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AIR QUALITY IMPACT ASSESSMENT REPORT
FOR

INTERVENTION ENGINEERING (PTY) LTD FOR THE PROPOSED ACTIVITIES TO BE LOCATED WITHIN THE PRE-EXISTING ARCELORMITTAL INDUSTRIAL FACILITY ON CORNER FRIKKIE MEYER AND ROGER DAYSON ROAD, CITY OF TSHWANE, GAUTENG PROVINCE

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Quality Control and Authorisation:

This report was compiled and authorised by:

Draft
Sindiso Lubisi

Reviewer:

This report was reviewed by:

Draft

Environmental Assessment Practitioner
Environmental Edge (Pty) Ltd

Reviewer:

The technical quality of this report was checked by:

Draft

Cyril Kamogelo Legong
EAPASA Reg: 2021/3159
SACNASP: Reg. 125866
Environmental Assessment Practitioner



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EXECUTIVE SUMMARY

Intervention Engineering (Pty) Ltd, hereafter referred to as “Intervention Engineering” or “the Company”, plans to occupy and operate an existing facility located within the pre-existing ArcelorMittal Industrial Facility on Corner Frikkie Meyer and Roger Dayson Road, in the City of Tshwane Metropolitan Municipality, Gauteng Province. Intervention Engineering plans to operate a foundry which will process scrap metal and cast it into aluminium, bronze as well as iron and steel products. As such, the facility requires an Atmospheric Emission Licence (AEL) to operate their emitting equipment.

The main objective of the Air Quality Impact Assessment (AQIA) is to determine the potential impact of emissions associated with the **facility’s** operational activities on ambient air quality in terms of criteria air pollutants such as particulate matter (PM), sulphur dioxide (SO₂), nitrogen dioxide (NO₂) and non-criteria air pollutants, namely hydrogen fluoride (HF), total volatile organic compounds (TVOCs), and ammonia (NH₃).

As part of this AQIA, a baseline assessment was undertaken to study the receiving area; specifically, to determine the prevailing meteorological conditions at the site, establish baseline concentrations of key air pollutants of concern in the area, identify existing sources of emissions, and identify key air quality sensitive receptors surrounding the project site. In studying the receiving environment, the following was found:

- Air Quality Sensitive Receptors (AQSRs) in the project area include urban residential areas, educational facilities, recreational facilities and hospitals. Residential areas within a 5 km radius of the study area include Quagga Estates which is the closest residential complex to the proposed site (about 1.05 km). Other residential areas include Iscor Park (north), West Park (north), Kwaggasrand (northwest), Proclamation Hill (northeast), Laudium (southwest), and Valhalla (southeast).
- The land use surrounding the facility includes urban built up, commercial, residential, and industrial properties, natural vegetation, and grassland, with various recreational areas also located nearby the proposed site.
- Existing key sources of pollution surrounding the facility include urban industrial activities and vehicle emissions.
- Based on MM5 meteorological data obtained from Envitrans for the period June 2023 to July 2023, the area is affected by frequent north-north-east winds with some occasional north-north-west winds. Long-term air quality impacts are therefore expected to be the most significant from the north-north-east of operations at Intervention Engineering.
- An analysis of ambient air quality monitoring data from the permanent Pretoria West and Market Tshwane Air Quality Monitoring Stations (AQMSs), for the period June 2020 – July 2023, indicated the following in terms of the status quo air quality around Intervention Engineering:
 - Daily average PM₁₀ concentrations for the period ranged between **21.324 µg/m³ – 47.41 µg/m³**, with an average for the period June 2020 – July 2023 of **32.391 µg/m³**.
 - Daily average PM_{2.5} concentrations for the period ranged between **12.088 µg/m³ – 35.123 µg/m³**, with an average for the period June 2020 – July 2023 of **21.781 µg/m³**.
 - Significant exceedances of the daily PM₁₀ and PM_{2.5} ambient air quality limits, i.e., 48 and 91 exceedances for PM₁₀ and PM_{2.5}, respectively. In terms of the South African National Ambient Air Quality Standards (NAAQS), no exceedances of the PM₁₀ and PM_{2.5} annual standards are permitted within a calendar year. Only four (4) exceedances of the PM₁₀ and PM_{2.5} 24-hour standards are permitted.
 - Daily average SO₂ concentrations ranged between 1.259 – 6.264 ppb, with an average of 3.591 ppb for the period.

- Only one exceedance of the annual SO₂ ambient air quality limits was observed during the period, and that was the daily concentration of 19.850 ppb, which was recorded on 17 January 2019. No exceedances of SO₂ annual standard are permitted within a calendar year.
- Daily average NO₂ concentrations ranged between 8.976 – 11.414 ppb, with an average of 10.331 ppb for the period.
- A total of 6 exceedances of the NO₂ hourly standard of 21 ppb were recorded during this period, with the highest hourly concentration of 24.385 ppb being recorded on 22 July 2019. No exceedances of NO₂ annual standard are permitted.

The main findings of the impact assessment are as follows:

- The key emitting activities at Intervention Engineering, include the electricity needed to power the furnaces and operational equipment, emission sources to be connected to 1x stack, as well as casting and cooling. These activities result in the emission of criteria air pollutants (PM, SO₂ and NO₂) and non-criteria air pollutants (HF, TVOCs and NH₃), which have an impact on ambient air quality.
- The point sources which trigger sub-categories 4.4 and 4.10 of Category 4 (Metallurgical Industries) in terms of Section 21 of NEM:AOA (No. 39 of 2004), were the focus of this assessment. A total of one (1) point source was assessed in this study and include:
 - A combined stack, which is associated with all potential emission sources.
- PM₁₀, PM_{2.5}, SO₂, NO₂, HF, TVOCs and NH₃ emission rates from the emission source operations were quantified through an emissions inventory for input into the model. Emission rates were generally low for all pollutants.
- Two scenarios were considered in the assessment:
 - Scenario A: Minimum Emission Standards (MES): where the MES for Intervention Engineering, i.e., the maximum threshold limit that is allowed for new plants (in terms of PM, SO₂ and NO₂, HF, TVOCs and NH₃, where applicable) as per listed activity sub-categories categories 4.4 and 4.10 of Category 4 (Metallurgical Industries) was considered for input into the model.
 - This is representative of potential impacts if the facility were emitting at the acceptable threshold that is permissible for sub-categories categories 4.4 and 4.10 of Category 4 (Metallurgical Industries). The emission standards were converted into emission rates for input into the model.
 - Results from this scenario remained significantly below the standard limits **and was lower than scenario B's results.**
 - Scenario B – Similar Operations: where emissions from similar operations were used with maximum allowed threshold limits for new plants as per listed activity sub-categories 4.4 and 4.10 of Category 4 (Metallurgical Industries) was considered for input into the model.
 - This is representative of potential impacts if the foundry was emitting at the acceptable threshold that is permissible for these sub-categories. The emission standards were converted into emission rates for input into the model.
 - Results from this scenario remained significantly below the standard limits and the values were slightly higher than scenario A's results.
- Simulated PM₁₀ and PM_{2.5} concentrations are well below the NAAQS in both the scenarios and fall well below the maximum daily and annual average background PM₁₀ and PM_{2.5} concentrations recorded at the Pretoria West and Market Tshwane AQMSs.

- Simulated HF, TVOCs and NH₃ are also low over the entire project area and its surroundings.
- Simulated SO₂ concentrations are low and fall below the applicable NAAQS over the project area. Simulated SO₂ concentrations are lower than the maximum hourly, daily and annual average background SO₂ concentrations recorded at the Pretoria West and Market Tshwane AQMSs.
- Simulated NO₂ concentrations are low and fall below the applicable NAAQS over the project area and its surrounding. Simulated NO₂ concentrations are lower than the maximum hourly and annual average background NO₂ concentrations recorded at the Pretoria West and Market Tshwane AQMSs.
- Simulated emission levels at all AQSRs modelled in the study (as described in Section 5.1) are low, with no exceedances of the applicable NAAQS, NDCR, or Alberta standards observed, where applicable.
- Other open-air fugitive emission sources associated with the facility such as casting, and cooling are also identified as key sources of emissions at the site. As such, the fugitive emission mitigation measures given in Section 7.2 of this report should be implemented, where possible and applicable, to reduce the impact of these sources.

To ensure the lowest possible impact on AQSRs and the environment, it is recommended that the air quality management measures as set out in this report should be adopted. These include the mitigation of sources of emission, the management of associated air quality impacts and the monitoring of emissions. Key aspects/recommendations are:

- Mitigation of fugitive emissions generated from all area sources at Intervention Engineering, as outlined in Section 7.2.
- Fume capture, extraction systems and stacks must be installed, maintained regularly, and operated to specifications, to ensure minimal fugitive emissions during melting cycles once the furnaces become operational.
- The stack design must be such that the height is above the height of the nearest building. It is advised that a stack height guideline be used.
- Continual stack emissions testing is recommended on an annual basis to determine the actual emission scenario at Intervention Engineering. Intervention Engineering should ensure that monitoring is undertaken in accordance with nationally or internationally acceptable methods. Should emissions of PM, SO₂, NO₂, HF, TVOCs and NH₃ exceed the acceptable MES, appropriate control measures need to be investigated and abatement equipment needs to be installed and/or improved where necessary to achieve compliance with the acceptable emission limits.
- Compliance with provisional AEL (PAEL) conditions and requirements is recommended, as outlined in Section 7.2 of this report, once the PAEL has been issued.
- As the facility is currently busy with a Waste Management Licence application process, an Environmental Management Programme (EMPr) must be drafted as per the regulative requirements for the facility.

The significance of the air quality impacts on AQSRs for scenario A: MES standards was found to be low for all modelled pollutants. Results from this scenario remained significantly below the standard limits and were lower than scenario **B's results**. With the mitigation measures proposed in place (Section 7.2), the significance of current impacts can be further reduced to minimal.

The significance of the air quality impacts on AQSRs for scenario A, which is representative of furnace operations emitting at the acceptable threshold that is permissible for sub-category 4.4 and 4.10, were found to be low with and without mitigation. Emissions at the facility should be maintained below the



MES limits as far as possible. Nonetheless, should Intervention Engineering ever reach the MES limits, the impact of the furnaces is still predicted to be relatively low inside and beyond the facility boundary.

The “no-go alternative”, which is the option of not fulfilling the proposed project, would result in zero gaseous and particulate emissions being emitted into the air, and thus high positive impacts, with no air quality impacts from the foundry on the site or surrounding local area.

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LIST OF ABBREVIATIONS

AEL	Atmospheric Emission Licence
AERMAP	Terrain Pre-Processor
AERMOD	Atmospheric Dispersion Modelling System
AERMET	Meteorological Data Preprocessor
AERMIC	American Meteorological Society and USEPA Regulatory Model Improvement Committee
AEP	Alberta Environmental Protection and Enhancement Act (EPEA), of 1999
APPA	Atmospheric Pollution Prevention Act
AQIA	Air Quality Impact Assessment
AQIAr	Air Quality Impact Assessment Report
AQMP	Air Quality Management Plan
AQMS	Air Quality Monitoring Station
AQSR	Air Quality Sensitive Receptor
ASTM	American Society for Testing and Materials
BTEX	Benzene, Toluene, Ethylene, Xylene
CO ₂	Carbon Dioxide
CH ₄	Methane
DEA	Department of Environmental Affairs (now known as the Department of Forestry, Fisheries and the Environment – DFFE)
DFFE	Department of Forestry, Fisheries and the Environment
DMP	Dust Management Plan
EIA	Environmental Impact Assessment
EMPr	Environmental Management Programme
EPEA	Alberta Environmental Protection and Enhancement Act, of 1999
GDARDE	Gauteng Department of Agriculture, Rural Development and the Environment
GHG	Greenhouse Gas
HF	Hydrogen fluoride
HFCs	Hydrofluorocarbons
LMo	Monin-Obukhov length
MM5	Mesoscale Meteorological Version 5 data
MES	Minimum Emission Standard
Mt	Megatonnes
N ₂ O	Nitrous Oxide
NAEIS	National Atmospheric Emissions Inventory System
NAAQS	National Ambient Air Quality Standards
NDCR	National Dust Control Regulations
NEMA	National Environmental Management Act, 1998 (Act No. 107 of 1998)
NEM:AQA	National Environmental Management: Air Quality Act
NH ₃	Ammonia
NH ₄ ⁺	Ammonium Ions
NO	Nitric Oxide
NO ₂	Nitrogen Dioxide
PAEL	Provisional Atmospheric Emissions Licence
PFCs	Perfluorocarbons
PM	Particulate Matter
PPE	Personal Protective Equipment
PRIME	Plume Rise Model Enhancements
PSU/NCAR	Pennsylvania State University-National Center for Atmospheric Research
SAAQIS	South African Air Quality Information System
SAGERS	South African Greenhouse Gas Emissions Reporting System
SF ₆	Sulphur hexafluoride
SO ₂	Sulphur Dioxide
TVOC	Total Volatile Organic Compounds
TBC	To be Confirmed
WHO	World Health Organisation
WML	Waste Management Licence

1. INTRODUCTION

Intervention Engineering (Pty) Ltd, hereafter referred to as “Intervention Engineering” or “the Company”, plans to occupy and operate an existing facility located within the pre-existing ArcelorMittal Industrial Facility on Corner Frikkie Meyer and Roger Dayson Road, in the City of Tshwane Metropolitan Municipality, Gauteng Province. Intervention Engineering plans to operate a foundry which will process scrap metal and cast it into aluminium, iron and steel, and bronze products. As such, the facility requires an Atmospheric Emission Licence (AEL) to operate their emitting equipment.

Environmental Edge (Pty) Ltd, hereafter referred to as “Environmental Edge”, was appointed by Intervention Engineering to compile an Air Quality Impact Assessment Report (AQIAr) as part of their Waste Management Licence and AEL application processes for their facility.

The main objective of the AQIA is to determine the potential impact of emissions associated with the facility’s operational activities on ambient air quality in terms of criteria air pollutants such as particulate matter (PM), sulphur dioxide (SO₂) and nitrogen dioxide (NO₂) as well as non-criteria air pollutants, namely hydrogen fluoride (HF), total volatile organic compounds (TVOCs), and ammonia (NH₃).

As part of this AQIA, a baseline assessment was undertaken to study the receiving area, specifically to determine the prevailing meteorological conditions at the site, establish baseline concentrations of key air pollutants of concern in the area, identify existing sources of emissions, and identify key air quality sensitive receptors (AQSRs) surrounding the project site.

1.1. Scope of Work

To meet the study objective, the following tasks were included in the scope of work:

- A review of emission sources and information collation;
- A review of regulations governing air quality impacts;
- A study of the receiving environment, including:
 - The location of AQSRs in relation to the facility;
 - Local atmospheric dispersion potential given meteorology, land use and topography; and
 - Current/status quo ambient air pollution levels.
- Compilation of an emissions inventory for key emission sources at the facility;
- Atmospheric dispersion simulations of ground level particulate and gaseous emissions for incremental impacts;
- Compliance and impact assessment;
- The recommendation of suitable management and mitigation measures; and
- The preparation of a comprehensive air quality specialist report.

1.2. Background and Project Description from an Air Quality Perspective

A detailed history of Intervention Engineering can be found in the Environmental Impact Assessment Report (EIAr). The summary below is included to provide context and background.

The facility in which the proposed activities are to be housed is within an industrial facility belonging to ArcelorMittal South Africa, the largest steel producer in sub-Saharan Africa. ArcelorMittal was founded in 1928 as Iscor Ltd, with the Pretoria West facility phased out for closure in 1982 due to very old equipment deemed uneconomic and pollution-causing.

Intervention Engineering plans to operate about four (4) furnaces which will be connected to the same emissions extraction unit (stack). The company plans to operate the facility as a foundry, processing scrap metal and casting them into aluminium, bronze as well as iron and steel products as **per clients’** specifications.

As such, the proposed activities trigger sub-categories 4.4 and 4.10 of Category 4 (Metallurgical Industries) in terms of Section 21 of NEM:AQA (Act No. 39 of 2004).

The following is a process description of the new proposed activities:

Wooden patterns and core boxes will be manufactured and repaired by hand. The patternmaker makes a template, which is called a pattern. The core box is the inside shape of the mold. These patterns and core boxes will then be used to make the sand molds. Sand will be reclaimed from casted molds for re-use for the next batch of molds. The molding boxes, which contain sand and castings, are to be put on a shakeout and the sand and the castings are separated. The shakeout is a vibrating table where the sand will fall through. The sand will then be transferred onto a conveyer belt. The sand will then be crushed into smaller pieces and conveyed by a sealed vibrating belt to a reclamation plant. The dust will be extracted into a bag house and the sand will then be pneumatically pumped into an attrition unit with sieves.

From this hopper it will be pumped into other hoppers for use at the continuous mixers by means of gravity feed. This process is where the molds will be made. The patterns will be placed inside a molding box, or a loose frame and the sand will be poured over the patterns. Once the sand is set, the molding box will be turned over and the patterns will be removed by means of hand or machine. The sand will be painted with a heat resisting coat of Mold paint. Cores will be placed into the mold to form the inside cavities. The mold top and bottom halves will then be closed, and the mold will then be ready to be poured.

For the molding process, a continuous sand mixer to mix silica sand with resins and hardeners will be used. Two percent resin will be added and 20% of the resin weight with a hardener will be used for the mold to set. Alkaline fenolic foundry resins will be used.

Silica sand (by weight) will be mixed with 1-3% Bentanite and 1-2% Coal dust. The sand product is called "Green sand". Between 2-3% of water will be added and mixed in a batch mixer to form a clay mixture. This clay mixture will be poured into a molding box and squeezed by a molding machine to achieve the desired strength. This sand will also be reclaimed for future use. Mold coat may be used, but often rarely in this process. This process is where sand forms are made to create the inside cavities of molds.

The same process as resin bonded sand will be used for larger cores. Ecolotec may be used, which is also a resin. Where used, it will be mixed into the sand by means of a small batch mixer. This sand will be hardened by a very small percentage of carbon dioxide gas. The cores will then be painted with mold coats and will then be ready for use.

Melting is basically a process where metal is transformed using energy from a solid to a liquid state. All melting shall take place in induction furnaces. Here scrap with a mix of ingots of aluminium, bronze as well as iron and steel will be melted.

Once the castings and sand are separated, the castings will be transferred from the shake out to the shot blast machine. Here the rest of the sand will be removed, and the castings will be cleaned by means of small steel balls which are called steel shot. The steel shot will be thrown at a very high velocity against the castings on a rotating table. This process then cleans the casting. Grit blasting will be used instead of sand blasting. Both grit blasting and shot blasting will be done in concealed areas.

The dust and sand will be extracted into a bag filter house. Once shot blasted, the castings will be transferred to the fettling bays (fettling means to clean and remove excess metal). Here, by hand-operated angle grinders and pedestal grinders, all the excess and unwanted material (runners, risers and fins) are removed, and the castings will be dressed and cleaned. Runners are excess materials where the metal enters the mold but does not form part of the castings and must be removed. This material (runners, risers and fins) will be re-melted again.

A process diagram for Intervention Engineering is provided in Figure 1-1 below.

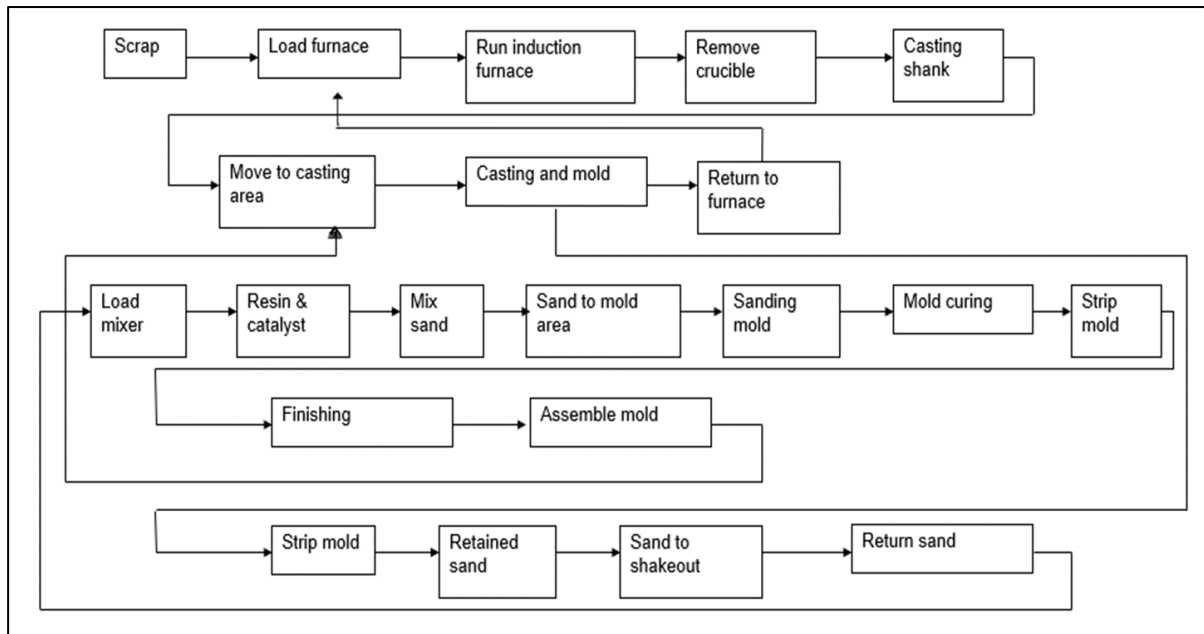


Figure 1-1: Intervention Engineering process diagram.

2. METHODOLOGY

A brief overview of the study methodology is included in this section.

2.1. Information Review

A review of information available for activities planned to be undertaken at Intervention Engineering was conducted. The following were considered in the review:

- Data supplied by Intervention Engineering via email/personal communication to/with Environmental Edge, which includes the process description, operational hours and emission sources;
- Minimum emission standards applicable to the operational activities at the facility in terms of Section 21 of the NEM:AQA;
- Stack parameters from foundries similar to Intervention Engineering.

In concurrence with regulatory requirements, the following was determined from the information review:

- The likelihood of atmospheric emissions being generated by the operational activities at the facility;
- Key sources and pollutants to be included in the emissions inventory; and
- Source parameters.

2.2. The Identification of Regulatory Air Quality Requirements and Assessment Criteria

Air quality requirements and assessment criteria were identified through careful review of the following:

- The South African National Ambient Air Quality Standards (SA NAAQS), as set out in terms of the NEM:AQA (Act No. 39 of 2004);
- The National Dust Control Regulations (NDCR) (2013), as set out in terms of the NEM:AQA (Act No. 39 of 2004); and
- The Alberta Ambient Air Quality Objectives and Guidelines Summary, as set out in terms of the Alberta Environmental Protection and Enhancement Act (EPEA), of 1999.

2.3. Study of the Receiving Environment

Physical environmental parameters that influence the dispersion of pollutants in the atmosphere include meteorology, land use and topography. An understanding of the atmospheric dispersion potential of the area is essential to an air quality impact assessment. Use was made of MM5 modelled meteorological data for the project area. MM5 meteorological data was obtained from Envitrans for the period 01 June 2020 to 31 July 2023. More details about the meteorological data are given in Section 5.2.1.

GIS maps were used to provide insight into the terrain and land use types around Intervention Engineering. Ambient air quality data is only available for PM (PM₁₀ and PM_{2.5}), SO₂ and NO₂ from the Pretoria West Air Quality Monitoring Station (AQMS) accessed from the South African Air Quality Information System (SAAQIS) website. Thus, only PM, SO₂ and NO₂ were considered in determining the air quality status quo.

2.4. Determining the Impact of the Project on the Receiving Environment

Determining the impact of operational activities at Intervention Engineering on air quality is a key outcome of the current study. To achieve this, an adequate emissions inventory, which takes into account all relevant pollutants associated with operations at Intervention Engineering, had to be compiled in this assessment.

The emissions inventory for the current study includes PM and gaseous emissions (SO₂, NO₂, HF, NH₃, and TVOCs) produced from the emission source operations. These pollutants were chosen based on the pollutants given under sub-categories 4.4 and 4.10 of Category 4 (Metallurgical Industries).

Thus, the impact assessment focused on the impact (on air quality) of the above pollutants.

One scenario was considered in the assessment, i.e. the new plant standard scenario. In other words, the maximum emission rate that is allowed in terms of Section 21 of NEM:AQA was considered in the assessment. The minimum emission standards (MES) were converted into emission rates (g/s) for input into the model. Thus, the emissions inventory was compiled for Intervention Engineering's furnace operations by making use of the following:

- The MES that are applicable to Intervention Engineering, i.e. the maximum threshold limit that is allowed for new plants for sub-categories 4.4 and 4.10 of Category 4 (Metallurgical Industries).

Other open-air fugitive emission sources associated with the facility such as casting and cooling are also identified as key sources of emissions at the site. However, emissions from these sources were excluded from the emissions inventory as the focus of this study was on the point sources (i.e., melting furnaces). Nonetheless, fugitive emission mitigation measures given in Section 7.2 of the report should be implemented, where possible and applicable, to reduce the impact of these sources.

Simulated pollutant concentrations were compared to South African National Ambient Air Quality Standards (NAAQS), where applicable. Comparisons were also made with the Alberta International Air Quality Guidelines to determine compliance, where South African NAAQS were not available.

The findings of the above components informed recommendations of air quality management measures, including mitigation and monitoring where applicable.

3. ASSUMPTIONS, LIMITATIONS AND EXCLUSIONS

The following important assumptions, exclusions and limitations to the specialist study should be noted:

Assumptions

- All project information required to calculate emissions for melting activities at the induction furnaces was provided by the client. Information provided and used as input into the model was assumed to be accurate and complete at the time of modelling.
- All input data assumed to affect emission rates, including volumetric flow rate, stack diameter and height, gas velocity, and stack height has been included in the model.
- Plant operations were assumed to occur for 24 hours a day, 7 days a week, which represents the worst-case scenario.
- Stack parameters such as gas exit velocity, gas exit temperature and volumetric flow rate were not known at the time of the modelling as the site has not been commissioned and stack monitoring has not yet been conducted. Therefore, these parameters were estimated based on stack parameters at two similar foundries.
- Stack height was estimated based on information provided by the client, unless otherwise specified.
- It was assumed that for each pollutant, the emission rate from each melting cycle was the same, regardless of how many cycles were run throughout the day.
- Mitigation measures were considered and are to be planned for and included. However, these were not input into the model in order to achieve the worst-case scenario of the proposed activities.
- The location and dimensions for the modelled source (i.e., stack) were based on the information provided by the client.
- Building downwash was considered in this study and the building heights were estimated based on Google Earth (~11 – 15m).
- There is a total of four melting furnaces which is assumed to melt aluminium, bronze, as well as iron and steel. Thus, emission rates at all melting furnaces were assumed to be the same (i.e. for Scenario A).
- The maximum allowed MES in terms of Section 21 of NEM:AQA was used in order to get the maximum dispersion of the allowed emissions.
- The MES rates were converted to g/s using dry volumetric flow rate value calculator from the AERMOD system.
- Each of the emission rates were multiplied by 4x to represent the total emissions, assuming that all will be connected to the same extraction unit (stack).
- Scenario B contains input data from similar operations triggering similar Section 21 activities and pollutants.
- The AERMOD system considers topographical and historical meteorological data in order to model the possible dispersion of the proposed activities.

Limitations

- The study was limited in that there was no background HF, NH₃, and TVOCs air quality data available for the site (within 10 km from Intervention Engineering), thus the cumulative scenario could not be assessed for these pollutants.
- The study is limited by the amount of detailed information that could be provided at the time of modelling.
- Detailed information for each emission source is required for input into the model, such as the dimensions, material throughputs, material characteristics and the exact locality of the

sources. In some instances, not all these details are known. To account for the emissions, assumptions and estimates were made where necessary.

Exclusions

- Background sources of emissions are excluded as the focus of this study was on Intervention Engineering and some detailed information for background sources was not available. However, background sources and the status quo of the area were considered in making conclusions as outlined in Section 5 of this report.

4. AIR QUALITY REGULATIONS AND ASSESSMENT CRITERIA

Prior to assessing the impact of current activities on the atmospheric environment, reference needs to be made to environmental regulations and guidelines governing emissions. Air quality guidelines and standards are fundamental to effective air quality management, providing the link between the source of atmospheric emissions and the user of that air at the downstream receptor site. Air quality guidelines and standards are normally given for specific averaging or exposure periods.

The subsections below summarise national and international legislation pertaining to air pollution and criteria and non-criteria air pollutants relevant to this study. A discussion on potential human health impacts associated with all pollutants included in this AQIAr is also provided. The legislation and guidelines provided below are not exhaustive, but rather aim to identify pertinent sections of the legislation.

4.1. National Regulations

4.1.1. *National Environmental Management: Air Quality Act (NEM:AQA), 2004 (Act No. 39 of 2004), as amended*

The National Environmental Management: Air Quality Act, 2004 (No. 39 of 2004), as amended (referred to as NEM:AQA), has shifted the approach of air quality management from source-based control to receptor-based control. The main objectives of the Act are:

- to protect the environment by providing reasonable measures for —
 - i. the protection and enhancement of the quality of air in the Republic;
 - ii. the prevention of air pollution and ecological degradation; and
 - iii. securing ecologically sustainable development while promoting justifiable economic and social development; and
- generally to give effect to section 24(b) of the Constitution in order to enhance the quality of ambient air for the sake of securing an environment that is not harmful to the health and wellbeing of people.

The Act provides for the establishment and formulation of NAAQS for substances or mixtures of substances that pose a health, well-being or environmental threat. It is possible to create more rigorous standards at the provincial and local levels.

The control and management of emissions in the NEM:AQA relates to the listing of activities that are **sources of emissions and the issuing of AELs**. **Listed activities are defined as activities which “result in atmospheric emissions and are regarded as having a significant detrimental effect on the environment, including human health”.** **Listed activities have been identified by the Minister of the** Department of Forestry, Fisheries and the Environment (DFFE) and atmospheric emission standards have been established for each of these activities. These listed activities require an AEL to operate. The issuing of AELs for listed activities is normally the responsibility of the Metropolitan and District Municipalities, except for those associated with mining operations.

In addition, the Minister may declare any substance contributing to air pollution as a priority pollutant. Any industries or industrial sectors that emit these priority pollutants will be required to implement a

Pollution Prevention Plan. Municipalities are required to “designate an air quality officer to be responsible for co-ordinating matters pertaining to air quality management in the Municipality”. The appointed air quality officer is responsible for the issuing of AELs.

4.1.1.1. Listed Activities and Minimum Emission Standards

The NEM:AQA requires all persons undertaking listed activities in terms of Section 21 of the Act to obtain an AEL. The listed activities and associated MES were issued by the then Department of Environmental Affairs (DEA) on 31 March 2010 (Government Gazette No. 33064 of 31 March 2010), as amended in:

- 2013 (Government Gazette No. 37054 of 22 November 2013);
- 2015 (Government Gazette No. 38863 of 12 June 2015);
- 2018 (Government Gazette No.41650 of 25 May 2018; Government Gazette No.42013 of 31 October 2018);
- 2019 (Government Gazette No.42472 of 22 May 2019); and
- 2020 (Government Gazette No. 43174 of 27 March 2020).

Intervention Engineering’s activities trigger sub-categories categories 4.4 and 4.10 of Category 4 (Metallurgical Industries) in terms of Section 21 of the NEM:AQA, and require an AEL to operate. An AEL Application will be lodged with the City of Tshwane Metropolitan Municipality once the WML is approved and issued by the Gauteng Department of Agriculture, Rural Development and the Environment (GDARDE) for the facility. A description of the listed activities is given in Table 4-1 below.

Table 4-1: Listed activities triggered by Intervention Engineering in terms of section 21 of NEM:AQA.

Category	Sub-category	Name of Listed Activity	Description	NOTES (REASONS)
4	4.4	Secondary Aluminium Production	Secondary aluminium production and alloying through the application of heat (excluding metal recovery, covered under Subcategory 4.21) – <i>All installations.</i>	Proposed expansion will include the production and/or aluminium products. This will require an Atmospheric Emissions Licence in terms of Section 21 of NEM:AQA.
4	4.10	Foundries	The production and/or casting of iron, iron ores, steel or ferro-alloys, including the cleaning of castings and handling of casting mold materials. – <i>All installations.</i>	Proposed expansion will include the production and/or casting of iron. This will require an Atmospheric Emissions Licence in terms of Section 21 of NEM:AQA.

Emissions emanating from production processes at the facility are therefore required to comply with the MES for new plants in terms of Section 21 of NEM:AQA.

South Africa launched an online national reporting system, referred to as the National Atmospheric Emissions Inventory System (NAEIS). The NEM:AQA requires all emission source groups identified in terms of the National Atmospheric Reporting Regulations (Government Gazette No. 38633 of 02 April 2015), to register and report emissions on the NAEIS. The Intervention Engineering plant is classified as a Section 21 emitter and is thus required to report annually and comply with the National Atmospheric Reporting Regulations.

4.1.2. Greenhouse Gas (GHG) Regulations

In terms of NEM:AQA, GHG means the gaseous constituents of the atmosphere, both natural and anthropogenic that absorbs and re-emits infrared radiation.

The following six GHG were declared a priority for air pollution in South Africa on 14 March 2014 by the DEA (Government Gazette No. 37421):

- Carbon dioxide (CO₂)
- Methane (CH₄)
- Nitrous Oxide (N₂O)
- Hydrofluorocarbons (HFCs)

- Perfluorocarbons (PFCs)
- Sulphur hexafluoride (SF₆)

The DEA released the National GHG Emission Reporting Regulations (Government Gazette No.40762, dated 3 April 2017), as amended (General Notice 994 in Government Notice 43712 of 11 September 2020). An individual defined in Annexure 1 of these Regulations as a Category A data provider must register their facilities using the online South African Greenhouse Gas Reporting System (SAGERS) (<https://ghgreporting-public.environment.gov.za/GHGlanding/>) and send an inventory of GHG emissions, activity data and GHG emissions report in the requested format given under Annexure 3 of these regulations on an annual basis.

The SAGERS has been set up by the DFFE specifically to allow for submissions and keeping of GHG emissions inventories. It is a GHG Reporting Module of the NAEIS. This portal is a web-based platform for the registration and submission of GHG emissions data by Category A data providers.

Objectives of the SAGERS include:

- Providing a user-tailored platform the category A data providers to register and report their annual GHG emissions data and the associated activity data.
- Providing methodological guidance on the quantification of GHG emissions and the embedded parameters for assessing the annual GHG emissions.
- Facilitating easy access to the parameters and GHG emission factors database embedded into the system.
- Serving as an information hub for data providers for accessing information relevant to the registration and reporting under the GHG Reporting Regulations.
- Providing relevant guidance, templates, guidelines, and information relating to compliance under the GHG Reporting Regulations 2017 published under GNR 275 in Government Gazette 40762 of 03 April 2017, as amended (General Notice 994 in Government Notice 43712 of 11 September 2020) promulgated under the NEM:AQA.

National Pollution Prevention Plan Regulations (Gazette No. 40996) were published on 21 July 2017 by the DEA. A pollution prevention plan will be required should the development:

- a) Undertake any of the activities identified in Annexure A of the National GHG Emission Reporting Regulations (Government Gazette No. 40762 of 3 April 2017) as amended (General Notice 994 in Government Notice 43712 of 11 September 2020), which involves the direct emission of GHG in excess of 0.1 Megatonnes (Mt) annually measured as carbon dioxide equivalents (CO₂-eq); OR
- b) Undertake any of the activities identified in Annexure A of the National Pollution Prevention Plan Regulations as a primary activity.

Intervention Engineering would trigger the GHG reporting requirement as there is no thresholds for industrial processes and product uses under Category 2C1 and 2C3, in terms of Annexure A of the National GHG Emission Reporting Regulations (Government Gazette No. 40762 of 3 April 2017), as amended (General Notice 994 in Government Notice 43712 of 11 September 2020).

Intervention Engineering would need to register, quantify and report on their GHG emissions on the SAGERS by the 31st of March of each year.

4.1.3. Ambient Air Quality Standards and Dust Deposition Standards

The final revised SA NAAQS were published by the Minister of Water and Environmental Affairs in the Government Gazette on 24 of December 2009 and included a margin of tolerance (i.e. frequency of exceedance) and implementation timelines linked to it. SA NAAQS for PM_{2.5} were published on 29 July 2012. The SA NAAQS closely follow the World Health Organization's (WHO) interim targets, which are for developing countries.

National Dust Control Regulations (NDCR) were issued by the DEA on 01 November 2013, with the aim of prescribing general measures for dust control in all areas. The NDCR prohibits activities which give rise to dust in such quantities that the dust fall at the boundary or beyond the boundary of the premises where it originates exceeds the limits as listed below. The regulated standards for dust fall are as follows:

- a) 600 mg/m²/day averaged over 30 days in residential areas, measured using reference method ASTM D1739.
- b) 1 200 mg/m²/day averaged over 30 days in non-residential areas, measured using reference method ASTM D1739.

Updated draft NDCR were published on 25 May 2018. The regulations prescribe the method that should be used for undertaking dust fall monitoring, which includes the use of dust bucket stations with a wind shield.

Table 4-2: Assessment of guidelines and standards for dust fall considered in the assessment.

Restriction Areas	Averaging (Exposure period)	Dust fall rate (D) ⁽¹⁾	Limit Value (µgm ³)	Limit Reference Value	Permitted frequency of exceedance
Residential Areas	1 month (30±2-day average)	D < 600	Not applicable	NDCR (2013)	Two within a year, no two sequential months ⁽²⁾
Non-Residential Areas	1 month (30±2-day average)	600 < D < 1200	Not applicable	NDCR (2013)	Two within a year, no two sequential months ⁽²⁾

Notes:

- (1) Dust fall rate in mg/m²/day
- (2) Per dust fall monitoring site.

Should a facility exceed the regulated dust fall standards, a dust management plan (DMP) must be developed and submitted to the air quality officer for approval, within three (3) months after submitting a dust fall monitoring report. The DMP must be implemented within a month after of the date of approval, and be updated annually, unless otherwise specified by the air quality officer.

4.1.4. Other Relevant Legislation

- Pollution Prevention Act (Government Gazette 40996, 21 July 2017); and
- Carbon Tax Act No 15 of 2019 (29 November 2013).

4.2. International Guidelines and Regulations for Pollutants

Typically, when either no local ambient air quality criteria exist, or the criteria are in the process of being developed, reference is made to international criteria. This serves to provide an indication of the severity of the potential impacts from proposed activities. The most widely referenced international air quality criteria are those published by WHO. However, in the current study, reference has been made to the Alberta Ambient Air Quality Objectives and Guidelines Summary (AEP, Air Policy, 2016, No.2 updated Jan 2019), as set out in terms of the Alberta Environmental Protection and Enhancement Act (EPEA), of 1999. The Alberta Ambient Air Quality Objectives and Guidelines have been used to determine compliance where SA NAAQS are not available (Table 4-3).

Table 4-3: Assessment of guidelines and standards for HF and NH₃ considered in the assessment.

Pollutant	Averaging (Exposure period)	Limit Value (µgm ³)	Limit Value (ppb)	Limit Reference Value	Permitted frequency of exceedance
HF	1-hour	4.9	6	Alberta Standards	-
NH ₃	1-hour	1 400	2 000	Alberta Standards	-

4.3. Human Health Impacts – Criteria & Non-Criteria Pollutants

4.3.1. Dust fall

Dust fall are particles with an aerodynamic diameter greater than 20 µm that have been entrained into the air by a physical process such as wind, movement of vehicles, stack emissions, or from fugitive dust. These particles are generally too heavy to remain in suspension in the air for any period and fall out of the air over a relatively short distance depending on a combination of various factors such as particle size, density, temperature (of the air and particle), emission velocity or method, ambient wind speed, and humidity. These particles are therefore commonly known as “dust fall”. Particulates in this range are generally classified as a nuisance dust and can cause physical damage to property and physical irritation to plants, animals and humans.

4.3.2. Particulates (PM₁₀ & PM_{2.5})

Particles can be classified by their aerodynamic properties into coarse particles, PM₁₀ (particulate matter with an aerodynamic diameter equal to or less than 10 µm, but more than 2.5 µm and fine particles, PM_{2.5} (particulate matter with an aerodynamic diameter equal to or less than 2.5 µm). The fine particles mostly contain secondary formed aerosols such as sulphates and nitrates, combustion particles and re-condensed organic and metal vapours. The coarse particles mostly contain earth crust materials and fugitive dust from roads and industries (Harrison and van Grieken, 1998) (Fenger, 2002).

Health studies have shown a significant association between exposure to particle pollution and health risks, including premature death. Health effects may include cardiovascular effects such as cardiac arrhythmias and heart attacks, and respiratory effects such as asthma attacks and bronchitis. Exposure to particle pollution can result in increased hospital admissions, emergency room visits, absences from school or work, and restricted activity days, especially for those with pre-existing heart or lung disease, older people, and children.

Particulate matter has been shown in many scientific studies to reduce visibility, and also to adversely affect climate, ecosystems and materials. PM, primarily PM_{2.5}, affects visibility by altering the way light is absorbed and scattered in the atmosphere. With reference to climate change, some constituents of the ambient PM mixture promote climate warming (e.g., black carbon), while others have a cooling influence (e.g., nitrate and sulphate), and so ambient PM has both climate warming and cooling properties. PM can adversely affect ecosystems, including plants, soil and water through its deposition and its subsequent uptake by plants or its deposition into water where it can affect water quality and clarity. The metal and organic compounds in PM have the greatest potential to alter plant growth and yield. PM deposition on surfaces leads to soiling of materials.

4.3.3. Sulphur Dioxide (SO₂)

SO₂ originates from the combustion of sulphur-containing fuels and is a major air pollutant in many parts of the world. Health effects associated with exposure to SO₂ include effects on the respiratory system. Being soluble, SO₂ is readily absorbed in the mucous membranes of the nose and in the upper respiratory tract.

Most information on the acute (short-term) effects of SO₂ is derived from short-term exposure in controlled chamber experiments. These experiments have demonstrated a wide range of sensitivity amongst individuals. Acute exposure of SO₂ concentrations may lead to severe bronchoconstriction in some individuals, while others remain completely unaffected. Response to SO₂ inhalation is rapid, with the maximum effect experienced within a few minutes. Continued exposure does not increase the response. Effects of SO₂ exposure are short-lived, with lung function returning to normal within a few minutes to hours (WHO, 2000).

Exposure to SO₂ over a 24-hour period has shown that when SO₂ concentrations exceed 250 µg/m³ in the presence of PM (such as sulphates), an exacerbation of symptoms is observed in some sensitive patients. More recent studies of health impacts in ambient air polluted by industrial and vehicular activities have demonstrated at low levels effects on mortality (total, cardiovascular and respiratory)

and increases in hospital admissions. Long-term exposure to SO₂ has been found to be associated with an exacerbation of respiratory symptoms and a small reduction in lung function in children in some cases. In adults, respiratory symptoms such as wheezing and coughing are increased (WHO, 2000).

4.3.4. Nitrogen Dioxide (NO₂)

Nitrogen dioxide (NO₂) is formed through the oxidation of nitric oxide (NO), a primary pollutant emitted from the combustion of stationary sources (heating, power generation) and from motor vehicles. Oxides of nitrogen (NO_x) are made up of NO, NO₂ and NO_x, with NO₂ being the most important from a human health point of view. NO₂ is an irritating gas that is absorbed into the mucous membrane of the respiratory tract. The most adverse health effect occurs at the junction of the conducting airway and the gas exchange region of the lungs. The upper airways are less affected as NO₂ is not very soluble in aqueous surfaces. Exposure to NO₂ is linked with increased susceptibility to respiratory infection, increased airway resistance in asthmatics, and decreased pulmonary function.

Short-term exposure to NO₂, at concentrations greater than 1 880 µg/m³, may result in changes in the pulmonary function in adults. Healthy people exposed to concentrations above 4 700 µg/m³ for less than 2 hours whilst at rest or during light exercise may experience pronounced decreases in pulmonary function (WHO, 2000). Long-term epidemiological studies have been undertaken on the indoor use of gas cooking appliances and health effects. Studies on adults and children under 2 years of age found no association between the use of gas cooking appliances and respiratory effects. Children aged 5 – 12 years have a 20% increased risk for respiratory symptoms and disease for each increase of 28 µg/m³ NO₂ concentration, where the weekly average concentrations are in the range of 15 – 128 µg/m³. Outdoor studies consistently indicate that children with long-term ambient NO₂ exposures exhibit increased respiratory symptoms that are of a longer duration. However, no evidence is provided for the association of long-term exposures with health effects in adults (WHO, 2000).

4.3.5. Hydrogen Fluoride (HF)

Hydrogen fluoride (HF) is a chemical compound that contains fluorine. It can be found as a colourless gas or as a fuming liquid, or it can be dissolved in water (CDC, 2018). It is called hydrofluoric acid once dissolved in water. HF acid is formed when compounds that contain fluoride dissolve in water (CDC, 2018). HF is a chemical compound that contains fluorine. HF is mainly used in the manufacture of refrigerators but can also be found in herbicides and over-the-counter products (CDC, 2018; ATSDR, 2014).

Exposure to HF can occur through numerous ways, such as drinking water, volcanic activity, from coal-fired power plants, industrial activity, inhalation at the workplace, and smoking (EPA, 2016). Hydrogen fluoride is absorbed easily through the skin and into the tissues in the body (CDC, 2018). The fluoride ion penetrates tissues and binds the calcium and magnesium, resulting in cell destruction (ATSDR, 2014).

At low concentrations, inhaled HF in the form of a vapour can cause irritation of the nose, throat and eyes. Inhalation at high concentrations can cause death from tissue damage, an irregular heartbeat or from fluid build-up in the lungs. This can lead to partial or full lung collapse (CDC, 2018; ATSDR, 2014). Drinking small amounts of highly concentrated HF, will affect major organs and can lead to death. Depending on the concentration and duration of exposure, when HF comes in contact with skin, it may cause pain, inflammation, and burns (ATSDR, 2014). In extreme, cases the tissue damage caused can also lead to premature death. Effects at low concentration exposure can take between 12 to 24 hours to show (CDC, 2018).

Long-term health impacts include chronic lung disease, severe scarring from burns, visual defects and permanent damage to the oesophagus and stomach (CDC, 2018).

4.3.6. Ammonia (NH₃)

Ammonia (NH₃) is a chemical compound occurring naturally and anthropogenically. It is a colourless gas that has a pungent odour. NH₃ can be pressurised to convert into a liquid. NH₃ can easily dissolve in water, where it exists as ammonium ions (NH₄⁺) (ATSDR, 2004).

Nitrogen is an important component of proteins, genetic material, chlorophyll, and other key organic molecules. Living organisms required NH₃ to survive. NH₃ is important for plant growth, as it can be broken down by bacteria to provide nitrogen-containing nutrient. Nitrogen also assists with controlling algae growth in water ecosystems. NH₃ is excreted by animals and produced during the decay of plants and animals (Vitousek, 1997). NH₃ is produced in our bodies on a daily basis by our organs, and by bacteria within our intestines (ATSDR, 2004).

As NH₃ is a naturally occurring compound, we are continuously exposed to it at low concentrations, in the air, water and soil. NH₃ is regularly being recycled in nature, therefore the compound does not exist for a long time in the environment.

NH₃ has various uses, such as in the manufacture of fertilizers and animal feed. It is also used in the manufacture of fibres, plastics, explosives, paper, and rubber. It is used as a coolant, in metal processing industries (WHO, 2003).

Ammonia has corrosive properties, and symptoms from exposure to ammonia occur to the parts of the body that come into direct contact with the chemical compound. Inhalation of ammonia may cause irritation to both eyes and throat, while direct contact with a highly concentrated form of ammonia may lead to severe burns. Depending on the severity of burns and where they occur, lung disease, blindness and death are likely to occur (ATSDR, 2004).

4.3.7. Volatile Organic compounds (VOCs)

VOCs are organic compounds with a true vapour pressure higher than 0.13 kPa at 20°C. Even though they exist in trace amounts they are significant in that they play an important role in atmospheric oxidation reactions in the troposphere and can act as a catalyst to produce other hazardous air pollutants. VOCs are often released during the production, use and disposal of household and commercial products including, cleaning agents, paints, varnishes, preservatives, pesticides, wood products, chemicals, adhesives and glues as well as flooring and carpeting products. Similarly, the storage and handling as well as the burning of fuels and products such as petrol, diesel and paraffin are common sources of VOCs.

Higher levels of VOCs are generally found in urban environments compared to non-urban areas. However, some VOCs have a relatively long atmospheric life span and can be detected in areas further downwind from the source. Also, trees are a natural source of biogenic VOCs, thus higher VOC concentrations are also found over forested areas.

There are a variety of different types of VOCs (~ > 300) that are released from anthropogenic sources, of which monoaromatic hydrocarbons are often the most abundant. Monoaromatic hydrocarbon pollutants include the BTEX group: benzene, toluene, ethylbenzene and xylene. BTEX is often measured and used as an indicator to represent other VOCs in air quality studies (Ware *et al.*, 1993; Zabiegala *et al.*, 2010).

Exposure to VOCs via inhalation can cause a variety of health effects depending on the concentration and type of VOC a person is exposed to and the duration of exposure. In general exposure to elevated levels of VOCs over a short duration can potentially cause skin, eyes, nose and throat irritations, headaches, drowsiness, nausea and vomiting. Exposure to low levels of VOCs over a longer duration period may potentially cause cancer, kidney and liver damage, chromosomal aberrations and blood disease (Duarte-Davidson *et al.*, 2001). It is necessary to determine the presence of VOCs, in areas where elevated levels of VOCs may be of concern, to appropriately manage air quality issues and implement mitigation measures.

Benzene is the only VOC that is legislated in terms of the South African National Environmental Management: Air Quality Act (No. 34 of 2004) and is a well-known carcinogen. Studies have shown that exposure to low and high concentrations of benzene can cause leukaemia (Cointreau, 2006; Duarte-Davidson *et al.*, 2001; Vrijheid, 2000; www.WHO.org, 2012). Bridges *et al.*, (2000) and Vrijheid (2000) argue that there should be no standard threshold limit for gases with carcinogenic properties. This suggests that people who are exposed to carcinogenic agents over a long period, irrespective of the concentration, are said to be at some level of risk to adverse health effects.

5. THE RECEIVING ATMOSPHERIC ENVIRONMENT

5.1. Local Study Area and Air Quality Receptors

The local study area for the AQIA was selected based on the extent of expected air quality impacts and possible sensitive receptors such as residential areas, educational and health facilities, dwellings and old age homes. A study area of 5 km east-west by 5 km north-south with the Intervention Engineering facility located approximately in the centre, was identified. Quagga Estates is the closest residential complex to the site and is about 1.05 km from the proposed site. Other residential areas include Iscor Park (north), West Park (north), Kwaggasrand (northwest), Proclamation Hill (northeast), Laudium (southwest), and Valhalla (southeast). Ambient concentrations simulated by the dispersion model were also calculated at the sensitive receptors (Section 6.2.3)

Table 5-1: Sensitive Receptor Locations Included in the AQIA (within <5 km radius).

ID	Name of Sensitive Receptor	Coordinates (UTM) 35S		Elevation (m)
		x	y	
SR01	GetOn Skills Development Centre	613389.9	7149461	1384
SR02	Voortrekkerhoogte begrafplaas	612327.4	7148162	1450
SR03	Thaba Tshwane City Hall	613057.2	7147738	1484
SR04	Vet clinic	612751.4	7147567	1450
SR05	N.M.C	613014.3	7147497	1457
SR06	Defence Sports Grounds Thaba Tshwane	614173.6	7147382	1467
SR07	Services Golf Club.	614603.9	7146919	1453
SR08	SA Army College	615025.6	7147352	1474
SR09	1 Military Hospital	616462.9	7148308	1478
SR10	Pretoria Dog Rescue	614208.1	7148144	1542
SR11	Paratus Primary School	614090.3	7146689	1491
SR12	Dwellings (Quagga Estates)	615002.8	7146675	1392
SR13	Personnel Service School	614603.9	7146919	1480
SR14	Jejani Royal Park	616247.6	7146333	1477
SR15	Pretoria Military Practical Shooting Club	617403.9	7147542	1441
SR16	Dwellings (VALHALLA)	615028.9	7145657	1428
SR17	Dwellings (Laudium)	610898.7	7147676	1474
SR18	Tshwane South TVET College - Pretoria West	613648.8	7150096	1348
SR19	Dwellings (Iscor Park)	613288.3	7150374	1353
SR20	Dwellings (West Park)	612896.9	7150848	1380
SR21	Dwellings (Kwaggasrand)	611599.1	7150446	1395
SR22	Dwellings (Proclamation Hill)	614071.1	7150982	1357
SR23	Voortrekker Monument	617439.1	7148592	1517
SR24	Pretoria West Hospital	614235.9	7152959	1354

5.2. Atmospheric Dispersion Potential

Meteorological mechanisms govern the dispersion, transformation, and eventual removal of pollutants from the atmosphere. The analysis of land use and topography as well as wind speed, wind direction, temperature and atmospheric stability is necessary to facilitate a comprehensive understanding of the dispersion potential of the site.

5.2.1. Surface Wind Field

The wind field determines both the distance of downward transport and the rate of dilution of pollutants. The generation of mechanical turbulence is a function of the wind speed, in combination with the surface roughness. The wind field for the study area is described with the use of wind roses.

Wind roses comprise 16 spokes, which represent the directions from which winds blew during a specific period. The colours used in the wind roses below reflect the different categories of wind speeds; the yellow area, for example, representing winds in between 2 and 4 m/s. The dotted circles provide information regarding the frequency of occurrence of wind speed and direction categories. The frequency with which calms occurred, i.e. periods during which the wind speed was below 1 m/s are also indicated.

The data described below is MM5 modelled meteorological data, obtained from Envitrans for the period June 2023 to July 2023. MM5 is a PSU/NCAR mesoscale model used to predict mesoscale and regional-scale atmospheric circulation. The model provides integrated model meteorological data, which can be used in a wide range of applications. This model is often used to create weather forecasts and climate projections. Details of the meteorological data used are summarised in Table 5-2 below.

Table 5-2: Meteorological data details.

Meteorological Data Details	
Met Data Information	Description
Met data type	MM5 AERMET-Ready (Surface & Upper Air Data)
Datum	WGS 84
Closest Town	Pretoria - South Africa
Time zone	UTC +2 hours
Period of record	June 2020 - July 2023
Met Station Parameters	Description
Anemometer height	13 m
Station base elevation	1 397 m
Upper air adjustment	-2 hours
Grid Cell Information	
Co-ordinates of centre met grid	25°46'15.65"S, 28° 7'50.08"E
UTM zone	-35
Cell dimension	12 km x 12 km
Surface Met Data	Description
File format	SAMSON file
Output interval	Hourly
Upper Air Data	Description
Format	TD-6201- Fixed Length
Reported in	GMT
Models used to process met data	Description
Model used to process data for wind roses	WR Plot
Model used to process data for AERMOD	AERMET

Wind roses for the period June 2020 - July 2023 are shown in Figure 5-1 to Figure 5-3 below. The average wind speed during this period was about 2.6 m/s, blowing from the north-north-east direction of the site, with some occasional north-north-west winds. Experienced winds reached maximums of over 6 m/s in all wind directions. Some prominent winds were also experienced from southeast east of the site. A calm percentage of 13% was experienced during this period. Daytime (06:00-18:00) winds were mostly from north-north-east of the site at an average of 2.3 m/s speed and was 17% calm. Nighttime (18:00-06:00) winds were prominently from north-north-east of the site with an average of 2.9 m/s speed and was 8% calm. A maximum wind speed of 12 m/s was experienced during daytime in the area.

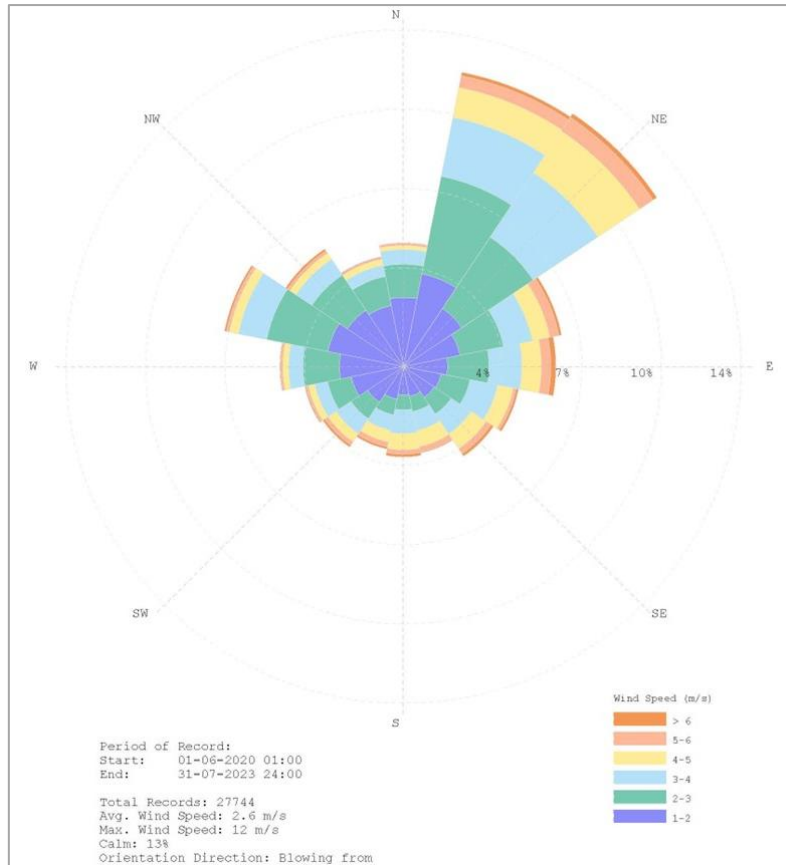


Figure 5-1: Period (01/06/2020-31/07/2023) average wind roses (daytime and nighttime). Av. wind speed was 2.6m/s NNE.

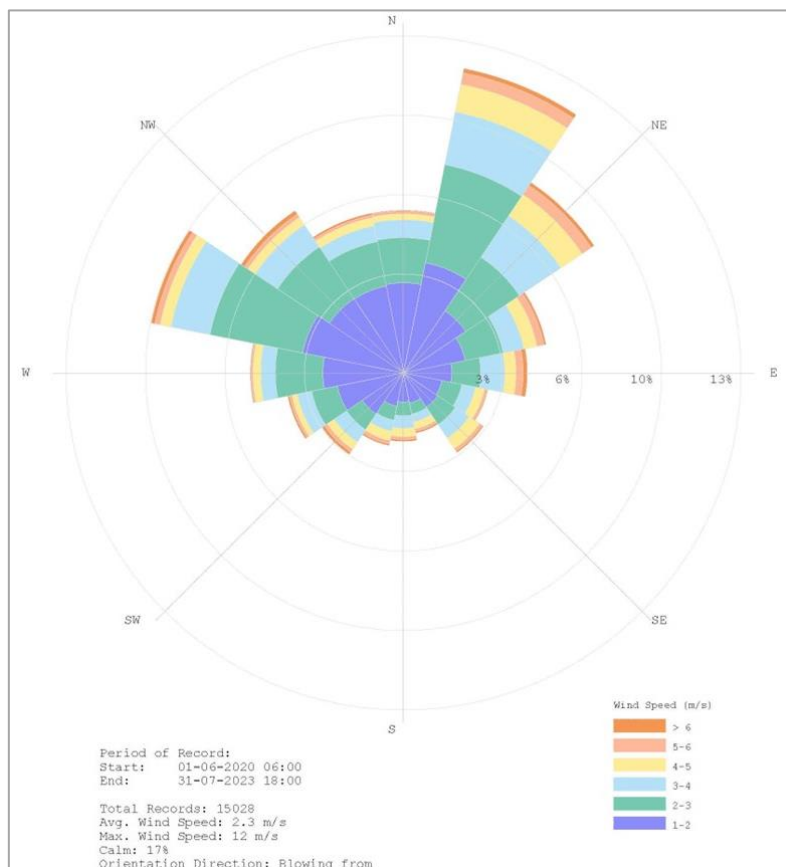


Figure 5-2: Period (01/06/2020-31/07/2023) average wind roses (daytime only). Av. wind speed was 2.3m/s NNE.

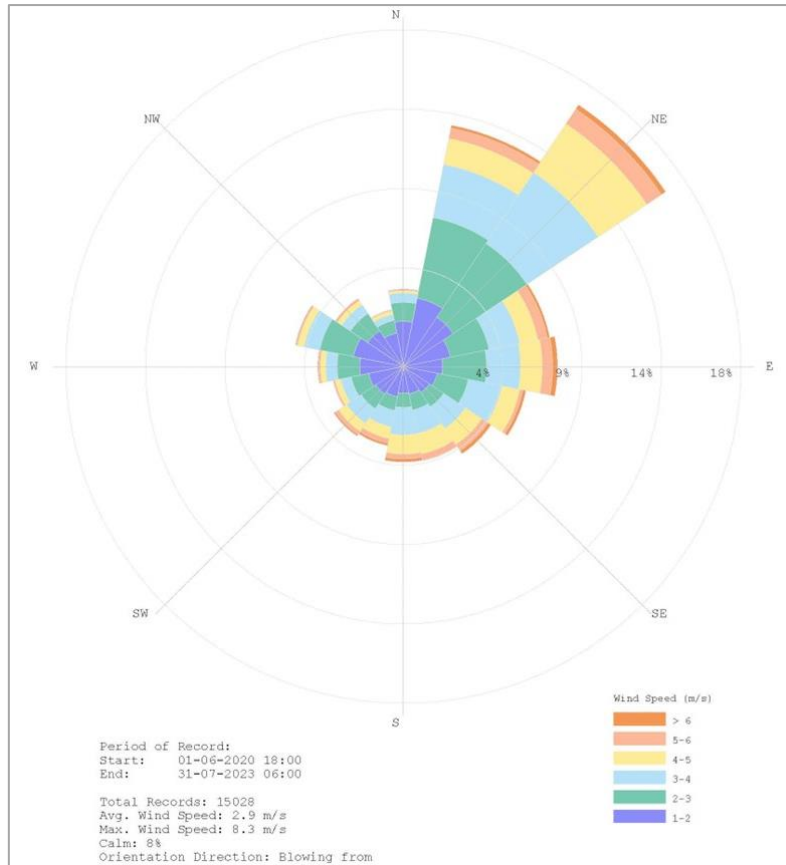


Figure 5-3: Period (01/06/2020-31/07/2023) average wind roses (nighttime only). Av. wind speed was 2.9m/s NNE.

5.2.2. Temperature

Air temperature is important, both for determining the effect of plume buoyancy (the larger the temperature difference between the plume and the ambient air, the higher a pollution plume can rise), and determining the development of the mixing and inversion layers. Minimum, maximum and mean temperatures as recorded at Intervention Engineering, are shown in Table 5-3. Period average maximum and minimum temperatures were 24.2 °C, and 13.3 °C respectively.

Table 5-3: Minimum, maximum and average temperatures for (2020 – 2023).

°C	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Min	13.8	15.6	14.2	11.6	8.7	3.8	2.6	3.4	9.0	11.0	13.4	13.1
Max	33.2	32.0	31.1	30.0	26.2	22.7	22.4	27.4	31.5	33.7	35.2	32.0
Ave	24.2	23.9	22.6	20.4	16.8	13.3	13.0	15.5	20.2	23.0	23.8	23.2

5.2.3. Rainfall

Rainfall has an overall dilution effect and cleanses the air by washing out particles and pollutants suspended in the atmosphere. Monthly total rainfall at Intervention Engineering for the period 2020 to 2023 is presented in Figure 5-4 below. The area receives, on average 0.0923 mm/hour of rainfall per year. Rainfall is received from October to May.

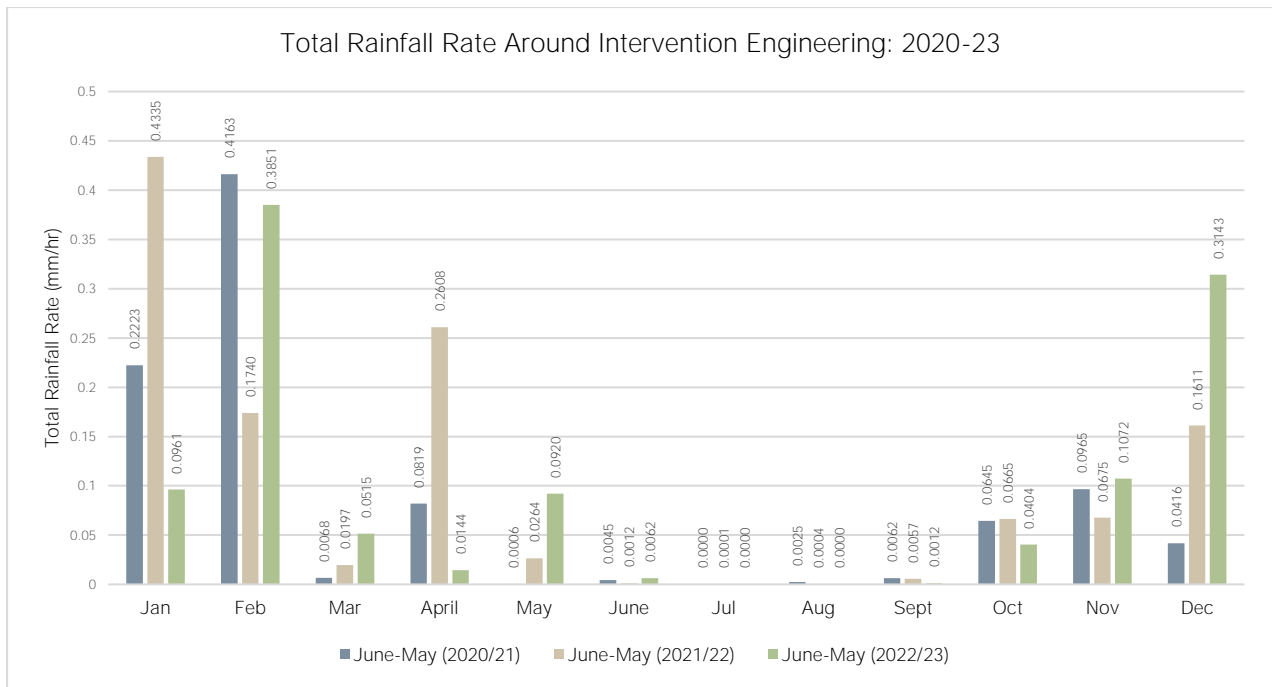


Figure 5-4: Total monthly rainfall for Intervention Engineering for 2020 - 2023.

5.2.4. Atmospheric Stability

Two parameters describe the atmospheric boundary layer properties: the boundary layer depth and the Monin-Obukhov length. The Monin-Obukhov length (L_{Mo}) provides a measure of the importance of buoyancy generated by the heating of the ground and mechanical mixing generated by the frictional **effect of the earth's surface**. Physically, it can be thought of as representing the depth of the boundary layer within which mechanical mixing is the dominant form of turbulence generation (AIRSHED, 2017; CERC, 2004). The atmospheric boundary layer constitutes the first few hundred metres of the atmosphere. During daytime, the atmospheric boundary layer is characterised by thermal turbulence **due to the heating of the earth's surface**. Nighttimes are characterised by weak vertical mixing and the predominance of a stable layer. These conditions are normally associated with low wind speeds and lower dilution potential (AIRSHED, 2017).

The highest concentrations for ground level, or near-ground level releases from non-wind dependent sources would be expected during weak wind speeds and stable (nighttime) atmospheric conditions. For elevated releases, unstable conditions will likely result in very high concentrations of poorly diluted emissions close to the stack. This is called looping and occurs mostly during daytime hours. Neutral conditions disperse the plume equally in both the vertical and horizontal planes and the plume shape is referred to as coning. Stable conditions prevent the plume from mixing vertically, although it can still spread horizontally (which is called fanning) (Tiway & Colls, 2010; AIRSHED, 2017). For ground level releases the highest ground level concentrations will likely occur during stable nighttime conditions (AIRSHED, 2017).

5.3. Status Quo Air Quality

5.3.1. Sources of Atmospheric Emissions

Several sources of atmospheric emissions (particulates and gases) exist around Intervention Engineering. These mainly include urban industrial activities and vehicle emissions.

5.3.2. Baseline Ambient Air Pollutant Levels

The air quality status quo at Intervention Engineering was assessed using 2020 – 2022 ambient data (for PM₁₀ and PM_{2.5}) from the Pretoria West and Market Tshwane AQMS, which was accessed via the online SAAQIS website. The Pretoria West AQMS is situated ~2.35 km west-south-west of Intervention

Engineering while the Market Tshwane AQMS is located ~5.23 km east-north-east of the site. There was no background air quality data (that could be determined) to present background concentrations for some of the air pollutants assessed in this AQIAr (i.e., HF, TVOCs, and NH₃). Furthermore, air quality monitoring of these pollutants is not undertaken at Intervention Engineering.

Dust fall data could not be provided in this AQIA report as there are no available dust fall networks operated near the project site, that could be determined.

Data availability for PM₁₀, PM_{2.5}, SO₂ and NO₂, at the Pretoria West and Market Tshwane AQMS over the period 2020 – 2022 is indicated in Table 5-4 below. Current levels of PM₁₀, PM_{2.5}, SO₂ and NO₂ are discussed in Section 5.3.2.1 to 5.3.2.4.

It must be noted that there are some missing data from the AQMS', thus the results presented below for all background pollutants must be viewed with caution.

Table 5-4: Ambient data availability over the period 2020 – 2022.

Year	PM ₁₀ (µg/m ³)	PM _{2.5} (µg/m ³)	SO ₂ (ppb)	NO ₂ (ppb)
2020	47.41	35.123	6.264	11.414
2021	21.324	12.088	3.250	8.976
2022	28.439	18.132	1.259	10.602
Average	32.391	21.781	3.591	10.331

5.3.2.1. PM₁₀ Concentrations

PM₁₀ concentrations for site surrounding areas during the period 2020 to 2022 are provided in Figure 5.6 below. Daily average PM₁₀ concentrations for the period ranged between 21.324 µg/m³ – 47.41 µg/m³, with an average for the period of 32.391 µg/m³.

A total of 48 exceedances of the PM₁₀ **daily standard of 75 µg/m³** were observed over the monitoring period. This is expected due to existing PM₁₀ sources located in the area, mainly urban industrial activities, and vehicle emissions.

Higher PM₁₀ concentrations were observed between May - September (late autumn, winter, and early spring), with the highest daily concentration of 150.462 µg/m³ being recorded on 08 July 2020.

In terms of the South African NAAQS, only four exceedances of the PM₁₀ 24-hour standard are permitted within a calendar year, while no exceedances of the PM₁₀ annual standard are permitted. This means that the area has already been experiencing higher levels of particulate matter than permitted.

5.3.2.2. PM_{2.5} Concentrations

PM_{2.5} concentrations for site surrounding areas during the period 2020 to 2022 are provided in Figure 5.7 below. Daily average PM_{2.5} concentrations for the period ranged between 12.088 µg/m³ – 35.123 µg/m³, with an average for the period of 21.781 µg/m³. A total of 91 exceedances of the PM_{2.5} daily standard of 40 µg/m³ were observed over the monitoring period. This is expected due to existing PM_{2.5} sources located in the area, mainly urban industrial activities and vehicle emissions.

Higher PM_{2.5} concentrations were observed between May - September (late autumn, winter, and early spring), with the highest daily concentration of 110.676 µg/m³ being recorded on 08 July 2020.

In terms of the South African NAAQS, no exceedances of the PM_{2.5} 24-hour and annual standards are permitted within a calendar year.

5.3.2.3. SO₂ Concentrations

SO₂ concentrations for the areas surrounding the site are provided in Figure 5.8 below for the period 2020 to 2022. Daily average SO₂ concentrations ranged between 1.259 – 6.264 ppb, with an average of 3.591 ppb for the period.

Existing sources of SO₂ within 20 km radius of the plant include solid fuel combustion in the townships/informal settlements, vehicle exhaust emissions from surrounding roads, and urban industrial activities.

Higher SO₂ concentrations were observed between June – December (late winter to late summer), with the highest daily concentration of 19.850 ppb being recorded on 17 January 2019.

In terms of the South African NAAQS, there was only 1 exceedance of the SO₂ daily standard of 19 ppb. No exceedances of SO₂ annual standard are permitted within a calendar year.

5.3.2.4. NO₂ Concentrations

NO₂ concentrations for the areas surrounding the site are provided in Figure 5.9 below for the period 2020 to 2022. Daily average NO₂ concentrations ranged between 8.976 – 11.414 ppb, with an average of 10.331 ppb for the period.

Higher NO₂ concentrations were observed between May and mid-June (autumn to mid-winter), with the highest hourly concentration of 24.385 ppb being recorded on 22 July 2019.

In terms of the South African NAAQS, a total of 6 exceedances of the NO₂ hourly standard of 21 ppb during this period. No exceedances of NO₂ annual standard are permitted.

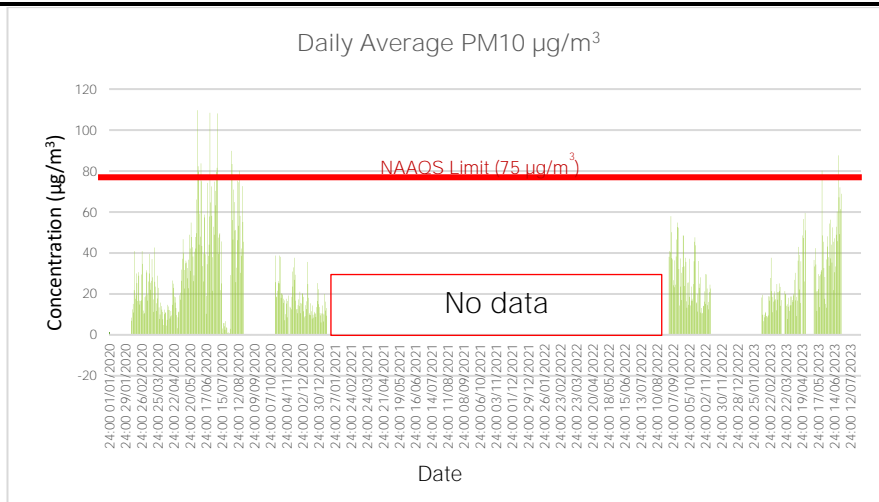


Figure 5-5: Daily PM₁₀ concentrations at PTA West & Tshwane Market AQMS for the period 2020 – 2023. A total of 48 exceedances of the daily standard of 75 µg/m³ over the period.

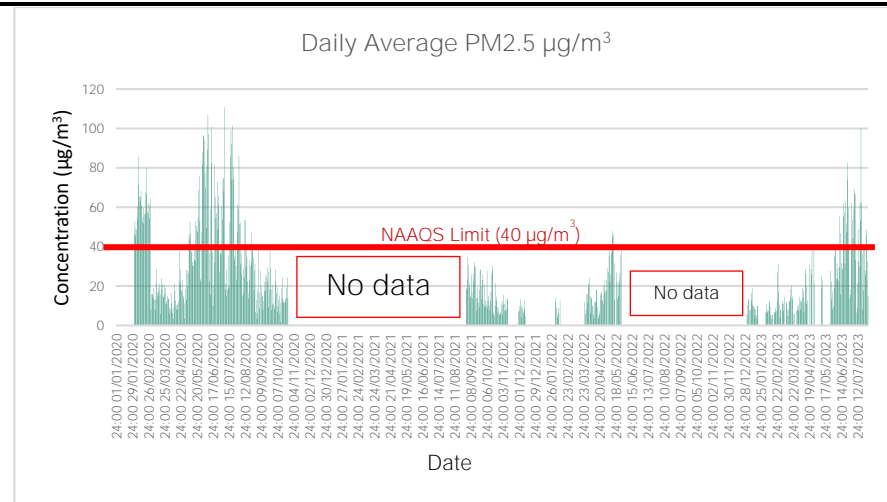


Figure 5-6: Daily PM_{2.5} concentrations at PTA West & Tshwane Market AQMS for the period 2020 – 2023. A total of 91 exceedances of the daily standard of 40 µg/m³ over the monitoring period.

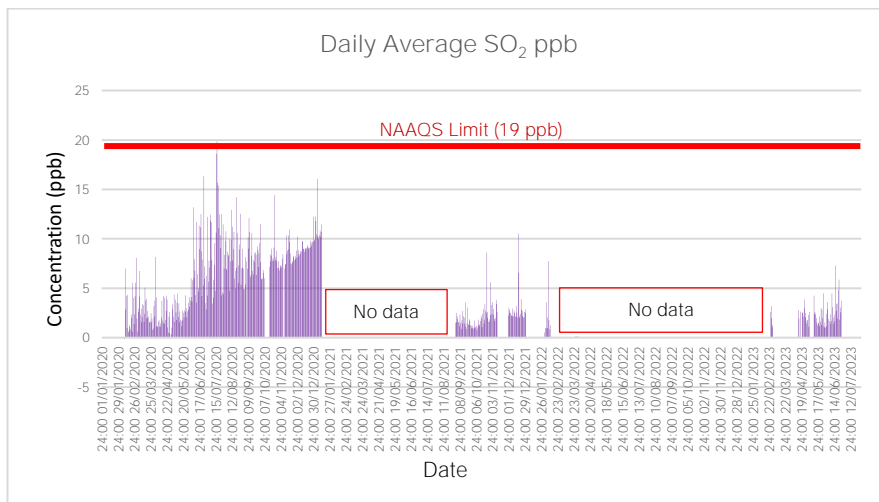


Figure 5-7: Daily SO₂ concentrations at PTA West & Tshwane Market AQMS for the period 2020 – 2023. Only 1 exceedance of the daily standard of 19 ppb over the monitoring period.

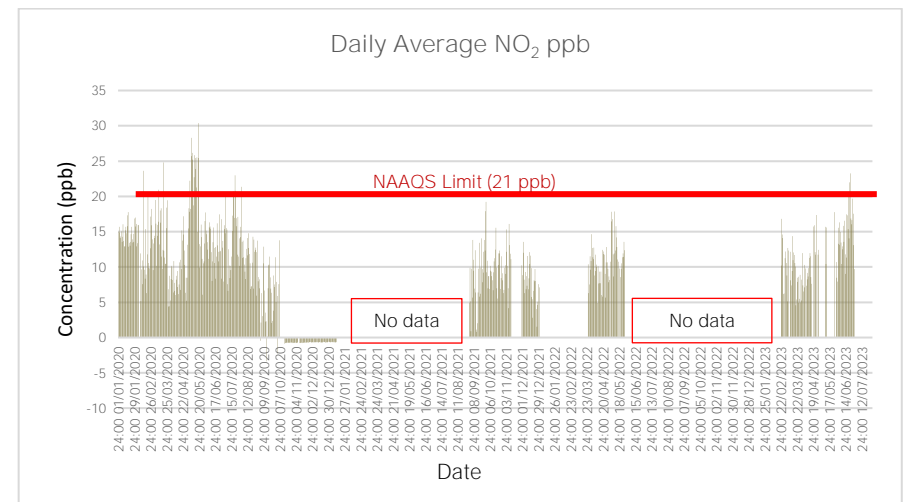


Figure 5-8: Daily NO₂ concentrations at PTA West & Tshwane Market AQMS for the period 2020 – 2023. A total of 6 exceedances of the daily standard of 40 µg/m³ over the monitoring period.

6. IMPACT ASSESSMENT

In this study, two scenarios were assessed:

- Scenario A: MES: where the MES for Intervention Engineering, i.e., the maximum threshold limit that is allowed for new plants (in terms of PM, SO₂ and NO₂, HF, TVOCs and NH₃, where applicable) as per listed activity sub-categories 4.4 and 4.10 of Category 4 (Metallurgical Industries) was considered for input into the model.
 - This is representative of potential impacts if the facility were emitting at the acceptable threshold that is permissible for sub-categories 4.4 and 4.10 of Category 4 (Metallurgical Industries). The emission standards were converted into emission rates for input into the model.
 - Results from this scenario remained significantly below the standard limits and the values were **lower than scenario B's results**.
- Scenario B – Similar Operations: where emissions from similar operations were used with maximum allowed threshold limits for new plants as per listed activity sub-categories 4.4 and 4.10 of Category 4 (Metallurgical Industries) was considered for input into the model.
 - This is representative of potential impacts if the foundry was emitting at the acceptable threshold that is permissible for the sub-categories. The emission standards were converted into emission rates for input into the model.
 - Results from this scenario remained significantly below the standard limits and the values were **slightly higher than scenario A's results**.

6.1. Atmospheric Emissions Inventory

6.1.1. Point Source (Stack) Parameters and Emissions

Point sources at Intervention Engineering include a stack with no abatement equipment in order to represent the worst-case scenario, associated/connected to all emission sources. All production operations at Intervention Engineering will utilise electricity as a power source.

Stack emissions monitoring has not yet been conducted at Intervention Engineering as this is a new site and equipment is yet to be commissioned. Therefore, all stack parameters, except stack height, were estimated based on common stack parameters.

For the scenario considered in this assessment, Section 21 MES rates for new plants for sub-categories categories 4.4 and 4.10 of Category 4 (Metallurgical Industries) were considered. In other words, the maximum emission rate that is allowed in terms of Section 21 of NEM:AQA was considered in the assessment. The MES were converted into emission rates (g/s) for input into the model.

Stack parameters and emission rates used are shown in Table 6-1 below. The following assumptions were made in this study:

- It was assumed that for each pollutant, the emission rate from each melting cycle was the same, regardless of how many cycles were run throughout the day.
- There are a total of four melting furnaces which are assumed to melt aluminium, bronze, as well as iron and steel. Emission rates at all melting furnaces are assumed to be the same (i.e. for Scenario A).
- The maximum allowed MES in terms of Section 21 of NEM:AQA was used in order to get the maximum dispersion of the allowed emissions.
- The MES rates were converted to g/s using dry volumetric flow rate value calculator from the AERMOD system.

- Each of the emission rates was multiplied by 4x to represent the total emissions, assuming that all will be connected to the same extraction unit (stack).
- Furnace operations were assumed to occur for 24 hours a day, 7 days a week, which represents the worst-case scenario.
- Scenario B contains input data from similar operations which trigger similar Section 21 activities and pollutants.
- All input data assumed to affect emission rates, including volumetric flow rate, stack diameter and height, as well as gas velocity has been included in the model.
- The AERMOD system considers topographical and historical meteorological data in order to model the possible dispersion of the proposed activities.

Table 6-1: Stack parameters and emissions – New Plant Standard Scenario.

Parameter ⁽¹⁾	x4 Aluminium Melting Furnaces	x4 Steel Melting Furnaces
Scenario A (Section 21 MES limits)		
Stack ID	SV01	SV02
Coordinates	TBC	TBC
Volumetric flow rate (Nm ³ /hr)	115.928	112.08
Diameter (m)	0.15	0.15
Height (m)	15	15
Gas exit temperature (°C)	97	143
Gas exit velocity	2.3	2.5
PM ₁₀ emission rate (g/s) ⁽⁴⁾	0.0024 [0.000609x 4]	0.003736 [0.000934x 4]
PM _{2.5} emission rate (g/s) ⁽⁵⁾	0.00024 [0.0000609x 4]	0.0003736 [0.0000934x 4]
SO ₂ emission rate (g/s)	N/A	0.04981332 [0.01245333x 4]
NO ₂ emission rate (g/s)	N/A	0.04981332 [0.01245333x 4]
HF emission rate (g/s)	0.0001288 [0.00003220222x 4]	N/A
NH ₃ emission rate (g/s)	0.0038644 [0.00096661x 4]	N/A
TVOCs emission rate (g/s)	0.00515 [0.001288089x 4]	N/A
Scenario B ⁽⁶⁾ (Similar Operations)		
Stack ID	SV01	SV02
Coordinates	TBC	TBC
Volumetric flow rate (m ³ /hr) ⁽⁶⁾	73.186	40.729
Diameter (m)	0.11	0.13
Height (m)	13	12.5
Gas exit temperature (°C)	97	121
Gas exit velocity	2.7	1.6
PM ₁₀ emission rate (g/s) ⁽⁴⁾	0.00812 [0.00203x 4]	0.004525 [0.001131361x 4]
PM _{2.5} emission rate (g/s) ⁽⁵⁾	0.000812 [0.000203x 4]	0.0004525 [0.0001131361x 4]
SO ₂ emission rate (g/s)	N/A	0.01810 [0.004525444x 4]
NO ₂ emission rate (g/s)	N/A	0.0543 [0.01357633x 4]
HF emission rate (g/s)	0.0004065888 [0.0001016472x 4]	N/A
NH ₃ emission rate (g/s)	0.00813178 [0.002032944x 4]	N/A
TVOCs emission rate (g/s)	0.0032527 [0.0008131777x 4]	N/A

1.

6.1.2. Fugitive Emissions

Open-air fugitive emission sources associated with the facility, such as casting and cooling are also identified as key sources of emissions at the site. However, emissions from these sources were excluded from the emissions inventory as the focus of this study was on the point sources (i.e., melting furnaces). Nonetheless, fugitive emission mitigation measures given in Section 7.2 of the report should be implemented, where possible and applicable, to reduce the impact of these sources.

6.2. Atmospheric Dispersion Simulations

The assessment of the impact of operations at Intervention Engineering's melting furnaces on the atmospheric environment is discussed in this section. To assess impact on the environment, the following important aspects need to be considered:

- The criteria against which impacts are assessed (as discussed in Section 4.1.3 and 4.2);
- The location of likely AQSRs (Section 5.1);
- The potential of the atmosphere to disperse and dilute pollutants emitted by the proposed activities (Section 5.2);
- Existing ambient pollutant concentrations (Section 5.3); and
- Atmospheric emissions (Section 6.1)

Dispersion models simulate ambient pollutant concentrations rates as a function of source configurations, emission strengths and meteorological characteristics, thus providing a useful tool to ascertain the spatial and temporal patterns in the ground level concentrations arising from the emissions of various sources.

Increasing reliance has been placed on concentration estimates from models as the primary basis for environmental and health impact assessments, risk assessments, as well as for deciding on emission control requirements. It is therefore important to carefully select a dispersion model (AIRSHED, 2017).

6.2.1. Dispersion Model Selection and Inputs

For the current study, the AERMOD dispersion model was used. AERMOD is a state-of-the-art Planetary Boundary Layer (PBL) air dispersion model, which was developed by the American Meteorological Society and the United States Environmental Protection Agency (USEPA) Regulatory Model Improvement Committee (AERMIC). AERMOD utilizes a similar input and output structure to ISCST3 and shares many of the same features, as well as offering additional features. AERMOD fully incorporates the PRIME building downwash algorithms, advanced depositional parameters, local terrain effects, and advanced meteorological turbulence calculations.

The AERMOD atmospheric dispersion modelling system is an integrated system that includes three modules:

- A steady-state dispersion model designed for short-range (up to 50 km) dispersion of air pollutant emissions from stationary industrial sources.
- A meteorological data pre-processor (AERMET) for surface meteorological data, upper air soundings, and optionally, data from on-site instrument towers. It then calculates atmospheric parameters needed by the dispersion model, such as atmospheric turbulence characteristics, mixing heights, friction velocity, Monin-Obukov length and surface heat flux.
- A terrain pre-processor (AERMAP) which provides a physical relationship between terrain features and the behaviour of air pollution plumes. It generates location and height data for each receptor location. It also provides information that allows the dispersion model to simulate the effects of air flowing over hills or splitting to flow around hills.

AERMOD includes Plume Rise Model Enhancements (PRIME) building downwash algorithms, which provide a more realistic handling of building downwash effects. PRIME algorithms were designed to address two fundamental features associated with building downwash; enhanced plume dispersion coefficients due to the turbulent wake and to reduce plume rise caused by a combination of the descending streamlines in the lee of the building and the increased entrainment in the wake. AERMOD is suitable for a wide range of near field applications in both simple and complex terrain. The evaluation results for AERMOD, particularly for complex terrain applications, indicate that the model represents significant improvements compared to previously recommended models.

AERMOD has been used in various dispersion modelling studies in the United States and around the world (Perry *et al.*, 2004).

Uncertainties are associated with any geophysical model. Therefore, to reduce the margin of error, the model is set up in such a way as to minimise the total error. The total uncertainty can be thought of as the sum of three components: the uncertainty due to errors in the model description of atmospheric physics; the uncertainty due to data errors; and the uncertainty due to stochastic processes (turbulence) in the atmosphere. Nevertheless, dispersion modelling is generally accepted as a valid tool to quantify and analyse the atmospheric impact of existing operations and for determination of the impact of proposed operations (AIRSHED, 2017).

Data input into AERMOD includes MM5 meteorological data (surface and upper air) for 2020 – 2023. Terrain data at a resolution of 90 m (SRTM90) is used for input into the model, as generated by the terrain pre-processor, AERMAP. A modelling domain of 5 km × 5 km was used. A multi-tier grid with a grid receptor spacing of 250 m (up to 5 km from facility) was used. Topographical data was included in the simulations.

6.2.2. Simulation Results

Dispersion simulations were undertaken for the following scenarios to determine:

- Predicted ground-level impacts for PM₁₀, PM_{2.5}, SO₂, NO₂, HF, NH₃, TVOCs from the operation of electric-fired furnaces associated with the new plant standard scenario for Intervention Engineering.

Dispersion simulations were undertaken to determine annual average, 24 hour and hourly average ground level concentrations rates, where applicable, for each of the pollutants considered in the study. Averaging periods were selected to facilitate the comparison of simulated pollutant concentrations to relevant SA NAAQS. There is no NAAQS data for HF, NH₃, TVOCs. Therefore, predicted incremental concentrations for HF and NH₃ are compared to the Alberta Ambient Air Quality International Guidelines, i.e., hourly limits of 4.9 µg/m³ and 1 400 µg/m³, respectively (AEP, Air Policy, 2016, No.2 updated Jan 2019).

For compliance assessment purposes, the 99th percentile of 1-hour and 24-hour average pollutant concentrations is presented. It should be noted that ambient air quality criteria apply to areas where the Occupational Health and Safety regulations do not apply, i.e., outside the property boundary. Ambient air quality criteria are therefore not occupational health indicators but applicable to areas where the public has access i.e., off-site. Results are discussed in more detail in subsequent sections.

6.2.2.1. Simulated results for the New Plant Standard Scenario.

Dispersion results show that over the assessed period, most of the concentration of all pollutants will be at about 500 m southwest from the site, with none of the identified sensitive receptors receiving any emissions close to the recommended limits. Figures 6-1 to 6-17 below show simulation results from both aluminium and iron and steel production processes as well as the average dispersion of the pollutants relative to the site location.

Simulated PM₁₀ and PM_{2.5} concentrations for both Scenarios A: MES limits and Scenario B: Similar Operations for aluminium production and iron and steel production are well below the NAAQS daily limits of 75 µg/m³ and 40 µg/m³ as well as the annual limits of 40 µg/m³ and 20 µg/m³, respectively. PM concentrations are also significantly below the maximum daily and annual averages of the background PM₁₀ and PM_{2.5} concentrations recorded at the Pretoria West and Market Tshwane AQMS’.

Similar to simulated PM₁₀ and PM_{2.5} concentrations, simulated HF and NH₃ concentrations for both scenarios modelled are well below the assessment criteria within the facility boundary, as well as at offsite locations, and are complying with the Alberta hourly limits of 4.9 µg/m (for HF) and 1 400 µg/m³ (for NH₃) – Figure 6-3, Figure 6-4, and Figure 6-11, Figure 6-12, respectively. Simulated TVOC emissions are also low over the entire project area (Figure 6-5 and Figure 6-13). There are no national or international standards for TVOCs that we could find to assess compliance. However, TVOC



emissions have been compared to the international hydrocarbon standards which recommend a limit of 500 $\mu\text{g}/\text{m}^3$ concentrations at any given time.

Simulated emission levels at all sensitive receptors modelled in the study (as described in Section 5.1) are low, with no exceedances of the applicable NAAQS, NDCR, or Alberta standards observed, where applicable. Maximum simulated $\text{PM}_{2.5}$, PM_{10} , SO_2 , NO_2 , HF, NH_3 and TVOC concentrations at the AQSRs are provided in Table 6-2 and Table 6-3 below.

For both scenarios, higher pollutant concentrations are expected closer to the furnace operations, within the facility boundary. Simulated $\text{PM}_{2.5}$, PM_{10} , SO_2 , NO_2 , HF, NH_3 and TVOC concentrations are anticipated to decrease as you move further away from the emission source. Thus, cumulative impacts for these pollutants will be higher nearer to the furnace operations. Additionally, the facility is in an area with significant existing background sources of pollution, especially urban industrial activities (as evident on land use map in Section 5.2.1). The existing air quality is most likely poor, and thus cumulative impacts for criteria air pollutants (PM_{10} , $\text{PM}_{2.5}$, SO_2 and NO_2) and non-criteria air pollutants (HF, NH_3 and TVOC) are predicted to be significant.

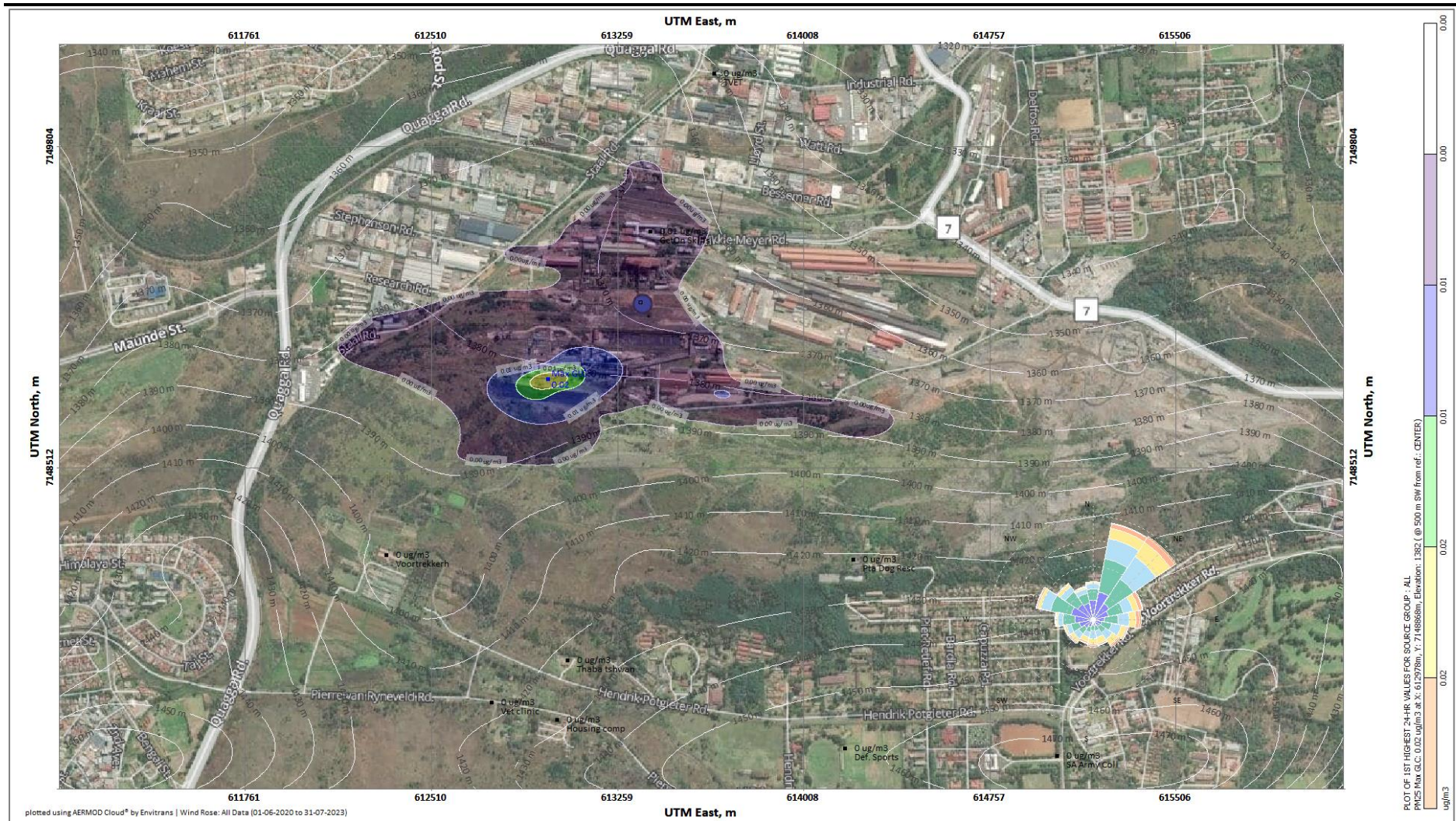


Figure 6-2: Simulated PM_{2.5} annual average incremental concentrations associated with aluminium production – Scenario A: Section 21 MES limits. Maximum dispersion of 0.02 $\mu\text{g}/\text{m}^3$ at approx. 500 m SW or site.

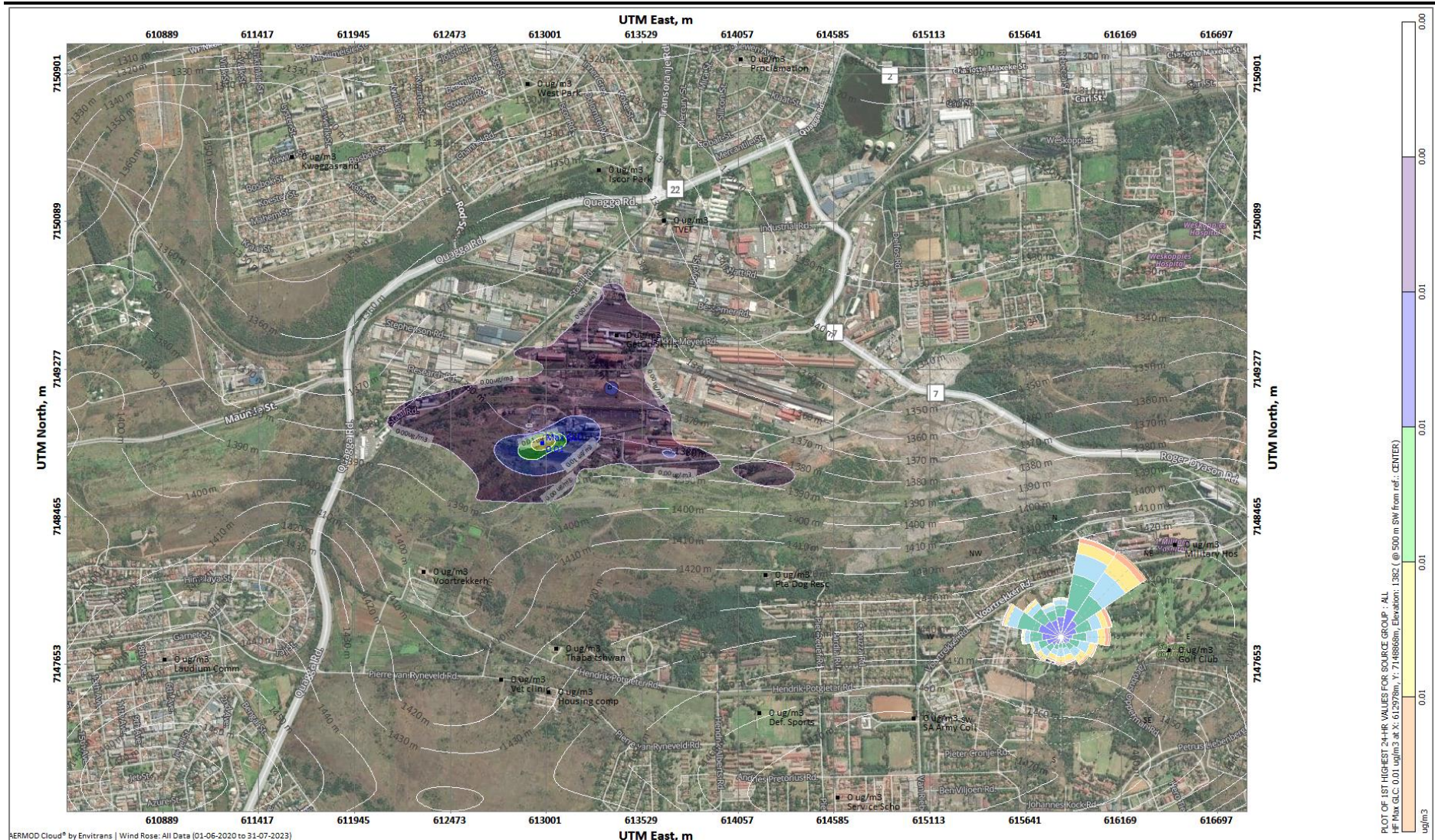


Figure 6-3: Simulated HF annual average incremental concentrations associated with aluminium production – Scenario A: Section 21 MES limits. Maximum dispersion of 0.01 $\mu\text{g}/\text{m}^3$ at approx. 500 m SW or site.

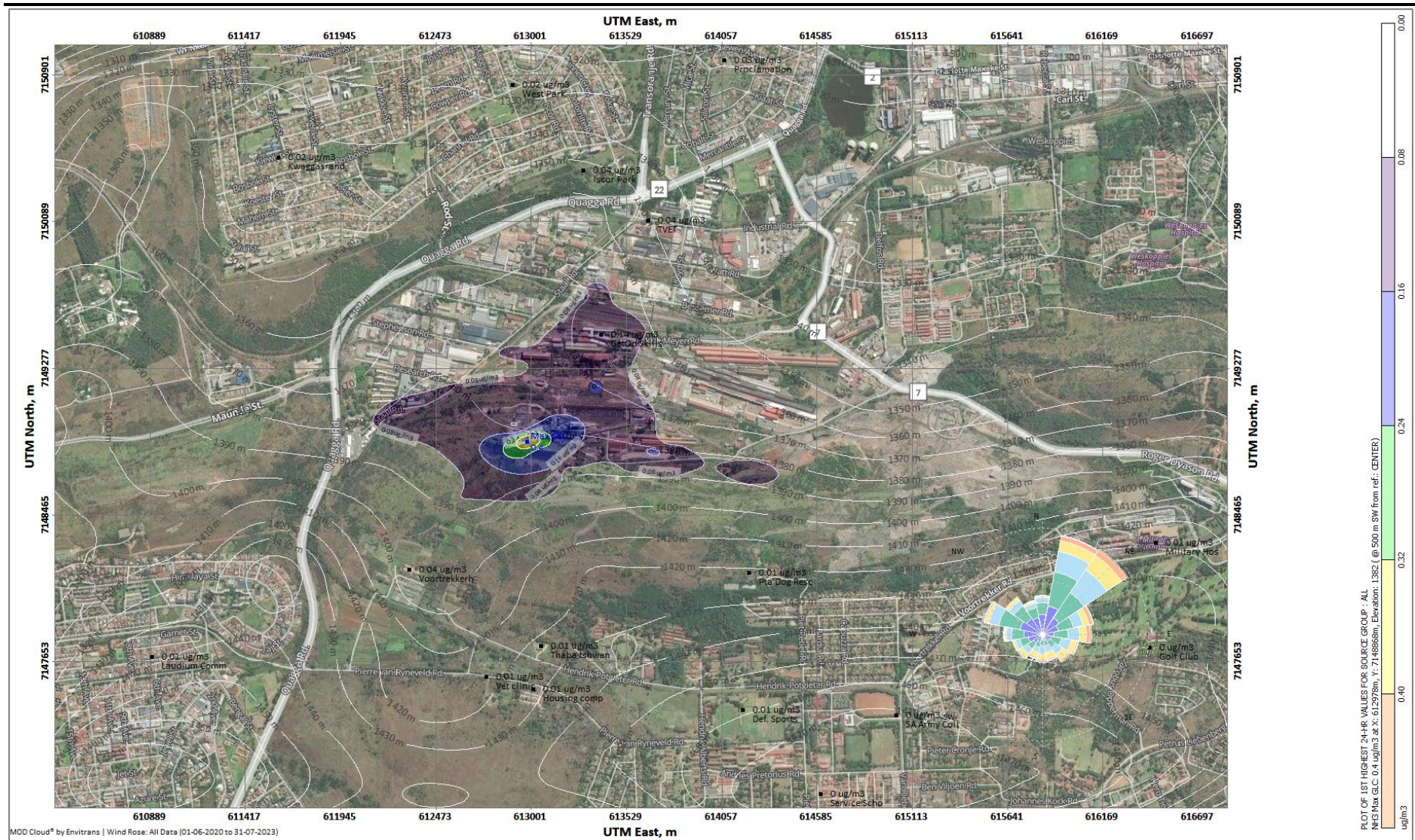


Figure 6-4: Simulated NH₃ annual average incremental concentrations associated with aluminium production – Scenario A: Section 21 MES limits. Maximum dispersion of 0.4 $\mu\text{g}/\text{m}^3$ at approx. 500m SW of site.

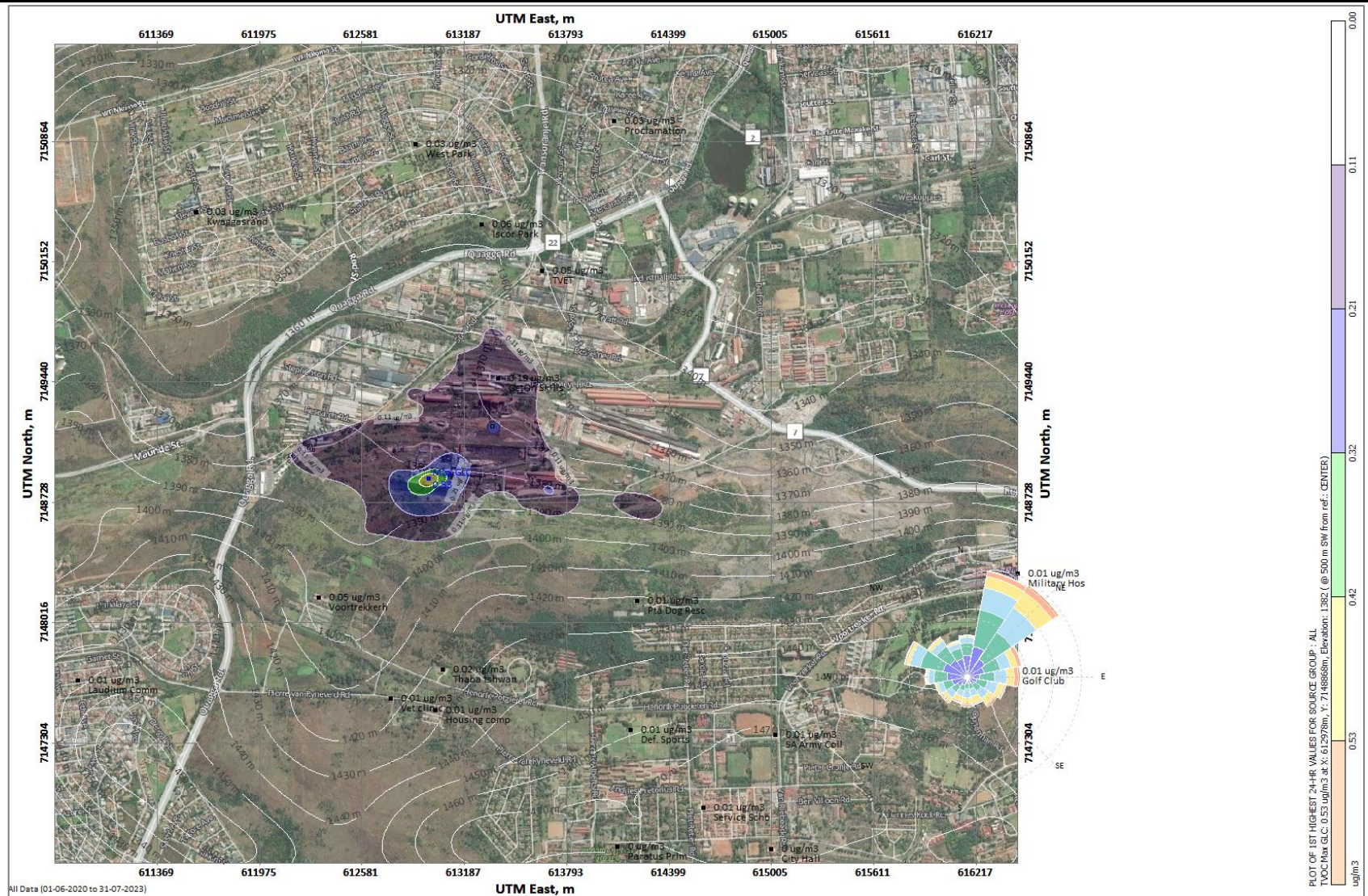


Figure 6-5: Simulated TVOCs annual average incremental concentrations associated with aluminium production – Scenario A: Section 21 MES limits. Maximum dispersion of 0.53 $\mu\text{g}/\text{m}^3$ at approx. 500 m SW of site.

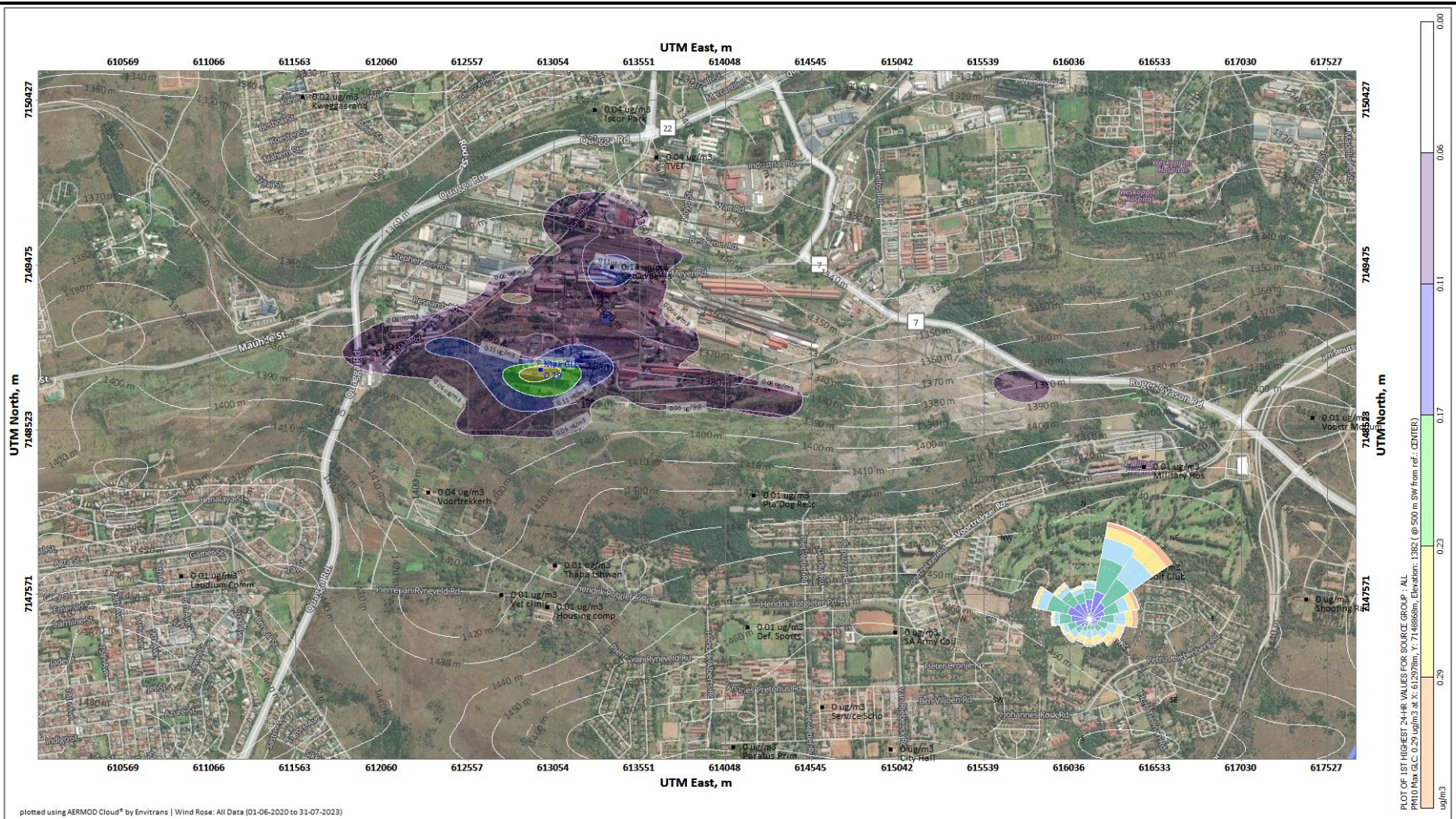


Figure 6-6: Simulated PM₁₀ annual average incremental concentrations associated with iron and steel production – Scenario A: Section 21 MES limits. Maximum dispersion of 0.29 µg/m³ at approx. 500 m SW of site.

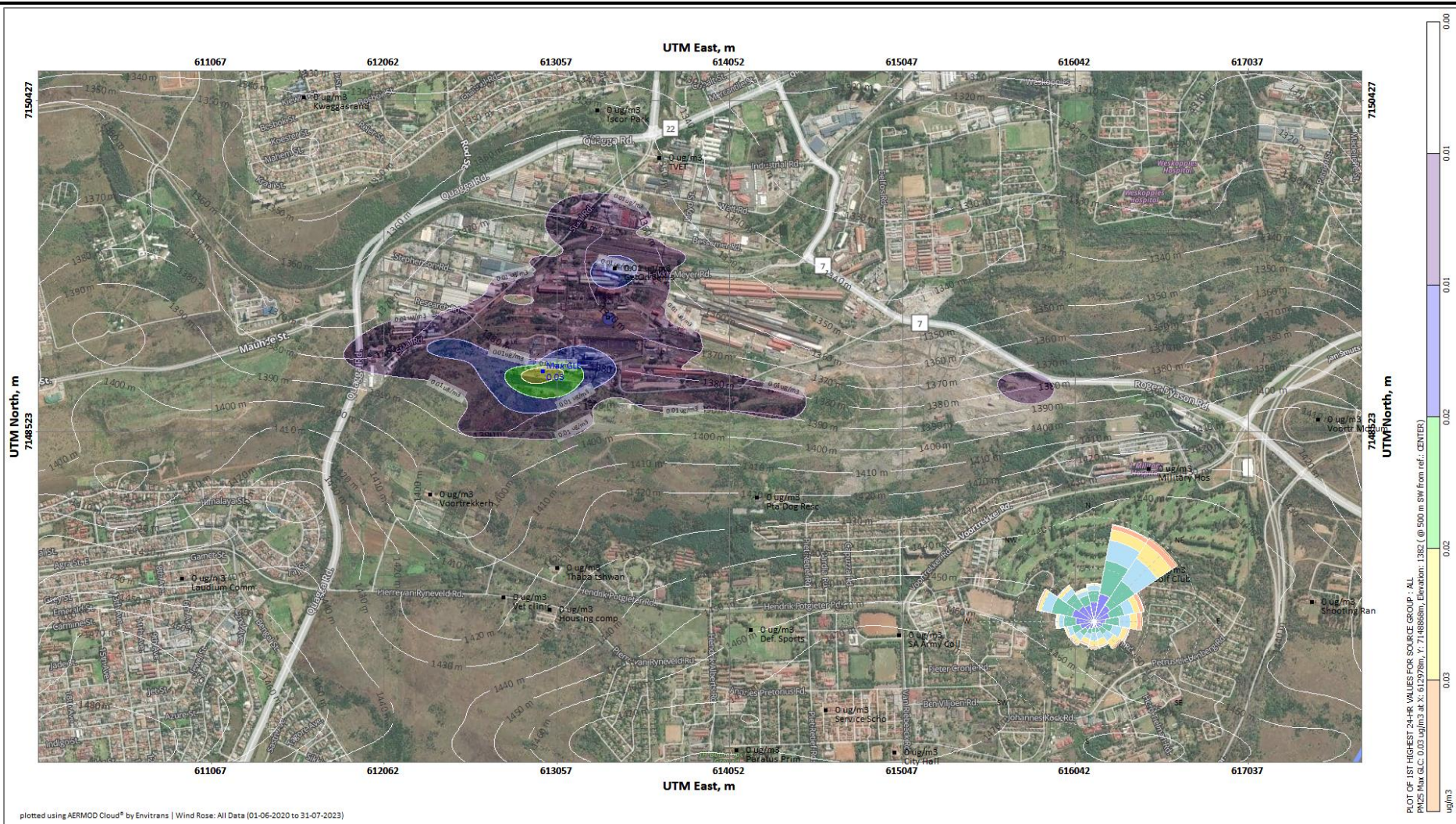


Figure 6-7: Simulated PM_{2.5} annual average incremental concentrations associated with iron and steel production – Scenario A: Section 21 MES limits. Maximum dispersion of 0.03 $\mu\text{g}/\text{m}^3$ at approx. 500 m SW or site.

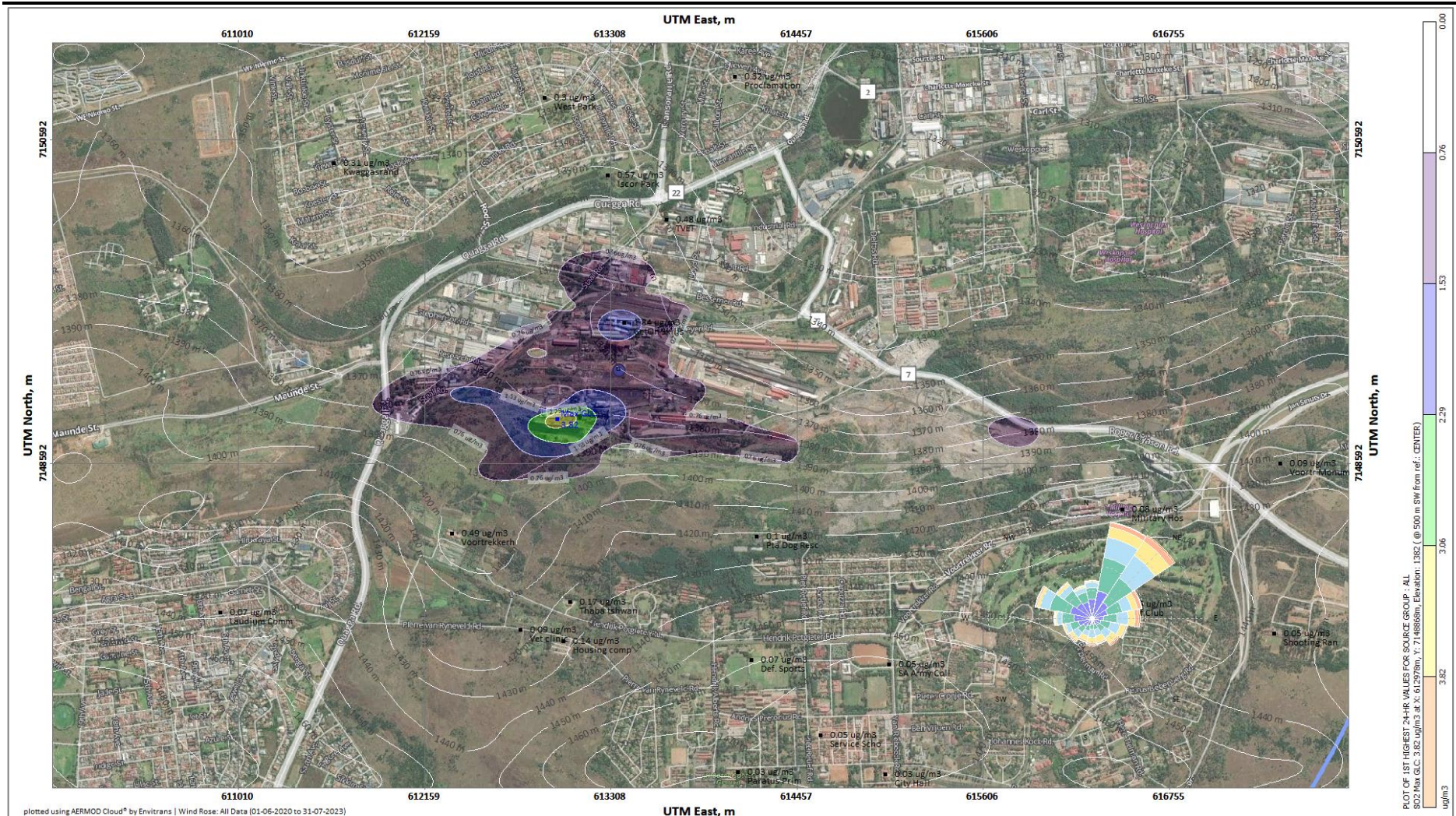


Figure 6-8: Simulated SO₂ annual average incremental concentrations associated with iron and steel production were the same – Scenario A: Section 21 MES limits. Maximum dispersion of 3.82 µg/m³ at approx. 500 m SW or site.

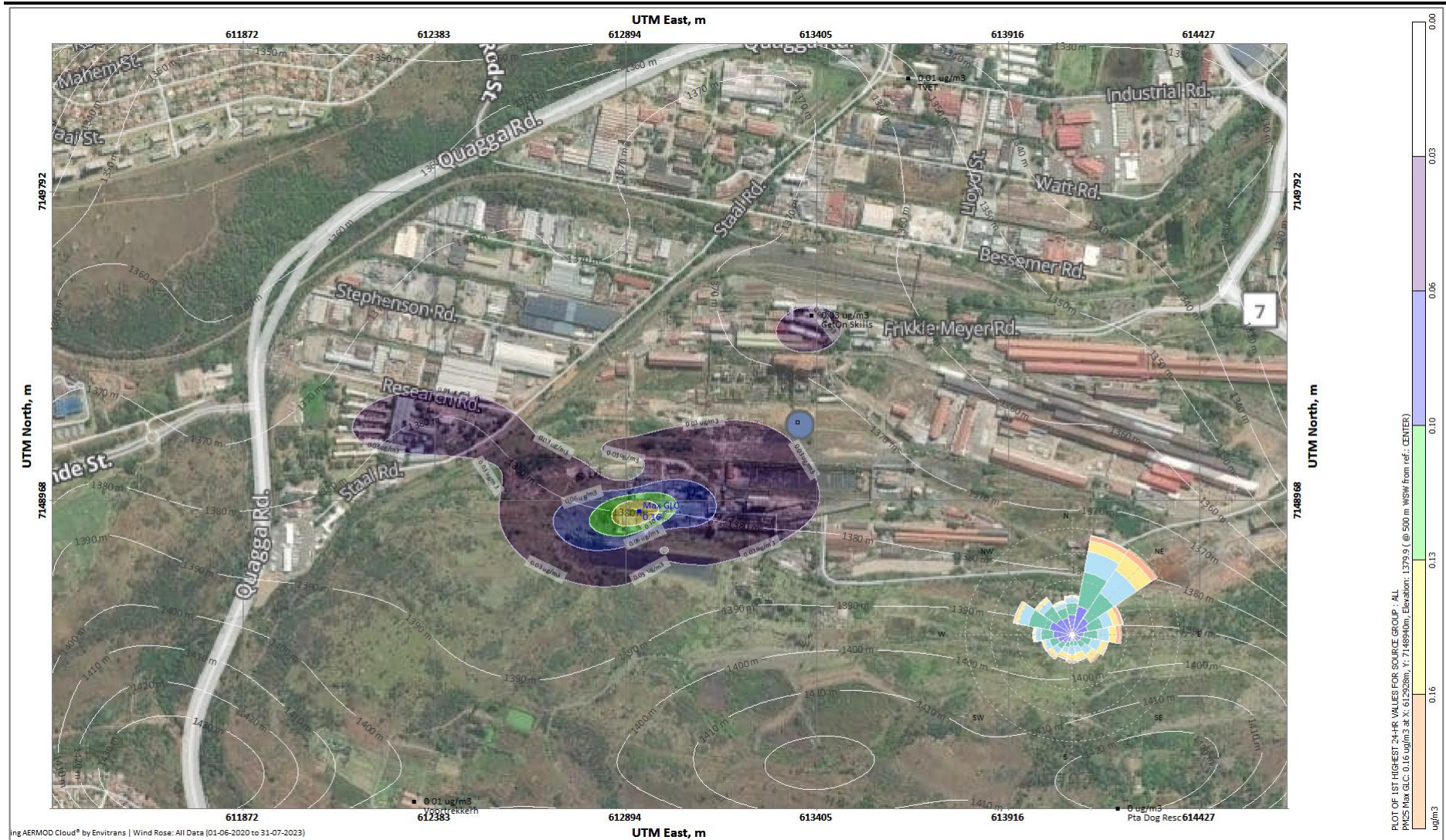


Figure 6-10: Simulated PM_{2.5} annual average incremental concentrations associated with aluminium production – Scenario B: Similar Operations. Maximum dispersion of 0.16 µg/m³ at approx. 500 m SW of site.

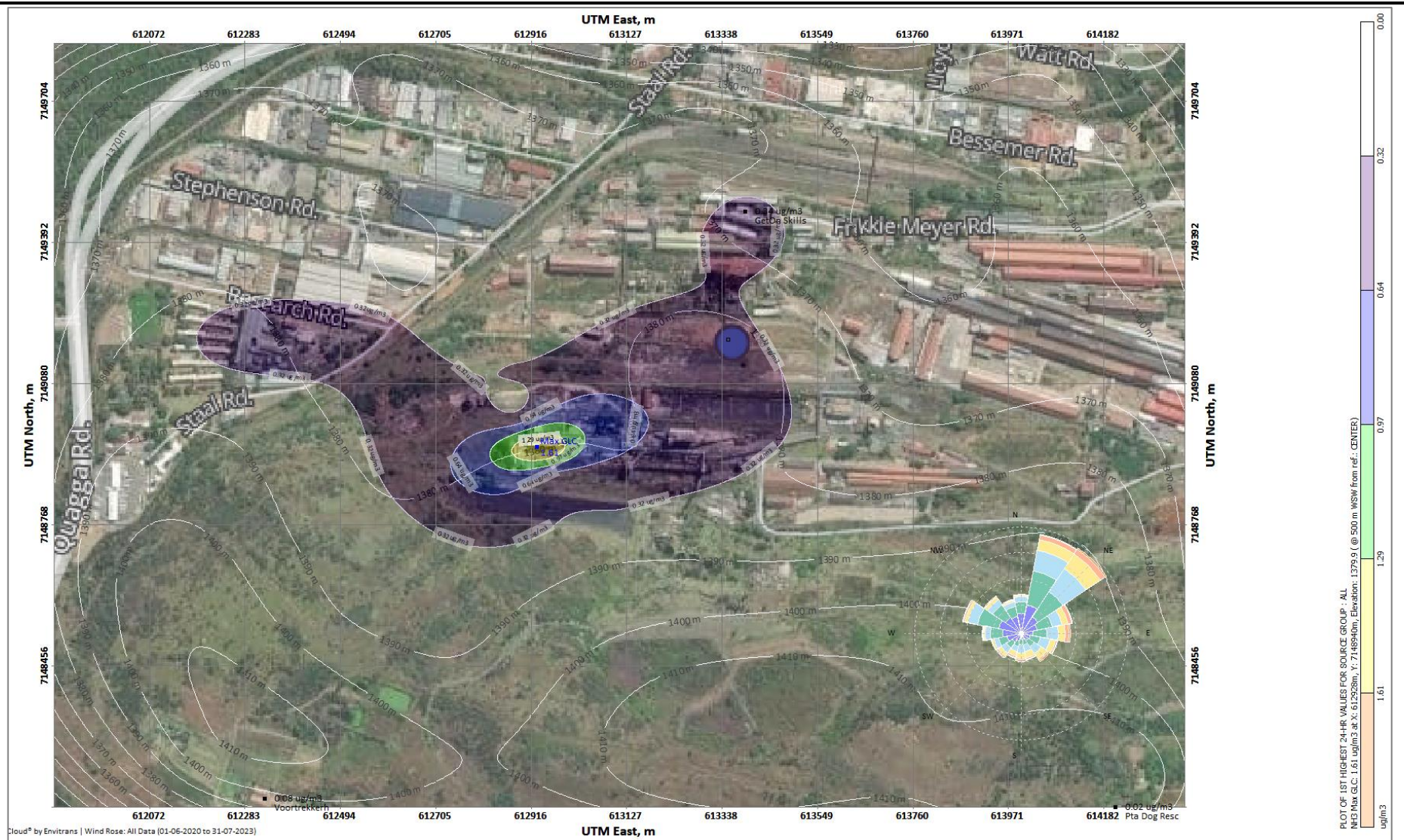


Figure 6-12: Simulated NH₃ annual average incremental concentrations associated with aluminium production – Scenario B: Similar Operations. Maximum dispersion of 1.61 µg/m³ at approx. 500 m SW of site.

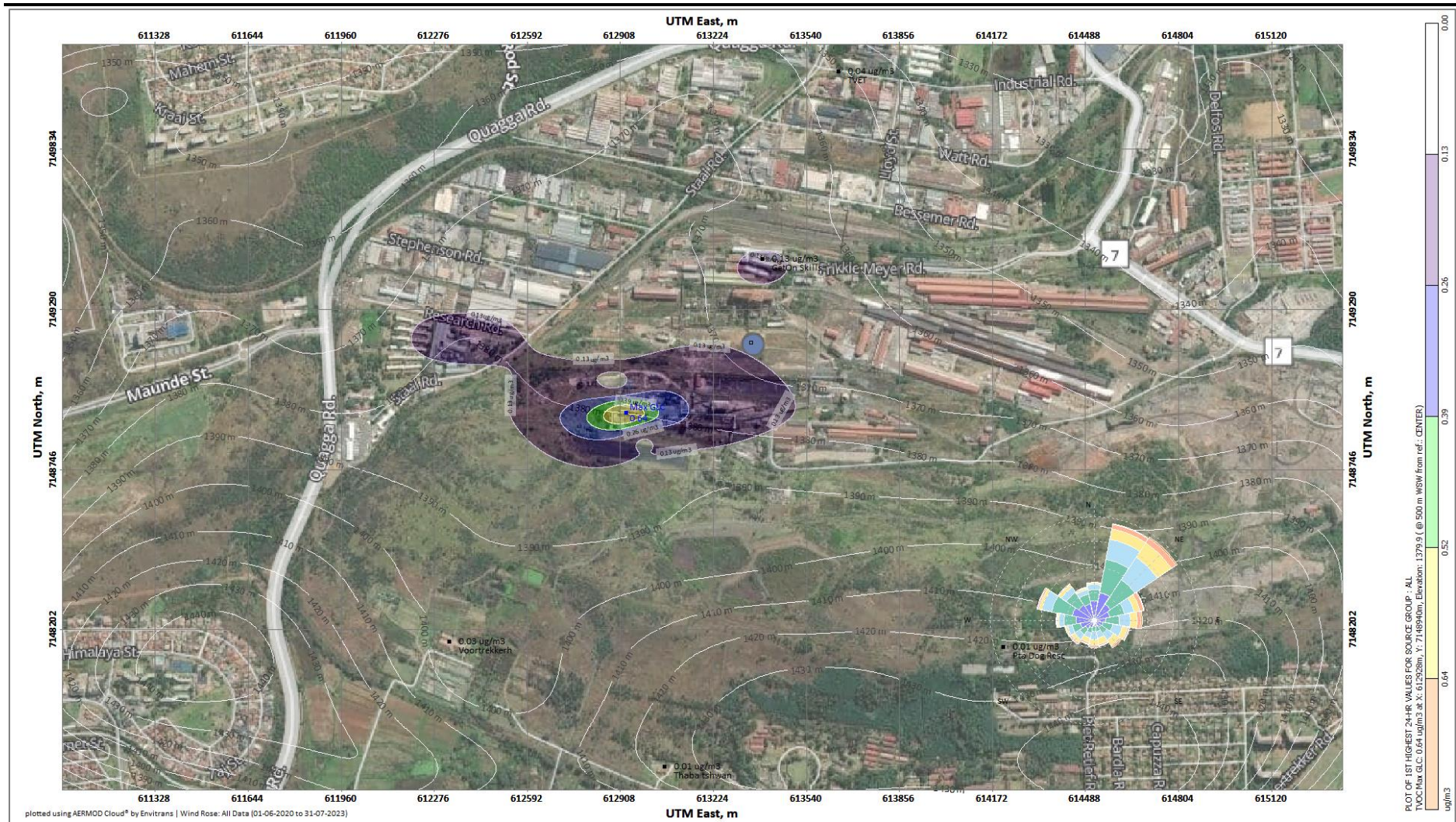


Figure 6-13: Simulated TVOCs annual average incremental concentrations associated with aluminium production – Scenario B: Similar Operations. Maximum dispersion of 0.64 $\mu\text{g}/\text{m}^3$ at approx. 500 m SW or site.

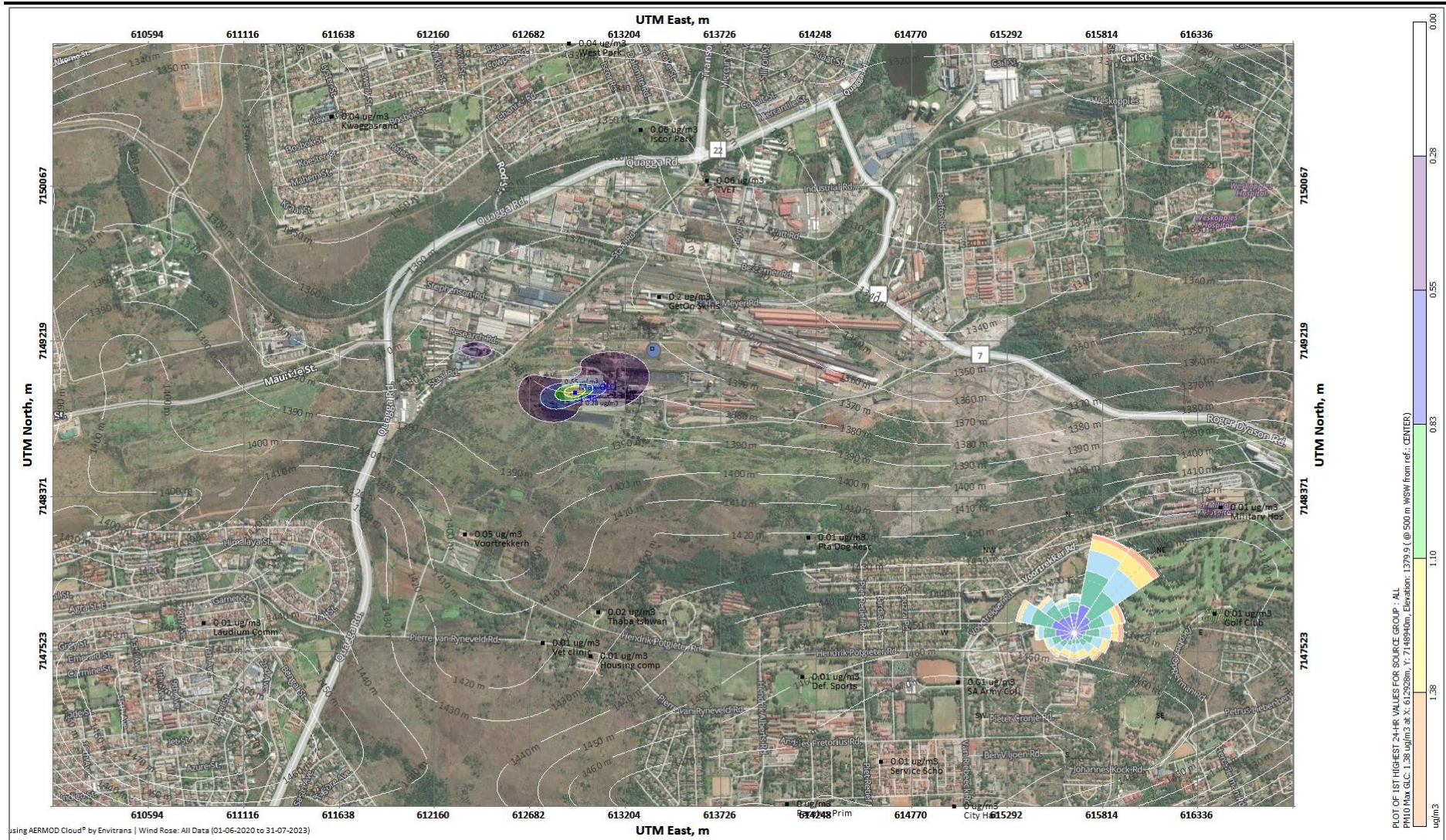


Figure 6-14: Simulated PM₁₀ annual average incremental concentrations associated with iron and steel production – Scenario B: Similar Operations. Maximum dispersion of 0.64 $\mu\text{g}/\text{m}^3$ at approx. 500 m SW of site.

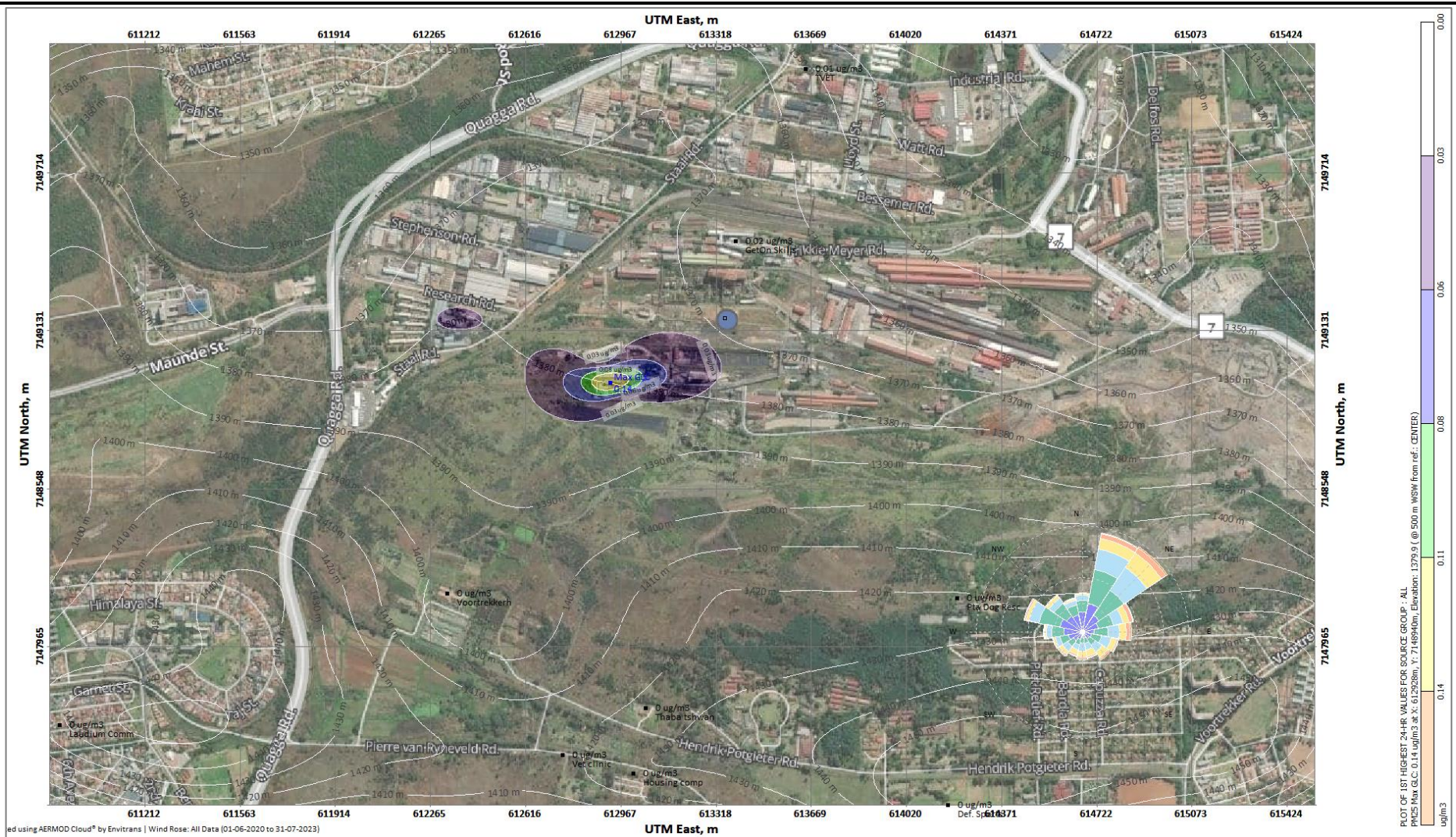


Figure 6-15: Simulated PM_{2.5} annual average incremental concentrations associated with iron and steel production – Scenario B: Similar Operations. Maximum dispersion of 0.14 µg/m³ at approx. 500 m SW or site.

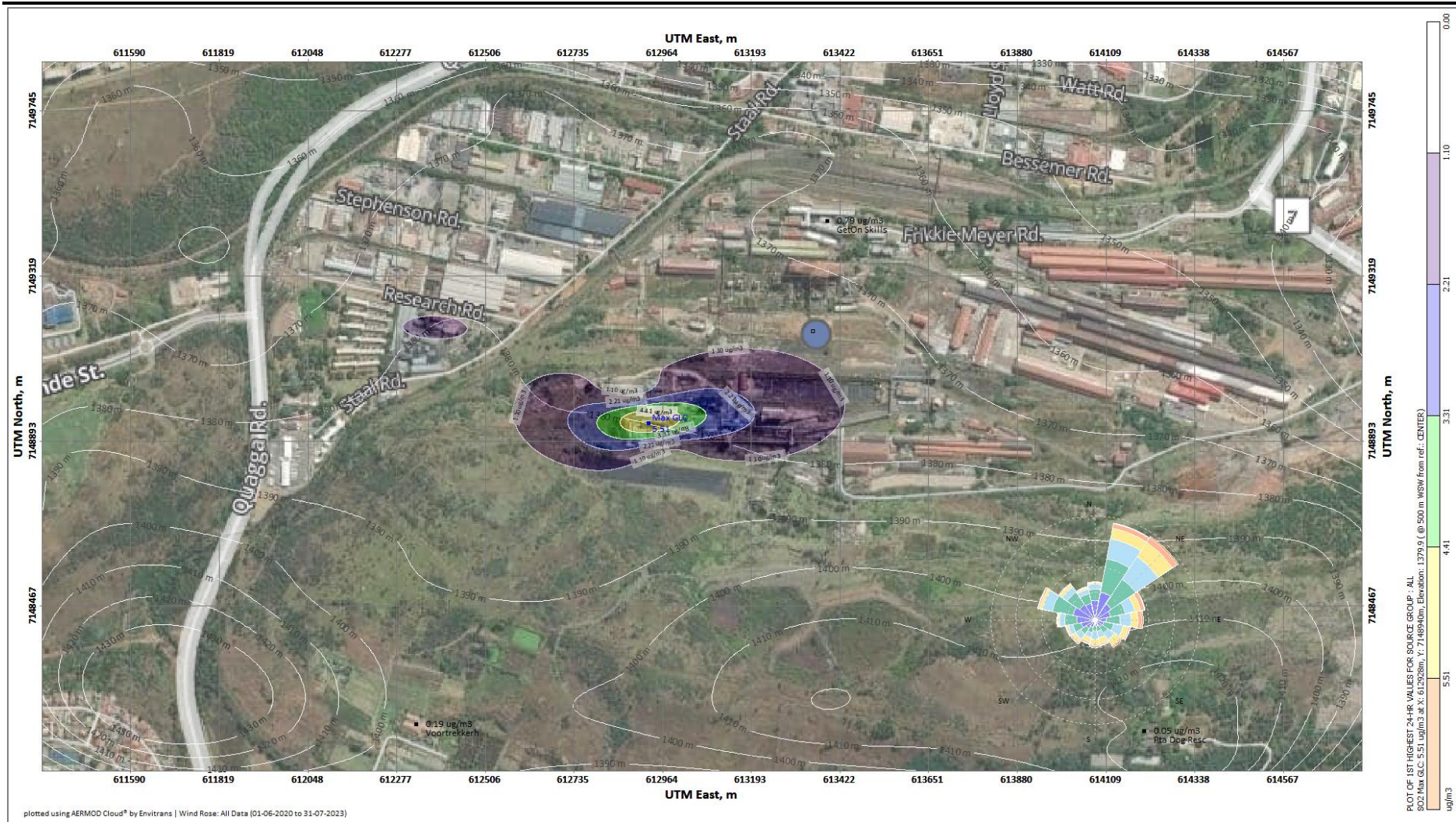


Figure 6-16: Simulated SO₂ annual average incremental concentrations associated with iron and steel production – Scenario B: Similar Operations. Maximum dispersion of 5.51 $\mu\text{g}/\text{m}^3$ at approx. 500 m SW or site.

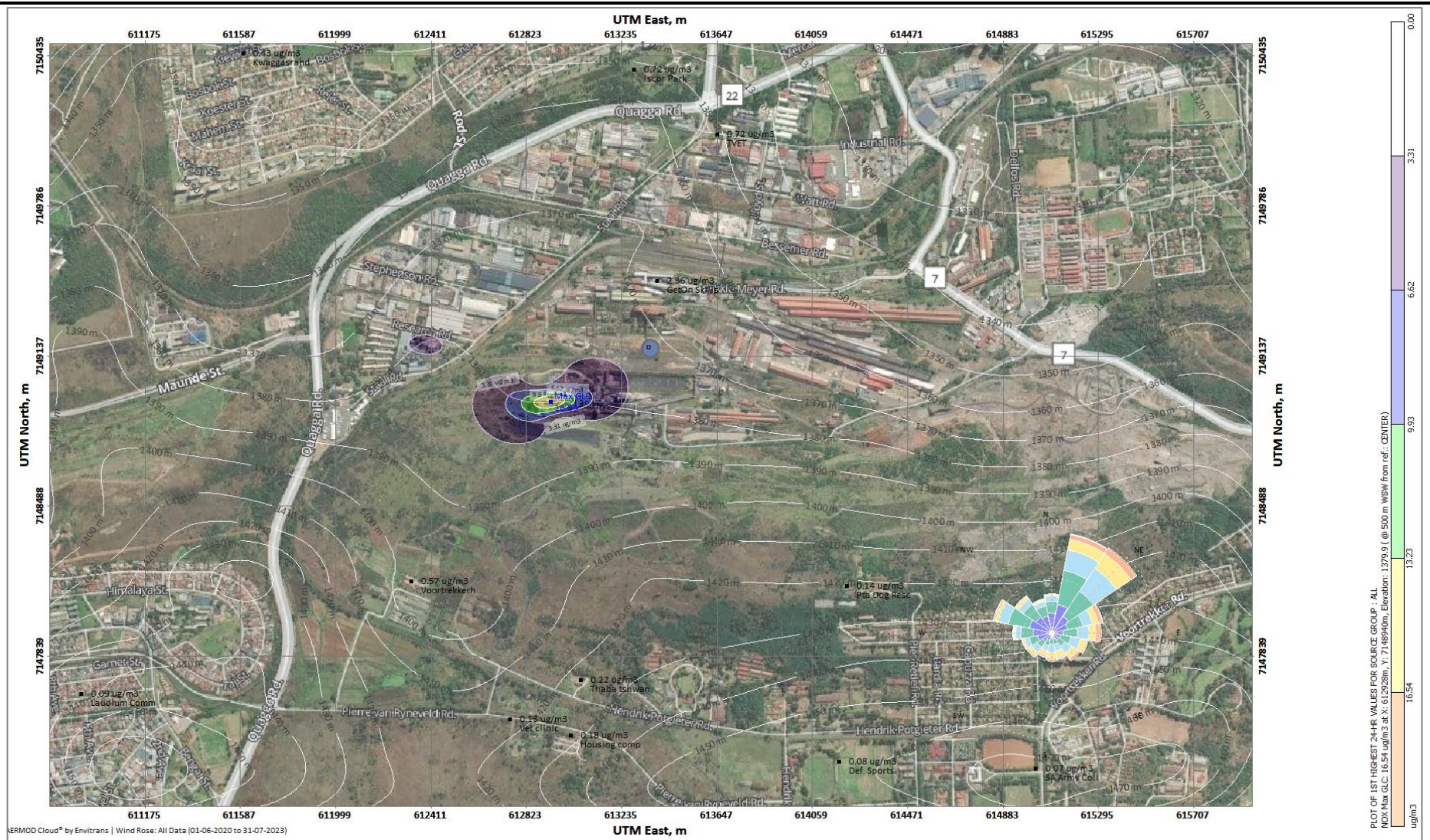


Figure 6-17: Simulated NO₂ annual average incremental concentrations associated with iron and steel production – Scenario B: Similar Operations. Maximum dispersion of 16.54 $\mu\text{g}/\text{m}^3$ at approx. 500 m SW of site.



6.2.3. Maximum Simulated Pollutant Concentrations

Maximum simulated pollutant concentrations at AQSRs (as described in Section 5.1) within 5 km radius of Intervention Engineering with limits are presented below (Table 6-2 and Error! Reference source not found.) for both modelled scenarios (MES limits and Similar Operations).

Table 6-2: Simulated PM₁₀, PM_{2.5}, SO₂, NO₂, HF, NH₃, TVOCs concentrations at AQSRs – MES Standard scenario. Concentrations are significantly lower than limits.

Receptor_ID	Average Time	Aluminium Production Incremental Concentrations (µg/m ³)										Iron & Steel Production Incremental Concentrations (µg/m ³)							
		PM ₁₀	NAAQS Limit	PM _{2.5}	NAAQS Limit	HF	AEP Limit	NH ₃	AEP Limit	TVOCs	AEP Limit	PM ₁₀	NAAQS Limit	PM _{2.5}	NAAQS Limit	SO ₂	NAAQS Limit	NO ₂	NAAQS Limit
GetOn Skills	24-HR	0.0889800	75	0.0089000	40	0.0047800	4.9	0.1432700	1400	0.1909300	500	0.0889800	75	0.0089000	40	1.8367000	125	1.8367000	200
Iscor Park	24-HR	0.0276700	75	0.0027700	40	0.0014800	4.9	0.0445500	1400	0.0593700	500	0.0276700	75	0.0027700	40	0.5700300	125	0.5700300	200
TVET	24-HR	0.0235300	75	0.0023500	40	0.0012600	4.9	0.0378900	1400	0.0504900	500	0.0235300	75	0.0023500	40	0.4865800	125	0.4865800	200
Voortrekkerh	24-HR	0.0235200	75	0.0023500	40	0.0012600	4.9	0.0378600	1400	0.0504600	500	0.0235200	75	0.0023500	40	0.4752300	125	0.4752300	200
Proclamation	24-HR	0.0158600	75	0.0015900	40	0.0008500	4.9	0.0255400	1400	0.0340400	500	0.0158600	75	0.0015900	40	0.3218700	125	0.3218700	200
Kwaggasrand	24-HR	0.0154700	75	0.0015500	40	0.0008300	4.9	0.0249100	1400	0.0332000	500	0.0154700	75	0.0015500	40	0.3141200	125	0.3141200	200
West Park	24-HR	0.0150000	75	0.0015000	40	0.0008000	4.9	0.0241500	1400	0.0321800	500	0.0150000	75	0.0015000	40	0.3041700	125	0.3041700	200
Thaba tshwan	24-HR	0.0081600	75	0.0008200	40	0.0004400	4.9	0.0131500	1400	0.0175200	500	0.0081600	75	0.0008200	40	0.1663200	125	0.1663200	200
Pret West Ho	24-HR	0.0077600	75	0.0007800	40	0.0004200	4.9	0.0124900	1400	0.0166400	500	0.0077600	75	0.0007800	40	0.1581000	125	0.1581000	200
Housing comp	24-HR	0.0068000	75	0.0006800	40	0.0003600	4.9	0.0109400	1400	0.0145900	500	0.0068000	75	0.0006800	40	0.1394900	125	0.1394900	200
Pta Dog Resc	24-HR	0.0048200	75	0.0004800	40	0.0002600	4.9	0.0077600	1400	0.0103400	500	0.0048200	75	0.0004800	40	0.0980500	125	0.0980500	200
Vet clinic	24-HR	0.0044000	75	0.0004400	40	0.0002400	4.9	0.0070900	1400	0.0094400	500	0.0044000	75	0.0004400	40	0.0906300	125	0.0906300	200
Voortr Monum	24-HR	0.0043100	75	0.0004300	40	0.0002300	4.9	0.0069400	1400	0.0092400	500	0.0043100	75	0.0004300	40	0.0882200	125	0.0882200	200
Military Hos	24-HR	0.0041800	75	0.0004200	40	0.0002200	4.9	0.0067300	1400	0.0089700	500	0.0041800	75	0.0004200	40	0.0846100	125	0.0846100	200
Laudium Comm	24-HR	0.0034300	75	0.0003400	40	0.0001800	4.9	0.0055200	1400	0.0073500	500	0.0034300	75	0.0003400	40	0.0701900	125	0.0701900	200
Def. Sports	24-HR	0.0033000	75	0.0003300	40	0.0001800	4.9	0.0053100	1400	0.0070700	500	0.0033000	75	0.0003300	40	0.0680400	125	0.0680400	200
Golf Club	24-HR	0.0026300	75	0.0002600	40	0.0001400	4.9	0.0042300	1400	0.0056400	500	0.0026300	75	0.0002600	40	0.0535000	125	0.0535000	200
Service Scho	24-HR	0.0024800	75	0.0002500	40	0.0001300	4.9	0.0039900	1400	0.0053200	500	0.0024800	75	0.0002500	40	0.0511700	125	0.0511700	200
SA Army Coll	24-HR	0.0024400	75	0.0002400	40	0.0001300	4.9	0.0039300	1400	0.0052300	500	0.0024400	75	0.0002400	40	0.0501000	125	0.0501000	200
Shooting Ran	24-HR	0.0022300	75	0.0002200	40	0.0001200	4.9	0.0035900	1400	0.0047900	500	0.0022300	75	0.0002200	40	0.0453900	125	0.0453900	200
City Hall	24-HR	0.0016200	75	0.0001600	40	0.0000900	4.9	0.0026100	1400	0.0034800	500	0.0016200	75	0.0001600	40	0.0332300	125	0.0332300	200
Valhalla Com	24-HR	0.0016000	75	0.0001600	40	0.0000900	4.9	0.0025700	1400	0.0034300	500	0.0016000	75	0.0001600	40	0.0330500	125	0.0330500	200
Paratus Prim	24-HR	0.0013700	75	0.0001400	40	0.0000700	4.9	0.0022100	1400	0.0029500	500	0.0013700	75	0.0001400	40	0.0279700	125	0.0279700	200
Jejani Royal	24-HR	0.0010400	75	0.0001000	40	0.0000600	4.9	0.0016700	1400	0.0022300	500	0.0010400	75	0.0001000	40	0.0213800	125	0.0213800	200
GetOn Skills	PERIOD	0.0047100	40	0.0004700	20	0.0002500	4.9	0.0075900	1400	0.0101200	500	0.0047100	40	0.0004700	20	0.0968800	50	0.0968800	40
Voortrekkerh	PERIOD	0.0008500	40	0.0000900	20	0.0000500	4.9	0.0013800	1400	0.0018300	500	0.0008500	40	0.0000900	20	0.0176900	50	0.0176900	40
Thaba tshwan	PERIOD	0.0003500	40	0.0000300	20	0.0000200	4.9	0.0005600	1400	0.0007400	500	0.0003500	40	0.0000300	20	0.0070900	50	0.0070900	40
Vet clinic	PERIOD	0.0003900	40	0.0000400	20	0.0000200	4.9	0.0006200	1400	0.0008300	500	0.0003900	40	0.0000400	20	0.0079500	50	0.0079500	40
Housing comp	PERIOD	0.0002800	40	0.0000300	20	0.0000200	4.9	0.0004500	1400	0.0006000	500	0.0002800	40	0.0000300	20	0.0057500	50	0.0057500	40
Def. Sports	PERIOD	0.0001000	40	0.0000100	20	0.0000100	4.9	0.0001600	1400	0.0002200	500	0.0001000	40	0.0000100	20	0.0021000	50	0.0021000	40
Golf Club	PERIOD	0.0001000	40	0.0000100	20	0.0000100	4.9	0.0001700	1400	0.0002200	500	0.0001000	40	0.0000100	20	0.0021400	50	0.0021400	40
SA Army Coll	PERIOD	0.0001000	40	0.0000100	20	0.0000100	4.9	0.0001500	1400	0.0002000	500	0.0001000	40	0.0000100	20	0.0019700	50	0.0019700	40
Military Hos	PERIOD	0.0001400	40	0.0000100	20	0.0000100	4.9	0.0002200	1400	0.0002900	500	0.0001400	40	0.0000100	20	0.0028200	50	0.0028200	40



Receptor_ID	Average Time	Aluminium Production Incremental Concentrations (µg/m ³)										Iron & Steel Production Incremental Concentrations (µg/m ³)							
		PM ₁₀	NAAQS Limit	PM _{2.5}	NAAQS Limit	HF	AEP Limit	NH ₃	AEP Limit	TVOCs	AEP Limit	PM ₁₀	NAAQS Limit	PM _{2.5}	NAAQS Limit	SO ₂	NAAQS Limit	NO ₂	NAAQS Limit
Pta Dog Resc	PERIOD	0.0002500	40	0.0000300	20	0.0000100	4.9	0.0004100	1400	0.0005400	500	0.0002500	40	0.0000300	20	0.0051700	50	0.0051700	40
Paratus Prim	PERIOD	0.0000700	40	0.0000100	20	0.0000000	4.9	0.0001100	1400	0.0001400	500	0.0000700	40	0.0000100	20	0.0013700	50	0.0013700	40
City Hall	PERIOD	0.0000700	40	0.0000100	20	0.0000000	4.9	0.0001000	1400	0.0001400	500	0.0000700	40	0.0000100	20	0.0013500	50	0.0013500	40
Service Scho	PERIOD	0.0000700	40	0.0000100	20	0.0000000	4.9	0.0001100	1400	0.0001500	500	0.0000700	40	0.0000100	20	0.0014600	50	0.0014600	40
Jejani Royal	PERIOD	0.0000500	40	0.0000100	20	0.0000000	4.9	0.0000800	1400	0.0001100	500	0.0000500	40	0.0000100	20	0.0010500	50	0.0010500	40
Shooting Ran	PERIOD	0.0000900	40	0.0000100	20	0.0000100	4.9	0.0001500	1400	0.0002000	500	0.0000900	40	0.0000100	20	0.0019300	50	0.0019300	40
Valhalla Com	PERIOD	0.0000500	40	0.0000000	20	0.0000000	4.9	0.0000700	1400	0.0001000	500	0.0000500	40	0.0000000	20	0.0009600	50	0.0009600	40
Laudium Comm	PERIOD	0.0001700	40	0.0000200	20	0.0000100	4.9	0.0002800	1400	0.0003700	500	0.0001700	40	0.0000200	20	0.0035800	50	0.0035800	40
TVET	PERIOD	0.0008000	40	0.0000800	20	0.0000400	4.9	0.0012800	1400	0.0017100	500	0.0008000	40	0.0000800	20	0.0158800	50	0.0158800	40
Iscor Park	PERIOD	0.0007600	40	0.0000800	20	0.0000400	4.9	0.0012200	1400	0.0016200	500	0.0007600	40	0.0000800	20	0.0152400	50	0.0152400	40
West Park	PERIOD	0.0005100	40	0.0000500	20	0.0000300	4.9	0.0008300	1400	0.0011000	500	0.0005100	40	0.0000500	20	0.0103800	50	0.0103800	40
Kwaggasrand	PERIOD	0.0003700	40	0.0000400	20	0.0000200	4.9	0.0006000	1400	0.0008000	500	0.0003700	40	0.0000400	20	0.0075600	50	0.0075600	40
Proclamation	PERIOD	0.0004000	40	0.0000400	20	0.0000200	4.9	0.0006400	1400	0.0008600	500	0.0004000	40	0.0000400	20	0.0080500	50	0.0080500	40
Voortr Monum	PERIOD	0.0001200	40	0.0000100	20	0.0000100	4.9	0.0002000	1400	0.0002600	500	0.0001200	40	0.0000100	20	0.0025300	50	0.0025300	40
Pret West Ho	PERIOD	0.0002000	40	0.0000200	20	0.0000100	4.9	0.0003200	1400	0.00042	500	0.0002000	40	0.0000200	20	0.0040100	50	0.0040100	40

Table 6-3: Simulated PM₁₀, PM_{2.5}, SO₂, NO₂, HF, NH₃, TVOCs concentrations at AQSRs – Similar Operations scenario. Concentrations are significantly lower than limits.

Receptor_ID	Average Time	Aluminium Production Incremental Concentrations (µg/m ³)										Iron & Steel Production Incremental Concentrations (µg/m ³)							
		PM ₁₀	NAAQS Limit	PM _{2.5}	NAAQS Limit	HF	AEP Limit	NH ₃	AEP Limit	TVOCs	AEP Limit	PM ₁₀	NAAQS Limit	PM _{2.5}	NAAQS Limit	SO ₂	NAAQS Limit	NO ₂	NAAQS Limit
GetOn Skills	24-HR	0.0889800	75	0.0089000	40	0.0168400	4.9	0.1432700	1400	0.1909300	500	0.0889800	75	0.0196500	40	0.7858800	125	2.3576500	200
Iscor Park	24-HR	0.0276700	75	0.0027700	40	0.0052600	4.9	0.0445500	1400	0.0593700	500	0.0276700	75	0.0060400	40	0.2415800	125	0.7247300	200
TVET	24-HR	0.0235300	75	0.0023500	40	0.0050200	4.9	0.0378900	1400	0.0504900	500	0.0235300	75	0.0059700	40	0.2386700	125	0.7160100	200
Voortrekkerh	24-HR	0.0235200	75	0.0023500	40	0.0041800	4.9	0.0378600	1400	0.0504600	500	0.0235200	75	0.0047500	40	0.1901700	125	0.5705000	200
Proclamation	24-HR	0.0158600	75	0.0015900	40	0.0031200	4.9	0.0255400	1400	0.0340400	500	0.0158600	75	0.0036500	40	0.1460600	125	0.4381900	200
Kwaggasrand	24-HR	0.0154700	75	0.0015500	40	0.0031000	4.9	0.0249100	1400	0.0332000	500	0.0154700	75	0.0036300	40	0.1450600	125	0.4351700	200
West Park	24-HR	0.0150000	75	0.0015000	40	0.0029800	4.9	0.0241500	1400	0.0321800	500	0.0150000	75	0.0035500	40	0.1421000	125	0.4263100	200
Thaba tshwan	24-HR	0.0081600	75	0.0008200	40	0.0015600	4.9	0.0131500	1400	0.0175200	500	0.0081600	75	0.0018100	40	0.0722500	125	0.2167400	200
Pret West Ho	24-HR	0.0077600	75	0.0007800	40	0.0014400	4.9	0.0124900	1400	0.0166400	500	0.0077600	75	0.0016400	40	0.0655300	125	0.1965800	200
Housing comp	24-HR	0.0068000	75	0.0006800	40	0.0012800	4.9	0.0109400	1400	0.0145900	500	0.0068000	75	0.0014700	40	0.0588000	125	0.1764000	200
Pta Dog Resc	24-HR	0.0048200	75	0.0004800	40	0.0009600	4.9	0.0077600	1400	0.0103400	500	0.0048200	75	0.0011300	40	0.0453600	125	0.1360900	200
Vet clinic	24-HR	0.0044000	75	0.0004400	40	0.0008500	4.9	0.0070900	1400	0.0094400	500	0.0044000	75	0.0010800	40	0.0432300	125	0.1297000	200
Voortr Monum	24-HR	0.0043100	75	0.0004300	40	0.0008300	4.9	0.0069400	1400	0.0092400	500	0.0043100	75	0.0009600	40	0.0385100	125	0.1155200	200
Military Hos	24-HR	0.0041800	75	0.0004200	40	0.0008100	4.9	0.0067300	1400	0.0089700	500	0.0041800	75	0.0009400	40	0.0374600	125	0.1123800	200
Laudium Comm	24-HR	0.0034300	75	0.0003400	40	0.0006600	4.9	0.0055200	1400	0.0073500	500	0.0034300	75	0.0007600	40	0.0304600	125	0.0913800	200
Def. Sports	24-HR	0.0033000	75	0.0003300	40	0.0005800	4.9	0.0053100	1400	0.0070700	500	0.0033000	75	0.0006500	40	0.0258500	125	0.0775600	200
Golf Club	24-HR	0.0026300	75	0.0002600	40	0.0004900	4.9	0.0042300	1400	0.0056400	500	0.0026300	75	0.0005600	40	0.0224400	125	0.0673100	200
Service Scho	24-HR	0.0024800	75	0.0002500	40	0.0004700	4.9	0.0039900	1400	0.0053200	500	0.0024800	75	0.0005500	40	0.0219100	125	0.0657400	200
SA Army Coll	24-HR	0.0024400	75	0.0002400	40	0.0004500	4.9	0.0039300	1400	0.0052300	500	0.0024400	75	0.0005200	40	0.0206400	125	0.0619100	200
Shooting Ran	24-HR	0.0022300	75	0.0002200	40	0.0004300	4.9	0.0035900	1400	0.0047900	500	0.0022300	75	0.0004900	40	0.0196500	125	0.0589500	200



Receptor_ID	Average Time	Aluminium Production Incremental Concentrations (µg/m3)										Iron & Steel Production Incremental Concentrations (µg/m3)							
		PM ₁₀	NAAQS Limit	PM _{2.5}	NAAQS Limit	HF	AEP Limit	NH ₃	AEP Limit	TVOCs	AEP Limit	PM ₁₀	NAAQS Limit	PM _{2.5}	NAAQS Limit	SO ₂	NAAQS Limit	NO ₂	NAAQS Limit
City Hall	24-HR	0.0016200	75	0.0001600	40	0.0003100	4.9	0.0026100	1400	0.0034800	500	0.0016200	75	0.0003600	40	0.0143900	125	0.0431800	200
Valhalla Com	24-HR	0.0016000	75	0.0001600	40	0.0002800	4.9	0.0025700	1400	0.0034300	500	0.0016000	75	0.0003100	40	0.0123700	125	0.0371000	200
Paratus Prim	24-HR	0.0013700	75	0.0001400	40	0.0002600	4.9	0.0022100	1400	0.0029500	500	0.0013700	75	0.0003000	40	0.0121300	125	0.0364000	200
Jejani Royal	24-HR	0.0010400	75	0.0001000	40	0.0001900	4.9	0.0016700	1400	0.0022300	500	0.0010400	75	0.0002100	40	0.0084100	125	0.0252200	200
GetOn Skills	PERIOD	0.0047100	40	0.0004700	20	0.0009200	4.9	0.0075900	1400	0.0101200	500	0.0047100	40	0.0011000	20	0.0438600	50	0.1315800	40
Voortrekkerh	PERIOD	0.0008500	40	0.0000900	20	0.0001500	4.9	0.0013800	1400	0.0018300	500	0.0008500	40	0.0001700	20	0.0069400	50	0.0208200	40
Thaba tshwan	PERIOD	0.0003500	40	0.0000300	20	0.0000600	4.9	0.0005600	1400	0.0007400	500	0.0003500	40	0.0000700	20	0.0029600	50	0.0088900	40
Vet clinic	PERIOD	0.0003900	40	0.0000400	20	0.0000700	4.9	0.0006200	1400	0.0008300	500	0.0003900	40	0.0000800	20	0.0032900	50	0.0098800	40
Housing comp	PERIOD	0.0002800	40	0.0000300	20	0.0000500	4.9	0.0004500	1400	0.0006000	500	0.0002800	40	0.0000600	20	0.0023800	50	0.0071500	40
Def. Sports	PERIOD	0.0001000	40	0.0000100	20	0.0000200	4.9	0.0001600	1400	0.0002200	500	0.0001000	40	0.0000200	20	0.0008200	50	0.0024500	40
Golf Club	PERIOD	0.0001000	40	0.0000100	20	0.0000200	4.9	0.0001700	1400	0.0002200	500	0.0001000	40	0.0000200	20	0.0008400	50	0.0025200	40
SA Army Coll	PERIOD	0.0001000	40	0.0000100	20	0.0000200	4.9	0.0001500	1400	0.0002000	500	0.0001000	40	0.0000200	20	0.0007600	50	0.0022700	40
Military Hos	PERIOD	0.0001400	40	0.0000100	20	0.0000300	4.9	0.0002200	1400	0.0002900	500	0.0001400	40	0.0000300	20	0.0011400	50	0.0034100	40
Pta Dog Resc	PERIOD	0.0002500	40	0.0000300	20	0.0000500	4.9	0.0004100	1400	0.0005400	500	0.0002500	40	0.0000600	20	0.0022300	50	0.0066800	40
Paratus Prim	PERIOD	0.0000700	40	0.0000100	20	0.0000100	4.9	0.0001100	1400	0.0001400	500	0.0000700	40	0.0000100	20	0.0005100	50	0.0015400	40
City Hall	PERIOD	0.0000700	40	0.0000100	20	0.0000100	4.9	0.0001000	1400	0.0001400	500	0.0000700	40	0.0000100	20	0.0005100	50	0.0015200	40
Service Scho	PERIOD	0.0000700	40	0.0000100	20	0.0000100	4.9	0.0001100	1400	0.0001500	500	0.0000700	40	0.0000100	20	0.0005500	50	0.0016500	40
Jejani Royal	PERIOD	0.0000500	40	0.0000100	20	0.0000100	4.9	0.0000800	1400	0.0001100	500	0.0000500	40	0.0000100	20	0.0003900	50	0.0011700	40
Shooting Ran	PERIOD	0.0000900	40	0.0000100	20	0.0000200	4.9	0.0001500	1400	0.0002000	500	0.0000900	40	0.0000200	20	0.0007500	50	0.0022400	40
Valhalla Com	PERIOD	0.0000500	40	0.0000000	20	0.0000100	4.9	0.0000700	1400	0.0001000	500	0.0000500	40	0.0000100	20	0.0003600	50	0.0010800	40
Laudium Comm	PERIOD	0.0001700	40	0.0000200	20	0.0000300	4.9	0.0002800	1400	0.0003700	500	0.0001700	40	0.0000400	20	0.0014000	50	0.0042000	40
TVET	PERIOD	0.0008000	40	0.0000800	20	0.0001800	4.9	0.0012800	1400	0.0017100	500	0.0008000	40	0.0002200	20	0.0089600	50	0.0268700	40
Iskor Park	PERIOD	0.0007600	40	0.0000800	20	0.0001600	4.9	0.0012200	1400	0.0016200	500	0.0007600	40	0.0001800	20	0.0073500	50	0.0220400	40
West Park	PERIOD	0.0005100	40	0.0000500	20	0.0001000	4.9	0.0008300	1400	0.0011000	500	0.0005100	40	0.0001200	20	0.0046900	50	0.0140700	40
Kwaggasrand	PERIOD	0.0003700	40	0.0000400	20	0.0000700	4.9	0.0006000	1400	0.0008000	500	0.0003700	40	0.0000900	20	0.0035000	50	0.0104900	40
Proclamation Voortr	PERIOD	0.0004000	40	0.0000400	20	0.0000800	4.9	0.0006400	1400	0.0008600	500	0.0004000	40	0.0001000	20	0.0038100	50	0.0114400	40
Monum	PERIOD	0.0001200	40	0.0000100	20	0.0000200	4.9	0.0002000	1400	0.0002600	500	0.0001200	40	0.0000300	20	0.0010000	50	0.0030100	40
Pret West Ho	PERIOD	0.0002000	40	0.0000200	20	0.0000400	4.9	0.0003200	1400	0.0004200	500	0.0002000	40	0.0000400	20	0.0017200	50	0.0051600	40

7. Main Findings and Recommendations

An AQIA was conducted for Intervention Engineering as part of their WML application process and AEL application process for the facility. The main objective of the AQIA was to determine the potential impact of emissions associated with the operational activities of the facility on ambient air quality in terms of criteria air pollutants (PM₁₀, PM_{2.5}, SO₂, NO₂) and non-criteria air pollutants (HF, NH₃, and TVOCs). The pollutants assessed in this study were chosen based on pollutants given under sub-categories 4.4 and 4.10 of Category 4 (Metallurgical Industries) applicable to the project.

7.1. Main Findings

In studying the receiving environment, the following was found:

- Air Quality Sensitive Receptors (AQSRs) in the project area include urban residential areas, educational facilities, recreational facilities and hospitals. Residential areas within 5 km radius of the study area include Quagga Estates which is the closest residential complex to the proposed site (about 1.05 km). Other residential areas include Iscor Park (north), West Park (north), Kwaggasrand (northwest), Proclamation Hill (northeast), Laudium (southwest), and Valhalla (southeast).
- The land use surrounding the facility includes urban built up, commercial, residential, and industrial properties, natural vegetation, and grassland, with various recreational areas also located nearby the proposed site.
- Existing key sources of pollution surrounding the facility include urban industrial activities and vehicle emissions.
- Based on MM5 meteorological data obtained from Envitrans for the period June 2023 to July 2023, the area is affected by frequent north-north-east winds with some occasional north-north-west winds. Long-term air quality impacts are, therefore, expected to be the most significant from the north-north-east of operations at Intervention Engineering.
- An analysis of ambient air quality monitoring data from the permanent Pretoria West and Market Tshwane Air Quality Monitoring Stations (AQMSes), for the period June 2020 – July 2023, indicated the following in terms of the status quo air quality around Intervention Engineering:
 - Daily average PM₁₀ concentrations for the period ranged between 21.324 µg/m³ – 47.41 µg/m³, with an average for the period of 32.391 µg/m³.
 - Daily average PM_{2.5} concentrations for the period ranged between 12.088 µg/m³ – 35.123 µg/m³, with an average for the period of 21.781 µg/m³.
 - Significant exceedances of the daily PM₁₀ and PM_{2.5} ambient air quality limits, i.e., 48 and 91 exceedances for PM₁₀ and PM_{2.5}, respectively. In terms of the South African National Ambient Air Quality Standards (NAAQS), no exceedances of the PM₁₀ and PM_{2.5} annual standards are permitted within a calendar year. Only four (4) exceedances of the PM₁₀ and PM_{2.5} 24-hour standards are permitted.
 - Daily average SO₂ concentrations ranged between 1.259 – 6.264 ppb, with an average of 3.591 ppb for the period.
 - Only one exceedance of the annual SO₂ ambient air quality limits was observed during the period in the area. with the exceeding daily concentration of 19.850 ppb being recorded on 17 January 2019. No exceedances of SO₂ annual standard are permitted within a calendar year.
 - Daily average NO₂ concentrations ranged between 8.976 – 11.414 ppb, with an average of 10.331 ppb for the period.



- A total of 6 exceedances of the NO₂ hourly standard of 21 ppb during this period, with the highest hourly concentration of 24.385 ppb being recorded on 22 July 2019. No exceedances of NO₂ annual standard are permitted.

The main findings of the impact assessment are as follows:

- The key emitting activities at Intervention Engineering include the electricity needed to power the furnaces and operational equipment, emission sources to be connected to 1x stack, as well as casting and cooling. These activities result in the emission of criteria air pollutants (PM, SO₂ and NO₂) and non-criteria air pollutants (HF, TVOCs and NH₃), which have an impact on ambient air quality.
- The point sources which trigger sub-categories 4.4 and 4.10 of Category 4 (Metallurgical Industries) in terms of S21 of NEM:AQA (No. 39 of 2004), were the focus of this assessment. A total of one (1) point source was assessed in this study and include:
 - A combined stack, which is associated with all potential emission sources.
- PM₁₀, PM_{2.5}, SO₂, NO₂, HF, TVOCs and NH₃ emission rates from the emission source operations were quantified through an emissions inventory for input into the model. Emission rates were generally low for all pollutants.
- Two scenarios were considered in the assessment:
 - Scenario A: MES: where the MES for Intervention Engineering, i.e., the maximum threshold limit that is allowed for new plants (in terms of PM, SO₂ and NO₂, HF, TVOCs and NH₃, where applicable) as per listed activity sub-categories 4.4 and 4.10 of Category 4 (Metallurgical Industries) was considered for input into the model.
 - This is representative of potential impacts if the facility were emitting at the acceptable threshold that is permissible for sub-categories 4.4 and 4.10 of Category 4 (Metallurgical Industries). The emission standards were converted into emission rates for input into the model.
 - Results from this scenario remained significantly below the standard limits and the values were **lower than scenario B's results**.
 - Scenario B – Similar Operations: where emissions from similar operations were used with maximum allowed threshold limits for new plants as per listed activity sub-categories 4.4 and 4.10 of Category 4 (Metallurgical Industries) was considered for input into the model.
 - This is representative of potential impacts if the foundry was emitting at the acceptable threshold that is permissible for the sub-categories. The emission standards were converted into emission rates for input into the model.
 - Results from this scenario remained significantly below the standard limits and the values were **slightly higher than scenario A's results**.
- Simulated PM₁₀ and PM_{2.5} concentrations are well below the NAAQS in both the scenarios and fall well below the maximum daily and annual average background PM₁₀ and PM_{2.5} concentrations recorded at the Pretoria West and Market Tshwane AQMSes.
- Simulated HF, TVOCs and NH₃ are also low over the entire project area and its surroundings.
- Simulated SO₂ concentrations are low and fall below the applicable NAAQS over the project area. Simulated SO₂ concentrations are lower than the maximum hourly, daily and annual average background SO₂ concentrations recorded at the Pretoria West and Market Tshwane AQMSes.
- Simulated NO₂ concentrations are low and fall below the applicable NAAQS over the project area and its surrounding. Simulated NO₂ concentrations are lower than the maximum hourly



and annual average background NO₂ concentrations recorded at the Pretoria West and Market Tshwane AQMSes.

- Simulated emission levels at all AQSRs modelled in the study (as described in Section 5.1) are low, with no exceedances of the applicable NAAQS, NDCR, or Alberta standards observed, where applicable.
- Other open-air fugitive emission sources associated with the facility such as casting, and cooling are also identified as key sources of emissions at the site. As such, the fugitive emission mitigation measures given in Section 7.2 of this report should be implemented, where possible and applicable, to reduce the impact of these sources.

7.2. Recommendations

Intervention Engineering plans to have an extraction hood over the shared common stack, which is connected to a baghouse.

Emissions at Intervention Engineering should be maintained below the MES limits as far as possible. Nonetheless, should Intervention Engineering ever reach the MES limits, the impact of the furnaces is still predicted to be relatively low inside and beyond the facility boundary for all pollutants associated to the proposed activities in terms of the Section 21 of NEM:AQA.

It is advised that extraction systems be installed over all emission units once they become operational. It is recommended to ensure that the stack height is above the height of the nearest building. A stack height guideline can be used as a reference. Intervention Engineering should conduct emissions monitoring on all emission sources for the relevant listed activities (sub-categories 4.4 and 4.10) and ensure that monitoring is undertaken in accordance with nationally or internationally acceptable methods at least on an annual basis.

It is also advised that Intervention Engineering must have process equipment maintenance plans in place for the equipment to be installed at the facility.

Once the PAEL for the facility has been issued, it is recommended that Intervention Engineering ensure compliance with the PAEL by implementing the measures provided in Table 7-1 below. Measures for the control of fugitive emissions from non-point sources at the facility are provided in Table 7-2 below. These are considered best practice for mitigating fugitive emissions and should be implemented or improved upon, where applicable.



Table 7-1: Summary of Recommendations and Monitoring Requirements to ensure AEL Compliance.

Recommendations	Reporting Requirements to authority	Reporting Frequency to authority <i>(unless otherwise stated in AEL)</i>
<p>Identified key sources of fugitive emissions at the facility are as follows:</p> <ul style="list-style-type: none"> • Casting area; and • Cooling area. <p>The recommendations provided in Table 7-2 should be implemented where applicable and possible to ensure fugitive emission mitigation during the operational phase of the facility:</p>	n/a	n/a
<p>Appoint a responsible person, such as an emission control officer or safety, health & environmental manager, to ensure compliance with the AEL. This person should be responsible for the following:</p> <ul style="list-style-type: none"> • ensure compliance with all AEL conditions; • implementation of all mitigation measures; • compilation and/or storage of relevant documents (such as maintenance checklists, complaints register, etc.). These documents should be readily available in the event of a site inspection; • submitting all required reports (e.g., annual AEL report, stack monitoring reports, etc.); • submitting a summary of complaints (monthly); • notifying the relevant licensing authority when needed; <p>Undertake/facilitate training for key personnel/contractors or staff to ensure compliance with the internal management plans and AEL conditions.</p>	n/a	n/a
<p>Submit an application to the relevant licensing authority, should any changes be required. The application should be submitted to the relevant licensing authority prior to the changes being made.</p> <p>Any changes to the following will require approval:</p> <ul style="list-style-type: none"> • Production processes • Production increases • Ownership • Contact details • Type and quantities of input materials • Type and quantities of products • Production equipment 	<p>A renewal/variation/transfer AEL application.</p> <p>Should any changes to the facility occur in the future, Intervention Engineering would need to assess whether a WML is required for any of the proposed changes. An EA, if required, must be obtained prior to any changes being made and the submission of an AEL application.</p>	<p>A renewal/variation/transfer AEL application must be submitted to the authority prior to any potential changes being made. Need to allow at least 90 days for approval in terms of AEL and 6-12 months for an EA (if required).</p>



<ul style="list-style-type: none"> • Treatment facilities • Building, plant, site layout or site of works 		
<p>Conduct stack emissions monitoring on all stacks for the relevant listed activities and ensure compliance with the MES with the use of abatement equipment, if required. Ensure that monitoring is undertaken in accordance with nationally or internationally acceptable methods.</p> <p>Ensure proper disposal of abatement equipment waste from bag filters associated with the baghouse (e.g., dust) using an approved waste disposal service provider.</p>	<p>Stack emissions monitoring report for each stack (i.e., baghouse stack).</p> <p>Abatement equipment waste disposal register and waste disposal certificates should be kept for any waste generated.</p>	<p>Stack monitoring reports required annually (unless otherwise stated in the AEL).</p> <p>Waste disposal certificates and register should be updated and submitted to the licencing authority when required.</p>
<p>Emissions from all activities associated with the listed activities must be properly extracted and mitigated with appropriate abatement equipment. No leakage of emissions (i.e., from stacks, baghouse units, etc.) should occur on-site.</p>	<p>Extraction system design and abatement equipment specifications.</p>	<p>As required by the licencing authority</p> <p>**should be kept up to date.</p>
<p>Ensure that all unit processes & apparatus used for undertaking the listed activities in question, and all appliances and mitigation measures for preventing or reducing emissions, are at all times properly maintained and operated.</p>	<p>Maintenance plan</p> <p>Maintenance checklists</p> <p>Vehicle service records</p>	<p>Checklists should be compiled as required: daily/weekly/monthly/quarterly/annually</p> <p>Checklists should be submitted to the licencing authority as required.</p> <p><i>*maintenance should be carried out as per the requirements in the maintenance plan.</i></p>
<p>Submit an annual AEL report within the required timeframe. This report should include:</p> <ul style="list-style-type: none"> • Compliance audit report; • Summary of major upgrades; • Pollutant monitoring trends; • GHG emissions; • Summary of complaints; • Any other required documentation. 	<p>Annual AEL Report</p> <p>AEL compliance audit reports</p>	<p>Annually (unless otherwise stated in the AEL)</p>
<p>Maintain and report monthly to the authority a complaint register. Should a complaint be logged, a report in the required format as per the AEL, should be submitted to the authority.</p>	<p>Complaint register</p> <p>Complaint investigation report</p>	<p>Complaint register to be reported monthly</p> <p>Complaint investigation report to be submitted if a complaint is received.</p>
<p>Registration and annual reporting on the NAEIS. Category A (listed activities) is required. The NAEIS is a national emissions inventory.</p>	<p>NAEIS online submission</p>	<p>Annually: from January – March of each year</p>
<p>An Environmental Management Programme (EMPr) will be compiled for the facility as part of the EIA. All recommendations and conditions contained within the EMPr must be implemented and complied with.</p>	<p>EMPr checklists</p> <p>EMPr compliance audit</p>	<p>As required (checklists)</p> <p>Annually (unless otherwise specified)</p>

Table 7-2: Recommended measures to Control Fugitive Emissions During Facility Operations (European Commission, 2005).

SOURCE	RECOMMENDED CONTROL MEASURES
Material storage and flow management	<ul style="list-style-type: none"> • Apply storage and handling methods for solids, liquids and gases to avoid any possible gas leaks, accumulation of dust, gaseous volatilisation and evaporation and any hazardous combustion; • Avoid outdoor material stockpiles. Where unavoidable, store materials under a roof and on an impermeable surface to reduce the accumulation of dust and associated windblown dust as well as dust entrainment on unpaved surfaces during the handling of materials; • For outdoor stockpiles, make use of binders, water sprays, stockpile management techniques, windbreaks, etc. to minimise fugitive emissions from exposure to wind fields; • For indoor stockpiles, make use of binders, water sprays, etc. to minimise fugitive dust emissions; • Restrict the distribution of materials to paved surfaces thus preventing dust entrainment during material handling activities; • Appropriate PPE should be worn by all employees; • Implement a fugitive dust management plan. This must be reviewed/updated on an annual basis.
Waste management	<ul style="list-style-type: none"> • Apply regulated storage and handling methods for any waste products; • Prevent the burning of waste materials and allow for appropriate re-use, recycling or frequent disposal thereof.
Pattern making, molding & core-making shop in sand molding foundries (where applicable)	<ul style="list-style-type: none"> • Vacuum clean and/or sweep the pattern and molding/core-making areas (specifically in sand molding foundries) frequently so as to avoid the accumulation of dust or fine particulates; • If possible, all activities should occur in an enclosed shelter that is connected to an extraction unit and if needed a control device (e.g. bag house); • Implement a fugitive dust management plan. This must be reviewed/updated on an annual basis.
Metal tapping, casting and cooling	<ul style="list-style-type: none"> • If possible, install an extraction system which can capture furnace emissions and if needed filter the emissions through a control device (abatement equipment); • Optimise the extraction system by keeping doors closed, preventing cross winds and sealing gaps and holes in the roof and walls; • Regularly maintain the extraction system vents/ducting and abatement equipment as per the manufactures specifications to ensure optimal extraction and control of emissions; • Conduct regular emission tests to ensure the system is working efficiently; • Apply a carefully designed working floor area to allow for effective extraction and control of emissions; • All activities should be undertaken in an enclosed room/area; • Implement a fugitive dust management plan, where applicable. This must be reviewed/updated on an annual basis.
Finishing and cleaning of castings	<ul style="list-style-type: none"> • Collect and treat any significant releases of off-gas using either wet or dry abatement measures (if needed); • Having extraction units and appropriate abatement equipment (e.g., baghouse) connected to key fugitive dust sources such as the shot blasting equipment. • Make use of clean fuels (lower sulphur content) during heat treatment; • If possible, finishing activities should be undertaken in an enclosed room that is connected to an efficient extraction system. Appropriate abatement equipment should be used to treat the captured emissions (if necessary); • Implement a fugitive dust management plan, where applicable. This must be reviewed/updated on an annual basis.
General measures	<ul style="list-style-type: none"> • Avoid outdoor unpaved surfaces where frequent disruption may occur (e.g., Offloading/loading area); • Frequently apply wet suppression or vacuum clean/sweep paved surfaces where vehicles/trucks/forklifts/tractors manoeuvre; • Regularly maintain (i.e., annually) mobile equipment to ensure combustion efficiency and prevent emitting relatively high levels of black smoke; • Have clear demarcated areas for different activities with well-defined boundary lines. For instance, the casting and cooling area in sand molding foundries should be clearly demarcated with a boundary line or barrier (e.g., bricks, steel guard rail, rope, etc.) to avoid sand from extending past the working area and prevent people from unnecessarily walking through the area; • Regularly maintain equipment, ducting and abatement equipment; • Regularly reassess where upgrades and changes can be made to improve operations efficiency and increase metal product yield; • If possible & necessary, make use of portable extraction or air filtration units; • Carry out good housekeeping practices.

8. IMPACT SIGNIFICANCE

8.1. Impact Assessment Methodology

8.1.1. Determination of Significance of Impacts

Significance is calculated by a synthesis of effect characteristics that include an impact's meaning and severity. Context refers to the regional scale, i.e., location, local, national or global, while intensity is characterized by the severity of the effect, e.g., the degree of variance from background conditions, the size of the affected area, the length of the impact and the overall likelihood.

Significance is an indicator of the importance of the effect, both in terms of physical scale and time scale, and thus demonstrates the degree of mitigation required. For each impact, the total number of points scored shows the extent of the impact's importance. Significance is calculated as shown in Error! Reference source not found. below.

8.1.2. Impact Rating System

Impact assessment must take into account the nature, scale and length of environmental impacts, whether they are positive (beneficial) or negative (negative) or not (detrimental). Where applicable, each impact is also assessed according to the project stages:

- Construction
- Operation
- Decommissioning

The proposal for mitigation or optimization of an effect is specific, where appropriate. It also includes a brief discussion of the effect and the reasoning behind the evaluation of its importance.

8.1.3. Rating System Used to Classify Impacts

The following rating system is applicable to the possible effects on the receiving environment and contains an objective impact mitigation assessment. Impacts were combined into one ranking. In assessing the significance of each issue, the following criteria including an allocated point system are used:

Table 8-1: Description of parameters used to determine impact significance.

NATURE		
A brief overview of the effects of the environmental parameters being evaluated in the context of the project is included. These criteria require a short-written statement of the environmental factor that a specific action or behaviour affects.		
GEOGRAPHICAL EXTENT		
This is described as the region over which the effect is transmitted. The magnitude and significance of an effect usually have distinct scales and grouping ranges are often needed. This is also useful in the thorough evaluation of a project in order to better define it.		
1	Site	The impact only affects the site.
2	Local/district	Have an effect on the local area or district.
3	Province/region	Have an effect on the entire province or region.
4	International and National	Have an effect on the entire country.
PROBABILITY		
This describes the chance of occurrence of an impact.		
1	Unlikely	The chance of the impact occurring is extremely low (Less than a 25% chance of occurrence).
2	Possible	The impact may occur (between a 25% to 50% chance of occurrence).
3	Probable	The impact is likely to occur (between a 50% to 75% chance of occurrence).
4	Definite	The impact will certainly occur (Greater than a 75% chance of occurrence).
REVERSIBILITY		
This describes the degree to which an impact on an environmental parameter can be successfully reversed upon completion of the proposed activity.		
1	Completely reversible	The impact is reversible with implementation of minor mitigation measures.
2	Partly reversible	The impact is partially reversible but more intense mitigation measures are required.
3	Barely reversible	The impact is unlikely to be reversed even with intense mitigation measures.

4	Irreversible	The impact is irreversible, and no mitigation measures exist.
IRREPLACEABLE LOSS OF RESOURCES		
This describes the degree to which resources are irreplaceably lost because of a proposed activity.		
1	No loss of resource.	The impact does not result in the loss of any resources.
2	Marginal loss of resource	The impact results in marginal loss of resources.
3	Significant loss of resources	The impact results in significant loss of resources.
4	Complete loss of resources	The impact results in a complete loss of all resources.
DURATION		
This describes the duration of the impacts on the environmental parameter. Duration indicates the lifetime of the impact because of the proposed activity.		
1	Short term	The impact and its effects will either disappear with mitigation or will be mitigated through natural process in a span shorter than the construction phase (0 – 1 years), or the impact and its effects will last for the period of a relatively short construction period and a limited recovery time after construction, thereafter it will be entirely negated (0 – 2 years).
2	Medium term	The impact and its effects will continue or last for some time after the construction phase but will be mitigated by direct human action or by natural processes thereafter (2 – 10 years).
3	Long term	The impact and its effects will continue or last for the entire operational life of the development but will be mitigated by direct human action or by natural processes thereafter (10 – 50 years).
4	Permanent	The only class of impact that will be non-transitory. Mitigation either by man or natural process will not occur in such a way or such a time span that the impact can be considered transient (Indefinite).
CUMULATIVE EFFECT		
This describes the cumulative effect of the impacts on the environmental parameter. A cumulative effect/impact is an effect which may not be significant but may become significant if added to other existing or potential impacts emanating from other similar or diverse activities as a result of the project activity in question.		
1	Negligible Cumulative Impact	The impact would result in negligible to no cumulative effects.
2	Low Cumulative Impact	The impact would result in insignificant cumulative effects.
3	Medium Cumulative impact	The impact would result in minor cumulative effects.
4	High Cumulative Impact	The impact would result in significant cumulative effects.
INTENSITY/ MAGNITUDE		
Describes the severity of an impact.		
1	Low	Impact affects the quality, use and integrity of the system/component in a way that is barely perceptible.
2	Medium	Impact alters the quality, use and integrity of the system/component but system/ component still continues to function in a moderately modified way and maintains general integrity (some impact on integrity).
3	High	Impact affects the continued viability of the system/ component, and the quality, use, integrity and functionality of the system or component is severely impaired and may temporarily cease. High costs of rehabilitation and remediation.
4	Very high	Impact affects the continued viability of the system/component, and the quality, use, integrity and functionality of the system or component permanently ceases and is irreversibly impaired (system collapse). Rehabilitation and remediation often impossible. If possible, rehabilitation and remediation often unfeasible due to extremely high costs of rehabilitation and remediation.

Table 8-2: Significance calculation and ratings.

SIGNIFICANCE			
Significance is determined through a synthesis of impact characteristics. Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. This describes the significance of the impact on the environmental parameter. The calculation of the significance of an impact uses the following formula:			
$SIGNIFICANCE = (Extent + probability + reversibility + irreplaceability + duration + cumulative\ effect) \times magnitude/intensity.$			
The summation of the different criteria will produce a non-weighted value. By multiplying this value with the magnitude/intensity, the resultant value acquires a weighted characteristic which can be measured and assigned a significance rating.			
Points	Impact Type	Impact Significance Rating	Description
>-90	Negative	Negative Very High Impact	The impact has highly significant effects and are unlikely to be able to be mitigated adequately. These impacts could be considered "fatal flaws".
-61 to -90	Negative	Negative High Impact	The impact has significant effects and requires significant mitigation measures to achieve an acceptable level of impact.
-31 to -60	Negative	Negative Medium Impact	The impact has moderate negative effects and requires moderate mitigation measures.
-1 to -30	Negative	Negative Low Impact	The impact has negligible negative effects and requires little to no mitigation.
0	Neutral	No Impact	The impact has no effects.

1 to 30	Positive	Positive Low Impact	The impact has minor positive effects.
31 to 60	Positive	Positive Medium Impact	The impact has moderate positive effects.
61 to 90	Positive	Positive High Impact	The impact has significant positive effects.
>90	Positive	Positive Very High Impact	The impact has highly significant positive effects.

Table 8-3: Rating of impacts for Scenario A – MES Standards.

IMPACT TABLE FORMAT			
	Description	Before Mitigation	After Mitigation
Air Quality Impact	Air Quality is most likely to be impacted by furnace operations at Intervention Engineering, through the emission of criteria and non-criteria air pollutants from melting and combustion activities into the atmosphere. Parameters from regulated limits in terms of Section 21 of NEM:AQA are considered		
Extent (Ex)	The impact is likely occurring and affects the local area. With implementation of additional, suitable mitigation measures, the impact can be reduced to only affect the facility site.	2	1
Probability (Pr)	Probability of the impact occurring, considering existing mitigation measures, is definite, but can be reduced to possible with implementation of additional, suitable mitigation measures.	4	2
Reversibility (Re)	Air quality is likely impacted by current furnace operations at the facility. However, the impact is partly reversible with the implementation of additional suitable mitigation measures. The impact will likely cease upon cessation of operations at the plant.	2	2
Irreplaceable loss of resources (L)	The impact will likely result in marginal loss of resources. However, with mitigations, no loss of resources would be realized.	2	1
Duration	The impact of current furnace operations at Intervention Engineering on air quality will last for the operational lifecycle of the facility but can be mitigated by human action.	3	3
Cumulative effect (CE)	The impact would contribute an insignificant amount to the cumulative effects. With mitigation, the impact would result in negligible to no effects.	2	1
Intensity/magnitude (M)	Impact alters the quality, use and integrity of the system/component but system/ component still continues to function in a moderately modified way and maintains general integrity (some impact on integrity). With mitigation, impact will affect the quality, use and integrity of the system/component in a way that is barely perceptible.	2	1
Significance Rating	The impact has negligible negative effects and requires little to no mitigation.	-30 (Negative Low Impact)	-10 (Negative Low Impact)
Mitigation measures	Mitigation measures that can be implemented to reduce the impact of furnace operations on air quality are outlined in Section 7.2. These include the installation of extraction systems and stacks, where applicable, and abatement equipment, if required, which will minimise the level of ground level air pollutants; compliance with MES of all applicable Section 21 listed activities; and compliance to provisional AEL requirements. The four (4) furnaces at Intervention Engineering must have extraction hoods over them and have stack which must be connected to a baghouse. The stack height should be at least ~12 m above ground.		

Table 8-4: Rating of impacts for Scenario A – Similar Operations.

IMPACT TABLE FORMAT			
	Description	Before Mitigation	After Mitigation
Air Quality Impact	Air Quality is most likely to be impacted by furnace operations at Intervention Engineering, through the emission of criteria and non-criteria air pollutants from melting and combustion activities into the atmosphere. Considering parameters from other similar operations.		
Extent (Ex)	The impact is likely occurring and affects the local area. With implementation of additional, suitable	2	1

	mitigation measures, the impact can be reduced to only affect the facility site.		
Probability (Pr)	Probability of the impact occurring, considering existing mitigation measures, is definite, but can be reduced to possible with implementation of additional, suitable mitigation measures.	4	2
Reversibility (Re)	Air quality is likely impacted by current furnace operations at the facility. However, the impact is partly reversible with the implementation of additional suitable mitigation measures. The impact will likely cease upon cessation of operations at the plant.	2	2
Irreplaceable loss of resources (L)	The impact will likely result in marginal loss of resources. However, with mitigations, no loss of resources would be realized.	2	1
Duration	The impact of current furnace operations at Intervention Engineering on air quality will last for the operational lifecycle of the facility but can be mitigated by human action.	3	3
Cumulative effect (CE)	The impact would contribute an insignificant minor amount to the cumulative effects. With mitigation, the impact would result in negligible to no effects.	3	1
Intensity/magnitude (M)	The impact alters the quality, use and integrity of the system/component but system/ component still continues to function in a moderately modified way and maintains general integrity (some impact on integrity). With mitigation, impact will affect the quality, use and integrity of the system/component in a way that is barely perceptible.	2	1
Significance Rating	The impact has negligible negative effects and requires little to no mitigation.	-32 (Negative Low Impact)	-10 (Negative Low Impact)
Mitigation measures	Mitigation measures that can be implemented to reduce the impact of furnace operations on air quality are outlined in Section 7.2. These include the installation of extraction systems and stacks, where applicable, and abatement equipment, if required, which will minimise the level of ground level air pollutants; compliance with MES of all applicable Section 21 listed activities; and compliance to provisional AEL requirements. The four (4) furnaces at Intervention Engineering must have extraction hoods over them and have stack which must be connected to a baghouse. The stack height should be at least ~12 m above ground.		

The significance of the air quality impacts on AQSRs for Scenario A: MES was found to be low for all modelled pollutants. Results from this scenario remained significantly below the standard limits and were lower than **Scenario B's** results. With the mitigation measures proposed in place (Section 7.2), the significance of current impacts can be further reduced to minimal.

The significance of the air quality impacts on AQSRs for Scenario A, which is representative of furnace operations emitting at the acceptable threshold that is permissible for sub-categories 4.4 and 4.10, were found to be low with and without mitigation. Emissions at the facility should be maintained below the MES limits as far as possible. Nonetheless, should Intervention Engineering reach the MES limits, the impact of the furnaces is still predicted to be relatively low inside and beyond the facility boundary.

The “no-go alternative”, which is the option of not fulfilling the proposed project, would result in zero gaseous and particulate emissions being emitted into the air, and thus high positive impacts, with no air quality impacts from the foundry on the site or surrounding local area.

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