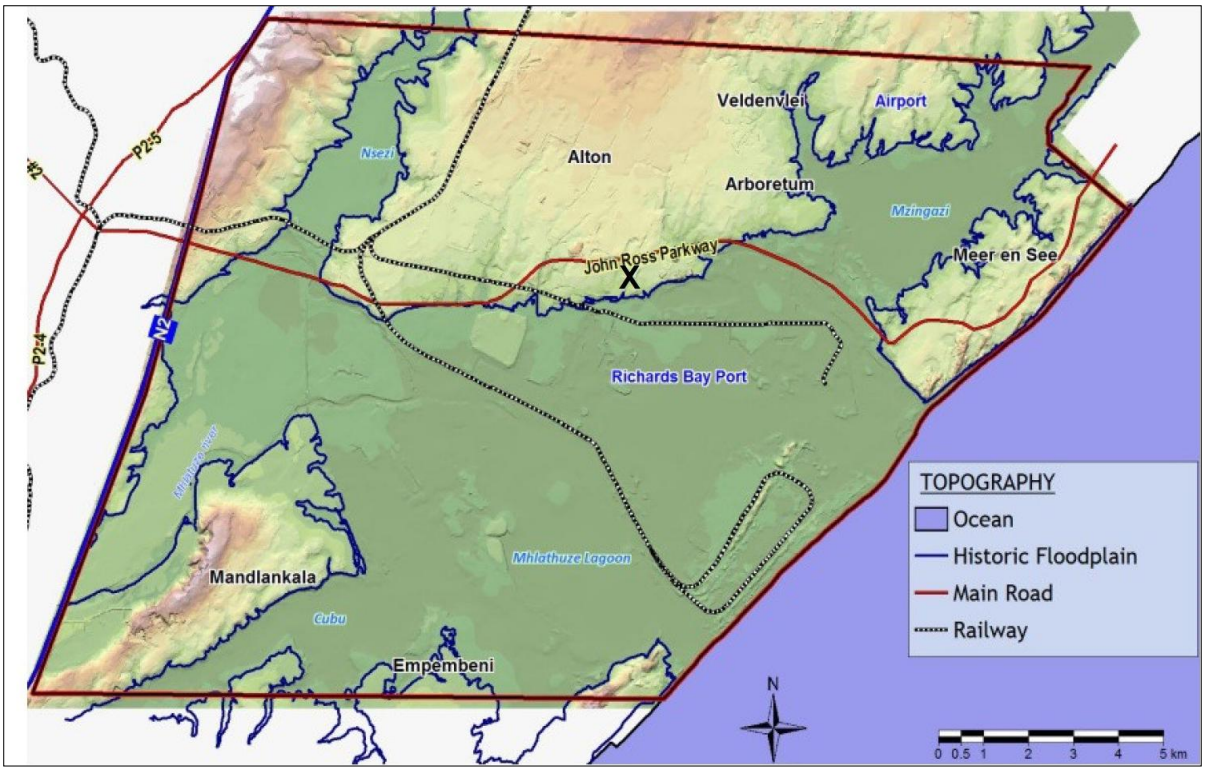


Figure 4: Zoomed in map of the main geomorphological features of Richards Bay (Kelbe, 2010). The approximate location of the project site is indicated by the black cross and the area shaded in green represents the historic floodplain

8.2 Climate and Meteorology Description

8.2.1 Introduction

Climate refers to long-term atmospheric conditions, while meteorology deals with the variability in atmospheric parameters that affect dispersion of pollutants. The FOSKOR site is located within the Natal Coastal Plain ecoregion, characterised by a warm, subtropical climate. According to the Köppen-Geiger climate classification, the climate is classified as Cfa (warm temperate, fully humid, hot summer) (Conradie, 2012).

Meteorological factors like wind speed, direction, temperature, pressure, and atmospheric stability play a crucial role in pollutant transportation and concentration levels. Stable atmospheric conditions lead to pollutant accumulation, while an unstable atmosphere promotes pollution dispersion. Dispersion occurs through horizontal transport and vertical mixing in the lower atmosphere, influenced by location, elevation, ambient meteorological conditions and time of day. The magnitude of horizontal transport depends on synoptic scale airflow, ranging from stagnation to swift transport. An overview of synoptic influences in southern Africa, affecting meteorological conditions and air pollution dispersion in the Richards Bay area is provided, followed by climatic conditions specific to the FOSKOR area.

8.2.2 Synoptic Meteorology

Southern Africa, located in the subtropical high-pressure belt, where the meteorology is influenced by several high-pressure cells, along with westerly wave and tropical easterly perturbations. Three main high-pressure cells dominate the region: the South Atlantic anticyclone, the South Indian anticyclone, and the Continental anticyclone over the interior (Tyson, 1986) and these systems control the meteorology and pollution dispersion. Anticyclones are associated with air subsidence, which produces clear, dry, stable conditions.

Seasonal changes in the intensity and position of the high-pressure cells, together with the influence of the tropical easterlies in the north and westerly waves, as part of the Rossby circulation in the south, controls the climate of southern Africa. During winter (Fig. 5(b)), the high-pressure belt strengthens and shifts northward, and the Continental anticyclone dominates the interior, resulting in stable, dry air conditions over the interior and eastern half of the country, usually typified by temperature inversions and a stratified atmosphere, which prevents upward mixing or vertical transport of pollution. The interior high-pressure cell occurs 79% of the time in June and July (Tyson, 1987). During these stable periods, characterised by low wind speeds, surface inversions develop due to nighttime cooling and pollutants are trapped below the stable layers; but during the day surface heating can erode or lift the stable boundary layer, allowing for some mixing and pollutant dispersal, especially if accompanied by onshore winds. Cold fronts, associated with westerly perturbations moving from west to east across the southern part of the country, occasionally disrupt the stable conditions by extending northward as far as northern KZN, bringing clouds, rain, cooler temperatures and wind shifts, typically from north-easterly prior to the front, to south-westerly after the front.

During summer (Fig 5(a)) the high-pressure belt weakens and shifts southward and is present only about 11% of the time (Tyson, 1987), allowing tropical easterly perturbations and low-pressure troughs to develop from the interior to the east coast. Converging air masses east of the trough cause uplift and air instability, resulting in convective thunderstorms and rainfall. These easterly waves and lows, which occur mainly in summer, bring summer rainfall. High rainfall events are also associated with cut-off low (COL) pressure systems, usually more prevalent during the change of seasons (i.e. spring and autumn) and the occasional dissipating tropical storm (ex-tropical cyclone) during summer to autumn, e.g. Domoina, January 1984; Imboa, February 1984.

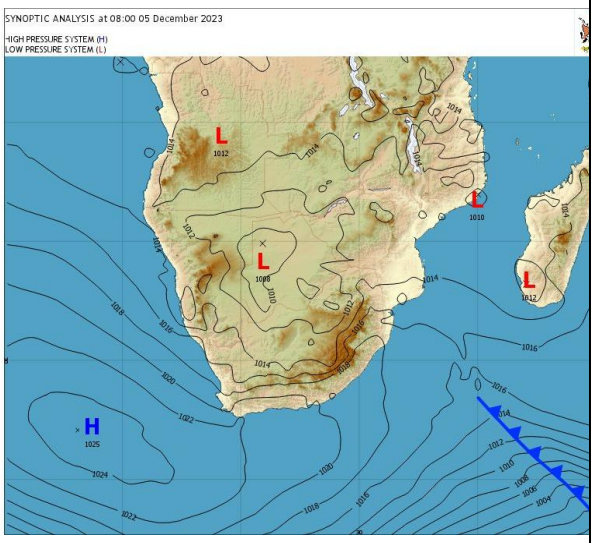
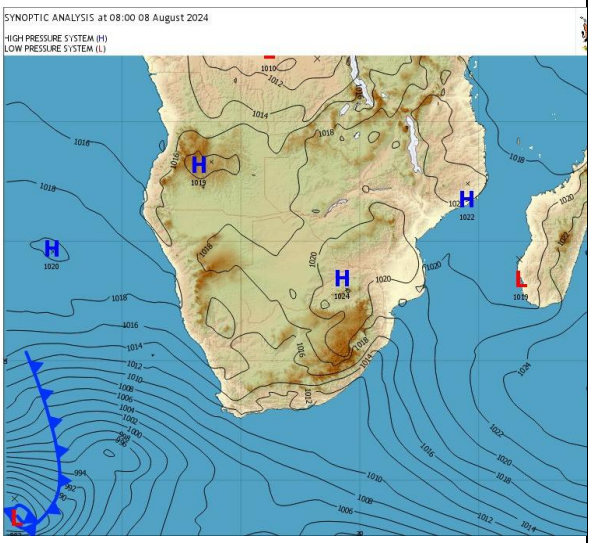
Summer	Winter
	

Figure 5: Examples of (a) summer, and (b) winter synoptic patterns over southern Africa (Meteona). Note the low-pressure trough over the interior during summer and the dominant high pressure over the interior during winter and approaching cold front west of the country.

8.2.3 Local Climatology

The weather data presented below was sourced from the Richards Bay Clean Air Association (RBCAA) air quality stations at Arboretum (30 m msl), which is 3.4 km ENE of the project site. Although the Harbour West (28°47'14.23"S, 32°1'37.43"E, 6 m amsl) station, which is approximately 1.9 km SSW of FOSKOR, is closer to FOSKOR, there were some concerns about the data quality, hence preference for the Arobretum data. Hourly average meteorological data for the period 1 January 2020 to 31 December 2025 was used. The South African Weather Services (SAWS) station at the Richards Bay Airport (6.8 km ENE) was used for long-term data comparisons and long-term rainfall data (1957 – 2025) was obtained from the South African Sugar Research Institute (SASRI) Felixton Sugar Mill (28°50'0"S, 31°53'0" E 46 m), some 16.5 km SSW of FOSKOR.

Local Wind

Air motion plays a major role in determining the distribution of emissions in the atmosphere and plume behaviour. Wind is very useful in diluting and dispersing air pollutants. Wind speed determines the distance a pollutant can be transported downwind and the rate of dilution and, together with air temperature and humidity, can influence the turbulence and hence uplift, or stability and mixing. The calmer the winds, the poorer the dispersion potential. Conversely, higher wind speeds will lead to improved dispersion. The wind direction determines the general path of pollutants and area of impact of a pollutant source. It is also important to consider that surface winds are influenced by topography.

Annual, seasonal and diurnal wind roses were processed using the RBCAA Arboretum January 2020 to December 2025 hourly average wind data. Wind roses are a useful tool in illustrating prevailing

meteorological conditions for an area, indicating wind speeds and directional frequency distribution. In the following wind roses, the colour of the bar indicates the wind speed whilst the length of the bar represents the frequency of winds blowing from a certain direction (as a percentage). The annual wind rose, using the 16 major compass points is shown in Figure 6(a), whilst Figure 6(b) provides the wind rose using 10-degree sectors. The level of detail in the 10-degree sectors was much more detailed, hence that format was adopted for the reporting. Figure 8 provides the seasonal breakdown and Figure 10 compares daytime to night-time winds. The monthly mean wind speed and maximum hourly average per month, as derived from the Arboretum station, is shown in Figure 11.

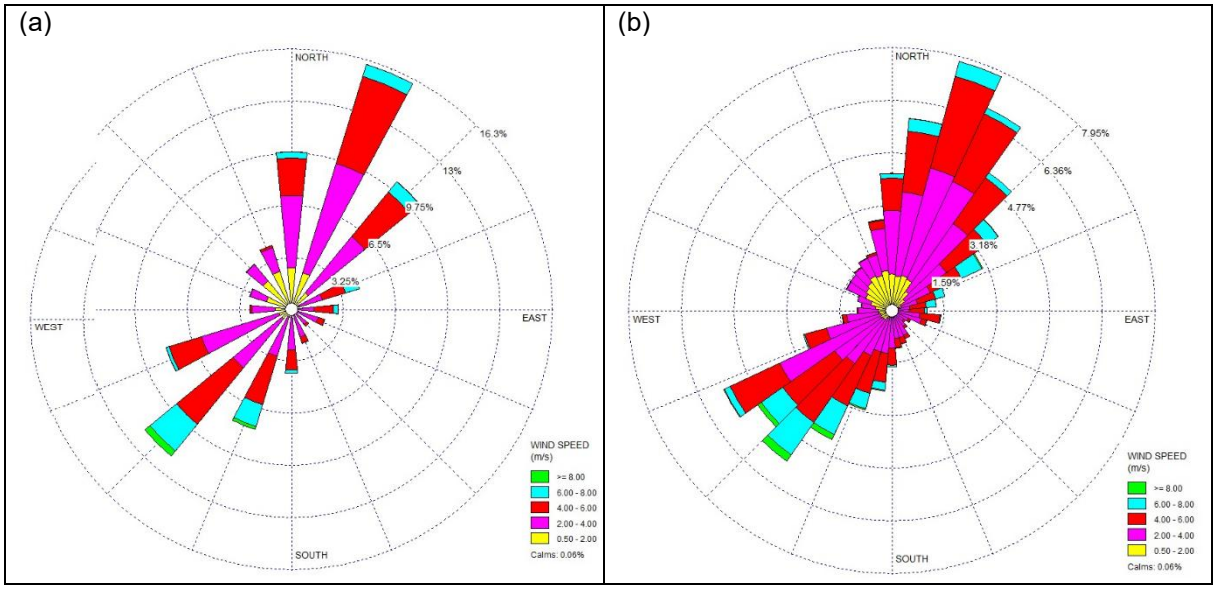


Figure 6: Annual wind rose for the RBCAA Arboretum meteorological station from 1 January 2020 to 31 December 2025 using (a) 16 major compass points, and (b) 10-degree sectors.

Winds blow predominantly along the NNE-SW axis, more specifically from the NNE-NE and WSW-SW sectors, with the NNE-NE winds predominating. The wind pattern is a function of large-scale circulation patterns over the sub-continent superimposed by an onshore daytime Seabreeze component (NE-SE) (refer Fig. 10(a)), especially during the summer months; note that winds from the ENE to ESE sector are absent during the winter (Fig. 8(c) and at night (Fig. 10(b)). Winds from the NNE–ENE sector are usually associated with high pressure and fine weather conditions, whilst winds from the southwest to WSW are often associated with inclement weather conditions. The strongest wind speeds come from the SW direction, usually associated with the arrival of a coastal low or cold front; the maximum hourly average wind speed for Arboretum was 10.9 m/s from 234°. Higher wind speeds are generally recorded during springtime and summer, and minimum average wind speeds are recorded during May to July (refer Fig. 11), when the interior and eastern half of the country is under the influence of stable conditions, associated with the continental high-pressure system.

The annual wind rose derived from AERMET/ AERMOD-Ready Data (2023-2025) is shown in Figure 7. Winds blow predominantly along the NNE-SSW axis, more specifically from the NNE and SSW sectors, with the NNE-NE winds predominating. The strongest wind speed comes from the SSW direction. The AERMET graph showed a higher frequency of westerly winds than the measured data and the southerly

modelled winds from AERMET were more from the south-west to WSW at the Arboretum station; the variations between modelled and measured data need to be considered when interpreting the dispersion model results, which are based on AERMET Overall, ,the two wind roses consist of similar predominant winds, however, AERMET derived shows the strongest windspeed (although note that the wind speed categories of the measured winds at Arboretum are slightly different to AERMET).

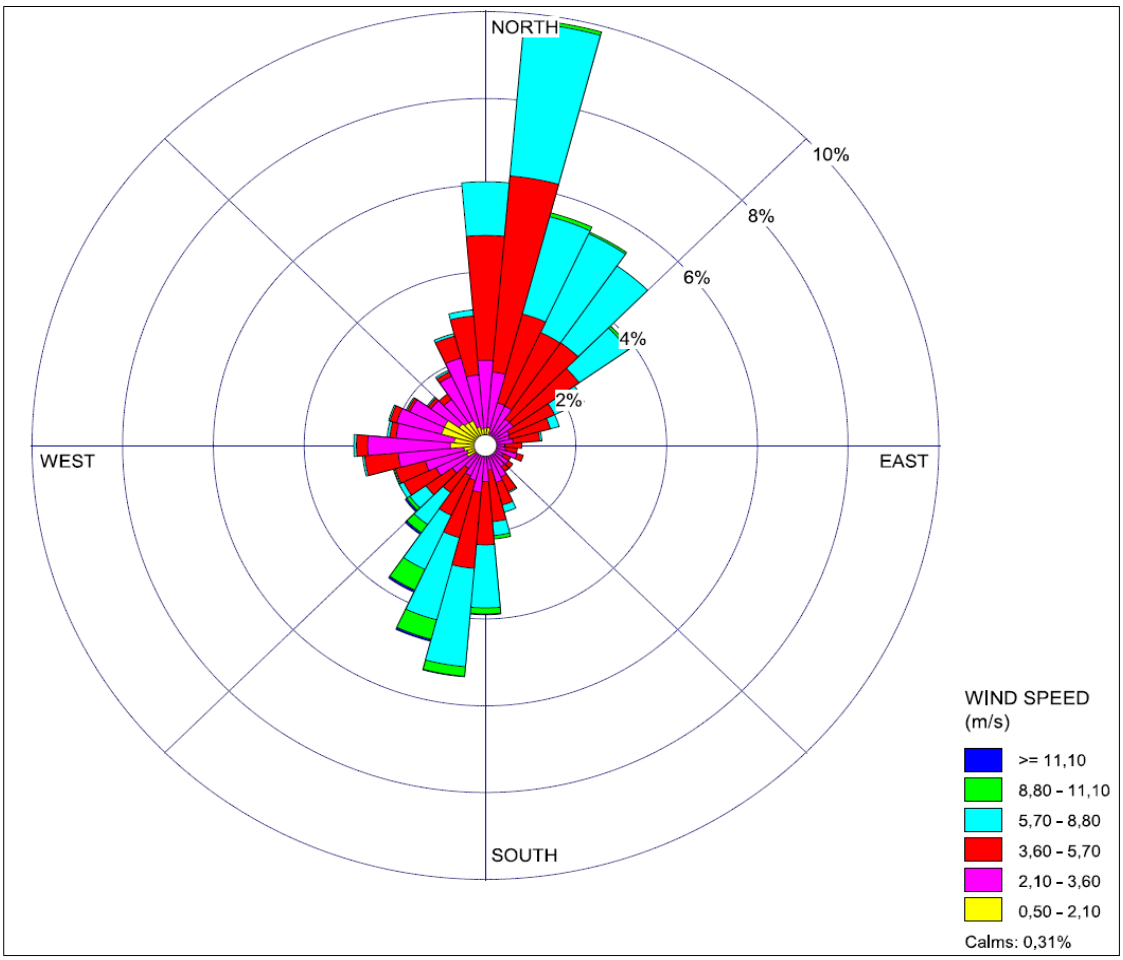


Figure 7: Annual surface wind rose derived from AERMET/ AERMOD-Ready Data (2023-2025).

The summer and autumn patterns (Figs 8(a) & (b)) are fairly similar, dominated by winds from the NNE-NE and SW-WSW, although speeds are a bit lighter during autumn. During winter (Fig 8(c)) more northerly to NNE winds prevail, associated with increased air stability, with a relatively higher proportion of light to moderate land breezes from the north-west and less frequent cold fronts bringing SW winds. Temperature inversions during stable air conditions are more common during this time, particularly during night-time and early morning, which inhibits dispersion of pollutants. An increase in wind speed is evident during spring (Fig. 11) and winds (Fig. 8 (d)) are more confined along the NNE-NE and SW-WSW axis.

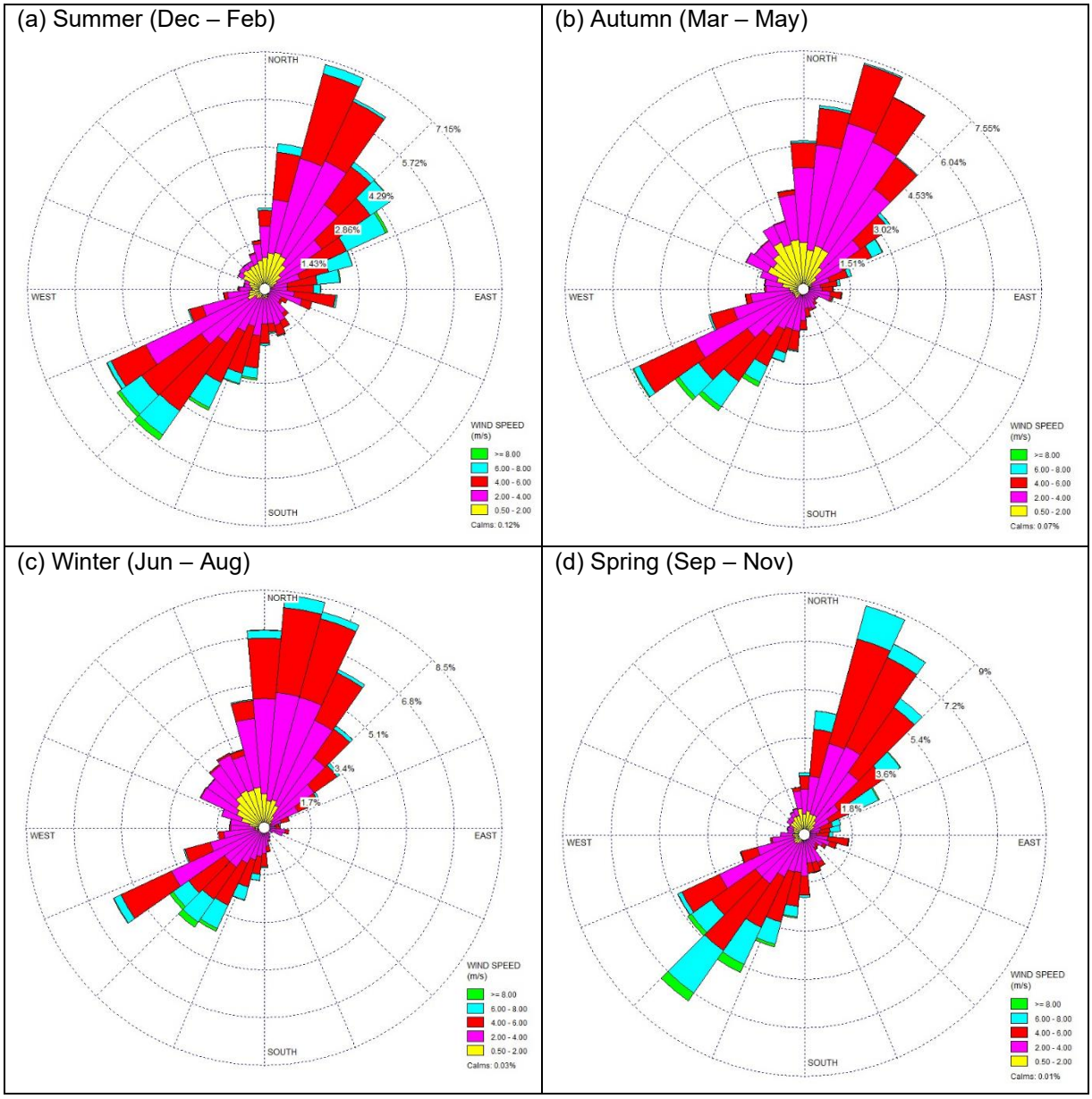
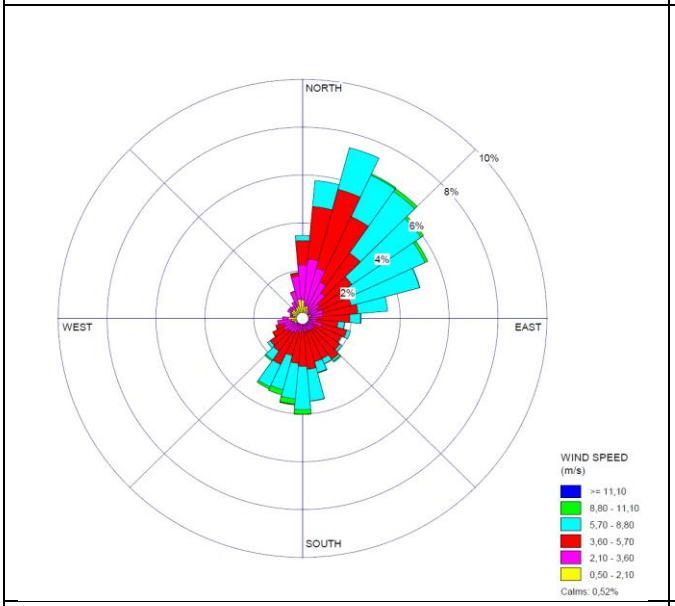


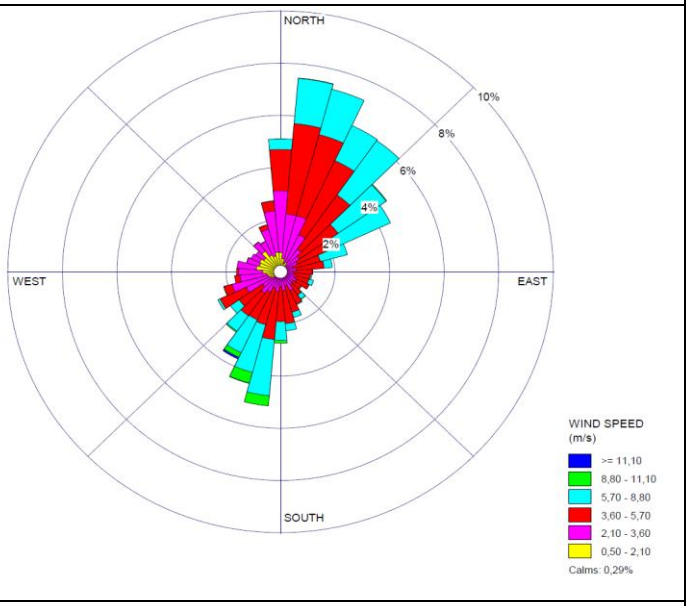
Figure 8: Seasonal wind roses for the RBCAA monitoring station at Arboretum, 2020-2025

The seasonal AERMET derived wind rose indicate the summer to autumn pattern (Fig. 9(a) and (b)) that is dominated by winds from NNE-NE and SW-SSW axis, with the NNE winds predominating. The strongest wind speed comes from the SSW direction, while the RBCAA monitoring station shows summer to autumn pattern (Fig. 8(a) and (b)) that is dominated by winds from NNE-NE and SW-WSW, however, AERMET derived Windrose shows the strongest wind speed.

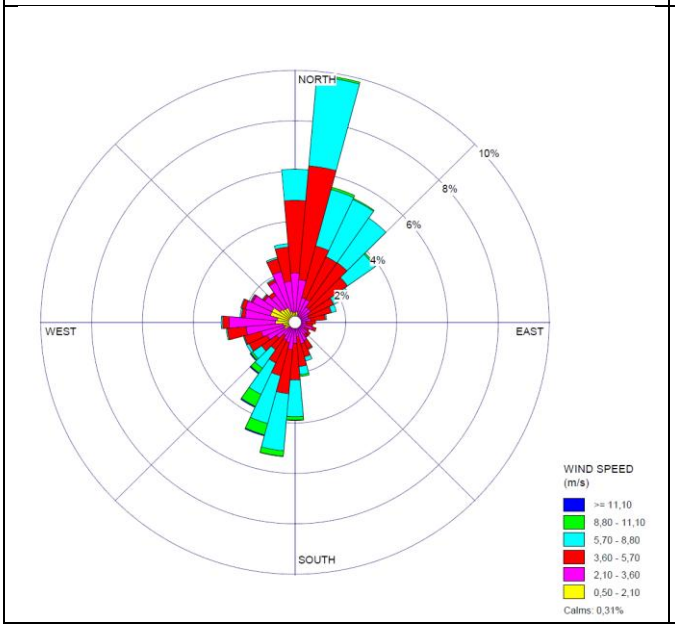
(a) Summer (Dec-Feb)



(b) Autumn (Mar-May)



(c) Winter (Jun-Aug)



(d) Spring (Sep-Nov)

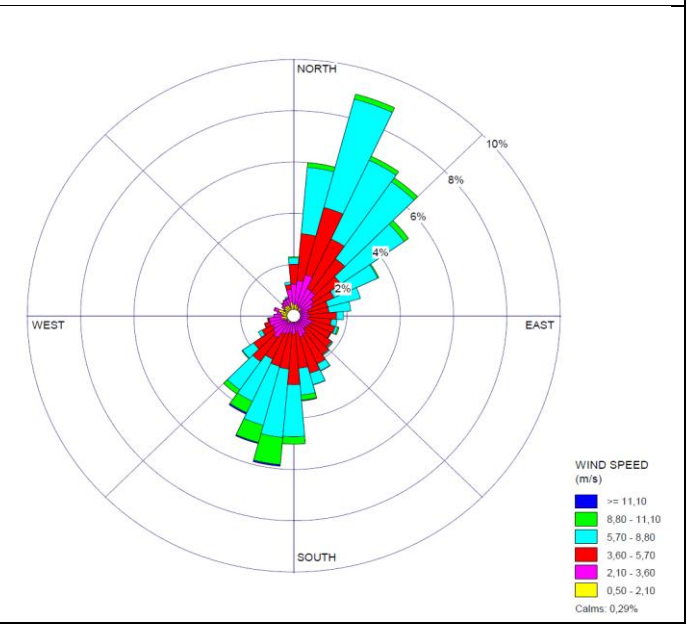


Figure 9: Seasonal wind roses derived from AERMET/ AERMOD-Ready Data (2023-2025)

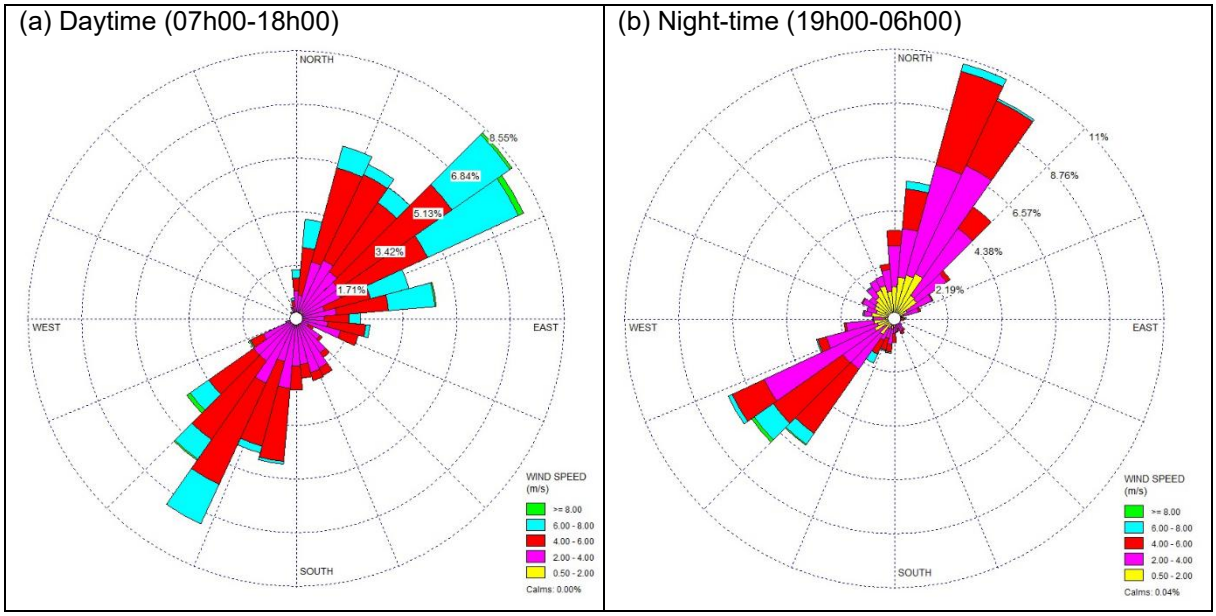


Figure 10: Annual (a) diurnal, and (b) nocturnal wind roses at the Arboretum station, based on 2020-2025 data.

The day-time winds at Arboretum are more from the NE to east and SSW, whereas night-time winds are more from the NNE and SW; a small proportion of light land breezes from the NW sector are evident at night. Wind speeds are generally stronger during the day (ave 4.36 m/s) than at night (ave 3.06 m/s) and are generally lighter during winter (May to July), when more stable conditions prevail, and increase during spring and summer (Fig. 11), during which dispersion conditions are enhanced.

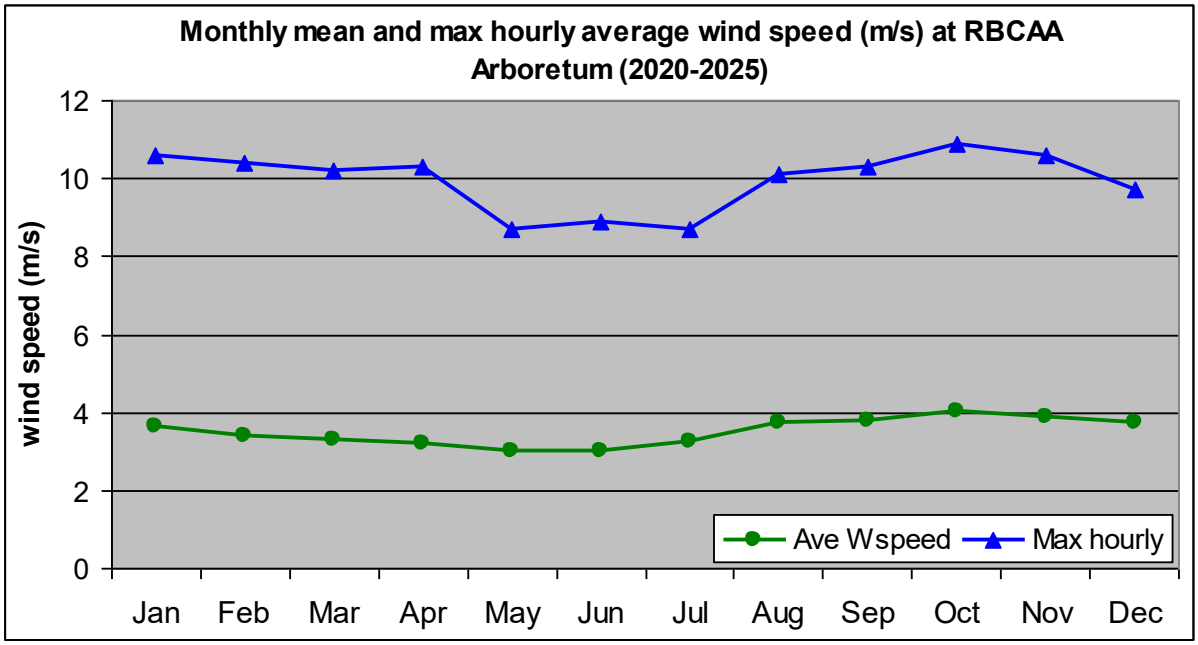


Figure 11: Monthly Average wind speed (m/s) at the Arboretum station, based on 2020-2025 data

Rainfall

Rainfall is a means of removing pollutants from the atmosphere and thus has important implications for pollution dispersion. The monthly average rainfall, measured at the SASRI Felixton Mill from 1957 to 2025 and long-term (20 year) rainfall measured by SAWS at the Richards Bay Airport is presented in Figure 12, along with the Airport long-term mean relative humidity (RH%). FOSKOR lies between the two meteorological measurement stations, hence rainfall data for both are shown. Although the annual rainfall figures are similar, with Felixton 1 229 mm and the Airport 1 228 mm, and both show higher summer rainfall and lower winter rainfall, the trends show some variability, viz. Felixton rainfall is consistently higher than the Airport from September to December, however the reverse is true for January to February, and particularly May. Rainfall is highest at both stations during January and February and lowest from June to August.

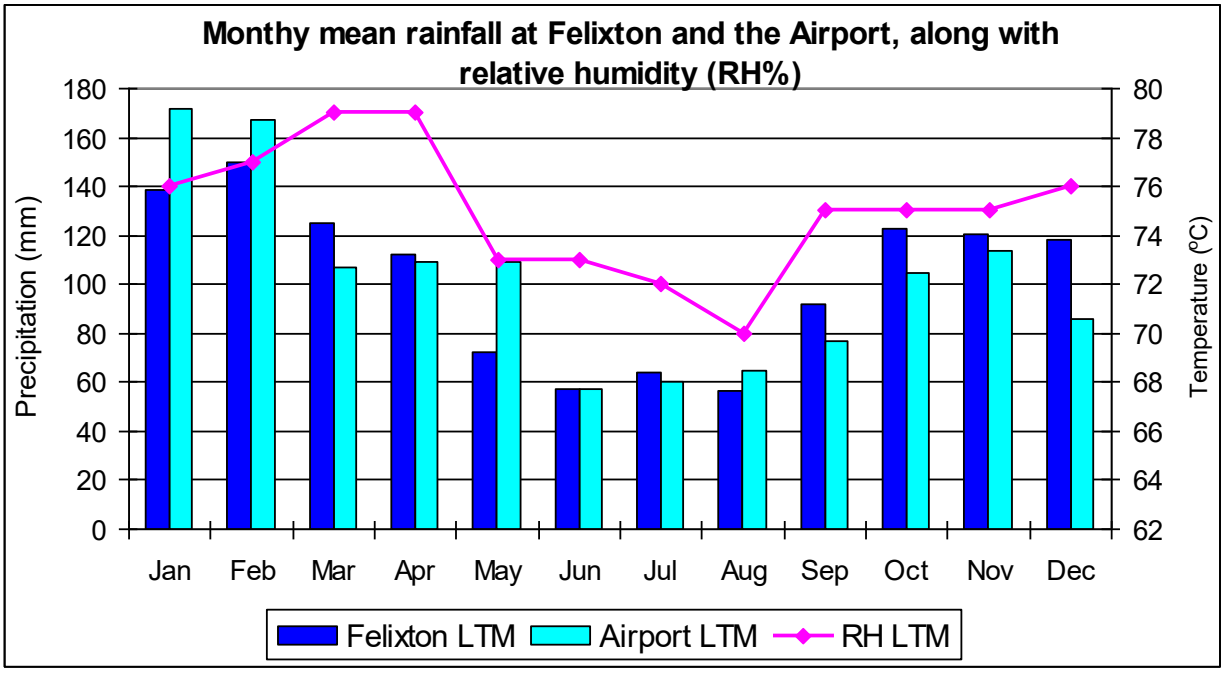


Figure 12: Long-term mean (LTM) monthly rainfall at SASRI Felixton, based on 1957 – 2025 data, and Richards Bay Airport (SAWS) 20-year mean monthly rainfall and relative humidity.

Relative Humidity (RH)

Humidity can affect air pollution in several ways, including the dispersion of pollutants, reactions between chemicals, movement of pollutants, visibility, precipitation, etc. (earthreminder.com). The role of humidity in air quality is complex, and scientific literature is fairly divided. Humidity affects the buoyancy of air: humid air is more buoyant than dry air and will therefore promote uplift and mixing; although conversely, it is claimed that humid air can also trap pollutants close to the ground. Humidity can speed up the chemical reactions that produce air pollutants, like ozone and particulate matter and act to decrease ozone pollution (UCAR) but can also play a role in the secondary production of aerosols (Choi, et al., 2023). The mean monthly relative humidity (RH %) for Richards Bay is indicated in Figure 12. There is general agreement with the rainfall trend, with RH higher during summer, in particular March and April, after the higher January to February rains, whilst the winter months are drier,

particularly August, prior to the onset of spring rains. There is diurnal variability in RH, linked to air temperature, with drier conditions generally experienced during daytime, particularly the afternoon, and more humid conditions overnight.

Air Temperature

Ambient air temperature is important, both for determining the effect of plume buoyancy (the larger the temperature difference between a plume and the ambient air, the higher the plume can rise), and for determining the development of mixing and temperature inversion layers. Average air temperature at Arboretum, Richards Bay (Figure 13) varies from 18.3°C in winter (July) to 26°C in summer (January). Hot days are possible during summer, with temperatures reaching over 40°C. Minimum temperatures can get cold during winter, dropping to a minimum of 5.8°C during July. Temperature inversions are common during the colder months, trapping atmospheric pollutants below the inversion layer, whilst during the warmer months surface heating promotes uplift, convection and mixing, which facilitates the dispersion of air pollutants.

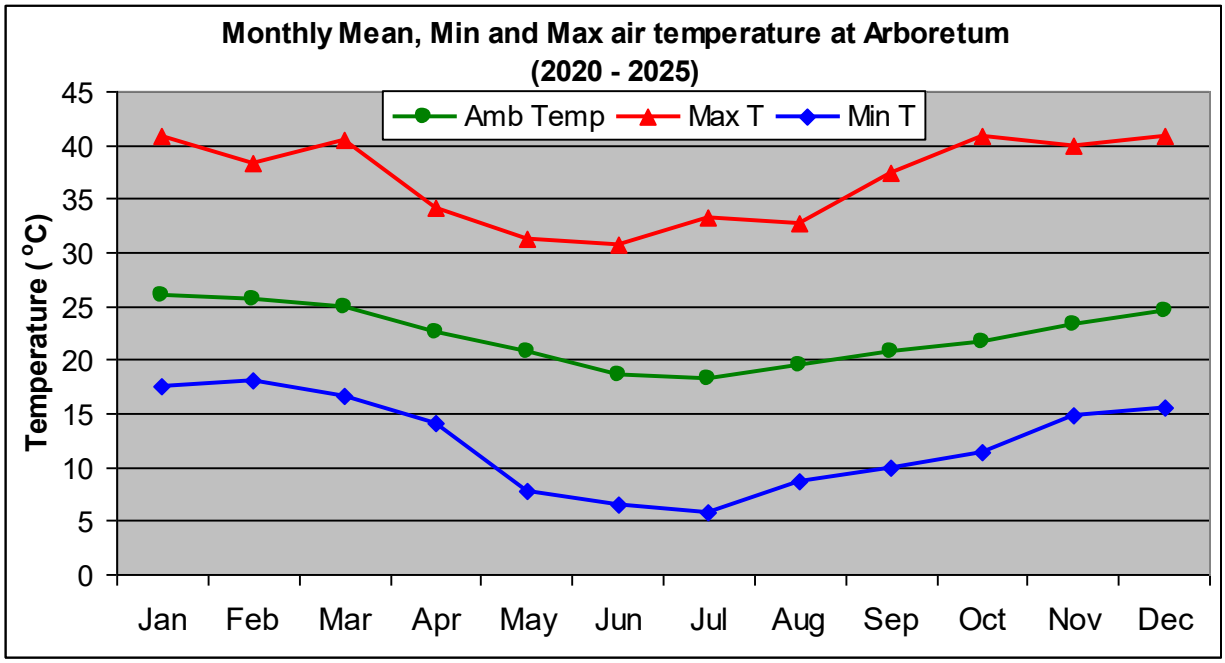


Figure 13: Monthly average air temperature and maximum and minimum hourly average air temperature per month recorded at the RBCAA Arboretum station (2020-2025)

8.3 Summary

Pollutant dispersion is generally enhanced during the summer months due to unstable atmospheric conditions associated with increased air temperatures, humidity, wind speeds and rainfall, whereas pollutant dispersion potential is lower during the cooler winter months, characterised by cooler air temperatures, lower humidity, wind speeds and rainfall and more stable atmospheric conditions. Considering the wind roses, the predominant dispersion direction of pollutants will generally be towards the north-east to ENE and SSW to south of the FOSKOR premises. During winter, stable atmospheric conditions and lower wind speeds result in poor dispersion and the potential for accumulation of pollutants below the inversion layer, especially at night and early morning.

9 AIR QUALITY IMPACTS

9.1 Areas of Influence

The potential direction of plume dispersion from the FOSKOR site can be visualised by superimposing the Arboretum annual wind rose, using the direction towards which the wind blows, over the surrounding area using Google Earth imagery (Figure 14). This can be used as a quality control check against the AERMOD model output. During northerly to NE winds, the plume from FOSKOR will disperse in a southerly to SW direction from FOSKOR to over the Harbour West area, where there are few sensitive receptors, the main ones being the TNPA permit office, Seafarers Centre and TNPA offices, Grindrod terminal (coal storage) and future Pier 605 port area. During SW-WSW winds the plume disperses north-eastwards over the Richards Bay CBD and Arboretum residential area and thence to the residential areas of Veldenvlei and Birdswood, where there are sensitive receptors.

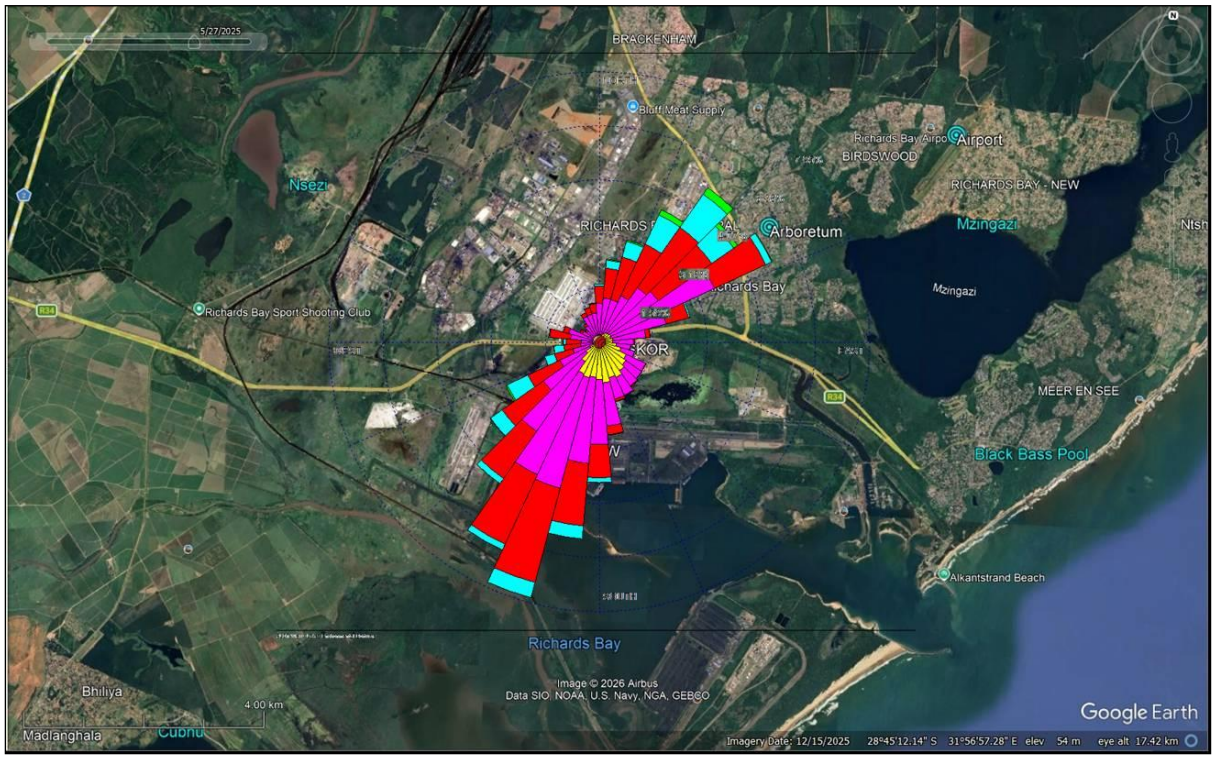


Figure 14: Arboretum annual wind rose, shown as direction towards which the wind blows, superimposed on the FOSKOR site and surrounds (Google Earth) to indicate the potential direction of plume dispersion.

Figure 15 provides examples of plume behaviour according to air stability and prevailing winds.

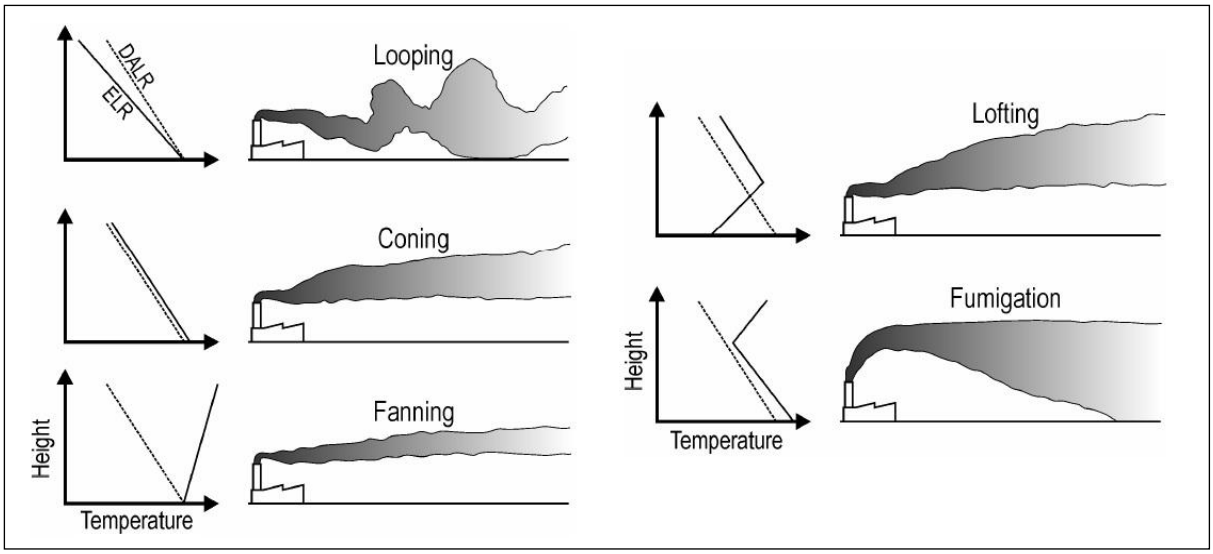


Figure 15: Plume types as a function of air stability and winds (after Diab, undated)

9.2 Health Effects

The pollutants of concern identified from the FOSKOR activity are particulate matter ($PM_{2.5}$ and PM_{10}), nitrogen dioxide (NO_2), and sulphur dioxide (SO_2).

Particulate Matter

Particulate matter is a pollutant that consists of solid and liquid particles suspended in the air. The size of the particles is directly linked to their potential to cause health problems. $PM_{2.5}$ particles are less than 2.5 micrometres in diameter, and PM_{10} particles are less than 10 micrometres in diameter. Inhalation of $PM_{2.5}$ particles can penetrate deep into the lungs and enter the bloodstream, short term exposure worsens asthma, bronchitis, and heart issues (Thangavel et al., 2022). PM_{10} mainly deposits in the upper airways, causing irritation and inflammation (Yadav et al., 2024).

Nitrogen dioxide

Nitrogen dioxide (NO_2) is a common air pollutant that is produced during various combustion processes. Elevated levels of NO_2 may result in increased respiratory problems, inflammation of the lining of the lungs, and reduced immunity to lung infections. People most likely to be affected are those with Asthma, heart disease, children, pregnant woman and the elderly (Jiang et al., 2019).

Sulphur dioxide

Sulphur dioxide affects human health when it is inhaled. It causes irritation of the nose, throat, and airways which results in coughing, wheezing, shortness of breath, or a tight feeling around the chest. People most likely to be affected are those with asthma or similar conditions (Khalaf et al., 2024).

9.3 Ambient Air Quality Monitoring Concentrations

The data in this report was obtained from the Richards Bay Clean Air Association (RBCAA) website. Figure 16 and Table 11 display the ambient air quality monitoring stations and parameters downloaded for the year 2025. The data is graphically represented in Figures 17 to 19. The National Ambient Air Quality Standards (NAAQS) presented in Table 9 were taken into account during the interpretation of the results.

Table 11: Ambient air quality monitoring stations from RBCAA website

Station	Parameters
Scorpio ES1	PM_{10}
Scorpio ES2	$PM_{2.5}$
Scorpio	SO_2
Richardia	SO_2, PM_{10}
Harbour West	SO_2, $PM_{2.5}$
Arboretum	SO_2



Figure 16: RBCAA Ambient Air Quality Monitoring Stations (Source: https://rbcaa.org.za).

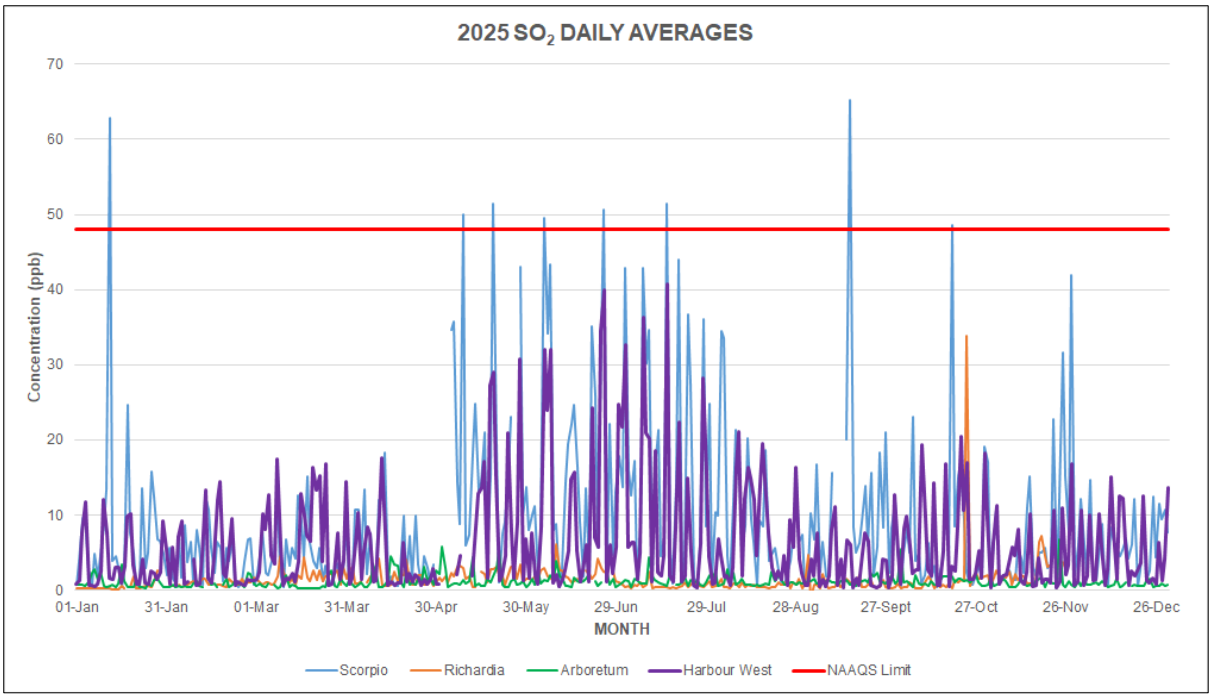


Figure 17: SO_2 Daily averages measured in 2025 (note that concentrations are in ppb)

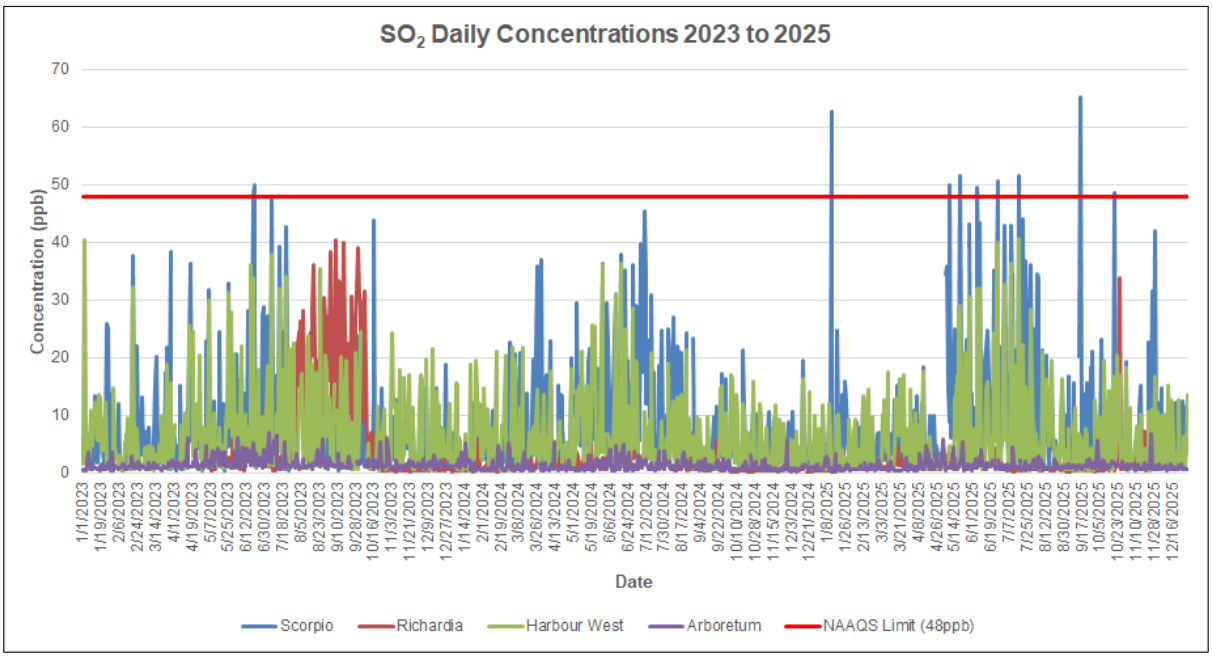


Figure 18a: SO_2 Daily averages measured 2023- 2025

The 24-hour average NAAQS of 48ppb was exceeded ten times at Scorpio Station, with a maximum measurement of 65.2 ppb recorded on 15 September 2025. The wind direction was northerly (14^0) with a wind speed of 3.6 m/s (gentle breeze), therefore the source was unlikely to be FOSKOR.

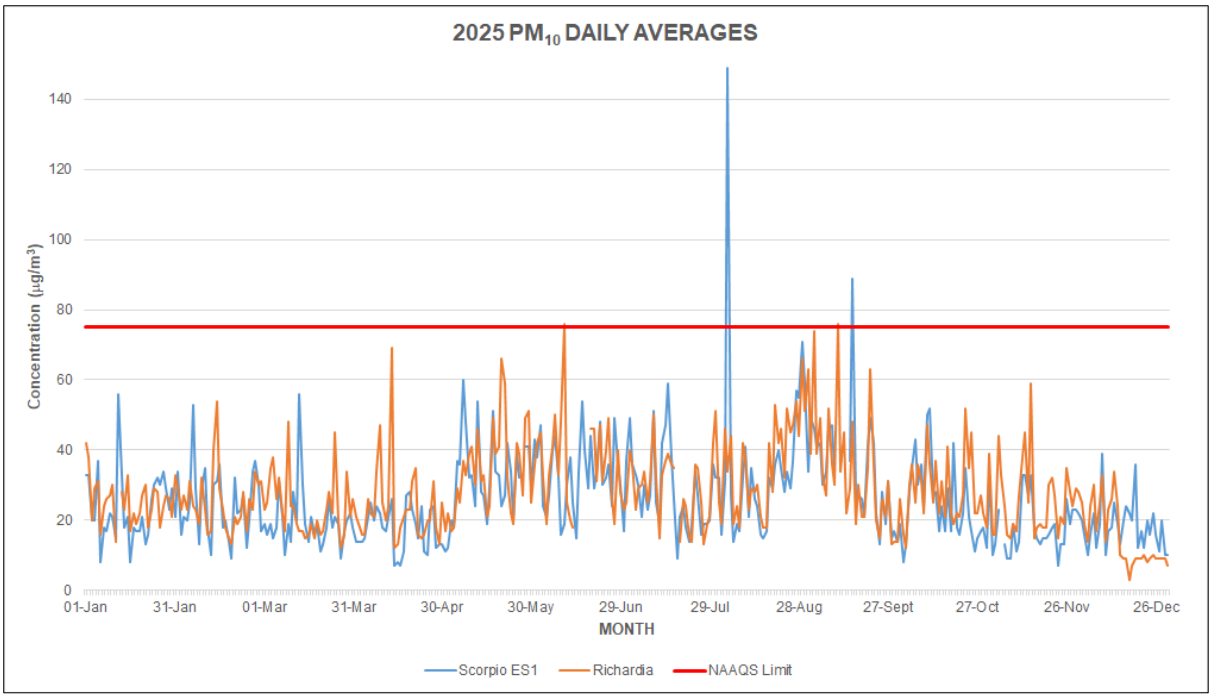


Figure 19: PM_{10} Daily averages in 2025

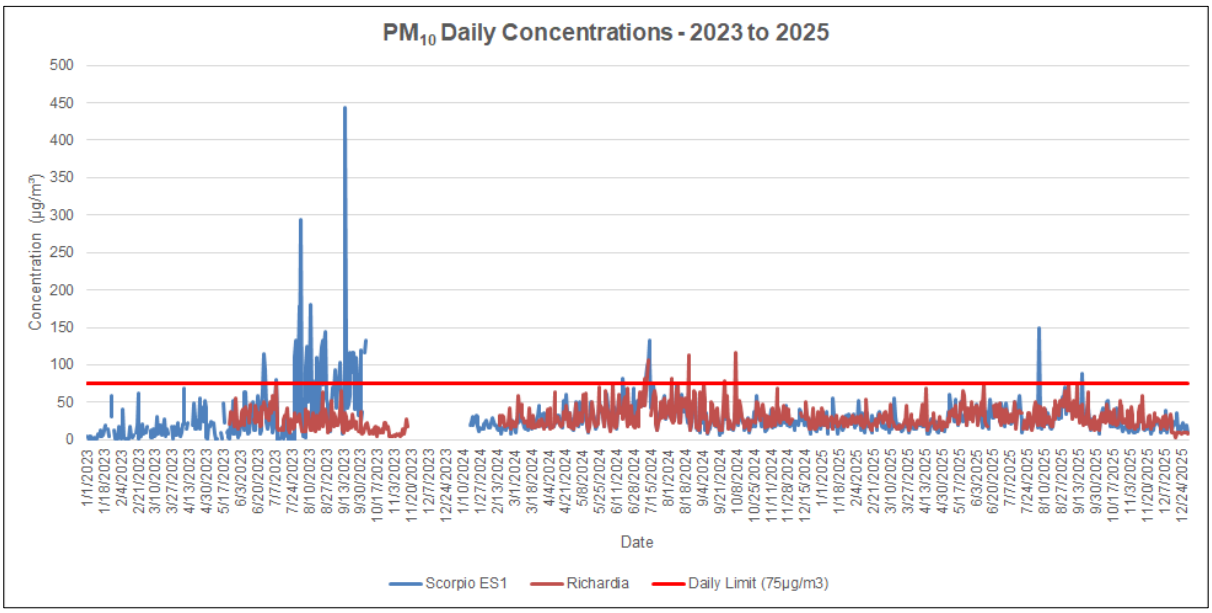


Figure 20: PM_{10} Daily averages 2023- 2025

The 24-hour average PM_{10} concentration exceeded the limit of 75 µg/m^3 41 times at Scorpio Station, with the highest measurement of 443 µg/m^3 on 15 September 2023 during northerly wind conditions at a wind speed of 4.5 m/s; again, based on the winds, the source was unlikely to be FOSKOR.

Additionally, PM_{10} exceeded the 24-hour limit 11 times at Richardia Station on 10 June 2025 and 07 October 2025 during northerly wind conditions at a wind speed of 4.5 m/s, with a maximum concentration of 117 µg/m^3. Based on the winds, the source was unlikely to be FOSKOR

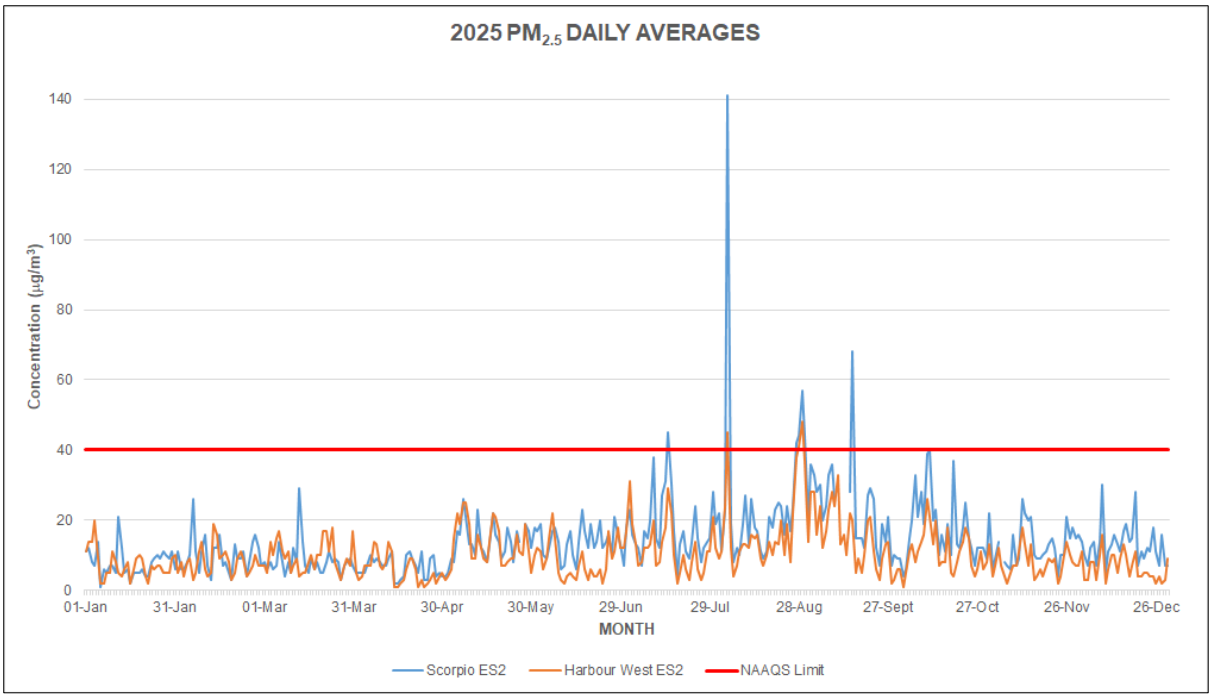


Figure 21: $PM_{2.5}$ Daily averages in 2025

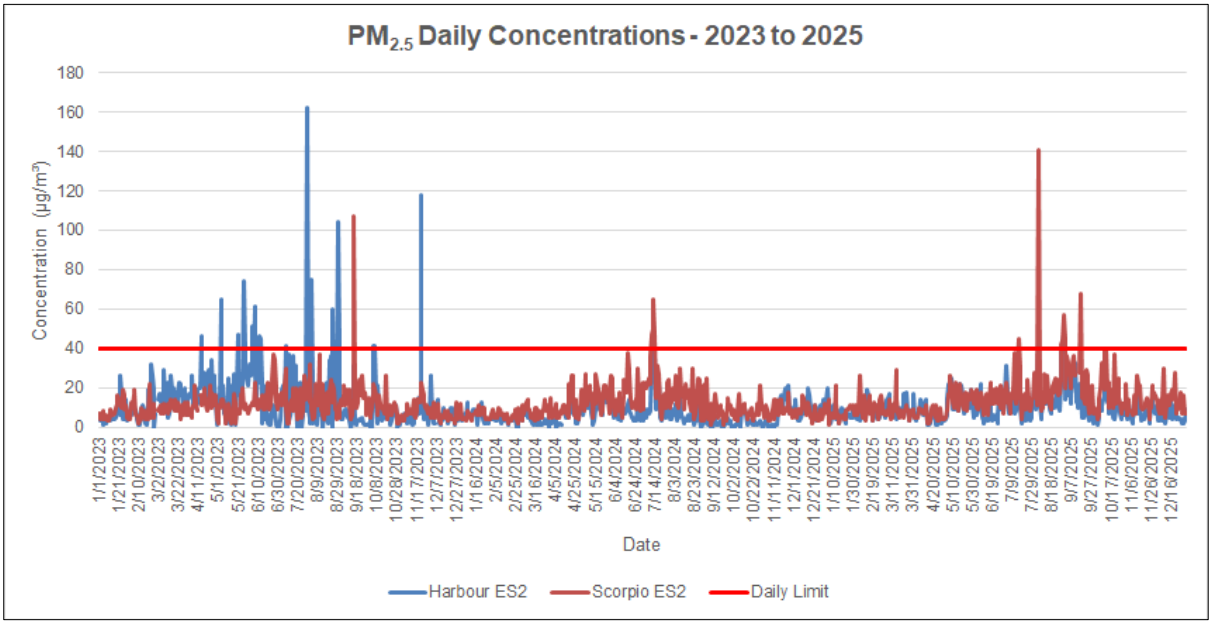


Figure 22a: $PM_{2.5}$ Daily averages 2023-2025

The $PM_{2.5}$ concentration exceeded the NAAQS limit of 40 µg/m^3 12 times at Scorpio Station and 22 times at Harbour West ES2. The highest $PM_{2.5}$ concentration of 162 µg/m^3 at Scorpio Station was recorded during northerly wind conditions at a wind speed of 4.5 m/s on 30 July 2023 while Harbour West ES2 measured the highest concentration of 141 µg/m^3 during north-north-east wind conditions at a wind speed of 3.4 m/s on 08 May 2025. Based on the wind direction, FOSKOR may have been a contributor to the elevated concentrations measured at Harbour West ES2; however there are a number of potential sources, therefore it is unsure to what extent FOSKOR may have contributed.

10 DISPERSION MODEL INPUT

The South African Government has issued a *"Code of Practice on the Use of Air Dispersion Modeling in Air Quality Management in South Africa,"* as published in Government Gazette No. 37804, No. R.533 on 11 July 2014. This code was consulted during the completion of this assessment. The pollutants of concern are particulate matter ($PM_{2.5}$ and PM_{10}), nitrogen dioxide (NO_2), and sulphur dioxide (SO_2).

The assessment specifically focuses on ambient air quality standards and, therefore, the exposure of workers within the FOSKOR site is not considered, as it falls under the jurisdiction of the Occupational Health and Safety Act.

Sensitive receptors such as schools, clinics, old age homes and hospitals have been identified and are presented in Section 10.1. Pollutant concentrations have been modeled for these locations.

10.1 Receptors

10.1.1 Multi-Nested Grid:

A multi-nested grid approach was adopted following the guidelines of GNR 533. This approach aims to define spatial points of maximum impact while ensuring reasonable computation times and adequate resolution.

The resolution and spatial limits of the multi-nested grid were determined based on the grid spacing recommendations outlined in GNR 533. The central point of the grid of receptors is located at the approximate centre of the FOSKOR site (UTM coordinates: 405668.44 m E, 6816726.68 m S, UTM zone 36 J). The multi-nested approach is detailed as follows:

- An inner bounding box measuring 2 km by 2 km, centred around the site, was established. Receptor spacing in both x and y directions was set at 50 m within this bounding box to form the primary grid.
- A secondary grid was created 4 km away from the primary bounding box in both x and y directions, with a grid spacing of 100 m.
- A tertiary grid was established 9 km from the primary bounding box in both x and y directions, with a grid spacing of 250 m.
- A quaternary grid was set up 14 km from the primary bounding box in both x and y directions, with a grid spacing of 1,000 m.

Table 12 and Figure 21 below provides an overview of the multi-nested grid dimensions,

Table 12: Nested Grid Dimensions

Multi Nested Grid and Spacing	Grid Boundary Dimensions
Primary Grid (50m)	2 km by 2 km
Secondary Grid (100m)	10 km by 10 km
Tertiary Grid (250m)	20 km by 20 km
Quaternary grid (1000m)	30 km by 30 km
Total number of receptors from multi-nested grids	20481

10.1.2 Sensitive (Discrete) Receptors

The area surrounding the facility was assessed to identify potential sensitive receptors, which are locations where vulnerable populations such as children, elderly, and infirm individuals are present in close proximity to the facility. These locations include schools, daycare centres, nursing homes, hospices and hospitals. A study radius of 5 km and 10 km was used for this assessment (see Fig. 20).

The review identified 30 potential sensitive receptors, which were considered in the modeling exercise. It is important to note that this list may not be exhaustive but is sufficient to cover the modeling area and address the most vulnerable population groups within 5 km and 10 km of the site. The closest sensitive receptor, Betesda Independent School, is approximately 1.5 km from the site.



Figure 23: Sensitive receptors within a 5-kilometre (red) and 10-kilometre (yellow) radius of FOSKOR (Google Earth, 2026).

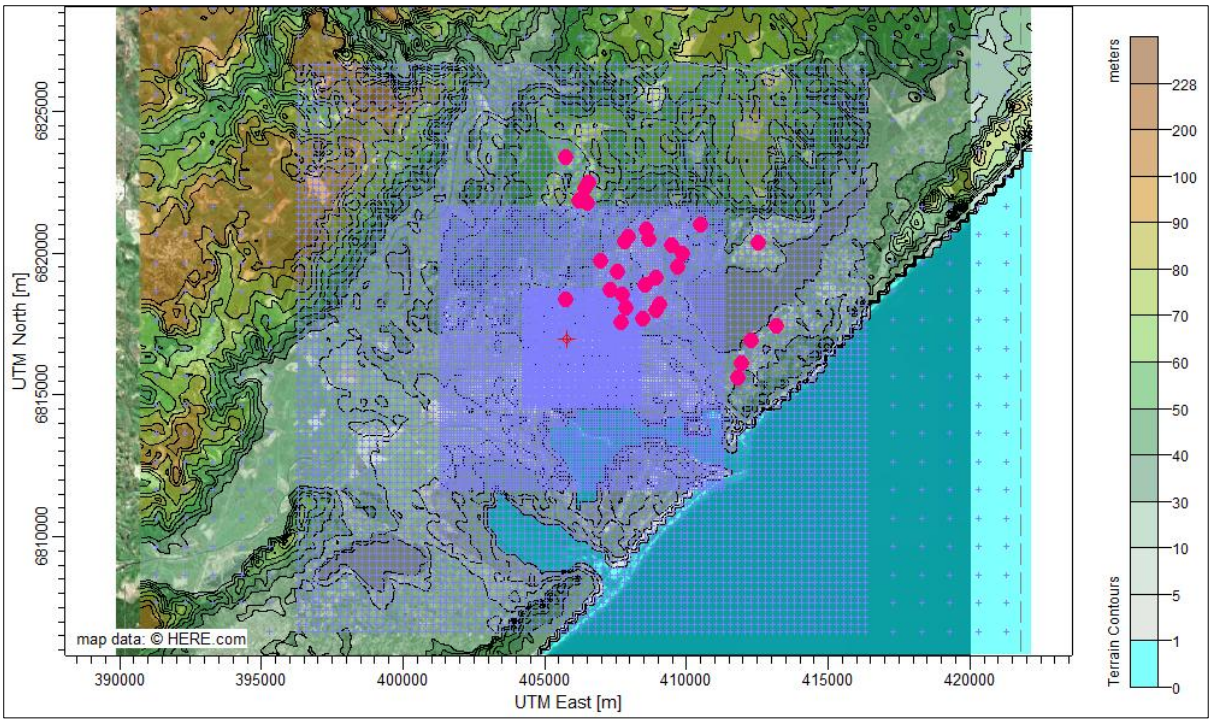


Figure 24: Sensitive receptors situated within 10 kilometres of the facility and Nested Grid (Lakes Environmental)

Table 13: Sensitive receptors identified with their location

Receptor	Distance (km)	Direction from Operation	UTM Coordinates (m)		Elevation (m)
			X	Y	
Aquadene Secondary school	6.5	North	405744.89	6823379.57	47
Arboretum Primary School	3.2	North-Northeast	408553.81	6818883.43	27
Betesda Independent School	1.5	North-Northwest	405751.18	6818363.52	36
Birdswood Secondary School	6.2	Northeast	410475.87	6821008.94	38
Brackenham Primary School	5.4	North	406428.81	6822298.30	64
Emmanuel Pre School & Creche	4.9	North	406184.98	6821856.41	55
John Ross College	2.1	Northeast	407840.34	6818088.81	31
Kati Primary School	7.2	Northeast	412513.67	6820359.81	19
Little Musketeers	5.7	East-Southeast	411792.26	6815616.14	25
Little People's Centre	3.5	Northeast	408905.22	6819148.50	18

Living Stones Babtist Church	5.6	North	406549.76	6822495.08	61
Lutheran Church	4.8	Northeast	409841.69	6819968.30	25
Mouse House Nursery School	7.1	East	413182.46	6817441.90	18
Mpuza Temple-Shembe	4.5	Northeast	409680.06	6819499.59	32
Mums Angel's Daycare	3.1	East-Northeast	409035.52	6818213.93	20
Mzingazi Lakeside Retirement Village	6.2	East	412295.16	6816934.20	13
Netcare The Bay Hospital	2.8	North-Northeast	407558.56	6819356.25	34
Rainbows End Day Care Centre	2.4	East-Northeast	408474.06	6817673.71	18
Richards Bay Assembles of GOD	1.7	Northeast	407682.39	6817567.60	23
Richards Bay Christian School	4.7	Northeast	408574.25	6820849.57	26
Richards Bay Primary School	5.9	East	411932.53	6816101.93	30
Richards Bay Muni Clinic	2.1	Northeast	407296.27	6818717.60	32
Richards Bay Secondary School	5.0	North	406494.17	6821751.51	55
Richardia Primary school	3.0	Northeast	408919.75	6817993.42	25
Savf Welfare Organisation	3.9	North-Northeast	407808.82	6820417.05	30
Stepping Stones Pre Primary	2.2	Northeast	407714.21	6818542.17	31
St Francis Church	4.4	Northeast	408647.80	6820497.79	16
Tiny Todz	4.8	Northeast	409483.01	6820298.45	19
Unjani Clinic Richards Bay	3.0	Noth-Northeast	406985.62	6819720.77	35
Veldenvlei Primary School	4.1	North-Northeast	407946.53	6820581.90	31

10.1.3 Plant Boundary

The plant boundary was demarcated using 20 cartesian boundary points, with additional intermediate receptors placed every 50 m along the plant boundary. The total number of plant boundary receptors was 30 receptors.



Figure 25: Map Showing Plant Boundary (Google Earth, 2026)

10.2 FOSKOR Buildings

Several buildings are located on the site. The dimensions of the buildings that could potentially cause building downwashes are outlined in Table 14 and shown in Figure 23. These dimensions were determined using Google Earth imagery and a site layout provided by FOSKOR.

According to US EPA regulations, a building is deemed close enough to a stack to cause wake effects if the distance between the stack and the nearest part of the building is less than or equal to five times the lesser of the building height or the projected building width.

Table 14: FOSKOR buildings

Building Identifier and Description	X Coordinate (m)	Y Coordinate (m)	Height (m)
BLD_1 Gas Boiler House	405743.87	6816929.06	8.9 - 10 m
BLD_2 Storage Room	405764.44	6816920.64	8 m
BLD_3 Bathrooms	405755.16	6816940.96	3 m
BLD_4 Mechanical Workshop	405779.93	6816961.45	7 m
BLD_5 Turbo Generator Room	405797.78	6816951.50	12 m



Figure 26: Aerial image (Google Earth) showing some of the FOSKOR buildings.

10.3 Point Source Emission

During the reporting period from 01 January to 31 December 2025, the FOSKOR gas boiler combusted 14,034,873.69 m^3 of natural gas, exceeding the permitted limit of 10,000,000 m^3. Emissions from the gas boiler stack were calculated for both scenarios and are presented in Table 16.

The air emissions data are categorized by scenarios and pollutant type, including particulate matter (<2.5 µm, <10 µm, <30 µm), sulphur dioxide (SO_2), and nitrogen oxides (NO_X) from the gas boiler. These emissions were used in the AERMOD modeling process.

The graphical representation of the stack location discharge point is shown in Figure 24, with corresponding references provided in Table 15. Stack dimensions are also included in the same table.

Table 15: Stack Dimensions and Associated Appliance

Stack Dimensions	Appliances Emitting Through Stack	Stack Dimensions	
		Height (m)	Diameter (m)
	Gas Boiler	11	1.3
Geographical Location	Map Reference	Location of Point Source	
		Latitude	Longitude
	A	28°46'18.01"S	32° 2'3.61"E



Figure 27: Point Source (Source: Google Maps Imagery © 2026)

The discharge point locations and corresponding references are shown in Table 17 below.

Table 16: 2025 Calculated Emissions for all scenarios

Scenarios	Emissions (g/s)				
	PM	PM_{10}	$PM_{2.5}$	NO_x	SO_2
Above permitted fuel	0.059	0.059	0.059	0.71	0.0085
Permitted fuel	0.042	0.042	0.042	0.51	0.0061

10.3.1 Derivation of emission factors

Emission factors have been developed by assessing the emissions from various industries and their typical related operations. These provide a long-term average of steady state emissions.

The emission factors presented in AP 42 are rated ranging from “A” to “E.” The rating is an indication of the factor’s reliability and robustness. The rating considers the tests used in determining the factor as well as the number of data sources used and representative characterisation of the data. Factors with

higher rating generally mean that the factor was derived using more data sources, and more widely accepted test methods. A rating of “A” is the highest while a rating of “E” is the lowest. An emission factor developed using for example a single observation with possibly unreliable testing methodology or one factor extrapolated from another factor for similar process will receive a lower rating.

There are two key steps used in the determination of factor rating. Step one involves reviewing data quality, the reliability of the emission data used for the study. Step two considers the ability of the factor to serve as a national annual average emission factor.

The assignment of emission rating is not an exact science therefore the ratings should be considered as approximations themselves. It should be noted that the factor rating does not imply confidence intervals or statistical error bounds. At best an emission factor rating is an indicator of accuracy and precision from a given number of sources.

10.3.1.1 Boiler Emissions

The overall usage for the boiler with the respective fuel type contribution was provided by FOSKOR.

10.3.1.2 Natural Gas Combustion

The US EPA has developed an emission factor approach to determine the emissions from natural gas combustion. The emissions from natural gas-fired boilers include nitrogen oxides (NO_x), trace amounts of sulphur dioxide (SO_2), and low amounts of particulate matter (PM).

Particulate matter emissions from natural gas combustion

Particulate Matter Emissions comprise of three key types: Total Particulate Matter, Filterable Particulate Matter and Condensable Particulate Matter. Because natural gas is a gaseous fuel, filterable PM emissions are typically low. The US EPA AP-42 (Chapter 1.4 Natural Gas Combustion) provides emission factors for Particulate matter (total particulate matter, filterable particulate matter and condensable particulate matter). Filterable particulate matter refers to the matter collected on the filter in terms of the US EPA Method 5.

Emission factors for Particulate Matter were sourced from Table 1.4-2.

NO_x emissions from natural gas combustion

The Emission factor used to determine Oxides of nitrogen (NO_X) emissions were sourced from Table 1.4-1 (with no abatement equipment).

SO_2 emissions from natural gas combustion

The total sulphur content of the fuel was provided by FOSKOR. Sulphur dioxide emissions from natural gas-fired boilers are low due to pipeline quality, natural gas contains low sulphur levels. The sulphur dioxide emissions were estimated to have assumed complete oxidation of all Sulphur in the fuel. These assumptions result in overestimates which are conservative in nature.

10.4 Model Input summary

Table 17: Model Input Data

Models	**Model Version**			
Assessment Level	Level 2			
Dispersion Model	Aermod View Version 13.0.0.			
Supporting Models	Aermet View Version 13.0.0. Aermap View Version 13.0.0.			
AERMOD PARAMETERS				
Pollutants modeled	$PM_{2.5}$, PM_{10}, NO_2, and SO_2			
Scenarios	Operational			
Average periods per pollutant	$PM_{2.5}$	PM_{10}	NO_2	SO_2
	24-hour and annual	24-hour and annual	1-hour and annual	1-hour, 24-hour and annual
Chemical transformation (NO_2/NO_x)	Nil			
Control Pathway Parameters	**Value**			
Dispersion coefficient	Rural			
Terrain	Flat and elevated terrain			
Exponential decay	No			
Output	Concentration / Dry Deposition			
Plume depletion	Dry and wet removal			
Flagpole receptors	Default (0.0m)			
Receptors				
Multi-Nested Grid	4 tier grids			
Discrete Cartesian	30 sensitive receptors			
Plant boundary receptors	20			
Total Receptors	20481			
Sources				
Point Source	Gas Boiler Stack			
Building Downwash	Yes			
Gas / Particulate Data	Non-Default - Particle size distribution			
Variable Emissions	N/A			
Output Pathway				
Percentile	99.00 Percentile Values			
AERMET INPUT PARAMETERS				
Data type	AERMET-Ready WRF-MMIF (Prognostic & Upper Air Met Data)			
Start-End date	1 January 2023 till 31 December 2025			
Grid cell centre (Latitude, Longitude)	28° 46.449'S, 32° 2.081'E			
Datum	WGS 84			
Cell dimension	4kmx4km			
Surface Met Data				
Format	SFC (Surface met data for pre-processing by AERMET)			
Anemometer height				
Base elevation above MSL	28.06 meters			
Time	UTC/GMT UTC + 2 hour(s) (data reported in local time)			
Output interval	Hourly			
Upper Air Data				
Format	TD-6201 – Fixed Length (upper air met data for pre-processing by AERMET)			
Time				
Output interval	00Z and 12Z			
Land characteristics (bowen ratio, surface albedo, surface roughness)	Urban / grassland			
AERMAP Input Parameters				
Terrain setting	Flat and Elevated			
Dimensions of region imported	31.5km x 31.5km			
Terrain data	SRTM1 – Version 3 (WEBGIS)			
Terrain data resolution (m)	30			
Elevations assignment	All sources, all receptors, all buildings			

11 DISPERSION MODELING RESULTS

Three scenarios were modelled for the gas boiler in isolation (excluding other plant sources):

- Scenario 1: Actual methane gas consumption in 2025, above the AEL limit (14,034,873.69 m^3 per year).
- Scenario 2: Maximum methane gas consumption permitted by the AEL (10,000,000 m^3 per year).
- Scenario 3: Proposed increase in methane gas consumption for the AEL variation (15,000,000 m^3 per year).

The maximum predicted concentrations of nitrogen dioxide[1] (NO_2), particulate matter (PM_{10} and $PM_{2.5}$) and sulphur dioxide (SO_2) on the modelled receptor grid and at the sensitive receptors are presented below. The values reported are the highest (worst-case) concentrations predicted over the three meteorological years modelled (2023 to 2025). Isopleth (contour) plots were also produced for each pollutant and averaging period to show the dispersion of emissions from the gas boiler stack at FOSKOR.

11.1 Modeling Methodology

Concentrations were modelled using AERMOD, the recommended model for Level 2 assessments in the Code of Practice for Air Dispersion Modelling in Air Quality Management in South Africa (Appendix A to the Regulations Regarding Air Dispersion Modelling, GN R533, Government Gazette 37804, 11 July 2014). AERMOD is a steady-state plume model that uses surface and profile meteorological data processed by AERMET. AERMET uses standard meteorological measurements and the surface characteristics of the modelling domain to calculate the boundary layer parameters from which AERMOD estimates wind, turbulence and temperature profiles.

AERMAP, the terrain pre-processor, processes terrain data and generates receptor and source elevations for AERMOD.

The model can be applied in rural and urban areas, over flat and complex terrain, to surface and elevated releases and to point, area and volume sources. In the stable boundary layer (SBL), AERMOD assumes a Gaussian concentration distribution in both the vertical and horizontal directions.

The model was used to predict the contribution of the gas boiler to ambient concentrations of particulate matter (PM_{10} and $PM_{2.5}$), nitrogen dioxide (NO_2) and sulphur dioxide (SO_2). For the short-term standards, the 99th percentile of the 1-hour and 24-hour averages was modelled. As a conservative assumption, all particulate matter from gas combustion was assumed to be $PM_{2.5}$; the PM_{10} and $PM_{2.5}$ results are therefore identical.

The AERMOD input data are detailed in Section 10.

1 As a conservative (worst-case) assumption, all oxides of nitrogen (NO_x) were assumed to be converted to NO_2.

11.2 Assumptions and Limitations

When interpreting the results of this study, it is important to consider the following assumptions and limitations:

- Dispersion models approximate real atmospheric processes but cannot reproduce them exactly. Gaussian plume and puff models are generally accepted to have an uncertainty range of −50% to +200%, and the results should be interpreted within this range.
- The modelled operating conditions are a simplified representation of actual operations but are considered representative of them.
- The atmospheric emissions activities are constant for 24 hours a day and 7 days a week.
- The meteorological conditions are represented by a combination of data from a single automatic weather station and numerical weather model data.
- Meteorological conditions are assumed to be consistent across the model domain.
- For the short-term averaging periods, maximum concentrations are reported as the 99th percentile. This excludes statistical outliers and is consistent with the frequency of exceedance permitted under the NAAQS.

These assumptions introduce uncertainties that limit result interpretation. To address these uncertainties, conservative decisions were made to ensure a worst-case scenario assessment.

11.3 Scenario 1: Methane Gas Consumption Above Allowable Limit (14,034,873.69 m^3)

The predicted levels of pollutants (PM_{10}, $PM_{2.5}$, NO_2 and SO_2) are below the National Ambient Air Quality Standards (NAAQS) across the modelled grid as shown in Table 18 and Figures 28 to 40 below. NO_2 had the highest concentrations relative to the NAAQS: the maximum 1-hour and annual concentrations of 134.83 µg/m^3 and 35.21 µg/m^3 were 67% and 88% of the respective standards.

Maximum predicted concentrations at the sensitive receptors were well below the NAAQS, with all concentrations below 1 µg/m^3 (Table 19). The highest concentrations were predicted at Betesda Independent School with NO_2 concentrations of 0.89 µg/m^3 (1-hour) and 0.11 µg/m^3 (annual).

Table 18: Maximum predicted gas boiler contribution on the modelled grid (Scenario 1)

Pollutant averaging (NAAQS)	Easting (X)	Northing (Y)	Predicted Concentrations (µg/m^3)	NAAQS
SO_2 1-hour	405717.29	6816967.20	1.60	**350**
SO_2 24-hour	405745.58	6817047.25	0.83	**125**
SO_2 Annual	405741.89	6817005.22	0.42	**50**
NO_2 1-hour	405717.29	6816967.20	134.83	**200**
NO_2 Annual	405741.89	6817005.22	35.21	**40**
PM_{10} 24- hour	405745.58	6817047.25	5.75	**75**
PM_{10} Annual	405741.89	6817005.22	2.92	**40**
$PM_{2.5}$ 24- hour	405745.58	6817047.25	5.75	**40**
$PM_{2.5}$ Annual	405741.89	6817005.22	2.92	**20**

Table 19: Predicted Gas Boiler Concentrations at Sensitive Receptors (Scenario 1)

Receptor	Gas Boiler Source Maximum Process Contribution (µg/m^3)								
	NO_2		PM_{10}		$PM_{2.5}$		SO_2		
	Annual Mean	99%ile 1-hour Mean	Annual Mean	99%ile 24-hour Mean	Annual Mean	99%ile 24-hour Mean	Annual Mean	99%ile 1-hr Mean	99%ile 24-hr Mean
Aquadene Secondary school	0.00652	0.07675	0.00054	0.00350	0.00054	0.00350	0.00009	0.00093	0.00073
Arboretum Primary School	0.02336	0.20421	0.00194	0.01115	0.00194	0.01115	0.00030	0.00276	0.00174
Betesda Independent School	0.10688	0.88731	0.00887	0.03864	0.00887	0.03864	0.00116	0.01013	0.00683
Birdswood Secondary School	0.00713	0.10505	0.00059	0.00364	0.00059	0.00364	0.00009	0.00126	0.00071
Brackenham Primary School	0.00998	0.11107	0.00083	0.00618	0.00083	0.00618	0.00013	0.00133	0.00105
Emmanuel Pre School & Creche	0.01194	0.12577	0.00099	0.00862	0.00099	0.00862	0.00016	0.00150	0.00144
John Ross College	0.04792	0.36135	0.00398	0.02893	0.00398	0.02893	0.00056	0.00546	0.00519
Kati Primary School	0.00684	0.06444	0.00057	0.00400	0.00057	0.00400	0.00008	0.00092	0.00080
Little Musketeers	0.01005	0.10857	0.00083	0.00558	0.00083	0.00558	0.00015	0.00186	0.00188
Little People’s Centre	0.01878	0.16581	0.00156	0.00903	0.00156	0.00903	0.00024	0.00222	0.00143
Living Stones Babtist Church	0.00917	0.10579	0.00076	0.00539	0.00076	0.00539	0.00012	0.00127	0.00103

Lutheran Church	0.01156	0.11058	0.00096	0.00547	0.00096	0.00547	0.00015	0.00141	0.00093
Mouse House Nursery School	0.00756	0.07624	0.00063	0.00683	0.00063	0.00683	0.00011	0.00124	0.00197
Mpuza Temple-Shembe	0.01273	0.16350	0.00106	0.00631	0.00106	0.00631	0.00019	0.00204	0.00122
Mums Angel's Daycare	0.02323	0.20592	0.00193	0.01365	0.00193	0.01365	0.00028	0.00319	0.00241
Mzingazi Lakeside Retirement Village	0.00914	0.09535	0.00076	0.00755	0.00076	0.00755	0.00013	0.00159	0.00166
Netcare The Bay Hospital	0.02946	0.30505	0.00245	0.01674	0.00245	0.01674	0.00034	0.00347	0.00380
Rainbows End Day Care Centre	0.03408	0.29804	0.00283	0.01650	0.00283	0.01650	0.00043	0.00516	0.00476
Richards Bay Assembles of GOD	0.06092	0.51864	0.00506	0.02739	0.00506	0.02739	0.00073	0.00902	0.00607
Richards Bay Christian School	0.01384	0.10911	0.00115	0.00631	0.00115	0.00631	0.00016	0.00126	0.00150
Richards Bay Primary School	0.00979	0.10591	0.00081	0.00665	0.00081	0.00665	0.00015	0.00187	0.00214
Richards Bay Muni Clinic	0.04673	0.51163	0.00388	0.03166	0.00388	0.03166	0.00051	0.00581	0.00551
Richards Bay Secondary School	0.01183	0.13222	0.00098	0.00659	0.00098	0.00659	0.00015	0.00156	0.00149
Richardia Primary school	0.02495	0.22894	0.00207	0.01267	0.00207	0.01267	0.00031	0.00370	0.00278
Savf Welfare Organisation	0.01788	0.13769	0.00148	0.00857	0.00148	0.00857	0.00020	0.00170	0.00124
Steppingstones Pre Primary	0.03875	0.31914	0.00322	0.01727	0.00322	0.01727	0.00044	0.00436	0.00300

St Francis Church	0.01542	0.11682	0.00128	0.00704	0.00128	0.00704	0.00017	0.00136	0.00174
Tiny Todz	0.01199	0.10587	0.00100	0.00553	0.00100	0.00553	0.00014	0.00132	0.00088
Unjani Clinic Richards Bay	0.02953	0.27813	0.00245	0.01313	0.00245	0.01313	0.00033	0.00313	0.00187
Veldenvlei Primary School	0.01642	0.12639	0.00136	0.00826	0.00136	0.00826	0.00019	0.00154	0.00114
Standard	**40**	**200**	**40**	**75**	**20**	**40**	**50**	**350**	**125**

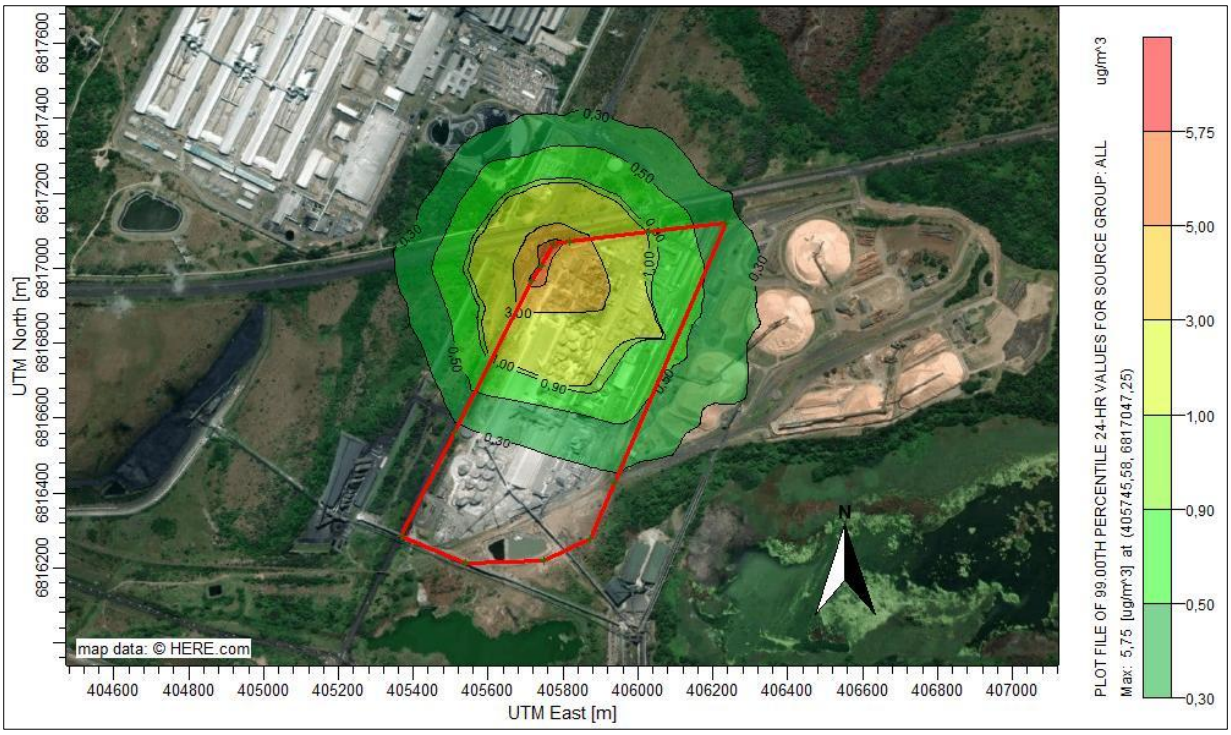


Figure 28: 99%ile of 24-hour Mean $PM_{2.5}$ Gas Boiler Contributions (Lakes, 2026)

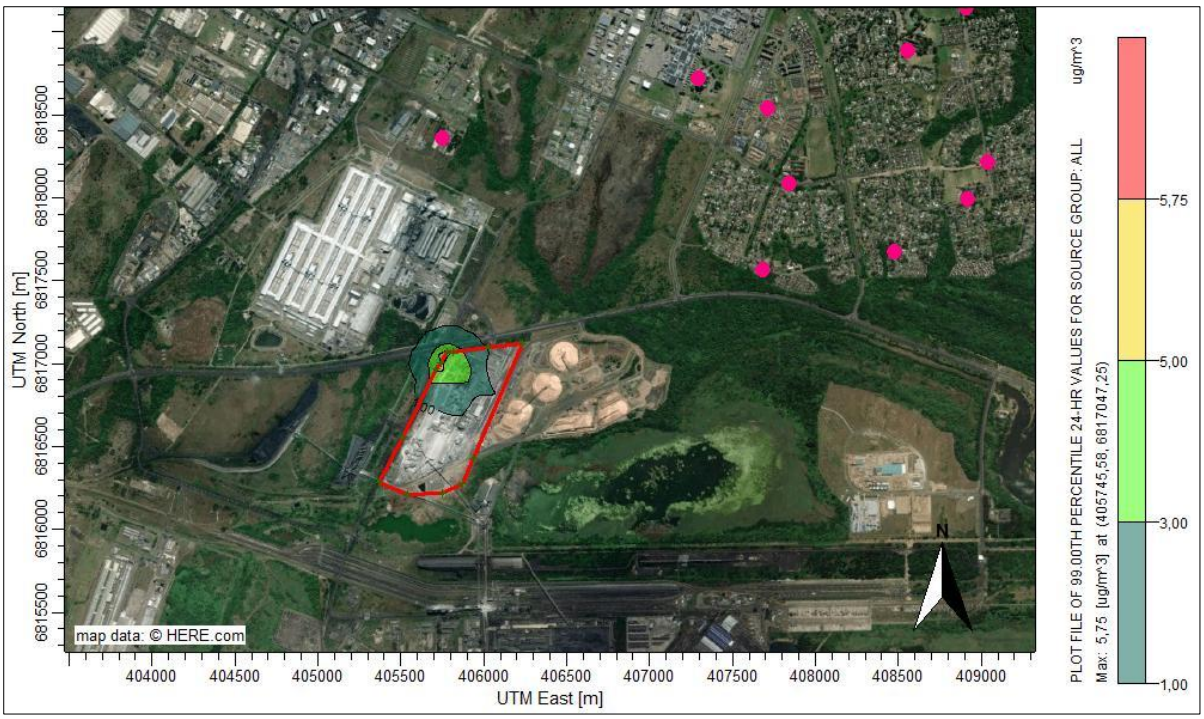


Figure 29: 99%ile of 24-hour Mean $PM_{2.5}$ Gas Boiler Contributions (+Sensitive Receptors) (Lakes, 2026)

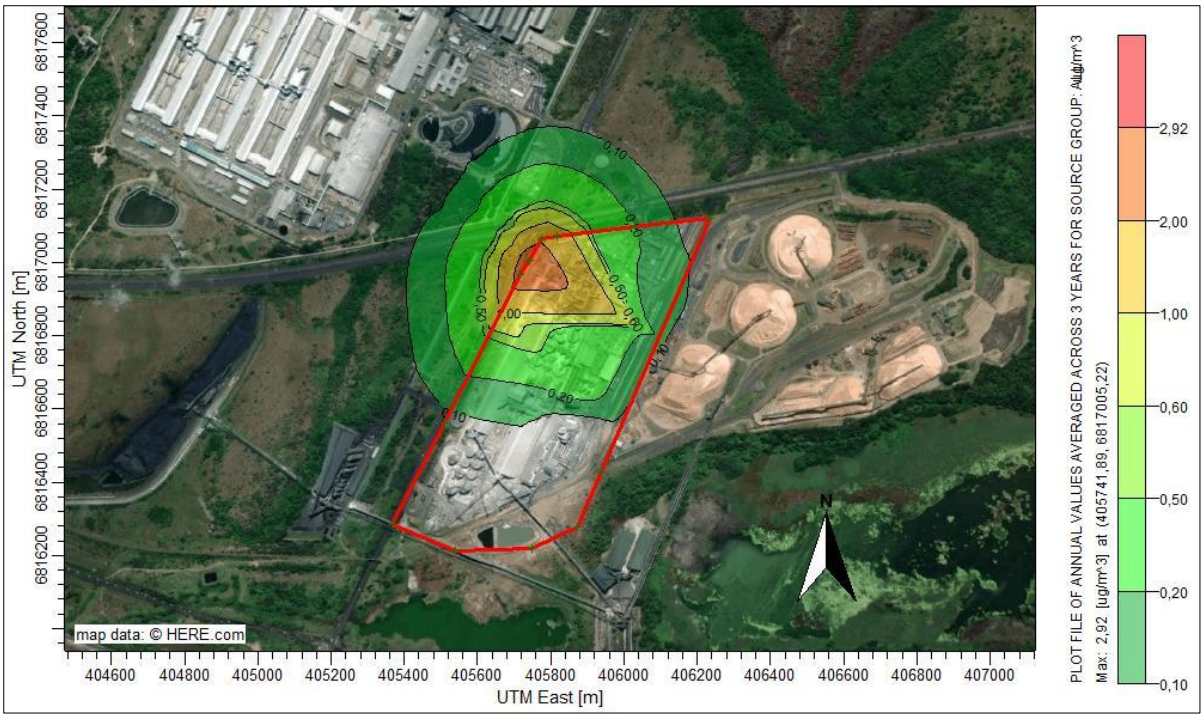


Figure 30: Annual Mean $PM_{2.5}$ Gas Boiler Contributions (µg/m^3) (Lakes, 2026)

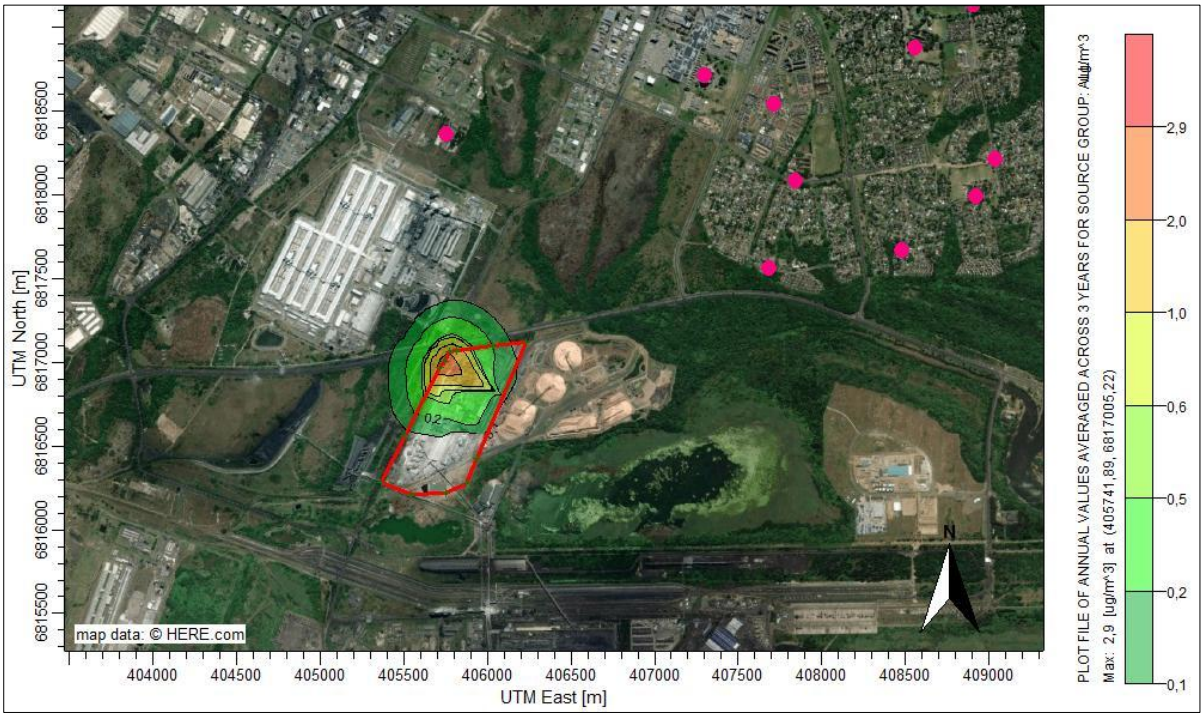


Figure 31: Annual Mean $PM_{2.5}$ Gas Boiler Contributions (+Sensitive Receptors) (Lakes, 2026)

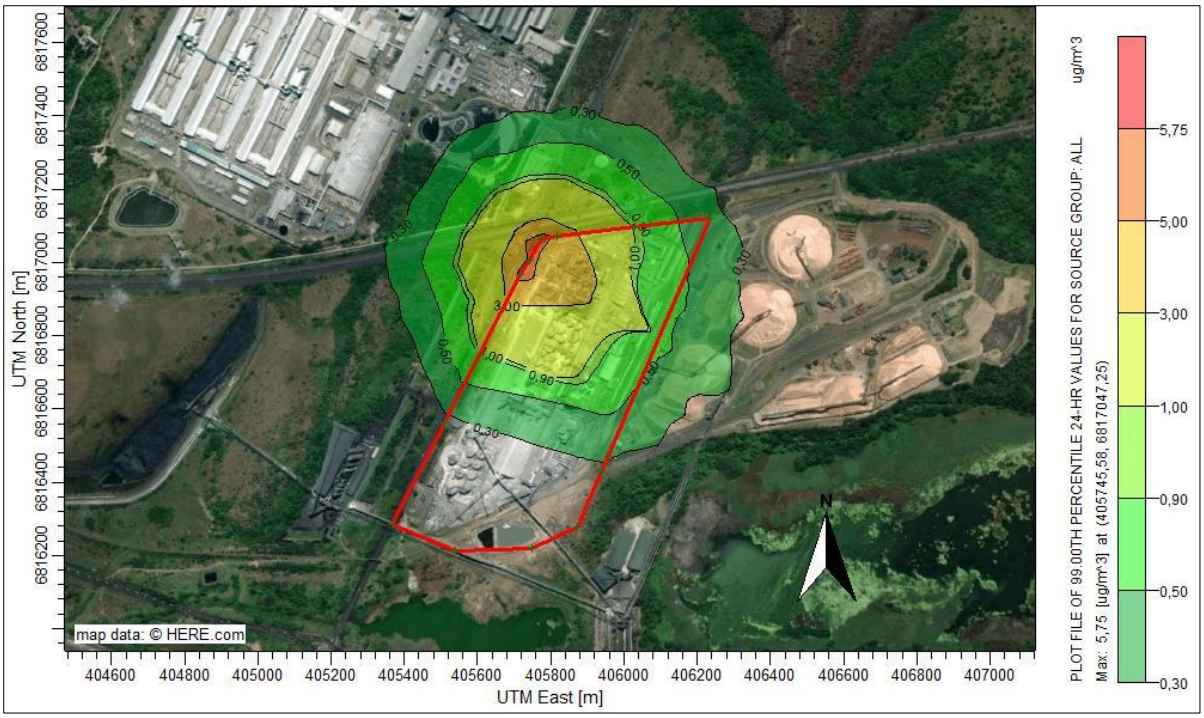


Figure 32: 99%ile of 24-hour Mean PM_{10} Gas Boiler Contributions (Lakes, 2026)

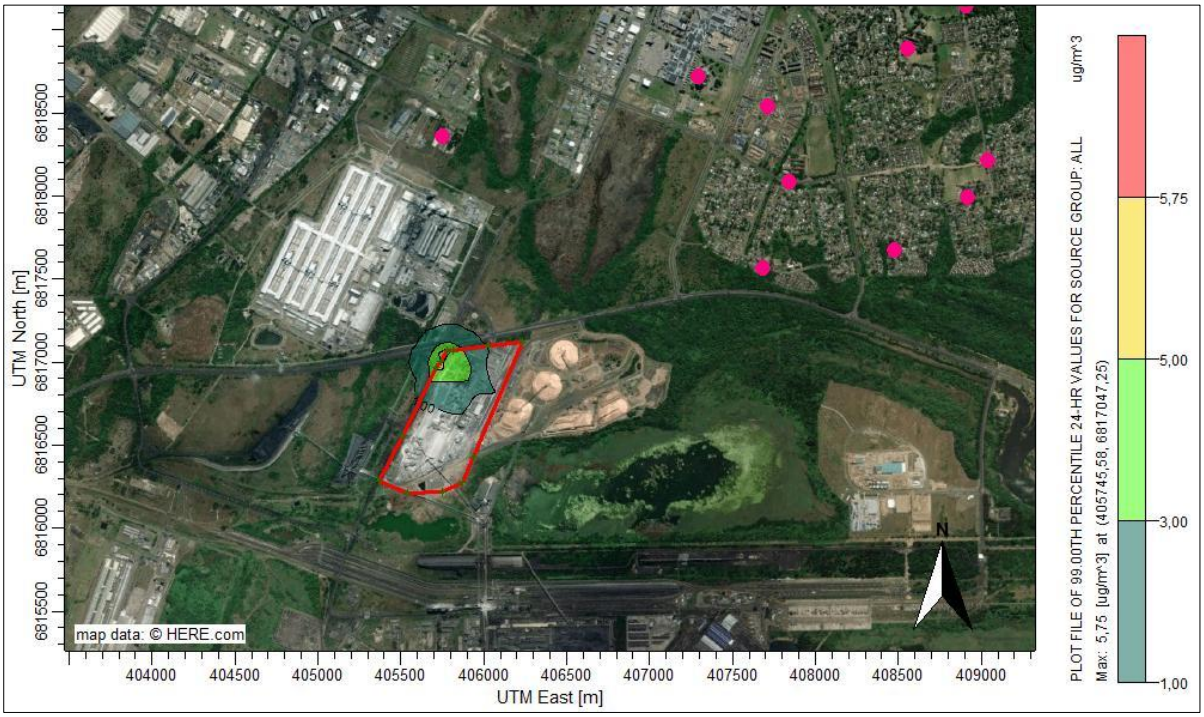


Figure 33: 99%ile of 24-hour Mean PM_{10} Gas Boiler Contributions (+Sensitive Receptors} (Lakes, 2026)

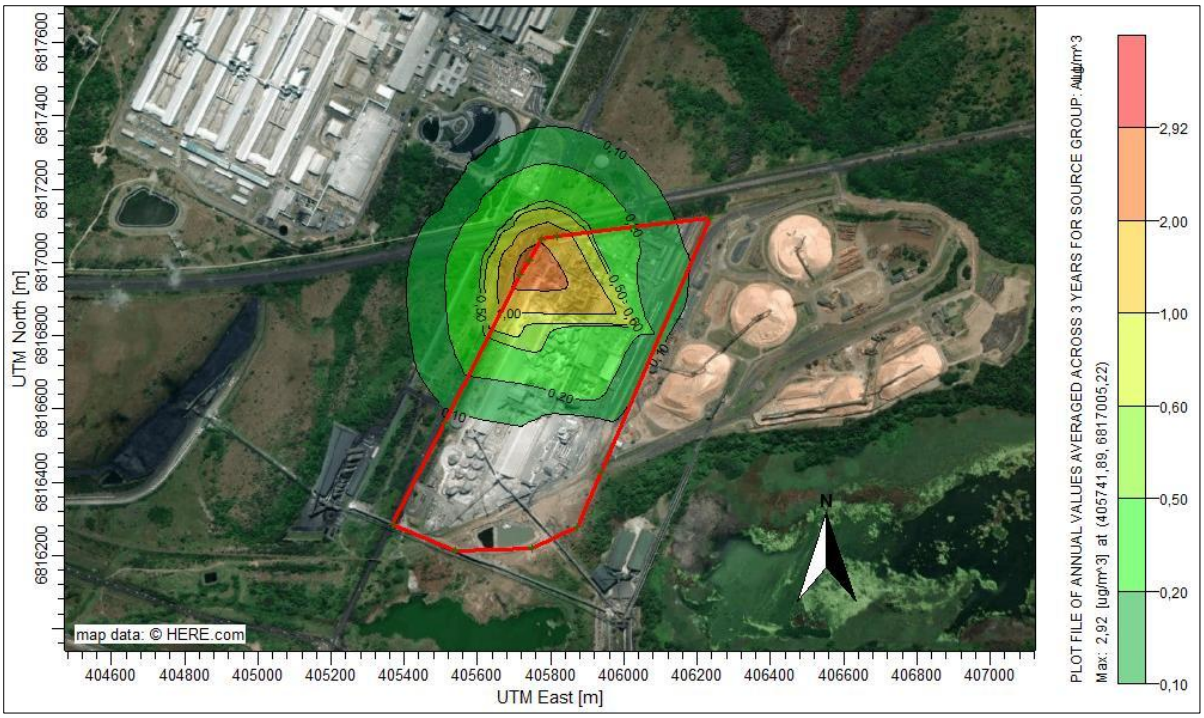


Figure 34: Annual Mean PM_{10} Gas Boiler Contributions (Lakes, 2026)

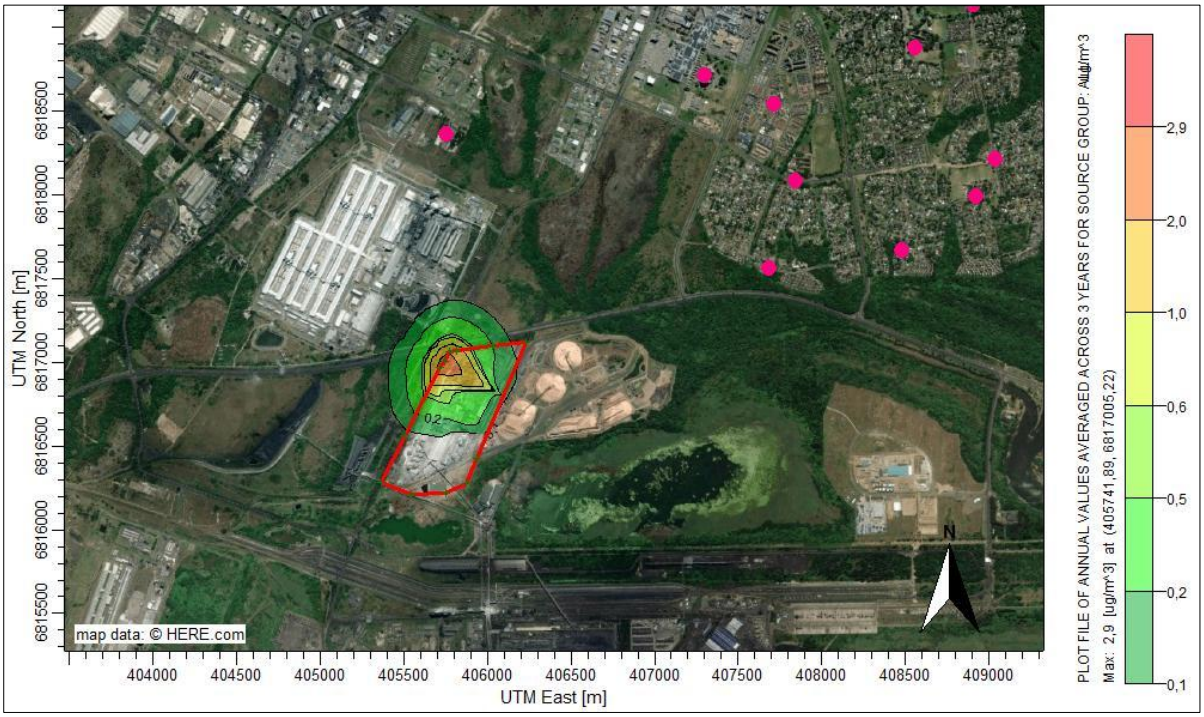


Figure 35: Annual Mean PM_{10} Gas Boiler Contributions (+Sensitive Receptors) (Lakes, 2026)

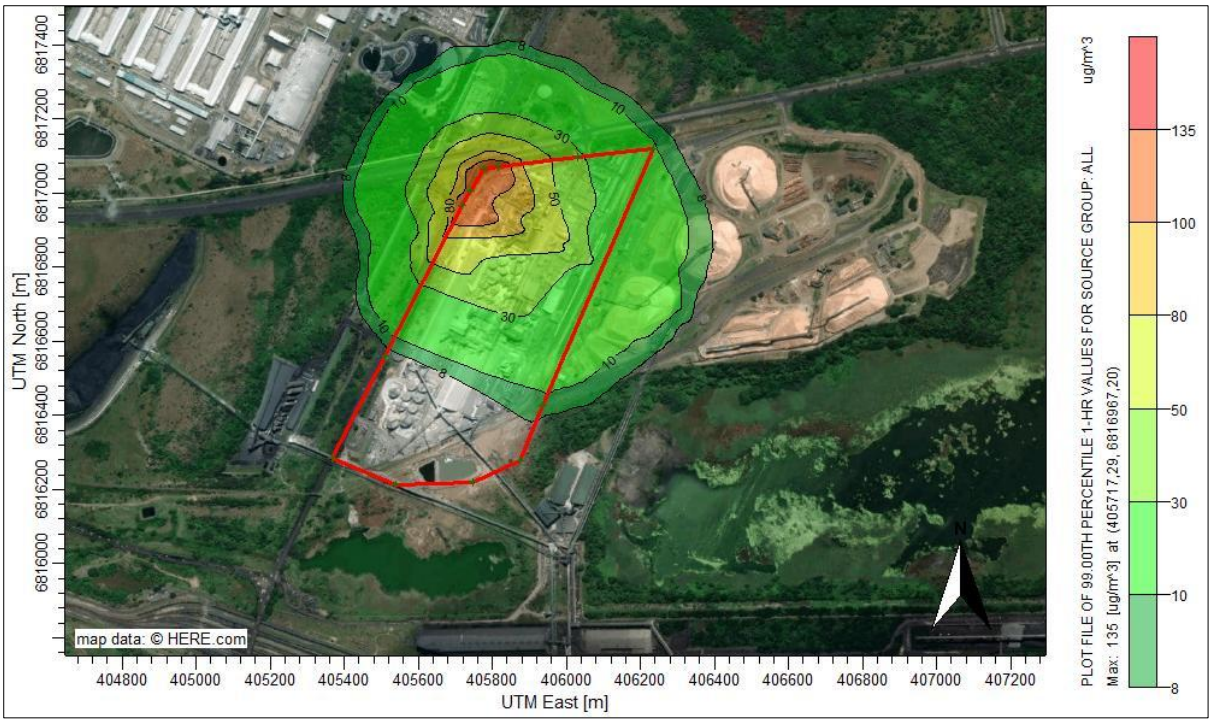


Figure 36: 99%ile of 1-hour Mean NO_2 Gas Boiler Contributions (µg/m^3) (Lakes, 2026)

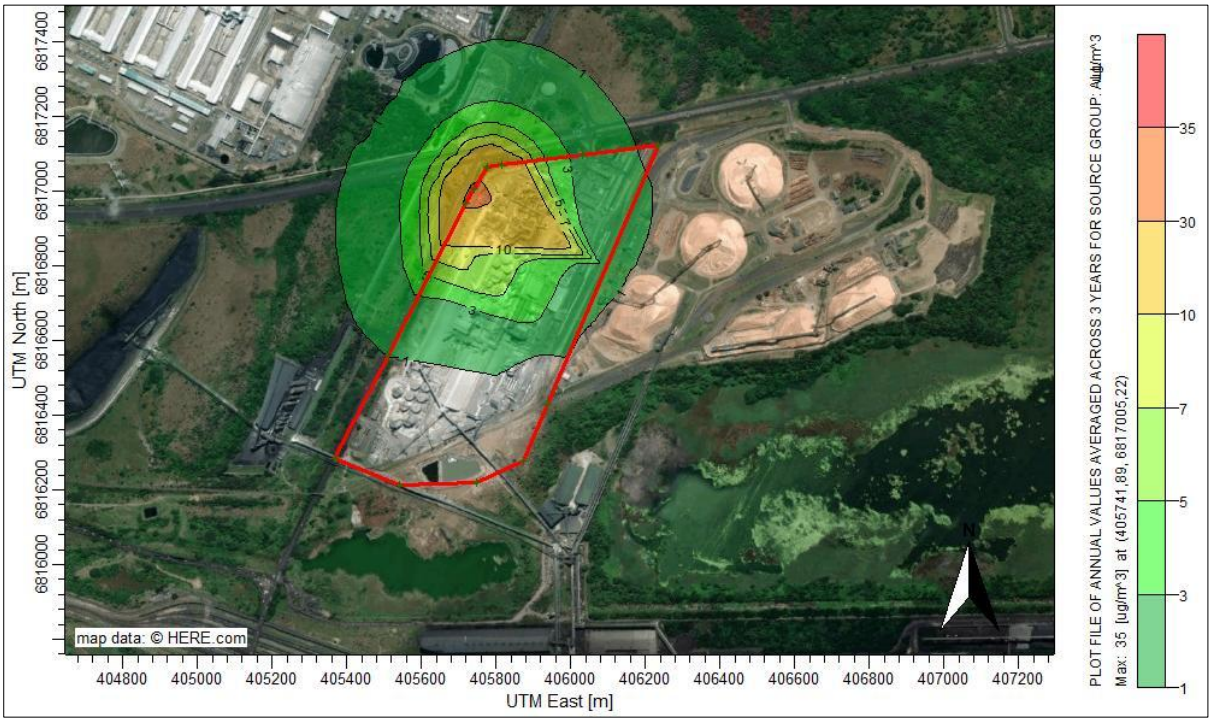


Figure 37: Annual Mean NO_2 Gas Boiler Contributions (µg/m$_3$) (Lakes, 2026).

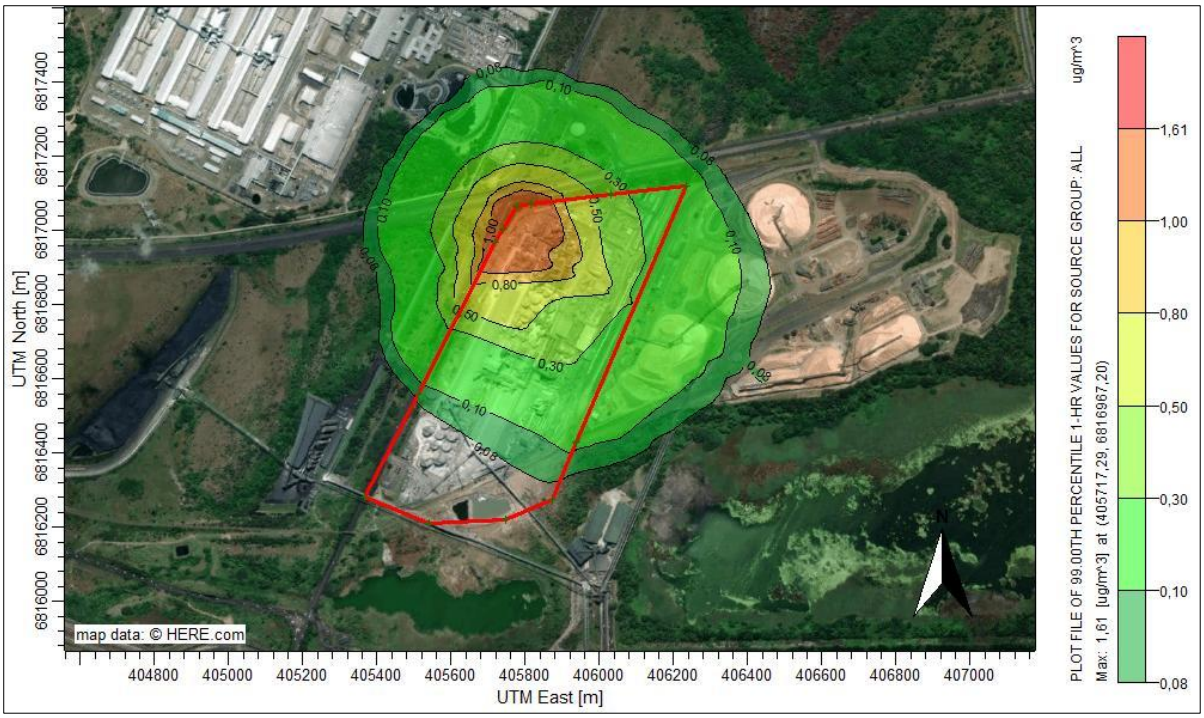


Figure 38: 99%ile of 1-hour Mean SO_2 Gas Boiler Contributions (Lakes, 2026)

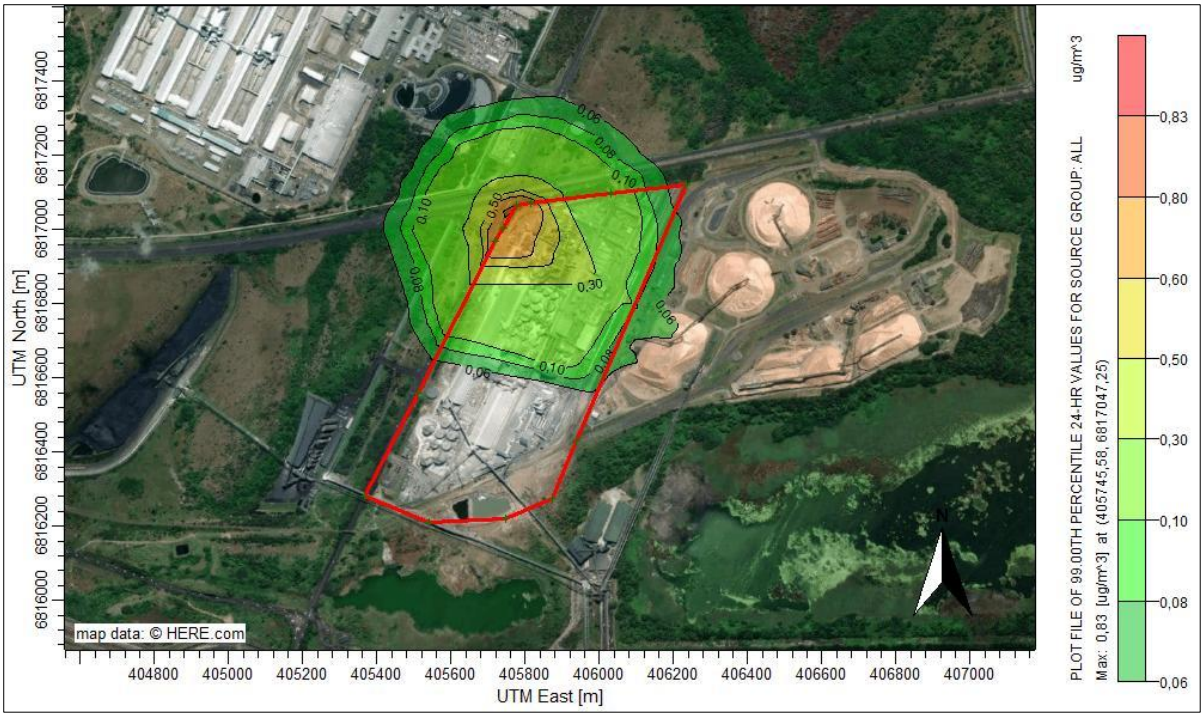


Figure 39: 99%ile of 24-hour Mean SO_2 Gas Boiler Contributions (Lakes, 2026)

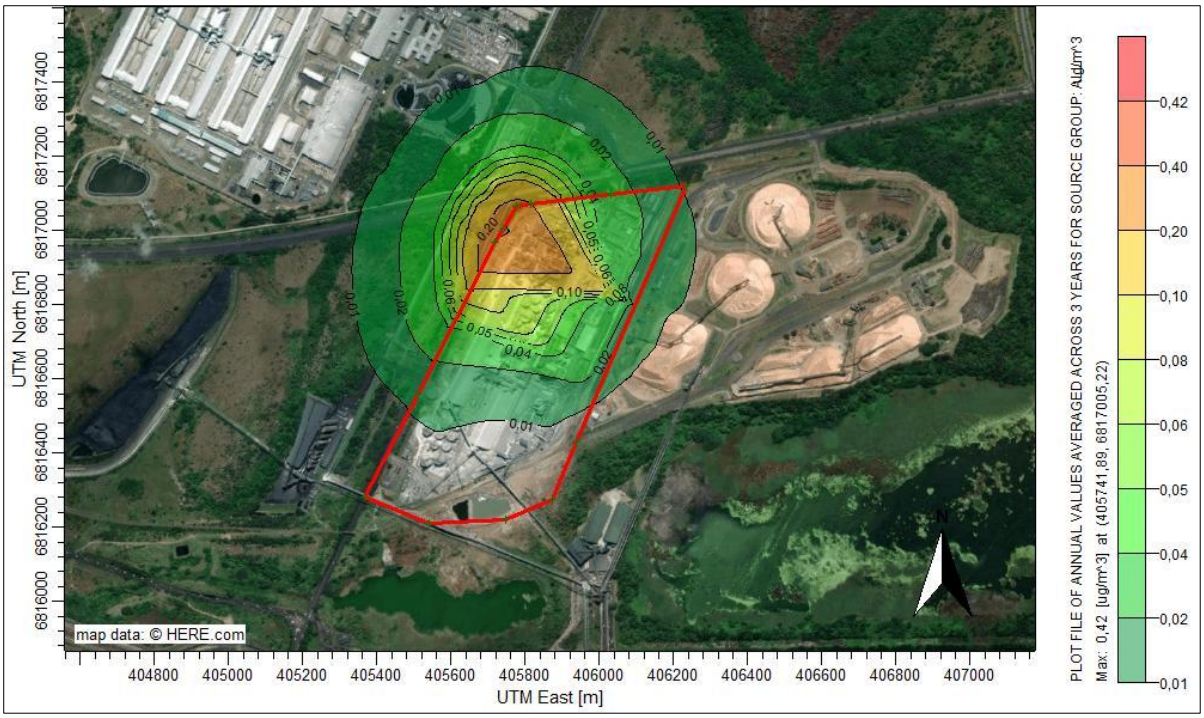


Figure 40: Annual Mean SO_2 Gas Boiler Contributions (Lakes, 2026)

11.4 Scenario 2: Methane Gas Consumption as Permitted (10,000,000 m^3)

Predicted concentrations of PM_{10}, $PM_{2.5}$, NO_2 and SO_2 were well below the NAAQS (Table 20). NO_2 again had the highest concentrations relative to the NAAQS: the maximum 1-hour and annual concentrations of 96.07 µg/m^3 and 25.09 µg/m^3 were 48% and 63% of the respective standards. Maximum predicted concentrations at the sensitive receptors remained below 1 µg/m^3 (Table 21).

Table 20: Maximum predicted gas boiler contribution on the modelled grid (Scenario 2)

Pollutant averaging (NAAQS)	Easting (X)	Northing (Y)	Predicted Concentrations (µg/m^3)	NAAQS
SO_2 1-hour	405717.29	6816967.20	1.15	**350**
SO_2 24-hour	405745.58	6817047.25	0.59	**125**
SO_2 Annual	405741.89	6817005.22	0.30	**50**
NO_2 1-hour	405717.29	6816967.20	96.07	**200**
NO_2 Annual	405741.89	6817005.22	25.09	**40**
PM_{10} 24- hour	405745.58	6817047.25	4.10	**75**
PM_{10} Annual	405741.89	6817005.22	2.08	**40**
$PM_{2.5}$ 24- hour	405745.58	6817047.25	4.10	**40**
$PM_{2.5}$ Annual	405741.89	6817005.22	2.08	**20**

Table 21: Predicted Gas Boiler Concentrations at Sensitive Receptors

Receptor	Gas Boiler Source Maximum Process Contribution (µg/m^3)								
	NO_2		PM_{10}		$PM_{2.5}$		SO_2		
	Annual Mean	99%ile 1-hour Mean	Annual Mean	99%ile 24-hour Mean	Annual Mean	99%ile 24-hour Mean	Annual Mean	99%ile 1-hr Mean	99%ile 24-hr Mean
Aquadene Secondary school	0.00464	0.05468	0.00039	0.00249	0.00039	0.00249	0.00005	0.00065	0.0035
Arboretum Primary School	0.01664	0.14550	0.00138	0.00795	0.00138	0.00795	0.00020	0.00172	0.00113
Betesda Independent School	0.07615	0.63220	0.00633	0.02755	0.00633	0.02755	0.00090	0.00747	0.00392
Birdswood Secondary School	0.00508	0.07484	0.00042	0.00259	0.00042	0.00259	0.00006	0.00088	0.00037
Brackenham Primary School	0.00711	0.07914	0.00059	0.00440	0.00059	0.00440	0.00008	0.00093	0.00063
Emmanuel Pre School & Creche	0.00850	0.08961	0.00071	0.00614	0.00071	0.00614	0.00010	0.00106	0.00087
John Ross College	0.03414	0.25746	0.00284	0.02062	0.00284	0.02062	0.00040	0.00304	0.00293
Kati Primary School	0.00488	0.04591	0.00041	0.00285	0.00041	0.00285	0.00006	0.00054	0.00041
Little Musketeers	0.00716	0.07735	0.00059	0.00398	0.00059	0.00398	0.00008	0.00091	0.00057
Little People’s Centre	0.01338	0.11813	0.00111	0.00644	0.00111	0.00644	0.00016	0.00140	0.00092
Living Stones Babtist Church	0.00653	0.07537	0.00054	0.00384	0.00054	0.00384	0.00008	0.0009	0.00055

Lutheran Church	0.00824	0.07879	0.00068	0.00390	0.00068	0.00390	0.00010	0.00093	0.00055
Mouse House Nursery School	0.00538	0.05432	0.00045	0.00487	0.00045	0.00487	0.00006	0.00064	0.00069
Mpuza Temple-Shembe	0.00907	0.11649	0.00075	0.00450	0.00075	0.00450	0.00011	0.00138	0.00064
Mums Angel's Daycare	0.01655	0.14672	0.00138	0.00973	0.00138	0.00973	0.00020	0.00173	0.00138
Mzingazi Lakeside Retirement Village	0.00651	0.06793	0.00054	0.00538	0.00054	0.00538	0.00008	0.00080	0.00076
Netcare The Bay Hospital	0.02099	0.21734	0.00174	0.01193	0.00174	0.01193	0.0025	0.00257	0.00170
Rainbows End Day Care Centre	0.02428	0.21235	0.00202	0.01176	0.00202	0.01176	0.00029	0.00251	0.00167
Richards Bay Assembles of GOD	0.04341	0.36952	0.00361	0.01953	0.00361	0.01953	0.00051	0.00436	0.00278
Richards Bay Christian School	0.00986	0.07774	0.00082	0.00450	0.00082	0.00450	0.00012	0.00092	0.00064
Richards Bay Primary School	0.00698	0.07546	0.00058	0.00474	0.00058	0.00474	0.00008	0.00089	0.00067
Richards Bay Muni Clinic	0.03329	0.36453	0.00277	0.02257	0.00277	0.02257	0.00039	0.00431	0.00321
Richards Bay Secondary School	0.00843	0.09420	0.00070	0.00470	0.00070	0.00470	0.00010	0.00111	0.00067
Richardia Primary school	0.01778	0.16312	0.00148	0.00903	0.00148	0.00903	0.00021	0.00193	0.00128
Savf Welfare Organisation	0.01274	0.09810	0.00106	0.00611	0.00106	0.00611	0.00015	0.00116	0.00087
Steppingstones Pre Primary	0.02761	0.22738	0.00229	0.01231	0.00229	0.01231	0.00033	0.00269	0.00175

St Francis Church	0.01099	0.08323	0.00091	0.00502	0.00091	0.00502	0.00013	0.00098	0.00071
Tiny Todz	0.00854	0.07543	0.00071	0.00395	0.00071	0.00395	0.00010	0.00089	0.00056
Unjani Clinic Richards Bay	0.02104	0.19816	0.00175	0.00936	0.00175	0.00936	0.00025	0.00234	0.00133
Veldenvlei Primary School	0.01170	0.09005	0.00097	0.00589	0.00097	0.00589	0.00014	0.00106	0.00084
Standard	**40**	**200**	**40**	**75**	**20**	**40**	**50**	**350**	**125**

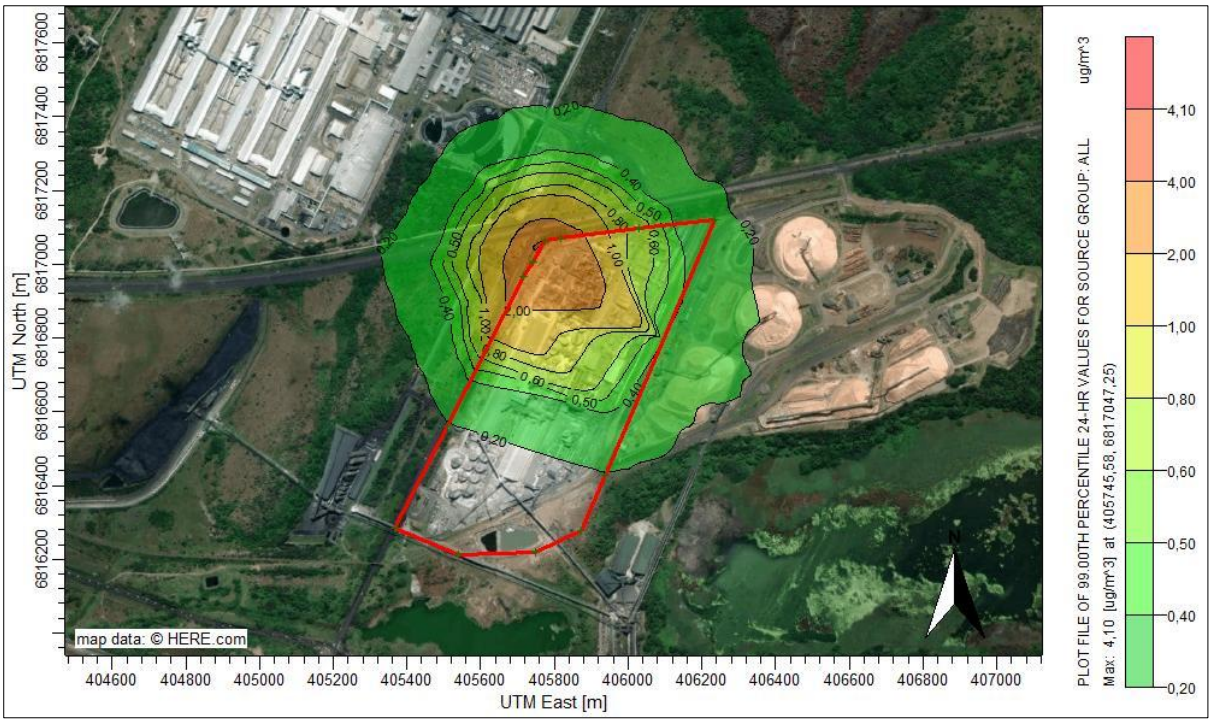


Figure 41: 99%ile of 24-hour Mean $PM_{2.5}$ Gas Boiler Contributions (Lakes, 2026).

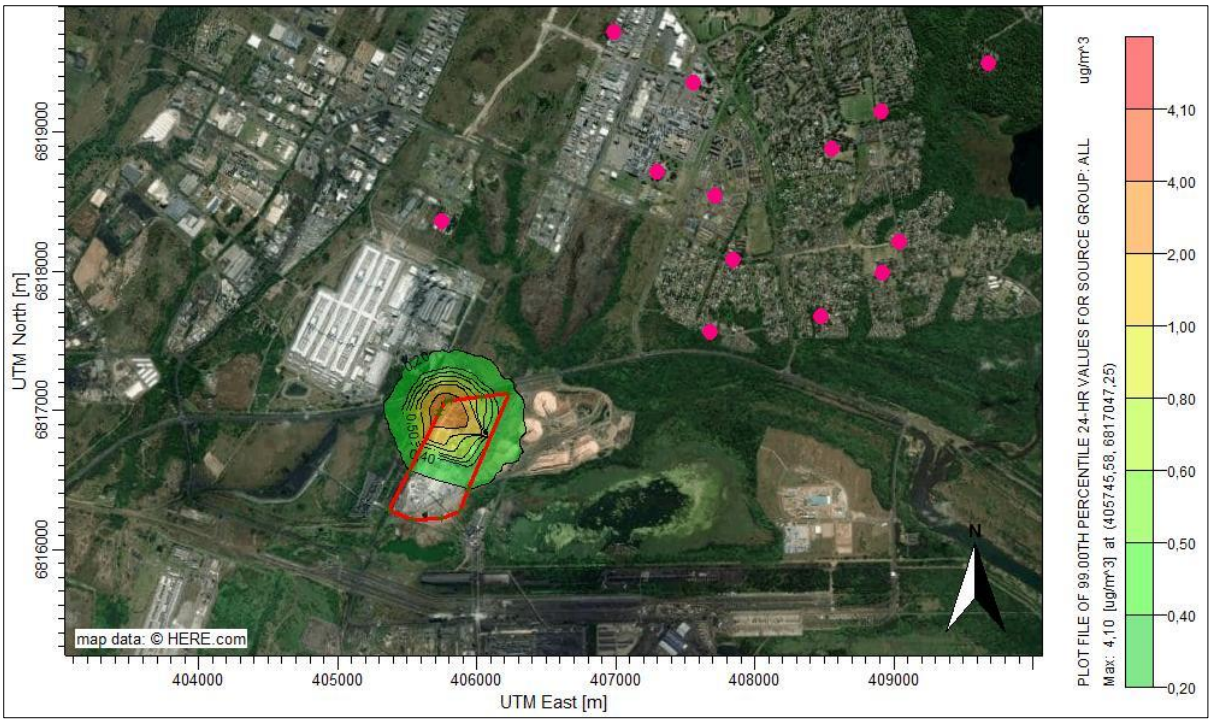


Figure 42: 99%ile of 24-hour Mean $PM_{2.5}$ Gas Boiler Contributions (+Sensitive Receptors) (Lakes, 2026)

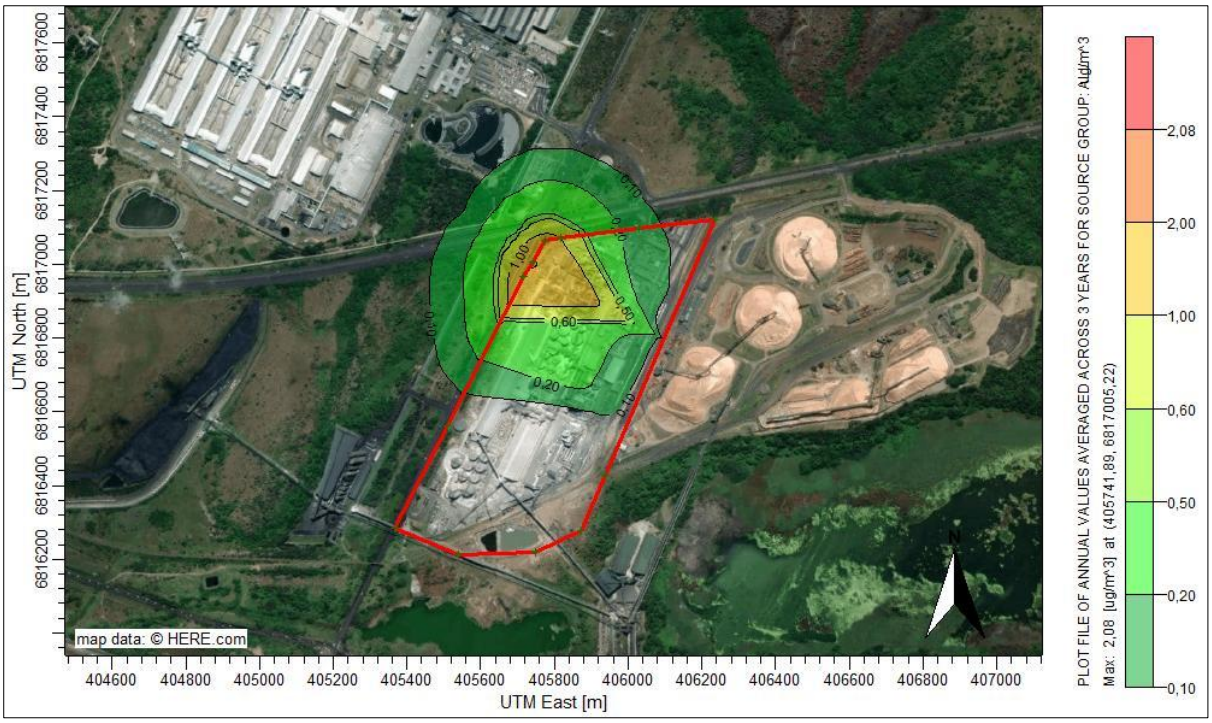


Figure 43: Annual Mean $PM_{2.5}$ Gas Boiler Contributions (Lakes, 2026)

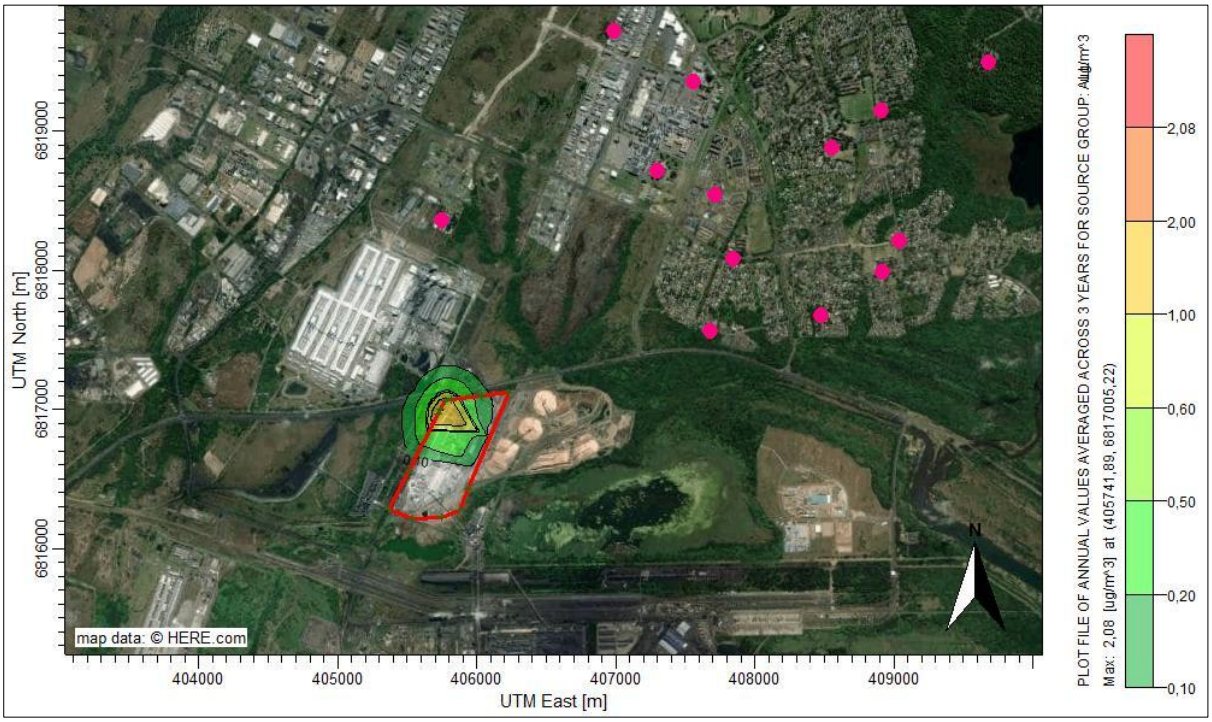


Figure 44: Annual Mean $PM_{2.5}$ Gas Boiler Contributions (+Sensitive Receptors) (Lakes, 2026)

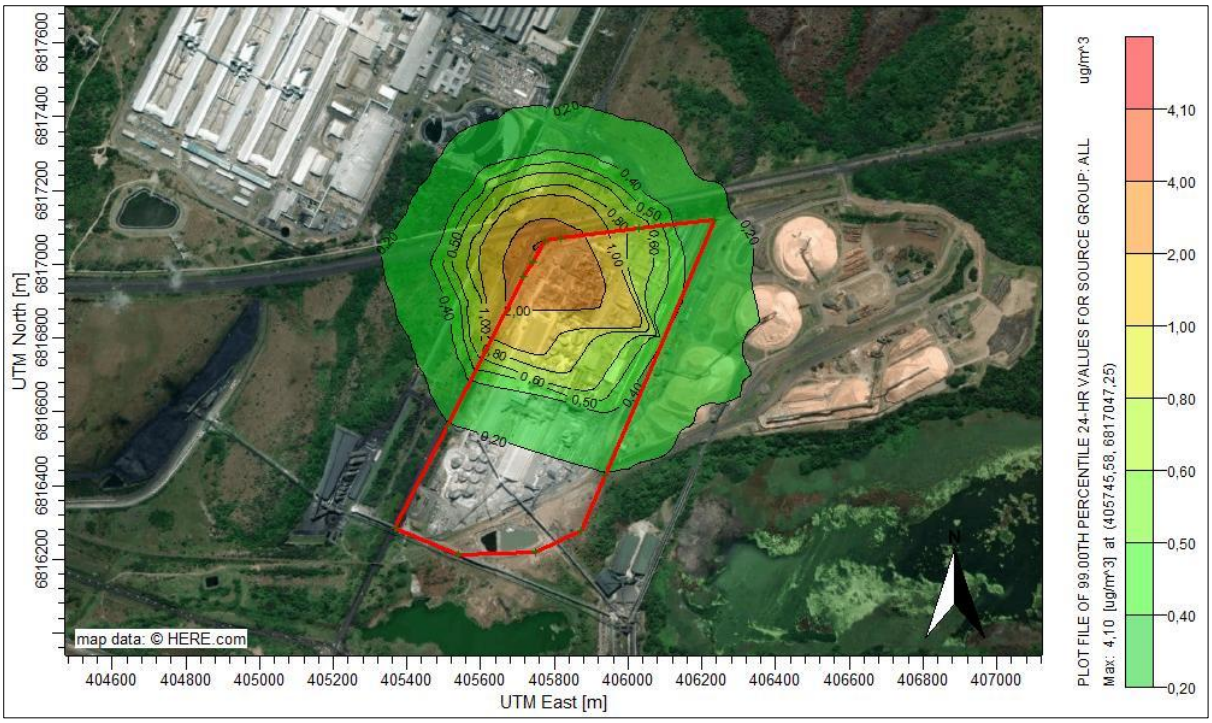


Figure 45: 99%ile of 24-hour Mean PM_{10} Gas Boiler Contributions (Lakes, 2026)

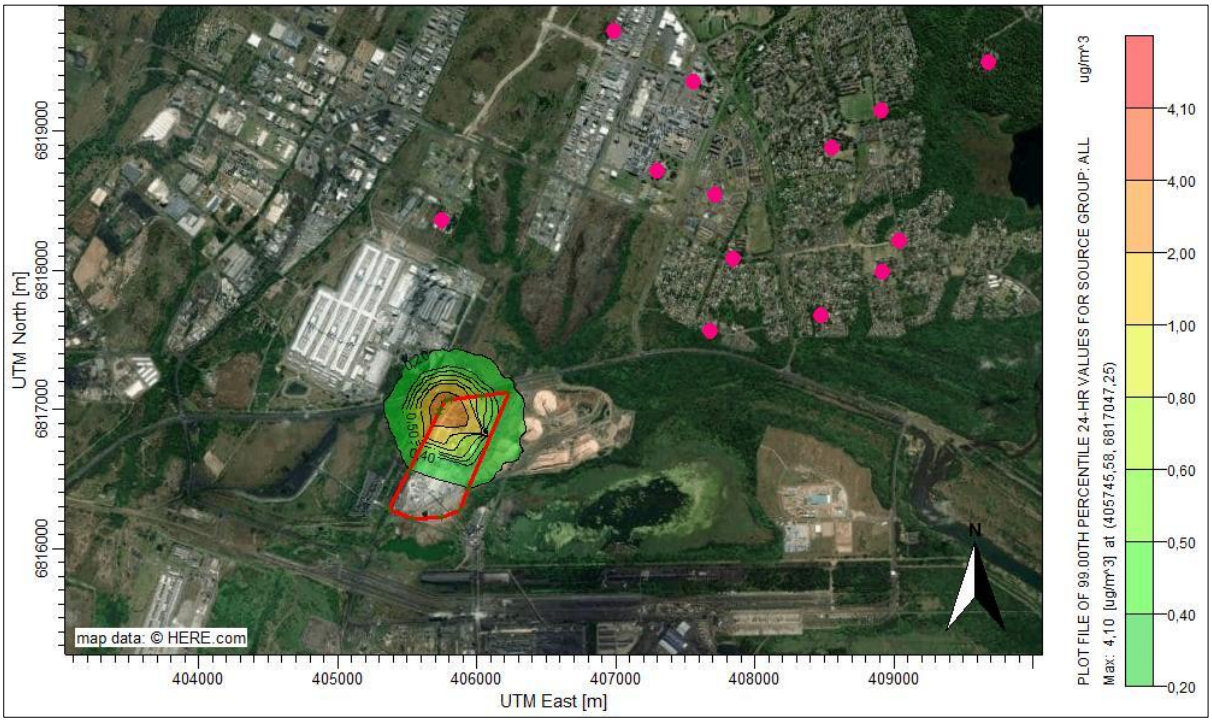


Figure 46: 99%ile of 24-hour Mean PM_{10} Gas Boiler Contributions (+Sensitive) (Lakes, 2026)

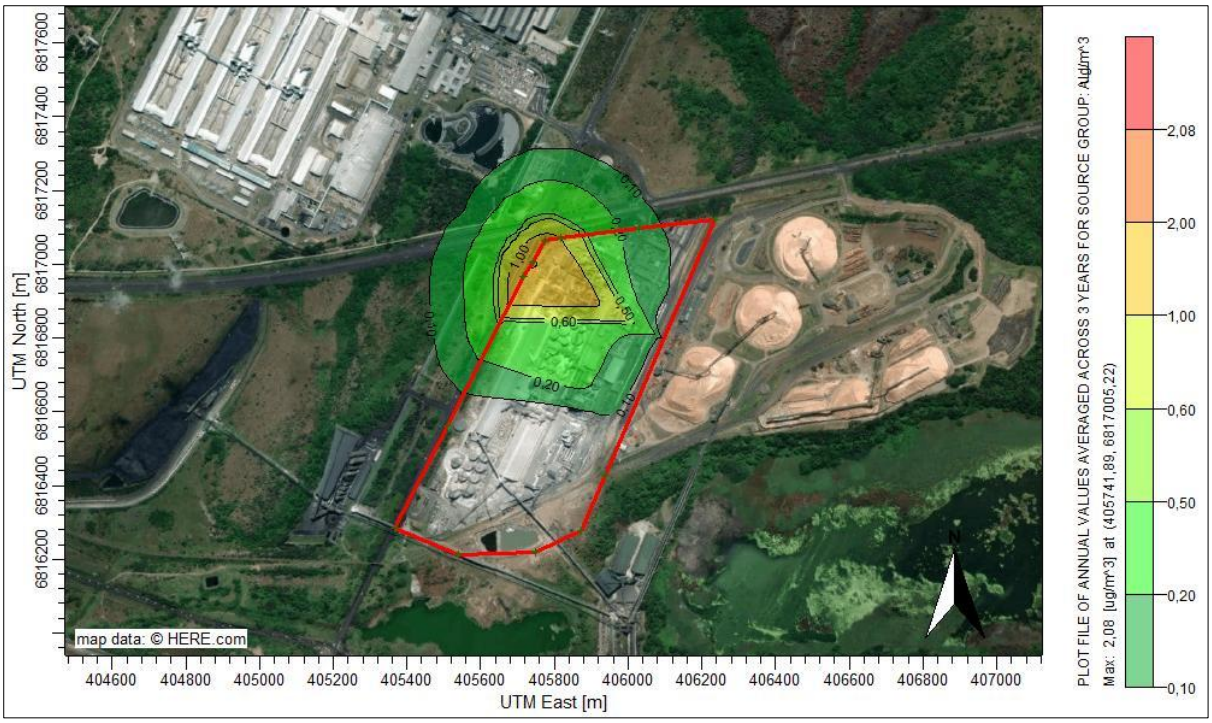


Figure 47: Annual Mean PM_{10} Gas Boiler Contributions (Lakes, 2026)

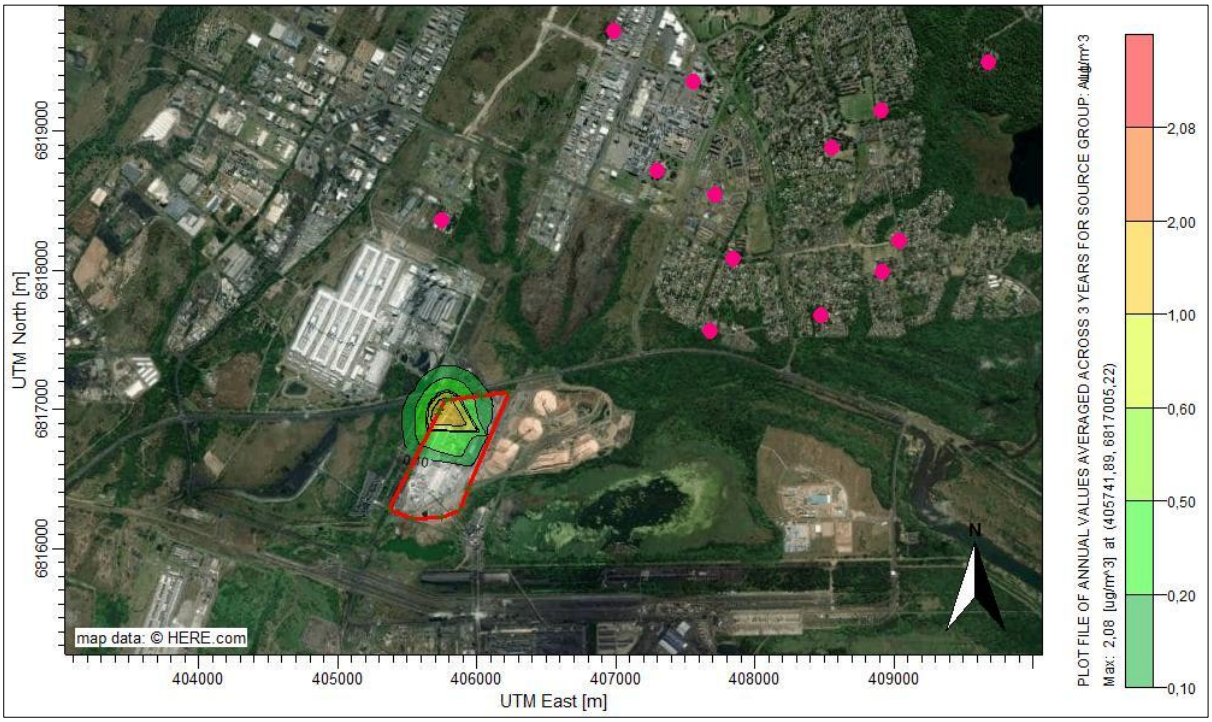


Figure 48: Annual Mean PM_{10} Gas Boiler Contributions (+Sensitive Receptors) (Lakes, 2026)

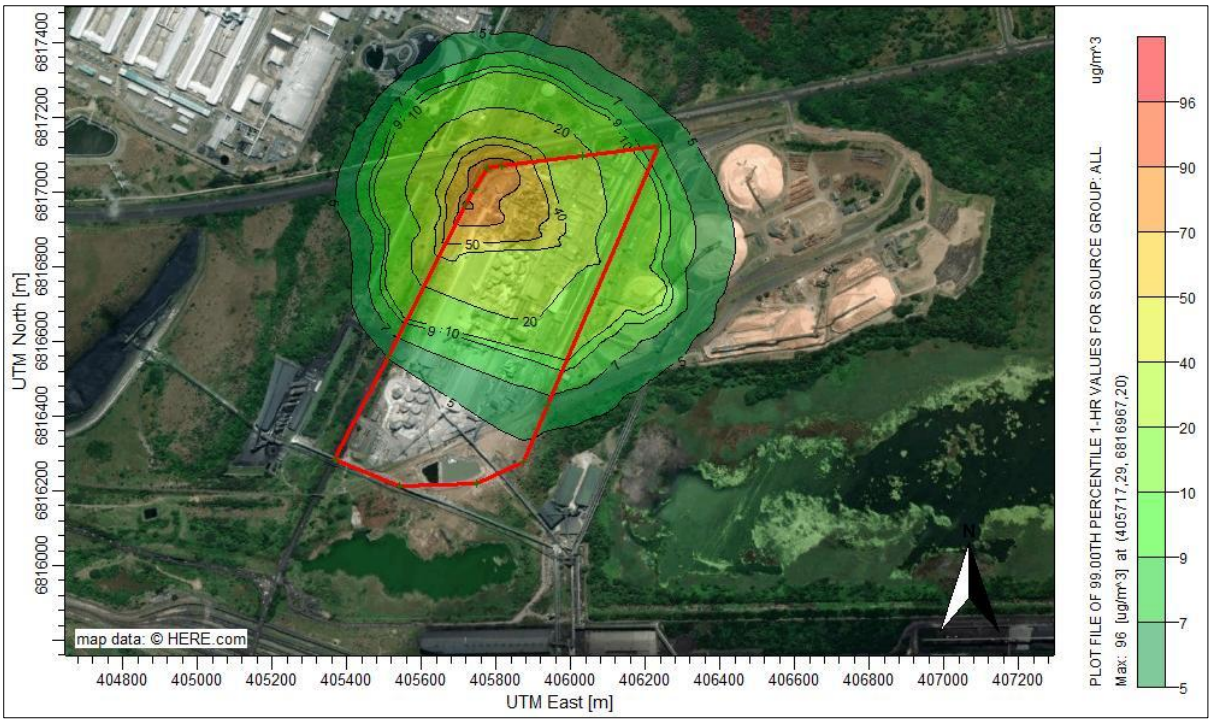


Figure 49: 99%ile of 1-hour Mean NO_2 Gas Boiler Contributions (µg/m^3) (Lakes, 2026)

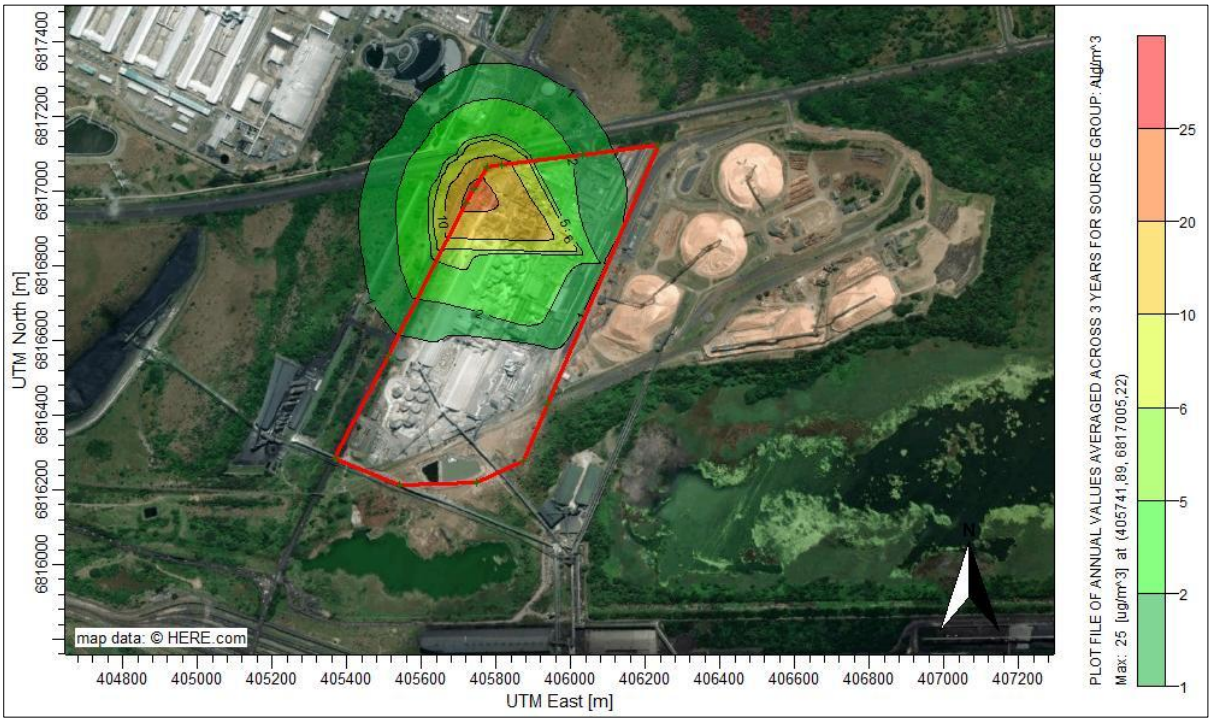


Figure 50: Annual Mean NO_2 Gas Boiler Contributions (Lakes, 2026)

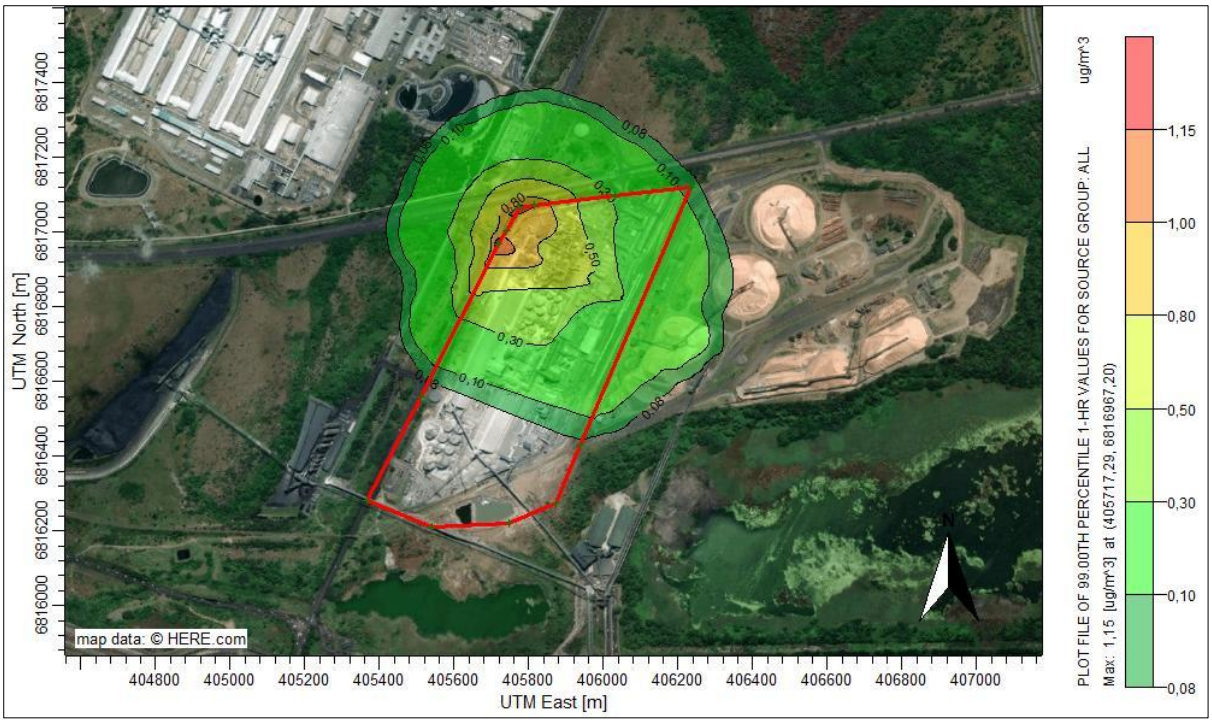


Figure 51: 99%ile of 1-hour Mean SO_2 Gas Boiler Contributions (Lakes, 2026)

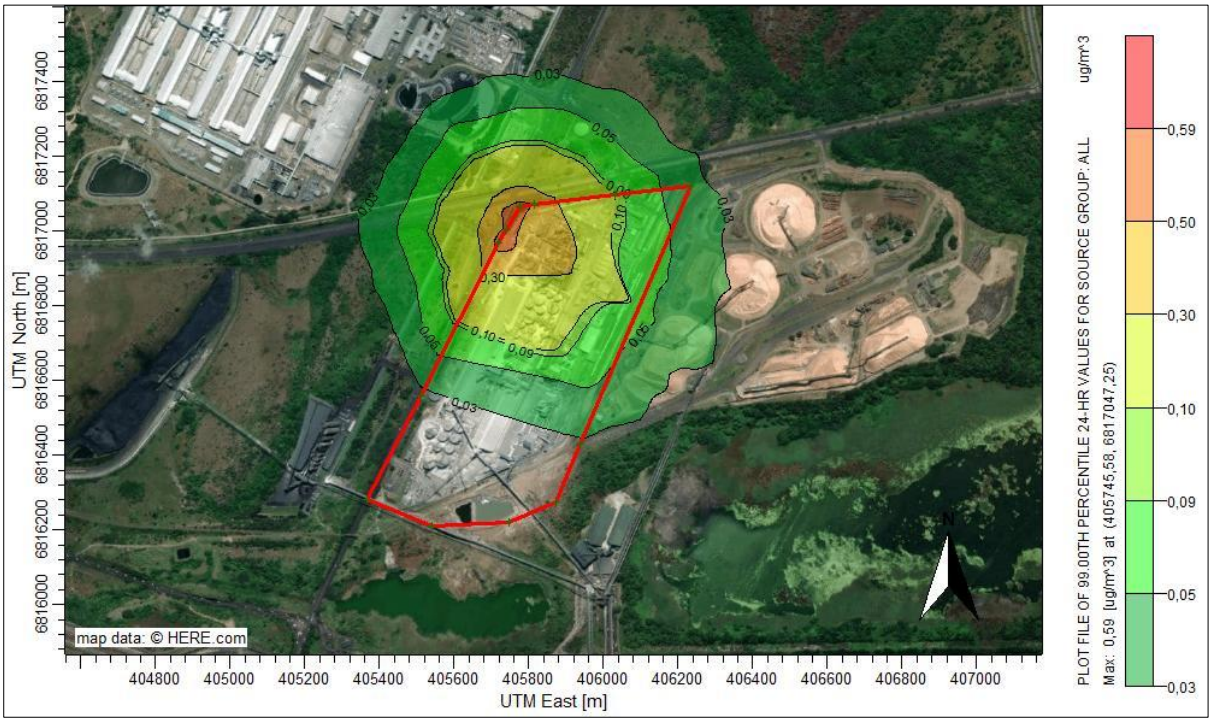


Figure 52: 99%ile of 24-hour Mean SO_2 Gas Boiler Contributions (Lakes, 2026)

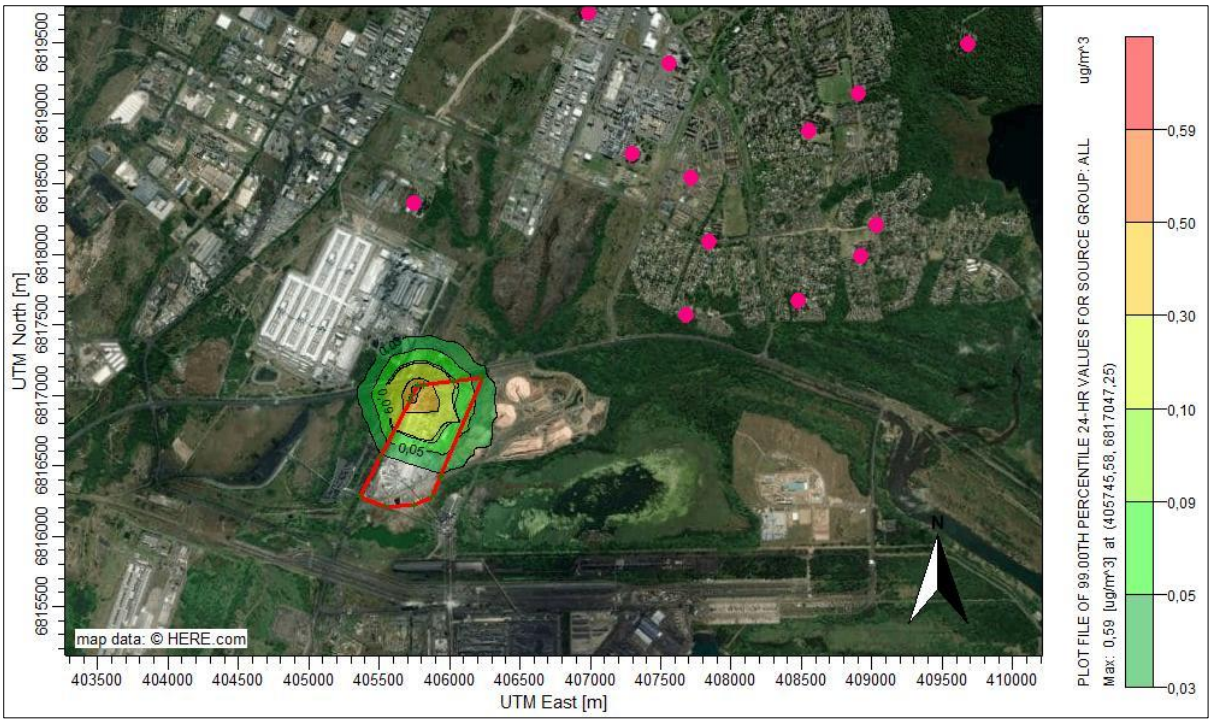


Figure 53: 99%ile of 24-hour Mean SO_2 Gas Boiler Contributions (+Sensitive Receptors) (Lakes, 2026)

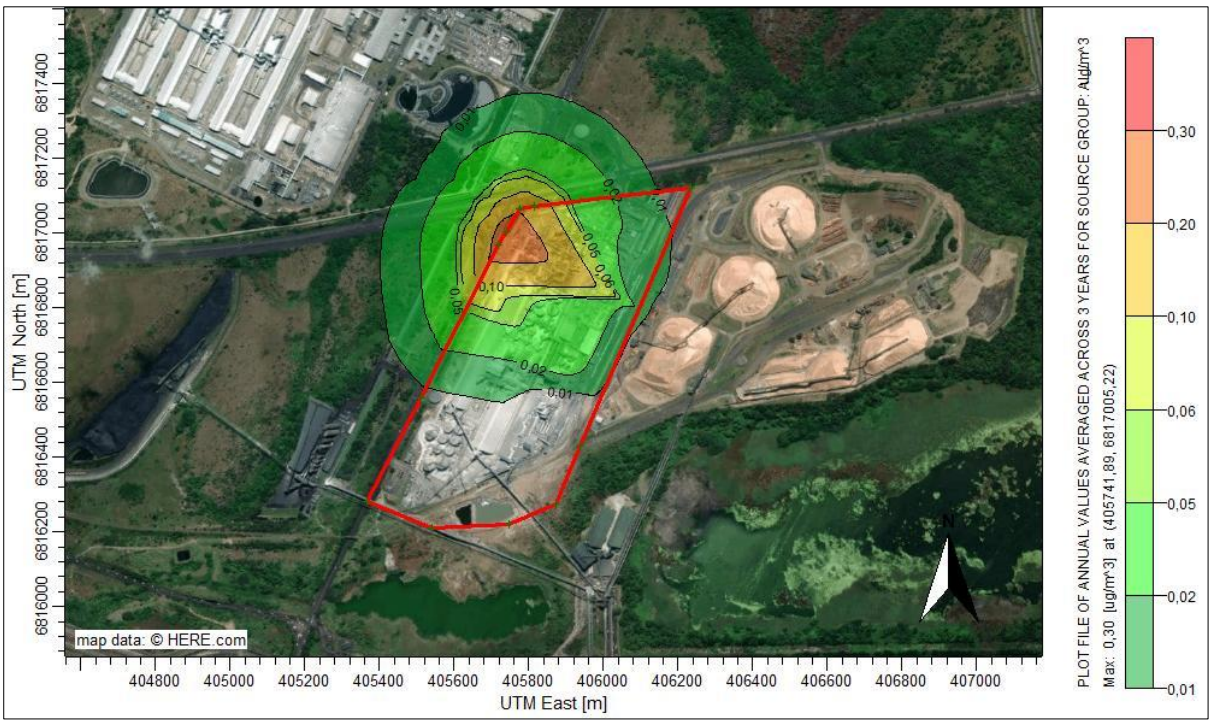


Figure 54: Annual Mean SO_2 Gas Boiler Contributions (Lakes, 2026)

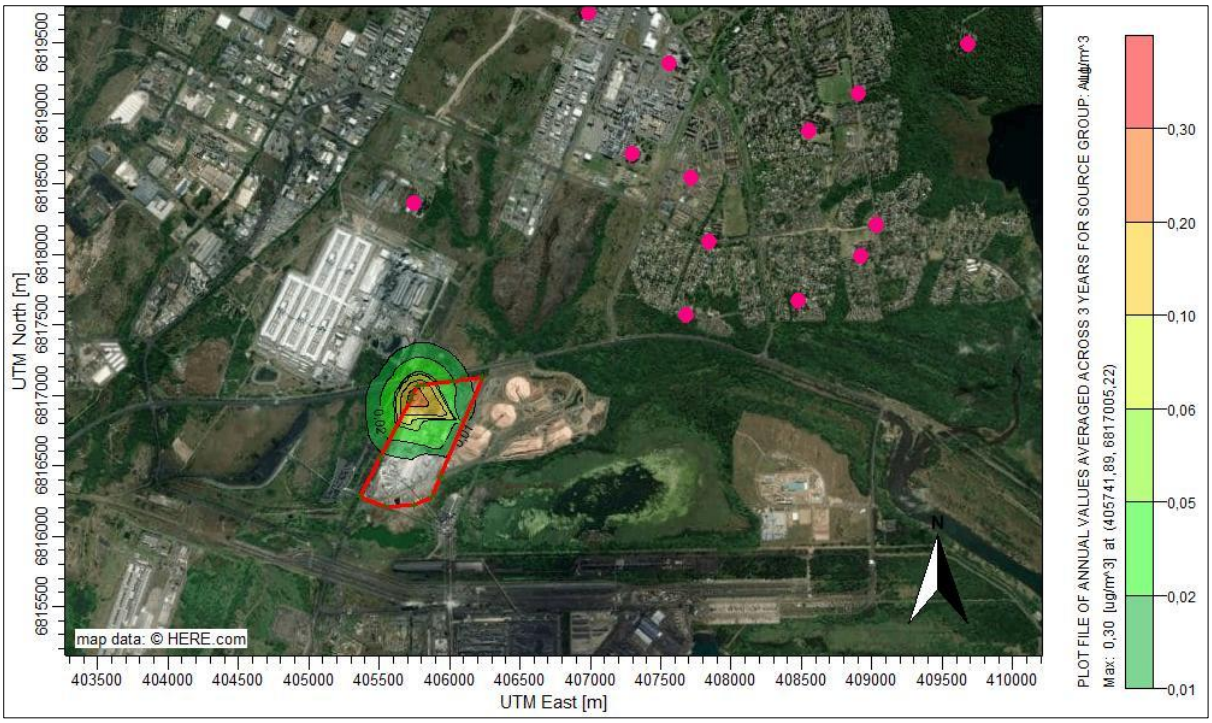


Figure 55: Annual Mean SO_2 Gas Boiler Contributions (+Sensitive Receptors) (Lakes, 2026)

11.5 Atmospheric Emission Licence (AEL) Variation

11.5.1 Scenario 3: Increase in Methane Gas Consumption (15,000,000 m^3)

Predicted concentrations of PM_{10}, $PM_{2.5}$, NO_2 and SO_2 were below the NAAQS across the modelled grid and at all sensitive receptors (Table 22; Figures 56 to 73). NO_2 had the highest concentrations relative to the NAAQS: the maximum 1-hour and annual concentrations of 144.10 µg/m^3 and 37.63 µg/m^3 were 72% and 94% of the respective standards. SO_2, PM_{10} and $PM_{2.5}$ concentrations were low, at no more than 16% of the respective standards.

Maximum predicted concentrations at the sensitive receptors were well below the NAAQS, with all concentrations below 1 µg/m^3 (Table 23). The highest concentrations were predicted at Betesda Independent School, with NO_2 concentrations of 0.91 µg/m^3 (1-hour) and 0.10 µg/m^3 (annual).

Table 22: Maximum predicted gas boiler contribution on the modelled grid (Scenario 3)

Pollutant averaging (NAAQS)	Easting (X)	Northing (Y)	Predicted Concentrations	NAAQS
SO_2 1-hour	405717.29	6816967.20	1.72	**350**
SO_2 24-hour	405745.58	6817047.25	0.88	**125**
SO_2 Annual	405741.89	6817005.22	0.45	**50**
NO_2 1-hour	405717.29	6816967.20	144.10	**200**
NO_2 Annual	405741.89	6817005.22	37.63	**40**
PM_{10} 24- hour	405745.58	6817047.25	6.15	**75**
PM_{10} Annual	405741.89	6817005.22	3.13	**40**
$PM_{2.5}$ 24- hour	405745.58	6817047.25	6.15	**40**
$PM_{2.5}$ Annual	405741.89	6817005.22	3.13	**20**

Table 23: Predicted Gas Boiler Concentrations at Sensitive Receptors (Scenario 3)

Receptor	Gas Boiler Source Maximum Process Contribution (µg/m³)								
	NO_2		PM_{10}		$PM_{2.5}$		SO_2		
	Annual Mean	99%ile 1-hour Mean	Annual Mean	99%ile 24-hour Mean	Annual Mean	99%ile 24-hour Mean	Annual Mean	99%ile 1-hr Mean	99%ile 24-hr Mean
Aquadene Secondary school	0.00819	0.08288	0.00068	0.00545	0.00068	0.00545	0.00010	0.00099	0.00078
Arboretum Primary School	0.02695	0.24682	0.00224	0.01295	0.00224	0.01295	0.00032	0.00295	0.00186
Betesda Independent School	0.10396	0.90672	0.00864	0.05078	0.00864	0.05078	0.00124	0.01083	0.00730
Birdswood Secondary School	0.00820	0.11319	0.00068	0.00525	0.00068	0.00525	0.00010	0.00135	0.00076
Brackenham Primary School	0.01168	0.11928	0.00097	0.00779	0.00097	0.00779	0.00014	0.00142	0.00112
Emmanuel Pre School & Creche	0.01395	0.13424	0.00116	0.01072	0.00116	0.01072	0.00017	0.00160	0.00154
John Ross College	0.05012	0.48879	0.00416	0.03859	0.00416	0.03859	0.00060	0.00584	0.00555
Kati Primary School	0.00756	0.08244	0.00063	0.00597	0.00063	0.00597	0.00009	0.00098	0.00086
Little Musketeers	0.01360	0.16686	0.00113	0.01398	0.00113	0.01398	0.00016	0.00199	0.00201
Little People’s Centre	0.02183	0.19861	0.00181	0.01066	0.00181	0.01066	0.00026	0.00237	0.00153
Living Stones Babtist Church	0.01065	0.11327	0.00088	0.00763	0.00088	0.00763	0.00013	0.00135	0.00110
Lutheran Church	0.01377	0.12662	0.00114	0.00691	0.00114	0.00691	0.00016	0.00151	0.00099

Mouse House Nursery School	0.01028	0.11135	0.00085	0.01467	0.00085	0.01467	0.00012	0.00133	0.00211
Mpuza Temple-Shembe	0.01714	0.18305	0.00142	0.00904	0.00142	0.00904	0.00020	0.00219	0.00130
Mums Angel's Daycare	0.02496	0.28544	0.00207	0.01790	0.00207	0.01790	0.00030	0.00341	0.00257
Mzingazi Lakeside Retirement Village	0.01204	0.14213	0.00100	0.01232	0.00100	0.01232	0.00014	0.00170	0.00177
Netcare The Bay Hospital	0.03074	0.31032	0.00255	0.02826	0.00255	0.02826	0.00037	0.00371	0.00406
Rainbows End Day Care Centre	0.03876	0.46229	0.00322	0.03538	0.00322	0.03538	0.00046	0.00552	0.00509
Richards Bay Assembles of GOD	0.06551	0.80807	0.00544	0.04515	0.00544	0.04515	0.00078	0.00965	0.00649
Richards Bay Christian School	0.01428	0.11254	0.00119	0.01118	0.00119	0.01118	0.00017	0.00134	0.00161
Richards Bay Primary School	0.01364	0.16769	0.00113	0.01592	0.00113	0.01592	0.00016	0.00200	0.00229
Richards Bay Muni Clinic	0.04523	0.52055	0.00376	0.04099	0.00376	0.04099	0.00054	0.00622	0.00589
Richards Bay Secondary School	0.01383	0.14007	0.00115	0.01110	0.00115	0.01110	0.00017	0.00167	0.00160
Richardia Primary school	0.02793	0.33161	0.00232	0.02065	0.00232	0.02065	0.00033	0.00396	0.00297
Savf Welfare Organisation	0.01812	0.15179	0.00151	0.00919	0.00151	0.00919	0.00022	0.00181	0.00132
Steppingstones Pre Primary	0.03960	0.39047	0.00329	0.02229	0.00329	0.02229	0.00047	0.00466	0.00320
St Francis Church	0.01502	0.12155	0.00125	0.01293	0.00125	0.01293	0.00018	0.00145	0.00186

Tiny Todz	0.01214	0.11803	0.00101	0.00656	0.00101	0.00656	0.00015	0.00141	0.00094
Unjani Clinic Richards Bay	0.02927	0.27991	0.00243	0.01393	0.00243	0.01393	0.00035	0.00334	0.00200
Veldenvlei Primary School	0.01675	0.13767	0.00139	0.00847	0.00139	0.00847	0.00020	0.00164	0.00122
Standard	**40**	**200**	**40**	**75**	**20**	**40**	**50**	**350**	**125**

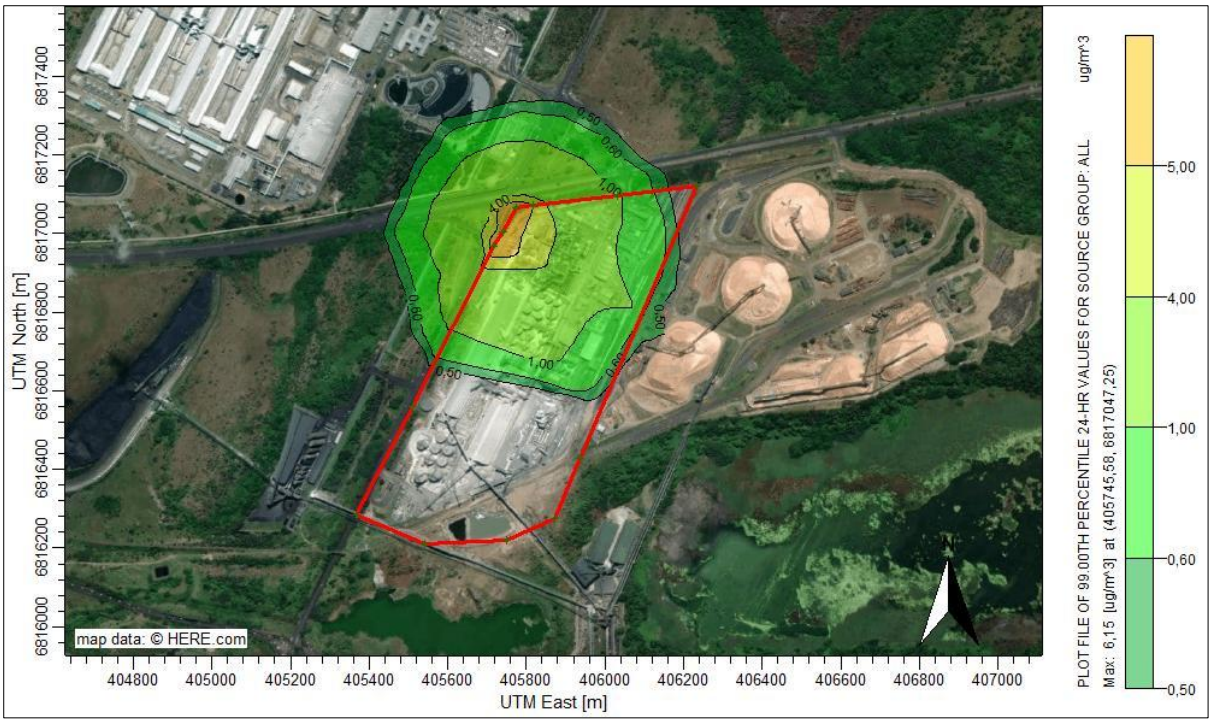


Figure 56: 99%ile of 24-hour Mean $PM_{2.5}$ Gas Boiler Contributions (Lakes, 2026)

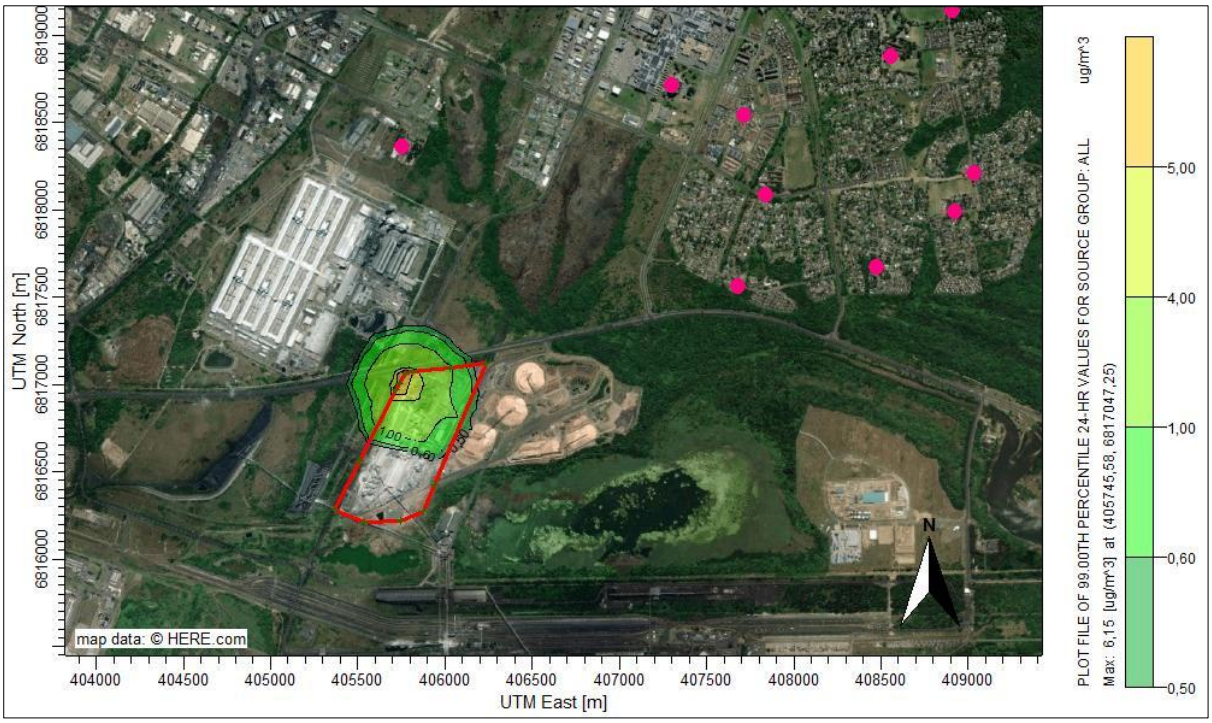


Figure 57: 99%ile of 24-hour Mean $PM_{2.5}$ Gas Boiler Contributions (+Sensitive Receptors) (Lakes, 2026)

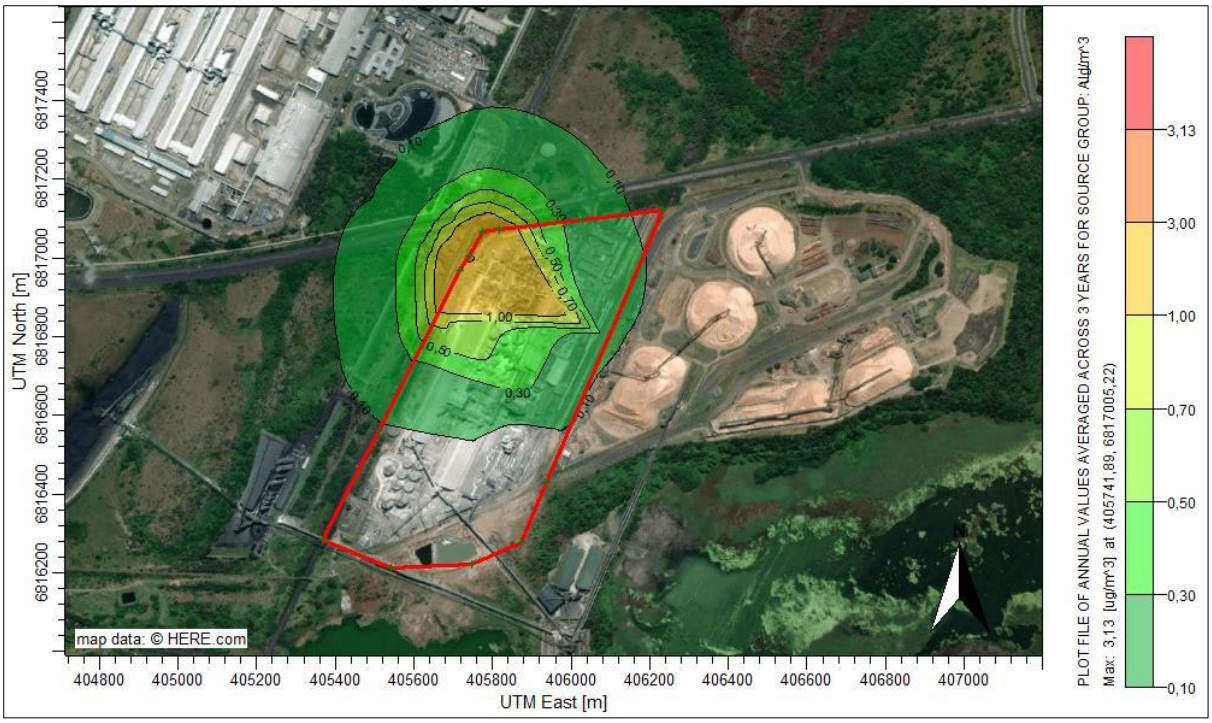


Figure 58: Annual Mean $PM_{2.5}$ Gas Boiler Contributions (Lakes, 2026)

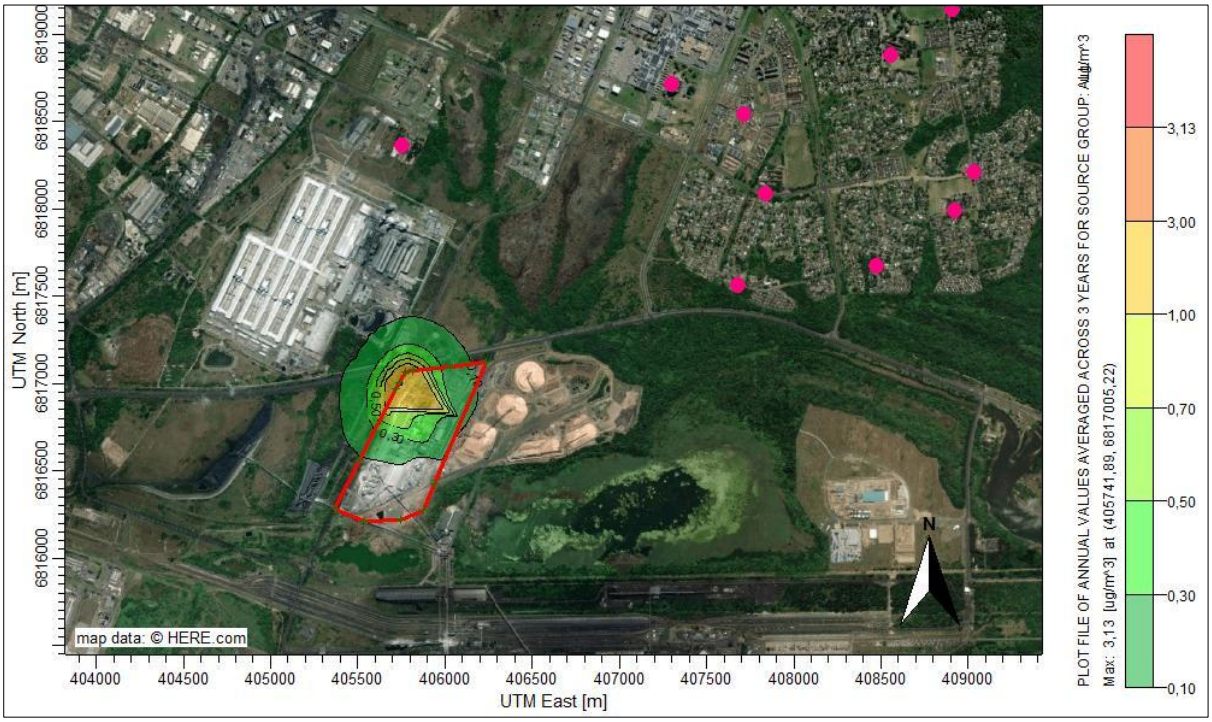


Figure 59: Annual Mean $PM_{2.5}$ Gas Boiler Contributions (+Sensitive Receptors) (Lakes, 2026)

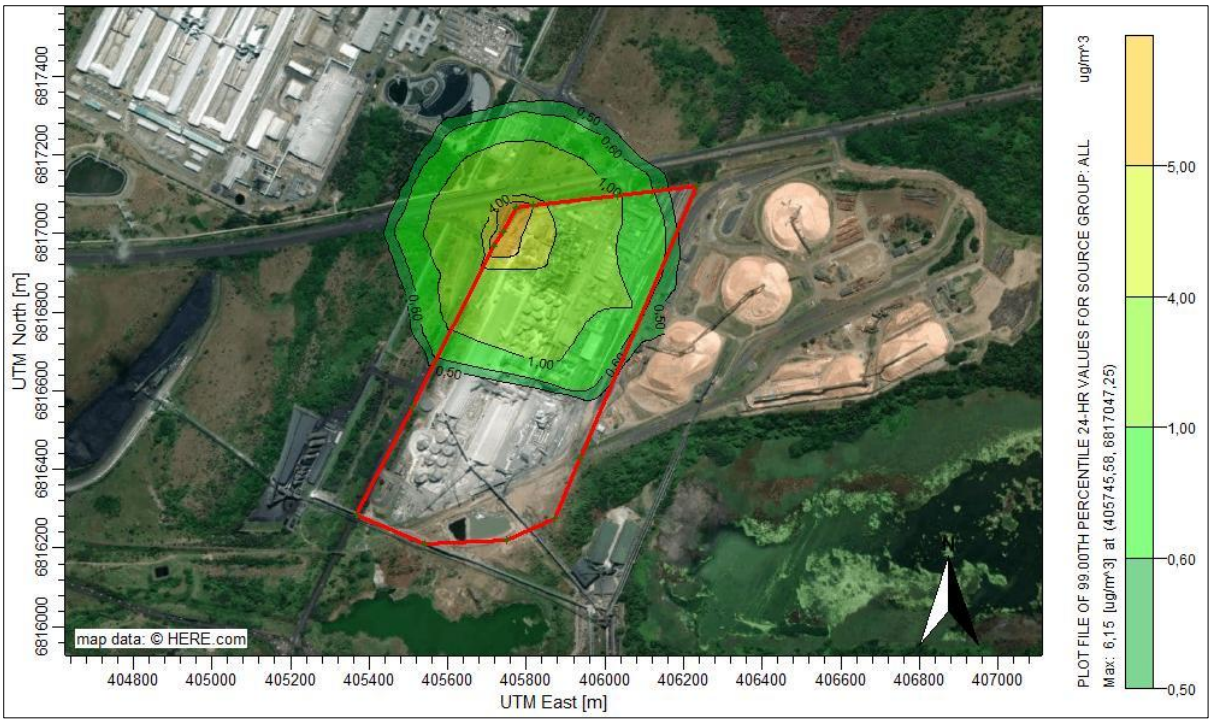


Figure 60: 99%ile of 24-hour Mean PM_{10} Gas Boiler Contributions (Lakes, 2026)

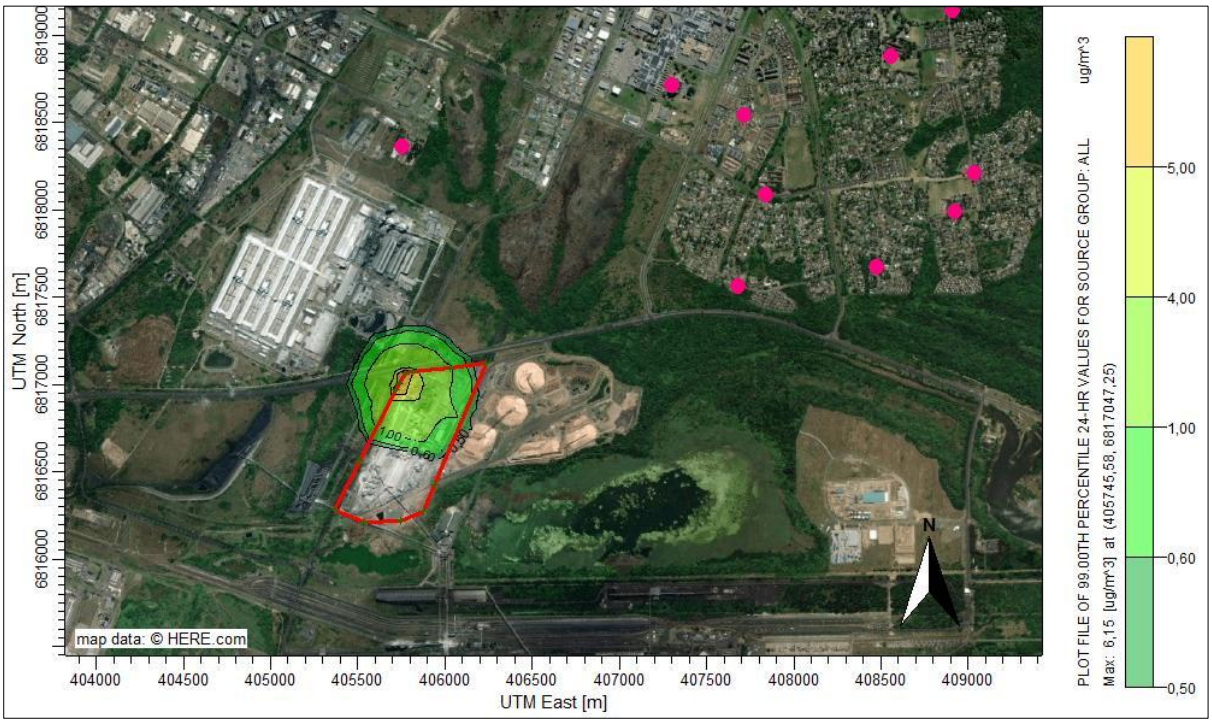


Figure 61: 99%ile of 24-hour Mean PM_{10} Gas Boiler Contributions (+Sensitive Receptors) (Lakes, 2026)

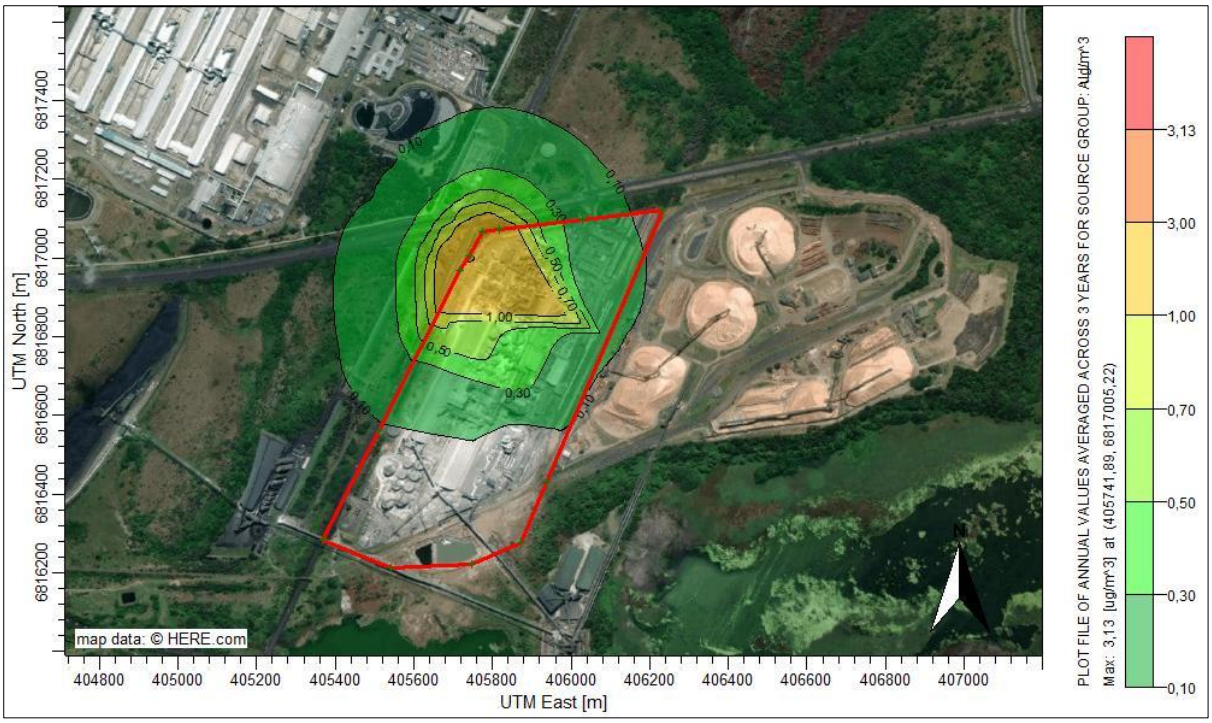


Figure 62: Annual Mean PM_{10} Gas Boiler Contributions (Lakes, 2026)

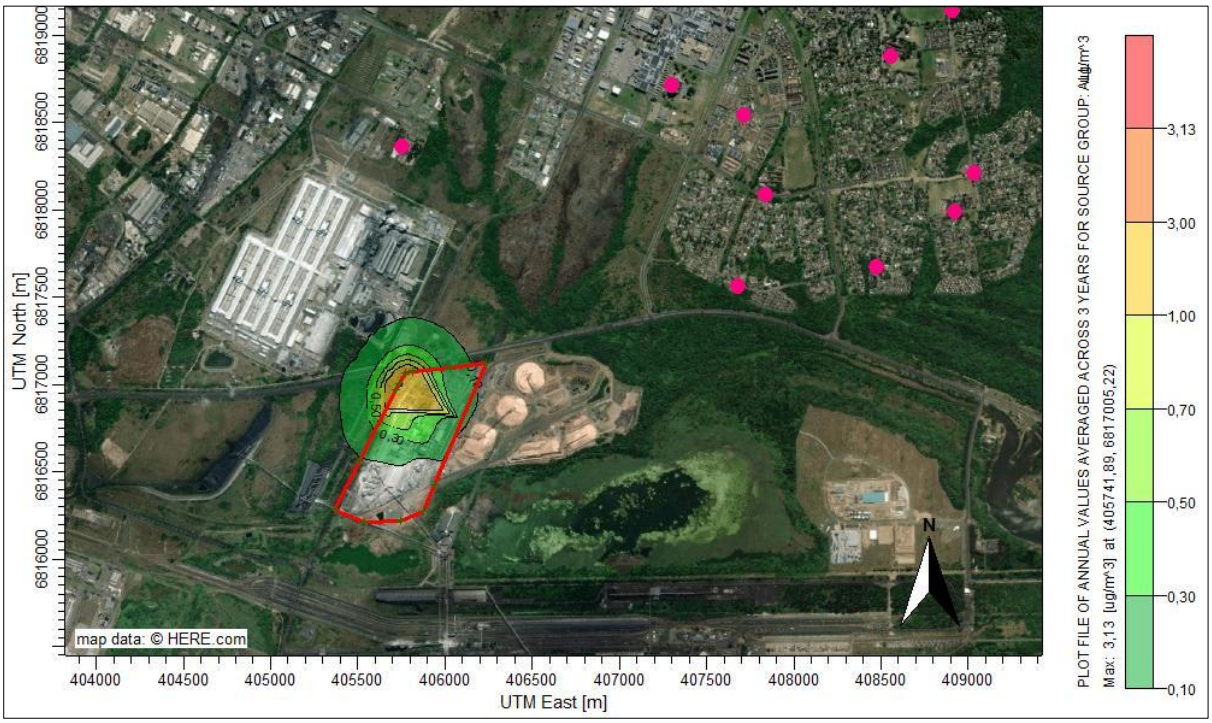


Figure 63: Annual Mean PM_{10} Gas Boiler Contributions (+Sensitive Receptors) (Lakes, 2026)

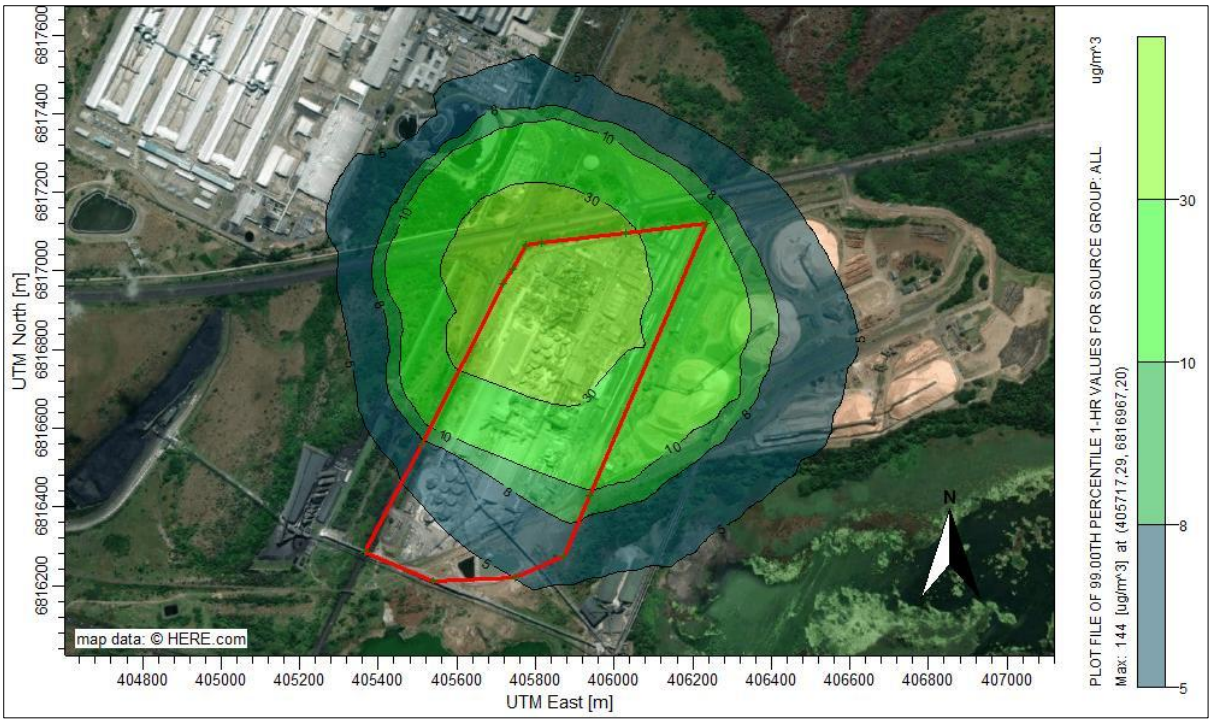


Figure 64: 99%ile of 1-hour Mean NO_2 Gas Boiler Contributions (Lakes, 2026)

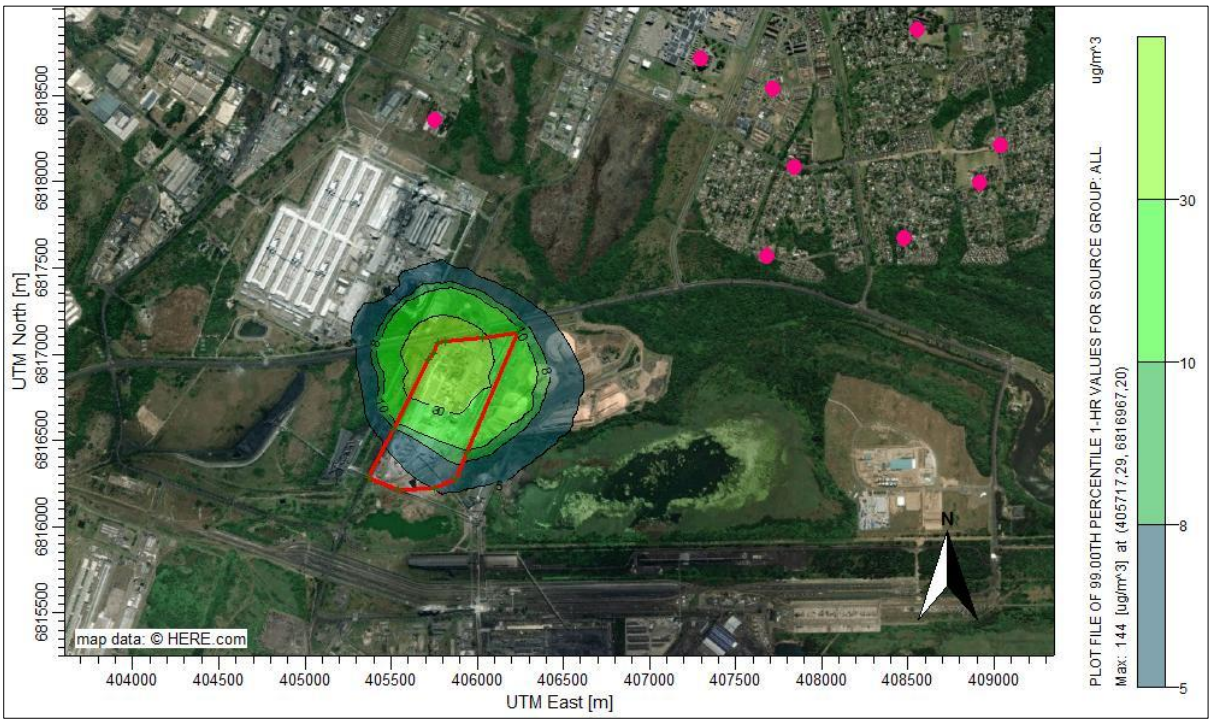


Figure 65: 99%ile of 1-hour Mean NO_2 Gas Boiler Contributions (+Sensitive Receptors) (Lakes, 2026)

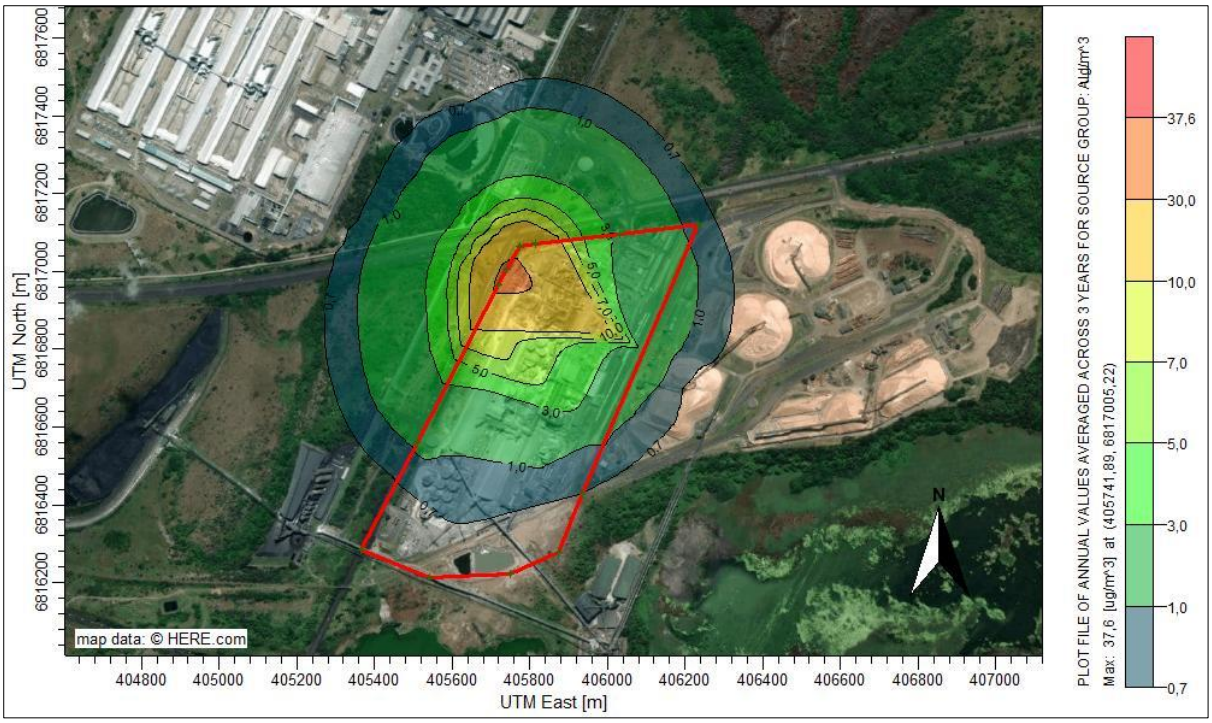


Figure 66: Annual Mean NO_2 Gas Boiler Contributions (Lakes, 2026)

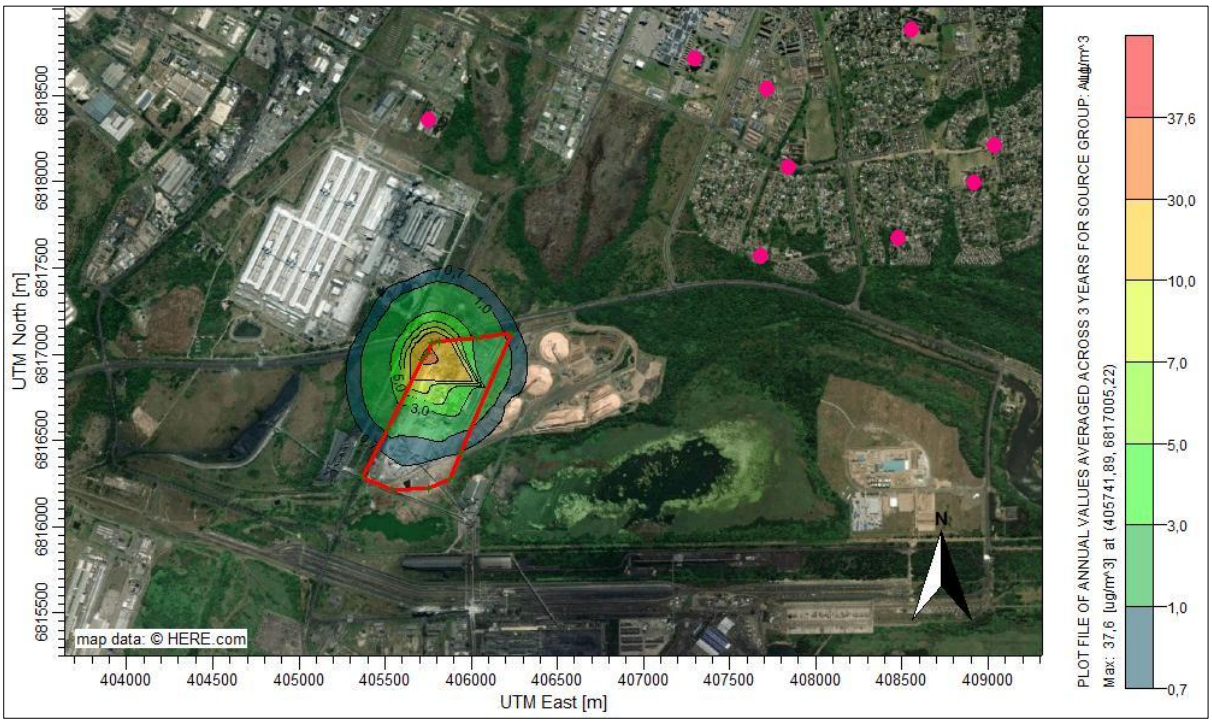


Figure 67: Annual Mean NO_2 Gas Boiler Contributions (+Sensitive Receptors) (Lakes, 2026)

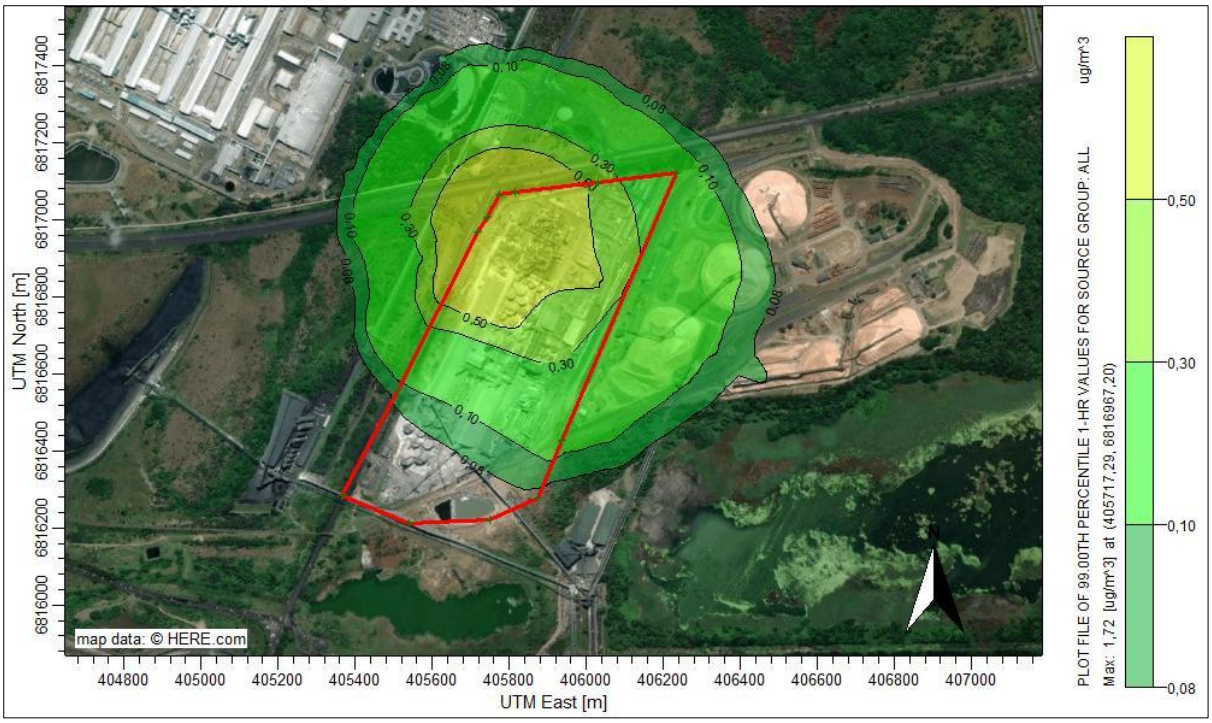


Figure 68: 99%ile of 1-Hour SO_2 Gas Boiler Contributions (Lakes, 2026)

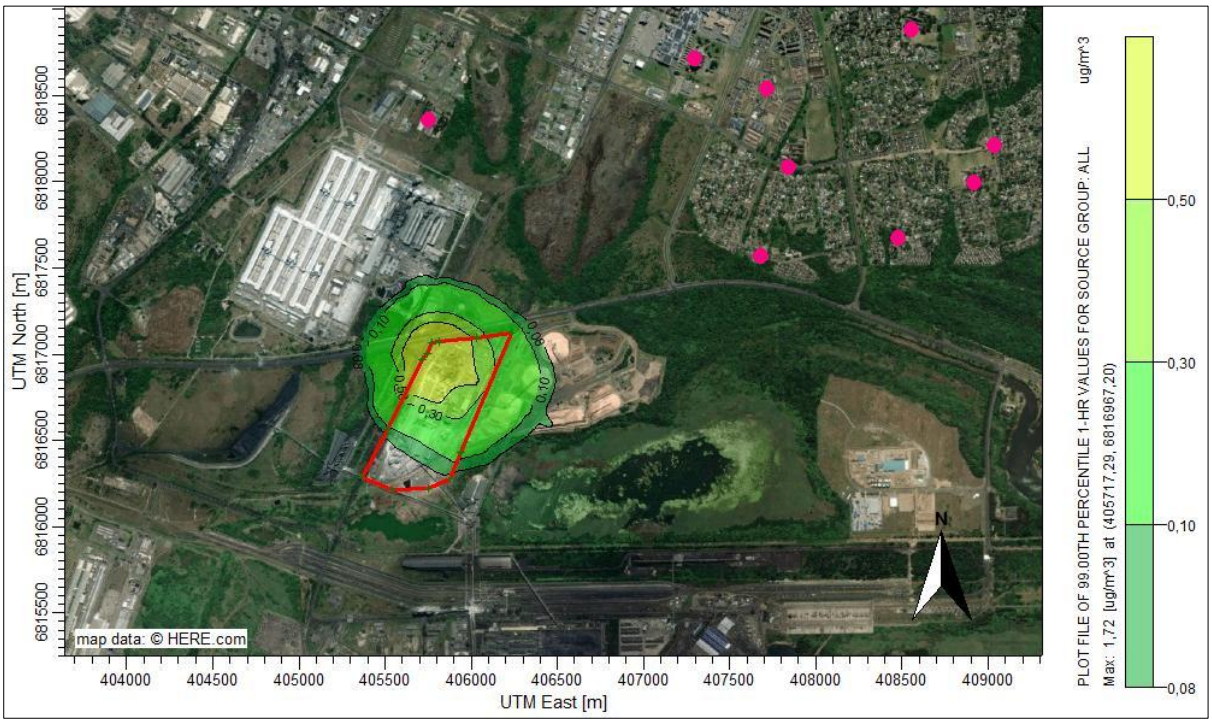


Figure 69: 99%ile of 1-Hour SO_2 Gas Boiler Contributions (+Sensitive Receptors) (Lakes, 2026)

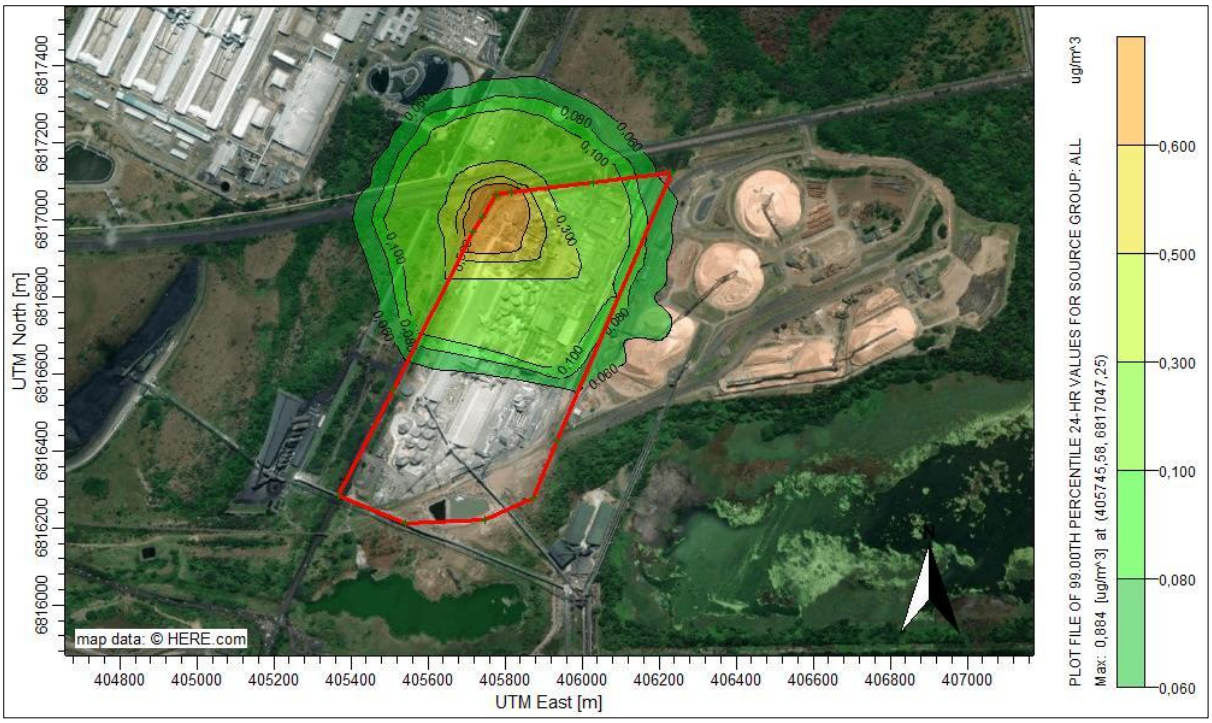


Figure 70: 99%ile of 24-Hour SO_2 Gas Boiler Contributions (Lakes, 2026)

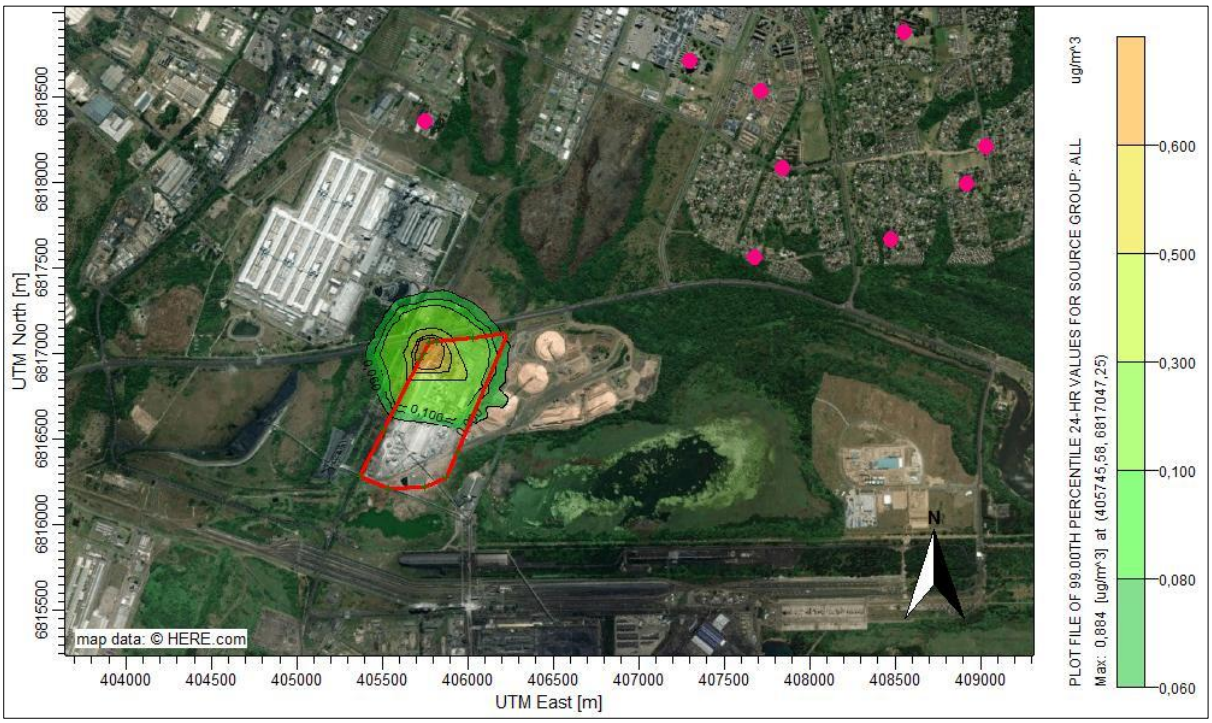


Figure 71: 99%ile of 24-Hr SO_2 Gas Boiler Contributions (+Sensitive Receptors) (Lakes, 2026)

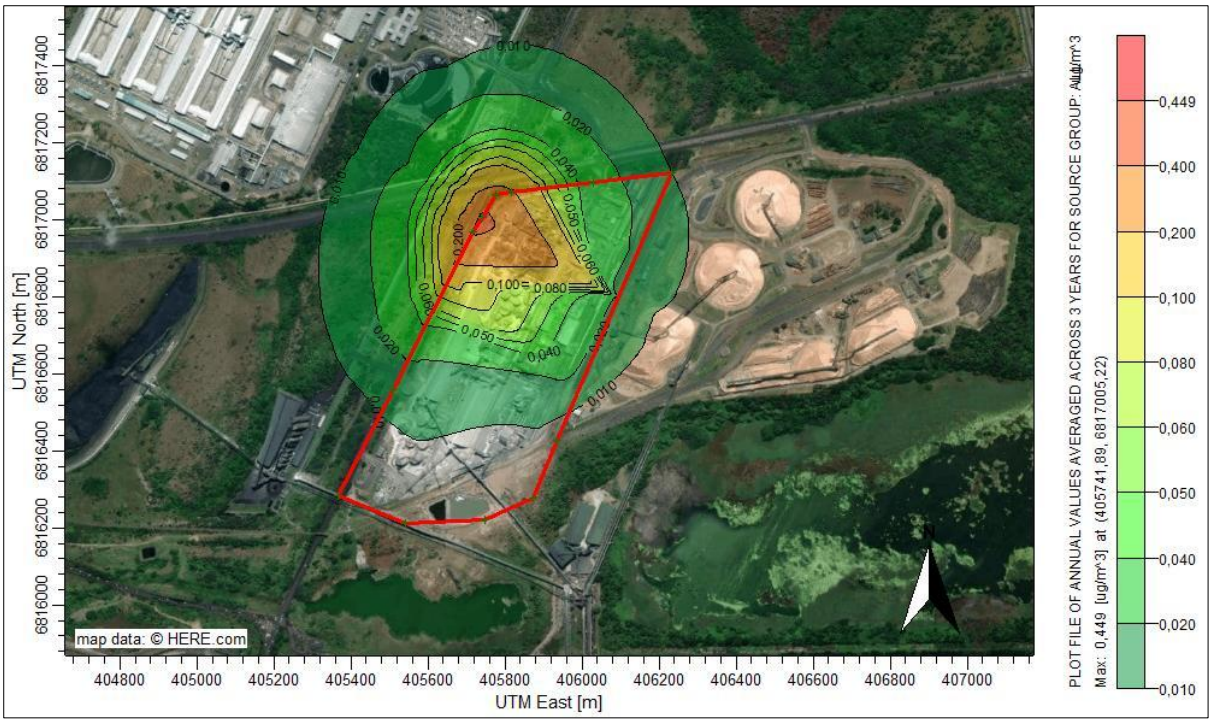


Figure 72: Annual Mean SO_2 Gas Boiler Contributions (Lakes, 2026)

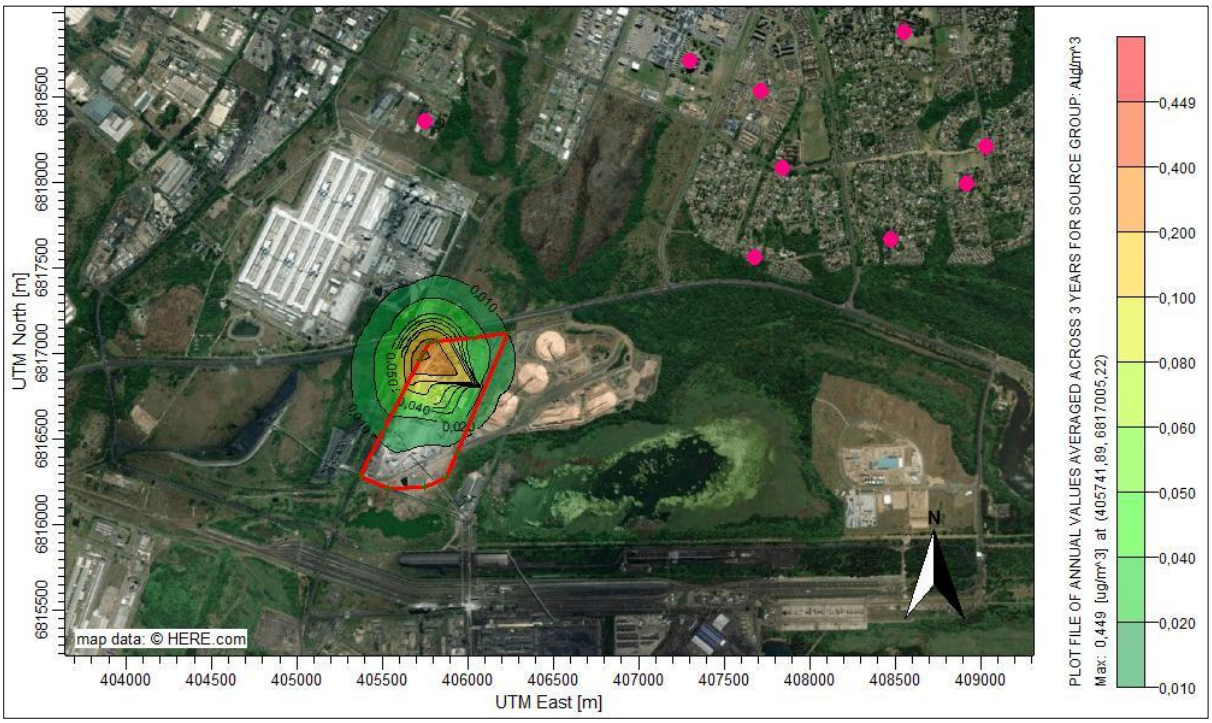


Figure 73: Annual Mean SO_2 Gas Boiler Contributions (+Sensitive Receptors) (Lakes, 2026)

11.6 Conclusions

The gas boiler was modelled in isolation from other plant activities for three fuel consumption scenarios. In all three scenarios, predicted concentrations of PM_{10}, $PM_{2.5}$, NO_2 and SO_2 were below the NAAQS across the modelled grid and at all sensitive receptors.

Predicted concentrations increase in direct proportion to fuel consumption. Under Scenario 3, the proposed consumption of 15,000,000 m^3 per year for the AEL variation, all concentrations at the sensitive receptors remain below 1 $\mu g/m^3$, which is less than 1% of the NAAQS. The gas boiler therefore poses a low risk to air quality at the sensitive receptors.

NO_2 is the pollutant of most concern. The highest NO_2 concentrations occur on the modelled grid close to the plant (Tables 18, 20 and 22). Under Scenario 3, the maximum annual NO_2 concentration of 37.63 $\mu g/m^3$ is 94% of the NAAQS of 40 $\mu g/m^3$. This result is conservative, because all NO_x is assumed to be converted to NO_2.

On this basis, the proposed increase in permitted methane gas consumption to 15,000,000 m^3 per year is acceptable from an air quality perspective, provided the recommendations below are implemented.

In all scenarios, the highest predicted concentration isopleths for all pollutants were confined mainly to the vicinity of the FOSKOR plant, with limited impact beyond the plant boundary. The highest concentrations would therefore mainly affect FOSKOR employees, although concentrations remained below the NAAQS. Workplace exposure is regulated separately under the Occupational Health and Safety Act, 1993 (Act No. 85 of 1993).

11.7 Recommendations

The following is recommended:

1. **AEL variation:** FOSKOR should submit this report with its application to vary the AEL, to increase the permitted methane gas consumption to 15,000,000 m^3 per year in terms of Section 46 of the National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004).
2. **Fuel consumption monitoring:** Methane gas consumption should be recorded monthly and tracked against the annual AEL limit, so that any future exceedance is identified early rather than during annual greenhouse gas reporting.
3. **Stack emission testing:** FOSKOR should conduct periodic stack emission testing for particulate matter, NO_x and SO_2 in accordance with the AEL conditions and the applicable Minimum Emission Standards (GN 893 of 2013, as amended), to confirm that actual emissions are consistent with the emission factors used in this assessment.

12 COMPLAINTS

Complaints Report								
Type (Dust, Noise and offensive odours)	**Physical Address**	**Source**	**Date and time the complaint was registered**	**Description**	**Date and time the complaint was attended**	**Who attended the complaint**	**Root cause analysis**	**Corrective action taken**
Visible	CBD	Foskor	14/01/2025 12:11	Abnormal emissions from C-stack	22/01/2025 18:48	Silungile Msane	The acid strength probe was faulty	
Clinical + Visible	Vicinity of Foskor	Foskor	16/01/2025 11:00	John Ross traffic light at Foskor. Complainant reported a gas cloud at the intersection emanating from Foskor. Had to close vehicle windows. Complainant alleges that they witnessed people running out of Foskor, who then informed the complainant that there was a fire and a gas leak.	22/01/2025 18:39	Silungile Msane	In the morning of January 16, 2025, fire was observed at Filter number 3 of the Sulphuric Acid Plant. Sulphuric Acid Plant has 3 filters namely filter no.l filter no.2 and filter no.3. These filters are used to filter molten sulphur and separate the clean sulphur from the sulphur ash. When fire occurs in the filter, the sulphur ash forms smoke which contains small amounts of SO2 gas because of the sulphur content that remains in the ash during the process of filtration. The cloud seen was as a result of the smoke resulting from the fire.	
Visible	Vicinity of Foskor	Foskor	16/01/2025 12:11	Big white cloud at the bridge	22/01/2025 18:48	Silungile Msane	In the morning of January 16, 2025, fire was observed at Filter number 3 of the Sulphuric Acid Plant. As a result of this fire, there was smoke observed in the Sulphuric Acid Plant.	
Odour	Vicinity of Foskor	Foskor	16/01/2025 12:43	Pungent odour. Complainant reported that they had been informed that individuals onsite at Foskor were purchasing respirators.	22/01/2025 18:48	Silungile Msane	In the morning of January 16, 2025, fire was observed at Filter number 3 of the Sulphuric Acid Plant. As a result of this fire, there was smoke in the vicinity of the Sulphuric Acid Plant.	

Visible	Vicinity of Foskor	Foskor	16/01/2025 12:58	Low hanging cloud over foskor	22/01/2025 18:48	Silungile Msane	In the morning of January 16, 2025, fire was observed at Filter number 3 of the Sulphuric Acid Plant. As a result of this fire, there was smoke in the vicinity of the Sulphuric Acid Plant.	
Visible	Vicinity of Foskor	Foskor	05/02/2025 12:44	Excessive emissions emanating from the Foskor stack	07/02/2025 13:09	Silungile Msane	Acid strength below the specification limits.	
Noise	Richards Bay	Foskor	12/03/2025 17:00	From around 17h00 residents of Arboretum, Veldenvlei and Wildenweide started reporting on social media their extreme concern regarding loud abnormal noises. Residents of Arboretum Extension confirmed that it was emanating from the Foskor facility. Residents described it as sounding as if the facility was about to explode, another saying that in their 35 years of living in Arboretum extension they had never experienced anything like this. In Veldenvlei the rumbling was heard earlier and sounded like thunder.	12 & 18/03/2025 14:04 & 13:13	Sandy Camminga and Silungile Msane	The RBCAA contacted Foskor. Their preliminary response stated that the noise was related to increased steam pressure on the line resulting in the opening of the relief valve. The cause of the activation of the pressure relief valve is that the A & B Sulphur section that uses a lowpressure system of 29 bar got a higher steam pressure of approximately 45 bar. Because there was a demand for additional steam for Phosphoric Acid there was simultaneous increase of the plant rates (B and C Plants). Increased plant rates resulted in an increase of steam production and thus increased pressure in the pipeline.	
Noise	Arboretum Ext	Foskor	16/04/2025 22:45	A loud noise and odour coming from Foskor	23/04/2025 16:47	Silungile Msane	Noise complaint: around the time of the exceedance, the steam pressure exceeded maximun settings on the relief valve on the 11-bar steam system in Sulphuric acid C plant causing a loud noise. Odour complaint: Based on the SO2 trends around the time of the	

							complaint, there were no abnormalities present in the plant conditions. However it must be noted that the odour complaint was not clear regarding the type of odour experienced.	
Abnormal Emissions	Richards Bay	Foskor	10/01/2026 15:20	Abnormal emissions from A/B stack	19/01/2026 15:13	Silungile Msane	Defects or clogging of the absorption tower internals, as well as contamination of the raw sulphur with plume-visibility-inducing agents such as hydrocarbons.	• Procure full-body acid-resistant moonsuites • Inspection of absorption towers. • Analyse the raw sulphur for hydrocarbon contaminats
Excessive Emissions	Richards Bay	Foskor	21/01/2026 07:18	Excessive emissions emanating from the Foskor C Plant	11/02/2026 14:37	Silungile Msane	The Sulphuric Acid C Plant was compelled to reduce production rates to minimum due to external factors including phosphate rock shortage at the Phosphoric Acid Plant. Operating at reduced rates requires the plant to function closer to the process gas dew point temperature. Under these conditions, increased water vapour will be present in the stack emissions, resulting in the formation of a visible white plume. Note: Incident Investigation available.	

Excessive Emissions	Richards Bay	Foskor	28/01/2026 17:03	Excessive emissions emanating from the Foskor C Plant	11/02/2026 14:37	Silungile Msane	The Sulphuric Acid C Plant was compelled to reduce production rates to minimum due to external factors including phosphate rock shortage at the Phosphoric Acid Plant. Operating at reduced rates requires the plant to function closer to the process gas dew point temperature. Under these conditions, increased water vapour will be present in the stack emissions, resulting in the formation of a visible white plume. Note: Incident Investigation available.	

13 CURRENT OR PLANNED AIR QUALITY MANAGEMENT INTERVENTIONS

No current or planned air quality management interventions

14 COMPLIANCE AND ENFORCEMENT ACTIONS

N/A

15 REFERENCES

1. Choi, W., Ho, C.H. and Kim, K.Y. (2023). Critical Contribution of Moisture to the Air Quality Deterioration in a Warm and Humid Weather. *Scientific Reports,* 13(1), p.4260.
2. Conradie, D.C.U. (2012, July). South Africa's Climatic Zones: Today, Tomorrow. *International Green Building Conference and Exhibition*, pp. 1-9.
3. Department of environmental affairs South African government (2004) national environmental management: air quality act, 2004 (act no. 39 of 2004).
4. Diab, R. Air Pollution Meteorology: National Air Quality Management Programme Phase II Transition Project. *Department of Environmental Affairs and Tourism*, Book 2.
5. Foskor. (2025). Abnormal occurrence report. January.
6. Foskor. (2025). Abnormal occurrence report. April.
7. Foskor. (2025). Abnormal occurrence report. June.
8. Foscor. (2024-2025). Complaints Register.
9. Google Earth – Digital Globe Aerial Satellite Imagery.
10. Google Earth and Google Earth imagery have been used for mapping purposes.
11. Guastella, I. (2026). Meteorological Context for Atmospheric Impact Report: FOSKOR-Richards Bay.
12. Jiang, Y., Niu, Y., Xia, Y., Liu, C., Lin, Z., Wang, W., Ge, Y., Lei, X., Wang, C., Cai, J. and Chen, R. (2019). Effects of Personal Nitrogen Dioxide Exposure on Airway Inflammation and Lung Function. *Environmental Research*, 177, p.108620.
13. Kelbe, B. (2010). Hydrology and Water Resources.
14. Khalaf, E.M., Mohammadi, M.J., Sulistiyani, S., Ramirez-Coronel, A.A., Kiani, F., Jalil, A.T., Almulla, A.F., Asban, P., Farhadi, M. and Derikondi, M. (2024). Effects of Sulphur Effects of Sulphur Dioxide Inhalation on Human Health: A Review. *Reviews on Environmental Health*, 39(2), pp.331-337.
15. Lakes environmental (2024). Aermod Tech Guide, Gaussian Plume Air Dispersion Model.
16. Pope, C. A. (1992). Daily Mortality and PM_{10} Pollution in Utah valley. *Archives of Environmental Health*, 47(3), pp. 211-217.
17. Republic of South Africa. (2014). Code of practice for air dispersion modeling in air quality management in South Africa.
18. Republic of South Africa. (2012). Government gazette no. 35463 vol. 564 department of environmental affairs no. 486 national ambient air quality standard for particulate matter with aerodynamic diameter less than 2.5 micrometres ($PM_{2.5}$).
19. Republic of South Africa. (2009). Government gazette no. 32816 vol. 534 government notices department of environmental affairs no. 1210 national environmental management: air quality act, 2004 (act no. 39 of 2004) national ambient air quality standards.
20. Thangavel, P., Park, D. and Lee, Y. C. (2022). Recent Insights into Particulate Matter ($PM_{2.5}$)-Mediated Toxicity in Humans: An Overview. *International Journal of Environmental Research and Public Health*, 19(12), p.7511.

21. The United States Environmental Protection Agency. AP-42: Compilation of Air Emissions Factors from Stationary Sources.
22. Tyson, P.D. (1987). Climatic Change and Variability in Southern Africa. Oxford Press, Cape Town, pp. 220.
23. Yadav, V.K., Bijekar, S., Gacem, A., Alkahtani, A.M., Yadav, K.K., Alreshidi, M.A., Kumar, P., Ghosh, T., Verma, R.K., Mishra, S. and Patel, A. (2024). The Impact of Fine Particulate Matters (PM_{10}, $PM_{2.5}$) from Incense Smokes on the Various Organ Systems: A review of an Invisible Killer. *Particle & Particle Systems Characterization*, 41(5), p.2300157.